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PEER

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SEISMIC ANALYSIS AND REHABILITATION OF A 15 STORY PRE-NORTHRIDGE STEEL MOMENT RESISTING FRAME BUILDING

James O. Malley
Senior Principal and COO
Degenkolb Engineers
San Francisco, CA
malley@degenkolb.com

ABSTRACT

This presentation summarizes the seismic analysis and rehabilitation design of a fifteen story steel moment resisting frame building that was built with connection details that were found to be vulnerable to fracture in the 1994 Northridge, California earthquake. This building is in Oakland, California, less than five miles from the Hayward Fault.

Previous testing of the existing connections indicated that the welded connections were highly vulnerable to fracture, and consequently the building presented a risk to life safety in the event of a major earthquake. Seismic strengthening to meet the State of California Guidelines for the Seismic Retrofit of State Buildings Risk Level III resulted in a requirement to reduce the interstory drifts to 1.5% in a 475-year return period event.

After considering several retrofitting schemes including connection strengthening, BRBF's and seismic isolation, a scheme that included strengthening some existing pre-Northridge moment frame connections and adding viscous dampers was selected. The use of the viscous dampers allowed connection strengthening to be limited to sixty percent of the existing connections thereby lessening disruption to the building occupants.

Since the existing moment connections had performed so poorly in previous testing, and because the size of the members in this building exceeded those that had been previously tested, a series of four full-scale tests were performed to confirm the validity of the connection upgrade design. Advanced nonlinear time history analyses of building frames were performed to refine the selected scheme and perform member checks. These models included nonlinear fiber elements that approximated the fracture behavior observed in the existing connection tests, flexural hinges that approximated the test results of the strengthened connections, and nonlinear damper elements to explicitly capture the added damping from the fluid viscous dampers.

The presentation will summarize the rehabilitation analysis, design and testing program.

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