
Navigating Seismic Risk in Schools: Adapting to Regulatory Change

P. Campbell¹, M. Willard² & S. Osborne²

1. WSP, Auckland, New Zealand
2. Ministry of Education, New Zealand

ABSTRACT

The recent Government announcement regarding changes to the Earthquake-Prone Building (EPB) system marks a significant shift in New Zealand's seismic risk landscape. This decision has direct implications for the School Property portfolio, which is predominantly characterised by one- and two-storey buildings that would no longer meet the revised EPB criteria.

Over the past 30+ years, the Ministry of Education has invested significantly in identifying and managing seismic risk across its school property portfolio. This commitment to seismic resilience is expected to continue, even as the regulatory environment and understanding of seismic risk continue to evolve. The proposed changes reinforce the need for organisations, particularly those managing large property portfolios, to establish clear seismic policies and risk thresholds, rather than relying solely on legislative requirements.

This paper presents examples of currently known buildings with significant design and construction deficiencies to illustrate the need to take an ongoing active approach to managing seismic risk in a clear consistent and proportionate manner. The Ministry's Seismic Policy and Seismic Risk management Procedures for Existing School Buildings (August 2025) are intended to be updated in response to the proposed regulatory changes and used to clearly articulate how investment decisions for seismic improvements are prioritised and guided.

1 INTRODUCTION

1.1 Objectives

This paper offers the perspective of a steward of one of the New Zealand's largest property portfolios as we seek to adapt to seismic regulatory changes. The importance of understanding the changing risk resulting from the reduced scope of buildings that could be considered as EPB under the proposed regulations is highlighted. The case for proactive management of seismic risk for all portfolio buildings is demonstrated via recent case studies.

1.2 Background

The school property portfolio consists of more than 15,000 school buildings across nearly 2,100 state schools each with various investment needs. Over the past 30+ years the Ministry of Education has invested significantly in identifying and managing the seismic risk of structures within this portfolio.

From 1998-2001 The Ministry commissioned a structural survey by registered engineers of all school buildings. This survey identified and remediated vulnerable building elements, such as heavy roofs, brick walls, and heavy ceilings, with remedial work undertaken to 11% of buildings across the portfolio. The survey also focused on identifying visible structural weaknesses, and assessments were undertaken to address these, where required.

More recently, following the 2010/2011 Canterbury Earthquake Sequence, the Ministry established programmes that sought to manage the seismic assessment of school buildings across New Zealand between 2011 and 2016. Buildings assessed below 34%NBS were prioritised for remediation while buildings that rated below 67%NBS upgraded where they were subject to other planned building interventions such as building refurbishment or weathertightness remediation.

While these assessment programmes have ended, the Ministry continues to actively manage the seismic resilience of its property portfolio, incorporating seismic risk review into future asset investment decisions.

The Earthquake-Prone Building (EPB) System, introduced through the Building (Earthquake-Prone Buildings) Amendment Act 2016, established a nationally consistent framework for identifying and mitigating seismic risk in New Zealand. For nearly a decade, this system has shaped the Ministry of Education's investment strategy for existing school buildings and has been a key driver of internal policy development.

In September 2025, the Government announced proposed legislative changes to the Earthquake-Prone Building (EPB) system. The implication of these changes for the school property portfolio and the need to update the school seismic policy to continue to manage seismic risks is outlined in this paper.

While this paper focuses on managing seismic risk in existing structures, the Ministry is also proactively addressing seismic risk in new buildings. This includes adopting design standards that target higher levels of performance and encourage simple, regular structural forms. The Ministry has strengthened its assurance processes through design reviews and the use of construction advisors to ensure new buildings meet these objectives and avoid future seismic prone buildings.

1.3 School Seismic Policy and Procedures

The Ministry has legislative responsibilities under both the Health and Safety at Work Act 2015 (HSWA) and the Building (Earthquake-prone Buildings) Amendment Act 2016 to manage seismic risk across the school property portfolio. The School Seismic Policy (August 2024) and the Seismic Risk Management Procedures for Existing School Buildings (August 2024) sets out how the Ministry meets these obligations in a practical, proportionate, and consistent manner.

Generally, this requires seismic information to be reviewed as part of broader planned investment activities, such as significant refurbishment projects or weathertightness remediation. Coordinating seismic reviews and any resulting upgrades with these activities recognises the significant disruption seismic work can cause in operational schools. By aligning projects where possible, the Ministry aims to minimise disruption while delivering work in a more cost efficient and integrated way.

For the last decade, investment decisions have been guided by the %NBS metric and regulatory compliance requirements. For buildings that rate below 34%NBS, seismic upgrade is required to at least 34%NBS in accordance with the requirements of the Building Act 2004. Buildings that rate above 34%NBS are not subject to minimum regulatory upgrades. However, the Ministry of Education seismic policy requires a range of seismic upgrade options to be explored to identify whether any reasonable and proportionate strengthening be undertaken at the time of building upgrades or refurbishment.

For buildings that rate below 34%NBS, the Ministry has developed a formal process for communicating risk information to stakeholders resulting in clearer communication and better-informed decision making.

2 CURRENT EPB SYSTEM AND IMPLEMENTATION CHALLENGES

2.1 Current EPB system

The seismic risk of existing buildings in New Zealand is primarily managed through the Building (Earthquake-prone Buildings) Amendment Act 2016 which categorises New Zealand into three seismic risk areas and regulates how seismic risk is identified and remediated (through strengthening or demolition).

In practice, where a seismic assessment rates a building below 34%NBS the building is generally deemed an Earthquake-prone Building and is subject to regulatory seismic upgrade or demolition within statutory timeframes. Failure to remediate the building within the statutory timeframes can result in significant fines, prosecution, and potential demolition undertaken by the territorial authority at the owners cost.

2.2 Implementation Challenges

After nearly a decade in use, the (Earthquake-prone Buildings) Amendment Act 2016 is broadly considered effective in enhancing the seismic resilience of the school property portfolio. However, several challenges have emerged, including the following:

1. Variability of seismic assessments including use of engineering judgement (e.g. consideration of secondary and tertiary load paths), insufficient discussion of the real consequences of failure for low-rated elements, and communication that is unclear for non-engineers. All of which has contributed to heightened concern and anxiety.
2. Risk perceptions that are strongly tied to the %NBS rating. Buildings assessed below 34% NBS are often assumed to be inherently unsafe, despite limited understanding of the actual risk associated with various NBS scores or the specific structural vulnerabilities identified.
3. Uncertainty about the interaction between the Health and Safety at Work Act (HSWA) and the Building Act. This ambiguity can lead to PCBUs to adopt overly risk-averse positions, aiming to avoid any potential health and safety exposure without fully considering the broader risks and consequences of building closure.
4. Concerns about potential media attention and reputational damage drives risk averse decision making. This is reinforced when highly publicised cases involve urgent building closures, unintentionally establishing precedents and creating a self-reinforcing cycle of increasing urgency.

5. Difficulty in planning, funding and implementing seismic upgrades on challenging sites (e.g. constrained sites, limited decant space, and multiple impacted buildings) within the statutory timeframes. This is a particular issue for school buildings as school buildings are generally deemed Priority Buildings and in High and Medium seismic areas and are required to be strengthened in half the typical statutory timeframes.

Recent industry guidance on seismic assessment and risk communication, together with the Ministry's updated School Seismic Policy (August 2025) and Seismic Risk Management Procedures for Existing School Buildings (August 2025), has helped address many of the challenges outlined above. These improvements, supported by clear communication from experienced engineers, have strengthened consistency and understanding across the sector. However, further action at both the legislative level and within industry guidance would provide additional support and enhance the effectiveness of the current system.

3 PROPOSED CHANGES TO EPB SYSTEM

3.1 Summary of changes

In 2025, the Government signalled a significant shift in seismic risk regulation by announcing proposed legislative changes to the Earthquake-Prone Building (EPB) system. The intent is to focus regulatory effort where it matters most, on higher seismic risk regions and high-risk building types. Key proposals include:

- Removal of the NBS metric from the EPB framework.
- Exclusion of one or two storey buildings from the EPB framework, apart from those of URM construction.
- Exclusion of buildings located in low seismic hazard zones (such as Auckland, Northland, and the Chatham Islands) from the EPB framework.
- Introducing tiered mitigation requirements informed by emerging engineering methodologies, calibrated to both geographic location and building typology.
- Removing the obligation for concurrent fire safety and accessibility upgrades during seismic remediation projects.
- Removing the Priority Building classification and associated shorter timeframes.

The proposed changes both narrow the number of buildings requiring minimum regulatory upgrade and, in many cases reduce the scope of minimum seismic upgrade.

3.2 Implications on the school property portfolio and recent examples

The school property portfolio includes more than 15,000 buildings across nearly 2,100 state schools. Around 98% of these buildings are one or two storeys. Among the relatively small number of buildings that are three storeys or higher, roughly half are located in High or Medium seismic zones.

Under the proposed changes to the EPB system, fewer than 1% of school buildings would meet the building typology and location criteria for being classified as earthquake prone. As a result, approximately 99% of the portfolio would not be subject to any regulatory seismic upgrade requirements.

However, experience over the past decade has shown that some, one and two-storey buildings, including those in low seismic zones, can still have significant seismic design and construction deficiencies that require attention. These cases highlight the residual risks that may remain unaddressed under the proposed changes

and reinforce the importance of building owners developing their own seismic policies to ensure these risks continue to be actively managed.

3.2.1 Recent school case studies

These case studies demonstrate that a passive response to the proposed EPB legislative changes may lead to organisations/property portfolio managers accepting a higher level of seismic risk than intended. Notably, all of these case studies fall outside the building typologies covered by the proposed EPB legislation.

In evaluating seismic risk and determining appropriate occupancy recommendations, the Ministry has relied on the Engineering Advisory Group to apply engineering judgment and internal Ministry processes to consider those elements that could cause a potential collapse mechanism rather than relying solely on individual element NBS scores.

3.2.1.1.1 Case Study 1

A school located in a low-seismic region and constructed in the early 2000s comprises seven two-storey buildings and a gymnasium, all designed by the same architect and structural engineer.

A detailed seismic assessment completed in 2024 rated all two-storey buildings at 15% NBS (IL3), while the gymnasium achieved 70% NBS (IL3). Significant weathertightness issues were also identified across the site.

In general, the buildings all contain multiple critical structural weaknesses (CSW) arising from significant deficiencies in the original design and detailing. Some minor construction defects were also observed. As several buildings share the same design, these deficiencies are present across the entire campus rather than being isolated to a single structure.

The main CSWs include:

- Inadequate load paths at roof level
- Absence of a lateral load-resisting system for the glazed atria glass wall.
- Incomplete or poorly detailed loadpaths in general
- Lack of tie elements within the concrete floor diaphragm. The result of this is that in a seismic event the heavy concrete floor will be highly torsional, and seating will be insufficient to maintain gravity support.
- Foundation capacity deficiencies

While the deficiencies identified were unlikely to result in loss of gravity support in low levels of earthquake shaking, their performance at higher levels of shaking and their potential consequences resulted in the Ministry completing priority short-term interim works to install missing load path elements ahead of any future upgrade design and implementation.

3.2.1.1.2 Case Study 2

A second case study also involves a school located in a low-seismicity region and constructed in the early 2000s. The school comprises nine two-storey buildings (utilising concrete hollowcore or double-tee flooring systems) and a gymnasium, all designed by the same architect and structural engineer.

The campus includes six predominantly rectangular teaching blocks, a gymnasium, performing arts centre, a library and an administration building.

A load path review of the two-storey teaching blocks in 2025 identified significant design deficiencies that warranted priority interim strengthening prior to undertaking any more detailed assessment. Inspection of the

steel concentrically braced frames (CBFs) and their connections revealed that the primary lateral load-resisting elements were undersized, inadequately detailed, and lacked redundancy, creating a credible risk of collapse at seismic demands well below current code design loads.

Intrusive investigations also uncovered substantial construction defects, particularly poor weld quality, that further compromised the expected seismic performance.

Failure of the suspended concrete floors is expected either through column buckling or, more likely, p-delta effects triggered by the torsional response once deficient brace welds fail. Because the teaching blocks share a common structural design, these deficiencies are present across the entire campus.

3.2.1.1.3 Case Study 3

Two two-storey teaching blocks and a two-storey administration building, located in a high seismic zone and constructed circa 2000, were assessed following the identification of weathertightness issues. Despite being relatively modern buildings, detailed seismic assessments rated them at 15%NBS (IL3). Although the buildings were designed by the same architect, different structural engineers were involved.

All buildings exhibit incomplete or deficient load paths, with particular concern around the suspended concrete diaphragm floors, though roof diaphragm deficiencies were also present on all buildings. A further common issue was the inadequate out-of-plane support to heavy precast panels, some of which functioned as shear walls and others as cladding panels. While some interim seismic upgrades were completed to the two teaching blocks these were ultimately demolished. Interim works have also been completed to the administration building which continues to be occupied while plans are developed and implemented.

3.2.1.1.4 Case Study 4

A two-storey teaching block located in a low seismic area and constructed in 2011 and assessed in 2024 as part of planned refurbishment works to the lower level. The seismic assessment identified several deficiencies, including poor detailing and connectivity of the timber shear walls and a lack of tension reinforcement in the level-one topping slab, which sits over plywood sheathing supported by timber floor joists.

Although the building received a low rating, its overall structural regularity and the presence of well-distributed lateral load-resisting elements meant that, following review by the Ministry's Engineering Advisory Group, it was not considered to present a life-safety risk. Instead, straightforward seismic upgrades were recommended for inclusion in the refurbishment project, with additional improvements to be incorporated into future works on the upper floor.

3.3 Adapting to regulatory change

Effectively managing seismic risk across a national portfolio of school buildings requires a structured approach that balances regulatory compliance, risk reduction, and fiscal constraints. The Ministry of Education faces a complex decision-making environment: policy settings must respond to evolving legislative frameworks while ensuring that investments deliver intended educational outcomes while also balancing a range of other asset management objectives, including achieving the greatest possible improvement to life safety, within a finite budget. Three strategic options have been identified for future management of seismic risk across the portfolio.

1. Incorporating Current Regulatory Settings into the Ministry Seismic Policy

The first option is to embed the existing regulatory settings, principally the current Earthquake Prone Building (EPB) framework directly into an updated Ministry Seismic Policy. This approach offers clarity and

consistency by aligning the Ministry's internal practices with well understood existing legislation. Under this option, a building's seismic risk profile would continue to be determined primarily through a threshold based on the New Building Standard (%NBS). While straightforward to implement, this approach largely confines the Ministry to a compliance driven system, which limits the Ministry's ability to systematically address buildings that may pose elevated life safety or functional risks in a cost efficient and targeted manner. Further, the continued use of the %NBS metric as a trigger to drive seismic upgrades and occupancy decisions will continue to have the same challenges as outlined in section 2.2.

2. Aligning Risk Settings with the Proposed EPB Legislative Changes

The second option involves aligning the Ministry's seismic risk settings with the proposed changes to the EPB legislation currently under consideration by Government. While alignment with revised legislative settings would ensure ongoing compliance, the proposed legislative scope remains limited. The reforms capture a small proportion (<1%) of the Ministry of Education's property portfolio. The proposed legislation does not provide an effective mechanism for addressing vulnerabilities not captured by the EPB framework such as those described in Section 3.2.1. Consequently, if the Ministry fully aligns with the revised EPB system, residual risk will remain across the portfolio. Importantly the deficient buildings identified in the case studies would not be identified and the deficiencies addressed..

3. Updating the Ministry's Seismic Policy to resolve some of the challenges with current and proposed EPB legislation.

The third option is to update the Ministry's Seismic Policy to incorporate a decision-making system which allows for measurable comparison of seismic risk across numerous structures. This approach moves beyond strict regulatory compliance and adopts a more targeted assessment of building vulnerability, and consequence with greater use of expert engineering judgement.

Figure 1 presents a preliminary risk matrix currently under development, which could be integrated into the Ministry's Seismic Policy to support consistent comparison of risk across multiple assets. The matrix structure allows deficiencies to be assessed in terms of both likelihood and consequence, providing a quantifiable basis for prioritising seismic risk mitigation actions across the portfolio. The matrix can be used to guide both more detailed seismic assessment requirements as well as seismic upgrade, targeting those of higher risk category.

Adopting a risk-based matrix enables the Ministry to direct investment towards interventions that yield the greatest reduction in life-safety and functional risk, thereby optimising the use of available funds. In addition, a risk-based matrix provides a transparent and repeatable method for decision-making, enhancing accountability and communication with stakeholders.

Risk Matrix (Draft)		Consequence		
Likelihood of Event	Minor Unlikely to cause injury. Rare occupancy / exposure e.g. storage or plant rooms.	Moderate Some injuries likely, but unlikely to cause fatalities. Infrequently occupied/no congregation areas.	Major Serious injuries or fatalities possible. Typically involves partial loss of vertical support or collapse of localised heavy elements.	Severe Multiple fatalities and widespread injuries. Involves major loss of support/structural failure.
Possible/Infrequent Moderate shaking intensity (100yr return period)	Low	Medium	High	Very High
Unlikely/Less Frequent Significant shaking intensity (500yr return period)	Low	Low	Medium	High
Rare Major shaking intensity (1000yr return period)	Low	Low	Medium	Medium

Figure 1: Indicative Life Safety Risk Matrix.

An example illustrating how the risk-based matrix can be applied using two of the case studies presented in Section 3.2 is provided in Figure 2.

Building Description	Seismic Vulnerability	%NBS Score	Seismic Vulnerabilities	Engineering Judgement	Consequence	Likelihood	Life Safety Risk Category	Cost	Actions
Two storey timber-framed structure with concrete topping slab to level 1 timber floor	Level 1 Diaphragm	20%	-Poor connections between concrete topping slab and timber joists and boundary walls. - Lack of tension capacity.	The aspect ratio of the diaphragm means that compression arches can form resulting in very little tension demand in the slab. The report suggests a lack of fixity between the diaphragm and the bracing walls at the perimeter, but this neglects that the diaphragm is effectively captured by the boundary joist and wall plate fixings. Given the relatively small displacement and assuming nominal carpentry connections, it is unlikely that this will create a life safety issue.	Minor	Unlikely	Low	\$\$	No seismic upgrade required. Consider upgrading hold-down fixings and diaphragm wall connections during future planned internal refurbishment.
	Level 1 Timber Shear Walls	20%	Lack of hold-down fixings	Low axial load and low aspect ratio to walls will mean shear walls will rock but unlikely to result in any life safety issues.	Minor	Unlikely	Low	\$	
	Ground Floor Timber Shear Walls	20%	Lack of hold-down fixings		Minor	Unlikely	Low	\$	
	Foundations	80%	Insufficient overturning capacity	Not a life safety issue.	Minor	Rare	Low	\$\$\$	

Paper 87– Navigating Seismic Risk in Schools: Adapting to Regulatory Changes

Two storey steel-frame structure with level 1 concrete hollowcore floor	Steel moment frames (transverse and longitudinal)	15%	-Poor detailing to moment connections - Insufficient section capacity	Large lateral displacements and failure of key connections with increased earthquake shaking.	Severe	Possible	Very High	\$\$\$	- Undertake short-term interim works within 2-years targeting school holiday periods. Reduces risk category from Very High to Medium. - Undertake seismic upgrades to steel moment frames, roof and floor diaphragms within 10-year period following completion of interim works, prioritising the steel frames and concrete floor diaphragm.
	Plywood roof diaphragm	15%	No plywood sheet perimeter blocking prevents shear transfer between adjacent sheets.	Large lateral displacements of roof with potential for localised instability of secondary and non-structural elements (e.g. ceilings). Plywood sheets and roof cladding will provide some stiffening effect.	Moderate	Possible	Medium	\$\$	
	Concrete floor diaphragm	15%	- Poor detailing of diaphragm connections to lateral resisting systems. - Insufficient diaphragm tension tie members.	Localised failure of the concrete in tension propagating with increased earthquake shaking. Overall collapse of the floor not likely under a low shaking, low cycle event.	Severe	Possible	Very High	\$\$\$	
	Foundations	>67%	-	Not a life safety issue.	Minor	Rare	Low	-	
	Precast stairs	>67%	-	Not a life safety issue.	Minor	Rare	Low	-	

Figure 22: Example application of the life safety risk matrix to school buildings.

Option 3 is currently the Ministry's preferred approach, although further work is underway to refine the matrix as a potential tool for application to school buildings.

4 CONCLUSIONS

The proposed changes to the Earthquake Prone Building (EPB) system mark a significant shift in how seismic risk will be regulated in New Zealand, greatly reducing the number of school buildings subject to mandatory upgrade. However recent case studies demonstrate that significant vulnerabilities are present within the Ministry's building portfolio which will fall outside the scope of the proposed framework.

Relying solely on regulatory triggers, either current or proposed, will not adequately address these risks across the Ministry's diverse portfolio. A strengthened seismic policy supported by a structured and transparent risk-based decision-making approach would allow the Ministry to identify, compare, and prioritise seismic vulnerabilities more effectively.

By adopting this approach, the Ministry can continue to improve seismic resilience over time, and direct investment where it delivers the greatest life-safety benefit within available funding, as resources allow.

The Ministry will continue to monitor any changes to the Building (Earthquake-prone Buildings) Amendment Bill arising from the Select Committee process and will update its Seismic Policy and Seismic Risk management Procedures for Existing School Buildings before the new legislation comes into force.

5 REFERENCES

Ministry of Business, Innovation and Employment. (2025). Earthquake-prone building system and seismic risk management review: Report (Proactive release).

Ministry of Education. (2025). School Seismic Policy (Version 1). Ministry of Education.

Ministry of Education. (2025). Seismic risk management procedures for existing school buildings (Version 1). Ministry of Education