Jordan University of Science and Technology

Estimation of Maximum Inelastic Displacement Demand for Dominant Residential Buildings in Jordan under Earthquake Excitation

Authors: Hanan Al-Nimry and Galal Al-Mekhlafi

Abstract: The residential building stock in Jordan post 1990 is dominated by a local type of construction wherein weak RC frames are infilled with multi-layered walls utilizing limestone masonry backed with plain concrete (stone-concrete walls). On the other hand, bearing walls of limestone masonry backed with plain concrete were used for the exterior walls of a very large number of residential buildings in Jordan prior 1990. This study is concerned with the estimation of maximum lateral displacements for the dominant residential buildings in Jordan that comprise stone-concrete walls under earthquake excitations. Eighteen buildings representing the two structural systems (infilled RC frames and bearing wall construction) were examined. In addition to the structural system, the investigated parameters included the building height, plan area, and vertical stiffness irregularities. Using SAP2000N, three-dimensional models were built for each of the representative buildings. Nonlinear static analysis was used to arrive at their capacity curves. Four approximate techniques were implemented to estimate the maximum inelastic displacement demand of these buildings under earthquake excitation: nonlinear dynamic analysis of an equivalent single-degree-of-freedom (SDOF) system, constant ductility procedure, capacity spectrum method and displacement coefficient method. Accordingly, upper and lower bound displacement values were obtained. Analysis results confirmed that the maximum lateral displacements of the investigated buildings do not exceed 1.2% of the total building height. This signifies the major contribution of the stiff exterior stone-concrete walls in limiting the lateral drift of stone-concrete buildings. The maximum displacement demand of mid-rise frames was found to be 100-108% of the demand on bearing wall systems in zones of low seismicity and 78-119% in zones of moderate seismicity. In low-rise infilled frames, the maximum displacement demand was less (0.82-0.90 times)