

Dear Customer

Please find enclosed Amendment 12, effective 14 February 2014, to the Acceptable Solutions and Verification Methods for Clause B1 Structure of the New Zealand Building Code. The previous amendment to B1 was Amendment 11, August 2011.

| <b>Section</b> | <b>Old B1</b>                                     | <b>February 2014 Amendments to B1</b>                       |
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| B1/AS1         | Remove pages 23, 23A–D, 24                        | Replace with new pages 23, 23A–D, 24                        |
| B1/VM4         | Remove pages 79/80                                | Replace with new pages 79/80                                |





MINISTRY OF BUSINESS,  
INNOVATION & EMPLOYMENT  
HĪKINA WHAKATUTUKI

# Acceptable Solutions and Verification Methods

For New Zealand Building Code Clause  
**B1 Structure**



## Status of Verification Methods and Acceptable Solutions

Verification Methods and Acceptable Solutions are prepared by the Ministry of Business, Innovation and Employment in accordance with section 22 of the Building Act 2004. Verification Methods and Acceptable Solutions are for use in establishing compliance with the New Zealand Building Code.

A person who complies with a Verification Method or Acceptable Solution will be treated as having complied with the provisions of the Building Code to which the Verification Method or Acceptable Solution relates. However, using a Verification Method or Acceptable Solution is only one method of complying with the Building Code. There may be alternative ways to comply.

Users should make themselves familiar with the preface to the New Zealand Building Code Handbook, which describes the status of Verification Methods and Acceptable Solutions and explains alternative methods of achieving compliance.

Defined words (italicised in the text) and classified uses are explained in Clauses A1 and A2 of the Building Code and in the Definitions at the start of this document.

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are available from [www.dbh.govt.nz](http://www.dbh.govt.nz)**

## New Zealand Government

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## Document Status

The most recent version of this document (Amendment 12), as detailed in the Document History, are approved by the Chief Executive of the Ministry of Business, Innovation and Employment.

The previous version of this document (Amendment 11) will cease to have effect on 14 August 2014.

People using this document should check for amendments on a regular basis. The Ministry of Business, Innovation and Employment may amend any part of any Verification Method or Acceptable Solution at any time. Up-to-date versions of Verification Methods and Acceptable Solutions are available from [www.dbh.govt.nz](http://www.dbh.govt.nz)

| <b>B1: Document History</b>                   |                 |   |   |
|---|-----------------|---|---|
|   | <b>Date</b>     | <b>Alterations</b>  |   |
| First published                               | July 1992       |   |   |
| Amendment 1                                   | September 1993  | p. ix–xii, References<br>p. 1, 1.3, 1.4.1–1.4.3,<br>2.1, 2.2, 3.1–3.3, 4.1, 5.1<br>p. 2, 6.1, 6.2, 8.1, 9.1<br>p. 4, 11.1, 12.1<br>p. 5, 1.2, 2.1, 2.2, 3.1, 3.2,s<br>4.1, 4.2, 6.1, 6.2, 7.1   | p. 9, 1.0.1, 1.0.5 b) c)<br>p. 10, 2.3.5<br>p. 13, Figure 4<br>p. 14, 2.3.6<br>p. 16, 2.3.8, 2.3.9<br>p. 34, Table 1<br>p. 47, 1.0.1<br>pp. 49–54, Index  |
| Amendment 2                                   | 19 August 1994  | pp. i and ii, Document History<br>pp. vii and viii, Contents<br>pp. x and xi, References<br>p. xiv, Definitions<br>p. 1, 1.4.2, 5.1<br>p. 2, 6.1<br>p. 5, 1.3, 3.1, 4.1<br>p. 6, 7.1<br>p. 10, 2.3.5<br>p. 12, Figure 3<br>p. 13, Figure 4<br>p. 14, 2.3.6, 2.3.7 | p. 15, Tables 4 and 5<br>p.16, 2.4.1<br>p. 21, Figure 2<br>p. 22, Figure 3<br>p. 32, 2.2.4<br>p. 33, 1.0.2<br>p. 34, 3.2.1, Table 1<br>p. 35, 4.1, 4.1.2, 4.1.3, 4.2.1,<br>4.2.2, 4.3, 4.3.1, 5.0.1, Table 2<br>p. 36, 6.1.2, 7.1, 7.1.1<br>p. 37, 7.3.4<br>pp. 49, 50, 51, 54, Index |
| Reprinted incorporating Amendments 1 and 2    | October 1994    |   |   |
| Amendment 3                                   | 1 December 1995 | p. ii, Document History<br>p. ix, References<br>p. 1, 3.1   | p. 5, 6.2<br>p. 50, Index   |
| Reprinted incorporating Amendments 1, 2 and 3 | July 1996       |   |   |
| Amendment 4                                   | 1 December 2000 | p. ii, Document History<br>pp. vii and viii, Contents<br>pp. ix – xii, Revised References<br>pp. xiii and xiv, Definitions  | pp. 1–4A, Revised B1/VM1<br>pp. 5 and 6, Revised B1/AS1<br>pp. 33–63, Revised B1/VM4<br>p. 65, Revised B1/AS4<br>pp. 67–72, Revised Index   |
| Erratum                                       | 9 February 2001 | p. 46, 4.3.2 a) i)  |   |
| Amendment 5 incorporating Erratum             | 1 July 2001     | p. 2, Document Status<br>p. 3, Document History<br>p. 7, References   | p. 41, 1.7.2 Comment<br>p. 49, 2.2.4<br>p. 48, 1.9.1 b) i)  |
| Amendment 6                                   | 1 March 2005    | p. 11, References   |   |
| Amendment 7                                   | 1 April 2007    | pp. 11–12, 14, References<br>pp. 15–16, Definitions   | p. 18, 6.1  |

**B1: Document History**

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| Amendment 8   | 1 December 2008                                   | p. 2, Document Status<br>p. 3, Document History<br>p. 9, Contents<br>pp. 11–14, References<br>pp. 15–16, Definitions   | pp. 17–22B, B1/VM1<br>p. 51, B1/VM4 1.0.5, 2.0.1<br>p. 56, B1/VM4 Figure 2<br>p. 70, B1/VM4 B1.0.2<br>pp. 83–84, 86 Index                            |
| Amendment 9   | 30 September 2010                                 | pp. 2–3, Document History, Status,<br>pp. 11–14, References<br>p. 20, B1/VM1 2.2.13<br>p. 21, B1/VM1 3.0, 5.1<br>pp. 22–22B, B1/VM1 11.0<br>pp. 23–24, B1/AS1 6.0, 6.1, 6.2,<br>6.3, 6.4, 7.1, 7.2, 7.3, 7.4 | p. 27, B1/AS2 1.0.5<br>p. 44, B1/AS3 1.7.9<br>p. 47, B1/AS3 1.8.5, 1.8.6<br>p. 49, B1/AS3 2.1.1, 2.2.4<br>p. 63, B1/VM4 4.3.2<br>p. 67, B1/VM4 5.3.1 |
| Reprinted incorporating Amendments 4–9  | 30 September 2010                                 |  |  |
| Erratum 1   | 30 September 2010                                 | p. 21, B1/VM1 3.1  |  |
| Amendment 10 (Canterbury)   | Effective from 19 May 2011 until 31 January 2012  | p. 9, Contents<br>p. 12–14, References<br>p. 15, Definitions<br>p. 17, B1/VM1  | p. 20, B1/VM1 2.2.14A to 2.2.14D<br>pp. 23–23C B1/AS1 1.4, 2.0, 3.0, 4.0<br>p. 48, B1/AS3 1.9.3<br>p. 84, Index                                      |
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Amend 4  
Dec 2000

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Dec 2000

Amend 4  
Dec 2000

Amend 4  
Dec 2000



Amend 11  
Aug 2011

# References

For the purposes of New Zealand Building Code compliance, the acceptable New Zealand and other Standards, and other documents referred to in these Verification Methods and Acceptable Solutions (primary reference documents) shall be the editions, along with their specific amendments, listed below. Where the primary reference documents refer to other Standards or other documents (secondary reference documents), which in turn may also refer to other Standards or other documents, and so on (lower order reference documents), then the applicable version of these secondary and lower order reference documents shall be the version in effect at the date these Verification Methods and Acceptable Solutions were published.

Amend 12  
Feb 2014

Amend 7  
Apr 2007

Amend 12  
Feb 2014

## Standards New Zealand

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| Amend 11<br>Aug 2011 | AS/NZS 1170: Structural design actions –  | VM1 1.0, 2.1, 2.2,<br>5.2, 6.1, 7.1, 8.1 |
| Amend 12<br>Feb 2014 | Part 0: 2002 General principles<br><i>Amends: 1, 2, 3, 4, 5</i>   | AS1 7.2, 7.3<br>VM4 2.0, B1.0            |
| Amend 12<br>Feb 2014 | Part 1: 2002 Permanent imposed and other actions<br><i>Amends: 1, 2</i>   |  |
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|                      | Part 3: 2003 Snow and ice actions<br><i>Amend: 1</i>  |  |
| Amends<br>10 and 11  | NZS 1170: Structural design actions –<br>Part 5: 2004 Earthquake actions – New Zealand  | VM1 2.1, 2.2                             |
| Amend 11<br>Aug 2011 | <b>COMMENT</b><br>The above suite of Structural Design Action Standards, together with their amendments, are referred to collectively as "AS/NZS 1170". |  |
| Amend 8<br>Dec 2008  | AS/NZS 1664: Aluminium structures –<br>Part 1: 1997 Limit state design<br><i>Amend: 1</i>   | VM1 7.1                                  |
| Amends<br>8 and 9    |   |  |
| Amend 7<br>Apr 2007  | AS/NZS 1748:- Timber – Stress graded for structural purposes<br>Part 1: 2011 General requirements<br><i>Amend: 1</i>                                    | VM1 6.1<br>VM1 6.1                       |
| Amend 12<br>Feb 2014 | Part 2: 2011 Qualification of grading method<br><i>Amend: 1</i>   | VM1 6.1                                  |
|                      | AS/NZS 2032: 2006 Installation of PVC pipe systems<br><i>Amend: 1</i>   | AS1 6.3                                  |
|                      | AS/NZS 2033: 2008 Installation of polyethylene pipe systems<br><i>Amends 1, 2</i>   | AS1 6.4                                  |
| Amend 9<br>Sep 2010  | AS/NZS 2566: 2002 Buried Flexible pipelines.<br>Part 1: 1998 Structural Design<br>Part 2: 2002 Installation   | AS1 6.1<br>AS1 6.2                       |

**STRUCTURE**

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|                      | AS/NZS 2918: 2001          | Domestic solid fuel heating appliances installation  | AS3 3.2.1, 2.2.4   |
| Amend 9<br>Sep 2010  | NZS 3101:-<br>Part 1: 2006 | Concrete structures standard<br>The design of concrete structures<br><i>Amend: 1, 2</i>  | VM1 3.1, 11.1  |
| Amend 6<br>Mar 2005  |                            |  |  |
| Amend 8<br>Dec 2008  | NZS 3106: 2009             | Design of concrete structures for the storage of liquids.  | VM1 3.2  |
| Amend 9<br>Sep 2010  |                            |  |  |
| Amend 7<br>Apr 2007  | NZS 3109: 1997             | Concrete construction<br><i>Amend: 1, 2</i>  | AS3 1.8.2, 1.8.5 b),<br>2.2.1 c), 2.2.3                                |
| Amend 9<br>Sep 2010  | NZS 3112:-<br>Part 2: 1986 | Methods of test for concrete<br>Tests relating to the determination of strength of concrete<br><i>Amend: 1, 2</i>  | AS3 1.8.3 c)   |
| Amend 9<br>Sep 2010  |                            |  |  |
|                      | NZS 3404:-<br>Part 1: 1997 | Steel structures standard<br>Steel structures standard<br><i>Amend: 1, 2</i>   | VM1 5.1  |
| Amend 9<br>Sep 2010  |                            |  |  |
| Amend 11<br>Aug 2011 |                            |  |  |
|                      | NZS 3603: 1993             | Timber structures standard<br><i>Amend: 1, 2</i> (Applies to building work consented prior to 1 April 2007)<br><i>Amend: 1, 2, 4</i> (Applies to building work consented on or after 1 April 2007) | VM1 6.1,<br>VM4 5.3.1  |
| Amend 7<br>Apr 2007  |                            |  |  |
| Amend 10<br>May 2011 | NZS 3604: 2011             | Timber framed buildings  | AS1 1.4, 3.1, 4.1<br>AS3 1.1.1, 1.9.1 b),<br>1.9.2, 1.9.5,<br>2.2.1 b) |
| Amend 11<br>Aug 2011 |                            |  |  |
| Amend 9<br>Sep 2010  | NZS 3605: 2001             | Timber piles and poles for use in building   | VM4 5.3.1  |
| Amend 7<br>Apr 2007  | NZS 3622: 2004             | Verification of timber properties<br><i>Amend: 1</i>   | VM1 6.1  |
| Amend 11<br>Aug 2011 |                            |  |  |
| Amends<br>9 and 12   | NZS 3640: 2003             | Chemical preservation of round and sawn timber<br><i>Amends: 1, 2, 3, 4, 5</i>   | VM4 5.3.1  |

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|                      | AS/NZS 3725: 2007 Design for installation of buried concrete pipes  | VM1 11.1   |
| Amend 8<br>Dec 2008  |   |  |
|                      | AS/NZS 3869: 1999 Domestic solid fuel burning appliances –<br>Design and construction   | AS3 2.1  |
| Amend 9<br>Sep 2010  |   |  |
|                      | AS/NZS 4058: 2007 Pre cast concrete pipes (pressure and non-pressure)   | VM1 11.1   |
| Amends<br>10 and 11  | NZS 4210: 2001 Code of practice for masonry construction: materials<br>and workmanship  | AS3 1.8.1, 1.8.3 (f<br>and g)                                  |
| Amend 9<br>Sep 2010  | <i>Amend: 1</i>   |  |
| Amend 11<br>Aug 2011 | NZS 4211: 2008 Specification for performance of windows   | VM1 12.1   |
| Amend 8<br>Dec 2008  |   |  |
| Amend 11<br>Aug 2011 | NZS 4219 : 2009 Seismic Performance of Engineering Systems<br>in Buildings  | VM1 1.3.1  |
| Amend 9<br>Sep 2010  | NZS 4223:-<br>Part 1: 2008 Glazing in buildings<br>Glass selection and glazing<br>Part 2: 1985 The selection and installation of manufactured<br>sealed insulating glass units  | AS1 7.1, 7.2.1, 7.3.7<br>AS1 7.2                               |
| Amend 9<br>Sep 2010  | <i>Amend: 1, 2</i>  |  |
| Amend 9<br>Sep 2010  | Part 3: 1999 Human impact safety requirements   | AS1 7.3  |
| Amends<br>10 and 11  | Part 4: 2008 Wind, dead, snow, and live actions   | AS1 7.4  |
| Amend 12<br>Feb 2014 | NZS 4229: 2013 Concrete masonry buildings not requiring<br>specific engineering design  | AS1 1.4, 2.1<br>AS3 1.1.1, 1.8.4,<br>1.9.2, 1.9.5,<br>2.2.1 b) |
| Amend 8<br>Dec 2008  | NZS 4230: 2004 Design of reinforced concrete masonry structures<br><i>Amend: 1</i>  | VM1 4.0  |
| Amend 11<br>Aug 2011 | NZS 4251:-<br>Part 1: 2007 Solid plastering<br>Cement plasters for walls, ceilings and soffits  | AS1 5.1  |
| Amends<br>10 and 11  | NZS 4297: 1998 Engineering design of earth buildings  | VM1 8.1  |
|                      | NZS 4299: 1998 Earth buildings not requiring specific design<br><i>Amend: 1</i>   | AS1 1.4, 4.1   |
|                      | NZS 4402:-<br>Part 2:<br>Test 2.2: 1986 Methods of testing soils for civil engineering<br>purposes. Parts 2, 4 and 5: 1986 and 1988<br>Soil classification tests<br>Determination of liquid limit<br>Test 2.6: 1986 Determination of the linear shrinkage | VM1 11.1<br><br>Definitions<br>Definitions                     |

|                      |  | Where quoted                  |
|----------------------|--|-------------------------------|
|                      | Part 4: Soil compaction tests  |                               |
|                      | Test 4.2.3: 1988 Relative densities  | VM4 4.1.1                     |
|                      | NZS 4431: 1989 Code of practice for earth fill for residential development<br><i>Amend: 1</i>                      | VM1 10.1                      |
|                      | AS/NZS 4600: 2005 Cold-formed steel structures   | VM1 5.2                       |
| Amends<br>10 and 11  | AS/NZS 4671: 2001 Steel Reinforcing Materials<br><i>Amend: 1</i>   | AS1 2.1.5, 3.1.8<br>AS3 1.8.5 |
|                      | AS/NZS 4680: 2006 Hot-Dip Galvanised (zinc) Coating  | AS3 1.8.6                     |
| Amend 9<br>Sep 2010  |  |                               |
| Amend 8<br>Dec 2008  | SNZ HB 8630: 2004 Tracks and outdoor visitor structures  | VM1 2.2.9                     |
|                      | <b>The National Association of Steel Framed Housing Inc (NASH)</b>   |                               |
| Amend 11<br>Aug 2011 | NASH Standard: Residential and Low Rise Steel Framing Part 1 2010<br>Design Criteria                               | VM1 5.3                       |
|                      | <b>British Standards Institution</b>   |                               |
|                      | BS 8004: 1986 Code of practice for foundations   | VM4 4.0.3                     |
|                      | <b>Standards Australia</b>   |                               |
| Amend 9<br>Sep 2010  | AS 1397: 2001 Steel sheet and strip – Hot-dipped zinc-coated<br>or aluminium/zinc-coated                           | AS3 1.7.9                     |
| Amend 11<br>Aug 2011 | AS 2159: 1995 Rules for the design and installation of piling<br>(known as the SAA Piling Code)<br><i>Amend: 1</i> | VM4 4.0.3                     |
|                      | <b>American Society of Testing and Materials</b>   |                               |
|                      | ASTM D1143: 1981 Test method for piles under static axial<br>compressive load                                      | VM4 4.0.3                     |
|                      | <b>New Zealand Geomechanics Society</b>  |                               |
|                      | Guidelines for the field descriptions of soils and rocks in engineering<br>use. Nov 1988                           | VM1 11.1                      |
|                      | <b>New Zealand Legislation</b>   |                               |
| Amend 8<br>Dec 2008  | Chartered Professional Engineers of New Zealand Act 2002   | VM1 1.0                       |

# Definitions

This is an abbreviated list of definitions for words or terms particularly relevant to these Acceptable Solutions and Verification Methods. The definitions for any other italicised words may be found in the New Zealand Building Code Handbook.

Amends  
7 and 12

**Adequate** *Adequate* to achieve the objectives of the *Building Code*.

Amend 8  
Dec 2008

**Alter** in relation to a *building*, includes to rebuild, re-erect, repair, enlarge and extend the *building*.

**Baluster** A post providing the support for the top and bottom rails of a barrier.

**Boundary joist** A joist running along the outer ends of the floor joists.

Amend 7  
Apr 2007

**Building** has the meaning ascribed to it by sections 8 and 9 of the Building Act 2004.

**Building element** Any structural and non-structural component or assembly incorporated into or associated with a *building*. Included are *fixtures*, services, *drains*, permanent mechanical installations for access, glazing, partitions, ceilings and temporary supports.

Amend 10  
May 2011

**Canterbury earthquake region** is the area contained within the boundaries of the Christchurch City Council, the Selwyn District Council and the Waimakariri District Council.

**Chimney** A *non-combustible* structure which encloses one or more *flues*, *fireplaces* or other heating appliances.

**Chimney back** The *non-combustible* wall forming the back of a *fireplace*.

**Chimney base** That part of a *chimney* which houses the *fireplace*.

**Chimney jambs** The side walls of a *fireplace*.

**Combustible** See *non-combustible*.

Amend 8  
Dec 2008

**Construct** in relation to a *building*, includes to design, build, erect, prefabricate, and relocate the *building*.

**Drain** A pipe normally laid below ground level including fittings and equipment and intended to convey *foul water* or *surface water* to an *outfall*.

**Factor of safety** in relation to any *building* means the ratio of resisting forces to applied forces for a given loading condition. It is generally expressed to two significant figures.

**Fireplace** A space formed by the *chimney back*, the *chimney jambs*, and the *chimney breast* in which fuel is burned for the purpose of heating the room into which it opens.

**Fixture** An article intended to remain permanently attached to and form part of a *building*.

**Flue** The passage through which the products of combustion are conveyed to the outside.

**Gather** That part of a *chimney* where the transition from *fireplace* to stack occurs.

**Good ground** means any soil or rock capable of permanently withstanding an ultimate bearing pressure of 300 kPa (i.e. an allowable bearing pressure of 100 kPa using a factor of safety of 3.0), but excludes:

- a) Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids,
- b) Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested, from the liquid limit, in accordance with NZS 4402 Test 2.6, and
- c) Any ground which could foreseeably experience movement of 25 mm or greater for any reason including one or a combination of: land instability, ground creep, subsidence, (liquefaction, lateral spread – for the *Canterbury earthquake region* only), seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots.

Amend 4  
Dec 2000

Amend 10  
May 2011

**COMMENT:**

Soils (excepting those described in a), b) and c) above) tested with a dynamic cone penetrometer in accordance with NZS 4402 Test 6.5.2, shall be acceptable as good ground for *building* foundations if penetration resistance is no less than:

- a) 5 blows per 100 mm at depths down to twice the footing width.
- b) 3 blows per 100 mm at depths greater than twice the footing width.

Depths shall be measured from the underside of the proposed footing.

**Hearth** The insulating floor under the *fire* and in front and at the sides of the *fireplace*.

**Intended use**, in relation to a *building*:

- a) includes any or all of the following:
  - i) any reasonably foreseeable occasional use that is not incompatible with the *intended use*;
  - ii) normal maintenance;
  - iii) activities undertaken in response to *fire* or any other reasonably foreseeable emergency; but
- b) does not include any other maintenance and repairs or rebuilding.

**Nominal pile width** The least width of a pile in side view and is equal to the diameter in round piles.

**Non-combustible** Materials shall be classified as *non-combustible* or *combustible* when tested to: AS 1530 – Part 1.

**Other property**

- a) means any land or *buildings*, or part of any land or *buildings*, that are—
  - i) not held under the same *allotment*; or
  - ii) not held under the same ownership; and
- b) includes a road

**Sitework** means work on a *building* site, including earthworks, preparatory to or associated with the *construction*, *alteration*, demolition or removal of a *building*.

**Specified intended life** has the meaning given to it by section 113(3) of the Building Act 2004.

Section 113(3) states:

“(3) In subsection (2), **specified intended life**, in relation to a building, means the period of time, as stated in an application for a building consent or in the consent itself, for which the building is proposed to be used for its intended use.”

**Strength reduction factor** The factor by which the ultimate strength is multiplied to obtain the design strength.

**COMMENT:**

NZS 4203: 1992 uses the terms ideal strength in place of ultimate strength, and dependable strength in place of design strength.

**Surface water** All naturally occurring water, other than sub-surface water, which results from rainfall on the site or water flowing onto the site, including that flowing from a *drain*, stream, river, lake or sea.

**Territorial authority (TA)** means a city council or district council named in Part 2 of Schedule 2 of the Local Government Act 2002; and—

- a) in relation to land within the district of a *territorial authority*, or a *building* on or proposed to be built on any such land, means that *territorial authority*; and
- b) in relation to any part of a coastal marine area (within the meaning of the Resource Management Act 1991) that is not within the district of a *territorial authority*, or a *building* on or proposed to be built on any such part, means the *territorial authority* whose district is adjacent to that part.

**Verification Method** means a method by which compliance with the *Building Code* may be verified.

Amend 12  
Feb 2014

Amend 4  
Dec 2000

Amend 7  
Apr 2007

Amend 7  
Apr 2007

Amend 8  
Dec 2008

Amend 8  
Dec 2008

Amend 2  
Aug 1994

Amend 8  
Dec 2008

# Verification Method B1/VM1

## General

Amend 10  
May 2011Amend 8  
Dec 2008

### 1.0 General

**1.0.1** The Standards cited in this *Verification Method* provide a means for the design of structures to meet the performance requirements of New Zealand Building Code Clause B1 Structure. For any particular *building* or *building* design, the *Verification Method* shall consist of AS/NZS 1170 used in conjunction with the relevant cited material standards as modified by this *Verification Method*.

**1.0.2** Modifications to the Standards, necessary for compliance with the New Zealand *Building Code*, are given against the relevant clause number of each Standard.

**1.0.3** Citation of Standards in this *Verification Method* is subject to the following conditions.

- a) The citation covers only the scope stated or implicit in each Standard. Aspects outside the scope, when applied to a particular *building*, are not part of the *Verification Method*.
- b) Further limitations, modifications and/or constraints apply to each Standard as noted below.
- c) Provisions in the cited Standards that are in non-specific or unquantified terms do not form part of the *Verification Method*. Non-specific or unquantified terms include, but are not limited to, special studies, manufacturer's advice and references to methods that are appropriate, adequate, suitable, relevant, satisfactory, acceptable, applicable, or the like.
- d) Where AS/NZS 1170 is used in combination with other Standards cited in this *Verification Method* and there are incompatibilities with these other Standards, then the underlying philosophy, general approach, currency of information and methods of AS/NZS 1170 are to take precedence.

Amend 11  
Aug 2011Amend 11  
Aug 2011Amend 11  
Aug 2011

- e) An engineer with relevant experience and skills in structural engineering shall be responsible for interpretation of the requirements of the Standards cited when used for *building* structure design. A structural engineer who is chartered under the Chartered Professional Engineers of New Zealand Act 2002 would satisfy this requirement.

#### COMMENT

The Standards referenced in this *Verification Method* relating to *building* design require the application of specialist engineering knowledge, experience and judgement in their use.

### 2.0 Structural Design Actions Standards

**2.1** The requirements of the AS/NZS 1170 suite of Standards are to be complied with. These comprise:

AS/NZS 1170.0: 2002 including Amendments 1, 2, 3, 4 and 5

AS/NZS 1170.1: 2002 including Amendments 1 and 2

AS/NZS 1170.2: 2011 including Amendments 1, 2 and 3

AS/NZS 1170.3: 2003 including Amendment 1, and NZS 1170.5: 2004.

#### COMMENT

This suite of Standards, together with their amendments, are referred to collectively in this *Verification Method* as "AS/NZS 1170".

**2.2** The requirements of AS/NZS 1170 are subject to the following modifications.

**2.2.1 Material Standards** Where AS/NZS 1170 calls for the use of appropriate material Standards, only those material Standards referenced in this *Verification Method* B1/VM1 are included. Use of other Standards with AS/NZS 1170 must be treated as an alternative means of verification.

Amend 8  
Dec 2008Amend 12  
Feb 2014Amend 11  
Aug 2011Amend 11  
Aug 2011Amend 11  
Aug 2011

**2.2.2 Notes in AS/NZS 1170** "Notes" that relate to clauses, tables or figures of AS/NZS 1170 are part of the *Verification Method*.

**COMMENT**

AS/NZS 1170 makes a general statement that notes are not an integral part of the Standard. However, in many cases the content of the notes makes them an integral part of the interpretation of the Standard. In these cases, the notes have been specifically cited as being part of this *Verification Method*.

**2.2.3 AS/NZS 1170 Part 0, Clause 4.1**

**General** Add the following to the end of the Clause:

"The combination factors for permanent actions (dead loads) are based on the assumption that they have a coefficient of variation of approximately 10%. Situations where this assumption is not valid are outside the scope of this *Verification Method*."

**2.2.4 AS/NZS 1170 Part 0, Clause 4.2.4**

Replace the Clause with the following:

"The combination of actions for checking strength and stability for the ultimate limit state for *fire* shall be as follows:

(a) During the *fire*:

(i)  $[G, \text{thermal actions arising from } fire, \Psi_{\ell}Q]$

together with:

(ii) a lateral force of 2.5% of  $(G + \Psi_c Q)$  applied as per Clause 6.2.2.

(b) After the *fire* until the *building* is either repaired or demolished:

(i)  $[G, \text{thermal actions arising from } fire, \Psi_{\ell}Q]$

together with the more critical of either:

(ii) a lateral force of 2.5% of  $(G + \Psi_c Q)$  applied as per Clause 6.2.2.

or

(iii) a uniformly distributed horizontal face load of 0.5 kPa in any direction.

Account shall be taken of the effects of the *fire* on material properties and the geometry of the structure."

**2.2.5 AS/NZS 1170 Part 0, Clause 5.2**

**Structural models** Delete (a) to (d) in Clause 5.2 and replace with:

"(a) Static **and/or** dynamic response.

(b) Elastic **and/or** non-elastic (plastic) response.

(c) Geometrically linear **and/or** geometrically non-linear response.

(d) Time-independent **and/or** time-dependent behaviour."

**COMMENT**

Each of the modelling approaches (a), (b), (c) and (d) allows only one method. This is unnecessarily restrictive since designers may decide to use both approaches for a particular *building*. Accordingly, "or" has been replaced with "and/or".

**2.2.6 AS/NZS 1170 Part 1, Table 3.2**

Replace the entry for "R2, Other roofs (i) Structural elements" with:

"R2 Other roofs (i) Structural elements 0.25 1.1"

Delete Note 2

Delete Note 3

**2.2.7 AS/NZS 1170 Part 1, Clause 3.6 Barriers**

In the first paragraph, second sentence, delete "... top edge or handrail..." and substitute "... top edge **and rail**..."

Delete the second paragraph and substitute:

"Apply as detailed below the uniformly distributed line loads (kN/m), uniformly distributed loads (kPa) and concentrated loads (kN) given in Table 3.3.

For the purposes of applying loads, a rail shall be any *handrail* or any top rail having a width in plan of greater than 30 mm.

The following are separate load cases, and one load at a time, either vertical or horizontal, is to be applied.

(a) Line loads (kN/m). Regardless of barrier height, line loads need not be applied more than 1200 mm above the floor (or stair pitch line):

(i) For domestic and residential activities, other residential (Row 2 of Table 3.3)

- For barriers with a rail or rails:

- apply the horizontal load to the top rail

Amend 11  
Aug 2011

Amend 12  
Feb 2014

Amend 8  
Dec 2008

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Dec 2008



- where the top of the barrier is not a rail and where it is less than 200 mm above the top rail, the horizontal load to the top of the barrier may be reduced by 50%, otherwise apply the full horizontal load
  - apply the vertical load to the top of the barrier.
  - For barriers without a rail, apply:
    - the horizontal load at 900 mm above the floor (or stair pitch line)
    - 50% of the horizontal load to the top of the barrier
    - the vertical load to the top of the barrier.
- (ii) For all types of occupancy other than Row 2 of Table 3.3:
- apply the loads to the top edge of the barrier and to the top rail
  - where the top of the barrier is not a rail and where it is less than 200 mm above the top rail, the horizontal load to the top of the barrier may be reduced by 50%, otherwise apply the full horizontal load.
- (b) Distributed loads (kPa):
- For all types of occupancy:
- consider the load as acting over the whole area bounded by the top of the barrier and the floor line for the full length of the barrier
  - distribute this load to the appropriate solid portions of the barrier.
- (c) Concentrated loads (kN):
- For all types of occupancy:
- consider each concentrated load to be distributed over a circular or square area of 2000 mm<sup>2</sup>
  - apply concentrated loads so as to produce the most severe effect on the structural element being considered

- concentrated loads applied more than 1200 mm above the floor (or stair pitch line) may be reduced by 50%
- where the barrier infill or *balustrade* consists of parallel vertical members, less than 100 mm wide and with spaces between them of less than 100 mm, 50% of the concentrated load may be applied to each vertical member."

**COMMENT**

In Table 3.3, "external balconies" for domestic and residential activities applies to decks, balconies, verandahs and the like of individual houses as well as multi household unit buildings. Such barriers may be required by Clause F4 of the *Building Code*.

**2.2.8 AS/NZS 1170 Part 1, Clause 3.8**

**Car park** Add to the last paragraph of Clause 3.8:

"The basis for determining the horizontal impact actions on barriers quoted in the Clause, including the assumed deceleration distances, is given in Clause C 3.8 of the Commentary to AS/NZS 1170 Part 1. Different design actions may be derived using Equation C3.8, provided that:

- (i) The deceleration length applied is based on analysis or tests.
- (ii) The vehicle mass and associated velocity are not reduced from those quoted in Commentary Clause C3.8."

**2.2.9 AS/NZS 1170 Part 1, Appendix B**

Replace the last paragraph with the following:

"For the design of outdoor visitor structures as defined in SNZ HB 8630: 2004, the imposed actions must be as given by that publication with references to NZS 4203 replaced by equivalent references to AS/NZS 1170."

**2.2.10 AS/NZS 1170 Part 2, Clauses 3.2**

**and 4.4.3** Add the following at the end of Clauses 3.2 and 4.4.3:

"Where local wind design information is more onerous than determined by this Standard and is published and required to be used by any *territorial authority* for its area, this local wind design information shall take precedence over the equivalent information in this Standard for the determination of wind actions on *buildings*."

Where such local wind design information is less onerous than that of this Standard, the use of such information is not part of this *Verification Method*."

areas this may involve considerable cost consequences and a reduction in requirements is acceptable when site-specific hazard studies are undertaken."

**Consequential changes due to 2010/11 Canterbury earthquakes**

**COMMENT:**

1. As a result of the 2010/11 sequence of earthquakes in Canterbury, there is a heightened risk of seismic activity over the next few decades above that currently factored into structural design requirements. B1/VM1 is amended to reflect an increased seismic hazard factor for the *Canterbury earthquake region*.
2. The seismic hazard factor Z defined in NZS 1170 Part 5 (Table 3.3) has been raised for the *Canterbury earthquake region*. This is reflected in the following amendments to B1/VM1.

**2.2.12 AS/NZS 1170 Part 3, Clause 2.1**

Add the following at the end of Clause 2.1:

"Where local snow and ice design information is more onerous than determined by this Standard and is published by any *territorial authority* for its area, this local snow and ice design information shall take precedence over the equivalent information in this Standard for the determination of snow and ice actions on *buildings*.

**2.2.14a NZS 1170 Part 5, Clause 3.1.4**

Add (to the end of Clause 3.1.4):

"The minimum hazard factor Z (defined in Table 3.3) for the *Canterbury earthquake region* shall be 0.3. Where factors within this region are greater than 0.3 as provided by NZS 1170 Part 5, then the higher value shall apply.

The hazard factor for Christchurch City, Selwyn District and Waimakariri District shall apply to all structure periods less than 1.5 seconds."

**COMMENT:**

The revised Z factor is intended only for use for the design and assessment of buildings and structures, pending further research. All structures with periods in excess of 1.5 seconds should be subject to specific investigation, pending further research.

Where such local snow and ice design information is less onerous than that of this Standard, the use of such information is not part of this *Verification Method*."

**2.2.13 AS/NZS 1170 Part 3, Clause 5.4.3**

Add the following to end of Clause 5.4.3:

"For Regions N4 and N5 the minimum value of  $s_g$  for the ultimate limit state only must be taken as 0.9 kPa."

**2.2.14b NZS 1170 Part 5, Table 3.3**

|               |     |              |      |   |
|---------------|-----|--------------|------|---|
| Delete row:   | 102 | Christchurch | 0.22 | - |
| Replace with: | 102 | Christchurch | 0.3  | - |
| Delete row:   | 101 | Akaroa       | 0.16 | - |
| Replace with: | 101 | Akaroa       | 0.3  | - |

**2.2.14 NZS 1170 Part 5, Clause 1.4**

Add the following to the end of the Clause 1.4:

"Where a special study yields a site-specific uniform risk design spectrum for 500 year return period equivalent to a hazard factor, Z, of less than 0.08, a design spectrum equivalent to at least  $Z = 0.10$  may be adopted and the minimum magnitude 6.5 earthquake need not be considered.

**2.2.14c NZS 1170 Part 5, Clause 3.1.5**

Add (as another paragraph after the last sentence in Clause 3.15):

"In the *Canterbury earthquake region*, the risk factor for the serviceability limit state shall not be taken less than  $R_s = 0.33$ ."

**COMMENT:**

In areas where the uniform risk hazard factor is less than 0.08, the use of a minimum hazard factor  $Z = 0.13$  implies design for earthquakes with extremely low probabilities of occurrence. For some projects in these

**2.2.14d NZS 1170 Part 5, Figure 3.4**

Figure 3.4 Hazard factor Z for the South Island is amended as per Paragraph 2.2.14A above.

Amend 12  
Feb 2014

Amend 9  
Sep 2010

Amend 8  
Dec 2008

Amend 11  
Aug 2011

Amend 10  
May 2011

**2.2.15 NZS 1170 Part 5, Clause 4.2 Seismic weight and seismic mass** After: "0.3 is the earthquake imposed action (live load) combination factor for all other applications" add the following:

"except roofs.

$\psi_E = 0.0$  is the earthquake imposed action (live load) combination factor for roofs."

**2.2.16 NZS 1170 Part 5, Sections 5 and 6 Time history analysis** Time history analysis is not part of this *Verification Method*.

**COMMENT:**

Time history analysis is a highly specialised method of assessing structural response to earthquakes. It requires many detailed and interdependent assumptions to be made in relation to the nature of earthquake shaking and its propagation from the source, the properties of the *building* site and the detailed characteristics of the *building* and its structural elements.

AS/NZS 1170 outlines the steps for time history analysis in some detail, but the applicability of each step needs to be evaluated on a *building-by-building* basis. More importantly, the output of the analysis needs to be examined carefully in each particular context.

Time history analysis can be an acceptable aid to verifying compliance with structural requirements provided that:

- It is carried out by specialists with in-depth experience in applying the technique.
- The output of the analysis and the viability of the resulting structural design are reviewed by an independent team experienced in both analysis and design.

**2.2.17 NZS 1170 Part 5, Clause 5.2.2.3, equation 5.2(4)** Delete equation 5.2(4) and replace with:

$$C_d(T) = \frac{C(T) S_p}{k_\mu} \quad \dots \text{5.2(4)}$$

**2.2.18 NZS 1170 Part 5, Clause 6.1.4.1 Requirement for modelling** Delete the last sentence of the first paragraph and replace with:

"The model shall include representation of the diaphragm's flexibility."

Delete the third (last) paragraph.

### 3.0 Concrete

**3.1 NZS 3101: Part 1** subject to the following modifications:

a) Replace clause 4.8 **External walls that could collapse outward in fire** with:

**4.8 External walls that could collapse inwards or outwards in fire**

#### 4.8.1 Application

This clause applies to external walls which could collapse inwards or outwards from a building as a result of internal fire exposure. All such walls shall:

- Be attached to the building structure by steel connections;
- Be restrained by these connections, when subject to fire, from inwards or outward movement of the wall relative to the building structure; and
- Comply with the appropriate provisions of this Standard for walls.

#### 4.8.2 Forces on connections

The connections between each wall and the supporting structure shall be designed to resist all anticipated forces. In the absence of a detailed analysis, the connections shall be designed to resist the largest of:

- The force resulting from applying Clause 2.2.4 of Verification Method B1/VM1;
- for walls fixed to a flexible structure of unprotected steel, the force required to develop the nominal flexural strength of the wall at its base;
- for walls fixed to a rigid structure such as reinforced concrete columns or protected steel columns or another wall at right angles, the force required to develop the nominal flexural strength of the wall at mid-height.

b) Amend Clause **9.3.9.4.13 Minimum area of shear reinforcement**

In Clause 9.3.9.4.13 c) delete the words after "750 mm" and substitute "and the depth of the precast unit is equal to or less than 300 mm."

c) Amend Clause **18.7.4 Floor or roof members supported by bearing on a seating**

Add to the end of Clause 18.7.4 (g)(ii) add an additional sentence:

“The details given by C18.6.7(e) may be applied to hollow-core units where the depth of the precast unit is equal to or less than 300 mm.”

Erratum 1  
Sep 2010

Amend 9  
Sep 2010

**3.2 NZS 3106**

**4.0 Concrete Masonry**

Amend 8  
Dec 2008

**4.1 NZS 4230**

**5.0 Steel**

Amend 9  
Sep 2010

**5.1 NZS 3404: Part 1**

Amend 8  
Dec 2008

**5.2 AS/NZS 4600** subject to the following modifications:

Amend 11  
Aug 2011

a) Actions must be determined in accordance with AS/NZS 1170. All references to NZS 4203 are replaced by equivalent references to AS/NZS 1170.

Amend 8  
Dec 2008

b) The term “normative” identifies a mandatory requirement for compliance with this Standard.

c) The term “informative” identifies information provided for guidance or background which may be of interest to the Standard’s users. Informative provisions do not form part of the mandatory requirements of the Standard.

d) Where this Standard has provisions that are in non-specific or unquantified terms then these do not form part of the *Verification Method* and the proposed details must be submitted to the *territorial authority* for approval as part of the *building consent* application. This includes, but is not limited to, special studies and manufacturer’s advice.

e) All stages of *construction* of a structure or part of a structure to which this Standard is applied shall be adequately reviewed by a person who, on the basis of experience or qualifications, is competent to undertake the review.

f) The extent of the review to be undertaken shall be nominated by the design engineer, taking into account those materials and workmanship factors which are likely to influence the ability of the finished construction to perform in the predicted manner.

g) At the end of the first paragraph of Appendix A add the words “Unless noted otherwise a document referred to below shall be the version of that document current at the date of issue of this Standard or if amendments are cited to this Standard in the “References” pages of this document at the latest date of those amendments.”

Amend 12  
Feb 2014

h) Appendix B shall be read as normative with “shoulds” changed to “shalls”.

**5.3 NASH Standard** – Residential and Low-rise Steel Framing Part 1: Design Criteria.

Amend 11  
Aug 2011

**6.0 Timber**

**6.1 NZS 3603** subject to the following modifications:

a) Actions must be determined in accordance with AS/NZS 1170. All references to NZS 4203 are replaced by equivalent references to AS/NZS 1170.

Amend 11  
Aug 2011

b) Delete Clause 2.2.1.2 and replace with:  
“Machine stress-grading shall be in accordance with AS/NZS 1748 as modified by NZS 3622. Machine stress-graded timber shall have its properties verified, and be identified, in accordance with the requirements of NZS 3622.”

Amend 11  
Aug 2011

Amend 7  
Apr 2007

Amend 8  
Dec 2008

**7.0 Aluminium**

**7.1 AS/NZS 1664.1** subject to the following modifications:

a) Actions must be determined in accordance with AS/NZS 1170. All references to NZS 4203 are replaced by equivalent references to AS/NZS 1170.

Amend 11  
Aug 2011

b) The terms “capacity factor” and “strength limit state” are to be read as “*strength reduction factor*” and “ultimate limit state” respectively.

Amend 8  
Dec 2008

- c) Where this Standard has provisions that are in non-specific or unquantified terms then these do not form part of the *Verification Method* and the proposed details must be submitted to the *territorial authority* for approval as part of the *building consent* application. This includes, but is not limited to, special studies and manufacturer’s advice.
- d) All stages of *construction* of a structure or part of a structure to which this Standard is applied shall be adequately reviewed by a person who, on the basis of experience or qualifications, is competent to undertake the review.
- e) The extent of the review to be undertaken shall be nominated by the design engineer, taking into account those materials and workmanship factors which are likely to influence the ability of the finished *construction* to perform in the predicted manner.
- f) Clause 1.2 to read “**MATERIALS** This Standard applies to aluminium alloys listed in Table 3.3(A) that comply with AS 1734, AS 1865, AS 1866, AS 1867 and AS 2748.1.”
- g) At the end of the first paragraph of Clause 1.4 add the words “Unless noted otherwise a document referred to below shall be the version of that document current at the date of issue of this Standard or if amendments are cited to this Standard in the “References” pages of the Acceptable Solutions and Verification Methods at the latest date of those amendments.”

Amend 8  
Dec 2008

Amend 8  
Dec 2008

Amend 8  
Dec 2008

Amend 12  
Feb 2014

## 8.0 Earth Buildings

**8.1 NZS 4297** subject to the following modifications:

Actions must be determined in accordance with AS/NZS 1170. All references to NZS 4203 are replaced by equivalent references to AS/NZS 1170.

Amend 11  
Aug 2011

## 9.0 Foundations

See B1/VM4.

Amend 12  
Feb 2014

## 10.0 Siteworks

### 10.1 NZS 4431

### 11.0 Drains

**11.1 AS/NZS 3725** subject to the following modifications:

**Clause 3** Add to the list of reference documents:

“NZS 3101 The design of concrete structures.

NZS 4402 Methods of testing soils for civil engineering purposes: Tests 2.4, 2.8, 4.1.1, 4.2.1, 4.2.2, 4.2.3 and 5.1.1.

New Zealand Geomechanics Society, Guidelines for the field description of soils and rocks in engineering use.”

**Clause 4** In the paragraph headed “(c) Select fill”, after the words “given in Table 1” add “or the New Zealand Geomechanics Society Guidelines”.

**Clause 5** In definition of Pt, replace “AS 4058” with “AS/NZS 4058”

**Clause 6.4** Replace the word “may” with “shall”. Delete the words “Superimposed concentrated dead loads should be avoided.”

**Clause 6.5.3.1** Delete the words “The appropriate road vehicle loading shall be specified by the relevant highway authority or owner”.

**Clause 6.5.3.2.2.2** Replace the word “may” with “shall”.

**Clause 6.5.4.3** Delete the words “unless otherwise specified by the Relevant Authority”.

**Clause 6.5.5** Delete the first words “For” and after the words “for aircraft types” add the words “is outside the scope of this Standard but...”

**Clause 7** Replace the word “should” with “shall”.

Amend 9  
Sep 2010

**Clause 10.3** After the words “the test load” add “or proof load”.

**Appendix A** Delete “Normative” and replace with “Informative”

**Appendix B** Delete “Normative” and replace with “Informative”

## 12.0 Windows

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**12.1 NZS 4211** subject to the following modification:

References to air leakage, water leakage and operational effectiveness of opening sashes in NZS 4211, are non-structural considerations and do not apply to this document.

Amend 11  
Aug 2011

Amend 12  
Feb 2014

## 13.0 Seismic Performance of Engineering Systems in Buildings

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**13.1 NZS 4219** subject to the following modifications in the *Canterbury earthquake region*:

Where the building structure period is less than 1.5 seconds, the zone factor Z shall be determined from the Standard but shall not be less than 0.3.

**COMMENT:**

All building structure periods in excess of 1.5 seconds should be subject to specific investigation, pending further research.

The component risk factor  $R_C$  shall be determined from the Standard but shall not be less than 0.33.

Amend 11  
Aug 2011

Amend 9  
Sep 2010

Amend 8  
Jun 2008

# Acceptable Solution B1/AS1

## General

### 1.0 Explanatory Note

Amend 12  
Feb 2014

**1.1** B1/AS1 contains Acceptable Solutions for Masonry (Paragraph 2.0), Timber (Paragraph 3.0), Earth Buildings (Paragraph 4.0) and Stucco (Paragraph 5.0), Drains (Paragraph 6.0) and Glazing (Paragraph 7.0).

Amend 11  
Aug 2011

**1.2** B1/AS gives an Acceptable Solution for small *chimneys* (referred to in Paragraph 8.0).

**1.3** Modifications to the Standards, necessary for compliance with the New Zealand Building Code, are given against the relevant clause number of each Standard.

### 1.4 Consequential changes due to 2010/11 Canterbury earthquakes

Amend 11  
Aug 2011

#### COMMENT:

Raising the seismic hazard factor Z in NZS 1170 Part 5 (Table 3.3) for the *Canterbury earthquake region* through amendments to B1/MM1 requires consequential amendments to NZS 4229, NZS 3604 and NZS 4299 referenced in B1/AS1.

### 2.0 Masonry

**2.1 NZS 4229** subject to the following modifications:

#### 2.1.1 NZS 4229 Clause 7.8.3

Delete clause 7.8.3.

Replace with:

"All slab-on-ground reinforcing shall extend to within 75 mm of the outside edge of the slab (including the foundation wall) and shall consist of a minimum 2.27kg/m<sup>2</sup> welded Grade 500E reinforcing mesh sheets (1.14 kg/m<sup>2</sup> in each direction), which shall be lapped at sheet joints such that the overlap measurement between the outermost cross wires of each fabric sheet is equal to the greater of one of the following:

- the spacing of cross wires plus 50 mm;
- 150 mm; or
- the manufacturer's requirements.

Slabs shall have a maximum dimension of 18 m between free joints."

Amend 12  
Feb 2014

### 2.1.2 NZS 4229

Foundations in the *Canterbury earthquake region* only where *good ground* has not been established.

#### COMMENT:

Foundations for houses built on ground that has the potential for liquefaction or lateral spread are outside the scope of B1/AS1.

Foundation designs for houses built in areas that have the potential for liquefaction, as defined by the Christchurch City Council, the Selwyn District Council and the Waimakariri District Council, may be in accordance with the MBIE Guidance Document "Repairing and rebuilding houses affected by the Canterbury earthquakes" (refer to [www.mbie.govt.nz](http://www.mbie.govt.nz)).

The foundation options in the MBIE Guidance Document apply to properties in the *Canterbury earthquake region* that have been categorised as Technical Category 1 to 3 (TC1, TC2 and TC3).

For TC1 properties, provided the conditions for *good ground* in Section 3 of NZS 3604 are met, house foundations following B1/AS1 can be used.

For TC2 and TC3 properties the MBIE Guidance Document provides a range of foundation solutions depending on expected ground movement and available bearing capacity. These parameters also determine the degree of involvement of structural and geotechnical engineers and the extent of specific engineering design.

Further guidance is being developed for other New Zealand regions and it is expected that this will inform the wider building and construction sector in due course. In the meantime for properties outside the *Canterbury earthquake region* that have the potential for liquefaction, MBIE recommends that further engineering advice is sought. For these properties a foundation solution following those provided for TC2 in the MBIE Guidance Document may be appropriate.

Amends  
11 and 12

**3.1.2 NZS 3604 Section 5 Bracing Design**

Make the following amendments:

Amend Figure 5.4, Earthquake zones, so that all the area within the Christchurch City Council boundary is within Zone 2.

Amend Figure 5.4 Earthquake zones, so that the lowest zone within the Selwyn or Waimakariri District Council boundaries is within Zone 2. Areas within Selwyn District that are designated as Zone 1 in NZS 3604 shall become Zone 2.

**3.1.3 NZS 3604 Clause 7.5.2.3**

Delete: Clause 7.5.2.3

Replace with: "Clause 7.5.2.3 The combined foundation and edge details shall be constructed as shown in Figures 7.13(B), 7.14(B) or (C) (and Figures 7.15(B) and 7.16(B) or (C) for foundations supporting a masonry veneer)."

**3.1.4 NZS 3604 Figure 7.13**

Delete: Figure 7.13(A) – Foundation edge details – In situ concrete – Dimensions & reinforcing for single storey.

Amend title of Figure 7.13(B) to "Dimensions & reinforcing for 1 or 2 storeys".

**3.1.5 NZS 3604 Figure 7.14**

Delete: Figure 7.14(A) – Foundation edge details – Concrete masonry – Single storey

Amend title of Figure 7.14(B) to "1 or 2 storeys", and add a note: "for a single storey foundation, 15 Series masonry may be used and the minimum footing width may be 190 mm".

**COMMENT:**

Unreinforced and untied slab to footing single storey option removed.

Amend 11  
Aug 2011

Amend 11  
Aug 2011

Amend 11  
Aug 2011

Amend 11  
Aug 2011

Amend 10  
May 2011

Amend 12  
Feb 2014

**3.0 Timber**

**3.1 NZS 3604** subject to the following modifications:

**3.1.1 NZS 3604 Paragraph 1.3 Definitions**

Add (in the definition for Good Ground):  
"(liquefaction, lateral spread – for the *Canterbury earthquake region* only)"  
after "subsidence" in subparagraph (c).

Amend 11  
Aug 2011

Amend 10  
May 2011



**3.1.6 NZS 3604 Figure 7.15**

Delete: Figure 7.15(A) – Masonry veneer foundation edge details – Dimensions and reinforcement for single storeys.

**COMMENT:**

Unreinforced and untied slab to footing single storey options removed.

**3.1.7 NZS 3604 Figure 7.16**

Delete: Figure 7.16 (A) – Masonry veneer foundation edge details – Concrete masonry – Single storey.

**COMMENT:**

Unreinforced and untied slab to footing single storey option removed.

**3.1.8 NZS 3604 Clause 7.5.8.1**

Delete: Clause 7.5.8.1

Replace with: “Clause 7.5.8.1 All slab-on-ground floors shall be reinforced concrete in accordance with Clauses 7.5.8.3, 7.5.8.4 and 7.5.8.6.4. All reinforcing steel, including welded mesh, shall be Ductility Class E in accordance with NZS 4671.”

**3.1.9 NZS 3604 Clause 7.5.8.3**

Delete: Clause 7.5.8.3

Replace with: “Clause 7.5.8.3 All slab-on-ground reinforcing shall extend to within 75 mm of the outside edge of the slab (including the foundation wall) and shall consist of a minimum 2.27 kg/m<sup>2</sup> welded reinforcing mesh sheets (1.14 kg/m<sup>2</sup> in each direction), which shall be lapped at sheet joints such that the overlap measurement between the outmost cross wires of each fabric sheet is equal to the greater of one of the following:

- the spacing of cross wires plus 50 mm,
- 150 mm or
- the manufacturer’s requirements.

Slabs shall have a maximum dimension of 24 m between free joints.”

**3.1.10 NZS 3604 Clause 7.5.8.6.2**

Delete: Clause 7.5.8.6.2

**3.1.11 NZS 3604 Figure 7.18**

Delete title: Figure 7.18 – Irregular slab (plan view) (see 7.5.8.6.2)

Replace with: “Figure 7.18 – Irregular slab (plan view) (see 7.5.8.6.4)”.

**3.1.12 NZS 3604 Clause 7.5.8.6.3**

Delete: Clause 7.5.8.6.3.

**3.1.13 NZS 3604 New Clause**

Add new: “Clause 7.5.8.8 Free Joints.

At free joints, slab reinforcement shall be terminated and there shall be no bonding between vertical concrete faces (prevented by using building paper or a bituminous coating). R12 dowel bars 600 mm long shall be placed at 300 mm centres along the free joint and lapped 300 mm with slab reinforcement on both sides of the joint. All dowel bars on one side of the joint shall have a bond breaker applied, e.g. by wrapping dowel bars for 300 mm with petrolatum tape. Joint dowel bars must be installed in a single plane, in true alignment and parallel.”

**3.1.14 NZS 3604 Foundations in the Canterbury earthquake region only where good ground has not been established**

**COMMENT:**

Foundations for houses built on ground that has the potential for liquefaction or lateral spread are outside the scope of B1/AS1.

Foundation designs for houses built in areas that have the potential for liquefaction, as defined by the Christchurch City Council, the Selwyn District Council and the Waimakariri District Council, may be in accordance with the MBIE Guidance Document “Repairing and rebuilding houses affected by the Canterbury earthquakes” (refer to [www.mbie.govt.nz](http://www.mbie.govt.nz)).

The foundation options in the MBIE Guidance Document apply to properties in the *Canterbury earthquake region* that have been categorised as Technical Category 1 to 3 (TC1, TC2 and TC3).

For TC1 properties, provided the conditions for *good ground* in Section 3 of NZS 3604 are met, house foundations following B1/AS1 can be used.

For TC2 and TC3 properties the MBIE Guidance Document provides a range of foundation solutions depending on expected ground movement and available bearing capacity. These parameters also determine the degree of involvement of structural and geotechnical engineers and the extent of specific engineering design.

Further guidance is being developed for other New Zealand regions and it is expected that this will inform the wider building and construction sector in due course. In the meantime for properties outside the *Canterbury earthquake region* that have the potential for

Amend 11  
Aug 2011

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Feb 2014

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Aug 2011  
Amend 10  
May 2011

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Aug 2011

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Aug 2011

Amend 10  
May 2011

Amend 11  
Aug 2011

Amend 12  
Feb 2014

liquefaction, MBIE recommends that further engineering advice is sought. For these properties a foundation solution following those provided for TC2 in the MBIE Guidance Document may be appropriate.

Amend 12  
Feb 2014

#### 4.0 Earth Buildings

Amend 11  
Aug 2011

**4.1 NZS 4299** subject to the following modifications:

Amend 11  
Aug 2011

##### 4.1.1 NZS 4299, Paragraph 1.3 Definitions

Add (in the definition for Good Ground):  
“(liquefaction, lateral spread – for the *Canterbury earthquake region* only)”  
after “subsidence” in subparagraph (c).

Amend 11  
Aug 2011

##### 4.1.2 NZS 4299, Clause 2.3 Earthquake zones

Add to the end of Clause 2.3:

“The earthquake zone factor > 0.6 shall apply to the *Canterbury earthquake region*.”

Amend 11  
Aug 2011

##### 4.1.3 NZS 4299, Figure 2.1 Earthquake zones

On the map shown in NZS 4299 Figure 2.1 Earthquake zones, the *Canterbury earthquake region* shall be interpreted as having an earthquake zone factor of > 0.6.

Amend 11  
Aug 2011

##### 4.1.4 NZS 4299, Clause 4.8.6.

Delete: Clause 4.8.6

Replace with: “Clause 4.8.6 The thickness and reinforcement and detail of concrete slabs shall comply with the requirements of NZS 3604 as modified in B1/AS1 Paragraph 3.1.”

Amend 10  
May 2011

#### 4.1.5 NZS 4299 Foundations in the Canterbury earthquake region only where good ground has not been established

Amend 11  
Aug 2011

##### COMMENT:

Foundations for houses built on ground that has the potential for liquefaction or lateral spread are outside the scope of B1/AS1.

Foundation designs for houses built in areas that have the potential for liquefaction, as defined by the Christchurch City Council, the Selwyn District Council and the Waimakariri District Council, may be in accordance with the MBIE Guidance Document “Repairing and rebuilding houses affected by the Canterbury earthquakes”(refer to [www.mbie.govt.nz](http://www.mbie.govt.nz)).

The foundation options in the MBIE Guidance Document apply to properties in the *Canterbury earthquake region* that have been categorised as Technical Category 1 to 3 (TC1,TC2 and TC3).

For TC1 properties, provided the conditions for *good ground* in Section 3 of NZS 3604 are met, house foundations following B1/AS1 can be used.

For TC2 and TC3 properties the MBIE Guidance Document provides a range of foundation solutions depending on expected ground movement and available bearing capacity. These parameters also determine the degree of involvement of structural and geotechnical engineers and the extent of specific engineering design.

Further guidance is being developed for other New Zealand regions and it is expected that this will inform the wider building and construction sector in due course. In the meantime for properties outside the *Canterbury earthquake region* that have the potential for liquefaction, MBIE recommends that further engineering advice is sought. For these properties a foundation solution following those provided for TC2 in the MBIE Guidance Document may be appropriate.

Amend 12  
Feb 2014

#### 5.0 Stucco

Amend 10  
May 2011

#### 5.1 NZS 4251

**6.0 Drains**

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**6.1 AS/NZS 2566.1**

**6.2 AS/NZS 2566.2**

**6.3 AS/NZS 2032**

**6.4 AS/NZS 2033**

Amend 9  
Sep 2010

## 7.0 Glazing

**7.1 NZS 4223.1** subject to the following modifications:

**Clause 1.2(e)** Reword to read:

“For framed, unframed, and partly framed glass assemblies in buildings up to 10 m high, glass shall be selected in accordance with section 5.”

### 7.2 NZS 4223.2

#### 7.2.1 201 Selection and installation of sash and frames

Delete Clause 201.1 (b)

Replace with: “Clause 201.1(b). They must allow for contraction and expansion of the building and comply with relevant clauses of AS/NZS 1170 and NZS 4223.1 section 3.5.”

### 7.3 NZS 4223.3

#### 7.3.1 Related documents, New Zealand Standards

Delete NZS 4203: 1992 General structural design and design loadings for buildings

Replace with: “AS/NZS 1170 Structural Design Actions.”

#### 7.3.2 Clause 310.1

Delete Clause 310.1

Replace with: “Glazing used in any building in situations that require protection for occupants from falling 1000 mm or more from the floor level shall meet the barrier requirements of AS/NZS 1170 as modified by B1/VM1.”

#### 7.3.3 NZS 4223: Part 3 Clause 312.2 Unframed or partly framed balustrades and fences

Delete Clause 312.2 (a) and (b)

Replace with: “Unframed and partly framed balustrade systems shall be designed in accordance with AS/NZS 1170 as modified by B1/VM1.”

#### 7.3.4 NZS 4223: Part 3 Clause 312.3 Structural balustrades and fences

Delete Clause 312.3

Replace with: “Clause 312.3. Where glass is used as a structural member, toughened safety glass shall be used. The thickness used shall be determined in accordance with AS/NZS 1170 as modified by B1/VM1.”

#### 7.3.5 NZS 4223: Part 3 Section 313 Stairwells and Porches

Delete Clause 313.1

Replace with: “Glazing in stairways within 2000 mm horizontally or vertically, from any part of a stairway or landing shall be Grade A safety glass in accordance with Table 3.1. Stairways include stairwells, landings and porches and comprise at least two risers. All glazing in stairways protecting a fall of 1000 mm or more shall also meet the barrier requirements of AS/NZS 1170 as modified by B1/VM1.”

**7.3.6 Table 3.7** Glazing protecting a difference in level in any building.

Delete Table 3.7

**7.3.7 Table 3.8** Unframed or partly framed balustrades and fences.

Delete Table 3.8

#### Appendix 3.E

Delete Appendix 3.E

Replace with: “Refer to NZS 4223 Part 1 Section 5.4”

### 7.4 NZS 4223.4

## 8.0 Small Chimneys

See Acceptable Solution B1/AS3.

Amend 11  
Aug 2011

Amend 12  
Feb 2014

Amend 12  
Feb 2014

Amend 11  
Aug 2011

In addition there is a small positive water pressure acting on the underside of the wall which reduces the vertical load applied to the foundation.

$$u = 0.4 \times 9.81 = 3.92 \text{ and } V_{\text{drained}} = 154.87 - 3.92 \times 2.65 = 144.48$$

This has the effect of changing slightly  $X$  and  $e$ , hence  $B^I$  and  $q_d$ . We have from the first ultimate limit state the moment about the heel of the wall of the vertical forces = 131.29 kNm per metre length of the wall, so:

$$X = (131.29 - 3.92 \times 2.65 \times 2.65/2)/144.48 = 0.813$$

$$\text{Eccentricity of load: } e = 70.47 \times 1.44/144.48 = 0.703$$

$$B^I = 2 \times (2.65 - 0.813 - 0.703) = 2.27$$

$$\text{Design bearing pressure: } q_d = V_{\text{drained}}/B^I = 144.5/2.27 = 63.7 \text{ kPa}$$

For  $\phi$  equal to  $25^\circ$  the bearing capacity factors are:  $N_c = 21$ ,  $N_q = 11$  and  $N_\gamma = 9$ .

Determine ultimate bearing strength:

$$q_{u,\text{drained}} = c^I \lambda_{cs} \lambda_{cd} \lambda_{ci} \lambda_{cg} N_c + q^I \lambda_{qs} \lambda_{qd} \lambda_{qi} \lambda_{qg} N_q + 0.5 B^I \gamma^I \lambda_{\gamma s} \lambda_{\gamma d} \lambda_{\gamma i} \lambda_{\gamma g} N_\gamma$$

Shape factors  $\lambda_{cs}$ ,  $\lambda_{qs}$  and  $\lambda_{\gamma s}$  shall be taken as 1.0 as foundation is assumed to be long compared to its width. Also ground inclination factors  $\lambda_{cg}$ ,  $\lambda_{qg}$  and  $\lambda_{\gamma g} = 1.0$  as the foundation is horizontal. Thus we need only to evaluate depth and load inclination factors.

Depth factors:

$$\lambda_{qd} = 1 + 2 \tan \phi^I (1 - \sin \phi^I)^2 (D_f/B) = 1 + 2 \tan(25)(1 - \sin(25))^2 (0.4/2.27) = 1.05$$

$$\lambda_{cd} = \lambda_{qd} - (1 - \lambda_{qd})/N_q \tan \phi^I = 1.05 - (1 - 1.05)/11 \tan(25) = 1.06$$

$$\lambda_{\gamma d} = 1$$

Load inclination factors:

$$\lambda_{qi} = (1 - 0.7H/(V_{\text{drained}} + c^I B^I \cot \phi^I))^3 = (1 - 0.7 \times 70.47/(144.48 + 12.5 \times 2.27 \times \cot(25)))^3 = 0.46$$

$$\lambda_{ci} = (\lambda_{qi} N_q - 1)/(N_q - 1) = 0.40$$

$$\lambda_{\gamma i} = (1 - H/(V_{\text{drained}} + c^I B^I \cot \phi^I))^3 = (1 - 70.47/(144.48 + 12.5 \times 2.27 \times \cot(25)))^3 = 0.28$$

$$q_{u,\text{drained}} = c^I N_c \lambda_{cd} \lambda_{ci} + q^I N_q \lambda_{qd} \lambda_{qi} + 0.5 B^I \gamma^I N_\gamma \lambda_{\gamma d} \lambda_{\gamma i}$$

$$= 12.5 \times 21 \times 1.06 \times 0.40 + 3.3 \times 11 \times 1.05 \times 0.46 + 0.5 \times 9 \times 2.27 \times 8.2 \times 1 \times 0.28 = 152.29$$

$$q_{\text{dbs\_drained}} = q_{u,\text{drained}} \Phi_{bc} = 152.29 \times 0.45 = 68.5 \quad q_d = 63.7$$

**Thus OK as  $q_{\text{dbs\_drained}} > q_d$**

## C12.0 Sixth Ultimate Limit State (long term foundation sliding failure)

The design sliding strength is derived from the sliding resistance on the base and the passive resistance from the clay in front of the embedded part.

$$\text{Sliding resistance: } S_{\text{drained}} = c^I B^I + V_{\text{drained}} \tan \phi^I = 12.5 \times 2.27 + 144.48 \times \tan(25) = 95.75$$

$$\begin{aligned} \text{Passive resistance: } P_{p,\text{drained}} &= 0.5 K_p \gamma^I T_f^2 + 2c^I T_f \sqrt{K_p} \\ &= 0.5 \times 3.5 \times 8.2 \times 0.4^2 + 2 \times 12.5 \times 0.4 \times \sqrt{3.5} = 21.00 \end{aligned}$$

$$\text{Design sliding strength: } S \Phi_{sl} + P_p \Phi_{pp} = 95.75 \times 0.8 + 21.00 \times 0.45 = 86.05$$

$$H = 70.5$$

**Thus OK as  $S \Phi_{sl} + P_p \Phi_{pp} > H$**

**C13.0 Comments**

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The above calculations reveal that, for static loading, it is the long term case that is critical. Also for the short term cases the sliding strength derived from passive earth pressure in front of the embedded foundation is significant.

If the horizontal earthquake acceleration is increased much above 0.2g the third ultimate limit state becomes the limiting case as bearing failure is initiated. However, as explained in clauses 4.11.2.4 and C4.11.2.4 of NZS 4402: 1992, controlled sliding and tilting of the foundation during the passage of an earthquake is possible if the resulting post-earthquake permanent displacements are acceptable. The procedures and criteria for this approach are beyond the scope of this document.