COVER STORY:
CIVIL & STRUCTURAL ENGINEERING
The Residences at W Singapore - Sentosa Cove

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FEATURES

08 CIVIL & STRUCTURAL ENGINEERING: COVER STORY:
The Residences at W Singapore - Sentosa Cove
The project received recognition for its design and engineering safety.

12 CIVIL & STRUCTURAL ENGINEERING:
Circle Line Stage 5
Overcoming challenging site conditions, the project went on to win an award for design and engineering safety.

18 PROJECT APPLICATION:
The 'Lilac' line forges ahead
Construction chemicals from Mapei have been used for the new underground railway line in Italy.

22 PROJECT APPLICATION:
Tekla software used to build the Supertrees at Gardens by the Bay
Advanced Information Technology helped in the creation of these complex structures.

26 MARINE & OFFSHORE ENGINEERING:
Enabling rapid asset data capture
Advanced software helps to manage unstructured information and ensure safe and effective operation of an FPSO vessel.

28 MARINE & OFFSHORE ENGINEERING:
Jaya takes delivery of new multi-purpose platform supply vessel
The sophisticated vessel was built in the company's Batam shipyard.

28 MARINE & OFFSHORE ENGINEERING:
Bentley acquires MOSES engineering software for offshore structures
The company has extended its leadership position.

29 MARINE & OFFSHORE ENGINEERING:
Lloyd's Register and A*STAR IHPC open joint laboratory
The facility will enable R&D work that will lead to technical innovations in the energy and marine industries.

30 MARINE & OFFSHORE ENGINEERING:
OSV Singapore 2013 presents developments in offshore support vessels
The 5th presentation of this biennial event was held recently.

REGULAR SECTIONS

02 IES UPDATE
24 PRODUCTS & SOLUTIONS
32 EVENTS
36 NEWS
IES UPDATE

Message from the Vice President, Industry and PR Group

As urbanisation increases throughout the world, the optimum allocation of land space in cities for a variety of uses becomes extremely important.

The scarcity of land, due to the competing yet equally compelling demands for different developmental activities, means that a large part of the infrastructural facilities including power and water supply as well as railway transportation will have to be located underground. And in order to facilitate further economic growth, countries and cities may even decide on the creation of living and working space as well as storage space, underground.

Together with the increase in foundation requirements for new buildings and other structures, these strategies will raise new challenges in geotechnical engineering. These challenges relate to the understanding of soil conditions and properties at the various locations, in order to design and execute excavation works and the construction of underground structures, on budget and on schedule, ensuring safety as well as minimal disturbance to the environment and people in the neighbourhood of the projects.

With respect to underground work, the issues of safety and costs are of extreme importance. There are also issues concerning the operation and maintenance of underground facilities and structures to be considered, and the need for repair and refurbishment work, over time.

Therefore new technologies and equipment will have to be introduced, and concurrently, engineers and technicians will have to be trained and certified to the highest standards, in order to achieve the objectives.

The utilisation of underground space can thus be optimised, as cities seek to accommodate the various requirements of land for different activities so as to ensure balanced growth in all areas.

Er. Koh Beng Thong
Vice President, Industry and Public Relations Group
Chairman, Civil & Structural Engineering Technical Committee
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COURSE PREVIEW
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Venue: SAA-GE City Campus
Speaker: Professor Kevin Jameson
Director, Applied Finance Centre

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31st Conference of the ASEAN Federation of Engineering Organizations (CAFEO 31)

IES is pleased to announce that it is organising a team to CAFEO 31 which will be held from 10 to 14 November 2013 in Jakarta, Indonesia. In conjunction with the conference, The Institution of Engineers Indonesia (PII) will also be organising optional tour packages and spouse programmes.

Information on the CAFEO 31 Programme and tour details can be obtained from the official CAFEO 31 website at www.cafeo-31.com.

Those who are interested in participating in CAFEO 31 should immediately email valerie.ng@iesnet.org.sg

Seeking volunteers for IES Oil & Gas Sub-Committee

The IES Oil & Gas Sub-Committee is looking for new blood to join its ranks. The sub-committee is devoted to promoting professional aspects of the oil & gas industry, especially in the upstream oil and gas production and processing areas, and to broadening the knowledge of members in the technology of hydrocarbons - in the areas of research, design and operations.

Those who are interested in this industry, are full of ideas and have a passion for building up the image of oil & gas engineers, and wish to make a difference and help promote awareness of this industry, are invited to join this sub-committee. They should email yakwan18@hotmail.com.

Exemplary Site Supervisor Award 2013

The Exemplary Site Supervisor Award is intended to recognise the exceptional dedication and contributions of site supervisors in structural works, towards ensuring that buildings are constructed in accordance with their design specifications and building regulations. It aims to acknowledge publicly outstanding individuals who have made significant contributions and efforts towards the achievement of overall construction safety and productivity.

The Award has two categories, namely (1) Exemplary Resident Technical Officer Award and (2) Exemplary Resident Engineer Award.

Nominations for the Award should meet the following criteria:

a) Nominee must be an accredited Site Supervisor with the Joint Accreditation Committee of The Institution of Engineers Singapore (IES) and Association of Consulting Engineers Singapore (ACES).

b) One (1) candidate may be nominated for only one category of the Award.

c) Nominee must have worked in the construction industry in the supervision of structural works for at least 5 years.

d) Members or associates of the Award Committee may not be nominated.

The nominated candidates will be judged on the basis of the following:

a) Diligence in keeping and maintaining site records and plans

b) Competency in ensuring construction quality and site safety

c) Vigilance in monitoring the construction impact to adjacent building properties

d) Resourcefulness in resolving site technical issues

e) Technical accomplishments and other evidence of merit

Short-listed nominees may need to attend an interview before the Award Committee. The nominees will be assessed, based on the information requested in the attached nomination form. The decision of the Award Committee will be final.

Awardees will receive the Award in the form of training vouchers, certificates of outstanding performance etc from the Guest-of-Honour at the IES/ACES RE/RTO Awards Night. In addition, the names of the Award winners will be published on the IES website.

IES and ACES will notify all nominees of the results of the Award. Enquiries concerning entries for the Exemplary Site Supervisor Award may officially be made in writing to:

The Secretary
Exemplary Site Supervisor Award
The Institution of Engineers, Singapore
70 Bukit Tinggi Road
Singapore 289758
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THE BASICS OF PROFESSIONAL INDEMNITY INSURANCE FOR ENGINEERS

The subject of Professional Indemnity ("PI") Insurance is not new to Singapore Engineering Professionals. However, misconceptions surrounding this topic and what it does or does not cover continues to exist. In this article, we will attempt to succinctly explain the policy in a way useful to non-insurance laypersons.

WHAT DOES THE POLICY ACTUALLY COVER?

Taking away the semantics of the wordings, almost all PI policies share the following four characteristics:

- If an Insured Engineer commits a professional error or omission, or he is accused by one party (usually his client) that he has committed a professional error or omission; AND
- If a legal proceeding is pursued against him, or a legal action is threatened against him by that party to recover their losses; AND
- He notifies his PI Insurer within the current policy period; THEN
- His PI Insurer will pay for the legal defence costs and damages awarded against him up to the limit purchased under the PI policy.

THAT’S SIMPLY WHAT IT COVERS.

The natural rejoinder to this is, “If the policy can be described in so few words, how is it possible that most PI policy contracts are at least 15 pages long and printed on the smallest font visible to the naked eye?” Well, the reason for this is that apart from the fundamental intent of the policy which is described above, the insurer needs to set the parameters of the basic cover by reference to various factors e.g. how much to pay, what losses are not payable, what is the cut-off date for acts and omissions that are not covered.

WHO CAN YOU CALL IF YOU WANT TO KNOW MORE?

We at Lockton, are specialists in the area of risk transfer. With our expertise we work with NTUC to make you an offer that should not be missed. It has been structured and tailored to meet the specific needs of all engineers. This has never been done or achieved before!

If there are any questions that you have, please write or contact any of the following and we will respond to you with Plain English answers.

Mr C. Nandakumar
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Email: ahfaat.chin@asia.lockton.com

Ms Tracy Ho
DID: 6326 9221
Email: tracy.ho@asia.lockton.com

WHAT IS THE LEAST YOU SHOULD KNOW ABOUT YOUR PI POLICY?

These are the points in summary:

- The policy only pays for legal liability due to your professional errors, and not the errors of other parties. The only exception perhaps is where you are sued for the errors of other parties which you are vicariously liable for, which a "subcontractors and consultants" extension will usually take care of.

- The policy only pays for your errors occurring after the Retroactive Date. The Retroactive Date can usually be found in your policy schedule, i.e. the page that has your firm’s name, period of insurance, limit of indemnity etc. If there is no retroactive date, or the retroactive date is unlimited, it means that the policy will pay for any errors regardless of when it occurs.

- The policy only pays if you notify the Insurer within the period of insurance stated in the policy schedule. If you have a claim or an alleged claim of error or omission and you only notify the Insurer after the policy expires, the policy will not pay.

- If you are aware of some circumstance that may eventually lead to a claim made against you – YOU SHOULD NOTIFY THIS TO YOUR INSURERS IMMEDIATELY WITHIN THE POLICY PERIOD. This is especially important across a policy expiry date. Your insurance cover will likely to be severely compromised if you fail to report a known circumstances promptly.
At Lockton we can also assist you with obtaining:

Mandatory **Private Medical Insurance** for your expat workers in accordance with MOM guidelines

**Construction and Erection All Risks Insurance** against loss or damage to the contract works, erection works and third party liability arising in connection with the execution of the installation and erection of ready-built engineering projects and in connection with the execution of building projects

**Work Injury Compensation Insurance** to indemnify you in respect of your statutory liability under the Work Injury Compensation Act (WICA) or common law. These claims may consist of injured employees claiming medical leave, medical expenses as well as compensation for permanent incapacity or death, as stipulated by the Act

**Marine Cargo Insurance** against physical loss or damage to goods and merchandise while in transit by any method of conveyance

**Upstream & downstream oil and gas**- Onshore and offshore exploration, production, pipelines, transportation & storage systems, crude oil & LNG refining & processing, petrochemical including construction risk

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The Residences at W Singapore - Sentosa Cove

The project won a BCA Design and Engineering Safety Excellence Award (Merit), under the Residential Category, at BCA AWARDS 2013.

The Residences at W Singapore - Sentosa Cove is the first of three developments to be designed and constructed as part of the Quayside Collection which also includes W Singapore - Sentosa Cove hotel and Quayside Isle (as shown in the site location map). The residential site is next to Sentosa’s waterway and is bounded by the hotel and Quayside Isle. A tunnel links the southern end of the residential site to the basement carpark of the hotel.

The residential development consists of 19 six-storey high blocks, with attics and basement carparks. The site which is only 6 m away from the sea wall of Sentosa waterway is split by a sluice gate that cuts across the middle. The sluice gate regulates the levels and quality of the water in the waterway. There is a protection zone on either side of the sluice gate where no structure is sited. As a result, the superstructure has to span across the sluice gate.

DESIGN

Design processes and solutions that emphasise safety

The development is founded on reclaimed sand with pockets of intermediate soft marine clay between 5 m and 10 m below the ground level. Despite the relatively light building load, additional soil investigations were carried out and they revealed that part of the site was not suitable for raft foundation due to excessive long-term settlement.

In addressing this complex geological constraint, the project team decided to adopt bored pile foundation for the residential blocks north of the sluice gate and raft foundation with ground improvement for the remaining areas.

In comparison with raft foundation with deep ground improvement at the soft strata, bored pile foundation was found to be a cost-effective solution in dealing with the loose sand and pockets of soft marine clay at depths beyond 7 m.

Settlement analysis of areas where raft foundation was adopted revealed that a combination of soil improvements, ie soil replacement and Deep Cement Mixing (DCM) columns, were required to keep the long-term building settlement within the acceptable limit.

Soil replacement essentially replaces the soil in the reclaimed land. The replaced soil thickness is about 2 m and just above the Stiff Silty Clay layer of SPT 15.

The sand was compacted using roller compaction to achieve the tip resistance, $q_t$, of 12 MPa and an $E$ of 44 MPa.

DCM columns, 0.85 m in diameter, spaced at 1.5 m centres were used in areas where soil replacement was not possible. The area replacement ratio is around 25.2%. The equivalent treated soil layer has an $E$ of 28 MPa.
To predict the performance of the raft foundation on soil replacement and DCM columns, a PLAXIS 3D FEM Model was used to analyse and study the soil-structure interaction.

The PLAXIS modelling helped to predict the long-term settlement of the raft foundation. Soil parameters were first assumed from published literature and later correlated with in-situ soil tests such as the Cone Penetration Test (CPT) and the Plate Bearing Test (PLT). The final results of the geotechnical analysis were cross-checked against the test results, to validate the findings. After rigorous analyses using PLAXIS, it was found that the long-term deflection is less than 25 mm and within the acceptable settlement for the raft foundation.

**Quality approach in design, details and specifications**

To ensure the quality of the DCM columns, 37 in-situ CPTs...
were carried out to verify that the soil has been improved to the required stiffness and has achieved the desirable and allowable bearing pressure. Core samples of the DCM columns were also extracted to validate the Elastic Modulus of the improved soil. The results of the CPT were calibrated and correlated with the assumed soil parameters and back analysed to validate the predicted performance of the raft foundation.

To ensure that the soil replacement and placement of DCM columns were carried out in accordance with the specifications, PLTs were carried out on both the original hard ground and on the improved soil layers for bench-marking and comparison purposes. The plate bearing was 300 mm in diameter and the load was up to 180 kPa. However, the in-situ PLT results were too small to reproduce the response of large raft foundations. The measured settlements were used in a PLAXIS analysis to predict the long-term deflection of the raft foundation. It was concluded that the total long-term settlement of the raft in the DCM and soil replaced area would be less than 25 mm under the maximum load of 250 kPa.

During the construction of the superstructure, settlement at the walls, columns and slabs were monitored regularly to verify and validate the actual settlements. The measured settlements of the building after construction were well within the PLAXIS-predicted values.

CONSTRUCTION quality and safety

Before the construction activities commenced, the method statement was reviewed. Construction quality was closely monitored for any non-conformance issues and these were addressed promptly to prevent the issues from deteriorating.

Site safety audits were carried out on a regular basis to ensure that all the safety issues were being addressed. In addition to the internal safety audits, an external safety auditor, engaged by the client, audited the site at critical construction stages and reported directly to the client. A total of four site safety audits were arranged during foundation, excavation, raft and piling, and superstructure stages. No major safety issues were found during the audits.

The ERSS (Earth Retaining or Stabilising Structures) proposal submitted by the contractor’s PE was reviewed and independent in-house analyses were carried out to address any shortcomings. The comments were given to the contractor for compliance.

Public safety

With the use of soil replacement, DCM columns and bored pile foundation, transmission of vibrations to the surrounding neighbourhood, sluice gate and the seawalls was kept to a minimum. Real-time vibration and noise instrumentation was installed at regular space intervals, to ensure there was no breach of the allowable limits.

During the excavation stage, inclinometers, tilt plates, settlement markers and water standpipes were installed around the excavation boundary and monitored twice a week during excavation work. Any excessive movements indicated by the instrumentation were reviewed immediately and rectification works were carried out to alleviate the issues.

PROJECT CREDITS

Project
The Residences at W Singapore - Sentosa Cove

Qualified Person
Er. Song Wee Ngee

C&S Consultant
KTP Consultants Pte Ltd

Builder
Dragages Singapore Pte Ltd

Developer
Cityview Place Holdings Pte Ltd

Architects
Axis Architects Planners Pte Ltd

3D FEM Model of Raft
**PLAXIS analysis using PLT results**

**Diagram:**
- **Avg Raft settles = 9.5 mm; ks = 180 kPa/9.5 = 19,000 kN/m³**
- **E=40 MPa (N=26 to 30)**

**Table:**

<table>
<thead>
<tr>
<th>Plate Load Test</th>
<th>6</th>
<th>08/22/08</th>
<th>National University of Singapore</th>
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**Image:**
- A close-up view of the completed The Residences at W Singapore - Sentosa Cove
Circle Line Stage 5
by Er. S Mahatma, Executive Director, Transportation, Singapore, AECOM

The Circle Line Stage 5 (CCL5) contract, also known as Construction Contract C856 was awarded in October 2004 by the Land Transport Authority (LTA). CCL5 was the last stage of the Circle Line and was opened to the public in October 2011. A winner of the BCA Design and Engineering Safety Excellence Award, under the Civil Engineering Category, at BCA AWARDS 2012, the project was commended for adopting highly efficient engineering approaches to enhance productivity, site safety and quality, under challenging site conditions.

The Circle Line route.

THE PROJECT
The Circle Line Stage 5 (CCL5) runs from Haw Par Villa Station in the west to the Harbour Front station in the east. It comprises:

• Four underground stations - Haw Par Villa, Pasir Panjang, Labrador Park and Telok Blangah
• Two cut & cover tunnels. The two stretches of the tunnels are the Pasir Panjang Cripple Siding (350 m long x approx 18.5 m wide), and the Harbour Front Cross-Over (145 m long x approx 13.5 m wide).

THE CHALLENGES
Space constraints
The alignment of CCL5 is generally under the existing roads and buildings. However, along Pasir Panjang Road and Telok Blangah Road, it runs adjacent to a number of buildings and in close proximity to the West Coast Highway viaduct. During the course of design development, the team undertook several reviews and refinements of the CCL5 alignment, to avoid sensitive buildings and utilities. However, owing to space constraints, CCL5 tunnels were required to run underneath a number of buildings and structures, including sensitive

Geological profile along the CCL5 alignment.
shallow founded shophouses near Pasir Panjang, a substation, a nine-storey RC pile-founded building and a six-storey building with a basement that was still under construction. In addition, the twin tunnels were required to run in close proximity to each other as well as to pile foundations of adjacent elevated viaducts, a sensitive high power substation, a building basement, cable tunnels and other significant structures.

**Complex geological conditions**

The geology along the tunnel alignment can be grouped into three different categories. In the first stretch between Haw Par Villa Station and Pasir Panjang Station, the geology at the tunnel horizon is generally Jurong Formation residual soil SV and SIV (completely weathered rock) overlain by thin localised layers of Kallang Formation. For the second stretch, between Pasir Panjang Station and Labrador Park Station, it is generally Kallang Formation, comprising soft marine clay; estuarine, fluvial clay; and fluvial sand overlain by fill. At some locations of this stretch, a mixed face formation comprising Jurong Formation rock of weathering grade SIII/SII and Kallang Formation exists. Beyond Labrador Station, the geology is generally Jurong Formation rock of weathering grade SIII, consisting of sandstone and mudstone. At three locations, where the alignment crosses existing canals, deep valleys of Kallang Formation exist, extending into the tunnel horizon. In addition, two fault zones, one at Pepys Road and another at Henderson Road, were encountered.

**Haw Par Villa Station**

Haw Par Villa station is located at the junction of West Coast Highway and Pasir Panjang Road, next to the entrance of Haw Par Villa. It is a two-level, 20 m deep station which also serves as a civil defence shelter. The entrance for this station is located adjacent to the high ground of Haw Par Villa where sensitive and
delicate exhibits are located. Close proximity to high ground at Haw Par Villa required the adoption of an enhanced structural system and a working gap between the temporary earth retaining wall and the permanent structure. This required a detailed two-dimensional analysis of a 16-m-deep cantilever retaining wall utilising the box stiffness of the entrance adit box at the two ends of the cantilever wall.

The geological formation at Haw Par Villa Station mainly consists of residual soils of the Jurong Formation, with an average SPT N value of about 25. Though the station structure consists of a two-level main station box of 20 m depth and a single level adit and entrance structure of 12 m depth, a raft foundation system was used for the entire station, thus eliminating the need for a deep foundation system and improving the buildability. A comprehensive iterative analysis, using a combination of sectional analysis and plate analysis, considering the entire station with entrance and adit structure, helped to address any differential settlement-related issues. In order to construct the temporary retaining wall over the high slope, the builder adopted an embankment supported by a geogrid.

**Pasir Panjang Station**

Pasir Panjang Station, along Pasir Panjang Road, is located next to the Pasir Panjang Food Centre.

At the Pasir Panjang Station, the geological formation consisted of deep Kallang Formation underlain by Jurong Formation. The Kallang Formation extends beyond the formation level at the eastern end of the station, while the other end of the station is seated on competent Jurong Formation. A deep raft foundation system consisting of a uniform base slab and diaphragm wall at the perimeter of the station was adopted, eliminating the use of a pile foundation system, thus improving the productivity. A comprehensive analysis, consisting of sectional and plate analyses, was carried out to allow for forces from different subgrade systems below the base slab, in the evaluation of the station box behaviour under the varying geological conditions.

The settlement of the PPSE (Pasir Panjang Semi Expressway) viaduct’s piles, due to other adjacent construction works, necessitated the need for a robust earth retaining / temporary works system (ERSS). During the course of design, a number of sensitivity analyses of the various ERSS designs were carried out to study the impact on the PPSE structure. A diaphragm wall system was adopted to enhance the robustness of the earth retaining system due to its close proximity to the PPSE viaduct which is only about 7 m from the station boundary. The use of perimeter diaphragm walls enhanced the counter flotation capacity of the 20 m deep station.

While the diaphragm walls for the Pasir Panjang Station were being constructed, the PPSE viaduct was affected due to other works nearby. In order to successfully excavate and construct the station without further affecting the PPSE structure, the robust earth retaining system that was adopted, consisted of cross walls at the pier locations. Various options for the cross wall configuration were studied, including a full height wall, a deep raft foundation system consisting of a uniform base slab and diaphragm wall at the perimeter of the station was adopted at the Pasir Panjang Station.
low level wall below the formation, a wall above the base slab, and a suspended wall above the concourse slab. In addition, single, double and triple cross wall options were studied. Finally, a suspended cross wall was adopted, between the ground level and concourse level, that spanned between the diaphragm walls and was internally supported by steel posts.

**Labrador Park Station**
Labrador Park Station is located at the junction of Pasir Panjang Road, Telok Blangah Road and Alexandra Road. In order to minimise the land intake, the station planning was revised several times, resulting in the station being located close to the TBSE (Telok Blangah Semi Expressway) viaduct and a three-storey building, as well as the ventilation and escape staircases under the viaduct. The presence of artesian conditions and the unbalanced load due to the nearby high ground at Keppel Golf Club together with the constraints due to the close proximity of structures, made the use of a diaphragm wall necessary.

**Telok Blangah Station**
Telok Blangah Station is located at the junction of Telok Blangah Road and Henderson Road. The excavation for the station was only about 2.8 m away from the ramp structure of the TBSE viaduct. A careful analysis of the excavation was required, to determine its impact on the ramp pier. Special instrumentation was installed on the viaduct pilecaps.

**Cut & Cover tunnels**
The cut & cover tunnel at Pasir Panjang is about 345 m long and is situated close to the PPSE viaduct for its entire length. It is also close to a single storey building and a seven-storey high power substation. The geological formation at this location is mainly Kallang Formation, extending almost to the formation level, and underlain by Jurong Formation. A detailed assessment of the impact on the adjacent structures was carried out, which suggested the adoption of a robust 1 m thick diaphragm wall as the earth retaining system. With the adoption of the perimeter diaphragm wall and a flat plate floor system, the use of bored piles below the base slab was eliminated.

The cut & cover tunnel at Harbour Front is situated very close (about 5 m) to King’s Dock, a gravity structure and the TBSE viaduct structure. King’s Dock exerts unbalanced forces on the cut & cover tunnel. Though the ground condition here consists of SIII/SIV Jurong Formation, the combination of a 800 mm thick and a 1 m thick diaphragm wall was chosen, considering the close proximity of King’s Dock.

**Bored tunnel planning and design**
In general, residential, commercial or industrial buildings exist on the sides of urban roads and there is no exception with regard to construction work.
to the CCL5 stretch of the alignment. On the side of the road where the tunnel was constructed, there exists a sensitive high power substation, a building with extended basement, single and two storey shophouses, and residential apartments. The horizontal alignment of CCL5 tunnels was developed taking into consideration the constraints imposed by the foundation of the elevated viaduct, on one side, and buildings with various uses, on the other side. At the western extremity of CCL5, the inner track tunnel crosses the alignment of the elevated viaduct, to avoid the down ramp of the road. Provisions had been made in the foundation of the viaduct with long pilecaps with piles on both sides of the tunnel. At certain locations, the clear distance between the pile and tunnel is only 2.6 m.

As a result of the restrictions due to the location of the basement of a building, on one side, and the piles for the viaduct structure, on the other side, the twin bored tunnels was brought closer than the conventional minimum clear distance of one tunnel diameter. The clear distance between the tunnels was only 3 m, for a distance of about 120 m. The tunnel lining for this part was designed for the effects of the close spacing and sequential tunnelling.

Over another stretch, constraints forced the inner tunnel to run above a utility tunnel (then under construction) of similar size. Though the clear distance between the utility tunnel and the CCL5 tunnel was one tunnel diameter; at the location of a sump pit, the clear distance between the CCL5 sump invert and the utility tunnel extrados was only 1.8 m. The effect of the CCL5 tunnel on the flotation of the utility tunnel and the effect of the CCL5 sump pit on the structural integrity of the utility tunnel were checked.

The alignment was influenced by one sensitive high power 400 kV substation and two 22 kV substations. As the ground conditions at the 22 kV substations were identified as favourable, the alignment was allowed to pass directly under them. However, due to the significance of the 400 kV substation, which caters to the needs of almost one half of Singapore, the alignment was tweaked so that it passes on one side of it. Due to the presence of the viaduct, the alignment could not be moved entirely out of the influence zone and the clearance between the piles of the substation and the bored tunnel is only 3.8 m. A detailed specialist impact assessment was commissioned to study the predicted impact of the tunnels on the transformers, switchgear and cables sited within the substation.

Again, as a result of the constraints due to the viaduct, the alignment had to run under a single storey animal welfare building and two blocks of two-storey shophouses along their entire length of about 90 m. The 40-year-old shophouses are of RC frame structure, supported on shallow foundation with bakau piles. The tunnelling work at this stretch was further complicated by the geology, defined by soft ground and mixed face conditions. The undercrossing of the shophouses posed the most significant risk in the CCL5 tunnelling alignment. However, with the application of focused mitigation measures and stand-by contingency plans, the tunnels were constructed with only slight disruption to the building occupiers.

**PROJECT CREDITS**

Project
Circle Line Stage 5

Qualified Persons
Er. Lee Chung Shek
Er. S Mahatma

C&S Consultant
AECOM Singapore Pte Ltd

Builder
Sembawang Engineers & Constructors Pte Ltd

Developer
Land Transport Authority

Architectural Consultant
SAA Architects Pte Ltd
RMJM Singapore Pte Ltd

**BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD**

The Design and Engineering Safety Excellence Award recognises the efforts of the Qualified Person for structural works, his or her firm and the project team, for ingenious design processes and solutions in overcoming project challenges and ensuring safety in the design, construction and maintenance of building and civil engineering projects locally and overseas.

The Award aims to:
- Inculcate a strong safety culture among building professionals in developing the built Environment.
- Recognise the Qualified Persons for structural works and their firms for engineering achievements.
- Provide an avenue through which competition for work excellence can be enhanced.

**AWARD CATEGORIES**

The Award is given out under the following categories:
- Residential
- Commercial
- Institutional and Industrial
- Civil Engineering
- Overseas
The horizontal alignment of CCL5 tunnels was developed taking into consideration the constraints created by the proximity of the foundation of the elevated viaduct, buildings of various uses, a utility tunnel, as well as electrical substations.
The ‘Lilac’ line forges ahead

The new underground railway line is part of the expansion project for the large infrastructure network that will be in place in Milan, Italy, ahead of Expo 2015.

The prestigious underground railway line, in Milan, Italy, is a work in progress. It is expected to be completed and ready for Expo 2015. Mapei is involved in two stretches of the project - the stretch from Bignami to Garibaldi and the stretch from Garibaldi to the San Siro Stadium. When it eventually operates at full regime, the M5 is expected to contribute to a reduction of 5 million private car journeys per year.

Underground works
After having already taken part in the work on the M1 red line, the M2 green line and the M3 yellow line, Mapei is now involved in the ‘lilac’ line. The new line will have 19 stations along a 12.6 km stretch. It will be a light railway line that is completely automated. There will be no conductor or ‘fixed’ operators but only a few ‘floating’ operators.

Cutting-edge solutions
The tunnels have been constructed using two different techniques. Parts of the tunnels have been excavated using a 9.4 m diameter Lovat TBM (Tunnel Boring Machine), and then lined with prefabricated blocks. The other parts have been excavated using traditional techniques and the lining (primary support) includes the installation of hundreds of metal ribs and a layer of shotcrete, followed by an inverted arch finishing layer and protective lining. Numerous Mapei products have been used on this important site. To condition the soil during the mechanical excavation work, POLYFOAMER FP foaming agent and the polymer MAPEDRILL M3 were used. To repair the prefabricated concrete stones forming the ceiling of the tunnel, MAPEGROUT T60 and MAPEGROUT LM2K were used after protecting the steel reinforcing bars with MAPEFER 1K, while MONOFINISH mortar was used to smoothen the concrete.

Mobile works
Over the last few years, the technology of concrete has reached such innovative quality and performance levels that dedicated mix-designs can now be formulated to not only help solve the problems of complying with UNI-EN standards, but also to support specific design requirements for the execution of complex constructions such as viaducts, bridges, tunnels and large buildings.

All this has one aim - to extend the service life of reinforced concrete constructions. In terms of the technical assistance provided, Mapei goes much further than simply supplying products. The company’s well-equipped fleet of mobile laboratories can carry out a multitude of wet tests directly on site, to determine various properties of concrete such as air and water content, density and consistency, and ensure compliance with the most recent, specific UNI-EN standards. This safe, reliable technical consultancy service is available to
Two phases of the construction of the tunnels. Images by M5 SpA.

Construction work on the M5 underground railway line in Milan has been ongoing since 2007 and is scheduled to be completed in 2015. Image by Mapei.
manufacturers of concrete, to enable them to mix cementitious agglomerates, taking into consideration the final use, transport and application times, and the logistics for mounting formwork and handling of all the steelwork required. The Mapei team has provided support for its clients during every phase of the execution of this project, from the design of the concrete mixes, to the qualification of materials on site, and right up to quality control of the concrete mixes once they have been applied.

The admixtures
To mix the concrete, two families of high concentration, polymer-based super-plasticising admixtures have been used, depending on the specific design requirements and/or the raw materials available - DYNAMON SX (SX 32 and SX 34) and DYNAMON SR (SR1 and SR 912/914). They are all based on DPP (Designed Performance Polymer) technology, a new chemical process which, through total monomer design (the know-how is exclusive to Mapei), allows the characteristics of the admixture to be modulated according to the specific performance requirements of the concrete employed. Because of its high workability, concrete made with this type of admixture is easy to apply while fresh and offers high mechanical performance when it hardens. The products from the DYNAMON family are also part of the Real (Robustness Enhancing Admixture Line) category of admixtures for concrete, characterised by a lower water/cement ratio, higher mechanical strength, extended maintenance of workability, and ease of pumping with no segregation or bleeding.

The UTT line
Large underground works and tunnels, in particular, offer specific challenges due to their considerable complexity during both the design phase and the execution phase. This type of work is often carried out in extreme conditions and requires the skill of specialised technicians who, thanks to their vast experience, have the ability to handle unforeseen problems and guarantee that work progress quickly and according to specifications. These technicians have the backing of a range of high-tech products produced and marketed by Mapei under its UTT (Underground Technology Team) range.

MAPEPLAN TU S, a part of this family, is a range of synthetic PVC-P waterproofing membranes that, thanks to the use of the exclusive ‘multi-extrusion coating’ technology, offers high performance characteristics and durability. Among the fundamental characteristics of this product, which has been used here to waterproof the tunnels and stations, are its excellent workability and weldability. Hot welding, in particular, causes the molecular chains to melt and fuse together to form a bond that is resistant to the pressure of water and mechanical stresses.

PROJECT CREDITS
Project
M5 Underground Railway Line, Milan, Italy
Period of Construction
2007 to 2015 (expected year of completion)
Client
Milan City Hall
Works Management
Ingegneria SPM, Milan
Consortium Contractors
Astaldi SpA (Consortium Lead)
Alstom Ferroviaaria SpA
AnsaldoBreda SpA
Ansaldo Trasporti Sistemi Ferroviari SpA
Azienda Trasporti Milanesi SpA

INTERVENTION BY MAPEI
Period of Intervention
Ongoing since 2007
Contribution by Mapei
Supply of admixtures for concrete and waterproofing products from the UTT division, and provision of on-site technical assistance through the company’s fleet of mobile laboratories
Mapei products used
Admixtures for concrete
Dynamon SX 32
Dynamon SX 34,
Dynamon SR1
Dynamon SR914
Dynamon SR912
Ground conditioning
Mapedrill M3 / Polyfoamer FP
Restoration and smoothing of concrete
Mapegrout T60
Mapegrout LM2K
Mapefer 1K
Monofinish
Waterproofing
MAPEPLAN TU S
Websites for further information
www.mapei.com & www.utt-mapei.com

This editorial feature is based on an article from Realtà Mapei INTERNATIONAL no 44.
Transforming a world of dreams and visions into reality.

In your home. At your office and bank. In your children’s school, local churches and theatres, you will find the same quality of Mapei products that have been used in some of the most accomplished civil engineering works in the world. Mapei provide a unique quality in a range of products that provide solutions regardless of the scale of project. With universal effectiveness and ease of use. Mapei – an innovative product first developed through 18 research centres worldwide, available to you to transform your visions into reality. Discover our world at: www.mapei.com.sg
Tekla software used to build the Supertrees at Gardens by the Bay

The 18 giant steel and concrete trees (Supertrees) at Gardens by the Bay are between 25 m and 50 m high. These are made of concrete trunks and tubular steel branches at the top of each tree. The tops of some of the trees have solar cells that generate power for use in the conservatories below. The trunks of the Supertrees are clad by a steel frame and draped with many types of climbers, flowers and ferns.

The Supertrees also allow visitors to enjoy the view from above. A 128 m long steel suspension bridge links two of the taller trees together and allows visitors to soak in the view from 22 m above the ground.

Steel is a critical component of the entire project. It is used for the frames around each trunk and for the network of branches that form the canopy. The steel work was the responsibility of TTJ Design and Engineering (TTJ), a subsidiary of TTJ Holdings Limited. The steel fabricator relied heavily on Tekla for the entire project.

Design has complex geometries

TTJ is one of the largest structural steel fabricators in Singapore.

On this project, TTJ worked closely with the architects and structural construction consultants to fabricate the parts needed for the Supertrees.

Working with the design drawings for construction, TTJ began by using Tekla to create the general arrangement drawings together with connection details. The drawings were then sent back to the architect and consultants for their approval.

Tekla has been deployed within TTJ for the past 10 years, being one of two pieces of software that the company uses to create drawings of steel parts. Tekla, however, is used exclusively for complex jobs.

Tekla was especially necessary on this project because of the complex geometries involved in constructing the canopy.

The interlocking branches at the crown of each tree are a delicate network of steel tubes encircled by a stainless steel cable that pulls the structure together. The cable ensures that the branches do not start sagging and put undue stress on the entire canopy.
To reduce the weight of the overall structure, the steel used in this canopy is very thin, some of it being just 3.2 mm thick. As a result, just 920 t of steel were used to build the 18 soaring Supertrees.

TTJ took about one and a half months to model each tree, with Tekla. If an ordinary CAD software was used to do the models, it would have taken three times longer. Part of what speeds up the process is the extensive library of parts that exists, and that can be manually added to.

Once the architects and consultants approved the general arrangement drawings for the trees, TTJ used Tekla to generate the shop drawings for fabricating every steel part needed and the joints, right down to the bolts.

At the factory, the drawings were used to fabricate the necessary parts. Apart from the shop drawings, the factory also relied on Tekla’s 3D models to help the fabricators visualise the structure - a vital step given the complex geometry of each part.

After the parts were made, they were pre-assembled at the workshop first for checking before being blasted, painted, and then sent to the actual site for erection.

At the site, workers from TTJ assembled the different parts to form each tree again, relying on the drawings and the 3D models to help them.

Overall, the project took about two years to go from the drawing board to the actual structures on the ground.

Fabrication process is speeded up
Tekla has numerous attributes that make it ideal for steel fabricators. For example, it is able to handle changes on the fly, so any changes proposed by the architect to the original drawing are automatically reflected in the general arrangement drawing.

Tekla
With an ambition to multiply its customers’ potential to think and achieve big, Tekla provides a BIM (Building Information Modelling) software environment that can be shared by contractors, structural engineers, steel detailers and fabricators, as well as concrete detailers and manufacturers.

The highly detailed as-built 3D models created, combined and distributed with Tekla software enable the highest levels of constructability and production control.

Centralising building information in the model allows for more collaborative and integrated project management and delivery. This translates into increased productivity and elimination of waste, thus making building and construction projects more sustainable.
Volvo FMX Tridem trucks offers advantages in construction work

As one of the industry’s leading providers of heavy vehicle solutions, Volvo Trucks is always developing ways to help customers improve their productivity levels. One tried-and-tested method adopted by Volvo is to customise trucks to cater to the specific operating needs of fleet owners.

Trucks designed for earthworks

The Volvo FMX Tridem, for instance, was customised for the construction industry for earthworks excavation at the start of 2013. Each Tridem truck is fitted with 12 wheels, instead of the regular 10.

Compared to the regular 6x4 ten-wheeler tipper trucks, a Tridem truck is able to carry a maximum 19 t of load per trip, which is said to be a 15% increase in payload.

This helps increase productivity since fewer trucks and less manpower are needed for an excavation project. Also, fuel consumption and job completion times are reduced.

Special features

On top of offering better fuel economy than a comparable truck, a special feature of the Tridem is its small turning radius, despite its extra length. This is important for Singapore, where roads are narrower and more difficult to navigate around.

When driven empty, the Tridem’s last axle can be lifted, allowing for less rolling resistance, less tyre wear and better fuel economy. When loaded, the last axle comes down to carry greater loads. However, this does not result in a larger turning radius as the last axle is steered just like the first one.

The Tridem is also eco-friendly. Euro 5-certified, the Tridem truck is fuel-efficient and has a lower carbon emission, thus helping to lessen the impact that excavation works have on the environment.

Success in the Singapore market

Since its introduction, Tridem trucks have helped key construction companies in Singapore increase their productivity and profitability.

Construction fleet owners are beginning to adopt more Tridem trucks, with over 80 sold to-date.

With its success here, Volvo Trucks has decided to use the Singapore model to promote Tridem trucks to other markets in the region, such as Malaysia and Indonesia where there are many earthworks excavation projects.

Since setting up its multi-brand truck dealership facility in Tuas in 2011, Volvo Trucks has achieved a strong foothold in the Singapore construction industry, with the majority of large construction companies using Volvo Trucks in their operations.

Volvo Trucks is one of the world’s leading manufacturers of heavy trucks. The company has a strong market share in the European heavy-duty truck segment.

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Woodside is the largest operator of oil and gas production in Australia, and also the country’s largest independent dedicated oil and gas company. On behalf of some of the world’s major oil and gas companies, Woodside operates several facilities including six liquefied natural gas (LNG) trains, five offshore platforms (one under construction) and four oil floating, production, storage and offloading (FPSO) vessels. The company produces about 900,000 barrels of oil each day from an extensive portfolio of facilities. It is also the most active exploration company in the deepwater provinces of Australia, having participated in about 40% of Australia’s deepwater exploration wells.

Throughout Woodside’s 58-year history, it has pursued excellence in its safety and environmental performance, and it aims to ensure that wherever it operates, the community benefits from its presence. Woodside strives to be a global leader in upstream oil and gas.

Woodside’s Ngujima-Yin FPSO is currently moored 50 km off the Western Australia coast. Ngujima-Yin is 333 m long and is the largest FPSO in Australian waters. The vessel operates at a depth of 350 m and has a daily production capacity of 120,000 barrels of oil.

Intergraph was engaged by Woodside to help prepare the engineering scope for execution. The engineering information for Ngujima-Yin was found in multiple data sources from several international locations. Data and documents were inconsistent and in different formats because they were managed differently at each location. There were also multiple versions of drawings and documents. Without a single set of masters, it was difficult to determine the latest and most accurate versions. To bridge this gap and move forward with the safe and effective operation of Ngujima-Yin, an accurate ‘as-is’ status of the FPSO was required.

Making unintelligent information smart

Woodside chose SmartPlant Fusion, a new solution developed by Intergraph, to specifically tackle the challenges of managing unstructured information. SmartPlant Fusion is designed to rapidly capture, organise and make large volumes of previously unstructured information available through a simple web portal interface, in a highly organised and intuitive manner. The types of unstructured information include:

- Documents
- Drawings
- Lists and sheets
- 3D models
- Laser scan images
- High-resolution photography

The Ngujima-Yin FPSO has a daily production capacity of 120,000 barrels of oil.
SmartPlant Fusion is a fast way to make documents and drawings available for decision support. It enables intuitive navigation with an accurate representation of the way things are really connected, making unintelligent information smart.

SmartPlant Fusion automatically reads the loaded information as it incorporates many industry standards (such as databases) and new technologies. More than 360,000 documents (at about 1,000 documents per hour) were loaded into SmartPlant Fusion as a single source of information, with cross-referenced links to the original files. The Intergraph solution created associations using unique alias pattern matching, such as tag-to-document relationships, even when the tag name was not always perfect. Woodside could then navigate and view the documents via a web portal interface, as well as analyse the information to determine the set of master versions.

Improving project analysis
SmartPlant Fusion helps to improve analysis time because it enables the engineer to quickly search a document and view every version before making an assessment. It also enables multiple users to work within the single master data source, eliminating errors from duplication or working on outdated versions. SmartPlant Fusion contains an integral web-based portal, providing project personnel remote access to live data during the project phase, an important requirement for major projects. It is set up with Woodside’s workflow processes to enable documentation approval and acceptance.

Integration with laser scan technology
Woodside could also execute field-based data capture using SmartPlant Fusion. The collection of accurate, ‘as-built’ data is highly important for an existing brownfield asset. This would normally be a tedious and potentially dangerous process because the engineer would have to physically inspect the facility and collect such data. However, since SmartPlant Fusion can capture and organise high-definition surveying information, Woodside could use Leica Geosystems laser scanners to provide an accurate ‘as-exists’ view of the Ngujima-Yin FPSO. Woodside could then compare the ‘as-exists’ view with the ‘as-is’ engineering information to record the FPSO’s ‘as-built’ status accurately. SmartPlant Fusion reduces the amount of time required on-site, which helps to reduce costs and improve personnel safety.

Expanding the SmartPlant Enterprise environment
SmartPlant Fusion supports the intelligent organisation of unstructured data and documents, and improves the quality and integrity of engineering information. This solution can be easily applied to existing operating assets and brownfield facilities. The ‘as-exists’ view provided by SmartPlant Fusion can then be integrated with Intergraph’s other SmartPlant Enterprise solutions.

CD-adapco contributes to ORACLE TEAM USA’s victory in the 34th America’s Cup

CD-adapco was the Official Supplier of CFD (Computational Fluid Dynamics) software to ORACLE TEAM USA which won the 34th America’s Cup, the world’s oldest international sporting trophy and the most famous prize in sailing. CD-adapco’s STAR-CCM+ was used throughout the development process to refine the hydrodynamic and aerodynamic performance of ORACLE TEAM USA’s AC72 catamarans.

Unlike previous contests, a loophole in the rules for the 34th edition of the race allowed the wing masted catamarans to ‘foil’ (sailing parlance for hydrofoiling), that is, they literally fly on downwind sections, with both hulls above the water, supported by only slender rudders and dagger boards, achieving speeds of over 40 knots (46 mph), providing both hydrodynamic and aerodynamic challenges for the design team.

The result hinged on the design modifications made by ORACLE TEAM USA after going 8-1 down, that led it to eight consecutive victories, and win the first-to-nine contest. ORACLE TEAM USA confirmed that STAR-CCM+ played a critical role in the CFD simulations that led to the race-winning modifications.

CD-adapco
CD-adapco is said to be the world’s largest privately held CFD focused CAE provider. The company’s core products are the technology-leading simulation packages, STAR-CCM+ and STAR-CD. The scope of its activities, however, extends well beyond CFD software development to encompass a wide range of CAE services in fluid dynamics, heat transfer and structural engineering.
Leading offshore energy services provider, Jaya Holdings Limited (Jaya), has confirmed the on-time delivery of its second new multi-purpose platform supply vessel (MPSV), Jaya Vigilant. It sailed from Jaya’s shipyard in Batam recently and was immediately on hire by its charterer for a term programme in East Africa. The vessel will load a remotely operated vessel (ROV) spread and mobilise across the Indian Ocean to load further subsea equipment for the client in Durban in October.

‘Jaya Vigilant exemplifies the increasingly sophisticated vessels which Jaya’s Batam shipyard is able to build and customise on time and within budget. The vessel has a 50 ton subsea crane with active heave compensation for service in water depths of up to 3,000 m. We have installed two HiPAP ultra short base line transponders to give very accurate station keeping for subsea work, in addition to the standard DGPS and Cyscan systems on board’, said Mr Venkatraman Sheshashayee, CEO, Jaya Holdings.

‘In order to save our clients mobilisation time and cost, the vessel was delivered fully equipped with a mezzanine deck for the ROV spread, additional cables, survey area on the bridge and additional satellite broadband internet connection in place. Similar to her sister ship, ‘Jaya Valour’, there is a gym and an internet café on board for the crew’, he added.

Jaya Vigilant has accommodation for 60 people on board and is fully compliant with the SPS Code 2008. It has 1,000 m² of clear deck space, a modern fast rescue craft, FiFi One for emergency response and full under deck cargo capacities for mud, bulk, brine and marine gas oil. Jaya has added additional power supplies on deck to support the seabed coring, ROV and hydrographic survey spread requirements, and the vessel has its own water maker to increase autonomy.

The next deliveries from Jaya’s Batam yard will be a DP2 work boat with accommodation for 249 people, and two DP2 ROV support vessels with 100 ton cranes.

Bentley Systems Incorporated, a leading company dedicated to providing comprehensive software solutions for sustaining infrastructure, recently announced that it has acquired the MOSES software business from Ultramarine Inc. Used around the world, MOSES is a premier analysis and simulation software for complex projects involving the transportation and installation of offshore structures, including the launch of jackets and floatover of topsides.

Featuring functionality covering the full range of stability, motions, and mooring of single or multiple floating bodies, MOSES has become the mainstay for professional engineers to reliably meet stringent offshore code requirements, reduce project risks, and increase safety. With this newest addition to its portfolio, Bentley further strengthens its position in the accelerating offshore energy industry, following its acquisition in March 2011 of SACS, the flagship software for the structural design of fixed offshore structures. The integration of MOSES and SACS contributes to comprehensiveness in offshore engineering, in particular for the analysis and design of floating production, storage, and offloading (FPSO) structures.

**SACS**

SACS continues to support the world’s offshore engineers. Better-engineered, safer offshore structures will play an ever greater role in sustaining the world’s economies and environment. Accordingly, SACS is being applied to enable more complex marine endeavours.

For example, in the Tokyo International Airport re-expansion project, Nippon Steel & Sumikin Engineering Co Ltd used SACS to conduct fatigue analysis on the 1,100 m long steel jacket structure for the runway that extends into the sea. Recently, SACS contributed to the salvaging of the Costa Concordia from the marine sanctuary off the Italian island of Giglio, where it capsized last year. In this project, TECON Srl used SACS to design underwater platforms and other auxiliary structures that helped the ship to be righted intact - an unprecedented process that minimised environmental impact.
Lloyd’s Register (LR) and A*STAR’s Institute of High Performance Computing (IHPC) have officially opened a joint laboratory which will deliver innovative technological solutions to address the challenges faced by the marine, energy and offshore sectors.

This initiative is realised as part of LR’s US$ 35million investment in its Global Technology Centre (GTC) set up in Singapore in 2012. It is also pursued under LR’s agreement with the Agency for Science, Technology and Research (A*STAR) to collaborate on R&D projects as a key part of the centre’s activities.

The joint laboratory will leverage on IHPC’s capabilities in computational fluid dynamics (CFD) and engineering mechanics, to develop computational modelling and simulation, and bespoke technical solutions for businesses in the marine, energy and offshore sectors. Some of the joint projects, which rely on numerical modelling using CFD tools, include wave-in-deck impact analysis on offshore structures, floating offshore wind turbines operating in deep water areas and the enhancing of virtual wave tank and deep ocean basin capabilities.

Both the joint laboratory and IHPC are co-located within A*STAR premises at Fusionopolis, to facilitate close and seamless exchanges between researchers from both parties. Over 10 researchers are now carrying out projects in the laboratory.

Dr Claus Myllerup, Senior Vice President of Energy Technology and Managing Director of LR’s Singapore GTC, and Prof Alfred Huan, Executive Director of A*STAR IHPC, jointly officiated the opening.

“We have received encouraging feedback from clients who recognise the strength of joint capabilities we have obtained by bringing together subject matter experts from across LR and appreciate that we are recruiting young and bright talents to work on industry-relevant research projects with us as part of their PhD studies. Equally important, our work is also enabling us to engage local Small and Medium sized Enterprises (SMEs), either as partners in joint industry projects or suppliers of specific services. This is helping to further improve the technological infrastructure of the local offshore and marine sector. Singapore GTC is part of a global R&D network which comprises the LR GTC at the University of Southampton coupled with 48 other Lloyd’s Register Foundation-sponsored academic and technical institutions. Such a strong global network not only enables us to acquire vast global knowledge and expertise, but also remain sufficiently versatile to act locally,” added Dr Myllerup.

Said Prof Alfred Huan, “The investments by Lloyd’s Register in the GTC is a major boost for R&D activities in our marine and offshore sector, which will translate into opportunities for more value-add and business to our local partners. IHPC is excited to embark on joint projects with Lloyd’s Register, being a leading authority on safety in the global energy and maritime arenas. We are confident that our strengths in modelling and simulation, combined with LR’s expertise in these domains, will catalyse innovations and ideas to benefit the industry on the whole and present development mileage to companies to equip themselves for new challenges in these sectors.”

Singapope’s marine and offshore industry has grown significantly over the last few years, recording an output increase of more than 30% from 2006 to 2011.

A*STAR’s cooperation with Lloyd’s Register, the world’s first classification society, provides a strategic platform to develop key research capabilities in this important sector.
OSV Singapore 2013 presents developments in offshore support vessels

OSV Singapore 2013, the 5th International Conference on Technology and Operation of Offshore Support Vessels, was held on 24 and 25 September 2013, at Singapore Polytechnic.

The conference was organised by The Joint Branch of the Royal Institution of Naval Architects (RINA) and the Institute of Marine Engineering, Science and Technology (IMarEST) (Singapore); Newcastle University (Singapore); and Singapore Maritime Academy, Singapore Polytechnic.

Close to 150 delegates, representing various sectors of the marine & offshore industry, including representatives from shipowners, shipyards and marine equipment manufacturers, as well as consultants academics and others, attended the event.

The Guest-of-Honour at the opening of OSV Singapore 2013 was Mr Choo Chiau Beng, CEO, Keppel Corporation and Chairman, Keppel Offshore & Marine.

The event commenced with a Welcome Address delivered by Mr Tan Kim Pong, Chairman, The Joint Branch of RINA and IMarEST (Singapore) and Chairman, Organising Committee of OSV Singapore 2013.

This was followed by a speech from the Guest-of-Honour.

Following Mr Choo’s speech, the ‘Opening of the Technical Stream’ was performed by Dr Arun Kr Dev, Senior Lecturer, Marine and Offshore Technology, Newcastle University (Singapore) and Chairman, Technical Committee of OSV Singapore 2013.

Another highlight of the Opening Ceremony was a Keynote Speech delivered by Prof R W Birmingham, Professor in Small Craft Technology, School of Marine Science and Technology, Newcastle University, UK. The title of his presentation was ‘The Importance of Context in the Design of Small Vessels’.

At the Opening Ceremony, Mr B H Wong of Ezra Holdings and Dr Alf-Kare Adnanes of ABB were commended for their continuous support of OSV Singapore, since its inception, through their excellent technical papers.

Also, Keppel Singmarine and ABB received acknowledgement for their continuous sponsorship of OSV Singapore for the last five consecutive conferences.

A total of 15 technical papers were presented over the two days of the conference.

This series of biennial OSV Singapore Conferences was first held in 2005, making Singapore the first country in the world to host such an event. Accordingly, OSV Singapore 2013 marks the 8th year since the inaugural presentation of the event.

This year’s conference was sponsored by Keppel Singmarine, Wartsila and ABB, and supported by the Institution of Engineers, Singapore (IES).
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The third Singapore Construction Productivity Week 2013 (SCPW 2013) was celebrated, with a series of events, from 29 July to 2 August 2013. Whilst highlighting the achievements and challenges in the construction industry’s productivity journey, the various events also presented a platform for suppliers, developers, architects, consultants and builders to come together and exchange ideas.

The Opening Ceremony for SCPW 2013, held at the Singapore EXPO on 31 July, was officiated by Mr Tharman Shanmugaratnam, Deputy Prime Minister and Minister for Finance, Singapore.

In a speech made on the occasion, Mr Tharman said, “We have made gradual progress in the last few years, but a major journey in productivity lies ahead. There is great scope for us to catch up with practices in several of the developed countries, by adopting better technologies and work processes and upgrading our skills”.

He pointed out that the tightness of the labour market is not a temporary situation and that the survival and growth of SCPW 2013 provides platform for sharing experiences and displaying new technologies and skills.

The Guest-of-Honour, Mr Tharman Shanmugaratnam, launched the Singapore Construction Productivity Week 2013.

Mr Tharman viewing a Cross Laminated Timber exhibit at the BCA booth.
companies in the sector will hence depend on how quickly and effectively solutions are brought in, that have reduced dependence on labour in other countries, and investments are made in local innovations.

Mr. Tharman said that in order to move the sector to a new level in the coming years, new capabilities have to be built up and much tighter integration has to be achieved within the construction value chain, from developers to contractors and suppliers.

He highlighted the opportunity for the sector to embrace new, labour-saving technologies such as Prefabricated Prefinished Volumetric Construction (PPVC) and cross-laminated timber (CLT).

Further, as more pre-casting and pre-fabrication are encouraged, there is also the need for more off-site pre-fabrication facilities, and the government will accordingly release sites for Integrated Construction and Precast Hubs (ICPH), Mr. Tharman said.

He also addressed the issue of talent and skills development.

“We have put in place a suite of programmes to attract local professional talent into the construction sector, and raise the skills of tradesmen and workers”, Mr. Tharman said.

He revealed that BCA Academy will be starting a new Bachelor’s programme focusing on construction management. It will be the academy’s first full-time degree programme, and aims to nurture industry professionals who will be well-versed in the different aspects of the construction cycle, and who in time can help to lead efforts to transform the industry.

MEMORANDA OF UNDERSTANDING

As part of the continuing efforts to build new capabilities and foster more partnerships to achieve stronger integration across the entire construction value chain, two Memoranda of Understanding (MOUs) were signed at the Opening Ceremony for SCPW 2013.

An MOU was signed between the Singapore Institute of Architects (SIA) and the rest of the Construction Industry Joint Committee (CIJC), as a result of which SIA and other CIJC associations will collaborate to adopt an online, cloud-based BIM design object library (SIA iDOL) developed by SIA. This is in support of Singapore’s drive towards adopting BIM technology as an important means to transform the industry work practices for higher productivity. This MOU aims to reduce duplication of efforts by individual firms in developing similar design objects suitable for BIM software solutions commonly used in the Singapore construction industry. It hopes to standardise the property set and external references for design objects, to achieve an information-rich model that can support lifecycle usage, and hopes to provide the iDOL content free-of-charge to members of CIJC associations.

SIA will be responsible for defining, creating and maintaining a suite of generic and manufacturer-specific architectural design objects for the industry and for providing, operating and maintaining SIA iDOL. The responsibilities of the other CIJC associations are to encourage all their respective members to adopt the use of the iDOL.

The other MOU was signed between People’s Association (PA) and Building and Construction Authority (BCA), as a result of which the two organisations will collaborate on a joint programme where students from BCA Academy will undertake projects to convert paper-based building plans of PA’s Community Clubs into digital BIM format. The purpose is to improve the quality and productivity in the design, construction and lifecycle operation and management of PA’s building facilities. At the same time, the partnership will provide internship opportunities to students of BCA Academy.
On the need for tighter integration within the construction industry, Mr Tharman said, “We must achieve stronger integration along the value chain of construction, because this too is critical to raising productivity. This refers to integration among developers, architects, engineers, surveyors, project managers, contractors - including better integration between main contractors and sub-contractors - and suppliers. We can use new project management tools and processes to accelerate this integration”.

He spoke of the particular potential of Building Information Modelling (BIM) as a whole new way of working for the players in the value chain, and of Early Contractor Involvement as another important form of integration.

Concluding his speech, Mr Tharman said, “Over the next few years, public sector projects will account for about half of total construction demand in Singapore. The public sector must therefore continue to lead in pushing construction productivity efforts. We will also continue to work closely with the industry and support our companies in this journey of transformation in the built environment sector”.

**KEY EVENTS AT SCPW 2013**

**BIM Competition 2013**

For the third consecutive year, BCA organised the online BIM competition in conjunction with the Singapore Construction Productivity Week.

Within a 48-hour competition period, teams were required to provide detailed BIM models and documentation, to the extent possible. The information provided included architectural and structural designs, building services designs and calculations, sun and wind analysis, energy analysis and consumption data, constructability analysis, model checks etc.

For the first time, the multi-disciplinary collaboration subcategories under ‘Industry’ and ‘Education’ were open for international participation.

Since the introduction of the BIM competition in 2011, it has received much attention and support from the built environment industry. This year, a total of 37 teams signed up, eight of which were from overseas, from countries such as South Korea and the United Kingdom.

**BIM Mobile App Challenge 2013**

The BIM Mobile App Challenge is a new competition that caters to the increasingly popular usage of tablets in the industry.

The BIM Mobile App Challenge 2013 aimed to gather innovative ideas on mobile applications that can help architects, engineers, contractors, quantity surveyors and building owners to collaborate better using BIM, from the design to the construction stages.

A total of eight teams submitted written proposals, and six teams went on to develop their ideas into prototypes.

**Skilled Builders Competition 2013**

The Skilled Builders Competition 2013 was jointly organised by BCA, the Singapore Contractors Association Limited (SCAL) and the Specialist Trade Association of Singapore (STAS).

It aims to foster better productivity through technology adoption and promote proper work procedures and highlights the importance of using the right skills to achieve productivity improvements.

The challenge was to produce accurate and high quality work within a designated time-frame - essential requirements for today’s fast-paced construction industry. Participants were awarded certificates of participation and prizes were given out to the winners in several categories.

**Build Smart Conference 2013**

The Build Smart Conference 2013 was a two-day conference that focused on Construction Technology and BIM.

The aim of the conference is to keep the industry updated on innovative construction technologies, raise industry awareness on productivity and showcase projects that have successfully adopted productive methods of construction.

**BuildTechAsia2013**

BuildTechAsia2013 was a regional tradeshow for the building and construction industry. Organised by Sphere Exhibits and hosted by BCA, the three-day trade show was a key event in SCPW 2013. It focused on Construction IT and key productive technologies that can help companies to grow and cope with the demands of an evolving industry which is confronted by a tightening in the supply of foreign workers and which needs to constantly elevate what is considered as acceptable standards.

**Meeting of International Panel of Experts**

BIM has been identified as one of the game-changing technologies to improve productivity in Singapore. To promote the wider adoption of BIM in the industry, BCA launched a BIM Roadmap in 2010.

An International Panel of Experts (IPE) was also formed to review the policies and initiatives under the BIM Roadmap. The first IPE meeting was held in November 2011.

This year’s panel included experts from Australia, Germany, Norway, South Korea, the United Kingdom and the United States. At the BIM IPE meeting this year, BCA sought the advice from both international and local experts to discuss the direction for BIM implementation in Singapore, moving forward.
ARCHITECTURE AND BUILT ENVIRONMENT 2013 PRESENTS INNOVATIVE TECHNOLOGIES

Architecture and Built Environment 2013 (ABE2013) was held from 31 July to 2 August 2013 at Singapore EXPO.

The event featured the displays of 180 exhibitors from 18 countries and attracted 6,345 visitors, representing a 16% increase compared to the number of attendees last year.


ABE2013’s core show, BuildTechAsia2013, was hosted by the Building and Construction Authority (BCA) as a key event of Singapore Construction Productivity Week 2013 (SCPW 2013).

A spectrum of technologies, products and services were showcased at ABE2013. Collectively, ABE2013 looked at the building and construction industry, and included all forms of structures. The event covered the entire supply chain needs from concept and design to construction, and to operational life and demolition.

BuildTechAsia2013 covered all aspects of building and construction, particularly Building Information Modelling (BIM); Construction IT; prefabricated structural systems; prefabricated architectural systems; prefabricated M&E systems; smart materials; and smart construction technologies, products and services.

Among the exhibits at BuildTechAsia2013 were two new labour-saving technologies - Prefabricated Prefinished Volumetric Construction (PPVC) and Cross Laminated Timber (CLT).

Facilities Management Solutions Expo 2013 highlighted automation in facilities management.

InterDecAsia2013 presented materials and composites that can influence interior design work and productivity.

AsiaLighting2013 showcased the latest lighting solutions, whilst placing an emphasis on industrial lighting.

The next event in the annual series of exhibitions, ABE2014, is scheduled to be held in October 2014 at Singapore EXPO. The show will focus on BuildTechAsia and Facilities Management Solutions Expo.
BuildTechAsia 2013 presented two new labour-saving technologies for the building and construction industry - Cross Laminated Timber (CLT) and Prefabricated Prefinished Volumetric Construction (PPVC).

**CROSS LAMINATED TIMBER**

CLT panels are made from wood harvested from sustainably managed forests, by binding layers of the timber at 90°, using structural adhesives. Unlike sawn timber, CLT can support heavier loads and can be used for structural and non-structural components in buildings. Also, as it is flexible and light (weighing about 500 kg/m³, compared to reinforced concrete which weighs 2,400 kg/m³), it can be used for the construction of walls and even floors, beams and columns, and lift shafts.

Depending on the dimensions of the structural and non-structural elements, the CLT panels can comprise more than three layers of timber and can be manufactured in varying sizes, with a maximum length of 18 m and a thickness of 0.5 m. The CLT panels are also cut in factories for window and door openings before they are assembled on-site.

**Benefits of using CLT for construction**

- Reduction of waste onsite and positive impact on the surrounding community (via reduced construction noise, truck movements and reduced concrete / general dust emission).
- Faster construction and less labour needed on site, compared to conventional construction methods.
- Sustainability benefits throughout a building's lifecycle - timber has the lowest energy and water consumption of any building material and it is a renewable structural building material. Even at the time of demolition, CLT is recyclable and can be reused.
- CLT also provides a higher level of thermal performance, reducing heating and cooling costs for occupiers.

**Limitations and challenges in adopting CLT**

- One possible limitation in using CLT in developments is the height of the building. The Forte (designed and built by Lend Lease in Melbourne, Australia) is 10 storeys high and is currently the tallest residential timber building in the world.
- Analysis and testing are also being carried out to assess CLT's moisture control and performance management in the tropics, and it is being designed to meet local fire safety regulations and termite protection and treatment requirements.

**CLT in Singapore**

In terms of regulatory clearance, CLT has already obtained In-Principle Acceptance from all the technical agencies for use in Singapore. However, its use is subject to certain conditions, such as the building height and design requirements.

**PRE-FABRICATED PRE-FINISHED VOLUMETRIC CONSTRUCTION**

Under PPVC, complete flats or modules made of multiple units, with internal finishes, fixtures and fittings, are manufactured in factories, and are then transported to site for installation in a lego-like manner.

**Benefits of PPVC**

- PPVC can help to significantly speed up construction.
- Dust and noise pollution can be minimised as more activities are done off-site.
- With the bulk of the installation activities and manpower moved off-site to a factory-controlled environment, site safety will also improve.

**Limitations and challenges in adopting PPVC**

- While the technology has been in use in other countries like Australia, developers might have some concerns on the long-term implications of using PPVC (eg corrosion of steel), and there could be some resistance to the technology's adoption.
- Technically, there is no reason why PPVC is less maintainable compared to traditional buildings. To overcome these issues would require changing the mindset of the developers so that they move away from the traditional methods of construction and adopt the new technology to reap benefits in productivity and quality.

**PPVC in Singapore**

In terms of regulatory clearance, PPVC has already obtained In-Principle Acceptance from all the technical agencies, for use in Singapore.

Nanyang Technological University plans to use PPVC in its new hostel project. When confirmed, it will be the first major high-rise development in Singapore to use this technology.
SEF Groupannouncesthenewintegrated
construction and precast hub

SEF Group Ltd (SEF) recently announced the development of its first Integrated Construction and Precast Hub (ICPH) at Kaki Bukit. The ICPH is the first to be awarded under a public tender by the Building and Construction Authority (BCA) as part of the government’s initiatives to transform the industry to one that adopts highly productive technology and mechanisation.

Upon completion, the new ICPH will be equipped with an automated production line using advanced European technologies. It will have an annual production capacity of more than 100,000 m³ of precast components. This is three times more than the output of a conventional open precast yard. The factory setting not only speeds up the production process but also provides better quality control of the precast concrete products. The ICPH is also capable of producing more than 25 types of components, including structural, architectural as well as preassembled products, for use in both public and private sectors projects.

In land-scarce Singapore, the concept of an integrated hub will allow more efficient use of land. Besides the production of precast components, the 32,608 m², five-storey building will also be used for related purposes such as offices and dormitories for workers. The SEF’s ICPH will be the first in Singapore to make use of a multi-tiered fully automated storage system. The storage system is capable of storing more than 100 trailers worth of completed components including bulky 3-D components such as household shelters. In addition, the system for tracking inventory of precast components as well as the preparation prior to delivery, is also fully automated. SEF will be integrating advanced Building Information Modelling (BIM) software with control and management software to gather installation updates from project sites to achieve ‘Just in Time’ production, in order to cut down on storage space.

Dr John Keung, CEO of BCA said, “With our productivity drive towards off-site production, mechanisation and standardisation, the demand for precast components will increase significantly in the next few years. The concept of the integrated construction and precast hub is suitable for Singapore as it allows us to intensify land use while ensuring production of high quality precast components. Such facilities will be the next step forward for our local precasters, towards automation, process integration, improved quality and significant productivity improvement.”

BCA will be rolling out more tenders for new ICPHs, about two to three more this year, to boost the industry’s capability and capacity in this area. Dr Keung urged those who are interested in the upcoming land tenders to look out for the announcements.

Ms Eileen Ng, Managing Director of SEF said, “We see automation as the way forward as there is a huge opportunity in making use of technology to meet construction needs. Prefabrication has been well-accepted locally but there is still potential to automate the processes to improve productivity. The ICPH gives us a platform on which we can integrate all technologies from design to production and delivery into seamless processes. This intensified development has sophisticated production lines to achieve large productivity gains.”

Despite having a large production capacity, the ICPH will be adopting environment-friendly practices to cut down on water consumption. These include recycling and treating rainwater and grey water (collected from wash basins and shower areas) and reusing it as industrial water for production purposes. The recycled water is expected to fulfill daily production needs. In addition, there will also be a highly efficient heater that will reduce energy consumption and boiling time by up to 50%, in the supply of hot water for production use. SEF will also be employing a more productive ‘suspension concrete’, on top of normal concrete, in its production of precast components, which can help cut down the amount of cement, aggregate and water used, by up to 30%.

The ICPH will be named ‘SEF SPACEHub’, to reflect the company’s focus on Sustainability in its core business of Prefabrication, Architecture, Construction and Engineering. The ICPH is expected to start its production next year.
More benefits can be reaped from Building Information Modelling

An International Panel of Experts (IPE) was in Singapore from 30 July to 1 August 2013, to discuss how Singapore’s built environment sector can be transformed, using Building Information Modelling (BIM), in order to achieve greater efficiency and higher productivity.

The panel noted that there has been significant progress in promoting BIM in Singapore, with the adoption rate going up from 20% in 2009 to 65% today. The IPE commended Singapore for being in a leading group of countries at the forefront of driving BIM transformation and adoption through public and private sector partnership.

The panel believes that building upon this success, the focus going forward broadens to how Singapore can maximise the future potential of BIM, specifically in the areas of lifecycle benefits such as the operation and maintenance of buildings and assets, as well as transforming construction procurement processes through greater collaborative working.

“The construction industry is currently moving towards the re-engineering of its processes, to be leaner and more efficient. The BCA is playing a lead role in this process transformation. Singapore stands out in its leadership compared to countries in Europe and possibly the rest of the world. While the first BIM roadmap in Singapore focused on getting people to start using BIM, the next stage is to broaden its application of BIM, especially in the area of the management and operation of existing buildings and other assets”, said Prof Stephen Lockley, one of the members of the IPE.

The IPE recommended that a national BIM research roadmap be formulated with the two new Centres of Excellence (COE) at the National University of Singapore (NUS) and Nanyang Technological University (NTU), and that the new COEs at NUS and NTU should work with government procurement entities (GPE) and private sector stakeholders to develop research in BIM that will transform the built environment sector.

The key value of BIM lies in enabling collaboration among different project partners, to jointly develop new solutions, better manage project risk and enhance decision-making. For instance, general project partners, to jointly develop new solutions, better manage lifecycle BIM solutions.

Besides the IPE BIM meeting, an inaugural Government BIM symposium for government representatives from over 10 countries was organised by the Building and Construction Authority (BCA) to facilitate the sharing of experiences in the adoption of BIM. While different countries are at various stages of adopting BIM, common challenges were identified, such as the need for BIM-related training, as well as the uptake of full lifecycle BIM solutions.

The IPE recommended that Singapore should continue to facilitate international collaboration and exchange on BIM planning and deployment at the governmental level.

Co-Chair of the International Panel of Experts and BCA Chief Executive Officer Dr John Keung said, “We thank the members of the IPE for sharing their insights into how we can further drive the BIM transformation process in Singapore. Their recommendations would serve as critical inputs to the formulation of BCA’s second BIM Roadmap. Moving ahead, we will bring the usage of BIM to a higher level, to maximise the benefits of BIM to the built environment”.

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Minister of State for Trade and Industry Mr Teo Ser Luck recently opened JTC Corporation’s JTC Small Footprint Standard Factories (SFPs) located at Buroh Street, Tanjong Kling.

The SFP is one of JTC’s innovative industrial infrastructure concepts targeted at SMEs to help them enhance competitiveness and increase land productivity. This next-generation standard factory is specially designed such that manufacturing activities that are traditionally located across a single storey, can now be located over three storeys. This allows the factory to occupy a smaller footprint, thereby reducing the land area needed. By taking up less land, the SFP reduces business costs for industrialists and optimises the use of Singapore’s industrial land.

The SFP’s unique feature is its structural provisions which provide flexibility for industrialists to install their preferred choice of material handling systems that best cater to their operational needs. This enables production activities that are traditionally carried out over a single floor to be integrated over multiple floors, without the need for the industrialist to further modify the building structures extensively. This enables industrialists to enjoy faster start up and also reduces their upfront capital costs. In addition, the design layout of the factory unit ensures that the production process is seamless and provides optimal flexibility for industrialists to further expand their business operations.

Mr Png Cheong Boon, JTC’s CEO said, “The SFP is the latest innovative infrastructure piloted by JTC that caters to the needs of a broad segment of SMEs. SMEs could redesign their manufacturing processes so that they can be housed on multi-storeys thereby reducing the land area required for production. This in turn lowers their land and set up costs, and enhances their competitiveness. We are encouraged to know that SMEs have responded very positively towards this development. JTC will continue to develop such innovative facilities to help enterprises improve productivity and competitiveness, and support the transformation of Singapore’s industries”.

At the official opening event, JTC announced that eight of the 18 SFPs have been taken up within the first year of the project’s completion.

CSC releases updates to Tedds 2013

Leading structural software developer, CSC, has released updates to Tedds 2013, its market leading software for performing automated structural and civil engineering calculations. Engineers will now benefit from increased functionality for analysing frames, accessing a broad library of calculations and creating high quality documentation.

Tedds’ 2D frame analysis template now includes a wizard, enabling engineers to create frames and trusses quickly, by defining just a few parameters of the structure. While saving time inputting large or repetitive configurations, the new frame wizard allows engineers to create a wide range of trusses in addition to frames, with the option for flat or pitched roofs, as well.

Document storage has been significantly enhanced as a result of which Tedds calculation data can now be stored directly within the Microsoft Word document, removing the need for separate files. Engineers can also save their documents to cloud storage solutions, such as SkyDrive or Dropbox, and share documents more easily via email or document management systems.

Tedds 2013
Tedds 2013 is a new version of structural calculation software from CSC. Up to twice as fast as its predecessor, Tedds 2013 includes a new and fully integrated 2D frame analysis application, many new and enhanced calculations to both Eurocodes and British Standards, and it is compatible with Microsoft Word 2013.

The new analysis application was developed in collaboration with Imperial College’s Prof Izzuddin and enables engineers to access a range of analysis options within Tedds, avoiding the need to use separate analysis software. Engineers can now analyse frames, trusses, cranked beams and portal frames, and then create a single project document including calculations, notes and sketches.

Tedds 2013 has new calculations for designing masonry columns and steel masonry supports, retaining walls, lintels and RC deep beams, along with many other significantly enhanced calculations. It also includes unique features enabling engineers to create their own bespoke calculations, along with new API functionality for communication with other software applications.

More information on Tedds can be obtained from www.cscworld.com.
HDB launches public exhibition on new housing areas

The Housing & Development Board’s (HDB) ‘Future Homes, Better Lives’ exhibition, which was held at the HDB Hub Atrium, from 29 August 2013 to 15 September 2013, showcased the broad development plans for three new housing areas - Bidadari, Tampines North and Punggol Matilda.

The exhibition, which was launched by the Minister for National Development, Mr Khaw Boon Wan, is part of HDB’s efforts to consult and seek public feedback on the upcoming plans.

As the master planner and developer of Singapore’s public housing estates, HDB is constantly on the lookout for innovative ideas to provide residents with a quality living environment. In line with HDB’s Roadmap to provide well-designed, sustainable and community-centric towns, HDB also consciously provides for community spaces to encourage interaction and cultivate strong community bonds.

The plans for Bidadari, Tampines North and Punggol Matilda will capitalise on their individual distinctive character to bring about a unique identity and living experience. They will build on each estate’s history, distinctive local flavour and features.

Five key ideas will guide the development plans of the three areas, namely:

a) Distinctive housing districts with unique identities
b) Green housing districts with community gardens and abundant greenery
c) Vibrant community spaces to encourage community activities
d) Rekindling memories to form new ties and communities
e) Promoting a healthy lifestyle with well-connected cycling and pedestrian networks

The implementation of these new urban design concepts will add to the vibrancy of the Singapore housing landscape. They will characterise the next generation of public housing over the next decade.

Bidadari

Located in the central region of Singapore, Bidadari is bounded by Bartley Road to the north, Upper Serangoon Road to the west, Sennett Estate to the south and Mount Vernon Road to the east. It is well-served by Woodleigh and Bartley MRT stations on the North-East Line and the Circle Line, respectively. Bidadari Estate will be a tranquil urban oasis, where residents can relax and connect with family and friends in a garden-like setting. HDB envisions it to be ‘A Community in a Garden’.

Some of the plans for Bidadari Estate include:

a) A 10 ha Bidadari Park with a lake that will form the new green lung for the estate;
b) Six distinctive neighbourhoods, each with unique identities through the use of varied building forms that respond to the different characteristics of Bidadari.

c) Public spaces for community gathering and events within a garden-like setting.

d) A mixed-use Market Square commercial cluster, together with commercial and social communal facilities pavilions to serve the needs of residents.

e) A pedestrianised Upper Aljunied Road, transformed into a Heritage Walk, with mature trees and which captures fond memories of Bidadari’s heritage.

f) A seamless pedestrian and cycling network to make travelling within Bidadari more pleasant and convenient.

Tampines North
Tampines North is envisioned to be a new ‘green shoot’ and extension of Tampines Town. The vision for Tampines North is ‘Tampines in Bloom: Budding Communities within a Green Tapestry’. Guided by this vision, Tampines North will capitalise on its existing greenery and proximity to Tampines Town to create an attractive living environment, through five key strategies.

These strategies are designed around a striking ‘leaf’ concept and include:

a) A 7.5 ha meandering Boulevard Park that will form the green spine for Tampines North, providing a scenic and seamless connection between Sun Plaza Park in the south to Sungei Api Api in the north.

b) A ‘Blossoms Walk’ within the Boulevard Park to create a local yet distinct identity.

c) A 10 ha Quarry Park which could connect to Pasir Ris Town in the future.

d) A seamless pedestrian and cycling network that will weave through the various housing districts, enabling residents to cycle and walk around Tampines North with convenient links to the main activity spine.

e) A new distinctive landmark mixed development comprising both commercial and residential uses, and integrated with a bus interchange.
Punggol Matilda
Under the Phase 2 master plan for Punggol New Town, unveiled in October 2012, Punggol will feature seven distinctive eco-town districts, each with a unique identity and character. Capitalising on its proximity to the waterfront and taking inspiration from its heritage, the Matilda district of Punggol is set to be an attractive waterfront housing district with many flats commanding waterfront views. Planning for Matilda was inspired by the ‘verandah’ feature of the old Matilda House and its surrounding lush greenery. Hence the vision of Matilda District - ‘Verandah by the Waterfront’.

Some of the new plans for Punggol Matilda include:
a) New housing forms with integrated landscaped decks that provide ‘door-step’ accessibility to the precinct amenities.
b) A Community Street leading to the waterfront, designed as an urban verandah with ‘living rooms’ as rest points for residents to sit and chat.
c) Leafy walkways to provide seamless sheltered connectivity between the residential precincts and the waterfront promenade.
d) A vibrant waterfront shopping mall, as well as recreational amenities and parks for community events.

Moving forward
The exciting developments for the three housing areas are slated to take place within the next few years. The first project in Punggol Matilda with the new housing form was launched in the BTO exercise in September 2013. This will be followed by Tampines North in the second half of 2014 and Bidadari in 2015. More details will be made available closer to the actual launches.
A total of 18 awards were presented by HDB this year to consultants and contractors for their efforts in designing and constructing quality HDB projects. Acting Minister for Manpower Mr Tan Chuan-Jin handed out the awards to the winners during the HDB Awards 2013 gala dinner on 3 September 2013.

The HDB Awards recognise HDB’s industry partners for their effort and support in providing quality public housing for Singaporeans. There are two types of HDB Awards – the Design Award and the Construction Award.

The Casa Clementi project swept top honours in this year’s HDB Awards. Besides picking up the Design Award, the project was also accorded the Distinguished Construction Award – the pinnacle of the HDB Awards. The housing project is one of the largest public housing projects developed by HDB with 10 high-rise residential blocks consisting of 2,234 dwelling units. Despite the scale of this project, it was completed on time and the judges were impressed with its excellent design and quality.

HDB’s Chief Executive Officer, Dr Cheong Koon Hean said, “Guided by the HDB Roadmap of creating well designed, sustainable and community-centric towns, HDB’s priority is in designing and building new public housing flats that are of good quality. However, we cannot do this alone. The road to provide a better living environment for Singaporeans involves the support and collaboration of our industry partners. As can be seen from the many award winners this year, our industry partners have given HDB strong support to deliver quality housing”.

**HDB Design Award Winners**

The HDB Design Award recognises consultants and architects who have produced outstanding design of public housing projects that meet the comprehensive design guidelines set out by HDB.

Among the Design Awards winners this year, the recently completed Casa Clementi and Punggol Breeze received the top accolades. The projects add to the distinctive identity and character of both towns.

The Build-to-Order (BTO) project, Waterway Cascadia secured the Innovative Design Award. When completed, the residential development with its unique design, will offer residents a panoramic view of the Punggol Waterway.

**HDB Construction Award Winners**

The Construction Award recognises contractors who deliver quality housing projects through innovative solutions while upholding high construction standards. Punggol Sails stood out in this regard, achieving a CONQUAS score of 93.7 - the highest ever for a public housing project.

This year, a new criterion has also been added to the evaluation, to recognise contractors that are not only competent in their craft but who also take the effort to engage residents and stakeholders. For instance, the builders of Casa Clementi actively engaged and maintained close communication with the residents and the school in the vicinity of their project, and worked to minimise construction disamenities.
### HDB Design Awards - Award Winners

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<thead>
<tr>
<th>Project</th>
<th>Category</th>
<th>Consultant</th>
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<tbody>
<tr>
<td>Casa Clementi</td>
<td>Housing</td>
<td>Surbana International Consultants Pte Ltd</td>
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<td>Punggol Breeze</td>
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<td>Surbana International Consultants Pte Ltd</td>
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### Innovative Design Award

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<th>Project</th>
<th>Category</th>
<th>Consultant</th>
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<tr>
<td>Waterway Cascadia</td>
<td>To-Be-Built</td>
<td>ADDP Architects LLP</td>
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### HDB Design Awards - Certificate of Merit Winners

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<tbody>
<tr>
<td>Punggol Sails</td>
<td>Housing</td>
<td>P &amp; T Consultants Pte Ltd</td>
</tr>
<tr>
<td>Punggol Spectra</td>
<td>Housing</td>
<td>Interconsultants Pte Ltd</td>
</tr>
<tr>
<td>Senja Greeen</td>
<td>Housing</td>
<td>SAA Architects Pte Ltd</td>
</tr>
<tr>
<td>Firefly Park @ Clementi</td>
<td>Park</td>
<td>Surbana International Consultants Pte Ltd</td>
</tr>
</tbody>
</table>

### To-Be-Built Projects (Innovative)

<table>
<thead>
<tr>
<th>Project</th>
<th>Category</th>
<th>Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depot Heights</td>
<td>Housing</td>
<td>HDB Building Research Institute</td>
</tr>
<tr>
<td>Keat Hong Mirage</td>
<td>Housing</td>
<td>P &amp; T Consultants Pte Ltd</td>
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</tbody>
</table>

### HDB Construction Awards - Award Winner (Distinguished)

<table>
<thead>
<tr>
<th>Project</th>
<th>Category</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casa Clementi</td>
<td>Housing</td>
<td>Straits Construction</td>
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</table>

### HD Construction Awards - Certificate of Merit Winners

<table>
<thead>
<tr>
<th>Category</th>
<th>Contractor</th>
<th>Project</th>
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<tbody>
<tr>
<td>Housing</td>
<td>Ho Lee Construction</td>
<td>Fernvale Lodge</td>
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<tr>
<td></td>
<td>LC &amp; T Builder</td>
<td>Punggol Spectra</td>
</tr>
<tr>
<td></td>
<td>Qingjian International (South Pacific)</td>
<td>Punggol Breeze</td>
</tr>
<tr>
<td></td>
<td>Qingjian International (South Pacific)</td>
<td>Senja Greeen</td>
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<table>
<thead>
<tr>
<th>Category</th>
<th>Contractor</th>
<th>Project</th>
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</thead>
<tbody>
<tr>
<td>Hi-Tek Construction</td>
<td>Design &amp; Build of 3 LUP Precincts</td>
<td>Pasir Ris St 11 (Blk 118-129)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tampines St 81/ Ave 4 (Blk 801-803, 805-814, 817-820)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clementi Ave 3 (Blk 426-435)</td>
</tr>
<tr>
<td></td>
<td>China Jingye Engineering</td>
<td>Design &amp; Build of 6 LUP Precincts</td>
</tr>
<tr>
<td></td>
<td>Clementi Ave 4/5 (Blk 371-381)</td>
<td>Clementi West St 2 (Blk 728-731)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jurong East St 24 (Blk 241-245)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>French Rd (Blk 801)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>King George's Ave (Blk 804, 806)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upper Boon Keng Rd (Blk 15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design &amp; Build of 1 LUP Precinct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedok Reservoir Rd (Blk 601-605 &amp; 607)</td>
</tr>
</tbody>
</table>
Good public rapport and design key to Casa Clementi’s success

Completed in June 2012, Casa Clementi is one of the largest public housing projects ever developed by HDB. The distinctive development comprises a variation of towering 20-, 28- and 40-storey blocks, providing Clementi Town with an interesting skyline.

The evaluation panel was particularly impressed with the work of the contractors, Straits Construction, this year. Not only did they manage to complete a mammoth task of building 10 high-rise residential blocks, consisting of 2,234 dwelling units on schedule, they also achieved a high CONQUAS score of 91.5 for their work.

The project team had to plan ahead and work together on innovative solutions to complete this project on time. For instance, the team managed and planned the logistics for building constructions that used precast components. In anticipation of the large volume of precast installation work, the team allocated ample space for storage of the precast components and designed vertical storage space for items that needed to be lifted. The result was productivity gains at the work site as the precast components could be promptly erected to form the building structure.

Clear communication is key

Besides quality and innovation, a new criterion has also been added to the evaluation this year, to recognise contractors who have demonstrated strong communications and effective engagement with residents and stakeholders. With the construction of HDB flats taking place amidst existing developments, soft skills in managing the needs and concerns of surrounding residents and stakeholders have become important as well.

In the course of building Casa Clementi, Straits Construction proved to be outstanding in building good rapport with the surrounding community. In a mature estate like Clementi, the contractor’s key concern in building the project was minimising inconvenience to residents in the neighbourhood. With the project’s close proximity to Nan Hua High School and residential blocks along Clementi Ave 1, the project team had to manage the construction activities to reduce noise levels.

The team actively engaged the residents, schools and authorities to manage their concerns. Throughout the construction period, regular dialogue sessions with Nan Hua High School were conducted to maintain close communication with them. When there were piling and hacking works, noise barriers were also installed to mitigate the noise pollution.

Creating a quality living environment

For creating a quality living environment for its residents, Casa Clementi also bagged the HDB Design Award. In spite of the project’s high plot ratio, residents in Casa Clementi enjoy generous green spaces.

Surbana International Consultants worked closely with HDB on the overall site planning and design execution. The project team took advantage of the long linear land parcel by aligning the residential blocks along the perimeter to maximise the north-south orientation. This in turn provides optimal views for residents in these flats. This arrangement meant that the team could also develop an expansive roof garden where residents can enjoy a variety of communal spaces in a garden setting.

A focal point of Casa Clementi is the ‘tree-top walk’. Designed to enhance universal accessibility, this barrier-free central spiral ramp connects the roof garden to the semi-basement car park.

Maintaining close partnership to meet future challenges

The quality standards and good design found in the Casa Clementi project aligns with the three thrusts in HDB’s Roadmap announced in 2011 - to create well designed, sustainable and community-centric towns.
Punggol Breeze - modern public housing that is well designed and well built

Besides receiving the Design Award, Punggol Breeze was also accorded the Certificate of Merit - Construction Award, at HDB Awards 2013.

Completed in December 2012, Punggol Breeze is a premium Build-To-Order (BTO) project with a total of 12 residential blocks with 964 dwelling units, offering a mixture of 4-room and 5-room flats. Bounded by Punggol Drive and Edgefield Plains, the development is conveniently served by Oasis LRT station, which is just two stops away from the Punggol MRT station.

Delivering good design to residents is key

At the macro level, HDB puts in place comprehensive design guidelines to steer its consultants in designing the projects. The central focus of the Punggol Breeze project is its expansive greenery which is well-integrated with community spaces for residents.

In Punggol Breeze, Surbana International Consultants has created a good living environment for residents by bringing functional, yet aesthetically-pleasing designs to the project. Residents enjoy one of the longest linear roof gardens (at 270 m) to be found in any HDB development. This roof garden is situated in the middle of the precinct, allowing residents a panoramic view of the lush greenery from their homes. Extensive greening also helps to reduce heat and glare. Within the adjacent common green area, a bio-retention swale is purposefully created to retain and cleanse rainwater runoff.

HDB also worked closely with Surbana to ensure public and recreational spaces for residents are available at their doorsteps. Within the lush landscape of the roof garden, the consultants have successfully carved out pockets of social and activity spaces to provide facilities such as a children’s playground, fitness corners, and seats for informal interaction.

Such spaces can encourage greater bonding not just within the family but also among the community.

Quality homes for residents

As a project of considerable scale, comprising 12 residential blocks and one of the longest HDB multi-storey car parks cum linear roof gardens, the judges were impressed that Punggol Breeze was not only delivered on schedule, but it even managed to attain a remarkable CONQUAS score of 92.2 for the quality of the building works.

This achievement is no easy feat. Given its large scale, the winning contractor, Qingjian International (South Pacific) Group Development Co Pte Ltd, had to plan ahead in order for the project to progress smoothly. In addition, the team implemented innovative construction solutions that not only raised the site productivity but also further enhanced the quality of the building works.

For instance, the team initiated the use of a precast concrete skin for all external precast column joints, eliminating the need for external formworks. The result is better quality finishes, as the quality of the finishes can be better controlled in a factory environment. Doing away with the external formworks also subsequently increased the manpower productivity on site.
HDB Peak Forum 2013

About 500 people, including HDB's industry partners, academics and professionals attended the HDB Peak Forum 2013 which was held on 4 September 2013 at the HDB Hub auditorium.

A line-up of distinguished speakers addressed the theme ‘Quality Environment, Quality Living’.

The HDB Peak Forum 2013 attracted about 500 attendees.


All images by HDB.

Among the speakers at the forum were Mr Moshe Safdie, the renowned architect and Ms Lim Shu Ying, Director (Urban Design), HDB.
The inaugural BCA-Industry Built Environment Sponsorship Award Ceremony 2013 was held on 16 August at the BCA Academy. BCA (Building and Construction Authority) and 13 built environment firms awarded a record 188 sponsorship awards to undergraduate and diploma students.

Over 1,000 applications were received this year, which is a positive signal that there is strong interest in the built environment sector, a key pillar of Singapore’s economy. The ceremony was attended by close to 400 students, parents, academia and industry stakeholders.

The sponsorship awards are in addition to the 166 undergraduate and diploma scholarships that were awarded at the BCA-Industry Built Environment Scholarship Award Ceremony 2013, held on 2 August.

As announced by Prime Minister, Mr Lee Hsien Loong, in his National Day Rally Speech this year, the built environment sector will experience robust growth with construction demand sustaining beyond 2030. To build the competent workforce that the sector needs, BCA offers a comprehensive suite of seven manpower development programmes.

The Undergraduate Sponsorship Programme is one of the additions that will help in casting the net wider to attract more locals, in order to build up a strong localised workforce for the sector. This will also help to rejuvenate the workforce as the sector needs more passionate young individuals to lead the transformation of the sector through innovation and ground-breaking achievements, to create the best built environment for Singaporeans.

Attracting more locals to the built environment sector.
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