NZS 1170.5:2004
Incorporating Amendment No. 1

New Zealand Standard

Structural design actions

Part 5: Earthquake actions – New Zealand

NZS 1170.5:2004

This New Zealand standard was prepared by Technical Committee BD-006-04-11, Earthquake Loadings in New Zealand under Joint Committee BD-006, General Design Requirements and Loading on Structures. It was approved by the Council of Standards New Zealand on 21 December 2004. It was published on 22 December 2004.

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New Zealand Standard

Structural design actions

Part 5: Earthquake actions – New Zealand

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PREFACE

This Standard was prepared by the Standards New Zealand Technical Committee BD/6/4/11. This was initially a Joint Standards Australia/Standards New Zealand Technical Subcommittee of Committee BD-006, General Design Requirements and Loading on Structures which was to develop a Joint Australia/New Zealand Earthquake Actions Standard. The development of a Joint Earthquake Standard proved to be impractical and hence separate country specific Standards were proceeded with as part of the 1170 suite of Standards. It follows the philosophy and principles that are set out in the Preface to Part 0.

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This Standard, taken together with the other joint Parts of the 1170 suite, superseded NZS 4203:1992, *General structural design and design loadings for buildings*. This Standard incorporates Amendment 1 (September 2016). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The 1170 series, *Structural design actions*, comprises the following parts, each of which has an accompanying Commentary that is published as a Supplement:

AS/NZS 1170 *Structural design actions*

AS/NZS 1170.0:2002 Part 0: *General principles*

AS/NZS 1170.1:2002 Part 1: *Permanent, imposed and other actions*

AS/NZS 1170.2:2002 Part 2: *Wind actions*

AS/NZS 1170.3:2003: Part 3: *Snow and ice actions*

NZS 1170 *Structural design actions*

NZS 1170.5:2004 Part 5: *Earthquake actions – New Zealand*

(Also to be published is AS 1170.4, *Earthquake actions – Australia* which will have application only in Australia.)

The Commentary to this Standard is NZS 1170.5 Supplement 1, *Structural design actions—Earthquake actions – New Zealand – Commentary (Supplement to* NZS 1170.5:2004). The Commentary is intended to provide background to the various provisions in the Standard, to suggest approaches that may satisfy the intent of the Standard, and if appropriate, describe differences between this and previous editions of the Standard. References are provided for further reading and these are given at the end of each section of the Commentary.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the Appendix to which they apply. A 'normative' Appendix is an integral part of a Standard, whereas an 'informative' Appendix is only for information and guidance. The Standard includes Appendix D 'Requirements for material design Standards' as an informative Appendix that is included to guide developers of material specific structural design Standards that are intended to be used in conjunction with NZS 1170.5. Appendix D does not have application to the design of a specific structure where a conforming material specific structural design Standard is being used.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard, NZS 1170.5, sets out procedures and criteria for establishing the earthquake actions to be used in the limit state design of structures and parts of structures within New Zealand that are within the scope of AS/NZS 1170.0.

The design of the following structures for earthquake actions is outside the scope of this Standard:

(a) Bridges.
(b) Tanks containing liquids.
(c) Civil structures including dams and bunds.
(d) Offshore structures that are partly or fully immersed.
(e) Soil retaining structures.

This Standard does not address the effects of slope instability, liquefaction, fault displacement, seiche and/or tsunami resulting from earthquake shaking. Amd 1 Sep '16

This Standard is to be used in conjunction with material specific structural design Standards that comply with the requirements of Appendix D. Such a Standard is referred to here as an appropriate material Standard.

1.2 DETERMINATION OF EARTHQUAKE ACTIONS

Earthquake actions for use in design, E_u for ultimate limit state and E_s for serviceability limit state, shall be appropriate for the type of structure or element, its intended use, design working life and exposure to earthquake shaking. Earthquake actions determined in accordance with this Standard shall be deemed to comply with the requirements of this Clause.

1.3 LIMIT STATES

The requirements for the ultimate and serviceability limit states as defined in AS/NZS 1170.0 are deemed to be satisfied by compliance with this Standard.

1.4 SPECIAL STUDIES

A special study shall be carried out to justify any departure from or extension of the provisions of this Standard. Such studies are outside the scope of this Standard but some guidance is given in AS/NZS 1170.0, Appendix A. Where a special study is carried out to justify departure from this Standard, the minimum provisions of this Standard that are not specifically addressed by the special study shall still apply, including the maintenance of the underpinning principles and performance objectives of this Standard.

NOTE: The minimum Z values may not be reduced by special studies. Amd 1 Sep '16

1.5 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

NZS

Amd 1 Sep '16 | 3101:2006 Concrete Structures Standard Parts 1 and 2

AS/NZS

1170 Structural design actions

1170.0:2002 Part 0: General principles

1170.1:2002 Part 1: Permanent, imposed and other actions

1170.3:2003 Part 3: Snow and ice actions

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Ministry of Business, Innovation and Employment, the New Zealand Building Code Handbook, Verification Methods and Acceptable Solutions

1.6 UNITS

Except where specifically noted, this Standard uses SI units of kilograms, metres, seconds, Pascals and Newtons (kg, m, s, Pa, N).

1.7 DEFINITIONS

Definitions of the terms used in this Standard shall be as given in Appendix A.

1.8 NOTATION

The notation used in this Standard shall be as given in Appendix B.

SECTION 2 VERIFICATION

2.1 GENERAL REQUIREMENTS

2.1.1 General

All structures shall comply with the requirements for the ultimate limit state and the serviceability limit state as set out in Clauses 2.3 and 2.4 and the appropriate material Standard.

2.1.2 Structural systems

All structures shall be configured with a clearly defined load path, or paths, to transfer the earthquake actions (both horizontal and vertical) generated in an earthquake together with gravity loads to the supporting foundation soil. All elements shall be capable of performing their required function while sustaining the deformation of the structure resulting from the application of the earthquake actions determined for each limit state.

2.1.3 Localized actions

Structural elements and members shall be tied together to enable the structure to act as a whole in resisting seismic actions. Consideration shall be given to actions induced in individual elements due to the displaced shape and the gravity loads.

2.1.4 Earthquake limit state design performance requirements

The design performance requirements are as follows:

(a) Ultimate limit state for earthquake loading shall provide for:

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(i) Maintenance of overall structural integrity and gravity load support, while accounting for horizontal and vertical deflections, soil structure interaction, and sliding of the structure or its parts;

(ii) Maintenance of stability against overturning;

(iii) Avoidance of collapse or loss of support to parts of categories P.1, P.2, P.3 and P.4 (Section 8); and

(iv) Avoidance of damage to non-structural systems necessary for building evacuation following earthquake that would render them inoperative.

(b) Serviceability limit states for earthquake loading are to avoid damage to:

(i) The structure and the non-structural components that would prevent the structure from being used as originally intended without repair after the SLS1 earthquake as defined in Clause 2.4; and

(ii) In a structure with a critical post earthquake designation (i.e. importance level 4) all elements required to maintain those operations for which the structure is designated as critical, are to be maintained in an operational state or are to be returned to a fully operational state within an acceptable short timeframe (usually minutes to hours rather than days) after the SLS2 earthquake as defined in Clause 2.4.

2.2 STRUCTURAL TYPES

2.2.1 Ductile structures

A ductile structure is one where the structural ductility factor is greater than 1.25 but does not exceed 6.0.