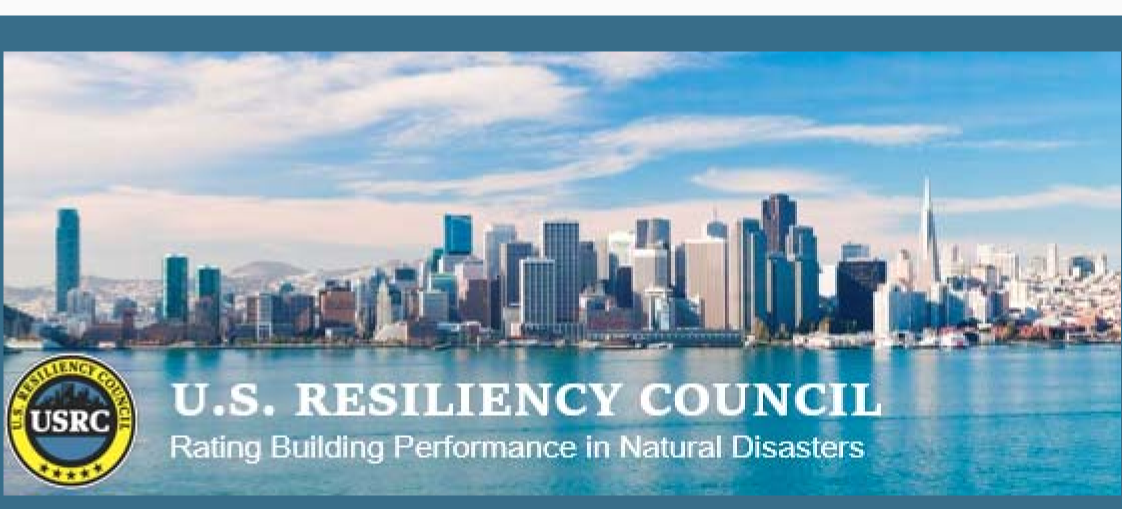

A SUSTAINABLE BUILDING MUST BE RESILIENT AS WELL

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Sustainability and Resilience: Two Terms, One Goal

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At a recent presentation on resilience, a topic that is becoming ubiquitous at conferences and forums around the world, the presenter, an architect, was describing a new building that he had recently completed. It utilized a state-of-the-art reclamation system that reduced water consumption by more than 50%. He highlighted the sustainable features of the system and its contribution to the building's LEED Platinum rating. He then went on to say that because the building was located in an area of the country that was likely to experience higher drought levels in the coming decades due to climate change, the fact that the building used so much less water also made it resilient to future natural disasters. This architect's deft pivot, re-branding an environmentally friendly design feature to one that also contributed to long term resilience was emblematic of the evolution in focus among the design profession toward resilience based design.

Green design alone is not sustainable

I had a discussion with a friend a few years back who really wanted to buy a new Prius because it was so environmentally friendly. I commented that she might be better off buying a used Corolla that got 50 mpg, because the car was already built. Regardless of a building's "green" features, which are intended to reduce the use of or impact on finite resources over the building's lifetime – water, energy, clean air – the biggest environmental impact a building has is during its construction. Renewable materials such as heavy timber, and the use of recycled materials in many buildings reduce this impact, but the energy cost of manufacturing and assembling the building components is still the largest contributor. ***Therefore, the longer a building lasts before it needs to be replaced, the more sustainable it will be.***

Consider the example of the Bullitt Center in Seattle, hailed as "the greenest commercial building in the world"[i] by its developers. The building, dedicated on Earth Day, 2013, is an energy net-positive space boasting some of the most state-of-the art environmentally friendly features that include solar panels, rainwater catchment, use of sustainable wood framing materials, and even self-composting toilets. According to Dennis Hayes, the Bullitt Foundation CEO, "The building was designed to last 250 years, so we expect many decades of favorable economic returns."[ii]

The Bullitt Center, however, is located in a region of very high seismicity. Seattle and the rest of western Washington is at substantial risk of a major earthquake along the Cascadia Subduction Zone Fault, which is capable of producing a Magnitude 9.0 earthquake that would produce nearly fifty times more energy than what was released during the 1906 Great San Francisco Earthquake. Experts estimate the probability of such an event occurring over the next fifty years at between one in three and one in ten[iii].

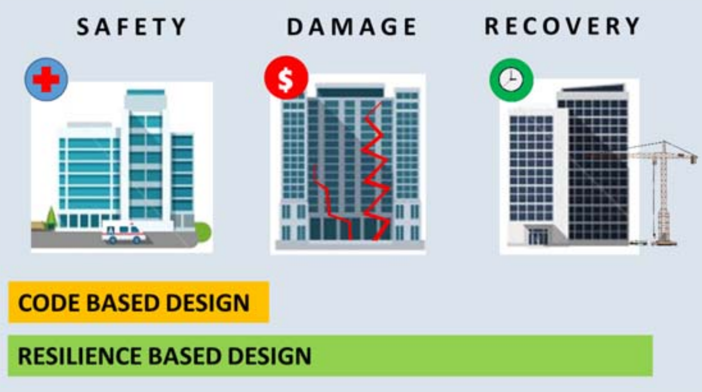
The Bullitt Center was engineered with a structural system employing concentric steel braced frames (CBF) as shown in the photograph below. Studies over the past ten years at universities such as UC Berkeley and others suggest that CBF's can be among the poorer performing modern structural systems in terms of earthquake resistance. Brace buckling, fracture of gusset plates and yielding of the beams above the braces may result in large permanent building deformations that could render buildings a total economic loss after a major seismic event. The Bullitt Center website makes no mention of the building's expected seismic performance over its intended "250 year" lifetime.

The question this raises is obvious. If there is a 10%-33% chance of a catastrophic earthquake hitting the Seattle area in the next fifty years that could render buildings with CBF's as total losses, how can a building truly be considered green and sustainable if it generates thousands of tons of debris and a huge environmental cost should it have to be demolished and rebuilt after just fifty years?

Source: The Bullitt Foundation

Resilience based design is an economical solution

The Building Code is often misunderstood as a standard that ensures a building is "proof" against the hazard for which it was designed. In fact, the stated goal of codes for standard occupancy structures is to produce buildings that are safe, and will not collapse under extreme loading. It is possible, even probable in many instances, that the buildings will be so heavily damaged that they are not economical to repair, and will have to be replaced. As an example only two modern buildings collapsed in the February 11, 2011 earthquake in Christchurch, New Zealand, but 70% of the buildings in the central business district were eventually demolished as a result of heavy damage. New Zealand codes and construction practices are similar to those of the US. Resilience based design, as promoted by the US Resiliency Council, considers strategies to measure and improve building performance across the dimensions of damage and recovery as well as safety.



Several studies over the past fifteen years suggest that the construction and design costs for a building that achieves a LEED Platinum rating are on the order of 5-10% above a building that is not LEED Certified. The marketplace has absorbed this cost because of the high public demand for sustainable buildings. What might be surprising to learn, however, is that to achieve resilient design that considers the value of reducing damage, recovery time and ultimately the probability of having to replace a building after a major natural disaster, the costs are similarly on the order of 1-5% above a building that meets only minimum Code standards. Thus, achieving a US Resiliency Council Platinum Rating for a building that will likely suffer only minimal damage that is easily repaired and will be immediately functional after a large earthquake or hurricane, can result in major savings over the intended lifetime and represent a truly sustainable structure.

The New San Bernardino Justice Center, a $300 million courthouse, was completed in 2014 and represents an example of resilience based design. The 11-story building was founded on base isolators that will allow it to achieve the highest level of performance in a major Southern California earthquake, likely commensurate with a USRC Platinum Rating. The additional cost of employing the base isolation system was on the order of only 1% of the total construction cost.

US Resiliency Council · 35 Valley Road · Atherton, Ca 94027 · USA