VERIFICATION OF RAPID VULNERABILITY ASSESSMENT METHOD FOR LOW-RISE INFILLED RC FRAMES IN THAILAND

Wongsa Wararuksajja[1*], Jarun Srechai[2], Sutat Leelataviwat[3], Virote Boonyapinyo[4], and Jirawat Junruang[5]

[1] Rajamangala University of Technology Thanyaburi, Phatum Thani, Thailand, [2] Burapha University, Chonburi, Thailand, [3] King Mongkut's University of Technology Thonburi, Bangkok, Thailand, [4] Thammasart University, Phatum Thani, Thailand, [5]Rajamangala University of Technology Tawan-ok, Chonburi, Thailand.

*Corresponding author: wongsa.w@en.rmutt.ac.th

1. INTRODUCTION

One of the key issues in calibrating rapid seismic vulnerability screening method, especially for areas with infrequent earthquakes, is the lack of past damage and building performance data for references. To circumvent this problem, a rapid seismic vulnerability assessment method for Thailand developed by the Department of Public Works and Town Planning (DPT) were assessed using collapse simulation of selected building structures. Typical representative low-rise RC frames were selected as case studies. These included a school building, an office building, a commercial building, and an apartment building. The buildings were first assessed using selected rapid vulnerability screening methods. Collapse analysis of the selected representative buildings was then carried out using the Multiple Strip Analysis Method [1]. The results of from the collapse simulation were compared with the results from the rapid screening methods. The probability of collapse of selected buildings was identified and was used as the basis to fine-tune the rapid seismic vulnerability assessment scoring method. Recommendations for the improved scoring method were then provided.

2. DPT RAPID ASSESSMENT METHOD

The rapid vulnerability assessment method aims to quickly assess the seismic vulnerability of a building structure with minimum calculation. The DPT method relies on structural survey and building characteristics to quickly assess collapse likelihood. The vulnerability is provided by assessment score which considers structural types, building height irregularity, soil type, and seismic hazard at the site. First the building is given a base score. The base score is then increased or decreased for each building feature in the check list depending on whether that feature is favorable or unfavorable to seismic resistance. If the final score is less than a certain threshold, the building is deemed unsafe and further measures should be taken. The method was adapted from FEMA154 with the scores modified to suit Thailand sites and building characteristics. Ideally, the final assessment score from the method should collate with probability of collapse [2] given by

$$P(Collpase) = 1/10^{s} \qquad (1)$$

where s is the score obtained from the assessment.

3. CASE STUDY BUILDINGS

In this study, the probability of collapse of selected buildings were evaluated and compared with the probability of collapse estimated from the rapid assessment method. In total, 7 buildings were used as example buildings. These included regular and irregular school buildings (School 01 and School 02), regular and irregular office buildings (Office 01 and Office 02), regular and irregular apartment buildings (Apartment 01 and Apartment 02), and a commercial building (Commercial 01). Fig. 1 shows the example structures used in this study. The irregularity of the structures lies mainly in the way the strong infill walls are distributed within the building. The buildings were given the vulnerability scores based on the DPT method.

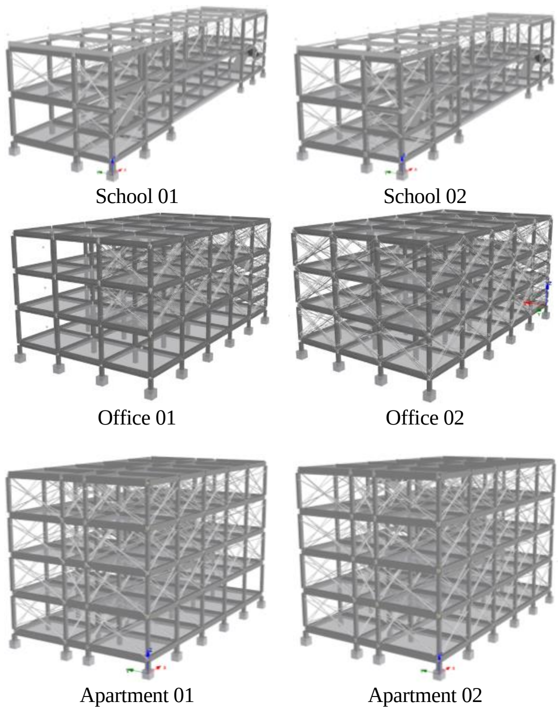
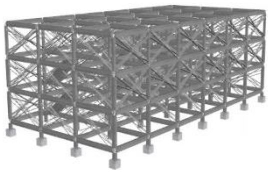


Fig. 1. Example Building Structures

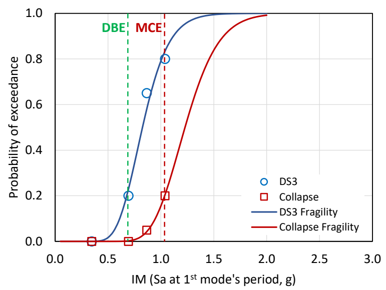


Commercial 01

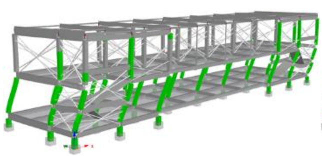
Fig. 1. Example Building Structures (cont.)

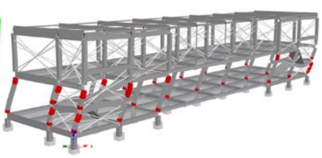
3. ASSESSMENT OF COLLAPSE PROBABILITY

Collapse analysis of the selected representative buildings was carried out using the Multiple Strip Analysis (MSA) Method [1]. Detailed 3D FEM models were created for each building [3] and nonlinear dynamic analyses were carried out at 4 different of ground motion intensity levels using 20 ground motions at each level. Fragility curves were generated to obtain the probability of collapse. Fig.2 shows examples of the results from one of the buildings from the analysis.



Fragility curve





Rebar yielding Concrete crushing

Fig. 2. Fragility Curve and Failure Pattern of School 01 Building.

3. RESULT CALIBRATION

Based on the collapse probability results obtained from MSA method, the vulnerability scoring was adjusted such that the final score of the building collated closely with the probability of collapse. Fig. 3 shows the correlation between the final scores and the probability of collapse before and after calibration.

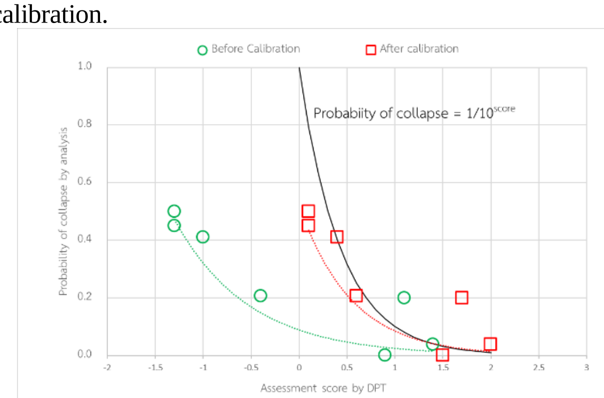


Fig. 3. Correlation between the final assessment scores and the probability of collapse.

4. CONCLUSIONS

The rapid seismic vulnerability assessment method for Thailand developed by the Department of Public Works and Town Planning (DPT) were assessed using collapse simulation of selected building structures. It was found that the assessment scores tended to correlate with the probability of collapse of the building, i.e., the lower the scores, the higher the probability of collapse. The building scores could be adjusted and calibrated based on collapse simulation so that the final score correlated well with the probability of collapse.

5. ACKNOWLEDGEMENT

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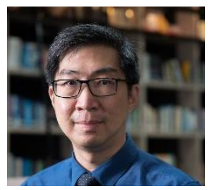

Sutat Leelataviwat is currently an associate professor in Civil Engineering and an assistant director for research and technology at the Institute for Scientific and Technological Research and Services (ISTRS) at the King Mongkut's University of Technology Thonburi. He obtained Ph.D. in Structural Engineering from the University of Michigan at Ann Arbor, USA. His research interests include seismic design and behavior of RC and steel structures, seismic retrofitting of structures, and energy-based seismic design methods. He is also a member of the committee on the Effects of Earthquakes and Wind Loads and advisor for the committee on Steel Structures, Engineering Institute of Thailand.

Virote Boonyapinyo is currently a professor in Civil Engineering, Faculty of Engineering, Thammasat School of Engineering, Thammasat University. He obtained B.Eng and M.Eng from Chulalongkorn University and D.Eng in Structural Engineering from the Yokohama National University, Japan. His research interests include Wind Tunnel Test of High-Rise Buildings and Long-Span Bridges, Earthquake-Resistant Analysis and Design of Bridges and Buildings, Analysis and Design of Steel Structures. He is also a chairman of the subcommittee on the Effects of Earthquakes and Wind Loads, and advisor for the subcommittee on Steel Structures, Engineering Institute of Thailand under H.M. the King's Patronage.

Jarun Srechai is currently an assistant professor in Civil Engineering at Burapha University. He obtained Ph.D. in Civil Engineering from Chulalongkorn University, Thailand. His research focused on seismic design and evaluation of RC structures. He is also a committee member of the Effects of Earthquakes and Wind Loads Engineering Institute of Thailand.

Wongsa Wararuksajja is currently an assistant professor in Civil Engineering at Rajamangala University of Technology Thanyaburi. He graduated with a Ph.D. in Structural Engineering from King Mongkut's University of Technology Thonburi, Thailand. His research interests are seismic design and behavior of infilled RC frame.

Jirawat Junruangg is currently a lecturer at the Faculty of Engineering and Architecture at Rajamangala University of Technology Tawan-ok. He obtained a B.Eng in Civil Engineering from King Mongkut's University of Technology North Bangkok, as well as M.Eng and D.Eng in Structural Engineering from Thammasat University, Thailand. His research interests include wind tunnel testing of high-rise buildings and long-span bridges, simulating airflow over structures using Computational Fluid Dynamics, and earthquake-resistant analysis and building design.