Gathering of Views and Opinions on Seismic Investigations in Peninsular Malaysia – Report on the IEM Workshop on Earthquake (Part 1)

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IEM TECHNICAL COMMITTEE ON EARTHQUAKE

Note: This is Part 1 of a two-part article. Part 2 will be published in the November 2011 issue.

AFTER the two-day course on earthquake ground motions and responses of reinforced concrete buildings on 22-23 June 2010, delivered by Prof. Nelson Lam from Melbourne University, Australia, and Dr Tsang Hing Ho from Hong Kong University (which was reported in the February 2011 issue of JURUTERA), a two-day workshop was held at Bangunan Ingenieur. The topic of discussion revolved around earthquake engineering development in Malaysia, with a specific focus on the determination of suitable peak ground accelerations for Peninsular Malaysia.

The panel of experts invited to provide their inputs and opinions included Prof. Lam, Dr Tsang and Dr Kusno Megawati from Nanyang Technological University (NTU), Singapore. The participants were specially invited by the Civil and Structural Engineering Technical Division, IEM (CSETD) and Geotechnical Engineering, as well as the IEM Technical Committee on Earthquake. The workshop was chaired by Ir. MC Hee, who is a member of CSETD and the WG1 Chairman of the Technical Committee on Earthquake.

DAY 1 PROCEEDINGS

The following is based on written notes by Ir. Mun Kwai Peng, a member of the Technical Committee on Earthquake.

Seismic attenuation models and peak ground accelerations

Prof. Lam started by delivering a short presentation on his research work on seismic engineering in Australia, and the formulation of the Component Attenuation Modelling (CAM) method, which has been widely used by many researchers in the Asia-Pacific region, including India and China, where earthquakes of both near and far fields are common occurrences. He then presented some of the provisions and recommendations of Eurocode 8 or EN 1998-1, which is a standard document currently being evaluated by the IEM Technical Committee on Earthquake for adoption as the Malaysian Standard.

When questioned by a participant, Prof. Lam explained that the formulated CAM model is a deterministic approach to working out the peak ground accelerations and other related parameters. The method focused on attenuation modelling on the transmission of seismic waves from the epicentres at certain distances from the measured site, hence there is no emphasis on probabilistic considerations.

Local researchers have tended to apply probabilistic approach in determining attenuation models based on established methods formulated in the United States. From the findings of PGA values published in noted papers, these are in the range of 0.08g to 0.10g for the western side of Peninsular Malaysia.

These predicted PGA values are considered quite high considering that the Malaysian Meteorological Department (MMD) has produced recorded measurements of very low local PGA values (from 0.0015g to 0.003g) at the height of the 2004 Boxing Day earthquake in Banda Aceh, and also from the far field seismic wave transmitted during the 26 March 2005 Nias earthquake.

Far field seismic effect from Sumatra

Prof. Lam gave an interesting insight into the earthquake effect in Peninsular Malaysia. For long distance or far field earthquake effect, he suggested that the code drafters should not refer to recommendations from any standards or codes of practice. For example, for the Sumatra subduction zone earthquake (on the western side facing the Indian Ocean), the Eurocode 8 models cannot be used in this country.

By that, he meant that the seismic response spectra or peak ground acceleration methodology may not be applicable. However, the seismic design detailing for structures, such as for reinforced concrete buildings, may be applicable if the right ductility class is used. For example, in Peninsular Malaysia, the classification DCL (ductility class low) or even DCM (ductility class medium) may be considered for design consideration.

The subduction zone offshore on the west coast of Sumatra is more seismically active compared to the land faults along the inland of Sumatra.

Local earthquakes or near field seismic considerations

The next panel expert to present his view was Dr Kusno. He introduced his research background and the latest

development in his research findings on carrying out data collection and acquisition in the study of ground soil profile through the use of the geophone and global positioning system (GPS). He has done such fieldwork surveys in Indonesia, Singapore and Hong Kong. The intention of the site work investigation is to learn and correlate the soil profiles to past earthquake events occurring at the surveyed sites.

From the data collected and analysed, a true picture can then be formed on how the seismic waves can be attenuated (reduced in its dynamic effect) or be magnified, especially in soft clayey soils, as experienced in the "bowl of jelly" effect during the earthquake of Mexico City in 1985. Dr Kusno was quite concerned with the possibility of a local earthquake occurring in Bukit Tinggi, and he recommended intensive investigation by local researchers in this area.

Dr Tsang concurred with Dr Kusno, and based on his previous experience while carrying out a joint geophone seismic survey with Dr Kusno and his team from NTU, he said it would be worthwhile for Malaysia to undertake a similar geophone seismic survey in Kuala Lumpur and its surrounding area, of which he would be glad to assist. He even suggested for Malaysia to send representatives to participate in a geophone survey exercise in Hong Kong that has been planned for next year. From the technological transfer and knowledge gained, local researchers could then take the lead to initiate similar geophone survey exercises in Peninsular Malaysia, starting from the Klang Valley region.

On a side note, Dr Kusno mentioned that he has employed both probabilistic and deterministic approaches in ascertaining seismic parameters such as PGA values, and from his experience, the results of both methods are not that far off.

Bukit Tinggi fault line and its long-term implications

There were various views from the floor on how the local earthquake from the far field Sumatra seismic wave may not be as dangerous as the potential local or near field earthquakes. Earthquakes in East Malaysia are not something new. For example, in places such as Lahad Datu, Sabah, the ground motion felt were always a cause for concern, in view of some of the damages found in building structures and injury to the local inhabitants. However, in the peninsula itself, there is a local fault which has been identified at Bukit Tinggi, near Bentong, Pahang.

With an estimated total length of 80km, the vicinity of the Bukit Tinggi fault means that earthquakes with a magnitude of 3.5 have been experienced before. The latter has been confirmed by the records of the MMD, Seismic Division. The workshop participants all agreed (with recommendations from the international panel of experts) to the suggestion to monitor the Bukit Tinggi fault for three years. Once sufficient data has been gathered, these shall then be sent to the panel experts for further study and verification.

The workshop participants agreed with this direction, but questions were raised on the long-term research effort required and the necessary substantial funding that would be needed. Although this effort should be opened to all stakeholders, it has to be led by research institutions and seismic experts, including geologists. Not only did a representative from the Ministry of Science, Technology & Innovation (MOSTI) voiced the ministry's interest in supporting such work, the effort would also be a good platform for all stakeholders to come together and support IEM in collaboration with local universities and overseas seismic experts.

Further fieldwork or desk study work has to be done, such as searching for the archive of past records and investigation reports previously submitted. It was brought to the attention of the workshop participants

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that the Department of Minerals and Geoscience (JMG) has carried out a geological survey of the Bukit Tinggi fault, however, the completed report has been classified and will not be circulated before declassification. It was suggested that the relevant authorities, including MMD, should be contacted for the release of the said document for study by the panel experts. A representative from JMG was invited to attend the second day of the workshop.

Financial support from governmental agencies for local seismic studies

Financial support was also required from various governmental agencies which have a stake in the health and development of the local construction industry, namely, Jabatan Kerja Raya (JKR) or the Public Works Department, the Construction Industry Development Board (CIDB), MOSTI through its Department of Standards Malaysia (DSM) and, last but not least, the Ministry of Housing and Local Government (MOHLG). The specific study areas that need the immediate attention of local researchers should include the following:

- attenuation model;
- design return periods for earthquake;
- attenuation properties of local soil;
- peak ground acceleration;
- peak ground velocity;
- peak ground displacement; and
- soft soil amplification

A likely outcome of the study is the production of a seismic hazard map for Malaysia (starting first with Peninsular Malaysia), and perhaps a seismic response spectra for far field earthquakes from Sumatra. A suggestion was made by Prof. Lam to merge the local and far field seismic response spectra, and to study the need to produce a response spectrum for both types of earthquakes, instead of having two separate entities.

Foreseeable local earthquake intensity scenarios

At this point, Prof. Lam provided one of the most interesting pieces of information. With regards to the 80km long Bukit Tinggi fault, which is located only about 20km away from the Kuala Lumpur city centre and only a stone's throw away from Genting Highlands, Prof. Lam suggested that the highest possible magnitude of earthquake that can be generated from the fault could be in the range of M7.2. From his years of research experience, the following estimated peak ground accelerations and velocities were suggested in Table 1.

The three international panel experts were of the opinion that, based on the research findings from their work on far field seismic effect (due to Sumatra's subduction zone) and with reference to work by others (including Prof. Balendra at NUS), a PGA value of 0.015g for Peninsular Malaysia is not far fetched. This coincides with the BS8110's provision for 1.5% notional lateral loads (based on dead loads on the particular floor in question).

Table 1: Suggested PGA and PGV values for a range of earthquake magnitude 20km away

Types of structures affected	Measured earthquake magnitude at source 20km away	Peak ground acceleration (PGA)	Peak ground velocity (PGV)
Exceptionally sensitive	M6.5	180 gals (or 0.18g)	180m/s
Hospitals	M6.0	150 gals (or 0.15g)	110m/s
Others	M5.5	80 gals (or 0.08g)	60m/s

And to add to their estimation, a soil magnification of 4 would be acceptable, not a magnification of 10 as proposed by a local researcher.

Conclusion to Day 1 proceedings

It has been said that intraplate earthquakes can take anywhere from 500 to 1200 years to occur again (which is synonymous with the concept of return periods). Earthquakes are extremely difficult to predict, and it is even more difficult to believe that it will not happen again at the same location. The Bukit Tinggi fault is moving and is continuing to move – perhaps at a rate of several millimetres over hundreds or thousands of years. And the fact that it had previously experienced a M3.5 earthquake makes it a likely candidate for more earthquakes in the foreseeable future.

In comparison, Prof. Lam noted that, the intraplate faults in Australia have no prior records of earthquake incidents, and in areas previously defined as seismic free zones, the sudden and unexpected occurrence of M5.5 earthquakes (e.g. in Newcastle, NSW in 1989 and in Kargoolie, Western Australia in 2009) had literally sent shockwaves around the continent. It has brought about substantial changes in the seismic design provisions in the Australian Standards for engineering structures. ■

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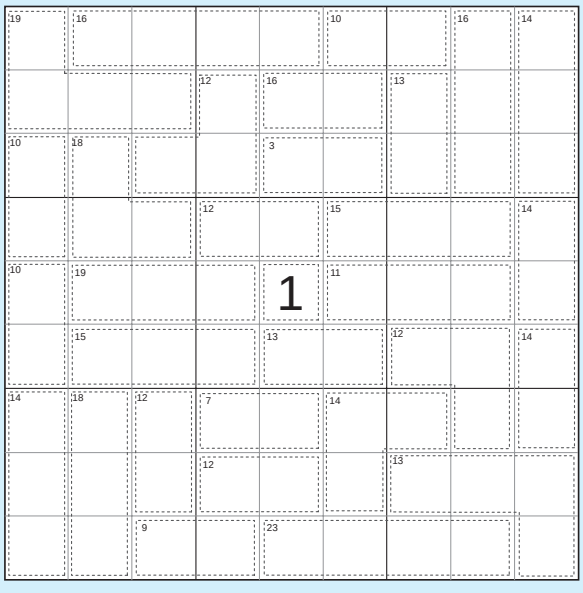
1) IEM is pleased to announce that Library information is now available on the IEM Portal (www.myiem.org.my). Members can now perform various activities such as searching for book titles, lodging of book requests (recommendations) and making book reservations through the Internet.

   Members are required to produce their membership cards for scanning purposes when borrowing books from the Library. (The Library is open every Monday to Friday from 9.00 a.m. to 6.00 p.m. and every Saturday from 9.00 a.m. to 1.00 p.m.)

2) IEM has subscribed to the ICE Ground Engineering eBooks and Journal Collection from 2000 onwards. Members are able to view and download full text articles (in PDF format) in the Library.

The Library Sub-Committee wishes to thank the Geotechnical Engineering Technical Division for bearing the cost of subscribing to the journal.



1SUDOKU Centerpiece "1"

by Mr. Lim Teck Guan

Fill in the remaining 80 squares with single digits 1-9 such that there is no repeat of the digit in every Row, Column and Block. The number at the top left hand corner of the dotted cage indicates the total for the digits that the cage encompasses.

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(*Solution is on page 57 of this issue.*)