

Comparison of Retrofitting Techniques for Existing Steel Moment Resisting Frames

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ABSTRACT

Seismic protection of critical facilities such as hospitals, emergency response centers, and schools is crucial since these buildings must remain in full service after major earthquakes. A new modular, multiple-panel infill system made of a ductile, high-performance fiber reinforced concrete (HPFRC) is currently under investigation with a focus on protecting such critical facilities (see Figure 1). Through analysis models validated by panel experiments, it has been found that the panel system when installed in a steel moment frame designed prior to major earthquake events (Northridge, 1994, Kobe, 1995) limits residual story drifts as well as frame damage (see Figure 2 median story residual drifts for a set of 40 ground motions in California for a design level event (DLE) and a maximum considered event (MCE)). Large-scale hybrid simulation experiments of a steel moment frame retrofitted with the proposed infill panel system will be conducted during summer 2009 at the NEES facility at University of California at Berkeley.

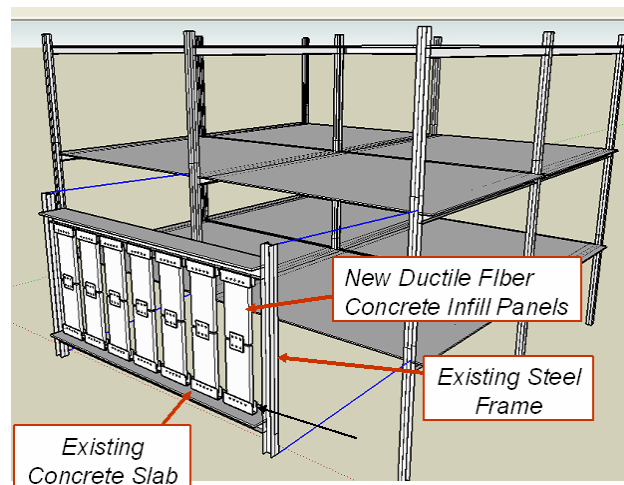


Figure 1. New ductile fiber concrete infill panel system for retrofit of steel frames

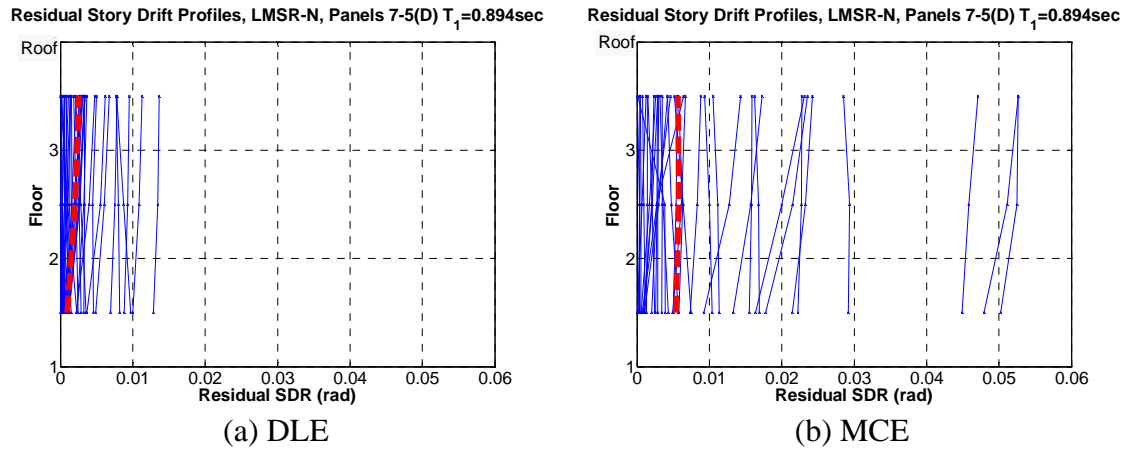


Figure 2. median residual drifts of the SAC-3Story LA building after retrofitting it with the new infill panel system; (a) Design level earthquake (10% probability of exceedence in 50 years); (b) Maximum considered earthquake (2% probability of exceedence in 50 years)

The infill panel system is an easily replaceable fuse type energy dissipation system and based on input of leading engineering practitioners it can also be used for new design. However, the primary objective of this paper is to compare alternative retrofit techniques for seismic protection of existing steel moment resisting frames with the infill panel retrofit system. The focus is on seismic behavior of retrofitted steel frames with buckling restraint braces (BRB) or viscous dampers compared to the seismic behavior of the same steel frames retrofitted with the new ductile HPFRC infill panel system. The effectiveness of the three seismic retrofit techniques is evaluated based on analytical simulations of the SAC 3-story and 9-story structures utilizing incremental dynamic analysis with a set of 40 representative ground motions from California. Cost effectiveness of the alternative retrofit techniques is also addressed.