The Seismic Assessment of Existing Buildings

Technical Guidelines for Engineering Assessments

July 2017

Overview and Summary

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Introduction

This document provides an overview of the *The Seismic Assessment of Existing Buildings: Technical Guidelines for Engineering Assessments* (the Guidelines). The regulatory linkages with the amendments made to the earthquake-prone provisions of the Building Act by the Building (Earthquake-prone Buildings) Amendment Act 2016, which came into force on 1 July 2017, are also summarised.

The Guidelines have been produced by three technical engineering societies (New Zealand Society for Earthquake Engineering (NZSEE), the Structural Engineering Society (SESOC) and NZ Geotechnical Society (NZGS)), in conjunction with the Ministry of Business, Innovation and Employment (MBIE) and the Earthquake Commission (EQC). The Guidelines are jointly published by these organisations, who will also be responsible for the ongoing management of and updates to the document.

The Guidelines supersede the previous assessment guidance published in 2006 by NZSEE (*The Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*).

The Guidelines are incorporated by reference in MBIE's new methodology for identifying earthquake-prone buildings (the EPB Methodology), where they are referred to as the *Engineering Assessment Guidelines*.

Version 1 of the Guidelines was released on 3 July 2017, and can be downloaded from the website www.EQ-Assess.org.nz.

Purpose and Scope of the Guidelines

The purpose of the Guidelines is to provide engineers with the technical basis (both the framework and tools) to carry out seismic assessments of existing buildings.

The Guidelines support seismic assessments undertaken for a range of purposes, covering both regulatory requirements and property risk identification.

The principal outcome of a seismic assessment using the Guidelines is a rating expressed as a percentage of the *new building standard* that applies for an equivalent new building on the same site. For seismic assessment purposes, *new building standard* refers to the minimum life safety performance requirements of Clause B1 of the Building Code.

Methods covering two levels of assessment are provided – firstly, the Initial Seismic Assessment which enables a broad indication of the likely earthquake rating of a building and secondly, the Detailed Seismic Assessment which provides a more comprehensive assessment where required.

One of the primary uses of the Guidelines is as part of the process of determining whether or not a building is earthquake prone in terms of the Building Act. Under the new requirements associated with the Building (Earthquake-prone Buildings) Amendment Act that came into force on 1 July 2017, the Guidelines must be used as the basis for all engineering assessments that TAs will use to determine whether or not a building is earthquake prone. The Guidelines should be read and applied in conjunction with MBIE's EPB Methodology.

The Guidelines are not intended for use as an Alternative Solution for compliance purposes for a new building.

A broader objective of the Guidelines is to reduce the variation between assessments on the same building. However, it should be appreciated that there will always be a degree of variation between assessments, as the overall process of seismic assessment is a judgement-rich exercise.

Format and Structure of the Guidelines

The Guidelines are structured in three parts, as follows:

Part A: *Assessment Objectives and Principles*

This part outlines the scope and application of the Guidelines, and provides an overview of the seismic assessment process generally. The linkage with the relevant requirements of the Building Act and the associated regulatory requirements is described.

Part B: Initial Seismic Assessment

This part describes the method of application of the Initial Seismic Assessment (ISA) methodology (including the Initial Evaluation Procedure), which enables a broad indication of the likely level of seismic performance of a building. It supports both the identification and the engineering assessment processes for the Building Amendment Act, which are applied using the EPB Methodology.

Part C: *Detailed Seismic Assessment*

This part describes the method of application of the Detailed Seismic Assessment methodology, which provides a more comprehensive assessment of the likely seismic performance of a building. It supports the engineering assessment process for the Building Amendment Act, applied using the EPB Methodology.

Document Preparation and Ongoing Management

The revised guidelines were prepared during the period 2014 to 2017 by a range of practitioner and academic engineers specialising in the seismic assessment of existing buildings. This work has been co-ordinated by a Project Technical Group on behalf of NZSEE, SESOC, NZGS, MBIE and EQC. Funding has been provided by MBIE and EQC, with additional time-in-kind contributions from industry.

Oversight to this work has been provided by a Project Steering Group with representation from the above organisations, as well as from Local Government New Zealand and territorial authorities.

The technical sections were peer reviewed by a combination of leading international and domestic specialists in seismic assessment.

The ongoing management and maintenance of the new Guidelines will be undertaken by the parties to the document – namely NZSEE, SESOC, NZGS, MBIE and EQC - via a Memorandum of Understanding that formally establishes a joint committee of these organisations. This committee is responsible for monitoring the implementation of the Guidelines and overseeing subsequent technical updates and developments.

NZSEE will continue as the lead organisation to organise training and respond to enquiries and questions on the Guidelines.

Key Technical Features

For Detailed Seismic Assessments, the Guidelines place greater emphasis on understanding the 'deformability' of the building in order to obtain more appropriate ratings, rather than assigning the overall building rating just on the basic strength of the weakest member or element. This focus on displacement capacity allows the capacity of different structural systems to be appropriately added together by providing direct allowance for non-linear behaviour. Emphasis is placed on the use of the Simple Lateral Mechanism Analysis (SLaMA) at the initial stages of a Detailed Seismic Assessment.

The Guidelines also place particular emphasis on the need to assess the primary gravity structure as well as the primary lateral structure, recognising that it is the performance of the former and the degree of protection afforded to it by the latter that determines how well the whole building will meet its life safety objectives under different levels of earthquake shaking.

Within Part C, a new section on Geotechnical Issues (C4) provides guidance on the geotechnical considerations in assessing existing buildings, including when they can be expected to significantly influence the overall behaviour of a particular building. Along with the further developments in other sections, a new section on timber-framed structures (C9) addresses a gap in the previous guidelines with respect to low-rise structures. A further new section (C10) covers other building elements that do not form part of the primary structure. This section provides a linkage with the new requirements of the Building Act to include Parts of buildings in the assessment.

There is also better integration of several sections with latest research outcomes and international Codes and documents for the assessment of existing buildings. For example, American standard ASCE 41 may be used with appropriate interfacing and integration with Guideline procedures.

A further new development is the provision for an *Assessment Summary Report* to summarise the key points from both Initial Seismic Assessments and Detailed Seismic Assessments. This summary must be included at the front of all engineering assessments for earthquake-prone buildings purposes, and its use is strongly encouraged for all assessments using the new Guidelines. A template version of the summary can be downloaded from www.EQ-Assess.org.nz. This summary will provide more consistency both in the information provided and the way it is provided, and hence enable clearer communication between all parties, including situations where there is a need to reconcile different assessments.

Further Developments Proposed

The Kaikoura Earthquake of November 2016 highlighted the challenges in establishing seismic assessment ratings for ductile multi-storey buildings with precast concrete floor systems. A panel has been established by MBIE to develop further guidance on how these buildings should be assessed, and this will lead to a revision of the Guidelines section C5 Concrete Buildings as it relates to diaphragm elements.

It is also intended that an additional section on reinforced masonry (typically in the form of concrete block masonry) will be developed during 2017/18.

Updates and changes to the Guidelines will be subject to prior industry consultation.

The reduction of seismic risk via strengthening or other improvement measures remains the primary objective, rather than just the assessment of a building's capacity. Section A10 provides a general overview and outline of the key principles associated with designing seismic improvement, and this will be expanded upon with a separate new framework for undertaking seismic improvement, to be developed during 2017/18. Case studies and practice examples are to be added subsequently.

Monitoring and Feedback

Please go to www.EQ-Assess.org.nz to provide feedback or to request further information about these Guidelines.

Errata and other technical developments will be notified via www.EQ-Assess.org.nz .