

Retrofit vs. Repair: Economic Benefits and Costs of Seismic Retrofit of Non-Structural Components

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Abstract. The attention given to the seismic resiliency of non-structural components has been increasing steadily during recent years. Major academic and industry research projects have been undertaken both to determine the seismic vulnerability of non-structural components and to develop retrofit strategies to increase the resiliency of these components. While some of these strategies are being mandated by legislation, other strategies are implemented voluntarily by building stakeholders, such as owners and occupants. These different stakeholders may have different objectives for seismic retrofit. Although tools currently exist to assess the implications of different retrofit strategies on seismic losses, the focus is normally on how specific retrofits can reduce the need for repairs, without fully accounting for the differences in costs of retrofit compared to the expected costs of repairing the same damaged elements after an earthquake.

As a case study of this broader perspective, this paper seeks to identify retrofit strategies that may be economically beneficial to building owners based on a system-wide analysis of several alternatives. The archetype building used for this purpose is a three-storey steel moment-resisting frame system with office type occupancy in Seattle, Washington, in the United States. The FEMA P-58 methodology is used to determine the expected annual loss in terms of dollars and downtime, and the implementation cost of each retrofit is estimated using currently available cost-estimating software packages. The cost and construction downtime associated with each of these retrofits are compared with the expected increase in resiliency obtained from the loss estimation so as to determine the most beneficial retrofit strategies. Recommendations are then provided that rank the selected non-structural components according to the priority of their retrofit in order to minimize either direct economic losses or downtime.

Keywords: Cost-Benefit Analysis, FEMA P-58, Non-structural Retrofit Strategies, Economic losses, Downtime.