

2-Day Symposium and Workshop on Earthquake Engineering in Malaysia & Asia Pacific Region 2011

By Ir. Prof. Dr Jeffrey Chiang Choong Luin



Ir. Prof. Dr Jeffrey Chiang holds several posts in IEM, namely Honorary Secretary of IEM, Past Chairman and committee member of Civil & Structural Engineering Technical Division for session 2012/2013 and Chairman of Technical Committee on Earthquake. He is also Head of Civil Engineering at INTI International University.

The above event was jointly organized by IEM Civil & Structural Engineering Technical Division and the Faculty of Engineering & Science of Universiti Tunku Abdul Rahman on 6-7 December 2011. It was held at Armada Hotel, Petaling Jaya, and was well attended by 110 participants on Day 1 Symposium followed by 85 participants having attended the Day 2 Workshop.

For the Day 1 symposium, the line-up of speakers was a true international representation of earthquake experts from the Asia Pacific Region. They are as follows, with their respective presentation paper titles:

- (1) "Introductory Paper on Current Status in Earthquake Effects Study in Malaysia and Possible Lessons to be Learnt From Regional Seismic Experts", by Ir Assoc Prof Dr Jeffrey Chiang Choong Luin (Malaysia)
- (2) "Keynote Paper on Are Our Structures Safe From Collapse in Local Earthquake Scenarios", by Assoc Prof Dr Nelson Lam (Australia)
- (3) "Invited Paper on Regional Seismic Hazard Posed by the Mentawai Segment of the Sumatran Megathrust: Source, Path and Site", by Dr Kusnowidjaja Megawati (Singapore)
- (4) "Invited Paper on Performance Requirements and Design Spectrum Model for Structures in Regions of Low-to-Moderate-Seismicity", by Dr Tsang Hing-Ho (Hong Kong)
- (5) "Keynote Paper on Canadian Seismicity and Seismic Design Practice in Canada", by Prof Murat Saatcioglu (Canada)
- (6) "Special Invited Paper on Infrastructure Damage by the 2011 Great East Japan Earthquake", by Dr Keiichi Tamura (Japan)
- (7) "Invited Paper on The Vietnam Design Code TCXDVN 375:2006, and Its Application in Practice", by Dr Nguyen Dai Minh (Vietnam)

The Day 1 symposium ended at 5.30pm with a lively questions and answers session, with many questions posed by members of the audience, wanting to know the implications of earthquake design standards if imposed to the local construction industry.

The Day 2 Workshop kicked off at 9.00am with three short lectures as follow:

- (1) "Invited presentation on Assessment of Seismic Hazard for Peninsular Malaysia (I): Scenario Based Approach", by Associate Professor Dr Nelson Lam (University of Melbourne), assisted by Engr Looi Ting Wee
- (2) "Invited presentation on Probabilistic Approach for Determination of Design Spectrum Model for Peninsular Malaysia", by Dr Tsang Hing Ho (Hong Kong University), assisted by Engr Looi Ting Wee
- (3) "Invited presentation on Site Characterisation Using Microtremor Survey Method", Dr Kusnowidjaja Megawati (Nanyang Technological University, Singapore)

The first presentation by Assoc Prof Dr Nelson Lam was a Part I lecture series, focusing on Reviewing the Attenuation Modeling and the use of the Component Attenuation Method (CAM). He described the various methodologies adopted in determining seismic intensity measurement based on empirical models, semi-theoretical models, intensity models and the use of stochastic simulations. He presented the development of the CAM method various earthquake events which had occurred in the region, i.e. Melbourne, Hong Kong, Northern Iran, Central China and Sumatra.

The second morning presentation by Dr Tsang Hing Ho, was divided in two parts, i.e. Part I (Background and Methodology) and Part II (Literature Review). The topics covered in Part I included the following: Concepts of Design Spectrum (DS) and Uniform Hazard Spectrum (UHS), Probabilistic Seismic Hazard Assessment (PSHA), Seismic Zoning Map, and alternative PSHA methods. Historical earthquake events in South China were shown as a guide to the use of PSHA method. The Attenuation model developed for Central and Eastern North America was presented as the basis for further development into UHS method as used in the Hong Kong studies. The difference in basic approach for deterministic and probabilistic methods was explained, while the PSHA method was elaborated, using the Hong Kong model developed by ARUP in 2011.

The basic procedures involved in using PSHA method is as follow:

- (1) Identifying and characterizing the seismic sources that define the geographical variation of earthquake activity.
- (2) Proposing a model of earthquake recurrence, with respect to its magnitude, in which observed seismicity can be used to determine the model.
- (3) A ground motion prediction equation (GMPE) is required to determine the amplitude of ground shaking.
- (4) Develop a Logic Tree framework, to link up, the source models, GMPEs, recurrence models, to account for uncertainty in the modeling.
- (5) Finally, all the uncertainties in earthquake location, size and ground motion prediction are combined to obtain the probability of exceedance of ground shaking parameter, during a particular time period.

The Part II lecture on Literature Review was presented in detail by Engr Looi Ting Wee, based on his preliminary research findings in collaboration with both Assoc Prof Dr Nelson Lam and Dr Tsang Hing Ho. Further details would be made available upon completion of his study by middle of 2013.

The last speaker to present in the morning session was Dr Kusnowidjaja Megawati on the use of Microtremor Survey Method using Singapore as a test site. Basically, the microtremor survey method is non-invasive, relatively cheap and is quick to conduct on site.

The principle behind the method is as follows: Assuming that Rayleigh wave is the dominant seismic wave in a microtremor, the velocity of the Rayleigh wave can be computed with frequency or phase velocity. From there, the shear-wave velocity profile of the site of measurement can be derived.

Dr Megawati presented the use of horizontal-to-vertical spectral ratio (HVSr) method, which involves single station microtremor measurements. As a reliability check of measurements taken at three sites in Singapore, Table 1 indicates a close match of the measured results against ground motion data and borehole log data.

Table 1 – Comparison of site fundamental estimation (Hz)

Investigated site	Site fundamental frequency estimation (Hz)		
	Microtremor survey	Ground motion data	Bore log data
NTU	3.5	3.3	3.6
KAPK	1.1	1.2	1.2
BESC	1.4	1.6	1.6

Dr Megawati proceeded to describe the use of array configuration for triangulated arrangement of multiple measuring stations in the use of microtremor survey, so as to obtain frequency measurements at larger depths on site. On the Bukit Tinggi fault (in Peninsula Malaysia), it was suggested that the steps to verify an active fault is to carry out site investigation work, involving trenching and borehole investigation.

In the forum discussion period, the following were key topics raised by some members of the audience.

The definition of far field or long distance earthquake was asked, and Dr Tsang suggested that there is no definite term for that, but the following may be used as a general rule:

Near field earthquake:	Source is 30-50 km away from site
Medium field earthquake:	Source is 150 – 250 km away from site
Far field earthquake:	Source is 300 – 400 km away from site

On the threat of inland Sumatra earthquake fault, which may generate an earthquake of magnitude 8.0M at 300 km away from Peninsular Malaysia, Dr Kusno Megawati is of the opinion that the inland Sumatra fault is quite segmented, the longest is 50-60km, at most it can generate an earthquake of magnitude 7.2M or 7.8M (if measured in Singapore). These possible intra-fault events do also have to be considered but they are not as serious compared to the case of the subduction zone in western offshore of Sumatra, which was responsible for the 2004 earthquake of magnitude 9.0M resulting in the devastating tsunami that followed.

On the rationale for Vietnam to adopt Type 1 response spectra recommended by Eurocode 8, the experts agreed with its adoption, since this is suitable for near field earthquakes, which are predominant in Vietnam. Unlike in Malaysia, which so far has experienced tremors felt from far field earthquakes originating from Sumatra, there is also the possibility of localized or near field earthquakes in the Peninsular itself at Bukit Tinggi. Dr Nuyen Dai Minh clarified that Vietnam’s Technical Committee decided to adopt Type 1 response spectrum, due to its earthquake magnitude being less than 5.5M, and the focus was on building structures with natural periods ranging from 1.5 to 4 seconds.

Prof. Murat Saatcioglu suggested for Malaysia to adopt the hybrid approach, i.e. to consider response spectrum that can cater for both near and far field earthquake events. It may be a good idea to consider the Uniform Hazard Spectrum (UHS), which is under consideration in USA. Dr Kusno Megawati suggested that the Singapore approach is to consider the hybrid approach, by combining into one response spectrum graph, with the far field earthquake being dominant, and the near field is considered as background seismicity. Prof Nelson Lam is of the opinion that UHS may be a suitable hazard categorization for high-rise buildings, but may not be a suitable response spectrum to use on similar high-rise buildings in Malaysia.

Prof. Nelson Lam sketched out the possible hybrid model to represent the far and near field earthquake events, and also the UHS model.

At the end of the workshop, many grounds have been covered, and more work has to be planned over the next year or two, to proceed onto the next level, i.e. producing a workable and practical seismic response spectrum for Peninsular Malaysia, to take into account of both the far field and near earthquakes. The next Symposium and Workshop session is planned for either end of 2012 or in early 2013.