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MODAL DAMPING EFFECT IN ECCENTRICALLY BRACED FRAMES UNDER PULSE-TYPE GROUND MOTIONS

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Abstract

Eccentrically Braced Frames (EBFs) are widely adopted in seismic design owing to their balanced combination of strength, stiffness, and energy dissipation capacity. However, the effect of modal damping in EBFs subjected to pulse-type ground motions (PGMs) has received limited attention in the field of structural vibration control. This study examines the seismic response of short-link EBF systems under two representative PGMs (with four earthquake records), considering scenarios with and without the inclusion of modal damping. A six-story inverted-V braced frame located in a high-seismicity region of Türkiye is selected as the case study. Nonlinear time-history analyses (NTHAs) are performed using ground motion records classified according to pulse parameters. Key performance indicators—such as inter-story drift ratios (IDRs), story displacements, base shear–roof displacement response, residual IDRs, plastic hinge distribution, the mean shear forces at the links at each floor, input and hysteretic energy ratios and shear force vs. deformation hysteresis loop of critical link—are systematically evaluated and compared across the selected records. The findings demonstrate that incorporating modal damping substantially alters the dynamic response, particularly under motions characterized by high T_p/T_1 ratios, high PGV/PGA values and large pulse amplitudes. These results underscore the critical importance of accurately representing modal damping in the seismic assessment and design of EBFs subjected to strong PGMs.

Keywords: Eccentrically braced frames, pulse-type ground motions, short link, modal damping effects