Seismic performance of controlled spine frames

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Abstract

Damage concentration in limited levels of frame structures has often occurred during past major earthquake events, which has raised attention for the need of improving their structural integrity. To overcome those problems, a controlled spine frame system has been proposed. [1-3] This spine frame system consists of (1) a pin-based stiff braced steel frame or reinforced concrete (RC) wall (i.e., the spine frame), (2) replaceable energy-dissipating members, and (3) envelope moment-resisting frames. Numerical studies have demonstrated that the proposed system has excellent performance in preventing damage concentration, providing self-centering and robustness against large earthquakes for low-rise buildings.

Effect of diverse structural properties on the seismic performance of buildings adopting controlled spine frames has been studied. The effect of building height, yield drift of dampers, spine-to-moment frame stiffness ratio, and damper-to-moment frame stiffness ratio are illustrated in detail and their optimal values are discussed. Besides the continuous spine frame configuration, segmented spine frame configurations are proposed to prevent immense demand on energy-dissipating capacity of dampers and strength of spine frames.

Seismic evaluation method based on equivalent linearization techniques has been developed, and verified by time-history analysis. Boundaries of key structural parameters for using the proposed evaluation methods are determined based on a desired accuracy of the evaluated results.

References

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