Two-Day Symposium – Workshop on Earthquake Engineering in Malaysia and Asia Pacific Region


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THE Two-Day Symposium cum Workshop on Earthquake Engineering in Malaysia and Asia Pacific Region was the continuation of a series of earthquake lectures and courses held in 2011 and 2012. It was organised by the Civil & Structural Engineering Technical Division of IEM, in collaboration with IEM Technical Committee on Earthquake.

The lectures, delivered by various renowned speakers, were held on 10 and 11 April 2013 at Armada Hotel, Petaling Jaya. 93 participants attended the symposium which kicked off with an opening speech by a special invited guest, En. Mahadir Mohamed who represented Standards Malaysia, the main sponsor of the event.

The following is the line-up of speakers:

(1) An introductory paper by Ir. Prof. Dr Jeffrey Chiang, Chairman of IEM-TC Earthquake.

(2) **Seismic Hazard Assessment in Europe**, by Prof. Friedemann Wenzel from Karlsruhe Institute of Technology, Germany.

(3) **Performance of Structures in Region of Lower Seismicity**, by Prof. John Wilson from Swinburne University of Technology, Melbourne.

(4) **Determination of the Seismic Loads based on TCXDVN 375:2006 and Comparisons with those obtained from other codes**, by Dr Nguyen Dai Minh from Vietnam Institute for Building Science & Technology (IBST) Hanoi.

(5) **A Global Approach to Ground Motion Predictive Relationships for Structural Design Applications**, by Prof. Nelson Lam from University of Melbourne.

(6) **Seismic Hazard Assessment for Sri Lanka**, by Dr Srikanth Venkatesan from Victoria University, Melbourne.

(7) **Local Site Effects on Earthquake Loading Model in Regions of Low-to-Moderate-Seismicity**, by Dr Hing-Ho Tsang from Karlsruhe Institute of Technology, Germany.

The second day was the workshop consisting of three forums:

1. Seismic Hazard and Design Spectrum Model for Peninsular Malaysia
2. Site-Specific Design Spectrum Model and
3. The Way Forward.

The modified distant earthquake model was first introduced with rigorous steps involved to determine the period dependant correction factor, forming a probabilistic Uniform Hazard Spectrum (UHS) with a 2,500-year return period (RP). It was followed by a detailed discussion on local earthquake modelling, which was linked to Professor Nelson Lam's "global approach on seismic hazard model", with deterministic approach based on Peak Displacement Demand (PDD) and reaching a magnitude-distance combination of M6R20-30, resulted in notional peak ground acceleration (PGA) of 0.13g. Finally, the process of unifying the two response spectrum models into a single hybrid response spectrum of displacement (RSD) was explained. The distance effects were discussed, taking KL and Penang as examples. The recorded earthquake data, Eurocode 8 (EC8) type 1 and 2 spectrum and 1.5% of notional load were also compared to the proposed hybrid model. In the final discussion, the task force suggested further unifying the model by harmonising the short period (taking KL as benchmark at notional PGA 0.13g) and the long period (taking Penang as benchmark at 400km from Sumatera Subduction fault) throughout the peninsula for engineering design simplicity.

The second invited presentation on "Study on Hypocenter relocation of the local earthquake in Malay Peninsula using the Modified Joint Hypocenter Determination (MJHD) and HYPOCENTER Programs" was presented by Dr Mohd. Rosaidi from the Malaysian Meteorological Department (MMD). The calibration work of relocating 13 hypocenters of local earthquakes using MJHD approach and Hypocentreprograms were presented.

The second forum was chaired by Professor Nelson Lam. Dr Hing-Ho Tsang talked on "Recommended Site-Specific Design Spectrum Model for Malaysia". First, the site classification and site factor in EC8 were discussed. Other alternatives of site amplification were presented by introducing the Germany spectrum with site factors, non-linear model for the next European GMPE, readily available computer program like SHAKE and SIREN, and site effect terms as continuous functions of site period. Finally, the use of a simplified non-linear formula for S-factor, which can be further simplified into two design charts or programmed into a spreadsheet, was discussed by using the example of a site in Hong Kong, along with comparisons using SHAKE and EC8 models.

During the Forum (2) open discussion session, a few guidelines for site factor were highlighted in order to make a decision on the format to be coded into the Malaysia earthquake standard in future. The displacement-based approach and whether or not the Malaysian code should adopt this came under discussion. This approach had been used by some engineers at the forum, with experience in seismic design. They adopted a force based design approach and, using the displacement-0 based approach as a performance check, had arrived at a logical, reasonable and satisfactory result. The international panel speaker, Professor John Wilson, suggested that no matter is RSD

or RSA, so the response spectrum model forming the Acceleration Displacement Response Spectrum (ADRS) must be robust.

Another important point brought forward for discussion was the option of a hand calculation non-linear site factor formula (presented by Dr Hing-Ho Tsang) or the use of SHAKE or SIREN site factor program. Some practicing consultants are inclined towards the use of SPT (due to abundance of bore-log data) as reference into the site class table and the use of simplified formula for hand calculation. Professor John Wilson stated that the whole sub-surface geological profiles are necessary in order to perform the options above. Professor Friedemann Wenzel suggested relating the site factors to the geological features of the country. For example, in Germany, the site factor is pre-fixed by coordinates and engineer does not need to calculate the site factor. Professor Nelson Lam suggested that the conventional code approach – by specifying site factor in tables in accordance to SPT and shear wave velocity – could be applied for simple and general structures as a first tier approach. A higher tier approach using hand calculation of non-linear site factor incorporating site period parameter, could be proposed for very important structures and for very bad soil conditions. There was no further opposition on the suggested two-tier method.

There was further discussion on the decision of the option of dynamic soil column hand calculation S-factor as higher tier method, the decision of bilinear format, site corner period and site factor. It was noted that the bilinear format is the way to go and that further work needs to be done on the site corner period and site factor. A suggestion was made by practicing consultants to eventually map the urban areas of Malaysia using the bore-log archived data. The above discussions were endorsed in the workshop in Forum (2) (see Figure 1).

Professor John Wilson chaired the final forum, "The Way Forward". Key points to reach a consensus discussed were as follow:

1. The use of 2,500 years RP and displacement based approach
2. The further unified model for the whole of Peninsular Malaysia
3. Two-tier site factor approach
4. Behaviour/Ductility "q" factor
5. Equivalent seismic base shear design for simple structure
6. Others: Non-structural elements, adoption of EC8

1. THE USE OF 2,500 YEARS RP AND DISPLACEMENT BASED APPROACH

The discussion was focused on the use of 2,500 years, 500 years and 100 years RP as life-safety limit state, damage control limit state and service ability limit state. The international panel (Professor John Wilson, Professor Nelson Lam, Dr Nguyen) and IEM WG1 Chairman Ir. M.C. Hee explained on the different types of RP and the displacement-based design approach. It was suggested to check life-safety (survival) limit state using 2,500 years RP where the displacement component should be taken into consideration. For design, it was suggested to scale it down to 500 years RP as damage control limit state using the q factor. The representative from the oil and gas industry further affirmed this approach and quoted the ASCE code using a factor of 2/3 (=0.67) to scale the maximum considered earthquake 2,500 years RP spectrum into design earthquake spectrum.

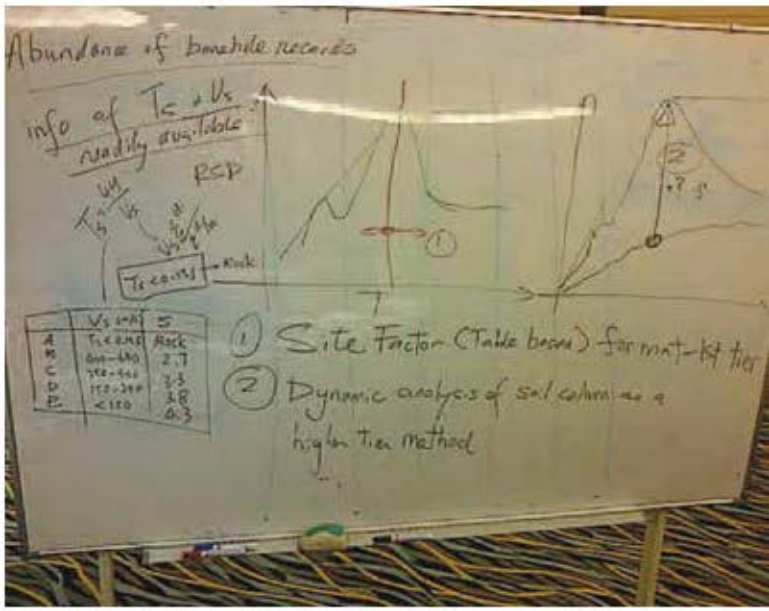

Figure 1: Forum (2) site factor discussion and endorsement, sketched out on whiteboard

2. THE FURTHER UNIFIED MODEL FOR THE PENINSULA

As presented in Forum (1), the task force proposed a more unified model for Peninsular Malaysia and this was put forward for discussion to reach a consensus. Various opinions were given. In general there were two schools of thoughts. The practicing structural consultants preferred the use of one standardised hazard model for ease of design. However it was noted that this must be subjected to impact study on the existing structures for cost implication. Other non-engineering industries were concerned with the social security impact, and preferred the use of hazard map.

It was pointed out that the contour hazard map was only feasible for long distance earthquakes in the case of Peninsular Malaysia (and not for local earthquakes due to paucity of recorded data). Professor Friedemann Wenzel agreed on the idea of having a single value for now, due to uncertainties at this point for a low and moderate seismic area like the peninsula, unless there is more recorded data and scientific justification in the future. The general consensus was agreeable on the proposed spectrum using a hybrid approach and to come out with the National Annex (NA) of EC8 as soon as possible for the industry. Further

refinement (eg: contour map, benchmark M-R combination) could be made in the future.

3. TWO-TIER SITE FACTOR APPROACH

This decision was made in Forum (2) and again endorsed in Forum (3).

4. BEHAVIOUR/DUCTILITY "q" FACTOR

Professor John Wilson suggested that the q factor should be a minimum of current Malaysia practice. Ir M.C. Hee suggested a value of 1.5 (as stipulated in EC8), a fairly conservative value without seismically detailed joint, but mainly due to inherent ductility/robustness of existing structure. The q factor related to bridges was highlighted as different by bridge structural designers. However, the spectrum for both buildings and bridges is the same. Further work ought to be carried out by IEM C&S earthquake TC WG2.

5. EQUIVALENT SEISMIC BASE SHEAR DESIGN FOR SIMPLE STRUCTURE

The equivalent seismic base shear design method was also discussed. Using Australia as an example, Professor John Wilson said that for ordinary building under 15m high, this simplified approach came in handy for designers. It was agreed to incorporate this simplified method for ordinary buildings as earthquake engineering knowledge was not well established yet among consultants in Malaysia.

6. OTHERS: NON-STRUCTURAL ELEMENTS, ADOPTION OF EC8

Concerns about non-structural elements were raised. IEM TC Earthquake Chairman Professor Jeffrey Chiang said this issue had been taken into consideration and that WG4 was formed to tackle the issue of non-structural elements under seismic load.

One of the main queries of the industry was the adoption of EC8 in Malaysia. The IEM Organisers revealed that EC0, EC1, EC2 and EC7 part 1 had been submitted and was awaiting parliament reading and approval. Then the industry would go through a transition period. EC8 will follow the same route.

At the end of Forum (3), Professor John Wilson summarised all the points mentioned above. It was noted that the benchmark impact study was essential to justify the use of the proposed spectrum, benefits for civil protection (saving lives) and its cost implication. Also, one of the aims of the workshop was to achieve a coded standard that was not overly complicated for all relevant engineering industry stakeholders to adopt and apply.

The workshop ended at 5.30 p.m. with the appreciative participants giving a round of applause to the invited panel of international seismic experts. Tokens of appreciation were also presented to the individual panel speakers. ■

Note: To read the full article, please refer to www.myiem.org.my

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