Seismic risk assessment of confined masonry buildings in Colombia

Resumen

Confined masonry (CM) dwellings are widely used in Latin American countries. CM is Colombia's second most predominant structural typology after unreinforced masonry buildings. CM structures are a formal structural system comprising an unreinforced masonry (URM) panel confined by reinforced concrete (RC) elements. The construction procedure for CM entails erecting the walls incrementally, one story at a time, followed by installing an RC confinement frame. Recent earthquakes have exposed that CM buildings have better behavior than URM ones. However, some CM structures have experienced severe damage or collapse under historical seismic events (e.g. Kahramanmaras, Puebla, Armenia earthquakes). A seismic risk model provides information about the social and economic consequences of future earthquakes on the building stock of a country and the population. Developing a national seismic risk model requires information on (i) the expected seismicity in the territory (seismic hazard model), (ii) the building stock and population exposed to such hazard (exposure model), and (iii) the vulnerability of the exposed structures when subjected to expected seismic actions (fragility and vulnerability model). This study aims to contribute to the third component, namely, it will focus on developing analytical fragility and vulnerability functions for representative CM structures. To do so, this study curated a database of 34 CM buildings. From such database, 72 archetype buildings that represent standard construction practices in Colombia are proposed. The response of all archetype buildings is assessed with Nonlinear Response History Analysis (NLRHA). A novel modification of a previous model implemented by Borah et al. (2021) is used in this step. The variables obtained from the analysis correspond to the maximum inter-story drift (IDR), the peak floor acceleration (PFA), and the maximum residual inter-story drift (RIDR). Fragility and vulnerability functions are proposed for all the components of the archetype buildings and are then used to develop the fragility, vulnerability, and risk functions of all archetype structures. The findings of the current study are applicable not only to Colombia but can also be extended to other Latin American countries that share similar construction techniques and standards for masonry construction. The outcomes of this research are intended as inputs for the National Seismic Risk Model of Colombia currently being developed as a collaborative project involving the National Geological Service, the Colombian Association of Engineering Faculties (ACOFI), and several universities in the country, including Universidad del Norte and Universidad Militar Nueva Granada.