Prefabircated Construction Systems for Building and Civil works adopted in Hong Kong

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Development and Application of Prefabricated Technology in Building Construction in HK

1. Had been used once in early 1970s in a pilot project to construct a series of 17-storey public houses

2. Used in a broader scale in the mid/late 1980s in the construction of public houses where all the façades of the flats were constructed in precast in a after-fixed manner

3. Improvement to public houses by introducing in-situ joined façade and broader use of other precast elements in early/mid 1990s.

4. A few private developments pioneered in the use of prefabricated system in the construction of buildings of various nature since early 1990s.
Development and Application (continue)

5. Packaged projects introduced from late 1990 onward by the Hong Kong government for the construction of a series of schools using semi-prefabricated method

6. A series of government quarter buildings using similar construction techniques were introduced in 2000

7. A few special buildings such as bus depot or train station podium employed large amount of prefabricated elements of which some were primary structural members (1997 onward)

8. Popular use of prefabricated external wall from 2002 onward in residential buildings due to the introduction of a new guideline encouraging the use of precast façades as a form of green elements in construction (exemption of Gross Floor Area)
Generations of Public Houses (Harmony Block) constructed using semi-prefabricated concept
First generation of Harmony Block using after-fix façade

Later version of Harmony Block using in-situ façade cast at the same time with structural walls
Precasting yard was set up to produce precast elements for public housing projects in early to mid 1990.
After-fix façade system required the formation of small amount of in-situ joint and grouting that easily caused leaking problem.
Detail of façade installation using in-situ jointing arrangement in the later version of Harmony Block Construction.
Forming the floor slab in the Harmony Block construction using semi-slab (right) and aluminium formwork (above)
Introduction of mechanical formwork systems incorporating the standard precast elements in the construction of latest version of public houses in the late 1990s.
Public houses using Concord design with special emphasis on the use of mechanicalised construction system
Layout of the Concord Block showing the position of the cast-in-situ core wall, shear walls and precast façade.
Other pioneered projects in the early 1990s constructed using semi-prefabricated concept.
The construction of the Headquarter and Members Facilities Complex for the Hong Kong Jockey Club
Forming the floor slab using precast secondary beams and semi-slab for the main building (above) and members’ complex (right)
Detail of the floor system with the cast in-situ main beams and the place-in precast secondary beams.
Introduction of prefabricated concept to construct government quarters in 2000
Government quarters in West Kowloon
Layout of the quarter building showing typical phasing arrangement of work
Features in the construction – extensive use of precast façade and lintel beams, precast cast-in-situ internal partitions are also introduced
Detail of the façade and the lintel beam installation
Installation of the cast-in-situ precast internal partition
Construction of special buildings using high proportion of precast since 1998
Construction of the Kowloon Canton Rail podium deck – cargo handling bay on the ground level and on top for a large-scale residential development afterward.
Forming of the cast-in-situ main beams
Jointing detail of the main beam and precast secondary beams
Semi-slab with RC topping to form the composite podium deck
Kowloon Motor Bus Maintenance Depot

- 3-level depot building with columns, main and secondary beams all in precast
Erecting of the building frame using precast columns and beams
Connecting the precast column to the foundation cap with a base plate
Placing the secondary beams onto the main beam
Connecting beams to columns by stitching, a means to provide an in-situ joints with rigid RC links
Detail of the beam/column and beam/beam joints
Recent Residential/Commercial Developments using prefabricated concept to construct
Residential development at Cyber Port
Façade and general installation details
Features in the construction – large amount of external walls are constructed in precast façade units, with major structural links tie back to the inner shear walls and floor slab.
Incorporation of other sophisticated formwork in construction –
steel gang form for walls and table form for floor
Construction features – the use of large amount of precast units both of structural or architectural nature. This includes the balcony, façade units, loss-form for external walls and some shading fins.
Detail of the precast balcony unit
Detail of the loss-form
Residential development at Ma Tau Wai
Overview of the precast installation arrangement
Façade installation detail as seen on the floor deck
Cambridge House – a 42-storey Office Building at Quarry Bay
Features in construction – precast beam trough and precast sub-slab with RC topping forming the floor system
Placing of the precast beam trough to form the floor layout
Recent Achievements of Hong Kong’s Prefabricated Technology

- Previous defects such as leakage problems have been improved
- Application diversified to other forms of construction
- Capable to apply to rather complicate-shaped buildings
- Incorporation of other advanced technology in the construction (such as use with mechanical form/tensioned elements)
- Generally mastering of skill and growing popular
Future Trend in the application of Prefabricated Technology in Hong Kong

1. To increase the use of prefabrication for more structural elements such as for beam, column or load bearing wall

2. Use more modulated elements or plug-in units

3. Use more for architectural or decorative elements

4. Incorporation of other composite elements in the design such as using at the same time with structural steel

5. Apply prefabrication more to medium-rise buildings with more standardized structural items

6. Improve the supply chain management to make production more efficient and economical
Practical Constraints

1. Tighter coordination to allow for structural design, construction planning, procurement & approval procedure

2. Required a critical amount of precast items before work can be economically used

3. Huge work space for handling precast elements especially in congested urban environment in Hong Kong

4. Congested site environment makes access and delivery of heavy precast units to the work spot becomes difficult

5. Quality assurance become critical especially where large amount of precast components are used as structural nature
Examples of very congested construction environment where prefabrication approach is adopted
Example of Innovative Project (Local)

The Integer
The Integer House at Admiralty
Floor plan of the experimental house
The working concept
Typical connection details
Assembly of the 3-D modules
Possible future development for high-rise structures using similar concept
Example of Innovative Project (overseas)

The Habitat 67 in Montreal, Canada
Habitat 67 as seen along the bank of St Lawrence River
Habitat 67 as seen along the bank of St Lawrence River
Close up look of the modulated dwelling units
Close up look of the modulated dwelling units and the linking structure in the form of a access corridor
View as seen on the deck level
Forming and Installation of the modulated units
Installation of the modulated units and the associated structure
Section through structure showing modular house with gardens, pedestrian streets, and the mechanical and electrical distribution.
Connecting the modules
Prefabricated Construction

Application in Civil Works
Examples of application of prefabricated techniques in civil construction works

1. Used in highway projects such as cantilevered deck of elevated bridge, parapets of expressway and road curb
2. Precast girder units or beams for elevated roadway (viaduct)
3. Precast beams or decks for elevated pedestrian footbridges
4. Tunnel lining especially for tunnel formed by tunnel boring machine
5. Decks for long span bridges
Examples of application (continue)

6. Marine work such as seawall and deck of terminal berth

7. Soil retaining element such as for earth-balanced type retaining structure

8. Platform for railway station

9. Parapets and noise barrier panels

10. Overhanging ducts or services channels for underground facilities

11. Nullah section for storm water discharge
Elevated pedestrian footbridge in Mong Kok
Piers formed using precast column
Precast girder erected on top of the piers to form the main span of the footbridge
Extending precast plank to form the deck of the footbridge
Structural arrangement of the footbridge
Precast V-shape beam for the Route 3 elevated expressway at Kwai Chung

Precast V-shape beam being lifted to pier head by launching gantry
Precast box-girder for the Rambler Strait Bridge of Route 3
Forming the elevated bridge of the West Kowloon Expressway
West Kowloon Expressway – installing the precast box girder using balanced cantilever method with the help of track mounted gantry crane
Forming the elevated track of the West Rail using the slung launching girder
Forming the elevated track of the West Rail using the longitudinal steel support beam
Forming the elevated track of the KCR Ma On Shan Line by precast girder and lifted to deck level for erection using mobile crane
Placing the precast girder in position
Project example – Road T7 in Ma On Shan (TTD project)

Technical Features

1. Total length of viaduct – 2200m (approx.)
2. Span length – Average 40m
3. Total nos. of segment used – 790 nos.
4. No. of segment per span – average 14 nos.
5. Weight of segment – ranging from 50 to 98 tons
6. Weight of the launching machine – 310 tons
7. Max. weight of machine with segments – 1300 tons
8. Length of launching machine – 85m
9. Casting of the box-girder segment – match-cast
Construction of highway bridge using precast box-girder (viaduct) – Road T7 in Ma On Shan
Early stage of the project – formation and forming the piers for the viaduct.
Overall layout of the precasting yard
Forming the box-girder units
Formwork to form the inner void of the box-girder units
Overview of the launching machine
Launching sequence of the box-girder units using launching machine
Installation of the box-girders
Installation of the box-girders
Other example of application in civil engineering works
Precast parapet unit for the highway and railway road/track way
Precast floating slab for the laying of railway track
Tunnel lining formed by precast segments
Detail of the lining as seen inside the tunnel tube
Forming the station platform using precast curb and plank (KCR Tsim Sha Tsui Station)
Forming the cable hood
Delivery of the precast units
Forming the deck of the berth for the Container Terminal No. 9

Forming the deck of the Ting Kau Bridge using precast concrete plank
Precast concrete plank as cover to podium deck
Precast vertical panel forming an earth-reinforced type retaining structure
Forming storm water discharge culvert – Tseung Kwan O Reclamation
Delivery and storage along the temporary seawall

Prepare for the foundation to support the culvert
Precast units to form the 4m high 5-cell culvert system in Tseung Kwan O
Positioning the Precast units onto the culvert alignment
Precast culvert in the form of semi-submerged tube – Tsuen Wan West Reclamation as advanced work for the West Rail Tsuen Wan Station
Sinking of the precast culvert section
Positioning of the culvert section onto the formed bed
Connecting the culvert from the precast section to the in-situ section
Precast box as footing to bridge tower – Tsing Ma Bridge tower on Ma Wan side
Precast box as pump house for water cooling system in the Central Reclamation
End of Presentation
and
Thank you

If you require more information about the Author’s recent work on various technology topics, you can enter his homepage at

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