

## EARTHQUAKE LOSSES AND FUNCTIONAL RECOVERY OF WELDED STEEL MOMENT FRAMES AND THEIR ROLE IN RETROFIT DECISIONS

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**Abstract:** *Many tall buildings on the west coast of the United States rely on welded steel moment frames (WSMFs) of the kind that experienced premature brittle fractures during the 1994 Northridge and 1995 Kobe earthquakes. Despite their known vulnerabilities, the vast majority of existing tall WSMF buildings have neither been evaluated nor retrofitted. To support the development of risk mitigation policies for these structures, this paper presents the results of detailed evaluations of seismic economic losses and functional recovery time associated with these buildings. The loss assessment leverages structural models capable of predicting flange fracture and simulating post-fracture behavior with significantly more accuracy than the plastic hinges used in previous studies. Moreover, the assessments apply state of the art computational methodologies to estimate the functional recovery time in a manner consistent with the Performance-Based Earthquake Engineering (PBEE) framework using FEMA P58 and the recently developed ATC-138 and TREADS frameworks. The estimated functional recovery times are transformed into functional economic losses using a rational approach to estimate the dollar loss per day based on knowledge from the real estate market. The combined economic losses—direct from repair costs and indirect from downtime—enable a financial analysis of the potential benefits of hypothetical retrofit interventions such as strengthening every connection and column splice. The results demonstrate that the benefits of either retrofit intervention vary substantially between those calculated for a single scenario (intensity- or scenario-based assessment) and those calculated from accumulating the expected annual loss over a holding period with a given discount rate. These distinct results for the same retrofit intervention highlight that it is the decision makers who must choose the approach that is most informative for their decision.*