

JTC Industry Seminar: Innovations In Structural Engineering Systems

Programme brought to you by the Future of Building and Infrastructure Division and the Technical Services Division

As the master planner of Singapore's industrial landscape and the Centre of Excellence for Public Projects, JTC works with industry partners such as government agencies, regulators, Institutes of Higher Learning, consultants, builders, and suppliers to co-create innovative structural engineering systems for translation to project implementation.

Recently, four such projects that aim to improve productivity and safety while reducing design and construction time, manpower, costs, materials, and embodied carbon were completed. At this seminar, built environment professionals will share key insights on these innovations.

- · Welcome address by JTC Assistant CEO (Engineering & Operations), Mr. Calvin Chung
- · Opening address by BCA Commissioner of Building Control, Er. Thanabal Kaliannan
- Book launch for Design of High Performance Pre-Engineered Steel Concrete Composite
 Beam for Sustainable Construction
- Design of High Performance Composite Beams (HPCB) using Pre-Engineered S460 Steel Sections
 Presented by Professor Chiew Sing Ping, Singapore Institute of Technology
- Hybrid Mounting Bracket System (HMB)
 Presented by Mr Park Jae Hyuk, Managing Director, SEN Engineering Group
- Concrete-Encased Concrete-Filled Steel Tube (CECFST) Composite Column design with precast RC or prefabricated steel beam connections
 Presented by Professor Tan Kang Hai, Nanyang Technological University
- Steel Reinforced Concrete (RCS) hybrid framing system design (FAST Connection) Presented by Associate Professor Pang Sze Dai, National University of Singapore

WHO SHOULD ATTEND:

Built Environment professionals, relevant Industry Qualified Persons and technical professionals.

Collaborators:









30 August 2024

12:00pm to 5:30pm (Registration and lunch starts from 12:00pm - Seminar commences at 1.30pm)

Fees: Complimentary (Lunch and refreshments provided)

PDU Points: To be confirmed

Format: In-person lecture at The JTC Summit Theatrette

To register, visit the link below or scan the QR Code.

https://go.gov.sg/jtc-industry-seminar-ises



In support of:

Build

For enquiries, please email: Cheryl_YEO@jtc.gov.sg



FULL SEMINAR PROGRAMME

12:00pm - 1:30pm	Registration and Lunch
1:30pm – 1:50pm	Seminar Commencement, Welcome and Opening Addresses Welcome by JTC Corporation ACEO Mr. Calvin Chung, Opening Address by BCA Commissioner of Building Control Er. Thanabal Kaliannan
1:50pm – 2:00pm	Book Launch Design of High Performance Composite Beams (HPCB) using Pre-Engineered S460 Steel Sections
2:00pm - 2:40pm	Presentation on Design of High Performance Composite Beams (HPCB) using Pre-Engineered S460 Steel Sections Presentation by SIT Prof. Chiew Sing Ping
2:40pm - 3:15pm	Tea Break and Book Sales
3:15pm - 3:45pm	Presentation on Hybrid Mounting Bracket (HMB) System Presentation by SEN Engineering MD Mr. Park Jae Hyuk
3:45pm - 4:15pm	Presentation on Concrete Encased Concrete Filled Steel Tube (CECFST) Composite Column design with precast RC or prefabricated steel beam connections Presentation by NTU Prof. Tan Kang Hai
4:15pm – 5:15pm	Presentation on Steel Reinforced Concrete (RCS) hybrid framing system design (FAST Connection) Presentation by NUS Assoc. Prof Pang Sze Dai
5:15pm – 5:30pm	Seminar Closing

ABOUT JTC

Since its inception in 1968, JTC has played a strategic role in ensuring Singapore stays innovative and dynamic amid global manufacturing trends.

As a government agency under Singapore's Ministry of Trade and Industry, JTC is paving the way forward for Singapore's industrial landscape with sustainable, green and smart estate masterplans such as one-north, Seletar Aerospace Park, Jurong Innovation District, and Punggol Digital District. Our estates attract new investment and foster collaborative ecosystems that strengthen Singapore's position as an advanced manufacturing hub. We also drive innovation in the Built Environment sector by piloting new construction technologies.

For more information on JTC, visit <u>www.jtc.gov.sg</u>.

Address: The JTC Summit, 8 Jurong Town Hall Road, Singapore 609434 | Tel: 1800 568 7000 | Web: www.jtc.gov.sg







JTC SENIOR LEADERSHIP

Mr Calvin Chung, Assistant Chief Executive Officer (Engineering and Operations Group), JTC

Mr Calvin Chung is the Assistant Chief Executive Officer (Engineering and Operations Group) at JTC, the government agency responsible for developing industrial infrastructure that supports the growth of new industries and the transformation of enterprises in Singapore.

He is in charge of the engineering and operations group, which covers the design and planning, project management as well as the facility management of JTC's development. Prior to his current appointment, Calvin was the Chief Technology Officer and Senior Director in the Ministry of National Development (MND). He was in charge of driving the Science & Technology development and policy within the Built Environment and R&D agenda with agencies that include HDB, URA, BCA, NParks, LTA and JTC through initiatives such as the City of Tomorrow R&D Programme.

In the past 18 years, Calvin has been actively involved in the full spectrum of building and infrastructure works. This includes the planning, conceptualisation and development of a number of large scale projects e.g. Jurong Island, Tuas View Extension, Marina Bay Cruise Centre etc. He also spearheaded JTC's Built Environment digitalisation and innovation agenda and was also the Corporation's Chief Sustainability Officer.

He has a particular interest in environmental impact assessment and hydrodynamics simulations and was directly involved in the execution of the Pulau Ular reclamation, which was one of the first marine project to implement a comprehensive environmental assessment and monitoring throughout the whole works. Calvin possesses deep technical expertise in reclamation, environmental engineering and sand sourcing in the public sector. He is active in inter-agency technical committees and professional bodies, engaging a wide range of partners, experts and stakeholders across departmental, ministerial and national boundaries on issues like engineering capability, sustainability, climate change to protect Singapore's interests. He is the board treasurer of SGBC, a member of NTU (Civil & Env engineering) School Advisory Committee and a senior member in IES and is currently helping as an accessor for IES' Chartered Engineer programme.

He graduated with a Bachelor (Hons) degree and Master of Engineering from the National University of Singapore. He also holds a Master of Science in Hydraulic Engineering from Delft University of Technology and Master of Science in Environmental & Water Resources Management from the National University of Singapore.









GUEST OF HONOUR

Er. Thanabal Kaliannan, Commissioner of Building Control, Group Director (Building Resilience), BCA

Er. Thanabal is a registered Professional Engineer and an Accredited Checker. He was actively involved in various code review committees as part of Singapore's Eurocode migration exercise which he was instrumental in overseeing and implementing. He has worked on various initiatives to enhance the resilience and sustainability of the construction sector such as the development and implementation of BC1, the design guide for alternative steel and the certification scheme for ready-mixed concrete for structural applications. Er Thanabal as part of the workgroup that developed the BC3 Guidebook for the design of buildings in Singapore against long distant tremor effects was instrumental in its inception and drafting. He also headed the development and implementation of the periodic façade inspection regime in ensuring the proper maintenance of our building facades.

Er Thanabal serves the industry and engineering profession in various committees such as the Singapore Structural Steel Society where he serves as the 1st Vice President, SFA's Institutional Animal Care and Use Committee and the Institution of Engineers, Singapore's Geotechnical Division. He has also earlier served in the Singapore Accreditation Council and has chaired its Council Committee for Lab Accreditation.

For his distinguished public service and invaluable contributions to the engineering community, Er. Thanabal was conferred the Public Administration Medals, Bronze and Silver in 2012 and 2020 respectively, the Distinguished Partner Award by the Enterprise Singapore and the Singapore Accreditation Council in 2021 and the Civil & Environmental Engineering Outstanding Alumni Award by NTU in 2022.

Qualification BEng and MSc (Civil Engineering) (National University of Singapore)









Professor Chiew Sing Ping

Presentation on Design of High Performance Composite Beams (HPCB) using Pre-Engineered S460 Steel Sections

An alternative high-performance pre-engineered steel-concrete composite beams (HPCB) system has been developed to improve the sustainability and reduce the input of raw materials and eCO2 in the construction of heavily loaded and long spanned industrial buildings, which are predominately reinforced concrete (RC) structures in Singapore. The HPCB combines a high-performance green concrete slab in grade C55/67 and an asymmetrical steel section in grade S460M that is designed according to the bending moment and shear force diagrams. Different from conventional universal beams that are symmetrical and efficient for standalone applications, the pre-engineered section minimizes the size of the top flange and web which contribute little to bending moment resistance in a composite beam. While reducing the redundant weight, the use of lighter steel section also shifts up the plastic neutral axis to the concrete slab such that the steel is subjected to tension only and thus free from buckling issues. Design equations derived from Eurocode 4 approach for ultimate limit state and serviceability limit state will be introduced with worked examples to facilitate adoption by professionals.

Speaker's Profile

Er. Professor Chiew Sing Ping is Professor of Civil Engineering and Programme Leader of Civil Engineering as well as Head of the Construction Technology Innovation Laboratory (CTIL) at Singapore Institute of Technology (SIT). He was previously Head of the Division of Structural Engineering and Mechanics at Nanyang Technological University (NTU), Singapore from 2008 to 2014. He is also a Member of the Panel of Expert Advisors of the Land Transport Authority (LTA), Past President and Honorary Fellow of the Singapore Structural Steel Society (SSSS). His research and expertise are related to structural steel and composite steel-concrete construction, and he has delivered many industry and key note lectures, written 5 books, and published more than 200 refereed technical papers in international refereed journals and conference proceedings.









Mr. Park Jae Hyuk, Managing Director, SEN Engineering Group

Presentation on Hybrid Mounting Bracket (HMB) System

Hybrid Mounting Bracket (HMB) system of SEN is an innovative, efficient, and safe solution for modern construction technology. It involves installing brackets assembled with angles onto the Prefabricated Steel Reinforced Concrete (PSRC) column, placing precast concrete (PC) beams on these brackets, then integrating the components by pouring concrete. Shear keys are present at the ends of the PC beams to facilitate the integration, ensuring rigid joints between the column and PC beams, allowing continuous beam design. HMB system enhances constructability by allowing the PC beams to be placed on the HMB without additional bolting or welding, simplifying the connection details. In addition, both PSRC column and PC beam provides sufficient concrete cover which omits the need for fire-resistance works. In conclusion, HMB is a system which minimizes and simplifies the on-site works which enhances constructability, reduce manpower and increase safety.

Speaker's Profile

Mr. Park Jae Hyuk is a dynamic and results-driven Managing Director with a strong background in Business Development, Organization Management, and Project Management within the construction industry. With over a decade of experience in various leadership roles, he has demonstrated expertise in BIM/VDC Implementation, Design/VE Management, and Pre-Construction Services.

His international experience spans across Singapore, Malaysia, Indonesia, South Korea, and the Netherlands, working with reputable companies such as SEN SG Pte. Ltd., GS Engineering & Construction, and Ballast Nedam. Park Jae Hyuk holds a Master's degree in Construction Management and Engineering from Delft University of Technology and a Bachelor's degree in Architectural Engineering and Business Administration from Yonsei University.

He is recognized for his contributions to the industry through major publications and conference papers on topics such as geometric quality inspection, design coordination strategies, and process modeling in construction. Park Jae Hyuk's blend of technical expertise, innovative thinking, and strong leadership skills make him a valuable asset in driving business growth and excellence in construction projects.









Professor Tan Kang Hai

Presentation on Concrete Encased Concrete Filled Steel Tube (CECFST) Composite Column design with precast RC or prefabricated steel beam connections

An innovative code-compliant structural system composed of concrete-encased CFST column to composite beam or precast RC beams will be presented. The concrete-encased CFST column consists of an inner concrete-filled steel tube (CFST) and an outer reinforced concrete (RC). Due to the existence of outer RC, the concrete encased CFST column can achieve high fire resistance, good durability under corrosion and easier connections with RC beams. The confinement from the outer RC also allows usage of thin steel tube with higher strength.

Compared with RC columns, concrete encased CFST columns have both higher strength and ductility owning to existence of the inner CFST. Due to the application of high strength concrete and thin-walled high strength steel tube in CFST, the section size of concrete-encased CFST columns could be reduced. The composite column can be utilized as precast column, where industrialization construction with high efficiency and low labor cost can be achieved. The inner CFST columns can be tween precast columns and between precast columns and between precast column and precast beam are conducted.

Speaker's Profile

Professor Tan Kang Hai is Director of Protective Technology Research Centre (PTRC) in CEE School. Prof Tan's research work formed the technical basis of the circular from Singapore Civil Defence Force (SCDF) on "Fire Safety Design of Multistorey steel-framed buildings with composite slabs". In 2014, he secured an MND fund to develop a safe and cost-effective design for Singapore's mega underground cavern developments. The research resulted in an innovative design concept for underground life safety and technical disclosures for fire protection coating and cementitious concrete composites. With strong support from MHA, he is involved in drafting of a Singapore design guide to mitigate progressive collapse of structures.

Prof Tan has authored/co-authored over 290 SCI top-tier international journal publications. From Google Scholar, he has 13965 citations with an H-index of 66. He won the "Certificate for Highly Cited Research" in Engineering Structures. Out of 41 PhD students he graduated, about half are in academia. Prof Tan has given about 60 keynotes and invited seminars, and 90 professional short courses to engineering fraternity.









Professor Tan Kang Hai

Speaker's Profile (cont.)

A registered Professional Engineer in Singapore since 1996, he is also a Specialist PE (Protective Security) from 2019 from his many research projects with DSTA. He sits in the HDB Civil & Structural Engineering Advisory Panel and serves as one of the two external panel members for HDB Engineering Awards. He is Deputy-Chair of Institution of Engineer Singapore (IES) for Technical Committee of Infrastructure Cluster and serves as a member in the National Scientific Review Panel for MND for City of Tomorrow grant call. He is in the technical committee (Building Structure & Sub-structure) 17th Standards Council Term and represents IES in the Selection Panel for certifying Fire Safety Engineers since 2005. Currently, he is Chairman of the Appeals Advisory Board for Infrastructure Protection (IPA) Act. He has been a member of Fire Safety Appeals Board Committee from 2005 to 2016.

His engineering consultancies often involved performance-based approach to fire scenarios or progressive collapse resistance analysis. He is a specialist consultant to HDB on a PPVC project and Changi Airport Group on Terminal 5. His motto is that research through laboratory testing of structures and mechanical models should translate into practical design guides and influence engineering practice.









Associate Professor Pang Sze Dai

Presentation on Steel Reinforced Concrete (RCS) hybrid framing system design (FAST Connection)

The advancement in jointing technology presents an opportunity to enhance productivity in steel and composite structures construction. In Singapore, there is a pressing need to boost productivity while reducing reliance on manpower in the construction industry. The introduction of composite structures holds the potential to improve construction productivity and efficiency by leveraging the strengths of both concrete and steel while mitigating their respective weaknesses. Composite structures, which involve encasing steel members in reinforced concrete, also offer improved fire resistance. However, the connections between structural members, present a challenging task due to the encasement of steel members.

The introduction of Composite structures comprising Reinforced Concrete columns and Steel beams (RCS) offers a promising solution. RCS frames are highly efficient composite framing systems that feature reinforced-concrete columns (RC) and steel beams (S) connected by moment-resisting joints. The proposed connection of the RCS frames includes the through steel beam, secondary beam, and integrated cover plate, which can replace transverse reinforcement in the RC column and steel beam joints. This innovative connection method eliminates the need for formwork for wet work at joints, reduces reinforcement congestion, and enhances on-site productivity and ease of installation.

Speaker's Profile

Dr. Pang Sze Dai graduated from the National University of Singapore with B.Eng. (First Class Honours) and M.Eng. degrees in 2001 and 2002 respectively under the Accelerated Master's Program (AMP), and from the Northwestern University with Ph.D. degree in 2005. He researched on the behaviour of profiled steel-concrete composite structures subjected to blast loading for his M.Eng thesis and on the size effect arising from energetic and probabilistic fracture mechanics in the mechanical properties of quasi-brittle materials for his Ph.D dissertation.







Associate Professor Pang Sze Dai

Speaker's Profile (cont.)

Dr. Pang joined the National University of Singapore in 2006 as an Assistant Professor in the Department of Civil and Environmental Engineering (CEE) and the Engineering Science Programme (ESP). He designed and taught modules for the newly set-up ESP and the fresh approach towards students' learning was awarded the Faculty of Engineering Innovative Teaching Award. The students that he has mentored in CEE and ESP has won multiple awards at faculty and university levels which include the Faculty Innovation and Research Awards, University Outstanding Undergraduate Researcher Awards, University Student Achievement Awards. At international level, the teams that he has mentored for the annual international earthquake design competition in Taiwan and has won top awards every year. On top of the teaching of modules and mentoring of students, he has been active in administrative roles as the Acting Programme Manager for the M.Sc (Civil) and M.Sc (Geotech) programmes in 2008-2010, and is currently the Curriculum Coordinator for the Design-Centric Curriculum which is delivered by Engineering Design and Innovation Centre.

Dr. Pang is currently working on research in the area of protective building and sustainable building technologies using principles from bio-mimicry and is also researching on the size effect in cementitious and metal matrix composites. He has attracted close to \$\$3 million in research funding as Principle Investigator and collaborator. He has served on the committees for a number of major conferences, reviewed for multiple journal articles and also served as external reviewer for national research projects. He has also provided his expertise to the industry for consultations on structural dynamics, steel structures and seismic engineering.





ACKNOWLEDGEMENTS

SPECIAL THANKS

To Building and Construction Authority (BCA) Commissioner of Building Control and Group Director for Building Resilience, Er. Thanabal s/o Kaliannan, for gracing this event. This programme would not have been possible without the support of seminar collaborators Professor Chiew Sing Ping (and Team) from the Singapore Institute of Technology (SIT), Professor Tan Kang Hai (and Team) from Nanyang Technological University (NTU), Mr. Park Jae Hyuk (and Team) from SEN Engineering Group and Associate Professor Pang Sze Dai (and Team) from the National University of Singapore (NUS).

DIRECTIONS

From Jurong East MRT Station (NS1|EW24|JE5) or Jurong East Interim Bus Interchange, use J-Walk (overhead bridge) and walk towards the JTC Summit building.



If driving, please consider parking options nearby like:

- Jurong Town Hall, 9 Jurong Town Hall Road Singapore 609431
- JEM, 50 Jurong Gateway Road Singapore 608549
- GENTING HOTEL JURONG, 2 Town Hall Link, Singapore 608516
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