LECTURE

Experimental validation of performance-based seismic design of steel MRFs with compressed elastomer dampers using real-time hybrid simulation

To expand the use of passive energy dissipation, economical structural dampers and performance-based design procedures for buildings with dampers should be developed and experimentally validated.

A recent collaborative research program was directed to produce a marketable compressed elastomer damper for cost-effective hazard mitigation. The compressed elastomer damper is constructed by pre-compressing a high damping elastomeric material into steel tubes. This innovative construction results in viscous-like damping under small strains and friction-like damping under large strains.

The seminar will present an experimental program based on the use of real-time hybrid simulation to validate the performance-based design of a prototype two-story steel MRF building equipped with compressed elastomer dampers. The laboratory specimens, referred to as experimental substructures, were two individual compressed elastomer dampers. The remainder of the building was modelled as an analytical substructure with the aid of a new nonlinear finite element program which was implemented into the Real-Time Integrated Control System of the Lehigh NEES Earthquake Simulation Facility. A series of real-time hybrid simulations were performed to acquire response statistics under the design basis earthquake and the maximum considered earthquake.

Statistical experimental response results incorporating the ground motion variability confirmed that a steel MRF with compressed elastomer dampers can be designed to perform better than conventional steel SMRFs, even when the MRF with dampers is significantly lighter in weight than the conventional SMRF.

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