



THE SEISMIC RESILIENCE INITIATIVE

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The combined destruction of property from “mega” hurricanes Harvey, Irma and Maria could exceed \$200 billion according to the firm Moody’s Analytics. Astounding as that number is, the most recent California Shake Out study estimates that a major quake along the San Andreas Fault could cause more than \$200 billion in physical and economic damage by itself, and result in 1,800 or more deaths.

Contributing to this risk is the fact that in major cities throughout California and much of the west coast, 80-90% of the building stock was constructed before the advent of what engineers consider to be “modern” building codes, and those that are designed to current codes are meant to protect the lives of occupants in a major earthquake, not eliminate damage or recovery time. Two major earthquakes struck Christchurch, New Zealand in 2010 and 2011. Fortunately, only two of the thousands of modern buildings in the downtown collapsed; but over 50% of the entire building stock was eventually demolished because of excessive damage. This would be completely unacceptable for any city in the United States facing similar risks.



Source: <http://cityhubla.github.io>
Figure 1 – Los Angeles. Only the buildings in orange were designed after the adoption of modern building codes; the remainder likely were not.

California ranks as the sixth largest economy in the world. 17 percent the nation’s job growth and 24 percent of its gross domestic product increase between 2012 and 2016 can be attributed to California, according to Stephen Levy, director of the Center for Continuing Study of the California Economy. If the Golden State were to suffer a catastrophe of epic proportions from an earthquake, the impacts would be felt throughout the nation. Resilience against earthquakes is not only a California issue, but also a matter of national, and potentially global concern.

The US Resiliency Council, a nonprofit organization, was founded in 2011 with the mission to establish and implement meaningful rating systems that describe the performance of buildings during earthquakes and other natural hazard events nationwide, to educate the general public to understand these risks, and to thereby improve societal resilience. The USRC’s members include many of the foremost earthquake engineering firms and professional societies in the country, and it has been recognized by FEMA, the States of California and Oregon, The Pew Charitable Trust and others as one of the nation’s leading organizations dedicated to helping achieve true community and corporate sustainability through the promotion of resilience based design.

Several large cities in California, including Los Angeles and San Francisco, have adopted earthquake retrofit ordinances that require mitigation of seismically vulnerable buildings like soft story apartments and older concrete structures. A few smaller cities have followed suit, but the vast majority of communities in seismically active states have no such ordinances, which can be costly to implement for both building owners and the cities themselves.

The National Institute of Building Sciences in its seminal report, *Mitigation Saves*, estimates that every dollar spent on mitigation society returns a resilience benefit of four dollars or more. The California Seismic Safety Commission in 2000 issued a report on lessons learned from major quakes striking Turkey, Greece and Taiwan. “Earthquakes can strike urban areas without notice and with devastating impacts,” the report said. “... California must continue to prepare for major seismic events to strike.”

If the nation is to avoid the painful lesson of Christchurch, New Zealand – that there is a deep miscommunication between the engineering community and the public about the expected performance of buildings in earthquakes and other natural hazards – then states must begin to provide that information in an objective and scientific way. Cities that have adopted retrofit ordinances begin by identifying potentially vulnerable buildings, which typically include older concrete, masonry, steel and wood structures that were designed before the adoption of modern building codes. A recent article in the Los Angeles Times <http://www.latimes.com/world/mexico-americas/la-fg-mexico-city-earthquake-20171110-htmlstory.html>, describes the consequences in the recent Mexico City Earthquake when residents do not have access to this information.



Source: LA Times, Los Angeles County Tax Assessor Database
Figure 2 - The location of “soft story” apartment buildings in Los Angeles County.

California already requires that state owned or leased facilities, including agency offices and its state university systems, be evaluated to determine whether they may present a risk to the occupants. The US Resiliency Council believes that all building owners, tenants, lenders, insurers and the general public have a right to understand whether the buildings in which they live, work or conduct business are potentially hazardous during a major earthquake. Cities and states will use this information to better understand their risks and develop long-term strategies to mitigate them. One of the most costly mistakes made by states and by the federal government over the past decades is having out-of-date flood maps that allow construction in flood prone areas. The consequences of this were devastatingly evident just this summer following Hurricane Harvey. Statewide databases of potentially vulnerable buildings, and a seismic rating for every new building built, will greatly increase understanding of risk and allow governments and individual property and business owners to develop long term strategies to improve resilience. Consider the Monroey Sticker, which by law has to be affixed to every new car sold in the United States, and provides a prospective buyer with information not only on the vehicle’s safety, but also on how much the owner can expect to spend annually on fuel.



Figure 3 – A Monroey sticker, required to be affixed to the window of every new car sold in America.

With state-of-the-art engineering science, today’s structural engineers are able to provide the same information to building stakeholders: will the building be safe, what is the cost of damage it is likely to suffer, and how long will it be until people can reenter the building and begin to resume working or living there.

Code Performance	USRC BUILDING RATING SYSTEM		
	SAFETY	DAMAGE	RECOVERY
★★★★★	Blocking exit paths unlikely	Minimal Damage (<5%)	Immediate to Days
★★★★	Serious injuries unlikely	Moderate Damage (<20%)	Within days to weeks
★★★	Loss of life unlikely	Significant Damage (>20%)	Within weeks to months

High Performance