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EFFECT OF MULTI-DIRECTION ANALYSIS ON THE FRAGILITY CURVES OF REGULAR RC BUILDINGS

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Recently, fragility functions are used to study the vulnerability of structures. Currently, the analytical fragility functions are developed by two-dimensional analysis of structures, and the effect of three earthquake component and three-dimensional analysis is neglected. However, some studies have been conducted to develop fragility function of the structure by 3D analysis. Presumably, three-dimensional analysis of structures was required for the asymmetric and irregular structures, and symmetric structures are exempt from that. However, even in a perfectly symmetric structure, the difference between the earthquake components may cause differences between each direction. Xu et al. compared the fragility function of asymmetric structure which developed by 2D and 3D analysis and showed that the using 2D analysis underestimated the results. In this study, to investigate the effect of 3D analysis on the fragility function of structures, three perfectly symmetrical reinforced concrete structures with moment resisting frame system were investigated in the far-field of the earthquake. The result is then compared with the corresponding fragility curves developed by the two-dimensional analysis.

Three symmetrical buildings with 3, 6, and 9 stories are designed according to the sixth and ninth volume of the Iranian national building regulations and the fourth edition of Iranian seismic code (see Figure 1). The response of structures in 2D and 3D analysis was evaluated by OPENSEES under 17 pair of far-field time histories which recorded on soil type III. For the 3D model, the two-directional incremental dynamic analysis was performed, and their median IDA is compared with traditional IDA in Figure 2 as a function of spectral acceleration at the period of first structural mode. As it can be seen in this figure, the median of IDA of 3D structure capture higher drifts. Moreover, the maximum drift of taller structures gets higher.

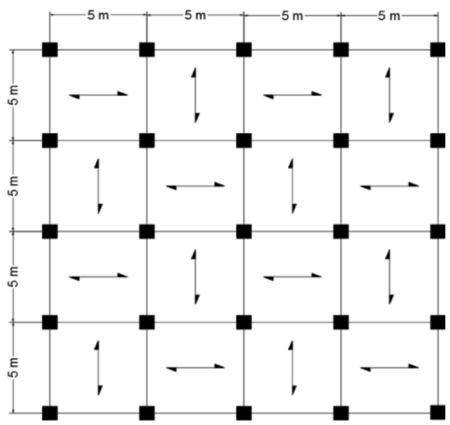

Figure 1. The plan of studied buildings.

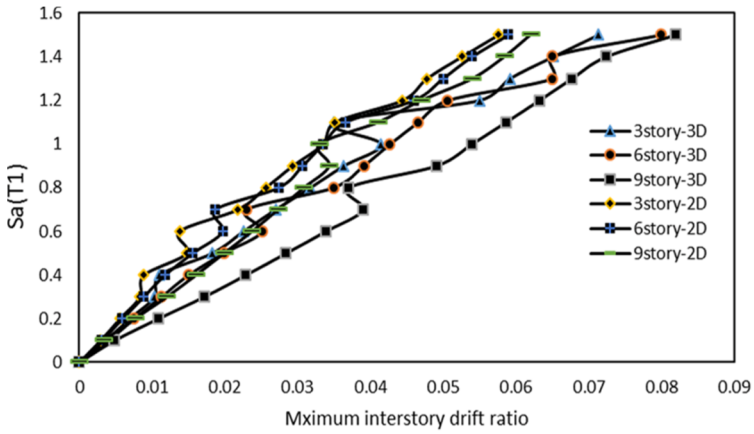

Figure 2. Comparison of the IDA curves of the studied structure by 2D and 3D analysis.

The fragility function of structures is also developed and depicted in Figure 3. The results indicated that the median of the fragility curve of the 2D structure is higher than the 3D structure, which demonstrates that the 2D analysis cannot demonstrate the real vulnerability of structure. Besides, from the fragility results, it can be indicated that the taller structure is more vulnerable to the earthquake in both types of analysis.

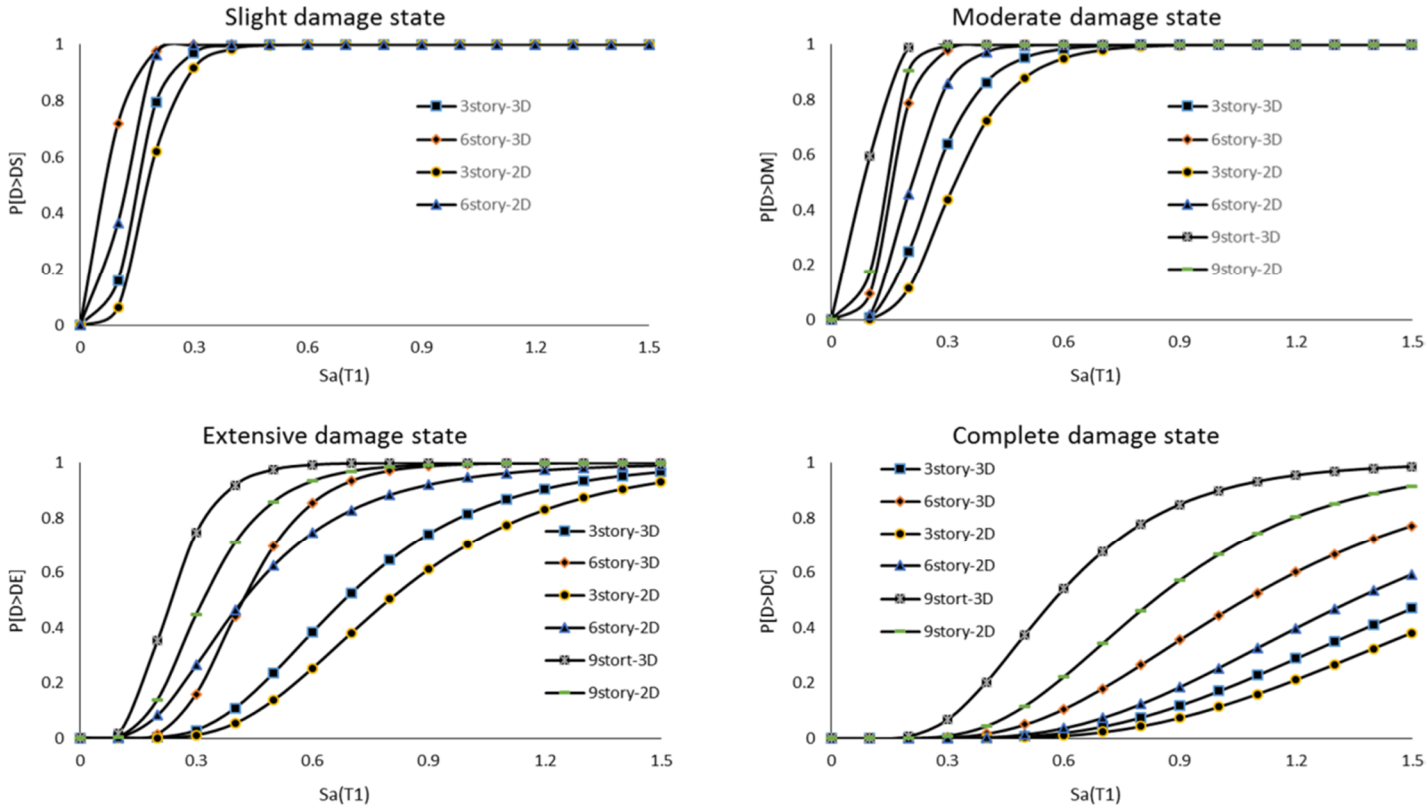

Figure 3. Comparing fragility curves of structures by 2D and 3D analysis.

REFERENCES

Dadashi, R. and Nasserasadi, K., (2015). Seismic damages comparison of low-rise moderate reinforced concrete moment frames in the near- and far-field earthquakes by a probabilistic approach. *Int. J. Adv. Struct. Eng., 7*(2), 171-180.

Hosseinpour, F. and Abdelnaby, A.E. (2017). Fragility curves for RC frames under multiple earthquakes. *Journal of Soil Dynamic and Earthquake Engineering*, *98*, 222-234.

Ghersi, A. and Rossi, P.P. (2001). Influence of bi-directional ground motions on the inelastic response of one-storey in-plan irregular systems. *Journal of Engineering Structures*, *23*(6), 579-591.

Xu, H. and Gardoni, P. (2016). Probabilistic capacity and seismic demand models and fragility estimates for reinforced concrete buildings based on three-dimensional analyses. *Journal of Engineering Structures, 112*, 200-214.