Title Effects of Plan-Eccentric Infill Walls Configuration on 3D nonlinear response of reinforced concrete frame buildings

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Abstract

The masonry infill walls are generally considered as non-structural elements in buildings. In fact, these masonry infill walls affect the behavior of the buildings under earthquake loads. This study is conducted to investigate the effects of non-uniform distribution of masonry infill walls (both in plan and elevation) on the nonlinear response of gravity load designed non-ductile reinforced concrete frame buildings. Five typical infill walls building configurations were selected from the field data survey in Bangladesh. Five infill wall configurations on the first storey of the buildings were no infill walls, infill walls only at one corner, no infill walls at one side and middle frame of the building (so called "Open front"), infill walls only at the boundary of the building, and full infill walls throughout the building. Several nonlinear features of gravity load designed non-ductile reinforced concrete buildings such as beams, column, beam-column joints, and infill walls were modeled. The nonlinear responses of buildings were assessed by performing 3D nonlinear static and nonlinear dynamic time history analyses in OpenSees. In addition to this, incremental nonlinear dynamic time history analysis was also carried out to obtain the level of PGA that each building can sustain under different ground motions. Results show that infill walls on the first storey significantly affect the lateral stiffness and strength of the buildings. Full infill walls on the first storey can develop up to 49% higher base shear strength as compared to the building configurations with no infill walls on the first storey. The results show that non-uniform distribution of infill walls in plan can develop torsional irregularities which significantly contribute to the lateral response. Corner infill wall building can develop top floor rotation of 38 times higher than no infill wall buildings and this floor rotation can contribute up to 62% to the roof displacement of the building. Furthermore, results show that fairly regular and uniform distribution of infill walls (in both plan and elevation) can increase the seismic performance of buildings and sustain relatively high PGA. Results show boundary infill walls and full infill walls buildings can sustained strong ground motion up to 0.35g PGA.

Keywords Masonry Infill Walls, 3D Nonlinear Response, Soft Storey, Torsional Irregularity, Nonlinear Static Pushover Analysis, Nonlinear Dynamic Time History Analysis.