



IEM-IES One Day Seminar on Precast Concrete for Highrise

By Ir. Prof. Dr Jeffrey Chiang and Ir. Hooi Wing Chuen

On 25 July 2011 at Hotel Armada, Petaling Jaya, the IEM Civil and Structural Engineering Technical Division hosted a joint seminar on Precast Concrete for Highrise, in collaboration with The Institution of Engineers Singapore (IES). The event was sponsored by Eastern Pretech (Malaysia) Sdn Bhd, and it was well attended by 111 participants, many of whom were practicing professional engineers.



The invited speakers were Er Lawrence Pak Yew Hock (Deputy Director, HDB Singapore), Mr Tan Chee Hock (Sr Project Manager, Chip Eng Seng Contractors Pte Ltd, Singapore) and Er Lim Chong Sit (Tiong Seng Contractors Pte Ltd).

Er Lim Chong Sit started the seminar at 9.15 am by presenting his slides on the development of precasting technology in Singapore entitled “Precast Technology – The Way to Sustainable Construction and Higher Productivity”. He explained that the initiative was led by the HDB, which was tasked with delivering affordable housing to the public at a rate of 25,000 units a year. The initiative helped Singapore’s construction industry move away from labour intensive, low mechanization and low productivity methods of the 60’s and 70’s to achieve higher productivity and quality demanded by Singaporeans. As a result HDB was able to reduce the delivery time for new housing from 5 years to 2.5 years.

Er Lim with the help of his slides took participants through the learning curve of the early 1980s working from low rise housing and industrial buildings to the current state of precasting technology in Singapore. He showcased examples of various designs tried and the various problems encountered along the way, such as leaking joints, complicated connections, constructions and coordination problems.

Only through large scale implementation, intensive R&D, strong commitment and perseverance of the HDB, were the problems overcome and solutions were developed to move precasting technology forward. Some of these efforts included:

- Introduction of modular formwork system,
- Setting up operations hiring formwork to contractors,
- Financial incentives to help contractors procure machines,
- Improving cashflow of contractors,
- In house-design & standardisation, and
- Use of latest integrated design & detailing BIM software

A token of appreciation was presented to him for his hard work in delivering his interesting lecture and responding well to queries posed during the Q&A session, before the mid-morning coffee break.

At 10.45 am, after the coffee break, Er Lawrence Pak took over the helm and gave his presentation on the topic, “Adoption of Innovative Prefabrication and Precast Construction Technology to Enhance the Construction Productivity in the Singapore Public Housing Projects”. The focus was on the steps taken by the Housing Development Board of Singapore (HDB) in:

- Productivity enhancement initiatives
- Prefabrication and precast system & innovations

The approaches taken to achieve the objectives are multi-fold, i.e.

- Facilitate co-operation between direct stakeholders (designers, suppliers and contractors)
- Develop standardisation (where modularization comes into play)
- Optimise usage of standard components (which is very similar to the Integrated Building System or IBS as promoted by CIDB Malaysia)
- Encourage interchangeability
- Simplify site operations
- Emphasis on buildable design

The above gave rise to extensive design and application of precast concrete systems, into all aspects of structural components, such as,

- Prefabricated reinforcement and wire meshes
- Effective waterproofing system to joints
- Precast Façade envelopes (which eliminates scaffolding)
- Precast floor slabs
- Precast column and wall systems (both non-load bearing and load bearing)
- Precast water tanks (improving the maintenance-free life of tanks)
- Prefabricated bathroom and toilet systems

- A variety of design and finishes are possible (such as curved components, 3-D volumetric or angular, and profiled finish)

After the detailed presentations on the above, it was time for lunch break at 12.30 pm.

Following the lunch break at 2.00 pm, Er Lawrence Pak continued his lecture on the topic “The Pinnacle @ Duxton – HDB’s 50-Storey Residential Project”, a new highrise precast concrete public housing project.

The contract sum was S\$279 million, over a 3½ year period (from April 2005 to December 2009). It consisted seven residential blocks of 50 storeys high, and joined by 12 number of sky bridges at the 26th and 50th storeys, providing spaces at top levels for rest and recreational facilities – a very unique feature, but becoming very common nowadays in Singapore context. This was in the light of similar design features of sky bridges at Marina Bay structures lining up in the Singapore city skyline!

Er Lawrence Pak focussed mainly on the development and design stages, and how it had an impact on the design of traditional residential apartment homes in Singapore. He gave an overview of the project information, such as floor layout, landscaping, consultants involved, and also on the structural scheme. From thereon, he described the analytical and design approach adopted, the wind tunnel study, and the avoidance of soft storey in the structural design.

He then delved into the rationale for a precast system for the project, such as:

- Buildability and productivity
- Scheduling and the need to reduce noise and dust
- Quality finishes and better waterproofing
- Reduced wastage and emphasis on skilled workers



And in order to implement the above system, the following structural considerations are taken into account:

- Design for precast right from the initial stage
- Design for cycle time
- Juggle the need for performance and economical design, i.e. robustness and ease of production
- Ensure water tightness in envelopes and slabs, i.e. wet joints at walls, floor topping and concealment of services

- Remove the need for external plastering work

Er Lawrence Pak shifted the focus onto the modularization approach, in applying the required innovative tools and their benefits:

Modularisation		
Innovative tools	Standardisation	• Shape and sizing • Projections – nibs, canopies, kerbs • Recesses • Repeatability of moulds
	Integration of panels	• Limited by panel weight • Enhance tower crane utilisation • Improve site productivity
	Volumetric	• 3-dimensional form • Component weight
	Multi-tiering	• Vertical cycle in work progress • Sequencing in construction cycle time
Benefits	• Repeatability • Economies of scale • Highly buildable and factory-driven • Integration of arch features and services	

After the mid-afternoon coffee break at 3.45 pm, the seminar moved on to the session in which Mr Tan Chee Hock presented on the topic entitled, “Construction of the Pinnacle @ Duxton”, which was undertaken by his company under his charge. Mr Tan focussed his lecture on the four key considerations in ensuring the success of the project from the point of view of the contractor, i.e.

- Project management
- Construction quality
- Public relation
- Technical contribution / innovations

The co-ordination of many different fields/specialisations and trades had been made much easier by careful and intensive pre-construction planning, and the adoption of precast concrete has resulted in a smoother co-ordination by the project management team.

The usage of precast concrete technology / system has very much contributed to the construction quality aspects, in terms of finishes and alignments. And the public relation and media exercises carried out had made the project widely known to the many public housing residents on the new design and construction concept adopted, and this may be the benchmark for future HDB projects to strive for.

As for the technical merits / innovations side, Mr Tan highlighted on the usage of precast façade wall in lieu of reinforced concrete wall to the external facades of the podium structures. Other innovations cited, include the use of spiral connectors in lieu of splice sleeve in the connection between the column/wall, had increased the speed and cost effectiveness of the precast panel installation.

Er Lawrence Pak in his final session made his foray into geotechnical design on the foundation aspects, i.e. the use of pile-raft foundation (consisting of 1500mm diameter bored piles, and the careful planning in temperature control while carrying out thick raft concrete pour.

Finally, he wrapped up the session by presenting more details into the pride in The Pinnacle @Duxton project, i.e. the 12 number of prefabricated sky bridges. They are essentially designed as 3-D steel truss system, with concrete topping on Bondek, against the usual design loadings specified in BS6399, including wind load and notional load, except for seismic actions. 3-D modeling designs, using ETABS and SAP2000 were undertaken to ensure structural viability, bearing in mind key considerations for constructability in the following:

- Ease of assembly and erection procedure on site
- Use of strand jack lifting system to ensure precise placement to final position
- Lifting of sky bridges as a full assembled unit
- Emphasis on safety aspects at all times

Indeed, the transformation to the Singapore skyline has been most profound with the completion of this project and some other preceding ones, which had opened up the use of high air space for human functions in dwellings and recreations.

Towards the end of the seminar, during the Q&A session, Er Lawrence Pak had a field day taking on many of the questions from the floor. It was a very lively session, and Er Pak did not disappoint by giving very detailed replies and providing useful suggestions on how precast concrete technology can be further enhanced in the local construction industry, i.e. by tackling problems head on, and not to give the impression that precast systems are somewhat inferior or more expensive than cast-in situ method of construction. For every setback faced, there will always be viable solutions. And that has been the hallmark of success by HDB in Singapore over the years, in using precast technology.

The seminar ended at 5.30 pm, with a token of souvenir given by the organiser to Er Lawrence Pak, to the loud applause given wholeheartedly by members of the audience.

