

**Two-Day Course on
Seismic Design to Eurocode 8**
(Including 3 Case Studies Designed for Seismic Action
– addressed by 2 Singapore Consultants and
1 Hong Kong Consultant)



Organiser : IES/IStructE Joint Committee
Date : Wednesday, 5 April & Thursday, 6 April 2017
Time : 9.00 am to 6.00 pm
Venue : Cinnamon Room, Level 5
 Novotel Singapore Clarke Quay
 177A River Valley Road, Singapore 179031
Course Fee : Attending the 2-day course



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| | <p>\$780.00 (IES/IStructE Members) \$880.00 (non-members) \$600.00 (Retired IStructE Members, Unemployed IStructE Members and IStructE Graduate Members) \$400.00 (Full-time students from NUS/NTU/Student Members of IES/IStructE) Fee is inclusive of 7% GST, paperback course notes, IStructE “Manual for the seismic design of steel and concrete buildings to Eurocode 8”, lunch and light refreshments.</p> |
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Course: Seismic Design to Eurocode 8

Eurocode 8 (EC8) is a state-of-the-art third generation code for seismic design. It includes well-established concepts such as energy dissipation and new concepts such as displacement-based method. EC8 provides the most comprehensive and up-to-date set of design rules currently available and is now the single seismic design code in Europe. It represents a significant step forward in harmonising design and analysis of earthquake-resistant structures throughout Europe and potentially around the world. Fee is inclusive of 7% GST, paperback course notes, and the IStructE “Manual for the seismic design of steel and concrete buildings to Eurocode 8” to aid better understanding and application of seismic design of steel and concrete structures.

Professor Costas Georgopoulos (from Kingston University London) will deliver key advice and guidance on seismic design and analysis of structures to EC8. A clear and effective introduction is made to earthquake damage, causes and lessons learned. This is followed by the underlying principles of seismic behaviour, conceptual design and analysis. The principles are linked to the Code through worked examples and structured discussion. Emphasis is placed on reinforced concrete building structures although the concepts are widely applicable.

Professor Costas Georgopoulos continues on the second day providing European design examples. Three eminent local practising engineers will also share their experience in the design of tall buildings in Singapore to EC8. The three speakers are:

- Er. Aaron Foong, KTP Consultants
- Dr Kong Kian Hau, ECAS Consultants
- Dr Goman Ho, Ove Arup and Partners Hong Kong Ltd

Who Should Attend ?

The course offers a comprehensive introduction to seismic design to EC8, including practical design examples of real-life structures in Singapore. It helps civil/structural engineers in understanding the effects of seismicity, in the design of structures subject to seismic loads to comply with EC8 and to appreciate the issues related to Singapore conditions.

The course is particularly suitable for:

- Practising Engineers and Project Planners seeking guidance on the application of EC8.
- Graduate Engineers undertaking their initial professional development.
- Academicians/researchers/students with limited seismic design experience.

Day 1 Programme: Course on Seismic Design to Eurocode 8

| Time | Topic |
|-------------|--|
| 0815 – 0900 | Registration @ Foyer of Cinnamon Room, Level 5, Novotel Singapore Clarke Quay |
| 0900 – 0905 | Opening Address by Er. A/Prof Lok Tat Seng Chairman, IES/IStructE Joint Committee and Session Chair |
| 0905 – 0920 | Course Introduction <ul style="list-style-type: none">• Introduction and setting of course objectives |
| 0920 – 0955 | Earthquake Damages & Causes <ul style="list-style-type: none">• Behaviour of structures subjected to earthquakes• Causes of earthquake damages• Lessons learned from failures |
| 0955 – 1030 | Principles of Conceptual Design of Buildings <ul style="list-style-type: none">• Desirable features of earthquake resistant buildings• Regularity in plan and elevation• Response of structural and non-structural elements |
| 1030 – 1045 | Morning Tea / Coffee Break |
| 1045 – 1130 | Ground Motions & Geotechnical Aspects <ul style="list-style-type: none">• Measuring earthquake motions• Ground types• Site and topography effects• Seismic response spectrum |
| 1130 – 1215 | Performance Requirements & Compliance Criteria <ul style="list-style-type: none">• Seismic hazard• Response of structures• Stiffness – Strength – Ductility• Fundamental Requirements• Compliance criteria |
| 1215 – 1345 | Lunch @ Dragon Phoenix Restaurant (Level 6) |
| | Session Chairman: Er. Michael Sien, IES/IStructE Joint Committee |
| 1345 – 1430 | Seismic Analysis <ul style="list-style-type: none">• Choice of analysis method• Modelling for analysis• Response Spectrum Analysis• Combinations of analysis results |

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| 1430 – 1530 | Equivalent Static Analysis (with worked examples) <ul style="list-style-type: none"> • Equivalent lateral force analysis |
| 1530 – 1545 | Afternoon Tea / Coffee Break |
| 1545 – 1630 | Safety Verifications (with worked examples) <ul style="list-style-type: none"> • Requirements of No Collapse Limit State • Requirements of Damage Limitation State |
| 1630 – 1730 | RC Design & Detail (with worked examples) <ul style="list-style-type: none"> • RC Local ductility • RC Detailing rules |
| 1730 – 1800 | Q&A and Discussion by A/Prof Lok Tat Seng Chairman, IES/IStructE Joint Committee |

Day 2 Programme

| Time | Topic |
|-------------|--|
| 0815 – 0900 | Registration @ Foyer of Cinnamon Room, Level 5, Novotel Singapore Clarke Quay |
| 0900 – 0905 | Opening Address by Er. Dr Ho Kwong Meng Vice-Chairman, IES/IStructE Joint Committee and Session Chair |
| 0905 – 1030 | Presentation by Prof Costas Georgopoulos |
| 1030 – 1045 | Morning Tea / Coffee Break |
| 1045 – 1215 | Presentation by Er. Aaron Foong, KTP Consultants |
| 1215 – 1345 | Lunch @ The Spice (Level 7) Session Chairman: Er. Wijaya Wong, IES/IStructE Joint Committee |
| 1345 – 1515 | Presentation by Dr Kong Kian Hau, ECAS Consultants |
| 1515 – 1530 | Afternoon Tea / Coffee Break |
| 1530 – 1730 | Presentation by Dr Goman Ho, Ove Arup and Partners Hong Kong Ltd |
| 1730 – 1800 | Q&A & Discussion by A/Prof Pang Sze Dai Committee Member, IES/IStructE Joint Committee |

Biography of Professor Costas Georgopoulos



Professor Costas Georgopoulos holds the Chair in Structural Engineering Practice and he is Head of Civil Engineering Department at the School of Natural and Built Environments, Kingston University London. He has published widely, contributed to the development of EC8 and the Institution of Civil Engineers' unique 1-day CPD course on "*Seismic Design to EC8: The Essentials*" for practising engineers. His relevant credentials to the course are summarised below :

- **Chartered Engineer (CEng)**, Fellow of the Institution of Structural Engineers (**FIStructE**), Fellow of the Institution of Civil Engineers (**FICE**), Fellow of the Concrete Society (**FCS**) and Fellow of the Higher Education Academy (**FHEA**), with many years unique multi-sector international professional experience in Consulting Engineering, Academia and Professional Bodies in the UK (The Concrete Centre) and overseas.
- **Structural Designer** with expertise in seismic design of conventional earthquake-resistant buildings (Greece) and state-of-the-art earthquake-qualified structures such as the £350m Nuclear Submarine Refitting Facility at Rosyth Dockyard in Scotland and the £1b 'Sizewell B' 'Pressurized Water Reactor' Nuclear Power Station in England.

- **Senior Academic** with expertise in structural engineering, specifically in advanced concrete design including seismic actions (teaching the subject at postgraduate level); Author of the EC8 Chapter in PP1990, the British Standards Institution (BSI) Guide to Structural Eurocodes for training students and lecturers in the UK and worldwide; Author of the Expert Commentary for the BSI EC8 on-line; Member of BSI committee B/525/8 responsible for EC8; Reviewer of IStructE Essential Knowledge Text on Dynamics and currently authoring IStructE Examples to EC8 publication.

Professor Georgopoulos' contributions to IStructE include Academic Qualifications Panel (2005-2010), Education Panel (2009-2012), Education Project Committee (2012 to date), Research Panel (2007-2016), Southern Branch (Chair 2009), Council (2012-2014), Seismic and Dynamic Events Panel (2016 to date).

Day 2 Programme: Practical Application of Seismic Design to Eurocode 8 – Case Study of High Rise Buildings

The presentation will share the pertinent seismic driven aspects from a practical case study on the structural design of high-rise residential buildings in Singapore in compliance with EC8 under construction. It aims to cover the design considerations, design implementations, structural analysis modelling, foundation design and material selection to comply with EC8 in the local context. Attendees can expect to have an appreciation of the practical application of EC8 to the design of high-rise buildings in Singapore.

Biography of Er. Aaron Foong

Er. Aaron Foong, *BEng(Hons), MSc(Civil), MIES, MIStructE, PEng, CEng(UK), ASEAN CPE, DfSP*



Er. Foong Aaron is a Director of Civil and Structural Engineering at KTP Consultants. A Chartered Engineer, his technical leadership and hands-on multi-disciplinary engineering approach has seen the successful completion of a wide range of building typologies and infrastructure project developments in the region. In Singapore, he completed the engineering design and construction supervision of recent award-winning public and private developments including the NUS AS8, Sentosa Family Entertainment Centre, The Scotts Tower, CTHub Complex and the Metropolis. In 2015, he was conferred the coveted Young Structural Engineer of the Year Award from the Association of Consulting Engineer Singapore (ACES) which celebrates substantial and sustained contribution to the structural engineering profession with excellent work that demonstrates high quality design and engineering abilities. To date, he is honoured to have received two Design Excellence & Safety Engineering (DESEA) awards from the Building and Construction Authority (BCA) for his highly innovative and safety-driven approach in optimising engineering design & construction methodologies.

Brief Synopsis

Title: Over strength and Ductility of RC Shear-Wall Frame Buildings Not Designed For Seismic Loads

Buildings sited outside the seismic zones such as those in Singapore are previously designed according to BS 8110 which does not have provision for seismic loads. However, due to far field effects of earthquake from Sumatra and site effects, these buildings are occasionally subjected to tremors. "Past experience during earthquakes reveal that buildings which are designed for seismic loads are able to withstand earthquakes of magnitude several times larger than that for which they have been designed". This is largely due to over strength and ductility of the structure.

The speaker shares part of his PhD Thesis under supervision of his Main Supervisor Professor T. Balendra (whom served in the Working Group leading to development of BC3: 2013) and Co-Supervisor Professor Tan Kiang Hwee of NUS (whom served in the Technical Committee leading to development of Singapore National Annex to EC8 i.e. SS EN 1998-1: 2013). Amongst the many conference papers published from this thesis, one International Journal Paper was published with the title "*Analysis of long-distance earthquake tremors and base shear demand for buildings in Singapore*" Balendra T., Lam N.T.K., Wilson J.L., K.H. Kong (2002). *Engineering Structures*, Vol.24, pg. 99-108. Indirectly, this research study is one of the many other research works done contributing a part to development of BC3: 2013 & SS EN 1998-1: 2013.

Biography of Dr Kong Kian Hau

Dr Kong Kian Hau, B.Eng (Civil) (1st. Class Hons., NUS), PhD (Structural Engineering, NUS), MIES, MStructE, CEng (UK), IntPE (UK).



Dr. Kong Kian Hau is an Associate at ECAS Consultants which specialises in Buildings & Infrastructure Projects (including Bridges). He is a Chartered Engineer & International Professional Engineer (UK) with 11 years of experience as a Site & Resident Engineer, Senior Design & Project Engineer, Design Manager for many residential, commercial, institutional, industrial and civil engineering master planning works locally and overseas. In Singapore, Dr Kong had lead the engineering design and project management of private developments including condominiums (The Quartz, The Regency, Amber Residences), commercial developments (Alexandra Central, Westgate). In 2012, he was one of the invited speakers in the IES-IStructE Seminar for Design and Construction of Tall Building on the topic, "*Basic General Analysis and Design Considerations for Tall Buildings*". He has 5 years of Research & Development (R&D) experience as a NUS Research Engineer & Research Fellow and was awarded the *NUS President Graduate Fellowship* in 2002 during his PhD candidature which recognized NUS students with outstanding performance and applicants who show great promise. Dr. Kong's contributions to IStructE include BIM Panel (2015 to date), Seismic and Dynamic Events Panel (2016 to date), Committee Member of IES-IStructE Joint Committee and Editor for "*The Structuralist*" (2012 to date). He is an IES representative in the Structural Steel Work Inspection Committee in the Singapore Accreditation Council (SAC) & Working Group Member on Design For Maintainability and served in the IES Civil & Structural Engineering Technical Committee since 2012.

Brief Synopsis

Seismic design of tall buildings in low-to-moderate seismic area

Hong Kong is one of the well-known cities with dense population, tall buildings but with strong wind. As Hong Kong do not have seismic provision in designing buildings, all the buildings are designed to resist wind load as the major source of lateral load. Hong Kong is located in a low-to-moderate seismicity area, with resilience point of view especially for such dense populated city, seismic provision to buildings should be imposed.

It is because all the buildings in Hong Kong need to resist strong wind that the design of tall buildings in HK is controlled by stiffness or in engineering term - wind control. Therefore, tall buildings in HK are generally very stiff laterally and have a very high spare capacity to resist severe earthquake event. Transfer structures in Hong Kong is common because of the program requirement in each development such as shear wall structures on top and frame structures in below for retails and car parking. Such transfer structures are in general not recommended in seismic design. Extensive research had been carried out recently in Hong Kong by engineers and academia for low ductility demand buildings such as tall buildings and also tall buildings with transfer. The presentation will briefly explained the latest research in this area and proposed methods in handling tall buildings in low-to-moderate seismicity area.

KEYWORD: Winds, earthquakes, low-to-moderate seismicity, tall buildings, ductility demand

Biography of Dr Goman Ho



Dr Goman Ho is an Arup Fellow, the global leader for Arup Tall Buildings Skills Network and an Adjunct Professor of Hong Kong Polytechnic University. He has been working with Arup since post-graduation from Hong Kong Polytechnic University in 1992. He was involved as PD/PM/PE for a number of projects such as 1km long Beijing Capital International Airport Terminal T3, 320m span Beijing Olympics National Stadium (Bird Nest), Beijing CCTV HQs, 597m tall Tianjin Goldin 117 and Cheung Kong Centre in HK which has 7 levels of basement,

He is currently the project/technical director of a 650m tall tower in Wuhan, the new Taoyuen Airport Terminal 3 in Taiwan and also leading an international team in drafting the first seismic design standard in Hong Kong.

He is also strong in academic and research. He is currently an Adjunct Professor of Hong Kong Polytechnic University of Department of Civil and Environmental Engineering. He has published more than 20 technical papers in International Journal and Conferences. He is co-author of *"Outrigger Design for High-Rise Buildings"* published by CTBUH and also contribute a Chapter in a book *"Techniques in Vibration Analysis of Structural Steel Frames"*, published by Elsevier Applied Science.

TERMS & CONDITIONS FOR COURSE REGISTRATION

Registration

Registration will be on a first-come-first-served basis and will only be confirmed upon receipt of full payment by IStructE Singapore unless otherwise invoiced to company.

All registration must be submitted with the completed Registration Form.

Closing Date & Payment

The closing date for registering for the course shall be **Monday, 27 March 2017**. Cheque should be crossed and made payable to "IStructE Singapore", with the **Title of The Event** indicated clearly written on the back of the cheque and submitted with the completed Registration Form attention to:

IES/IStructE Joint Committee

70 Bukit Tinggi Road
Singapore 289758

Confirmation of Registration

Confirmation of registration will be given 5 working days prior to the course via email, and you are required to acknowledge it. If you do not receive the said confirmation email, please email Ms. Angela Loke at **Singapore-IStructE@ies.org.sg**

We reserve the right to allow only confirmed registrants to attend the event.

Refunds and Cancellations

No refunds will be made for withdrawals. Replacement will be allowed only if written notice is received by us at least 3 working days before the course. Replacement is allowed but restricted to once only. However, when an IES/IStructE member is replaced by a non-member, the participant shall pay the difference in the relevant fees at least 3 days before the course.

Course Cancellation/Postponement

Changes in venues, dates, time and speakers for the Events can occur due to unforeseen circumstances. IStructE Singapore reserves the full rights to cancel or postpone the Event under such circumstances without prior reasons. Every effort, however, will be made to inform the participants or contact person of any cancellation or postponement.

Fees will be refunded in FULL if the Event is cancelled by IStructE Singapore.

Enquiries

Please email Ms. Angela Loke for more information at **Singapore-IStructE@ies.org.sg**



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1 Hong Kong Consultant)**

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Please tick the appropriate box

- \$780.00 (IES/IStructE Members)
- \$880.00 (non-members)
- \$600.00 (Retired IStructE Members, Unemployed IStructE Members and IStructE Graduate Member)
- \$400.00 (Full time students from NUS/NTU/Student Members of IES/IStructE)

Fees are inclusive of 7% GST, one copy of paperback course notes, Manual, lunch and light refreshments

Name: Mr / Ms / Dr / Prof / Er. _____

NRIC: _____ Designation: _____

Company: _____

Address: _____

Tel: _____ Fax: _____

Email: _____

Dietary Preference: Chinese / Muslim / Vegetarian (*please delete accordingly*)

Please indicate:

- IES Members IES Membership No.: _____
- IStructE Members IStructE Membership No.: _____
- IStructE Graduate Members IStructE Membership No.: _____
- Retired IStructE Members, Unemployed IStructE Members
- Students (Full time students from NUS/NTU/Student Members of IES/IStructE)
- Non-Members
- Sponsored by Company (*Please send an invoice to my company*)

PE No : _____ (if applicable) STU : RE / RTO : _____ (if applicable)

Payment Mode: Cheque No.: _____ Amount (S\$): _____

Crossed cheques should be made payable to "IStructE Singapore" and mail together with the Registration Form to:

IES/IStructE Joint Committee

70 Bukit Tinggi Road
Singapore 289758