THE INVESTIGATION OF SAFE RESIDUAL DRIFT OF SYMMETRIC RC COREWALL STRUCTURES AGAINST IMMEDIATE AFTERSHOCKS

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Strong ground motions may induce permanent or residual displacements to structures, and are probable to be followed by several less violent aftershocks within minutes to days after the mainshock leaving no time for repair or retrofit, hence the casualties tend to increase.

Previous research has suggested the residual drift limits with regards not only to structural performance as in SEAOC-2000 (Vision, 1995) proposing performance level based on residual drift values, but also to building functionality (i.e. in one study it was found that the residents of buildings with residual inclination of greater than 0.008 rad experience headaches and dizziness (McCormick et al., 2008) and in another research it was shown that doorway system malfunction occurs in buildings with residual displacement of greater than 0.005 rad (JBDPA, 2001).

A methodology is discussed in this study to investigate the maximum residual displacement of code-conforming RC corewall structures that guarantees no risk of collapse against immediate aftershocks. It is suggested that the building undergoing larger residual deformations than the safe values investigated herein, must be evacuated.

Three 10, 20 and 30-story RC frame-core wall buildings with 6-meter spanned buildings designed in accordance with modern seismic codes are modeled to capture the nonlinear responses in the platform of Opensees software. Beams and columns are modeled by concentrated hinges based on IMK hysteretic model (Lignos & Krawinkler, 2011) and a shell element, ShellNLDKGQ (Lu et al., 2018) is employed for nonlinear modeling of shear walls. Seismic performance of the buildings is to be discerned throughout Cloud Analysis once as mainshock analysis and then as mainshock-aftershock sequence. To this aim and for the matter of accuracy approximate number of 500 un-scaled strong records (including non-pulse and pulse records) are implemented as the mainshock. It is worthy of mentioning that ground motion scaling is liable to inaccurate overestimation the earthquake intensity and therefore is avoided in here (Chandramohan et al., 2013).

The methodology entails the inspection of the nonlinear dynamics analysis results to attain the cases where the residual displacement had occurred which is relatively infrequent in case of core wall systems due to the high stiffness. The mainshock analysis cases with the residual displacement are subsequently subjected to real (unscaled) after shock records in a mainshock-aftershock analysis. The 250 stronger of the 500 recorded aftershock ground motion are selected for this purpose; each of the three buildings was excited to rigorous number of 15×250=3750 ground motion sequences and the cases that the structures collapse (numerical non-convergence in the analysis or surpassing the interstory collapse limit) are inspected. The safety residual drift limits are then inferred from the mainshock-aftershock analysis that results in collapse of the structure (Table 1) and collapse fragility curves are plotted for those cases with residual drift less than the suggested safe limits (Figure 1).

Table 1. Suggested Safe Interstory Residual Drift.

Story Number	Safe Interstory Residual Drift (%)
10	1.0
20	0.5
30	0.2

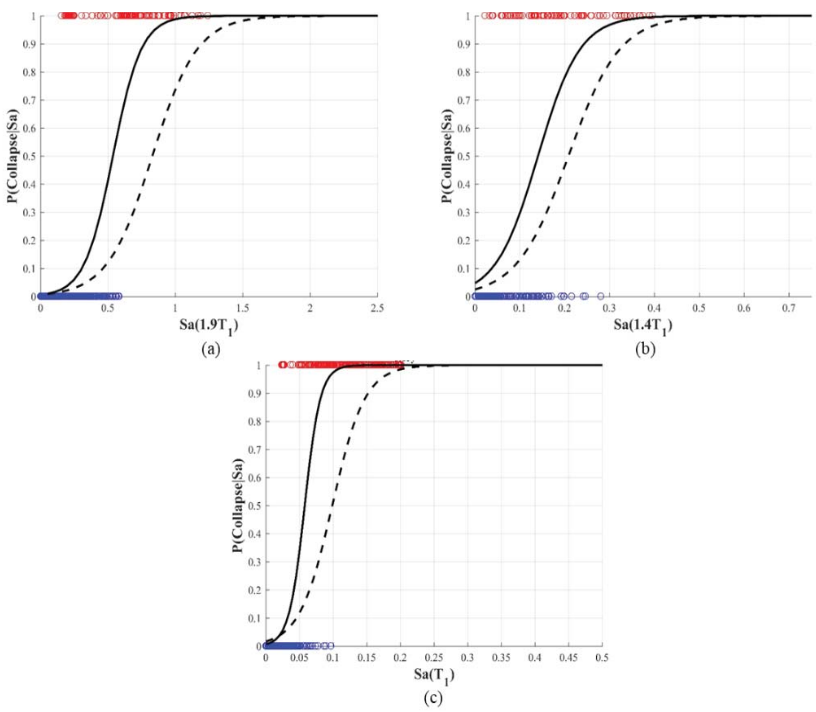

Figure 1. Collapse Fargility Curve of the intact building (solid line) and of the building that undergoes smaller residual drift than the proposed limits (dashed line): a) 10-story b) 20-story c) 30-story.

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