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Assessment of alternative ground motion simulation techniques in nonlinear time history analyses of base isolated multi-story frame building: a case study

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In recent decade, base isolation system for buildings has been commonly used as retrofitting strategy. Evaluation of structural responses for such a system subjected to severe earthquakes is challenging since some regions have very few and scatted ground motion data set. Simulated ground motions can be an alternative to overcome this issue. There are several ground motion simulation methods available that provide varying levels of goodness fit between observed and synthetic data; therefore, it is important to investigate the efficiency of synthetics in predicting seismic responses of structures before using them for engineering purposes. In this study, a six-storey steel moment-resisting frame is selected from the SAC Steel Project and retrofitted with lead rubber bearings (LRB) in accordance with ASCE 7-10. Then, nonlinear time history analysis of the structure is carried out using the real and simulated records of the 6 April 2009 L′Aquila (Italy) earthquake (Mw=6.3). For this purpose, simulated records of the 2009 L′Aquila earthquake generated based on both the Hybrid Integral-Composite method and the Stochastic Finite-Fault method are employed. The results of analyses from observed and the synthetic records of this event are compared in terms of maximum inter-storey drifts, displacements, accelerations at each story level and input energy. Overall, the results show that the difference in terms of the real and estimated demand parameters from two alternative ground motion simulation techniques is negligible.

Keywords: Base isolation, the 2009 L'Aquila earthquake, nonlinear time history analysis, stochastic finite-fault method, hybrid integral-composite method, simulated ground motions.