Preview of National Annex to EC8: Seismic Loadings for Peninsular Malaysia, Sabah and Sarawak

INTRODUCTION
In April 2013, a technical paper entitled ‘Recommended Earthquake Loading Model For Peninsular Malaysia’ was published in IEM Jurutera. This was followed by a publication in IStructE Conference 2013 (held in Beijing and Shanghai) under the title ‘Earthquake Loading Model In The Proposed National Annex To Eurocode 8 For Peninsular Malaysia’, both of which were presented by Professor Nelson Lam (refer to Figure 1).

In both papers, the Preliminary Hybrid Seismic Response Spectrum Model for Peninsular Malaysia was presented internationally for the first time.

From the April 2013 IEM workshop on earthquake and the two technical papers published in 2013, the following are the key points to note:

1. The use of 2,500-year return period and displacement based approach for seismic analysis.
2. One unified standardised seismic response spectrum model developed for the whole peninsula.
3. Two-tier site factor approach to account for local conditions.

In the IEM workshop on ’2-day Workshop on Recommended Earthquake Loading Model in the Proposed National Annex to Euro Code 8 for Sabah, Sarawak & Updated Model for Peninsular Malaysia’ held on 16th-17th July, 2014, the updated preliminary design spectrum for Peninsular Malaysia and a newly established preliminary design spectrum for Sabah and Sarawak were introduced.

The report gave a brief introduction into the three response spectra mentioned above, for a return period of 2,500 years of seismic wave transmission at bedrock level.

PENINSULAR MALAYSIA
For the distant earthquake model, the Uniform Hazard Spectrum (UHS) developed by Pappin et al (2011) was modulated to incorporate the latest updates of Ground Motion Prediction Models. For the local earthquake, a deterministic design scenario of M6 at R=20km, based on global hazard model was recommended, reconciling with the world average of intraplate earthquakes for a return period of 2,500 years.

The updated model was revised from the proposed 2013 Design Spectrum Model for Peninsular Malaysia to cater for better understanding of local intraplate earthquakes and modulated corner periods. Combining both distant and local hazards, the updated model was presented in both displacement-based and force-based formats and expressed algebraically in a manner similar to EC8 peak ground acceleration format.

Figure 2a below is the displacement spectra and figure 2b is the acceleration spectra. From the figures, up to period of 2s, the spectra is controlled by the local earthquake, after 2s the distant earthquake controls.

SARAWAK
With reference to Kuching, Sarawak, earthquakes of magnitude 3.5Mb to 5.3Mb have occurred within 500 km from Kuching. There are some major faults in the State, including the Keilwai Fault and Bukit Masing Fault (Figure 3).

A single unified response spectrum for Sarawak is recommended, using the same principle as that for the updated model for Peninsular Malaysia, such that the local and distant models are regulated using the displacement format (Figure 4a) and presented both in displacement and EC8 peak ground acceleration format (Figure 4b). As seen in the figure, the design spectrum for Sarawak is controlled by the local earthquakes.
Local seismicity and distance reference to Kuching Sarawak

- Since 1874 – 21 earthquakes, magnitude from 3.5 – 5.3 Mb
- Major Faults
  - Lutan Line; former subduction
  - Bukit Mersing Line
  - Kelawai Fault
  - West Barum Line
  - Tubau Fault

Source: 2009 ASSESSMENT OF THE SEISMIC THREATS TO MALAYSIA FROM MAJOR EARTHQUakes IN THE SOUTHEAST ASIAN REGION AND SEISMOTECTONIC MAP OF MALAYSIA AND FAULT LINE ZONE STUDY FORUM

Figure 3: Kuching Reference Distance to fault zones

SABAH

Since Sabah is very near highly volatile, earthquake-prone countries such as Indonesia and Philippines, the chances of an earthquake happening there cannot be taken lightly or overruled. In the past, earthquakes of magnitude greater than 5 have been recorded at a distance of approximately...
100km from Sabah (Figure 5). Hence a unified design model for the whole of Sabah was recommended (Figure 6a/b), similar to that for Peninsular Malaysia and Sarawak.

**PRELIMINARY COSTING**

Preliminary structural cost implication due to the proposed Hybrid Design Spectrum was carried out on structures of rigid-jointed frame for 1-storey and 5-storey buildings, shear wall-frame for 10-storey and cored-wall for 30-storey buildings.

Refer to the IEM "2-day Workshop on Recommended Earthquake Loading Model in the Proposed National Annex to Euro Code 8 for Sabah, Sarawak & Updated Model for Peninsular Malaysia, 16th-17th July, 2014 lecture notes for further details in the costing.
FEATURE

Refer to the IEM "2-day Workshop on Recommended Earthquake Loading Model in the Proposed National Annex to Euro Code 8 for Sabah, Sarawak & Updated Model for Peninsular Malaysia", 16th-17th July, 2014 lecture notes for further details.

CONCLUSION

It can be concluded that:

1. Hybrid Design Response Spectrum for Sarawak is dominated by local earthquake with a peak ground acceleration of 0.1g for a return period of 2,500 years at bedrock level.

2. Hybrid Design Response Spectrum for Sabah is dominated by long distant earthquake with a peak ground acceleration of 0.8g for a return period of 2,500 years at bedrock level.

3. Preliminary structural cost increase (excluding foundation) is only 3.4% for a 10-storey building.

RECOMMENDATION

The recommended earthquake design spectrums presented at the workshop are as summarised below in Table 1.

Table 1. Parameters for Hybrid Design "Spectrum for P. Malaysia, Sabah, Sarawak"

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<th>Parameter</th>
<th>RSA</th>
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<th>SD(Tp)</th>
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<th>Tb</th>
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<td>0.1</td>
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<td>0</td>
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REFERENCES


Pengumuman yang ke-74

Institusi mengucapkan terima kasih kepada semua yang telah memberikan sumbangan kepada tabang Bangunan Wisma IEM. Alih-alih IEM dan pembaca yang ingin memberikan sumbangan boleh berbuat demikan dengan memuat turun borang di laman web IEM http://www.iem.org.my atau menghubungi secretariat di +603-7568 4003/5518 untuk maklumat lanjut. Senarai penyumbang untuk bulan September 2014 adalah seperti jadual di bawah:

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