

Study Group on Earthquake Risk Buildings – 1999/2000 Report



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Conference

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ABSTRACT: This report summarises the recent and current activities of the Society's Earthquake Risk Buildings Study Group. Work over the past year has focused on completing the document *An Initial Evaluation Process For Identifying Buildings Not Safe in Earthquake*, which was released in draft form via a series of seminars in August 2000. Subsequently, the Study Group has been significantly expanded to tackle the task of producing Detailed Procedures for assessing and improving the structural performance of earthquake risk buildings.

1 Introduction

1.1 Background

Although the proposed changes to the Building Act have not progressed since their presentation to the Minister of Internal Affairs in November 1998, the Study Group has been actively developing technical documentation that will be required by consultants and territorial officials. Work during 1999 and early 2000 culminated in the release of the document *An Initial Evaluation Process for Identifying Buildings Not Safe in Earthquake* in draft form in August 2000. This document was presented at a series of national presentations attended by a total of approximately 450 people in August 2000.

The considerable task of producing Detailed Procedures for the assessment and improvement of structural performance of earthquake risk buildings has commenced, and a new and expanded Study Group formed. This Group has been tasked by BIA with preparing a document which essentially draws together, updates and extends the Society's publications *Guidelines for Assessing and Strengthening Earthquake Risk Buildings (the revised 'Red Book')* (NZSEE, 1995), and *The Assessment and Improvement of the Structural Performance of Earthquake Risk Buildings (the 'Green Book')* (NZSEE, 1996).

1.2 Study Group Members

Prior to September 2000, the Study Group members were David Brunson, David Hopkins, Rob Jury and Bruce Shephard.

In recognition of the need for broader representation from design offices, Territorial Authorities and researchers for producing the Detailed Procedures, the Study Group was broadened and restructured in September 2000. The members of this new Group are:

David Hopkins (Convenor)	Sinclair Knight Merz
David Brunson (Project Manager)	Spencer Holmes
Charles Clifton	HERA
Carl Devereux	Ian Smith & Partners
Rob Jury	Beca Carter Hollings & Ferner
John Mander	University of Canterbury
Bob Park	University of Canterbury
Nigel Priestley	University of California, San Diego
Lou Robinson	Hadley & Robinson
Bruce Shephard	Seismic Consultants Ltd
Craig Stevenson	Connell Wagner
John Taylor	Christchurch City Council
Grant Wilkinson	Holmes Consulting Group

2 The Proposed Changes to the Earthquake Prone Provisions of the Building Act

The recommended amendments to the Building Act submitted to the Minister of Internal Affairs by the Building Industry Authority in November 1998 are detailed in *Building Industry Authority News* (BIA, 1999). The key elements of the proposed new earthquake prone provisions are:

- They will apply to buildings of all types of construction (no longer limited to unreinforced masonry buildings)
- There is a change of terminology from “dangerous building” to “building which is not safe” and from “insanitary building” to “building which is not sanitary”.
- Earthquake prone buildings will be defined in terms of ‘code of the day’, rather than a superseded New Zealand Standard
- The threshold level is to be raised to one-third of the current New Zealand Standard (e.g. currently NZS4203:1992)
- If a building does not meet this threshold requirement, then it should be strengthened to a level as nearly as is reasonably practicable as if it were a new building.

The one-third criterion was adopted by BIA on the recommendation of the NZSEE Study Group as an appropriate trigger level for classification of buildings as not safe in earthquake. Buildings which fail the one-third criterion represent those with the risk of being a threat to life of about 20 times greater than that of a building meeting current code requirements. The proposed changes therefore target only those buildings which represent a high risk. The primary emphasis is on larger, taller buildings and highly populated locations. While other buildings representing a lower risk are not excluded, in practical terms it is expected that they would have a lower priority for action.

The process of identifying and addressing earthquake risk buildings is seen as comprising three key steps:

1. *Preparing an inventory* – TAs may carry out an assessment to identify the building stock in their district that may be unsafe in earthquake.
2. *Investigation* – for those buildings so identified, the TA may require that the owner has a detailed engineering assessment carried out.
3. *Improvement of performance* – for buildings confirmed as being unsafe in earthquake from the investigation, the TA may require structural improvement.

It can therefore be seen that the proposed changes are *enabling* legislation – that is, the Territorial Authority still has the discretion to decide whether or not to take action in any particular case. The Territorial Authority still has the discretion to specify the required timetable for doing work necessary to make a building safe and sanitary on a case by case basis.

With regard to the status of the proposed changes, the Building Act Amendment Bill is expected to be included in the Parliamentary Programme in 2001. A Select Committee process will follow.

3 Initial Evaluation Process

The Initial Evaluation Process is intended to be a coarse screening involving as few resources as reasonably possible. This would be followed by a more detailed assessment of those buildings identified in the initial evaluation as likely to be not safe in earthquake.

The objective of the initial evaluation is to identify, with an acceptable confidence level, all those buildings which will prove not safe in earthquake. At the same time, the initial evaluation process must not catch an unacceptable number of buildings which pass the test on a detailed evaluation. It is envisaged that this procedure would be applied by experienced earthquake engineers, typically on behalf of either TAs (district-wide), buildings owners and managers (e.g. a building portfolio) or prospective purchasers (individual buildings).

The IEP is described in detail in the Society's publication (NZSEE, 2000). It is designed as a largely qualitative process involving considerable knowledge of earthquake behaviour of buildings and judgment as to key attributes and the effect on performance. For a typically multi-storey building, the process is envisaged as requiring 2 to 4 hours of effort. This would be largely a visual assessment, but supplemented by information from previous assessments, readily available documentation and general knowledge of the building.

4 Grading Scale

In addition to the legislative requirements proposed by the BIA, NZSEE is keen to introduce into the property market a system for grading buildings according to their assessed structural performance. The aim is to raise awareness in the industry and allow market forces to work. In time, owners of lowest grades of buildings will find themselves under pressure to improve them or face loss of revenue.

Table 1 indicates the grading scheme proposed. This is linked to the outcome of the Initial Evaluation Process (i.e. as a provisional grade) or from the detailed evaluation – both expressed as a percentage of current code performance.

Table 1: Summary Of Proposed Building Grading Scale

Building Grade	Percentage of New Building Performance (Strength)	Approximate Risk Relative to a New Building
A+	>100	< 1
A	80 to 100	1 to 2 times
B	50 to 80	2 to 8 times
C	33 to 50	8 to 20 times
D	20 to 33	20 to 40 times
E	<20	More than 40 times

5 Detailed Procedures

The Detailed Procedures currently being prepared will have the following features and characteristics:

- They are focused on the proposed changes to the dangerous and insanitary provisions of the Building Act
- Interpretation of the proposed Act wording will be expressed in everyday engineering terms via technical criteria
- Structural forms and materials that are (i) most commonly encountered and (ii) considered to pose a highest risk in terms of the proposed changes will be covered by the initial version of the Detailed Procedures
- A range of analysis options will be presented, along with guidance as to how they should be applied to the different types and forms of existing buildings
- The Detailed Procedures will be intended for application by suitably experienced earthquake engineers
- The document will be a “best practice guideline” rather than a means of compliance

The combination of the range and complexity of existing buildings and the methods of analysis means that considerable judgement will always be necessary in applying the procedures. It is not considered possible to produce a deterministic set of procedures for existing buildings that will generate identical outcomes when applied by different engineers to the same building. The focus of the Detailed Procedures is however on minimising the range of findings that different engineers would arrive at for any particular building.

It is intended that the *process framework* provided by the Detailed Procedures would allow flexibility for engineers to make appropriate assumptions, exercise judgement and be innovative, provided that a conservative and reasoned approach is adopted.

It is envisaged that the overall document will be in “ringbinder” concept for ease of subsequent updating. It is likely to comprise 4 sections, as follows:

- Section 1 – Summary of the Building Act amendments and discussion of the regulatory considerations (e.g. processes and timeframes)
- Section 2 – Initial Evaluation Process – as already prepared, subject to comments received and integration with the Detailed Procedures
- Section 3 – Detailed Procedures
- Section 4 – Applications – case studies, project summaries

Section 3 will focus on the assessment of structural performance, including the definition and explanation of performance criteria, description of the alternative approaches that could be adopted and details of methods to evaluate the *demands* on the structure (for a given level of earthquake event), and evaluating the *capacity* of a structure. Guidance will also be provided on how to improve the structural performance of a building where found necessary. This is likely to comprise options and strategies and a description of linkages back to analysis models that may have already been developed during the assessment phase.

Both force-based and displacement-based methods of analysis will be described. Emphasis will be placed on determining a realistic assessment of building performance based on its characteristics, in particular those of critical members.

It is intended that a draft of the Detailed Procedures will be released nationally as a draft for comment in the last quarter of 2001.

6 Presentations and Publicity

The earthquake prone buildings seminar series in August 2000 sponsored by the Building Industry Authority successfully informed a range of people about the proposed changes to the Building Act and the technical procedures being produced by the Society.

One of the key issues to emerge from the discussions at these presentations was the different attitudes to the proposed full discretion being left with TAs as to the extent to which (if at all) they would apply the new provisions. A number of people felt that the effectiveness of the proposed changes would be greatly diminished with all aspects being at the discretion of the TA. There was strong support for at least the initial inventory step being mandatory, as the original February 1998 proposal had reflected. However, while a common approach across all TAs might be desirable, the discretionary aspect of the proposed changes enables due regard to be taken of local community and individual building economic issues.

At these seminars, the authors expressed the view that the new provisions would be effective if each TA adopted a conscious and consistent policy towards affected buildings, including the establishment of an overall set of risk reduction objectives and time frames.

It was also noted that more than half of the questions from the audiences related to the practicalities of how earthquake upgrading should be related to the *alterations* and *change of use* provisions, particularly with regard to setting time frames. Consideration is being given to preparing additional notes which provide guidance and options to TAs, possibly for inclusion in Section 1 of the proposed document. Discussions are being held with the Building Officials' Institute of New Zealand with a view to setting up a separate working group for this purpose.

Presentations on the Initial Evaluation Process and Grading Scale have also been given to the Insurance Council Commercial Buildings Committee and the Property Council of New Zealand.

7 The Path Ahead

The proposed changes to the earthquake prone provisions of the Building Act represent an opportunity to make a significant step forward in reducing earthquake risk in New Zealand.

There is much work to be done this year in order to capitalise on this opportunity. In addition to developing supporting technical documentation for NZSEE members and others, the Study Group will be involved in justifying the proposed changes during the challenging Select Committee process. While there will always be differing opinion on certain matters of engineering detail, it is clear from the reaction from audiences at the IEP Seminars that there is general agreement on the need to extend the application of earthquake risk reduction measures beyond the present scope of unreinforced masonry buildings.

It will be important that this general view be communicated strongly throughout the legislative process.

Comments and opinions from members regarding either the Initial Evaluation Process, the Grading Scale or the proposed Detailed Procedures are welcome at any stage.

8 Acknowledgements

The continuing generous financial support from the Building Industry Authority for the work of this group is particularly appreciated. It is important to acknowledge that many of the achievements of the Study Group over the past 6 years have been due to the strong encouragement and financial support from the Building Industry Authority.

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The authors would also like to acknowledge the efforts and enthusiasm of fellow Study Group members,

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