THE EARTHQUAKE EFFECT OF DOUBLE STOREY RC BUILDING DUE TO SURROUNDING EARTHQUAKE IN MALAYSIA

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Thesis submitted in fulfillment of the requirements for the award of the degree of
B. Eng. (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources
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LIST OF ABBREVIATIONS

JKR	Malaysian Public Work Department
MGDM	Minerals and Geoscience Department of Malaysia
MMD	Malaysian Meteorological Department
PGA	Peak Ground Acceleration
PGV	Peak Ground Velocity

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ABSTRACT

Most structures in Malaysia do not consider for seismic design during its service lifetime. However, recently, Malaysia experienced a tremor events in Ranau, Sabah and it might be effected the structures in Malaysia by the tremors of earthquake in Malaysia and also from neighbouring countries such as Philippines, Indonesia etc. The aim of this study is to identify the behaviour of double storey reinforced concrete building that subjected to earthquake excitation. This research presents the comparative analysis between using Esteem Structural and SAP2000 software. The structure is in three-dimensional form and it is tested with dead load, live load and environmental load such as wind and current load with addition of earthquake ground accelerations from Aceh earthquake. The response of the structure due to the above loadings are illustrated and discussed. Results such as the natural frequencies, vibration modes of the structure, displacement, bending moment and shear stress, etc. are collected and analyzed for both software and be compared. From the analysis result, SAP2000 is more detailed and accurate compared to Esteem. Generally, the building structure with consideration of seismic ground motion is still within the member capacity desirable range. In summary, the double storey reinforced concrete building is yet consider safe and does not require seismic design for this moment of time

ABSTRAK

Kebanyakan struktur di Malaysia tidak mempertimbangkan untuk reka bentuk seismik semasa hayat perkhidmatannya. Walau bagaimanapun, kebelakangan ini Malaysia mengalami gempa bumi di Ranau, Sabah dan kemungkinan struktur di Malaysia akan terjejas daripada kesan gegaran gempa bumi di Malaysia dan juga dari negara-negara jiran seperti Filipina, Indonesia dan lain-lain Tujuan kajian ini adalah untuk mengenal pasti tindak balas bangunan konkrit dua tingkat yang dikenakan pengujaan gempa bumi bertetulang. Kajian ini menunjukkan perbandingan analisis antara menggunakan Esteem dan SAP2000. Struktur adalah dalam bentuk tiga dimensi dan ia diuji dengan beban mati, beban hidup dan beban persekitaran seperti angin dan beban semasa dengan penambahan beban seismik daripada gempa bumi yang berlaku di Aceh. Gerak balas struktur yang disebabkan oleh beban di atas digambarkan dan dibincangkan. Keputusan seperti frekuensi semula jadi, mod getaran struktur, anjakan, momen lentur dan tegasan ricih, dan lain-lain yang dikumpul dan dianalisis untuk kedua-dua perisian dan dibandingkan. Hasil daripada pemerhatian mendapati SAP2000 lebih terperinci dan tepat berbanding Esteem. Secara umumnya, struktur bangunan dengan pertimbangan pergerakan tanah seismik masih dalam julat wajar kapasiti anggota. Ringkasnya, dua tingkat bertetulang bangunan konkrit belum mempertimbangkan selamat dan tidak memerlukan reka bentuk seismik untuk masa ini masa

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Malaysia experienced a relatively strong earthquake recently in Sabah with moment magnitude 6.0 on June this year. These were the strongest earthquake that happens in Malaysia that lasting for thirty seconds since 1976. The tremors exactly struck Ranau and can be felt by the other places like Tambunan, Kota Kinabalu, Sandakan and Tawau. The results from the earthquake, the Kinabalu Park, hostels and the rest house near the Mount Kinabalu has been seriously damaged and temporarily closed. Besides, weak tremors occurred 47 times around 2.2 to 3.3.

Malaysia is labeled as positioned at incredibly some distance far away from the active seismic fault zone. Also known as earthquake free zone. Malaysia is located on a Sunda Tectonic Plate that lies among the Australian and Eurasian Plate in the west of Peninsular Malaysia, while the Philippine Sea Plate and Eurasian Plate on the Borneo of Malaysia. Even though, the tremor effects from the neighboring country still can be felt. Table 1 shows the earthquakes felt in Malaysia from year 1909 to 2005 for Peninsular Malaysia and from 1923 to 2005 for East Malaysia (Taksiah A. Majid, 2007). Since Malaysia is situated in the safe mood region from the earthquake, most of the building in the country does not check earthquake loadings into structural design consideration.

Table 1.1: Earthquake felt in Malaysia

State	Frequencies	Maximum Intensity Observed (Modified Mercalli Scale)
Peninsular Malaysia (1909-2005)		
Perlis	2	IV
Kedah	9	V
Penang	31	IV
Perak	18	IV
Selangor/ KL	37	IV
Negeri Sembilan	4	V
Melaka	9	V
Johor	21	IV
Pahang	4	III
Terengganu	1	IV
Kelantan	3	IV
Sabah and Sarawak (1923-2005)		
Sabah	24	VII
Sarawak	5	V

Source: Taksiah A. Majid, Shaharudin Shah Zaini, Fadzli Mohd. Nazri, 2007

Based on the past earthquake effect, there were no impacts on the building in Malaysia. But, regarding to a Great Sumatra – Andaman earthquake occurred on December 2004 that caused the strong tsunami and devastated a part of Peninsular Malaysia. In addition, it also damaged the building cause by the sequences of the earthquake effect. Since having affected by the neighboring earthquake and itself, Malaysia has come to realize and concern about earthquake seismic design consideration.

1.2 PROBLEM STATEMENT

Recently, Malaysia is facing a difficulty due to the earthquake that happen in Ranau, Sabah, whereas, Malaysia was categorized as a free seismicity group. From this situation, Malaysia need come to realize that seismic hazard from the earthquake is certain and become a probable that can threaten the safety of the public and may damage to the properties. Such concern is attributed to the buildings in Malaysia less than one percent of it are seismic resistance (Taksiah Abdul Majid, 2009).

Earthquake cannot be predicted nor can be prevented. After a large earthquake struck Acheh in Sumatra, Indonesia, it had become warning to all Malaysians as they can feel the tremors in their home ground. In addition, the far-field quake sources, it has been reported that tremors are being felt within Peninsular Malaysia due to correction of Bukit Tinggi fault line (30 km from Kuala Lumpur) after the strong earthquake in 2004 (MMD, 2011). Hence, it is important to consider the probability of hazard from small magnitude intraplate earthquakes at Peninsular Malaysia.

After experiencing several tremors originating from neighbor country and within the country, Malaysia starts considering the earthquake design consideration. Based on a previous investigation (MOSTI, 2009), it had stated that almost of the buildings in Peninsular Malaysia were in great state and only about 50% of buildings chosen had been discovered in deterioration of concrete problems because of vibration throughout earthquake. It has additionally been reported that the design of vertical component in procurement were deficient for no less than half of the building picked.

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