Nonlinear Seismic Fragility Assessment of Masonry-Infilled RC Frame Structures

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Abstract:

This study presents a nonlinear seismic fragility assessment of masonry-infilled reinforced concrete (RC) frame structures, focusing on the influence of varying infill percentages on seismic performance. Although masonry infill walls are often treated as non-structural elements, they can significantly alter the lateral stiffness, base shear capacity, and damage response of RC buildings. Numerical models were developed using equivalent diagonal strut representations for infill walls, and nonlinear static (pushover) analyses were performed to evaluate story-level displacements and strength. Results show that masonry infill reduces the fundamental period by up to 68% and lateral displacements by up to 80%, thereby enhancing seismic resistance. However, the increased stiffness also leads to higher axial and shear demands on structural elements. Fragility curves were generated to estimate the probability of damage across various limit states, indicating that buildings with higher infill ratios perform better in early damage stages but may fail abruptly once infills crack or crush. These findings highlight the dual role of infill walls in improving strength while introducing design challenges. The study offers practical insights for seismic design and retrofitting of infilled RC frames in earthquake-prone regions.

Keywords:

Bare frame, Fragility analysis, Masonry infill wall, Nonlinear analysis, Pushover analysis, RC frame structures, Soft-storey.