



BCA AWARDS 2016

Recognising Excellence in the Built Environment

Building and Construction  Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.



Design and Engineering Safety Excellence Awards

THE BCA DESIGN & ENGINEERING SAFETY EXCELLENCE AWARDS 2016 gives recognition to the Qualified Person for Structural Works [QP(ST)], QP(ST)'s firm and the project team for ingenious design processes and solutions in overcoming project challenges to ensure safety in design, construction and maintenance of building and civil engineering projects locally and overseas.

The Awards aim to:-

- a. inculcate a strong safety culture among building professionals in developing our built environment
- b. give recognition to QP(ST)s and their firms for engineering achievements
- c. provide an avenue through which competition for work excellence can be enhanced.

The Awards will be given out for the following categories:

- Residential
- Commercial
- Institutional and Industrial
- Civil Engineering
- Overseas

Sky Habitat

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. LAI HUEN POH
C&S Consultant	RSP Architects Planners & Engineers (Pte) Ltd
Builder	Shimizu Corporation
Developer	CapitaLand, Mitsubishi Estate Asia Pte. Ltd. & Shimizu Investment (Asia) Pte. Ltd.
Architectural Consultant	DCA Architects Pte Ltd

AWARD – RESIDENTIAL CATEGORY

KEY CHALLENGES

- Turning an attractive design philosophy into reality, translating the intricate design analysis into simple language, be understood and building safe. 3 foremost tests put before us,
- The design of the major splay shear walls outspreading at the base at an angle of 72.65 deg.
- Cascading volumes of terraces of a seemingly unsolved Rubik's Cube twist require transfer 2 sets of diverging grid systems at pivotal floors.
- Sky bridges, three 'aerial streets' community space connect the towers, with landscaped gardens at level 14 & level 26, and the sky pool atop the building at level 38.

SOLUTIONS

- Adopt Tension-Compression Tie concept in analysis and design of the outspreading concrete walls. Compression tie beams created at level 14 whilst introducing a tension tie post-tensioned beam at lowest B2 level to make sure that the push & pull interactive load are closely looped. In addition, the effective wall cross sectional dimensions and critical load passage are aligned by gravitation to bring weights down to the deep foundation.
- Embrace structural steel transfer trusses and concrete walls at pivotal floors along building façade to transmit large amount of loads streaming down from floors above to foundation below. The design and detail has successfully bridged loads across residence units and safe bearing on top of the splay walls without infringing an inch of space deliberated for interior consumption.
- The pick of structural steel sky bridge scheme based on weight, construction economy, constructability and safety allow us to design independent, light and simple structure bridging across the 2 towers with a clear span of approximately 29m. The sky bridges designed & modelled as pin-roller end condition with safe allowable range limits for movement flexibility. Moreover, the inspection of the steel sky bridges made easier to be carried out by prefabricating the sky bridges on ground before hoisting and installing to high level. Hence, the qualities of sky bridges are assured.

SkyTerrace@Dawson

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. Koh Boon Liang
C&S Consultant	Ronnie & Koh Consultants Pte Ltd
Builder	Shimizu Corporation
Developer	Housing & Development Board
Architectural Consultant	SCDA ARCHITECTS PTE LTD

AWARD – RESIDENTIAL CATEGORY

KEY CHALLENGES

- The tower blocks are made up of 4 dwelling units at each floor and the floor layout is not the same through the height of the building. Hence, one of the challenges is to design and coordinate the structural framing of the blocks.
- The second challenge is to design and plan for the construction of the precast 3-D modular volumetric façade for this project.
- The third challenge is to design the sky bridges which act as refuge floors and sky terraces. The sky bridges are straddled between the five blocks where the units at the side of the building are staggered at each floor.

SOLUTIONS

- Due to the different layout at each floor, consultant's design team faced the difficulty of placing the columns inside the unit as the rooms at each floor are not align with the rooms at the upper floor or lower floor. After numerous round of coordination, the consultant's design team decided to place the column at the perimeter of the units and realign the windows so that all the columns are continuous from the pilecap to the roof level.
- Before erecting any new precast component, contractor must submit the method statement to ensure any single precast component can be installed safely during construction stage. Full scale mock-up unit was also constructed to study the visual impact and the potential risk during the installation of precast component before actual construction.
- Various schemes were studied for the construction of the sky bridge. Eventually, consultant's design team decided to assemble the steel structure with bondek and safety barrier on ground in 3 parts and lift it up by using synchronize hydraulic strand jacks and connect the 3 parts at the actual floor level.

Singapore Sports Hub

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. Chia Wah Kam Er. Dr. See Lin Ming Er. Mak Swee Chiang
C&S Consultant	Arup
Builder	Dragages Singapore
Developer	SportsHub Pte Ltd
Architectural Consultant	Arup Associates + DP Architects

AWARD – COMMERCIAL CATEGORY

KEY CHALLENGES

- The Singapore Sports Hub is made up of nine key sports and leisure facilities built on a compact piece of land. One of the challenges is to design the National Stadium to suit our tropical climate for the proposed events.
- The typical geology on this site consists of Marine Clay – a soft and clayey soil typology which makes excavations difficult and risky. On the Sports Hub site, the depth of Marine Clay varied up to about 20m deep.
- The designs of the structures were complex and the team had to coordinate with many project parties to deliver the design under a tight delivery.

SOLUTIONS

- The dome form of the National Stadium roof was developed to achieve the canopy and was a unique response to Singapore's tropical climate, providing shelter both inside and outside the stadium. By incorporating a moving roof, the stadium can be naturally ventilated and protected from the harsh climate, allowing events to be hosted even during the hottest parts of the day.
- To overcome the soft Marine Clay, Arup designed a post-tensioned concrete ring beam 1.5m deep, 6m wide, and 9m from ground. The ring beam together with the column pairs below is an integral component of the roof structure, and is critical in supporting the weight of the entire roof. The ring beam maximised efficiencies in the roof structure and also eliminated risks related to construction on poor ground conditions. Sitting atop the ring beam are 20 elegantly designed thrust blocks which restrain the lateral thrusting forces of the dome roof.
- BIM was extensively on the entire project for efficiency in cost, time and construction – a forward thinking and innovative approach for its time. BIM automated the flow of information between the engineering analysis and design models, and the documentation models, improving the quality of the information by reducing the situations of human error. BIM also enabled the early identification of clashes in design which could be rectified before they were erected on site, achieving a high standard of safety in construction.

Downtown Line Stage 2 (Contract 921 - Rochor and Little India Stations and Tunnels)

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. You Fook Hin
C&S Consultant	Mott MacDonald Singapore Pte Ltd
Builder	Ssangyong Engineering & Construction Co., Ltd
Developer	Land Transport Authority
Architectural Consultant	Architects 61 Pte Ltd

AWARD – CIVIL ENGINEERING CATEGORY

KEY CHALLENGES

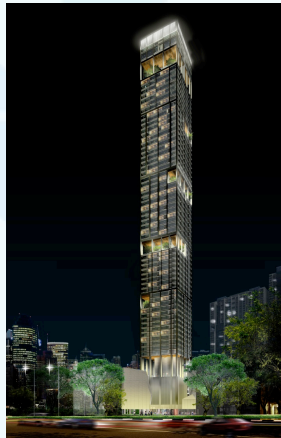
- Construction of 2 MRT stations, cut and cover tunnels and bored tunnels located in busy urban environment in close proximity to old buildings and the NEL MRT. Requiring the realignment and reconstruction of a 1km section of Rochor Canal, on top of the works. Necessitating more than 50 traffic diversions on Sungei Road and Rochor Canal Roads from 2009 to 2014.
- Challenging ground conditions with deep soft Marine Clays at the Rochor site and interfaces between Old Alluvium, Fort Canning Boulder Bed and Jurong formation at the Little India site.
- Limited working space for installation of diaphragm walls or bored piles at certain locations for stations and Rochor which is very close to old shop house and heritage monument – Abdul Gafoor Mosque.

SOLUTIONS

- Through design assumptions and innovative design solutions utilising 3D analysis, the correct balance between robust and cost effective design has been achieved. Impact assessment and sensitivity studies were carried out.
- A novel design solution for the elliptical shaft, without struts, was adopted. A number of different design measures to control ground movement and building damage were utilised combined with well-regulated safety inspections & monitoring of the works by all parties.

The Altez

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. Yeo Choon Chong
C&S Consultant	KTP Consultants Pte Ltd
Builder	Woh Hup (Private) Limited
Developer	Bishan Properties Pte Ltd
Architectural Consultant	RSP Architects Planners & Engineers (Pte) Ltd

MERIT – RESIDENTIAL CATEGORY

KEY CHALLENGES

- Engineering one of the tallest residential buildings in Singapore with a tower height of 243m and a tower slenderness ratio of 8.4 within a congested site.
- To optimise the stacking of six levels of transfer floors and increase the efficiency of the floor plates.

SOLUTIONS

- A robust structural transfer system that was seamlessly integrated with the lateral load resisting system with high strength concrete and overall piled raft foundation was configured in totality with detailed construction methodology to achieve an impressive zero accident record for this super high-rise construction.
- Specialist wind tunnel testing was employed to optimise the overall efficiency of the structures and ultimately human occupancy comfort by considering the aerodynamic effect of the actual shape of the structure with the influence of adjacent built up buildings and topography.

The Luxurie

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er Aaron Foong Kit Kuen
C&S Consultant	KTP Consultants Pte Ltd
Builder	Tiong Seng Contractors Pte Ltd
Developer	Keppel Land Realty Pte Ltd
Architectural Consultant	ADDP Architects LLP

MERIT – RESIDENTIAL CATEGORY

KEY CHALLENGES

- Commitment to increase productivity and safety of the two (2) levels of basement construction to minimise outflow of soil disposal.
- The design of 18m diameter volcano-shaped clubhouse without any internal columns to create a 360 degree unblocked view.

SOLUTIONS

- The green yet robust earth retaining system for the basement maximises the negotiation of space usage between the development basement footprint and neighbour to incorporate a hybrid system of tiered open cut system with soil strengthening and removable soldier piles with steel raker struts. The innovative flexible “pin” connection for the rakers had eliminated site welding on this critical joint in maximising the quality control and overall safety of the system.
- Sophisticated engineering analysis was carried out to design the voided biaxial flat plate and inverted drop panel system to achieve a basement structures with a flat soffit, lowest concrete usage possible and highest headroom possible to optimise the overall depth of underground space utilisation.
- Slanting steel mullions of the glass façade panels were re-designed as main structural load bearing elements.

orchardgateway

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. Kam Mun Wai & Er. Dr. Shahzad Nasim
C&S Consultant	Meinhardt (Singapore) Pte Ltd
Builder	Hyundai Engineering & Construction Co., Ltd
Developer	ORCHARDGATEWAY PRIVATE LIMITED
Architectural Consultant	AWP Pte Ltd

MERIT – COMMERCIAL CATEGORY

KEY CHALLENGES

- Construction of Basement below Stamford Canal up to 18m deep in close proximity to Somerset MRT Station and adjoining properties and services in variable and poor ground conditions.
- Construction of underground pedestrian retail underpass below Orchard Road and provision of 2 direct connections to MRT station at B1.
- Unique curved towers design.

SOLUTIONS

- Mapping of rock contours to facilitate foundation installation and adoption of robust earth retaining/stabilising structure incorporating top down construction.
- Safeguarding integrity of canal via suspension from precast beams above for basement construction below the canal to avoid affecting its flow and capacity and use of fully precast construction for slabbing over canal.
- Construction of Orchard Road underpass with multi-stage traffic lane diversions and micropile installation at basement formation level to minimise disturbance and inconvenience to traffic and pedestrian flow and minimal interference to MRT operations.
- Efficient structural framing system to create iconic architecture.

Downtown Line Stage 2 (Contract C916 - Station and tunnels at Beauty World)

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



MERIT – CIVIL ENGINEERING CATEGORY

KEY CHALLENGES

- Close proximity of existing buildings and utilities to the excavations and presence of a busy intersection.
- Complex Geotechnical conditions (Bukit Timah Granite and Kallang Formation coexist, with highly undulating rock head).
- Launch Shaft at one end of the station requiring partial demolition and creating imbalance in lateral loading.
- TBM Bored tunnel crown situated just under the formation level of the adjoining entrances, limiting embedment depth of ERSS temporary retaining walls.

SOLUTIONS

- Comprehensive geotechnical analysis, including 3D Plaxis for damage assessment of the buildings.
- SBP shear wall concept for the Launch Shaft, with selected tension piles to resist the overturning effects due to the unbalanced earth pressure.
- Cautious use of redundant ERSS systems above the bored tunnels at the entrances.
- Integration of SBP wall with stabilised rock head for ERSS system.

Qualified Person	Er. Tan Beng Chun (Anthony), Er. Raymond Laurie Hatfield
C&S Consultant	WorleyParsons Pte Limited, PR Consultants Offshore
Builder	McConnell Dowell SEA Pte. Ltd.
Developer	Land Transport Authority
Architectural Consultant	DP Architects Pte Ltd

Jubilee Bridge

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er. Dr. See Lin Ming and Er. Wong Ling Chye
C&S Consultant	Arup
Builder	Marina Technology & Construction
Developer	Urban Redevelopment Authority of Singapore
Architectural Consultant	Cox Architecture and architects61

MERIT – CIVIL ENGINEERING CATEGORY

KEY CHALLENGES

- The 220m long, 6m wide Jubilee Bridge weighs 3,000 tonnes, consists of three spans and rests its entire weight on two slim columns. The design team were challenged to achieve the architectural intent of a slender bridge form that provides unobstructed access for watercraft navigation and minimised clutter in the picturesque Marina Bay area.
- Construction of the bridge was set within a tight space, and disruptions to the surrounding maritime, pedestrian and vehicular traffic had to be kept to a minimum.

SOLUTIONS

- Arbeautiful and slender curved geometry at the apex of the bridge. Pinning its entire weight on the two columns not only requires a robust structural system but one that provides maximum flexibility and strength to resist any accidental impact forces. Arup proposed a flexible design by using a system of twin blades column with post-tensioning tendons to define the bridge columns. This configuration allows the substructure to attract less load from the superstructure. In this way, forces induced by the expansion and contraction of the bridge deck caused by temperature change, and concrete creep and shrinkage effect can be minimised. Not only does this allow for a more economical piles foundation design, it is also more sustainable for maintenance in the long run.up pushed boundaries on the structural design to achieve a high span-to-depth ratio.
- To construct within a tight space and in the maritime environment, the bridge was built using a precast segmental balance cantilever construction approach. Precast segments were added, one by one, on alternating sides of a central pillar, so the whole structure was kept balanced.

BCA Academy - Academic Tower

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er Lai Huen Poh [QP(D)] Er Beh Swee Chiew [QP(S)]
C&S Consultant	RSP Architects Planners & Engineers (Pte) Ltd
Builder	Progressive Builder Pte Ltd
Developer	BCA Academy
Architectural Consultant	RSP Architects Planners & Engineers (Pte) Ltd

MERIT – INSTITUTIONAL & INDUSTRIAL CATEGORY

KEY CHALLENGES

- Site constraint such as a single access via the very busy Braddell Road.
- Construction within a builtup environment and the close proximity to the Bishan SMRT Depot.

SOLUTIONS

- Engineering solutions were provided with the architect to optimize building form through standardization and modularization. Structural and non-structural elements were prefabricated offsite with an overall precast concrete area of more than 88%. Extensive use of precast components enabled high constructability score index and buildability score.
- To minimize and mitigate impact within a built environment and to the neighbours, fully cased bored piles were adopted within the MRT reserves, structural steel construction was selected for entrance canopy as well as design and construct around the mature conserved trees in the courtyard with due diligence.

Halliburton Technology Campus

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARD



Qualified Person	Er Lai Huen Poh
C&S Consultant	RSP Architects Planners & Engineers (Pte) Ltd
Builder	Obayashi Corporation
Developer	HAL Completions Mfg Pte Ltd
Architectural Consultant	RSP Architects Planners & Engineers (Pte) Ltd

MERIT – INSTITUTIONAL & INDUSTRIAL CATEGORY

KEY CHALLENGES

- Construction of 12 nos. of huge and deep test cells into thick underlying sand layer and marine clay.
- The design objectives of speed, ease of construction, economy, sustainability and safe work environment.

SOLUTIONS

- Creative adoption of bored pile methodology to construct the test cells which had eliminated the possible risk if open cut and fill method was used.
- Adopted the Pre-Engineered Steel Building design for a more optimal and economical use of steel sections which resulted in a speedier and safer construction.
- Adopted the ECI contracting approach to overcome the time constraints and enhanced the certainty in project delivery.

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS

AWARD

Project name

Sky Habitat

Category

Residential Category

QP / QP company

Er. Lai Huen Poh

RSP Architects Planners & Engineers (Pte) Ltd

SkyTerrace@Dawson

Residential Category

Er. Koh Boon Liang

Ronnie & Koh Consultants Pte Ltd

Singapore Sports Hub

Commercial Category

Er. Dr. See Lin Ming / Er. Chia Wah Kam /

Er. Mak Swee Chiang

Arup

Downtown Line Stage 2
(Contract 921 - Rochor and Little India
Stations and Tunnels)

Civil Engineering Category

Er. You Fook Hin

Mott MacDonald Singapore Pte Ltd

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS

MERIT

Project name

The Altez

The Luxurie

orchardgateway

Downtown Line Stage 2
(Contract C916 - Station and tunnels
at Beauty World)

Category

Residential Category

Residential Category

Commercial Category

Civil Engineering Category

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Er. Yeo Choon Chong
KTP Consultants Pte Ltd

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Er. Tan Beng Chun, Anthony/
Er. Raymond Laurie Hatfield
WorleyParsons Pte Limited /
PR Consultants Offshore

DESIGN AND ENGINEERING SAFETY EXCELLENCE AWARDS

MERIT

Project name

Jubilee Bridge

BCA Academy - Academic Tower

Halliburton Technology Campus

Category

Civil Engineering Category

Institutional & Industrial Category

Institutional & Industrial Category

QP / QP company

Er. Dr. See Lin Ming / Er. Wong Ling Chye
Arup

Er. Lai Huen Poh [QP(D)] &
Er. Beh Swee Chiew [QP(S)]
RSP Architects Planners & Engineers (Pte) Ltd

Er. Lai Huen Poh