

A Case Study on the Seismic Performance Assessment of the High-Rise Setback Tower Under Multiple Support Excitations on the Basis of TBI Guidelines

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Abstract : This paper describes the three-dimensional seismic performance assessment of a high-rise steel moment-frame setback tower, designed and detailed per the 2010 ASCE7, under multiple support excitations. The vulnerability analyses are conducted based on nonlinear history analyses under a set of multi-directional strong ground motion records which are scaled to design-based site-specific spectrum in accordance with ASCE41-13. Spatial variation of input motions between far distant supports of each part of the tower is considered by defining time lag. Plastic hinge monotonic and cyclic behavior for prequalified steel connections, panel zones, as well as steel columns is obtained from predefined values presented in TBI Guidelines, PEER/ATC72 and FEMA P440A to include stiffness and strength degradation. Inter-story drift ratios, residual drift ratios, as well as plastic hinge rotation demands under multiple support excitations, are compared to those obtained from uniform support excitations. Performance objectives based on acceptance criteria declared by TBI Guidelines are compared between uniform and multiple support excitations. The results demonstrate that input motion discrepancy results in detrimental effects on the local and global response of the tower.

Keywords : high-rise building, nonlinear time history analysis, multiple support excitation, performance-based design

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