

Seismic Effects: A Threat to Local Structures?

Due to its strategic location, Malaysia is generally spared from any major active seismic activities. However, when natural disasters like earthquakes occur in neighbouring countries, the effects can be felt locally even though the epicentre of the earthquake is hundreds of miles away. In recent months, the inhabitants of Bukit Tinggi experienced tremors due to minor movements from the earth. Although there were no reports of major structural damage, the incident has raised quite a few questions. One of the major concerns is this: "Are high-rise buildings in Malaysia able to withstand such tremors and should future developments be designed for seismic effects?" JURUTERA met up with Engr. Dr Jeffrey Chiang Choong Luin, Chairman of the Civil and Structural Engineering Technical Division of IEM, for some answers.

In your opinion, what is the current ability of local structures to withstand tremors in view of the mild earthquakes at Bukit Tinggi in recent months?

First of all, the mild tremors felt at Bukit Tinggi recently are due to a previously inactive fault line that exists along that area. It is not unusual for some movements along fault lines which are classified as inactive. As for the ability of local structures to withstand such tremors, the effect would be minimal for low-rise building structures (up to four or five storeys), whereas for the inhabitants of high-rise buildings (up to 7 storeys and above), they may feel sideway movements of the structure in response to the tremors. Generally, these buildings would still be structurally sound. Now, to date, most if not all, structures in Malaysia are not designed for seismic actions as Malaysia is considered to lie on a non-earthquake prone zone.

Nevertheless, the current practice by local structural engineers is to consider horizontal forces (or actions) acting on a building structure based on the existing concrete design code of practice (i.e. BS8110) in the form of notional horizontal forces taken as equal to 1.5% of the characteristic

dead load for a particular floor level. In many or the majority cases of structures in Malaysia, this seems to be sufficient to cater for both wind forces and seismic effects. Wind forces (of course), need to be designed for separately. Bear in mind that most of the tremors felt in Peninsular Malaysia originated from seismic actions in Sumatra which are classified as far field effects or of long distance type effects of earthquake.

Unlike Peninsular Malaysia, the inhabitants of Sabah and Sarawak may experience more local earthquakes due to the existence of fault lines that are more active. However, the effects of the earthquake would still be mild and be within acceptable limits.

Despite assurances from the authorities that the recent tremors are minimal and would not cause structural damage or endanger lives, should civil and structural engineers begin to take the necessary precautions to protect new and existing structures from earthquake damage in Malaysia? How can this be done?

In a press interview given by our Immediate Past President, Y. Bhg. Datuk Engr. Prof. Dr Ow Chee Sheng to Berita Harian sometime back in 2005, he proposed that local engineers be more proactive to come up with precautionary measures to ensure that existing structures are designed adequately to resist movements due to seismic tremors felt in Malaysia. This is a revolutionary statement because it involves the engineers who need to check or survey the structural integrity of existing structures, not only to ensure its seismic-resistant capability, but also perhaps to ensure that they are at least designed and built in accordance to current standard requirements. This is to avoid a situation where structures are not designed or built properly in accordance to engineering specifications.

Besides that, The Institution of Engineers, Malaysia (IEM), is also in collaboration with other government agencies (such as the Construction

Industry Development Board and the Public Works Department) and other local stakeholders in the construction industry, to draft a 'Guideline on Design for Seismic Action for Building Structures in Malaysia'. The guideline is expected to be ready by the end of the year. This also ties in with the proposals put up by IEM in their 'Position Paper on Issues Related to Earthquake', which was recently endorsed and approved by the IEM Council. The work is undertaken by a Technical Committee formed by IEM, and is chaired by Engr. Dr Ch'ng Guan Bee, a well-known local earthquake specialist. A few other IEM members, including myself, are actively involved in the committee together with representatives from local public universities, government agencies, consulting engineers, architects, contractors and developers.

It was reported that readings below five on the Richter scale are considered small earthquakes that cannot damage buildings. What level of protection do these measures provide?

The Richter scale is often misconstrued as a measure of how 'big' is the effect on building structures at certain locations away from the source of epicentre of an earthquake. It is not a true measure at all, since the Richter scale measures the 'size' of the earthquake at source. A true measure of the earthquake effect on local ground and buildings is to use the Peak Ground Acceleration (PGA) which measures the intensity of the earthquake felt by structures at a certain distance away from the earthquake source. It uses the unit of g ($=9.81\text{m/s}^2$) or gravitational acceleration. In Malaysia, the tremors felt are usually in the range of $0.01g$ to a high of $0.03g$, or if translated to layman terms, 0.0981m/s^2 to 0.2943m/s^2 .

Generally, a tremor measuring $0.15g$ to $0.2g$ would result in some structural damages to buildings.

For example, during the December 24, 2004 earthquake at Aceh which caused the now infamous tsunami which swept all over the Indian Ocean and killed over

200,000 people, the reading on the Richter scale was 9.0. During another earthquake in Nias, Sumatra in 28 March 2005, the Richter scale measurement is lower than the Aceh earthquake at 8.7, but the inhabitants in Peninsular Malaysia felt that the tremors from the Nias earthquake were stronger. Of course, other factors do come into play, for example, ground conditions and the depth of the epicentre, which will affect how the seismic waves are transmitted to far flung areas.

Hence, readings based on the Richter scale are not the true measure to ascertain the degree of severity in ground movements and damages to buildings due to earthquake, where the epicentre is a distance away.

There were also concerns of an increased potential of landslides if the tremors occurred during the rainy season as frequent tremors would cause instability to slopes. How can engineers alleviate this fear? Should owners of structures built on slopes be concerned?

This question seems more appropriate for geotechnical engineers as landslides are phenomena due to nature as well as manmade and are quite unpredictable. I really do not wish to encroach into other engineering specialty, but to date, we do not seem to have any indication that earthquake tremors would cause instability to slopes. The main culprits are the usual – excessive water runoff left unchecked, soil erosion and what not. Hence, building owners or owner of

developments on hill slopes should really check on the groundwater conditions, followed by a check on earthquake tremors if necessary.

There are claims that many structural engineers implement the conventional approach to protect buildings by increasing the strength of the buildings so that they do not collapse during earthquakes although this approach is not entirely effective. Your comments please.

I disagree with this statement. The method mentioned is actually effective, but only up to a certain extent, after which the designer (engineer) would do well to ensure that the joints in a structure are sufficiently ductile, so as to be able to transfer excessive loadings to other parts of the structure, should one side be impaired. This is to ensure that the overall structure is still able to support the necessary loadings, and, most importantly, allow for sufficient time for the inhabitants to evacuate, if necessary.

What is the level of seismic awareness in Malaysia currently? How can we increase the level of seismic awareness among engineers?

Presently, the level of seismic awareness among engineers in Malaysia is quite low because it is not in their nature to design for seismic effects. At the same time, there are also no subjects on seismic awareness in the curriculum of civil and structural engineers. I believe that it would be a

good idea to introduce courses on the topic to create awareness. Nowadays, engineers do not only work in Malaysia but also around the world. It would serve them well to have some basic grounding on the subject.

It has to be two-pronged. The authority, together with local specialists, has to organise technical talks, seminars and even forums on design of structures for seismic effect. Through this way, knowledge and information can be disseminated to, not only engineers, but perhaps also to members of the public.

On the other hand, engineers must also take the initiative to learn or read up on the aspects of earthquake pertaining to structural design, and most importantly, attend technical talks and seminars on seismic actions, especially those organised by IEM. Those are the right forums for them to question the authority and experts, and also to put forward their viewpoints and opinions. Among those who frequently give talks and courses on seismic design is Assoc. Prof. Dr Azlan bin Adnan, who is Research Head of Structural Earthquake Engineering Research (SEER) at Universiti Teknologi Malaysia, Skudai, Johor. He is one of the foremost authorities on seismic effects in Malaysia, and he is also involved in the IEM Technical Committee on Earthquake.

Through these means, we can move forward to come up with the right plan and course of action by local engineers to alleviate the concerns of the public of their personal and property safety. ■

ERRATA

Our Apologies

In Engr. Lum Youk Lee's article entitled 'Mechanical Engineering Outlook 2008' published in the February 2008 issue of Jurutera, a portion of the article was erroneously removed. We apologise for the error. The conclusion should read as follows:

'However, the extra effort to elevate an ordinary "compliance" based on an "operational efficiency" based building system design does not seem to be appreciated nor well rewarded.

Such phenomenon will certainly continue to haunt the profession both technically and economically. Perhaps, until all of us start to say "tak nak" to inferior mechanical engineering decisions, there will be fewer brain drains amongst the mechanical engineers in Malaysia.'