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SEISMIC RISK ANALYSIS OF A DOME-ROOF ADOBE HOUSE CONSIDERING IN-PLANE AND OUT-OF-PLANE RESPONSE OF WALLS

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In this article, the seismic performance of a typical dome-roof adobe building is investigated numerically through calibrated macro-modelling. The model had been previously tested on the shaking table at Sharif University of Technology. The selected excitation is Zarand Earthquake (2005), Chatrood station. Since the scaling of the models was performed according to Gravity Forces Neglected procedure, the acceleration and velocity in the model were amplified and decreased 1.5 times, respectively. Besides, the records were intensified in the time domain and the velocity amplitude was remained intact. Two models namely the unretrofitted and retrofitted are studied. The photograph of the models are shown in Figure 1.

(a) Unretrofitted model (b) Retrofitted model

Figure 1. Photograph of the models (Bakhshi et al., 2017).

The unretrofitted model was excited at the levels of 25%, 70%, 100% and 125% and was destroyed in the last stage due to detachment of perpendicular walls followed by roof collapse. Regarding the performance of the unretrofitted model, the retrofitting plan was directed toward two targets; (1) maintaining the integrity and box-like behavior of the structure and preventing the in-plane shear sliding cracks from widening. The implemented system was made up of eight horizontal steel rods which tied the parallel walls and welded steel mesh on one side on the walls, which covered only the upper half of them without any shotcrete. The retrofitted model was excited at levels of 25%, 100%, 125%, 150% and 175% and withstood acceptably without undergoing any serious damages. The experienced damages were from higher behavioral modes, i.e. the step-diagonal cracks in some wall originated from torsion. The macro-model employs two different adobe walls behaviors, i.e. in-plane and out-of-plane. The schematic beam-column walls together with translational springs are shown in Figures 3 and 4 to simulate the in-plane and out-of-plane response of such walls, respectively.

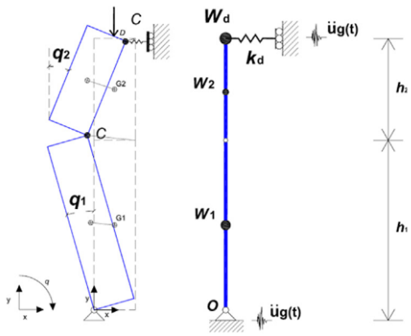

Figure 2. Model of the wall in out-of-plane bending (Landi et al., 2015).

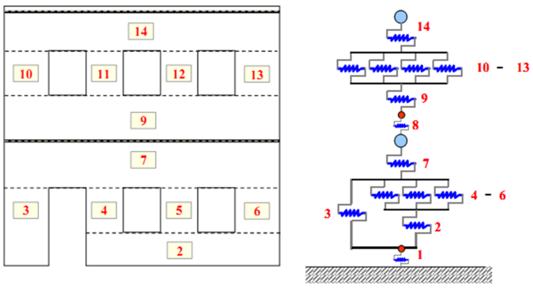

Figure 3. Model of the wall in in-plane behavior (Park et al., 2008).

Based on a set of un-scaled ground motion records, a non-linear dynamic analysis procedure called Modified Cloud Analysis (Jalayer et al., 2017) is used in order to derive the fragility curves for various discrete limit states for the adobe building before and after the retrofit. These fragility curves are used to obtain estimates of expected annual loss for the building in both configurations.

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