PARTNERING FOR INNOVATION

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1. INTRODUCTION

The Hong Kong Housing Authority, being a progressive property developer, has very early on taken the lead in promoting the use of innovative construction methods and techniques for raising the standards of efficiency, quality, safety, health and environmental management in the building construction industry. Working closely with the Authority, Shui On Building Contractors has taken strong initiatives in its research and development efforts to achieve breakthroughs in quality, safety and environmental performance.

2. PARTNERING EFFORTS AND INNOVATION SINCE THE 80'S

An atmosphere of "partnering" has been instilled by the Housing Authority in its relationship with the contractors long before the term itself is quoted for its present day connotation in the construction industry. Under this atmosphere, innovative ideas in building construction are continually being put forth by contractors and successfully implemented in various Housing Authority projects. Many of such innovations have turned into widely accepted standard practices in the industry today. Some of Shui On's contributions are briefly outlined in the following.

2.1 Use of Large Panel System Formwork to Replace Timber Formwork

In the early 80's the Hong Kong Housing Authority pioneered a drive for the use of large panel steel formwork system in residential housing construction in order to improve quality and speed. Responding to this incitement, Shui On was among the first contractors to implement the concept by expediting the development of steel system formwork and bringing in new engineering techniques from overseas. Through continuous research for a shorter construction cycle time and other improvements, a Half Tunnel Formwork System was developed for monolithic casting of the walls together with the slab. With the support from the Housing Authority, the engineering teams of the HA and Shui On worked together to iron out all technical problems. This system was first adopted in the Hang On Estate Phase 1 project in 1985. Aided by in situ steam curing, an unprecedented one-day construction cycle time was achieved. The success of this method was subsequently extended to the construction of Leung King Estate Phase 2 and Cheung On Estate Phase 2 in the following year. Although the system had proved to be successful, its further usage and development were hindered due to the unavailability of suitable floor plans and much stricter Fire and Labour regulations.

2.2 Application of Aluminium Formwork System

Shui On is targeting its research and improvement efforts on practical issues down to the working level. In order to achieve still better maneuverability and adaptability in the application of system formwork, Shui On was the first contractor to introduce the aluminium formwork system to the local building construction industry. The system was accepted by the Housing Authority for its first application in construction of the annex block at Kwai Chung Area 9H Phase 2 project in 1992, and then at the Fanling Area

39A Phase 1 and 47B Phase 1 project in 1993 and 1994 respectively. Later in 1994, the system was applied in the construction of two New Cruciform Block buildings in Tsui Wan Estate. Aluminium formwork is an environmentally friendly product as it is reusable and recyclable. Use of timber is very much reduced and less construction waste is generated. Some other contractors and even private sector developers have also been adopting similar systems in recent years.

2.3 Development and Application of Precast Façades

Shui On's development of precast façades for Housing Authority projects began in 1990 as a joint effort with the Design and Standard Section of the Hong Kong Housing Department. A precast façade prototype was installed at the mock up centre for Harmony Blocks at Hang Lam Street. As a pilot project, the precast façade was put into full-scale application for the first time in the construction of Tin Yiu Estate Phase 3 in 1990. As precast façades are manufactured in the factory, high standard of finish and consistence of quality can be achieved. And since the window frame is cast in at the factory, installation work is much simplified. At the same time, the long-existing water leakage problem around aluminium windows is minimized. Site safety is improved by reducing the need to work on the outside of the building. Dramatic improvements are seen compared with traditional in situ form-working systems. In recent years the private sector is adopting similar techniques, following the footsteps of the Housing Authority.

2.4 Application of the JumpLift System

The JumpLift can be defined as the combination of a "builder's lift" for construction use and a "permanent lift" for end users. It is designed as an alternative to the conventional passenger hoist used on construction sites. As its name implies, the JumpLift "jumps" as the building "grows up" and is finally converted into a permanent lift.

Contrary to a builder's lift, which is driven by a rack and pinion system and attached on an outer wall of a building, the JumpLift is driven by a traction motor using suspension steel wire ropes inside an enclosed lift shaft. While still providing lift service at lower floors, the JumpLift will continue its installation works to extend the lift service upward in stages in pace with the construction programme. When the lift machine room is completed, the JumpLift will then be converted into a permanent lift. Fully enclosed inside the lift shaft, the system is weatherproof. Noise and dust emission to the surroundings is kept to a minimum. The JumpLift complies with the safety regulations for both permanent lifts and passenger hoists. It is fully automatic in operation, and is equipped with all safety features such as safety gears, over-speed governors, electrical and mechanical door locks (for car and landings), buffers, safety door edge and a safety switch in the lift shaft.

The JumpLift system was first applied in Shui On's Private Sector Participation Scheme project at Tseung Kwan O Town Lot No. 62, Tseung Kwan O Area 65A (Bauhinia Garden) in 2000. With the partnering spirit Shui On has offered, at no extra cost to the Client, to use the JumpLift purely as the builder's lift at the Lam Tin Estate Phase 6 project, and the proposal has been approved by the Authority. Seeing the benefits of the system, some private developers have recently begun to adopt the JumpLift in their building projects.

2.5 Panel Wall with Concealed Conduits

To simplify the installation of concealed electrical conduits and junction boxes, they are pre-installed in lightweight concrete panel walls during the casting process. At the construction site, the electrician can simply join up the free ends of the embedded conduits

in the panel wall with those in the slab. This method significantly reduces the amount of cutting, chasing and patching-up work during installation of conduit systems in panel walls. The quality of finish and site housekeeping can be controlled more easily. The casting-in of the electrical conduits and junction boxes is offered by Shui On as part of panel wall production without any extra cost to other parties. The system has been tried out in several projects and is well accepted by the electrical subcontractor.

2.6 Wastewater Treatment Facilities

Responding to the need to better control and recycle construction wastewater, a wastewater treatment plant was designed for use on project sites. The in-house design was first applied at the Homantin South Phase 3 project in 1997. Wastewater generated on site was collected and treated for reuse in car wheel washing, dust control, etc. Water consumption was reduced and the quality of any surplus discharge is kept within statutory limits. The wastewater treatment plant is now a standard provision on all Shui On sites.

2.7 Application of a Large Material Hoist

Shui On is always ready to bring in new equipment to meet the needs of our projects. At the Yau Tong Estate Phase 5 project, as the terrain made vertical transportation difficult, a material hoist with a capacity of 6 tonnes and a 6 metres by 3 metres platform (which is so far the largest of its kind in use on local construction sites) was introduced in 2000 in order to achieve efficient material handling and transportation.

2.8 Bringing in Successful Experience from Japan

After their study tour in Japan, Shui On's management introduced several new techniques:

- **The Aluminium Working Bench** was developed to get rid of the accident-prone "make do" bench commonly found on sites so as to improve site safety. The device is sturdy, stable, handy and easy to be carried around and has become a standard provision on all Shui On sites.
- The Japanese practice of **Safe Working Cycle** was introduced to facilitate daily communication with workers and to promote their sense of awareness in quality, health and safety. Reckoning that the root of site problems lies in the working level Shui On is the first contractor to implement Safe Working Cycle in Housing Authority projects. This practice has now been extended to all Shui On project sites with encouraging results.

3. CURRENT RESEARCH AND DEVELOPEMNT

Currently, Shui On's research and development focuses on prefabrication. Prefabricated components such as tiled panels, unitized bathrooms and precast slabs are being tested and put forth for the Housing Authority's consideration.

3.1 Precast Panels with Tile Finish

Tile de-bonding has long been a serious problem faced by the construction industry. Led by the Housing Authority, Shui On developed a system of precast panels with tile finish for internal walls. Trial panels running the whole length of a typical corridor were put up in the Po Lam Road Phase 5 project. The corridor width was not affected since the panel thickness was kept at a minimum. Mechanical fixing connections were used to replace traditional chemical bonding agents. This precast technique also improves site tidiness, workmanship and quality by minimizing in situ cutting of tiles and wet trade work. The system is welcomed by the Housing Authority and is now being considered for full-scale installation in one of our project sites.

3.2 Prefabricated Bathrooms

Two systems of prefabricated bathrooms, by different manufacturers, have been developed and submitted for consideration for application in Housing Authority projects. Both systems are of an inherently waterproof design so that the long-existing water leakage problem in traditionally constructed bathrooms is eliminated. The rounded internal corner design makes cleaning easy, avoiding the accumulation of water and dirt or the infestation of bacteria. Factory production quality of finish is achieved and installation is simplified to involve one or two trades only. The use of lightweight and long-lasting material renders handling and transportation easy and safe. The first system is of the panel wall and base pan type. A wide range of wall finish, from the traditional wall tile to PVC film, is available for choosing. The second system is of fibreglass construction, and the bathroom unit is assembled and delivered as a complete cubicle. Waterproofing is tested in the factory before delivery. The bathroom unit can be lifted and installed in position in a single operation. The use of these prefabricated bathrooms shortens installation time and reduces construction waste. Wet trade work is reduced to a minimum, thus improving site housekeeping.

3.3 The Superslab

A semi-precast slab system, the Superslab, was studied by the Housing Authority to improve quality of construction. Responding to HA's notice in September 2001, Shui On promptly began to get ready for a trial project due to start early 2002. The Superslab panels, originating from German technology, are in the form of reinforced concrete panels with lattice girders. The slabs are manufactured in an automatic production process at Daido's Tai Po factory. The introduction of the lattice girder stabilizes the panel during transportation, handling and installation. It also helps solve the common cracking and de-bonding problems inherent in other semi-precast systems currently in use. This specially designed three-dimensional rebar ensures a maximized spacing between supporting props. The girder acts as support for the top structural steel and its steel content is utilized to replace structural bars, acting as shear connectors. After installation and pouring of the topping concrete the semi-precast panels become an integral part of the structure, transforming the slab into a monolithic concrete structure.

4. IT Applications

Following the dramatic development of the Internet in the past few years, various industries are adopting web based solutions and applications. However, the development of IT applications in traditional fields such as the construction industry is comparatively slow.

Shui On is one of the few construction companies who realize that change is inevitable. A construction information system (CIMS) had been developed by Shui On jointly with HKPU and used in the Ma Hang Village Phase 3 project commencing 1998. Following this successful trial, the company decided to extend the system into a web based project management system. Subsequently SOCAM.com was established and launched on December 18, 2000.

Driven by a special development team with construction management, procurement and IT expertise, Shui On has developed and implemented tailor-made Internet solutions for the company's procurement and project management processes.

The ultimate goal of Shui On is to provide a full service IT solution with flexibility and speed for use in the control of quality, cost, as well as environmental, health and safety issues in the construction industry. Shui On is the first company in Hong Kong to apply web-based technology in managing construction projects. Some of the major applications are described in the following.

4.1 Electronic Project Management System (e-PMS module of SOCAM.com)

The e-PMS is a web-based management system developed to handle vast amount of documentations, aiming to streamline the day-to-day site office operations and to allow efficient information flow between the project site and the head office. The system includes the following modules:

- Document control
- Instruction and requisition control
- Designs / Drawings / Materials submission and control
- Progress control by means of daily reports, progress photos, management review, etc
- Quality control
- Inventory control
- Centralized library

4.2 Electronic Tendering System (e-Tendering)

This system is developed for tendering and selection of suppliers and subcontractors. The Hong Kong Post Office "I-cert" and "Public Key Infrastructure (PKI)" technologies are used. Tenderers are authenticated by their I-cert and their tender offers are encrypted with PKI. For security purposes, the "tender box PC" is protected with fingerprint lock. Ariba software is used in the e-tendering approval workflow.

The system improves communication with sub-contractors. A considerable amount of paperwork and photocopying are reduced.

4.3 Electronic Health, Safety and Environment (e-HSE)

Shui On has developed a database application for Health, Safety and Environment information management with the following modules:

- Subcontractor evaluation module;
- Workmen compensation module;
- HSE training module.

4.4 Mobile Computing for In-Process Inspection and Direct Labour Productivity System

A system was developed for operational staff with the use of handheld computers for in-process control and final defect checking. Detail records made during inspections are downloaded to the site server and processed quickly so that quality standards can be maintained accordingly. Much less paperwork is generated while the inspection process and quality control procedures are streamlined.

A direct labour productivity system was developed to monitor labour productivity, quality control, bonus allocation and cost control. Centralized database storage facilitates reviewing and monitoring by the Management.

4.5 Electronic Data Interchange (EDI)

Linking between construction sites and head office is maintained by leased lines and the set up also allows data exchange with other

parties such as the Client, the Architect, Engineers and other Consultants.

4.6 Benefits of SOCAM.com

The Electronic Project Management System is an innovation towards a total solution at the project management level. Benefits offered by the system are as follows:

- It enables effective progress monitoring and quality control by the management. Problems can be discovered and dealt with promptly.
- It provides an efficient management tool to ease the paperwork workload of the project team.
- The web-based design provides instantaneous visibility to Senior Management stationed in the Head Office.
- Conducted via the Internet and a local computer system, the e-Tendering system provides a web-based portal for the tendering process to replace the traditional paper-based tendering process.
- A Smart Card Access Control System developed based on contact-less smart card technology, linked to the e-PMS system, keeps electronic records of in-out transaction for each worker.
- With the use of the electronic database system, less paperwork is generated, thus saving office storage space. Cost saving is achieved by saving operations and administration time.
- A centralized database allows site engineers to tackle repetitive works such as engineering details, quality standards and management procedures.

5. CONCLUSION

With the leadership, guidance and encouragement of the Hong Kong Housing Authority, considerable advancement has been seen in various aspects of the building construction industry, including project management, construction technology, quality control, and environmental, health and safety management. The Housing Authority's emphasis on the partnering approach will continue to be the driving force towards new heights of achievements, encouraging stakeholders in the industry to set similar targets. Shui On, as one of the partners of the Housing Authority, is well prepared to take on new challenges to achieve innovations and improvements. Some of our latest efforts in this area include the application of the JumpLift and precast panels with tile finish at Lam Tin Estate Phase 6; the application of the Superslab at Pak Tin Phase 3&6; and the proposal of using the prefabricated bathroom at a trial project. Following the policy of the Housing Authority towards sustainability, Shui On's future research and development will focus on off-site prefabrication of building components. Particular considerations will be given to quality improvement, safety at work and cost effectiveness.

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