Joint Committee on the Seismic Assessment of Existing Buildings

Review of the Implementation and Application of the Engineering Guidelines

Project Report

March 2023

Contents

1. Introduction

1.1 Purpose of Review

The purpose of the review is to capture lessons from the use of the Guidelines since their release in July 2017, and to inform the management and maintenance of the Guidelines by the organisations responsible for their stewardship (MBIE, EQC, NZSEE, SESOC and NZGS). An associated purpose is to inform the work programme for the Guidelines currently being established by the Joint Committee representing those organisations.

In simple terms, the review aimed to identify:

- What are the positive features of the Guidelines and how they have been stewarded?
- Where are the areas where the Guidelines and their management can be improved?

1.2 Scope of Review

The review covered the range of purposes that assessments are undertaken for, including those beyond those for building regulatory purposes.

The review excluded the wider earthquake prone buildings 'system' elements such as the Building Act provisions, regulations and the EPB methodology itself.

While the focus of the review placed more emphasis on how the Guidelines were applied by engineers and the associated issues such as access to additional information and training, the perspectives of territorial authority building control officials was sought on the interface between the EPB methodology and the Guidelines as an important aspect of their implementation. As well as formally citing the Guidelines, the EPB methodology defines the scope of engineering assessments, how they are to be summarised and the criteria for acceptance by territorial authorities.

1.3 Basis of Review

The review involved one online workshop with 19 territorial authority representatives and three half-day workshops in Wellington, Auckland and Christchurch that were attended by 40 engineers. Workshop participants were selected by the Joint Committee and MBIE, with input from the three engineering technical societies for the nomination of engineers.

The workshops were facilitated by Dave Brunsdon from the Joint Committee, who has also prepared this review report.

2. Overview of Workshops

2.1 Workshop Scope and Participants

Workshop invitations were sent to 23 building control officials from 17 territorial authorities and 55 engineers from a range of consulting practices based in different locations (metropolitan and provincial) and reflecting a range of size of structures assessed. The building control officials were selected by MBIE and the engineers were nominated with input from NZSEE, SESOC and NZGS.

The workshops were attended by 19 building control officials and 40 engineers plus MBIE Building System Performance and Building System Assurance representatives. The building control officials represented 14 territorial authorities. The engineers (33 structural and 7 geotechnical) were from 24 consulting practices and organisations across New Zealand. Technical Society representatives on the Joint Committee also participated in the workshops.

The full list of workshop participants is provided in Appendix A.

2.2 Workshop Structure

Both sets of workshops were organised around the following themes to provide some structure to the discussions:

1. Management and monitoring of the Guidelines
2. The ability to respond to questions from users
3. The process for addressing errors in the Guidelines discovered by users, and incorporating advances in knowledge
4. Technical training on the use of the Guidelines
5. Applying the geotechnical step function (C4)
6. Assessing concrete buildings and elements (Yellow C5)
7. The handling of parts of buildings (C10) and interconnected structures
8. Gaps in current guidance

While many of the themes overlapped, the close inter-relationship between the first four themes emerged as a key high-level outcome, as commented on later.

It was acknowledged that the primary interface that BCOs have with the Guidelines is through MBIE's *EPB methodology*, as noted in Section 1.2.

3. Summary of Key Observations

The main discussion points from the workshops are presented in Appendix B, grouped under the themes outlined in the previous section.

The key observations from the workshop discussions are summarised in this section.

3.1 Achievements of the Guidelines

TA perspective

TA participants noted that assessments using the 2017 Guidelines were producing clearer and more consistent assessments than under the previous guidelines – 'a big improvement', and 'a huge leap forward'. The structure and format of assessment reports had noticeably improved. The Assessment Summary Report template was seen as a significant contributor to this improvement, and a valuable tool for all parties.

Engineers' perspective

The key success areas of the Guidelines and opportunities for future improvement of management and monitoring arrangements are summarised in Table 1 on the following page. These perspectives are consistent with those of the territorial authority representatives in relation to the key themes.

3.2 'Bigger Picture' Observations

Workshop participants were very conscious that the Guidelines are leading to low-rise buildings (other than Unreinforced Masonry) being given ratings that don't reflect their general overall resilience. This is thought to be a combination of demands being overstated for light framed and clad construction and due to Parts loadings, and capacities being understated. Guidance is therefore needed to enable secondary pathways to be better recognised and drawn upon in establishing overall ratings for low-rise buildings.

The inappropriateness of using the full seismic assessment process for identifying and addressing design shortcomings in buildings of newer construction was also commented on. A comprehensive load path review, which may or may not lead to further analysis and element assessment, is seen as a better starting point than a Detailed Seismic Assessment.

Table 1: Success Areas and Opportunities (from Engineers' workshops)

	Successes	Opportunities
1	The Guidelines are viewed as an essential document for seismic assessments (EPB or other purposes) and a huge step forward, and have led to significant improvement in the quality of assessments.	The primary purpose of seismic assessments should be re-emphasised to owners and engineers, along with what the assessment can (and can't) deliver namely: • to identify the vulnerabilities of buildings • providing information on life safety risk, not levels of damage and asset protection The lack of clarity associated with the introduction of Yellow C5 has highlighted the need for a process establishing how new knowledge (NZ and international) is brought through within a defined monitoring and updating cycle.
2	The Guidelines have been instrumental in getting engineers to look at buildings more holistically (applying displacement-based thinking), and to look for the 'important stuff' (ie. vulnerabilities and areas to focus on).	More insight and tools are needed to enable more realistic assessment of low-rise construction.
3	The Guidelines have provided insights as to where and how guidelines and standards for new building design need to develop (specifically displacement-based design), as well as shining the light on recent poor design practice.	Consideration should be given to a new branding of the assessment result which disconnects it from 'new building standard' that is subject to change.
4	The results of assessments have led to owners undertaking seismic strengthening to address vulnerabilities, which is the wider objective of seismic assessment.	Workshop participants however expressed some concern about whether some of the strengthening work is actually warranted, particularly in relation to low-rise buildings.
5	The 2017 Guidelines have encouraged engineers to think beyond design load levels	How to do this for some forms of construction requires further work.
6	The Guidelines have encouraged greater collaboration between geotechnical and structural engineers.	Awareness of how structural and geotechnical engineers should interact on assessments needs to be extended to achieve more consistent use of geotechnical information.
7	The 'rainbow diagram' (Fig A3.2) provides valuable assistance in understanding and communicating performance expectations and uncertainty, and could be used more.	There is a need to better clarify the purpose and limitations of '%NBS' as a risk metric.
8	The Assessment Summary Table has been widely adopted, and has led to a significant improvement in how assessments reports are summarised and presented. This is valuable for engineering review purposes as well as being required for EPB regulatory purposes.	There is the opportunity to expand the Assessment Summary Table to include some of the risk measures identified in MBIE's Seismic Risk Guidance

3.3 Areas of System Development Identified

There is a clear demand from TAs and engineering practitioners for a system that links together technical clarifications and training within an active monitoring framework.

The core elements of this system and how they interact can be indicated as follows:

1. A defined annual monitoring process

   which draws upon information from

2. A system for receiving and addressing questions and suggestions on the provisions of the Guidelines and providing clarifications through a combination of 'noticeboard/ informal' and 'authoritative' means

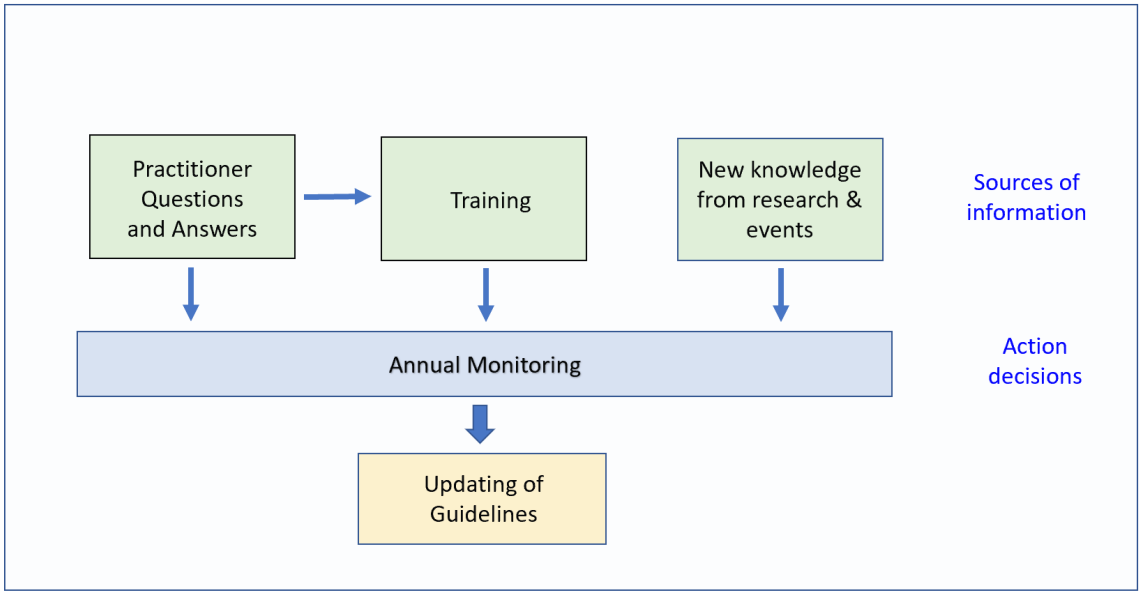
   that operates within a defined framework with

3. Agreed processes and pathways for progressively incorporating changes in knowledge and filling out gaps in knowledge within a defined cycle

   and

4. A structured approach to technical training that focuses on regular delivery in different formats

A schematic representation of how the system for managing the Guidelines is envisaged to operate is shown below:



4. Recommendations

As a new programme of work in support of the development of the Guidelines is established through the Joint Committee, this review of the first five years of their use and oversight provides clear indications as to where the priorities should be focused.

Six recommendations are provided for consideration and incorporation in the work programme currently under development by the Joint Committee. The first overarching recommendation relates to the system needed to support the successful implementation of the Guidelines, and the others are aimed at wider and more strategic technical needs.

The first recommendation is to treat the Guidelines more holistically as a system for the purposes of ensuring they are appropriately managed, as outlined on the previous pages. The system should comprise an active monitoring framework with feedback loops that link together the supporting activities such as providing timely feedback on technical questions, and training.

The second associated recommendation is to place priority on establishing a structured approach to technical training. A key component of future training is to re-emphasise the importance of considering how a building overall will perform, and to look beyond the numerical output from the model of the building. While the focus on establishing and reporting the scores of individual elements is useful to enable readers to understand the hierarchy of vulnerabilities, it is apparent some assessments are simply reporting the lowest score as the rating for the building rather than considering how the building as a whole is likely to perform.

Several areas within the Guidelines have been identified where updating and/ or further explanation is needed. The third recommendation is therefore that a work programme of technical updates be developed and commenced, with priorities and extent as directed by the Joint Committee.

In terms of the refinement and development of the Guidelines, this review has highlighted concern around many low-rise buildings being given ratings that don't reflect their general overall resilience. This is considered to be due to a combination of the likely overstatement of demand for light framed and clad construction and understatement of capacity available through secondary load paths. The fourth recommendation is to establish a technical workstream to reflect on the ratings that are being recorded for low rise buildings (other than unreinforced masonry), and consider whether adjustments should be made to certain provisions within the Guidelines.

A further issue that has arisen from the review is the inappropriateness of using the full detailed seismic assessment process for identifying and addressing design shortcomings in buildings of more recent construction. The fifth recommendation is therefore to develop guidance on undertaking comprehensive load path reviews focusing on identifying vulnerabilities as a more appropriate starting point for reviewing buildings of recent design and construction (eg. less than ten years).

The challenges associated with using the term 'New Building Standard' for seismic assessments of existing buildings when the basis for new building design is continuing to evolve was raised during this review. In the face of the release of the updated National Seismic Hazard Model, and that many seismic assessments are being undertaken to understand the current level of seismic risk rather than for earthquake prone buildings purposes, there is both the need and opportunity to review how the term New Building Standard is applied. The final recommendation addresses this and the possible expansion of the standard Assessment Summary Table to include some of the risk measures identified in MBIE's Seismic Risk Guidance.

These recommendations are summarised in the following table:

Recommendation 1	The Guidelines should be managed more holistically as a system, comprising an active monitoring framework with feedback loops that link together the supporting activities such as timely feedback on technical questions, and training.
Recommendation 2	Priority should be placed on establishing a structured approach to technical training. A key focus of training is re-emphasising the importance of considering how a building overall will perform.
Recommendation 3	A work programme of technical updates be developed and commenced, with priorities and extent as directed by the Joint Committee, and communicated to industry.
Recommendation 4	Establish a technical workstream to reflect on the ratings that are being recorded for low rise buildings (other than unreinforced masonry), and consider whether adjustments should be made to certain provisions within the Guidelines.
Recommendation 5	Develop guidance on undertaking comprehensive load path reviews focusing on identifying vulnerabilities as a more appropriate starting point for reviewing buildings of recent design and construction.
Recommendation 6	The Joint Committee should review how the term *New Building Standard* is applied for seismic assessments of existing buildings given the continuing evolution of the basis for new building design. Consideration should also be given to expanding the standard Assessment Summary Table to include some of the risk measures identified in MBIE's Seismic Risk Guidance.

Appendix A: Workshop Participants

A1: Territorial Authority Workshop

Organisation	Name
Auckland Council	Patrick Cummeskey & Jose Paul
Hamilton City Council	Ian Shireffs & Alister Arcus
Tauranga City Council	Michael Sheridan & Rob Wickman
Whakatane District Council	Jeff Farrell
Manawatu District Council	Karel Boakes
Upper Hutt City Council	Helen Davis
Hutt City Council	Claire Stevens
Wellington City Council	Ryan Fraser
Nelson City Council	Bruce Mutton
Hurunui District Council	Kerry Walsh & Cameron Ashworth
Waimakariri District Council	Greig Wilson
Timaru District Council	Jayson Ellis
Dunedin City Council	Neil McLeod & Peter Brookland
Invercargill City Council	Michael Hartstonge
MBIE Building System Performance	Mark Ryburn
MBIE Building System Assurance	Matt Grant

A2: Engineers Workshops

Wellington

Organisation	Name	Discipline
Aurecon	Tessa Beetham	Structural
Beca	Rob Jury and Henry Tatham	Structural
CGW	Audrey Farreyre	Structural
Clendon Burns & Park	Anthony Taylor	Structural
Dunning Thornton	Alastair Cattanach	Structural
GHD	Amy Williams	Structural
Holmes Consulting	Laura Whitehurst	Structural
Sawrey Consultants	Stephen Sawrey	Structural
Silvester Clark	Ignatius Black	Structural
Spencer Holmes	John McNaughton	Structural
Tonkin & Taylor	Stuart Palmer	Geotechnical
Manawatu District Council	Karel Boakes	Building Control Manager
MBIE Building System Performance	Ken Elwood	
MBIE Building System Performance	Mark Ryburn	

Auckland

Organisation	Name	Discipline
Arnold and Johnstone	Gavin Douglas	Structural
Aurecon	Craig Stevenson	Structural
BCD	Adam Langsford	Structural
Beca	Craig Lavin	Structural
Beca	Phil Clayton	Geotechnical
Compusoft	Nic Brooke	Structural
Holmes Consulting	Andy Thompson	Structural
Structure Design	Ashley Smith	Structural
Riley Consultants	Nigel Fitch	Geotechnical
RS Engineering	Rachel Wright	Structural
Tonkin & Taylor	Guy McDougall	Geotechnical
University of Auckland	Jason Ingham	Structural
WSP	Paul Campbell and Julian Benito	Structural
MBIE Building System Performance	Ken Elwood	

Christchurch

Organisation	Name	Discipline
Aurecon	Lee Howard	Structural
Aurecon	Dominic Mahoney	Geotechnical
Beca	Jared Keen	Structural
Beca	Richard Young	Geotechnical
Calibre	Sean Gardiner	Structural
Elmac	John Mackenzie	Structural
GHD	Andrew McMenamin	Structural
Holmes Consulting	Stuart Oliver	Structural
Lewis Bradford	Tim Shannon	Structural
Structex	Tim Keating	Structural
Tonkin & Taylor	Hayden Bowen	Geotechnical
WSP	Jess Orpwood	Structural
Ministry of Education	Mark Willard	Structural

Appendix B: Key Workshop Comments and Discussion Points

B1: TA Workshop

The key comments and discussion points from the TA workshop noted under each of the themes are summarised below:

1. Alignment between the EPB Methodology and the Guidelines

The general view was that the EPB Methodology and Part A of the Guidelines were consistent in what they required to be covered, particularly in relation to parts.

The wider use of the term 'earthquake rating' in the Guidelines to encompass all %NBS ratings than specifically defined in the legislation was noted as a potential inconsistency.

2. The handling of parts of buildings, including interconnected structures

The treatment of parts in section A4 of Part A of the Guidelines (particularly tables A4.1 and A4.2) was generally considered clear and aligned with the requirements of the EPB methodology.

The lack of clarity of how engineers scoped their assessment of parts (ie. what was included and excluded) and conveyed this in their reports is however a concern, and the common subject of followup questions from TAs.

In respect of interconnected structures, TAs noted the difficulty in getting engineers to adequately investigate and assess how sections under different ownership interact. This appears to be more of an issue for low- and medium-rise structures in smaller centres where ISAs can otherwise suffice if well applied. Greater education of both owners and engineers appears necessary. For engineers, this could include supplementing the wording currently in section A4.3.3 B*uildings with interconnected structures* with the diagrams used in training on the EPB methodology.

Addressing interconnected structures was acknowledged as being one of the most challenging aspects of the new EPB system.

3. Management and monitoring of the Guidelines

The management and monitoring of the Guidelines as the technical component of the system was considered adequate by the TA participants.

4. The ability to address questions from users of the document (ie. the EQ-Assess website)

Participants had typically not sought clarification of the Guidelines in the course of their work. For those that had via the EQ-Assess website, the period of time that it took for an answer to be provided was commented on.

5. The process for addressing errors in the Guidelines discovered by users, and other advances in knowledge

It was noted that the process for incorporating new technical information and knowledge did need to be clarified and streamlined in order to avoid the repetition of the Yellow C5 chapter situation.

6. Issues arising from reviewing and accepting Previous Assessments (prior to July 2017)

The process of reviewing and accepting Previous Assessments (those prior to July 2017) is prescribed under section 3.3 of the EPB methodology. The need to take heavy façade elements (with associated public risk) into account when not typically included in earlier assessments was noted as requiring attention in the EPB methodology. Similar questions relate to buildings that are now recognised as comprising interconnected structures.

One learning from the Kaikoura Earthquake was that previous assessments required engineering confirmation that earthquake damage had not occurred prior to acceptance by a TA, and that this would also be a worthwhile addition to the EPB methodology.

7. Clarifying where ISAs are valid assessments as opposed to when DSAs are required

Discussion highlighted the different levels of detail that may apply to assessments as opposed to that required to inform strengthening designs. On the one hand, where it is apparent that a building will rate less than 34%NBS and it is a straightforward low-rise structure, only a brief assessment (eg. an ISA) may well suffice, provided that it clearly identifies all the elements scoring less than 34%NBS. However on the other hand, where strengthening design depends upon existing building elements (or where existing secondary structural elements will be retained), that design needs to be informed by a reasonably detailed assessment.

The requirements of owners, including likely time frames prior to strengthening, may therefore be an influencing factor on the decision on how detailed the assessment needs to be at a particular point in time.

It was considered useful if the Guidelines could emphasise the need for specific element assessments to be undertaken as an input to strengthening designs – not necessarily a full DSA, but that strengthening designs were unlikely to be acceptable of an ISA.

Similarly, re-emphasising in the Guidelines that assessments with ratings close to the 34%NBS EPB threshold were likely to receive close TA scrutiny (irrespective of being from an ISA or DSA) is considered worthwhile.

8. Other general points raised

Other general points included:

- The lack of technical engineering training is reducing the effectiveness (currency) of the engineering qualification statements provided in the Assessment Summary Tables.
- There is a continued difficulty in obtaining engineering assessments in some centres (engineering capacity).
- This is leading to some TAs facilitating sets of engineers to undertake main street assessments, in addition to driving consistency in smaller towns.
- Some engineers are still overstating the accuracy of the assessment results (ie. to single percentages). The expression of ISA results in say 10% bands is seen by some as warranting further consideration.
- TAs need to be careful in accepting engineering assessments onto property files when submitted voluntarily – TAs need to either review them as they would an assessment for EPB purposes or have suitable disclaimer text to clearly portray. Similar challenges are associated with 'accepting' the nominated %NBS level achieved in strengthening consents.
- Several participants noted that younger engineers were reporting with greater clarity and consistency than some older engineers, who have not changed their reporting approach.

Overall: Successes and Opportunities

Participants noted that assessments using the 2017 Guidelines were producing clearer and more consistent assessments than under the previous guidelines – 'a big improvement', and 'a huge leap forward'.

The structure and format of assessment reports had noticeably improved. The Assessment Summary Report template was seen as a significant contributor to this improvement, and a valuable tool for all parties.

Opportunities for refinement and addition to the Guidelines (primarily in relation to Part A) were identified in the above comments.

B2: Engineers Workshops

The key comments and discussion points from the three Engineers' workshops noted under each of these themes are summarised below:

1. Management and monitoring of the Guidelines

a) The view was expressed that the monitoring process should be defined, and should be informed by an analysis of questions from practitioners to understand where current and future issues are (ie. cross-reference to Theme 2).

b) The Guidelines should also be monitored against and calibrated with international assessment guidance

c) Participants indicated that an annual meeting of the Guidelines partners, with associated communication of plans and intentions to industry, is the minimum required engagement.

d) Planned and active management of the Guidelines is seen as important - having a more defined cycle for updates to the Guidelines is seen as being desirable.

e) Considerable frustration was expressed about the inability to communicate with owners about the intended technical and regulatory pathway and update timelines for the Guidelines (particularly Yellow C5). Having to re-explain changes to the Guidelines (and hence assessment results) has caused credibility challenges for the profession.

2. The ability to respond to questions from users of the document (ie. the EQ-Assess website)

a) While most workshop participants no longer used or accessed EQ-Assess (some were even unaware of it), its value as the dependable source of current information and to easily access sections was acknowledged.

b) The desirability of industry having an active vehicle/ mechanism for accessing the latest information was highlighted (in essence, a technical network). The forms of this latest information cover:

   i) Status of elements of the Guidelines

   ii) Flagging known errors (actual or potential) as they are identified, prior to resolution

   iii) Additional commentary on/ interpretation of areas of potential ambiguity

   iv) Relevant reviewed conference papers (covering technical and case study aspects)

c) It was observed that engineering practices of a certain size had the ability to navigate areas of uncertainty in the Guidelines, but small and medium size practices have a greater need for interpretive advice.

d) It was also noted that it is highly desirable to have access to this form of advice rather than learning through peer reviews. Most questions on the Guidelines boil down to two aspects – *how to interpret the provisions* and *how to apply them*.

e) Having a rolling series of FAQs structured by themes and topics is seen as a basic way of starting this process. Another suggestion is to have a 'live' version of the Guidelines with sticky notes and/or hyperlinks to explanations added.

f) The need to balance having 'authoritative statements' vs 'open forum/ noticeboard' environments is important. Both are considered valuable, noting the importance of timeliness for most forms of information. Having a moderating group (eg. appointed by the Joint Committee) is seen as key to enabling timely authoritative statements.

3. The process for addressing errors in the Guidelines discovered by users, and other advances in knowledge

a) It was noted that the process for incorporating new technical information and knowledge did need to be clarified and streamlined in order to avoid the repetition of the Yellow C5 chapter situation.

b) MBIE are developing a pathway framework for the incorporation of new technical information generally. This will include having certain forms of information available in draft format for industry trialling and feedback, to avoid putting new/ unverified information into guidance and standards.

c) The different drivers for changes to the Guidelines can be considered under the following categories:

1. Errata – eg. typos/ incorrectly transcribed equations/ incomplete sentences
2. Clarifications of interpretation – addressing incomplete explanations or ambiguous text
3. Changes in knowledge in particular areas – new research, earthquake learnings (NZ and overseas)
4. Filling out gaps in knowledge – areas known to not be documented (eg. partially reinforced masonry)
5. The need for a more general re-write - due to adjustments in general assessment philosophy or affecting several sections

d) A general observation was that the profession tends to latch onto prescriptive approaches and utilise them to the maximum. This leads to losing the ability to use judgement.

4. Technical training on the use of the Guidelines

a) The lack of technical training on the Guidelines has been of concern to practitioners. This has forced medium and larger practices to develop and deliver their own internal training.

b) The importance of engineers being able to access technical training to maintain their confidence in the judgement-rich aspects of assessment in order to avoid undue conservatism was emphasised.

c) Regular training also creates the opportunity for engineers to ask questions on matters of interpretation.

d) 'Little and Often' is seen as a key guiding principle in designing and delivering training, along with being innovative in the use of face-to-face, webinar and video recorded components. The SLaMA video by Weng Yuen Kam in 2016 is an example of a high value short video.

e) A clearer analysis of which aspects of assessment warrant face-to-face training is needed.

f) The need for re-iteration of the key points in relation to complex concepts was noted. This highlights the value of having access to video recordings of face-to-face training sessions.

g) Sessions that work through issues involving both structural and geotechnical engineers is seen as a high value area to address a particular area of need.

h) While worked examples are seen as valuable, it was observed that many are often idealised. Although typically featuring less detail, case studies are seen as being of high value, as they can provide insights as to how engineers have 'read' a complex building and formed a view on the more holistic issues.

i) In terms of the different levels of seniority and experience to target for training, intermediate to senior engineers are seen as preferable in order to focus on exercising judgement. There is an equal need to assist engineering practices in training younger engineers in the basics of assessment – particularly the fundamental difference between design and assessment.

j) The value of post-graduate courses on assessment that are periodically delivered by Auckland and Canterbury universities was also noted, but that they need be structured as part of an integrated training programme.

k) Training should re-iterate the fundamentals such as the need for a building to have a reasonably complete load path before it can be analysed (eg. floor to wall and roof connections in URM buildings).

l) Another training need is in the area of writing up and explanation of the risk aspect of assessments. This is seen as an opportunity to bring through some of the risk messages in the July 2022 MBIE Seismic Risk Guidance document.

m) A further suggested area of training need is in the conducting of peer reviews of seismic assessments.

n) In response to a question about the barriers for engineers in attending training, direct cost is not seen as being a particular barrier (it is usually a secondary consideration to loss of productive time), provided that the training is part of a wider training delivery programme with all key elements articulated.

o) The value of running training on draft guidance was also noted, as this always identifies the rough edges that improves the final form of guidance.

p) Encouragement for greater use of flowcharts to illustrate processes, rather than words, both for within the Guidelines and as a basis for training

q) Consideration should be given to using a train-the-trainer approach, as was successfully used for ISA training in 2014/15.

5. Applying the geotechnical 'step function' (C4)

a) There is currently inconsistent understanding and application of the geotechnical step function by engineers.

b) In particular, there is a need for more clarity around when a geotechnical step change is and isn't likely to occur. It should correspond to a sudden change in ground conditions rather than progressive/ incremental deterioration. The key consideration is the significance for the structure – are you likely to lose stability that could lead to collapse? (ie. having a geotechnical step change is not necessarily fatal for the structure).

c) Acknowledgement that the range of circumstances (both ground and structure) that can give rise to a step change has led to much of the inconsistency and variation in application between practices. There is a need for better guidance on translating this to %NBS scores.

d) Other contributing factors noted include the lack of alignment between the scope and definition of Severe Structural Weaknesses and the C4 Step Change, and the seemingly conservative nature of geotechnical information (eg. the calculated potential onset of liquefaction doesn't necessarily correspond to the expected behaviour of the ground).

e) The iterative nature of evaluating ground capacities corresponding to increasing levels of acceleration was also noted. The associated difficulty in quantifying the pathway from 'a little movement to a lot of movement' was also commented on.

f) Having the ability to firstly, understand and secondly, explain the uncertainty associated with step change is seen as being key (eg. commentary akin to 'Designing for Uncertainty' guidance?).

g) It was observed that knowledge of C4 and the step function is not widespread amongst geotechnical engineers, as many geotechnical practices have key individuals that focus on assessment work.

h) A re-iteration of how the underlying principles should be applied, set against various circumstances to better illustrate the principles, is seen as being relatively urgent (a combination of enhanced guidance and training). This includes emphasis on the need for geotechnical and structural engineers to work closely together.

i) The emphasis should be on types of structures that are clearly more vulnerable to poor ground performance (eg. analogous to 'ledge' type structures).

j) Another area of need is clarity on where you do (and don't) need geotechnical input for assessments, and what form this should take and at what stages

- eg. initial desktop review of available information and interaction with the structural engineer to determine if further and more specific information is required, and obtaining this where considered necessary

k) Some engineers are relying on older and/ or limited geotechnical information (including those commissioned for other purposes); some assessments expressly exclude geotechnical considerations, without realising that the %NBS rating they provide is invalid.

l) It was also noted that some TAs do not accept engineering assessments without geotechnical reports. This is not seen as being appropriate as a blanket rule.

m) Other geotechnical areas of uncertainty relate to basement structures where low scores typically result from the application of earthquake retaining wall loadings – but have life safety failures of these structures been observed? The corollary from retaining walls in the Port Hills of Christchurch was that walls that were poorly designed for static loadings

and/ or poorly constructed failed, whereas adequately designed and constructed walls didn't.

6. Assessing concrete buildings and elements (Yellow C5)

a) As noted earlier, the unclear regulatory pathway associated with the introduction of Yellow C5 and lack of associated communications from 2018 was seen as very unsatisfactory.

b) The introduction of Yellow C5 at a time when engineers were still becoming familiar with the revised Guidelines has led to 'change fatigue' on the part of both engineers and owners.

c) The project in the first half of 2023 to update certain aspects of Yellow C5 was outlined for the benefit of workshop participants. These improvements will be proposed irrespective of future incorporation into the Red Book for regulatory purposes.

d) Areas of particular focus in the forthcoming update of Yellow C5 include:

- Clarifying the intent and application of certain provisions
- Aligning the criteria for SSW with those in C1
- Providing additional guidance for diaphragms in low-rise buildings and those above 9 storeys (both the demand and capacity; questions as to whether results from the current guidance are reflecting the transient nature of diaphragm loading)
- For precast floor systems, introducing the new findings on beta hollowcore units from the ReCast project
- Aiming to put the different systems in context ie. better reflect the continuum from higher risk hollowcore and double tee systems through rib systems and lower risk flat slab systems

7. The handling of parts of buildings (C10), including interconnected structures

<u>Parts</u>

a) One of the biggest challenge in respect of Parts is the question of how comprehensively engineers need to inspect buildings at the scoping stage of an assessment to determine if heavy non-structural elements are present (especially with regard to ceiling spaces). The variability in practice on this was commented on.

b) The difficulty in calculating scores for heavy suspended ceiling systems and the associated sensitivity of score was also noted.

c) Concern was expressed about the impact of the current high Parts loadings from NZS1170.5 – low scores are being generated as a result, and there is scepticism as to whether they are warranted for many structures, especially low-rise buildings.

d) Clarity on where masonry veneer does/ doesn't need to be specifically assessed (eg. requiring evaluation of ties adjacent to egress ways?).

e) Guidance on how to realistically assess the probable capacities of cast-in and post-installed concrete anchors is also required, noting that new design standards are conservative and are heavily penalising previous retrofits.

Interconnected structures

f) Additional guidance is needed on the assigning of different scores to different sections of interconnected buildings, including treatment of different Importance Levels and egress.

g) Advice on qualitative ways of evaluating whether or not different lateral load resisting systems in adjoining one and two storey buildings will impact the scores for a specific property (a particular issue in smaller towns and suburban areas) should be developed.

8. Gaps in Current Guidance

a) Reinforced concrete masonry (including partially reinforced masonry). This had been previously identified by the Guidelines authors as being the next section to write (ie. C11)

b) The required geotechnical inputs for ISAs

c) Enabling the rocking of walls and braced frames in low-rise lightweight structures to be taken into account

d) Walls and floor diaphragms – the levels of movement before loads in diaphragms are redistributed

e) Guidance to clarify (and hopefully reduce) the numbers of load cases that need to be evaluated with respect to concurrent directions of loading

f) Clarifying the anticipated margin for loadings beyond ULS (particularly important for regions of lower seismicity).

- For example, do C5 and C6 offer the same reliability/ margin?
- The different ways that column sway mechanisms are being evaluated

g) Better definition/ example of application of Importance Levels, and scope of assessment of IL4 structures

h) Concrete-encased steel sections

i) Transverse loading on stair flights (but has that been observed as a failure mode?)

j) Clarifying the boundary conditions required for the analysis of key URM elements such as gable ends

k) More clarity on the limitations of using force-based assessments without prior SLaMA pushovers

l) For assessing buildings where no drawings can be found, more guidance on the extent of intrusive investigation required

m) Consideration of introducing a reliability factor to account for conveying the increased uncertainty in such situations, and requiring the outcome ratings to be reported as a band

n) How to assess previous retrofit work (both older and recent work)

Other Discussion Points

Applicability of %NBS ratings

Overall guidance on where %NBS ratings should and shouldn't be used is seen as important. The observation was made in all three workshops that %NBS ratings are currently being used far too widely (eg. insurance).

Low-rise lightweight buildings

As part of a wider discussion on whether many of these structures are warranting the low calculated ratings, the inability to quantify secondary load paths such as provided by roof and wall steel sheet cladding was highlighted as an area requiring specific attention.

Participants commented that the high (and potentially unnecessary) remediation costs for these buildings are often significant.

When do recent buildings warrant assessment?

Greater clarity is sought on situations when relatively new buildings should have an assessment undertaken. The relevance of a %NBS rating for buildings less than ten years old unless they have multiple established vulnerabilities was questioned.

Views were expressed that full DSAs are not generally warranted where specific (often local) vulnerabilities are apparent. A load path review based on the drawings with a focus on key vulnerabilities of modern construction (eg precast floors and precast panel connections) is seen as the primary requirement in such situations.

The associated point is that the unsuitability of ISAs for most modern buildings should be highlighted.

Guidance on Seismic Improvement

Guidance is sought at both the philosophy and detail levels – particularly how assessed capacities of existing elements from assessments are taken through into strengthening designs – ie. extension of the current A10.

Also design values for composite materials applied to existing structure (eg. FRP on URM walls) would be useful.

Obligations to Report Low Ratings to Territorial Authorities

Discussion established the view that there is no specific obligation to require owners to report low ratings to TAs, or ethical obligation on engineers to do so.

It is however important for engineers to actively encourage owners to disclose low ratings to occupants and users of the building.

The updated National Seismic Hazard Model

Guidance is needed on how to use the updated model for assessments for other than EPB purposes.