The Seismic Assessment of Existing Buildings

Technical Guidelines for Engineering Assessments

Revised Draft – 10 October 2016

Part B – Initial Seismic Assessment

New Zealand Society for Earthquake Engineering

Document Status and Amendments

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2016_SB	3 June 2016	Draft for Sector Briefings
2016_C	10 Oct 2016	Revised draft to accompany consultation proposals for the regulations and EPB methodology under the *Building (Earthquake-prone Buildings) Amendment Act 2016*

This document is intended to be referenced by the Earthquake Prone Buildings (EPB) Methodology being developed under the provisions of the Building (Earthquake-prone Buildings) Amendment Act 2016. It is also intended to be endorsed by MBIE for use as guidance under section 175 of the Building Act 2004 to the extent that it assists practitioners and territorial authorities in complying with that Act.

Document Access

This draft document may be downloaded from www.EQ-Assess.org.nz in parts:

1 Part A – Assessment Objectives and Principles

2 Part B – Initial Seismic Assessment

3 Part C – Detailed Seismic Assessment

Updates will be notified on the above website.

The document is expected to be published before the Act comes into force, when the regulations and EPB Methodology associated with the Building (Earthquake-prone Buildings) Amendment Act 2016 come into force.

Document Management and Key Contact

This document is managed jointly by the Ministry of Business, Innovation and Employment, the Earthquake Commission, the New Zealand Society for Earthquake Engineering, the Structural Engineering Society and the New Zealand Geotechnical Society.

Please use the feedback forms on www.EQ-Assess.org.nz to provide feedback or to request further information about these draft Guidelines.

Acknowledgements

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Appendices

B1. Introduction

B1.1 General

The Initial Seismic Assessment (ISA) is the recommended first step in the overall assessment process. It is intended to be a coarse evaluation involving as few resources as reasonably possible and it is expected that an ISA will be followed by a Detailed Seismic Assessment (DSA) where important decisions are intended that are reliant on the seismic status of the building. Such decisions might include those relating to pre-purchase due diligence, arranging insurance, confirming the earthquake-prone status and prior to the design of seismic retrofit works. An ISA completed with a high level of information available may be sufficient to confirm the earthquake prone status of a building at the discretion of the assessing engineer.

The process that is adopted for the ISA will, to a large extent, depend on the particular objectives of the assessment and the number of buildings that are involved. The ISA process for a portfolio of buildings or for the identification of earthquake-prone buildings by a Territorial Authority (TA) may have a different focus from that for a single building. The principal elements of the ISA process are shown in Figure B.1.

When multiple buildings are involved, prioritisation may be necessary as it may be impractical to assess all buildings simultaneously and immediately. Accordingly there may be a need to focus resources on buildings which have the potential for greatest gains. Prioritisation will not be an issue if only a small number of buildings are being considered.

The main tool provided in these guidelines for the initial assessment of buildings is the Initial Evaluation Procedure, referred to as the IEP. The IEP is described below and in Appendix BA, and is essentially unchanged from the version updated in 2014 (NZSEE Guidelines (2006) including corrigenda 1, 2, 3 and 4). This, in turn, is essentially the same, but with some refinements, as the IEP introduced in the 2006 guidelines. It is recognised that for particular types of building the IEP can be meaningfully enhanced by considering other attributes that are specifically targeted to the type of building. Appendix BB contains specific provisions for unreinforced masonry buildings which are intended to be used in conjunction with the IEP. However, the attribute method generally requires a greater level of knowledge of a building than is typically expected or intended for an IEP carried out as part of a basic ISA.

A fundamental aspect of the IEP is the identification, and qualitative assessment, of the effects of any aspects of the structure and/or its parts that would be expected to reduce the performance of the building in earthquakes, and thereby increase the life safety risks to occupants and/or have an adverse effect on neighbouring buildings. These deficiencies in the building are referred to as potential critical structural weaknesses (CSWs).

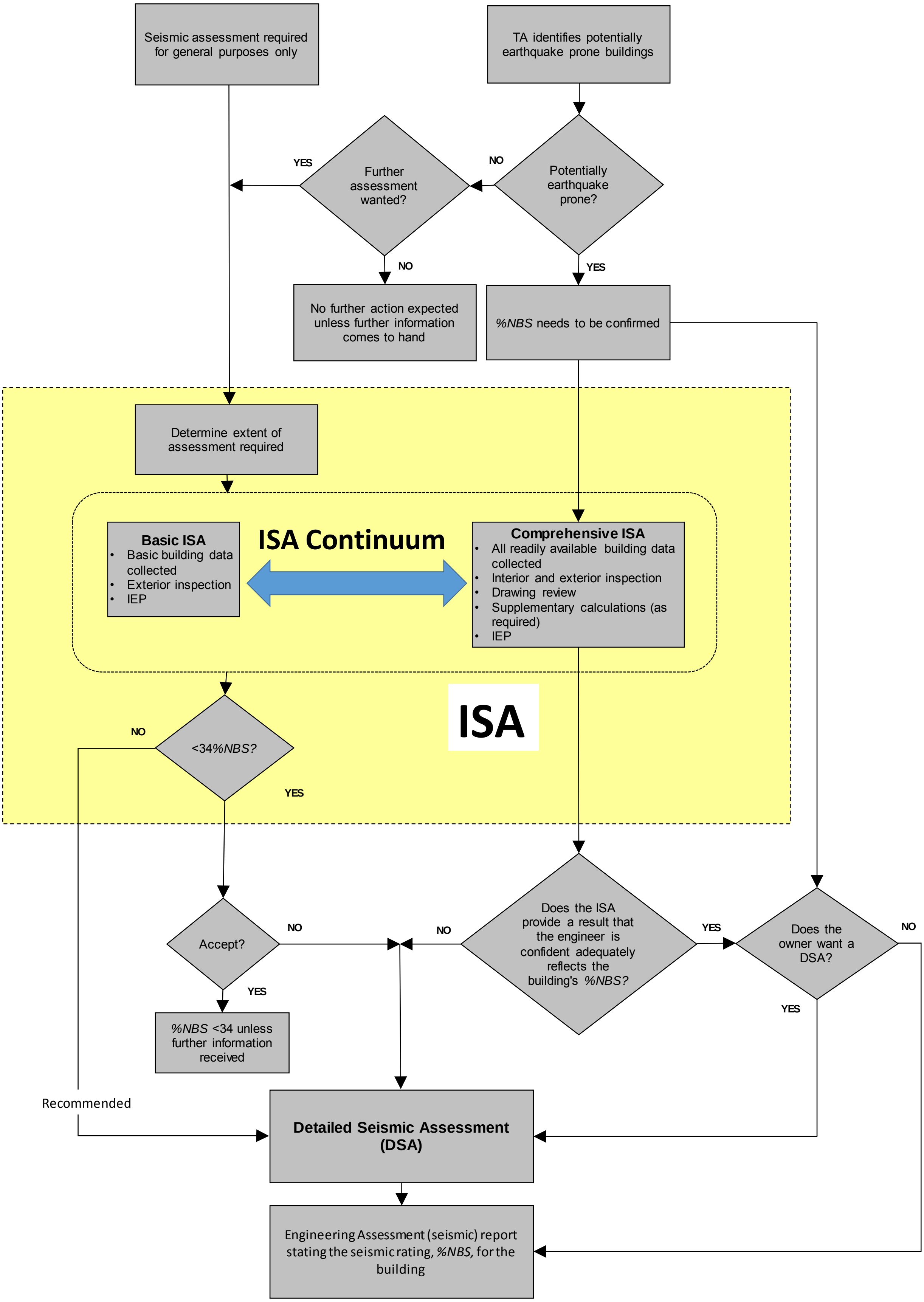

Figure B.1: Diagrammatic Representation of Initial Seismic Assessment Process

While other procedures can be substituted for the IEP in the ISA, it is important for consistency that the essence of the IEP is maintained and that the result is reflective of the building as a whole.

Calculations to support judgement decisions on particular aspects of the ISA are encouraged. This would be expected to lead to a more reliable seismic rating from the ISA without the full cost of a DSA. However, care should be taken to avoid over-assessment in one area at the expense of another without a more holistic assessment of the building. The potential rating for a building as a whole from an ISA must reflect the best judgement of the assessor, taking into account all aspects known to the assessor.

The result from the ISA process is reported in terms of a *%NBS* (percentage of new building standard) seismic rating in a similar fashion to the result from a DSA, but must be considered an initial or interim result for the reasons outlined above. It therefore reports a *potential* rating for the building, and all potential SWs are given the status of potential CSWs. Further, more detailed assessment, or consideration of further information, could potentially raise or lower the ISA rating and this should be expected.

An ISA can be carried out with varying levels of knowledge. For example an ISA can be completed solely on the basis of an exterior inspection, or could extend to a detailed review of drawings. The use of the original drawings will allow a reasonable review of internal details such as foundations, stairs, column ductility and floor type.

Note:

The use of original drawings is recommended if the building is rating around the threshold levels of 34*%NBS* and 67*%NBS*.

As indicated on Figure B.1 a comprehensive ISA, with reference to drawings, interior and exterior inspections and supplemented with calculations (if required) may, at the discretion of the assessor, be used to confirm the status of an earthquake prone building. It is likely that this option would only be viable in cases where the assessment is clearly indicating either the building is earthquake prone, or it is not. The viability of this option is still under discussion as noted in the following section.

The reporting of the results of the ISA should be appropriate for the particular circumstances. It is recommended that when ISA reports are sent out to building owners and/or tenants they include explanatory information such as a description of the building structure, the results of the ISA, the level of knowledge available and the limitations of the process. Expectations for the reporting of an ISA are outlined in Section B5, with a recommended template provided in Appendix BC.

Recommended template letters for territorial authorities (TAs) advising owners of the outcome of TA generated assessments are provided in Appendices BD and BE.

B1.2 Regulatory Considerations

ISAs and IEPs as outlined in the NZSEE's 2006 Guidelines have been used extensively by a number of TAs as a method of establishing which of the buildings in their cities or district are potentially earthquake prone. This has typically been undertaken as part of active earthquake-prone buildings policies established under the Building Act 2004.

The EPB Methodology under the Building (Earthquake-prone Buildings) Amendment Act 2016 will contain profiles of potentially earthquake-prone buildings – categories of buildings with known seismic vulnerabilities and that can be considered potentially earthquake prone. For buildings in these categories, it is anticipated that the TA will write to the owners and request an *engineering assessment* in accordance with the provisions of the Building (Earthquake-prone Buildings) Amendment Act 2016.

Criteria for when an ISA may be used as an *engineering assessment* in terms of the EPB Methodology under the Building (Earthquake-prone Buildings) Amendment Act 2016 are under development and will be subject to consultation.

TAs may also continue to use the ISA as a more specific screening tool or as an additional engineering input to the profiling process for certain types of buildings.

Note:

Criteria for the acceptance under the Building Amendment Act of IEPs and ISAs that have previously been submitted to TAs in relation to their earthquake-prone buildings policies or for other reasons will be established as part of the EPB Methodology development process. These criteria will take into account factors such as the level of detail of the assessment and the degree of review or moderation that has been applied. This does not include situations where s124 notices under the current legislation have already been issued based on an ISA and/or IEP. In these cases, it is expected that buildings already identified as earthquake prone and issued with a notice requiring remediation work will have their notice replaced under the new provisions, so long as the building remains within the scope of the Amendment Act. Obligations on owners to undertake remediation work and further engineering assessment to move out of earthquake prone status will remain. MBIE are preparing guidance on the procedures that will be expected to be followed during the transitional phase as the new legislation is brought into force.

B1.3 Definitions

CBD	Central Business District
Critical Structural Weakness (CSW)	The lowest scoring structural weakness determined from a DSA. For an ISA all structural weaknesses are considered to be *potential* critical structural weaknesses.
Earthquake-Prone Building (EPB)	A legally defined category which describes a building that that has been assessed as likely to have its ultimate capacity (which is defined in Regulations) exceeded in moderate earthquake shaking. In the context of these guidelines it is a building with a seismic rating of less than 34%*NBS* (1/3 new building standard).
Earthquake Risk Building (ERB)	A building that falls below the threshold for acceptable seismic risk, as recommended by NZSEE (i.e. <67%*NBS*).

IEP	Initial Evaluation Procedure
IL	Importance Level defined by AS/NZS 1170.0:2002
ISA	Initial Seismic Assessment
NBS	New Building Standard – i.e. the standard that would apply to a new building at the site. This includes loading to the full requirements of the Standard.
NZS	New Zealand Standard
NZSEE	New Zealand Society for Earthquake Engineering
PAR	Performance Achievement Ratio
PIM	Project Information Memorandum – refer to Building Act Section 31
Potential Critical Structural Weakness (pCSW)	All potential structural weaknesses are considered to be potential CSWs at the time of an ISA
Severe structural weakness (SSW)	A defined structural weakness that is associated with potential catastrophic collapse and for which the capacity may not be reliably assessed based on current knowledge. For an ISA, all Severe Structural Weaknesses are considered to be *potential* Severe Structural Weaknesses and are only expected to be noted when identified.
Seismic rating	The rating given to a building as a whole to indicate the seismic standard achieved in regard to human life safety compared with the minimum seismic standard required of a similar new building on the same site. Expressed in terms of percentage of new building standard achieved (*%NBS*).
Seismic score	The score given to part of a building to indicate the seismic standard achieved in regard to human life safety compared with the minimum seismic standard required of a similar new building on the same site. Expressed in terms of percentage of new building standard achieved (*%NBS*).
SLS	Serviceability limit state as defined in NZS 1170.5:2004 (or NZS 4203:1992), being the point at which the structure can no longer be used as originally intended without repair
Structural Weakness. (SW)	An aspect of the building structure and/or the foundation soils that scores less than 100*%NBS.* Note that an aspect of the building structure scoring less than 100*%NBS* but greater than or equal to 67*%NBS* is still considered to be a Structural Weakness even though it is considered to represent an acceptable risk.
T(L)A	Territorial (Local) Authority. Use of TA in this document is intended to describe a Council administering the requirements of the Building Act. A Council's role as a building owner is intended to be no different from any other building owner.
Ultimate limit state (ULS)	A limit state defined in the New Zealand loadings standard NZS 1170.5:2004 for the design of new buildings
URM	Unreinforced masonry
%NBS	Percentage of new building standard

B1.4 Notation

Symbol	Meaning
b	Span of diaphragm perpendicular to direction of loading
D	Depth of diaphragm parallel to direction of loading
I	Importance Factor defined by NZS 4203:1992 used for the design of the building
k_{μ}	Structural Ductility Scaling Factor defined in NZS 1170.5:2004
M	Material Factor defined by NZS 4203:1992
$N(T,D)$	Near Fault Factor defined by NZS 1170.5:2004
$pCSW$	Potential Critical Structural Weakness. A Structural Weakness identified by an ISA and having the potential to be the CSW.
R	Return Period Factor defined by NZS 1170.5:2004 based on the importance level appropriate for the building in accordance with NZS 1170.0:2002
R_0	Risk Factor used for the design of the building
S	Structural Type Factor defined in NZS 4203:1992
S_{p}	Structural Performance Factor defined in NZS 1170.5:2004
Z	Seismic Hazard Factor defined by NZS 1170.5:2004
Z_{1992}	Zone Factor from NZS 4203:1992 (for 1992-2004 buildings only)
Z_{2004}	Seismic Hazard Factor from NZS 1170.5:2004 (for post August 2011 buildings only)
$(\%NBS)$	Percentage of New Building Standard achieved
$(\%NBS)_{\mathrm{b}}$	Baseline Percentage of New Building Standard
$(\%NBS)_{\mathrm{nom}}$	Nominal Percentage of New Building Standard
μ	Structural Ductility Factor defined by NZS 1170.5:2004

B2. Assessing Post-1976 Buildings

Buildings designed and constructed using seismic design codes from 1976 onwards need to be approached from a slightly different perspective when undertaking an ISA. They are unlikely to be earthquake prone, but can contain structural weaknesses that could lead to a sudden, non-ductile mode of failure at levels of seismic shaking less than current design levels for the Ultimate Limit State ULS shaking. It is important that buildings that may be *earthquake <u>risk</u> buildings* but are not *earthquake prone* (i.e. they lie between 34*%NBS* and 67*%NBS*) and that have unacceptable failure modes are identified. How this might be done is discussed further in Section B3.

In buildings of this era, the greater use and availability of computer programs for structural analysis and architectural developments has led to the adoption of sometimes quite complex structural configurations and lateral load paths. Whereas for earlier buildings it might have been possible to identify a generic structural form from an exterior inspection, it is often difficult to pick this for post-1976 buildings. This is particularly the case for mixed-use buildings involving the competing structural layouts of accommodation, office and car parking. These structures typically feature offset columns or other transfer structures which cause irregular steps in the load path that may or may not have been taken into account appropriately in the original design.

Post-1976 buildings can also feature potential CSWs that relate to detailing issues rather than configurational SWs relating to regularity. Examples of these can include:

- heavily penetrated floor diaphragms (typically reinforced with welded wire mesh) which may lack adequate collector elements back to the lateral load resisting structure
- exterior columns without sufficient connection back into the supporting diaphragm
- non-structural infill walls with some movement allowance but an insufficient allowance to meet current code requirements
- egress/access stairs which may not have sufficient displacement capacity for the expected inter-storey drifts
- steel tension braces which may be vulnerable to fracture at threaded ends, where there may be insufficient threaded length to allow the required inelastic drift to develop, and
- detailing no longer considered to provide the level of ductility assumed at the time of design or previous strengthening.

It is therefore important that ISAs on post-1976 buildings involve both a full interior inspection and a review of available structural documentation.

Further guidance on using the IEP methodology for post-1976 buildings is given in Section B4.6.

B3. Potential Severe Structural Weaknesses

There are some severe structural weaknesses (SSWs) that experience in previous earthquakes shows are often associated with catastrophic pancake collapse or significant loss of egress. It is important that the potential existence of these is noted as part of an ISA assessment even if the ISA seismic rating is greater than the required target level (e.g. the earthquake-prone threshold). At the ISA level, these are referred to as potential SSWs that could result in significant risk to a significant number of occupants. These potential SSWs should not be confused with the *severe* performance categorisation for the other more general potential CSWs scored within the IEP.

It is considered reasonable to limit consideration of potential SSWs to buildings of three or more storeys, as it is unlikely that buildings with fewer storeys would contain sufficient occupants to be considered a significant risk in this context. Similarly it is unlikely that buildings with lightweight (e.g. timber) floors (with the possible exception of URM buildings) are of the type that would be particularly susceptible to pancake failure.

The potential SSWs considered to be indicative of possible significant loss of resilience and rapid deterioration of performance in severe earthquake shaking are:

1. **A weak or soft storey, except for the top storey**
   This SSW has the potential to concentrate inelastic displacements in a single storey. It may be difficult to identify without calculation unless that storey height is much larger than for the other storeys and the element sizes have not been obviously increased to compensate.

2. **Brittle columns and/or brittle beam /column joints the deformations of which are not constrained by other structural elements**
   Older multi-storey framed buildings with little or no binding reinforcement (beam/column joints), small columns and deep beams are particularly vulnerable to severe earthquake shaking. Once the capacity of the columns has been exceeded, failure can be expected to be rapid. When associated with a soft storey, the effect can be even greater.

3. **Flat slab buildings with lateral capacity reliant on low ductility slab-to-column connections**
   Although not common in New Zealand, this building type has a poor record in severe earthquakes overseas. The failure is sudden, resulting in pancaking of floor slabs as the slab regions adjacent to the columns fail in shear. This SSW may be mitigated by special slab shear reinforcement and, to some extent, by the presence of slab capitals.

4. **No effective connection between primary seismic structural elements and diaphragms**
   Buildings with no obvious interconnection between primary seismic structural members, such as lateral load resisting elements and diaphragms, have little chance of developing the full seismic capacity of the structure in severe earthquakes, especially when the building has irregularities and/or the need to distribute actions between lateral load resisting elements.

5. **Seismically separated stairs with ledge and gap supports.**
   This need only be an identifiable issue here for buildings with more than six storeys. It is considered that evacuation of lower height buildings will be relatively easily achieved through other means.

It is acknowledged that these SSWs and/or any mitigating factors that are present may only be recognisable from construction drawings, and therefore an ISA based on a visual inspection only will not necessarily identify their presence. The SSWs highlighted above vary slightly from those which require specific consideration in a DSA. This is because some of the above (e.g. weak or soft stories) can be assessed adequately in a DSA and others listed for special consideration in Part C may be difficult to identify from an ISA. The intent is to note the listed items only if they have been observed and not to require confirmation that they are not present as part of an ISA.

Both the Initial Evaluation Procedure (IEP) and the template letter provided in the appendix to this section have provision for recording the presence of these potential issues.

B4. Initial Evaluation Procedure (IEP)

B4.1 Background

The IEP is an integral part of the ISA process outlined in these guidelines. The IEP has been designed to accommodate a varying level of knowledge of the structural characteristics of a building and its parts and also recognises that knowledge of the building may increase with time. It is therefore expected that an IEP may be carried out several times for the same building and that the assessed rating may change as more information becomes available. Therefore the level of information that a particular IEP has been based on is a very important aspect of the assessment and must be recorded so that it can be referred to by anyone considering or reviewing the results.

The expectation is that the IEP will be able to identify, to an acceptable level of confidence and with as few resources as possible, most of those buildings that fall below the EPB target without catching an unacceptable number of buildings that will be found to pass the test after a DSA. Accordingly an IEP score higher than the EPB target may be sufficient to confirm that the building is not earthquake prone. Of course the IEP cannot take into account aspects of the building that are unknown to the assessor at the time the IEP is completed and cannot therefore be considered as reliable as a DSA.

The IEP was developed in 2000 and first presented in June 2006. Since that time thousands of buildings throughout New Zealand have been assessed using this procedure and a number of issues have become apparent. These include:

- the wide range of scores achieved for the same buildings by different assessors
- undue reliance being placed on the results of the IEP, notwithstanding the stated preliminary/first-stage nature of this assessment
- an inappropriate level of accuracy being implied in some assessments
- lack of application of judgement in many assessments that is often evidenced by an unreasonably low score that even the assessor does not support
- varying skill level of assessors, many of whom lack the experience to apply the judgements required
- the incorrect view of some assessors that assessments are solely restricted to the issues specifically raised in the IEP and also do not include the secondary structural and critical non-structural components
- further confirmation from the Canterbury earthquakes of 2010/11 regarding the performance of buildings over a range of earthquake shaking levels, and
- a need to recognise that the importance level classification of a building may have changed since the design was completed.

This section provides guidance to assessors on how to address specific issues with the objective of achieving greater consistency in assessments. However, it should not be assumed that the higher level of guidance given will address all aspects and compensate for a lack of assessor experience and/or judgement.

Section B4.6 provides guidance on a number of specific issues that have arisen and includes suggestions on how to allow for these in an IEP assessment.

Many buildings have now been assessed using the IEP. The changes made to this section in this latest version are not expected, or intended, to significantly alter the previous scores of buildings, if the judgement of experienced seismic engineers has been exercised.

B4.2 Level of Experience Required

The IEP is an attribute based and largely qualitative process which is expected to be undertaken by experienced engineers. It requires considerable knowledge of the earthquake behaviour of buildings, and judgement as to key attributes and their effect on building performance.

Therefore, it is critical to the success of the IEP that this level of assessment is carried out, or reviewed by, New Zealand Chartered Professional Engineers (CPEng), or their equivalent, who have:

- sufficient relevant experience in the design and evaluation of buildings for earthquake effects to exercise the degree of judgement required, and
- had specific training in the objectives of and processes involved in the initial evaluation procedure.

The IEP is not a tool that can be applied by inexperienced personnel without adequate supervision. Less experienced ‘inspectors’ can be used to collect data on the buildings, provided that they have an engineering background so that the information collected is appropriate. The lower the experience of the inspectors, the greater the need for adequate briefing and review by experienced engineers before the IEP building score is finalised.

B4.3 Limitations

The IEP is a qualitative assessment, based on generic building characteristics. There are limitations to what can be achieved using this process, some of which have been discussed above. It is recommended that assessors make the end users and receivers of the IEP assessment reports fully aware of the limitations of the process when discussing the results. Some of the limitations are listed below to assist in this process.

In particular, the following points should be noted:

- The IEP assumes that the buildings have been designed and built in accordance with the building standard and good practice current at the time the building was constructed. In some instances, a building may include design features ahead of its time, leading to better than predicted performance and therefore warranting a higher rating. Conversely, some unidentified design or construction issues not picked up by the IEP process may result in the building performing not as well as predicted.
- An IEP can be undertaken with variable levels of information; e.g. exterior only inspection, structural drawings available or not, interior inspection, and so on. The more information available, the more reliable the IEP result is likely to be. It is therefore essential that the information sources available for the assessment are recorded and that

the likely effect of including additional information, such as inspection of drawings is reported.

- The IEP is intended to be somewhat conservative, identifying some buildings as earthquake prone, or having a lower *%NBS* rating, than might be shown by subsequent detailed investigation to be the case. However, there will be exceptions, particularly when potential CSWs cannot be recognised from what is largely a visual assessment of the exterior of the building.
- The IEP cannot take into account aspects of the building that are unknown to the assessor at the time the IEP is completed. This is also the case with a DSA, but perhaps less likely given the greater level of information required.
- An IEP is designed to assess the building against the Ultimate Limit State only. It does not assess against the Serviceability Limit State (SLS) as defined in AS/NZS 1170.0:2002. This is consistent with the general seismic assessment approach in these guidelines of focusing only on aspects that could impact on life safety, but it is important to bring this to the attention of the building owner or end user of the assessment results.
- For buildings designed after 1976, drawings and/or design calculations should be reviewed for an IEP assessment, unless it is a very preliminary screening. This is because of the increased complexities due to a significant change in construction materials and technology, structural systems, assumed ductility, sophistication of analysis and design procedures post the mid-1970s. Drawings should also be reviewed if the structural system is not clear, or if the building has been strengthened, irrespective of the vintage of the building.
- The IEP is an attribute based procedure where identified potential CSWs are penalised and the penalties are accumulated. For buildings with several potential CSWs, unrealistically low ratings may result, even after the full available adjustment for judgement. In such cases, the end users receiving the rating should be cautioned that the rating may not be truly representative of the seismic performance of the building (particularly around the earthquake prone level) and that a DSA is recommended.
- TAs are required to consider any information that might be available for a building. This means that they reserve the right to react to any additional information and adjust the seismic status of a building at any time, even though they may have carried out the process (that may have included an IEP) that conferred the original status. Therefore, reliance on an IEP for important decisions carries risks.
- The IEP process is only intended to focus on the building under consideration. It does not consider aspects such as the possible detrimental effects of neighbouring buildings (as current legislation assumes that these are the responsibility of the neighbour) or the hazards resulting from items that could be classified as building contents. However, these items may be important considerations for building owners and tenants, and should be brought to their attention if this is appropriate for the level of assessment being undertaken.

B4.4 Dealing with Differences in Assessment Results

Due to the qualitative nature of the assessment it should not come as a surprise that, in some circumstances, assessments of the same building by two or more experienced engineers may differ – sometimes significantly. This is to be expected, especially if the level of information available was different for each assessor.

It is expected that experienced engineers will be able to identify the critical issues that are likely to affect seismic performance and that, through discussion, a consensus position will be able to be agreed. For the same reason, an IEP assessment that has been independently reviewed is likely to be more robust than one based solely on the judgement of one engineer.

In situations where assessment outcomes are significantly different, assessors should enter into a dialogue to understand the points of difference. It is recommended that any differences in opinion in the IEP assessments that cannot be resolved through discussion and sharing of information are resolved by the completion of a DSA, either for the aspect under contention if it is appropriate to consider this in isolation, or for the building as a whole.

All judgements made need to be justified/substantiated, if requested (e.g. by TAs), and preferably recorded on the IEP sheets and as part of the ISA.

Note:

If the assessor is aware of other assessments of the same building an attempt should be made to obtain these so that any differences can be rationalised. Resolving differences in advance of finalising and submitting an ISA, if possible, will assist in maintaining the credibility of what is essentially a judgement based process.

One of the main areas of difference in assessment results at the IEP level of assessment could be expected to be the different levels of information available to the assessor.

B4.5 Outline of the Process

An outline of the Initial Evaluation Procedure (IEP) is shown in Figure B.2.

This process involves making an initial assessment of the standard achieved for an existing building against the standard required for a new building (the percentage new building standard, or *%NBS*).

The IEP outlined below is based on the current Standard for earthquake loadings for new buildings in New Zealand, NZS 1170.5:2004, as modified by the New Zealand Building Code. It is assumed that the person carrying out the IEP has a good knowledge of the requirements of this Standard.

The first step is to survey the subject building to gather relevant data on its characteristics, sufficient for use in the IEP.

The next step is to apply the IEP to the building and thereby determine the percentage of new building standard (*%NBS*) for that building.

%NBS is essentially the assessed structural standard achieved in the building (taking into consideration all reasonably available information) compared with requirements for a new building and expressed as a percentage. There are several steps involved in determining *%NBS*, as outlined in the following sections.

A *%NBS* of less than 34 (the limit in the legislation is actually one third) fulfils one of the requirements for the building to be assessed as earthquake prone in terms of the Building Act.

A *%NBS* of 34 or greater means that the building should be regarded as being outside the requirements of the earthquake-prone building provisions of the Building Act, although the TA will need to be satisfied that the assessment is valid. It is likely that the IEP will need to be at the more comprehensive end of the continuum possible with review of drawings and interior inspections for the TA to be satisfied (refer to Figure B.1).

A *%NBS* of 67 or greater means that the assessment is indicating that the building should be a significant earthquake risk, based on NZSEE recommendations.

Note:

It is important to realise that the reliability of the *%NBS* rating determined at the IEP level will depend on the level of information that has been available during the assessment process. A rating determined by DSA should generally be assumed to be more reliable than one from an ISA.

For a typical multi-storey building, the process is envisaged as requiring limited effort and cost. It would be largely a visual assessment, but supplemented by information from previous assessments, readily available documentation and general knowledge of the building.

The IEP should be repeated if more information comes to hand. It should also be repeated until the assessor believes the result is a fair reflection of the standard achieved by the building.

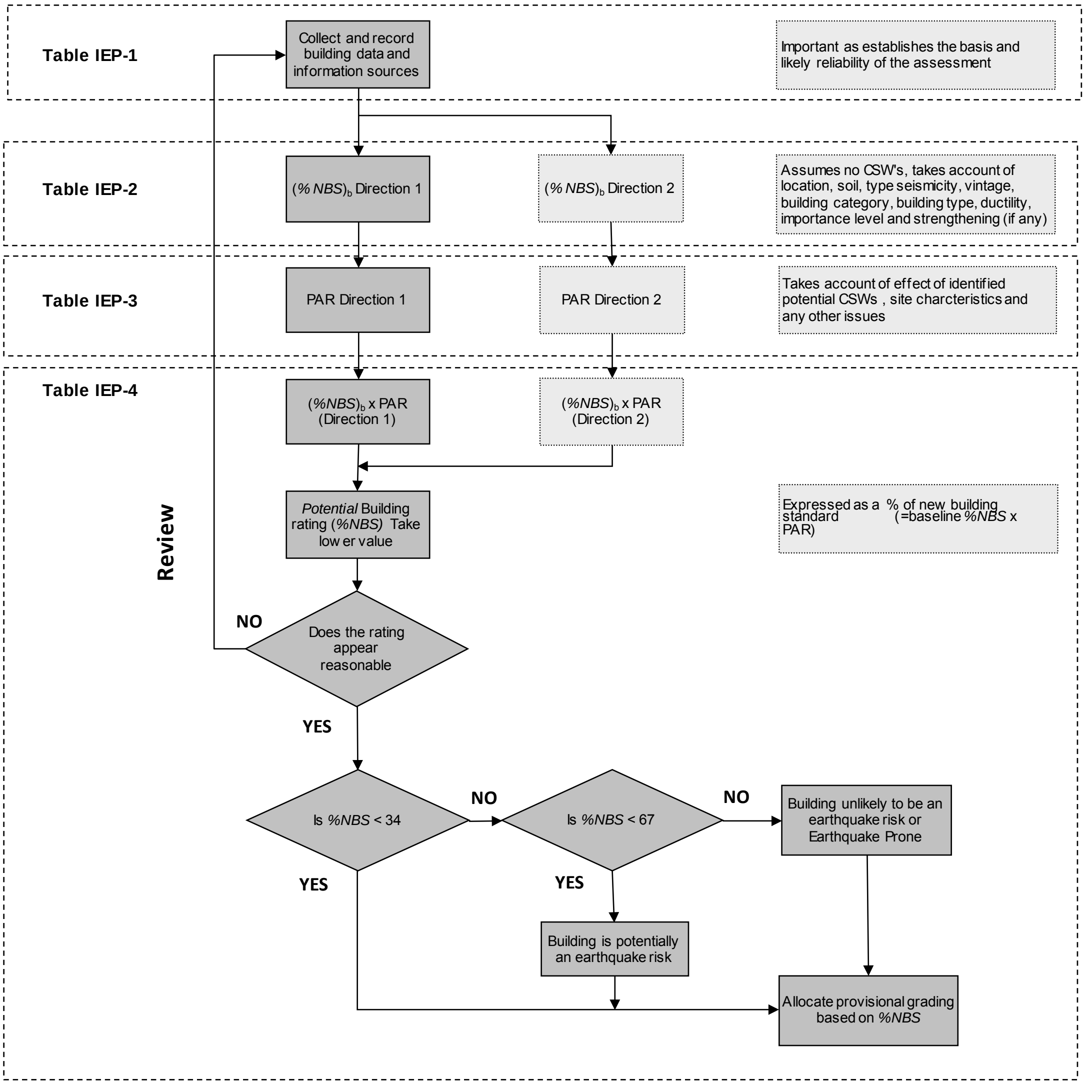

Figure B.2: Initial Evaluation Procedure

The IEP as presented can be used for unreinforced masonry (URM) buildings; however it may be difficult to apply in some circumstances. An attribute scoring process (refer to Appendix BB) is suggested as an alternative to the Steps 2 and 3 of the IEP (refer to Appendix BA) but will generally require a greater knowledge of the building than typically expected or intended for an IEP.

B4.6 Specific Issues

The purpose of this section is to provide guidance on how to address some commonly encountered issues.

It is recognised that some of these issues will not be identifiable without access to drawings or an internal inspection of the building. However, this is consistent with the objectives that underpin the IEP assessment, and buildings should not be penalised in the IEP unless there is some evidence that the issue is present. The IEP can be amended at any time if further information comes to hand. Note also the recommendation in Section B4.3 and in Section B4.6.2 to review drawings for post-1976 buildings.

Judgement decisions on particular aspects of the IEP can be supported by calculations. This would be expected to lead to a more reliable (but still *potential*) rating from the IEP without the full cost of a DSA. However, care should be taken to avoid over-assessment in one area at the expense of another. The potential rating for a building as a whole from an IEP must reflect the best judgement of the assessor, taking into account all aspects known to the assessor.

B4.6.1 Implied accuracy and limitations

The IEP is an initial, largely qualitative, score based assessment dependent on knowledge available at the time of the assessment.

%NBS ratings determined by an IEP should, therefore, reflect the accuracy achievable and not be quoted other than as a whole number. Except for the ranges 34 to 37% and 67 to 69% it is further recommended that the ratings be rounded to the nearest 5*%NBS*.

Assessors should consider carefully before rating a building between 30 and 34*%NBS* or between 65 and 67*%NBS*. The ramifications of these ratings are potentially significant in terms of additional assessment required; perhaps for arguable benefit.

Providing specific ratings above 100*%NBS* is also to be discouraged as they may provide an erroneous indication of actual performance. It is recommended that such ratings are simply stated as >100*%NBS*.

The score based nature of the IEP can lead to very low ratings for some buildings. While these low ratings may correctly reflect the number of the potential CSWs present they may not truly reflect the expected performance of the building, particularly when considering against the EPB criteria. In such cases the assessor should be careful to advise his/her client of the limitations of the IEP and of the recommendation that a DSA should be completed before any significant decisions are made.

B4.6.2 Post-1976 buildings

Note the following for buildings designed after 1976:

- From the mid-1970s, perhaps coinciding with the introduction of the modern earthquake design philosophies into Standards and the greater availability and use of computer programs for structural analysis, quite complex structural configurations and lateral load paths were often adopted. Whereas for buildings built earlier it might have been possible to identify a generic structural form from an exterior inspection, it is often difficult to pick this for post-1976 buildings.

  For this reason it is highly recommended that drawings and/or design calculations of post-1976 buildings be reviewed for an IEP assessment, unless it is only a preliminary screening or drawings cannot be located. In such cases it might be best to err on the side of caution if it is suspected that there might be issues with the structural system.

- Consideration should be given to the following:
  - location and clearance to non-structural infill walls (refer to Section B4.6.6)
  - poorly configured diaphragms (refer to Section B4.6.13)
  - gap and ledge stairs, particularly if these are in a scissor configuration (refer to Section B1.1.1)

- non-ductile columns (refer to Section B4.6.14)
- unrestrained/untied columns (refer to Section B4.6.15)
- detailing and configuration of shear walls (refer to Section B4.6.16).

It is not expected that the issues outlined above will result in an earthquake-prone designation, although this cannot be completely discounted.

B4.6.3 Timber framed buildings

The Christchurch earthquakes have confirmed what has been long known that timber framed residential and small commercial buildings generally perform extremely well in earthquakes and, even when significantly distorted due to ground movements, the risk of fatalities as a result is low.

Buildings of this type have been shown to have significant inherent capacity and resilience (beyond the Ultimate Limit State as might be determined by consideration of NZS 3604:2011 requirements) which means that they should rarely be found to be less than 34*%NBS* unless they are located on a slope and have substructures that are poorly braced and/or poorly attached to the superstructure. Buildings located on flat sites and poorly attached to their foundations may come off their foundations. However, although this may lead to significant damage, this is unlikely, on its own, to result in fatalities, particularly if the floor is less than 600 mm above the ground. These buildings are rarely completely reliant on their diaphragms unless the spacing of parallel walls is large.

Whether or not these building are potentially earthquake risk will depend on issues such as:

- site characteristics
- age (i.e. is the building likely to have been engineered? Correct application of non-specific design requirements such as NZS 3604:2011 may be considered as achieving this.)
- adequacy of connection between subfloor and super structure
- poorly braced basement structures
- walls lined with materials of little reliable capacity
- excessive spacing between walls
- condition (decayed timber, etc)
- excessive stud height
- roof weight.

Larger timber framed buildings such as churches, school and church halls and commercial buildings have also been shown to have inherent capacity and resilience and to perform in earthquakes well above what their ultimate limit state capacity as assessed in comparison to new building requirements might suggest. These buildings are typically characterised by larger spans, greater stud heights, greater spacing between walls and fewer connection points between building elements than for the smaller, more cellular buildings discussed above. Nevertheless, these buildings should also rarely be classified as potential EPBs unless the following are evident, and then judgement will be necessary to determine the likely effect:

- missing load paths (e.g. open frontages, particularly at ground floor level of multistorey buildings)
- obvious poor connections between elements (e.g. between roof trusses and walls)

- lack of connection between subfloor and super structure and poorly braced basement structures for building on slopes
- walls lined with materials of little reliable capacity
- heavy roofs
- likely effect on non-structural elements of a particularly hazardous nature (e.g. effect of building racking on large areas of glazing or of brick veneers adjacent to egress paths).

At the earthquake risk level the other aspects given above for the smaller buildings will also be relevant.

To reflect these observations the following parameters may be assumed for timber framed buildings in the IEP:

- S_p may be taken as 0.5
- for most buildings of this type plan irregularity may be assumed to be insignificant
- unbraced subfloors for buildings on flat ground may be assumed insignificant if the height above the ground is less than 600 mm
- no penalty should typically be applied for site characteristics; e.g. liquefaction (refer also to Section B4.6.17.
- ductility, μ is equal to 2 and 3 for pre and post 1978 buildings respectively.

The judgement F Factor should be chosen to reflect the overall expected performance of the building based on the observations set out above. For timber framed structures of a cellular configuration, F Factor values approaching the upper limit should be used.

B4.6.4 Lightweight, single storey industrial structures

Single storey industrial structures with profiled steel roofing and wall cladding typically perform well in earthquakes. These buildings typically have steel portals carrying the seismic loads in one direction and steel bracing (roof and wall) in the other.

Such structures should rarely be found to be less than 34*%NBS*. Although the cladding cannot be relied on in a design sense, it is nevertheless likely to provide reasonable capacity if bracing is missing.

Weaknesses that could potentially affect the capacity of these structures include:

- missing wall and/or roof bracing
- lack of lateral flange bracing to portals
- open walls with little obvious bracing
- non-capacity designed bracing connections.

B4.6.5 Tilt-up industrial structures

Concrete tilt-up panels inherently provide significant lateral capacity to a building. However, the capacity that can be utilised is very dependent on the connections from the panels to the structure (typically the roof structure) and the capacity of the roof diaphragm.

If complete load paths can be seen (including the roof diaphragm), with no obvious problems with the connections (e.g. missing or obviously undersized bolts, poor welds to weld plates), such buildings are unlikely to be earthquake prone.

Non-ductile mesh as the sole means of panel reinforcement could lead to an issue for panels under face loading.

Any identified issues should be subjected to further investigation. The heavy nature of these buildings and possible lack of redundancy means that they are unlikely to perform well when the earthquake shaking is greater than moderate if: any failures occur in connections, the diaphragms have insufficient capacity to transfer loads (e.g. such as might be necessary when large wall openings are present), or there are reinforcement fractures in the panels.

It is recommended that an inspection of the interior of such buildings be included when completing an IEP.

B4.6.6 Secondary structural and non-structural elements

The behaviour of secondary structural and non-structural (SSNS) elements, where the failure of these could present a hazard to life or damage to neighbouring property, must be considered in the overall assessment of the building.

Table A1.1 provides an outline of the SNSS elements that can give rise to a significant life safety hazard, and that should be considered in a seismic assessment.

Such items that must be included in an assessment include, but are not limited to:

- unreinforced masonry parapets and walls (refer to Section B4.6.7) and chimneys (refer to Section B4.6.8)
- masonry veneers above a public thoroughfare, neighbouring buildings or egress routes (refer to Section B4.6.9).
- precast panels located over egress routes, public areas or neighbouring buildings (refer to Section B4.6.21)
- heavy and large items of building services plant, tanks, etc (refer to Section B4.6.20)
- heavy non-loadbearing partition walls (refer to Section B4.6.10)
- stairs (refer to Section B4.6.11)
- support frames for cladding systems including curtain walls (refer to Section B4.6.19)

Note:

These elements also fall within the scope of Parts under the Building Amendment Act for the purposes of determining whether or not a building is earthquake prone (refer to Part A).

The behaviour of general building services is not intended to limit the seismic rating of a building.

B4.6.7 Unreinforced masonry parapets and walls

The presence of unreinforced masonry walls (irrespective of whether or not these are bearing walls) or cantilevering parapets should be sufficient grounds to rate a building as <34*%NBS*, at least until the stability of the wall or the effectiveness of the restraint of the masonry can be confirmed.

Appendix BB contains specific provisions for unreinforced masonry buildings which are intended to be used in conjunction with the IEP. However, the attribute method generally requires a greater level of knowledge of a building than is typically expected or intended for an IEP.

B4.6.8 Chimneys

Experience indicates that chimneys can be vulnerable, even at levels of earthquake shaking consistent with EPB considerations; particularly if they are unreinforced or poorly restrained back to the building. Failure of such chimneys has led to fatalities in past earthquakes in New Zealand and this should be reflected in the IEP assessment.

The following approach is recommended for the assessment of chimneys and the effect on the building score:

A building with a chimney should be assigned a seismic rating of less than 34*%NBS*, and the Factor F in Table IEP-3 set accordingly, if either:

- the chimney is not restrained by the roof structure, or other fixing, at the roofline, **OR**
- the chimney meets all of the following criteria:
  - it is constructed of unreinforced masonry or unreinforced concrete, **AND**
  - the ratio of the height of the chimney (measured vertically from the chimney intersect with the lowest point on the roofline to the top of the chimney structure (excluding any protruding flues or chimney pots)) and its plan dimension in the direction being considered is more than:

    1.5 when $ZR > 0.3$, or
    2 when $0.2 < ZR < 0.3$, or
    3 when $ZR < 0.2$

    where:

    Z and R are as defined in NZS 1170.5:2004, **AND**
  - if any one or more of the following applies:
    - there is any possibility that the chimney could topple onto an egress route, entrance way, over a boundary (including over a street frontage), over any public/private access way or more than 2 m down onto an adjoining part of the building, or
    - the roofing material comprises concrete masonry, clay tiles or other brittle material, unless suitable sheathing (extending horizontally at least the height of the chimney away from the chimney) has been laid within the ceiling space to prevent the roofing material and collapsed chimney from falling through the ceiling.

The particular issues from these options that have made a building with a chimney less than 34*%NBS* should be recorded in the IEP.

B4.6.9 Masonry veneers

If a masonry veneer above an egress route or public thoroughfare were to become separated from the supporting structure, this would create a significant life safety hazard.

Heavy veneers in these locations consisting of stone or brick of thickness greater than the standard 110 mm units requires specific investigation.

Veneers that have ties (from any code era) are considered to rate >34*%NBS*.

Accordingly, if the presence of ties to veneers above egress routes and public thoroughfares is indicated from scanning, then a rating of >34*%NBS* can generally be taken. For buildings of three or more storeys, verification of the condition and effectiveness of the veneer ties by intrusive investigation is required. This can be undertaken as part of an ISA or be recommended for inclusion within a subsequent DSA.

A building with masonry veneer cannot be rated >67*%NBS* without verifying the condition and effectiveness of ties by intrusive investigation.

B4.6.10 Heavy non-loadbearing partition walls

Heavy non-loadbearing partition walls typically comprise:

- unreinforced clay brick masonry
- hollow clay brick masonry (which can be filled or unfilled, reinforced or unreinforced), or
- concrete block masonry (which can be solid or hollow, unfilled, partially filled or fully filled, and reinforced or unreinforced).

Common issues that affect the seismic behaviour of heavy non-loadbearing partition walls include:

- insufficient or absent restraint at the tops of the walls to prevent out of plane movement
- insufficient gaps between ends of walls and the main structure to allow for interstorey drift.

Heavy non-loadbearing partition walls will generally rate <34*%NBS* if they are either unreinforced or have nominal top restraint. Partition walls with reinforcement and restraint can be rated >34*%NBS* without a detailed investigation and calculation.

Heavy non-loadbearing partition walls cannot be rated >67*%NBS* without a detailed investigation and supporting calculations.

B4.6.11 Stairs

Stairs required for egress or above occupied areas should be considered as part of an IEP.

The experience of the Canterbury earthquakes has been that some stairs may be vulnerable in earthquakes. The arrangement that was shown to be particularly vulnerable was the “gap and ledge” stair where a heavy stair flight (typically precast concrete) is vertically supported on a corbel, typically with a seating less than 100 mm, and with or without a definite gap.

Monolithic concrete stairs in multistorey reinforced concrete or steel frame buildings could be similarly vulnerable.

Such details, on their own, are very unlikely to make a building rate less than 34*%NBS* unless the flights are precariously supported, but their presence should result in a rating less than 67*%NBS*.

The ability of the connections of steel stair framing to withstand the interstorey drifts needs consideration. Generally this would be very unlikely to make a building rate less than 34*%NBS.*

Where concrete stair flights are cast integrally with the floors of a building, they may influence the response of the primary structure in an earthquake, and in turn be susceptible to failure. This needs to be considered a potential structural weakness (refer to Table BA.4).

B4.6.12 Masonry infill panels

Infill masonry panels are typically used to form boundary walls within concrete and encased steel frames.

Prior to the early 1970s, infill masonry walls typically comprised unreinforced brick and concrete masonry blocks, mortared up against the framing elements with no seismic separation.

From the early 1970s, infill walls (typically in reinforced blockwork) were separated from the primary structure to prevent the walls from carrying in-plane shear and therefore participating in the lateral load resisting system. Prior to 1992, the separation requirements were much less than subsequently required. Gaps of 10 mm to 20 mm were common and in many instances filled with sealants or fillers that were only partially compressible.

However, once these gaps have been taken up, the walls will act as shear walls to the limit of their capacity. Problems arise because of the irregular layout of the secondary structural wall panels, both in plan and over the height of the structure. The eccentricities that result can be severe. If gaps have been provided it is unlikely that the building will score less than 34*%NBS* but the expected performance at higher levels of shaking will be dependent on the wall layouts and the type of primary structure present. The effects will be greater for more flexible primary structures such as moment resisting frames.

Infill walls not separated from the primary structure should be considered as shear walls of uncertain capacity and scored accordingly. Their impact on the regularity of the structure (horizontal and vertical) should be carefully considered. In many cases it may be difficult to determine the effect, and a DSA is recommended.

As noted in the previous section, the potential for masonry infill panels to fail out of plane when there are gaps between the panel and the perimeter framing (particularly adjacent to egressways, public spaces and thoroughfares) should be assessed and appropriate scoring and recommendations made.

B4.6.13 Diaphragms

The role of diaphragms in a building may be complex. All diaphragms act as load collectors distributing lateral load to the lateral load resisting elements. Where the lateral load resisting system changes (e.g. at basements or transfer levels) the diaphragms may also act as load distributors between the lateral load resisting elements. In the post elastic range, progressive inelastic deformations in lateral load resisting elements may impose significant internal forces detrimental to both the diaphragms and the behaviour of the lateral load resisting elements.

In addition to the configuration (plan irregularity) issues noted in Figure BA.5 and Table BA.4 there are also issues relating to diaphragm detailing that could affect the seismic performance of the building as a whole. These include:

- poor placement of penetrations interrupting potential load/stress paths
- inadequate load paths (e.g. no chords which lead to little in-plan moment strength or lack of means to transfer loads into the lateral load resisting system (e.g. lack of “drag” steel to concrete walls)
- incomplete or inexistent means of load transfer, e.g. missing roof bracing elements
- inadequate capacity in the diaphragm and its connections, and
- poor connections from non-structural elements to the diaphragms, (e.g. connections from the tops of brick walls to the diaphragms).

The potential behaviour of precast floor diaphragms (and in particular hollow core floors) has received much attention over the last decade and evidence of diaphragms under stress was seen after the Christchurch earthquakes. This included:

- cracking in floor toppings and fracture of floor mesh (a particular issue if mesh is the sole reinforcement in the topping), and
- separation of the perimeter concrete frames from the diaphragm, e.g. after elongation of the concrete beams, fracture of the topping reinforcement or lack of ties to the perimeter columns.

Diaphragm capacity issues are unlikely to become an issue until the earthquake shaking becomes severe so are unlikely, on their own, to cause the building to be rated less than 34*%NBS*.

The assessor will need to use his or her judgement to assess the effect of missing elements and will need to check for the existence of other, less direct or less desirable load paths for transferring loads before determining that the building’s rating is less than 34*%NBS*.

B4.6.14 Non-ductile columns

Investigation into the collapse of the CTV building during the 22 February 2011 Christchurch earthquake highlighted the potential for incorrect interpretation of requirements for secondary columns in buildings designed using NZS 3101:1982. These requirements were clarified in NZS 3101:1992 so there is potential for non-ductile secondary columns in buildings designed during the period roughly from 1982 to 1992.

Such detailing is unlikely to make the building rate less than 34*%NBS*, unless the columns are already highly stressed under gravity loads. However, the presence of non-ductile columns should result in the building being rated less than 67*%NBS*.

B4.6.15 Unrestrained/untied columns

The evidence would suggest that there are a number of multistorey buildings constructed in the 1980s that have perimeter frames where the columns are not adequately tied back into the floor diaphragm. In some cases, as noted in Section B4.6.13 above, the floor mesh taken over the beam reinforcement provides the sole means of restraint. The lack of column ties is likely to lead to a rapid reduction in capacity of the columns once beam elongation and/or fracture of the slab mesh has occurred.

The lack of column ties back to the floors is unlikely to make the building rate less than 34*%NBS* but should result in a rating less than 67*%NBS*.

B4.6.16 Concrete shear wall detailing and configuration

The performance of concrete shear wall buildings in the Canterbury earthquakes has indicated that current detailing for ductility (spacing and positioning of wall ties) may not be sufficient when the wall is subjected to significant non-linear behaviour. Asymmetric walls (i.e. C and L shaped walls) were also shown to be problematic when capacity design procedures were not applied. New provisions for wall detailing are being developed: when they are finalised the *%NBS* for existing buildings will need to be compared against these requirements.

This issue is unlikely to cause post-1976 buildings to be rated less than 34*%NBS*, but could potentially reduce the rating below 67*%NBS*.

B4.6.17 Site characteristics

Identified site characteristics (including geohazards and potentially at risk neighbouring buildings, etc) that could have a direct impact on the building and, as a result, could lead to the building presenting an enhanced risk to building occupants, those in the immediate vicinity of the building, or to adjacent property must be recorded on the IEP forms and in the covering letter. The assessor will therefore need to be cognisant of the site's terrain setting and have an awareness of the possible geohazards and other hazards that could impact on the building.

Penalties are applied based on the potential effects on the building in a severe earthquake. Therefore the penalty should not be reduced simply because the hazard is not expected to initiate at levels of shaking implied by the *%NBS* rating.

Penalties are generally not applied for hazard sources located outside the site. This includes geohazards such as rock fall from above, rolling boulders, landslide from above and tsunami and hazards resulting from neighbouring buildings (e.g. adjacent URM walls and parapets). This is consistent with the philosophies underlying the concept of earthquake prone buildings within the Building Act where the focus is on the building and its effect on its neighbours rather than the risk presented by neighbouring property.

Site characteristics that are to be considered, and will potentially attract a penalty include: excessive ground settlement, liquefaction, lateral spreading and landslide from below. Penalties should only be applied, however, when these issues would lead to building damage of an extent that would result in the potential enhanced risks outlined above and when there is some evidence that the particular hazard exists. For example a building should not be penalised solely because it is located on a slope. For such a building to attract a penalty there must be evidence of prior slope instability or knowledge of instability and the potential loss of support of the building must be such that it would be likely to lead to the enhanced risks outlined.

The Canterbury earthquakes have provided evidence that, on its own, liquefaction is unlikely to lead to a risk to life in light timber buildings or other low rise (less than three storeys) buildings that are well tied together and are therefore likely to maintain their integrity after significant settlement occurs. However, unstrengthened URM buildings are considered to be particularly vulnerable to ground settlement of the extent expected if liquefaction occurs.

Issues relating to ground amplification are assumed to be dealt with when setting the subsoil conditions in the determination of $(\%NBS)_{\mathrm{nom}}$. However, as with any other issue, the assessor is required to make a judgement call regarding any additional impact on the score that may be appropriate, over and above any allowance in the procedure.

Assessors are referred to geohazard assessments that have been carried out for TAs and Regional Councils to identify the potential hazards that are likely to be appropriate for the site in question. These are typically in the form of hazard maps. Assessors are also referred to Table BA.4 and to Section C4 of these Guidelines for further discussion on geotechnical matters.

B4.6.18 Importance Level 3 and 4 buildings

The influence of original Ultimate Limit State design load levels will be reflected in the seismic rating determined by the IEP for buildings that are now categorised as either Importance Level 3 or 4.

Even though consideration of serviceability limit states is considered outside the scope of the IEP, the effect of non-structural items such as brick veneers, infill walls and the like on egress routes or the ability to continue to function, should be considered for buildings classified as Importance Level 3 or 4.

B4.6.19 Lightweight cladding systems including curtain walls

While the failure of individual panes of glass or individual lightweight cladding panels is not typically considered to be of sufficient severity to meet the criteria associated with a significant life safety hazard, or damage to adjacent buildings, as defined in these guidelines, failure of a glazing or cladding support system, where large sections could fall, would. Also meeting the criteria would be large glass panels adjacent to egress routes.

The more likely cause for system failure of these elements that would lead to them falling from the building, is failure of the connections to the structure due to undersizing and inadequate allowance for building movements.

At the time an ISA is completed the connections will not often be available to view.

It is considered that the connections are unlikely to score less than 34*%NBS* but that a score greater than 67*%NBS* should not be assumed unless the connections have been viewed and confirmed as reasonable.

Therefore it is considered reasonable to assume that these elements are unlikely to make the building rate less than 34*%NBS* but should result in a rating less than 67*%NBS* unless the connections are able to be assessed.

B4.6.20 Building services plant, tanks, etc

In-ceiling building services and lightweight services in general are not intended to influence a building's rating. The exceptions include heavy items such as large tanks and large items of plant which if they were to lose support could fall and create a significant life safety hazard.

If heavy items are precariously supported or have no restraint, and their failure could lead to a significant life safety hazard, they should be scored below 34*%NBS*. If restraints have been provided it is considered reasonable to assume that the score is greater than 34*%NBS*. Robust connections and/or supports would need to be present before scoring these items over 67*%NBS*.

Tanks with hazardous contents will require special consideration.

B4.6.21 Precast panels

Issues relating to precast panels include:

- whether they are primary structure or secondary structure
- their size
- the effect they may have on the building structure regularity (horizontal and/or vertical) if they are not adequately separated from the expected structural deformations of the structure, and/or
- the hazard they may present if they were to fall from the building. For this situation the focus will be on panels located over egress routes, public areas or neighbouring buildings
- the detailing of the connections to the structure
- the condition of the fixings.

When precast panels have clearance to the building structure or are obviously built into the structural system, they may be assumed to score above 34*%NBS*.

In order to score above 67*%NBS*, panels should be clearly recognizable as either primary or secondary structure. If it is determined that they are primary structure, the connections to the structure would be expected to be robust reflecting the actions that would need to be transferred. If secondary structure, then separations to reflect the need to accommodate the flexibility of the structure and at the same time provide restraint to the panels under face loading would be expected. Slotted holes should be inspected to ensure that bolts are appropriately positioned in the slots and that the connection is free to slide.

B5. Reporting

B5.1 General

The manner in which the results of an ISA are reported is extremely important to ensure that the results are appropriately interpreted and their reliability is correctly conveyed.

Recipients of an ISA carried out by a TA must be warned of its limitations and the need to proceed to a DSA if any decisions reliant on the seismic status of the building are contemplated.

To avoid misinterpretation of an ISA result by building owners and /or building tenants it is recommended that the ISA (which is typically expected to be in the form of an IEP) is accompanied by a covering letter. This letter should describe the building, the scope of the assessment, the information that was available, the rationale for the various decisions made, the limitations of the process and the implications of the result. A template covering letter showing how these aspects might be addressed is provided in Appendix BC.

When the results of a TA-initiated ISA are being reported, building owners must be advised of the limitations of the process employed. Suggested wording is provided in Appendices BD and BF respectively for the situation where the building has been found to be potentially earthquake prone and not to be earthquake prone. If the IEP assessment report is to be provided in the event the building has been found not to be earthquake prone, it should be made clear that the primary objective has been to determine the earthquake prone status and not necessarily the rating for the building.

The template letters should be amended, if appropriate, to suit the particular circumstances. However, it is recommended that they retain the key elements noted.

B5.2 Technical Summary

To achieve consistency in assessment outputs being reported and to allow comparisons between assessments of multiple buildings, a stand-alone technical summary should be provided as part of the reporting using the template given in Appendix BF.

Note:

Providing a technical summary in a consistent form is considered to be an important part of an ISA, particularly when this is used as the justification for the seismic rating for earthquake prone building purposes. It will be very useful for TA’s managing the requirements of the Earthquake Prone Building legislation, to owners of multiple buildings and also future assessors of the same building.

The same template is presented in Section C1 to record the results of a DSA.

Appendix BA: Initial Evaluation Procedure – IEP

This appendix describes the steps involved in the IEP, and includes the worksheets (Tables IEP 1 – IEP 4), and information tables and figures required to carry it out. Appendix BA.2 provides further guidance and commentary to support the process.

BA.1 Summary of Step-by-Step Procedures

As noted in Appendix BA, Steps 2 and 3 may not be appropriate for unreinforced masonry buildings. Assessors are referred to an alternative approach for such buildings that uses attribute scoring to assess *%NBS* directly (refer to Appendix BB).

Working spreadsheet versions of Tables IEP-1, 2, 3 and 4 are available from the EQ-assess website to assist in the application of the IEP.

Step 1 Collect general information

Use Table IEP-1.

1.1 Add photos of the building exterior for all visible exterior faces, showing features.

1.2 Draw a rough sketch of the building plan that can be ascertained from the exterior of the building, noting relevant features.

1.3 List any particular features that would be relevant to the seismic performance of the building.

1.4 Note if the building has been strengthened in the past and the level of strengthening targeted at that time.

1.5 Record the characteristics of any adjacent buildings if the separation is not sufficient to prevent pounding.

1.6 Note any information sources used to complete the assessment.

Step 2 Determine baseline percentage of new building standard $(\%\boldsymbol{NBS})_{\mathbf{b}}$

Use Table IEP-2. ***An assessment is required for each orthogonal direction***:

2.1 Determine $(\%NBS)_{\rm nom}$ = A x B x C x D as shown (making any adjustments to account for reaching minimum lateral coefficients in either the design of current Standards), unless the building is post 2004; in which case set this equal to 100% and go to Step 2.7.

2.2 a) Refer to NZS 1170.5:2004 for Near Fault Factor.

b) Calculate Near Fault Scaling Factor.

2.3 a) Refer to NZS 1170.5:2004 for Hazard Factor.

b) Calculate Hazard Scaling Factor (Factor F).

2.4 a) Refer to original design for design Importance Level if date of design is post-1984, otherwise set to 1.0. For buildings designed prior to 1976 and known to have been designed as a public building I may be taken as 1.25.

b) Refer to original design for design Risk Factor or set to 1.0.

c) Determine current Return Period factor from Table BA.1.

d) Calculate Return Period Scaling Factor (Factor G).

2.5 a) Assess available ductility for building (refer to Table BA.2 for maximum allowable).

b) Obtain Ductility Scaling Factor (Factor H) from Table BA.3. Set to 1.0 for post 1976.

2.6 a) Obtain Structural Performance Factor from Figure BA.2, or from the appropriate materials Standard, whichever requires the greater value.

b) Calculate Structural Performance Scaling Factor (Factor I).

2.7 $(\%NBS)_{\mathrm{b}}$ = $(\%NBS)_{\mathrm{nom}}$ x E x F x G x H x I as shown.

Step 3 Determine performance achievement ratio (PAR)

Use Table IEP-3. ***An assessment is required for each orthogonal direction***:

3.1 Assess effect on structure of each potential CSW.
(Choose from the factors given – do not interpolate. Note that a severe categorisation for the general factors considered in the IEP should not be confused with a potential SSW determined in Step 8 and described in Section B4.)

3.2 Note that the effect of any known potential CSWs not listed, is intended to be via Factor F.

3.3 Refer to Sections BA.2.3 and B4.6 for further guidance as required.

3.4 PAR = A x B x C x D x E x F as shown.

Step 4 Determine the percentage of new building standard, *%NBS*

Use Table IEP-4.

4.1 Compare product of PAR x $(\%NBS)_{\mathrm{b}}$ for each direction.

4.2 *%NBS* = the lowest value of PAR x $(\%NBS)_{\mathrm{b}}$.

4.3 Review and adjust as necessary.

Step 5 Is the seismic rating less than 34*%NBS*?

Use Table IEP-4. Assess on basis of *%NBS* in Step 4.

Step 6 Is the building potentially earthquake risk?

Use Table IEP-4. Assess on basis of *%NBS* in Step 4:

6.1 If *%NBS* $\geq$ 67 then it is not considered to be a significant earthquake risk.

6.2 If *%NBS* < 67 then a DSA is recommended before confirming the building as earthquake risk.

Step 7 Provide provisional grading based on IEP

Use Table IEP-4. Assess on basis of *%NBS* in Step 4:

7.1 Grade building based on *%NBS* seismic rating using the relative risk table provided in Part A (refer to Part A.). Use the lowest result from consideration of both orthogonal directions.

Step 8 Note any identified potential SSWs that could result in significant risk to a significant number of occupants

Use Table IEP-5.

8.1 If the number of storeys is less than or equal to 3 it is assumed that the number of occupants is not significant and no further consideration of this issue is required for the ISA.

8.2 If the floors and/or the roof are not of heavy (concrete) construction it is assumed that the risk is not significant and no further consideration of this issue is required for the ISA.

If the number of storeys is greater than three and the floors and/or roof are of heavy construction then the presence of the listed potential SSWs should be noted. Note that the potential stair issue is only activated in the list if the number of storeys is greater than or equal to six.

Table IEP-1: Initial Evaluation Procedure – Step 1

Initial Evaluation Procedure (IEP) Assessment - Completed for *{Client/TA}* Page 1

WARNING!! *This initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for Earthquake Engineering document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in conjunction with the limitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering calculations, or engineering judgements based on them, have not been undertaken, and these may lead to a*

Street Number & Name:		**Job No.:**	
AKA:		**By:**	
Name of building:		**Date:**	
City:		**Revision No.:**	

Table IEP-1 Initial Evaluation Procedure Step 1

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

NOTE: THERE ARE MORE PHOTOS ON PAGE 1a ATTACHED

1.2 Sketches (plans etc, show items of interest)

NOTE: THERE ARE MORE SKETCHES ON PAGE 1a ATTACHED

1.3 List relevant features (Note: only 10 lines of text will print in this box. If further text required use Page 1a)

1.4 Note information sources Tick as appropriate

Visual Inspection of Exterior	☐	**Specifications**	☐
Visual Inspection of Interior	☐	**Geotechnical Reports**	☐
Drawings (note type)	☐	**Other (list)**	☐

Table IEP-1a: Carry-over page, if required

Initial Evaluation Procedure (IEP) Assessment - Completed for *{Client/TA}* **Page 1a**

Street Number & Name:	a	**Job No.:**	e
AKA:	b	**By:**	f
Name of building:	c	**Date:**	20/01/1989
City:	d	**Revision No.:**	g

Table IEP-1a Additional Photos and Sketches

Add any additional photographs, notes or sketches required below:

Note: print this page separately

WARNING!! *This initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for Earthquake Engineering document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in conjunction with the limitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering calculations, or engineering judgements based on them, have not been undertaken, and these may lead to a different result or seismic grade.*

Table IEP-2: Initial Evaluation Procedure – Step 2

Initial Evaluation Procedure (IEP) Assessment - Completed for *{Client/TA}* **Page 2**

Street Number & Name:	a	**Job No.:**	e
AKA:	b	**By:**	f
Name of building:	c	**Date:**	20/01/1989
City:	d	**Revision No.:**	g

Table IEP-2 Initial Evaluation Procedure Step 2

Step 2 - Determination of *(%NBS)*$_b$

(Baseline *(%NBS)* for particular building - refer Section B5)

2.1 Determine nominal *(%NBS)* = *(%NBS)*$_{nom}$

	Longitudinal	Transverse
a) Building Strengthening Data		
Tick if building is known to have been strengthened in this direction	☐	☐
If strengthened, enter percentage of code the building has been strengthened to	N/A	N/A
1945		
b) Year of Design/Strengthening, Building Type and Seismic Zone		
Pre 1935	○	○
1935-1965	○	○
1965-1976	○	○
1976-1984	○	○
1984-1992	◉	○
1992-2004	○	○
2004-2011	○	◉
Post Aug 2011	○	○
Building Type:		
Seismic Zone:	Zone C	
c) Soil Type		
From NZS1170.5:2004, Cl 3.1.3 :	A or B Rock	A or B Rock
From NZS4203:1992, Cl 4.6.2.2 : **(for 1992 to 2004 and only if known)**		
d) Estimate Period, *T*		
Comment: h_n =	42	42 m
A_c =	1.00	1.00 m²
Moment Resisting Concrete Frames: $T = \max\{0.09h_n^{0.75}, 0.4\}$	○	○
Moment Resisting Steel Frames: $T = \max\{0.14h_n^{0.75}, 0.4\}$	○	○
Eccentrically Braced Steel Frames: $T = \max\{0.08h_n^{0.75}, 0.4\}$	○	○
All Other Frame Structures: $T = \max\{0.06h_n^{0.75}, 0.4\}$	○	○
Concrete Shear Walls: $T = \max\{0.09h_n^{0.75}/A_c^{0.5}, 0.4\}$	○	○
Masonry Shear Walls: $T \leq 0.4sec$	○	○
User Defined (input Period):	◉	◉
Where h_n = height in metres from the base of the structure to the uppermost seismic weight or mass. **T:**	2.00	2.00
e) Factor A: Strengthening factor determined using result from (a) above (set to 1.0 if not strengthened) **Factor A:**	1.00	1.00
f) Factor B: Determined from NZSEE Guidelines Figure 3A.1 using results (a) to (e) above **Factor B:**	0.30	1.00
g) Factor C: For reinforced concrete buildings designed between 1976-84 Factor C = 1.2, otherwise take as 1.0. **Factor C:**	1.00	1.00
h) Factor D: For buildings designed prior to 1935 Factor D = 0.8 except for Wellington where Factor D may be taken as 1, otherwise take as 1.0. **Factor D:**	1.00	1.00
***(%NBS)*$_{nom}$ = AxBxCxD** ***(%NBS)*$_{nom}$**	30%	100%

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Table IEP-2: Initial Evaluation Procedure – Step 2 continued

Initial Evaluation Procedure (IEP) Assessment - Completed for *{Client/TA}* **Page 3**

Street Number & Name:		**Job No.:**	
AKA:		**By:**	
Name of building:		**Date:**	
City:		**Revision No.:**	

Table IEP-2 Initial Evaluation Procedure Step 2 continued

2.2 Near Fault Scaling Factor, Factor E

If $T \leq 1.5$sec, Factor E = 1

Longitudinal | Transverse

a) Near Fault Factor, *N(T,D)* N(T,D):

(from NZS1170.5:2004, Cl 3.1.6)

b) Factor E = 1/N(T,D) **Factor E:**

2.3 Hazard Scaling Factor, Factor F

a) Hazard Factor, *Z*, for site

Location:

Z = (from NZS1170.5:2004, Table 3.3)

Z_{1992} = (NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))

Z_{2004} = (from NZS1170.5:2004, Table 3.3)

b) Factor F

For pre 1992 = $1/Z$

For 1992-2011 = Z_{1992}/Z

For post 2011 = Z_{2004}/Z

Factor F:

2.4 Return Period Scaling Factor, Factor G

a) Design Importance Level, I

(set to 1.0 if other than 1965-1984, or not known)

I =

b) Design Risk Factor, R_o

(set to 1.0 if not known)

R_o =

c) Return Period Factor, R

(from NZS1170.0:2004 Building Importance Level)

Choose Importance Level ○ 1 ◉ 2 ○ 3 ○ 4 | ○ 1 ◉ 2 ○ 3 ○ 4

R =

d) Factor G = IR_o/R

Factor G:

2.5 Ductility Scaling Factor, Factor H

a) Available Displacement Ductility Within Existing Structure

Comment: μ =

b) Factor H k_μ | k_μ

For pre 1976 (maximum of 2) =

For 1976 onwards =

Factor H:

(where k_μ is NZS1170.5:2004 Inelastic Spectrum Scaling Factor, from accompanying Table 3.3)

2.6 Structural Performance Scaling Factor, Factor I

a) Structural Performance Factor, S_p S_p =

(from accompanying Figure 3.4)

b) Structural Performance Scaling Factor = $1/S_p$ **Factor I:**

Note Factor B values for 1992 to 2004 have been multiplied by 0.67 to account for Sp in this period

2.7 Baseline %NBS for Building, *(%NBS)$_b$*

(equals **(%NBS)$_{nom}$ x E x F x G x H x I**)

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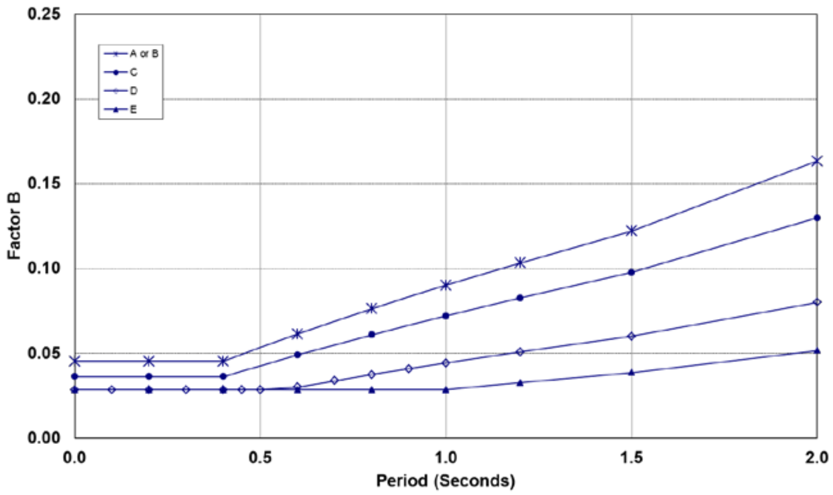


Figure BA.1(a): Factor B Pre-1965, All Zones

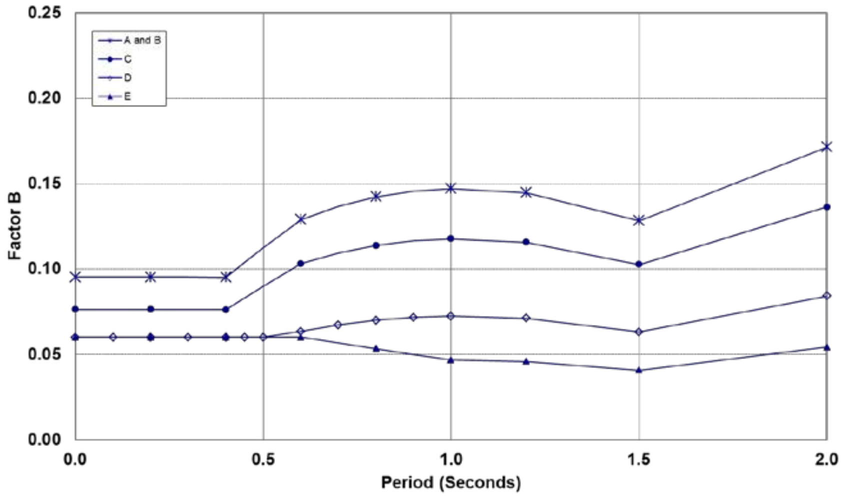


Figure BA.1(b): Factor B 1965-76, Zone A

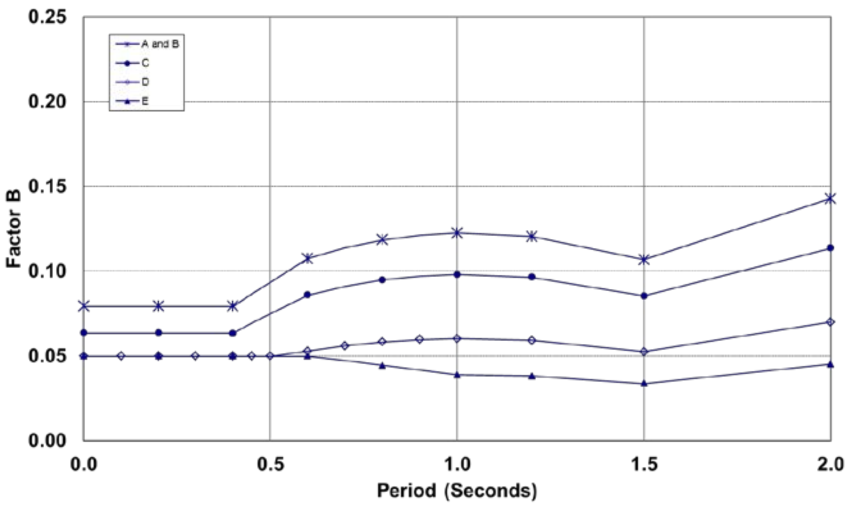


Figure BA.1(c): Factor B 1965-76, Zone B

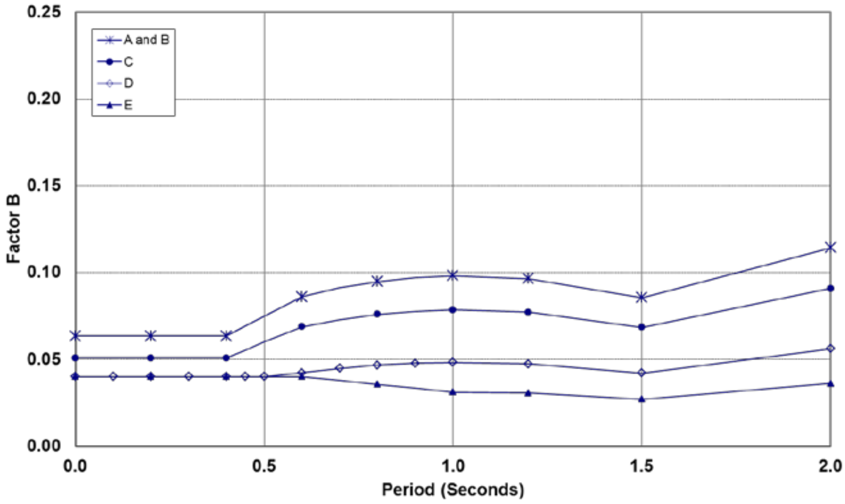


Figure BA.1(d): Factor B 1965-76, Zone C

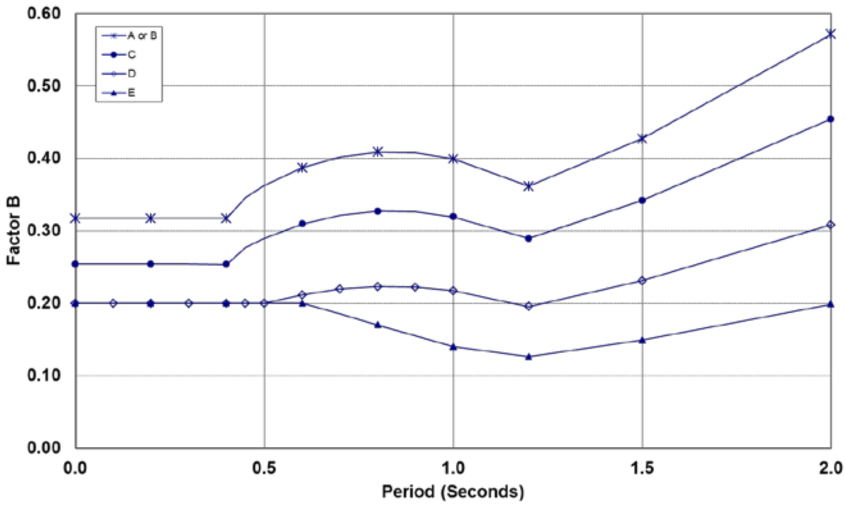


Figure BA.1(e): Factor B 1976-92, Zone A

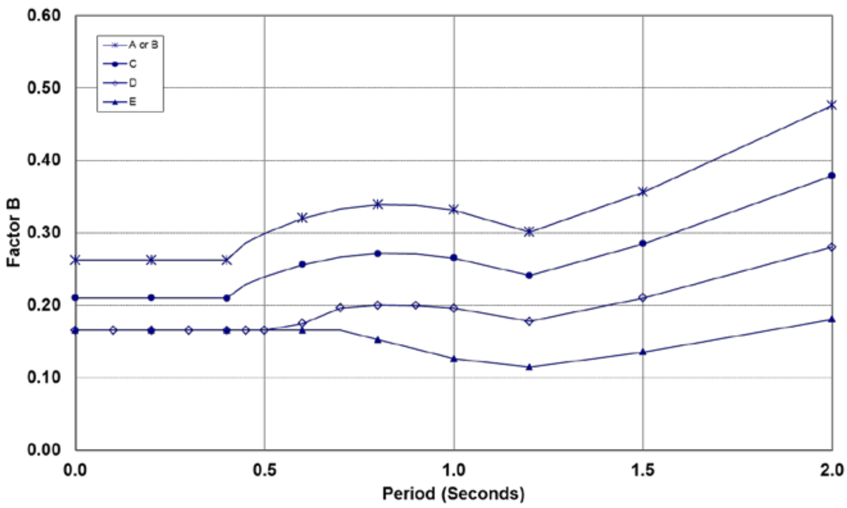


Figure BA.1(f): Factor B 1976-92, Zone B

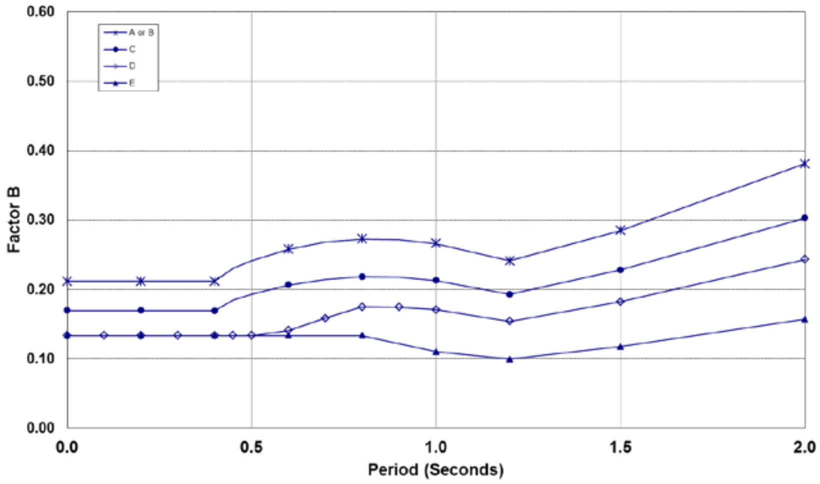


Figure BA.1(g): Factor B 1976-92, Zone C

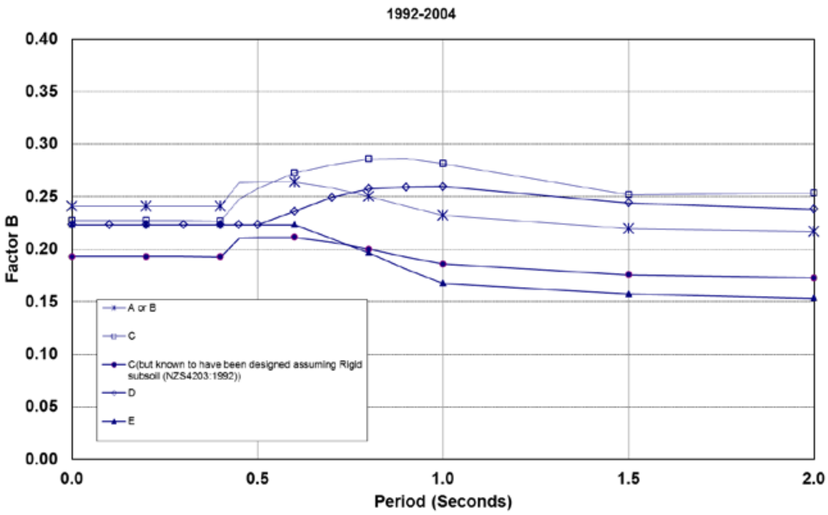


Figure BA.1(h): Factor B 1992-2004

Figure BA.1: Factor B for Different Building Design Vintages

Table BA.1: Current Return Period Factor, *R*

Importance Level	Comments	*R*
1	Structures presenting a low degree of hazard to life and other property	0.5
2, or if otherwise unknown	Normal structures and structures not in other importance levels	1.0
3	Structures that as a whole may contain people in crowds or contents of high value to the community or pose risks to people in crowds	1.3
4	Structures with special post-disaster functions	1.8
5	Special structures (outside the scope of this Standard—acceptable probability of failure to be determined by special study)	

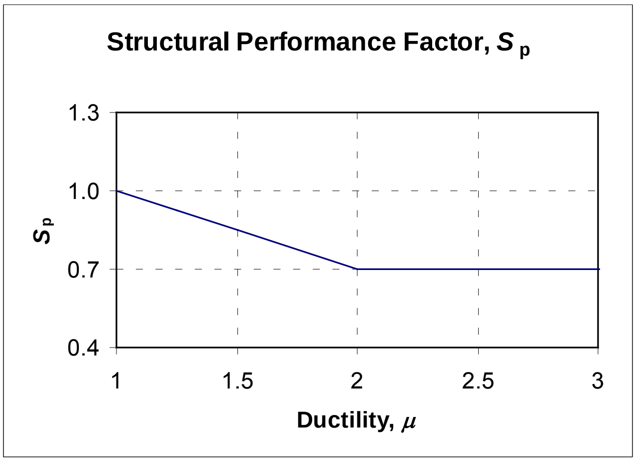
Table BA.2: Maximum ductility factors to be used in IEP

Structure Type	Maximum ductility factor			
	Pre-1935	1935-65	1965-76	>1976
Unstrengthened URM buildings	1.5	1.5	N/A	N/A
All other buildings	2	2	2	6

Table BA.3: Ductility Scaling Factor, Factor H

	Structural Ductility Factor, μ							
	1.0		1.25		1.50		2	
Soil Type	A,B,C & D	E	A,B,C & D	E	A,B,C & D	E	A,B,C & D	E
Period, *T*								
≤ 0.40s	1	1	1.14	1.25	1.29	1.50	1.57	1.70
0.50s	1	1	1.18	1.25	1.36	1.50	1.71	1.75
0.60s	1	1	1.21	1.25	1.43	1.50	1.86	1.80
0.70s	1	1	1.25	1.25	1.50	1.50	2.00	1.85
0.80s	1	1	1.25	1.25	1.50	1.50	2.00	1.90
≥1.00s	1	1	1.25	1.25	1.50	1.50	2.00	2.00

Note:
For buildings designed post 1976, Factor H shall be taken as 1.0.



Where S_p is the Structural Performance Factor from NZS 1170.5:2004, Clause 4.4.2
For light framed timber structures S_p = 0.5

Figure BA.2: Structural performance factor, S_p

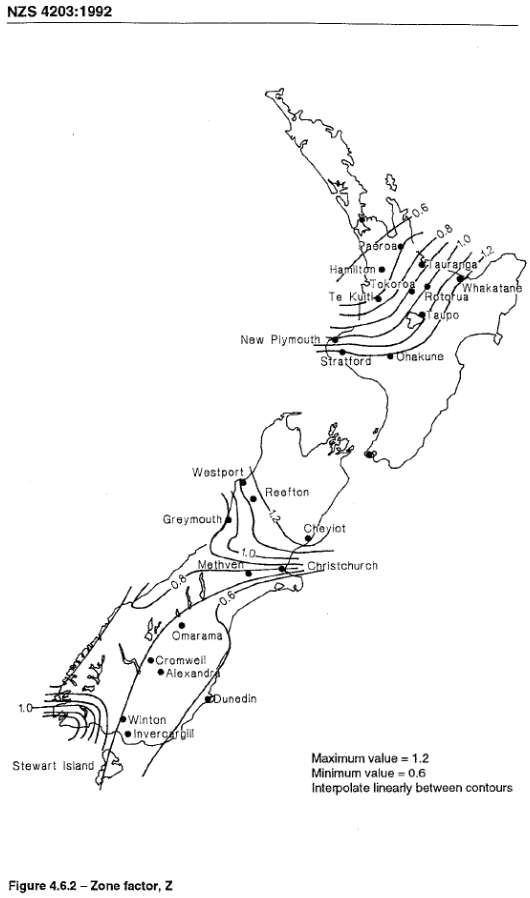


Figure BA.3(a): NZS 4203:1984, NZS 4203:1976 and NZSS1900:1965 Chapter 8

Figure BA.3(b): NZS 4203:1992

Figure BA.3: Extracts from previous Standards showing seismic zoning schemes

Table IEP-3: Initial evaluation procedure – Step 3

Initial Evaluation Procedure (IEP) Assessment - Completed for {Client/TA} **Page 4**

Street Number & Name:		**Job No.:**	
AKA:		**By:**	
Name of building:		**Date:**	
City:		**Revision No.:**	

Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)
(Refer Appendix B - Section B3.2)

a) Longitudinal Direction

potential CSWs | **Effect on Structural Performance** **(Choose a value - Do not interpolate)** | **Factors**

3.1 Plan Irregularity
Effect on Structural Performance ○ *Severe* ○ *Significant* ⊙ *Insignificant* **Factor A** 1.0
Comment

3.2 Vertical Irregularity
Effect on Structural Performance ○ *Severe* ○ *Significant* ⊙ *Insignificant* **Factor B** 1.0
Comment

3.3 Short Columns
Effect on Structural Performance ○ *Severe* ○ *Significant* ⊙ *Insignificant* **Factor C** 1.0
Comment

3.4 Pounding Potential
(Estimate D1 and D2 and set D = the lower of the two, or 1.0 if no potential for pounding, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

Note:
Values given assume the building has a frame structure. For stiff buildings (eg shear walls), the effect of pounding may be reduced by taking the coefficient to the right of the value applicable to frame buildings.

Factor D1 For Longitudinal Direction: 1.0

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 1	⊙ 1	○ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

Comment

b) Factor D2: - Height Difference Effect

Factor D2 For Longitudinal Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Height Difference > 4 Storeys	○ 0.4	○ 0.7	⊙ 1
Height Difference 2 to 4 Storeys	○ 0.7	○ 0.9	○ 1
Height Difference < 2 Storeys	○ 1	○ 1	○ 1

Comment

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance ○ *Severe* ○ *Significant* ⊙ *Insignificant* **Factor E** 1.0
Comment

3.6 Other Factors - *for allowance of all other relevant characteristics of the building* **For ≤ 3 storeys - Maximum value 2.5 otherwise - Maximum value 1.5. No minimum.** **Factor F** 1.0
Record rationale for choice of Factor F:
Comment

3.7 Performance Achievement Ratio (PAR)
(equals **A x B x C x D x E x F**)

PAR
Longitudinal **1.00**

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Table IEP-3: Initial evaluation procedure – Step 3 continued

Initial Evaluation Procedure (IEP) Assessment - Completed for {Client/TA} **Page 5**

Street Number & Name:		**Job No.:**	
AKA:		**By:**	
Name of building:		**Date:**	
City:		**Revision No.:**	

Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)
(Refer Appendix B - Section B3.2)

b) Transverse Direction

Factors

potential CSWs **Effect on Structural Performance** **(Choose a value - Do not interpolate)**

3.1 Plan Irregularity
Effect on Structural Performance ○ Severe ○ *Significant* ⦿ *Insignificant* **Factor A** 1.0
Comment

3.2 Vertical Irregularity
Effect on Structural Performance ○ Severe ○ *Significant* ⦿ *Insignificant* **Factor B** 1.0
Comment

3.3 Short Columns
Effect on Structural Performance ○ Severe ○ *Significant* ⦿ *Insignificant* **Factor C** 1.0
Comment

3.4 Pounding Potential
(Estimate D1 and D2 and set D = the lower of the two, or 1.0 if no potential for pounding, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

Note:
Values given assume the building has a frame structure. For stiff buildings (eg shear walls), the effect of pounding may be reduced by taking the coefficient to the right of the value applicable to frame buildings.

Factor D1 For Transverse Direction: 1.0

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 1	○ 1	⦿ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

Comment

b) Factor D2: - Height Difference Effect

Factor D2 For Transverse Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Height Difference > 4 Storeys	○ 0.4	○ 0.7	⦿ 1
Height Difference 2 to 4 Storeys	○ 0.7	○ 0.9	○ 1
Height Difference < 2 Storeys	○ 1	○ 1	○ 1

Comment

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance ○ Severe ○ *Significant* ⦿ *Insignificant* **Factor E** 1.0
Comment

3.6 Other Factors - *for allowance of all other relevant characteristics of the building* **For ≤3 storeys - Maximum value 2.5 otherwise - Maximum value 1.5. No minimum.** **Factor F** 1.00

Record rationale for choice of Factor F:
Comment

3.7 Performance Achievement Ratio (PAR)
(equals **A x B x C x D x E x F**)

PAR
Transverse **1.00**

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Table IEP-4: Initial evaluation procedure – Steps 4, 5, 6 and 7

Initial Evaluation Procedure (IEP) Assessment - Completed for {Client/TA} **Page 6**

Street Number & Name:		**Job No.:**	
AKA:		**By:**	
Name of building:		**Date:**	
City:		**Revision No.:**	

Table IEP-4 Initial Evaluation Procedure Steps 4, 5, 6 and 7

Step 4 - Percentage of New Building Standard *(%NBS)*

		Longitudinal	Transverse
4.1	**Assessed Baseline *%NBS (%NBS)*$_b$** (from Table IEP - 1)	75%	75%
4.2	**Performance Achievement Ratio (PAR)** (from Table IEP - 2)	1.00	1.00
4.3	**PAR x Baseline *(%NBS)*$_b$**	75%	75%
4.4	**Percentage New Building Standard *(%NBS)* - Seismic Rating** (Use lower of two values from Step 4.3)		75%

Step 5 - Is *%NBS* < 34? NO

Step 6 - Potentially Earthquake Risk (is *%NBS* < 67)? NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade B

Additional Comments (items of note affecting IEP based seismic rating)

Relationship between Grade and *%NBS* :

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	79 to 67	66 to 34	33 to 20	< 20

initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for ng document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in imitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering eering judgements based on them, have not been undertaken, and these may lead to a different result or seismic grade.

Table IEP-5: Initial evaluation procedure – Step 8

Initial Evaluation Procedure (IEP) Assessment - Completed for {Client/TA} **Page 7**

Street Number & Name:		Job No.:	
AKA:		By:	
Name of building:		Date:	
City:		Revision No.:	

Table IEP-5 Initial Evaluation Procedure Step 8

Step 8 - Identification of potential Severe Structural Weaknesses (SSWs) that could result in significant risk to a significant number of occupants

8.1	Number of storeys above ground level	4
8.2	Presence of heavy concrete floors and/or concrete roof? (Y/N)	Y

The following potential Severe Structural Weaknesses (SSWs) have been identified in the building that could result in significant risk to a significant number of occupants:

- **1. None identified** ☐
- **2. Weak or soft storey (except top storey)** ☐
- **3. Brittle columns and/or beam-column joints the deformations of which are not constrained by other structural elements** ☐
- **4. Flat slab buildings with lateral capacity reliant on low ductility slab-to-column connections** ☐
- **5. No identifiable connection between primary structure and diaphragms** ☐
- ☐

IEP Assessment Confirmed by ______ **Signature**

______ **Name**

______ **CPEng. No**

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engineering

BA.2 Guidance and Commentary

BA.2.1 Step 1 – Collect general information (Table IEP-1)

The first step in the IEP should be to collect relevant information necessary to carry out the assessment and to record this as the basis of the assessment. It is a fundamental premise of the IEP that limited definitive information is likely to be available and the assessment will necessarily be made on the basis of a visual inspection of only the exterior of the building.

Photographs of the building should be taken as part of the IEP and should form part of the permanent record. Likewise a record of the features observed and the extent of information that was available at the time of the assessment will be important considerations if the assessment is questioned in the future. Table IEP-1 provides a means of recording this information.

BA.2.2 Step 2 – Determine baseline percentage of new building standard $(\%NBS)_{b}$ (Table IEP-2)

Introduction

One of the first questions typically asked regarding existing buildings is how their overall expected seismic resistance compares to a building designed to the standard required for new buildings as specified in NZS 1170.5:2004. The comparison available through the IEP provides a simple and convenient measure of relative performance in earthquake provided that the limitations of the IEP are recognised (refer to Section B4.3).

It must be emphasised that the percentage figure derived, $(\%NBS)_{b}$, is a first step in any evaluation. It gives only an indication of the likely situation. It does not take full account of the particular characteristics of a building, which may be beneficial (as in the case when extra walls are added for architectural reasons but are nevertheless significant structural elements). It also does not take into account the effect of potential CSWs that can greatly reduce the overall seismic resistance predicted by the $(\%NBS)_{b}$ calculation.

Approach

There are a number of variables that feed into the calculation of a *baseline* percentage current code ratio $(\%NBS)_{b}$. These include:

- the natural period of vibration of the building
- its location in relation to seismic hazard
- the site sub soil characteristics
- the vintage or code to which the building was designed or strengthened. If the building has been strengthened, the level of strengthening is required
- the available ductility in the building
- design and current importance level designation of the building.

Different codes have had different requirements for design over the years. In broad terms this amounts to:

- pre-1935: no seismic design (except for buildings in Wellington)
- pre-1965: typically design for 0.1 g lateral force
- 1965-76: design to NZSS1900:1965, Chapter 8
- 1976-92: design to NZS 4203:1976, with some changes to risk and importance factors and for reinforced concrete structures in 1984
- 1992-2004: design to NZS 4203:1992
- post-2004: design to NZS 1170.5:2004.

Note:

Each orthogonal direction should be assessed separately unless it is clear from the start which governs.

Definitions

$(\%NBS)_{\mathrm{nom}} \Rightarrow$ The assessed nominal performance compared to NZS 1170.5:2004, assuming ductility of 1.0, Hazard factor of 1.0, Near Fault factor of 1.0, Return Period factor of 1.0, and Structural Performance factor of 1.0 (refer to Table IEP-1).

$(\%NBS)_{\mathrm{b}} \Rightarrow$ The baseline $(\%NBS)$ modifies $(\%NBS)_{\mathrm{nom}}$ to account for assessed ductility, location (hazard factor and near fault factor NZS 1170.5:2004) and occupancy category (i.e. return period factor) but assuming a good structure complying with the relevant code provisions at the time it was built.

The resulting value of $(\%NBS)_{\mathrm{b}}$ may be regarded as a measure of the seismic capacity of a well designed and constructed regular building of its type and vintage on the site in question. It is a "yardstick" against which to measure the effect of critical structural weaknesses that may exist in a particular building of the same type.

Note that an assessment of the likely ductility is required but the choice of ductility for post 1976 buildings will have little effect on the IEP score. In formulating the process it has been assumed that what constitutes available ductility has not changed significantly since 1976. If this is not correct the adjustment should be via the F-Factor in Step 3.2.

PAR $\Rightarrow$ The performance achievement ratio (PAR) may be regarded as the ratio of the performance of the particular building, as inspected, in relation to a well designed and constructed regular building of its type and vintage on the site in question that just meets the requirements of the code of the day. Therefore such a building would have a PAR of 1.0 (refer to Table IEP-3).

It is expected that all known issues (including for those items that would be considered as parts of the building but nevertheless would present a life safety risk should they fail) will be included in the assessment of PAR.

$\%NBS \Rightarrow$ Percentage of new building standard $\%NBS$. This adjusts $(\%NBS)_{\mathrm{b}}$ to account for particular characteristics of the building especially critical structural weaknesses (refer to Table IEP-4).

Note:

$\%NBS$ = $(\%NBS)_{\mathrm{b}}$ x Performance Achievement Ratio (PAR)

= a relative measure, in percentage terms, of the earthquake performance of the building under consideration with respect to NZS 1170.5:2004, taking into account critical structural weaknesses and other relevant features.

Step 2.1: Determine nominal percentage of new building standard $(\%\boldsymbol{NBS})_{\mathbf{nom}}$

Use the steps (a) to (g) to calculate $(\%NBS)_{\mathrm{nom}}$ using the following equation:

$$(\%NBS)_{\mathrm{nom}} = A^{*}B^{*}C^{*}D \qquad \text{…BA.1}$$

a) Determine code used in design of building

Note:

If the building is known to have been strengthened, adjust $(\%NBS)_{nom}$ for appropriate level of strengthening.

- Pre-1935:
  Refer to discussion in (f) below.
- Pre-1965 (0.08 g uniform load or 0.06 g applied as a triangular load)
- 1965-1976 (NZSS1900, Chapter 8):
  - Zone A
  - Zone B
  - Zone C
- 1976-1992 (NZS 4203:1976 or NZS 4203:1984)
  - Zone A
  - Zone B
  - Zone C

  For concrete structures designed to NZS 4203:1976 (refer also to (e) below).
- 1992-2004 (NZS 4203:1992)
- Post 2004 (NZS 1170.5:2004).

b) Determine soil type at the site

- Use NZS 1170.5:2004 classifications:
  - Class A – Strong rock
  - Class B – Rock

- Class C – Shallow soil sites
- Class D – Deep or soft soil sites
- Class E – Very soft soil sites.

c) Assess period of building

- Use any recognised method.
- Note that accurate analysis is not warranted in many cases since results are not highly sensitive to changes in period. Refer to Figure BA.1 for an indication of the variation.
- Simplified period calculations given in Table IEP-2 come from the commentary of NZS 1170.5:2004 with an additional limit on A_c.

d) Use appropriate part of Figure BA.1 to determine Factor B.

e) Concrete buildings designed to NZS 4203 up to 1984 were required to be designed using a structural material factor, M = 1.0. This was amended in NZS 4203:1984 to M = 0.8; hence the adjustment required by Factor C. Factor C shall be taken as 1.0 for buildings outside the date range 1976 to 1984.

f) Prior to 1935, no earthquake provisions were in place in New Zealand except for Wellington. While it would be possible to discount completely the seismic performance of buildings built prior to 1935 this is clearly too severe. The approach taken in the IEP is to assume that buildings built in Wellington prior to 1935 will perform at least as well as those designed to NZSS 95 (1939) as they are likely to have been subjected to some design for earthquake. Elsewhere a 20% penalty has been included (Factor D) to reflect that these buildings would not have been required to be designed for earthquake. It is expected that major deficiencies, if any, will be picked up in the assessment of PAR. For post-1935 buildings Factor D shall be taken as 1.0.

Step 2.2: Determine Near Fault scaling factor (Factor E)

a) Use NZS 1170.5:2004 to determine the $N(T, D)$ value applicable for a new building at the site of the existing one under consideration.

Step 2.3: Determine Hazard scaling factor (Factor F)

a) Use NZS 1170.5:2004 to determine the Hazard Factor, Z, for the site.

b) For 1992-2004 also determine the Zone Factor, Z, for the site from NZS 4203:1992 (refer to accompanying Figure BA.3(b)).

Step 2.4: Determine Return Period scaling factor (Factor G)

a) and b) Enter design values for I and R_0, if known. Otherwise enter 1.0. For buildings designed pre-1976 and known to have been designed as a public building, I may be taken as 1.25.

c) Use NZS 1170.0:2004 (accompanying Table BA.1) to determine the building's current Importance Level and enter appropriate Return Period Factor from Table BA.1.

d) Calculate Return Period Scaling Factor.

Step 2.5: Determine Ductility scaling factor (Factor H)

a) Assess overall ductility available in the building in question (refer to Table BA.2 for maximum values).

b) Read Ductility Scaling Factor from Table BA.3.

For 1976 onwards the ductility is effectively included in the appropriate part of Figure BA.2 therefore set as 1.0.

Prior to 1976 take the value from within the table. This value varies with period and soil type and is effectively k_{μ} from NZS 1170.5:2004.

Step 2.6: Determine Structural Performance scaling factor (Factor I)

Use NZS 1170.5:2004 or the appropriate materials Standard (whichever provides the higher value) to determine the Structural Performance Factor (refer to Figure BA.2).

Step 2.7: Determine baseline percentage of new building standard for building $(\%\boldsymbol{NBS})_{\mathbf{b}}$

a) Use values from Steps 2.1 to 2.7 to calculate $(\%NBS)_{\mathrm{b}}$ using the following equation:

$$(\%NBS)_{\mathrm{b}} = (\%NBS)_{\mathrm{nom}} =^{*} E^{*}F^{*}G^{*}H^{*}I \qquad \text{…BA.2}$$

$$(\%NBS)_{\mathrm{b}} = (\%NBS)_{\mathrm{nom}} * \frac{1}{N(T,D)} * \left(\frac{1}{Z}\, or\, \frac{Z_{1992}}{Z}\right) * \frac{IR_0}{R} * (\mu \text{ or } 1) * \frac{1}{S_{\mathrm{p}}} \qquad \text{…BA.3}$$

where:

$(\%NBS)_{\mathrm{b}}$	=	is the baseline percentage capacity of the building assuming regular, complying construction.
$(\%NBS)_{\mathrm{nom}}$	=	the nominal value of $(\%NBS)$ which assumes $N(T,D) = 1.0, Z = 1.0$,

$R = 1.0, \mu = 1.0$, and $S_{\mathrm{p}} = 1.0$

$N(T,D)$	=	the near fault factor from NZS 1170.5:2004.
Z	=	the hazard factor from NZS 1170.5:2004.
Z_{1992}	=	the zone factor from NZS 4203:1992 (for 1992-2004 buildings only).
R	=	the return period factor from the accompanying Table BA.1.
R_0	=	the risk factor used for the design. If it is not known with certainty, R_0 = 1
I	=	the importance factor used for the design of the building, applicable for 1965-1984 buildings only and only if known with certainty, otherwise take as = 1.0.

For buildings designed 1965 to 1976 as public buildings take I = 1.25, otherwise take as = 1.0

k_μ	=	the structural ductility scaling factor from accompanying Table BA.3. Note that μ cannot be greater than the values given in Table BA.2.
S_p	=	the structural performance factor applicable to the type of building under consideration (refer to Figure BA.2.

Factor B

The above procedure allows calculation of $(\%NBS)_b$ for a particular type of building provided that its location and original design code are known, and an assessment of the available ductility is made.

The values for Factor B shown in Figures BA.1(a) to BA.1(h) are based on:

- near fault factor of 1.0
- hazard factor of 1.0
- return period factor of 1.0
- ductility of 1.0
- structural performance factor of 1.0.

The values for Factor B shown are the ratios of the NZS 1170.5:2004 coefficient on the above basis and the coefficient that comes from the Standard used in design (that depends on date of design). Refer to Figure BA.4.

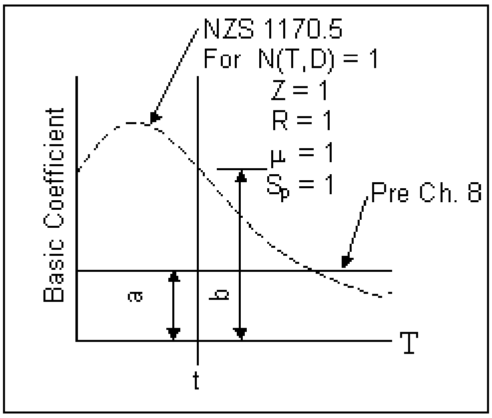


Figure BA.4(a): Pre-NZSS1900:1965

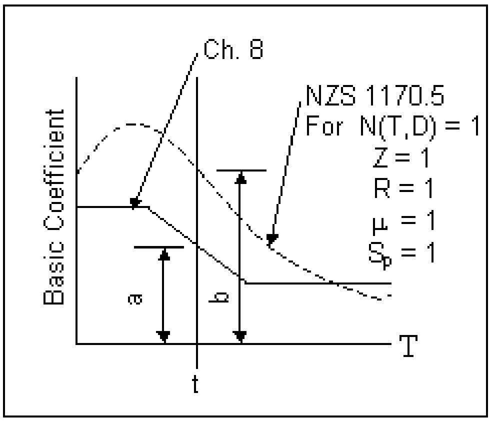


Figure BA.4(b): NZSS1900:Chapter 8: 1965

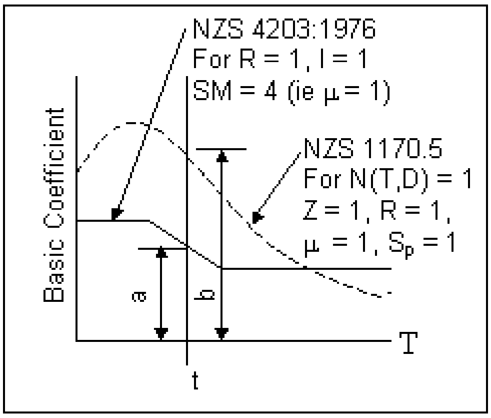


Figure BA.4(c): NZS 4203:1976

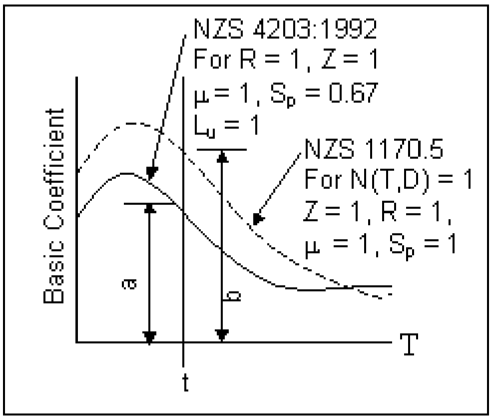


Figure BA.4(d): NZS 4203:1992

Figure BA.4: Concepts behind Scaling Factor *B*

For a particular T, $(\%NBS)_{\mathrm{nom}}$ = a/b

a) to adjust for near fault factor multiply by Factor E $= \frac{1}{N(T,D)}$

b) to adjust for hazard factor multiply by Factor F $= \frac{1}{Z}$ for pre 1992, or

$= \frac{Z_{1992}}{Z}$ for 1992-2003

$= \frac{Z_{2004}}{Z}$ for August 2011 onwards. This allows for the change in Z in the Canterbury region following the Canterbury earthquakes.

c) to adjust for return period factor multiply by Factor G $= \frac{IR_0}{R}$

d) to adjust for ductility multiply by Factor H $= k_{\mu}$ for pre 1976, or

$= 1$ for 1976 onwards

e) to adjust for structural performance multiply by Factor I $= \frac{1}{S_{\mathrm{p}}}$

The values for Factor B are approximate and based on the simplifying assumptions listed below. Assessors can substitute their own code comparisons if they wish.

Assumptions inherent in the assessment of $(\%NBS)_{\mathrm{b}}$

There are a number of assumptions inherent in the assessment of $(\%NBS)_{\mathrm{b}}$. These include that:

- the building has been designed and built in accordance with the building standard current at the time, and good practice.
- the building has been designed for the correct subsoil category. (Make pro-rata adjustments according to NZS 1170.5:2004 spectra, if this is not the case). Note that the rigid subsoil category in NZS 4203:1992 has been split into two categories in NZS 1170.5:2004. The IEP assumes that buildings on site subsoil type C (NZS 1170.5:2004) designed to NZS 4203:1992 would have been designed assuming intermediate subsoil. The procedure allows an adjustment if it is known that rigid subsoil was originally assumed.
- buildings designed prior to 1965 have had their assessed capacity increased by a factor of 1.5 to convert from allowable stress to ultimate limit state design and divided by 1.4 to convert from a rectangular shear distribution over the height of the building to a triangular distribution with 10% of the base shear applied at the roof. (The basis for this is the ratio of overturning moments derived by the two methods.)
- buildings designed to the 1965 code have had their period shifted by a factor of 1.25 to take account of greater flexibility resulting from the allowance for cracking assumed in later Standards.
- buildings designed to the 1976 code are assumed to use the same elastic spectral values as given in the 1984 code. Therefore for a μ of 1, the 1976 values are increased by a factor of 4 (i.e. SM = 4).
- buildings designed to the 1992 code are assumed to have been designed for a S_{p} of 0.67. If this is not the case adjust accordingly.

BA.2.3 Step 3 - Determine performance achievement ratio (PAR) (Table IEP-3)

Assessment of effects of potential critical structural weaknesses (Steps 3.1 to 3.4)

Note:

Consider each orthogonal direction separately unless it is clear from the start which governs.

A potential critical structural weakness (CSW) is any potential structural weakness (SW) in the structure that could potentially influence its performance/capacity in severe earthquake shaking. Some examples are provided in Figure BA.5. The Building (Earthquake-prone Building) Amendment Act 2016 confirms that parts of buildings will not be able to be excluded from consideration.

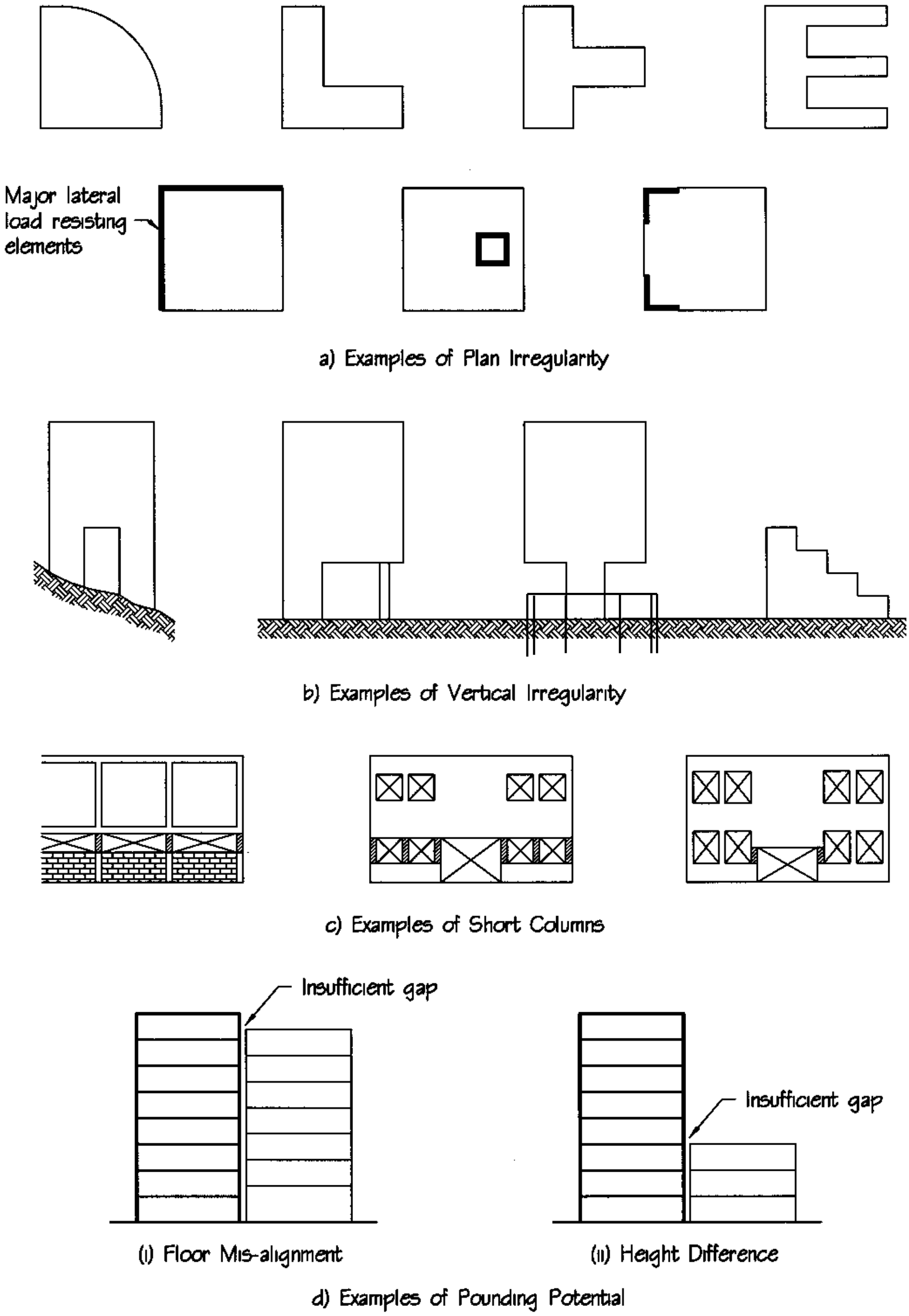


Figure BA.5: Examples of potential Critical Structural Weaknesses

Note:

Figure BA.5 does not describe all potential critical structural weaknesses that need to be considered.

Therefore potential CSWs are not solely restricted to the features shown in Table IEP-3. Any identified potential CSWs that are not included specifically in Table IEP-3 are expected to be accounted for by setting an appropriate value for Factor F.

The effect on the structural capacity is assessed on the basis of the severity of the potential CSW in each case.

Definitions of insignificant, significant and severe

Insignificant — The potential CSW is not evident in the building and/or its parts or is of such an extent or nature that it is very unlikely to lead to loss of life and/or have an impact on neighbouring property and/or impede egress from the building *when the building is subjected to severe earthquake shaking.*

Significant — The potential CSW is evident in the building and/or its parts and is of such an effect or nature that it is likely to lead to moderate loss of life and/or have a significant impact on neighbouring property and/or impede egress from the building when the building is subjected to severe earthquake shaking. To have a significant consequence under this level of shaking, the potential CSW would be likely to result in deformations in the structure and/or its parts such that localized collapse should be considered a possibility.

Severe — The potential CSW is evident in the building and/or its parts and is of such an extent or nature that it is likely to lead to significant loss of life and/or have a severe impact on neighbouring property and/or severely impede egress from the building when the building is subjected to severe earthquake shaking. For the potential CSW to be categorised as having a severe consequence, it would need to result in partial or complete collapse of the building and/or its parts.

Some examples of potential CSWs are shown in Figure BA.5 and guidance on determining the severity for common potential CSWs is provided in Table BA.4. When applying severity to the potential CSWs in accordance with Table BA.4, consideration should be given to the objectives in the above severity definitions.

The severe rating above should not be confused with the identification of a potential SSW.

Compensating provisions (Step 3.6)

The F-factor (or compensating factor) has been introduced in the IEP assessment process. It reflects the assessors' confidence of the final building rating. In general, this factor has been devised to account for:

- any parameter including other CSWs that might not have been accounted for in the evaluation process discussed above, but the assessor believes that should be accounted for
- apparent CSWs that might have been compensated for in design
- hidden strength and weaknesses
- compensation for over penalty
- higher levels of ductility than might have been assumed in the design of the building
- potential hazards to life (including from parts of buildings)
- any other parameters.

Table BA.4: Guide to severity of potential Critical Structural Weaknesses

	Effect on structural performance		
potential Critical Structural Weakness	**Severe**	**Significant**	**Insignificant**
Plan irregularity L-shape, T-shape, E-shape	Two or more wings length/ width > 3.0, or one wing length/width >4	One wing length/width > 3.0	All wings length/width ≤ 3.0
Long narrow building where spacing of lateral load resisting elements is …	> 4 times building width	> 2 times building width	≤ 2.0 times building width
Torsion (corner building)	Mass to centre of rigidity offset > 0.5 width	Mass to centre of rigidity offset > 0.3 width	Mass to centre of rigidity offset ≤ 0.3 width or effective torsional resistance available from elements orientated perpendicularly.
Ramps, stairs, walls, stiff partitions	Clearly grouped, clearly an influence	Apparent collective influence	No or slight influence
Vertical irregularity Soft storey	Lateral stiffness of any storey < 0.7 of lateral stiffness of any adjoining storeys	Lateral stiffness of any storey < 0.9 of lateral stiffness of the adjoining storeys	Lateral stiffness of any storey ≥ 0.9 of lateral stiffness of the adjoining storeys
Mass variation	Mass of any storey < 0.7 of mass of adjoining storey	Mass of any storey < 0.9 of mass of adjoining storey	Mass of any storey ≥ 0.9 of mass of adjoining storey
Vertical discontinuity	Any element contributing > 0.3 of the stiffness/ strength of the lateral force resisting system discontinues vertically	Any element contributing > 0.1 of the stiffness/ strength of the lateral force resisting system discontinues vertically	Only elements contributing ≤ 0.1 of the stiffness/strength of the lateral force resisting systems are discontinuous vertically
Short columns Columns < 70% storey height between floors clear of confining infill, beams or spandrels	Either > 80% short columns in any one side Or > 80% short columns in any storey	> 60% short columns in any one side > 60% columns in any one storey	No, or only isolated, short columns, or Columns with width > 1.2 m, or Free column height/column width ≥2.5.
Pounding effect Vertical differences between floors ≤ 20% storey height of building under consideration			No penalty
Vertical differences between floors > 20% storey height of building under consideration	0 < separation < 0.005 H	.005 H < separation < 0.01 H	Separation > 0.01 H
	where H = height to the level of the floor being considered		
Height difference effect No adjacent building, or height difference < 2 storeys			No penalty
Height difference 2–4 storeys	0 < separation < 0.005 H	0.005 H < separation < 0.01 H	Separation > 0.01 H
Height difference > 4 storeys	0 < separation < 0.005 H	0.005 H < separation < 0.01 H	Separation > 0.01 H, or Floors aligning and height difference < 2 storeys, **or** At least one building is lightweight construction
	where H = height of the lower building and separation is measured at H		

	Effect on structural performance		
potential Critical Structural Weakness	**Severe**	**Significant**	**Insignificant**
Site characteristics (refer to TA or Regional Council hazards maps, where available)	Unstable site. Structure prone to underslip and very susceptible to excessive loss of foundation support.	Signs of past site instability. Underslip may threaten structure and structure not capable of sustaining loss of foundation support.	Geohazards are not a significant threat to life in or immediately outside the building
	Significant liquefaction potential and building very susceptible to excessive settlement	Liquefaction potential and structure not capable of sustaining soil deformation	Liquefaction potential but structure capable of sustaining soil deformations

In general, 1.0 is considered as the base number. The factor should be less than 1.0 to reflect deficiencies not accounted in the process or to highlight that a detailed assessment of the building as a whole or of some specific parts is recommended. Similarly the factor could be more than 1.0 to reflect that the building has higher capacity than evaluated above. The limits on the compensating-factor are as follows:

- No limit on factor less than 1.0
- Up to 2.5 for buildings up to three storey high
- Up to 1.5 for buildings higher than three storeys high.

Reasons for adopting a compensating factor higher than 1.0 include, but are not limited to:

- greater than minimum lengths of shear wall
- design for significantly higher gravity loading than current use requires
- need to compensate for otherwise severe effect of combinations of potential CSWs that are not mutually exclusive (e.g. when a single issue results in both a plan and vertical irregularity – although in such cases it is acceptable to penalise assuming only one potential CSW)
- ductile detailing in pre-1976 buildings
- even in older timber houses higher ductility could be available
- compensating for inappropriate assignment-of penalties (e.g. a soft storey mechanism is unlikely if reasonable walls are present, in the direction under evaluation)
- presence of details that are known to improve performance (e.g. existence of bond beams in unreinforced masonry buildings)
- frame buildings with strong column-weak beam are unlikely to develop soft storey mechanism despite having a stiffness discontinuity in the vertical direction
- buildings with long walls are unlikely to develop soft storey mechanisms
- pounding against walls rather than columns, or wall and frame rather than between frame and frame structure
- pounding between lightweight and stiff heavy buildings is unlikely to be a serious issue
- the known resilience of timber buildings to earthquake shaking
- any other known factor.

It may be apparent that potential critical structural weaknesses have been compensated for in design. This should be established by viewing building design/construction documentation as part of the assessment. Note that even where compensating design has been carried out, a building with discontinuities, such as those nominated as potential CSWs, will likely suffer more damage than a geometrically regular building.

There may be negative factors that are known but have not been included in the IEP assessment. In such cases it is up to the judgement of the assessor to evaluate the potential life-safety risk and adjust the *%NBS* down accordingly. If a reasonable hazard due to structural or non-structural items exists it is recommended to set *%NBS* < 34 with a note that the earthquake prone classification is due to these items.

Possible negative factors include but are not limited to:

- quality of previous retrofit, if any
- hierarchy of failure, and consequences
- the hazard arising from parts of buildings such as face loaded infill panels, parapets, chimneys and stairs where this might be known.

These, and other issues, are discussed in more detail in Section B1, together with guidance on how to make allowance for them in an IEP.

The maximum value of Factor F has been set at 1.5 (no minimum) unless the building has no more than three storeys in which case a maximum value of 2.5 has been set (also no minimum). The reason for the distinction based on height is that it is felt that there is more scope for judgement for low rise structures and any positive compensating factors are likely to have a more dramatic effect on earthquake performance.

Factor F is entirely based on the judgement of the assessor and therefore it is a requirement of the IEP that the factors that have led to the decision for Factor F be appropriately recorded.

It is expected that the assessor may need to revisit Factor F after a *%NBS* score has been determined if this score appears unreasonable or not reflective of actual observed building behaviour. Such review is a part of the overall process as indicated in Figure B.2 and below.

Calculation of performance assessment ratio (PAR) (Step 3.4)

This is simply the product of the factors identified and shown on Table IEP-3. The focus of the review is on the capacity to resist lateral load.

The score for the building shall be taken as the lowest result for the two directions considered.

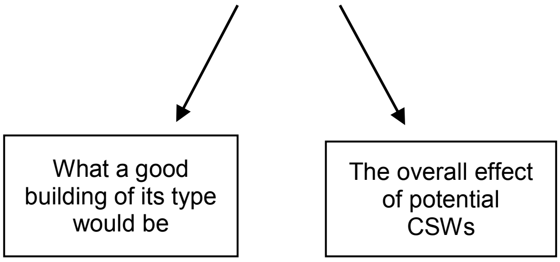
As noted above the assessor should now stand back and reflect on the appropriateness of the *%NBS* that has been determined. If the result is considered unrealistic or inappropriate, the assessor should review all steps including the available information on the building, and whether this is sufficient, and also the basis for the Factor F. Several iterations may be required.

If the IEP cannot provide a result that the assessor is satisfied with, by virtue of the limits on Factor F, the assessor shall note this in the assessment.

BA.2.4 Step 4 - Determine the percentage of new building standard, *%NBS* (Table IEP-4)

This is a simple calculation:

$$\%NBS = (\%NBS)_{\mathrm{b}}\ x\ PAR$$



BA.2.5 Step 5 – Is the building seismic rating less than 34*%NBS*?(Table IEP-4)

%NBS greater than 34[1]	⟶	YES – Building does not require further action in terms of the Building Act unless further knowledge becomes available that suggests otherwise.
%NBS less than or equal to 34	⟶	YES – Building meets one of the criteria for an earthquake-prone building in terms of the Building Act. Further action is required, e.g. TA consideration, DSA, review of drawings or further inspections.

BA.2.6 Step 6 – Is the building an earthquake risk?(Table IEP-4)

%NBS greater than or equal to 67	⟶	YES – Building is unlikely to be an earthquake risk unless further knowledge becomes available that suggests otherwise.
%NBS less than 67	⟶	YES – Building is potentially an earthquake risk. Further action is recommended, e.g. DSA, review of drawings or further inspections.

BA.2.7 Step 7 – Provide provisional grading based on IEP (Table IEP-4)

The grading scheme shown in Part A is being promoted by the New Zealand Society for Earthquake Engineering to improve public awareness of earthquake risk and the relative risk between buildings.

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[1] The target for an earthquake prone building is defined in legislation as one third of the requirements for a new building. In these guidelines this target has been rounded up to the nearest whole number as 34*%NBS*.

It is not a requirement of the Building Act to provide a seismic grade but it is strongly recommended that this be recorded so as to promote the concept of seismic grading.

Seismic grading determined from the results of the IEP should be considered provisional and subject to confirmation by detailed assessment.

The NZSEE grading scheme is only intended to grade the building under consideration. Aspects such as the possible detrimental effects of neighbouring buildings or the hazards resulting from items that could be classified as building contents are not considered but may nevertheless be important considerations for building owners, and tenants and should be brought to their attention if this is appropriate for the level of assessment being undertaken.

BA.2.8 Step 8 – Note identified potential SSWs from list provided

Table IEP-5 has six tick boxes which only need to be considered if the building has more than three stories and has heavy floors and/or a heavy roof. The first box will be ticked when none of the listed potentially SSWs have been identified as being present. The other boxes represent the five potential SSWs that represent particular weaknesses (vulnerabilities) that it is believed have significant potential to lead to catastrophic collapse and/or loss of egress that would result in a significant risk to occupants.

The six tick boxes are:

1. None identified. This should not be construed as advice that none are present.
2. A weak or soft storey, except for the top storey.
3. Brittle columns and/or brittle beam/column joints the deformations of which are not constrained by other structural elements.
4. Flat slab buildings with lateral capacity reliant on low ductility slab to column connections.
5. No effective connection between primary seismic structural elements and diaphragms.
6. Seismically separated stairs with ledge and gap supports.

If any two of the items 2 to 5 have been ticked then careful consideration should be given before scoring the building above earthquake prone level. The F factor would then be set as considered appropriate noting that a DSA is recommended to confirm the score.

It is acknowledged that these structural weaknesses may only be recognisable from construction drawings and therefore an ISA based on a visual inspection only will not necessarily identify their presence.

The presence of any of these potential SSWs should also be noted in the covering report (refer to Appendix BC).

Appendix BB: Initial Seismic Assessment of Unreinforced Masonry Buildings using an Attribute Scoring Methodology

BB.1 General

For URM buildings built prior to 1935, the ISA can be carried out using the attribute scoring method outlined in this appendix. The *%NBS* is then determined directly from the Total Attribute Score as described below.

The recommended procedure is:

- complete the attribute scoring Table BB.1 using the guidance provided in Table BB.2
- from the Total Attribute Score determine the *%NBS* from Table BB.3.

Interpolation may be used for intermediate attribute scores. While attributes may differ for each principal direction, it is the intention that the attribute score apply to the building as a whole. Therefore, it will be necessary to choose an Attribute Score that is representative of the building. This will not necessarily be the lowest score for either direction but can conservatively be taken as such.

Given that local collapse is viewed as having the same implications as total collapse, attributes should correspond to the weakest section of a building where relevant.

The derivation of *%NBS* using the attribute scoring method outlined, assumes that all appendages likely to present a hazard have been adequately secured or measures taken to remove the risk to life, e.g. provision of appropriately designed canopies or designated “no go” zones adjacent to the building.

If appendages have not been restrained the *%NBS* shall not be taken greater than 34*%NBS*.

Table BB.1: Assessment of Attribute Score

Item		Attribute ranking				Assessed score	
		0	1	2	3	Long	Trans
1	**Structure continuity**	Excellent	Good	Fair	Poor or none		
2	**Configuration**						
2a	Horizontal regularity	Excellent	Good	Fair	Poor		
2b	Vertical regularity	Excellent	Good	Fair	Poor		
2c	Plan regularity	Excellent	Good	Fair	Poor		
3	**Condition of structure**						
3a	Materials	Sound	Good	Fair	Poor		
3b	Cracking or movement	Not evident	Minor	Moderate	Severe		
4	**Wall (URM) proportions**						
4a	Out of plane	Good			Poor		
4b	In-plane	Excellent	Good	Fair	Poor		
5	**Diaphragms**						
5a	Coverage	Excellent	Good	Fair	Poor		
5b	Shape	Excellent	Good	Fair	Poor		
5c	Openings	None			Significant		
6	**Engineered connections between floor/roof diaphragms and walls, and walls and diaphragms** capable of spanning between	Yes			No		
7	**Foundations**	Excellent	Good	Fair	Poor		
8	**Separation from neighbouring buildings**	Adequate			Inadequate		
		Total Attribute Score:		**For each direction**			
				For building as a whole			

Note:

For definition of grading under each attribute refer to Table BB.2.

Table BB.2: Definition of attributes and scores

		Attributed Score[1]
Attribute Item (1): Structure continuity		
Totally un-reinforced masonry		3
Some continuity, e.g. un-reinforced masonry with a reinforced concrete band at roof *or* floor level		2
Good continuity, e.g. un-reinforced masonry with reinforced bands at *both* roof and floor levels		1
Full continuity (i.e. vertical stability not reliant on URM), e.g. reinforced concrete or steel columns and beams with un-reinforced masonry walls/infill or separate means of vertical support provided to floors and roof		0
Attribute Item (2): Configuration		
(a)	Plan regularity	
	Severe eccentricity, i.e. distance between storey centre of rigidity and the centre of mass for all levels above that storey, $e_{\mathrm{d}} < 0.3\,b$ (b = longest plan dimension of building perpendicular to direction of loading)	3
	$e_{\mathrm{d}} < 0.3\,b$	2
	$e_{\mathrm{d}} < 0.2\,b$	1
	Building symmetrical in both directions	0
(b)	Vertical regularity	
	Vertical stiffness discontinuities or discontinuities in load paths present	3
	All walls continuous to foundations	2
	and no soft storeys *and* minimal vertical stiffness changes	1
	and no weak storeys *and* no significant mass irregularities	0
	where: • *soft storey* is a storey where the lateral stiffness is less than 70% of that in the storey above or less than 80% of the average stiffness of the three storeys above • *weak storey* is a storey where the storey strength is less than 80% of the strength of the storey above *a mass irregularity* exists if the mass varies by more than 50% from one level to another (excluding light roofs which should be considered as a part of the building).	
(c)	Diaphragm shape	
	Sharp re-entrant corners present where the projection of the *wing* beyond the corner > 0.15 b	3
	Regular in plan	0
Attribute Item (3): Condition of structure		
(a)	Materials	
	Poor, i.e. considerable deterioration, fretting or spalling, etc., or lime or other non-competent mortar or rubble wall construction	3
	Fair, i.e. deterioration leading to reduced strength	2
	Good, i.e. minor evidence of deterioration of materials	1
	Sound	0

<table>
<tr><th colspan="5"></th><th>Attributed Score[1]</th></tr>
<tr><td>(b)</td><td colspan="4">Cracking or movement</td><td></td></tr>
<tr><td></td><td colspan="4">Severe, i.e. a considerable number of cracks or substantial movement leading to reduced strength or isolated large cracks
Moderate
Minor
Non-evident</td><td>3
2
1
0</td></tr>
<tr><td colspan="5">Attribute Item (4): Wall (URM) proportions</td><td></td></tr>
<tr><td>(a)</td><td colspan="4">Out of plane performance</td><td></td></tr>
<tr><td></td><td colspan="4">Poor:
- for one storey buildings $hw/t > 14$ and $lw/t > 7$
- for multistorey buildings:
top storey $hw/t > 9$ and $lw/t > 5$
other storeys $hw/t > 20$ and $lw/t > 10$</td><td>3</td></tr>
<tr><td></td><td colspan="4">Good (not poor)
where
hw = height of wall between lines of positive lateral restraint, and
lw = length of wall between lines of positive lateral restraint</td><td>0</td></tr>
<tr><td>(b)</td><td>In plane performance[2]</td><td colspan="3">A_p/A_w</td><td></td></tr>
<tr><td colspan="2" rowspan="2"></td><td rowspan="2">One storey building</td><td colspan="2">2 and 3 storey buildings</td><td rowspan="2"></td></tr>
<tr><td>Top storey</td><td>Other stories</td></tr>
<tr><td></td><td>Poor
Fair
Good
Excellent</td><td>≥25
>20
>15
≤15</td><td>≥20
>15
>10
≤10</td><td>≥17
>12
>7
≤7</td><td>3
2
1
0</td></tr>
<tr><td></td><td colspan="4">where A_w = cross sectional area of all URM walls/wall sections extending over full height of storey
A_p = plan area of building above storey of interest.
For buildings of greater than 3 stories take attribute score = 3</td><td></td></tr>
<tr><td colspan="5">Attribute Item (5): Diaphragms (refer to Figure BB.1)</td><td></td></tr>
<tr><td>(a)</td><td colspan="4">Coverage</td><td></td></tr>
<tr><td></td><td colspan="4">No diaphragm
Full diaphragm
To achieve an attribute ranking of 0 requires a diaphragm to be present at each level, including roof level, covering at least 90% of the building plan area at each level. Interpolation for attribute rankings of 1 and 2 may be made using judgement on the extent of coverage. Note that unless the diaphragm is continuous between walls, its effectiveness may be minimal.</td><td>3
0</td></tr>
</table>

						Attributed Score[1]
(b)	Shape	**Limiting span to depth ratios for diaphragms of different construction material**				
		Concrete	**Sheet materials**	**T&G timber**	**Steel roof bracing**	
	Poor	> 4	> 4	> 3	> 5	3
	Fair	< 4	< 4	< 3	< 4	2
	Good	$\leq$ 3	$\leq$ 3	$\leq$ 2	$\leq$ 3.5	1
	Excellent	As for good, but in addition the projection of “wings” beyond sharp re-entrant corners < 0.5b.				0
(c)	Openings					
	Significant openings					3
	No significant openings					0
	Interpolation for attribute rankings of 1 and 2 may be made using judgement					
	Significant openings are those which exceed the limiting values given below.					

	Diaphragm construction material	**Limiting values of**		
		X/b	Y/D	
	Concrete	0.6	0.5	
	Sheet material	0.5	0.4	
	T&G timber	0.4	0.3	
	Refer to Figure BB.1 for definition of terms			

Attribute Item (7): Foundations	
Separate foundations with no interconnection *or* un-reinforced piles (unless ramification of pile failure is assessed to be minor).	3
Pads, strips or piles with some interconnection. Concrete piles to be reinforced unless ramification of pile failure is assessed to be minor.	2
Pads, strips or piles with good interconnection in both directions.	1
Concrete raft with sound connections to walls.	0
Attribute Item (8): Separation	
Inadequate – no separation provided or obviously inadequate provisions for separation	3
Adequate – separation provided	0

Note:

1. Individual attribute scores may be interpolated.
2. This is an index describing the extent of brick walls within the building. The numbers given are only loosely related to lateral load capacity.

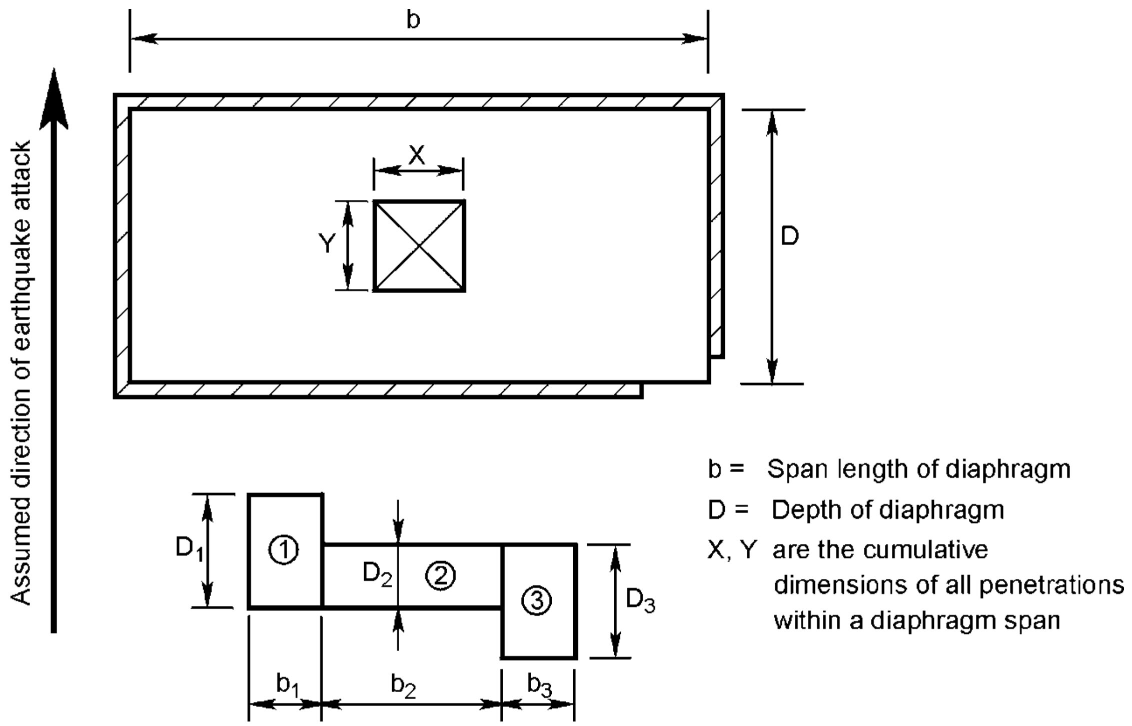

Figure BB.1: Diaphragm parameters

Table BB.3: Assessment of *%NBS* from Attribute Score

Item	Attribute Score	*%NBS*
1	A score of 0 for all attribute scoring items	$67\ x\ 1/Rx\ 0.4/Z^1$
2	Less than or equal to 1 for all of attribute scoring items 1 to 6 inclusive, and less than 2 for each of attribute scoring items 7 and 8	$34\ x\ 1/Rx\ 0.4/Z$
3	As for 2 but a score of 0 for attribute scoring item 1	$40\ x\ 1/Rx\ 0.4/Z$
4	5 < Total Attribute Score $\leq$ 10	$20\ x\ 1/Rx\ 0.4/Z$
5	10 < Total Attribute Score $\leq$ 15	$15\ x\ 1/Rx\ 0.4/Z$
6	15 < Total Attribute Score $\leq$ 25	$10\ x\ 1/Rx\ 0.4/Z$
7	Total Attribute Score > 25	$5\ x\ 1/Rx\ 0.4/Z$

Note:

1. *R* and *Z* are defined in NZS 1170.5:2004.

Appendix BC: Template Covering Letter – Building Owner or Tenant Commissioned IEP

Building Owner
PO Box XYZ
SHAKESVILLE

Date

Dear Sir

Seismic Assessment and Improvement of Buildings Guidelines - Part B

We have now completed an Initial Seismic Assessment (ISA) of the building at XX Tremor Grove, Shakesville using the Initial Evaluation Procedure (IEP) as described in Part B of the guideline document, *The Seismic Assessment of Existing Buildings-Technical Guidelines for Engineering Assessments*, dated [**XXX**]. The assessment was carried out after completing a site visit [*add anything else that formed the basis of the assessment e.g.* and reviewing the original structural drawings *etc*].

Executive Summary

*Provide the final **potential** seismic rating and building grade. Note the Importance Level (in accordance with NZS 1170.5:2004) that was assumed to apply as this will define the new building standard that the building is rated against. Use the following form XXX%NBS* (ILY).

Give the potential status of building in relation to 34%NBS and the Earthquake Risk (67%NBS) criteria.

Note if any of the potential SSWs in IEP Table 5 have been identified and that these could potentially present an enhanced risk in severe earthquake shaking.

The ISA is considered to provide a relatively quick, high-level and qualitative measure of the building's performance. A more reliable result will be obtained from a Detailed Seismic Assessment (DSA) and is recommended for this building. A DSA could find structural weaknesses not identified from the IEP, or that identified potential CSWs have been addressed in the design of the building.

Introduction

Provide the background and basis of .the assessment, i.e. that it has been based on the IEP as defined by the Technical Guidelines for Engineering Assessments.

Background to the IEP and Its Limitations

The IEP procedure was developed in 2006 by the New Zealand Society for Earthquake Engineering (NZSEE) and updated in 2016 to reflect experience with its application and as a result of experience in the Canterbury earthquakes. It is a tool to assign a percentage of New Building Standard (*%NBS*) rating and associated grade to a building as part of an initial seismic assessment of existing buildings.

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The IEP enables territorial authorities, building owners and managers to review their building stock as part of an overall risk management process.
Characteristics and limitations of the IEP include:

- An IEP assessment is primarily concerned with life safety. It does not consider the susceptibility of the building to damage, and therefore to economic losses.
- It tends to be somewhat conservative, identifying some buildings as earthquake prone, or having a lower *%NBS* score, which subsequent detailed investigation may indicate is less than actual performance. However, there will be exceptions, particularly when potential critical structural weaknesses (CSWs) are present that have not been recognised from the level of investigation employed.
- It can be undertaken with variable levels of available information, e.g. exterior only inspection, structural drawings available or not, interior inspection, etc. The more information available, the more representative the IEP result is likely to be. The IEP records the information that has formed the basis of the assessment and consideration of this is important when determining the likely reliability of the result.
- It is an initial, first-stage review. Buildings or specific issues which the IEP process flags as being problematic or as potentially critical structural weaknesses, need further detailed investigation and evaluation. A Detailed Seismic Assessment is recommended if the seismic status of a building is critical to any decision making.
- The IEP assumes that the buildings have been designed and built in accordance with the building standard and good practice current at the time. In some instances, a building may include design features ahead of its time - leading to better than predicted performance. Conversely, some unidentified design or construction issues not picked up by the IEP process may result in the building performing not as well as predicted.
- It is a largely qualitative process, and should be undertaken or overseen by an experienced engineer. It involves considerable knowledge of the earthquake behaviour of buildings, and judgement as to key attributes and their effect on building performance. Consequently, it is possible that the *%NBS* derived for a building by independent experienced engineers may differ.
- An IEP may over-penalise some apparently critical features which could have been satisfactorily taken into account in the design.
- An IEP does not take into account the seismic performance of non-structural items such as ceilings, plant, services or general glazing that are not considered to present a significant life safety hazard.

Experience to date is that the IEP is a useful tool to identify potential issues and expected overall performance of a building in an earthquake. However, the process and the associated *%NBS* rating and grade should be considered as only providing an indicative indication of the building's compliance with current code requirements. A detailed investigation and analysis of the building will typically be required to provide a definitive assessment.

Include if appropriate and if comfortable that the rating reflects the buildings expected behaviour.

The IEP has been based on a review of drawings and an inspection of both the interior and exterior of the building and can be considered to be a comprehensive assessment at the DSA level. The rating determined is greater than 34*%NBS* and therefore, if ratified by the TA, the building should not be considered as earthquake prone.

Basis for the Assessment

The information we have used for our IEP assessment includes:

List the information that has been available to carry out the assessment, e.g.: structural drawings, whether the site visit included an interior inspection, basis for the assessment of geotechnical conditions.

Building Description

The building located at [WW Tremor Grove, Shakesville] is [X] storey structure designed in [YYYY]. It is currently used as [ZZZZZZ].

Provide a brief description of the building including relevant features such as age, structural configuration, lateral seismic resisting system in each direction, relationship to neighbouring buildings and foundation/soil conditions.

IEP Assessment Results

Our IEP assessment of this building indicates the building can achieve XXX%*NBS* (ILY) in the longitudinal direction and YYY%*NBS* (ILY) in the transverse direction. The IEP assessment of this building therefore indicates an overall score of ZZZ%*NBS* (ILY), corresponding to a 'Grade X' building as defined by the New Zealand Society for Earthquake Engineering (NZSEE) building grading scheme. This is [*above/below*] the threshold for earthquake prone buildings (34%*NBS*) but [*above/below*] the threshold for earthquake risk buildings (67%*NBS*) as recommended by the NZSEE.

The key assumptions made during our assessment are shown in Table 1 below. Refer also to the attached IEP assessment.

Table 1: IEP Assessment Results

Fill in the scoring assumptions from the IEP

Briefly outline the justification for the scoring decision. Justification is an important aspect of the IEP as it records the judgement decisions of the assessor

IEP Item	Assumption	Justification
Date of Building Design		
Soil Type		

IEP Item	Assumption	Justification
Building Importance Level		
Ductility of Structure		
Plan Irregularity Factor, A		
Vertical Irregularity Factor, B		
Short Columns Factor, C		
Pounding Factor, D		
Site Characteristic		
F Factor		

IEP Grades and Relative Risk

Table 2 taken from the NZSEE Guidelines provides the basis of a proposed grading system for existing buildings, as one way of interpreting the *%NBS* seismic rating.

Table 2: Relative Earthquake Risk

Building Grade	Percentage of New Building Strength (*%NBS*)	Approx. Risk Relative to a New Building	Life-safety Risk Description
A+	>100	<1	low risk
A	80 to 100	1 to 2 times	low risk
B	67 to 79	2 to 5 times	low or medium risk
C	34 to 66	5 to 10 times	medium risk
D	20 to 33	10 to 25 times	high risk
E	<20	more than 25 times	very high risk

This building has been classified by the IEP as a grade [X] building and is therefore considered to be a [YYYYYYYY] life-safety risk.

The New Zealand Society for Earthquake Engineering (which provides authoritative advice to the legislation makers, and should be considered to represent the consensus view of New Zealand structural engineers) classifies a building achieving greater than 67*%NBS* as "Low Risk", and having "Acceptable (improvement may be desirable)" building structural performance.

Seismic Restraint of Non-Structural Items

During an earthquake, the safety of people can be put at risk due to non-structural items falling on them. These items should be adequately seismically restrained, where possible, to the NZS 4219:2009 "The Seismic Performance of Engineering Systems in Buildings".

An assessment has not been made of the bracing of the ceilings, in-ceiling ducting, services and plant or contents. We have also not checked whether tall or heavy furniture has been seismically restrained or not. These issues are outside the scope of this initial assessment but could be the subject of another investigation.

If particular potential hazards that could lead to an enhanced risk have been identified during the assessment, but they do not influence the %NBS rating (e.g. geo-hazards outside the site boundaries, tsunami, adjacent URM walls etc) they should be noted here.

Other Issues

Although their identification is beyond the scope of this assessment and they do not influence the *%NBS* score for the building, the following hazard(s) have been identified as potential issue(s) for this building:

List any hazards.

Conclusion

Our ISA assessment for this building, carried out using the IEP indicates an overall score of XXX*%NBS* (ILY) which corresponds to a Grade Z building, as defined by the NZSEE building grading scheme. This is [*above/below*] the threshold for Earthquake Prone Buildings (34*%NBS*), and [*above/below*] the threshold for Earthquake Risk Buildings (67*%NBS*) as defined by the NZSEE.

The ISA is considered to provide a relatively quick, high-level and qualitative measure of the building's performance. In order to confirm the seismic performance of this building with more reliability you may wish to request a DSA. A DSA would likely focus on the following issues:

List the issues identified, including all CSWs (including those identified when establishing the F-Factor).

A DSA would also investigate other potential weaknesses that may not have been considered in the initial seismic assessment.

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If any potential Severe Structural Weaknesses (SSWs) have been noted in Table IEP-5 of the IEP
While completing this ISA we identified the following potential Severe Structural Weakness(es) in the building:

List any potential Severe Structural Weaknesses noted in Table IEP-5 of the IEP.

If confirmed as structural weaknesses these could have the potential to significantly reduce the resilience of the building and adversely affect its performance in severe earthquakes.

We trust this letter and initial seismic assessment meets your current requirements. We would be pleased to discuss further with you any issues raised in this report.

Please do not hesitate to contact me if you would like clarification of any aspect of this letter.

Experienced, Competent and Appropriately Trained Structural Engineer

CPEng

Encl: IEP Assessment

Appendix BD: Template Covering Letter – Potentially Earthquake Prone Building from a TA Initiated IEP

Date

Dear Sir/Madam

Potentially Earthquake-Prone Building

Site Address:

Legal Description

The Council has completed an initial seismic assessment for the above building.

You are receiving this letter as you are shown on our records as being the owner of this building, or you are identified as a director of the company which owns the building, or you have an interest in the land on which the building is situated. Please advise the writer if this is not the case.

An initial evaluation procedure (IEP) seismic assessment for the building has been completed in accordance with the requirements of the New Zealand Society for Earthquake Engineering (NZSEE) *"Guidelines on Assessment and Improvement of the Structural Performance of Buildings in Earthquake"* 2006 New Zealand This assessment found that the building achieves less than 34 percent of the current seismic loading standard (NZS 1170.5:2004). A copy of this assessment is included for your information. The building has therefore been listed as potentially earthquake-prone.

As the property owner, you now have until XXXX to provide relevant information to the Council on any matters that may affect the structural performance of the building.

We recommend that you engage a structural engineer to carry out a detailed seismic assessment of the building and provide us with a copy so that we may XXXX whether or not the building is earthquake-prone. To assist with the engineer's assessment of the building, we would recommend that you provide them with a copy of the enclosed IEP.

Please send any additional information about the building to eqpbuildingproject@wcc.govt.nz.

If you do not provide any relevant information to us before the date above, the Council will take the view that you agree with the assessment by our engineers and that you accept that the building is earthquake prone.

Once all the information we have received has been assessed, we will contact you to notify you of our decision on the building's status. If the building is confirmed as earthquake-prone, the Council will issue an earthquake-prone building notice to you as the owner, or the occupiers and to any persons or organisations which have an interest in the building. This is required under section 125 of the Building Act 2004. A copy of the section 124 notice will be fixed in a prominent position on the building.

Page 2

Information regarding the potentially earthquake-prone status of the building, including this letter, is publicly available on request and will be included in land and project information memoranda (LIMs and PIMs).

If you have any questions about the assessment or the process please do not hesitate to contact me.

Yours sincerely

Encl. IEP Assessment

Appendix BE: Template Covering Letter – Not Earthquake Prone from a TA Initiated IEP

Date

Dear Sir/Madam

Building Not Considered to be Earthquake-Prone

Site Address:

Legal Description

An initial seismic assessment for the above building using the initial evaluation procedure (IEP) in accordance with the requirements of the New Zealand Society for Earthquake Engineering (NZSEE) *"Guidelines on Assessment and Improvement of the Structural Performance of Buildings in Earthquake"* 2006 New Zealand, has been completed by Council contracted engineers.

The result of this assessment indicates that the building achieves greater than 34 percent of the current seismic building standard (NZS 1170.5:2004). Accordingly, we are satisfied that the building should not currently be defined as earthquake-prone under section 122 of the Building Act 2004.

Please note that the IEP assessment has been carried out by the Council as part of a coarse screening exercise and should not be relied on for any other purpose. We recommend that, as the owner, you engage a suitably qualified engineer to undertake a detailed assessment of the building if the seismic status of the building is important for any decisions that you need to make.

If there are changes to legislation or seismic loading standards, or if we receive any further relevant information about the building, the building may require assessment to determine the impact on its seismic status relative to the earthquake prone building legislation.

Information abo the earthquake-prone status of the building, including this letter, is publicly available on request and will also be included in land and project information memoranda (LIMs and PIMs).

Yours sincerely

Encl. Earthquake-prone buildings brochure

Appendix BF: Template for the Engineering Assessment Technical Summary

Engineering Assessment Technical Summary

Overview

The following table is the proposed template for summarising an Engineering Assessment completed using *The Seismic Assessment of Existing Buildings* document - the Guidelines (see www.EQ-Assess.org.nz).

This table contains a summary of the building and relevant assessment information, the engineering methodology used and findings of the assessment.

The final file format of the summary table is still to be determined.

Building Information	
Building Name/ Description	
Street Address	
Territorial Authority	
No. of Storeys	
Area of Typical Floor (approx.)	
Year of Design (approx.)	
NZ Standard Designed to	
Structural System including Foundations	
Key features of ground profile and identified geohazards	
Previous strengthening	
Heritage Issues/ Status	
Other	
Assessment Information	
Consulting Practice	
CPEng Responsible	
Date/Version of Drawings Reviewed	
Geotechnical Report(s)	
Date Building Inspected	
Previous Assessment Reports	
Other Relevant Information	

Summary of Engineering Assessment Methodology and Key Parameters Used	
Occupancy Type(s) and Importance Level	
Site Subsoil Class	
Summary of Assessment Methodology Used	
Other Relevant Information	

Assessment Outcomes	
Assessment Status	Draft or Final
Assessed Seismic Rating	<e.g. 45%*NBS* (IL2)>
Seismic Grade	
For an ISA:	
Describe the Potential Critical Structural Weaknesses	
Does the result reflect the building's expected behaviour or is more information/ analysis required?	
Is a DSA recommended?	
If Yes, what form should the DSA take/ what are the specific areas to focus on?	

For a DSA:	
Describe the Governing Critical Structural Weakness and Likely Mode of Failure	
Comment on Parts identified and assessed	
Recommendations	

<add any additional commentary only if required.>

Draft Seismic Assessment Summary Template 20161010