MEDIA RELEASE

BCA HONOURS TEN ENGINEERS FOR THEIR ENGINEERING ACHIEVEMENTS

- Awards for six Professional Engineers in recognition of their excellence in engineering solutions which led to the safe implementation of their projects; while four others received Merits

Singapore, 10 May 2018 – For their excellent and safe engineering solutions in Singapore's built environment, ten Professional Engineers were recognised in this year's Building and Construction Authority (BCA) Design and Engineering Safety Excellence Awards 2018. Six of them will receive the top honour for overcoming project and site challenges with their resourceful and safe engineering designs and construction.

2. Commenting on this year's award winners, BCA Group Director (Building Engineering) Engineer Chew Keat Chuan said, "We are commending ten Professional Engineers who have displayed great skill and professionalism in overcoming engineering challenges and bringing their projects to completion safely. Their accomplishments underscore the importance of engineering careers in Singapore and demonstrate good opportunities are available for aspiring Singaporeans who wish to pursue engineering careers in the Built Environment."

3. Award winner, Engineer Lai Huen Poh from RSP Architects Planners & Engineers (Pte) Ltd was faced with the challenge of not only having to complete the iconic Changi Airport Terminal 4 (T4) in 30 months but also deal with the urgent

need to complete part of the 1st and 2nd storey floors within 12 months to allow other subcontractors to start their works to meet the project's deadline. Engineer Lai realised early on that construction productivity would be key for the timely completion of the project and therefore made plans to have most of the T4's structure prefabricated offsite, then transported and assembled onsite.

4. In addition, Terminal 4's 21 gangways also had to be prefabricated offsite and assembled onsite – two at a time and without any welding works – because they were located just metres away from where aircrafts were parked at the airport. Engineer Lai also worked closely with the project team which suggested and implemented a unique "Hat First" construction method for the main Terminal 4 building. The roof "Hat" was completed ahead of the floors below from the "middle out". This provided a safe and conducive working environment for early commencement of finishing and services works as well as early installation of the airport's Baggage Handling System.

5. Another engineering feat by Engineer Lai was the use of long steel roof trusses to support the roof of T4's departure halls to meet the design requirements of a visually appealing, column-free hall.

6. Another two Award winners, Engineers Tan Yoong Heng and Cheryl Lee, were faced with the challenge of constructing the Downtown Line underground tracks under the Singapore River, historical buildings such as the National Museum, through the Fort Canning Hill, and a narrow strip of land between two HDB blocks and the State Court. An added complexity was the need to ensure that underground construction works near Bras Basah did not affect the integrity of three existing MRT lines – the Circle Line, North East Line and North South Line.

7. A notable engineering feat by Engineers Tan and Lee included the removal of the embankments and temporary diversion of the Singapore River for two years to

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facilitate of the construction MRT tunnels running from Chinatown to Fort Canning. They also used a 3D modelling and analysis of the historical National Museum's existing foundations to ensure that the construction works would not have an impact on its structure. As a result of their efforts, thousands of Downtown Line commuters now enjoy a safe ten-minute ride between Chinatown, Fort Canning and Bencoolen stations. Their journey would take them safely through tunnels that, at some parts, are less than a metre from the foundations of nearby buildings.

8. The ten award winners for the Design and Engineering Safety Excellence and Awards will be recognised at the annual BCA Awards Night held on the evening of 22 May 2018 at the Resorts World Sentosa. Minister for Social and Family Development and Second Minister for National Development, Mr. Desmond Lee will be gracing the ceremony as the Guest-of-honour.

Factsheets:

Annex A – About the BCA Design Engineering and Safety Excellence Awards 2018

Annex B – BCA Design Engineering and Safety Excellence Awards winners

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Issued by the Building and Construction Authority on 10 May 2018

About Building and Construction Authority

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, 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.

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ABOUT THE BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD

The BCA Design and Engineering Safety Excellence Award recognises the efforts of Qualified Persons (Professional Engineers) for structural works, their 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 categories are:

- Residential
- Commercial
- Institutional & Industrial
- Civil Engineering
- Small-scale projects (Project cost is less than S$30 million)
- Overseas

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

2018 Winners

	Qualified Persons (Professional Engineers)	Category	Project
1	Engineer Lai Huen Poh	Award - Institutional & Industrial	Changi Airport Terminal 4
2	Engineer Tan Yoong Heng	Award - Civil Engineering (joint winners)	DTL3 C937 Fort Canning Station and Associated Tunnels
3	Engineer Cheryl Lee Zi Du		
4	Engineer Chia Wah Kam	Award – Commercial (joint winners)	Tanjong Pagar Centre
5	Engineer Jason Tan Bok Leng		
6	Engineer Teh Hee Seang	Award - Institutional & Industrial	The Wave
7	Engineer Foo See Lim	Merit - Civil Engineering	i. C922 - Construction and Completion of Expo Station for DTL3 ii. D&B Entrance C and D at DTL3 Tampines East Station
8	Engineer Leong Meng Sun	Merit - Institutional & Industrial	National Gallery Singapore
9	Engineer Kam Mun Wai	Merit - Institutional & Industrial (for (i)) and Residential (for (ii))	i. Sengkang General Hospital ii. Watertown & Waterway Point
10	Engineer Dr. Shahzad Nasim	Merit - Residential	The Venue Residences & Shoppes

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Award Institutional & Industrial
Changi Airport Terminal 4

Qualified Person

Er. Lai Huen Poh

C&S Consultant

RSP Architects Planners & Engineers (Pte) Ltd

Builder

Takenaka Corporation

Developer

Changi Airport Group (Singapore) Pte Ltd

Architectural Consultant

SAA Architects Pte Ltd

Challenges

- Tight design and construction schedule for construction of 5 blocks of buildings and airport facilities within 37 months.
- 60m large span roof structure at Departure Check- in Counter area with 18.5m cantilever roof at Departure Kerbside and massive transfer trusses at the Arrival Immigration Hall to achieve spatial and column free environment.
- Proposed Finger Pier and 21 numbers of Fixed Gangway structures located within Airside with live aircraft parking stands designed and implemented to comply with requirements of strict security clearance and airside operational needs.

Solutions and Features

- Adopting Building Information Modelling (BIM) and prefabricated volumetric design and construction.
- Full Precast System Approach with use of Advanced Precast Mechanical beam shoe Connectors. Precast Beams and Planks designed for both temporary and permanent stage loads to eliminate the necessity of 9m high scaffoldings and props.
- The use of repetitive simple plane frame steel roof trusses with secondary beam system simplifies detailing and allows for off-site prefabrication to speed up erection and work proceed simultaneously. Innovative addition of "knee brace" between trusses at roof level provides the lateral restraint for continuous truss bottom chord in compression at supports.

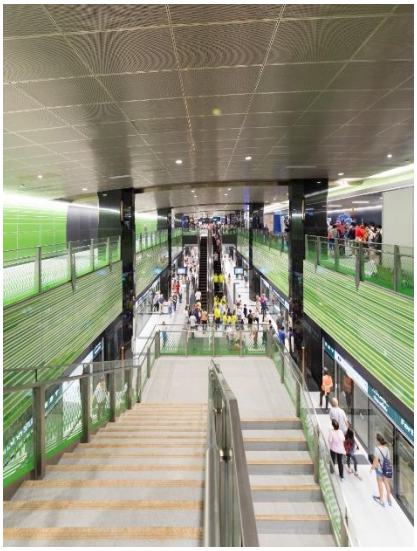
BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

- Used Innovative and game -changing Advanced L2 and Hat First Construction Methodology implemented by Takenaka Corporation.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Award Civil Engineering

Downtown Line 3 Contract 937 Fort Canning Station and Associated Tunnels



Qualified Person

Er. Tan Yoong Heng

Er. Cheryl Lee Zi Du

C&S Consultant

Arup Singapore Pte Ltd

Builder

GS Engineering & Construction Corporation

Developer

Land Transport Authority

Architectural Consultant

Aedas Pte Ltd

Challenges

- Contract 937 - Fort Canning station and associated tunnels was constructed within a very dense and congested urban network, and avoiding impact to it was critical to the project's success.
- The key challenges included the temporary diversion of the Singapore River, tunnel construction overcrossing/undercrossing of existing MRT lines at minimal clearances; and tunnelling in very close proximity to numerous existing underground structures.

Solutions and Features

- An innovative, first-of-its kind temporary diversion of the Singapore River was designed to facilitate removal of all underground obstructions well in advance so as to reduce construction risk during tunnelling works.
- As opposed to creating standalone structures for cripple sidings on a separate land parcel, Arup developed an innovative and cost-effective solution by locating them within the station box. This overcomes space constraints in a congested area, and avoided the need for extensive construction within Fort Canning Park.
- Value engineering resulted in the design of a shallower station which translated into enhancing the overall safety and productivity of the project.
- A stringent tunnelling regime applying tight volume loss controls and real-time monitoring was implemented during tunnel construction.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Award Commercial
Tanjong Pagar Centre

Qualified Person

Er. Chia Wah Kam

Er. Jason Tan Bok Leng

C&S Consultant

Arup Singapore Pte Ltd

Builder

Samsung C&T Corporation Singapore

Developer

GuocoLand Group

Architectural Consultant

Skidmore, Owings & Merrill LLP

Architects 61 Pte Ltd

Challenges

- Tanjong Pagar Centre, one of the tallest buildings in Singapore, is a vibrant mixed-use development that stands at 290m.
- The development sits on a congested site bounded by a few roads, the busy Tanjong Pagar MRT station and a number of other historic shophouses.
- The tall, slender and inclined building geometry exerts opposing forces at different levels, posing unique engineering challenges.

Solutions and Features

- A top-down construction approach was adopted so that the progress of superstructures was advanced within a robust design of temporary supports and sequence of works. This allowed the optimisation of basement construction which translated to time and cost savings.
- To work around the challenge of space constraints, steel was adopted for the office podium and basement structures - an unusual but practical solution to achieve speed and ease of construction.
- Pre-setting was done to take into account the building's movement, overcoming the inclined building geometry.
- At the upper levels where the building transits from office to residential space, an innovative transfer and belt-truss system was designed to achieve stability of the overall tower structure.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Award Institutional & Industrial

The Wave

Qualified Person

Er. Teh Hee Seang

C&S Consultant

T.Y.LIN International Pte. Ltd.

Builder

B19 Technologies Pte Ltd

Developer

Nanyang Technological University

Architectural Consultant

Sembcorp Architects & Engineers Pte Ltd/ Toyo Ito & Associates, Architect

Challenges

- Singapore's first large-scale Mass Engineered Timber Building.
- Huge timber arched roof that spans 72 m is amongst the world's longest span of its kind.
- Familiarity with design codes for engineered timber products.

Solutions and Features

- Use of innovative and sustainable glulam and cross-laminated timber (CLT) which has high strength-to-weight ratio.
- Choice of 3-pin arched roof beams enable construction without scaffolding and in short period. This result in a safe and fast construction method.
- Simplicity for construction due to high level of prefabrication and minimum waste as the timbers are precision cut at factory and delivered to site.
- Systematic and coordinated approach to research and understand the fundamental technical characteristic and behaviour of timber, consultations with the regulating agencies and technical committee to achieve safe and acceptable design solutions.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Merit Civil Engineering
C922 - Construction and Completion of Expo Station for DTL3

Qualified Person

Er. Foo See Lim

C&S Consultant

Meinhardt Infrastructure Pte Ltd

Builder

Samsung C & T Corporation Singapore

Developer

Land Transport Authority

Architectural Consultant

GreenhilLi Pte Ltd

Challenges

- The Interchange Station is located underneath a T-Junction at Expo Drive and Changi South Ave 1. It is undercrossing the existing East-West Line (Changi Airport Branch) viaduct perpendicularly and causing impact on the existing MRT structure to a large extent.
- Station construction was obstructed by the existing piles of EWL piers. New foundation system had to be introduced to transfer the existing structural loads prior to construction.
- There were existing EWL piers with short pile length within the influence zone. Strengthening the pile group was required to withstand additional forces and deflection induced by deep excavation.

Solutions and features

- The design used the concept of "Strengthening in advance of undermining". Construction sequence was set to follow the design strictly.
- New foundation member was designed and installed to competent soil stratum to resist forces induced by excavation as well as imposed loads from the new and existing MRT structures.
- Transfer beam was constructed below existing pilecap to facilitate preloading to warrant load transfer is effective before proceeding with deeper excavation.
- Incremental deformation of the affected MRT structures was predicted at every stage of excavation. The prediction was used to assess the structural performance by real time monitoring.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Merit Civil Engineering
D&B Entrance C and D at DTL3 Tampines East Station

Qualified Person

Er. Foo See Lim

C&S Consultant

Meinhardt Infrastructure Pte Ltd

Builder

GS Engineering & Construction Corp.

Developer

Land Transport Authority

Architectural Consultant

ONG&ONG Pte Ltd

Challenges

- Entrance C & D undercrossing road junction at the intersection of Tampines Ave 2 and Tampines Ave 9 were added at the halfway mark of construction.
- There are numerous underground utilities clashing with the original tunnel ERSS. These critical utilities need to be protected during excavation.

Solutions and features

- Mining method was introduced to construct the alternative T-shaped subway instead of the conventional braced excavation method which is time-consuming and involving massive traffic and utility diversions.
- The mining tunnel was formed by a series of interlocking steel pipe installed by micro-tunnelling technology. It was optimised to have steel pipes on three sides and precast concrete footing at the base.
- The excavation within tunnel was facilitated by temporary steel frames at regular spacing based on modular design. The overall construction time was reduced significantly with excavation taking place from both ends of the tunnel.
- Sequential block casting of the reinforced concrete lining was carried out to ease the retrieval of temporary steel frames prior to sealing off the construction joints.
- Incremental deformation of the affected MRT structures was predicted at every stage of excavation. The prediction was used to assess the structural performance by real time monitoring.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Merit Institutional & Industrial
National Gallery Singapore

Qualified Person

Er. Leong Meng Sun

C&S Consultant

CPG Consultants Pte Ltd

Builder

Takenaka-Singapore Piling Joint Venture

Developer

National Gallery Singapore

Architectural Consultant

CPG Consultants Pte Ltd & Studio Milou, Singapore

Challenges and solutions

- Retain & protect existing decorative façade walls (24m high free-standing walls after demolition).
- Excavate & construct the 16m deep basement structures, within the building perimeter and in very close proximity to the preserved façade.
- Suspend entire existing structures (CH Chamber) at the 3rd storey with its columns removed below; while excavating and constructing the basement beneath these preserved structures.

Solutions and features

- Underpin conserved structures with a network of needle beams, underpinning beams and micropile foundation.
- Install a stabilising shoring system to hold up the 24m tall free-standing façade walls after demolition works. Top-down construction utilised together with a stiff diaphragm wall to minimise movement of the basement retaining walls.
- Very detailed construction sequence need to be worked out between the structural engineer and contractor to ensure that the robustness and stability of the preserved and conserved structures.
- Transfer structures installed to support the elevated and preserved CH Chamber with jacks and pre-loading applied to ensure proper load transfer.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Merit Institutional & Industrial
Sengkang General Hospital

Qualified Person

Er. Kam Mun Wai

C&S Consultant

Meinhardt (Singapore) Pte Ltd

Builder

Penta-Ocean Construction Co., Ltd

Developer

Ministry of Health

Architectural Consultant

DP Architects Pte Ltd

Challenges and solutions

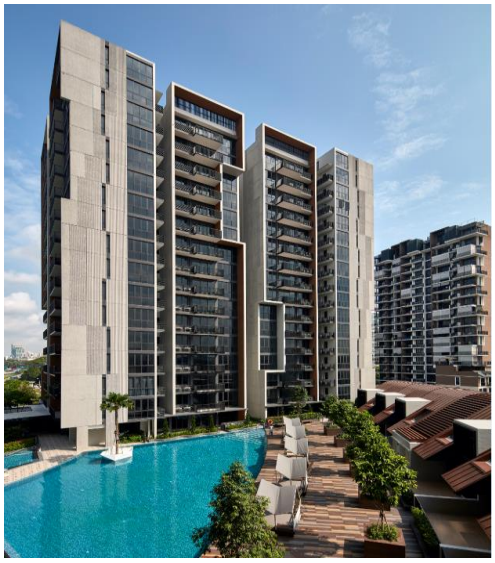
- Deep excavation of 12m in poor ground condition.
- Congested surrounding, access constraints and close proximity to Cheng Lim LRT station & viaducts, public housing and schools, widening of existing roads along Sengkang East Road, Sengkang East Way & Anchorvale Street.
- Low floor-to-floor height due to AMSL limit.

Solutions and features

- Innovative hybrid retaining wall system of diaphragm wall and secant pile wall to overcome difficult ground conditions, better control of ground movements and yet offer an overall cost-effective design.
- With careful planning, integration of temporary construction access and storage into ERSS design that enabled smooth uninterrupted access, excavation and earth disposal.
- Flat slab system provides high flexibility for routing of M&E services and maximises headroom in an otherwise very low floor-to-floor height.
- Innovative beam stitching technique for the LRT link bridges enabling uninterrupted access for commuters using the LRT.
- Extensive use of prefabrication where possible.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Merit Residential
The Venue Residences & Shoppes



Qualified Person

Er. Dr. Shahzad Nasim

C&S Consultant

Meinhardt (Singapore) Pte Ltd

Builder

Dragages (S) Pte Ltd

Developer

Crescent View Development Pte Ltd (JV between CDL and Hong Leong Holdings Limited)

Architectural Consultant

Aedas Pte Ltd

Challenges and solutions

- Very congested site next to heavy-traffic along Upper Serangoon Road, Macpherson Road and PIE, and in close proximity to sensitive shop houses, next to MRT tunnels, DTSS tunnels etc.
- Poor ground conditions with soft marine clay.
- Building foundation and basement structures had to be designed to safeguard adjacent existing sensitive shop houses, DTSS tunnels, MRT tunnels, Road Tunnels, Expressway bridge etc.

Solutions and features

- Innovative development and use of Peanut shaped self-supporting Strut free Diaphragm Wall Retention System for 3 level Basement Excavation and Construction.
- Extensive use of Precast Beam, Slab, Wall Systems and integrating façade Reckli finishes with Precast RC wall.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2018 WINNERS

Merit Residential
Watertown & Waterway Point

Qualified Person

Er. Kam Mun Wai

C&S Consultant

Meinhardt (Singapore) Pte Ltd

Builder

Hyundai Engineering & Construction Co Ltd

Developer

Emerald Star Pte Ltd and

FC Retail Trustee Pte Ltd

Architectural Consultant

RSP Architects Planners & Engineers (Pte) Ltd

Challenges and solutions

- Deep basement excavation of more than 20m in poor ground conditions.
- Undulating ground terrain resulting in unbalanced excavation on 3 sides of the development. The level difference is in excess of 15m.
- Integration with an existing cantilevered diaphragm wall that was constructed to facilitate the excavation for the waterway.

Solutions and fearures

- The Earth Retaining / Stabilising System (ERSS) adopted for the unbalanced excavation comprised a hybrid of diaphragm wall and secant pile wall. Diaphragm walls formed an effective resistance and transfer of the unbalanced lateral loads to the ground. The diaphragm walls not only act as a retaining wall, it also provide shear walls to resist and transfer the lateral loads to the ground.
- Cross diaphragm walls were introduced along strategic locations in the basement to transfer the lateral loads due to lack of passive resistance from the waterway. They were also designed as load bearing foundation elements to support the retail and residential structure above.
- Localised ground improvement was carried out where Kallang Formation was encountered to improve the soil shear strength and stiffness to better control ground movements.