ANALYSIS OF SSI EFFECT ON SEPARATION GAP REQUIREMENT FOR RC MID-RISE BUILDINGS IN YANGON

K.M. KYAW[1] and K. MEGURO[2]

[1] Project Researcher, Institute of Industrial Science, The University of Tokyo, Japan
[2] Professor, Institute of Industrial Science, The University of Tokyo, Japan
Correspond to K.M. Kyaw (khin22@iis.u-tokyo.ac.jp)

Keywords: *soil-structure-interaction (SSI), separation gap, nonlinear dynamic, reinforced concrete*

1. INTRODUCTION

Building suffers different types of damage during earthquake events dominated by seismicity of the region, underlying soil condition and dynamic characteristics of the building itself. Severe damages in buildings due to collision have been reported in the past earthquake events [1]. To avoid pounding, sufficient separation gap should be provided between the buildings. Whether ABS, SRSS or DCC methods are used in analysis, it is important to predict the horizontal displacements accurately.

Many researchers found out that soil-structure-interaction (SSI) effect is important in determining the accurate dynamic responses of the building during shaking [2]. Inter-story drift ratio of SSI considered case exhibits the larger value compared to conventional fixed base case. Because of increased ISD, seismic capacity of building decreases, and it will affect the adjacent buildings resulting in pounding potential.

Buildings in central business district (CBD) of Yangon have been closely situated, very less or almost no gap. Moreover, due to the economic and construction development, many mid-rise buildings have been constructing in sub-urban area of Yangon. In Nov 2019, mid-rise buildings tilting and leaning problems, after slight earthquake of magnitude 4.1 Richter Scale with its epicenter near Yangon, have been reported in sub-urban areas. It highlighted the need of vulnerability assessment and importance of separation gap.

2. NUMERICAL MODELING AND ANALYSIS

Two cases of adjacent RC building condition are considered in this analysis (Fig-1); case 1 (8-story next to 7-story) and case 2 (6-story next to 5-story building). Three different base conditions; fixed, SSI base (V_s 150 m/s) and SSI base (V_s 250 m/s), are considered under Northern Calif-03 earthquake event. Nonlinear time history analysis is carried out using the scaled ground motion that matched the target spectrum of Yangon.

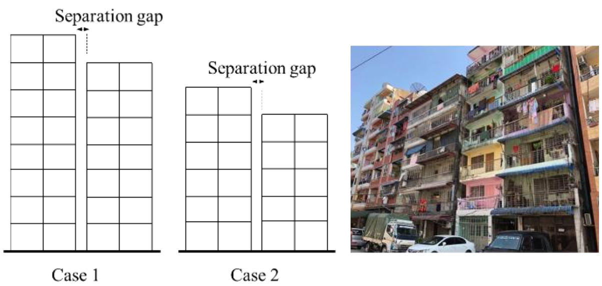

Figure 1. Building adjacency cases & Yangon CBD area

The commercial software program Extreme Loading ® for Structures is used in numerical modeling. Soil-structure-interaction is considered through interface elements. Maximum displacement responses are measured at the top-level of lower height building. Displacement responses from one building is subtracted from the others to get the clear distance between two adjacent buildings before collision each other.

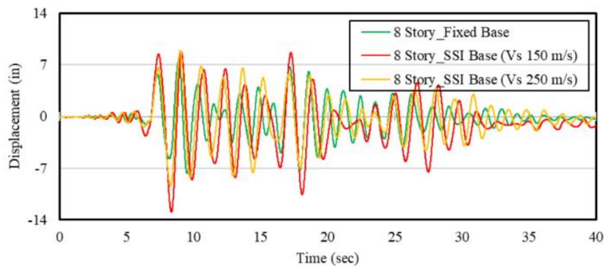

Figure 2. Displacement responses of 8-story buildings

Soft soil case (V_s 150 m/s) exhibits the maximum displacement response for all building. There is phase variance in displacement responses for different base conditions. Effect is prominent for 8-story building as shown in Fig-2. This may be due to the interaction effect between soil and foundation.

Table 1. Summary of required separation gap

Adjacency	Fixed	SSI *(V_s 250 m/s)*	SSI *(V_s 150 m/s)*
Case 1	7.50 in.	9.40 in.	6.50 in.
Case 2	4.45 in.	6.09 in.	9.16 in.

3. CONCLUSIONS

The result shows that separation gap required to avoid pounding-induced damage seems to be affected by SSI. In both adjacency cases, conventional fixed base analysis will underestimate the required clear distance between adjacent buildings and will lead to pounding during shaking. Therefore, SSI effect should be accounted in estimating the behaviors of structures during earthquake. This study takes into account only one ground motion and it is planned to consider a large number of ground motions for general assessment in the future. Inventory of pounding potential building types can be a useful information for urban planning, limiting separation gap requirement and prioritization of retrofitting.

REFERENCES

[1] M. Kamal, M. Inel, J. Buil. Eng. 30 (2022) 104784.
[2] M. Nakhaei, M.A. Ghannad, J. Stru. Eng. 30 (2008) 1491-1499.