

Annexe B: Fact sheets on winning projects

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2014 *Residential Category – Award*

The Interlace

	Qualified Person	Er. Yap Mui Cheng, Serena
	C&S Consultant	T.Y.Lin International Pte. Ltd.
	Builder	Woh Hup (Private) Limited
	Developer	Ankerite Pte Ltd
	Architectural Consultant	RSP Architects Planners & Engineers (Pte) Ltd

Challenges

- Interlocking blocks generate multi-directional stresses and deformation, which is not common in normal single block buildings. Under the loading from six-storey blocks, the main cores are subjected to forces in different directions at each Super Level stack. Therefore, the long and short term effects must be carefully considered in the analysis and design.
- A major challenge is to design a suitable long span transfer structure which will carry the six-storey residential block to span across the two main cores at the ends of the building, as well as to devise a suitable construction method to facilitate the construction of the superblocks at height.
- Optimisation of space utilisation within the units by controlling the structural sizes.

Solutions and Features

- Drawing on T.Y. Lin International's expertise in pre-stressing and bridge engineering, a 2.5m deep post-tensioned pre-stressed concrete box girder transfer deck was proposed as part of the value engineering exercise during the D&B tender. This system provides strong lateral and torsional stability with a clear load path to the foundations. The design eliminated the need for the thick and heavy spine and cross walls (original tender), reduced the overall weight of the buildings, freed up space within the units and supported the constructability of the development.

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- Rigorous and comprehensive structural analysis was an integral part of design development. The focus of this was to study and capture overall building behavior arising from the complex nature of the layout of the buildings and the magnitude of the project. This analysis included:
 - staged construction analysis was used to assess the impact on the main core that resulted from each stage of construction, especially at the transfer deck
 - global analysis - a full-scale 3D model of was built to obtain the interlocking force and moment envelope in mega columns
 - local analysis was used to provide the stress distribution for the transfer decks
- The construction methodology of the transfer deck was based on bridge engineering; adopting the established double cantilever for construction at height. Redundancy was built into the casting sequence so that after each stage of casting, the transfer deck would be self-supporting.
- High strength concrete of G80 was used in the mega columns to minimise the size of the columns as part of the space optimisation works.

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DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2014 *Civil Engineering – Award*

Singapore Downtown Line Stage 1, Contract C908 Telok Ayer Station

	Qualified Person	Er. Soon Won Moi
	C&S Consultant	Mott MacDonald Singapore Pte Ltd
	Builder	Samsung-Soletanche Bachy France Joint Venture
	Developer	Land Transport Authority
	Architectural Consultant	ONG&ONG Pte Ltd

Challenges

- Excavation through poor ground conditions comprising thick layer of soft marine clay and in close proximity of existing structures such old pre-war shop-houses, office blocks and within busy CBD artery.
- Over-crossing of new Downtown Line (DTL) tunnels over existing twin bores of the existing East-West MRT line (EWL). DTL tunnels will rise to only 1.5m below the ground level, scraping across the top of the EWL tunnels with less than 1m clearance.

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Solutions and Features

- Innovative design of “Trouser Legs” concept for diaphragm wall (D-wall) design, characterised by the long panels spaced at regular intervals for the tunnels. Long D-wall panels were designed to reach the hard soil strata at deeper depths and acted both as earth-retaining and foundation elements. This innovation shortened the construction period, which minimised disruption to public and enhanced public safety.
- Complex and innovative temporary works, design and careful sequencing for DTL tunnel crossing excavation above existing EWL tunnels which enabled the excavation and construction of the crossing to be carried out without adverse impact to EWL tunnels. The operation of EWL trains continued unceasingly throughout the construction of DTL & EWL crossing.

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DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2014 *Civil Engineering Category – Award*

Marina Coastal Expressway (Contract 485)

	Qualified Person	Er. Adrian Billingham Er. Lai Hock Sai
	C&S Consultant	WorleyParsons Pte Ltd
	Builder	Penta-Ocean Construction Co., Ltd.
	Developer	Land Transport Authority
	Architectural Consultant	-

Challenges

- Excavation under the seabed across the mouth of Singapore River through poor ground conditions, comprising very deep deposits of soft, compressible marine clays.
- Sequencing of open cut excavations within a 420m wide stretch of Marina Bay to ensure uninterrupted discharge from Marina Barrage.
- The scale of works associated with a 10-lane tunnel constructed within two large cofferdams.

Solutions and Features

- A portion of the Stage 1 cofferdam was left in place to allow connection of the Stage 2 works. The resulting “island” was stabilised at the transition face by a soil improved berm and progressively trimmed down as the Stage 2 cofferdam works progressed.
- Significant lateral loading was safely transferred back to ground by connecting the cofferdam longitudinal pipe pile walls with steel plates at the east end wall, thereby ensuring a stiff, stable load path.

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- Comprehensive analysis of the tunnel temporary and permanent works was performed, including: 3-Dimensional Plaxis analysis of the cofferdam end walls; finite element analysis of the temporary pipe pile, and; thermal analysis of the tunnel to account for concrete casting sequence.
- Collaboration between engineer and builder on safety features, such as left-in-place jacks to facilitate safe de-stressing and additional monitoring of base heave performance.

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DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2014 *Residential Category – Award*

Marina Bay Suites



Qualified Person	Er. Dr. Shahzad Nasim
C&S Consultant	Meinhardt (Singapore) Pte Ltd
Builder	Woh Hup (Private) Limited
Developer	Marina Bay Suites Pte Ltd
Architectural Consultant	Architects 61 Pte Ltd

Challenges

- Design of a 245m high residential tower on reclaimed land and thick soft marine clay.
- The complex layout with a larger footprint, straddling across the existing Common Services Tunnel (CST) and box drain.
- Designing the building for safety, buildability and economy in a congested site, located next to existing MRT tunnels, CSTs, a 8-meter wide box drain and a new Underground Pedestrian Network, and completing the construction within 37.5 months.

Solutions and Features

- Devised an innovative deep perimeter belt beams system at refuge floors and innovative use of coupling beams at all floors to enhance building performance.
- Collaborated with architects to revise the building layout to a smaller footprint with a taller tower to eliminate the need for a deep transfer structure across the CST and box drain, saving substantial cost and time and mitigating any construction risk.

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- Devised innovative Caisson-type sinking box method of strut-free and safe excavation for 9.2m deep lift pits.
- Use of modular and repetitive structural system reduced typical floor cycle time to only six days while achieving a high CONQUAS score.

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DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2014 *Residential Category – Award*

Casa Clementi

	Qualified Person	Er. Ng Peng Yuen
	C&S Consultant	Surbana International Consultants Pte Ltd
	Builder	Straits Construction Singapore (Pte) Ltd
	Developer	Housing & Development Board
	Architectural Consultant	Surbana International Consultants Pte Ltd

Challenges

- Effective design and construction of a large building project (for 2,234 dwelling units) within a small area in close proximity to existing housing estates, schools, MRT station and heavy traffic on adjacent roads.
- Coming up with innovative designs for the large semi-basement car park which provides direct access to all residential blocks, and for common green spaces on the eco-decks with community facilities for multi-generation users.
- Adopting a sustainable design with lower usage of concrete materials.
- Ensuring construction safety while minimising environmental impact.

Solutions and Features

- By adopting precast concrete design and fabrication, the goals of efficiency, productivity, constructability, delivery, quality, sustainability, safety and optimal environmental impact were achieved for the project.
- Strategic design of the large semi-basement car park with optimal platform level chosen to reduce earth works and without the need for extensive shoring system. It is naturally ventilated, lit and drained by gravity flow.

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- Pile optimisation strategy adopted, which resulted in reduction in construction cost, concrete materials usage and time for piling works.
- Innovative construction safety systems implemented on site were three-tier climbing platforms, easy-to-install mesh barricades, hanging walkway, portable safety platforms and safety barriers. The builder also incorporated an innovative site water collection and recycling system to reduce water consumption and discharge of effluents to public drains.

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DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2014 *Residential Category – Merit*

Cube 8 Residences, Singapore

	Qualified Person	Er. Kam Mun Wai
	C&S Consultant	Meinhardt (Singapore) Pte Ltd
	Builder	Dragages Singapore Pte Ltd
	Developer	City Developments Ltd
	Architectural Consultant	ADDP Architects LLP

Challenges

- Developing a basement and foundation system for the 36-storey tower with two basements for movement of 100mm for the future infrastructure tunnel retention system at close proximity to site.
- Designing the tower with ten-storeys of the building cantilevered 4.5m above Sky Terrace at Level 24.
- Designing the building for safety, buildability and economy in a congested site next to busy Thomson Road and PIE, at close proximity to the existing 35m wide box drain, adjacent to the future SURS and with poor soil conditions.

Solutions and Features

- Devised an innovative design after thoroughly studying several alternatives, assisted by extensive analyses. Replaced secant pile walls and barettes in the conforming tender to resist lateral movements by a simple retention system, yet managed to comply with requirements imposed on the Design & Build Contract, with substantial cost & time savings achieved.

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- Use of innovative proprietary cantilever construction platform system to build the cantilevered portion of building above Level 24.
- Use of modular and repetitive structural system reduced typical floor cycle time to only six days while achieving a high CONQUAS score.
- Extensive use of precast elements, Prefabricated Bathroom Units and system formwork to enhance buildability, constructability and productivity, making the construction faster and the site neater and safer.

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**DESIGN AND ENGINEERING
SAFETY EXCELLENCE AWARDS 2014
*Institutional and Industrial – Merit***

National University Hospital Medical Centre

	Qualified Person	Er. Ng Swee Tong
	C&S Consultant	T.Y.Lin International Pte. Ltd.
	Builder	Penta-Ocean Construction Co., Ltd.
	Developer	National University Hospital (S) Pte Ltd
	Architectural Consultant	Consultants Incorporated Architects + Planners

Challenges

- The 19-storey Medical Centre with GFA of 72,000 m² above the existing Circle Line (CCL) tunnels and Kent Ridge Station was designed with load provision for a 7-storey building only.
- Undulating site terrain involving 14m deep excavation in both basement and spiral ramp construction.
- Construction activities next to existing Kent Ridge Wing and main building.

Solutions and Features

- Designed the steel transfer structures to be supported on two rows of mega composite columns for an additional ten levels to bridge over the station.
- Adopted hybrid ground anchors as earth retaining and stabilising structures system and top-down method of construction in design to meet the movement criteria and to safeguard the adjacent buildings, MRT structures/ tunnels and the adjoining roads.

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- Designed for off-site fabrication of structural steel works to mitigate vibration and noise generated by construction activities and installed real time noise monitoring system at the hospital with SMS alerts.

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