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Influence of Ground Motion Characteristics on the Seismic Vulnerability of Bridges

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Abstract

This study focuses on understanding and quantifying the differences in vulnerability of highway bridges when subjected to near-field pulse-like ground motions and long duration records as compared to widely available far-field ground motions that are short-duration. For this purpose, a case-study highway bridge located in the Himalayan region is selected. Suites of near-field pulse-like and long duration ground motions are selected that are spectrally equivalent to recorded far-field short-duration ground motions widely adopted for the design and assessment of bridges. A detailed FE model of the bridge is developed, and a set of non-linear time-history analyses are performed for each ground motion suite at numerous scaled intensity levels to develop seismic fragility curves. Results reveal that there is a 33% difference in the median fragility estimates of complete damage state between short and long duration record sets, and a 25% difference between long duration and pulse-like record sets. The findings highlight the inclusion of ground motion duration and velocity pulse-like effects for the design and construction of highway bridges.

Keywords: Bridges, Near-field pulse-like ground motions, Long-duration ground motions, Seismic fragility curves