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Fragility Analysis of a Soft First-Story Building in Mexico City

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Abstract : On 09/19/2017, a Mw = 7.1 intraslab earthquake occurred in Mexico causing the collapse of about 40 buildings. Many of these were 5- or 6-story buildings with soft first story; so, it is desirable to perform a structural fragility analysis of typical structures representative of those buildings and to propose a reliable structural solution. Here, a typical 5-story building constituted by regular R/C moment-resisting frames in the first story and confined masonry walls in the upper levels, similar to the collapsed structures on the 09/19/2017 Mexico earthquake, is analyzed. Three different structural solutions of the 5-story building are considered: S1) it is designed in accordance with the Mexico City Building Code-2004; S2) then, the column dimensions of the first story corresponding to S1 are reduced, and S3) viscous dampers are added at the first story of solution S2. A number of dynamic incremental analyses are performed for each structural solution, using a 3D structural model. The hysteretic behavior model of the masonry was calibrated with experiments performed at the Laboratory of Structures at UNAM. Ten seismic ground motions are used to excite the structures; they correspond to ground motions recorded in intermediate soil of Mexico City with a dominant period around 1s, where the structures are located. The fragility curves of the buildings are obtained for different values of the maximum inter-story drift demands. Results show that solutions S1 and S3 give place to similar probabilities of exceedance of a given value of inter-story drift for the same seismic intensity, and that solution S2 presents a higher probability of exceedance for the same seismic intensity and inter-story drift demand. Therefore, it is concluded that solution S3 (which corresponds to the building with soft first story and energy dissipation devices) can be a reliable solution from the structural point of view.

Keywords : demand hazard analysis, fragility curves, incremental dynamic analyzes, soft-first story, structural capacity
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