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Seismic Performance of Gravity Load-Designed RC Frame Buildings in Jordan: a Prelude into the Effect of Masonry Infills

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Abstract: Fifty four infilled reinforced concrete (RC) frame buildings were selected and designed to represent typical Jordanian low and medium rise buildings designed to resist gravity loads only. Using SAP2000 software, nonlinear static analysis was performed on three dimensional models of the representative buildings. The study parameters included building height; horizontal and vertical irregularities; as well as type and layout of walls. The inverted triangular and Square Root of Sum of Squares (SRSS) lateral load patterns were used for irregular buildings. Analysis results indicated that commonly encountered horizontal and vertical irregularities associated with presence of re-entrant corners and soft stories negatively affects the elastic stiffness, energy dissipation and lateral resisting capacities of the investigated buildings. Analysis results confirmed that using RC walls, rather than masonry walls, in the staircase unit greatly enhances the seismic performance of buildings provided the RC walls followed a symmetrical plan arrangement about one of the principal axes. The majority of the investigated buildings exhibited a maximum inter-story drift ratio below 1.5% at the yielding strength and 3.8-4.8% at ultimate strength indicating that severe structural damage may take place under strong earthquake excitations. Plastic hinge formation signified the use of faulty design concepts violating the traditional strong column-weak beam concept of earthquake-resistant design. Compared with the inverted triangular lateral load pattern, using the SRSS pattern for pushover analysis of irregular buildings had a negligible impact on lateral load resistance but significantly affected stiffness and energy dissipation values.