UNIVERSITI TEKNOLOGI MARA

NUMERICAL STUDY ON SEISMIC RESPONSES FOR HIGH RISE BUILDING BY DIFFERENT POSITIONS OF WATER TANKS AS MULTIPLE TUNED LIQUID DAMPER

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PhD

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

For a country like Malaysia which located at stable Sunda Shelf, an earthquake event is an unthinkable, however at end of year 2002, Sumatra earthquake had caused a panic to lot of people in Penang with few buildings were damages. Majority old high-rise building in Malaysia was not design for earthquake but equip with water tanks. Thus, the main objective of this study is to find the ideal location and water level of tuned liquid damper (water tanks) that give optimum structural response reduction during Southern Sumatra earthquake. The key research for this thesis is numerical analysis using SAP2000, but two shaking table experiments were performed for validation purposes of software modelling. Artificial Neural Networks are utilized to simulate human decision-making abilities to predict new desire output which is based on past input and output data. Three parameters were considered which are mass ratio, depth ratio and water tanks positions. From the shaking table test results, it was found that there is no arrangement of Multiple Tuned Liquid Damper that performs better at all motion levels. In terms of overall performance, however, arrangement 2 is preferred. This study also highlights three different heights of high-rise reinforced concrete structures which are 10, 15 and 20 storey high in order to see the relationship between building height and water tanks position during earthquake excitation. Results shows each position of water tanks will gave a different response reduction depending on the height of building. This indicate that multiple water tanks capable to reduce the structure response during earthquake excitation by adjusting water level and its setup location. Artificial Neural Network predicted 25 storey high based on the input and output gathered in SAP2000. According to Artificial Neural Network, a 25-story height filled with only 1/4 of water has the lowest acceleration reaction. As a result, in areas with low seismic activity, such as Malaysia, where these water tanks serve a function other than just water storage, multiple water tanks can be considered cost-effective as a passive damper.

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