Two-Day Course on Structural Resilience
(Structural resilience to requirements of Eurocode 1 EN 1991-1-7, Including Case Studies on Blast Design – addressed by Singapore Consultants)

Organiser: IES/IStructE Joint Committee
Date: 26 & 27 September 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:
$780.00 (IES/IStructE Members)
$880.00 (non-members)
$600.00 (Retired IES/IStructE Members and Unemployed IES/IStructE Members)
$400.00 (Full-time students from NUS/NTU/Student Members of IES/IStructE)

Fee is inclusive of 7% GST, course notes, IStructE “Manual for the Systematic Risk Assessment on High-Risk Structures against disproportionate collapse” (worth approx. $126), lunch and tea/coffee breaks.

Introduction: Structural Resilience

Robustness is part of our protection against uncertainty and has been recognised and embodied in the British Standards since the UK Ronan Point collapse in 1968 as an essential aspect of good structural design practice. Since Eurocode implementation there has been particular requirement in Eurocode 1 part 1-7 to specifically consider the risks associated with a high risk structure through the use of a systematic risk assessment. Risk could be associated with the probable events that could happen throughout the life cycle of the building (e.g. vehicle impact, fire, vehicle borne incendiary explosive device). The course seeks to inform and equip the participants with knowledge of structural resilience and the necessary toolkit for carrying out this systematic risk assessment, in view of the recent increasing number of malicious and terrorist attacks on prominent building targets globally which present a large and emerging challenge for Designers and Structural Engineers. The key note speaker David Cormie, will discuss and provide project examples to illustrate the application of key concepts. Two local practitioners would also present on topics of blast resilience and mitigation on projects in Singapore.

Speakers are:

- David Cormie, Associate Director, Resilience, Security and Risk, Arup, London UK
- Dr Ang Choon Keat, Blast Engineering Consultant, Prostruct Consulting Pte Ltd, Singapore
- Er. BG (NS) Wesley D’aranjo, Security and Blast Consultant, Beth-El (Asia Pacific) Pte Ltd, Singapore
Who Should Attend?

The course offers a comprehensive introduction to structural resilience – to the requirements of Eurocode 1 EN1991-1-7 including systematic risk assessment of high risk structures relevant to Singapore conditions.

The course is particularly suitable for:
- Practising Engineers and Project Planners seeking guidance on structural resilience and resistance to progressive collapse.
- Design for Safety Professionals.
- Academicians/researchers/students.
- Engineers undertaking their initial professional development.
- Other practising specialists (e.g. Fire Safety Engineers).

Day 1 Programme

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<tr>
<th>Time</th>
<th>Topic</th>
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<tr>
<td>0815 – 0900</td>
<td>Registration @ Foyer of Cinnamon Room, Level 5, Novotel Singapore Clarke Quay</td>
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<tr>
<td>0900 – 0905</td>
<td>Opening Address by Er. A/Prof Lok Tat Seng Chairman, IES/IStructE Joint Committee</td>
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| 0905 – 0920 | Course Introduction  
|             | · Background – historical development of robustness                 |
| 0920 – 0955 | Hazards 1:  
|             | · Terrorism  
|             | · Vehicle impact                                                   |
| 0955 – 1030 | Hazards 2:  
|             | · Corrosion  
|             | · Human error                                                      |
| 1030 – 1045 | Morning Tea / Coffee Break                                           |
| 1045 – 1130 | Hazards 3:  
|             | · Case studies - collapses  
|             | · Lessons learned from failures                                    
|             | · Protection of structures against collapse                         
|             | · Fundamental Requirements  
|             | · Stiffness, strength, ductility                                    |
| 1130 – 1215 | Principles of Conceptual Design of Buildings  
|             | · Security by Design principles                                     
|             | · Desirable features of collapse- and blast-resistant structures    
|             | · Regularity in plan and elevation, redundancies                    
|             | · Response of structural and non-structural elements               
|             | · Behaviour of structures subjected to blast loading               |
| 1215 – 1345 | Lunch @ The Spice (Level 7)                                           |
|             | Session Chairman: Er. Wijaya Wong  
|             | Hon. Secretary, IES/IStructE Joint Committee                        |
| 1345 – 1430 | · Risk management in design and construction                       
|             | · Duties of a designer                                              |
| 1430 – 1530 | · Managing risk in construction: a practical example                
|             | · Safety Verifications (with worked examples)  
|             |   1. Requirements of Damage Limitation                              
<p>|             |   2. Requirements of No Collapse                                    |</p>
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<tr>
<td>1530 – 1545</td>
<td>Afternoon Tea / Coffee Break</td>
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<tr>
<td>1545 – 1630</td>
<td>• Principles of design against disproportionate collapse</td>
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<td>• Code requirements of EN 1991-1-7</td>
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<td>1630 – 1730</td>
<td>RC Design &amp; Detail (with worked examples)</td>
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<td>• RC Detailing rules – ductility, resilience</td>
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<td>1730 – 1800</td>
<td>Q&amp;A and Discussion by A/Prof Lok Tat Seng</td>
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<td>Chairman, IES/IStructE Joint Committee</td>
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**Day 2 Programme**

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<tr>
<td>0815 – 0900</td>
<td>Registration @ Foyer of Cinnamon Room, Level 5, Novotel Singapore Clarke Quay</td>
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<tr>
<td>0900 – 0905</td>
<td>Session Chair: Er. Dr Ho Kwong Meng</td>
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<td></td>
<td>Vice-Chairman, IES/IStructE Joint Committee</td>
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<tr>
<td>0905 – 1030</td>
<td>• Requirements for systematic risk assessment: Class 3 structures</td>
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<td>• Tolerability of risk</td>
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<td>• IStructE guidance: design of high-risk structures against disproportionate collapse</td>
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<tr>
<td>1030 – 1045</td>
<td>Morning Tea / Coffee Break</td>
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<tr>
<td>1045 – 1215</td>
<td>• Risk identification: a practical example/workshop exercise</td>
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<td>• Methods for analysis of resistance to disproportionate collapse</td>
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<td>• Case study: preparing a systematic risk assessment</td>
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<td>1215 – 1345</td>
<td>Lunch @ Dragon Phoenix Restaurant (Level 6)</td>
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<td>1345 – 1545</td>
<td>Session Chairman: Er. Michael Sien</td>
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<td>Asst. Hon. Treasurer, IES/IStructE Joint Committee</td>
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<td>1545 – 1600</td>
<td>Afternoon Tea / Coffee Break</td>
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<tr>
<td>1600 – 1730</td>
<td>Presentation by Er. BG(NS) Wesley D’aranjo</td>
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<tr>
<td>1730 – 1800</td>
<td>Q&amp;A &amp; Discussion by Er. Leonard Heng</td>
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**Biography of David Cormie**

David is the leader of blast engineering and structural resilience in Arup. He is an Associate Director in Arup’s Resilience, Security and Risk practice, and is a Fellow of the Institution of Structural Engineers and the Institution of Civil Engineers. David has spent his career to date studying the behaviour of buildings and other structures under beyond-design basis events, and undertaking first-principles risk-based design against extreme accidental and malicious actions. He now specialises in the design of buildings and other structures against counter-terrorist explosive threats, and has led the counter-terrorist and security design of a wide range of landmark and high-profile/high-threat buildings worldwide in the rail, airport, commercial, financial, data and sports and leisure sectors.

In 2009, David published *Blast Effects on Buildings*, a major new edition of this key textbook in the field of blast engineering first published in 1995. Owing to his experience in structural robustness and risk-based design, in 2012 David was appointed by the Institution of Structural Engineers to prepare a manual on the systematic risk assessment for the design of high-risk structures against disproportionate collapse. He has presented at conferences worldwide on protective design and lectures on blast engineering to civilian and military engineers.

David is a Fellow of IStructE and also the technical author of the IStructE manual on Systematic Risk Assessment of High Risk Structures against Disproportionate Collapse.
Dr. Ang Choon Keat is a registered Professional Engineer (Civil) in Singapore with more than a decade of experience in design consultancy and project management for building and infrastructure projects in the public and private sectors.

Choon Keat provides engineering consultancy in civil and structural engineering, including blast consultancy for protective structures in both private and public sectors. He has a strong track record in analyzing and designing of buildings and infrastructure to resist blast and weapons effects, including safe storage of explosives. Choon Keat has considerable expertise in performing Security By Design (SBD) studies in Singapore and is familiar with Singapore’s authorities (Ministry of Home Affairs) requirements and submission. His portfolio includes blast consultancy for transportation, social and community, data centres, military and police, healthcare, and industrial and infrastructure projects.

Choon Keat was a member of international committees for experts in explosive safety and has collaborated with local and international partners from other technical agencies, universities and research centres on research into protective structures and explosive safety.

Security by Design - Key Considerations and Implementation in the Design of Protective Structures in Singapore

In the recently released terrorism-threat assessment report, Ministry of Home Affairs (MHA) has commented that the terrorism threat to Singapore is at its highest level in recent years.

This talk will present the “Security-By-Design” methodology that was introduced by MHA to guide those who design and construct buildings in incorporating security features from the very beginning of the building design process. The presentation would include examples of protective design in local context and practices that are implemented for the protection and sustenance of the assets and functions while minimizing the risk of disruption to operations.
Biography of Er. BG(NS) Wesley D’aranjo

Er. BG(NS) D’aranjo is a design consultant with many years of designing structures against the effects of explosive blasts. He is a Chartered Engineer, Fellow of Institution of Electrical Engineers (UK), Fellow of Institution of Engineers Singapore (IES) and registered Professional Engineer (Electrical). His last appointment in Government was Deputy Secretary (Technology) and has served as Chief Technologist and Chief Engineer in the Ministry of Defence. He is a Brigadier General (NS) in the Republic of Singapore Air Force. He is also the recipient of the inaugural Defence Technology Medal (Outstanding Service) in 2015 for his exceptional and dedicated service in building up Singapore’s defence science and engineering. He is currently Managing Director of Beth-El (Asia Pacific) Pte Ltd.

Engineering of blast resilient glazing in Singapore

The evolution of glass technology for use in building façade has allowed both architects and engineers to be bolder in their designs, using larger and heavier glazing. Unfortunately, the trend of terrorist-related, specifically bomb threats, has also been on a rise, with the aim to cause mass casualties. In the event of a blast, highly energized fragmentation is produced from glazing, which is dangerous to innocent bystanders. Therefore, not only is it pertinent that the glazing do not become a hazard but rather it should provide a first level of defense to the building occupants. This talk will share on why blast resilient windows and curtain walls are needed and also introduce state-of-the-art technology in the engineering of blast resilient glazing in Singapore. The talk will also share on practical implementation of blast resilient glazing on actual projects in Singapore.
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 the Committee 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, 11 September 2017**. Cheque should be crossed and made payable to “[IStructE Singapore](mailto:Singapore-IStructE@ies.org.sg)”, 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  
c/o 531 Upper Cross Street #03-61  
Hong Lim Complex  
Singapore 050531

**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 to 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 venue, dates, time and speakers for the Events can occur due to unforeseen circumstances. The Committee reserves the full right 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.

**Enquiries**
Please email Ms. Angela Loke for more information at: [Singapore-IStructE@ies.org.sg](mailto:Singapore-IStructE@ies.org.sg)
REGISTRATION FORM

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Please tick the appropriate box

☐ $780.00 (IES/IstructE Members)  ☐ $880.00 (non-members)
☐ $600.00 (Retired IES/IstructE Members and Unemployed IES/IstructE Members)
☐ $400.00 (Full time students from NUS/NTU and Student Members of IES/IstructE)

Fees are inclusive of 7% GST, one copy of 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.: _________________________

☐ Retired IES/IStructE Members and Unemployed IES/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 this Registration Form to:

IES/IstructE Joint Committee
c/o 531 Upper Cross Street #03-61
Hong Lim Complex
Singapore 050531