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ENERGY FACTOR OF HIGH STRENGTH STEEL MOMENT RESISTING FRAMES EQUIPPED WITH ENERGY DISSIPATION BAYS UNDER MULTIPLE NEAR-FAULT EARTHQUAKES

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ABSTRACT

The seismic energy factor is a reliable demand indicator for quantifying the seismic demand of structures, and both strength demand and deformation demand can be prescribed with the indicator. This paper presents the seismic energy factor of high strength steel moment resisting frames equipped with energy dissipation bays (HSSF-EDBs) under repeated near-fault earthquakes. The paper commenced with a brief introduction of the structural concept of HSSF-EDBs, and the feasibility of the trilinear kinematic hysteretic model for idealising the force-displacement response of the novel system was demonstrated using previous experimental data. To shed lights on the effect of repeated earthquakes on the energy factor of trilinear oscillators that represent HSSF-EDBs, a near-fault earthquake database was established using one hundred (100) near-fault earthquakes, and synthetic repeated earthquakes were produced and used as seismic excitations. To clarify the cascading effect among the hysteretic parameters and repeated seismic events on the energy factor, spectral analyses of the trilinear single-degree-of-freedom systems were performed. The parameters considered in this numerical investigation included the post-yielding stiffness ratios, the structural period and the corresponding inelastic deformation range in various yielding stages. The results of the statistical investigation show that the hysteretic parameters interacted with the seismic sequence effect induced by repeated ground motions. An evident increase on the energy factor quantifying the peak seismic demand of HSSF-EDBs was characterised when the system experienced repeated earthquake ground motions. Therefore, it is obvious that the utilisation of peak ground acceleration in current seismic design provisions is insufficient for prescribing the seismic demand of a HSSF-EDB.