nzsee
NEW ZEALAND SOCIETY FOR EARTHQUAKE ENGINEERING

Earthquake Ratings and Seismic Retrofit Following the Release of TS 1170.5

Advice for Owners and Building Users

Prepared In collaboration with SESOC, NZGS and MBIE

Endorsed by the Joint Committee for Seismic Assessment of Existing Buildings (NZSEE, NZGS, SESOC, MBIE, NHC)

August 2024

Background and Summary

For the seismic design of buildings in Aotearoa, the Earthquake Actions Standard NZS 1170.5:2004 is usually used. It defines earthquake shaking loads—and it is referenced in Building Code compliance documents.

During February 2024, Standards NZ released a public consultation draft of a new Technical Specification DZ TS 1170.5:2024 *Structural Design Actions – Part 5: Earthquake Actions* (or TS 1170.5 in short). It is intended for **new building** design and its release is summarised in this TS 1170.5 Release Advisory. A finalised version of TS 1170.5 is anticipated to be published once changes resulting from the public consultation phase are incorporated.

This advice relates to the earthquake rating system for **existing buildings**, and the design of seismic retrofit work, following the release of TS 1170.5. This advice does not relate to the EPB review announced by the Minister for Building and Construction in April 2024. This document reiterates the current regulatory requirements for EPB Buildings, but its primary purpose is to advise owners who have been undertaking (and can continue to undertake) voluntary (non-regulated) assessment and seismic retrofit work outside of the EPB system.

KEY MESSAGES

- **The release of a future Earthquake Actions Standard (including TS 1170.5 once finalised and published) does not change *Earthquake Ratings* (%NBS) or *Seismic Grades* (A+ through E).**
- *Earthquake Ratings* (%NBS) and *Seismic Grades* should continue to use NZS 1170.5:2004. This is important to ensure the existing building assessment system continues to function as it has been designed—and to allow fair and comparative assessment between buildings.
- The *Building (Earthquake-prone Buildings) Amendment Act 2016* requires NZS 1170.5:2004 to be used when determining if a building is *Earthquake-prone*.
- It's best to communicate seismic life-safety performance using *Seismic Grades* (A+ through E) and their corresponding relative risk descriptions (*Low Risk* to *Very High Risk*). This should sit alongside layperson 'consequence statements' that describe the identified vulnerabilities and the potential consequence of their failure (provided by engineers). This is the best way to understand the risks associated with any vulnerabilities that an assessment has identified (rather than just %NBS ratings).
- Over the next few years, MBIE and stakeholders will work on proposals to update Building Code compliance documents for seismic aspects of new design work. They will consider the new TS 1170.5 is part of this. This is a separate decision process to the framework used to manage and communicate risk in existing buildings and it will not affect the *Earthquake Ratings* and *Seismic Grades* that apply to existing or retrofitted buildings.
- When buildings are undergoing a 'Change in Use', structural performance needs to comply *as near as is reasonably practicable* (ANARP) with the Building Code. This could require seismic retrofit work. Until it is no longer referenced by Building Code compliance documents, the current NZS 1170.5:2004 remains the standard defining the earthquake loading that complies with the Building Code, and hence, ANARP should be assessed against the earthquake loads in NZS 1170.5:2004.

Earthquake Ratings and Seismic Grades for Existing Buildings

The *NZSEE Grading Scheme* adopted by the Seismic Assessment Guidelines is summarised in Table 1. This is adapted from Table A3.1 of the Seismic Assessment Guidelines (Part A). All assessments (including those that are completed voluntarily outside of the *Earthquake-prone Building Methodology*) should calculate and report *Earthquake Scores/Ratings* and *Seismic Grades* in accordance with Table 1.

Table 1: The NZSEE grading system that should continue to be used after TS 1170.5 is published (and after any subsequent Building Code update). Grades A+ through E should continue to use NZS 1170.5:2004.

Seismic Grade	Rounded Earthquake Rating (calculated using NZS 1170.5:2004)	Life-safety risk description (Note 2)
A+	>100 (Note 1)	Low Risk
A	80-100	
B	67-79	Low to Medium Risk
C	34-66	Medium Risk
D	20 to 33	High Risk
E	15 to <20	Very High Risk
	<15%	

*Note 1: An "A++" zone has been indicated in Figure 1 below to differentiate (diagrammatically) a Grade A+ building that **also** has sufficient capacity to meet the current Earthquake Actions Standard of the day (such as the finalised TS 1170.5).*

Note 2: This describes life safety risk relative to a similar new building on the same site. It can also be interpreted more generally as the risk of failure if a significant (and low probability) earthquake were to occur. It does not consider the consequences of a potential failure, which is why the 'consequence statements' given by assessing engineers are very helpful and important.

RECOMMENDED PRACTICE WHEN COMMUNICATING SEISMIC RISK

Although calculated %NBS scores are a fundamental engineering tool in seismic assessment (for life-safety risks), the risks implied by the percentage scores are generally not well understood by end users. There are wide and often biased interpretations, and the percentages can imply a level of precision which is not feasible in seismic assessment. The recommended practice is to use the *Seismic Grades* and their risk descriptions in communications. *Seismic Grades* are not new; they are included in the Seismic Assessment Guidelines (Part A) and are required as part of the Assessment Summary Report. They can apply individually to each vulnerability that an assessment identifies—as well as to a building's overall grade (determined by the lowest score).

Alongside good engineering commentary on the vulnerabilities themselves (if any are present), *Seismic Grades* and consequence statements (short statements that describe the physical consequence of a potential failure) are a better general descriptor of the issues. They are more reflective of the precision involved in estimating seismic risk.

Communicate using the Seismic Grades and their risk descriptions, alongside layperson commentary on vulnerabilities and the possible consequence of their failure. This should result in better decision outcomes.

The ‘alpha’ grades are also preferable to using %NBS Ratings that are greater than 100%. It is hard for end users to know how to value such high scores and what these numbers should mean. Fixation on these percentages can introduce bias into decision making.

SEEKING HIGHER SEISMIC PERFORMANCE IN BUILDINGS

NZSEE, and the Joint Committee support and celebrate all efforts to improve seismic safety and resilience—in context. Building owners or tenants who *are* interested in higher earthquake performance, in new and existing buildings, are encouraged to consider this in the context of other important building performance measures. This could include tolerance for earthquake damage and property loss, or operational disruption (the ability to keep using commercial premises or stay in your home or apartment after a large earthquake).

It could also include non-earthquake related building performance measures, such as:

- Operational energy efficiency and thermal efficiency, air quality and comfort,
- Fire safety,
- Accessibility,
- Environmentally responsible governance—the continued use or reuse of existing built infrastructure in Aotearoa (instead of demolishing and rebuilding) helps to reduce our embodied carbon emissions.

The different earthquake risks (life safety, versus damage and downtime) are indicated graphically in Figure 1. This figure places our existing building system into the context of newer design approaches—and it reiterates that *Seismic Grades* (and %NBS scores) only consider life-safety.

Voluntary grades for ‘Low Damage Buildings’ will be defined by *Low Damage Seismic Design* guidelines in preparation. The *Low Damage Seismic Design* framework has been developed for new building design. However, comparable performance could be achieved by well performing existing buildings, or through well-conceived, high performing retrofits. This is something that can be discussed with engineers when making decisions about buildings.

The Ministry of Building, Innovation and Employment’s *Seismic Risk Resource for Commercial Building Tenants* can help facilitate these discussions with commercial property owners and tenants.

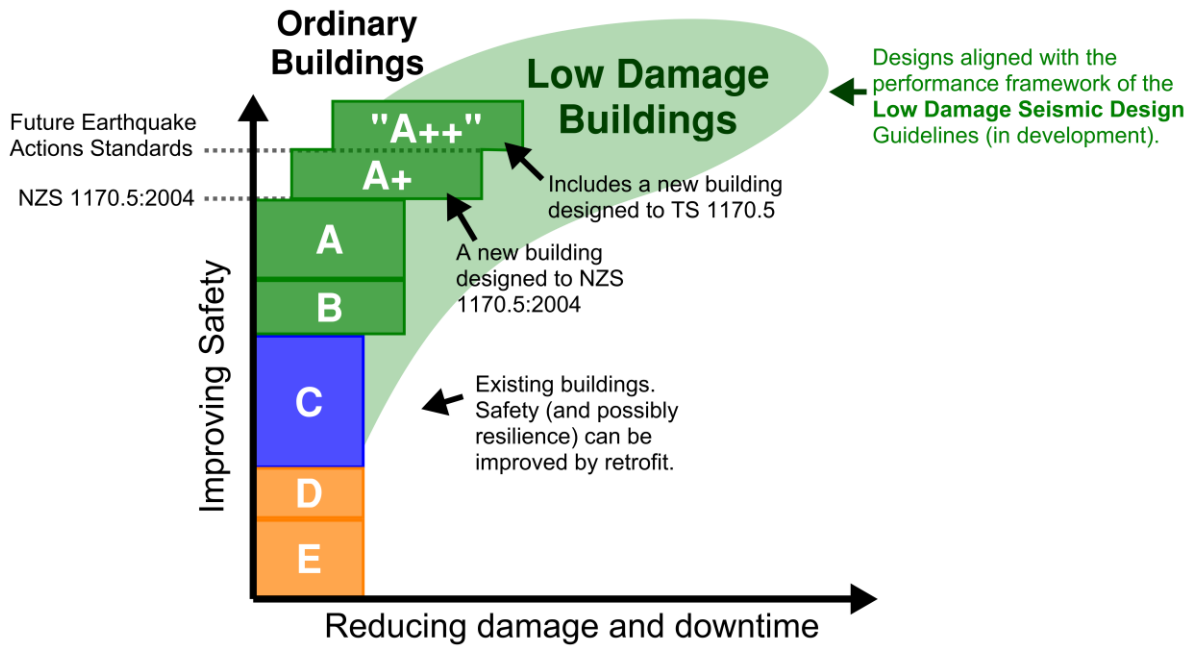

Figure 1: A graphic of the NZSEE grading framework outlined in Table 1 that should be used for all assessments. It shows how future Earthquake Actions Standards relate to the way Seismic Grades are assigned. It shows the benefits of Low Damage Seismic Design—one of the key focus areas of standards development for new buildings that can also be relevant for some high performing retrofits.

Design of Seismic Retrofit Work

RECOMMENDED PRACTICE WHEN ESTABLISHING STRENGTHENING TARGETS

The first step in retrofit is establishing the overall performance objectives desired by the building owner and users, then reviewing these against the vulnerabilities that have been identified in the building's assessment. Building owners (or end users) will often have a desired *Seismic Grade* in mind for the building as a whole (from Table 1 and Figure 1). However, from an engineering and risk outcome perspective, it is more important to understand the underlying risk profile and how each of the various vulnerabilities (and their potential consequences) could be improved or eliminated through retrofit or other risk mitigation.

Consideration of consequence is the key here, as this is not well captured in the grades alone.

When addressing a vulnerability through retrofit (and working with engineers to set objectives and scope the retrofit work), the aspirational objective that is initially recommended should be to either:

- Remove the vulnerability. That is, design the strengthening or retrofit so that the vulnerability and the risk associated with the no longer exists at all, or,
- Reduce the risk so that the score associated with its assessment achieves a *Low-Risk* grade (ideally A+ or A++ if practical).

This is a better long-term and enduring approach to risk management. But where this approach is impractical, a higher risk will need to be accepted. Work with your engineer to seek the best balance between risk reduction and cost of remediation. Figure 2 illustrates this by a simple diagram. Sometimes a point is reached (the circled point) where a significant increase in the sacrifice (i.e. the cost of the work) is made for a comparatively small further gain in the resulting benefit (earthquake safety). Applying this concept can help to get the most value from investment in seismic retrofit.

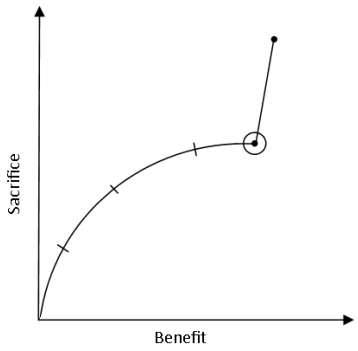

Figure 2: A diagram reproduced from MBIE guidance on buildings undergoing alterations.[1] This concept is also relevant when working with engineers to set voluntary seismic retrofit objectives and could apply to individual seismic vulnerabilities, or to a building's overall seismic performance.

It is important to be clear that to *minimally* comply with the *Building (Earthquake-prone Buildings) Amendment Act 2016*, buildings with an *Earthquake-prone Building* notice only need to be seismically upgraded so that they are not *Earthquake-prone* within the specified timeframes (or if triggered by 'substantial' alteration work as defined by Section 133AT). This means they only need to score ≥ 34% NBS or ≥ Grade C, *Medium Risk* when the seismic work is completed. This does not change with the release of TS 1170.5 nor with any future change to Building Code compliance documents.

[1] The companion advisory for engineers (and the Seismic Assessment Guidelines) has information on seismic compliance considerations and relevant Building Act requirements when embarking on building alterations or changes in use. These should be discussed with your engineer.

THIS COMMUNICATION IS ENDORSED BY THE JOINT COMMITTEE FOR SEISMIC ASSESSMENT AND RETROFIT

The Joint Committee for Seismic Assessment and Retrofit (JC-SAR) comprises representatives from the five organisations originally partner to the development of the 2017 Seismic Assessment Guidelines; the Ministry of Business, Innovation and Employment (MBIE), the New Zealand Geotechnical Society (NZGS) the New Zealand Society for Earthquake Engineering (NZSEE), the Structural Engineering Society of New Zealand (SESOC) and the Natural Hazards Commission Toka Tū Ake (formerly EQC).

Its purpose is the joint oversight of the system used to assess, communicate, manage and mitigate seismic risk in existing buildings. The Joint Committee reviews how the guidelines are functioning in practice, identifies areas that require further input and development, and either advises on or assists in the development of proposals for work programmes that contribute towards these objectives.

DISCLAIMER

The material contained in this document is intended as a guideline only, and should interpreted in conjunction with advice provided by professional engineers, and with reference to the companion document *Earthquake Ratings and Seismic Retrofit of Existing Buildings Following the Release of TS 1170.5 | Advice for Engineers* which contains additional technical background.

All readers should satisfy themselves as to the applicability of the recommendations made and should not act on the basis of any matter contained in this document without considering, and if necessary taking appropriate professional advice on, their own particular circumstances.

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