MEDIA RELEASE

BCA CONFERS AWARDS ON FIVE PROFESSIONAL ENGINEERS FOR THEIR ENGINEERING FEATS

Singapore, 29 April 2019 – Recognising their engineering feats which resulted in the safe implementation of their projects despite the challenges, five Professional Engineers were commended under the Building and Construction Authority's (BCA) Design and Engineering Safety Award 2019. Of the five, three Professional Engineers were given the Excellence Award, while the other two were accorded the Merit Award.

2. BCA Group Director (Building Engineering) and Commissioner of Building Control Engineer Chew Keat Chuan said, "Professional Engineers play an important role in our built environment, ensuring the safety of our buildings while transforming the way we build Singapore. The Design and Engineering Safety Award honours Singapore's best engineering talents who have developed creative engineering solutions to overcome challenging architectural designs and site constraints to bring their projects to their safe completion. We hope that the recognition will inspire Singaporeans towards making an impact on our country's development through a fulfilling and rewarding career in our built environment."

Excellence Award winner: Engineer Kam Mun Wai – Frasers Tower

3. Situated in heart of Singapore's Central Business District, Frasers Tower is an iconic and slender 38-storey high-rise tower with its sloping façade. Engineer Kam's challenges for this project were the variable ground conditions which affected how he had to design its structural foundation, the site's close proximity to other buildings – including a 94-year-old national monument – in the dense city centre, and its architectural design with the façade sloped at a five-degree angle.

4. To protect the structural integrity of the adjacent buildings – including the monument, Engineer Kam devised a solution using earth retaining wall structures and a "top-down" construction method to minimise any ground movement during construction. In catering for the building's angled façade, Engineer Kam designed a complex but robust system of structural elements by analysing the forces and loads that were exerted to each element while keeping to its architectural design. He also designed the building's foundation such that it optimises the favourable ground

conditions, reducing the amount of materials and resources needed for its construction.

Excellence Award winner: Engineer Aaron Foong - The Arc

5. The Arc is one of the Nanyang Technological University's newest buildings in its campus with smart classrooms and a 108-seat lecture theatre. Its architectural design resembles a piano or a harp (i.e., a curvilinear building geometry) and includes two basement levels of classrooms and workshops. Engineer Foong's challenge was to integrate its architecture with an existing 16-m unbalanced sloping terrain, which contains existing network of telecommunication and electrical cables, and fire hydrant pipes that lead to other buildings, and its close proximity to many existing buildings.

6. To overcome these challenges, Engineer Foong used building information modelling (BIM) for The Arc's design and construction of its foundation, to detect and avoid clashes with the existing service pipes and cables. Engineer Foong's engineering solution allowed these existing underground services to co-exist with the Arc's piled foundation without costly and time-consuming works to divert them. Also, he modelled a three-dimensional sequence of the excavation works for the 16-m unbalanced slope such that the builders could complete them safely and systematically.

7. The Design and Engineering Safety Award winners will be recognised at the BCA Awards ceremony held on the evening of 29 May 2019 at the Resorts World Sentosa. Guest-of-Honour Minister of State for National Development and Manpower, Mr Zaqy Mohamad will present the award to the deserving winners during the ceremony.

Annex – BCA Design and Engineering Safety Award winners

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About BCA

The Building and Construction Authority (BCA) of Singapore champions the development of an excellent built environment for Singapore. BCA's mission is to shape a safe, high quality, sustainable and friendly built environment, as these are four key elements where BCA has a significant influence. In doing so, it aims to differentiate Singapore's built environment from those of other cities and contribute to a better quality of life for everyone in Singapore. Hence, its vision is to have "a future-ready built environment for Singapore". Together with its education arm, the

BCA Academy of the Built Environment, BCA works closely with its industry partners to develop skills and expertise that help shape a future-ready built environment for Singapore. For more information, visit www.bca.gov.sg.

DESIGN AND ENGINEERING SAFETY AWARD 2019

Commercial – Excellence

Frasers Tower

Qualified Person	**Er. Kam Mun Wai**
C&S Consultant	**Meinhardt (Singapore) Pte Ltd**
Builder	**Hyundai Engineering & Construction Co. Ltd**
Developer	**Frasers Property Singapore**
Architectural Consultant	**DP Architects Pte Ltd**

Challenges

- Iconic and slender high-rise tower with sloping façade
- Deep basement construction in highly variable Jurong Formation
- Close proximity to Telok Ayer Chinese Methodist Church (National Monument of Singapore), the Clift and Bangkok Bank Building
- Construction of underground pedestrian walkway to Tanjong Pagar MRT Station Underpass
- Congested site and access constraint in dense city centre

Solutions and Features

- Adoption of a robust, practical and yet cost-efficient Earth Retaining/Stabilising Structures (ERSS) comprising secant pile wall and semi-top down construction method to minimise wall deflection, ground movement and water drawdown. This had resulted in the safe execution of the 3-level basement construction, without adversely affecting the integrity of adjacent sensitive properties and structures.
- Sustainable raft foundation system with settlement-reducing piles for the high-rise tower and tension piles for the podium. The favourable ground stratum below the basement was strategically considered to provide support to the building

structure. Piles were introduced to reduce stress concentration and control settlements. The use of this innovative hybrid foundation system for a high-rise building had resulted in substantial time and cost savings compared to a conventional fully-piled foundation system.

- Flat plate system for basement and podium to facilitate semi-top down construction and enhance buildability and productivity
- Highly buildable, repetitive and standardised post-tensioned band beam system for the typical office floors enabling the adoption of light-weight table forms for faster construction
- Innovative, well-defined structural load paths and key structural elements design and detailing, taking into due consideration the gravity loads, high wind loads and additional horizontal forces as a result of the sloping columns and slenderness of the high-rise tower.
- Safe and practical top down method for the construction of the underground pedestrian walkway to Tanjong Pagar MRT Station Underpass, involving temporary traffic diversion of Telok Ayer Street and suspension of underground services.

DESIGN AND ENGINEERING SAFETY AWARD 2019

Institutional & Industrial – Excellence

THE ARC

Qualified Person	**Er. Aaron Foong Kit Kuen**
C&S Consultant	**KTP Consultants Pte Ltd**
Builder	**Lian Ho Lee Construction (Private) Limited**
Developer	**Nanyang Technological University**
Architectural Consultant	**DCA Architects Pte Ltd / KIRK**

Challenges

- Curvilinear building geometry within a 16m height sloping site surrounded by existing buildings on all sides

- Presence of multiple critical live underground services corridor overlapping directly with the building footprint

Solutions and Features

- Innovative Building Information Modelling (BIM) with Virtual Design and Construction (VDC) technology seamlessly implemented from design to construction achieving a safe and buildable structure-foundation outcome

- Elimination of intrusive services diversion by creatively engineering the co-location of building structures and services corridor by way of self-stabilising micropile groups foundation

- Design of a strutless excavation system with contiguous bored pile wall and removable ground anchor system to achieve safe and productive construction works within the high unbalanced slope

DESIGN AND ENGINEERING SAFETY AWARD 2019

Institutional & Industrial – Excellence

National Centre for Infectious Diseases and Centre for Healthcare Innovation

Qualified Person	**Er. Kam Mun Wai**
C&S Consultant	**Meinhardt (Singapore) Pte Ltd**
Builder	**Kajima Overseas Asia (Singapore) Pte. Ltd.**
Developer	**Ministry of Health**
Architectural Consultant	**CPG Consultants Pte. Ltd.**

Challenges

- Deep basement construction (up to 24m) in highly variable Jurong Formation
- Unbalanced excavation due to undulating ground terrain 15m across site
- Construction of 3 numbers of deep underpasses below Jalan Tan Tock Seng
- Erection of 3 bridges to provide inter-building connectivity to Tan Tock Seng Hospital and Lee Kong Chian (LKC) School of Medicine
- Close proximity to existing hospitals, LKC conservation building and surrounding residential developments
- Fast track programme

Solutions and Features

- Innovative and robust Earth Retaining/Stabilising Structures (ERSS) comprising contiguous bored pile wall and full top down construction method to minimise wall deflection, ground movement and water drawdown. This had resulted in the safe execution of the 4-level basement construction, without adversely affecting the integrity of adjacent sensitive properties and structures.

- Adoption of full top down method to enable excavation and superstructure construction concurrently due to the fast track programme

- Hybrid piled raft foundation system maximising the favourable ground condition resulting in time and cost savings to the foundation

- Flat slab system for basements to facilitate full top down construction and enhance buildability and productivity

- Highly buildable, repetitive and standardised semi-precast system with band beams and hollow core slabs for the superstructure, designed for future proofing

- Robust and practical Earth Retaining/Stabilising Structures (ERSS) system for the construction of the 3 underpasses, involving multi-staged road diversion of Jalan Tan Tock Seng.

- Light weight composite steel trusses with segmental and sequential erection enabling safe construction of the bridges over the busy Jalan Tock Seng Seng road.

DESIGN AND ENGINEERING SAFETY AWARD 2019

Institutional & Industrial – Excellence

My First Skool Large Childcare Centre at Punggol Dr

Qualified Person	**Er. Lauw Su Wee**
C&S Consultant	**LSW Consulting Engineers Pte. Ltd**
Builder	**Kwan Yong Construction Pte Ltd**
Developer	**NTUC First Campus Co-Operative Limited**
Architectural Consultant	**LAUD Architects Pte Ltd**

Challenges

- It is a fast track project aiming to deliver the building in one year for the operation of the new childcare centre in time;
- The building is of irregular shape, like two “seashell” pivoting around the centre point;
- The building also featuring a 12m height, curved glass façade supported by steel framing, at the back of each “seashell”;
- The client would like to have a more open space and lesser columns for flexibility and re-partitioning of the rooms in the near future;

Solutions and Features

- Full precast floor system with precast pre-tensioned rib beams and powerdek as left in formwork, such that the basic structure of the 2-story building with roof terrace was completed within 3 months;
- Long span (up to 18m) post-tensioned curve main beams was adopted, so as to give more column free space within the building;
- DfMA solution for the 12m height curve façade, with standardized and repetitive vertical and horizontal trusses, fabricated in the factory and assembled on site.

DESIGN AND ENGINEERING SAFETY AWARD 2019

Institutional and Industrial – Merit

Assisi Hospice

Qualified Person	**Er. Tan Wai Houng**
C&S Consultant	**Meinhardt (Singapore) Pte Ltd**
Builder	**Soil-Build (Pte). Ltd.**
Developer	**Assisi Hospice**
Architectural Consultant	**New Space Architects Pte Ltd**

Challenges

- Site has surrounding constraints with existing MRT Circle Line tunnels, Marymount Flyover, MacRitchie Viaduct, Thomson Road, Future MRT Thomson Line, Future North-South Expressway tunnels.
- Unbalanced excavation due to undulating ground terrain with 10 m difference next to existing Assisi Hospice.
- Long span link bridge connecting north and south of building, at 4th storey.

Solutions and Features

- Robust Earth Retaining Stabilising System (ERSS) comprising sheetpiles with partial excavation on 2 sides and secant bored piles on 2 sides, strutted to central basement structure / island. Analysis carried out incorporated movement limits by LTA. Detailed 2D and 3D finite element modelling was carried out systematically to analyse and design the SBP system.
- The robust ERSS minimises the impact of ground movement to neighbouring properties, including sensitive structures such as MRT Circle line tunnels, fly over viaduct structure and existing Mount Alvernia hospitals and Assisi Hospice structures. The use of SBP instead of conventional cut and cover method

mitigate the impact of ground movements, vibrations, existing structure movements etc.

- Repetitive flat plate structural system designed for typical ward levels, minimising floor-to-floor height, construction time, and enhancing site productivity and construction safety.

- Extensive coordination on routing of M&E services with ceiling spaces and provision of penetration through slabs and beams using BIM, and extensive collaboration of Consultants, Builder and Client throughout design and construction stages to meet Client requirements.

- Composite steel floor system for the link bridge to enhance buildability, productivity and safety in construction.

DESIGN AND ENGINEERING SAFETY AWARD 2019

Civil Engineering – Merit

Contract 1688- Construction of Station EW30 and Viaduct for Tuas West Extension

Qualified Person	**Er. Rengasamy Selvaraju**
C&S Consultant	**AECOM Singapore Pte Ltd**
Builder	**Shanghai Tunnel Engineering Co (Singapore) Pte Ltd**
Developer	**Land Transport Authority**
Architectural Consultant	**Aedas Pte Ltd**

Challenges

- 4 level Interchange Station above live 6-lane roadway (2 carriageways).
- Continuous long, 5 spans (53m-75m-75m-75-53m) with curved alignment at the crossing of Pan-Island Expressway along Tuas Road, where the rail viaduct will be constructed over live traffic.
- Construction of the rail viaduct that crosses over an existing road viaduct at Ayer Rajah Expressway at a height of 21m over busy live traffic.
- Limestone cavity encountered during construction of piling.

Solutions and Features

- Main RC frames cast-in-situ every 25m to piled foundations and PSPC girders as main floor elements between frames. Use of PC planks / metal decking between PSPC beams. The roof is a steel diagrid modular truss system erected on site. Many stages of traffic diversions carried out to construct foundations and use of lifting equipment where necessary.

- Using the balance cantilever method over the live Pan-Island Expressway with the segmental post tensioned precast beams across. This Method adjusts for changes in pier distances and suitable for curved spans. Also, the system minimises construction and footprint over live traffic and Work can be staged to suit ongoing traffic conditions.

- The span-by-span technique is employed to construct the rail viaduct over an existing road viaduct at Ayer Rajah Expressway. The beams were launched at 21m above ground at 36m long span and maintaining a safe working environment at height with no impact on the AYE

- Additional probing has been carried out at every pile proposed at the cavity prone location to ensure the cavity depth from ground level and the pile design was revised accordingly. Permeant casing are provided from ground level and terminate below 500mm from the bottom of cavity.