Saving the past: new challenges for earthquake prone buildings in New Zealand

Chris Paul Murphy

Unitec Institute of Technology, Auckland, New Zealand
cmursy@unitec.ac.nz

Abstract: The challenges facing heritage buildings in New Zealand will become all the more significant if legislation to strengthen building code requirements for these buildings is enacted. The strengthening proposals particularly affect old buildings constructed in unreinforced brick masonry. Many of these are “home shop” buildings with home accommodation above the ground floor retail space. Some have heritage value. The proposed legislation will affect all parts of New Zealand, regardless of the particular region’s exposure to earthquake risk. The implications of the upgrade are significant, both for owners and for townscape to which they belong. If the cost puts the viability of the building at risk, the owner will be in a position where demolition is the only feasible option. This could have far reaching implications for the social and heritage wellbeing of many small towns within New Zealand. This paper will report on the submissions to the proposed legislation, particularly as they relate to small-scale unreinforced brick masonry buildings. It will highlight strategies from those submissions that have the potential to enhance the life of some of these buildings, particularly in low risk earthquake zones, without unduly compromising cost and safety considerations.

Keywords: Unreinforced masonry; earthquake-prone; buildings.

1. Background

Legislation in the form of The Building (Earthquake-prone Buildings) Amendment Bill 2013 was introduced into the New Zealand Parliament on 13th December 2013. The aim of the legislation was to improve methods of managing New Zealand’s stock of earthquake buildings. The legislation arose out of the recommendations of the Canterbury Earthquake Royal Commission (2012), an examining body assembled to examine the reasons for the collapsed buildings following the two earthquakes that rocked the city of Christchurch. Christchurch, New Zealand’s second most populated city, suffered two significant earthquakes across a six-month period. An earthquake of magnitude 7.1 struck on September 4th 2010, followed by another on the 11th February 2011, this time of magnitude 6.3. The February earthquake caused extensive damage across the city and was responsible for the deaths of some 185 people, mostly as a result of building collapse.
Buildings affected by the earthquake included many small, unreinforced masonry (URM) retail buildings commonly referred to as “home shop” or “house shop” buildings, the main focus of this paper. (Figure 1) This building typology, so called because the shop owners retailed their wares on the ground floor and lived with their families in the upstairs portion of the predominantly two-storey building, formed the backbone of the many urban streetscape settlements that grew up around the larger cities in New Zealand, mostly between the years 1880+ to the 1920-1930s. In Auckland for example, such centres as Ponsonby, Grey Lynn, Herne Bay, Dominion Rd, Mt Eden, Otahuhu and Papakura have URM home shop buildings still gracing the main streets. External construction was single or cavity brick construction, often with protruding parapets elaborately adorned. Floors were constructed of timber, with strip timber tongue and groove flooring. Access to the upper floor, where the owner and family lived, was by internal stair. (Figure 2)

Figure 1: Christchurch earthquake. Parapet veranda and facade damage (source D. Wetley, 2010).

Figure 2: Ponsonby Rd. Auckland (source: C. Murphy).
The proposals, if they are as expected carried through into legislation, will have a significant impact on the heritage value of many small towns throughout New Zealand, especially in older communities where many buildings within the local shopping precinct are constructed in URM, and as such regarded as “earthquake-prone”.

2. Criticisms of existing earthquake policy

Whilst the present act requires Local Authorities to develop policies around earthquake-prone buildings, there is, according to the Ministry of Business Innovation and Employment (MBIE) Consultation Document, large discretion in the present system as to “how actively they identify and deal with these buildings.”

Individual local authorities have very different approaches to implementing current policy requirements. Some local authorities are not actively identifying earthquake-prone buildings or requiring building owners to deal with them. Other authorities have taken some action, but have given building owners very long timeframes to resolve problems. A number of authorities have taken strong action, including requiring higher strengthening than required by law. (Ministry of Business (A), 2012, p16)

The MBIE suggested some 15000-25000 buildings would fall into the earthquake-prone category but acknowledged this figure was a very broad estimate as only a few local authorities “can provide good data”. (Ministry of Business (A), 2012, p6)

Of the 66 local authorities, only 23 were able to provide any information on the number of earthquake-prone buildings in their districts, and much of the information received was incomplete. (Ministry of Business, 2012, p120)

The call for submissions brought a substantial response; with MBIE indicating over 530 submissions received. These were from a broad cross section of community life, including a significant 42% from members of the public. Refer Table 1. (Ministry of Business, (B), 2012)

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>42%</td>
</tr>
<tr>
<td>Building Owners</td>
<td>18%</td>
</tr>
<tr>
<td>Local Government</td>
<td>10%</td>
</tr>
<tr>
<td>Architects and Engineers</td>
<td>10%</td>
</tr>
<tr>
<td>Others</td>
<td>20%</td>
</tr>
</tbody>
</table>

3. Risk analysis and time frames

The proposed legislation originally treated the whole of NZ as a uniform risk, with the upgrading of URM and earthquake-prone buildings required within a specified time frame (15 years) applied uniformly across the whole of New Zealand. This stance has since been changed with the MBIE document acknowledging the original proposal had met considerable resistance from submitters.

Submissions from the Auckland Council, the largest Territorial Authority in New Zealand, helped to change this stance. They were based on a risk analysis survey from GIS Science, a research consultancy
commissioned by the Auckland Council, which looked at the statistical probability of a significant earthquake and the likely costs, number of collapses, and number of deaths that could result. (Cousins et al, 2014)

GIS Science suggested the risk levels to life from an earthquake were for Auckland statistically very low, even for earthquakes with a return period of 500 years or more (0.002 annual probability), with the number of deaths in the Region from this return period estimated as 7, with 2 deaths within Auckland city itself. Auckland, the location of many URM buildings has, suggests the GIS report, rarely experienced even low-level earthquake shaking “since Europeans first settled there in the early 1800s and there appear to be no historical earthquake casualties”. The Modified Mercalli intensity (MMI), an indication of earthquake intensity, has never been exceeded in excess of MM6, with only occasionally localized intensities of MM4 and MM5 shaking, and one instance only of MM6 shaking in 1891 (the Waikato Heads earthquake), located some 50 km south of Auckland near the mouth of the Waikato river. (Cousins et al, 2014, p23)

As it stands, the legislation now acknowledges different time frames for different zones, with timeframes for assessment and strengthening varying between 15 and 35 years, depending upon the risk zone.

Figure 3 indicates the three earthquake risk zones, low, medium and high. Wellington (the capital) is within a high-risk zone (the Wellington fault bisects the southern part of the city), whilst Auckland, the largest city, is within a low-risk zone.

![NEW RISK ZONES FOR STRENGTHENING](image)

Figure 3: New EQ risk zones (source: NZ Herald, May 2015).

4. Barriers to revitalization and enhancement of heritage buildings

4.1. Excessive strengthening requirements

Whilst the time allowances have been eased, the requirement remains for URM and other earthquake prone buildings to be upgraded to a minimum of 34% of the NBS, regardless of the location of the building. This, suggests researchers such as Tailrisk Economics, effectively means the safety standard for
Saving the past: new challenges for earthquake prone buildings in New Zealand

A building in Auckland (a low risk earthquake area) is about “three thousand times stronger than the one applied in Wellington (a high risk area). (Harrison et al, 2013) What is more, suggests the Tailrisk report, compliance with the minimum standard for Auckland will result in a cost in excess of three billion dollars, (Tailgate’s own report puts it as high as $10 billion) “but is expected to take 4,000 years to save a single life” (Harrison et al, 2013, p6). The report suggest that the definition of what constitutes an “earthquake-prone” building should be urgently revisited and based on evidence of risk and not graded according “to their estimated strength relative to the new building code”. (Harrison et al, 2013, p8)

Other submitters responding to the Consultative document also criticised the excessive life safety standard applied to earthquake prone buildings.

Smoking alone kills 20 times as many people each and every year as were killed in Christchurch. The total number of Kiwis killed by earthquake is one tenth of those killed by smoking and the same for obesity… (Ministry of Business, (B), 2012, p12)

4.2. Insurance and financial barriers

Submitters responding to the Consultation document documented concerns of considerable importance. Comments included concerns about the lack of insurance for such URM buildings impacting on the ability to obtain bank finance to upgrade, assuming of course the loan-to-value ratios support a loan in the first place. Where they do not, and in many small provincial areas with low value and low rent properties, that is the case, financial support is required. The Auckland Council’s submission recognised this dilemma and suggested that “bank loans be guaranteed for owners needing to upgrade buildings and for the cost of a seismic retrofit (just that component) be deemed ‘repairs and maintenance’ rather than ‘capital expenditure’ for tax purposes”. [Ministry of Business, (B) 2012, p18]

No financial support has been offered to date; yet there are considerable penalties for non-compliance. These include a fine of up to $200,000 if the seismic work is not completed by the deadline and a fine of up to the same amount for failing to comply with safety requirements imposed by a territorial authority. Such an approach is certain to cause wholesale demolition of the home shop in provincial areas, where values are relatively low and financial and insurance costs outweigh rental benefit likely from any strengthening. In large centres such as Auckland, the costs benefits would be mixed. High value areas such as Ponsonby or Devonport with a degree of heritage protection may survive. Areas of lessor value, such as Dominion Rd or Papakura would see at the very least most of the structures removed for new construction.

Where territorial authority or other government support is not forthcoming, demolition is likely as the only viable course of action available.

5. Conclusion

The MBIE Summary of Submissions document indicated a broad level of support for the government making improvements to New Zealand’s earthquake prone system. There was a lack of support for the “one size fits all” approach to risk, especially in low risk areas such as Auckland. Additional research is needed to develop and test alternative compliance processes, similar to the risk matrix assessment process used to determine cladding profiles and capable of being used, at least for low and medium risk zones, by non-engineer professionals. The aim would be to secure these small-scaled heritage building in such a way that fixes the most dangerous parts of a building and allows it to “fail safely” in a significant earthquake, but by the same token limits upgrading costs to levels where on-going
occupation of these heritage structures continues to be viable. Deaths from persons trapped within URM buildings in the Christchurch earthquake numbered 4. Mortality from persons outside and killed by falling debris, on the other hand, numbered 35.

The biggest risk to public safety in Whanganui is from bits of building falling into the street in the central business district. (Maslin, 2015)

Many of these home shop buildings are small and have very low occupancy rates. Given the long return periods for even MM6 and MM7 earthquakes in low risk areas such as Auckland, there is a case for limiting the strengthening upgrade to securing protruding or dangerous elements such as verandas and parapets, and strengthening the balance of the parts to enable a "fail safe" situation to result.

Local factors such as wind speed are already a part of the National Building Code. The wind speed for any proposed building varies depending upon location such as proximity to the sea, whether urban or rural (open ground), or in a hill (exposed) or valley (sheltered) situation. The Building Code also acknowledges variations in general wind speed for different parts of New Zealand, resulting in different levels of bracing requirements dependent on assessed risk. Why should not a similar process apply to earthquake risk? Whilst regional variation introduces complexity into legislation, a suggested approach that takes into account such factors for an area as seismicity, economic profile (high value, high rent versus low value and low rent), local heritage issues and the likely impact of the legislation on the local community should be worthy of further scrutiny.

Cladding options differ in new residential buildings dependant on a risk matrix that takes into account the severity of local conditions and the type and complexity of building being constructed. Why cannot similar factors be used to mitigate the time frames and strengthening requirements of URM buildings?

The Financial Amendment Bill No 3 gave limited support to homeowners in New Zealand forced to repair their homes due to their buildings leaking through no fault of their own. Why not a similar financial scheme for the owners of heritage valued URM buildings forced by legislation to strengthen their buildings to an arbitrary value of the NBS, regardless of its location?

Historic buildings will always be at risk suggests Hassler (2009) because modern land-use planning and regulations “regularly lead to considerable losses of historic substance in areas close to historic city centres because potential financial returns on future use are compared with the proceeds of a change of use of existing buildings.” If however Government policy means mass demolition of street heritage – which will happen here in the parts of New Zealand towns and cities if upgrade costs are too prohibitive and owners exercise their rights to demolish - the very attractiveness of a neighbourhood will be diminished, and with it, suggests Hassler, the potential returns associated with that same attractiveness. (Hassler, 2009)

References


