

Cost-Benefit Assessment of Replacing Seismically Vulnerable Nonductile Reinforced Concrete Frame Structures

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Nonductile reinforced concrete frame structures, like those constructed in California before the mid 1970s, are vulnerable to earthquake-induced collapse, potentially endangering the life safety of building occupants. Recent research predicts that these older reinforced concrete frame structures are approximately 30 to 40 times more susceptible to seismic collapse than modern reinforced concrete frame structures designed according to today's building codes. Nonductile reinforced concrete frame structures are also more likely than their modern counterparts to experience earthquake damage, incurring significant repair costs. Seismic deficiencies in California's older reinforced concrete frame structures could be mitigated by seismic retrofit or replacement.

In this study, cost-benefit assessment is used to evaluate the cost-effectiveness of replacing existing seismically vulnerable reinforced concrete frame to improve seismic safety. A set of typical older California reinforced concrete frame structures are evaluated using performance-based earthquake engineering techniques to assess the risk of earthquake-induced collapse, damage and related economic losses, and possible fatalities, and compared to a set of typical modern California reinforced concrete frame structures. The cost-benefit assessment accounts for the costs of building upgrades or replacement and the benefits of these actions, including improved seismic safety and reduced earthquake damage and repairs. Unsurprisingly, results of cost-benefit assessment show that replacing these vulnerable structures reduces the threat risk to life safety and decreases seismic-related damage. However, because the benefits tend to be dominated by improved safety, these improvements may cost between \$2 and \$5 million per life saved. These observations can be used to develop cost-effective and equitable policies for mitigating California's nonductile reinforced concrete frame structures.