Study of the damage of reinforced concrete shear walls during the 2010 Chile earthquake

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Abstract

Reinforced concrete shear wall buildings have shown, in statistical terms, an adequate performance in past seismic events. However, a specific damage pattern was observed in 2010 Chile earthquake in some shear walls located in the lower building stories, usually associated with high axial stresses, lack of transverse reinforcement, and vertical irregularity. Results show that the nature of this failure led to a sudden degradation in strength and stiffness of walls and resulted in very limited ductility. This research aims to study analytically this damage pattern of shear wall buildings during the 2010 earthquake. By starting with two■dimensional inelastic pushover finite element models using diana, two walls that were severely damaged during the earthquake were studied in detail using different load patterns and stress–strain constitutive relationships for concrete in compression. These models were validated with experimental data of four reinforced concrete walls available in the literature. It can be shown that the geometry of the damage in the building walls cannot be correctly represented by conventional pushover load patterns that ignore the lateral and axial interaction. Indeed, the failure mechanism of walls shows strong coupling between lateral and vertical deformations within the plane of the wall. Results shown for a three■dimensional inelastic analysis of the building are consistent with these two■dimensional results, and predict a brittle failure of the structure. However, these models predict a large increase in axial load in the walls, which needs to be validated further with more experimental and analytical studies.

Keywords

Shear wall damage, Pushover analysis, Inelastic finite element models, Dynamic inelastic analysis, Reinforced concrete buildings, Thin shear walls.