Good Practice Promotion Kit
Lifting Operation of Tower Crane
Disclaimer

It is the responsibility of duty holders to ensure site safety. The provisions of this Promotion Kit should not be regarded as exhausting all matters which need to be covered by relevant safety legislation. Compliance with the provisions hereof does not relieve any person undertaking the work of their statutory responsibility or confer upon any person immunity from legal obligations. The site management should formulate relevant safe working procedures and management system according to the actual environment and operations on their construction sites, and provide training to and supervision on workers in order to ensure that the working team understand and follow necessary safety measures to prevent accidents.

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Advocate workplace safety for a better tomorrow
Foreword

Acknowledgements

General Hazards in Operation of Tower Cranes

Personnel Engaged in Tower Crane Operation

Lifting Gear

Site Planning and Coordination

Lifting Panel Formwork

Lifting Precast Elements (Facades)

Lifting General Construction Materials

Lifting Concrete Hoppers

Lifting Materials (Formwork / Scaffolding)

Lifting Materials (Plumbing / Fire Services / Electrical Works)

References and Index
Foreword

Introduction

Tower cranes are widely used for lifting operations in construction sites and statistics show that accidents arising from tower crane lifting can result in serious injuries and/or physical damage if the work process is not properly managed. To ensure safety in the workplace, tower crane lifting must be supervised and carefully managed by duty holders at all levels. The pre-requisites for safe operaton of tower cranes comprise the following:

- Good-conditioned lifting appliances and lifting gear
- Appointment of qualified / competent personnel, including tower crane operators, riggers, signallers and a responsible person for overseeing the entire lifting operation
- Proper work planning including risk assessment and system for coordinating various tasks etc.

Safety First, Zero Incident

As a proactive and caring public sector developer, the Hong Kong Housing Authority (HA) is committed to promoting site safety through partnership with industry stakeholders, along with system drivers through the supply chain. “Safety First” is always an integral part of our work and we emphasize “ZERO incident” as a performance goal to provoke vigilance on all fronts.

The Purpose of Producing Good Practice Promotion Kit

There are specific regulatory and code of practice requirements governing safe use of tower cranes and related duties/responsibilities of contractors and other relevant personnel. For the furtherance of good practices and propagation of safety awareness, we have sought support from industry experts and practitioners, including the Labour Department, the Occupational Safety and Health Council, the Construction Industry Council Training Academy, the Hong Kong Construction Association Limited and the Hong Kong Professional Hoisting Engineering Association Limited, to compile this “Good Practice Promotion Kit - Lifting Operation of Tower Crane” in collaboration.
The Contents of Promotion Kit

The Promotion Kit comprising a video cum a booklet (precise version of the video) is aimed to provide a practical guide to safe lifting operation of tower cranes based on site practices and practical examples in HA new works construction sites, with contents covering management and planning of tower crane lifting operation.

The Promotion Kit, with different topical chapters featuring lively case studies / practical examples and highlighted imperatives, were compiled in a straightforward way to demonstrate the rudiments of safe practice of tower crane lifting. Major topics include:

- General Hazards in Operation of Tower Cranes
- Personnel Engaged in Tower Crane Operation
- Lifting Gear
- Site Planning and Coordination
- Lifting Panel Formwork
- Lifting Precast Elements (Facades)
- Lifting General Construction Materials
- Lifting Concrete Hoppers
- Lifting Materials (Formwork / Scaffolding)
- Lifting Materials (Plumbing / Fire Services / Electrical Works)

Aspirations

We earnestly hope that frontline personnel on site can make the best use and benefit from heeding the very practical and well-tested examples offered in this Promotion Kit, yet the provisions of this Promotion Kit should not be regarded as exhausting those matters which need to be covered by relevant safety legislation. Compliance with the provisions hereof does not relieve persons undertaking the work of their statutory responsibility or confer upon any person immunity from legal obligations.
Foreword

The site management should plan their work properly with safety in mind, devise “site specific” and “operation specific” procedures (namely formulate relevant safe working procedures and management system according to the actual context and specific operations on their construction sites), and provide training to and supervision on workers in order to ensure that the whole working team can understand and follow necessary safety measures, thereby preventing accidents.

The production of Good Practice Promotion Kit has validated the spirit of “learning by good examples” and the result of “collaborative teamwork”. In charting site safety forward, we sincerely hope that all industry stakeholders will continue to put good practice into actions, effectively manage, supervise and coordinate their works, strengthen communication and support to one another throughout the supply chain, and adopt safe lifting practice. Through the publication of the series of Good Practice Promotion Kit, we would also like to take this opportunity to encourage all those concerned to work together to foster a site safety culture.

HDSSSC wishes you all the best!

The Housing Department Site Safety Sub-committee (HKSSSC)
July 2010

Jointly produced by:
- Hong Kong Housing Authority
- Labour Department
- Occupational Safety and Health Council
- Construction Industry Council Training Academy
- Hong Kong Construction Association Limited
- Hong Kong Professional Hoisting Engineering Association Limited
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- Labour Department
- Occupational Safety and Health Council
- Construction Industry Council Training Academy
- Hong Kong Construction Association Limited
- Hong Kong Professional Hoisting Engineering Association Limited

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Fall of Workers From Heights

- Failing to adopt appropriate safety precautions, such as wearing a safety belt secured to an anchorage point, may lead to the fall of lifting personnel from heights during tower crane erection, climbing, telescoping or dismantling operations.
- A rigger may fall off when securing a load for lifting.
- A signaller may fall from a place without protective barriers while giving hand signals.

Fall of Tools From Heights

- Failing to properly place and store tools in an orderly manner may lead to the fall of tools from heights.
Tower Crane Toppling / Collapse or Loosened Parts Falling Off

- Improper design or erection of the crane foundation may cause a tower crane to topple or collapse. For example, the crane foundation is not designed or constructed under supervision by a Registered Structural Engineer.

- Using improper or substandard parts, say, with improper size, too small to fit in properly or not original parts of crane, may cause a tower crane to topple or collapse.

- Non-compliance with the guidelines or instructions of the user manual during the erection, climbing and dismantling operations may also cause a tower crane to topple or collapse or the loosened parts to fall off.

Tower Crane Collision

- If two or more tower cranes are operated in a construction site with overlapping zones but without proper coordination, collision may occur.

Fall of Loads

- Loads which have not been properly secured or tied up may slip off during lifting operations and fall off from heights.
Excessive Loading

- Failure to observe the Safe Working Load (SWL) capacity may lead to over stressing of the tower crane and result in accidents.

Operating Tower Cranes Under Inclement Weather Conditions

- Operating tower cranes under inclement weather conditions such as strong wind and rainstorm may lead to very serious accidents. Under such weather conditions, it is very difficult to maintain the stability of the load during lifting operations.
- Poor visibility and an unstable tower crane are highly accident-prone.
**DOs**

- Warning signs in both Chinese characters and English lettering for areas at ground level within lifting zone.
- Operators of tower crane must hold tower crane operator certificate with sufficient experience.
- The tower crane should be inspected, thoroughly examined and tested periodically.
- Tower crane operator certificate and inspection form of the tower crane are prerequisite to operation of the tower crane.
- The tower crane operator should be able to receive signals clearly from the signaller.
- The tower crane operator can view the scene of the lifting object through CCTV system during lifting operation.
- It is suggested for the signaller only to communicate with the operator of tower crane during the lifting operation.
- Besides signalling by hands, other means of communication such as walkie-talkies or mobile phones are also possible.
- Ensure that the automatic safe load indicator is installed.
- Provide safe means of access and egress.
- The lifting routes should not collide with any object and the lifting zone should be fenced off.
- Travel speed of the loads shall be as slow as possible.
- Be cautious to the lifting height of the jib and the distance of the hook.
- When the tower crane is not in operation, the crane’s trolley must be positioned near the tower at minimum radius, with the hook raised to its highest position.
- During typhoons, the jib shall be set to the typhoon’s leeward side with the brake released allowing the jib to swing freely.
DONT’s 🚫

- Lifting load not to exceed Safe Working Load (SWL).
- Lifting routes shall not come across any building or pass over any person.
- Do not carry out lifting operations under the following circumstances:
  - Signalling is unclear.
  - There is a person below the object being lifted.
  - There is a person on the object being lifted.
  - The object being lifted is buried below ground.
  - The object being lifted is pulled up at an inclined angle.
  - The object being lifted is not securely tied up.
  - The object being lifted consists of loose parts.
  - The weight of objects being lifted is unknown.
  - Strong wind signal is hoisted.

Items for Discussion

1. What are the general hazards encountered in operating tower cranes?
2. What are the “DOs” and “DONT’s”?
Personnel Engaged in Tower Crane Operation

Personnel for Safe Tower Crane Lifting Operations

- The “Code of Practice for Safe Use of Tower Cranes” published by the Labour Department stipulates that certain personnel are designated to ensure safe tower crane lifting operations. These persons are the owner, the competent person, the competent examiner and the responsible person.

- The “Construction Industry Council’s Publication - Guidelines on Safety of Tower Cranes” also stipulates two additional personnel for safe tower crane lifting operations. They are competent mechanical engineer and supervising engineer.

Owner

- The owner must ensure that all tower cranes are operated by trained and qualified crane operators.

Competent Person

- The competent person is responsible for executing the duties of the owner, for the inspection of lifting appliances / lifting gears and the supervision on the erection, climbing, telescoping and dismantling of tower cranes, and shall be:
  - Appointed by the specialist contractor or the owner of the lifting appliances / lifting gears.
  - Properly trained with relevant practical experience.
Personnel Engaged in Tower Crane Operation

Competent Examiner

- The competent examiner is responsible for conducting tests and thorough examinations to the lifting appliances / lifting gears, and shall be:
  - Appointed by the owner of the lifting appliances / lifting gears.
  - A registered professional engineer within a relevant discipline.
  - Properly trained with relevant practical experience.

Responsible Person

- The responsible person, appointed by the contractor, is responsible for the control of the overall tower crane lifting operation and ensuring the proper implementation of a site safety management system.

Competent Mechanical Engineer

- The competent mechanical engineer, employed by the tower crane owner, is responsible for conducting pre-delivery and pre-erection examination of tower crane as well as the certification of the anchorage of the tower crane before the tower crane may be erected.

Supervising Engineer

- The supervising engineer, employed by the contractor, is responsible for controlling, monitoring and supervision of tower crane operations.
Contractor’s Foreman

- Monitor lifting operations in the construction site.
- Help monitor the daily operation of the anti-collision system and report promptly on any irregularities for follow-up actions.

Frontline Personnel

Tower crane lifting operations also involve three categories of front line personnel, namely:

- Tower Crane Operator
- Rigger
- Signaller

Tower Crane Operator

- The tower crane operator is responsible for operating the tower crane correctly and safely, and can communicate with the signaller by hand signals or through a communication device, and shall:
  - Be at least 18 years of age and hold a valid crane operation certificate.
  - Be physically fit.
  - Be familiar with hand signal for communication.
Personnel Engaged in Tower Crane Operation

Rigger

- The rigger is responsible for securing the load for attaching and detaching it to and from the hook, so as to ensure safety in lifting operations, and shall:
  - Have received appropriate training on general safe lifting operations.
  - Be capable of selecting lifting gears suitable for the loads.
  - Liaise with the signaller for directing the movement of the crane safely.

Signaller

- The signaller is responsible for relaying the signal from the rigger to the crane operator, and shall:
  - Have received appropriate training on general safe lifting operations.
  - Be able to direct the movement of the crane and loads.
- The signaller should be equipped with the following items:
  - A safety helmet of the designated colour.
  - A reflective vest.
  - A portable communication device (for communication with the tower crane operator).

Item for Discussion

1. What are the main duties of the personnel engaged in tower crane lifting operations?
Lifting Gear

Pre-use Inspection

- All lifting gears should be inspected by a competent person each time before use and should be marked with a Safe Working Load (SWL).

Lifting Gears

- Lifting gears play an important part in the lifting operation. Their function is to rig the objects securely and hang them on the crane. All lifting gears shall be tested by competent examiners.
- There are different kinds of lifting gears such as the commonly-called “wire”, “metal chain”, “shackle” and spreader beam etc.

Wire Rope Slings

- Use suitable wire rope slings and conduct regular examination. If more than one wire rope slings are used for lifting, use a shackle to join them and ensure that the angle between the slings should not exceed 90 degrees.
Never use damaged wire rope slings.
During lifting, the Safe Working Load (SWL) must not be exceeded.
Regular inspections shall be conducted.
Sudden lifting is not allowed.
The wire rope slings shall not be used and shall be disposed if they are damaged:

Wire Rope Clips
- Wire rope clips must be properly installed.
- Thimbles should be equipped.
- At least three wire rope clips should be installed.
- Wire rope clips must be installed in correct direction.
- The distance between the wire rope clips must be the same and should be six times the diameter of the wire rope sling. The first wire rope clip should be installed as close to the thimble as possible.

Method of connecting the wire rope slings

Chain Slings

- Chain slings are generally made of alloys. Any defect in one section may render the whole chain sling unsafe.

- Do not use chain slings that are stretched, bent, worn out, or with cuts and cracks.

- A damaged chain sling will suddenly break and the damage is not as easily detectable as compared to wire rope slings. Therefore, a wire rope sling must be selected wherever possible for lifting.

- The chain sling shall not be used under the following conditions:
Shackles

- Do not replace the shackle pin with a bolt.
- Ensure the pin is totally locked and the shackles do not lean on one side during lifting.
- Do not use screw pin shackles if the pin can roll and unscrew.
- Shackle pins must always be attached to the hook.
- Washers may be used to centre the shackle.
- If the load shifts, the sling will unscrew the shackle pin.

Eye Bolts

- The hook must not be directly fixed onto the eye bolt.
• The angle of lifting the eye bolts must not be less than 45 degrees.
• Do not use a sling to pass through a pair of eye bolts.

Hooks

• All hooks (except for those in special design) should be equipped with a safety latch.
• Do not remove or tie up the safety latches.
• Hooks are a vital part of lifting gears, with a variety of design to cater for different lifting purposes.
• Hooks can be installed with swivels to allow the load to turn.
• Maintain the hook in a vertical position. If the hook is eccentrically loaded, the Safe Working Load (SWL) will be reduced.
3 Lifting Gear

Spreader Beams

- Spreader beams are commonly used for lifting long loads.
- The Safe Working Load (SWL) of the contact points of the beams must not be exceeded.
- The weight of spreader beams must be included as part of the lifting load.

Colour Coding

- Using a colour code system to show that the lifting gear has been checked and can be used safely in the prescribed period.
- Shackles to be coated with prescribed colour code.
- Lifting I-beam to be coated with prescribed colour code.
- Workers should be informed of colour code system.

Preparations for Lifting

Task Coordination

- Formulate a detailed plan of “task coordination and safe working procedures” in order to prevent accidents in lifting operations.
- Implement safety management system to suit the actual site and specific operations on site.
Conduct thorough communication and training, and carry out supervision, to ensure the whole team understand and follow safety guidelines.

**Lifting Workflow**

- Contractors must strictly follow the safety code for the lifting workflow and ensure that all gears are in good condition.

**General Arrangements and Checks**

- Erect notice boards to display information about the lifting operation and safety code.
- Ensure that the automatic safe load indicator has been installed.
- Ensure that the communication between the signaller and the crane operator is conducted through hand signals, intercom or mobile phones, and that the crane operator can receive clear signals from the signaller.

- Safe access to the lifting area.
- Proper enclosure of the lifting area.
Lifting Gear

- Demarcate and properly enclose lifting zone.
- Provide sufficient space and passages for access and lifting operation by workers.
- In case of bad weather or any problems, consider suspending or rescheduling the operation.

Lifting Tackles and Gear

- Choose lifting tackles and gears appropriate to the size of the load; and the tackles and gears must be tested and thoroughly examined by a competent examiner.
Checking Lifting Gear

- Before lifting, check the lifting gear to ensure it is securely, adequately and correctly installed.

Checking Hazards of Falling Objects

- Check whether there is any hazard or potential cause of falling objects, and whether members of the lifting team are taking the right positions.

Protect Sharp Edges / Corners

- Where necessary, protect the sharp corners/edges of the load or the gear with appropriate protective pads or wooden panels.

CCTV Monitoring System

- Contractors should install a CCTV monitoring system on the jib of the crane and designated lifting areas so that the crane operator would have clear views on the whole lifting operation.
3 Lifting Gear

Important Points to Note

- Do not proceed with lifting operation when the working conditions are improper.
- Safe Working Load (SWL) must not be exceeded.
- No person shall be under the load during delivery.
- The load must be securely fastened.

- Do not start lifting where the weight of the load is unknown.

Items for Discussion

1. What is Safe Working Load (SWL)?
2. What is the SWL of the lifting gear you are using?
3. What are the parts of the lifting gear you are using which require examination before lifting?
4. If you spot problems with the lifting gear, what will you do?
5. What should be taken into consideration in the lifting area?
6. What are the necessary documents to be obtained before using the lifting tackles/ gears?
7. What are the points to note for the pre-lifting examination?
8. Name three improper conditions for lifting.
Planning / Coordination Process

- Arrange initial meeting and site inspection with crane provider to establish:
  - Site restrictions and hazards (physical and environmental), such as:
    - Overhead services.
    - Underground services / voids.
    - Risks to and from adjacent undertakings and tower crane collision.
    - Access issues.
  - Temporary works requirements.
  - Liaison / arrangements with adjacent occupiers / owners and local / statutory authorities for road closures etc.

Risk Assessment and Method Statement

- Conduct comprehensive risk assessment with clear method statements to address all hazards / risks.
- Method statements should include:
  - Detailed sequence including hold points, beyond which progress cannot continue until being checked and signed off.
  - Drawings, plans and elevations together with appropriate calculations to indicate crane setup areas and exclusion zones etc.
  - Tower crane manufacturer’s details.
  - Emergency and contingency procedures.
- Erection crew qualifications and training.
- Sign off section for crane provider and competent mechanical engineer.
- Test, thorough examination and handover procedures etc.

Formulation of a Detailed Work Plan

- Establish a proper safe system of work for tower crane operations.
- Formulate a safe and detailed work plan including the prevention of tower crane collision in accordance with the requirements of the safe method statement.

- Minimise the frequency of entering the overlapping zones.
- Conduct regular joint testing (at least once a week) to examine the effectiveness of the anti-collision system.
Erecting and Dismantling, Telescoping and Climbing of Tower Crane

- Before delivery of a tower crane to a site, a competent mechanical engineer is required to issue:
  - A report on pre-delivery verification of components.
  - A report on pre-delivery inspection.
  - Certification of tower crane anchorage.

- Before erecting a tower crane, safety officer should consult a registered mechanical engineer and conduct a risk assessment.
- Supervised by an engineer with relevant competence.
- The specialist contractor should work in accordance with the risk assessment report (with Chinese version) and the instruction of tower crane manufacturer.
4 Site Planning and Coordination

- During erection of a tower crane, the venue should be fenced off.
- The crew of tower crane workers should be trained, have sufficient experience and supervised by a competent person with at least 10 years of relevant experience in operating tower crane on the same model line.
- Observe “Construction Industry Council’s Publication – Guidelines on Safety of Tower Cranes”.
- The owner of a tower crane should engage a “Competent Mechanical Engineer” (CME) to conduct pre-delivery and pre-erection examination of tower crane.
- The contractor should appoint a “Supervising Engineer” to control, monitor and supervise operations on tower cranes.

Use of Anti-collision System

- Follow manufacturer’s instruction and manual for installation, calibration, testing, inspection, maintenance and use of the anti-collision system. (All tower cranes within the overlapping zones should be installed with the same anti-collision system.) Appropriate adjustment should be made to the distance of the overlapping zones of the tower cranes.
Access to Overlapping Zones

- When a crane jib is 15 metres apart from another crane jib in the overlapping zone, the tower crane will slow down and a warning will be sounded. The tower crane will stop operation when its jib is 10 metres away from another jib in the overlapping zone.

Audio and Visual Signal

- The operator’s cabin of the tower crane will receive a continuous audio and visual signal which reminds the operator to slow down a crane when the crane approaches a zone with the risk of collision.

Reset and Testing

- If alterations have been made to tower cranes, the anti-collision system should be reset by a competent person.
- In resetting the anti-collision system, attention should be paid to the physical performance of the tower crane, such as its braking time and distance to ensure that the tower crane can stop without collision after receiving signals from the anti-collision system. In this respect, a suitable safe distance should be worked out and maintained.
4 Site Planning and Coordination

Communication System

- Provide an effective communication system specifically designed for tower crane operations.

Establishing a Permit to Work System

- If by-pass function is to be activated for special operations, a permit to work system should be developed for such operations, which must be closely supervised and monitored.
- Ensure that the anti-collision system is in operation at all times.
- The by-pass key should not be directly controlled by the tower crane operator and must be kept by a responsible person on site.

Periodic Inspection

- Arrange for periodic inspection of the system by a competent person and keep a proper record for such purposes. Ensure the anti-collision system is always in good working condition.

Surveillance of Overlapping Zones of Tower Cranes through a Computer System

- The anti-collision system allows the site personnel to surveil through computer monitors the crane movements in the overlapping zones within and outside the work site at all times.
Protection Zones

- The protection zones prohibit tower cranes or loads from entering zones which are under protection, such as schools and train rails.

Training and Supervision

- Provide adequate information, instruction, training and supervision to ensure the safety and health of all personnel concerned.

Case Study of Accident and Analysis

Case Study

In a construction site, three tower cranes were erected for lifting construction materials. Each of the cranes had its own operation zone. On the day of the accident, one of the tower cranes mistakenly intruded the operation zone of another crane and crashed on the sling of the crane which was being used to lift a load of wood, making the load swing violently. As a result, a worker on the ground was hit and sustained injuries.

Crane collision results in hitting and injuring worker
Case Analysis

Causes of the Accident

- Each tower crane was equipped with a limit switch to prevent the crane from entering the lifting areas of other cranes. Investigations revealed that the operator of the tower crane concerned had tampered with the limit switch so that the crane could enter the lifting area of another crane.
- Limit switches were not effective in preventing the collision of tower cranes.

Safety Measures

- A suitable anti-collision system should be installed.
- Tower crane operators should not tamper with any safety device or equipment.

Important Reminders for Personnel Engaged in Tower Crane Lifting

Responsible Person

- Establish and implement the important measures and procedures for the set-up, use, regular testing, adjustment, maintenance and inspection of the anti-collision system of tower cranes.
- Provide safety instructions, training, control and supervision for workers of different posts in relation to the operation of the tower crane.
• Establish and implement as necessary the “Control Measures for Crane Operation When the By-pass Function of the Anti-collision System is Activated Under Special Circumstances”.

• Maintain close contact and communication with the contractors of the adjacent sites in relation to tower crane operation.

**Contractor’s Foreman**

• Monitor lifting operations in the construction site.

• Help monitor the daily operation of the anti-collision system and report promptly on any irregularities for follow-up actions.

**Tower Crane Operator**

• Ensure effective operation of the anti-collision system.

• Activate the by-pass function of the anti-collision system only under permitted circumstances and conditions. Conduct testings before resuming operation in the overlapping zones.

**Signaller / Rigger**

• Carry out requisite safety procedures under the safe lifting plan at the construction site.

• Stay fully alert during lifting operations in the overlapping zones and report immediately to the responsible person of the construction site any unsafe conditions such as malfunction of anti-collision system for necessary action.
Owner

- The owner must ensure that all tower cranes are operated by trained and qualified crane operators.

Competent Person

- The competent person is responsible for executing the duties of the owner, for the inspection of lifting appliances/ lifting gears and the supervision on the erection, climbing, telescoping and dismantling of tower cranes.

Competent Examiner

- The competent examiner is responsible for conducting tests and thorough examinations to the lifting appliances / lifting gears.
Competent Mechanical Engineer

- The competent mechanical engineer, employed by the tower crane owner, is responsible for conducting pre-delivery and pre-erection examination of tower crane as well as the certification of the anchorage of the tower crane before the tower crane may be erected.

Supervising Engineer

- The supervising engineer, employed by the contractor, is responsible for controlling, monitoring and supervision of tower crane operations.

Items for Discussion

1. What are the points to note for tower crane lifting during the early site planning and layout stage?
2. What are the safety precaution measures for tower crane operations?
3. What are the main considerations in risk assessment of tower crane operations?
4. Where are the purposes and the optimum location for installing CCTV monitoring system?
5. What are the preventive measures of tower crane collision?
6. Please highlight the features of the anti-collision system.
7. What are the points to note for the personnel involved in tower crane operations?
5 Lifting Panel Formwork

Storage of Panel Formwork

**Designated Storage Areas**

- Lifting of materials must be carried out in designated lifting areas.
- Panel formwork must be stored in designated storage areas with enough space and access to ensure the safety of lifting personnel, tools and objects.

**Safe Access**

- For site planning, consideration needs to be given to the arrangement of the formwork storage locations and workers’ working locations to maintain safe access and minimize the risk of workers being struck by panel formworks.

**Safe Moving and Lifting**

- Three workers should be assigned to handle lifting and storing of panel formwork. One worker would communicate with the tower crane operator with a walkie-talkie while the other two would place the formwork in a proper position, with each carrying out his own duty.

**Fencing Off Properly**

- Fence off all panel formwork lifting and storage areas to avoid the danger caused by intrusion by other workers.
Warning signs

- Put up warning signs such as “Lifting at Height Underway”.
- Warning signs must be posted at conspicuous locations in the fenced-off areas to warn the workers of other trades not to enter the operation zones of the lifting and storage areas.

Lifting of Panel Formwork

- Lift and move the panel formwork only in suitable weather and under suitable traffic conditions.

Supporting Brackets for Panel Formwork

- Check whether the supporting brackets for the panel formwork are:
  - Secure
  - Sufficient
- Check whether placement of panel formwork is proper.

Correct Placement of Panel Formwork

- The storage of formwork is to be designed by a qualified engineer, taking into account factors such as the inclination angle of storage, the placement of supporting brackets and other supplementary measures. Contractors have to provide training to and supervision on all site personnel to ensure that the whole team including workers know how to carry out the instructions accordingly, and appoint supervisors to monitor their implementation.
Good Practices in Lifting Panel Formwork

Design Lifting Route of Panel Formwork

- According to the normal lifting route of the panel formwork to floor level, the formwork is to be lifted vertically from the storage area until it can be seen by the crane operator, who will lift it towards the direction where it should be placed and then place it in an appropriate position.

Number All the Panel Formwork Storage Areas if there are More Than One in the Site

- To prevent workers from putting the panel formwork in a non-designated area, all storage areas should be numbered, and there should be sufficient communication among workers to avoid putting the formwork in a wrong place.

Put Up the Code of Practice in a Prominent Position in the Site

- Put up graphic illustrations of safety practice in the site for reference and compliance so that the work process can be carried out safely.

Panel Formwork Working Platform

- Riggers must use the panel formwork working platform provided to carry out their work and should not climb on the formwork for the sake of convenience.
Safe Access For Workers

- To provide safe access for workers can enhance efficiency and avoid the fall of person.

Check Before Use

- Check carefully whether the eye bolts (lifting eyes) are secure before hooking them with the hooks. Identify the centre of gravity of the panel formwork and choose suitable eyes for hooking to avoid sliding.

Check Condition of Eyes Bolts

- Before hoisting panel formwork, workers should check the condition of the eyes bolts to avoid danger during lifting.

Anchor Spare Hooks

- Spare hooks should be anchored to the guardrails of the panel formwork to avoid danger.
Lifting Panel Formwork

Signaller Should Give Signal To Crane Operator For Lifting

- After the load has been attached and riggers have left panel formwork, signaller should give signals to crane operator to lift formwork slowly and observe whether formwork is moving normally.

Signaller and Crane Operator Should Maintain Close Communication

- After panel formwork has been lifted, signaller and crane operator should maintain close communication. Signaller should keep watching to make sure the lifting is not too fast and formwork does not swing too much until the formwork being lifted comes into crane operator’s view.

Temporary Storage of Panel Formwork

- Formwork must be stored in a designated and numbered storage area.
- Formwork should be stored with the plain surface facing each other to avoid collision and collapse.
- Signaller must first inspect whether the lifting route is safe. Formwork foreman should also give appropriate instructions to the workers engaged in the work and inspect lifting operations on site.
Lifting Panel Formwork

- During lifting, formwork should be lifted according to the priority in the design.
- Signaller must first inspect whether the lifting route is safe. Formwork foreman should also give appropriate instructions to the workers engaged in the work and inspect the operation on site.

Lifting Double Panel Formworks

- Formwork must be securely braced with suitable ties when two sets of formwork are lifted or stored temporarily.

Hoisting of Panel Formwork For Lift Well

- During lifting, workers must wear full body safety harness anchored to an independent life line.
- As it is not suitable to install railings on the panel formwork for lift well because of work procedures, workers working on the top of the formwork for lift well must anchor their full body safety harness to an independent life line that can prevent fall of person.
5 Lifting Panel Formwork

Good Practices of Putting Down Panel Formwork on Floor Level

Tighten the Screws of the Panel Formwork

• The supporting brackets and fixed screws must be secure to avoid the danger of collapse.

Check Whether the Railings are in a Proper Condition

• After panel formwork is securely in place, workers should check the stability of the railings on the formwork to avoid the fall of person.

Case Study and Analysis of Lifting Panel Formwork

Case Study 1

A rigger of a site was responsible for anchoring the crane hook to the panel formwork and then using a walkie-talkie to tell the crane operator to lift the formwork to the roof of the building under construction.

When the accident happened, the rigger was standing on a panel formwork of 2.5m high preparing for hooking.

Rigger standing on a 2.5m panel formwork anchoring the crane hook to panel formwork
When the crane operator was lowering the hook to the last formwork to be lifted, the hook suddenly hit the rigger on his head and caused a fatal fall.

![The hook hit the rigger on his head and killed him](image)

**Case Analysis**

**Causes of the Accident**

The crane operator continued to lower the crane hook to lift the formwork without getting any effective signals from the rigger and a clear view of the operation zones area.

![Crane operator lowered the crane hook without receiving any signals from rigger](image)

**Case Study 2**

A rigger accidentally slipped and his toes were caught between the panel formwork and the floor after he instructed the crane operator to put the formwork onto floor level. As a result, three of his toes had to be removed.

![Rigger's toes were caught between panel formwork and floor when slipped](image)
Safety Measures

- Provide riggers with suitable working platform for attaching hooks.
- Provide workers with safety training on lifting.
- Supervise the lifting procedures to ensure compliance with the safety measures.
- Provide an effective communication system.

Important Reminders for Personnel Engaged in Tower Crane Lifting

Responsible Person

- The responsible person such as the contractor’s foreman, should provide an effective and practicable safety management system for the lifting operation, including:
  - The consideration of a safe lifting operation when designing the site layout.
  - Properly arranging the time schedule of lifting operations.

Contractor’s Foreman

- Maintain good communication and liaison with the signallers, riggers, panel formwork foremen and crane operators.
- Properly and evenly arrange the time schedule of daily lifting operations.
- Help monitor the safety of lifting.

**Tower Crane Operator**

- Monitor the safety of lifting with a closed circuit television surveillance system.
- Maintain good communication and liaison with the riggers and signallers.
- Stop unsafe lifting.
- Ensure the effective operation of the tower crane anti-collision system.

**Signaller**

- Maintain good communication and liaison with the riggers, panel formwork foremen and crane operators.
- Stop unsafe lifting operation.
- Ensure that no worker stays near the operation boundary and lifting route before signalling the lifting.

**Rigger**

- Maintain good communication and liaison with the signallers, panel formwork foremen and crane operators.
- Ensure that no worker stays near the operation boundary and lifting route before signalling the lifting.

**Items for Discussion**

1. What are the correct steps in attaching hooks?
2. What do we need to observe when lifting the panel formwork off the ground?
3. What will you do if you notice something wrong with the load such as finding it too close to the building or scaffold?
4. What are the correct steps in detaching hooks and the things we need to pay attention to?
5. What are the important points to note for personnel engaged in tower crane lifting?
Storage of Facades

Designated Storage Areas

- Facades must be stored in designated storage areas.
- Storage areas must be provided with enough space and access to ensure the safety of personnel, tools and objects.

Safe Access

- For proper site planning, consideration needs to be given to the arrangement of the facade storage location and workers’ working location to minimize the risk of workers being struck by the facades.

Safe Moving and Lifting Facades (Aided With the Use of Guide Ropes)

- The signaller should maintain good communication with the rigger and crane operator with the use of communication equipment. The workers can use guide ropes to stabilise the facades.

Fencing Off Properly

- The facade areas should be properly fenced off to avoid the danger caused by intrusion by other workers.
Put Up Warning Signs of “Lifting at Height in Progress”

- Put up warning signs at prominent positions outside the storage areas for precast elements to warn the workers of lifting operations inside the areas.

Use Suitable Cranes / Gears

- Use cranes that are suitable for lifting and moving facades.
- Consider whether adverse weather conditions and the traffic flow will affect the safety of workers when carrying out lifting in the sites.

Supporting Brackets for Facades

- Check whether the specially made supporting brackets for facades in the storage areas are secure and safe.
- For the sake of safety, facades should be sufficiently supported by designated brackets.
- Facades should be correctly mounted on the supporting brackets.
Good Practices in Lifting Facades

Design Lifting Route of Facades

• Design lifting route of facades. Number all the storage areas for facades if there are more than one in the site. Workers should also maintain proper communication to prevent the facades from being wrongly placed.

Usage of Bracket-Supported Working Platform

• Facade riggers must use the bracket-supported working platform provided to carry out their work and should not climb on the facades for the sake of convenience.

Choose Appropriate Lifting Beams When Lifting Different Facades

• Since facades come in different sizes, appropriate lifting beams must be used when lifting facades with different centres of gravity.

Check Facades Eye Bolts Carefully

• Check carefully whether the eye bolts (lifting eyes) on the facades are secure and without wear before attaching them with the hooks. Should any problems arise, the operation must be stopped at once.
Properly Fastened Stand-By Hooks

- Stand-by hooks should be properly fastened to prevent swinging and causing injury to workers.

Spare Lifting Chain

- Apart from the original lifting chain, a spare lifting chain should be in place as a back-up.

Signaller Giving Out Lifting Signals

- After completing the slinging operation, the signaller should give signals to the crane operator to lift the facade slowly.

Close Communication Between Signaller and Crane Operator

- After the facade is lifted, the signaller should closely liaise and communicate with the crane operator. The signaller should keep watching to ensure that the lifting is not too fast and that the load does not swing too much until the facade being lifted comes into the crane operator’s view.
Closed Circuit Television Monitoring

- Install closed circuit television (CCTV) monitoring systems on the jibs of the crane and at designated lifting areas to help monitoring the lifting operations by the crane operator.

Audio and Flash-Light Alarms

- Install audio and flash-light alarms in the lifting areas on the ground to alert workers of the lifting in progress.

Good Practices of Lowering Facades on Floor Level

- Remove any refuse at the joints and prepare for the assembly.
- Designated workers work together to fix the facade to its proper position.

- For the sake of safety, when a worker uses an aluminum ladder to reach for the hooks on the facade to detach them, another worker should secure the ladder.
• Panel strut and screws should be installed properly to ensure the facade is securely fixed on floor level.

• The hooks on the facade should not be detached until after all the supporting brackets are installed.

**Case Study of Accident and Analysis**

**Case Study**

A crane operator lifts a precast element to the top floor of a building under construction. When he was preparing to lower the precast element to a designated location for assembly, it accidentally struck a worker working nearby. Unable to escape in time, the worker had his leg trapped between the precast element and the floor, resulting in fractures to his leg.
Case Analysis

Causes of the Accident

- Before signalling the crane operator to lower the precast element, the signaler failed to ensure that the workers working on floor level were well away from the lifting area.

Safety Measures

- Engage qualified signalers to assist in the lifting operations.
- Provide the workers concerned with safety training on lifting.
- Before signalling the crane operator to lower the precast element, the signaler should ensure that workers are well away from the lifting area.
- Monitor the procedures for lifting operations to ensure compliance with the relevant safety measures by the workers.

Important Reminders for Personnel Engaged in Tower Crane Lifting

Responsible Person

- To provide an effective and practicable safety management system for the lifting operation, including:
  - Properly arrange the time schedule of lifting operations.
  - Engage qualified riggers and signalers.
  - Provide a closed circuit television (CCTV) monitoring system to monitor the lifting operations.
Contractor’s Foreman

- Maintain good communication and liaison with the signallers, riggers and crane operators.

Tower Crane Operator

- Ensure the effective operation of the tower crane anti-collision system.
- Employ a closed circuit television (CCTV) monitoring system to monitor the lifting operations.
- Maintain good communication and liaison with the riggers and signallers.

Signaller

- Maintain good communication and liaison with the riggers and crane operators.
- Before signalling to lift the load, ensure that there is no worker in the vicinity and along the lifting route.

Rigger

- Maintain good communication and liaison with the signallers and crane operators.
- Securely fasten the load to be lifted.
- Before signalling to lift the load, ensure that there is no worker in the vicinity and along the lifting route.

Items for Discussion

1. What are the correct steps in attaching hooks?
2. What do we need to observe when lifting the facades off the ground?
3. What will you do if you notice something wrong with the load such as finding it too close to the building or scaffold?
4. What are the correct steps in detaching hooks and the things we need to pay attention to?
5. What are the important things which the personnel engaged in tower crane lifting need to pay attention to?
Preparations for Lifting Operations

- Adequate competent personnel should be on duty, namely, the responsible person, tower crane operators, signallers and riggers.

- Use appropriate and certified lifting gears.

- The packing requirements, weight and measurements of the load to be lifted should be determined in order to devise the suitable lifting method.

- For lifting of steel casing or steel pipes, use a wire-rope sling to encircle the load two times with tail ropes at both ends to stabilise the load.

Correct Rigging Practices

- For different loads to be lifted, suitable rigging methods should be adopted to avoid the slings from slipping and loosening which can cause hazards.

- When using webbing slings in a lifting operation, examination should be made to detect if there are defects.
• Tail ropes should be used as appropriate to avoid swaying motion of the load to be lifted, thus preventing the associated hazards.

Use appropriate tail ropes to avoid swaying of load

Accurate Signals

• Signallers must note the lifting path, and the raising and landing points of the load to be lifted in order to maintain a safe clearance from buildings.

Signaller should maintain safe clearance of load from building

• Lifting personnel must note the obstacles along the lifting path of the load to avoid collision and dangers.

Note obstacles along lifting path

Signalling

• Signals should be made in a simple manner for clear and correct reception which should be confirmed by the transmitting party.

Signals should be made in a simple manner

• Walkie-talkies should operate on a channel assigned exclusively to tower crane operations.
Lifting Materials

- When lifting materials, the angle between any two legs of a sling must be less than 90 degrees. Tail ropes should be used as appropriate.
- Break-bulk items must be lifted in a certified skip.

- Reinforced steel bars to be lifted must be encircled by a sling.

- Wooden beams to be lifted must be encircled two times with a canvas webbing sling.

- Angle bars to be lifted should be secured in place with wooden battens of lengths similar to those of angle bars to prevent displacement.

- ‘I beams’ to be lifted should be properly fastened with a sling and clipped at both ends to prevent slipping.
Important Reminders for Personnel Engaged in Lifting General Construction Materials

**Responsible Person**

- Formulate a lifting operation plan and appoint suitable and competent persons.
- Keep all systems in good working order.

**Contractor’s Foreman**

- Provide information of the load to the tower crane operators, signallers and riggers when carrying out the lifting operation plan.
- Provide proper guidance and supervision on the operation in progress.

**Tower Crane Operator**

- Follow the rules stipulated in the lifting operation plan when carrying out a lifting operation.
- Keep good communication with the signallers to ensure safety during lifting operations.
Lifting General Construction Materials

- Make proper use of the walkie-talkie channel assigned exclusively to tower crane operations.
- Immediately cease operating a tower crane upon detecting irregularities in its functioning, the load being lifted or the lifting method.

Signaller

- Follow the rules stipulated in the lifting operation plan when carrying out a lifting operation.
- Give correct signals to tower crane operators and keep close communication with riggers during a lifting operation.
- Check for obstacles within the lifting routes/areas and give clear instructions to tower crane operators.

Rigger

- Make correct choice and use of lifting gear and keep good communication with signallers.
- Inspect whether the lifting gear is in safe working order.

Items for Discussion

1. What are the preparations prior to a lifting operation?
2. Where should you stay when a heavy load is raised?
3. What are the main points to note in rigging practices?
4. What should a signaller do and pay attention to?
5. What should a rigger do upon detecting a defective lifting gear prior to a lifting operation?
6. What are the points to note for a signaller in using radio communication equipment?
7. What are the main points to note for lifting reinforced steel bars?
8. What are the main points to note for lifting angle bars?
9. What are the main points to note for personnel engaged in tower crane lifting operations?
8 Lifting Concrete Hoppers

Storage of Concrete Hoppers

- Concrete hoppers must be kept in a designated storage area which is properly fenced and provided with adequate space and accesses.

Fencing Off Properly

- A concrete hopper lifting area must be situated on a level ground which is properly fenced off with warning notices on display, e.g. “Lifting in Progress Overhead”.

Lifting Plan

- Establish a lifting plan.
- The signallers and the tower crane operators should remain in close contact and communication during a lifting operation.

Important Reminders for Personnel Engaged in Lifting Concrete Hoppers

Responsible Person

- Formulate a lifting operation plan and appoint suitable and competent persons.
- Keep all systems in good working order.
Contractor’s Foreman

- Provide information of the load to the tower crane operators, signallers and riggers when carrying out the lifting operation plan.
- Provide proper guidance and supervision on the operation in progress.

Tower Crane Operator

- Follow the rules stipulated in the lifting operation plan when carrying out a lifting operation.
- Keep good communication with the signallers to ensure safety during lifting operations.
- Make proper use of the walkie-talkie channel assigned exclusively to tower crane operations.
- Immediately cease operating a tower crane upon detecting irregularities in its functioning, the load being lifted or the lifting method.

Signaller

- Follow the rules stipulated in the lifting operation plan when carrying out a lifting operation.
- Give correct signals to tower crane operators and keep close communication with riggers during a lifting operation.
- Check for obstacles within the lifting routes/areas and give clear instructions to tower crane operators.
Rigger

- Make correct choice and use of lifting gears and keep good communication with signallers.
- Inspect whether the lifting gears are in safe working order.

Case Study of Accident and Analysis

Case Study

A hopper loaded with concrete was conveyed by a tower crane to a working platform about 3.3 metres above ground. When a worker was attempting to release concrete from the hopper, the hopper suspended by a sling suddenly detached from the crane hook and fell onto the working platform, causing it to collapse. The three workers on the platform fell to the ground and were injured. The half-loaded concrete hopper fell further to the ground level and struck a levelling worker to death.
Lifting Concrete Hoppers

Case Analysis

Causes of the Accident

- The hook of the tower crane was fitted with a safety latch but it was found deformed and bent to one side.

- The detachment of the sling from the crane hook was probably caused by the concrete hopper having struck against the reinforcement bars of the formwork. When the movement of the hopper was abruptly stopped by the impact, the sling was forced out of the hook. The forceful departure of the sling might have caused the deformation of the safety latch. It was also possible that the safety latch had already been damaged during the operation before the accident.

- It is not necessary to undertake both the concrete pouring and levelling work at the same time. The levelling work can be carried out after concrete pouring has been completed.
Safety Measures

- No workers should stay below a hopper being lifted overhead.

- When approaching a working platform, concrete hopper should be lowered at reduced speed to avoid impact.

- Consideration should be given to using alternate concrete conveying equipments, such as a concrete pump, to eliminate the hazards associated with the lifting operation.

- Adequate information, instructions and training should be provided to the workers in relation to the hazards and safety precautions in a lifting operation.

Items for Discussion

1. What is the proper hooking procedure?
2. What are the points to note when a concrete hopper is lifted overhead?
3. What would you do if you notice irregularities of a concrete hopper, say, the hopper being transported too close to a building or scaffold?
4. What are the proper unhooking procedure and the related points to note?
5. What are the points to note for personnel engaged in tower crane lifting operations?
Designated Lifting Areas

- Lifting operations must be carried out within designated lifting areas.

Design of the Lifting Route

- Design, formulate and inspect a lifting path that does not pose any hazards to other workers or is not obstructed by other objects, e.g. the height of scaffolds.

Use Suitable Cranes / Gears

- Suitable lifting gears should be selected on account of the weight and shape of the load to be lifted, the length of such gear, etc.

Check Before Use

- The selected lifting gear should be inspected to rule out any obvious defects prior to use.
Correctly Secure Wood / Bamboo Before Lifting

- Materials such as wooden boards and bamboo poles to be lifted should be at least encircled twice and tightly secured with a canvas webbing sling, nylon webbing sling or fibre core wire rope but never with a metal chain.

Correctly Tie Metal Before Lifting

- Metal tubular scaffolding frames to be lifted should be secured with a four-legged metal chain prior to lifting.

Signaller Should Signal Crane Operator For Lifting

- Upon completion of the whole rigging procedure, and having placed his arms in a safe position, the signaller can give instructions to the tower crane operator to raise the load slowly to about 1 metre above ground. Subsequently, he should visually observe if the load is abnormal or insecure.

Blow Whistle To Start Lifting Operation

- Blow a whistle to alert workers working in the vicinity that the lifting operation is starting.
Signaller and Crane Operator Should Maintain Close Communication

- When the load is lifted overhead, the signaller and the tower crane operator should remain in close contact and communication. The load should be lifted up to a height of about 5 metres before any change in direction is made.

Signaller Should Monitor Entire Lifting Process

- The signaller should observe the entire lifting process to ensure that the load is transported at neither too hasty a speed nor with any undue movement until it is within the view of the tower crane operator.

Good Practices for Unloading a Load on Floor Level

Rigger at Endpoint to Receive Load

- A competent rigger/signaller should be sent in advance to receive the load at the endpoint (e.g. a working floor) of the lifting operation.

Inspect Unloading Point

- The unloading point (e.g. a working floor) for the load stated in the lifting operation plan should be inspected by the signaller to ensure that it is safe and structurally capable for unloading the load.
- Wedges should be placed if necessary to facilitate the detaching of the lifting gear tied to the load.
Communication Between Signaller and Tower Crane Operator

- The signaller on the working floor should firstly communicate with the ground-level signaller and the tower crane operator to make ready for receiving the load before taking up the duties of a signaller.
- The signaller on the working floor blows a whistle to alert workers working in the vicinity that the lifting operation is in progress.

Signaller to Direct Tower Crane Operator

- The tower crane operator should be directed by signaller to transport the load to the specific unloading point.

Unloading Materials

- The floor-level signaller should observe that the unloading point is clear of other workers and safe. He should then direct the tower crane operator to lower the load slowly and ensure that no lifting gear will be stuck between the load and the wedges.
- When the load has landed, observation should be made to ascertain its stability before detaching the lifting gear.

Detaching Loads

- After detaching the lifting gear, and having placed his hands in a safe position, the signaller on the working floor should direct the tower crane operator to raise the lifting gear slowly until it is completely detached from the load.
The hook, if any, attached to the lifting gear should be hooked onto the shackle so that it will not accidentally catch other objects.

Completion of Task

The signaller on the working floor makes further communication with the ground-level signaller and the tower crane operator to affirm completion of the task and revert the duties to the ground-level signaller.

Case Study of Accident and Analysis

Case Study 1

A formwork worker was responsible for rigging some used wooden boards to form a stack with a double-legged chain sling by double choker hitch method.

One end of the sling was tied to a general metal ring which was hung on the hook of a tower crane. Each leg of the sling encircled the stack of wooden boards once and then anchored back to the sling itself with a latch hook.

While the stack was being lifted past a bar-bending yard, a leg of the sling suddenly broke loose. The whole stack fell down from height and fatally struck two workers working on the yard.
Case Analysis

Causes of the Accident

- The choker hitch formed by the metal chain sling could not firmly grip the wooden boards which were loosely gathered. Moreover, the wooden boards had been used and some of them had even deformed with nails and debris on the surfaces. They might slip or displace during lifting when there were no other means to tighten them up.

- The probable cause of the accident is that the latch hook of a leg of the chain sling had not been fully locked. In the course of lifting, the latch hook detached from the sling owing to the swaying motion of the wooden boards which were not fastened. Consequently, the wooden boards scattered and fell.

Safety Measures

- Avoid using a choker hitch only to tighten a loose pile of wooden boards, which should instead be firmly secured and then rigged to prevent displacement in the course of lifting.

- The lifting path should not pass through an area with workers working therein.

- Provide safety training to workers on lifting and rigging.
• The responsible person is required to supervise the workers, making sure that they adhere to the safety rules for the lifting and rigging procedures.

Case Study 2

In a construction site, workers used a chain sling (safe working load: 1 tonne) to rig several dozens of metal concrete-supporting frames (weight: 2 tonnes). Thereafter, a tower crane lifted the bundle of metal frames from the ground floor to the ninth floor.

In the course of lifting, the sling suddenly split apart. The metal frames fell to the ground from height and injured a worker working thereon. The chain sling used in the accident had no testing or examination records.

Case Analysis

Causes of the Accident

• The metal frames exceed the Safe Working Load (SWL) of the chain sling.
• The chain sling used for the lifting operation was neither suitable, examined nor tested.
Safety Measures

- Regular testing and examination must be performed by a competent examiner for the chain slings prior to use.
- The weight of a load must be determined or properly assessed so that it will not exceed the Safe Working Load (SWL).
- The lifting path should not pass over an area with workers working therein.
- The responsible person is required to supervise the workers, making sure that they adhere to the safety rules for the lifting and rigging procedures.

Important Reminders for Personnel Engaged in Tower Crane Operations

Responsible Person

- Provide an effective and practical management system for safe lifting operations, namely, to:
  - Formulate and implement a safe lifting operation plan.
  - Take account of lifting operations when devising a site layout.
  - Intersperse lifting operations at appropriate time intervals.
  - Appoint competent riggers and signallers.
  - Keep a tower crane anti-collision system in good working order.
  - Provide closed-circuit televisions (CCTVs) to monitor the lifting system.
  - Install a tower crane anti-collision system.
  - Collect safety statistics and data regarding site lifting operations, as well as views from the staffs.
  - Regularly examine the effectiveness of the safe lifting operation plan.
9 Lifting Materials (Formwork / Scaffolding)

Contractor’s Foreman

- Take part in the risk assessment of the lifting operation plan, assist in identifying potential hazards and provide feasible work safety options.
- Familiarise himself with the rigging methods for different kinds of construction materials.
- Supervise riggers on the use of suitable rigging methods and lifting gears for lifting different construction materials.

Tower Crane Operator

- Keep the tower crane anti-collision system in good working order.
- Perform safety monitoring of lifting operations through the CCTV monitoring system.
- Keep in good contact and communication with the riggers and signallers.
- Stop unsafe lifting operations.
- Report unsafe lifting practices to the responsible person.

Signaller

- Keep in good contact and communication with riggers and tower crane operators.
• Carry out the safe lifting operation plan of the site.
• Cease unsafe lifting operations.
• Keep workers away from the clearance area and the lifting path before giving signals to start a lifting operation.
• Listen and adhere to the safety advice given by the management personnel.
• Report unsafe lifting practices to the responsible person.

Rigger

• Keep in good contact and communication with signallers and tower crane operators.
• Carry out the safe lifting operation plan of the site.
• Rig the load to be lifted in a safe manner.
• Keep workers away from the clearance area and the lifting path before giving signals to start a lifting operation.
• Listen and adhere to the safety advice given by the management personnel.
• Report unsafe lifting practices to the responsible person.

Items for Discussion

1. What is the proper hooking procedure?
2. What are the points to note when a load is lifted overhead?
3. What would you do if you notice irregularities of a load, say, the load being transported too close to a building or scaffold?
4. What are the proper unhooking procedure and the related points to note?
5. What are the points to note for personnel engaged in tower crane lifting operations?
Good Practices In Lifting Materials

- Follow the planned hoisting route for material lifting and make sure that it will not endanger other workers.
- Materials should be bundled up securely before hoisting.
- Metal pipes easily slip from the slings during hoisting because of their smooth surface. When hoisting metal pipes, bundle them up securely with nylon sling to minimise slipping. Grip both ends of the metal pipes with slings and stabilise the slings with belts.
- Tag lines should be tied to both ends of the materials being hoisted for controlling the position during lifting.

Signaller To Give Out Lifting Signals

- Signaller/ rigger should signal the crane operator after slinging.

Signaller To Monitor Lifting

- Signaller/ rigger should check if the load is tied securely and the sling is in correct position.
Communication Between Signaller and Crane Operator

- During lifting operation, signaller/rigger should communicate with the crane operator closely to guard against the materials being lifted too fast or swagging too much till the loads come into the sight of the crane operator.

Signaller To Direct Crane Operator

- After the loads have come into the sight of the crane operator, the signaller on the working floor should direct the crane operator where to place the materials.

Good Practices In Lowering Materials To The Working Floor

Lowering Materials

- Ensure that the space for lowering the materials is adequate while the working floor is strong and level enough, and that the materials will not obstruct the access or endanger others’ safety.
- After the materials have been lowered, sling can be pulled out by hand. If not, use planks or strong props to support the materials so as to allow easy removal of the sling. Never use a hook to pull the sling by force as this may cause the materials to tilt or turn over.
- When detaching the nylon sling, beware that the materials may scatter and cause injury to workers.
Signaller To Check Endpoint Location

- Signaller should check if there is any obstruction around the location where the materials are to be placed.

Signaller To Direct Crane Operator

- Signaller should direct the crane operator to lower the materials to the designated spot.

Signaller To Check Before Detaching

- Signaller should check if the materials are properly placed on the designated spot before the slings are detached by the rigger.

After Detachment

- After detaching the sling, the rigger should direct the crane operator to raise the crane hook slowly.
Case Study of Accident and Analysis

Case Study 1

On a construction site, workers hoisted a generator from the ground floor to the roof of a building with a tower crane. Two canvas belt slings were used to tie the generator by basket hitch method, then the upper ends of the sling legs were connected to a shackle while the shackle was buckled on the hook of the crane. During hoisting, one of the canvas belt slings slipped suddenly and the generator fell from a height. Fortunately, no injury was caused as no one was working in the operation area.

Case Analysis

Causes of the Accident

The slings in basket hitch and arranged in cross could not grip the generator securely. One of the slings was displaced when the generator had just been lifted up from the ground. As the slings had not been checked for displacement to facilitate timely rectification, the generator slipped off the slings during hoisting.
Safety Measures

- Two slings with choker hitch should be used to grip the generator firmly.
- While the generator starts to be lifted from ground floor, tower crane operator should stop lifting for competent person to proceed checking on stability and safety of loads lifting.
- The responsible person is required to supervise the workers, making sure that they adhere to the safety rules for the lifting and rigging procedures.

Case Study 2

A crane operator used a tower crane to lift three metal pipes, 6m long and 0.3m in diameter each, from the ground floor to the roof of a building under construction. The metal pipes were tied with two chain slings in double wrap and choker hitch. During hoisting, the metal pipes slipped off the slings and fell onto the road beside the building, causing damage to several moving vehicles and injury to one driver.
Case Analysis

Causes of the Accident

- Owing to their smooth surface, the metal pipes slipped off the chain slings during hoisting. The chain slings were placed too close to the middle of the metal pipes that affected the stability of hoisting.

Safety Measures

- Use a suitable sling such as fibre belt to replace chain sling in hoisting metal pipes.
- The 3 pipes should be tied together first.
- Whenever possible, use a spreader beam to ensure the slings can firmly grip both ends of the metal pipes.

Important Reminders for the Personnel Involved in Tower Crane Operation

Responsible Person

- Ensure that the personnel responsible for the preparation, erection and operation of tower crane and others involved in the hoisting work have received training related to safety and operation procedures.
- Ensure that all the tower cranes are operated by trained, experienced, competent and qualified operators.
- Ensure that the personnel involved in directing, suspending and handling loads have received training on the principle of operation; are capable of ascertaining the weight and judging the distance, height and clearance; are able to select suitable lifting gears and rigging methods; and are able to direct the movement of tower crane and loads to ensure the safety of all the personnel involved in the operation.
Lifting Materials
(Plumbing /Fire Services /Electrical Works)

• Formulate a safety plan for the operation of tower crane, instructing all the personnel involved in the method of safe operation, and define the safety responsibilities of individuals.

Contractor’s Foreman

• Ensure that the personnel responsible for the preparation, erection and operation of tower crane and others involved in the hoisting work have received training related to safety and operation procedures.
• Ensure that all the tower cranes are operated by trained, experienced, competent and qualified operators.
• Arrange the time, location and order for tower crane operation.
• Make arrangement to clear the area of hoisting and check adjacent areas to make sure that they are obstruction free.
• Ensure that the personnel involved in directing, suspending and handling loads have received training on the principle of operation; capable of ascertaining the weight and judging the distance, height and clearance; are able to select suitable lifting gears and rigging methods; and be able to direct the movement of tower crane and loads to ensure the safety of all the personnel involved in the operation.

Tower Crane Operator

• At least 18 years of age and hold a valid crane operation certificate.
• Be familiar with the duties of a rigger and hand signals given by a rigger or a signaller.
• Fully understand the radio signals used for communication by the parties involved.
Signaller

- When the tower crane operator does not have a clear view, relay the directions from the rigger to the tower crane operator.
- With an adequate eyesight, hearing and responding ability.
- Be familiar with hand signals and can relay clearly and correctly the directions given by a rigger.
- Wear a reflective vest for easy identification by the crane operator.

Rigger

- At least 18 years of age.
- Be physically fit for handling the hoisting operation.
- Have received appropriate training on the principles of using sling; be capable of assessing the weight of loading; judging the distance, height and clearance.
- Be capable of selecting lifting gears suitable for the loads.
- Understand hand signals and be capable of sending clear and correct signals.
- Fully understand the radio signals used for communication by the parties involved.
- Wear a reflective vest for easy identification by the crane operator.

Items for Discussion

1. Please state the proper procedures to buckle loads to a hook.
2. Please state the points to be noted when materials are lifted from the ground.
3. When the load being hoisted is found too close to the building or scaffolding, what will you do?
4. Please state the proper procedures for detaching loads from a hook and the points to note.
5. Please state the points to be noted by the personnel involved in tower crane operation.
References and Index

References

Relavant Safety Standards, Codes of Practice, Guidance Notes and Guidelines

- Code of Practice for Safe Use of Tower Cranes (LD)
- An Analysis on Occupational Fatalities - Casebook Volume No. 2 (LD)
- An Analysis on Occupational Fatalities Casebook (Volume 4) (LD)
- Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear (LD)
- Guidelines on Safety of Tower Cranes (Version 2)(CIC)
- Safe Lifting (OSHC)
Index

Abbreviation

CIC  Construction Industry Council
HA  Housing Authority
HD  Housing Department
HDSSSC  Housing Department Site Safety Sub-committee
LD  Labour Department
OSHC  Occupational Safety & Health Council

A

Accident  3, 15, 26-27, 37-38, 46-47, 56-57, 63-65, 72, 74
Alarms  45
Anti-collision system  8, 21, 23-25, 27-28, 30, 40, 48, 66-67
Automatic safe load indicator  4, 16

B

Bamboo poles  60
Bar-bending yard  63
Basket hitch method  72

C

Canvas belt  72
Case analysis  27, 38, 47, 57, 64-65, 72, 74
Case study  26, 37-38, 46, 56, 63, 65, 72-73
CCTV monitoring system  18, 30, 45, 47-48, 67
Chain slings  12, 66, 73-74
Checking  18, 73
Choker hitch  63-64, 73
Collision  2, 8, 20-21, 23-25, 27-28, 30, 35, 40, 48, 50
Colour coding  66-67
Communication system  15

25, 39
References and Index

Competent examiner 6-7, 10, 17, 29, 66
Competent mechanical engineer 6-7, 21-23, 30
Competent person 6, 10, 23-25, 29, 52, 54, 73
Computer monitor 25
Concrete hoppers 54-55, 57-58
Concrete pouring and levelling work 57
Concrete pump 58
Construction materials 26, 49, 51-53, 67
Contractor 6-8, 16, 18, 22-23, 28, 30, 32, 39, 48, 52, 55, 67, 75
Contractor’s foreman 8, 28, 39, 48, 52, 55, 67, 75

D

Designated lifting areas 18, 31, 45, 59
Detailed work plan 21
Double choker hitch method 63

E

Erecting and Dismantling, Telescoping 22
and Climbing of Tower Crane
Eye bolts 13-14, 34, 43

F

Facade 41-48
Fall 1-2, 18, 34, 36-38
Fence off 31, 41
Fibre core wire rope 60
Floor level 33, 37-38, 45-47, 61
Foreman 8, 28, 35-36, 39, 48, 52, 55, 67, 75
Formwork 31-40, 57, 59, 61, 63, 65, 67
Formwork worker 63
Four-legged metal chain 60
Full body safety harness 36

G
General construction materials 49, 51-53
Good Practices 33, 37, 43, 45, 61, 69-70
Guide ropes 41

H
Hand signal 1, 8, 16, 75-76
Hazards 1, 3, 5, 18, 20, 49-50, 58-59, 67
Hitch 63-64, 72-73
Hook 4, 9, 13-14, 34, 37-40, 43-46, 48, 56-58, 63-64, 68, 70-72, 76

I
Inclement weather 3
Independent life line 36
Inspection 4, 6, 10-11, 20, 22-23, 25, 27, 29

J
Jib 4, 18, 24, 45

L
Lift well 36
Lifting 1-19, 26-37, 39-45, 47-71, 73-76
Lifting path 50, 59, 64, 66, 68
Lifting tackles 17, 19
References and Index

Limit switch 27

M

Metal tubular scaffolding frames 60
Method statement 20-21

N

Notice boards 16

O

Obstacles 50, 53, 55
Obstruction 71, 75
Overlapping zones 2, 21, 23-25, 28
Owner 6-7, 20, 23, 29-30

P

Panel formwork 31-40
Permit to Work 25
Plumbing 69, 71, 73, 75
Precast element 31, 33, 35, 37, 39, 41-43, 45-47
Protection zone 26
### R

<table>
<thead>
<tr>
<th>Term</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio signal</td>
<td>75-76</td>
</tr>
<tr>
<td>Reflective vest</td>
<td>9, 76</td>
</tr>
<tr>
<td>Registered structural engineer</td>
<td>2</td>
</tr>
<tr>
<td>Responsible person</td>
<td>6-7, 25, 27-28, 39, 47, 49, 52, 54, 65-68, 73-74</td>
</tr>
<tr>
<td>Rigger</td>
<td>1, 8-9, 28, 33, 35, 37-41, 43, 47-49, 52-53, 55-56, 61, 66-71, 75-76</td>
</tr>
<tr>
<td>Risk assessment</td>
<td>20, 22, 30, 67</td>
</tr>
</tbody>
</table>

### S

<table>
<thead>
<tr>
<th>Term</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Working Load (SWL)</td>
<td>3, 5, 10-11, 14-15, 19, 65-66</td>
</tr>
<tr>
<td>Safe working order</td>
<td>53, 56</td>
</tr>
<tr>
<td>Safety belt</td>
<td>1</td>
</tr>
<tr>
<td>Safety latch</td>
<td>14, 57</td>
</tr>
<tr>
<td>Safety measures</td>
<td>27, 39, 47, 58, 64, 66, 73-74</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>59, 61, 63, 65, 67, 76</td>
</tr>
<tr>
<td>Shackles</td>
<td>13, 15</td>
</tr>
<tr>
<td>Signaller</td>
<td>1, 4, 8-9, 16, 28, 35-36, 39-41, 44, 47-50, 52-56, 60-63, 66-71, 75-76</td>
</tr>
<tr>
<td>Site layout</td>
<td>39, 66</td>
</tr>
<tr>
<td>Site planning</td>
<td>20-21, 23, 25, 27, 29-31, 41</td>
</tr>
<tr>
<td>Sling</td>
<td>10-14, 26, 44, 49, 51, 56-57, 60, 63-66, 69-74, 76</td>
</tr>
<tr>
<td>Spreader beam</td>
<td>10, 15, 74</td>
</tr>
<tr>
<td>Storage area</td>
<td>31-33, 35, 41-43, 54</td>
</tr>
<tr>
<td>Supervising engineer</td>
<td>6-7, 23, 30</td>
</tr>
<tr>
<td>Supporting brackets</td>
<td>32, 37, 42, 46</td>
</tr>
</tbody>
</table>

### T

<table>
<thead>
<tr>
<th>Term</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag line</td>
<td>69</td>
</tr>
<tr>
<td>Task coordination</td>
<td>15</td>
</tr>
<tr>
<td>Thimble</td>
<td>11-12</td>
</tr>
<tr>
<td>Tools</td>
<td>1, 31, 41</td>
</tr>
</tbody>
</table>
## References and Index

<table>
<thead>
<tr>
<th>Item</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tower crane operator</td>
<td>4, 8-9, 25, 27-28, 31, 40, 48-49, 52-55, 60-63, 67-68, 73, 75-76</td>
</tr>
<tr>
<td>Tower Crane</td>
<td>1-9, 20-31, 39-40, 47-50, 52-58, 60-63, 65-68, 72-76</td>
</tr>
<tr>
<td>Unloading point</td>
<td>61-62</td>
</tr>
<tr>
<td>Walkie-talkie</td>
<td>4, 31, 37, 50, 53, 55</td>
</tr>
<tr>
<td>Wedges</td>
<td>61-62</td>
</tr>
<tr>
<td>Whistle</td>
<td>60, 62</td>
</tr>
<tr>
<td>Wire rope slings</td>
<td>10-12</td>
</tr>
<tr>
<td>Wooden boards</td>
<td>60, 63-64</td>
</tr>
<tr>
<td>Workers</td>
<td>1, 15, 17, 23, 27, 31-37, 39, 41-45, 47, 56, 58-60, 62-66, 68-70, 72-73</td>
</tr>
<tr>
<td>Working floor</td>
<td>61-63, 70</td>
</tr>
<tr>
<td>Working platform</td>
<td>33, 39, 43, 56, 58</td>
</tr>
</tbody>
</table>
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