Please find enclosed Amendment 19, effective 28 November 2019, to the Acceptable Solutions and Verification Methods for Clause B1 Structure of the New Zealand Building Code. The previous amendment to the B1 Acceptable Solutions and Verification Methods was Amendment 18, in June 2019.

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**Document Status**

The most recent version of this document (Amendment 19), as detailed in the Document History, is approved by the Chief Executive of the Ministry of Business, Innovation and Employment. It is effective from 28 November 2019 and supersedes all previous versions of this document.

The previous version of this document (Amendment 18) will cease to have effect on 31 March 2020, except for the Definition of Good ground in B1/AS1, which will cease to have effect on 29 November 2021.

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.building.govt.nz

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# 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.

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The above suite of Structural Design Action Standards, together with their amendments, are referred to collectively as “AS/NZS 1170”.

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NZS 4431: 1989  Code of practice for earth fill for residential development
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AS/NZS 4600: 2005 Cold-formed steel structures
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AS/NZS 4680: 2006 Hot-Dip Galvanised (zinc) Coating
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SNZ HB 8630: 2004 Tracks and outdoor visitor structures

The National Association of Steel Framed Housing Inc (NASH)

NASH Standard Part 2: May 2019 Light Steel Framed Buildings

British Standards Institution

BS 8004: 1986 Code of practice for foundations

BS EN 14399 High-strength structural bolting assemblies for preloading

Part 1: 2015 General requirements

Part 2: 2015 Suitability for preloading

Part 3: 2015 System HR. Hexagon bolt and nut assemblies

Part 5: 2015 Plain washers

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AS 1391: 2007 Metallic materials – Tensile testing at ambient temperature

AS 1397: 2011 Steel sheet and strip – Hot-dipped zinc-coated or aluminium/zinc-coated

AS 2159: 1995 Rules for the design and installation of piling (known as the SAA Piling Code)

American Society of Testing and Materials

ASTM D1143: 1981 Test method for piles under static axial compressive load

New Zealand Geomechanics Society

Guidelines for the field descriptions of soils and rocks in engineering use. Nov 1988

New Zealand Legislation

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International Organization for Standardization

ISO 15630-2 2010: Steel for the reinforcement and prestressing of concrete – Test Methods – Part 2 Welded Fabric

ISO 17025: 2005 General requirements for the competence of testing and calibration laboratories
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.

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

**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.

**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.

**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 jamb** The side walls of a fireplace.

**Combustible** See non-combustible.

**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 jamb, 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, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots.
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.
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.
ψ_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:
\[ C_d(T) = \frac{C(T) S_p}{k_\mu} \] ...

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:

3.1.1 Clause 18.7.4.4 Detailing requirements for support of hollow core floors
At the end of Clause 18.7.4.4 (b) 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 400 mm.”

COMMENT:
Welded wire fabric that is used in designs to NZS 3101 is subject to the requirements of Paragraph 14.0 Ductile Steel Mesh of this Verification Method.

3.2 NZS 3106

4.0 Concrete Masonry

4.1 NZS 4230

5.0 Steel

5.1 NZS 3404: Part 1
subject to the following modifications:

5.1.1 Clause 2.2.1 Specification
In Clause 2.2.1 a) replace:
“AS 1163 Cold-formed structural steel hollow sections AS 1594 Hot-rolled steel flat products”,
with
“AS/NZS 1163 Cold-formed structural steel hollow sections
AS/NZS 1594 Hot-rolled steel flat products”

5.1.2 Clause 2.3.1 Steel bolts, nuts and washers
In Clause 2.3.1 add the following to the end of the Clause:
“BS EN 14399-3 High-strength structural bolting assemblies for preloading, System HR. Hexagon bolt and nut assemblies
**5.1.3 new Clause 3.10 Documentation**
Insert the following after clause 3.9:

“Clause 3.10 Documentation
The requirements in AS/NZS 5131 Section 4.1.1 General shall be applied.”

**5.1.4 Clause 9.3.1 Bolts and bolting category**
In Clause 9.3.1.2 replace:

“and AS 1559”

with

“, AS 1559, BS EN 14399.1, BS EN 14399.2, BS EN 14399.3 and BS EN 14399.5”.

**5.1.4A Section 13 Design of composite members and structures**
Replace Section 13 Design of composite members and structures with the following:

“13 Design of composite members and structures shall be in accordance with AS/NZS 2327.”

**5.1.5 Section 14 Fabrication**
Replace Section 14 Fabrication with the following:

“14 Fabrication
The fabrication of steel structures shall be in accordance with AS/NZS 5131.
Construction categories for the purposes of this Standard shall be determined in accordance with Appendix C of AS/NZS 5131.”

**5.1.6 Section 15 Erection**
Replace Section 15 Erection with the following:

“15 Erection
The erection of steel structures shall be in accordance with AS/NZS 5131.
Construction categories for the purposes of this standard shall be determined in accordance with Appendix C of AS/NZS 5131.”

**5.1.7 Section 16 Modification of Existing Structures**
Replace Section 16 Modification of existing structures with the following:

“16 Site modifications during erection and modification and repair of existing structures
Site modifications during erection and modification and repair of existing structures shall be in accordance with AS/NZS 5131 Section 14 Site modifications during erection and modification and repair of existing structures.”

**5.1.8 new Section 18 Architecturally Exposed Structural Steelwork**
Insert the following after Section 17:

“18 Architecturally exposed structural steelwork
The requirements in AS/NZS 5131 Section 10 Architecturally exposed structural steelwork shall be applied.”

**5.1.9 Appendix A**
Replace references to AS/NZS 3678, AS/NZS 3769.1 and AS/NZS 3679.2 in NZS 3404 with the 2016 versions that are referenced in this Verification Method

**5.1.9A Appendix C**
Replace Appendix C Corrosion Protection with the following:

“Appendix C Corrosion Protection
Corrosion protection shall be in accordance with SNZ TS 3404.”

**5.1.10 Appendix D**
Replace Appendix D Inspection of Welding to AS/NZS 1554.1 with the following:

“Appendix D Inspection of Welding
The recommendations in AS/NZS 5131 Appendix I Inspection of Welding and Bolting. (Informative) should be used.”

**5.1.11 Appendix K**
Replace Appendix K Standard test for evaluation of slip factor (normative) with the following:

“Appendix K Standard test for evaluation of slip factor (normative)
The requirements in AS/NZS 5131 Appendix G Standard test for evaluation of slip factor shall be used.”

**5.1.12 Appendix L**
Replace Appendix L Inspection of bolt tension using a torque wrench (informative) with the following”
Acceptable Solution B1/AS1

General

1.0 Explanatory Note

1.1 B1/AS1 contains Acceptable Solutions for
Masonry (Paragraph 2.0), Timber (Paragraph
3.0), Earth Buildings (Paragraph 4.0), Stucco
(Paragraph 5.0), Drains (Paragraph 6.0), Glazing
(Paragraph 7.0) and Steel (Paragraph 9.0).

1.2 B1/AS3 is 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

COMMENT:

Raising the seismic hazard factor Z in NZS 1170 Part 5
(Table 3.3) for the Canterbury earthquake region
through amendments to B1/VM1 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/m² welded Grade 500E
reinforcing mesh sheets (1.14 kg/m² 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.”

2.1.2 NZS 4229
Foundations 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.

The MBIE/MfE guidance document “Planning and
engineering guidance for potentially liquefaction-prone
land” outlines a risk-based process to identify and
manage liquefaction-related risk in land use planning and
development decision-making.

For houses built in areas that have the potential for
liquefaction, the MBIE guidance document “Repairing
and rebuilding houses affected by the Canterbury
earthquakes” may be appropriate. This guidance
provides a range of potential foundation solutions
depending on expected ground movement and available
bearing capacity. These parameters also determine
the required degree of involvement of structural and
geotechnical engineers and the extent of specific
engineering design.

2.1.3 NZS 4229 Grade 500E welded steel
mesh

Where Grade 500E welded steel mesh is
specified, it shall meet the requirements of
Paragraph 14.0 in B1/VM1.
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,” after “subsidence” in subparagraph (c).

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.

3.1.2A NZS 3604 Clause 7.4.1.3
Delete Subclause 7.4.1.3 (c).

3.1.2B NZS 3604 Figure 7.10(b)
On the plan view replace the text “2/M12 x 250 mm coach screws at 140 crs vertically” with “2/M12 x 240 mm coach screws at 140 crs vertically.”

3.1.2C NZS 3604 Figure 7.10(c )
On the plan view insert the text “At each strap location (at joist ends and nogging), 2/M12 x 240 mm long coach screws are required.”
On the plan view, replace the text “2/M12 x 250 mm coach screws at 140 crs vertically” with “2/M12 x 200 mm coach screws at 140 crs vertically.”
On the section view, replace the text “M12 x 200 mm coach screws at 400 crs vertically” with M12 x 240 mm coach screws at 140 crs vertically.
Delete “2/M12 bolts at 400 crs” which tie laminations together along edge joists and along boundary joists.

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”, and add a note: “for a single storey foundation, 15 Series masonry may be used and the minimum footing width may be 190 mm”.

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.

3.1.6 NZS 3604 Figure 7.15
Delete: Figure 7.15(A) – Masonry veneer foundation edge details – Dimensions and reinforcement for single storeys.
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 options 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 AS/NZS 4671.”

Where Grade 500E welded steel mesh is specified, it shall meet the requirements of Paragraph 14.0 in B1/VM1.

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/m² welded reinforcing mesh sheets (1.14 kg/m² 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 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.

The MBIE/MfE guidance document “Planning and engineering guidance for potentially liquefaction-prone land” outlines a risk-based process to identify and manage liquefaction-related risk in land use planning and development decision-making.

For houses built in areas that have the potential for liquefaction, the MBIE guidance document “Repairing and rebuilding houses affected by the Canterbury earthquakes” may be appropriate. This guidance provides a range of potential foundation solutions depending on expected ground movement and available bearing capacity. These parameters also determine the required degree of involvement of structural and geotechnical engineers and the extent of specific engineering design.
3.2 Slab-on-ground in expansive soils

3.2.1 NZS 3604 Clause 1.1.2 Buildings covered by this Standard

Amend 1.1.2(a) to read:
“Buildings founded on good ground or on expansive soils where the requirements of 1.1.5 are met”

3.2.2 NZS 3604 New Clause

Add new: “Clause 1.1.5 Buildings on expansive soils

Buildings on expansive soils shall be supported on slab-on-ground foundations complying with 7.5.13 and in addition to 1.1.2 shall be limited as follows:

(a) single storey, stand-alone household unit, and

(b) maximum length or width of floor of 24.0 m including any attached garage, and

(c) simple plan shapes such as rectangular, L, T or boomerang, and

(d) concrete slab-on-ground with a minimum thickness of 100 mm and a minimum concrete compressive strength of 20 MPa, and

(e) simple roof forms, incorporating hips, valleys, gables or mono pitches, and

(f) maximum overall height of 7.0 m to roof apex from lowest cleared ground level, and

(g) maximum roof height of 3.0 m, and

(h) roof slope between 10° and 35° from the horizontal, and

(i) maximum span of roof truss 12.0 m, and

(j) external walls maximum of 2.4 m height studs, other than gable end walls and walls to mono-pitched roofs, which shall not exceed 4.0 m.

COMMENT:

Floor plans

Where floor plans incorporate re-entrant corners then continuity of the exterior ground beam shall be maintained by continuing it as an internal beam, with the exterior beam details continued for a length of at least 1.0 m into the internal beam. This is only applicable where internal beams are specified in Tables 7.4A and 7.4B. This is aimed to bring the solution in NZS 3604 in line with Clause 5.3.8 of AS 2870:2011.

3.2.3 NZS 3604 Clause 7.5.1

Add the following paragraph at the end of Clause 7.5.1:

“Slabs on expansive soils for buildings meeting the requirements of 1.1.5 shall, in addition to meeting the requirements of 7.5.1 to 7.5.12, meet the requirements of 7.5.13. Where there is conflict the requirements of 7.5.13 shall apply.”

3.2.4 NZS 3604 New clause, tables and figures

Add new: Clause 7.5.13 Slab-on-ground in expansive soils

7.5.13.1 Identification of expansive soils

7.5.13.1.1 Should reasonable enquiry as outlined in 3.1.3 show any signs of expansive soils, the expansive soil class, as defined in AS 2870, shall be established by one or all of:

(a) enquiry to the local territorial authority, and/or

(b) reference to the certificate of suitability issued in terms of NZS 4431, and/or

(c) a soil test undertaken by a suitably qualified soils engineer.

7.5.13.1.2 Expansive soil class shall be defined as:

(a) Slightly ‘S’, having an $I_s$ range of 0–1.9%, and a 500 year design characteristic surface movement return ($y_g$) of 22 mm, or

(b) Moderately ‘M’, having an $I_s$ range of 2.0–3.7% and a 500 year design characteristic surface movement return ($y_g$) of 44 mm, or
(c) Highly ‘H’, having an $I_{SS}$ range of 3.8–6.5% and a 500 year design characteristic surface movement return ($y_s$) of 78 mm, or
(d) Extremely ‘E’, having an $I_{SS}$ range of 6.6–7.5% and a 500 year design characteristic surface movement return ($y_s$) of 90 mm.

7.5.13.2 Maximum aspect ratio of concrete slabs
The aspect ratio of the concrete slabs or bays of concrete slabs, such as in the case of L, T or boomerang concrete slab shapes, shall not exceed 5 to 1 (length to width).

7.5.13.3 Foundation details
7.5.13.3.1 For the identified expansive soil class the foundation details, external and internal thickenings shall be as follows.
(a) For light wall claddings refer to Table 7.4A and Figure 7.22.
(b) For medium wall or heavy wall claddings refer to Table 7.4B and Figure 7.23.

7.5.13.3.2 Situations where no internal thickenings shall be required are limited to a rectangular slab with long side not exceeding 17.0 m. Where this limit is exceeded, add additional internal thickenings across the slab with the same cross section dimensions and reinforcing as the external footing, so that the centre to centre spacing of thickenings is always less than 17.0 m.

**COMMENT:**
**Design constraints:**
a) The characteristic surface movements and the corresponding expansivity classifications have been calculated based on design for ultimate limit state (ULS) conditions for a 1 in 1000 year “extreme” drought event, and the serviceability limit state (SLS) conditions for a 1 in 500 year drought event.
b) Maximum soil movements are calculated to be based on a 500 year return period for SLS, and a 1000 year return period for ULS*;

(*NB: This differed from the recommendations contained within BRANZ Study Report 120A (BSR120A) which used a 300 year return period for the design level drought conditions)

c) Climate parameters adopted from BSR120A of $\Delta u = 1.2 \, \text{pF}$, $H_s = 1.5 \, \text{m}$, and a crack depth of 0.5 $H_s$
d) The $I_{SS}$ (soil stability index) ranges attributed to the expansivity classifications as defined in 3.2.4 above have been calculated using the parameters presented in BSR120A and Equation 2.3.1 of AS 2870:2011.
e) Sites subject to parameters that differ from those mentioned above, in particular sites where the crack depth is less than 0.75 m, such as cut natural ground or clay backfill, require specific engineering assessment to confirm their appropriate site classification.
f) The effects of nearby trees (whether existing, recently removed, or future planting) are not considered in these solutions. It is recommended that specific geotechnical engineering advice is obtained where a tree is within a lateral distance of 1.5 times its mature height of the foundations.

**Maintenance of foundations in expansive soils**
Normal maintenance is that work generally recognised as necessary to achieve the expected performance over time of the foundation located on expansive soils. Unless otherwise specified by the designer and noted on the drawings, basic normal maintenance tasks should ensure that:
a) the drainage and wetting of the site is controlled so that extremes of wetting and drying of the soils are prevented, and
b) the position and operation of gardens adjacent to the dwelling are controlled, and the planting of trees near to foundations is suitably restricted, and
c) any leaks which develop in plumbing, storm water or sanitary sewage systems are repaired promptly.
### Table 7.4A  Reinforced concrete foundations in expansive soils for light wall claddings

Clause 7.5.13 and Figure 7.22

<table>
<thead>
<tr>
<th>Expansive soil class</th>
<th>Slightly 'S'</th>
<th>Moderately 'M'</th>
<th>Highly 'H'</th>
<th>Extremely 'E'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil embedment (De)</td>
<td>375 mm</td>
<td>525 mm</td>
<td>575 mm</td>
<td>625 mm</td>
</tr>
<tr>
<td>Top steel (A&lt;sub&gt;s&lt;/sub&gt; top)</td>
<td>2/D16</td>
<td>2/D16</td>
<td>2/D16</td>
<td>2/D16</td>
</tr>
<tr>
<td>Bottom steel (A&lt;sub&gt;s&lt;/sub&gt; bottom)</td>
<td>1/D16</td>
<td>1/D25</td>
<td>1/D20</td>
<td>1/D25</td>
</tr>
<tr>
<td>Maximum spacing of internal thickenings</td>
<td>no internal thickening</td>
<td>no internal thickening</td>
<td>2.5 m crs.</td>
<td>2.5 m crs.</td>
</tr>
<tr>
<td>Depth of thickening (D1)</td>
<td>–</td>
<td>–</td>
<td>400 mm</td>
<td>450 mm</td>
</tr>
<tr>
<td>Base width (B1)</td>
<td>–</td>
<td>–</td>
<td>300 mm</td>
<td>350 mm</td>
</tr>
<tr>
<td>Top steel (A&lt;sub&gt;s&lt;/sub&gt; top)</td>
<td>–</td>
<td>–</td>
<td>2/D20</td>
<td>2/D20</td>
</tr>
<tr>
<td>Bottom steel (A&lt;sub&gt;s&lt;/sub&gt; bottom)</td>
<td>–</td>
<td>–</td>
<td>2/D16</td>
<td>2/D20</td>
</tr>
</tbody>
</table>

### Table 7.4B  Reinforced concrete foundations in expansive soils for medium wall and heavy wall claddings

Clause 7.5.13 and Figure 7.23

<table>
<thead>
<tr>
<th>Expansive soil class</th>
<th>Slightly 'S'</th>
<th>Moderately 'M'</th>
<th>Highly 'H'</th>
<th>Extremely 'E'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil embedment (De)</td>
<td>500 mm</td>
<td>550 mm</td>
<td>775 mm</td>
<td>800 mm</td>
</tr>
<tr>
<td>Top steel (A&lt;sub&gt;s&lt;/sub&gt; top)</td>
<td>2/D16</td>
<td>2/D20</td>
<td>2/D20</td>
<td>3/D20</td>
</tr>
<tr>
<td>Bottom steel (A&lt;sub&gt;s&lt;/sub&gt; bottom)</td>
<td>2/D16</td>
<td>2/D16</td>
<td>2/D20</td>
<td>2/D20</td>
</tr>
<tr>
<td>Maximum spacing of internal thickenings</td>
<td>–</td>
<td>2.5 m crs.</td>
<td>2.5 m crs.</td>
<td>2.5 m crs.</td>
</tr>
<tr>
<td>Depth of thickening (D1)</td>
<td>–</td>
<td>350 mm</td>
<td>450 mm</td>
<td>500 mm</td>
</tr>
<tr>
<td>Base width (B1)</td>
<td>–</td>
<td>300 mm</td>
<td>300 mm</td>
<td>350 mm</td>
</tr>
<tr>
<td>Top steel (A&lt;sub&gt;s&lt;/sub&gt; top)</td>
<td>–</td>
<td>2/D16</td>
<td>3/D20</td>
<td>3/D20</td>
</tr>
<tr>
<td>Bottom steel (A&lt;sub&gt;s&lt;/sub&gt; bottom)</td>
<td>–</td>
<td>2/D16</td>
<td>2/D16</td>
<td>2/D20</td>
</tr>
</tbody>
</table>
**Figure 7.2.2** Reinforced concrete foundations in expansive soils for light wall claddings
Clause 7.5.13 and Table 7.4A

Note: It would be considered good practice to construct corner junctions with the longitudinal reinforcing lapping around the corners and to construct internal beams with longitudinal bars at standard 90° hooked into the perimeter beams to provide adequate anchorage.

**Figure 7.2.3** Reinforced concrete foundations in expansive soils for medium wall and heavy wall claddings
Clause 7.5.13 and Table 7.4B

Note: It would be considered good practice to construct corner junctions with the longitudinal reinforcing lapping around the corners and to construct internal beams with longitudinal bars at standard 90° hooked into the perimeter beams to provide adequate anchorage.
4.0 Earth Buildings

4.1 NZS 4299 subject to the following modifications:

4.1.1 NZS 4299, Paragraph 1.3 Definitions
Add (in the definition for Good Ground):
“liquefaction, lateral spread,” after “subsidence” in subparagraph (c).

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.”

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.

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.”

4.1.5 NZS 4299 Foundations 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.

The MBIE/MfE guidance document “Planning and engineering guidance for potentially liquefaction-prone land” outlines a risk-based process to identify and manage liquefaction-related risk in land use planning and development decision-making.

For houses built in areas that have the potential for liquefaction, the MBIE guidance document “Repairing and rebuilding houses affected by the Canterbury earthquakes” may be appropriate. This guidance provides a range of potential foundation solutions depending on expected ground movement and available bearing capacity. These parameters also determine the required degree of involvement of structural and geotechnical engineers and the extent of specific engineering design.

5.0 Stucco

5.1 NZS 4251
6.0 Drains

6.1 AS/NZS 2566.1, including Amendment 1

6.2 AS/NZS 2566.2, including Amendments 1, 2 and 3

6.3 AS/NZS 2032

6.4 AS/NZS 2033
7.0 Glazing

7.1 NZS 4223.1

7.2 NZS 4223.2

7.3 NZS 4223.3

7.3.1 Clause 22.4.3 modified
Delete clause 22.4.3
Replace with:

“22.4.3 Structural glass barriers

Structural glass barriers use glass as a structural element and are normally classified by the following types. Glass design for these types shall comply with the following tables (see note 1):

Table 14 - Structural balustrade – cantilevered glass;
Table 15 - Structural balustrade – two-edge point fixed;
Table 16 - Structural balustrade – two-edge support;
Table 17 - Structural balustrade – three-edge support.

Design types and glass types not shown in Tables 14 to 17 require specific design.

All structural glass barriers safeguarding a fall of 1000 mm or more shall have interlinking rails, which in the event a glass pane breaks, spans the broken pane at the required barrier height and,

i) resists Line and Concentrated design loads (SLS) specified in Tables 14 to 17, and

ii) does not deflect more than 100 mm, in any direction, under the design loads.

Interlinking rails are not required for a heat-strengthened or toughened laminated safety glass barrier that:

(a) has a top capping, corner brackets or a proprietary system and will, when both panes of the laminate are fractured, resist a 0.2 kN concentrated load and not deflect more than 250 mm (see note 2), or

(b) has two or three edges supported by structural sealant joints or continuous clamps, and will, when both panes of the laminate are fractured, resist a 0.2 kN concentrated load and not deflect more than 250 mm (see note 2), or

(c) has a stiff interlayer and will, when both panes of the laminate are fractured, resist a 0.2 kN concentrated load and not deflect more than 250 mm (see note 2). Physical testing must be undertaken to demonstrate compliance with the load and deflection requirements for laminated glass barriers with a stiff interlayer (see note 3).

Physical testing of glass barriers must include all components of the barrier system, including all structural connections. Loads and deflections must be applied and measured horizontally, at midspan, at the required barrier height. The concentrated load shall be applied over an area of 100 mm x 100 mm and for at least one minute.

NOTE –

(1) The design of structural connections, fasteners and mounting hardware, that are part of the glass barrier, is outside the scope of this Standard and must be specifically designed.

(2) Laminated glass is susceptible to minor edge delamination, depending on the interlayer type and laminating process. Normally this will not affect the mechanical properties but can be noticeable on exposed edges.

(3) Test results for dual pane fracture of laminated glass barriers with stiff interlayers are not applicable to barriers that have narrower glass panes than that tested.”

7.4 NZS 4223.4

8.0 Small Chimneys

See Acceptable Solution B1/AS3.

9.0 Steel

9.1 NASH Standard Part 2 Light Steel Framed Buildings