Joint Committee for Seismic Assessment and Retrofit of Existing Buildings

# Guidance for Commissioning and Undertaking Reviews of Seismic Assessments

Report JC 25-02

April 2025

New Zealand Geotechnical Society

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SESOC

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT HĪKINA WHAKATUTUKI

Natural Hazards Commission Toka Tū Ake

# Foreword

The Joint Committee for Seismic Assessment and Retrofit of Existing Buildings is responsible for the joint oversight of the system used to assess, communicate, manage and mitigate seismic risk in existing buildings. It reviews how the Seismic Assessment 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. The Joint Committee includes representatives from the Natural Hazards Commission Toka Tū Ake, the Ministry of Business, Innovation & Employment, and the technical societies (New Zealand Society for Earthquake Engineering, New Zealand Geotechnical Society and the Structural Engineering Society of New Zealand).

The Joint Committee's Vision is that:

- Seismic retrofits are being undertaken when necessary to reduce our seismic risk over time while limiting unnecessary disruption, demolitions and carbon impacts, promoting continued use or re-use of buildings.
- Decisions on retrofitting are informed by an appropriate understanding of seismic risk and are aligned with longer term asset planning.
- Seismic assessment and retrofit guidelines help engineers focus on the most critical vulnerabilities in a building, serve the needs of the market and regulation, and evolve through a stable ongoing cycle allowing new knowledge and improvements to be included in a predictable manner, including the consideration of objectives beyond life safety.
- Engineers are supported in the implementation of Seismic Assessment and Retrofit Guidelines through a range of training and information sharing strategies, including tools for risk communication to manage unnecessary vacating of buildings.
- Society is informed about the level of risk posed by existing buildings.

**Acknowledgements**

This document was prepared by Dave Brunsdon on behalf of the Joint Committee, with input from other Joint Committee members including Nic Brooke (Compusoft), Alistair Cattanach (Dunning Thornton), Ken Elwood (MBIE/NHC), Rob Jury (Beca), Stuart Palmer (Tonkin + Taylor), Henry Tatham (Beca) and Andy Thompson (Holmes), and from Tania Williams (Engineering New Zealand).

Funding from MBIE Building System Performance Branch is gratefully acknowledged.

# Version Record

| Version | Date | Purpose/ Summary of changes |
|---|---|---|
| **1** | April 2025 | For industry feedback |
| | | |

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*JC 25-02*

*Guidance for Commissioning and Undertaking Reviews of Seismic Assessments*

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# Contents

## Executive Summary


**Objective**

The objective of this report is to provide guidance on the different forms of review that can be undertaken for seismic assessments and on the approaches to be taken by reviewers in order to improve the consistency, efficiency and effectiveness of reviews.

Reviews of seismic assessments of existing buildings typically do not warrant the level of technical and process detail required for building consent applications. This guidance outlines the options for different levels of review, appropriate to both client and regulatory requirements. The associated aim of this guidance is to reduce the 'compliance' focus of technical reviews in acknowledgement of the high levels of engineering judgement involved in assessment.

The wider aim is to inform clients as to the level of review they actually require, in order to avoid the default assumption that they need a full technical peer review.

**Area of Focus**

The report has two main areas of focus:

1. Outlining the different types of reviews that can be applied to seismic assessments, their characteristics and the approaches to be applied by the reviewer; and
2. Providing guidance on when assessments undertaken prior to the 2017 Guidelines should be revisited.

**Target Audience and Report Structure**

While the primary target audience for this guidance is engineers undertaking seismic assessments and reviews of assessments, it is considered that this document will provide useful information for non-technical people involved in the commissioning of reviews.

Sections 2 and 3 provide the context for assessment reviews and outline the features of the different review types. Section 4 outlines the key considerations when scoping assessment reviews, and Section 5 provides an update on the Engineering New Zealand service for reconciling different seismic assessments. These sections are considered relevant to owners and tenants of buildings as well as territorial authorities and engineers.

The subsequent sections provide more information for engineers carrying out reviews. Section 6 provides a framework for high-level reviews, which are seen as the essential starting point for reviews, and in many cases being sufficient to meet client needs. Section 7 provides guidance on when and how to evaluate earlier assessments undertaken prior to the 2017 Guidelines.

**Key Messages**

The key messages in this guidance document are summarised below:

1. There are different drivers for reviews of seismic assessments, and different types of reviews that correspond to these drivers.
2. The continuum of types of reviews can be broadly characterised as:
    - No review
    - High-level/ qualitative review
    - Targeted quantitative review
    - Full technical/ quantitative
3. Being clear on the need for and purpose of any review of an assessment is the essential first step in scoping the level of detail of the review. The likely review pathway should ideally be mapped out prior to the commencement of an assessment.
4. Undertaking a high-level review as the first step in a review process is seen as being important in order to appropriately select the level of further review that is warranted. In many cases, a high-level review is all that is required.
5. Significant decisions can result from the receipt of a low seismic rating. These can range from decanting a building if appropriate risk advice is not taken, investing in significant strengthening or even demolition. Assessing engineers and reviewers alike therefore need to be aware of the consequences of an assessment being unduly conservative. This is a particular point of difference between reviews of assessments and peer reviews of designs of new buildings and strengthening work.
6. Ensuring that an assessment appropriately reflects the expected performance of the building and is not either simply reflecting the lower bound point at which element strength is exceeded or providing an overly optimistic view that overlooks key vulnerabilities should be an area of focus of any review.
7. A key aspect of both assessments and reviews is having a clear understanding of when a significant life safety hazard does (and doesn't) arise from an element with a low calculated ultimate strength. This issue is covered in more detail in Joint Report JC 25-01 *Applying Engineering Judgement in Determining When a Significant Life Safety Hazard Occurs*.
8. All types of assessment reviews need to be undertaken by experienced structural engineers. This is particularly the case where assessments involve a significant component of judgement, and for all qualitative reviews.
9. One of the key areas where careful judgement is required from the reviewer is in relation to the nature and extent of geotechnical input required.
10. Given the emphasis on the judgement component of assessments, it is not expected that reviews apply the same level of 'compliance rigour' as is involved in a Design Review Producer Statement (PS2). Exceptions to this are where the assessment feeds directly into the building consent for a strengthening design, or situations where the building is occupied by a large number of people and a significant vulnerability is present.

# 1. Introduction

## 1.1. Report Objective and Overview

The objective of this report is to provide guidance on the different forms of review that can be undertaken for seismic assessments and on the approaches to be taken by reviewers in order to improve the consistency, efficiency and effectiveness of reviews.

Reviews of seismic assessments of existing buildings typically do not warrant the level of technical and process detail required for building consent applications. This guidance outlines the options for different levels of review, appropriate to both client and regulatory requirements. The associated aim of this guidance is to reduce the 'compliance' focus of technical reviews in acknowledgement of the high levels of engineering judgement involved in assessment.

The wider aim is to inform clients as to the level of review they actually require, in order to avoid the default assumption that they need a full technical peer review.

The report has two main areas of focus:

1. Outlining the different types of reviews that can be applied to seismic assessments, their characteristics and the approaches to be applied by the reviewer, and
2. Providing guidance on when assessments undertaken prior to the 2017 Guidelines should be revisited.

While the primary target audience for this guidance is engineers undertaking seismic assessments and reviews of assessments, it is considered that this document will provide useful information for non-technical people involved in the commissioning of reviews.

Sections 2 and 3 provide the context for assessment reviews and outline the features of the different review types. Section 4 outlines the key considerations when scoping assessment reviews, and Section 5 provides an update on the Engineering New Zealand service for reconciling different seismic assessments. These sections are considered relevant to owners and tenants of buildings as well as territorial authorities and engineers. The subsequent sections provide more information for engineers carrying out reviews. Section 6 provides a framework for high-level reviews, which are seen as the essential starting point for reviews, and in many cases being sufficient to meet client needs. Section 7 provides guidance on when and how to evaluate earlier assessments undertaken prior to the 2017 Guidelines.

## 1.2. Background

The need for guidance in relation to peer reviews of seismic assessments was first identified by the Joint Committee in November 2022. Among the issues identified were inconsistent approaches being applied by peer reviewers, and reviewers taking a compliance focus similar to that required for peer reviews for building consents.

Given the more judgement-rich process that is inherent with seismic assessment, a compliance focussed approach is not always well suited to the peer review of seismic assessments. The associated perception by assessing engineers that they needed to be fully

comprehensive in their assessments to ensure they avoided an adverse peer review was also observed as taking some assessments into greater detail than the assessment warranted or that the client was needing.

In addition to providing information and guidance on the different levels of review for assessments, there is an opportunity to make highly experienced earthquake engineers available to provide input to assessments as part of quality assurance processes. In addition to the education opportunity that this would represent in terms of how engineering judgement is applied to assessments, this could also enable more systematic gathering of information to identify areas of improvement needed in the assessment guidelines.

Engineering New Zealand has offered a service since 2017 for situations where different seismic assessments of the same building need to be reconciled. This service has however not seen many requests. This is due in part to the incidence of two assessments being produced for the one building having reduced since the changes to the EPB provisions and release of the updated Guidelines in 2017. Perceived cost barriers have also limited the uptake of the service.

The wider context for this report is provided by the Engineering NZ Peer Review Practice Note. It is also noted that SESOC is currently refreshing their peer review guidance for new building designs.

## 1.3. About this report

This report has been developed by the Joint Committee for Seismic Assessment and Retrofit of Existing Buildings with funding from MBIE and support from Engineering New Zealand.

This project contributes to the wider programme objectives of the work of the Joint Committee to improve the consistency and quality of seismic assessments.

# 2. The Context for review of seismic assessments

This section reflects on the context of a seismic assessment and how this influences the form and extent of its review. Seismic assessments encompass various forms and levels of detail depending on the nature of the building and the requirements of the brief from those commissioning the assessment. They range from basic Initial Seismic Assessments through to comprehensive Detailed Seismic Assessments (refer to Part A of the Seismic Assessment Guidelines[1]). The difference between assessment reviews and peer reviews of designs of new buildings and strengthening are highlighted.

## 2.1. Understanding the purpose of a review

Choosing the most appropriate form of review is typically influenced more by the context of the assessment than the level of detail of the assessment or the complexity of the building. There are different drivers for reviews of seismic assessments, and different types of reviews that correspond to these drivers. The purpose of the original assessment sets the scene for the need for and objectives of a review of that assessment. The level of review should be influenced by the level of assurance being sought by either the client (owner or tenant) or, for earthquake prone regulatory considerations, the territorial authority.

In some cases, the client simply wants to know that the rating is broadly appropriate, whereas in other cases the specific rating has risk, commercial or regulatory implications, and needs validation, particularly where the assessed rating is close to a key threshold criteria. Often the objective is to know whether the building is above or below a key threshold such as 34% or 67*%NBS*, or in simple terms, which 'third' does the building sit within, with reference to Figure 1 following.

An intermediate level of refinement is provided by the letter grades provided for in the Guidelines, as indicated in Figure 2. Use of these grades can be used (and should be encouraged) to guide the level of detail required in the review – for example, it may be that all parties can agree that an assessment outcome of Grade C (between 34 and 67*%NBS*) is appropriate without requiring full agreement on the actual *%NBS* value.

An important consideration is the consequence of the assessment outcome. For example, if establishing the scope of the resulting retrofit is the specific outcome of the assessment, the review should address whether the extent of the assessment has been appropriate to adequately identify the required scope.

[1] *The Seismic assessment of Existing Buildings – Technical Guidelines for Engineering Assessments* building.govt.nz

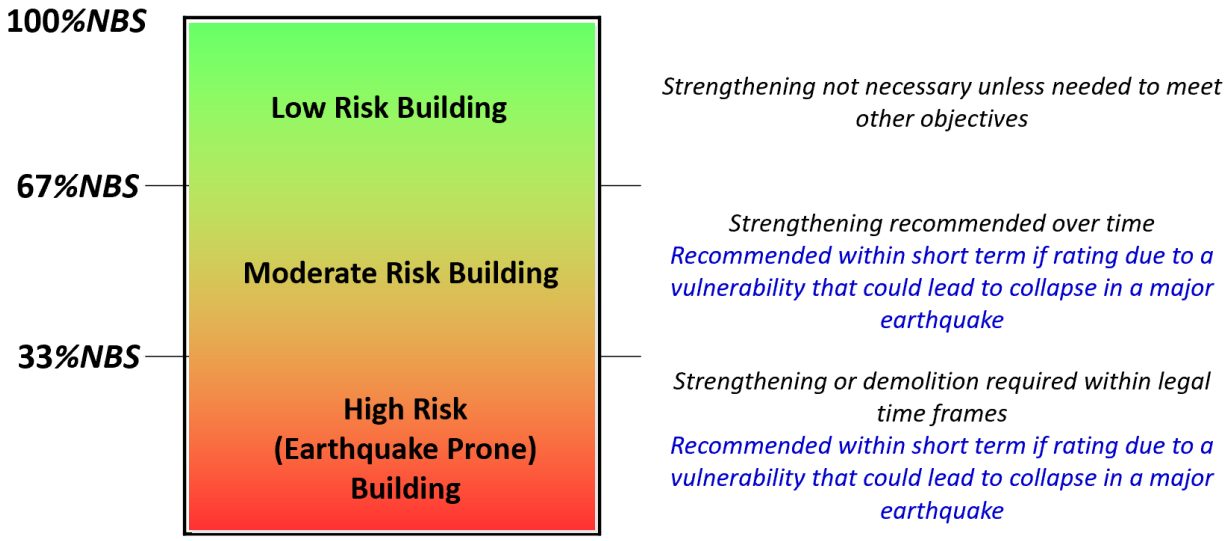


**Figure 1: The broad categorisation of seismic assessment outcomes**

| Percentage of New Building Standard *(%NBS)* | Alpha rating |
|---|---|
| >100 | A+ |
| 80-100 | A |
| 67-79 | B |
| 34-66 | C |
| 20 to <34 | D |
| <20 | E |

**Figure 2: The letter grades for seismic assessments**

*(from Table A3.1 of Part A of the Guidelines)*

There are also situations where no review is required. This may be due to (for example) the straightforward nature of the structure, or reflect the level of confidence that the client has with the engineer in terms of their experience and their quality assurance processes.

Another situation that leads to the need for a review is where a building has a seismic assessment that was undertaken prior to the release of the updated Guidelines in 2017. Guidance for this situation is provided in Section 7.

For complex structures, and those with challenging geotechnical conditions, a more comprehensive review may be warranted where the consequences of the assessment result are significant[2]. For situations where there will be a heavy reliance on the element scores in the scoping and design of strengthening to follow, verification of these scores and, more importantly, the nature of the vulnerabilities to be addressed are likely to be required.

The continuum of types of reviews can therefore be broadly characterised as:

- No review
- High-level/ qualitative review
- Targeted quantitative review
- Full technical/ quantitative

While not technically a review, the option of a client commissioning an independent assessment also exists.

Undertaking a high-level review as the first step in a review process is seen as being important in order to appropriately select the level of review that is warranted. This staged progression is illustrated in Figure 3 below.

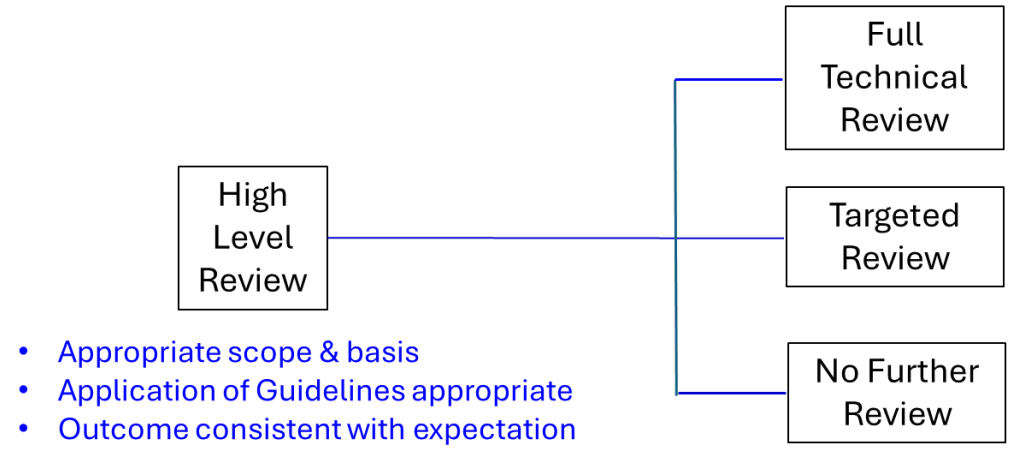


**Figure 3: How high-level reviews inform the level of assessment review required**

A key point is that in many cases, a high-level review is all that is required.

[2] Indications of review requirements from a geotechnical perspective are outlined in Section C4.8.4 of the Seismic Assessment Guidelines

## 2.2. The focus of reviews is on the application of engineering judgement

A key area of focus in any form of review is how the assessing engineer has applied their judgement. This is where Initial Seismic Assessments require consideration to be confident that the required levels of judgement have been applied, in the absence of detailed calculations. For Detailed Seismic Assessments that identify a potential step change (geotechnical or other[3]), the significant impact on the rating can warrant careful review – either a targeted review that focuses on that aspect and the associated assessment content, or a more comprehensive overall technical review.

For all assessments, a clear understanding of when a *significant life safety hazard* does (and doesn't) arise from an element with a low calculated ultimate strength also involves considerable judgement. This is explored further in the section below.

Given this emphasis on the judgement component of assessments, it is not expected that reviews apply the same level of 'compliance rigour' as is involved in a Design Review Producer Statement (PS2). An exception to this is where the assessment feeds directly into the building consent for a strengthening design.

One aspect that assessing engineers and reviewers alike need to be aware of are the consequences of an assessment being unduly conservative. This is a particular point of difference between reviews of assessments and peer reviews of designs of new buildings and strengthening work. Significant decisions can result from the receipt of a low seismic rating. These can range from decanting a building if appropriate risk advice is not taken, investing in significant strengthening or even demolition.

## 2.3. Understanding *significant life safety hazard*

*Significant life safety hazard (SLSH)* is defined in C1.1.2 of the Guidelines:

> *A hazard resulting from the **loss of gravity load support** of a member/element of the primary or secondary structure, or of the supporting ground, or of non-structural elements that would reasonably affect a number of people. When shelter under normally expected furniture is available and suitable, mitigation of the hazard below a significant status is assumed.*

This is further emphasised in Section A3.1.1 in Part A of the Assessment Guidelines, which states:

> *Failure of building or building section as a whole (leading to collapse) is considered to be a significant life safety hazard, but failure of individual members/ element in the primary structure will only constitute a significant life safety hazard, when considered individually, **if their failure causes them to fall**.*

[3] The point at which the behaviour of the structure, ground or foundation is considered to abruptly deteriorate or reduce

This requires a clear understanding of how the elements and the structure overall deforms with increasing lateral load, taking into account the ability to redistribute the load to other primary load paths and all possible secondary load paths, as well as the resulting consequence of 'failure' (i.e. occurrence of loss of gravity support) of an element.

In all situations, engineering judgement should be carefully applied in order to determine whether an element has yet reached its ultimate deformation capacity, and if so, whether (in the context of all elements and available load paths) this is likely to give rise to a SLSH, rather than simply assuming that this is the case. This typically involves consideration of how the element itself and adjacent elements deform in response to increasing levels of ground shaking, and how the building overall is likely to respond – all with a focus on assessing whether gravity support is maintained or lost.

This is particularly important for buildings assessed using the force-based approach, which needs to look beyond the point at which ultimate strength is exceeded in the modelled structure. Ideally the deformability of the primary structure is evaluated via some form of pushover analysis (e.g. a Simple Lateral Mechanism Analysis, or SLaMA) as per the Guidelines recommendations, but even if this isn't undertaken, qualitative pushover thinking should be applied. This may mean that some elements are not scored at all even though they may not comply with requirements for that element in a new building.

The most obvious examples of where low element scores don't correspond to significant life safety hazards come from the typologies of timber and steel framed low-rise buildings. For these types of structures, alternative or secondary load paths almost always exist, although often not readily quantifiable. There are however other building typologies where the calculated exceedance of ultimate capacity does not necessarily correspond to a significant life safety hazard.

Further commentary on this aspect of applying engineering judgement is provided in the companion report issued by the Joint Committee[4].

[4] Joint Committee on Seismic Assessment and Retrofit, April 2025: *JC 25-01 Applying Engineering Judgement in Determining When a Significant Life Safety Hazard Occurs* design.resilience.nz

# 3. Features of the different review types

This section provides an outline of the characteristics of different levels of assessment reviews as outlined in the previous section, and their scope and form of output. The focus in this section is on the review of individual assessments rather than the reconciliation between different assessments of the same building, which is covered in Section 7.

All types of assessment reviews need to be undertaken by experienced structural engineers. This is particularly the case for qualitative reviews. One of the key areas where careful judgement is required from the reviewer is in relation to the nature and extent of geotechnical input required.

## 3.1. High-level (qualitative) reviews

**Key Characteristics and Scope**

- An overall 'sensibility' check that focuses more on the scope of the assessment and the process that has been followed rather than the outcome.
  - Reviews of this nature can be as brief as establishing that the assessment has an appropriate scope and basis, the Guidelines have been appropriately applied (including the 2017 version for EPB purposes) and that the outcome is consistent with general expectations for buildings of its typology.
  - This should be the first step in any more comprehensive review.
- Aspects to evaluate include:
  - The building is adequately described and has been appropriately inspected (i.e. indicating the level of understanding of the structure from the assessor)
  - The primary lateral load resisting system has been appropriately described and assessed, including consideration of the ability of other elements to maintain vertical load carrying capacity.
  - That relevant secondary structural and non-structural elements have been identified and assessed.
- Will include a review of available drawings.
- Will include consideration of geotechnical conditions, and may include a desktop geotechnical review.
- May include an inspection of the building.
  - Particularly if there is potential for the building to have had its structural system modified from what is indicated in the drawings.
- The output of a high-level review may include identification of aspects that warrant quantitative review, or may recommend a more comprehensive technical (quantitative) review (targeted or full).
- Will include a review of the decisions around SLSHs.

**Form of output**

- Reports summarising high-level reviews can be in a relatively brief letter format which notes the scope and limitations of the review and key observations.

A framework for undertaking high-level reviews is outlined in Section 5.

## 3.2. Targeted technical (quantitative) reviews

**Key Characteristics and Scope**

- In addition to a high-level qualitative review of the assessment, independent calculations of the aspects of the structure that impact on the area being targeted to a level considered necessary by the reviewer.
  - This is typically done when one specific aspect of the structure dominates the assessed rating (i.e. one element score is much lower than the others) and qualitative review raises questions about its assessment or designation as a SLSH.
- Includes geotechnical aspects where they impact the response of the aspect of the building that is being specifically evaluated.
  - Could include a review of the application of the geotechnical step change provisions and whether or not the geotechnical aspect is likely to lead to an SLSH, as implied by the scoring, or ever.

**Form of Output**

- A letter report that summarises:
  - the scope and limitations of the review (especially important for Targeted Reviews);
  - the structure and geotechnical information reviewed and key points;
  - the areas that were subject to the targeted review, and how that was undertaken; and
  - the findings of the review.

## 3.3. Full technical (quantitative) reviews

**Key Characteristics and Scope**

- In addition to a general review of the assessment, independent calculations of the structure overall and key elements to a level considered necessary by the reviewer.
- Other key aspects to be covered include:
  - how well the response of the building overall has been addressed, and if appropriate consideration has been given to how a significant life safety hazard can develop as opposed to only reporting on the lowest scoring element.
  - establishing the key areas where engineering judgement has been (or should be) applied, and the appropriateness of that judgement (or lack of).

**Form of Output**

- Letter report covering the areas outlined above for targeted reviews and review log as appropriate (i.e. following interaction with the assessing engineer on specific issues raised by the reviewer), and commentary on the nature and appropriateness of the engineering judgement applied by the assessing engineer.
- In some situations, an independent DSA and report may be the most effective form of completing a review. This can identify where different assumptions have been made and why.

# 4. Key considerations when scoping assessment reviews

As indicated in Section 2, the client objectives are the primary influence on the scope of assessment reviews. These objectives should ideally be established as part of the brief to the assessing engineer, and included in the pathway for taking the draft assessment report through to the final version.

## 4.1. Establishing the scope of the review

**Situations when a High-level Review is likely to be sufficient**

- Validation of assessments to establish whether they are either clearly above or below key regulatory or client policy threshold levels.
- In property portfolio situations, where there is strategic engineering oversight and/ or use of engineers familiar with the range and types of buildings across the portfolio.
- TA reviews of assessments submitted for EPB purposes[5]
- As part of forming a view as to whether or not a full technical review (quantitative) is warranted
- Where a high level of QA has already been undertaken (either by others within the practice or by another practice)
- When an additional seismic risk evaluation is required to inform continued occupancy decision-making for a building with an earthquake rating of less than 34*%NBS* (i.e. seeking to establish the significance of the vulnerabilities identified, as noted in MBIE's Seismic Risk Guidance[6])

**Situations when a Targeted Review is appropriate**

- When the recommendations from a high-level review are for specific aspects to be the subject of a quantitative review
- Where the assessing engineer recommends that particular aspects of their assessments be subject to a quantitative review
- When one specific aspect of the structure dominates the assessed rating (i.e. one element score is much lower than the others) and qualitative review raises questions about its assessment or whether that score corresponds to an SLSH.

**Situations when a Full Technical Review is more appropriate**

- Where an assessment forms a significant component of a retrofit, and is required by a BCA.
- Where an assessment is close to 34*%NBS* and a high-level review raises questions as to whether it could fall on the other side of the threshold.

[5] With regard to territorial authority reviews of assessments for EPB purposes, it is worth noting that when the EPB Methodology was prepared, MBIE's general expectation was that territorial authorities wouldn't be undertaking technical reviews of all assessments.

[6] MBIE 2022 *Seismic Risk Guidance for Buildings* building.govt.nz

Examples of situations where a particular form of review may be more or less applicable are indicated in Table 1 below.

**Table 1: Example situations where different levels of review can be appropriate**

| Situation | High-level (qual) Review | Targeted (quant) Review | Full (quant) Review | Comments |
|---|---|---|---|---|
| Due Diligence for Prospective Purchase | Y | Y | | Balancing the significance of the decision resulting from the assessment outcome with the typical time constraints |
| New Tenancy Advisory | Y | Y | | Providing advice to a potential tenant on various options in the market to allow comparison from seismic risk perspective |
| Tenancy Advisory | Y | Y | Y | When requested to provide an existing tenant with advice on a landlord assessment they have received<br>Start with high level and progress to targeted or full only if considered necessary |
| Seismic Retrofit Compliance Review | | Y | Y | Including situations where a full PS2 is requested by TA |
| Independent Review | Y | Y | Y | May be requested as a third party to assist with resolution of different assessments |
| Occupancy Review | Y | | | Required to understand the key risks identified in the DSA |

## 4.2. Documenting the scope of the review

It is important to clearly define the scope and form or output for all assessment reviews as part of the engagement process. This should also clarify what is not covered – for example, the rating is not being verified.

The scope of the review should also be clearly conveyed in the review report, including whether the scope changed from that originally agreed.

For high-level reviews in particular, it is essential to clearly limit the scope (it can be appropriate to refer to these as 'limited scope reviews'). Some examples of clarifying wording for inclusion in either the commissioning letter or the review summary letter are indicated below:

- We have carried out our work as a desktop exercise based on a review of the reports and drawings provided. We have not visited the site.

- We have assumed the accuracy and completeness of the assessing engineer's calculations and have not conducted a peer review nor generally carried out independent verification or calculations.
- We are not able to say whether we agree with the reported *%NBS* or seismic strengthening requirements, as we haven't done our own calculations to allow us to sufficiently get to this position.
- We have not carried out a review of other aspects of the building, such as seismic restraint of non-structural elements (ceilings, partitions, building services) or reviewed things such as building condition, asbestos, fire safety, or aluminium composite panels.
- Our report and advice have been prepared by *Engineer Company* at the request of *Client Company* and is exclusively for their use for the purpose for which it is intended in accordance with the agreed scope of work. *Engineer Company* accepts no responsibility or liability to any third party for any loss or damage whatsoever arising out of the use of or reliance on this report by that party or any party other than our Client.

Examples of concluding statements that summarise different review outcomes include:

- We consider the building rating reasonable and within the range we would expect.
- Based on our review of the available information it appears the assessing engineer *has/has not* followed generally accepted industry guidance to undertake their assessment.

It should be stated in any high-level review report that the conclusions are an opinion only, in order to emphasise that there is significant judgement involved.

# 5. Reconciling different seismic assessments

## 5.1. Background to the Engineering New Zealand reconciliation service

Prior to the 2016 revisions to the earthquake prone buildings provisions of the Building Act and the update of the Seismic Assessment Guidelines in 2017, it was not uncommon for there to be more than one recent assessment and rating for a particular building. This typically arose from the different ways engineers would apply the 2006 Guidelines in the face of the new knowledge that emerged following the Canterbury earthquakes, and the availability of overseas approaches. The 2006 Guidelines also had a relatively limited coverage of the full range of building types, as they were primarily focused on older, heavier and taller structures.

Another contributing factor was the different levels of experience of engineers undertaking assessments, given the high national demand for building assessments during that period.

Assessments being commissioned by the owners and tenants of buildings with the associated different commercial drivers also led to assessments with different ratings for the same building.

In response to questions from building owners as to how different ratings could be navigated, in 2018 Engineering New Zealand established an independent facilitation programme aimed at helping engineers agree on a narrower range of ratings. The focus is on facilitating discussions between two engineering practices that have presented assessments with diverging results in order to achieve a clearer outcome for the client.

This service provided experienced earthquake engineers that had been trained in facilitation as a service to be paid for by the parties involved. Engineering New Zealand currently has a small pool of engineers trained in facilitation available for this service. The appointed facilitating engineer would guide the technical discussion between the engineers but would not state an opinion or provide their own determination. The pre-requisite for a particular case being eligible for this facilitation is that the engineers involved must have attempted to resolve the differing assessments by meeting to discuss their findings and justifications, and have agreed on the key elements where disagreement exists.

## 5.2. Degree of uptake and current demand

There has been only a limited uptake of this service since its establishment. This is thought to be due to a combination of reasons.

Primarily, the implementation of the 2017 assessment guidelines with its wider coverage and regulatory mandate that it be used for earthquake prone purposes has reduced the extent to which other approaches have been used. These guidelines in themselves provide a clearer framework for engineers to resolve differences as they become apparent.

There has also been more common use of peer review processes, which in some cases involve working through identified issues more systematically.

A previous tendency for building owners to provide two different assessments to a territorial authority with the expectation that they would make the necessary calls as to which was the

more appropriate has also largely fallen away due to clearer focus of the EPB Methodology requiring owners to provide one assessment.

Differences in assessment between engineers engaged by owners and tenants have nevertheless continued to play out. These differences are more common in the more technically complex situations of multi-storey buildings with precast concrete floors and in situations where the outcome is more sensitive to the levels and form of judgement being applied. These situations are typically being addressed through a combination of mechanisms - essentially engineers working together through technical review processes and via legal processes.

Cost and time are other considerations that appear to have contributed to the limited uptake of the Engineering New Zealand reconciliation service. The parties involved in situations with different assessment outcomes appear reluctant to commit to the cost of another process which involves other engineers and doesn't have clear cost and time boundaries, and is non-binding.

A further consideration is that in a number of situations the engineers involved haven't engaged (or been able to engage) together, or if they have, not in sufficient detail to narrow and identify the areas of difference, thus not meeting the base eligibility criteria.

### 5.3. Current perspective

The Engineering New Zealand seismic reconciliation service remains a valid mechanism for situations where two parties have two seismic assessments with divergent outcome ratings for the same building.

It is suggested that the addition of an initial triage step by Engineering New Zealand would be of considerable value to the parties contemplating entering into the reconciliation process. This would involve the enabling by Engineering New Zealand of a limited number of hours of time from an experienced earthquake engineer to undertake an initial review of the assessments and supporting information. The purpose of an initial screening of the two assessments to establish that the areas of difference have been appropriately identified and provide confirmation that further investment in the reconciliation process is likely to be productive. Further consideration needs to be given to funding and liability aspects.

Having this triage undertaken prior to further financial commitment by the client parties would be of benefit to the parties and represents an appropriate contribution by the engineering profession.

# 6. A framework for high-level reviews

The framework on the following pages outlines the key aspects for high-level reviews to address, and provides questions and prompts for particular aspects to examine in the review.

These questions reflect shortcomings in assessment reports that are commonly encountered.

The first general set of aspects and questions apply to all seismic assessment reports, with reference to Part A of the Guidelines (Table 2). The following sections apply to Initial Seismic Assessments (Part B) (Table 3) and Detailed Seismic Assessments (Part C) (Table 4).

**Table 2: General considerations (for any assessment)**

| Aspect | Questions | Comments / Observations |
|---|---|---|
| **Description of the structure** | Is there a clear description of:<br>• the extent of the building and its interface with adjacent buildings<br>• the primary structure<br>• secondary structure<br>• heavy non-structural elements within the scope of the Guidelines<br>• geotechnical conditions | • In both narrative, diagrammatic and/ or photographic form<br>• This helps convey how well the assessing engineer understands the structure, and in particular the primary lateral load resisting system<br>• Noting that a broadly comparable level of descriptive detail is required for both ISAs and DSAs |
| | Does the building fall within one of the Profile Categories from the EPB Methodology? | • This indicates the potential level of TA interest, and the need to for rating to be based on the 2017 EPB Seismic Assessment Guidelines. |
| | Have any previous retrofits or significant alterations been identified? | • Important to understand the basis and assumptions for previous retrofits and alterations |
| **Inspection of the building** | Has the inspection been sufficiently comprehensive to understand the extent of heavy NSE and interfaces with adjacent buildings, and any possible modifications over time? | • The scope and extent of the inspection should be essentially the same for both ISAs and DSAs |
| **Assignment of Importance Level** | Does the indicated IL appropriately reflect the actual use of the building? | • The use and occupancy of the building should be clearly described to enable independent verification of the selected IL |
| **Assessment Summary Report** | Does the assessment include an Assessment Summary Table[7]? | • Required for assessments for EPB purposes; recommended for all assessments |

[7] Engineering assessment summary report template: building.govt.nz

**Table 3: Initial Seismic Assessments**

| Aspect | Questions | Comments / Observations |
|---|---|---|
| **Scope and content of the ISA** | Is it just IEP-based, or are there additional element-specific calculations? | • Checking that any additional calculations are focused on appropriate elements, and the outcomes are logically fed back into or in some way related to the IEP spreadsheet<br>• Checking that the possibility of geotechnical conditions dominating has been considered. |
| **Secondary Structural and Non-structural Elements** | Have SNSS been:<br>• appropriately identified?<br>• assessed? | • Likely to require specific calculations, as they are not covered in the IEP spreadsheet |
| **Key IEP factors** | Is the design era appropriately selected? | • If strengthened to a %age of a specific code, that the %age is included |
| | Are the key parameters appropriate - ductility assumed; $S_p$; F Factor | • Checking that not all the discretionary factors are at the ends of the ranges – i.e. not inappropriately favourable or unnecessarily conservative |
| | Horizontal and Vertical Irregularity and Short Columns | • Checking that the selected factors are not unnecessarily penalising the building, especially for low-rise buildings |
| **Sufficiency of ISA** | Does the ISA provide an appropriate assessment of the building; is a DSA likely to produce a significantly different rating? | • Acknowledging the constraints of the client brief |

**Table 4: Detailed Seismic Assessments**

| Aspect | Questions | Comments / Observations |
|---|---|---|
| **Scope of the DSA** | Are all elements of the structure included in the assessment? | |
| **Secondary Structural and Non-structural Elements** | Is the identification and extent of SNSS evaluated appropriate? | • It is generally not appropriate for potentially heavy NSE to be excluded from assessment scores |
| **Geotechnical considerations** | Has an appropriate level of geotechnical input been provided? | • For most DSAs there should be geotechnical input to identify if there are geotechnical hazards or adverse geotechnical conditions that warrant further consideration |
| **Method of analysis** | Has a SLaMA or other form of displacement-based analysis been undertaken? | • If the analysis is simply force-based, the result is likely to be conservative unless some form of displacement-based thinking has been applied |
| **Basis of seismic demand** | If only a force-based assessment, is the selection of ductility (and hence $S_p$) appropriate? | • While appropriate for design, the use of an overall ductility of 1.25 and $S_p$ of 0.9 for older structures can be unduly conservative for an assessment which is seeking to identify likely performance |
| **Element scores** | Do the listed element scores seem reasonable?<br>Have they given appropriate consideration to how the elements respond following the initial exceedance of element ultimate capacities? | • If they appear high or low, this may lead to recommendation for a more targeted review<br>• Initially calculated low scores may not correspond to a SLSH |
| **Overall rating** | Does the overall rating correspond to appropriate element scores and reflect the expected performance of the building overall? | • Has there been sufficient consideration of the consequence of element failure and overall building response? (refer Joint Committee Report JC 25-01) |
| **Inclusion of a Mode of Failure statement** | If less than 34%NBS, is there a mode of failure and physical consequence statement? | • Are all relevant secondary load paths identified? |
| **Need for more comprehensive technical review** | Are there specific elements in the assessment that warrant closer consideration and hence a Full Technical Review? | • Either structural or geotechnical<br>• Have all relevant failure modes been considered? |

# 7. Re-evaluating assessments undertaken prior to the 2017 Guidelines

This section addresses three common questions in relation to assessments that pre-dated the 2017 Guidelines:

1. When should early assessments be re-visited?
2. What re-assessment options are available?
3. When are new assessments warranted?

The key changes brought about by the 2017 Guidelines are briefly summarised, and commentary provided on which aspects and elements in the current guidelines were not covered by the 2006 Guidelines (or where assessment practice changed following the Canterbury earthquakes). Building typologies are utilised to provide a broad indication of considerations and issues to check.

## 7.1. Recap on the key changes brought through in the 2017 Guidelines

2017 represents a significant date for seismic assessments in NZ due to the Earthquake Prone Buildings Amendment Act and the release of the fully updated Seismic Assessment Guidelines. Some of the key changes include:

- The inclusion of Parts, which generated the need for scores for precast concrete panels; walls out of plane; heavy non-structural elements.
- The introduction of the concept of a *Severe Structural Weakness* - a defined structural weakness that is potentially associated with catastrophic collapse and for which the capacity may not be reliably assessed based on current knowledge.
- The related introduction of a geotechnical *step change* as part of a new section covering the geotechnical aspects of assessment.
- Both the 2017 and subsequent 2018 versions of section C5 on concrete structures featured a number of changes from the 2006 version. While many of these changes led to lower element scores, some enabled higher scores.
- An increase in allowable capacities for low-rise light clad timber framed structures.

## 7.2. Common issue with assessments undertaken using the 2006 Guidelines

The 2006 NZSEE Guidelines (and predecessor versions) focused on buildings of older and heavier construction – unreinforced masonry, pre-1976 concrete and steel framed buildings. These earlier versions of the Guidelines provided little guidance for post-1976 buildings and timber-framed construction.

Assessments of multi-storey buildings using the 2006 Guidelines typically focused on the primary lateral load resisting system and didn't evaluate floor diaphragms. As a result, these assessments in many cases overstated the applicable ratings.

In contrast, assessments of lightweight low-rise buildings typically understated the true ratings as they placed undue emphasis on the lack of roof diaphragms and didn't take account of secondary load paths.

## 7.3. When and how should early assessments be revisited

Consideration needs to be given as to whether an existing seismic assessment based on the 2006 Guidelines is sufficiently current, particularly if it is informing a key decision.

From a technical perspective, in addition to any specific client requirements, the need to revisit early assessments depends on the predominant structural characteristics and extent and nature of heavy non-structural elements.

There is often a misplaced expectation on the part of both engineers and clients that a detailed re-assessment is required to "confirm" a rating.

It should be noted that from a regulatory perspective, the EPB methodology allows previous assessments (those prepared using earlier versions of the Guidelines) to be accepted by territorial authorities for earthquake prone building purposes providing they meet minimum quality marks. These include that the building was comprehensively inspected and described in the assessment report, and the results expressed as a *%NBS* rating.

In the majority of cases, qualitative reviews are considered an acceptable way of validating the rating grade from a prior assessment. The focus of the review in this situation is forming an opinion as to whether the assessment is of a reasonable quality and identifying whether a vulnerability exists that may not have been previously identified, or whether any scores are likely to be materially misrepresented (relative to current guidelines).

## 7.4. Use of building typologies

There are different approaches that can be applied in reviewing older assessments. These depend on the options under consideration for the building and typology of the building.

Building typologies provide a basis for categorising buildings by their construction type and era to provide a broad indication of their potential seismic vulnerability, and can be used to indicate the relative level of risk from buildings that have already been assessed.

The typology categorisations outlined in Table 5 on the following pages utilise and build upon the Profile Categories established by MBIE for territorial authorities to identify potentially earthquake prone buildings. The Profile Categories are the building types for which territorial authorities have or will request seismic assessments from owners – unreinforced masonry buildings (Profile Category A); buildings of three or more storeys pre-1976 (B) and one and two storey pre-1935 (C).

These typologies provide a broad indication of issues to check in pre-2017 (2018) assessments, and from there, determining what form of further assessment (if any) is warranted, as suggested in the right-hand column of this table. The areas of vulnerability, change in the 2017 Guidelines and potential change in rating noted in the table are indicative only.

**Table 5: Potential application of building typologies to determine potential changes to ratings from earlier assessments and areas to focus on in a review**

| Type | Construction Era and Type | Areas of Vulnerability | Areas of Change in 2017 Guidelines | Potential Change in Rating | Initial Areas to Look At |
|---|---|---|---|---|---|
| **A** | Unreinforced Masonry | Façade and wall separation from floors and roof | Parapets and chimneys to be included | Likely to decrease if parapets previously excluded | Review scope of assessment, incl. load paths (assumptions around floor/ roof to wall connections) |
| **B** | Pre-1976 3 or more storeys | Columns; joints; singly reinforced walls; wall foundations; inadequate movement allowance of precast cladding panels; early precast concrete floors | Precast panels; plain round bars; SSW for heavily loaded columns and slab-column connections; heavy NSE | Likely to decrease | Review presence and extent of heavy elements and plain bars in primary structure |
| **C** | Pre-1935 1 or 2 storeys (heavy) | Separation of walls from floors and roof | Plain round bars | Minor | |
| **D** | 1936 to 1975 1 or 2 storeys | Separation of walls from floors and roof; failure of infill panels | Plain round bars; precast panels/ walls; partially grouted infill | Potential decrease | Has the form of masonry infill been appropriately identified? |
| **E1** | Post-1976 concrete construction of three or more storeys | Heavily loaded columns prior to NZS3101:1995; precast floor systems; diaphragms connecting column and walls elements; precast concrete stair flights | Precast concrete floors; precast panels; heavy NSE | Likely to decrease | Review presence and extent of heavy elements; precast floors and diaphragms and the previous coverage in the assessment |
| **E2** | Post-1976 steel construction of three or more storeys | Precast concrete floor systems with non-ductile mesh; precast concrete cladding panel connections; precast concrete stair flights | Precast panels; heavy NSE | Potential for decrease | Review presence and extent of heavy elements<br>Highlight the potential for fractures at beam-column connections |

| Type | Construction Era and Type | Areas of Vulnerability | Areas of Change in 2017 Guidelines | Potential Change in Rating | Initial Areas to Look At |
|---|---|---|---|---|---|
| **F1** | Post-1976 one or two storey construction with precast floor or wall elements | Precast concrete cladding panel connections to roof and associated bracing; precast floor systems; tall/ inadequately restrained concrete block walls | Precast concrete floors; precast panels; heavy NSE | Potential for decrease | Review presence and extent of heavy elements; load path review |
| **F2** | Post-1976 one or two storey construction with in-situ concrete floor and light or medium-weight cladding | | Heavy NSE | Minor | Review presence and extent of heavy NSE |
| **S** | Steel-framed construction 1 or 2 storeys (light) | | Support for consideration of secondary load paths (A4.3) | Likely to increase | Only if warranted to increase rating |
| **T** | Timber-framed 1 or 2 storey | | Increased capacity and decreased loading ($S_p$) | Likely to increase | Only if warranted to increase rating |

# 8. Summary and next steps

## 8.1. Key messages

1. There are different drivers for reviews of seismic assessments, and different types of reviews that correspond to these drivers.
2. The continuum of types of reviews can be broadly characterised as:
   - No review
   - High-level/ qualitative review
   - Targeted quantitative review
   - Full technical/ quantitative
3. Being clear on the need for and purpose of any review of an assessment is the essential first step in scoping the level of detail of the review. The likely review pathway should ideally be mapped out prior to the commencement of an assessment.
4. Undertaking a high-level review as the first step in a review process is seen as being important in order to appropriately select the level of further review that is warranted. In many cases, a high-level review is all that is required.
5. Significant decisions can result from the receipt of a low seismic rating. These can range from decanting a building if appropriate risk advice is not taken, investing in significant strengthening or even demolition. Assessing engineers and reviewers alike therefore need to be aware of the consequences of an assessment being unduly conservative. This is a particular point of difference between reviews of assessments and peer reviews of designs of new buildings and strengthening work.
6. Ensuring that an assessment appropriately reflects the expected performance of the building and is not either simply reflecting the lower bound point at which element strength is exceeded or providing an overly optimistic view that overlooks key vulnerabilities should be an area of focus of any review.
7. A key aspect of both assessments and reviews is having a clear understanding of when a *significant life safety hazard* does (and doesn't) arise from an element with a low calculated ultimate strength (refer also to Joint Committee Report JC 25-01).
8. All types of assessment reviews need to be undertaken by experienced structural engineers. This is particularly the case where assessments involve a significant component of judgement, and for all qualitative reviews.
9. One of the key areas where careful judgement is required from the reviewer is in relation to the nature and extent of geotechnical input required.
10. Given the emphasis on the judgement component of assessments, it is not expected that reviews apply the same level of 'compliance rigour' as is involved in a Design Review Producer Statement (PS2). Exceptions to this are where the assessment feeds directly into the building consent for a strengthening design, or situations where the building is occupied by a large number of people and a significant vulnerability is present.

## 8.2. Next steps

It is recommended that this report be socialised with the engineering community via a Technical Society-led workshop which covers other assessment topics.

The report should also be shared with the EPB Review Project Team and Steering Group.