

Preventing buildings from falling down: Challenges for earthquake-strengthening policy in small-town New Zealand

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Preventing Buildings from Falling Down: Challenges for Earthquake-Strengthening Policy in Small-Town New Zealand

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Abstract

The Canterbury earthquakes of 2010-11 and the announcement of the national earthquake prone building strengthening policy in New Zealand has apparently hindered activity in the property market affecting especially the older stock requiring seismic upgrade. The purpose of this paper is to focus on lower-value regional urban centres and the economic hardship they face for strengthening their building stock. Our investigation focuses on one town, Whanganui, but, the picture we paint of this town, the cases we analyse, and the incentives we detail, apply equally to dozens of other towns in New Zealand. These difficulties are not unique to New Zealand, as many places, globally, face the need to upgrade their infrastructure for protection against disasters and where governments have been struggling with similar difficulties in initiating earthquake strengthening of existing buildings. We analyse the current incentive schemes that can assist in achieving the policy goals and suggest alternative incentive schemes that can be implemented.

Keywords earthquake strengthening, heritage buildings, incentives, Canterbury earthquakes, small regional towns

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1. Introduction

Like many other countries on the Pacific Rim, and across other trans-plate boundaries, New Zealand experiences a lot of earthquakes. Most recently, destructive earthquakes (ones that destroyed significant amount of private property) occurred in 2010, 2011, 2013, and 2016. The 22nd of February 2011 earthquake in the city of Christchurch was especially destructive, causing the death of 185 people and leading to a reconstruction/recovery project whose costs surpassed NZ\$ 40 billion (17% of New Zealand's GDP at the time) (Potter et al., 2015).

The sequence of earthquakes in Canterbury in 2010-11, of which the 22/2/2011 earthquake in Christchurch was the most destructive, led to a reconsideration of earthquake policy in New Zealand. These events led, eventually, to changes in the New Zealand's government policy framework in dealing with existing earthquake-prone buildings - the focus of this paper.

As in most other countries, most of the policy attention directed at dealing with earthquake risk is on regulating the construction of new buildings. New Zealand had already started using building standards specifically designed to deal with earthquake risk after the destructive 1931 earthquake in Hawke's Bay; an event which killed 256 people and destroyed much of the cities of Napier and Hastings. As more knowledge about seismic risk was developed, it was incorporated into the building standards and they were modified several times during to ensuing decades. Attempts to deal systematically with the existing building stock, and reduce its associated seismic risks came much later.

The government included specific measures to address existing earthquake-prone buildings in the Building Act of 2004, but these measures were perceived to be inadequate, especially after the catastrophic earthquake in Christchurch in 2011. The government then passed the Building (Earthquake-prone Buildings) Amendment Act in 2016 (henceforth the Act); this Act was specifically designed to introduce significant tightening of the law around requirements for earthquake strengthening and shortening the time-frames in which these were mandated.

The Act provides a definition of earthquake-proneness, that is applied to buildings beyond a certain size, and which also depends on use and location. An earthquake-prone building is one which will exceed its designed capacity in a moderate earthquake (where the definition of moderate earthquake is risk-region dependent), and is therefore likely to cause injury or death in such a catastrophic event.¹

While the Act applies to the whole country, its implementation is left to the local Territorial Authorities. Specifically, they are tasked with identifying those buildings that are earthquake-prone and communicating with building owners about their legal obligations to strengthen them. In parallel, the government also introduced a new earthquake hazard risk map that set the required time-frames according to the risk associated with each region according to its stated seismic risk (see Figure 1).²

Insert Figure 1 here

The required strengthening is calculated based on the current National Building Standards (NBS). A building is considered earthquake-prone if its design is perceived to be less than 1/3 of the NBS (i.e., less than 34%). The Act requires owners of buildings to strengthen them up to 34% of the NBS. The Act does not allow the Territorial Authorities to require strengthening above 34%, though local authorities can attempt to incentivize strengthening to a higher standard.

Many of the buildings that are earthquake-prone are also designated as Heritage Buildings. In this case, a building's heritage status implies limits on what owners can do in developing their buildings, and what components of the building's heritage they are not allowed to modify. Because it is very often cheaper to demolish an earthquake-prone building and build a new one in its place, instead of strengthening the old building, it is not unusual that the heritage status of a building conflicts with its earthquake strengthening requirement (Goded et al., 2017, Henrich and McClure, 2017).

Owners of earthquake-prone buildings are thus often facing a difficult dilemma. Strengthening their building, especially if it is a very old building, can be very costly (Al-

Nammari & Lindell, 2009). It can be especially costly for heritage buildings, and for these buildings demolition may not be a permissible option. The deadlines imposed by the Act are still years away, but at the current rate of building strengthening that is being undertaken annually, there are going to be many hundreds of buildings nationwide that will not have been strengthened by their government-mandated deadlines.

Following the introduction of the original legislation, and especially following the destructive Christchurch earthquake, tenants have started to be willing to pay higher rents for apartments and offices in buildings that have higher NBS ratings. This safety-premium was especially noticeable in high-risk high-value urban centres (such as the capital city of Wellington) (Filippova et al., 2016). The safety-premium outside of the high-value urban centres remains much lower.

Meanwhile, the government and big commercial tenants have started to demand that buildings be at 2/3 (67%) of NBS, rather than the legislated threshold of 1/3 (34%) of NBS. These bigger organisations nowadays are not willing to rent, at all, buildings that are less than 67% NBS, so the implied safety-premium is quite high for properties that cater to these types of tenants. In the case of high-value centres, these market imperatives lead to a significant earthquake strengthening activity.

The purpose of this paper is to focus on lower-value regional urban centres and the economic hardship they face for strengthening their building stock. The investigation we undertake focuses on one town, Whanganui. But, the picture we paint of this town, the cases we analyse, and the incentives we detail, apply equally to dozens of other towns in New Zealand, and for that matter in many other countries. Many places, globally, face the need to upgrade their infrastructure for protection against disasters whereas the costs of strengthening of privately owned assets far outweigh the purely financial benefits that can be accrued to their owners if they invest in strengthening.

In the next section, we describe the town of Whanganui in detail, and analyse the economic realities faced by building owners who find that their earthquake-prone buildings need to be strengthened. Section 3 focuses on two case-studies that provide us with general insights

about the circumstances surrounding this strengthening requirement. In section 4, we analyse the current incentive schemes that can assist in achieving the policy goals as are described in the Act, and in section 5 we describe and assess additional alternative incentive schemes that can be implemented. Section 6 concludes with some summary observations about likely outcomes.

2. Whanganui

Administratively, New Zealand is comprised of 16 regions which are subdivided into 67 Territorial Authorities (TAs). The country is dominated by four core regions – Auckland, Waikato, Wellington and Canterbury – which generate 70.5% of the GDP and are home to 66.3% of the population (Nel, 2015), highlighting high degree of concentration and regional inequality. Despite New Zealand’s positive population growth, the lion share of this growth is taking place in Auckland and 13 other TAs, accounting for over 90% of the growth between 1996 and 2013 (Jackson, 2016).

Nel (2015) found that 37% of smaller urban centres and urban areas experienced population loss between 2006 -2013, providing further evidence of the gravitational pull of the main cities, and their respective economic trajectories. Changing agricultural practices resulted in fewer employment opportunities in peripheral and rural communities and accelerated the migration of people to the main urban centres. It is projected that about two thirds of TAs in New Zealand will experience population stagnation or loss by the end of 2043. This will limit local councils’ ability to develop and maintain infrastructure given their reliance on revenue generated locally from property taxation to fund most of their expenditures (Jackson, 2016). This fiscal squeeze on local councils hinders their ability to provide financial assistance to owners of seismically vulnerable buildings; but without seismic strengthening, the future sustainability of these urban councils becomes even more in doubt. Whanganui thus offers insights into the apparent differing economic realities that separate New Zealand’s core urban concentrations and its peripheral centres. These differences between core and periphery are not unique to New Zealand; and are equally present and problematic in seismically-exposed countries as diverse as the United States, Japan, China, or Israel.

For Whanganui, once New Zealand's fifth largest town, the change in region's fortunes came about in 1970s (Figure 2) and attests to the decline that the secondary centres experienced in terms of low economic growth, decreasing populations, lack of skilled workforce and weakening prospects for career growth (Baxendine et al., 2004, Le Herron, 1979). Shrinking population and growth in the older population have been Whanganui's reality and can be seen in Figure 3.

Insert Figure 2 here

Insert Figure 3 here

The government's earthquake-prone legislation mainly targets older commercial building stock as these are frequently assessed to be below the 34% legal threshold. In the main urban centres, like Auckland or Wellington, economic opportunities led to the demolition of older buildings and development of new bigger ones in the 1960s and 70s. This was not the case on the periphery, so the stock of remaining buildings there is much older (Russell & Ingham, 2008). Many older buildings that would have been otherwise replaced, still line the central streets of small towns like Whanganui.

With the Act now in place, many of the owners of these older buildings will be under pressure to strengthen their properties. Unlike residential buildings, commercial property is typically leased rather than occupied by its owners (Dunstan & Skilling, 2015). Owners therefore need to be relying on rental income to cover building expenses, including any costs of seismic strengthening. Yet, high vacancy rates in provincial towns (see below) reduce owners' ability to raise capital for seismic retrofitting leaving buildings to deteriorate.

Many of these older, and as yet unstrengthened, buildings are identified by the local council to have heritage status. Unable to retrofit these buildings with public funds, Whanganui is faced with the prospect of losing much of its heritage. Yet, there is growing evidence that urban environments benefit from heritage preservation, including social revitalisation of communities, tourism potential, and improvement of the quality of life (Vicente et al.,

2015). In addition, making the most of existing infrastructure has sustainability benefits while replacement requires the use of much precious resources.

This problem, quite obviously, is not disappearing, and with deteriorating and under-utilised building stock it will be progressively harder to preserve old town centres. A better understanding of the problems faced by the building owners and users, and the economic and social consequences of any earthquake-related policy and legislative changes is therefore needed.

As most of the affected building stock is located in the core of Whanganui, our study focuses on the commercial centre of the city.³ Whanganui District Council has identified the 'Central Commercial Zone' as priority area for strengthening; it is defined by city blocks along Victoria Avenue (Figure 4). On average, there were 50 vacant shop fronts along Victoria Avenue since 2014 - about 30% of the available space (Mainstreet Whanganui data). Demand for second-floor commercial spaces in the commercial centre is almost non-existent, with nearly 80% of such spaces in Victoria Avenue empty (Whanganui District Council, 2015).

Economic realities of the building owners within the Central Business District (CBD) can be gleaned from the employment index for occupations that require office and retail accommodation. As businesses leave the CBD this creates additional vacancies in the area. Consequently, once providing a ready market, declining numbers of office workers in the area and ever-growing presence of big box retailing and online shopping is reducing demand for small retail shops in the centre, forcing closures and driving vacancies up. As can be observed in Figure 5, Whanganui experienced economic growth in the commercial and retail sectors in the period leading up to the Global Financial Crisis. Since 2008, the number of employees has been in a steady decline, though there has recently been an apparent uptick in commercial occupations in 2015-16.

Insert Figure 4 here

Insert Figure 5 here

The building stock was largely developed during Whanganui's golden era of economic growth and prosperity from the late 1800s to the early 1930s. The town's built heritage is rich and is dominated by buildings from the early 1900s. The stock is overwhelmingly dominated by buildings used for retailing (approx. 65%), as historically town centres served as shopping and entertainment destinations for the adjacent rural settlements (Figure 6). Many of the buildings on Victoria Avenue and the neighbouring blocks within the Central Commercial Zone are protected by the council or are listed by Heritage NZ (Figure 7).

The New Zealand Heritage List/Rārangi Kōrero identifies New Zealand's significant and valued historical and cultural heritage places. The List is maintained by Heritage New Zealand – an autonomous Crown Entity established under the *Crown Entities Act 2004*.⁴ The List is maintained as an information tool, as inclusion in the list does not guarantee automatic protection nor does it necessarily implies regulatory and legal obligations on Heritage property owners. It is the District Plans, which are administered by local authorities, that set out the changes that can be made to a Heritage List property. Most district plans, including Whanganui's, place limits on proposed changes to heritage places and sites listed in their heritage schedules.

Recognising the town centre's unique heritage and its strategic importance in the town's revitalisation, the local council set the city centre as the target area for earthquake strengthening.

Insert Figure 6 here

Insert Figure 7 here

The Canterbury earthquakes and the announcement of the national earthquake strengthening policy in its aftermath has apparently hindered activity in the property market affecting especially the older stock requiring seismic upgrade. It is apparent that owners are facing pressure from their lenders and are forced to accept significant discounts when selling such properties. Retail and office rents generally remained flat with annual rates as low as \$80 per m² reaching up to \$250 per m² for upgraded and modernised spaces that

have been seismically refurbished. Average rental rates sit at around \$120 m2. However, if high vacancies persist further downward pressure on rents is likely.

While traditionally investment in 'bricks and mortar' rewarded owners with generous returns, the requirement to strengthen an earthquake-prone building in a town like Whanganui can turn an asset into a financial liability. Banks and insurance companies have reassessed their risks following the Canterbury earthquakes. As an additional requirement, banks generally restrict their new lending to buildings above 67% NBS whereas financing of buildings below that level require owners nowadays to demonstrate a strategy to strengthen within a short time and show ability to service higher levels of debt.

Insurance coverage is no longer typically available for EQPBs and, when it is, it is restricted to indemnity value which is far from sufficient to enable reconstruction and full recovery given the very low property values and high current construction costs (Whanganui Taskforce Minutes).⁵ As such, buyers of older commercial buildings struggle to source finance from conventional lenders with majority of transactions purchased solely with cash while only 37% of transactions were financed partially by banks (LINZ Title database).

Financing woes are seemingly affecting property values. Striking differences emerge in the transactions before and after the Canterbury earthquakes, the ensuing review of the Building Act, and the recently passed legislation targeting buildings constructed prior to 1976.

Using Whanganui District Council's District Valuation Roll and Sales Audit files that cover three latest revaluation cycles (2010-2016), we divided commercial properties into two subsets based on their age (pre- and post-1976). As seen in Table 1, the number of pre-1976 properties recalled by mortgagees (lenders) and sold as a result of borrowers (owners) failing to meet their obligations has increased significantly after the Canterbury earthquake sequence, while there has been no similar increase in post-1976 buildings. The number increased from 11% to 26% of sales, with virtually no such sales for post-1976 buildings either before or after the earthquakes. This is already indicative that the value of affected

properties has declined due to perceived earthquake risks – fears that were heightened after the Canterbury events.

It is likely that for many properties valued declines to the point where the outstanding debt on the property might have been in excess of the property's market value. This observation is further reinforced when we examine the difference between the realised sales price of properties that were sold and the assessed capital value of the buildings (columns 3-4 of Table 1). Whereas the market did not seem to discount the pre-1976 stock by much before the earthquakes, since the events commercial buildings are, on average, sold at almost 30% below their assessed value. No such equivalent gap between realised and assessed values is observed for the post-1976 buildings.

Insert Table 1 here

3. Two Building Case Studies

Whanganui's Victoria Avenue is one of New Zealand's most attractive main streets; it is full of historic buildings - a reminder of its early European settlement. But, many buildings sit vacant, and in need of strengthening. The Whanganui District Council is in the process of identifying EQPBs. Owners will then be given 12.5 or 25 years to strengthen or demolish, depending on the use of the building (priority buildings such as hospitals and schools will face the tighter deadline -see MBIE, 2017). To bring forward the inevitable and trying to avoid the financial burden of strengthening, some Victoria Avenue owners have applied for demolition consents since the legislation came into effect (Dudman, 2017). On the other hand, there is an emerging pressure to preserve history among some building owners who initiate seismic retrofitting early on, notwithstanding the far off deadlines they typically face (not until 2040). We interviewed two such 'champions' in Victoria Avenue. The building owners in these case studies represent the opposite sides of the spectrum with one being driven by positive investment returns while the other was motivated to gain secure accommodation during retirement.

3.1 Building #1

After retiring in 2015, the current owner purchased the building with the knowledge that it is earthquake-prone and would require mandated strengthening. The owner was attracted to the idea of inner city living, which in part motivated the purchase. The building itself was completed in 1909 and is a two-storey masonry structure with shops on the ground floor and vacant space upstairs. The building is a fine example of Edwardian Baroque architecture. It is listed in the Whanganui District Plan as a class B heritage item which is defined as "at a regional or local level it has several high heritage values and/or has good integrity".

The owner has engaged an engineering firm to develop a seismic strengthening solution to 34% NBS. The estimated cost of the seismic upgrade of this 380 m² building came to nearly \$215,000. In addition to the structural upgrade, the exterior and interior of the building was 'tired' and in need of architectural 'facelift'. Therefore, the owner also employed an architect to restore the building while maintaining the integrity of the original design. The value of the architectural contract was \$440,000, double the budget of the seismic works. This work included converting the second storey to an apartment for owner.

The works started in early 2016 and was expected to take around 12 months. The strengthening and restoration has not been without issues with cost overruns and over 50 variations in the scope of works. This caused delays of six months bringing the total cost to nearly \$800,000 (seismic \$290,000 and architectural \$510,000).⁶ To finance the retrofitting cost (both seismic and architectural), the owner relied on their own money, and chose not to secure a mortgage against the property in order to 'keep it clean, free of debt' for the children. It cost around \$760 per sqm to seismically strengthen while overall cost was approximately \$2,100 per sqm.

In comparison, redevelopment of another former retail earthquake-prone building in Victoria Avenue was completed at around the same time. The developer retained only the historic façade but decided to build new structure behind. The total per sqm cost of the redevelopment was approximately \$1,500. Similarly, building cost per sqm of a two-storey house with medium quality fittings in New Zealand averages \$2,200.⁷ It appears that the difference between refurbishment and new build costs is negligible. Conversely, Whanganui

is the most affordable housing market in the country with average price of a residential house is \$234,000 (QV residential house values, November 2017). Therefore, financially, retrofitting does not offer significant cost savings in comparison with new construction and therefore might not be attractive for a typical property owner.

During construction, the owner did not receive any financial incentives from the local council to help with the cost of earthquake strengthening. Towards completion of the project with the help of the local heritage group, the owner was successful in securing a \$15,000 grant from a national fund (HeritageEQUIP) that helps owners of historically significant EQPBs. Nevertheless, the owner was not motivated to gain financially from the project and was driven more by the vision of delivering a 'desirable, fine asset' to the community. The owner was determined to complete the project with or without support.

The owner is now, inadvertently, a property investor as the ground floor contains two small retail spaces, but has no prior experience in managing a commercial investment property. Before the works started, the two ground floor shops generated around \$19,000 in rent annually. Unfortunately, with the economic realities in Whanganui, the owner believes it would be difficult to find tenants who would be willing to pay higher rental, even though the space has been earthquake proofed and remodeled. Assuming the tenants would contribute to operations costs of the building, such as insurance and property rates, the owner would clear annually around \$15,000 which equates to return on investment (purchase price of the building and retrofitting cost) of just 1.4%.

3.2 Building #2

The owner of the second case study building is a local businessman/property investor with ownership interests in several buildings in Victoria Avenue. He has owned this particular building since the mid-2000s, well before the property market was affected by the Canterbury earthquakes. Externally, the architectural style of this standalone two-storey building is largely unchanged from the 1910 original design and 1927 additions. This has ensured that the heritage value of the building is held in high regard by Heritage New Zealand designating it as a Category 2 building.⁸ Internal alterations done in the 1970s

introduced new partitions and stairways while some of the historic features such as fireplaces were removed. Further renovations were completed in 2007 to accommodate professional offices on both floors.

From 2007, the building was occupied by two tenants (one per floor) until November 2014. Due to the earthquake vulnerability of the building, the owner was not able to maintain the full insurance coverage on the building and policy was reduced to the indemnity value of the building. This in turn exposed tenants' operations to additional risk and limited their ability to access business insurance (e.g. for business interruption). The ground floor tenant then decided in 2014 not to renew their lease. The main reason for this decision was the earthquake-prone status of the building; the tenant chose to relocate to a seismically strengthened building in Whanganui's town centre. This was a national tenant which had an internal policy requiring 67% NBS for all their premises. Faced with the prospect of a half empty building and prolonged loss of rental income, the owner decided to investigate earthquake-strengthening options and commissioned a detailed engineering assessment which gave it a low 17% NBS score. Having lost one tenant to a retrofitted building and taking into account the general market sentiment where quality tenants appear to have adopted a new 'pass-mark' criteria of 67% NBS or greater, the owner perceived that it would be 'commercially advantageous' to strengthen the building to 67%.

Preliminary construction cost estimates indicated strengthening cost of \$500,000 with additional restoration work requiring another \$250,000. Since the building had undergone renovation in 2006, the cost of architectural restoration was less in comparison with the first building (building #1). However, since the owner decided to strengthen to a higher percentage of NBS (67% vs 34%), the cost of structural upgrade was estimated at \$885 per sqm.

Given the significant outlay of capital for the building upgrade, the owner was seeking external funding from major banks. As one of the loan conditions, banks were looking for evidence of increased rental income and tenant pre-commitment. At the same time, the owner's own test for financial viability of a 'go decision' required rental income post-remediation sufficient to cover debt servicing of the construction loan and an investment

return on the book value of the building. With the help of a local heritage specialist, the owner applied for a major works grant from the Ministry for Culture and Heritage EQUIP fund (the grant can cover up to 50% of the strengthening work).

In order to assess the financial viability of the strengthening and remediation program for this building, we examined several scenarios with the information provided to us by the owner. Table 2 outlines the basic assumptions involved in analysis.

Insert Table 2 here

The common assumption for these scenarios was that the building would be fully tenanted (both floors occupied) with an increased rental of \$158 per sqm post-remediation. The amount of debt service varies with the amount of assistance (via grants) available to the owner. The available grant (Heritage EQUIP) would be capped at \$250,000 (50% of the strengthening cost). Therefore, the minimum required debt financing from a bank would be \$500,000 (\$250,000 strengthening + \$250,000 architectural restoration).⁹

From the scenario testing it is apparent that significant incentives are needed to meet the required financial viability of strengthening. In the absence of financial incentives, investment in retrofit will result in significant losses to the building owner. The minimum amount of grant that would result in a break-even outcome is \$220,000; this amount is close to the cap of the Heritage EQUIP grant funding that may be available for this strengthening project.

Insert Table 3 here

4. Current Incentive Programs

New Zealand's national framework to address earthquake vulnerability of existing buildings, as described earlier, appear to generate relatively little strengthening activity outside the main urban centres. There is increasing awareness that more financial resources or other incentivising schemes are needed in order to reward proactive building owners, given the

long-term horizon of regulatory obligations (30-35 years for a medium risk zone such as Whanganui). Most building owners appear to opt for a 'wait and see approach' to strengthening if, economically, investment in strengthening does not generate sufficient return; and it never does in New Zealand's numerous smaller towns.

Whanganui's case studies offer insight into the decision process of building owners affected by such legislation. There would always be a small minority of owners who decide to make structural repairs using their own funds almost irrespective of associated costs. Many more would be testing financial viability of such decisions and for most, if not all, these investments would only be perceived as commercially viable with significant subsidies and grant funding. In these cases, financial incentives may be able to serve as tipping points of strengthening and may also incentivise earlier action (rather than waiting for an approaching deadline). These types of public assistance can help ensure that retrofitted buildings will be retained as an important contributor to historic precincts that benefit community life while also securing commercial viability for building owners.

Whanganui's stock of commercial buildings is rather old; up to two-thirds (100) of the buildings in the main street predate 1950 and will potentially require strengthening (Figure 6). There are many challenges in strengthening historic buildings—raising finance, securing insurance, finding structural solutions— and at this point very few owners are 'taking the plunge' and attempting to find ways to strengthen their building. Owners of both buildings #1 and #2 are pro-active and are not the typical owner in Whanganui.

As noted earlier, the financial cost of retrofitting older buildings to current non-prone standard (above 34% NBS) is prohibitive in provincial New Zealand. Only in the main high-value urban centres can costs of retrofitting be recouped through much higher rental income. As such, if building owners are not as devoted to their asset as owner of building #1, there is a real need to incentivize earthquake retrofits through various financial carrots. The main program that is currently being used to do that is Heritage EQUIP, a program run by the New Zealand Ministry for Culture and Heritage. This program targets only nationally-designated heritage buildings, and provides grants that are designed to support strengthening projects.¹⁰ Other funding for heritage building strengthening is available from

the National Heritage Preservation Incentive Fund, the Regional Culture and Heritage Fund, and funding from local councils and the National Lottery.¹¹

Heritage EQUIP was not formulated specifically for provincial towns, but the fund did, for example, recently provide a significant grant for a strengthening of a Heritage building in Whanganui. Importantly, the fund is set up so that only up to 50% of strengthening costs are provided, and ostensibly the funding is only to be used for strengthening to the 34% threshold (and not beyond that). In practice, it is difficult to distinguish between strengthening to 34% or 67%. The 'quality' rental market now appear to demand 67%, so the financial incentives are such that strengthening to 67% is substantially more profitable, and the financial returns for strengthening only up to 34% are very limited.

While the government has set the 34% threshold as the legal threshold (even if it is ad hoc), 'the market' seems to have decided that 67% is the more important (but equally ad hoc) threshold and the one with which a significant rental premium is associated. Interestingly, it appears that this coalescing of market sentiment around 67% as the relevant threshold was initiated by various government departments which had decided independently not to set up operations in buildings that are less than 67% (and move away from buildings that are less than that). This threshold was then adopted by the national retail chains, by insurers when making their pricing decisions, and by banks in their lending decisions. Ironically, the now the de facto earthquake-prone threshold that was initiated by government is different from the de jure threshold as legislated by the same government (67% and 34%, respectively).

Some local authorities have started to offer incentive schemes or subsidies for earthquake retrofitting (e.g., in Dunedin), but in general these assistance programs are available in the biggest urban areas of Auckland and Wellington, where in any case the economic imperatives are such that strengthening is much more likely to be undertaken. At this point, the amounts of funding that is available through assistance programs, such as Heritage EQUIP, is far short of enabling a comprehensive strengthening program that will be able to achieve most of the required work program by the legislated deadlines in smaller towns.

The way these funding programs are currently set, they provide direct transfers to the building owners, and these building owners are able to fully capture any benefit that is accrued from the strengthening being funded. As such, and as in many cases the owners are relatively wealthy individuals, it is difficult to foresee a significant increase in the funding allotted for this purpose in the general budget. The next section therefore examines other possible policy tools, other than direct grants, that may incentivize earthquake retrofitting.

5. Possible Other incentives

The most obvious drawback of providing direct financial subsidies to building owners to strengthen their buildings is the high fiscal cost associated with that policy. In the New Zealand context, this cost is widely perceived to be prohibitive given the large number of early to mid 20th century buildings that require strengthening. This therefore necessitates prioritization and selective subsidization of only some buildings. There are political risks in this selectivity, so governments are somewhat reluctant to aggressively pursue a selective strengthening policy that supports only some owners.

The more likely choices are more limited programs that provide smaller subsidies to many buildings. In this case, however, these subsidies are typically insufficient to really affect the balance-sheet calculations of profitability of various actions, but should rather be thought of as generating 'nudge'-like changes in behaviour and thus increasing the likelihood of strengthening. There are, fortunately, several other options for policy to further incentivize strengthening, and some of these do not necessitate a significant and possibly prohibitive fiscal commitment.

Very few papers have tried to comprehensively assess such possibilities. An interesting exception is Segal et al. (2017).¹² They analyse the circumstances of residential apartment buildings in Israel – a country that is vulnerable to infrequent but potentially destructive earthquakes along the Rift Valley, potentially affecting some of the poorer provincial towns in Israel. As such, the difference between the Israeli problem of the highest risk being in disadvantaged areas, and the problems in New Zealand where the higher risk is maintained

in more disadvantaged areas because of the absence of strengthening incentives, are not that different.¹³

In Israel, the main policy tool has been a consenting allowance that permits additional entitlements for buildings that pursue strengthening (additional stories on the top of buildings, and additional floor area in existing stories). Since these additional entitlements are worth more in high-value major cities, it is only in those cities that the policy has had any real impact. As in the New Zealand case, this has led to buildings in high-value urban areas being strengthened at a much more rapid rate than buildings in the provincial periphery, where strengthening is rarely occurring given its high cost.¹⁴

The one crucial difference between our analysis here and the Segal et al. (2017) analysis of Israel is that their work focuses on residential buildings. The New Zealand government has long recognized residential accommodation as a special protected class of buildings that need special provisioning. Accordingly, the government has been providing an earthquake insurance scheme for residential buildings since the mid 1940s.¹⁵ The most recent formulation of this insurance program, the 1993 Earthquake Commission Act, specifically excludes any non-residential buildings from the insurance cover. The political and ethical imperatives of protecting residential buildings are clearly different than the protection of commercial buildings. There is widespread acknowledgment of the right of individuals for housing, and there is therefore widespread support to provide for earthquake protection of residential housing.¹⁶ Beyond the general question of government support for residential or commercial property owners, it is also important that commercial property owners are typically comparatively wealthy. The electoral support for significant funding streams targeting the wealthy is therefore more limited.

However, in provincial cities like Whanganui, there is a significant social value attached to maintaining a viable and successful central commercial district that will provide the amenities that the cities' residents typically want.¹⁷ Without some kind of support, it appears that these provincial commercial Main Streets will wither away as government offices, chain retailers, and increasingly smaller organisations are unable or unwilling to locate their operations in earthquake-prone environments.

It is also important to observe that these difficulties are not unique to New Zealand. Japan and California—two other earthquake hotspots—have been struggling with similar difficulties in initiating earthquake strengthening of existing buildings. The situation in Japan is very similar: Older buildings are widely perceived to be more vulnerable, as the advances in seismic regulations were largely motivated by more recent earthquakes.¹⁸ The Japanese government is offering a grant program for seismic retrofitting - this program is less generous but less selective than the EQUIP program discussed earlier. The local and central government in Japan together pay 23% of retrofitting costs, while the owner is liable for the rest. This program, however, is voluntary, and the take up is very low (Okazaki, 2010).¹⁹ Tax credits and subsidized loans are also available to help pay for seismic retrofits, but it appears that the value of these programs is quite limited.

All of this suggests that if outright fiscal support is unlikely to be forthcoming, there is a need to develop other incentivizing programs that can encourage and facilitate earthquake strengthening. Below, we investigate three additional possible incentive schemes that may assist in achieving higher rates of seismic retrofitting.

5.1. Grants for Equity

From the government's perspective, the drawbacks associated with grants are their fiscal costs and egalitarian considerations. In this case, it is possible for the government to offer grants in return for shared ownership rights in the buildings. Ownership shares in the building will both reduce the overall costs of the support program, and the government will be less exposed to criticism that it is using scarce fiscal resources to support wealthy building owners. On the other hand, if the program were to try and extract full return (including interest) for any public investment, it might not generate enough take-up by current building owners, thus defeating the purpose of such a scheme.

It is therefore necessary to develop incentive mechanisms that will encourage owners to retrofit and providing them just enough incentives to do so, while also not burdening the government (both fiscally and politically). Since the retrofitting is likely to increase the resale value of the building, it may seem appropriate for any funder of that retrofit will own

some of this increase in value. For example, if a building's value was assessed to be, say \$250,000 before retrofits, and twice as much after the seismic strengthening, and the government paid for 50% of the costs, it can potentially claim 50% of the increased value. In order to discourage owners from just receiving the government grant and then selling, the ownership share can be reduced if the building is not sold within a specified time frame (or its percent share could gradually reduce over time).

Similar arrangements of joint ownership between the government and private households are not that unusual and can be legislated. In New Zealand, for example, Housing NZ has shared equity schemes to enable low-income families to purchase a home.

Instead of shared-equity schemes, another option is for the government to provide subsidised loans or tax credits. Such schemes were introduced in Japan and California in order to encourage seismic retrofitting, but as we noted earlier, their success is fairly limited. In the global low-interest environment of the past decade, it is difficult to see how even no-interest loans provide sufficient incentive to trigger a lot more retrofitting. Loans could be structured with negative interest rates (so that the debt automatically gets decreased over time as long as ownership is maintained and servicing payments are current).

If these kinds of programs are still perceived as carrying a higher fiscal burden, the government can also limit itself to providing grants for the additional services that are required in the initial stages of a retrofit project. These can include the costs of demolitions and stripping of unsafe non-structural components, the cost of seismic engineering assessments, or the costs of architectural design and engineering retrofitting plans. These, especially if the government does these directly, rather than just provide cost refunds, might be successful in 'nudging' owners toward seismic strengthening of their buildings.

The main drawback of all of these suggestions is still their substantial fiscal cost. However, public risk tolerance for earthquakes might differ from other natural and man-made hazards and increased government funding was the preferred risk mitigation strategy (Henrich et al.,

2018). In the next two sub-section, we consider incentivising schemes that do not involve substantial fiscal costs (at least in most plausible scenarios).

5.2. *Insurance Warranty*

A crucial component of ownership of a building is the ability to insure it. In Whanganui, as in other similar small towns in New Zealand, insurance is no longer affordable for earthquake-prone commercial buildings. Retrofitting will enable owners to purchase insurance again, but this does not seem to be a strong enough incentive at this point. One possible solution is for the government to subsidise post-retrofit insurance premiums, or even provide a free insurance product to those building owners who choose to retrofit their buildings before a pre-specified deadline.²⁰

Premium subsidies for safer assets are, of course, not unusual in insurance markets at all. But the tying of lower premiums to retrofitting actions (rather than just the safety of the building) will necessitate some government intervention. Given the large difference between the costs and benefits of unsubsidised retrofitting (see building #2), it is unlikely that just providing subsidised insurance is going to provide a sufficient incentive to generate a significance increase in the motivation to retrofit.

The government could therefore attempt to lower the costs of other parts of the retrofitting process by providing further insurance. For example, the government could provide an insurance for building contractors to cover their retrofitting work; so that if the retrofitting ends up failing in an earthquake it does not impose a liability on the entities that were involved in the work (e.g., the engineer, the contractor, the trades-people). Beyond insuring their work, the government could also choose to provide further legal protection from any potential liability for failure of the retrofit to protect a building from an earthquake. In New Zealand, the government is already insuring residential properties, so extending the insurance program to retrofitted older commercial buildings outside of the main urban centres will not require new institutional structures.

5.3. *Technical knowledge and provision of information*

In the United States, FEMA has supported financially the development, the socialisation, and the adoption of new cheaper technologies. According to a survey conducted by Kohiyama et al. (2008), one of the main barriers to wider adoption of retrofitting is a perceived lack of information about available technologies and available reliable, knowledgeable and trustworthy contractors that can deploy these technologies in retrofitting projects. This perceived lack of information might indeed be the case in New Zealand as well, as one of building owners we spoke to in Whanganui expressed his frustration with the lack of trustworthy available contractors to even bid for the retrofitting work he wanted to do.

The government can step forward and fill in this information gap both by funding research programs into retrofitting technology, and also collect and coordinate the dissemination of information about the available contractors for these projects. While the cost of these might be well contained, it appears that they may enable many owners to overcome some of the barriers to completing retrofitting. In New Zealand, as well, the government is already doing that to some extent.²¹

Another option for the government is to focus its efforts on is to develop cheaper technologies that can achieve just minimum life safety considerations (possibly even below the 34% threshold). More limited funded projects like that can also potentially change some of owners' incentives by nudging them toward more 'safety-friendly' actions. The development of partial solutions that while not bringing heritage buildings quite up to the required threshold may be deemed sufficient for buildings with strong heritage importance whose preservation are valued by society. This requires exempting some (heritage) buildings from the full strengthening requirements (up to 34% NBS in the New Zealand case).

6. What's viable where – Conclusion

What are the viable policy options that will generate a significant speeding of the earthquake retrofitting process or at the very least will lead to a significant amount of restructuring and retrofitting before the legislative deadlines start to bite? We started this

paper by describing the financial dilemma that is faced by owners of earthquake-prone buildings outside the main urban centres of New Zealand, and continued by looking at two case-study buildings in the provincial town of Whanganui. One important insight from this analysis is that the financial barriers to retrofitting are formidable, and that without public financial support, most buildings – including heritage ones – will not be retrofitted by their respective owners.

In the next part of this analysis, we evaluated several other options that are available to the government, and that can tilt the scales and incentivize retrofitting. In particular, we focussed on liquidity/equity support, the provision of warranties, and the provision of scientific and technical knowledge. It is difficult to see how any of these possible changes will change the incentives sufficiently to bring about real transformation. However, taken together they might clearly tip the scales in favour of retrofits.

There might be other policy tools that have yet to be explored further. One suggestion is to differentiate the legal requirements in areas with weaker economic environments from the ones in the main urban centres. As such, for example, the law could specify that towns whose size is below a certain threshold should face the deadlines imposed on the lowest risk areas, irrespective of their actual location (or their actual risk). The clear downside to this exemption is that these peripheral centres will therefore remain less safe, and this can exacerbate their continuing relative economic decline.

One last possibility, is for strengthening to be undertaken directly by a public entity, with the aim that economies of scale (doing multiple buildings at the same time and with the same technology) will make the retrofitting significantly cheaper. This possibility has not been explored in the New Zealand context, but it is not clear that the construction sector that specialises in seismic retrofits indeed is characterised by scale economies. Even if it is, however, it is not clear whether such a concerted program if publicly managed (and mandatory) can legally pass muster.

Endnotes

¹ This definition emphasizes life safety and the safety of nearby properties. It is not concerned with any economic/property damages that may occur directly because of the building's failure nor does it take into account the future usability of the building.

² The country is divided into three zones, with the highest risk zone facing the tightest deadlines with respect to the identification and requirement to strengthen earthquake-prone buildings.

³ For the New Zealand statistical agency (Statistics nz), this area is in the Cooks Garden Area Unit.

⁴ The List is divided into five parts: (1) Historic Places - such as archaeological sites, buildings, memorials – these include Category 1 historic places that are of *special* or *outstanding* historical or cultural significance or value, and Category 2 historic places that are (only) of historical or cultural significance or value; (2) Historic Areas - groups of related historic places such as a geographical area with a number of properties or sites, a heritage precinct or a historical and cultural area; (3) Wāhi Tūpuna - places important to Māori for ancestral significance and associated cultural and traditional values; (4) Wāhi Tapu - places sacred to Māori in the traditional, spiritual, religious, ritual or mythological sense such as maunga tapu, urupā, funerary sites and punawai; and (5) Wāhi Tapu Areas - areas that contain one or more wāhi tapu.

⁵ Construction costs are likely to be even higher after any substantial earthquake event.

⁶ As the project's main contractor put it: 'earthquake strengthening is not a face lift' and 'budget blowouts' are unavoidable with old historic buildings. In addition, the building needed to comply with the current building code which can add to the cost significantly, especially the provision of disability access to retail spaces and fireproofing walls and ceilings.

⁷ These figures were obtained from the QV Costbuilder estimator: <https://qvcostbuilder.co.nz/>.

⁸ A Category 2 Heritage building is "a place of historical or cultural significance or value" according to the Heritage New Zealand Pouhere Taonga Act 2014.

⁹ At this stage, no grant funding is available for architectural restoration, therefore the owner would seek bank financing for this amount.

¹⁰ Small retrofit grants provide up to 50% of seismic strengthening costs up to a maximum grant of \$25,000, while major works grants support seismic strengthening projects involving comprehensive strengthening solutions, including large-scale or staged projects. The latter has no upper limit.

¹¹ The Regional Fund and the Lottery may also fund renovations of non-heritage community buildings.

¹² Their companion report is Negev et al. (2015).

¹³ Zolfaghari and Peyghaleh (2015) find that, in the Teheran case they examine, there is a trade-off between equity considerations and achieving the most comprehensive earthquake strengthening if budgets for strengthening are limited. No similar analysis was conducted elsewhere, and the analysis is somewhat sensitive to the types of equity and efficiency criteria being examined. Since our main topic here is not equity, we do not pursue this line of investigation. Vaziri et al. (2010) also focus on Teheran, but model the choice between strengthening and or waiting with any retrofits/rebuilding until an earthquake occurs and justifies re-development. Their algorithm tries to minimise costs while also minimising high-mortality events and average mortality.

¹⁴ Unlike New Zealand, these high-value urban areas in Israel are also, ironically, the ones with the lowest earthquake risk.

¹⁵ This insurance cover is significantly more comprehensive and cheaper than earthquake insurance available elsewhere - see, for example Nguyen and Noy (2017) for comparisons of the insurance programs in Japan, California, and New Zealand. Owen and Noy (2017) provide a more comprehensive international comparison of natural disaster insurance programs.

¹⁶ This right is enshrined in Article 11 of the United Nations' International Covenant on Economic, Social and Cultural Rights, of which New Zealand is a signatory.

¹⁷ See Mentz and Goble (2015) for a discussion on how earthquake strengthening can revitalise central business districts.

¹⁸ After the 1995 Kobe earthquake, the government introduced the Act for Promotion of Retrofitting (Okazaki, 2010).

¹⁹ According to Okazaki (2010), the program funded strengthening of about 43,000 buildings, out of 11.5 million houses that are assessed to be at risk. Comerio (2004) discusses the difficulties in implementing earthquake policy in California.

²⁰ See Fujimi and Tatano (2013) for an analysis of a similar program.

²¹ This specific research project was funded by QuakeCoRE, a publicly funded effort to research earthquake vulnerability and increase resilience.

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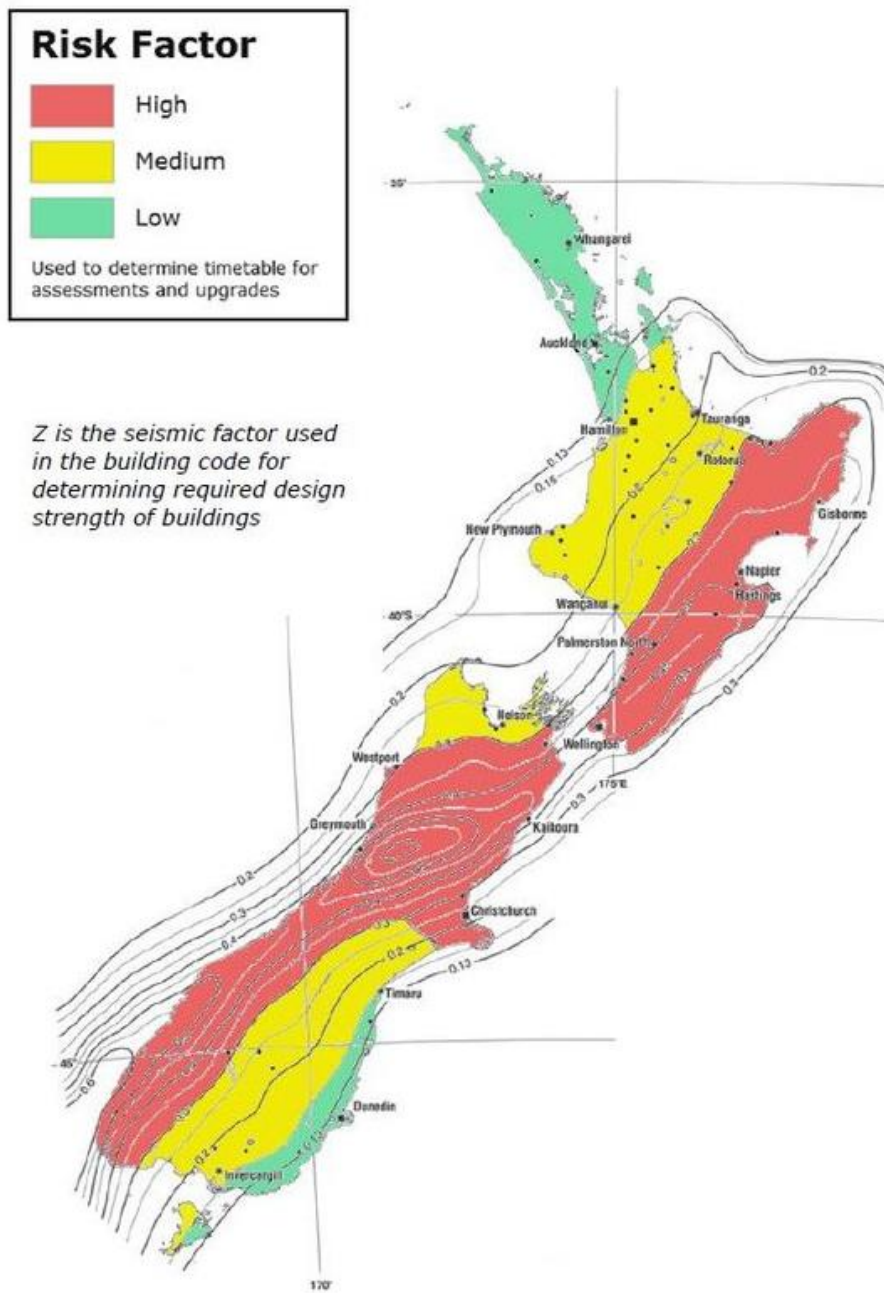
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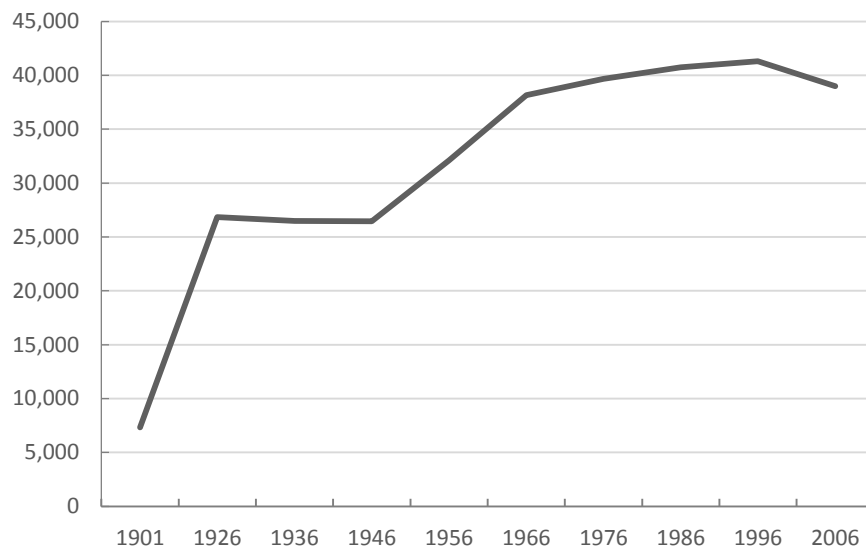
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Figure 1. Earthquake Risk Zones in New Zealand



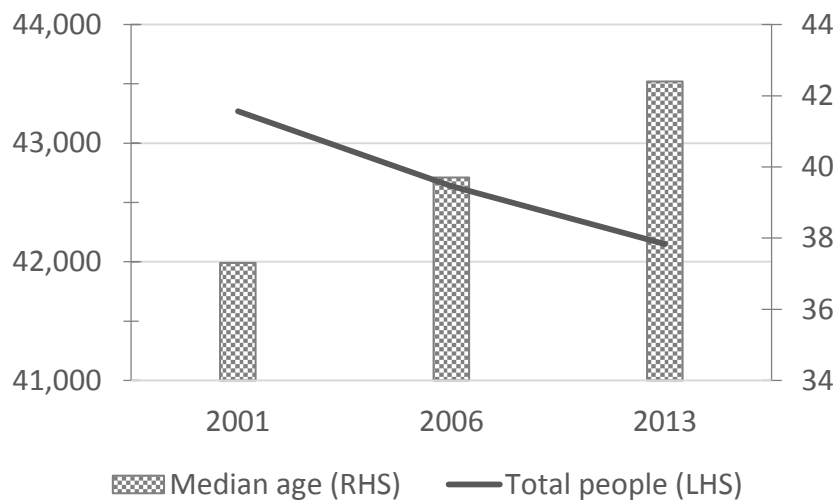
Source: NZ Government.

Figure 2: Population of Whanganui's Urban Area



Source: Grimes and Tarrant (2013).

Figure 3: Median Age and Total Residential Population Count in Whanganui District



Source: Census, Statistics NZ.

Figure 4: Location of the Central Commercial Zone in Whanganui



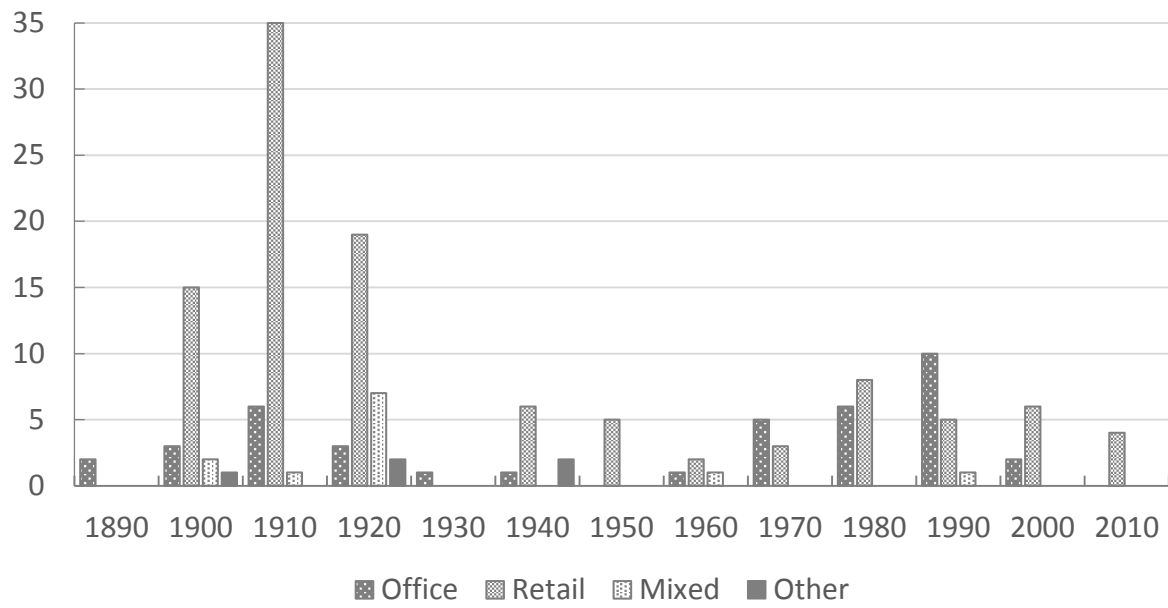
Source: Google Maps, Statistics NZ and Whanganui District Council.

Figure 5: Employment index of Cooks Garden Area Unit



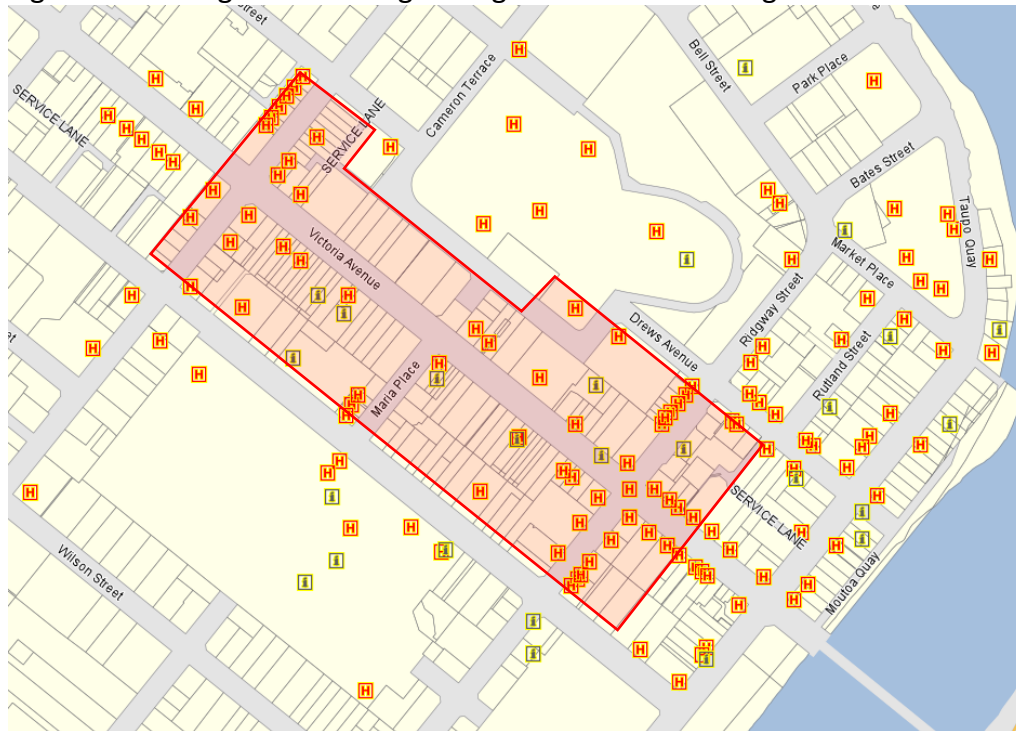
Source: Employee counts, Business Demography from Statistics NZ.

Figure 6. Buildings Within the Central Commercial Zone by Time of Construction



Source: Whanganui District Council, authors.

Figure 7. Buildings with Heritage Designation in The Whanganui District Plan



Source: Whanganui District Council.

Table 1. Analysis of commercial building sales within the Central Commercial Zone

Period of construction	% Mortgagee Sold		Average % difference (SP-CV)	
	Pre-quake (Q4'07-Q1'11)	Post-quake (Q2'11-Q3'16)	Pre-quake (Q4'07-Q1'11)	Post-quake (Q2'11-Q3'16)
Pre-1976	11%	26%	1.8%	-29.8%
Post-1976	0%	0%	-8.9%	4.4%

Source: Whanganui District Council.

Table 2. Assumptions used in scenario testing.

Building floor area:	565 m ² (288 m ² ground floor; 277 m ² first floor)
Current rental (pre-remediation)	\$126.70 per m2 (annually)
Rental post-remediation	\$158 per m2 (annually)
Construction cost	\$500,000 (strengthening) \$250,000 (architectural restoration)
Debt service	Interest at 5.5% pa spread over 15 years and repaid on a table mortgage basis
Return on the building	7.0% pa (return is based on the average yield achieved by commercial building owners in the CBD)

Source: authors

Table 3. Working example of scenarios

	Scenario 1 GO (\$250K EQUIP grant)	Scenario 2 Break-even (\$220K EQUIP grant)	Scenario 3 NO GO (NO EQUIP grant)
Annual Cash Flows			
Rental income	89,615	89,615	89,615
Debt service	-49,025	-51,967	-73,538
Return on the building	-37,883	-37,883	-37,883
Cash flow to owner	2,707	-235	-21,806

Source: authors



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