ABSTRACT

Three twelve-story reinforced concrete frame buildings with a soft first story, namely, the bare frame, the frame with brick masonry-infilled walls, and the proposed retrofit frame with brick masonry-infilled walls were evaluated using the newly developed performance based design concept (PBD). The study was motivated by the building failures resulting from a soft first story mechanism observed in the recent Taiwan and Turkey earthquakes. A performance based design concept (PBD), outlined in the 1997 NEHRP Guideline and Commentary for Seismic Rehabilitation of Building (FEMA 273 and 274) and the 1997 NEHRP Recommended Provisions and Commentary for Seismic Regulations for New Buildings and Other Structures (FEMA 302 and 303), was used as a guideline in the evaluation procedures. Nonstructural infilled wall effects and the rehabilitation using reinforced concrete walls were also investigated. For each frame, structural capacities obtained from pushover analysis, in this case inter-story drifts, were compared with structural inter-story drift demands determined by nonlinear time history dynamic analysis to find the probabilities of exceedance for each hazard level. Finally, the structural seismic performance for each frame was evaluated using a probabilistic approach.

It was found that structures having soft first stories create a vertical stiffness irregularity, which result in higher inter-story drifts of the first and second stories than those of the above stories during earthquake intensities. In addition, the proposed retrofit method by adding reinforced concrete structural shear walls is ineffective when structures are subjected to moderate and high earthquake intensities.