BUILDING PERFORMANCE

B1

B1 Structure

Acceptable Solution B1/AS3

Small chimneys

SECOND EDITION | EFFECTIVE 28 JULY 2025

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

Preface

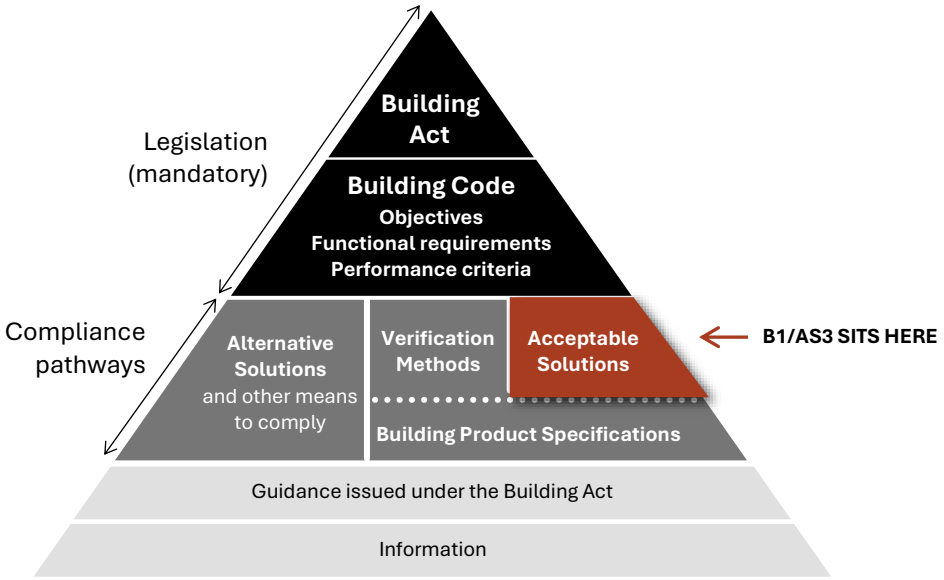
Document status

This document (B1/AS3) 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/AS3 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

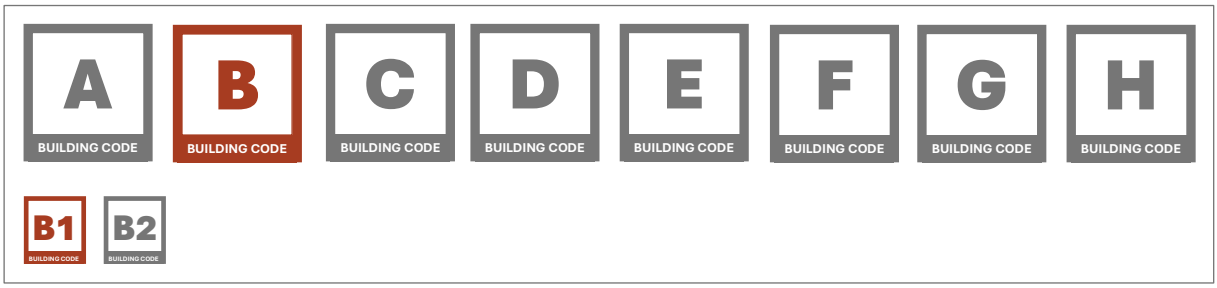
Each acceptable solution outlines the provisions of the Building Code that it relates to. Complying with an acceptable solution or verification method are ways of complying with that part of the Building Code. Other options for establishing compliance are listed in section 19 of the Building Act.

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/AS3. 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.
- Additional information on the document and its scope has been provided in Part 1. General.
- The acceptable solution now refers to the Building Product Specifications for pumice concrete units in Paragraph 2.2.3.2, reinforcing steel in Paragraph 2.2.5.1, hot dip galvanising in Paragraph 2.2.6.1, zinc coating of restraint components in Paragraph 2.5.1.2, and in the definition of non-combustible materials. More information on the Building Product Specifications is provided in Subsection 1.2.2.
- 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.

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 applies to small *chimneys* and to supporting *hearth* slabs for solid fuel burning domestic appliances.

1.1.2 Items outside the scope of this document

1.1.2.1 This acceptable solution does not include the necessary provisions to prevent the outbreak of *fire*. It is to be read in conjunction with Acceptable Solution C/AS1, Acceptable Solution C/AS2, or Verification Method C/VM1.

1.1.2.2 Depending on the particular installation, different *hearth* dimensions may be necessary to meet the requirements in Building Code clause C2 Prevention of fire occurring.

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.

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: 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.

1.2.2 Building Product Specifications

1.2.2.1 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

General

1.2.2.2 The Building Product Specifications cannot be used in isolation to demonstrate compliance with any requirements of the Building Code. To comply with B1/AS3, *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. Chimney construction

2.1 Overview

2.1.1 Type

2.1.1.1 This part contains *construction* requirements for small *chimneys* that are:

a) built of brickwork, concrete or precast pumice concrete; and

b) connected to timber frame complying with NZS 3604 or masonry *buildings* that comply with NZS 4229.

2.1.1.2 This includes requirements for:

a) materials used in *chimneys* in Section 2.2; and

b) foundations in Section 2.3; and

c) reinforcement of specific elements in Section 2.4,

d) *chimney* restraints in Section 2.5, and

e) systems to resist horizontal earthquake loadings in Section 2.6.

2.1.2 Height

2.1.2.1 The height of any *chimney* measured from the top of the *chimney* foundation slab to the top of the *chimney* stack shall not exceed 9 m. *Chimneys* shall not cantilever more than 2.4 m above the fixing at roof level (refer to Section 2.5).

2.1.3 Size

2.1.3.1 The width (measured along the *building* line) and depth (measured perpendicular to the *building* line) shall not exceed:

a) for the foundation and *chimney base*:

i) with precast pumice concrete: 1600 mm wide x 1050 mm deep, and

ii) with brickwork or concrete: 1200 mm wide x 1050 mm deep; and

b) for the *chimney* stack:

i) with a brick *chimney* with a single skin (see Figure 2): 500 mm wide x 500 mm deep, and

ii) with a brick *chimney* with a double skin (see Figure 3): 1200 mm wide x 680 mm deep; and

iii) with a concrete or precast pumice concrete: 1200 mm wide x 700 mm deep.

2.1.4 Chimney liners

2.1.4.1 Where *chimney* liners are used, they shall be separated from the *chimney* to ensure free thermal movement by:

a) coating the liner with a suitable debonding agent; or

b) wrapping the liner in a *non-combustible* material no less than 0.25 mm thick.

2.1.5 Chimney wall thickness

2.1.5.1 *Chimney* wall thicknesses at the *chimney* stack, *gather* and *chimney* base shall be no less than:

a) for a brick *chimney* with a single skin (see Figure 2.3.1.3A): 155 mm; and

b) for a brick *chimney* with a double skin (see Figure 2.3.1.3B): 245 mm; and

c) for concrete: 170 mm; and

d) for precast pumice concrete: 85 mm.

2.2 Materials

2.2.1 Brickwork

2.2.1.1 Brick *chimney construction* shall conform to the relevant sections of NZS 4210.

2.2.2 Concrete

2.2.2.1 *Chimneys*, foundations, and *hearth* slabs of reinforced concrete shall comply with the relevant clauses of NZS 3109 for ordinary grade concrete.

2.2.3 Pumice concrete units used in precast chimneys

2.2.3.1 Pumice aggregate used in pumice concrete units shall:

a) be free of *combustible* and organic matter, and

b) have a maximum size of 19 mm, where the volume of aggregate retained by a 4.75 mm standard test sieve is between 40% and 60%, and

c) have a mix ratio by volume of no greater than five parts of mixed pumice aggregate to one part of cement.

2.2.3.2 Pumice concrete units shall:

a) have a compressive strength of no less than 7 MPa at 28 days when tested in accordance with Subsection 3.1.1 of the Building Product Specifications; and

b) be air dried after *adequate* curing; and

c) kept under cover during storage and transport, and onsite.

2.2.3.3 When pumice concrete units are laid onsite, they shall:

a) be laid dry (unfinished work should be protected from the rain); and

b) be joined with mortar that complies with NZS 4210; and

c) have ducts filled with grout complying with NZS 4210, except where bars are anchored in the *gather* in accordance with Paragraph 2.4.3.2.

2.2.4 Concrete masonry

2.2.4.1 Concrete masonry *construction* for *chimney* foundation walls shall conform to the relevant sections of NZS 4229.

2.2.5 Reinforcing steel

2.2.5.1 Reinforcing steel used in *chimneys* shall:

a) comply with Subsection 3.2.1 of the Building Product Specifications; and

b) for brick, be embedded centrally in the thickness of the grout; and

c) for in-situ concrete, have cover to the steel in accordance with NZS 3109; and

d) for precast pumice concrete, be placed with grout in the preformed ducts in the units.

2.2.6 Hot dip galvanising

2.2.6.1 Hot dip galvanising shall comply with Paragraph 3.4.1.3 of the Building Product Specifications.

2.3 Foundations

2.3.1 Wall and slab foundations

2.3.1.1 *Chimneys* shall be built on a foundation comprising:

a) walls and slab for suspended floors (see Figure 2.3.1.1(a)); or

b) a thickened slab for ground floor slabs (see Figure 2.3.1.1(b)).

Chimney construction

2.3.1.2 The *chimney* foundation slab shall:

a) be *constructed* of reinforced concrete, as shown in Figure 2.3.1.1, on *good ground*; and

b) have a thickness of no less than 200 mm; and

c) be placed at a depth of no less than 300 mm below surrounding ground level; and

d) have D12 starters at 400 mm maximum centres to match vertical steel locations in the *chimney*.

2.3.1.3 The *chimney* foundation walls shall:

a) be *constructed* with:

i) 150 mm thick reinforced concrete; or

ii) 190 mm thick concrete masonry; or

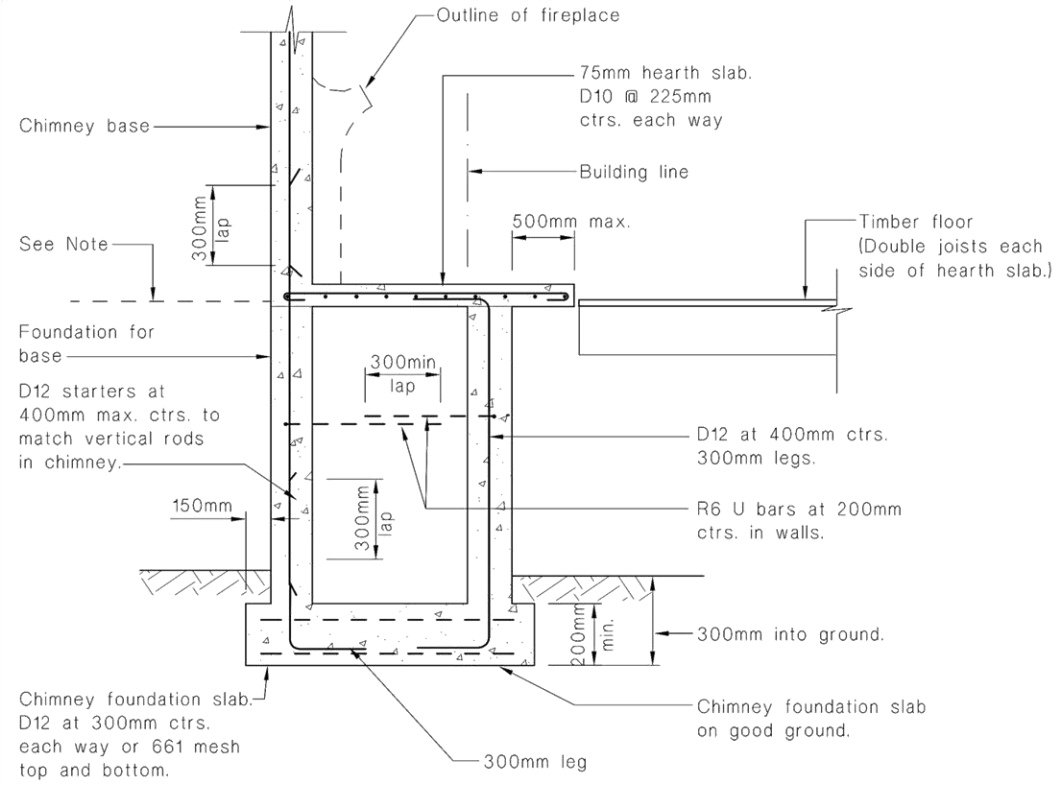
iii) brick in accordance with Figure 2.3.1.3A for a brick *chimney* with liner or Figure 2.3.1.3B for a brick *chimney* without liner, and

b) have vertical and horizontal reinforcing steel as required by Paragraph 2.4.3.1.

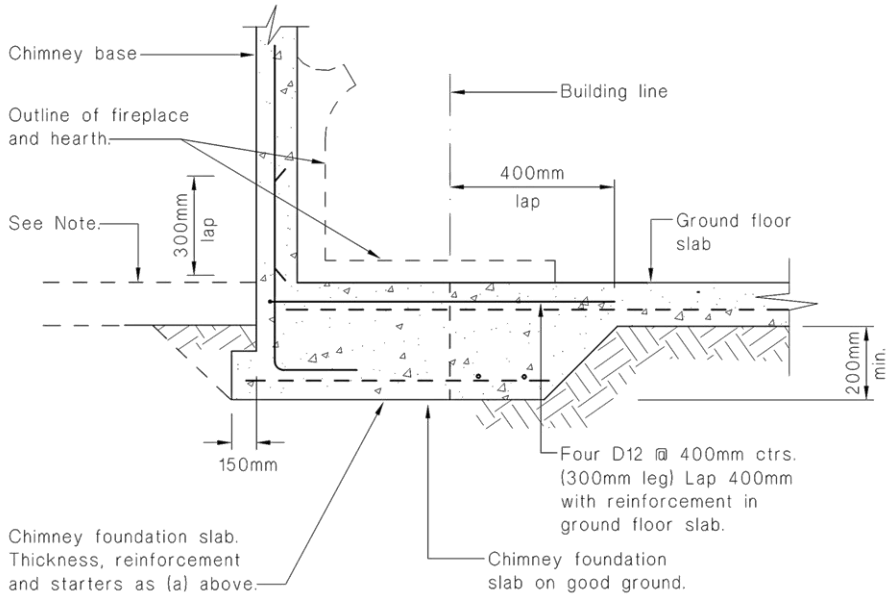
Chimney construction

Figure 2.3.1.1: Chimney foundation

Paragraphs 2.3.1.1(a), 2.3.1.2(a), 2.4.1.1, Figure 2.3.1.3A, Figure 2.3.1.3B, Figure 2.4.3.1A, and Figure 2.4.3.1B



(a) Suspended floor



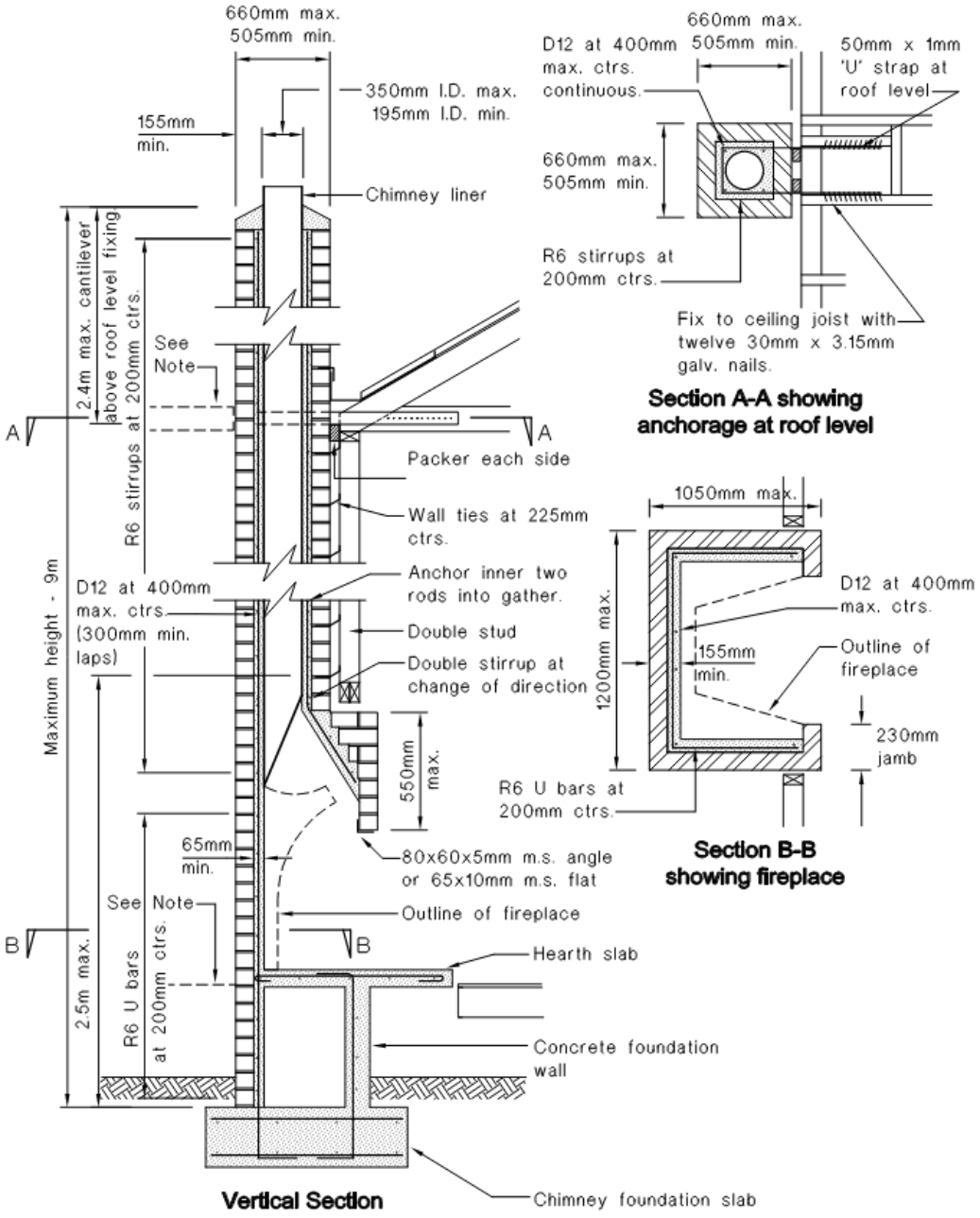
(b) Slab on ground

Note: These figures have been drawn for the *chimney* being exterior to the *building*. For the situation where the *chimney* is internal, the dotted line indicates the timber floor in (a) and the ground floor slab in (b).

Chimney construction

Figure 2.3.1.3A: Brick chimney with liner

Paragraphs 2.1.5.1(a), 2.3.1.3(a)(iii), 2.4.3.1, 2.5.1.3, 2.5.3.3, 2.5.3.4(a)(i), and 2.5.4.3



Notes:

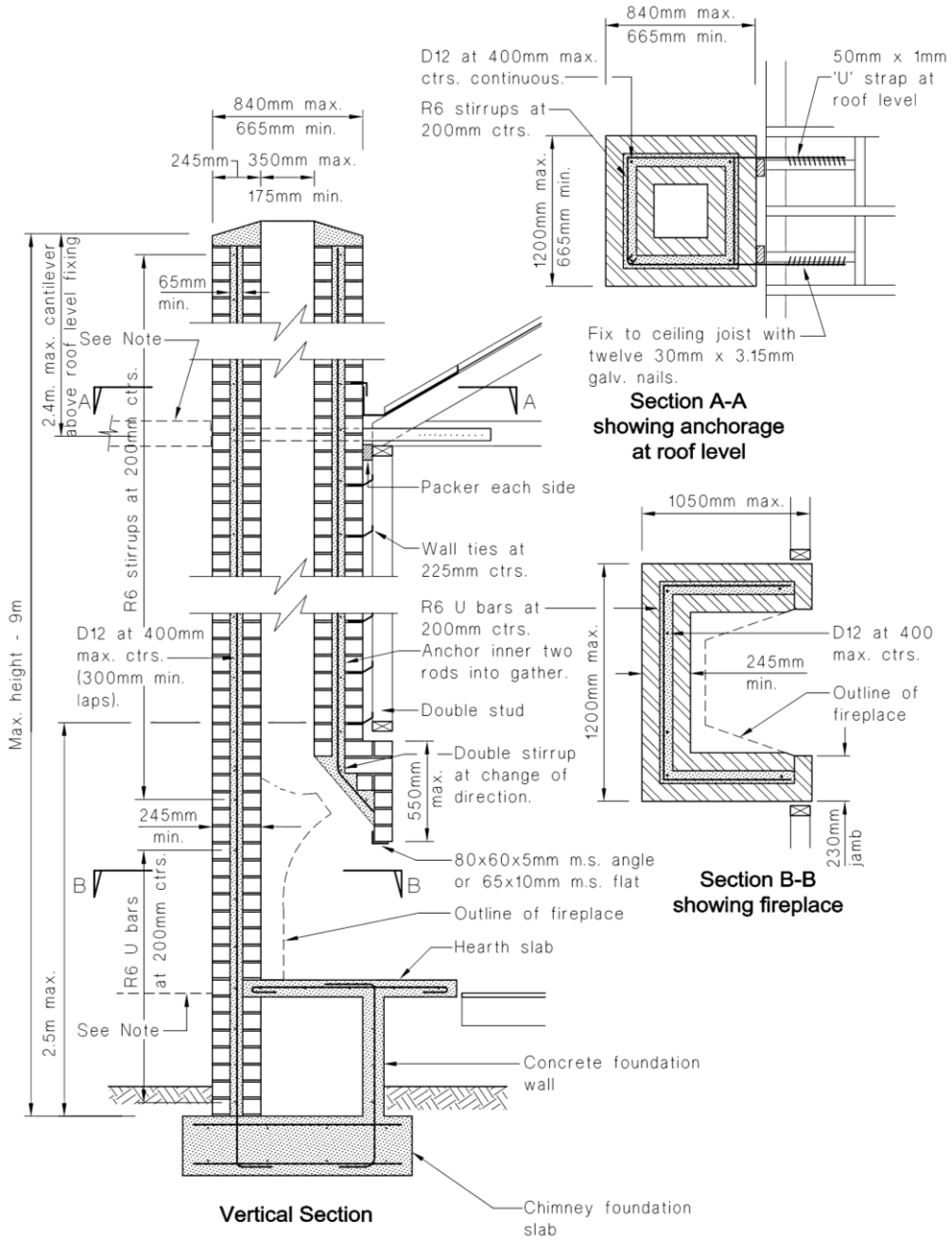
(1) This figure has been drawn for the *chimney* being exterior to the *building*. For the situation where the *chimney* is internal, the dotted line indicates the ceiling joists and floor.

(2) *Flues* must be sized to ensure *adequate* draught. Sizing depends on many factors including the height of the flue but generally *flue* cross-sectional area needs to be minimum of 1/12th of the *fireplace* opening. The *flue* also needs to be sufficiently large to enable cleaning. 195 mm is regarded as a practical minimum diameter.

(3) For *hearth* slabs and foundations, refer to Figure 2.3.1.1. For packers, refer to Paragraph 2.5.1.3. Refer to Subsections 2.5.3 and 2.5.4 for fixing with roof ties and wall ties.

Figure 2.3.1.3B: Brick chimney without liner

Paragraphs 2.1.5.1(b), 2.3.1.3(a)(iii), 2.4.3.1, 2.5.1.3, 2.5.3.3, 2.5.3.4(a)(i), and 2.5.4.3



Notes: (1) This figure has been drawn for the *chimney* being exterior to the *building*. For the situation where the *chimney* is internal, the dotted line indicates the ceiling joists and floor.

(2) *Flues* must be sized to ensure *adequate* draught. Sizing depends on many factors including the height of the flue but generally *flue* cross-sectional area needs to be minimum of 1/12th of the *fireplace* opening. The *flue* also needs to be sufficiently large to enable cleaning. 175 x 175 mm is regarded as a practical minimum size.

(3) For *hearth* slabs and foundations, refer to Figure 2.3.1.1. For packers, refer to Paragraph 2.5.1.3. Refer to Subsections 2.5.3 and 2.5.4 for fixing with roof ties and wall ties.

2.4 Reinforcement of specific elements

2.4.1 Hearths

2.4.1.1 *Hearth* slabs shall be *constructed* of concrete that is:

a) no less than 75 mm thick; and

b) reinforced with D10 bars located centrally at 225 mm centres each way (see Figure 2.3.1.1).

2.4.2 Chimney breasts

2.4.2.1 The widths of openings in *chimney breasts*, and their supporting lintels, shall comply with Table 2.4.2.1.

Table 2.4.2.1: Chimney breast openings and lintels

Paragraph 2.4.2.1 and Figure 2.4.3.1A

Material	Opening width	Lintel reinforcing
Brick	1.0 m maximum	65 x 10 mm mild steel flat bar, or 80 x 60 x 5 mm mild steel angle bar
Concrete	up to 900 mm opening	2 x D10 rods(1)
Concrete	900-1500 mm opening	1 x D12 upper rod(1) 1 x D16 lower rod(1)
Precast pumice	1.0 m maximum	2 x D10 rods(1)

Notes:

(1) Horizontal reinforcing rods to concrete and precast pumice are to be placed one above the other at a spacing of 75 mm and have R6 ties at 150 maximum centres.

2.4.3 Foundation walls, chimney bases, and chimney stacks

2.4.3.1 Foundation walls, *chimney bases* (including the *gathers*) and *chimney* stacks shall be reinforced by (see Figure 2.3.1.3A, Figure 2.3.1.3B, Figure 2.4.3.1A, and Figure 2.4.3.1B):

a) D12 bars at 400 mm maximum centres vertically, where laps in bars shall be no less than 300 mm; and

b) R6 bars at 200 mm centres horizontally in the form of closed stirrups in the stack and U bars elsewhere; and

c) double horizontal reinforcing at any change in direction of the vertical steel (for example, at the *gather*/stack intersection).

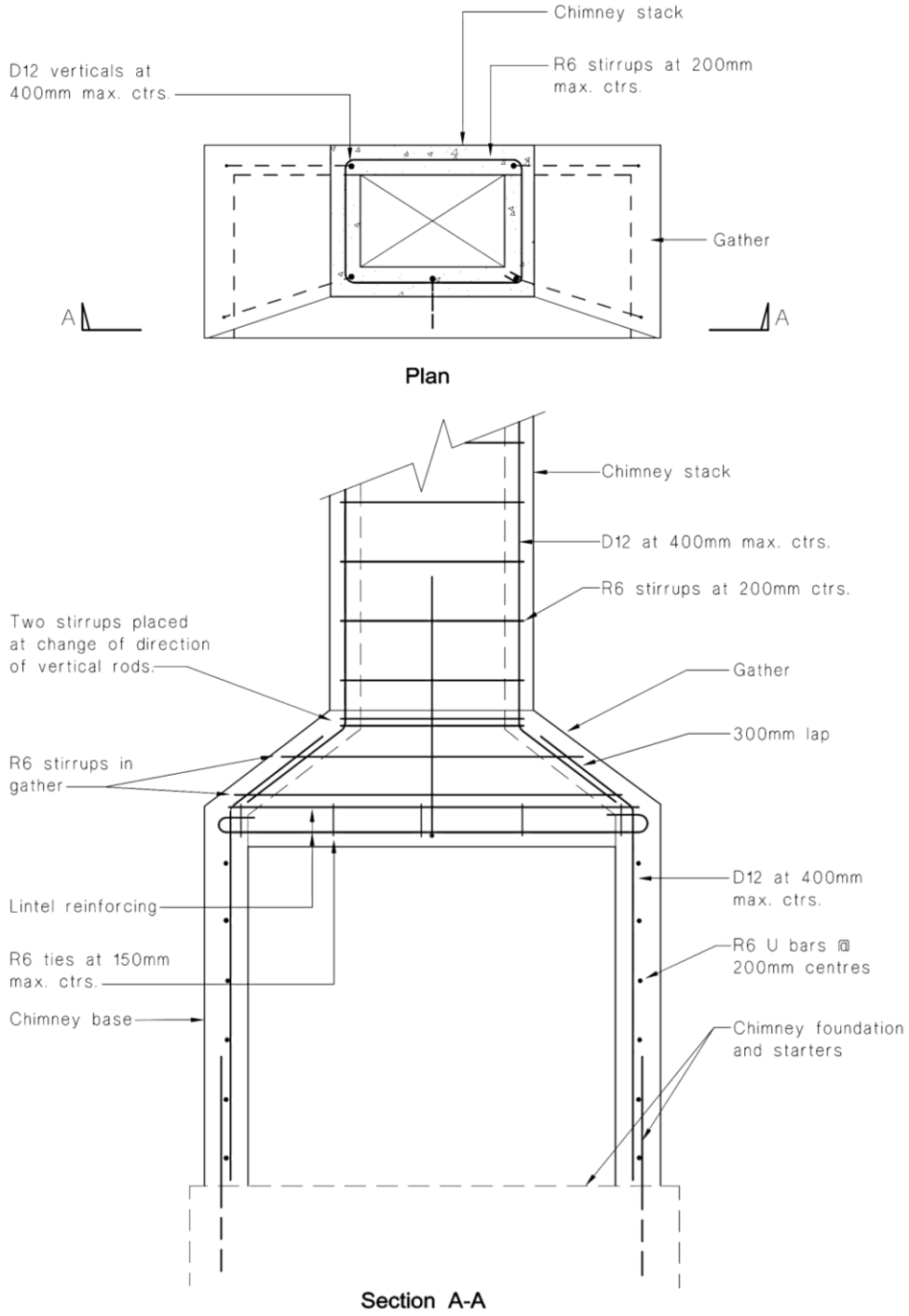
2.4.3.2 Bars that do not extend for the full height of the *chimney* shall be stopped in the *gather*:

a) for reinforced concrete and brick, by continuing these bars through to the far face of the *gather* and terminating with a 200 mm leg; and

b) for precast pumice concrete, by anchoring the last 200 mm of the bar in a non-shrinking cement-based grout that attains a minimum compressive strength of 30 MPa at 7 days (see Figure 2.4.3.1B).

Figure 2.4.3.1A: Reinforcing details for concrete and brick chimneys

Paragraph 2.4.3.1



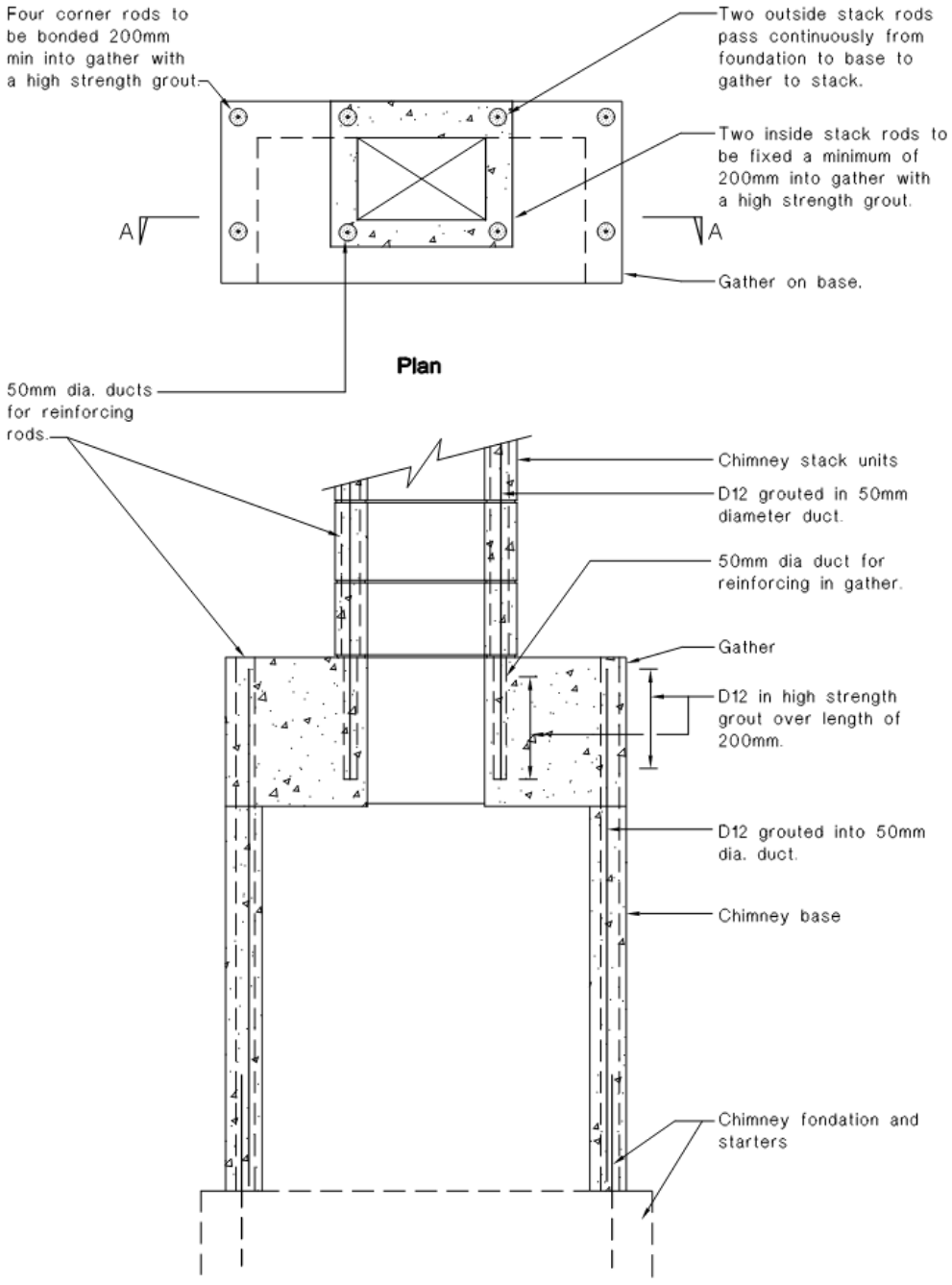
Notes:

(1) This figure has been drawn for a concrete *chimney* but the reinforcing details apply to brick *chimneys* except for the lintel described in Table 2.4.2.1.

(2) For *chimney* foundations, refer to Figure 2.3.1.1.

Figure 2.4.3.1B: Reinforcing details for precast pumice concrete chimney

Paragraphs 2.4.3.1 and 2.4.3.2(b)



Note: (1) For *chimney* foundations, refer to Figure 2.3.1.1.

2.5 Chimney restraints

2.5.1 Restraint methods and packers

2.5.1.1 *Chimneys* that are not *constructed* integrally with the *building* shall be secured by one of the following methods:

a) for brick, concrete or precast pumice concrete *chimneys*, floor and roof brackets in accordance with Subsection 2.5.2, or

b) for brick *chimneys*, a roof tie used in conjunction with closely spaced wall ties in accordance with Subsection 2.5.3, or

c) for precast pumice concrete *chimneys*, a roof tie used in conjunction with closely spaced wall ties in accordance with Subsection 2.5.4.

2.5.1.2 Where zinc coating of restraint components is required, it shall be no less than 300 g/m^2 and comply with Paragraph 3.4.1.2 of the Building Product Specifications.

2.5.1.3 Where a packer (see Figure 2.3.1.3A, Figure 2.3.1.3B, Figure 2.5.2.1, and Figure 2.5.3.6(b)) is shown between the *chimney* and *building*, it shall be:

a) concrete, brick, steel (angle, channel or Z section), or any insulating material that has a long-term operating temperature of no less than 150°C; and

b) secured in place to prevent it dislodging; and

c) capable of withstanding a compressive force of 10 kN without shortening by more than 1.5 mm.

> COMMENT: Acceptable Solution C/AS1 and Acceptable Solution C/AS2 require a 50 mm separation between the *chimney* and any *combustible* material. Where the *chimney* fixing described does not prevent the *chimney* moving within this gap, a packer is shown.

2.5.2 Floor and roof brackets method

2.5.2.1 *Chimneys* shall be restrained by brackets comprised of a 50 mm x 4 mm hot dip galvanised steel strap placed around the *chimney*. Each leg of the strap shall be horizontal and bolted to the joists with three M12 bolts at 75 mm centres as shown in Figure 2.5.2.1.

2.5.2.2 Brackets shall be located so that:

a) the distance between the top of the *chimney* foundation slab and the first bracket does not exceed 3.0 m; and

b) the distance between adjacent brackets does not exceed 3.0 m.

2.5.2.3 Where a *chimney* foundation wall is integral with a *building* foundation wall, the height to the first bracket may be measured from the top of the *building* foundation wall.

2.5.3 Roof tie and closely spaced wall ties method for brick chimneys

2.5.3.1 This method applies only from the *gather* to roof level of brick *chimneys*.

2.5.3.2 Brick *chimneys* shall be restrained at roof level by a strap or reinforcing bar used in conjunction with closely spaced wall ties.

2.5.3.3 The first of the closely spaced wall ties (see Figure 2.3.1.3A and Figure 2.3.1.3B) shall be located no more than 2.5 m below either:

a) the top of the *chimney* foundation slab; or

b) a floor bracket complying with Subsection 2.5.2 and the *chimney* below this bracket shall be fixed by floor brackets spaced in accordance with Subsection 2.5.2.

2.5.3.4 The strap or reinforcing bar shall be:

a) a zinc coated 50 x 1.0 mm mild steel 'U' strap that is:

i) cast into the grout and wraps around the reinforcing steel (see Figure 2.3.1.3A and Figure 2.3.1.3B), and

ii) placed at no more than 20° from the horizontal, and

iii) used in conjunction with a packer (complying with Paragraph 2.5.1.3) placed at the same level, and

iv) fixed with twelve 30 x 3.15 mm galvanised nails to roof or ceiling framing with nails spaced at no less than 35 mm in radiata pine, and 70 mm in other timbers; or

b) any proprietary bracing strip system of equal durability to the strap described in Paragraph 2.5.3.4(a) , and that is capable of carrying a seismic force of 12 kN without elongating by more than 1.5 mm; or

c) a cast-in hot dip galvanised deformed 6.0 mm reinforcing bar bent to a 'U' shape, with each end fixed to the roof or ceiling framing with six 50 x 4.0 mm galvanised fencing staples.

2.5.3.5 The restraint may be wrapped around the outside of the *chimney*, rather than be cast-in. Straps used this way shall be painted with a zinc rich primer.

2.5.3.6 Wall ties (see Figure 2.5.3.6(a)) shall be:

a) *constructed* from:

i) 4 mm diameter galvanised bar, or

ii) 25 x 1.5 mm zinc coated steel strip capable of withstanding a load of 1.2 kN without elongating or shortening by more than 1.5 mm; and

b) used in pairs for *chimneys* wider than 600 mm; and

c) located in mortar joints at 225 mm maximum centres up each side of the *chimney*.

2.5.4 Roof tie and closely spaced wall ties method for precast pumice concrete chimneys

2.5.4.1 This method applies only from the *gather* to roof level of precast pumice concrete *chimneys*.

2.5.4.2 Precast pumice concrete *chimneys* shall be restrained at roof level by a strap or reinforcing bar used in conjunction with closely spaced fixing ties or brackets.

2.5.4.3 The first of the fixing ties or brackets (see Figure 2.3.1.3A and Figure 2.3.1.3B) shall be located no more than 2.5 m below either:

a) the top of the *chimney* foundation slab; or

b) a floor bracket complying with Subsection 2.5.2, where the *chimney* below this bracket shall be fixed by floor brackets spaced in accordance with Subsection 2.5.2.

2.5.4.4 The strap or reinforcing bar shall be a:

a) 50 x 1.0 mm mild steel 'U' strap; or

b) hot dip galvanised deformed 6.0 mm reinforcing bar placed into the grout around the reinforcing steel.

2.5.4.5 Straps and bars shall meet the requirements in Paragraphs 2.5.3.4 and 2.5.3.5.

2.5.4.6 Fixing ties (refer also to Figure 2.5.3.6(b) Option A) shall be:

a) 4 mm galvanised wire hairpins; and

b) located in mortar joints between the units and spaced at no less than:

i) 320 mm centres for stacks up to 600 mm wide, and

ii) no less than 160 mm centres for stacks wider than 600 mm; and

c) hooked behind the reinforcing ducts and secured to the required adjacent double studding with four heavy duty fencing staples.

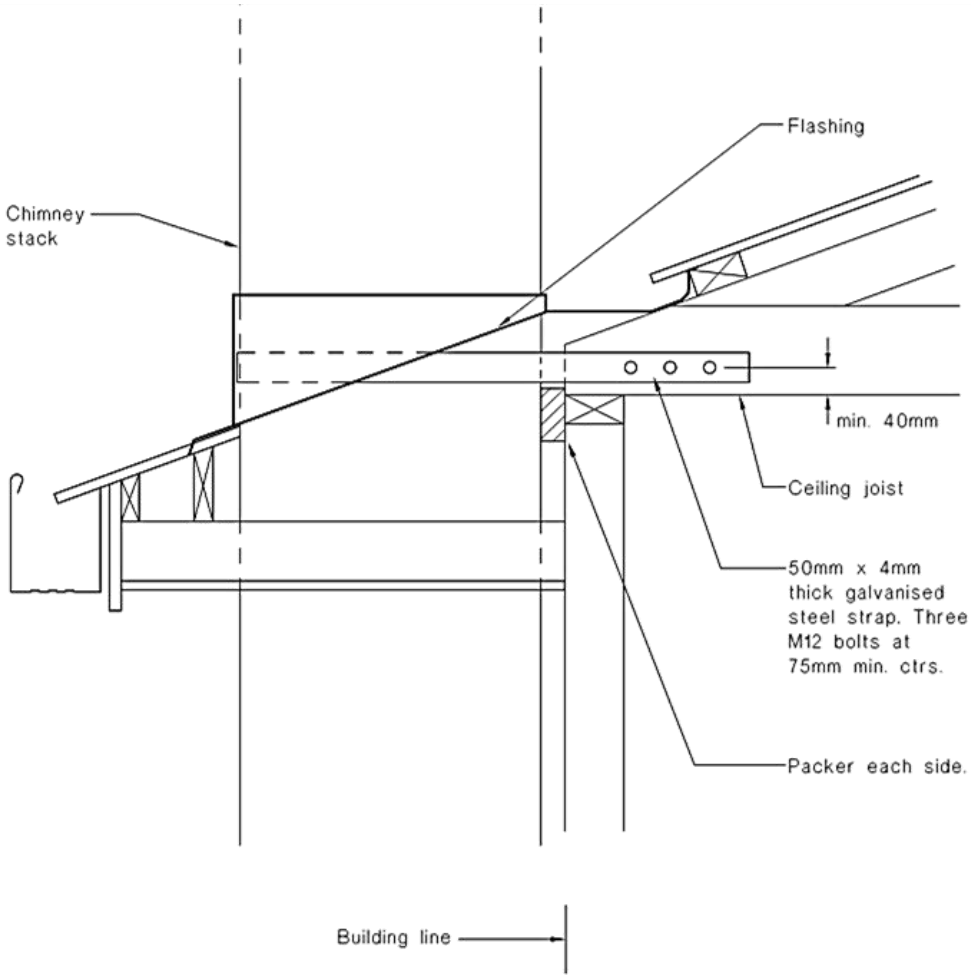
2.5.4.7 Fixing brackets (refer also to Figure 2.5.3.6 (b) Option B) shall be:

a) made from 5.0 mm thick mild steel angle and drilled with:
   i) a 50 mm diameter hole to suit the reinforcing duct location, and
   ii) a 14 mm diameter hole for the 12 mm diameter coach screw fixing to the double stud; and

b) located in mortar joints between the units and spaced at no less than:
   i) 480 mm centres for stacks up to 600 mm wide, and
   ii) 320 mm centres for stacks wider than 600 mm.

Figure 2.5.2.1: Chimney restraint for floor and roof brackets

Paragraphs 2.5.1.3 and 2.5.2.1



Sectional elevation

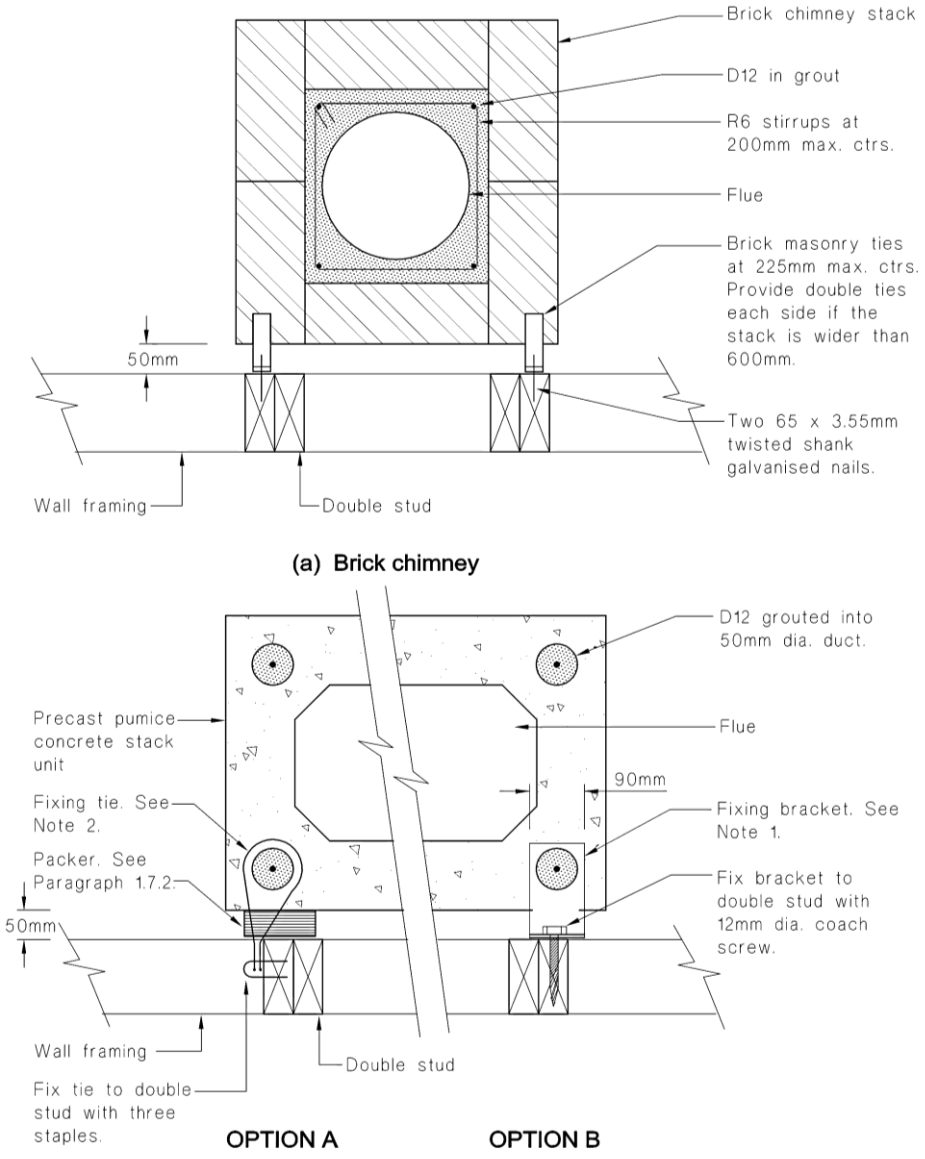
Notes:

(1) This figure is drawn for the roof restraint for a *chimney* on an exterior wall. The bracket details also apply to an interior *chimney*.

(2) For packers, refer to Paragraph 2.5.1.3.

Figure 2.5.3.6: Chimney restraint

Paragraphs 2.5.1.3, 2.5.3.6, 2.5.4.6, and 2.5.4.7



Notes:

(1) Brackets shall be made from 5 mm thick m.s. angle drilled with 500 mm diameter hole to suit the reinforcing duct. Locate brackets in the mortar joints between units at no more than:

(a) 480 mm maximum centres for stacks up to 600 mm wide; and

(b) 320 mm maximum centres for stacks over 600 mm wide.

(2) Ties shall comprise 4 mm galvanised hairpins located in the mortar joint between units at no more than:

(a) 320 mm maximum centres for stacks up to 600 mm wide; and

(b) 160 mm maximum centres for stacks over 600 mm wide.

(3) For packers, refer to Paragraph 2.5.1.3.

2.6 Systems to resist horizontal earthquake loadings

2.6.1 Buildings where earthquake bracing is required

2.6.1.1 Bracing shall be provided in those *buildings* where one or more of the following apply:

a) the area of the room containing the *chimney* exceeds 24 m^2; and

b) the floor area on any level of the *building* for a given chimney type (refer to Table 2.6.2.5 for *chimney* types) is less than:

i) 50 m^2 for *chimney* Type 1, and

ii) 75 m^2 for *chimney* Types 2, 3, and 4, and

iii) 150 m^2 for *chimney* Types 5, 6, and 7; and

c) the distance between supporting braced walls that are perpendicular to the wall where the *chimney* is located either:

i) exceeds 3.5 m, or

ii) exceeds 6.5 m and the wall is supported is at each floor level and the roof or ceiling level by either a structural diaphragm that conforms with the relevant requirements of NZS 3604 or by dragon ties that conform with Paragraph 2.6.1.2.

2.6.1.2 Where dragon ties are used, they shall:

a) consist of a continuous length of 100 x 50 mm timber fixed in accordance with NZS 3604 clauses 8.3.3.3 and 8.3.3.4; and

b) be run as a pair, with one dragon tie going from the wall where the *chimney* is located back to each of the supporting braced walls, and the enclosed angle between the wall where the *chimney* is located and each dragon tie shall be 60°; and

c) be located no more than 1.5 m out from each supporting braced wall.

2.6.2 Bracing requirements to resist horizontal earthquake loadings

2.6.2.1 *Buildings* described in Subsection 2.6.1 shall contain bracing elements to resist earthquake loads from the *chimney*. The bracing elements are additional to those required by NZS 3604 or NZS 4229.

2.6.2.2 Earthquake loads from the *chimney* shall be applied at roof level and at each floor where the *chimney* is connected. A *chimney* shall be considered as connected to the *building* when:

a) at roof level, it is held either by a roof bracket or by a roof tie; and

b) at ground floor level, it is either held by a floor bracket or the *chimney* base is integral with the *building* foundation wall; and

c) at an intermediate floor level, it is held either by a floor bracket or by closely spaced wall ties spanning the floor.

2.6.2.3 For earthquake ground movement in the direction perpendicular to the wall where the *chimney* is located, structural diaphragms shall be provided at roof/ceiling level and at each floor level where the *chimney* is connected. The diaphragms shall comply with all relevant clauses of NZS 3604 and NZS 4229.

2.6.2.4 For earthquake ground movement in the direction parallel to the wall where the *chimney* is located, bracing units are required, where the:

a) number of bracing units is determined in accordance with Paragraph 2.6.2.5; and

b) bracing units shall be provided solely by that wall.

2.6.2.5 The number of bracing units to be provided for each *chimney* connection is given in Table 2.6.2.5, where:

Chimney construction

a) in the *Canterbury earthquake region*, the earthquake bracing units at roof and floor connections shall be determined in accordance with Zone A; and

b) the number of bracing units required at floor connections other than the ground floor shall be taken as 60% of the value given in Table 2.6.2.5; and

c) the number of bracing units to be provided at any level shall be the sum of the bracing units required at each of the *chimney* connections above the level being considered.

COMMENT:

As an example, for a standard precast pumice concrete *chimney* in a two-storey *building* in Zone A that is connected to the *building* by a roof bracket and floor brackets at the ground and first floors, the number of bracing units required are:
a. 60 units just below roof level
b. 60 + (60% of 60) = 96 units just before first floor level
c. 60 + (60% of 60) + 60 = 156 units just below ground floor level.

Table 2.6.2.5: Bracing units required for each chimney connection to resist earthquake loadings

Paragraphs 2.6.1.1, 2.6.2.4(a), and 2.6.2.5

Chimney construction	Type	Maximum size of chimney stack(1)	Bracing units for Zone A(1)	Bracing units for Zone B(1)	Bracing units for Zone C(1)
Precast pumice – standard	1	500 x 400	60	50	40
– large	2a	1200 x 700	210	170	130
Brick chimney	3	500 x 500	90	70	60
– single skin	4	590 x 590	130	100	80
– double skin	5	1200 x 680	240	200	160
Concrete	6	590 x 590	210	170	140
	7	1200 x 700	390	320	260

Note:

(1) The number of bracing units are those required at the roof connection and at each floor connection according to the earthquake zone. The number of bracing units required at floor connections other than the ground floor shall be taken as 60% of the value shown in the table.

Part 3. Solid fuel burning appliances

3.1 Domestic appliances

3.1.1 Chimneys

3.1.1.1 *Chimneys* for solid fuel burning domestic appliances shall comply with:

a) Part 2. Chimney construction; or

b) with the relevant sections of AS/NZS 3869 and AS/NZS 2918 for sheetmetal *chimneys*.

3.1.2 Hearth slab

3.1.2.1 Solid fuel burning domestic appliances weighing no more than 130 kg shall be supported on a hearth slab that is:

a) 65 mm thick and comprised of ordinary grade concrete complying with the relevant clauses of NZS 3109; and

b) reinforced with 665 mesh or D10 rods at 300 mm centres each way placed centrally in the slab thickness; and

c) supported on a timber or concrete floor, or integral with a concrete floor, where the floor shall comply with NZS 3604 or NZS 4229 as appropriate.

3.1.2.2 *Hearth* slabs on a timber floor shall be held in position by supporting members on all four sides of the hearth. Each supporting member shall be held by four screws that:

a) have a minimum shank diameter of 4.88 mm; and

b) penetrate the floor framing by 50 mm.

3.1.2.3 *Hearth* slabs on concrete floors shall be secured in position by four D10 starter rods, which shall:

a) be located in each corner of the *hearth* slab; and

b) terminate at each end with standard hooks complying with NZS 3109.

Appendix A. References

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

Standards New Zealand		**Where quoted**
AS/NZS 2918:2001	Domestic solid fuel burning appliances	3.1.1.1(b)
NZS 3109:1997	Concrete construction Amendments 1 and 2	2.2.2.1, 2.2.5.1, 3.1.2.1(a), 3.1.2.3(b)
NZS 3604:2011	Timber framed buildings	2.1.1.1(b), 2.6.1.1, 2.6.1.2(a) , 2.6.2.1, 2.6.2.3, 3.1.2.1
AS/NZS 3869:1999	Domestic solid fuel burning appliances – Design and construction	3.1.1.1(b)
NZS 4210:2001	Code of practice for masonry construction: materials and workmanship, Amendment 1	2.2.1.1, 2.2.3.3
NZS 4229:2013	Concrete masonry buildings not requiring specific engineering design	2.1.1.1(b), 2.1.4.1, 2.6.2.1, 2.6.2.3, 3.1.2.1(c)
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

These standards can be accessed from www.standards.govt.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
Adequate	Adequate to achieve the objectives of the Building Code.
Building	Has the meaning given to it by sections 8 and 9 of the Building Act 2004.
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*.
Combustible	Material that is neither *non-combustible* nor *limited combustible*.
Construct	In relation to a *building*, includes to design, build, erect, prefabricate, and relocate the *building*; and construction has a corresponding meaning.
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.
Fire	The state of combustion during which flammable materials burn producing heat, toxic gases, or smoke or flame or any combination of these.
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.
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; 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.

Definitions

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

BUILDING PERFORMANCE

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