BUILDING PERFORMANCE

B1

B1 Structure

Acceptable Solution B1/AS1

Structural provisions for buildings

SECOND EDITION | EFFECTIVE 28 JULY 2025

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

Preface

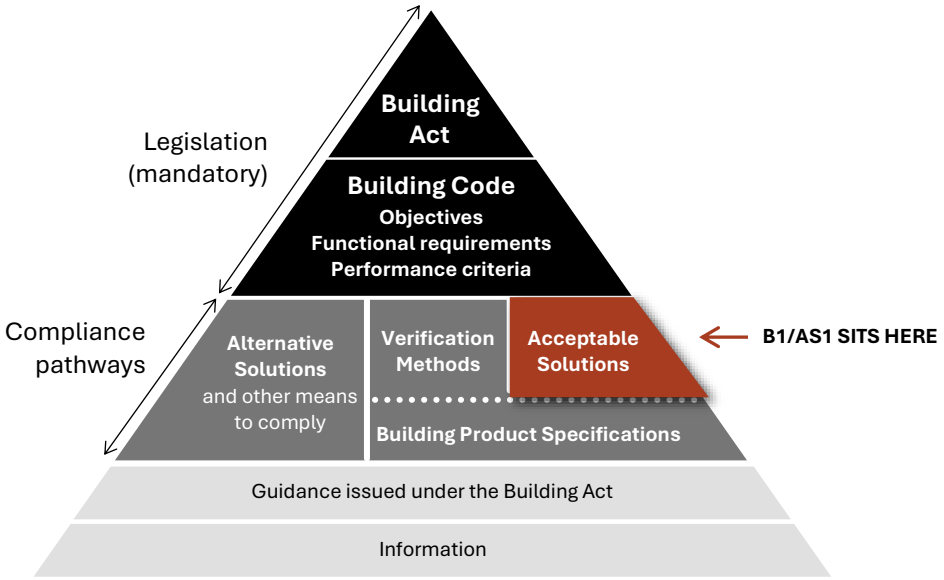
Document status

This document (B1/AS1) is an acceptable solution issued under section 22 (1) of the Building Act 2004 and is effective on 28 July 2025. It does not apply to building consent applications submitted before 28 July 2025. The previous Acceptable Solution B1/AS1 First Edition, as amended, can be used to show compliance until 31 July 2026 and can be used for building consent applications submitted before 1 August 2026.

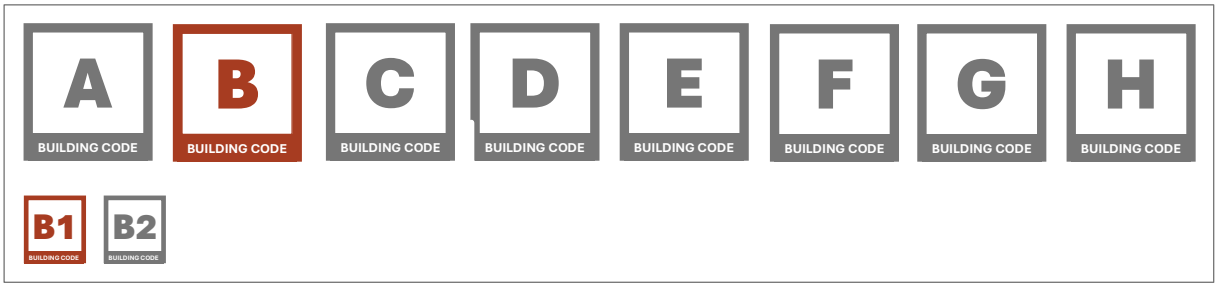
Building Code regulatory system

Each acceptable solution outlines the provisions of the Building Code that it relates to. Complying with an acceptable solution or verification method are ways of complying with that part of the Building Code. Other options for establishing compliance are listed in section 19 of the Building Act.

Schematic of the Building Code system



A building design must take into account all parts of the Building Code. The Building Code is located in Schedule 1 of the Building Regulations 1992 and available online at www.legislation.govt.nz.
The part of the Building Code that this acceptable solution relates to is clause B1 Structure.
Information on the scope of this document is provided in Part 1. General.



Further information about the Building Code, including objectives, functional requirements, performance criteria, acceptable solutions, and verification methods, is available at www.building.govt.nz.

Main changes in this version and features of this document

Main changes in this version

This acceptable solution is the second edition of B1/AS1. The main changes from the previous version are:

- The document has been published in a standalone format and the layout has been revised to improve clarity. This includes using a common structure for headings and text throughout the acceptable solution.
- Minor amendments have been made to correct typos, grammar, cross-references, punctuation, wording, and formatting of the document. This includes changes to headings, paragraphs, tables and figures, table and figure notes, and definitions. These amendments do not affect the level of performance required in the document but may assist in the interpretation of the requirements.
- The title of the document has been revised from "General" to "Structural provisions for houses and small buildings" to reflect the scope of the acceptable solution and the standards referenced within it. Additional information on the document and its scope is provided in Part 1. General.
- The acceptable solution now refers to the Building Product Specifications for welded steel mesh in Paragraphs 2.1.4.1 and 2.3.7.2, wall bracing of timber-framed buildings in Paragraph 2.3.4.2, timber piles in Paragraph 2.3.5.1, and glazing in Paragraph 3.3.1.1. More information on the Building Product Specifications is provided in Subsection 1.2.3.
- References have been revised to reflect the documents cited in this acceptable solution in Appendix A.
- Definitions have been revised to reflect the terms used in this acceptable solution in Appendix B.
- Comments regarding foundations where good ground has not been established have been relocated to Subsection 1.1.2 in order to make the scope of the document clear and avoid repetition in the acceptable solution.

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 acceptable solution or verification method at any time. Up-to-date versions of acceptable solutions or verification methods are available from www.building.govt.nz.

Features of this document

- For the purposes of Building Code compliance, the standards and documents referenced in this acceptable solution must be the editions, along with their specific amendments, listed in Appendix A.
- Words in *italic* are defined at the end of this document in Appendix B.
- Hyperlinks are provided to cross-references within this document and to external websites and appear with a blue underline.
- Appendices to this acceptable solution are part of, and have equal status to, the acceptable solution. Figures are informative only and the wording of the paragraphs takes precedence. Text boxes headed 'COMMENT' occur throughout this document and are for guidance purposes only.
- A consistent number system has been used throughout this document. The first number indicates the Part of the document, the second indicates the Section in the Part, the third is the Subsection, and the fourth is the Paragraph. This structure is illustrated as follows:

2	Part
2.5	Section
2.5.3	Subsection
2.5.3.1	Paragraph
2.5.3.1(a)	Paragraph (as a portion of the relevant paragraph)
2.5.3.1(a)(i)	Paragraph (as a portion of the relevant paragraph)

Contents

Part 1. General

1.1 Introduction

1.1.1 Scope of this document

1.1.1.1 This acceptable solution can be used to determine the structural provisions for *buildings* along with other specific *building elements* including:

a) masonry *buildings*; and

b) steel *buildings*; and

c) timber *buildings*; and

d) earth *buildings*; and

e) stucco; and

f) *drains*; and

g) glazing.

1.1.1.2 Limitations on the scope of this acceptable solution are specified in each of the cited standards along with the modifications and additional requirements stated in this document.

1.1.2 Items outside the scope of this document

1.1.2.1 This acceptable solution does not contain provisions for small *chimneys*. For small *chimneys*, refer to Acceptable Solution B1/AS3 or use an alternative means to demonstrate compliance.

1.1.2.2 Foundations for houses where *good ground* has not been established and the ground has the potential for liquefaction or lateral spread are outside the scope of the acceptable solution. Refer to Subsection 1.2.1 for how *good ground* is established.

1.1.3 Compliance pathway

1.1.3.1 This acceptable solution is one option that provides a means of establishing compliance with the functional requirements and performance criteria in Building Code clause B1 Structure. It can be used to demonstrate compliance with clauses B1.2, B1.3.1, B1.3.2, B1.3.3, B1.3.4, B1.3.5, B1.3.6, and B1.3.7.

1.1.3.2 If this acceptable solution cannot be followed in full, use an alternative means to demonstrate compliance.

1.2 Using this acceptable solution

1.2.1 Determining when good ground has been established

1.2.1.1 *Good ground* includes 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; and

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:

1. 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.
2. 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.
3. 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.

1.2.2 Modifications of standards

1.2.2.1 This acceptable solution contains modifications of cited standards in order to achieve compliance with the Building Code. The modifications are given for the relevant provisions in each standard.

COMMENT: Raising the seismic hazard factor Z in NZS 1170.5 (Table 3.3) for the *Canterbury earthquake region* through amendments to B1/VM1 requires consequential amendments to NZS 3604, NZS 4229, and NZS 4299 referenced in B1/AS1.

1.2.3 Building Product Specifications

1.2.3.1 This acceptable solution refers to the Building Product Specifications for *building* product standards and specifications in relation to their manufacture, fabrication, testing, quality control, physical properties, performance, installation, and/or maintenance

1.2.3.2 The Building Product Specifications cannot be used in isolation to demonstrate compliance with any requirements of the Building Code. To comply with B1/AS1, *building* products conforming to the Building Product Specifications must be used with the scope, limitations, and other applicable requirements set out in this acceptable solution.

Part 2. Buildings and structures

2.1 Masonry

2.1.1 Reinforced concrete masonry

2.1.1.1 Reinforced concrete masonry shall comply with NZS 4229 subject to:

a) the modifications in Subsection 2.1.2 and Subsection 2.1.3; and

b) the additional requirement for welded steel mesh in Subsection 2.1.4.

2.1.2 Referenced documents

2.1.2.1 In NZS 4229, replace reference to AS/NZS 4671:2001 with AS/NZS 4671:2019.

2.1.3 Concrete slab reinforcement

2.1.3.1 In NZS 4229, replace Clause 7.8.3 with:

a) "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^2 welded Grade 500E reinforcing mesh sheets (1.14 kg/m^2 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."

2.1.4 Welded steel mesh

2.1.4.1 Where Grade 500E welded steel mesh is specified, it shall meet the requirements of Subsection 3.2.2 of the Building Product Specifications.

2.2 Steel

2.2.1 Light steel frame

2.2.1.1 Light steel frame buildings shall comply with NASH Standard Part 2 Light Steel framed buildings.

2.3 Timber

2.3.1 Timber-framed buildings

2.3.1.1 NZS 3604 can be used for houses and small buildings subject to the modifications and additional requirements for:

a) referenced documents in Subsection 2.3.2; and

b) definitions in Subsection 2.3.3; and

c) bracing in Subsection 2.3.4; and

d) timber piles in Subsection 2.3.5; and

e) timber decks in Subsection 2.3.6; and

f) concrete slab-on-ground floors in Subsection 2.3.7; and

g) slab-on-ground in expansive soils in Subsection 2.3.8.

2.3.2 Referenced documents

2.3.2.1 In NZS 3604, replace reference to AS/NZS 4671:2001 with AS/NZS 4671:2019.

2.3.3 Definitions

2.3.3.1 In NZS 3604 Clause 1.3 Definitions for:

a) Good Ground, add "liquefaction, lateral spread" after "subsidence" in subparagraph (c); and

b) Bracing rating, remove "when tested in accordance with BRANZ Technical Paper P21"

2.3.4 Bracing design

2.3.4.1 In NZS 3604, make the following modifications in Section 5 Bracing Design:

a) modify Figure 5.4 Earthquake zones, so that all the area within the Christchurch City Council boundary is within Zone 2; and

b) modify 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.

2.3.4.2 In NZS 3604, where the bracing rating or bracing capacity of timber framed wall bracing elements must be determined, such as in Clauses 5.4 and 8.3.1, the bracing rating shall be determined in accordance with Subsection 3.5.3 of the Building Product Specifications.

2.3.5 Timber piles

2.3.5.1 Where timber piles are used in accordance with NZS 3604, they shall comply with Subsection 2.1.2 of the Building Product Specifications.

2.3.6 Timber decks

2.3.6.1 Remove Subclause 7.4.1.3 (c) in NZS 3604.

2.3.6.2 Modify Figure 7.10 (b) in NZS 3604 as follows:

a) on the plan view replace the text "2/M12 x 250 mm coach screws at 140 crs" with "2/M12 x 240 mm coach screws at 140 crs vertically."; and

b) on the plan view replace "2/M12 at 400 crs" twice with "2 M12 bolts at 140crs vertically to capture end joist laminations and blocking, and boundary joist laminations and blocking, at post centrelines."; and

c) add to Note 3: "All coach screws to have 50 x 50 washers."

2.3.6.3 Modify Figure 7.10 (c) in NZS 3604 as follows:

a) on the plan view, add the text "At each strap location (at joist ends and nogging), 2/M12 x 240 mm long coach screws are required."; and

b) on the plan view, replace the text "2/M12 x 250 mm coach screws at 140 crs vertically" with " 2/M12 x 200mm coach screws at 140 crs vertically" ; and

c) 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"; and

d) remove "2/M12 bolts at 400crs" which tie laminations together along edge joists and along boundary joists.

2.3.7 Concrete slab-on-ground floors

2.3.7.1 For foundation and edge details for concrete slab-on-ground floors, make the following modifications in Clause 7.5.2 in NZS 3604:

a) replace Clause 7.5.2.3 with:

i) "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)."; and

b) remove Figure 7.13(A) – Foundation edge details – In situ concrete – Dimensions & reinforcing for single storey; and

c) modify the title of Figure 7.13(B) to "Dimensions & reinforcing for 1 or 2 storeys"; and

d) remove Figure 7.14(A) – Foundation edge details – Concrete masonry – Single storey

e) modify the 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"; and

f) remove Figure 7.15(A) – Masonry veneer foundation edge details – Dimensions and reinforcement for single storeys; and

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

COMMENT: These modifications to the figures remove the unreinforced and untied slab to footing single storey option.

2.3.7.2 For the design of concrete slab-on-ground slabs:

a) in NZS 3604, replace Clause 7.5.8.1 with:

i) "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."; and

b) where Grade 500E welded steel mesh is specified, it shall meet the requirements of Subsection 3.2.2 of the Building Product Specifications.

2.3.7.3 For ground slab reinforcing, replace Clause 7.5.8.3 of NZS 3604 with:

a) "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^2 welded reinforcing mesh sheets (1.14 kg/m^2 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."

2.3.7.4 For unreinforced concrete slabs, in NZS 3604:

a) remove Clause 7.5.8.6.2; and

b) replace the title "Figure 7.18 – Irregular slab (plan view) (see 7.5.8.6.2)" with: "Figure 7.18 – Irregular slab (plan view) (see 7.5.8.6.4)".

2.3.7.5 For polypropylene fibre reinforced slabs, remove Clause 7.5.8.6.3 from NZS 3604.

2.3.7.6 For free joints, add the new clause to NZS 3604:

a) "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."

2.3.8 Slab-on-ground in expansive soils

2.3.8.1 In NZS 3604 Section 1.1 Scope:

a) for buildings covered by the standard, modify 1.1.2(a) to read: "Buildings founded on good ground or on expansive soils where the requirements of 1.1.5 are met"; and

b) add a new clause "Clause 1.1.5 Buildings on expansive soils":

i) "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:

1. 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.
2. Ground movement – Provision for the additional ground movement effects from trees near to foundations in expansive soils should be considered. Trees remove moisture from the soil for a radius equal to the height of the tree. This causes expansive soils to shrink to varying degrees, and when near houses leads to differential settlement occurring under foundations. Movement of the foundations may lead to cracks in the building and door jamming.
   Where existing trees (including trees that have been recently removed) are located closer to the foundations than 1.5 times the mature height of a tree, then additional geotechnical advice should be obtained. Planting of new trees should be avoided near foundations of new buildings or neighbouring buildings on sites with expansive soils.

2.3.8.2 In NZS 3604 Clause 7.5,

a) add the following paragraph at the end of Clause 7.5.1:

i) "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."; and

b) add the new clauses, tables, and figures:

i) **"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_{ss} range of 0–1.9%, and a 500 year design characteristic surface movement return (ys) of 22 mm, or

(b) Moderately 'M', having an I_{ss} range of 2.0–3.7% and a 500 year design characteristic surface movement return (y_s) 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:

1. 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 Δu = 1.2 pF, Hs = 1.5 m, and a crack depth of 0.5 Hs

d. The I_{ss} (shrink swell index) ranges attributed to the expansivity classifications as defined in Paragraph 2.3.8.2 b) have been calculated using the parameters presented in BSR120A and Equation 2.3.1 of AS 2870.

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.

2. 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

Forming part of the modifications to NZS 3604 for Clause 7.5.13.3.1

Expansive soil class	Slightly 'S'	Moderately 'M'	Highly 'H'	Extremely 'E'
Soil embedment (D_e)	375 mm	525 mm	575 mm	625 mm
Top steel (A_S top)	2/D16	2/D16	2/D16	2/D16
Bottom steel (A_s bottom)	1/D16	1/D25	1/D20	1/D25
Stirrups	R6/125 crs.	R6/125 crs.	R6/300 crs.	R6/300 crs.
Maximum spacings of internal thickenings	No internal thickening	No internal thickening	2.5 m crs.	2.5 m crs.
Depth of thickening (D1)	–	–	400 mm	450 mm
Base width (B1)	–	–	300 mm	350 mm
Top steel (A_S top)	–	–	2/D20	2/D20
Bottom steel (A_s bottom)	–	–	2/D16	2/D20
Stirrups	–	–	R6/150 crs.	R6/150 crs.

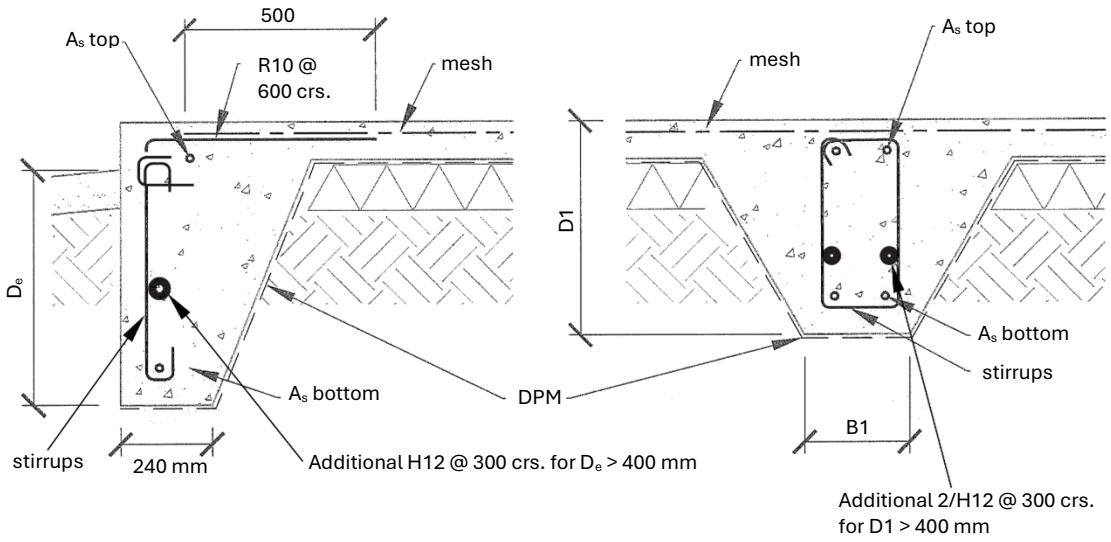
Table 7.4B: Reinforced concrete foundations in expansive soils for medium wall and heavy wall claddings

Forming part of the modifications to NZS 3604 for Clause 7.5.13.3.1

Expansive soil class	Slightly 'S'	Moderately 'M'	Highly 'H'	Extremely 'E'
Soil embedment (D_e)	500 mm	550 mm	775 mm	800 mm
Top steel (A_S top)	2/D16	2/D20	2/D20	3/D20
Bottom steel (A_s bottom)	2/D16	2/D16	2/D20	2/D20
Stirrups	R6/125 crs.	R6/250 crs.	R6/300 crs.	R6/300 crs.
Maximum spacings of internal thickenings	–	2.5 m crs.	2.5 m crs.	2.5 m crs.
Depth of thickening (D1)	–	350 mm	450 mm	500 mm
Base width (B1)	–	300 mm	300 mm	350 mm
Top steel (A_S top)	–	2/D16	3/D20	3/D20
Bottom steel (A_s bottom)	–	2/D16	2/D16	2/D20
Stirrups	–	R6/125 crs.	R6/150 crs.	R6/150 crs.

Figure 7.2.2: Reinforced concrete foundations in expansive soils for light wall claddings

Forming part of the modifications to NZS 3604 for Clause 7.5.13.3.1

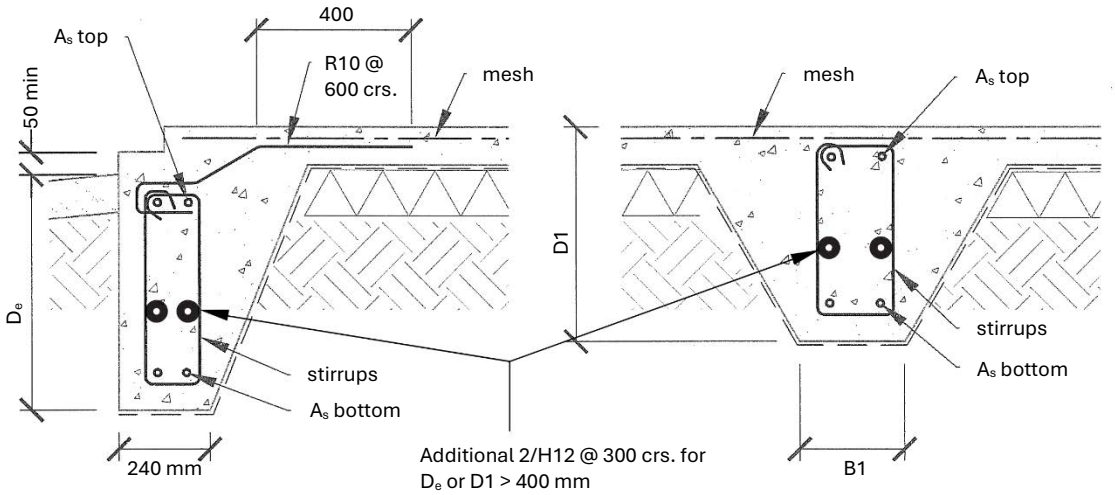


External footing Internal thickening

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

Forming part of the modifications to NZS 3604 for Clause 7.5.13.3.1



External footing Internal thickening

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.

2.4 Earth buildings

2.4.1 Earth walled buildings

2.4.1.1 Earth *buildings* shall comply with NZS 4299 subject to the modifications in Subsections 2.4.1, 2.4.2, and 2.4.3.

2.4.2 Definitions

2.4.2.1 In NZS 4299 Clause1.3 Definitions, add in the definition for Good Ground: “liquefaction, lateral spread,” after “subsidence” in subclause (c).

2.4.3 Earthquake zones

2.4.3.1 In 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.”

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

2.4.4 Concrete slab-on-ground floors

2.4.4.1 In NZS 4299, replace Clause 4.8.6 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 Acceptable Solution B1/AS1 Section 2.3.”

Part 3. Individual building elements

3.1 Solid plastering

3.1.1 Stucco

3.1.1.1 Stucco shall comply with NZS 4251.1.

3.2 Drains

3.2.1 Buried pipelines

3.2.1.1 *Drains* shall comply with:

a) AS/NZS 2566.1 for the structural design of buried flexible pipelines; and/or

b) AS/NZS 2566.2 for the installation of buried flexible pipelines; and/or

c) AS/NZS 2032 for the installation of PVC pipe systems; and/or

d) AS/NZS 2033 for the installation of polyethylene pipe systems.

3.3 Glazing

3.3.1 Glazing in buildings

3.3.1.1 Glazing shall comply with Paragraph 4.4.1.4 of the Building Product Specifications.

3.3.1.2 To determine the minimum glass thickness for vertical and sloped overhead glazing, glazing shall comply with NZS 4223.4.

Appendix A. References

For the purposes of Building Code compliance, the standards and documents referenced in this acceptable solution must be the editions, along with their specific amendments, listed below.

Standards New Zealand		Where quoted
NZS 1170.5:2004	Structural design actions – Part 5: Earthquake actions – New Zealand	1.2.2.1 Comment
AS/NZS 2032:2006	Installation of PVC pipe systems Amendment 1	3.2.1.1(c)
AS/NZS 2033:2008	Installation of polyethylene pipe systems Amendments 1, 2	3.2.1.1(d)
AS/NZS 2566.1:1998	Buried flexible pipelines – Part 1. Structural design Amendment 1	3.2.1.1(a)
AS/NZS 2566.2:2002	Buried flexible pipelines – Part 2. Installation Amendments 1, 2, 3	3.2.1.1(b)
NZS 3604:2011	Timber framed buildings	1.2.2.1 Comment, 2.3.1.1, 2.3.2.1, 2.3.3.1, 2.3.4.1, 2.3.6.1, 2.3.6.2, 2.3.6.3, 2.3.7.1, 2.3.7.2, 2.3.7.3, 2.3.7.4, 2.3.7.5. 2.3.7.6, 2.3.8.1, 2.3.8.2
NZS 4223.4:2008	Glazing in buildings – Part 4. Window, dead, snow, and live actions, Amendment 1	3.3.1.2
NZS 4229:2013	Concrete masonry buildings not requiring specific engineering design	1.2.2.1 Comment, 2.1.1.1, 2.1.2.1, 2.1.3.1
NZS 4251.1:2007	Solid plastering – Part 1. Cement plasters for walls, ceilings and soffits	3.1.1.1
NZS 4299:1998	Earth buildings not requiring specific design Amendment 1	1.2.2.1 Comment, 2.4.1.1, 2.4.2.1, 2.4.3.1, 2.4.3.2, 2.4.4.1
NZS 4402.2.2:1986	Methods of testing soils for civil engineering purposes – Test 2.2: Soil classification tests – Determination of liquid limit	1.2.1.1(b), Definitions
NZS 4402.2.6:1986	Methods of testing soils for civil engineering purposes – Test 2.6: Soil classification tests – Determination of the linear shrinkage	1.2.1.1(b), Definitions
NZS 4431:1989	Code of practice for earth fill for residential development	2.3.8.2
AS/NZS 4671:2019	Steel for the reinforcement of concrete	2.1.2.1, 2.3.2.1

These standards can be accessed from www.standards.govt.nz.

References

Standards Australia		**Where quoted**
AS 2870:2011	Residential slabs and footings	2.3.8.2, 2.3.8.1 Comment

This standard can be accessed from www.standards.org.au.

The National Association of Steel Framed Housing Inc. (NASH)	**Where quoted**
NASH Standard Part 2:May 2019 Light Steel Framed Buildings	2.2.1.1

This standard can be accessed from www.nashnz.org.nz.

BRANZ		**Where quoted**
BRANZ Study Report 120A:2008	Soil expansivity in the Auckland region	2.3.8.2 Comment

This document can be accessed from http://www.branz.co.nz.

Appendix B. Definitions

These definitions are specific to this acceptable solution. Other defined terms italicised within the definitions are provided in clause A2 of the Building Code.

Term	Definition
Boundary joist	A joist running along the outer ends of the floor joists.
Building	Has the meaning given 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 breast	The front *fireplace* wall *construction* above the *fireplace* opening.
Chimney jambs	The side walls of a *fireplace*.
Construct	In relation to a *building*, includes to design, build, erect, prefabricate, and relocate the *building*; and construction has a corresponding meaning.
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 forced 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.
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; and 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

Definitions

Term	Definition
	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.
Non-combustible	Material that meets the criteria for a non-combustible material in Section 8.1 of the Building Product Specifications.
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.

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