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Unbonded Fiber-reinforced Elastomeric Isolators Coupled with Negative Stiffness-based Dampers

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Abstract

The efficiency of unbonded fiber-reinforced elastomeric isolators (UFREI) in mitigating the seismic hazard due to near fault earthquakes on a benchmark structure is investigated. Since near fault ground motions often contain high amplitude and long period pulses, thus isolated structures are prone to high isolator displacements under such ground motions. Therefore, supplementary damping devices are installed alongside the non-linear UFREI isolation system in the benchmark structures to mitigate this excessive displacement demand on isolators under near fault ground motions. Negative stiffness dampers (NSD) are a relatively new kind of energy dissipation device based on a compressed spring and a viscous damper. It produces significant damping forces even with very low damping coefficients, and it has been seen to be particularly helpful in mitigating the seismic hazards due to long period near-fault ground motions.

The behaviour of the benchmark structures isolated using UFREI coupled with NSD is then further investigated under a wide range of ground motions, including both far-fault and near fault earthquakes. A significant improvement is observed in the UFREI isolated structure's response under both types of ground motions (especially under near-fault ground motions) with the inclusion of the NSD as a supplementary damping device.

Keywords: Unbonded fiber reinforced elastomeric isolators, Negative stiffness damper, Near fault earthquakes, Supplementary damping device