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on

Beyond Life-Safety: The Quest Continues

by

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ABSTRACT

When the concept of seismic design started early in the 20th century, it was initially expected that structures can be rendered earthquake-safe if they are designed to be stronger than the maximum seismic force likely to be imposed in their lifetime. Due to fundamental deficiencies in the knowledge of earthquake engineering/science and understanding of seismic performance of structures then, early seismic design practices had inherent flaws. With hindsight, it is now widely accepted that majority of existing old buildings are seismically vulnerable and need urgent intervention to enhance their seismic performance. Unsurprisingly, loss of lives in recent earthquakes has mainly originated predominantly from the collapse of old buildings.

Gradually evolving from the maiden naïve approach, the current version of seismic design targets life-safety in large and rare earthquakes. As a result, not many 21st century buildings have collapsed, and people have rarely died in such buildings even in very severe earthquakes. However, modern seismic design allows structures to damage even in minor-moderate shakings. Consequently, our modern building stock has invariably suffered damage in all recent earthquakes, and the financial losses to the community arising from damage and downtime of these buildings have been unacceptably high in many earthquakes.

Following the 2010-11 Canterbury (New Zealand) earthquake sequence, New Zealand engineers (justifiably) claimed that the performance of building stock in general was better than expected. This has perplexed the New Zealand public who are still struggling to cope with the huge scale of financial loss caused by this earthquake sequence. They are asking: “How can the engineers say we have done well? Do we need to go broke before they realize we have failed miserably?” This difference is mainly because of the different expectations of the engineers (life-safety) and the general public (economic consequences). Hence, it is necessary that the seismic design objectives be matched in line with public expectations.

Observations from recent earthquakes have highlighted that the majority of seismic loss in buildings are attributable to damage of secondary components (known as the *non-structural elements*). Hence, enhancing seismic performance of non-structural elements (SPONSE) is a must if we want to minimize financial implications of future earthquakes. Unsurprisingly, awareness of the importance of SPONSE research has significantly increased lately, and researchers are striving to better understand the inherent weaknesses in the current NSEs’ design and installation practices and to develop low-damage solutions for key NSEs.