Opinion

Engineering resilience

The poor outcomes for many modern multi-storey buildings in recent earthquakes mean it’s time to change the emphasis beyond life safety to reducing damage says structural engineer David Hopkins.

IN THE CANTERBURY EARTHQUAKES, Christchurch CBD was so affected that the city was closed for several years. Modern buildings were regarded as having done their job in protecting lives - equalling or exceeding expectations. However, many have now been demolished.

In Wellington, after the Kaikoura earthquake in November 2016, 80 buildings required detailed structural checks and several demolition. Businesses had to relocate to temporary premises. Apartment owners had to temporarily relocate because of damage to their building or an adjacent one, but overall, the city and CBD continued to function.

Structurally, what stands out is the vulnerability of modern multi-storey reinforced concrete structures with pre-cast floors and the damage to finishes, fittings and contents as buildings swayed.

Time for a review

What changes in structural engineering standards and practice would provide a better outcome in terms of resilience of cities and communities?

Structural integrity is paramount if a building is to perform well in strong earthquake shaking - that is, elements must be well tied together. The lack of integrity of structures with precast concrete floors is particularly concerning and requires a review of standards and practices with input from leading overseas structural engineers.

Building structures are designed so key elements permanently deform in strong earthquake shaking. In addition, the high levels of inter-storey drift allowed cause finishes and fittings to be damaged. We should question how well these approaches serve city resilience and review current standards and design practice.

Reduce damage to minimise downtime

The emphasis in structural design should extend beyond life safety to reducing damage to minimise downtime. Different structural design approaches can avoid the need to demolish buildings after a major earthquake.

These include low-damage design and seismic isolation. Low-damage design protects the structure while seismic isolation protects the whole building, including fittings and contents. These are two examples, but it is time for a thorough review of all structural engineering design options available, examining how structural engineering can contribute to improved city resilience.

Rigour at every stage

Regardless of changes in overall approach, it is important to be confident that what is built is as good as it can be. Every building is a prototype - a one of a kind. Rigour is needed at every stage, requiring application of engineering skills and resources in:

● the development of codes and standards
● design practice
● issuing building consents
● construction processes
● the supervision of construction
● the issue of Code compliance certificates.

A look at skills adequacy

The impacts on Christchurch and Wellington, and the subsequent reviews of many building designs, suggest there needs to be a review of the adequacy and effectiveness of the engineering skills and resources applied at each of these stages.

Achieving increased resilience in practice requires authorities, owners and structural designers to promote and adopt new approaches for the design of new buildings and for retrofitting existing buildings.

Owners and authorities need to demand application of the technical rigour each building deserves and to recognise the value of investment in it.