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SAVING THE HOME SHOP: THE FUTURE OF SMALL EARTHQUAKE PRONE BUILDINGS IN NEW ZEALAND

C. Murphy
Department of Architecture, Faculty of Creative Industries
Unitec Institute of Technology, Auckland
New Zealand

ABSTRACT

The New Zealand Government is in the process of considering a law that would require all commercial, multi-unit and multi-story residential buildings upgraded and strengthened to a minimum of 35% or more of the New Building Standard. Buildings so designated will have up to 15 years from the end of the review period to bring their buildings into line with these requirements. The proposal particularly affects old buildings constructed in unreinforced brick masonry. Many of these are home shop buildings with some heritage value, built around the turn of the 20th Century. Together they make up a considerable portion of many small town commercial precincts. 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 wellbeing of many small towns within New Zealand. The Governments decisions follow on from some of the recommendations of the Canterbury Earthquakes Royal Commission report on the recent Christchurch earthquake. The paper will examine these recommendations and report on the submissions to the proposed legislation, particularly as they relate to small-scale unreinforced brick masonry buildings. It will examine the social and economic effects of the legislation on the provincial town compared to inner city Auckland and suggest that there are other cost effective solutions to this dilemma than the route proposed by the impending legislation.

Key words: Earthquake prone buildings, construction technology, unreinforced brick masonry buildings

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Introduction

On September 4th 2010 a 7.1 magnitude earthquake struck the city of Christchurch, New Zealand's second most populated city. It was followed some six months later on the 11th February 2011 by another earthquake, this time of magnitude 6.3. This second earthquake caused extensive damage across the city and was responsible for the deaths of some 185 people, mostly as a result of building collapse. The Canterbury Earthquake Royal Commission, tasked with examining the reasons for these collapsed buildings, suggested a range of recommendations and actions designed to improve the response of the nation to another future earthquake. These recommendations have led to the introduction into the New Zealand Parliament of the Building (Earthquake-prone Buildings) Amendment Bill 2013, an amendment to the Building Act 2004, with the aim of "improving methods of managing New Zealand's stock of earthquake-prone buildings".

This paper will examine the recommendations put forward by the Canterbury Earthquakes Royal Commission (The Commission), outline the nature of the bill and its intent, and examine the submissions by the community and building industry made to the parliamentary select committee following its introduction to the Parliament on the 9th December 2013. The proposed amendments have created controversy within the building industry. The paper will examine the social and economic effects of the legislation on the provincial town compared to inner city Auckland and suggest that there are other more cost effective solutions to this dilemma than the route proposed by the impending legislation.

The Home Shop: Small Town Heritage

The Commission's proposals, if 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 unreinforced brick masonry (URM), and as such regarded as "earthquake-prone". Many of the small provincial towns serviced surrounding farming districts at a time when transport difficulties made travel any distance a difficult exercise. They served as the social and economic hub for the district. A common type of construction pre 1940 was the "home shop", typically with a modest retail area on the ground floor, and accommodation for the shop owner and their family on the upper level, accessed via an internal stair. External construction was single or cavity brick construction, often with protruding parapets elaborately adorned. Examples remain plentiful in centers such as Taumaranui, Paeroa, Thames, Gisborne, Napier, in the North Island, and Oamaru, Balcultha, Invercargill, Hokitika, to name but a few, in the South Island.

The home shop also formed the backbone of the many urban suburban settlements that grew up around the larger cities. In Auckland for example, such centers as Ponsonby,

Grey Lynn, Herne Bay, Dominion Rd, Mt Eden, Otahuhu and Papakura, have many URM home shop buildings still gracing the main streets. Data from the GIS Science Consultancy Report suggests some 20% of buildings constructed pre-1940 were constructed in Un-Reinforced Brick Masonry. Figure 1 refers [1, 4].

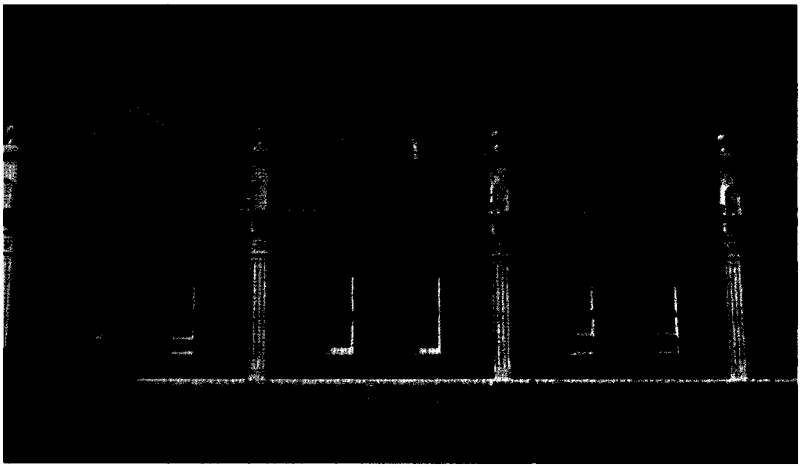

Figure 1 : Source: Author

The Canterbury Earthquakes Royal Commission Report

The Commission was of the view that existing buildings in New Zealand, particularly those older buildings constructed of unreinforced brick masonry (URM) and part of the communities mentioned above, are poorly managed in terms of their capacity to protect the inhabitants from the effects of earthquake. The recommendations were many and varied. The main recommendations, as they relate to URM buildings included amendments to The Building Act 2004 to ensure:

- Structural engineers in New Zealand are thoroughly familiar with the procedures needed to evaluate existing buildings and for the Ministry of Business, Innovation and Employment (MBIE), the government ministry responsible for building and construction, to take responsible oversight of this.
- A grading system for existing buildings is developed that is "able to be understood by the general public and adequately describes the seismic performance of a building."
- Hazardous elements within URM buildings are strengthened, or in the case of falling hazards, such as chimneys, parapets and ornaments, are removed.
- The creation of legislation to empower territorial authorities to ensure "timely improvements" in the strengthening of existing earthquake-prone URM buildings within their area of jurisdiction, and "*that the maximum time permitted to complete the evaluation and strengthening of existing buildings should be set nationally*" [Italics by Author]

Other recommendations of a more detailed nature gave advice on the degree of strengthening required. In general terms, to protect life safety, the Commission suggested the "shaking level" for these existing buildings be set at no less than "one third of the requirements for a new building. Where however elements of URM posed a particular threat to health and safety, that is, elements such as parapets, ornaments and external walls, that a higher level of protection would be warranted.

The Commission also suggested that territorial authorities have discretion "to adopt and enforce a policy that requires a higher standard of strengthening for buildings of high importance or high occupancy". Conversely, buildings that are very seldom used and so located such as where the risk to life of passers-by is considered minimal could be considered for exemption from strengthening requirements. Examples of buildings in this category could be those associated with farming.

The Commission acknowledged some URM buildings were of historical importance but was of the view that if considered dangerous, and that demolition was the only feasible option to making the building safe, then the building's status within the Historic Places Act should not prevent this demolition from being carried out [2, 7].

Consultative Process and Summary of Submissions

The Government response to The Commission's recommendations was to hold an internal ministerial review. It then combined its own ministry recommendations with those of The Commission and published a consultation document *Building Seismic Performance: Proposals to improve the New Zealand earthquake-prone building system: Consultation document* (Consultation Document). This document outlined the proposal options to improve the system for managing earthquake-prone buildings within New Zealand. It was released in December 2012, with submissions required on the proposals from the public by 8th March 2013 [3]. The submissions were themselves analysed in a subsequent report: Building Seismic Performance: Proposals to improve the New Zealand earthquake-prone building system: Summary of Submissions [4].

Criticisms of the Existing Policy

Whilst the present act requires Local Authorities to develop policies around earthquake prone buildings, there is, according to the 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 [3, 16].

The MBIE, in its Consultation Document 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" [3, 6].

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 [3, 12].

Under the current system, many earthquake-prone buildings are not being identified or dealt with in a timely and cost-effective way. The issues include too much variance in local authority practice, public confusion about risk, a lack of good data on buildings, and lack of central guidance to local authorities [3, 6].

Submissions Received

As can be expected for a country still getting to grips two years on with the enormity of the challenge faced by the earthquake, the call for submissions brought in a substantial response, with the MBIE document indicating over 530 responses received. These were from a broad cross section of community life, including a significant 42% being from individual submitters and members of the public. A cross sectional sample of the main categories can be seen in Table 1 [4].

Table 1 : Source MBIE: Summary of Submissions

Stakeholder	Percentage
Individual	42%
Building Owners	18%
Local Government	10%
Architects and Engineers	10%
Others	20%

Most submitters responding to the Consultation Document seem to appreciate the need for a cohesive strategy to improve New Zealand's earthquake-prone system but were divided on how to attain it. There was general support for the proposal requiring each local authority to assess the seismic capacity of certain earthquake-prone buildings within its jurisdiction. There was also general support from submitters for prioritizing assessment for certain earthquake-prone buildings and support, though mixed, for the claimed seismic capacity information for individual buildings to be entered onto a central register. There was mixed support for maintaining the present definition of an earthquake-prone building, that being a building "that is likely to collapse in a moderate

earthquake," with the definition of a "moderate earthquake" defined as "generating shaking at the building site that is one-third as strong a what a new building at the same site would be designed to withstand," or put more succinctly, at 33% of the New Building Standard (NBS) [4, 11]. Whilst there was general agreed improvements could be made, there was much in the policy to disagree about.

Concerns: Risk Assessment-"One Size Fits All"

The legislation requires all URM and other earthquake prone buildings to be ungraded to a minimum of 34% of the NBS, regardless of the location of the building. However, the level of risk from an earthquake varies considerably from other end of New Zealand to the other. There are in fact 3 zones, low, medium and high. Wellington (the capital) is in a high risk zone (the Wellington fault bisects the southern part of the city). Auckland is within a low risk zone. The application of the legislation regardless of location effectively means, suggests Tailrisk Economics, the life safety standard for 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) [5]. What is more, suggests the Tailgate 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" [5, 6]. The report suggests 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" [5, 8].

Other submitters responding to the Consultative document also criticized 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... [4, 12]

A risk analysis survey commissioned by the Auckland Council, the largest Territorial Authority in New Zealand, looked at the statistical probability of a significant earthquake and the likely costs, number of collapses, and number of deaths that could result.

They suggest 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), where as noted, the number of deaths in the Region is estimated as 7, with 2 deaths estimated 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 therein 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 [1, 23].

There is, the report notes, potential loss of life from two local fault sources, the Wairoa North fault, the only one within the Auckland Region boundary, and the Kerepehi fault (off shore segment) that lay further away, bisecting the Hauraki Plains and north into the Firth of Thames. In the case of the former, building collapse on or near the fault would be considerable. However, as the fault lays "mostly in farmland and forested country where there are very few buildings" little loss of life can be expected [1, 13]. This is in direct contrast to Wellington region, where the Wellington fault bisects in turn Wellington city, Lower Hutt and Petone, all commercial and/or residential areas, with Porirua, another residential district traversed by the separate Ohariu fault. In the case of the Kerepehi fault in the Firth of Thames however, damage at the fault line to buildings is non-existent, as the fault line is under water.

In both cases, the modelling indicates a level of intensity in the region and across Auckland city of between MM7 and MM8, with repair costs between $1-2 billion for buildings and 20-50 deaths. However, says the report, the danger is offset by the long return periods for both sources, these being 12,600 years for the Wairoa fault, and 20,000 years for the Kerepehi [1, 24].

The report also models the likely relationship between the MMI level (shaking intensity) and the likely probability of the degree of damage to a building (termed the "Damage stage"). This in turn, again via modelling, led to a prediction of a "Casualty state" for any occupant of a building. Casualty states ranged from CS0: None to CS5: Death.

For URM buildings in Auckland, the main building type focus of this paper, the likelihood of severe injury (casualty state CS3) from an occupant being in a URM building in a severe state of damage DS3 is less than 1% (0.24%). No deaths are predicted. The DS3 state is defined typically as a condition where there are "cracks in columns and beam column joints of frames, spalling of concrete cover, buckling of reinforcing rods, large cracks in partition and infill walls and failure of infill panels" [1, 13] (Table 2).

If this is so, then the criticism expressed by various submitters and within the separate report by Tailgate Economics, referred to above, would suggest that the legislation, framed as it is on the basis that risk levels are the same throughout New Zealand, is a distinct (though understandable) over reaction to the recent upheavals that occurred in Christchurch.

Table 2 : Source: GIS Science Report

Casualty State	Building Type: URM				
	DS1	DS2	DS3	DS4	DS5
CS1: Uninjured, or light injury	1	1	0.9576	0.8883	0.736
CS2: Moderate injury	0	0	0.04	0.07	0.12
CS3: Serious injury	0	0	0.0024	0.035	0.08
CS4: Critical Injury	0	0	0	0.0007	0.004
CS5: Dead	0	0	0	0.006	0.06

Concerns: Time Frames- "One Size Fits All"

The proposed legislation not only treats the whole of NZ as a uniform risk, it also requires the upgrading of URM and earthquake-prone buildings within a specified time uniformly across the whole of New Zealand. The MBIE document acknowledged this proposal met considerable resistance from submitters. Concerns were expressed about the "one-size fits all approach" inherent in the legislation.

> Whilst we agree with the retention of the current standard, the proposed timeframes and accountabilities appear too hard-hitting for our communities to absorb in any cost effective way [4, 11].

Similar arguments were put forward by other industry and Iwi organizations:

> Waikato-Tainui does not support proposals that take a "one size fits all" approach and recommend that you take a much broader basis for assessing risk from earthquake-prone buildings e.g. identify and categorise areas according to the likelihood of their experiencing an earthquake event i.e. high risk, medium risk, low risk [4, 1].

Whilst regional variation introduces complexity into legislation, submissions suggested an approach that took 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 the local community should be taken into account.

Many submitters suggested a staged approach to strengthening would provide an equitable solution to the concerns about safety considerations. The Wairoa District Council suggested:

> Further options on retaining decision making at local level, prioritization of building elements (such as parapet) that present greatest risk to life, and longer timeframes for full building upgrades is required if the outcomes and work of the CERC is to be delivered in a sustainable and enduring manner [4, 16].

Concerns: Construction Sector Capacity

Many submitters feel the existing legislation as proposed will result in a logjam of applications close to the 15-year termination period. The lack of suitably qualified structural engineers, the specialized nature of the work, the lack of familiarity with conservation techniques will put at risk a substantial number of small URM buildings, which, whilst they may not have significant historic status in themselves, contribute to a streetscape heritage that is of significant value and that, once lost, will never be regained.

The construction sector will also struggle to meet the upsurge in demand as the 15-year implementation period draws to a close, as the Heavy Industry Research Association suggests:

> Add to this [the Christchurch rebuild] the work associated to strengthen potentially 25,000 EPBs in the proposed timeframe, then considerable demands will be placed on the industry which will then revert back to zero when the demands have been met...a more holistic approach strategic approach correlated to the risk may benefit not only the wellbeing of our people but also the New Zealand economy" [4, 16].

Concerns: Financial and Insurance Implications

Submitters responding to the Consultation document voiced concerns that can only be briefly summarized in this paper, but are 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, then financial support is required. The Auckland Council's submission recognized 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" [4, 18]. Where territorial authority or other government support is not forthcoming, a Catch-22 situation arises, with demolition likely as the only viable course of action available.

Conclusion

The legislation as presently drafted requires Territorial Authorities to:

- Complete a seismic assessment of all non-residential, and multi-unit, multi-story residential buildings in their areas "within 5 years of the legislation taking effect"

- Enter the results of these assessments into a central register of earthquake-prone buildings
- Ensure the buildings on this register are either strengthened or demolished within 15 years of this time frame. x Require certain strategically placed and/or important buildings to be strengthened earlier than the national time frame and
- Allow exemptions in the form of extended time frames for Category 1 heritage buildings [6].

It requires all buildings to be assessed, and where considered earthquake prone, to be strengthened so they are no longer considered to be so. This threshold is 34% of the NBS. The present legislation, if unaltered, will require this work to be done to a single national time frame, without any exception that would take into account the earthquake risk of a particular building within a particular location. It follows hence that a URM building in a low risk area such as Auckland would be restricted to the same time frame as a URM building in Wellington, a known high risk area. The legislation does not appear to address the construction industry or the engineering sector's capacity to complete the work on time.

No financial support has been offered to date, yet there are considerable penalties for noncompliance. These include a fine of up to $200,000 if the seismic work is not completed by the deadline and a fine of up 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 centers 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.

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 restrictive time frame and the "one size fits all" approach to risk, especially in low risk areas such as Auckland. Local factors such as wind intensity and earthquake risk variation are already a part of the National Building Code and apply differently to different parts of the country, dependent on assessed risk. Cladding options differ in new residential buildings dependent on a risk matrix that takes into account local conditions. Why cannot such variation be used to mitigate the time frames and strengthening requirements of URM buildings? The Financial Amendment Bill No 3 gave limited support to homeowners 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.

Deaths from persons trapped within URM buildings in Christchurch numbered 4. Mortality from persons outside and killed by falling debris numbered 35. Why not limit the upgrade as suggested in URM buildings to "seismically dangerous elements such as unsupported verandas" [7]. This and the other strategies noted above would result in a more socially cost effective solution to this dilemma than the route proposed by the impending legislation.

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