MEDIA RELEASE

BCA AWARDS SIX ENGINEERS FOR THEIR ENGINEERING FEATS

- Engineers Aaron Foong of KTP Consultants and Kam Mun Wai of Meinhardt (Singapore) Pte Ltd received top awards for creative engineering solutions for their projects which were implemented safely while three other Professional Engineers received merit awards

Singapore, 29 May 2017 – The Building and Construction Authority (BCA) is awarding this year's BCA Design and Engineering Safety Excellence Awards to six Professional Engineers. Of these six Professional Engineers, three of them bagged the top award for their ingenious engineering solutions which overcome project challenges for safe designs and construction.

2. Commenting on this year's Award winners, BCA Group Director (Building Engineering) Engineer Chew Keat Chuan said, "By building taller and deeper in Singapore's densely built-up environment, engineers will have to continually change the way we build by using innovative, practical and safe solutions to overcome challenges such as site constraints and unique design features. Their work involves being creative, resourceful and passionate about using the skills and 'tools' they have to achieve outstanding feats in their engineering design and safety during construction. This year's Award confers recognition on six Professional Engineers who made exemplary contributions, not only to our built environment but also their profession."

Two exemplary award winners

3. Having to deal with difficult ground conditions and space constraints as well as foundation piles left behind by a demolished building, Engineer Aaron Foong had to devise engineering solutions for The Scotts Tower project. Adding on to his challenge was the site's close proximity (less than 9 metres away) to two underground MRT tunnels and the architectural requirement for columns – that will support all of the building's 30 floors above it – to be slanted.

4. In dealing with the difficult ground conditions, Engineer Foong adopted a robust and creative setup that enables two ring walls (inner and outer) to be installed concurrently, allowing excavation work to start once the inner ring is completed. He also used advanced computer software to simulate ground movements during construction so that he could determine the thickness of the walls, keeping any ground movements affecting the two MRT tunnels to a safe limit.

5. The architectural requirement for the slanted columns is an iconic feature of this development. Engineer Foong devised a clever "outrigger" structure that transfers part of the building's weight to its central core (which comprises lift shafts and staircases [see image on the next page]). While it is an important structural element of the building, Engineer Foong worked closely with the architect so that the outrigger structure becomes an aesthetic feature of the building.

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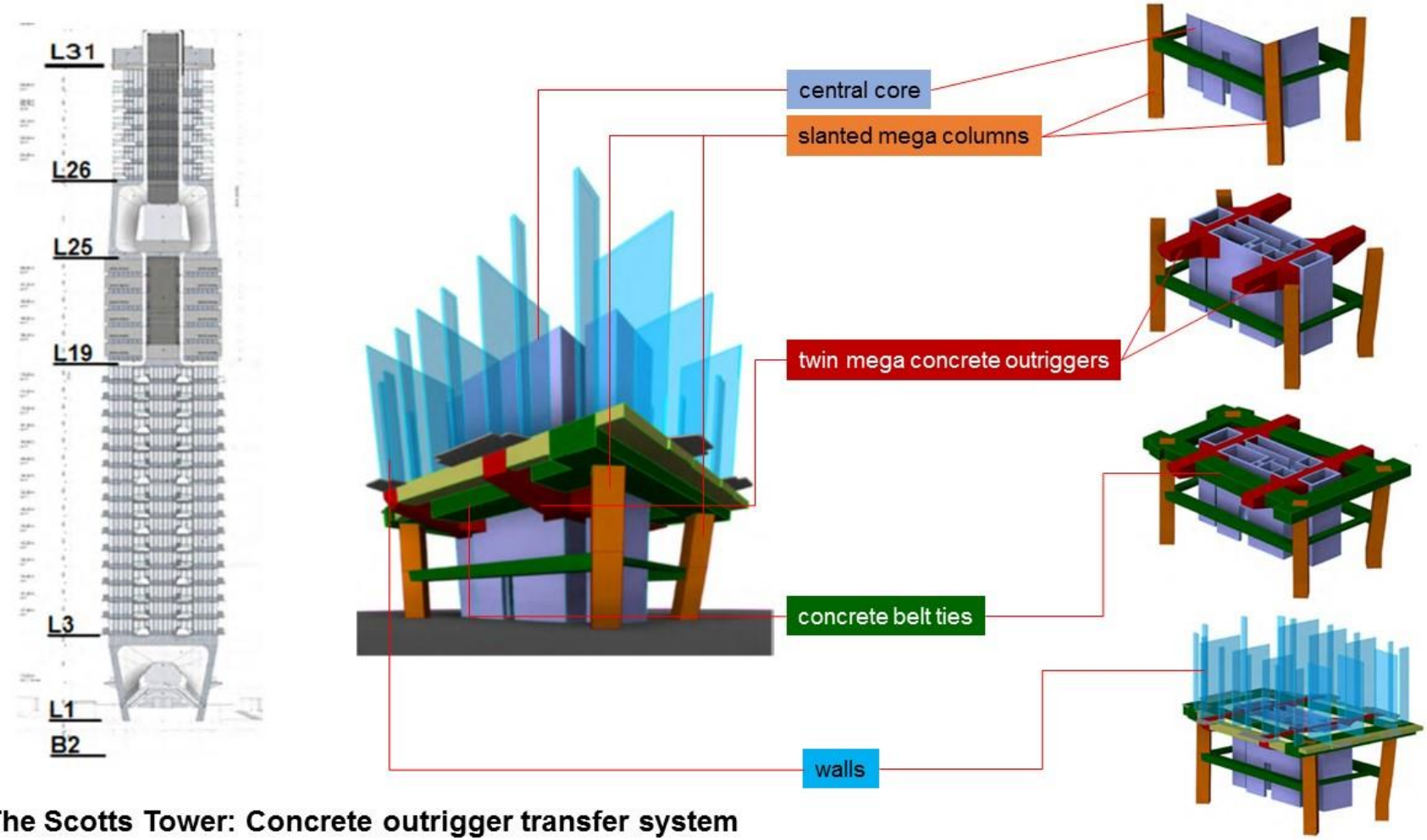

The Scotts Tower: Concrete outrigger transfer system

6. Another winner, Engineer Kam Mun Wai, was recognised for his project, the six-storey Singapore Management University School of Law, which houses the Kwa Geok Choo Law Library and David Marshall Moot Court. Its main structure comprises primary and secondary mega trusses made of structural steel, stacked on top of one another in orthogonal directions to provide a large space with no obstructing columns.

7. Today, part of the mega structure becomes part of the exposed architectural element that line part of the building's underground function hall. To ensure safe and productive excavation of up to 20m deep in difficult and variable ground conditions, rigid, contiguous piles of varying diameters form the "wall" of this development, resisting the lateral forces from the ground around it. With careful planning, the use of the mega trusses enabled excavation and construction to be carried out independently and concurrently over three zones across the site. Engineer Kam used these engineering solutions because of its proximity to conservation buildings (including pre-war shophouses), heritage trees and the Fort Canning Tunnel in the area.

8. The BCA Design and Engineering Safety Excellence Awards recognises Professional Engineers and their teams for their innovative design processes and solutions in overcoming project challenges.

9. The BCA Awards ceremony will be held on the evening of 13 June 2017 at the Resorts World Sentosa. The Minister of for National Development and Second Minister of for Finance Mr. Lawrence Wong will be gracing the ceremony as the Guest-of-Honour.

Factsheets:

Annex A – About the BCA Design Engineering and Safety Excellence Awards 2017

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Annex B – BCA Design Engineering and Safety Excellence Awards winners

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Issued by the Building and Construction Authority on 29 May 2017

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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, his 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
- Overseas

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

2017 Winners: At a glance

	Project	Category	Award	Qualified Person (Professional Engineer)
1	The Scotts Tower	Residential	Award	Engineer Aaron Foong Kit Kuen
2	H_2O Residences	Residential	Merit	Engineer Lauw Su Wee
3	SBF Center	Commercial	Award	Engineer Allan Teo Kok Jin
4	Galaxis	Commercial	Merit	Engineer Foo See Lim
5	NUS AS8	Institutional & Industrial	Award	Engineer Aaron Foong Kit Kuen
6	Singapore Management University School of Law	Institutional & Industrial	Award	Engineer Kam Mun Wai
7	Grace Assembly of God Church	Institutional & Industrial	Merit	Engineer Lauw Su Wee
8	Intra-Island Cableway at Sentosa Island	Civil Engineering	Merit	Engineer Lai Huen Poh

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Award Residential
The Scotts Tower

Qualified Person

Engineer Aaron Foong Kit Kuen

C&S Consultant

KTP Consultants Pte Ltd

Builder

Daewoo Engineering & Construction Co. Ltd

Developer

Far East Organization

Architectural Consultant

ONG&ONG Pte Ltd

Challenges

- The construction of the two levels of basement within the 10m depth of unfavourable soil conditions situated on the LTA MRT protection zone.
- The iconic high rise tower has a challenging geometry demanding a column-free volume spanning a maximum of 33m at Level 2 sky lobby periphery which truncates the vertical supports from all the thirty (30) floors of superstructure floors above it.
- The tower carries highly concentrated loads from inclined mega columns and central spine corewalls that are to be supported by a second generation foundation within a limited footprint shared with the abandoned foundation from the former Cairnhill Towers.

Solutions and features

- Dual-Ring earth retaining wall with a single layer of temporary steel strutting was designed to allow the tower construction to progress concurrently with the podium basement excavation with minimal obstruction for the soft marine clay removal and safeguarding the MRT tunnels along Scotts Road.
- A robust “outrigger” transfer system mobilising the high stiffness central corewalls spine with a pair of splayed balanced cantilever fin beams with secondary tie beams on four (4) inclined mega columns for optimised structural efficiency with high redundancy in load paths.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

- High capacity large diameter bored piles with base grouting enhanced the end bearing performance while optimising the tower foundation footprint intake.

Merit Residential
H_2O Residences

Qualified Person

Engineer Lauw Su Wee

C&S Consultant

LSW Consulting Engineers Pte Ltd

Builder

Woh Hup (Private) Limited

Developer

Impac Holdings Pte Ltd

Architectural Consultant

DP Architects Pte Ltd

Challenges and solutions

- The excavation works for the basement construction was a challenge as there are inherent unfavourable soil conditions. The excavation depth for two basements was 7m and the project locality is beside Layar LRT Station. The challenge is to construct the basement without affecting Layar LRT Station and the rail structures.
- Complex earth retaining or stabilising structure (ERSS) incorporates ground improvement with deep cement mixing method to stabilise the base and secant piles wall as temporary wall during construction and permanent wall upon completion of basement walls.
- Transfer Beams with upstand walls to function as a services corridor to be prevent any honeycombing or reinforcement congestions within the Transfer Beam which are a critical structures.
- The use of Precast Structures such as prefabricated bathroom units and toilet slabs allow for works being able to be done in parallel reduces construction time.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Award Commercial
SBF Center

Qualified Person

Engineer Allan Teo Kok Jin

C&S Consultant

KTP Consultants Pte Ltd

Builder

Woh Hup (Private) Limited

Developer

Far East Organization and Far East Orchard Limited

Architectural Consultant

DP Architects Pte Ltd

Challenges

- The development is located within the First Reserved Line of East-West Line MRT tunnel and in close proximity with adjoining structures of various services and buildings. It is one of the many slender buildings in Singapore Central Business District with tower height of 184m, floor plan width of only 20.2m and a slenderness ratio of 9.1.
- Differences between office (tower) and medical suite (podium) layout and column setting out plans due to different floor usage requirements.
- Pile raft foundation supporting the 31-storey office tower requires casting of thick RC (reinforced concrete) foundation which may create large cross-sectional temperature differential due to heat of hydration.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Solutions and features

- Top-down construction with secant bored pile wall system were adopted as the earth retaining and stabilising structure (ERSS) to minimise impacts and hazards to the neighbouring structures. Secant bored pile wall provides water tightness while constructed reinforced concrete slab possess greater stiffness as struts to the retaining secant bored pile wall.
- Transfer floor with long span transfer beams system was introduced at the intersection between office and medical suite floors to transfer loadings from different setting out of column positions.
- Main lateral load resistance system of the structure is provided by the tower lift core and gable end walls. The overturning moment acting on the building is resisted by a "push and pull" coupling effects generated by compression and decompression in the walls which minimises building sway and reduces accelerations under wind loads to acceptable levels for occupant comfort.
- A Adiabatic Temperature Rise test was conducted prior to actual casting of the thick reinforced concrete foundation to forecast the cross-sectional temperature differential. Data obtained from the tests are then used to carry out studies in minimising the risk of thermal cracking during construction.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Merit Commercial

Galaxis

Qualified Person

Engineer Foo See Lim

C&S Consultant

Meinhardt Infrastructure Pte Ltd

Builder

Singapore Engineering & Construction Pte Ltd

Developer

Ascendas Fusion 5 Pte Ltd

Architectural Consultant

Aedas Pte Ltd

Challenges and solutions

- Construction was within LTA's railway protection zone. One of the office blocks is supported on MRT station structure and there is connection to the station concourse by a pair of escalators through the deep basement wall.
- Design aimed to achieve seamless connectivity to surrounding buildings via underground linkways and elevated bridges. There was no disruption to commuters and business operations during construction.
- Unique building profiles of slanting and curving edges are integrated with long span structural system.
- Rigorous analysis and checking on interface requirements were performed to ensure no intolerable impact to adjacent structures.
- Physical connection to MRT station was done after the external hull completion under a fully-secured environment.
- Structural system was developed in conjunction with the contractor's core business and expertise for safe and quality works.
- Careful curtailment of structures was carried out to overcome temporary construction loads and permanent lateral sway caused by asymmetrical building layout.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Award Institutional & Industrial
NUS AS8

Qualified Person

Engineer Aaron Foong Kit Kuen

C&S Consultant

KTP Consultants Pte Ltd

Builder

Ken-Pal (S) Pte Ltd

Developer

National University of Singapore

Architectural Consultant

Architects 61 Pte Ltd

Challenges

- Building setting out being wrapped within an unbalanced slope height of 16.5m with left-in underground obstructions from the former admin block.
- Permanent lateral earth loads to this highly permeable building posed challenge to load path continuity.
- The undulating variation of soil geology across the site from weak residual consolidating soil to weathered hard siltstone poses potential long term differential settlement on the building.

Solutions and features

- Adoption of earth retaining and stabilising structures consisting of contiguous bored pile restrained by three (3) layers of removable ground anchor to achieve a strutless excavation depth of 16.5m in a safe manner.
- Rigorous design and robust detailing of a highly buildable structural frame to resist the locked-in lateral earth loads from the slope while achieving the architectural intent of discontinuity in space volumes
- A hybrid of piling and ground bearing raft foundation was adopted with double-prong solution in eliminating the constraints of existing left-in underground pile obstruction to free up the flexibility of new superstructure column placement and addressing the potential excessive structure settlement due to pockets of consolidating soil.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Award Institutional & Industrial
Singapore Management University School of Law

Qualified Person

Engineer Kam Mun Wai

C&S Consultant

Meinhardt (Singapore) Pte Ltd

Builder

Kajima Overseas Asia Pte Ltd

Developer

Singapore Management University

Architectural Consultant

MKPL Architects Pte Ltd

Challenges

- Deep excavation carried out in undulating site terrain, resulting in unbalanced excavation work and forces, in close proximity to conservation shophouses, the Fort Canning Tunnel, Peranakan Museum (a national monument) and heritage trees.
- Highly variable ground conditions with Fort Canning Boulder Bed with buried box drain across middle of the site requiring permanent drainage diversion
- Restricted building average mean sea level with very tight floor-to-floor height constraint
- Design requirement for long-span column-free function hall at Basement 1 with seminar rooms and teaching facilities above.
- Iconic law library dome, and cantilevered box structure overseeing Armenian Street.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Solutions and features

- Robust earth retaining or stabilising structure (ERSS) adopting cost effective contiguous bored pile wall and semi-top down construction. The ERSS design, coupled with a well-planned sequence and methodology, enabled substructure excavation and construction independently over three zones across the site. Real time automatic monitoring of movement in Fort Canning Tunnel for safety and improved productivity.
- Innovative and cost-efficient vertical stacking of primary and secondary warren trusses with composite steel floor decking from the second storey to the roof to provide column-free double volume space over B1 function hall. The warren trusses span 33.6m across the function hall. The trusses are fully coordinated and integrated with the architecture, school programming, as well as incorporating mechanical, electrical and plumbing services within the tight ceiling space. The warren trusses and composite steel framing were prefabricated off-site, assembled and lifted into position on site.
- Highly-buildable and efficient structural systems for other areas, to complement iconic architectural expressions.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Merit Institutional & Industrial
Grace Assembly of God Church

Qualified Person

Engineer Lauw Su Wee

C&S Consultant

LSW Consulting Engineers Pte Ltd

Builder

Gammon Pte. Limited.

Developer

Grace Assembly of God

Architectural Consultant

LAUD Architects Pte. Ltd

Challenges and solutions

- To conduct deep excavation in a closely built-up area with irregular basement layout and difficult ground condition. Various "column free" service halls and car park at 1st, 2nd and 3rd storey require long span structure solutions. Multi-storey transfer is required due to different floor layouts.
- "Strut free" semi-top down excavation with secant bored pile wall as retaining wall and perimeter of the basement slab as horizontal support; the 3-basement excavation was completed in four months.
- Two-way post-tensioned waffles slabs with only 750mm depth for maximum floor plate the size of 34m x 38m with minimum column/wall supports at the perimeter.
- 38m span composite trusses allow for a "column" free service hall; the nine composite trusses were fabricated off-site, while on-site assembling and erection only took three days.

BCA DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS 2017 WINNERS

Merit Civil Engineering
Intra-Island Cableway at Sentosa Island

Qualified Person

Engineer Lai Huen Poh

C&S Consultant

RSP Architects Planners & Engineers (Pte) Ltd

Builder

Gammon Pte. Limited

Developer

Sentosa Development Corporation

Architectural Consultant

RSP Architects Planners & Engineers (Pte) Ltd

Challenges and solutions

- To lay out and site of the three cableway stations and eight cableway towers within an established forested environment with considerations for site access, construction and future operational requirements. To resolve the cableway loads in various load combinations with efficiency of transferring these loads with coherent engineering and innovative and efficient use of intrinsic structural materials to achieve the building geometry with the required robustness, durability and sustainability.
- The building structure of the stations and towers were planned to respond to site topographies to optimise cut-and-fill, thus minimising soil disposal. Efficient use of contiguous bored pile walls, adopted as retaining structures to reduce cutting into the existing lush terrain and hill slope, minimising destruction and disturbance of the natural forest habitat. A balanced and innovative use and adoption of reinforced concrete with structural steel to achieve mass and robustness and integrating this to achieve the space and geometry unique to this building typology.
- The outcome is the maximum preservation of an established natural habitat and the integration of cableway structural elements within the elegant form envisioned by the architect and embraced by all stakeholders. An outcome safely and economically executed and implemented.