Acting on the Seismic Assessment of a Large Portfolio

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Like many government and private institutions, the New Zealand Department of Corrections has commissioned seismic assessments of all the buildings it uses. The more than 870 buildings throughout New Zealand are diverse in age, use, occupancy and ownership. The results of the assessments have had to be considered in terms of existing current and long-term strategies for facility upgrades and closures. No stranger to risk assessments and health and safety requirements, the Department has developed a robust methodology for prioritising its addressing of buildings requiring seismic strengthening. A regular special-purpose meeting of the Department's senior management team and external advisory under the chairmanship of its CEO has guided the development of the remediation response framework. The framework balances operational and budgetary restraints to improve the seismic resilience of its portfolio of buildings within an accelerated and timely manner. Mindful that other government Departments and private sector organisations are facing similar challengers, the Department is pleased to share its experience to date in this paper.

1 BACKGROUND

A number of government departments, banks and retailers occupy sites throughout New Zealand, and some of these have more than 500 sites that they own or lease. Some of these organisations have chosen to investigate the seismic resilience of their portfolio of buildings since the Canterbury earthquakes in 2010 and 2011. In almost all cases, such investigations are ahead of any similar ones initiated by territorial authorities implementing their earthquake-prone building policies, and a significant driver has been the desire to address staff concerns about whether their place of work has adequate seismic resilience.

It is common for leased space to be only one of a number of tenancies in the building. Some landlords have been quick to obtain independent seismic assessments to address their tenants' questions.

While finding the resources to undertake the assessment of a large building portfolio is one challenge, the bigger one has been to establish a policy to deal with the results. In particular, some organisations have felt it necessary to stop immediately the use of buildings that have been assessed as earthquake-prone (i.e., seismic resilience less than one third of that of a new code-compliant building). This is usually a more severe interpretation than that implicit in the territorial authority's earthquake-prone policy. Nevertheless, it seems obvious that if the seismic resilience is very low, the risk to occupants of remaining in the building may out-weigh the risks implicit in being forced to travel significant distances to use alternative accommodation.

2 DEPARTMENT OF CORRECTIONS – A SPECIAL CASE

2.1 Assessments commissioned

The New Zealand Department of Corrections (Corrections) occupies more than 870 buildings throughout New Zealand. These are diverse in age, use, occupancy and ownership. Some are as small

as assembly places and tool-storage facilities for Community Service programmes, while others contain large numbers in secure locations. Some parts of some prisons are more than 100 years old, and there are well-publicised commitments to close some of these facilities progressively.

Corrections moved quickly after the Canterbury events to commission consulting engineers Opus International Consultants Ltd (Opus) to undertake initial assessments of all buildings throughout New Zealand owned by the Department. The assessments requested were to be undertaken using the standard Initial Evaluation Procedure with the additional requirement that any critical structural weaknesses were to be identified. In parallel, Corrections wrote to all owners of leased space and asked them to provide any seismic assessments they had available for their building.

As the assessments were becoming available in May 2012, Corrections formed a Building Seismic Risk Committee chaired by the Department's Chief Executive, and comprised of most of the senior management team. The second author was invited to attend the monthly meetings to provide specialist opinion.

2.2 A Risk Framework Drafted

Corrections realised that the receipt of the seismic assessments would immediately require any reaction to them to take into account their long-term plans for their prisons in particular. Also, it was appreciated that prioritising of their response taking into account affordability and resource/budget constraints would require taking into account the use, importance and level of occupation of the buildings.

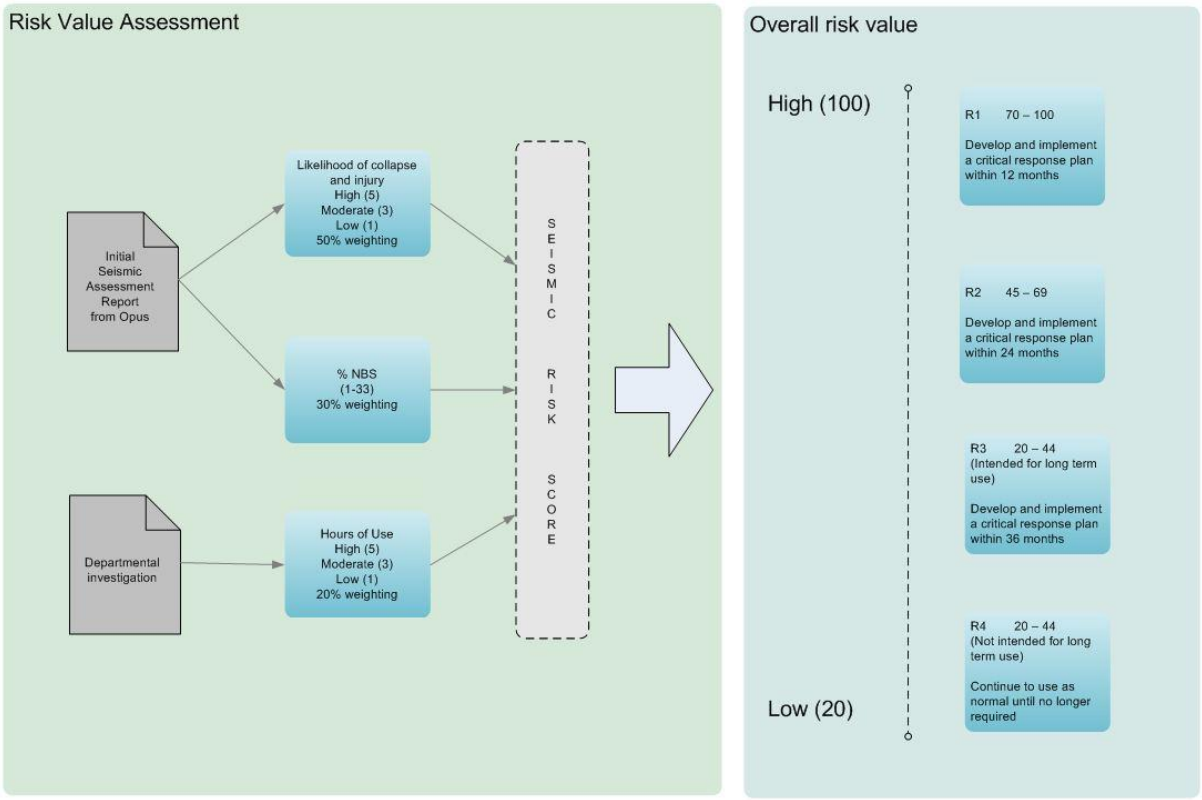
A draft *Risk Framework* was therefore developed with the objectives of:

- Quantifying the risk posed by each of any buildings assessed as earthquake-prone
- Determining for each such building a remediation response timeframe that would be consistent with its relative risk when compared to other Department earthquake-prone buildings, but which would also take account of affordability and resource constraints, and
- Determining a remediation response timeframe for these buildings that would meet or (ideally) exceed peer group norms.

Corrections recognised that it must meet its health, safety and duty of care responsibilities to all those in its buildings, be they employees, prisoners or visitors. The *Risk Framework* needed to provide a best-practice approach to ensure that the Department would be able to meet its responsibilities in a way that is both appropriate and consistent for all assessed buildings – whether identified as earthquake-prone or not.

The *Risk Framework* was shaped by the requirement for a quantitative, risk-based approach which measures the relative seismic risk posed by each building, and then derives a remediation timeframe based on that risk. It acknowledges that remediation timeframes cannot be determined solely by risk, but must also take into account affordability constraints, human resource availability, capability and wider site capital works synergies. It was soon recognised that the Department's owned portfolio (in terms of type and number of buildings) is in many respects atypical, and required a specific response in addition to the seismic risk assessment guidance developed by the Government Property Management Centre of Expertise.

The initial Risk Framework is summarised in the diagram below:



2.3 **Risk Framework Developed**

The Committee in their feedback requested two key changes to the *Risk Framework*. Firstly, they recommended disregarding the building's Prison Reconfiguration status as a factor because any building subject to this will be remediated quicker than any other category (i.e., within 12 months). The second change was that the renumbered R2 and R3 response options incorporate specific risk-based remediation timeframes, in line with the Committee's appetite for active response.

The Committee requested that a quantitative basis for allocating individual earthquake-prone buildings to specific remediation response categories be developed, and that the basis for the remediation category timeframes be explicitly defined.

Three discrete response timeframes to develop and implement a Critical Response Plan were subsequently determined. They are:

i) within 12 month, ii) within 24 months, and iii) within 36 months.

The draft *Risk Framework* presented to the Committee had allocated individual earthquake-prone buildings to one of several remediation response categories on the basis of four risk factors:

i) Likelihood of collapse - injury risk – High, Moderate or Low,

ii) %NBS – value between 1 and 33,

iii) Hours of use – High, Moderate or Low, and

iv) Subject to the Prison Reconfiguration Strategy – subsequently discarded.

These four risk factors were essentially filters which enabled each earthquake-prone building's response outcome to be determined. This approach was essentially qualitative and non-time specific. This approach was replaced by an overall, quantitative, risk-based approach.

Under the new approach a single, weighted risk value for each earthquake-prone building was to be calculated. This is the sum of the first three risk factors listed above (likelihood of collapse; %NBS; and hours of use).

A single risk value for each building was estimated as the sum of the three risk factors. This meant quantifying each of the risk factors. In the case of the 'likelihood of collapse injury risk' and 'hours of use': High = 5, Moderate = 3, and Low =1. That is, the greater the risk to the building and people in it, the higher the value. Similarly, the %NBS factor was recalculated within the same range (i.e., between 1 and 5), and on the same basis. For example, the lower the %NBS value, the greater the risk to the building and the building occupants, and vice versa. A building with a %NBS of 8 is recalculated to 4.125, and a building with a %NBS score of 32 is recalculated to 1.125.

Likelihood of collapse and injury risk contributed to 50% of the overall risk value weighting, %NBS to 30%, and hours of use to 20%. This weighting reflected the life-safety focus of the Department's seismic investigation. For ease of interpretation, each building's overall risk value was then multiplied by a factor of 10.

A building's overall risk value calculated under this approach is between 20 (least risky) and 100 (most risky) - with each building allocated to one of four response or remediation categories depending on its overall risk value and whether the building is intended for continued long-term use.

Ranges of risk value were defined to link with four categories of time within which to develop and implement a critical response plan:

Table 1 : Risk Value vs Category

Risk Value Range	Time to Develop & Implement	Category
100 - 70	Within 12 months	R1
45 - 69	Within 24 months	R2
20 - 44	Within 36 months	R3
	Continue to use as normal until no longer required, depending on whether the building is intended for continued long-term use or not	R4

In determining the risk weightings, the Department considered a number of weighting combinations. For example, Weighting Option B: 30% - 20% - 50% and Weighting Option C: 20% - 50% - 20%. In general, as soon as the weighting of the 'likelihood of collapse and injury' risk factor is lowered much below 50%, a re-ordering of overall building risk values occurs - such that some buildings with only a Moderate 'likelihood of collapse and injury' record higher risk values than some buildings with a High one. The same re-ordering occurs between some buildings with a Moderate and Low 'likelihood of collapse and injury'.

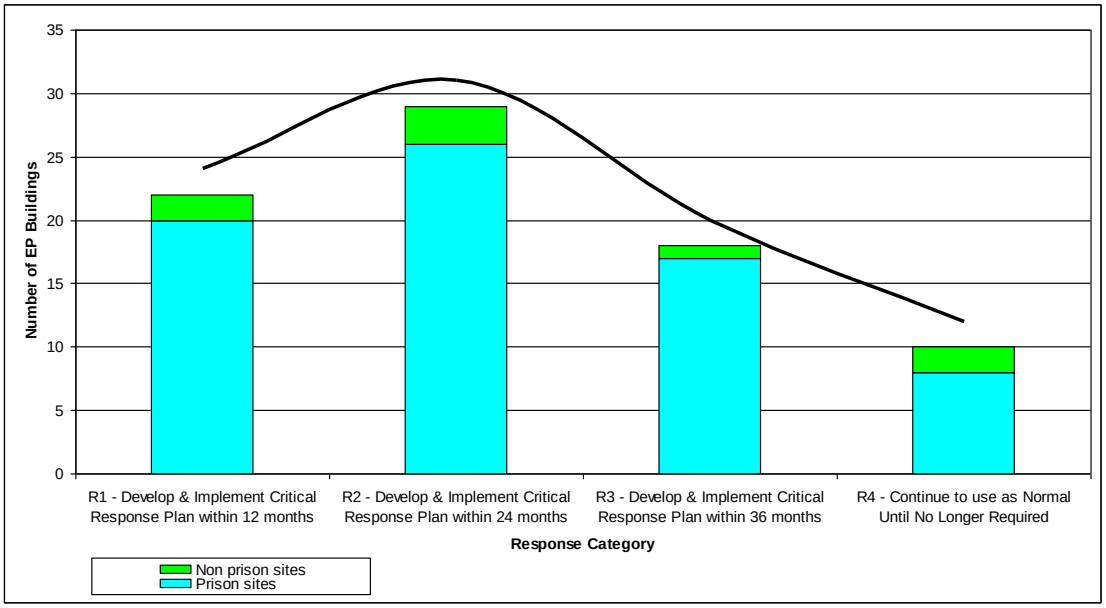
To reiterate, the Department's seismic investigation has a life-safety focus, and the weightings determined (50% - life safety; 30% - %NBS; and 20% hours of use) reflect that focus.

In summary, an earthquake-prone building's overall risk value, driven by likelihood of collapse and injury', determines its response category allocation. For buildings with an overall risk value of between 20 and 44, their allocation into either R3 or R4 is further determined by whether they are intended for long-term use.

More specifically, it is the algorithm of an individual building's risk factors that determines its response category and therefore drives the urgency of response. Buildings categorised as *R1* have a High 'likelihood of collapse and injury' and therefore 12 months represents a Departmental minimal acceptable time to remediate;

R2 (Moderate) buildings have a lesser risk, along with affordability and resource constraints, determining a longer remediation timeframe in comparison to *R1* buildings. Similarly, R3 and R4 (Low) buildings have an even lesser risk, along with affordability and resource constraints, determining a longer remediation timeframe in comparison to *R2* buildings.

The diagram below highlights the number of buildings in each response category (*R1* to *R4*).



This chart shows a total of 79 earthquake prone buildings, which includes 71 prison buildings and 8 non-prison buildings, but it excludes Dunedin Prison and Old Mount Eden Prison.

Figure 1 : Risk Framework – by Category

2.4 **Broad basis for the timeframes adopted**

There are four reasons for the broad basis of the categories *R1* to *R3*:

i) The threat posed by the building to its occupants under circumstances of a moderate earthquake. Under the *Risk Framework*, the greater the threat, the sooner a critical response plan is required to be developed and implemented.

ii) There are constraints, specifically in the areas of human resource availability and capability, both internal and external, which makes a more compressed remediation time-frame from that proposed challenging.

iii) The timeframes are considered against affordability. All seismic strengthening works need to be funded from existing funding streams. Consequently, the capital funding requirements of any seismic strengthening must be assessed against a multiplicity of varied departmental capital funding demands.

iv) Finally, it makes sense, both practically and economically, to co-ordinate where possible, seismic hardening at a site with other complementary capital works. The longer the remediation timeframe adopted, the easier it is to integrate other capital works into a seismic-hardening programme of works.

Where there is a conflict, Corrections have opted to be guided by the risk value when it comes to remediation response category.

The overall appropriateness of the remediation timeframes adopted by the Department can be gauged by comparing them with the earthquake-prone building seismic remediation timeframes adopted by territorial local authorities (TLAs). Table 2 presents the timelines adopted by the TLAs in those locations where the Department has prison sites.

Table 2: Remediation Timeframes for Earthquake Prone Buildings by TLA

Prison	TLA	Remediation Timeframes
Auckland	Auckland Council	10 years (IL3) to no less than 34%NBS
Waikeria	Waipa DC	No timeframe. Target level of 34%NBS
Tongariro-Rangipo	Taupo DC	2 years (IL3) to target level 67%NBS
New Plymouth	New Plymouth DC	20 years (IL3) to at least 34%NBS (encourages 67%NBS)
Wanganui	Wanganui DC	20 years (IL3) to target level of 34%NBS (encourages 67%NBS)
Manawatu	Palmerston North CC	20 years (IL3) to at least 67%NBS
Rimutaka	Upper Hutt CC	20 years (IL3) to a level of 34%NBS
Arohata	Wellington CC	10 – 20 years to target level of 34%
Wellington	Wellington CC	10 – 20 years to target level of 34%
Ch.Ch Men's	Christchurch CC	15 – 30 years to target level of 67%. Repair works must achieve 67%NBS.
Ch.Ch Women's	Christchurch CC	15 – 30 years to target level of 67%. Repair works must achieve 67%NBS.
Invercargill	Invercargill CC	No timeframe. Target level of at least 66%NBS.

With the exception of the Taupo District Council (Tongariro-Rangipo), the time-frames in the Department's Response Framework are significantly ahead of those required by the local TLA.

It was difficult, given that many public sector organisations were only at the early stages of addressing their seismic building issues, to get an overall picture of how the Department's proposed remediation timeframes compare to other public sector organisations. Discussion with the Property Management Centre of Expertise, however, pointed to the Department comparing favourably to other public sector organisations in process and progress.

Opus indicated to the Department, based on their New Zealand experience, that owners of buildings with a high level of importance or business continuity function are strengthening buildings as soon as practicable rather than using TLA timeframes. They noted that this can be budget-restricted, but commented that one of their major infrastructure clients was targeting five years.

Opus also provided information on their understanding of the typical timeframes around remediation ruling in the United States, specifically in California. They indicated to the Department their view that the 12, 24 and 36 months timeframes proposed appeared to be "certainly proactive and better than most".

3 THE ASSESSMENT RESULTS

Opus were briefed to provide structural engineering advice to determine the extent that the Department's owned habitable building portfolio complies with the seismic capacity requirements of the Building Act 2004, and to identify any buildings that do not meet minimum requirements under

the Act.

The evaluation involved 20 prisons (816 habitable buildings in total) and 49 non-prison sites. Of the 148 prison buildings evaluated by the Initial Evaluation Procedure, 73 were assessed as earthquake-prone (i.e., less than one-third of New Building Standard, NBS), 67 as earthquake risks (greater than one-third, but less than two-thirds of NBS, and eight as neither. Of the 14 non-prison buildings evaluated, eight were assessed as earthquake-prone, two as earthquake risks, and four as neither.

The table below summarises the overall performance of the Department's total habitable prison portfolio.

Table 3 : Habitable Prison Portfolio Estimated Building Performance

Category	No. of Buildings	% of all Buildings
> 100%NBS	188	23
≥ 67%NBS < 100%NBS	404	50
> 33%NBS < 67%NBS	151	18
≤ 33%NBS	73	9
Total	816	

3.1 **An initial seismic remediation plan for earthquake-prone buildings**

At an early meeting, the committee was asked to approve an Initial Seismic *Remediation Plan* that reflected the *Risk Framework* for each of the 73 prison buildings and eight non-prison buildings identified by the evaluation as earthquake-prone.

The initial *Remediation Plan* had two key objectives. The first was to ensure that those earthquake-prone buildings posing the greatest risk to occupants during earthquake events were addressed first and those posing the least risk to occupants during earthquake events would be addressed last. The second was to establish, for each earthquake-prone building, a specific deadline when remediation must be complete.

The development of each building's remediation plan did not initially involve discussion with people outside the committee, except for key people in an existing Prison Reconfiguration Team. Engagement with stakeholders, which was identified as a critical next step, would determine more accurately when remediation of individual buildings could begin and be completed.

The remediation plan for each individual building, with the exception of those subject to the Prison Reconfiguration, assumed that each building, unless stated otherwise, was required in the long-term. It was foreseen that this assumption would be challenged during site master-planning and business case development for construction programmes.

4 **MISCELLANEOUS COMMENTS ON PROCESS**

Corrections found that it had a slow response to requests to landlords of their leased buildings for IEP-type information. Eventually they decided to undertake some of these at their own cost.

It was noted that some landlords were not very responsive to requests from government department tenants to upgrade seismically their leased buildings which are not earthquake-prone. Some were wanting quid pro quo arrangements such as extensions to leases before agreeing to do the work.

Corrections' Committee decided to have its own short (two-week) deadline to come up with a plan of action for buildings scoring less than 10% in IEP screening. This followed the "Eliminate, isolate, minimise" approach as per any good health and safety policy.

5 SUMMARY

No stranger to risk assessments and health and safety requirements, the Department has developed a robust methodology for prioritising its addressing of buildings requiring seismic strengthening. A regular special-purpose meeting of the Department's senior management team and external advisory under the chairmanship of its CEO has guided the development of the remediation response framework.

The framework balances operational and budgetary restraints to improve the seismic resilience of its portfolio of buildings within an accelerated and timely manner. Mindful that other government Departments and private sector organisations are facing similar challengers, the Department is pleased to share its experience to date in this paper.