Consideration of Explosions, Fire and Impact Loads in Building Structural Design to Mitigate Disaster


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A short course entitled, "Life Threatening Incidents of Explosions, Fire and Impact in Building Structural Design to Mitigate Disaster" was organised by the Civil & Structural Engineering Technical Division of The Institution of Engineers, Malaysia (IEM) on the 29 and 30 May 2012 at Hotel Armada, Petaling Jaya, Selangor. A total of 89 participants had attended the course.

A total of eight technical sessions were conducted by three experts from Monash University and University of Melbourne, Australia:

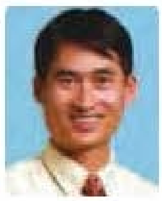
i. Lessons Learnt from Past Events
ii. Structural Design for Fire Resistance (I)
iii. Structural Design for Fire Resistance (II)
iv. Structural Design for Impact Actions (I)
v. Structural Design for Impact Actions (II)
vi. Blast Actions (I)
vii. Blast Actions (II)
viii. Structural Design for Impact Actions (III).

FIRE DESIGN

The subject of Fire Design according to the Eurocodes was delivered by Prof. Bill Wong from the University of Melbourne, Australia. He provided illustrations of various examples of disaster such as fire, structural failure of buildings and bridges, as well as their consequences. According to Eurocodes, Fire Design is meant to minimise the loss of lives and property should a fire occur in buildings. The current fire design is based on a Performance Based Approach, a methodology of design that is totally new in structural design philosophy. For example, the column is designed for the ultimate limit state in selection of materials, size and reinforcement to support the ultimate load. In cases where the column will require say about 80% of the capacity for service load, the remaining will be utilised for fire design. Such methodology is defined as Performance Based Approach.

Prof. Bill Wong also illustrated the methods used in Eurocodes for design of structural concrete and steel sections against fire. An Excel programme for designing a steel section was distributed to the participants without any charge. It was amazing to hear that the Windsor Tower fire in Spain 2005 did not cause structural collapse, even though the fire had burned the building continuously for 18 hours. He also illustrated the unfortunate case of the World Trade Centre collapse due to fire in the 'September 11 attack' (911) by terrorists, where an aircraft hit the said building.

EXPLOSION



The subject of explosion was delivered by Dr Tuan Ngo, a senior from the University of Melbourne, Australia. He introduced the subject by illustrating the effects of explosion created by terrorists all over the world. For example: Ronan Point (1968); St Mary Axe, London (10 April 1992); Bishopgate, London (24 April 1993); Oklohoma City (19 April 1995); Manchester (15 June 1996); Khobar Tower (25 June 1996); and the Australian Embassy bombing in Jakarta (2004).

He also illustrated how blasting propagates and its effects on buildings, especially the façade. Dr Tuan Ngo also provided some methods of design that would help resist blast forces. However, human beings would have no chance of surviving a blast because of the extreme pressures.

IMPACT

The subject of Impact loading was delivered by Prof. Nelson Lam from the University of Melbourne, Australia. He is no stranger to IEM members as he has conducted many short courses pertaining to Earthquake Engineering. He illustrated the effect of impact load on a structure for both horizontal and vertical structural members. Various configurations of structural members were illustrated such as simply supported, fixed end propped cantilever and cantilever. Impact of objects on slabs was also demonstrated.

The most important aspect of his presentation was his intention to unify the method of design to that of other structural dynamic problems, especially those unified to the method used in earthquake resistance design for buildings where the response spectrum is used. This will be a great simplification to the design of structure as no new code will be required for impact loading. The existing seismic code would be sufficient. ■

Ir. Mun Kwai Peng operates a company specializing in the use of stresswave measurement to perform dynamic load test on piles. He is a member of PPC, EC0, EC1, EC2, EC3, EC7, EC8 and Malaysian Wind Code committee. He is also the IEM SWO (Standard Writing Organisation) coordinator.

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