

# No Turning Back in Accepting New Design Structures For Earthquake Resistance



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*Ir. Prof. Dr Jeffrey Chiang is currently IEM Honorary Treasurer, has previously served as IEM Honorary Secretary, Chairman of IEM Civil & Structural Engineering Technical Division, Chairman of IEM-SWO Technical Committee on Wind Loads, as well as Secretary of IEM-SWO Technical Committee on Eurocode 2 Concrete Structures Design. Presently, Dr Chiang is also the Dean of the Faculty of Engineering & the Built Environment in SEGI University, Kota Damansara Campus, Petaling Jaya.*

by Putri Zanina

**The development of the National Annex (N.A.) to Eurocode 8 (EC 8) pertaining to the Design of Structures for Earthquake Resistance looks set to achieve its implementation objective with the latest move by the IEM-Technical Committee (TC) on Earthquake to invite the Public Works Department Malaysia (Jabatan Kerja Raya Malaysia or JKR) to jointly develop, promote and enforce the N.A.**

The invitation to JKR was extended during a dialogue session between the IEM delegation and the senior management and technical officials of the Civil and Structural Engineering Branch of JKR on 6<sup>th</sup> February 2015 at JKR Malaysia Headquarters in Kuala Lumpur.

Led by the Chairman of IEM-TC on Earthquake, Ir. Prof. Dr Jeffrey Chiang Choong Luin, the IEM representation was strengthened by the presence of the international expert group for Malaysian N.A. for EC 8, comprising Prof. Nelson Lam, Associate Professor and Reader in Civil Engineering at The University of Melbourne; Prof. Murat Saatcioglu, Professor in Civil Engineering, Faculty of Engineering, University of Ottawa, Canada; Ir. Adjunct Prof. M.C. Hee, the principal of M. C. Hee & Associates; and Hing-Ho Tsang, Senior Lecturer, Faculty of Engineering and Industrial Sciences, Swinburne University of Technology, Australia.

Present on behalf of JKR were the Director of Expert Services and Management Division, Civil and Structural Engineering Branch of JKR, Ir. Dr Kamaluddin b. Abdul Rashid, and senior officials of JKR's Civil and Structural Engineering Branch. Also present was the former Senior Director of the Civil and Structural Engineering Branch of JKR, Dato' Ir. Dr Abdul Aziz b. Haji Arshad, who retired from service recently.

## DEVELOPMENT FOCUS AREAS

In extending the invitation to JKR, which is the technical adviser to the Government of Malaysia on matters concerning the construction and maintenance of public infrastructure in the country, Ir. Prof. Dr Chiang emphasised on four parts of the N.A., which are particularly relevant to the work of JKR, namely:

- BS EN 1991-1-2:2003 Actions on Structures. Traffic Loads for Bridges.
- BS EN 1992-1-2:2004 Design of Concrete Structures. General Rules, Structural Fire Design.
- BS EN 1992-2:2005 Design of Concrete Structures. Concrete Bridges. Design and Detailing Rules.
- BS EN 1992-3:2006: Design of Concrete Structures. Liquid Retaining and Containing Structures.

He said these four areas, which are BS EN standards on concrete structures, would be the focus of development in the immediate future. "These British Standards have yet to be drafted as MS Eurocodes. They have to be further studied with a view for adoption and for developing the N.A. to EC 8 with local parameters incorporated into the code," he said, adding that JKR would be invited to join the TC to develop the four areas.

JKR's assistance is also needed in the move to adopt the EC. "There is no turning back, as the IEM-TC for Earthquakes has already voted to approve the adoption of the main EC8

***"Why do we have the perception that destructive earthquakes won't happen in Malaysia? Although the land size is small, you need to have statistical data based on research. Don't wait too long to capture statistics. You must interpret earthquakes because you have smaller land mass."***

*Prof. Nelson Lam, earthquake engineering expert*

document as MS EN 1998-1:2015. The next step to take is the adoption of the N.A. to EC 8 as N.A. to MS EN 1998-1:2015," he said.

### **OBSOLETE BRITISH STANDARDS IN CONSTRUCTION**

Besides requesting JKR to endorse the work done to date in view of the progress made towards the adoption of the N.A. to EC 8 for Malaysia, IEM also invited JKR to assist in educating the profession in adopting and enforcing the use of structural Eurocodes as MS EN standards in place of British Standards (BS), which have been withdrawn in the UK since 2012.

Ir. Prof. Dr Chiang explained that as a former British colony, Malaysia had been using BS in the construction industry in the past. However, the UK is now no longer using, updating or improving the BS as it is currently using Eurocodes.

Eurocodes are a set of harmonised technical rules developed by the European Committee for Standardisation for the structural design of construction works in the European Union (EU). In March 2010, Eurocodes became mandatory for the specification of European public works and have since become the de facto standard for the private sector in the EU.

"In view of the development, Malaysia must now adopt the EC as well. If we continue to use BS, we would be stuck in terms of advancement. Currently, the law states that the BS is the accepted standard for use in Malaysia. If there are any changes in the standard used, then it will conflict with the by-laws," said Ir. Prof. Dr Chiang.

He reiterated that IEM had studied the issue thoroughly and concluded that using EC was the way to go. "It is logical and reasonable to follow the steps taken by the UK, which had fully adopted the EC. We will have to adopt the EC in line with the withdrawal of the BS in Malaysia."

Besides the UK which has adopted EC 8 and produced its own N.A. to EC8, Singapore has also adopted EC 8 since 2013 and will be fully using it from April this year. As for Malaysia, Ir. Prof. Dr Chiang said, it was still at the deliberation stage and discussed by the TC. It now requires the input by all stakeholders of industries to produce the N.A. with local parameters before the full adoption of EC 8 by Malaysia. The N.A. document will be subject to voting later on. Full adoption can only happen with the acceptance of both EC 8 and the N.A. document. "What is crucial now is setting the deadline for the full adoption of the EC," he said.

He added that in line with the proposed adoption of the N.A. to EC 8, a guidebook is being prepared. Ir. Prof. Dr Chiang said it will be ready by the end of the year. Once the N.A. is adopted, all new projects must be designed according to the new code therefore the guidebook will be a necessity.

### **MALAYSIAN STANDARDS ALIGNED WITH EC**

Ir. Prof. Dr Chiang also presented the scope of BS EN 1998-1:2004 EC 8. It refers to the design of structures for earthquake resistance – General rules, seismic and rules for buildings. This applies to the design of buildings and civil engineering works in seismic regions and deals with the following:

- Basic performance requirements and compliance criteria applicable to buildings and civil engineering works in seismic regions.
- Rules of the representation of seismic actions and for their combination with other actions.
- Fundamental requirements and other relevant aspects of design and safety related to base isolation of structure specifically to base isolation of buildings.
- General design rules relevant specifically to buildings. Specific rules for various structural materials and elements relevant specifically to buildings.

He disclosed that in 2010, the Department of Standards Malaysia (Standards Malaysia) released a two-in-one package comprising the Malaysian Standards (MS) called MS EN 1990:2010 Eurocode: Basis of Structural Design as well as the MS EN 1990-2010 (National Annex) – Malaysia National Annex to Eurocode – Basis of Structural Design.

Also released was another package comprising the MS EN 1991-1-1: 2010 EC1: Actions on Structures – Part 1-1: General actions – densities self-weight, imposed loads for buildings, and the MS EN 1991-1-1: 2010 Malaysia National Annex to EC1: Actions on Structures – Part 1-1: General Action – densities, self-weight, imposed loads for buildings. The MS EN 1997-1-2012 (National Annex) Malaysia National Annex to EC 7: Geotechnical design – Part 1: General rules was also developed and released.

Ir. Prof. Dr Chiang, who is also the Dean of the Faculty of Engineering & Built Environment, SEGI University, has been actively involved in drafting the MS on design of concrete structures. He served as the TC's Secretary and was also the Past Chairman of IEM-TC for Wind Loading.



# IEM 56th Annual Dinner and Awards Night 2015 Programme Book



We are pleased to inform that IEM will be holding the 56th Annual Dinner and Awards Night 2015 on **18 April 2015**. Dimension Publishing has been appointed to put together the Annual Dinner Programme Book which will be circulated to all **1,200 guests** on that night at **Sime Darby Convention Centre**.

It is an annual event organised by IEM to present awards to winners of projects and at the same time to announce the new committee for year 2015/16. Special guests of honour will be invited to officiate the event.

We are now calling for interested advertisers to book their preferred advertising position in this programme book. Below please find the advertising rates for your immediate action and reply. We hope to hear from you soon before the closing date on **23 March 2015**.

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## RECENT PROGRESS OF IEM-TC ON EARTHQUAKE

Ir. Prof. Dr Chiang also took the opportunity during the dialogue to give a briefing on the progress made in recent years. He said the drafting of the N.A. for EC 8 as part and parcel of MS EN to be developed by Standards Malaysia started in 2007, about two years after the 2004 Aceh tsunami. The relevant IEM position paper on the need to have guidelines for earthquake engineering was released in 2007. In 2008, IEM as a standards writing organisation (SWO) was invited by Standards Malaysia through SIRIM Berhad to form a TC to draft the Malaysian Standard (MS), which would serve as the N.A. for earthquake design.

In 2009, following Ir. Prof. Dr Chiang's appointment as Chairman of the TC, all the relevant international standards around the world were studied. This move was part of the preparation to draft the N.A. (MS EN 1998 Part 1), which would tie in with the adoption of EC 8. The TC also organised a series of events, including symposiums and workshops from 2011 to 2013 which saw the participation of both local and international experts.

Last year, a two-day workshop was held to give further explanation on the progress. The highlight was the recommended earthquake loading model in the proposed National Annex to EC 8 for Sabah and Sarawak, as well as an update on the progress for Peninsular Malaysia. Discussions included the approaches for modelling site effects in local earthquakes and the method to compute the natural period with the use of shear wave velocity and how to use average shear wave velocities through layers of different soil with different soil properties.

As far back as 2010, the development progress of MS based on EC design was highlighted in the IEM magazine – *Jurutera*. The article focused on the need to adopt and implement EC in Malaysia, as well as develop the N.A. for the EC.

Ir. Prof. Dr Chiang also shared that a preview of the N.A. to EC 8: Seismic Loadings for Peninsular Malaysia, Sabah and

Sarawak was carried out in 2013. *Jurutera* magazine published a technical paper entitled "Recommended Earthquake Loading Model for Peninsular Malaysia" in April that year, and later published another paper on "Earthquake Loading Model in the Proposed National Annex to Eurocode for Peninsular Malaysia". In both papers, which were prepared by Prof. Lam, the Preliminary Hybrid Seismic Responses Spectrum Model for Peninsular Malaysia was presented internationally for the first time.

In 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 above-mentioned response spectre, for a return period of 2,500 years of seismic wave transmission at bedrock level.

Prof. Lam is an internationally recognised expert in structural dynamics, earthquake engineering and protective technology. In the past 25 years, he has been researching and consulting widely in this field and has published some 200 technical articles which include some 80 journal articles.

## MALAYSIA'S POTENTIAL SEISMIC HAZARDS

Invited by IEM TC to be a member of the study group, which is formed to study the key features for EC8 for Malaysia as far back as 2009, Prof. Lam said the Malaysian context is quite complex in terms of seismic hazard. "Malaysia has three distinct regions – Peninsular Malaysia, Sarawak and Sabah. Peninsular Malaysia is in the middle but away from the tectonic plate boundary, though quite near. It is the interpolate area – along tectonic area of Sumatra, and the Philippines, which is within the tectonic plate of regions including Australia. This is why I have been researching the same type of environment in the last 25 years – giving advice to some of these regions," he said.

He elaborated that Peninsular Malaysia falls under the plate that was hit by a massive earthquake, resulting in the 2004 tsunami. The seismic effects of the long distance earthquake



Photo 1: Some of the key participants of the dialogue between IEM delegation and JKR.

could be felt in Malaysia and Singapore. Peninsular Malaysia is subject to earthquakes that occur in long distances, including Sumatra, as well as susceptible to local hazards.

Sarawak, he continued, seems to be far way from these types of disturbances but the state has local earthquakes due to intraplate seismicity. Sarawak is subject to this sort of hazard.

Sabah is affected by high seismic activity dominated by active faults in surrounding seas of Sabah and The Philippines and therefore it has high risk. The seismicity here is random in nature, similar to the Australian environment.

"Land size in Malaysia is small, and you have not captured much data but earthquakes can still be potentially hazardous here. Data for Peninsular Malaysia has to be developed from scratch. Singapore is near to Kuala Lumpur so it has similar environment. We can apply the knowledge we have gathered on Singapore after the Aceh tsunami to Peninsular Malaysia.

Prof. Lam said local earthquakes in Malaysia are certainly something which researchers have ignored. "Hardly can we find local literature about this. All we obtained was a record of tremors in Bukit Tinggi near the capital city of Kuala Lumpur. But in 2013, another earthquake had happened up north in Perak. Bukit Tinggi activity is a local earthquake but it doesn't mean that it will only happen here. You cannot preclude it from happening elsewhere," he said.

"Why do we have the perception that destructive earthquakes won't happen in Malaysia?" Prof. Lam asked. "Although the land size is small, you need to have statistical data based on research. Don't wait too long to capture statistics. You must interpret earthquakes because you have smaller land mass," he urged. He revealed that Singapore has started implementing earthquake loading standard since last year. "But they have not yet incorporated their local provision in their standard. They are rolling out their standard in stages. Singapore also needs to consider the hazards of local earthquake," he added.

Sumatran earthquakes and long distance earthquakes can affect the taller buildings. Malaysians who were in tall buildings have been reported to have experienced earthquake tremors. Prof. Lam warned that should local earthquakes occur, they could be very hazardous to even low-rise buildings.

"In the summary of technical details which the TC for earthquakes is preparing in accordance with EC8, we will include the design for low collapse conditions. For hospitals, emergency services and other lifeline built facilities, Malaysia need to consider other design criteria which are more complete in terms of earthquake resistance. For most other

buildings, consider only low collapse potential," said Prof. Lam as he presented the recommended categories of building design for Peninsular Malaysia and Sarawak (see Table 1).

Prof. Lam said the recommendations at this stage are subject to more debate and check and balance. For Sabah, he said, different importance factors would have to be determined based on earthquake hazards potential occurring in the state. "It is also important to come out with comparisons with other countries like Singapore, Vietnam and China. Don't look at what we have got only but the observation must be consistent with what's around us," he said.

He added that JKR has a role to play. "This role is to help determine which buildings can be classified as what. The standards design for buildings and all the framework of classifying buildings must involve the government. The NGOs and the private sector can't do it as the country's infrastructure comes under the government."

He added that the outcome of research done by academicians must be considered. Another factor to consider is costing. "In preparing the N.A. to EC 8, look also at the cost aspect. If complying with the N.A. to EC 8 is very costly, no one will want to adopt it. The reaction of the industry has to be taken into account as well."

## SCENARIO IN CANADA

During the dialogue, Prof. Murat Saatcioglu also shared the Canadian experience. He said Canada suffers from earthquakes too. The interplate activities in the country are local therefore extra detailing design of buildings has to be done. He said poorly designed buildings and bridges in densely populated areas can result in devastating losses – both human and economic.

His research showed that the number of seismically deficient buildings and bridges in Canada was estimated to be alarmingly high, with worse scenarios in many other countries in the world.

Prof. Saatcioglu is the President of the Canadian Association for Earthquake Engineering. His recommendations include retrofitting and strengthening as the economically viable approach to reduce seismic risk. His research efforts include the development of new and innovative seismic retrofit technologies for reinforced concrete structures, such as buildings and bridges.

Both Prof. Lam and Prof. Murat were among the international experts invited to speak at the 3rd Symposium and Workshop on Earthquake in February in Kuala Lumpur. The event was part of the efforts geared towards drafting of the National Annex MS EN Standard Eurocode 1998 on earthquake which is scheduled to be ready by the middle of this year. ■

Table 1: Categories of Design Peak Ground Acceleration (PGA) on Rock Sites for Peninsular Malaysia and Sarawak

IMPORTANCE FACTOR	DESCRIPTION	CONSIDERED PGA (G'S)
0.8	Minor constructions	0.06 (0.8 x 0.07)
1.0	Ordinary buildings (individual dwellings or shops in low rise buildings)	0.07 (reference PGA)
1.2	Buildings of large occupancies (condominiums, shopping centres, schools & public buildings)	0.08 (1.2 x 0.07)
1.5	Lifeline built facilities (hospitals, emergency services, power plants & communications)	0.10 (Design PGA consistent with return period (RP) of 2,500 years)