Error Prone Bureaucracy

Earthquake strengthening policy formulation in New Zealand 2003–13: A study in failure

March 2014

tailrisk economics
te maha hoki o nga pihikete

About Tailrisk economics

Tailrisk economics is a Wellington economics consultancy. It specialises in the economics of low probability, high impact events including financial crises and natural disasters. Tailrisk economics also provides consulting services on:

- The economics of financial regulation
- Advanced capital adequacy modelling
- Stress testing for large and small financial institutions
- Regulatory compliance for financial institutions
- General economics.

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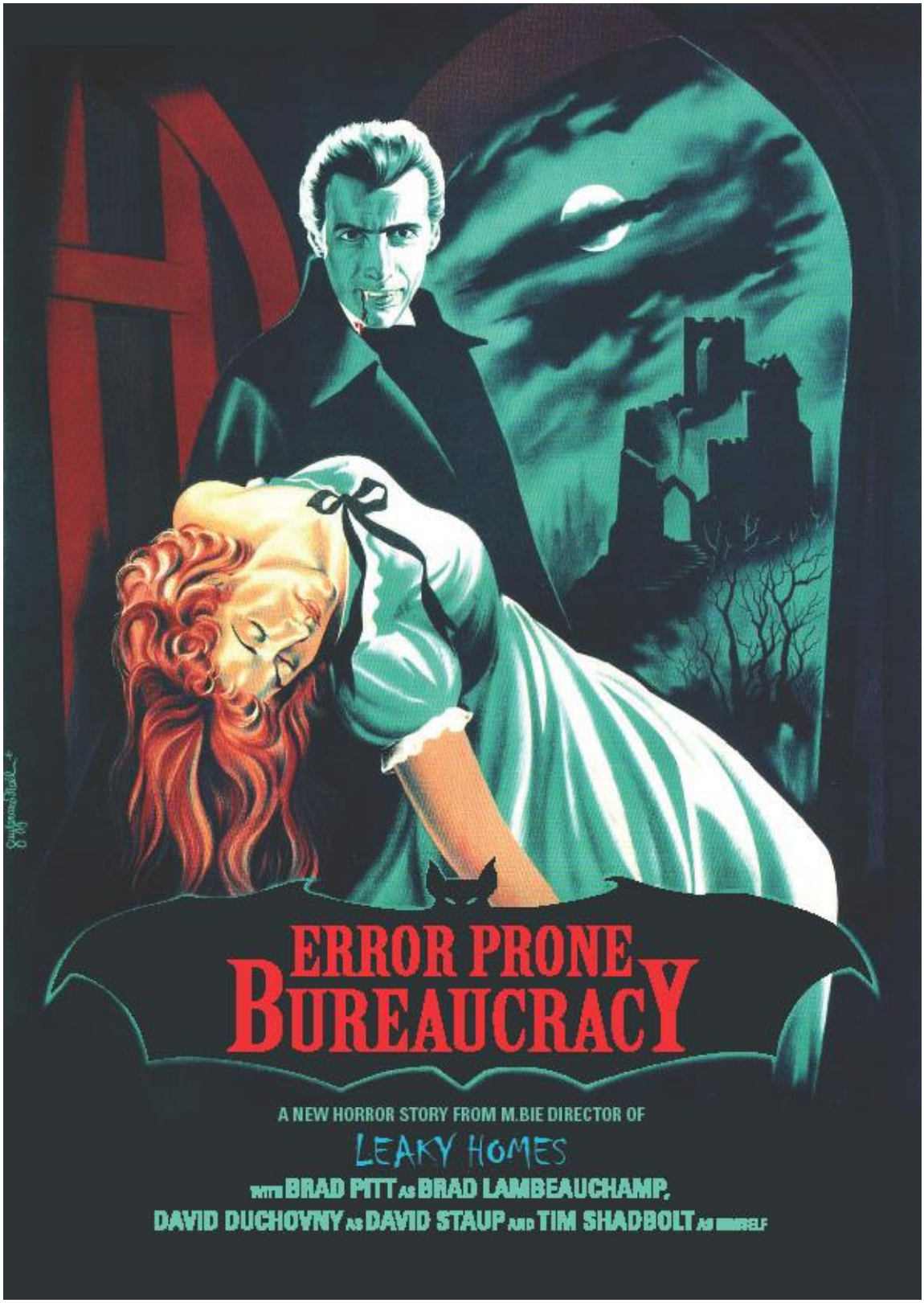
ERROR PRONE
BUREAUCRACY
A NEW HORROR STORY FROM M.BIE DIRECTOR OF
LEAKY HOMES
WITH BRAD PITT AS BRAD LAMBEAUCHAMP,
DAVID DUCHOVNY AS DAVID STAUP AND TIM SHADBOLT AS HIMSELF

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Executive summary

In December 2013, draft legislation was introduced into Parliament to amend the way the Building Act deals with seismic risk to buildings.

The key element in the legislation is the 'earthquake prone' building definition. The intention is to apply the existing calibration of 34 percent of the new building standard. At this level, the policy will cost over $10 billion, will negatively affect tens of thousands of people and have a potentially devastating impact on heritage buildings. It is critically important that the analysis backing the framework is soundly based. It is obvious that it is not. The benefits will be less than $100 million.

The policy can be expected to save just seven lives over the next 75 years. If $10 billion were spent improving road safety and health, thousands of lives could be saved.

No other country applies across-the-board national earthquake strengthening standards to existing buildings, because generally it does not make sense. In the United States, there is a legal requirement that Federal building strengthening proposals must be supported by a positive cost benefit analysis.

In New Zealand the calibration of the strengthening requirement has been bungled, which will lead to bizarre results.

- The life safety standard that is applied in Auckland is about three thousand times stronger than the one applied in Wellington. They should be the same;
- Compliance with the minimum standard could cost over three billion dollars in Auckland, but is expected to take 4,000 years save a single life. Three to eight Aucklanders are expected to die as a result of financial stress caused by the policy;
- Aucklanders will be forbidden to attend church in earthquake prone buildings when this is tens of thousands of times safer than alternative activities such as riding a bike.

The reason for these outcomes is that there was no analysis behind the calibration of the framework when it was introduced over 2004-2006, and the framework was never tested. It was badly flawed. The 'earthquake prone' building definition in the 2004 Building Act was operationalised by the New Zealand Society of Earthquake

Engineering (NZSEE), by establishing an arbitrary link to the new building code without serious regard to the costs and benefits of doing so.

This had the effect of increasing the life safety standard applied in Wellington by a factor of 5 to 10 above what a conservative cost benefit analysis would show to be appropriate. It also has the effect of exaggerating the measure of earthquake risk in the low seismic zones of New Zealand by using an artificially large earthquake based on the largest possible earthquake, rather than actual earthquake risk. For Auckland, this meant that risk was boosted by a very large margin and a large number of safe buildings fell into the 'earthquake prone' net.

The largest possible earthquake used in the framework is similar in magnitude to the largest possible earthquake that could occur in the United Kingdom. This means that if the British were to apply the New Zealand framework they would have hundreds of thousands of 'earthquake prone' buildings, which would cost hundreds of billions of pounds to strengthen, and their built heritage would be placed at enormous risk. Fortunately for the British they have more sense.

Correcting the errors in the measurement framework gives a very different picture of earthquake building risk in New Zealand. The Ministry of Business Innovation and Employment (The Ministry) has claimed that 15,000 to 25,000 New Zealand buildings 'are earthquake prone'. Applying a sensible cost benefit analysis and internationally recognised life safety standards, it is likely that:

- Only a few percent of the buildings currently designated as 'earthquake prone' would truly be excessively risky
- More than half could be effectively risk free.

The interpretation of 'earthquake prone' currently used by the NZSEE, and promoted by the Ministry, is not consistent with the definition of earthquake prone in the Building Act. Local Authorities have been unlawfully applying excessively high standards when they have been designating earthquake prone buildings.

The Ministry intends to apply the current, flawed, interpretation of 'earthquake prone' when it implements the amended Act. It has left the key term in the definition of earthquake prone building undefined to give it the flexibility to set the earthquake prone trigger point wherever it likes. The legal definition of earthquake prone building is likely to be ignored, and thousands of safe and very low risk buildings will be designated as earthquake prone.

A review of the Ministry's 2013 Regulatory Impact Assessment confirmed that the assessment was a sham. There was no intention of reviewing the earthquake prone

building threshold setting, despite a requirement to do so under the terms of reference for the inquiry, and despite overwhelming evidence that it had been miscalibrated. Options imposing lower standards, which would have clearly generated higher benefits, were never considered.

We assessed the Ministry's Regulatory Impact Assessment against the key requirements set out in the Treasury's Regulatory Impact Assessment handbook (2013). The Ministry's analysis failed on all but one of ten major criteria.

Our score for the assessment was 9.25 out of a possible 100. A competent agency should have been able to score a mark above 80.

Our review of costs and benefits showed that the costs of the policy will be much higher than the Ministry previously estimated. A broader assessment estimate put the total economic costs at $10.5 billion.

We also report on surveys we conducted to assess New Zealanders' capacity to understand earthquake risk and to make informed choices. Contrary to the Ministry's assertion that people cannot be relied on to make sensible decisions about earthquake risk, we found that respondents were broadly rational and did not believe that risk should be reduced at almost any cost.

Our overall conclusion is that the draft amendments to the Building Act are not based on a coherent analytical framework and are fundamentally flawed. They will result in substantial economic and social damage with very limited safety benefits.

Our key recommendations are that:

- The definition of earthquake prone building should be more precisely defined in legislation;
- The Government should go back to the drawing board and develop earthquake-strengthening standards and policies that are evidence based;
- An independent authority such as the Productivity Commission should be commissioned to do the analysis;
- The Health and Safety in Employment Act should be amended so death or injury in an earthquake are not grounds for prosecution under the Act;
- The current system that grades the earthquake risk of buildings according to their estimated strength relative to the new building code should be scrapped. It should be replaced by a measurement system that directly informs building occupants of their life safety risk, and provides a ready comparison with other risks commonly faced in daily life;

- The NZSEE should withdraw its earthquake strengthening recommendations;
- Territorial authorities should withdraw existing earthquake prone classifications that are not based on the legal definition of earthquake prone;
- The Government should use its powers and resources to strengthen buildings over a short time horizon, in the very few localised areas where this would generate a net benefit for New Zealand.

Part one: Introduction and Overview

Introduction

In December 2013, draft legislation was introduced into Parliament to amend the way the Building Act deals with seismic risk to buildings.

The key element in the legislation is the 'earthquake prone' building threshold. The existing calibration of 34 percent of the new building standard has been retained. At this level the policy will cost about $10 billion, and negatively affect tens of thousands of people. It is critically important that the analysis backing the framework is soundly based. It is obvious that it is not. The benefits will be less than $100 million.

Cost benefit analysis based on the Ministry of Business Innovation and Employment's (the Ministry) data shows that the policies will lead to bizarre results.

- The life safety standard that is applied in Auckland is about three thousand times stronger than the one applied in Wellington. They should be the same;
- Compliance with the minimum standard could cost over three billion dollars in Auckland, but is expected to take 4,000 years save a single life. Three to eight Aucklanders are expected to die as a result of financial stress caused by the policy.
- Aucklanders will be forbidden to attend church in earthquake prone buildings, when this is tens of thousands of times safer than alternative activities such as riding a bike.

The reason for these outcomes is that there was no analysis behind the calibration framework when it was introduced over 2004-2006, and the framework was never tested. It was badly flawed. The 'earthquake prone' building definition in the 2004 Building Act was operationalised by the New Zealand Society for Earthquake Engineering (NZSEE) by establishing an arbitrary link to the new building code without serious regard to the costs and benefits of doing so.

This had the effect of increasing the life safety standard applied in Wellington by a factor of 5 to 10 above what a proper cost benefit analysis would show to be appropriate. It also has the effect of exaggerating the measure of earthquake risk in the low seismic zones of New Zealand, by using an artificially high earthquake rather than actual earthquake risk. For Auckland, this meant that risk was boosted by a very

large margin and a large number of safe buildings fell into the ‘earthquake prone’ net.

The largest possible earthquake used in the framework is similar in magnitude to the largest possible earthquake that could occur in the United Kingdom. This means that if the British were to apply the New Zealand framework they would have hundreds of thousands of ‘earthquake prone’ buildings, which would cost hundreds of billions of pounds to strengthen, and their built heritage would be placed at enormous risk. Fortunately for the British, they have more sense.

Correcting the error in the measurement framework gives a very different picture of earthquake building risk in New Zealand. The Ministry has claimed that 15,000 to 25,000 New Zealand buildings are ‘earthquake prone’. Applying a sensible cost benefit analysis and internationally recognised life safety standards, it is likely that:

- Only a small proportion of the buildings currently designated as ‘earthquake prone’ would truly be ‘earthquake prone’ or excessively risky
- More than half could be effectively risk free

The interpretation of ‘earthquake prone’ building used by the NZSEE and promoted by the Ministry is not consistent with the definition of earthquake prone in the Act. Local Authorities have been unlawfully applying excessively high standards when they have been designating buildings as ‘earthquake prone’.

The Ministry intends to apply the current, flawed, interpretation of ‘earthquake prone’ when it implements the amended Act.

The purpose of this paper is to improve the quality of information available to Government, Parliament and the New Zealand people. They should be properly informed when the legislation is considered. We show how we got into the current situation and what should be done to fix it.

The framework of the paper

There are six more sections in the paper.

- Section two takes a step back to look at the history of the standards and examines how the current framework was constructed and calibrated, and how the legislation and regulations were passed
- Section three examines the draft legislation, identifies keys flaws and presents the main elements of an improved framework for the regulation of earthquake resistance in existing buildings

- Section four examines the Ministry's Regulatory Impact Assessment, and the associated Regulatory Impact Statement, to see if they were of an acceptable standard
- Section five reviews the costs and benefits of the proposed policies
- Section six reports on two surveys conducted by Tailrisk Economics on attitudes to the benefits and costs of earthquake strengthening
- Section seven discusses legal issues raised because various parties have not used the correct definition of earthquake prone building when advising clients or designating buildings.
- The final section summarises our main recommendations.

The arguments presented below are often technical, complex and sometimes difficult to grasp. At times, we have tried to assist the reader by representing some of the important points in a lighter style.

History of the calibration of the strengthening framework

Passage of the 2004 Act and 2005 regulations

The Ministry did no analysis to support the strengthening of standards in the 2004 Building Act

Documents obtained under the Official Information Act revealed that there was no supporting analysis for the widening of the classes of buildings that could be designated as earthquake prone, or the increase in the earthquake prone calibration from 16 to 34 percent.

It appears that the sole basis for the changes were verbal representations by earthquake engineering lobbyists. There was no supporting documentation.

The Ministry misled or failed to inform its ministers

Ministers were given no information that would allow them to make an informed decision about the changes to the 2004 Act. What little they were given was false.

Parliament not informed

Parliament did not debate the changes to the earthquake strengthening provisions in the Building Act, which were presented along with an extensive set of changes designed to prevent another 'leaky homes' disaster. Parliament was given no information that would have allowed it to make an informed decision on the earthquake strengthening changes.

Consultation on the 2005 regulations was inadequate

The 2005 regulations were a key part of the framework, because they calibrated the regime and set the standard to be applied to determine whether a building was earthquake prone. The consultation on the regulations was inadequate:

- Only a small number of interested parties were informed of the consultations. Most building owners were unaware that it was occurring.
- There was no supporting information that would provide an informed understanding of what the regulations were intended to achieve and why
- There was no alternative to the single proposal.

2004 Act and 2005 Regulations ignored in 2006 NZSEE seismic strengthening standards document:

The terms of the 2004 Act were ignored by a working group of the New Zealand Society of Earthquake Engineering (NZSEE), when they published an interpretation of its requirements in a document in 2006.

Instead, they substituted their own framework that was based on the new building standard. This had the effect of replacing the legal requirement that an 'earthquake prone building 'be likely to collapse in a moderate earthquake', to one that it be one-third the strength of a new building and should be very unlikely to collapse.

It also had the effect of passing the gross exaggeration of risk for the most populous parts of the country, which is embedded in the new building code, into the existing building earthquake prone building measurement framework. This had the effect of massively increasing the number of 'earthquake prone' buildings.

The minimum standard of 34 percent of the new building code was 'plucked out of the air'. There was no analytic framework or evidence to support it.

The Ministry supported the NZSEE's interpretation of the seismic strengthening standard and promoted it to local authorities as meeting the requirements under the Act. It is clear that it requires a much higher standard than the Act currently permits. Local Authorities have been encouraged to act unlawfully.

How should earthquake risk be regulated?

Definition of earthquake prone building in the new legislation

The key element in the legislation is the definition of earthquake prone building.

The definition of earthquake prone building has been amended to remove a redundant clause, but has the same meaning as the wording in the current Act. A building is earthquake prone if it "will have its ultimate capacity exceeded in a moderate earthquake (as defined in regulations)". The term ultimate capacity is not defined in the legislation, but it refers to the point at which the building is likely to collapse.

It is clear that the Ministry does not intend to apply this definition and will substitute the ultimate limit state approach used by the NZSEE, which references a point at which the building is unlikely to collapse. It appears that the Ministry has left the key term in the definition of earthquake prone building undefined to give it the flexibility to set the earthquake prone trigger point wherever it likes. The legal definition of earthquake prone building is likely to be ignored and thousands of safe and very low risk buildings will be designated as earthquake prone.

In our view it is critical that the term earthquake prone building is more precisely defined.

A possible definition could be: "An earthquake prone building is a building that has a 50 percent probability of collapsing in a moderate earthquake".

The size of the moderate earthquake would be used to calibrate the standard after an investigation of the costs and benefits of different standards.

An independent party should be commissioned to do that analysis. The Ministry is too committed to a flawed status quo to produce an authoritative review that would demonstrate a clear linkage to life safety outcomes, and a calibration that would deliver a net benefit to New Zealand.

Our preliminary analysis suggests that the moderate earthquake calibration would be higher (possibly a 250-300 year event) than the moderate earthquake that is currently defined in regulation, and would be associated with a life safety standard of around 1:10,000-15,000 years. This would imply an earthquake prone trigger point that would set a life safety standard which is 20 to 30 times safer than being in a car and 15 to 20 times safer than flying with a scheduled airline.

With this calibration, the number of earthquake prone buildings would fall sharply. It would make sense to scrap the review and registration process for lower seismic risk

areas. The likelihood of finding earthquake prone buildings in these areas is very low. The cost of just running the surveillance regime will far outweigh the benefits of strengthening.

The current system that grades the earthquake risk of buildings according to their strength relative to the new building code should be scrapped. It is inaccurate and gives a misleading impression of risk. It should be replaced by a measurement system that directly informs building occupants of their life safety risk and provides a ready comparison with other risks commonly faced in daily life.

Review of the Ministry's 2013 Regulatory Impact Assessment

Review was a sham

E-mail communications between government officials confirm that the review was a sham. There was no intention of reviewing the earthquake prone building threshold setting, despite overwhelming evidence that it had been miscalibrated. This was also clear from the structure of the review. Options, imposing lower standards, which would clearly have generated higher benefit cost ratios, were never considered.

Assessment of the adequacy of the Ministry's regulatory impact assessment

We assessed the Regulatory Impact Assessment (RIA), as summarised in the Regulatory Impact Statement (RIS), against the key requirements set out in the Treasury's Regulatory Impact Assessment handbook (2013). The Ministry's analysis failed on all but one of ten major criteria.

Our score for the assessment was 9.25 out of a possible 100. A competent agency should have been able to score a mark above 80.

One – Clearly define the true problem not the symptoms

The Ministry simply asserted that the problem was that there was an unacceptable level of risk without saying what level of risk would be acceptable and why the status quo failed to meet it.

Two – Establish that there is a market failure

The Ministry failed to establish that there was a market failure and did not make a case for regulation. The evidence shows that prior to the Christchurch earthquake individuals and markets were dealing with earthquake risk in a rational manner and that post Christchurch overreactions have been exacerbated by Ministry supported misinformation.

Three - Analyse all of the alternatives

The Ministry failed to analyse all the alternatives. The Ministry's cost benefit and other analysis clearly showed that more light-handed approaches would provide net benefit to New Zealand, but these were ignored. The examples of other countries were also ignored. New Zealand is the only country in the world that imposes across the board earthquake strengthening requirements for existing buildings.

Four - Produce and use a cost benefit analysis where possible

The Ministry did produce a cost benefit analysis but failed to use the results. Instead, it suggested that cost benefit analysis had 'limitations' for the analysis of high impact/low probability events. But it failed to explain what these limitations were, or to provide an alternative analytical framework. The Ministry is wrong about the use of cost benefit analysis. It is the accepted methodology for assessing seismic strengthening proposals. In the United States it is a legal requirement that Federal Agency seismic strengthening proposals have a cost benefit analysis that shows positive benefits.

Five - Quantify all of the costs

The Ministry failed to attempt to quantify the cost of the nationwide seismic assessment of buildings. Because adverse assessments will pressure building owners to obtain engineering reports, this programme could cost hundreds of million of dollars and will identify just a few genuinely dangerous buildings. Its assessment of strengthening costs was perfunctory and substantially underestimated the true costs.

Six – Identify affected parties and discuss the impacts of the proposals on them

The Ministry failed to make a serious attempt to assess the impact of the proposals on affected parties. If they had done so they would have identified the serious economic impacts on a large number of building owners and consequent risks to life and health. Our estimate of the number of lives lost due to the financial stress is between five and fifteen. This could well exceed the expected lives saved (just seven) over the Ministry's 75 year assessment period.

Seven – Identify regional impacts

The Ministry failed to show that, due to varying levels of seismic hazard in different areas of New Zealand, there are quite different relative costs and benefits in different cities.

In Auckland for example, the strengthening proposals could cost much more than $3 billion but:

- No lives will be saved over the 75 year analysis horizon;

- The present value of benefits will be less than $50,000; and
- The minimum life safety standard that will be imposed could be around one death in 300 million years. In the international risk literature 1:1,000,000 years is regarded as effectively risk free.

Eight- Identify distribution impacts

The Ministry failed to analyse and discuss distributional impacts. An analysis would have picked up the costs to building owners and transfers to earthquake strengthening professionals amounting to hundreds of millions of dollars.

Nine - Make a compelling case for the preferred option

The Ministry explained that its choice on the earthquake prone building threshold was based on support in responses to its consultation and is consistent with the Christchurch Earthquake Royal Commission's opinion.

A Regulatory Impact Assessment is meant to reflect the outcome of the Ministry's best advice based on evidence and analysis. Using what is little more than a biased poll of uncertain provenance, and a Royal Commission recommendation that was not based on any analysis, to settle the key and difficult calibration issue does not make a compelling case.

Ten - Provide an Agency Statement

The purpose of the agency statement is to point out the risks and limitation in the analysis. The Ministry's agency statement should have pointed out the obvious risks of relying on public feedback to calibrate the framework. It should have said that such an approach is very unreliable.

Instead, the statement was largely used to undermine the empirical analysis in the cost benefit analysis that it did not actually use.

A grossly inadequate regulatory assessment

In our view the Ministry's regulatory assessment was grossly inadequate and was designed to deliver, post Christchurch, a 'palatable' outcome rather one based on a rational consideration of costs and benefits.

A pass mark from Treasury

Treasury regulatory assessment team (RIAT) reviewed the Ministry's Regulatory Assessment Statement and declared it to be acceptable. It was a very light-handed

review but still identified some of the key problems, in particular the huge gap between costs and benefits. However, during the review process the team was informed that the review was not meant to be a real one – the earthquake prone trigger point had to stick to the status quo.

It appears that the pass mark was then given on the basis that the Ministry believed that the benefits exceeded the costs.

In our view the RIAT assessment standard was deficient. It means that an agency can substantially ignore the requirements in Treasury's assessment handbook, but still get a acceptable standard pass, which is conveyed to Cabinet, as long it states that it 'believes' that there are net benefits.

Analysis of costs and benefits

The cost benefit analysis commissioned by the Ministry in 2012 makes it obvious that the policies are very bad. It showed that the strengthening policies would cost, in present value terms, more than two billion dollars and have benefits of just over $40 million, when the benefits of a sound policy should exceed the costs. The position is actually much worse than depicted by the Ministry's analysis. While it is basically sound, it needs substantial adjustments to capture the full impact of the policies.

Taking account of the following:

- Pressures on building owners forcing them to strengthen much earlier than assumed in the cost benefit analysis
- Costs falling on a relatively small number of building owners which will have a higher welfare cost than if they were widely spread in the community
- An increase in the cost of strengthening to more comprehensively and realistically capture strengthening costs
- Market reactions caused by misinformation about the true nature of earthquake risk, and fears about the Ministry taking criminal prosecutions, on 'health and safety' grounds, against owners and tenants, inducing owners to strengthen above the minimum level
- Increases the economic costs to $8-13 billion. The benefits will be well under $100 million.

New Zealanders' understanding of earthquake risk

One of Ministry's key arguments is that people do not understand earthquake risk and have to be regulated because they will not act in their own best interests.

We conducted two surveys to test different elements of risk understanding.

The first, using a sample of Wellingtonians, explored how much apartment owners would be prepared to spend to reduce life safety risk from earthquakes. We found that respondents were rational, requiring an average real return of about 5 percent for their investment in earthquake strengthening, and that they understood and responded to relationships between risks and costs.

On average respondents were happy to accept risk levels more than 20 times higher than those that appear to be embedded in the earthquake prone building threshold for Wellington. This risk sensitivity is consistent, but more conservative than, the risk people are prepared to bear in other activities such as driving a car.

The second survey was of a sample of Auckland professionals designed to test how people respond to information about costs and benefits. They were asked if it was worth spending $1 billion to ensure that there were no earthquake prone buildings in Auckland (the actual cost will be much higher). Fifty percent said that it was worthwhile. When informed that the present value of the benefits of strengthening was just $20,000, 100 percent said the $1 billion should not be spent.

Our surveys show that people can make rational decisions about earthquake strengthening when given good information, and that people do not believe that strengthening should be pursued at any cost.

Who should pay?

If the Government is determined to proceed with the proposals then it should pay for most of the cost of strengthening. The benefits of the program are primarily political, and accrue to the government and its bureaucracy, not to building owners.

Conclusion

The proposed framework is not based on genuine safety concerns or a rational consideration of the costs and benefits of regulation. It is primarily about the Ministry and the Government being seen to be doing 'something' in the post Christchurch environment. The Government has received bad advice to maintain the

current earthquake prone building calibration. It should reverse that decision and introduce an evidence-based regime that complies with the law. It does no one any good to cause $8-12 billion of economic damage and destroy many lives as some kind of ‘memorial’ to Christchurch.

Figure 1: A toxic brew

The Dominion Post 29 August 2014

Three little pigs murdered after eviction from 'earthquake prone' brick house

Upper Hutt police confirmed that the partially devoured bodies of the three little pigs had been found in Whitemans Valley shortly after they were evicted from their earthquake prone brick house.

Ministry of Business Innovation and Employment spokesman, Brad Lambeauchamp, confirmed that the three little pigs' two-story building, which had been divided into three units, had been designated as earthquake prone in line with the Ministry's policy. "There was a widespread consensus that it posed an unacceptable risk to the occupants". Neighbors said that after the designation, the three little pigs were unable to obtain insurance at less than a ruinous price, and the bank recalled their mortgage and evicted the pigs.

Reacting to claims that the Ministry's policies had sent the much loved local personalities to an almost certain death, Lambeauchamp said it was important to appreciate that the three little pigs were running a one in a million year risk of being killed in an earthquake, and that this risk had now been reduced.

Police are seeking a large wolf, thought to reside in the area, to assist them with their inquiries. Residents have been warned not to approach the wolf who is known to be bad.

Artist's recreation based on eyewitness accounts

Part two: The background to the current framework: legislation, regulation and standard setting 2003-2006

This section is the core of the paper. It sets out how the earthquake prone building measurement framework, which was put in place over 2003-2006, was constructed and calibrated.

It addresses the puzzle raised by the Ministry's cost benefit analysis. If the cost benefit analysis is showing that that costs of seismic strengthening massively exceed the benefits, then either the strengthening framework has been miscalibrated or the problem is that the cost benefit analysis is not a reliable tool for policy making.

This section shows that the problem lies squarely with the NZSEE's earthquake prone building threshold calibration. There was no analytical basis for it. It is not based on a consideration of both costs and benefits. It is not even based on a logical and demonstrated link between earthquake strengthening and life safety outcomes.

How this came about is a complex story. We begin by providing an overview of the process, and then carefully explain the component pieces of the puzzle. We show that the current framework is unnecessarily complicated and opaque; has been badly miscalibrated; and that it does not give effect to the earthquake strengthening law as it currently stands.

An overview

The story in a nutshell

- Prior to 2003 some earthquake engineers wanted to increase the number of 'earthquake prone' buildings. It convinced the Ministry to advise the then Government to change the existing seismic strengthening standards by:
    - Expanding the scope of buildings subject to the earthquake prone test

    - Increasing the threshold percentage of the new building standard that defined an ‘earthquake prone building from 16 percent to 34 percent.

- It promoted an ‘earthquake prone‘ building measurement framework that defined ‘earthquake prone’ in terms of relative strength compared to a new building standard. The relative strength percentage was ‘plucked out of the air’. There was no analysis to support it. There was no demonstrated link between the earthquake prone building threshold and both life safety outcomes and the costs of earthquake strengthening;
- The new building code had been crafted to artificially boost earthquake risk over the most populous part of New Zealand by a large margin;
- The link to the new building code meant that the inflated earthquake risk estimates flowed through to the existing building requirements, and had a significant impact on the number of existing buildings captured by the strengthening threshold.

Steps in the process

One - The 2004 legislation and 2005 regulations
We explain what motivated the change in the legislation, how the Ministry went about changing the law and setting regulations, and what they did and didn’t tell Ministers and the public.

Two – The new building code 2004
The calibration of the new building code in 2004 and its links to life-safety outcomes are explained.

Three - The NZSEE interpretation of the framework
The NZSEE constructed a framework based on a link to the new building code that was intended to operationalise the building resilience requirements under the Building Act and regulations.

Four - Consequences of the link between the new building standard and existing building strengthening
This link is the centre of the story. We explain the rationale for the link, what impact it had on the ‘earthquake prone’ threshold value and its critical impact on the number of earthquake prone buildings.

Five - the Ministry’s understanding of the framework
We examine documents that show that the Ministry did not appear to understand the risk measurement framework.

The 2004 Act and 2005 regulations - the Ministry's role

2003 Cabinet Aide Memoire

The first documentary evidence we have of the processes that lead to the 2004 change in the Building Act that strengthened and broadened seismic strengthening requirements, was an Aide Memoire to Cabinet, apparently dated May 2003. The Memoire made the case to apply earthquake prone requirement to all buildings, to increase the trigger level that defined an 'earthquake prone' building, and to require local authorities to have an earthquake prone building policy.

It was explained that the earthquake prone provisions would be triggered if the building was likely to give rise to a loss of life in an earthquake that was one third as strong as the earthquake that would be used to design a new building on the site. This was an increase from 16 percent.

The argument for increasing the standard was as follows:

"Scientific knowledge has progressed and it is now accepted that the standards set under the former act, which refers to the building act 1965, is out of date and too low.

A building just meeting the standard under the former act represents more than 25 times the risk of a new building while the proposed threshold represents 10 times the risk of a new building."

Both of these statements were false or misleading.

While scientific knowledge about the effect of earthquakes on buildings had evolved prior to 2003, the claim that this led to the conclusion that earthquake strengthening standards were too low was not true. No other country had across the board earthquake strengthening standards and none were induced to adopt them over this period in response to changes in 'scientific' knowledge.

In New Zealand, an important study on the performance of reinforced concrete buildings in the 1931 Hawkes Bay earthquake (see box 1) showed that these buildings actually performed much better than the current seismic standards would predict.

We asked the Ministry, under the Official information Act, for documents that would have supported its contention that the standards that were set too low. There were none.

Box 1 Performance of reinforced concrete buildings and life safety risk

A paper by Van der Vorstenbosch, Charleston and Dowrick D.J. (2002) examined the seismic performance of reinforced concrete buildings in the 1931 Hawkes Bay earthquake.

They found that of the nearly 100 reinforced concrete building subject to the Hawkes Bay earthquake*, "most were practically unharmed, some suffered minor structural damage, a few (with moment resisting frames) suffered serious damage and one the Napier Nurses Home collapsed. The Nurses home was not representative of building construction at the time."*

They concluded after a detailed examination of 25 of the 45 surviving buildings that *"the excellent seismic performance of reinforced concrete buildings during the 1931 Hawkes Bay earthquake suggests current earthquake engineering analysis of similar pre-1935 low rise non-domestic reinforced concrete may underrate their seismic performance."*

Under the current NZSEE risk measurement framework the 45 surviving buildings are likely to be given a preliminary rating of 4 percent of the new building standard, leading the public to think they are extremely fragile. Most will probably be eventually found to be 'earthquake prone' and require strengthening despite having passed a very severe real test with flying colours.

The performance of reinforced concrete buildings in the Hawkes Bay earthquake gives a clue to the life safety risk posed by this class of buildings (we exclude the Napier Nurses Home which had readily identifiable risk vulnerabilities that would place it in a different risk class) in a high seismic risk area.

- If we assume the following:
- A collapse rate of 1 percent
- An event frequency of 1000 years for a 7.8 quake (it is higher)
- A death rate given collapse of 15 percent

Then the life safety risk is 1:667,000 years. It will be well over one billion in less seismically active areas.

Much of the concern and discussion in the Royal Commission report on the Christchurch earthquake was on the performance of unreinforced masonry buildings. There was no systematic analysis of the performance of reinforced concrete buildings, presumably because, with two exceptions that took many lives, they performed well.

There are 3,500 unreinforced masonry buildings in New Zealand, which means that there around 16,000 reinforced buildings, which according to the Ministry are earthquake prone, but on the evidence of two very severe earthquakes, should perform well in a strong earthquake.

What had evolved over the previous twenty years was a literature on earthquake strengthening policy analysis. Because of a US legal requirement that a positive cost benefit analysis was required to support the seismic strengthening of Federal buildings, there was a large body of evidence and analytic frameworks that could have been drawn on in the New Zealand context. This would certainly have shown that, over most of New Zealand, the existing standards were too high or unnecessary. But this was not done.[1]

The numbers on the relative risk of the different strengthening standards were simply made up. There were no documents to support them. The same figures have been cited by the NZSEE and the Ministry was obviously just passing on what they had been told.

The relative risk numbers were not based on data on the relative likelihood of building collapse at all. They were derived from a simple mathematical model of the likelihood of earthquakes, which is a quite a different thing. The NZSEE did not have a model that linked its measure of building strength to the likelihood of collapse.

The Ministry explained that three standards were considered; 16 percent, 33 percent and 50 percent. No evidence was provided on the respective costs and benefits of these options. We have asked for supporting documents under the Official Information act. There were none.

The 33 percent level was preferred because it was recommended by the NZSEE. It was further explained that the Society preferred a 67 percent level but recommended the 33 percent level, on balance, because a much larger number of buildings would be caught by the higher level.

The only reference to the benefits of the policy changes in the document was the sentence "*a decision to change the current provisions of the Act would result in large benefits if a trigger level earthquake were to occur (especially in terms of lives saved, injuries averted and reduced property damage)".*

This statement was false.

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[1] There was a cost benefit analysis (Hopkins and Stuart 2003) that suggested that at least in some cities there was a net benefit to strengthening. If known to the Ministry officials it may have influenced perceptions about the benefits of strengthening. The net benefits were generated by overstating the benefits and understating the costs by substantial margins. This study has now been superseded by the Martin Jenkins study as the best New Zealand cost benefit analysis of seismic strengthening.

The size of the trigger level earthquakes was known to the Ministry. The Wellington and Auckland earthquakes had maximum horizontal accelerations of 0.13g and 0.04g respectively. These are equivalent to earthquakes of approximately 5.5 and 4.5 respectively on the Richter scale. The Wellington quake will cause superficial damage and the Auckland quake will barely do more than rattle teacups. The claim that they will cause heavy damage and cost many lives is simply nonsense.

There are two possible explanations for the Ministry's claims.

The first is that they simply did not understand the logic of the system that the NZSEE was proposing. As we will see later the Society was not claiming that a moderate earthquake as would cause widespread death and damage. Rather they were making a different claim that with an earthquake of that size an earthquake prone building would exceed a technical reference point called its ultimate limit state. At that point the building would be very unlikely to collapse.

The second explanation is that the Ministry understood the system but was prepared to talk the event up to frighten ministers. It would take a brave minister, lacking any other source of advice, who would reject the Ministry's advice that appeared to show that the proposals would generate large benefits and save many lives.

It was also explained that there would be large costs, running to several billion dollars, if all owners of all existing buildings were required to make upgrades. But it was implied that this was not what really what was being proposed. Instead Territorial Local Authorities would be required to formulate an earthquake prone policy that would take account of local circumstances and the interests of both building users and owners. The implication was that a sensible implementation of the policy would avert the possibility of widespread economic costs and damage.

As far as we have been able to ascertain the Aide Memoire was the sole document that supported the legislation. There was no further evidence or advice to Ministers, the Select Committee or to Parliament.

Passage through Parliament

The strengthening amendments were passed together with a large number of changes to the Building Act that were primarily designed to address the problems that arose with leaky homes. Parliament focused on these provisions. There was no analysis or debate of the earthquake strengthening provisions.

Definition of earthquake prone building in the 2004 Building Act

The relevant change in the Building Act was section 122, which reads as follows:

(1) A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building —

(a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and

(b) would be likely to collapse causing—

(i) injury or death to persons in the building or to persons on any other property; or

(ii) damage to any other property.

Part (a) refers to a building exceeding its ultimate capacity. The term ultimate capacity is not often used (it does not appear in a Google search) but its meaning is reasonably clear. In geotechnical engineering, for example, the term ultimate bearing capacity, which is widely used, refers to the maximum theoretical pressure that can be supported without failure. It this context then, the term ultimate capacity means that maximum force a building can sustain without failing or collapsing. Because collapse is a probabilistic concept rather than a certainty, given a particular shock, a reasonable interpretation of ultimate capacity is that it is the point at which there is a 50 percent chance that a building will fail or collapse.

This definition of earthquake prone followed from the definition in the 1991 Building Act. In this Act, an earthquake prone building was defined as a building that would have its ultimate load capacity exceeded in a moderate earthquake, and thereby would be likely to suffer catastrophic collapse causing bodily injury or death to persons in the building, or to persons on any other property, or damage to any other property.

The seismic forces used to define the “moderate earthquake” were specified to be “one-half as great” as used for new building design.

The word likely in the second part of the definition can also be given the same statistical interpretation. Likely means a 50 percent chance of collapse.

Regulations defining moderate earthquake 2005

The Act required a 'moderate earthquake' to be defined by Regulation.

In 2005 the responsible Minister was given a memorandum saying that the Ministry would be consulting on the regulations that would define moderate earthquake. There was no explanation that would help the Minister understand what was being proposed, and what the effect of the regulations would be. It was simply stated that the regulations were required under the Building Act.

A later document to the Cabinet Economic Committee reported the results of the consultation. It said that some respondents were seeking clarity on the meaning of the terms 'likely to collapse' and 'ultimate capacity.' It was explained that the Ministry would be issuing guidance on these definitions.

The Committee might have expected that the Ministry would issue advice that would define the terms more precisely. That never happened.

Instead, a NZSEE working group issued their own guidance that did not use the terms in the Act. There is no evidence that Ministers were ever informed of what happened.

Consulting on the regulations

The regulations did go out to consultation, but the process was flawed.

Consultation was limited to a select group of insiders. Almost all building owners had no idea what was going on. The consultation document (see appendix A) was inadequate.

The document set out the legal definition of 'earthquake prone' and explained that a definition of moderate earthquake was required in terms of the legislation. It set out a single option of 33 percent as the trigger point. There was no information on the costs and benefits or possible impact of the single option. Respondents were asked whether the 33 percent was appropriate, and about likely impacts.

Taken together the legislation and regulations looked innocuous. Only buildings that were likely to collapse in a moderate earthquake were being targeted. It is difficult to object to a safety standard that would catch a relatively small number of buildings that were actual likely to collapse in a moderate earthquake – in Wellington about one in sixty years.

But the consultation was a deception. What was consulted on, was not what the Ministry and the NZSEE intended to implement. Their system was intended to catch, potentially, tens of thousands of buildings.

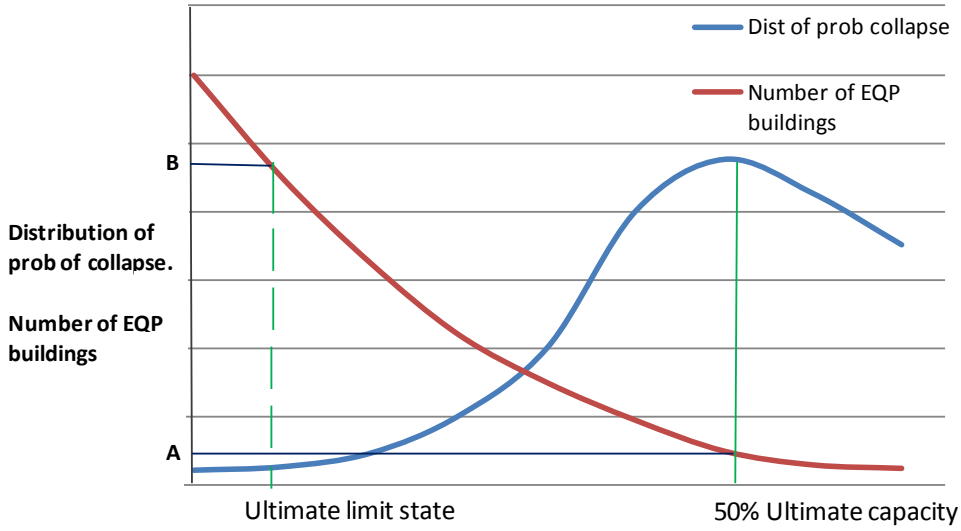
Box 2: Why the low moderate earthquake calibration?

An earthquake that is as one third as strong as the one that would apply to a new building is likely to occur in Wellington once every 60 or 70 years. This looks low for a regulatory trigger point.

However, the size of the earthquake is just one of two variables that will define the strength of the standard. The other is the probability that a building will collapse causing death or injury given the earthquake. The two variables can be combined to produce any number of building seismic strength levels. And there can be an array of combinations that will provide the same strength specification. A 60-year earthquake with a 2 percent probability of causing a collapse might yield a similar standard to, say, a 300 year quake with a 50 percent chance of causing a collapse.

While in principle a seismic strength standard could use any combination of the two variables, from a policy perspective, the more natural choice is to define the strength of the earthquake at the expected collapse point. Being told that an earthquake prone building is a building that has a fifty percent chance of collapse in a 1 in 300 year earthquake will mean more to the to the lay person than a 2 percent chance collapse in a 60 year event.

Figure 3: Earthquake prone building - ultimate capacity and ultimate limit state calibration



A – Earthquake building numbers Ultimate Capacity
B – Earthquake building numbers Ultimate Limit State

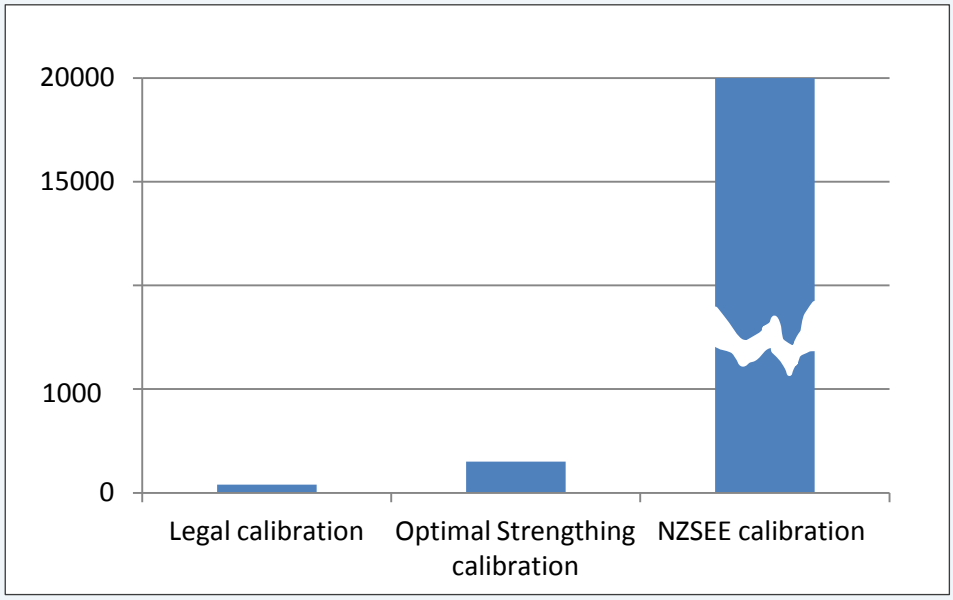
What is unsatisfactory, from a policy perspective, is where an 'Ultimate Limit State' (ULS) approach is used, but the probability of default at that state is not defined. That means that the calibration of moderate earthquake in the regulations becomes irrelevant, and the strengthening standard can be set anywhere the designer of the ULS likes. Parliament and Cabinet have no control over the process, and there is no link to the purposes of the policy.

It is critical that both elements in the calibration are defined at a political level, and not left to the NZSEE to define an earthquake prone building as it likes, or for the Ministry and the NZSEE to negotiate a 'solution' behind closed doors.

The current 'system' has resulted in a muddle with three different calibration points in play.

- The current legal calibration point, which is based on the legal definition of 'earthquake prone' and definition of a 'moderate earthquake'. Very few buildings would be earthquake prone using this definition.
- An evidenced based calibration point which would be based on the current legal definition of earthquake prone, and a stronger definition of moderate earthquake, which is calibrated to deliver net benefits to New Zealand from earthquake strengthening. A moderate number of buildings would be defined as earthquake prone.
- The NZSEE calibration point that uses an ultimate limit state definition and the current regulatory definition of moderate earthquake that defines 15,000-25,000 buildings as 'earthquake prone'.

Figure 2: Indicative earthquake prone building numbers



The new building standard NZS 1170.5

From a policy perspective, the key part of the 2004 New Building code is the accompanying commentary document that has a preliminary section that explains the logic behind the calibration of the code. Obviously it not enough simply to construct a code, it is also necessary to demonstrate that there is a link between the calibration of the code and the policy purpose of saving lives at an acceptable cost.

The document attempts to do this but does not do so using analytical tools such as a cost benefit analysis. Rather it starts what it describes as the international earthquake safety standard for new buildings of one death in 1,000,000 years and explains why the code could be reasonably claimed to meet that test. It sets out an analytical framework that could be used to test the life safety implications of the code but does not actually conduct the analysis.

Before we go on it is useful to put the 1:1,000,000 life safety 'standard' in context. It is very high.

It is the level that is widely accepted, in the life risk literature, as the standard for zero effective risk and a level of risk at which no further improvement in safety should be made.

It is a level that would be applied in practice in reasonably exceptional circumstances – and in particular where the marginal cost of securing safety benefits to this level is very low. For most activities a lower level of life safety will be acceptable. For example, in the UK the Health and Safety Executive adopted the following 'tolerable' levels of risk:

- 1 in 1,000 as the 'just about tolerable risk' for any substantial category of workers for any large part of a working life.
- 1 in 10,000 as the 'maximum tolerable risk' for members of the public from any single non-nuclear plant.
- 1 in 100,000 as the 'maximum tolerable risk' for members of the public from any new nuclear power station.

Returning to the 1,000,000 standard for the new building code, the International Standards Organization's standard ISO 2894 was cited as an authority. This reference does not exist. There is no mention in ISO 2894 (which covers general construction standards) to an earthquake safety standard at all, let alone a one in one million standard. Further, there is no reference in the standard ISO 3000, which does cover

earthquakes, to a one in 1,000,000 standard. That standard suggests that new building codes should have regard to the costs and benefits of seismic strengthening.

Perhaps what was meant in the commentary document is that there may be some sort of understanding that international earthquake codes (which New Zealand's is mostly modelled on) probably meet a very high safety life safety standard, which could be in the order of 1:1,000,000. As New Zealand has generally lower seismesticty than much of the world, where similar standards apply, it is possible that the calibration of the New Zealand standard is significantly higher than 1:1,000,000.

The next key part in the code, which is significant for existing building earthquake prone calibration, is the link between the life safety standard and the Ultimate Limit State calibration point for the code. The code is built around being robust to a one in 475 year earthquake, but this would not deliver a life safety standard of 1:1,000,000, so it is buttressed in various ways to deliver a much higher standard. The outcome is that the Ultimate Limit State is set to achieve a very low probability of collapse.

"It is an expectation of this Standard that under the ULS there will be a high degree of reliability of achieving the strength and ductility values that are assumed and therefore consequently there will be a very low risk at the ULS of:

- *Structural collapse;*
- *(b) Failure of parts and elements which would be life threatening to people within or around buildings;*
- *(c) Failure of parts or elements whose function is critical for the safe evacuation of people from the building. "*

Precisely what this 'high degree of reliability' means in more precise statistical terms is not explained. It could be 1:100 to one or it could be 1:500 to one. What this means is that there is no analytical link between the code and life safety outcomes. This weakness flows through to the existing building strengthening trigger point calibration.

Treatment of low seismic risk zones

The critical part of the code is that it makes an exception, in what in principle is a probability driven framework, for lower seismic risk zones. This is not a minor tweak to the standard framework. Because the low seismic zone covers two thirds of New Zealand's population, it is the heart of the code.

Here actual seismic risk is largely ignored and a minimum seismic shock substituted. There is no substantive discussion or justification of this minimum, other than that it is necessary to impose a seismic strengthening requirement over the low seismic zones. The actual risk in the most populous area of New Zealand is so low that in a risk-based framework no seismic strengthening is required.

It is stated that the minimum is based on an assumption

"that a structure anywhere in the country is likely to be subjected to, and should be able to survive earthquake motions at least as strong as those corresponding to the 84-percentile motions in a magnitude 6.5 normal-faulting earthquake at a closest distance of 20 km from the site.

The magnitude 6.5 earthquake was selected because it was the largest conceivable earthquake that could occur anywhere in the largest low seismic risk area.

It was understood that this would have a significant impact on the actual probability of the earthquake that is assumed to underpin the standard in less seismically active areas.

"It is recognized that for low seismicity zones the application of the shorter return period hazard and/or restrictions on materials and/or high values for R could in some cases lead to very high return periods for the ULS and therefore the implied collapse limit state. However, these conservatisms are not expected to unduly penalize buildings in these zones.

No examples of these 'very high return periods' were given and the reference to 'some cases' understates the impact of the rule change. It has an effect over a large part of New Zealand, and in particular on the populous Northern region including Auckland.

In the case of Auckland, we were able to make an assessment of the impact of the artificial earthquake adjustment on life safety standards, by looking at the impact of the 34 percent existing building trigger point on expected death rates. We used the Ministry's cost benefit analysis, which calculates expected death rates using the actual probabilities that earthquakes will occur.

We took the total expected number of lives saved per year for Auckland and Wellington, both without any strengthening, and with strengthening to the 34 percent standard. The difference between the two shows the impact of the strengthening policy.

For Wellington the difference was 0.1 and for Auckland it was 0.00022. Dividing by the number of earthquake prone buildings (750 for Wellington and 4,932 for the old

Auckland city) gives the expected life loss, per building, per annum. As the buildings were assumed to be the same size and have the same number of occupants in both cities, this figure would be the same if the same life safety standard was being applied to both cities.

This was not the case. In fact, the expected change in the loss of life per building was 3,000 times smaller in Auckland than in Wellington. Put another way, the Auckland life safety standard is more than 3,000 times tougher than the Wellington standard. This difference was generated by the using the artificially strong earthquake in the code.

If we accept, for the sake of this discussion, that the NZSEE's guess that the Wellington new building life safety standard is about 1:1,000,000 then the Auckland life safety standard is 1:3,000,000,000 or 3,000 times the effective zero risk standard.

Operationalising the Act: the NZSEE approach

A working group of the NZSEE produced a paper (Assessment and Improvement of the Structural performance of Buildings in Earthquakes) in June 2006, which was meant to operationalise the Earthquake Prone Building requirements under the 2004 Act and the 2005 Regulations.

Their approach was to recast the requirements so they would fit within the same framework as the new building code.

To do this they had to make the following very significant changes to the definitions of the key terms in the Act.

" (b) "likely to collapse causing injury or death to persons in the building" means that collapse and therefore loss of life could well occur as a result of the effects of earthquake shaking on the building."

The term 'could well occur' is a less precise term than 'likely' and could encompass a very wide range of outcomes. It could be argued that a event that had, say, a one in a hundred chance of occurring is something that could 'well occur'. This imprecision was deliberate, and was intended to allow a link to the Ultimate Limit State reference point in the new building code. At that point, collapse is an extremely low probability for new buildings, and was intended to still to be a 'very unlikely' event for existing buildings. This unlikely event was something that 'could well occur'.

The ‘collapse’ test was removed all together. It was suggested that this just reflected the general intention of the legislation.

The second change was to redefine the term “ultimate capacity” to mean “ultimate limit state” (it was not stated that this meant ultimate limit state as defined in the NZSEE’s document but this was the intent). Thus the term changes from a describing a point where there is a 50 percent chance of collapse, to one where the collapse point is undefined but probably ‘very unlikely’.

An earthquake prone building then is not one that does not meet a defined standard under law but is one that the NZSEE says is earthquake prone.

Figure 3: Legally ‘earthquake prone’

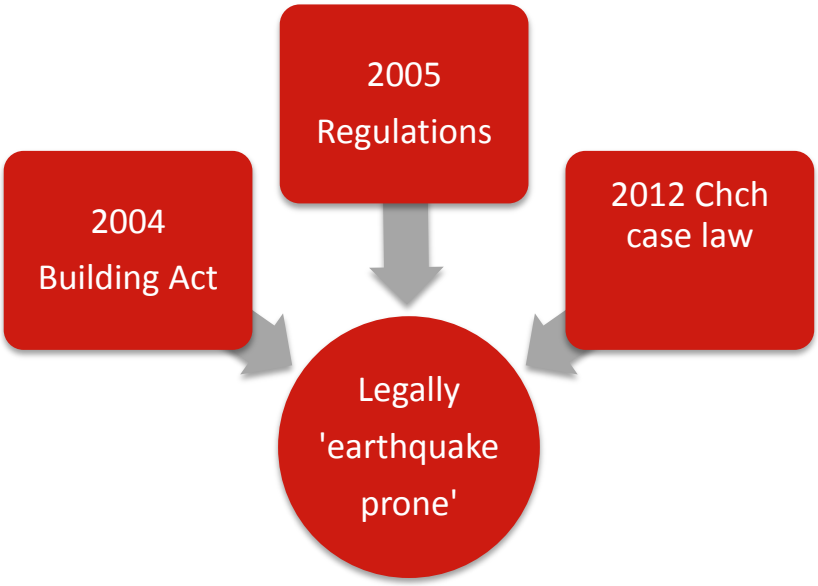
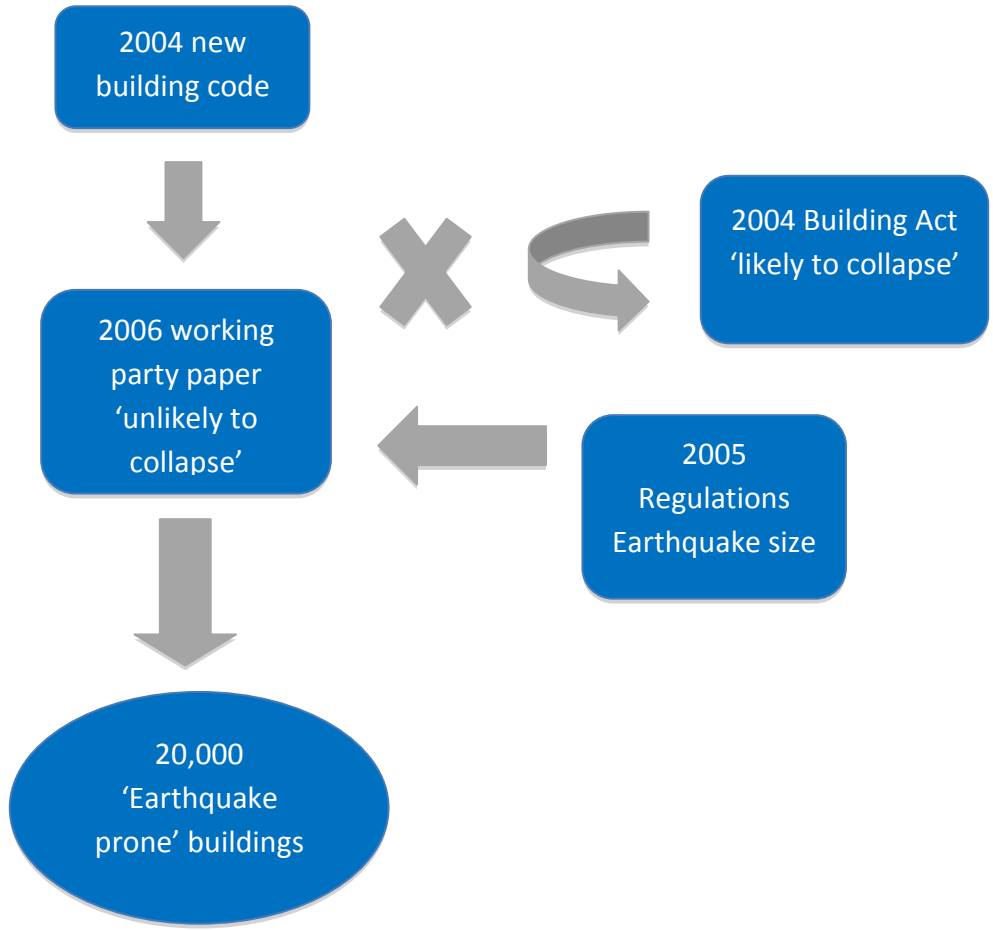


Figure 4: NZSEE definition of 'earthquake prone'



"Accordingly, the expression earthquake risk building is now regarded as applying to any building that is not capable of meeting the performance objectives and requirements outlined in this document."

The Ministry then gave their wholehearted endorsement to the framework and some local authorities went about implementing it.

Claimed Impact of the earthquake prone building status on life safety risk

It is claimed at one point in the NZSEE paper that the new earthquake prone building trigger point would have the effect of reducing risk from 25 times that of a new building to about 10 times. At another point, it is claimed that buildings at the 34 percent standard are 20 times as risky as new buildings. This claim has been repeated by the Ministry in various documents, and has served as their flagship piece of 'evidence'. There are several problems with the NZSEE assertion.

The first is that it is not based on any evidence about building safety risk. Instead, the NZSEE document references the mathematical shape of a functional form sometimes used to estimate the probability of an earthquake. This is different from a functional form that relates the strength of a building to the likelihood of a building collapse. The NZSEE appears to have done no analysis that would have allowed them to draw conclusions about the impact of building strengthening on collapse rates. The NZSEE document is misleading, because it suggests that there is some analysis behind the relationship. To a fearful and non-expert populace, the statement that risk will be reduced by half looks impressive.

Second, the probability of a building collapse is not the correct risk metric. It ignores the likelihood of death or injury if a building collapses. What is required is a measure of the risk of being killed or injured in an earthquake. This depends not just on the probability of collapse, but also on the likelihood of death or injury given a building collapse. This likelihood will vary by building type, and is generally much lower for the most so-called earthquake prone building (in particular unreinforced masonry buildings) than for more modern buildings. Hence the real risk gaps are much narrower than the ones the Ministry has presented. The point is illustrated by the Christchurch experience. Many unreinforced masonry buildings collapsed, or came close to collapsing, but there were only four deaths of occupants in those buildings – a very low casualty rate given the large number of occupants. The casualty rates in the two modern building failures were much higher.

The Ministry expert report (Taig 2012) provides more detail on this point and shows how unreinforced masonry buildings are no riskier than many much more highly rated buildings. In general, unreinforced masonry buildings may only be a quarter as risky as the NZSEE has represented them to be.

Third, the use of a relative, rather than an absolute, risk measure does not allow the user to understand the significance of the risk difference. For example, if the risk of a building collapse was one in 100 years then, for many people, a 50 percent reduction in that risk would be worth having. If, on the other hand, the risk was one in 1 billion then it is unlikely that anyone would be prepared to pay for a 50 percent risk reduction.

While the NZSEE risk scores do not have an obvious risk interpretation, people are naturally inclined to give them one, and these interpretations can be well off the mark. We are used to seeing things scored on a scale of 0 to 100 and naturally associate anything with a score of below 50 as a fail, and unacceptable, and our instinct is to seek as score of two thirds or above as acceptable score. From a life risk perspective, however, a building with a low score might be very low risk.

What is required is a risk measurement metric that tells people what the absolute level of risk is, and allows them to compare the risk of an 'earthquake prone' building with risks they are exposed to in their day to day lives. We present an effective risk measurement framework in section 3.

Consequences of the link between the new building standard and the existing building risk assessment framework

The critical part of the NZSEE approach to make a link between the new building standard and the existing building standard.

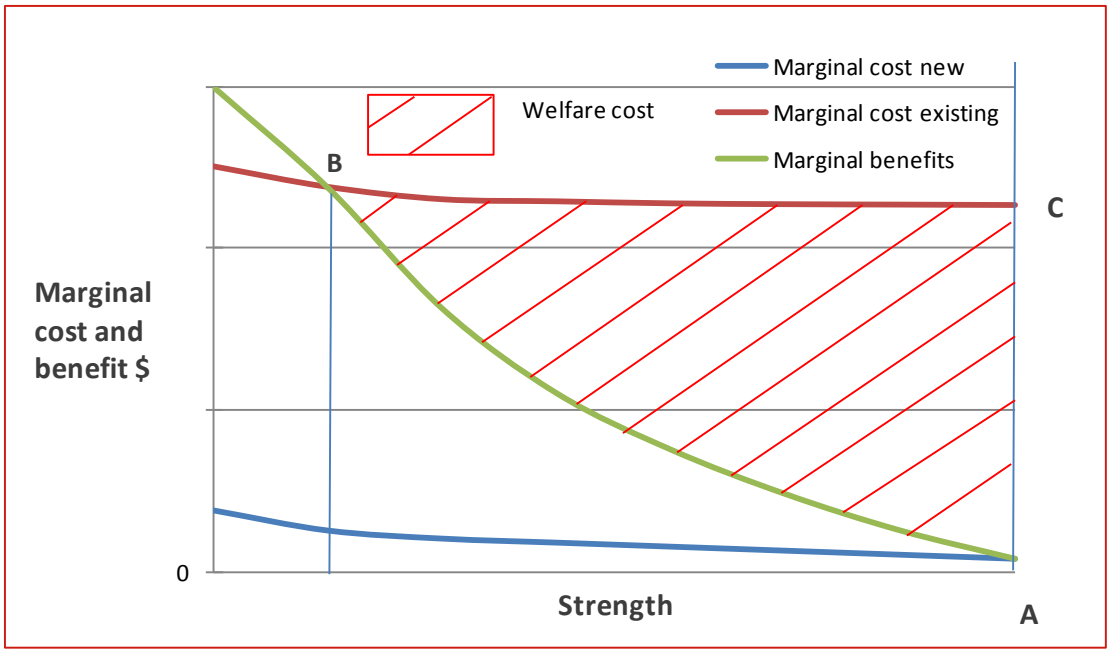
The key assumption underpinning the thinking here is that existing buildings should meet the new building standard. The actual targeted standard of 34 percent is seen as something of a temporary compromise and is desirable to meet at least a 67 percent standard and ideally 100 percent.

"The NZSEE recommends upgrading to as nearly as is reasonably practicable to that of a new building."

There is no analysis of the costs and benefits of reaching these respective limits and, as explained above, there was no real meaningful analysis of the life safety impacts. The 34 percent figure was just plucked out of the air.

We have reviewed a large amount of new building strengthening literature. We have never seen it argued that the appropriate benchmark level for existing building seismic strength is the new building code. All of the serious literature has been based on cost benefit analyses.

Figure 5: Optimal strengthening for new and existing buildings



A – Optimal new building strength

B – Optimal existing building strength

C – Strengthening existing buildings to new building standard

Difference between new and existing building standards

The logic of linking to the new building standard is obviously flawed and is not based on any serious consideration of the cost of achieving that standard. The cost factor with new and existing buildings can be very different.

The costs of upgrading a new building design for an improved level of seismic performance can be very low and in some cases may simply involve the reworking of the design at no extra cost. The cost of strengthening an existing building, on the other hand, can be very high. US government cost benefit studies show that it can often be as high as 50 percent of the replacement cost of a building and will generally mean that strengthening is not warranted. This point is illustrated in figure two, which shows, schematically, the optimal strengthening standards for new and existing buildings.

Without considerable analysis it is not possible to determine the optimal strengthening ratio. What we do know from the cost benefit analysis and the implied life safety standards is that the 34 percent ratio is way too high.

It is not necessary to run the existing building earthquake prone test through the new building seismic strengthening framework. It is not required by the Act and is a complex, opaque and economically and legally flawed methodology. A simpler and more effective methodology that works directly from the provisions of the Act to the strengthening requirements is outlined in part three of this paper.

Impact on property rights

The second problem with setting a high standard for existing building earthquake resilience is its impact on existing property rights. If the new building standard is increased then a prospective investor can make an assessment of the economics of a building investment, based on the new standards, and can decide not to go ahead if the new higher costs exceed the market value of the building.

With an existing building, however, the increase in strengthening costs falls directly on the market value of the investment, and the owner can do nothing to avoid its impact. A change in the building standard has the same economic impact as a directive that confiscates all or part of the value of the building.

Impact of the link on the calibration of the existing seismic standard

The key point is that the new building collapse likelihood standard of "a very low risk" at the ultimate limit state feeds though to the existing building standard, although there is a higher probability of collapse for existing buildings.

If the probability of collapse of a new building in the high seismic risk zone at the ULS were, say, 1:500 and existing buildings were 10 times more likely to collapse than a new building at that point, then the regime would produce an ULS collapse likelihood of 1:50

The second major impact is that the artificial earthquake is applied to existing buildings over the low seismic risk zones. This significantly changes the life safety standard of the earthquake prone trigger point for the most populous areas of New Zealand. Assuming the new building standard of 1:3 billion (the NZSEE's assumption of 1:1,000,000 for new buildings times the 3,000 risk multiplier) and that the difference between the new and existing building risk at the trigger point was 1:10 then the life safety standard would be 1:300,000,000. This is 300 times higher than the 'effectively no risk' standard.

The use of an 'artificial' earthquake will not explain all of the difference in the life safety calibration. The NZSEE framework was designed to deal with new building

design and does not directly model the likelihood of existing building collapse. On the other hand, the GNS Science modelling, that underpins the Ministry's cost benefit analysis, does model collapses and will provide a more accurate risk assessment.

Meeting the objectives of the Act

The NZSEE working group claimed that their framework meets the objectives of the Act.

"*For existing buildings – high risk, definition (b) converts the general intention of the words in the Act to definitive criteria that are recognised as achieving the same objective as the words in the Act."*

In section 4-3 of the document it is stated that:

" the ultimate limit state (ULS) reference line provides a consistent basis for determining when the threat to life is/is not acceptable,"…… " the reason being that ULS is implicitly the reference point for new buildings"

This argument does not work because the new building standard is not based on an actual measure of life safety risk and doesn't provide a consistent basis for measuring *"whether the threat to life is or isn't acceptable".* It is simply not possible to state that an 'earthquake prone building' in Auckland presents the same life risk as an earthquake prone building in Wellington.

For that reason the working group assertion that their definition *" achieves the general intention of the words in the act"* is wrong, and in any event is not relevant.

From a legal perspective, it is not the NZSEE's interpretation of the general intention of the Act that matters. It is what the words in the Act actually say. And what they say is reasonably clear. An earthquake prone building is a building that is likely (a 50 percent chance) to collapse in a moderate earthquake. If there is an issue with the calibration of the standard, then that should be addressed through a change in definition of moderate earthquake in the regulations.

NZSEE should withdraw its seismic strengthening recommendations

The NZSEE should immediately withdraw its seismic strengthening recommendations. They are not evidence based and present a grossly misleading picture of risk, and the benefits of strengthening, and are doing an enormous amount of harm.

Box 3: Decision metrics for earthquake safety calibration

Much of the confusion in the earthquake prone building definition discussion has been caused by different parties using different decision metrics for calibrating their earthquake prone building measurement frameworks. This box sets out the different metrics that could have been used, and some of their strengths and weakness.

Cost benefit analysis

Cost benefit analysis, which compares the present value of the expected costs and benefits of strengthening, is the most comprehensive and accepted methodology for assessing earthquake strengthening proposals. It is used regularly in the earthquake strengthening literature and is a requirement under US Federal law.

The decision metric is straightforward and intuitive. The strengthening standard should be calibrated to maximize the net benefits to the country.

It is a requirement for New Zealand regulatory assessment analysis where possible.

It is possible to produce credible cost benefit analyses of earthquake strengthening proposals in the New Zealand environment.

It is not true that cost benefit analysis does not work for low probability high impact events. Probability based analysis is regularly used to assess low probability high impact events in a variety of fields. For example, the Reserve Bank of New Zealand recently used a probability based cost benefit analysis to assess whether higher capital standards would have a net benefit by reducing the probability of financial crises. Financial crises are high impact low probability events.

It is also a metric that people use in their everyday lives. We do cost benefit analyses, based on an intuitive sense of key magnitudes, all the time. Airline passengers are aware that they can be killed in a plane crash, which is a high impact event, but they judge the probability, and so the expected cost, to be low and worth the benefits in terms of time savings and the possibility of travel.

A life safety standard

A life safety standard, such as a death rate of 1 in 10,000 years, considers only the main benefit of an earthquake strengthening regime, saving lives, but ignores the costs. If it is possible to calculate the life safety standard, which is the key step to estimating the benefits of strengthening, then is always worth taking the next step, and calculate the costs, to generate a full cost benefit analysis. Estimating costs is the more straightforward part of a cost benefit analysis.

Once a strengthening standard is set using a cost benefit analysis, a life safety standard will still be useful in conveying risk in a way people find easier to understand. It can also serve as an intuitive check on the cost benefit analysis. If the life safety standard is similar to that people are prepared to accept in other activities, then it may suggest that the cost benefit analysis is in the right ballpark.

Worst case decisioning

Sometimes referred to as the mini-max criteria, this decision metric focuses on minimizing losses of a worst-case event. It ignores the probability of the event.

There has been a limited argument for something like this metric in the New Zealand earthquake engineering literature. It is also the implied approach behind the NZSEE inserting an artificially high earthquake into the new building standard.

This metric may be of value in a few cases when there is very little information about the likelihood of different events ,and where the consequences of the worst case outcome is so much worse than other options. However, generally people have enough information to be able to make a decision that has some regard to probabilities.

For most decision making it just does not work. Take the example of the decision to take a flight. Under the mini-max criterion no one would ever fly. It is not worth dying to save some time.

As a government decision making tool its widespread use would be disastrous. It would invite lobbyists and bureaucrats to make fanciful claims about worst-case outcomes, to outdo rivals to make a grab for the country's limited resources.

It does not provide a justification for the current proposed level of seismic strengthening. One reason is that this strengthening will have only a relatively minor effect on the cost incurred in a major earthquake. It doesn't make sense to incurr substantial upfront costs to 'buy' the seismic strengthening risk mitigation.

Consider a large, 1:1,500 year event, Wellington earthquake that has a total economic cost of $30 billion (cost of death and injury, building and subsequent economic costs).
The building seismic strengthening requirements:

- Will have a only trivial impact on the cost of physical damage. Most assets (houses, infrastructure) are not captured by the requirement and the benefit for buildings strengthened to the 34 percent level will be not be substantial. Most will still have to be demolished or repaired after the earthquake.
- Will have little positive impact on post earthquake functioning (see Harrison 2013, Martin Jenkins 2013)
- Will reduce the number of deaths from 380 to 290 (Martin Jenkins)

The benefits from strengthening are likely to be well under $1 billion, or just 3 percent of the total costs of the event. This payout may not be much higher than the initial costs of strengthening.

This is equivalent to buying an insurance policy for a low probablity event where the payout is the same as the premium. No one would buy the policy.

Strengthen existing buildings if weaker than the new building code
This is the NZSEE's main decision metric.

Its lack of logic is discussed in the main text.

We have not seen this metric mentioned let alone argued in the serious earthquake strengthening literature.

What did the Ministry understand about the NZSEE framework?

There are just two sets of documents that give us an insight into the Ministry's current thinking on earthquake risk. The first was a document dated March 2012 that was intended to provide background for a strategic thinking meeting involving Ministry and Treasury officials on earthquake strengthening regulation. The document was heavily censored but appears to indicate that the Ministry had settled on a 1:50,000-year life risk standard for existing buildings.

The second set of documents are communications between Treasury and Ministry officials relating to the difference between the Christchurch Earthquake Recovery Authority (CERA) and the Ministry's minimum life risk standard of 1:50,000. CERA was applying a standard of 1:10,000 to the risks posed by boulders in the Christchurch hills and was thinking of reducing this to 1:1000.

It is apparent from the discussion that the officials had read the new building code document and believed that the international standard was 1:1,000,000, and that it must have been generated by a cost benefit analysis. It appears likely that the officials generated the 1:50,000 standard from the 1:20 relationship between the 100 percent new building standard and the 33 percent benchmark cited by the NZSEE. Officials do not appear to have been unaware that the key inputs into this analysis were not based on fact.

Critically they do not appear to have been aware that for the lower seismic areas the 1:50,000 benchmark was wrong. As explained above, it had to be multiplied by a factor of make up for the exaggeration of earthquake risk in the new building standard. In Auckland the starting point was not around 1:1 million; it was 1:3 billion.

Where officials appear to have gone astray, is that they have assumed that the adjustment factor for the low seismic areas captured all or most of the differences in seismic risk. It doesn't. It just captures the difference between the benchmark Wellington earthquake and the artificial minimum earthquake.

The Ministry's cost benefit analysis exposed this error, but officials appeared have been so wedded to the existing standard that they either did not make the connection, or they deliberately ignored the evidence. There is no written record of any analysis of the cost benefit results.

The communications also show that a Ministry official said that perhaps they should reconsider the 1:50,000 standard in the light of the CERA analysis but this suggestion was quickly retracted as 'not being possible'.

Dominion Post 30 June 2016 Wellington New Zealand

Former Chief Executive of MBIE imprisoned for 8 years for manslaughter of the three little pigs

The former chief executive of MBIE, David Staup, was sentenced in the Wellington High Court to 8 years imprisonment for the manslaughter of the three little pigs in 2014.

Justice Terremoto commended the jury for coming to the right decision. Staup's defense that the three little pigs were the authors of their own misfortune because they should have built a non-earthquake prone house out of straw or sticks was risible, said Justice Terremoto.

The Justice said that he was imposing a severe sentence in this case, not just because of the horrific way the three little pigs met their end, but because of Staup's disregard for the welfare of the vulnerable in our society in pursuing his own interests. "You knew that the earthquake strengthening had very limited benefits and heavy costs, and even the smallest child knows that a brick house is the only protection little pigs have against wolves. Nevertheless you promoted a ridiculously vigorous strengthening policy, that was bound to result in the loss of the house and lead to the three little pigs deaths, just to make yourself look good in the post Christchurch quake environment".

Earlier Brad Lambeauchamp, a former public relations consultant for the Ministry, had been given a light sentence. Lambeauchamp pleaded in mitigation that he was "just the coms guy and didn't know anything".

Lambeauchamp being sentenced

Part three: An outline of a rational and fair policy framework for managing seismic risk to buildings

Our outline of a rational and fair system for managing seismic risk covers three aspects of policy.

- The calibration of the minimum strengthening trigger point
- The system for providing information about the seismic risk posed by particular buildings
- Dealing with seismic risk under occupational health and safety legislation.

Calibrating the earthquake prone trigger point

The definition of earthquake prone building has been changed in the draft legislation. Under current legislation an earthquake prone building is defined as follows:

> *A building is **earthquake prone** for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building —*
>
> *(a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and*
>
> *(b) would be likely to collapse causing—*
>
> *(i) injury or death to persons in the building or to persons on any other property; or*
>
> *(ii) damage to any other property.*

This will be changed to:

133AB

Meaning of earthquake-prone building

*A building is **earthquake prone** for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction,—*

"(a) the building will have its ultimate capacity exceeded in a moderate earthquake (as defined in regulations); and

"(b)if the building were to collapse in a moderate earthquake, the collapse would be likely to cause—

"(i)injury or death to persons in the building or to persons on any other property; or

"(ii) damage to any other property.

The subtle change in the wording in the definition means that (a) becomes the operative section. As explained above this does not change the definition of earthquake prone because the two sections in the current legislation had the same meaning.

Critically the term *ultimate capacity* is not defined in the legislation. As explained previously it is a term that is little used, but it is clear that it refers to a collapse state. It also seems clear that the Ministry will not give it that meaning. Rather it will give it an 'ultimate limit state' interpretation. And as also explained above ultimate limit state can be calibrated to whatever the Ministry likes. The Act and the Regulations become irrelevant for defining the seismic strength trigger point.

The Ministry's intentions are clear because it has already set the calibration of moderate earthquake at one third of that applying to new buildings in the legislation.

It is difficult to understand why the critical term that defines earthquake prone has not itself been defined.

One possibility is that the Ministry simply doesn't understand the difference between a collapse state, and the ultimate limit state, as defined by the NZSEE, and thinks they are equivalent.

The other is that they want to leave the definition of earthquake prone building vague to give themselves the flexibility to set earthquake strengthening standards wherever they like. It is also possible that they didn't want to change the definition to 'exceed its Ultimate Limit State' because they would then be admitting that their

interpretation of the Act had been flawed all along, and that they had been promoting an unlawful regime.

The interpretation that the Ministry wants an unconstrained power to impose its standards is consistent with other provisions in the bill. The Ministry's obligation to consult has been reduced. They only have to listen to building owners who they deem to be 'representative'. The right for a building owner to appeal a designation and have recourse to the courts appears to have been removed.

It is unlikely that the Ministry will use what they regard as almost untrammeled power, to implement an evidenced based regime.

To do so it would have to admit to its historical errors, and that the whole registry regime is largely unnecessary. We can expect it to try and replicate the current flawed regime that will capture tens of thousands of very low risk buildings as earthquake prone.

It is critical therefore that:

- The definition of earthquake prone building is more precisely defined in legislation. The logical approach would be to retain the current clause (b) in the current Act because this provides the clearest link to the purpose of the legislation. Ambiguity about the meaning of the word 'likely' should be removed by replacing it with a statistical probability. The clause would read 'would have a 50 percent probability of collapsing in a moderate earthquake (as defined in regulations)'.
- The calibration of 'earthquake prone' point should be evidence based. A clear linkage should be established between standard life safety and the strengthening standard and the benchmark should deliver a demonstrated net benefit to New Zealand. The requirement that the 'earthquake prone' building measurement framework be calibrated using an evidenced based framework should be in the Act.
- An independent party should be commissioned to calibrate the risk model. The Ministry is likely to be too wedded to protecting its past mistakes to produce an authoritative report.
- The review and registration regime is scrapped for at least the lowest risk seismic area. The likelihood of finding earthquake prone buildings in these areas is very low. The cost of just running the surveillance regime will far outweigh the benefits of strengthening.

Calibrating the standard

It is not necessary, to give effect to the Act, to run the test for existing earthquake prone buildings, through the new building seismic strength framework. It is a complex, opaque and, as applied, a legally flawed methodology.

It is much simpler and more transparent to work directly with a relatively simple cost benefit analysis for a set of representative existing buildings. In a simple regime perhaps two categories would suffice - major city office buildings and apartment and provincial buildings.

Given estimates for the following:

- the value of a life and cost of injuries
- the average death and injury rate without strengthening
- the cost of a strengthening exercise that can reasonably be assumed to reduce the casualty rate by a designated proportion – say by 50 percent
- the time value of money
- the average occupancy rate including the occupancy rate for the adjoining side-walk.

It is possible to back out the required probability of the earthquake that would equate the costs and benefits of strengthening. For more densely occupied buildings such as a major city office building this probability could be, say 1:250-300 years. For less densely occupied apartment buildings and buildings in provincial cities it would be lower- say 1:150 years.

These earthquake probability figures would define the ‘moderate earthquake’ in the legislation and regulation. For example, a class A building would be an earthquake prone building if it had a 50 percent chance of collapse in an earthquake with a return time of 250 years.

The next step would be to calibrate the technical tests for an earthquake prone building so they so they would identify buildings that had, statistically a 50 percent likelihood of collapse in that earthquake.

Informing the public about seismic risk

The problem

A major part of the Government's proposals is a national registry for recording the seismic risk of buildings. There is no logic in building a national system that will be extremely expensive to implement, when in most of the country, the number of buildings that actually pose a material risk is trivial.

The national plan should be largely scrapped. Building owners should not be forced to spend money to make meaningless distinctions between the likelihood of building collapses and the probability of death. People don't, and shouldn't, care whether the likelihood of death in a particular building is one in five million years or one in ten million years.

Our proposal is that the rating system should be dropped for at least the least seismically risky zone.

The second issue is what measurement system should be used when it might be relevant to disclose seismic risk.

The existing system that represents risk as the strength of the building compared to the new building standard is badly flawed. The discussion in section three showed that it does not allow a direct understanding of risk, it is grossly inaccurate, is prone to misinterpretation and is open to manipulation.

The relative risk measure is psychologically manipulative and exploits fear and technical complexity to exaggerate the levels of risk that building occupants face.

The solution

Scrap the link to the new building code

The link to the new building code should be scrapped and replaced with a risk measure that is directly linked to life safety outcomes.

For example, the lowest risk grade would be described as a 1 and would apply to buildings where the expected loss of life was less than one per million years. Grade 2 would capture risk from 1:250,000-1,000,000 years and so on. It might be better to express the probability of life risk in terms of hours of occupancy because this would make it easier to make assessments against the risk of other activities.

It would also be useful to provide a risk comparator that showed the seismic risk of building occupancy compared to another activity, such as travel by car.

Table 1: An example of a grading system

Grade	Risk indicator High is lower risk Number of years you would have to occupy the building before you could be expected you be killed in an earthquake in terms of number of years:	Relative risk Compared to a travelling in a car this building is:
1	> 1,000,000	More than 2,000 times safer
2	250,000- 1,000,000	500-2,000 times safer
3	100,000-250,000	200-500 times safer
4	40,000- 100,000	80-200 times safer
5	10,000 - 40,000	20-80 times safer
6	Under 10,000	Up to 20 times safer
Travel by car	500	

Notes: Comparisons assume an average building occupancy of 2,000 hours per year.

The time spent in a car is assumed to be 500 hours per year

Dealing with seismic risk under the Health and Safety in Employment legislation

The problem

Under the Health and Safety in Employment Act 1992, an employer is required to take all practical steps to avoid injury or death to their employees. If they fail to do so, they may be subject to criminal prosecution and be sentenced to a period of imprisonment. The Act states:

" All practical steps means all steps to achieve the result that is reasonably practical to take in the circumstances having regard to

(a) The nature and severity of the harm that may be suffered

(b) The current state of knowledge about the likelihood that the harm will be suffered

(c) The current state of knowledge about the means available to achieve the result and about the likely efficacy to achieve the result

(d) The availability and cost of each of those means."

This list of criteria could mean almost anything, and gives employers no assurance that the Ministry will not prosecute them after an earthquake, at any level of earthquake preparedness. It could be argued, for example, that an employer who has employees in Wellington, who don't have to be there but could be located in a city with low seismic risk, had not taken 'all practical steps' to avoid injury or death. It is well known that the seismic risk is much higher in Wellington, and it is well known that relocation is an effective mitigant.

The Ministry has demonstrated that it doesn't place much weight on the cost of earthquake strengthening, and it can always point to a clear 'current state of knowledge' that a stronger building could have reduced death or injury. A prosecution after an earthquake event would have the advantage, from the Ministry's perspective, of providing a scapegoat that would deflect attention from possible criticism of its own performance.

There is a risk of prosecution with almost any building because the employer could almost always have shifted to an even stronger one. The risk becomes most acute for a building below the 34 percent level but is still real below, say, the 67 percent level, because the NZSEE have recommended that owners strengthen to that level.

Because of the risk of criminal prosecution, boards of some larger business have refused to sign off on policies that allow the leasing of all but the strongest buildings and have incurred substantial economic costs when leases have been abandoned.

The Ministry has belatedly acknowledged these issues and in December 2013 issued a position statement. It says that:

"*We will not take health and safety enforcement action against you in relation to a the structural integrity of your building to withstand an earthquake because this is covered by the Building Act requirements and any enforcement will come from your local council"*

But at another point it is stated that:

"*If the serious harm incident occurred as a result of a failure in your buildings structural integrity (its structural resilience to an earthquake) then we are* ***unlikely*** *to take any further action providing you have been complying with the Building Act and the timeframes imposed by your local council."*

This still leaves a risk for the owner and employer. Further the legal status of the statement in providing a defence for the owner or employer is uncertain and it is due for review in December 2015. The Ministry could change its mind at that point.

The solution

Injury or death due to a failure of a building structure should not be grounds for prosecution under the Health and Safety in Employment Act. The Act should be amended accordingly. Concerns about death and injury caused by non-compliance with the Building Act should fall within the compass of the Building Act.

Who should pay

It seems to be taken for granted by the Government that the costs of strengthening should be borne by owners. We have argued in this report that there is no case for widespread strengthening, and if this perspective is accepted then the issue of burden sharing should generally not arise. If the legislation nevertheless proceeds, then there are strong equity and economic arguments that the costs should be shared more widely.

Society should pay if it has very conservative risk preferences

Most 'earthquake prone' buildings are not, on any reasonable interpretation of the term, dangerous and pose much lower risks than society is prepared to accept in other walks of life. If society nevertheless insists on a much higher standard of safety for buildings, and change the rules to give effect to that preference, then it is reasonable that society as a whole should pay for benefits that do not accrue to building owners. Further, If the Ministry is correct that the wider social and economic benefits are material, then the incidence of costs should follow these benefits.

Burden sharing will improve the quality of decision making

After an event like Christchurch there is an understandable political imperative both at the local and national level to be seen to be doing 'something', regardless of the economic logic of that something. This is easier to do if the costs fall on a small minority of the population - property owners (who don't naturally attract sympathy if it is thought that they are large investors), and the policy does not have material budgetary implications.

If most of the costs were to fall on government, then the proposals would be likely to come under more scrutiny and the quality of the analysis and decision making might improve.

Burden sharing will reduce the economic costs of the proposal

If the costs are spread to taxpayers in general, then this will remove the welfare costs which arise when a large wealth shock is imposed on a small part of the population.

We think the best policy outcome is that the economics of earthquake strengthening are understood and policies are directed to the strengthening of buildings, in seismically active areas with design flaws, which are in a weakened condition, or which pose a material risk to pedestrians. However, if it is politically difficult to admit that the current implementation regime is flawed then the second best response would be to proceed to enforce just the least economically irrational parts of the proposals (dropping them for regions with low seismicity but proceeding with perhaps just the high seismic risk zone) but to recognize that the burden should principally fall on central and local government.

A starting point would be central government 80 percent, local authorities 10 percent, and owners 10 percent.

This would be affordable to central government, because strengthening would cover just a few hundred buildings.

Part four: Review of the adequacy of the Ministry's Regulatory Impact Analysis and Statement

In this section we review the adequacy of the Ministry's Regulatory Impact Analysis (RIA) and Regulatory Impact Statement (RIS). The analysis is assessed on ten major criteria set out in Treasury's regulatory assessment handbook.

We found that the regulatory impact assessment was very poor. It achieved a pass mark (5 out of 10) in just one of the assessment categories. The aggregate weighted average score was 9.25 out of 100.

We also discuss the assessment of the Ministry's RIA and RIS by the Treasury's Regulatory Impact Assessment Team. We found that the assessment was not adequate and that the conclusion that the RIA and RIS met the appropriate standard was wrong.

Finally, we discuss the Cabinet paper. It was based on the RIS but included some additional material that was misleading.

The basis for our assessment of the RIA and RIS

We have based our assessment of the Ministry's RIA and RIS on the purposes, frameworks and requirements set out in Treasury's Regulatory Impact Analysis Handbook dated August 2013.

The handbook describes the overall purpose of regulatory impact analysis in the following terms: *"to help achieve a high quality regulatory environment by ensuring that regulatory proposals are subject to careful and robust analysis. RIA is intended to provide assurance about whether problems might be adequately addressed through private or non-regulatory arrangements—and to ensure that particular regulatory solutions have been demonstrated to enhance the public interest."*

A RIA as summarized in the RIS should have two main benefits:

"*Enhancing the evidence base to inform decisions about regulatory proposals—to ensure that all practical options for addressing the problem have been considered*

and that the benefits of the preferred option not only exceed the costs but will deliver the highest level of net benefit, and

"the presentation of agencies' free and frank advice to decision-makers at the relevant decision points provides reassurance that the interests of all sectors of the New Zealand public have been considered. RIA also aims to encourage the public to provide information to enhance the quality of regulatory decisions, to further inform the evidence-base."

The content of a particular RIA will depend on the nature and importance of the issue. As earthquake strengthening standards will have very significant impacts on a large number of individuals and communities, a careful and detailed analysis would be required. Evidence of the analysis should be clearly set out in the RIS.

Assessment criteria

To assess whether the Ministry's regulatory impact assessment and statement have achieved the above objectives and standards we have distilled the extensive set of requirements and suggestions in the Treasury handbook down to ten key tests. A regulatory impact assessment should:

1. Identify the true problem not just the symptoms
2. Identify the full range of feasible options
3. Make the case for a regulatory intervention
4. Do a cost benefit analysis and make an assessment of the net benefits
5. Analyse regional or sectional costs and benefits where the proposals have disparate impacts
6. Identify and discuss distributional impacts
7. Identify affected parties and discuss the impacts the policies will have on them
8. Identify and quantify start-up and ongoing costs
9. Make a convincing case for the preferred option based on the evidence and analysis captured under the above headings
10. Draw attention to the limitation of the assessment in an Agency Statement.

It goes without saying that there should be no false or misleading statements in the RIS, and there should be no material omissions.

Preliminary issues

The scope of MBIE's review

It is important to be clear at the outset about the scope of the Ministry's review. Within scope of the review were:

- Government policies relating to earthquake-prone buildings
- Legislative and regulatory settings
- Related performance requirements and thresholds, compliance documents and guidance materials
- Implementation and administration.

The reference to legislative and regulatory setting clearly brings the calibration of the standards within scope.

However, both the conduct of the review and the discussion in the RIS and other documents, suggests that the Ministry did not want to conduct a serious review of the calibration of the standards. Rather they sought to limit themselves to a review of how the current standards were being implemented. In the review of responses to the 2012 seismic strengthening paper, comments on the trigger point calibration were identified as being out of scope.

If there was a restriction on the scope of the review then this should have been made clear in the RIS.

The Treasury handbook states. *"If the range of options has been previously limited by Cabinet or by specific Ministers, this should be made clear as part of describing the status quo. ", and*

"*If the range of feasible options for responding to an identified problem has been restricted without a formal Cabinet decision, the reasoning behind this direction should be explained by setting out the policy objectives in the RIS."*

No such statements were made in the RIS.

The Ministry's narrow view of their task cannot be sustained. We have made our assessments of the Ministry's analysis on the basis that calibration of the regime was a critical issue, and that the full range of options should have been considered.

Assessment difficulties

We have found it difficult to assess the Ministry's arguments in the RIS and related documents as if they were part of a conventional policy assessment where the conclusions follow reasonably logically from the analysis and evidence. They don't. The outcome with respect to the Earthquake Prone Building standard was predetermined, and any weakening of the standard was not to be considered. The real agenda was simply to be seen to be doing something.

As logical analysis, and in particular the Ministry's cost benefit analysis, did not reveal the 'right' answer, the RIS was reduced to an exercise in throwing out a few arguments with an air of plausibility to support the preferred outcome and discrediting the formal cost benefit analysis. Obfuscation, muddle and empty statements became the primary mode of discourse.

Obtaining information

This assessment has relied heavily on information obtained from Treasury and the Ministry under the Official Information Act. Treasury provided the full set of relevant documents. It is not clear whether the Ministry did.

Assessment against the Criteria

1. Problem Definition

The problem definition is captured in the following statement in the consultation document.

"A clear view has emerged, that from a societal perspective the current system for managing earthquake-prone buildings is not achieving an acceptable level of risk."

This is just an assertion that something is not right, it does not really tell us anything about the nature of the problem. There is no discussion or evidence to support the contention that an acceptable level of risk is not being achieved. It is not stated who has the clear view, whether it is just a small group of industry insiders or a wider set of parties. What is clear from the documentary evidence is that the Ministry never attempted to seek the informed views of the community on what would be an unacceptable level of risk.

From the above statement the Ministry goes straight on to focus on the number of 'earthquake prone' buildings, and the rate at which they are being rectified, as the problem. This is a case of focusing on a symptom not the underlying problem. If the calibration of the earthquake prone definition is flawed – and it is fundamentally flawed - then the Ministry concern with implementation is misdirected.

The fundamental problem with the Ministry approach to problem definition is that it failed to define an acceptable level of risk, and why it believed that the current situation was unacceptable.

A proper problem definition
The problem definition could have been crafted along the following lines.

"*We have considered the evidence on what kinds of risks that the public find acceptable and to set a benchmark of 1 life cost per 20,000 years as a trigger point maximum for buildings.*

Many buildings are exposing their occupants and passers-by to risks, which are in excess of the level of risks that the public are prepared to bear in their daily lives. Because individuals are not aware of the risks and buildings pose external risks to passerbys the market is not working efficiently and owners are not voluntarily strengthening their buildings even though the social benefits from doing so exceed the costs. It is necessary therefore to impose a minimum standard for seismic safety."

The problem was not defined in this way because the evidence could not support it.

Score 0

2. Identify the full range of feasible options

It is obvious from the cost benefit data that a lower strengthening standard, or possibly no standard at all, particularly in the low seismic zones, would have been attractive options. The cost benefit analysis shows that the higher the standard the greater the net costs. But these options with lower trigger points were not identified and investigated.

Score: 0

3. Making the case for intervention: the Ministry's case for market failure

We first address the question of whether there is a real market failure. Here the burden of proof sits with the Ministry. It is not enough to simply assume that regulation is required, a case has to be made.

The Ministry's case

The possibility of market failure appears twice in the RIS. In paragraph 21 it is stated *that "Prior to the Canterbury Earthquakes, the market had largely underestimated the risk that buildings with low seismic performance present."*

The case for government regulation is made in a following paragraph.

"However, replacing the current system with one that relies only on market mechanisms (largely demand and/or insurer driven) to drive improvements in the seismic performance of buildings (either through strengthening, demolition, or replacement) is not considered to be a viable option.

A completely market-based approach would rely on all parties (including building owners, users/public, and insurers) having access to the information they need in order to make appropriate risk management and/or investment decisions. It would also rely on all parties being able to understand the relevant information and having the capacity/capability to act on it. Education initiatives and/or voluntary rating and disclosure of building performance could assist this, for example. However, in this case it may be unrealistic to expect that all of these conditions could be met in practice at the same time.

There are also questions about whether, in the absence of government intervention, improvements in seismic performance of buildings would be sustained over time. It is reasonable to expect that interest may fade over time given the frequency of significant earthquake events."

An assessment of the Ministry's analysis

The Ministry's claim that there is a market failure is based on the argument that individuals can't be relied on to make rational decisions about earthquake safety.

There are two threads to this argument. This first is that earthquake risks are non-trivial. If they are trivial people are being quite rational when they ignore the risk. It is not a case of market failure.

The second is that were the risk is non-trivial people are not capable of understanding and acting on risk information.

If we are talking about the kind of information that the Ministry has provided or promoted, then the argument has some substance. The idea that a building will have its ultimate limit state exceeded in an earthquake with a horizontal acceleration of, say, 0.2 per second means nothing to the man in the street. In fact it would also be difficult for an engineer to make much of it, in risk terms, without additional information.

However, it is possible to put a building's risk characteristics into terms that the man in the street can understand and act on. Our survey of attitudes to the costs and benefits of seismic strengthening demonstrates that people can understand risk information when it is put in terms that relate to risks people run in their daily lives. A useful metric, that is widely used, is the number of years that could be expected to pass before one a person would die in the building.

Some people might be quite happy working in a building with a 1:20,000 likelihood because it is cheaper. An individual might reason that the occupying building is a forty times less risky than driving a car and be perfectly comfortable with that risk. A few others, of a very nervous disposition, might go with 1:500,000 standard and pay a little more rent to work in a stronger building. There is no reason to believe that the Ministry will improve the first person's welfare by forcing him out of the building and increasing the costs he has to pay.

The Ministry has produced no evidence to support its assertion that it can make better decisions for people than they can make for themselves.

The evidence clearly points the other way. Before the panic bought on in the wake of the Christchurch earthquake, and the misinformation spread by the Ministry and NZSEE gained a wider currency, building owners were rationally deciding not to strengthen their buildings.

We illustrate this below with some simple examples.

Some examples of market rationality

We assume that an Auckland property investor is contemplating strengthening an office building to the 34 percent of new building standard and examines the costs and benefits of doing so. Assuming a cost of $500 a square metre it would cost $10,000 per office worker for doing so. The investor would need to charge an additional $1,000 in rent to make a gross return of 10 percent. To assess the market's willingness to pay, our investor turns to the Ministry's earthquake strengthening cost benefit analysis, which shows how many lives would be saved in the old Auckland city, by the implementation of the 34 percent standard. It would be .00021 per year taking the extremely conservative assumption that earthquakes always occur in working hours. In reality the expected life saving would be less than a third of this.

Making some assumptions about the number of occupants per earthquake prone building it is possible to work from the aggregate loss figure to an expected probability of death for an individual. Our estimate is 26 per 100 million years. Strengthening would reduce this to 17 per 100 million years. Putting the same value on human life as the Ministry used in its cost benefit analysis, and assuming that this

was what the market used, the investor could calculate what the market would be prepared to pay for the reduction in risk.

It would be just 3.3 cents per year. This is obviously less than $1,000 the investor needs to earn to justify the investment.

This is not a case of market failure. Based on the best scientific evidence the risk of a severe earthquake in Auckland is so low that investors and building occupants are quite right to ignore it.

If we shift our sights to Wellington the absolute numbers change because there is a non-trivial, but still very low, chance of a major earthquake. Here the market would be prepared to pay $56 per year for the strengthening, still well short of the required $1,000 return.

Another perspective on the rationality of the Ministry's proposals is to consider the position of a churchgoer in Auckland. The Ministry thinks that they are exposing themselves to an unacceptable level of risk by sitting in an 'earthquake prone' church. If they went to church, say 20 times a year for an hour at a time then the chance of death would be one in 3.3 billion years. The Ministry wants this risk reduced one about one in 6.6 billion years. If the churchgoers do not strengthen their church then they will ultimately be forcibly restrained from attending it and the church will be demolished.

The churchgoers would then have to something else to do with their Sunday mornings. They might take up bike riding. That would be 37,500 times more risky than sitting in church.

To put the earthquake prone building risk figures in perspective, it is useful to compare them with some of the more unusual and unlikely causes of death reported by the US National Safety Council.

The chance of dying (in a year) from:

Fireworks discharge	1 in 55 million
Contact with venomous spiders	1 in 55 million
Bitten or struck by a dog	1 in 10 million
Lightning	1 in 5.5 million

The strengthening benchmark is not just bad policy, it is wildly irrational. Suppose an Aucklander was to present herself to her doctor saying that she was too afraid to attend church (which she loved to do), because there was a one in three billion chance that she would be killed over the course of a year, but that she would be quite relaxed if the risk was reduced to one chance in a six billion. It is likely that her fears would be regarded as irrational.

Obviously our property investors did not go through the process we described above. Common sense would have got him to the right answer more directly and simply. Similarly, there is no evidence that building tenants are unwittingly putting themselves at acute risk. For the great majority the risk posed by 'earthquake prone buildings' are so much lower than the risks accepted in the rest of their lives that it can rationally be ignored.

Bureaucratic failure

Even if a theoretical case could be made for market failure this has to be set against the more likely possibility of bureaucratic failure. Polices have to be designed and delivered by real live bureaucrats who will often deliver suboptimal outcomes. There are many reasons why policy implementation could be flawed and we have listed several below. In varying degrees the Ministry's implementation of earthquake strengthening regulation seems to have exhibited most, or all of them.

Authoritarian culture

Bureaucrats are likely to favour solutions that allow them to force people to do what they direct.

Lack of flexibility and capacity to admit to and rectify mistakes

Bureaucrats are loath to admit they are wrong and adapt to changing circumstances and new information.

Technical incompetence
The bureaucracy may not have the technical competence to develop a sensible policy framework.

Political Motivations
The bureaucracy may be driven by political imperatives rather than a desire to produce the best policy.

One size fits all
Regulatory minimums have to impose a common standard and cannot be adapted to accommodate a range of preferences.

Special interest capture/corruption
Bureaucrats may act to favour special interests. This may be because they have been bribed to do so, or are responding to more subtle incentives to please the industry or professional groups who they admire and seek pleasurable relationship with. Regulatory capture is a greater risk when the subject area is complex and bureaucrats are not confident in their own expertise.

The risk cost trade-off will be influenced by bureaucratic preferences
Bureaucrats pay more attention to risks because they have risk adverse personalities and will be alert to the risk of blame if there is an earthquake event. On the other hand, they do not bear the costs they impose on others, so they pay them much less attention.

Score 0

4. Produce a cost benefit analysis

The Ministry did produce a cost benefit analysis. However it never used it to assess the calibration of the strengthening trigger point. Instead it set out to discredit this analysis and implied that cost benefit analysis was not an appropriate tool to apply to the calibration problem. The RIS states, "*This paper also highlights the limitations of monetary NPV analysis when considering low probability/high impact risks.*

There was no subsequent discussion of these limitations in the Cabinet paper or the RIS. Nor was there any discussion of these 'limitations' in any of the supporting documentation let alone a consideration of any alternative analytical framework.

It appears that the real 'limitation' is that a structured cost benefit analysis comes up with, from the Ministry's perspective, the 'wrong' answer. This is not a limitation, it is just an example of a cost benefit analysis doing its job. A cost benefit analysis is

meant to make it harder for bureaucrats to resort to purely subjective decision-making, driven by zealotry, muddle or special interests, to carry the day. A cost benefit analysis forces more consistency, more rigorous thinking and allows a sense of the magnitude of the costs and benefits.

Contrary to what the Ministry claims, cost benefit analysis does not fail when applied to low probability events. Rather it is the benchmark form of analysis. It has been used extensively in the earthquake strengthening literature, and as noted above its use is mandatory for US federal government seismic strengthening proposal. Positive benefits have to be demonstrated.

If the Ministry wished to use a different approach then it was incumbent on it to explain what framework it was using and why. Simply to completely abandon any consistent and evidence based approach is obviously unsatisfactory.

There also seems to be an inference that the quantitative evidence should be discounted because the data is not sufficiently reliable. This does not hold up. The analysis was subject to sensitivity tests, and there was no conceivable set of tests and combination of events that could come even close to supporting the Ministry's position.

Score: 3

Marks were awarded because the Ministry did produce and publish a cost benefit study. Its quality could have been better. The Ministry was marked down because of their failure to use and understand it.

5. Identified affected parties and impacts discussed

The Ministry made no attempt to find out what individual parties would be impacted by the policies and how they would be affected. The only mention was in paragraph 75 where it is stated *"in some cases, decisions about the viability of certain buildings may be brought forward, putting financial pressure on owners who may have previously anticipated a longer timeframe."*

Here we set out some of the factors that would have come to light though a comprehensive analysis.

Most commercial investment properties are owned directly, either as single investments or as part of a relatively small portfolio. Relative few will be held as part of large portfolios, which are widely held by the investing public. The distinction is

important. In the latter the case the investor's risks are likely to be well diversified and the impact of the policy on building values will have a limited impact on their overall wealth.

With directly held properties the situation is quite different. Particularly if the investment is leveraged, then earthquake strengthening requirements can have a devastating impact on the owner's wealth. Many owners are older and will be relying on their property investment to fund their retirement. Those plans will be dashed. The 'demonization' of earthquake prone buildings has meant that some properties have lost tenants and have negative cash flows. Capital values collapse and some investors will lose everything.

Many of the worst affected will be apartment owners. They are aware that their building poses a higher life safety risk than a modern building, but they are prepared to live with that small risk. The strengthening requirements will have a very serious impact on many owners' finances. In some cases this could be manageable but for others strengthening costs could exceed the value of the apartment. The owner would be left with nothing but debt.

Financial stresses on building owners will pose a risk to health and in extreme cases lead to suicides. Obviously there is no empirical work on the relationship between economic stress, due to the implementation of earthquake strengthening regimes, and suicide rates that could give us a sense of the size of the suicide problem.

There is, however, a literature on the relationship between suicide rates and economic conditions which shows a clear relationship between economic adversity and suicide. Chang et al., for example, found in a broad cross-country study, that the effect of the Global Financial Crisis was to increase male suicide rates by about five percent. We drew on the literature, and made some judgments about the smaller scale of the earthquake strengthening 'shock', to model the impact that the imposition of the standard could have on New Zealand suicide rates. Our judgement is the impact on the overall number of New Zealand suicides of nearly 500 a year would be small, but the policies could plausibly take between 5 and 15 lives over the next 10 years.

Score 1

6. Identify distributional effects

The negative impacts on property owners are obvious. They are likely to have to spend money to strengthen their buildings. Nearly all of this will be wasted and represents a net wealth loss. The economic loss to owners was not specifically identified in the RIS.

On the other side of the ledger, professionals, especially earthquake engineers, will receive hundreds of millions of dollars in fee income. These gains were not identified or discussed.

Score 0

7. Identify and quantified costs

The capital costs of bringing buildings up to the 34 percent standard were identified and an attempt was made at quantification in the cost benefit analysis. However, the quality of the information provided about the costs could have been stronger. Given the large sums involved the Ministry should have conducted an intensive analysis.

The analysis of the costs of the initial identification of 'earthquake prone' buildings does not attempt any quantification and underplays the implications for owners.

'Initial identification and notification costs will largely fall on local and central government, however there are also likely to be some costs for affected owners'.

Contrary to the Ministry's implied assumption that the cost implications for building owners will not be large, they will be significant. Councils are likely to assign ratings based on broad building types and a 'walk-by assessment". Given the potential capital and other costs that will flow from an adverse assessment, owners will then feel compelled to prove that their building is not earthquake prone by obtaining an engineers report. It is better to spend say $10,000 to $20,000 in the hope that the engineers find that the building meets the 34 percent test, than be exposed to tenant flight, disruption to rental flows and heavy and uncertain capital cost.

As large numbers of owners are likely to be in this situation the aggregate costs will be significant.

Score 5

8. Examine regional costs and benefits

A key feature of the New Zealand seismic landscape is that the likelihood of a severe earthquake varies markedly by geographical region. For that reason New Zealand is divided into four zones for setting earthquake resilience standards for new buildings. The first zone, which covers about two thirds of the New Zealand population, including Northland, Auckland, the Waikato, the Western Bay of Plenty, Taranaki and parts of Southland and Otago, has very low seismic risk. According to the scientific advice from GNS Science, presented in the Ministry's cost benefit analysis, the probability of a quake severe enough to cause some deaths (measuring 8 on the

modified Mercalli index) in Auckland is one in 110,000 years compared with one in 1,500 for Wellington. With stronger earthquakes, capable of killing large numbers of people, the relative difference in risk becomes much higher.

Zone two, presents a more moderate risk and includes Christchurch, and the middle part of the North Island. Zone three, covering mainly Wellington and the East Coast of the North Island is regarded as relatively high risk. Zone four, which covers the South Island's Alps is seismically active but sparsely populated.

The Ministry did not present an analysis of costs and benefits on a zonal basis. If they had they would have shown that the ratio of costs to benefits varied sharply from zone to zone and that implied acceptable level of risk also varied markedly.

This point that a 'one size fits all approach' does not account for regional differences was made by several submitters to the consultation. There was no response from the Ministry in the RIS, but there was a brief discussion in the Cabinet paper on the issue. The Minister responded by saying, based on Ministry advice.

"*Because the definition of an earthquake prone building in the Act relates to the site of the building, I consider that issues of location risk are already adequately recognised as part of the decision to classify a building as being earthquake- prone. "*

This statement was not true. As discussed in section 3, the new building code, and hence the existing building standard, are not based on actual difference in seismic risk.

Because of the disparate impact of costs and benefits across the country, the Ministry should have produced costs benefits analyses on a zonal basis for the major urban areas, and illustrative provincial cities and smaller towns. Given their cost benefit methodology it would have been easy to do so.

Here we present an illustrative example for Auckland and Wellington. Note that the numbers are approximate because the relevant data is not always presented clearly, or at all, in the Ministry's cost benefit analysis paper. The example captures the costs and benefits of meeting just the minimum standards rather than the higher standards that the current framework is driving.

This analysis clearly shows that the extension of the regime to Auckland will have almost no benefits but heavy costs. Even viewed purely on a lives saved basis it fails. The likelihood of saving a single life is very remote, but strengthening will cause between 2 and 5 deaths. Note that all of the figures in table 4 below are approximate and are intended to illustrate relative magnitudes of the key inputs and outputs.

Table 2: Relative magnitudes of key costs and benefits

	Auckland	Wellington
Costs		
Capital Costs (to minimum) standard)	$3 billion	$300 million
PV Capital costs	$ 2 billion	$225 million
Welfare costs	$4.5million	$350 million
Benefits		
Lives saved over 75 years	None	3
Expected time to save a single life	4,000 years	25 years
PV of benefits	$50,000	$20 million
Benefit/cost ratio	1:87500	1:17.5
Minimum life safety standard	1: 300,000,000 years	1:100,000 years

Score: 0

9. Make a convincing case was for the preferred option

There are two explicit, and three more implicit, arguments for the Ministry's support for the NZSEE's interpretation of the existing strengthening threshold.

The basis for the Ministry's decision to retain the 33 percent threshold setting

The explicit basis for the Ministry's decision to retain the current threshold was that *"it is consistent with the Royal Commission's recommendations and was generally supported by submitters on the consultation document."*

This is a very weak argument for what is the centrepiece of the policy. If the Royal Commission had presented cogent arguments for the 33 percent trigger point the Ministry could and should have used them. But it didn't. The reason is that the Royal Commission did not come up with any cogent arguments (for an analysis of the Royal Commission's assessment see appendix two).

Relying on the numerical responses to the consultation document is equivalent to-taking guidance from a public opinion poll of uncertain provenance.

There are obvious problems with this.

- The respondents were largely dependent on the Ministry's consultation document for the background information to help them understand seismic risk. This information was, in many respects, biased and misleading and designed to influence opinion to support the Ministry's preferred outcome. A consultation document that supported the option of reducing the standard could have generated very different responses.
- The responses do not necessarily represent the views and preferences of the population at large. They might be heavily weighted with the views of pressure groups and to the narrow section of society who like to comment on matters of public moment or have a technical interest in the matter.
- It sits oddly with the Ministry's argument for market failure. The public can't be trusted to make their own decisions about the level of risk they are prepared to accept, because they don't have the knowledge to do so. But apparently they are well enough equipped to advise the Ministry on the much more complex problem of designing a national standard for earthquake resilience.
- Even the claim for respondent support for the policy is a stretch. About 50 percent of respondents supported the 33 percent trigger level but a significant majority argued for a further extension of the implementation timeframe. Support for a standard that you really don't want to see implemented is hardly support.

- The Ministry is paid to do the analysis and give advice to the best of professional ability. It should not rely on a 'poll' that has evidential value similar to a claim that 'my wife's uncle in Taihape thinks it is a good idea'.

There is no credible evidence against the proposal
As shown above, the argument that the cost benefit results can be discounted is wrong.

There are wider economic and social costs
It is stated that the cost benefit analysis does not cover all of the costs and benefits and there are others that are hard to quantify. This leaves the reader with the impression that these omitted benefits are significant and perhaps would have turned the result if quantification were possible.

This is misleading. The reason why the 'other benefits' were not quantified was because they were not material. This is obvious from the Martin Jenkins Cost Benefit report.

"*The CBA Model has not included an estimate of benefits that might accrue, after an earthquake event, from lower overall economic or social costs as a result of having strengthened earthquake prone buildings (EPBs).*

The basis for excluding such costs is as follows:

Our assumption is that only very large earthquakes will cause economic or social costs (e.g. Christchurch was a 1 in 2,500 year earthquake). The probability of very large earthquakes is so low that any probability-based benefits from strengthening buildings are small. Also, with very large earthquakes, the positive impact of a few strengthened EPBs is likely to be dwarfed by more significant impacts on infrastructure and residential dwellings. We would not expect to attribute much (if any) economic or social impacts to the demise or otherwise of EPBs.

There is likely to be a very narrow envelope of earthquake strengths where a strengthened EPB would remain standing and be useable after the event, but where it would not have survived if it hadn't been strengthened. This lowers the probability of there being a material reduction in impact on economic and social outcomes from strengthened EPBs compared to other impacts (such as infrastructure damage).

Similarly, in a large earthquake the damage to non- EPBs is likely to be large, and the damage to strengthened EPBs will also still be a major factor. These impacts may also dwarf whatever improvements may have been made by strengthening a small number of older buildings.

A material impact (on a New Zealand scale) on economic and social outcomes after an earthquake is only likely to occur in cities/towns where there is a relatively high probability of a large earthquake and where there is a large commercial/industrial area. This is only the case in Wellington, Hutt City, Christchurch and Palmerston North."

Playing the 'Christchurch card'

The Ministry tries to establish a link with the Christchurch earthquake as if to simply to mention Christchurch is to make a compelling case for its proposals.

"Some of the benefits associated with the proposals are difficult to quantify but can be very significant, as is evident following the Canterbury earthquakes. There is no discussion of these other factors.

It then goes on to cite the death statistics as if these provide further support.

Important information has emerged from the Christchurch experience, which is relevant to the earthquake strengthening debate (for a good discussions see Blaikie). First, there is a large amount of apparent randomness in the ways earthquakes affect buildings. Blaikie cites a range of a factor of three in the forces impacting on individual Christchurch buildings within a narrow geographical radius. That means that strengthening to the 34 percent standard will probably not be the decisive factor in whether an occupant is killed in an earthquake. Luck may play as big a part.

Second, buildings across the board performed much better than engineers had predicted. Our cities are much safer than we previously thought. In particular unreinforced masonry buildings performed about as well as new buildings were supposed to perform.

The casualty figures cited by the Ministry reinforce the point. Only four building occupants were killed by the collapse of the building they were occupying. As the Christchurch earthquake was a one in 2,500 year event and assuming, say, 25,000 occupants in the more than 2000 'earthquake prone' buildings this equates to a death rate of one in 6 million years for earthquake prone building occupants.

Why not a higher standard?

The Ministry also had to deal with the following question. "If the results of the cost benefit analysis can be safely discounted, and it doesn't matter that costs massively outweigh the benefits, then why not go for a higher standard and save still more lives."

In response it is implied that there are relatively limited benefits, from a life safety perspective, from having a higher trigger point. This is what the words in the RIS "*it*

(a higher standard) becomes more about preserving buildings or reducing broader social and economic impacts" are likely be taken to mean. The Ministry's statement is misleading. Their cost benefit analysis data shows that strengthening all buildings to the 34 percent threshold level will reduce potential fatalities in a major Wellington earthquake by only 25 percent.

10. The Agency statement

The purpose of the agency statement is to point out the risks and limitations in the analysis. The Ministry's agency statement should have pointed out the obvious risks of relying on public feedback to calibrate the framework. That was the model that the Ministry claims to have used. It would have to say that such an approach is very unreliable.

Instead the statement was largely used to undermine the empirical analysis in the cost benefit analysis that the Ministry did not actually use to guide its decisions.

Score 0

Overall assessment

The aggregate score weighted average score is 9.25 out of a possible 100. A quality review should score at least 80. A barely adequate score would be 60.

The Ministry failed to produce an acceptable regulatory Impact assessment by a very wide margin.

The Treasury Regulatory Impact Assessment Team (RIAT) assessment of the Ministry's RIA and RIS

In the Cabinet paper it was stated that the Ministry's RIS met the quality assurance criteria. This 'pass mark' was based on an assessment by Treasury's Regulatory Impact Assessment team (RIAT). Given the disparity between our assessment and RIAT's we reviewed the RIAT assessment process. Our review is based on an analysis of all of the documents relating to the RIATs review of the Ministry's RIS.

We concluded that the reason that the Ministry's RIS passed the quality assurance test was that the required standard was very low. The Ministry just had to say that it had made a judgment that the benefits exceeded the costs. They did not have to support this assertion with evidence or analysis.

The key elements of the Treasury review process were as follows:

- The reviewers were not subject experts. The review was based purely on a reading of the draft RIS. It appears that the Ministry did not provide supporting documentation, and Treasury did not do any independent research or analysis.
- The primary RIAT reviewer nevertheless quickly identified some of the key problems with the Ministry's RIA – notably the huge gap between costs and benefits and the lack of clarity about problem definition.

  "*In view of the huge excess of costs over benefits identified in the analysis, and the very small probability of death due to earthquake prone buildings falling over in a large magnitude earthquake, the statement that from a societal perspective the current system is not achieving an acceptable level of risk' is an important one. It sits awkwardly with the emphasis on the poor quality of available information about earthquake prone buildings, which implies that society does not actually know what it is talking about" ……*

  "The objective section might be balanced about what is meant by 'adequately balance' and an 'acceptable level of risk', to bring out the limitations of purely objective cost benefit analysis and the social and cultural factors that it cannot account for in this case."

  In an e-mail dated 9 July from Nicola Kirkup to Hayden Taylor (MBIE) and others:

  "Hayden, thanks for your further work on this. However we will need to push you further, not least because we have ourselves been getting push-back from senior colleagues about the extent to which material submitted to OEGI really makes its case.

  We would also like to see greater emphasis on the limitations section on the fact is that despite the uncertainties and informational limits, is that the likely additional costs of the action proposed hugely outweigh the additional benefits on any reasonable assumptions"

None of the substantive shortcomings identified by RIAT were addressed in the final RIS.

- There was no clear checklist against the quality criteria set out in the Treasury guidelines.

- There was substantial coaching and some drafting input from RIAT to get the document into the shape RIAT were eventually prepared to pass as acceptable.
- The Ministry appears to have made verbal representations to RIAT that there were significant benefits that could not be quantified in the cost benefit analysis. It seems that RIAT did not push back on these claims or review the cost benefit analysis that would have made it clear to them that the 'substantial additional benefits' claims were without foundation.
- RIAT became aware, despite the clear statement to the contrary in the terms of reference for the review, that it was not meant to be a real review of regulatory settings.

  In an e-mail to Nicola Kirkup, dated 9 July 2013, Hilary Blake a Treasury member of the Earthquake Co-ordination Team, said " *about the costs of upgrading earthquake prone buildings outweighing the benefits when those benefits are expressed only in terms of value of life. What is proposed here is not actually a new policy. To some extent therefore this is a review at the margin; Ministers have been quite clear that the existing threshold of 33% stays the same though there will be now some discretion to the buildings to which it will apply."*
- The process for finally deciding that the RIS met the quality standard was not clear or robust.

  There were two relevant e-mails. The first was an e-mail from Nicola Kirkup to James Sergeant (Treasury) on 11 July.

  "Most significantly he's added in new paragraphs 45-46 drawing attention to the non-decisions, which also italicized in the options paper, and heavily revised para. 96 in the conclusions. I'm inclined to say its now there."

It is difficult to see what was decisive about these additions. Paragraph 45 simply draws attention to a table that outlines the options that were considered.

The substantive points in Paragraph 46 appear to be " *it is important to note that several on balance decisions are required in the proposed system. …… Identifying preferred option requires judgment about whether the expected benefits of the option are justified given the anticipated costs/risks*. "

We found it difficult to understand the final sentence but the sense of it is probably that the Ministry made a judgment that the benefits exceed the costs. If this sentence was indeed decisive, then it appears that all an agency has to do to get 'acceptable' pass is say that it has made a judgment about costs and benefits. It

doesn't have to demonstrate that its decision is based on a clear and analytical framework and evidence or that there is a net benefit to New Zealand.

The second e-mail was from James Sergeant of Treasury to Nicola Kirkup on 11 July 2013. It reads:

"*Confirmed, that this now meets the standard. It has come a long way since the earlier draft*"

The assessment seems to have been primarily based on whether the RIS was in the right form, and whether at least some of the boxes had been ticked, in the sense that there were at least some words relating to the handbook requirements.

Assessment

In our view RIAT assessment of the Ministry's RIA and RIS was inadequate and its conclusion that it met the quality assurance criteria was wrong.

The cabinet paper

The cabinet paper was based on the RIA but differed in some key respects.

In particular:

- Some consultation respondents had identified the failure of the regime to account for regional differences in seismesticity as a problem. Cabinet was told that the regime did adequately capture these differences. This was not true. As noted above the above the life safety standard in Auckland is 3,000 times higher in Auckland than Wellington
- The intention to amend the legal definition of an earthquake prone building was signalled. It was inferred that this was a minor tidy up with no substantive effect. Cabinet was not told that the strengthening requirements implementation was based on a definition that was completely at odds with the legal definition.
- It was implied that the Ministry had analysis that showed that cost benefit analysis did not work for low probability events. This was not true.
- It was implied that there was analysis that captured a wider and substantial set of benefits than those captured in the cost benefit analysis. This was not true. It was also implied that the Ministry's assessment was based on these wider considerations.

Dominion Post 24 May 2019

Upper Hutt New Zealand

Memorial to three little pigs unveiled

A memorial to the three little pigs, who were murdered by the big bad wolf in 2014, was unveiled today in Whiteman's Valley, Upper Hutt.

Speaking at the unveiling the Prime Minister said that the tragic deaths of the three little pigs had not been in vain. "It provided the spark that led to the scrapping of the iniquitous earthquake strengthening legislation and to reforms that were truly effective in requiring civil servants to produce evidence based analysis".

Former Minister of Building, Maurice Williamson, said that the three little pigs affair was the biggest regret of his political career. " I suspected that the Ministry was feeding me nonsense and I should have taken notice of outside advice and stood up to them. The three little pigs tragedy probably cost us the 2014 election".

Whiteman Valley resident 'Wolf' Woolferd, who discovered the bodies of the three little pigs, and who campaigned for the memorial, said that it now a time for reconciliation. "Mr. Wolf was not all bad. Given his upbringing he could hardly have resisted the temptation placed his way by the Ministry."

Wolf was released from jail in 2018 and is now serving in a rehabilitation center for troubled puppies.

The Three Little Pigs memorial Whitemans Valley Upper Hutt

Part five: Costs and benefits of earthquake strengthening

The starting point for quantifying costs and benefits is the Martin Jenkins cost benefit analysis commissioned by the Ministry in 2012. The analytical framework is basically sound but the numbers reported in the August 2013 consultation document need, for a number of reasons, to be revised. These adjustments are explained below.

Pressure for earlier strengthening

Economic pressures on building owners will force them to strengthen earlier than assumed in the cost benefit analysis. Insurance and financing issues, which are largely driven by the earthquake prone designation, have meant that these buildings have become unsalable except at very steep price discounts.

We have assumed that the time to strengthening will be pulled forward to an average of four years.

Cost adjustment

Comparisons with US government cost benefit analysis data suggest that the costs used in the Ministry's cost benefit analysis have been significantly understated. A rule of the thumb from the US studies is that earthquake strengthening costs are about 50 percent of replacement costs. We assume that generally the US strengthening proposals were based on strengthening to new building standard. On the same basis it appears that the cost estimates used in the Ministry's cost benefit analysis cost benefit analysis are only around 20 percent of new building costs. No information was given in the costs benefit analysis paper about what the costs covered but it appears that they included just the structural work and missed the associated costs that can be extensive. The additional costs can include:

- Project management costs
- Remediation costs
- Loss of rents
- Retenanting costs

We have increased the costs assumed by the Ministry by 50 percent to account for these factors. This adjustment is likely to be on the low side.

Welfare cost adjustment

The costs of strengthening will fall on a relatively small number of building owners and will have a higher welfare cost than if they were widely spread in the community. As economic shocks that take a large proportion of a person's wealth, have a disproportionately bigger impact on welfare than smaller shocks, the dollar cost of the strengthening has as to be increased to account for this effect. We have conservatively increased the total strengthening dollar cost by a third to account for this wealth effect.

Strengthening above the minimum

Market reactions caused by misinformation about the true nature of earthquake risk, and fears about the Ministry taking criminal prosecutions, on health and safety grounds, against owner's and tenants, are inducing owners to strengthen above the minimum level. For many owners the defacto minimum has become 67 percent because the NZSEE has recommended it. The true benefits of doing so are minimal.

We have made the following assumptions about the proportions of buildings that will be strengthened above the minimum standard. There is obviously a wide margin of error around these assumptions, in part because some of the strengthening may have occurred anyway, post Christchurch, even without the incentives generated by the misleading earthquake strengthening framework. We have shaded our estimates to the low side to try to capture just the earthquake strengthening regime-generated costs.

Table 3: Assumptions of percentage of buildings upgraded

Upgrading	Proportion upgrading
Buildings currently below 33% - upgrade to 67%	40 percent
Buildings 33-67 % upgraded to 67% or higher	25 percent
Buildings at 67% upgraded to 100%	5 percent

Costs of reports for buildings designated as 'earthquake prone'

The Ministry says that it intends to implement a more efficient screening process so all potentially earthquake prone buildings do not require a full report. There are doubts about the efficacy of any screening process and there can no doubt that whatever is implemented will not be fully accurate. Of the estimated 82,000 pre -1976 buildings in New Zealand a large number will be found to be earthquake prone, but a proportion will not be.

Given the costs of strengthening, owners will have a strong incentive to commission a report in the hope that the report will find that they are really above the benchmark level. If half of the buildings are caught and the average report costs $20,000 then the total costs would come to $800 million. We have conservatively used a figure of $400 million.

Benefits of the policy

The Ministry's cost benefit study shows that the benefits of strengthening are around $40 million. To put the benefit estimate on the same basis as our adjusted cost estimate we need to account for:

- The benefits of the additional strengthening
- Bringing forward the strengthening timetable increasing the present value of benefits
- A higher cost assigned to deaths. The Ministry uses the valued used to assessing the impact of road safety improvements. An argument could possibly be made that this figure is a little light. We have increased the reported benefits (which do not all relate to deaths) by a factor of 25 percent.

Risk could also be understated if GNS Science has understated the number of active faults and hence the frequency of large earthquakes. However, even allowing for a large margin of error here does not alter the picture of the gap between costs and benefits. Doubling the number of large earthquakes would just push the total benefits to around $150-200 million.

On the other hand the Ministry's cost benefit analysis could have overstated some benefits.

- It appears that the benefits calculation was based just on daytime working day casualty rates. If this is so then expected casualties should be adjusted down by up to half to account for the much lower casualties that would be incurred outside working hours.
- A comparison with casualty rates in the model and the actual Christchurch experience suggests that the model overstates death rates by a factor of three.

- Death rates per building collapse appear to have been overstated for ‘earthquake prone’ buildings

Taken together our adjustments result in a net economic cost of over $10.5 billion with benefits of under $100 million. A rational policy would have net benefits.

Concessions to building owners largely worthless

Our assessment of the cost and benefits of strengthening also shows that the ‘assistance’ that the Government thought it was giving by allowing extra time for strengthening will be largely worthless. Once a building is tainted with the ‘earthquake prone label’ it becomes illiquid, may be impossible to finance and can attract punitive insurance rates. Owners will be forced to strengthen early.

Part six: Surveying attitudes to earthquake risk

This section reports on two surveys conducted by Tailrisk Economics on New Zealanders' attitudes to aspects of earthquake risk mitigation.

Remediating 'earthquake prone' building risk in Auckland

The first survey is designed to explore how people react to information about earthquake risk mitigation. It used a sample of 28 Aucklanders. Most were professionals.

They were asked two questions. The first was whether it worth spending $1 billion to strengthen all earthquake prone buildings in Auckland.

50 percent said that it would be worthwhile.

It was then revealed that the present benefits from the strengthening would be $20,000, and that it would take 4,000 years, on average, for a single life to saved.

100 percent of respondents said it was not worth spending $1 billion to make Auckland 'earthquake prone' free.

A typical comment was that it was absurd to spend $1 billion for benefits of just $20,000.

This illustrates that the respondents, could be mislead when they were not provided with enough information to make a judgment about the merits of the policy. Once provided with the information they understood the concept of a cost benefit analysis and did not believe that lives should be saved no matter the cost.

The respondents who did not initially agree that $1 billion should be spent commented that they were aware that earthquake risk in Auckland was very low, and intuitively felt that the expenditure did not make sense.

Willingness to spend to reduce earthquake risk

This survey was designed to explore what people are prepared spend to reduce their exposure to earthquake fatality risk. The survey covered 66, mainly professional, Wellingtonians.

Survey design

Respondents were asked to imagine that they were inner city apartment dwellers. They were presented with a schedule that represented different degrees of earthquake risk and then asked how risky the apartment would have to be before they were prepared to spend $100,000 to cut that risk in half. To focus the answers on the respondents risk preferences, respondents were to assume that they were given the $100,000, but that they were free to spend that $100,000 as they chose. This meant that respondents would not be budget constrained.

Respondents were given some risk reference points.

They were told about the life safety risks involved in driving, and that a life safety risk of 1 in 1,000,000 years was regarded as effectively riskless. The riskiness of the apartment was presented in terms of the expectation of number of years that would elapse before an expected death and shown in steps of ten:

1:10

1:100

1:1000

and so on until 1:1,000,000 years.

Respondents were asked to mark the level of risk that would prompt them to spend the $100,000 on earthquake strengthening. In interpreting the responses a response of, say 1:1000, was treated as a response of between 1:1000 and 1:10,000.

After answering the question with a $100,000 cost, respondents were then asked to indicate how high the risk would need to be if the cost of the earthquake strengthening was reduced to $10,000.

In assessing the respondents' rationality we assumed that they placed a value of $5,000,000 on a life when assessing the merits of the earthquake strengthening option. This is about one third higher than the figure that is currently used to evaluate road safety investments.

Results

Overall the results showed that the respondents were broadly rational. They:

- were able to grasp the concepts of risk and probability so they could make considered decisions
- gave the expected responses to a decrease in costs. They were more likely to strengthen if the cost was lower
- had an average required real rate of return of 5.1 percent for the earthquake risk reducing investment
- did not want to reduce risk at any cost.

These results are at odds with the picture painted by Ministry that building occupants do not have the intellectual capacity to make rational decisions.

They also contrast with an attitude of many in the earthquake engineering profession and bureaucratic enthusiasts have – that life safety should be pursued almost without regard for cost.

Part seven: Legal Questions

The extensive misuse of the NZSEE report raises a number of legal questions involving a number of parties in the process.

Questions raised under the current Act

1. Could an owner of an earthquake-prone designated building successfully challenge that designation on the basis that the Council's assessor came to his or her conclusion, in reliance on the NZSEE recommendations, contrary to the wording of section 122 of the 2004 Building Act?

There is a strong prospect this will occur, as the definitions used in the NZSEE document are clearly at odds with the wording of the Act. The NZSEE working group made the following interpretations:

(a) "ultimate capacity" means ultimate limit state capacity as defined in current design standards.

(b) "likely to collapse causing injury or death to persons in the building" means that collapse and therefore loss of life *could well occur* as a result of the effects of earthquake shaking on the building.

"Ultimate capacity" has a distinct separate meaning from "ultimate limit state". It refers to a collapse state not the NZSEE's definition of ultimate limit state

"Likely" does not mean "could well occur".

The NZSEE's argument that their approach delivers outcomes that are is substantively the same as would be delivered by a plain reading of the Act cannot be sustained. Their interpretation delivers quite different relative and absolute outcomes.

2. Could a Council's decision to incorporate the NZSEE recommendations into its earthquake-prone building policy be subject the judicial review?

It is beyond the scope of this paper to review the process each Council took in implementing its policy. There may be issues relating to appropriate consultation with affected parties. In

any event, there is a strong argument that the decision to incorporate the NZSEE recommendations is *ultra vires*. Given the concession in the NZSEE makes in its own recommendations that its interpretation of the legislation is controversial, we believe this argument has a strong prospect of success.

3. Does a Council have a duty of care to its ratepayers to implement policies and legislation lawfully? And if its implement of policy and legislation is found to be *ultra vires*, would that allow an affected ratepayer to recover damages in a suit of negligence (for the ratepayer's costs in engaging an engineer to inspect the property, costs of unneeded rectification works and any associated loss of income)?

The 'leaky buildings' saga has demonstrated the Courts' willingness to award damages against negligent Councils. We believe that the same willingness will ultimately be shown in these circumstances.

4. Have engineering firms, engaged to provide reports on Council earthquake-prone assessments, taken appropriate steps to ascertain whether the building is earthquake-prone according to the law, or have they relied on NZSEE's recommendations with no further investigation? If the latter, does this substantiate professional negligence?

The engagement of an independent expert engineer will vary from case to case. If the engineer did rely on the NZSEE recommendations in producing its report, its liability for professional negligence will turn on how it represented itself to the building owner. If the engineering firm held itself out to be a strategic consultant, as opposed to being solely engaged to assess the building on the NZSEE grounds, then we believe there exists a duty to investigate use of the NZSEE recommendations by the Council further.

5. Could the parties that have been involved with the NZSEE recommendations be guilty of obtaining by deception or causing loss by deception?

Section 240 of the Crimes Act 1961 reads (our emphasis added):

> (1) Everyone is guilty of obtaining by deception or causing loss by deception who, by any deception and without claim of right,—
>
> (c) induces or causes any other person to deliver over, execute, make, accept, endorse, destroy, or alter any document or ***thing capable of being used to derive a pecuniary advantage***; or
>
> (d) ***causes loss to any other person.***

(2) In this section, **deception** means—

(a) a false representation, whether oral, ***documentary***, or by conduct, where the person making the representation intends to deceive any other person and—
  (i) ***knows that it is false in a material particular***; or
  (ii) ***is reckless as to whether it is false in a material particular***; or

(b) an omission to disclose a material particular, with intent to deceive any person, in circumstances where there is a duty to disclose it; or

(c) a fraudulent device, trick, or stratagem used with intent to deceive any person.

We have explained previously the loss caused and the advantage gained by the building owners and engineers, respectively. The key question is whether the representations that caused those losses and advantages (contained in the NZSEE recommendations) were made with intent or recklessness.

Building (Earthquake-prone building) Amendment Bill

As discussed above the Bill currently under consideration does not change the substance of the definition of an earthquake prone building. It is also clear that the Ministry does not intend to comply with the amended Act when it develops a methodology that operationalises the earthquake prone building standard. This leaves open the possibility that:

- The Ministry's earthquake building methodology will be subject to a successful judicial review.
- Councils could refuse to designate buildings using a methodology that they believe to be unlawful.

Part eight: Main recommendations

Our main recommendations are as follows:

One The definition of earthquake prone building should be more precisely defined in legislation.

Two The Government should go back to the drawing board and develop earthquake-strengthening standards and policies that are evidence based

Three An independent authority such as the Productivity Commission should be commissioned to do the analysis.

Four The Health and Safety in Employment Act should be amended so death or injury in an earthquake are not grounds for prosecution under the Act.

Five The current system that grades the earthquake risk of buildings according to their estimated strength relative to the new building code should be scrapped. It should be replaced by a measurement system that directly informs building occupants of their life safety risk and provides a ready comparison with other risks commonly faced in daily life.

Six The NZSEE should withdraw its earthquake strengthening recommendations

Seven Territorial authorities should withdraw existing earthquake prone classifications that are not based on the legal definition of earthquake prone.

Eight If the Government decides to proceed with the proposals to force the strengthing of thousands of buildings to fulfill a 'societal need' to 'do something' after Christchurch then it should fund most of the strengthening work.

Nine The Government should use its powers and resources to strengthening buildings over a much shorter time horizon than currently proposed, in the very few localised areas where this would generate a net benefit for New Zealand.

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Appendix A: MBIE's 2005 Regulations Consultation Document

PART B: Definition of "moderate earthquake"

Reason for regulation

Section 122(1) of the Act provides as follows:

(1) A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building —

(a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and

(b) would be likely to collapse causing —

(i) injury or death to persons in the building or to persons on any other property; or

(ii) damage to any other property.

(2) Subsection (1) does not apply to a building that is used wholly or mainly for residential purposes unless the building —

(a) comprises 2 or more storeys; and

(b) contains 3 or more household units.

The definition of moderate earthquake is critical for making decisions about the need for remedial work to be undertaken on existing buildings to reduce health and safety risks associated with the collapse of buildings from earthquakes.

Objective of regulation

The Act requires each territorial authority to develop a policy by 31 May 2006, using the special consultative procedure under the Local Government Act 2002, that sets out its approach to exercising its powers to assess and require remedial work on buildings found to be earthquake prone (this will also include how the policy will apply to heritage buildings).

These measures recognise that local economic, social and other factors have an impact on the implementation of these provisions. They also recognise the need for a consistent, transparent and accountable approach to the implementation of these provisions in order to protect the interests of both building users and owners.

5

Options

The proposal is to prescribe in the regulations the definition of a moderate earthquake as "an earthquake that would generate shaking at the site of the building one-third as strong as the earthquake shaking that would be used to design a new building at that site".

Questions

(B)6. Is this an appropriate definition of 'moderate earthquake'? Are there any other matters that should be included in the definition?

(B)7. Would this be an appropriate starting point for considering what might be a 'moderate earthquake' for the purpose of the dangerous dam provisions of the Act? What other factors would be relevant for that definition?

(B)8. What impacts (positive and negative) do you think the proposed definition, or any alternative you have suggested, would have on you or building owners generally?

Appendix B: An analysis of the Royal Commission's arguments on the 34 percent trigger point

The Royal Commission process did not develop an analytical framework to assist its decision on the strengthening threshold. It listed some of the options and their pros and cons but provided no mechanism for choosing between them.

The Royal Commission did not:

- Commission its own expert work on the subject
- Call for submissions on the cost and benefits of strengthening
- Develop its own quantitative framework for measuring costs and benefits

The Commission was aware of the results of the MJA cost benefit analysis. It did not contest the assumptions or results. Rather it suggested that there were other benefits that were not captured by the study. It listed two. One of these was that its recommendation would give 'peace of mind'. The other was a recitation of the facts about Christchurch deaths and a statement that the number of dead in the earthquake came as a surprise. The latter was true, but in a 1:2,500 year event should not in itself be a surprise and it not clear how it supports the Royal Commission's policy recommendation.

On the peace of mind argument, this does have some value, but as 34 percent does not provide complete protection and not much protection against the really big quakes (the Commission's report showed that buildings strengthening to 34 percent failed at the same rate as the unstrengthen buildings) it cannot be represented as a solution for the 'truly nervous'.

With respect to the earthquake prone threshold the Commission simply said that:

"Apart from this one exception (on parapets and gable ends), *there appears to be no evidence that to protect life safety the shaking level to be resisted for earthquake-prone buildings should be set higher than one-third of the requirement for new buildings."*

The Commission either ignored the evidence in the cost benefit analysis work that a higher threshold would save some lives, or took the view that these benefits were not worth the costs.

The justification for an accelerated imposition of the 34 percent standard was that:

"There is …… considerable merit in completing the work expeditiously as there is obvious benefit in society being better prepared before a destructive earthquake."

There are no supporting arguments elsewhere in the report and no regard appears to have been given to the additional costs of the proposal or of regional differences in seismicity and in benefits and costs.