BRANZ

# BULLETIN

ISSUE 557

# TIMBER-FRAMED GARAGES

February 2013

- This bulletin is a design guide primarily for stand-alone timber framed garages constructed over a concrete slab on ground, built to NZS 3604:2011 *Timber-framed buildings* and not intended for use as a habitable space.
- The design of proprietary garages is outside the scope of this bulletin, but a number of its recommendations may be applied to their design.
- This bulletin updates and replaces Bulletin 395 of the same name.

# 1.0 INTRODUCTION

**1.0.1** This bulletin is a design guide for one-off stand-alone timber-framed garages constructed on a concrete slab on good ground, built to NZS 3604:2011 *Timber-framed buildings* and not intended for use as a habitable space.

**1.0.2** It updates and replaces Bulletin 395 of the same name.

**1.0.3** Garage constructions not covered by this bulletin are:

- proprietary garage systems, although a number of the recommendations in this bulletin may also be applied to their design
- those built from masonry in accordance with NZS 4229:1999 *Concrete masonry buildings not requiring specific engineering design*
- those requiring specific engineering design in accordance with AS/NZS 1170 *Structural design actions*, such as those with suspended timber floors supported on poles or piles
- garages where one or more walls are used to retain soil
- where the weight of the vehicles exceeds 2500 kg tare (unladen weight) – refer to AS/NZS 1170
- those that are steel-framed
- those with a post-laid concrete floor or a soil floor.

## 1.1 NEW ZEALAND BUILDING CODE

**1.1.1** All building work must comply with the performance requirements of the New Zealand Building Code (NZBC). As garages are not intended for use as a habitable space, BRANZ believes the mandatory Building Code requirements applying to their construction are to ensure:

- structural adequacy
- protection of neighbouring property
- durability.

**1.1.2** For timber-framed stand-alone garages on a concrete slab on ground, NZS 3604:2011 *Timber-framed buildings*, as modified by Amendment 11 to NZBC compliance document B1/AS1, is an Acceptable Solution to the Code's structural requirements. (Clause 1.1.2 and Table 1.1 in the standard identify free-standing garages as being within its scope.)

**1.1.3** Where a garage might be converted to a habitable space in the future, it must comply with the requirements of the NZBC for means of escape from fire, protection of other property, sanitary facilities and structural and fire-rating behaviour. BRANZ also recommends that it is able to meet the additional requirements of NZBC clauses E1, E2, E3, G4, G5, G7, G8 and H1.

# 2.0 GENERAL REQUIREMENTS

## 2.1 CONSENTS

**2.1.1** Building consent must be obtained before construction of a building. A resource consent will also be required if the proposed garage does not comply with the requirements of the district plan (relating to, for example, site coverage and closeness to boundaries). Consent applications must accurately show (using clear and detailed plans and specifications):

- the location of the planned garage and all other buildings on the site
- the location of boundaries
- the size and appearance (plans and elevations) of the garage, including ground
- levels and floor levels
- how the garage is to be constructed (cross-sections, footing details)
- bracing calculations
- accurate identification of the materials being used, their location in the building and, where necessary, evidence of their durability – simply stating 'long-run roofing' is insufficient detail, as the building consent authority (BCA) needs to know the material, its finish and the profile so that they can determine its compliance with the performance requirements of the NZBC
- stormwater drains and connections
- fire-resistant construction to be adopted for garages closer than 1 m to a legal boundary (some BCAs may have details available where fire resistance construction is required)
- location of existing drains and any other underground service(s) near the garage site.

## 2.2 NON-SPECIFIC STRUCTURAL DESIGN

**2.2.1** NZS 3604:2011 is deemed to comply with the performance requirements of NZBC clause B1 *Structure* – section 3.2 details the B1/AS1 modifications to NZS 3604:2011 foundation details.

**2.2.2** Key factors to be considered in the structural design of timber-framed garages include:

- provision of bracing to prevent damage from wind and/or earthquake
- preventing uplift damage from wind
- adequate soil bearing capacity.

## 2.3 SPECIFIC ENGINEERING DESIGN

**2.3.1** Specific engineering design of a garage may be required for:

- the wall incorporating the vehicle access door(s) if it falls outside the scope of NZS 3604 and requires specific design to ensure the lateral stability of the structure is maintained
- suspended timber-framed floors for garages, as they are outside the scope of NZS 3604
- suspended concrete floors
- garages with foundation wall heights over 2 m or those with a retaining wall
- lifting beams and their supports to ensure the structure can accommodate the loadings – the design calculations must be included with the building consent application
- portal frame design to the wall incorporating the vehicle access.

## 2.4 DURABILITY

**2.4.1** The minimum durability requirements of NZBC applying to garages are:

- not less than 50 years for structure
- not less than 15 years for claddings.

## 2.5 SIZES

**2.5.1** Under NZS 3604:2011, the maximum size of a free-standing garage with no internal walls is limited by the maximum permitted spacing of bracing lines, which gives a garage dimension of 6 x 7.5 m. Within that footprint, make allowance for the following:

- Territorial authority requirements relevant to vehicle access, garage siting, vehicle manoeuvrability, site coverage limitations and minimum garage size.
- Vehicle size and weight. Table 1 gives some data on average car sizes. For new garages, obtain accurate figures for the car being garaged, particularly with larger vehicles, as there is a wide range of sizes. For property resale value, allow for at least a 2–2.5 litre vehicle.
- Minimum dimensions to allow for driver and passenger access and general access around the vehicle. The width between the car and the garage side walls can be:
  - 450 mm where no access to the passenger door is required
  - 600 mm minimum for most people where access to the door is required – allow 800 mm minimum for cars where access to a back seat is via the front door, because the doors are wider
  - 950–1000 mm to allow the doors of a four-door car to open fully
  - 1150–1200 mm to allow the front door of a two or three-door car to fully open (where access to the back seat is through the front door)
  - for wheelchair access, a minimum of 1200 mm and preferably 1300 mm between the side of the car and the wall
  - 760 mm clear space in front of the car to allow access to the engine for regular engine maintenance.
- Space at the back of the car to allow access to the boot/hatch.
- Accessories such as tow bars, roof racks and towing mirrors, which increase the overall width, length or height of the vehicle.
- Location of the pedestrian access door to the garage.
- Doorway height (the height available after the door has been fitted – some tilting doors reduce the clearance height under the lintel or door head by 150 mm) and internal clear height (floor to ceiling joist or truss bottom chord). For example, light vans and four-wheel drive wagons are taller than cars. Always specify a higher rather than a lower door to allow for future changes of vehicle or the use of the garage for a caravan, boat or motorhome.
- Doorway width, to allow sufficient manoeuvring space and clearances for vehicle(s) to easily enter and exit without complicated manoeuvring and to lower the risk of the vehicle touching the door jamb. For single-vehicle garages, the door should be at least 500 mm wider than the vehicle (including the mirrors) but not less than 2400 mm wide. For garages that accommodate two or more vehicles, there should be a clearance of 250 mm between the car mirror and the closest jamb.
- Workshop or storage space. A bench across the end of a garage is normally 600–700 mm wide. If the intention is to work at the bench without removing the car, allow at least 760 mm between the end of the car and the bench.
- Type of door. For example, a door that projects past the front of the garage when opening may not be permitted where a garage is built up to the edge of the footpath boundary.

TABLE 1: VEHICLE SIZES AND WEIGHTS (2500 KG MAXIMUM)

| Vehicle description | Typical length (mm) | Typical width (mm) | Typical height (mm) | Typical deadweight (kg) |
|---|---|---|---|---|
| Car – 1000 cc max | 3500 | 1625 | 1400–1500 | 750 |
| Car – 1300 cc max | 3900 | 1650 | 1400–1500 | 950 |
| Car – 1600 cc max | 4300 | 1700 | 1400–1500 | 1100 |
| Car – 2000 cc max | 4700 | 1750 | 1400–1500 | 1200 |
| Car – 2500 cc max | 4800 | 1760 | 1400–1500 | 1400 |
| Car – 3000 cc max | 4900 | 1775 | 1400–1500 | 1550 |
| Car – 4000 cc max | 5100 | 1800 | 1400–1500 | 1650 |
| Car > 4000 cc | 5300 | 1800 | 1400–1500 | 2500 |
| Utility – single cab | 5000 | 1690 | 1600 | 1400 |
| Utility – double cab | 5000 | 1690 | 1600 | 1525 |
| Utility – 4WD | 5000 | 1690 | 1800 | 1650 |
| Van SWB | 4500 | 1780 | 2000 | 1400 |
| Van LWB | 5000 | 1780 | 2000 | 1800 |
| Van 4WD | 4500 | 1780 | 2100 | 1600 |
| 4WD wagon SWB | 3800 | 1750 | 1900–2100 | 2000 |
| 4WD wagon LWB | 5100 | 1750 | 1900–2100 | 2500 |
| Motorhome | 5000–8000 | 2300–2400 | 3500–3880 (4250 max permitted height) | 2000–6000 kg depending on size (6000 kg maximum weight that can be driven on car licence) |
| Caravan | 3500–9000 | 2300–2400 | 2600 | Up to 2800 |
| 2-tonne light truck | 5500–6000 | 2400 | 2100–2200 | 2500 |

### 2.6 FLOOR DESIGN LOADS

**2.6.1** Concrete floor slabs designed to the requirements of NZS 3604 section 7.5 as modified by B1/AS1 Amendment 11 (see 3.2) are suitable for garages accommodating vehicles of up to 2500 kg tare.

## 3.0 FLOOR CONSTRUCTION

**3.0.1** For garages designed to NZS 3604, section 7.5 of the standard (as modified by Amendment 11 to B1/AS1) sets out the construction requirements.

### 3.1 FLOOR SLABS

**3.1.1** Concrete slabs on ground must meet the following requirements:

- Be reinforced and have the slab reinforcing tied in to the foundation wall reinforcing.
- Incorporate a damp-proof membrane (DPM) under the concrete slab. Damp proofing of new concrete slabs is best carried out as for a standard house slab, with the polyethylene DPM or proprietary concrete underlay laid over sand blinding (nominal minimum thickness of 5 mm or a maximum thickness of 25 mm) before the slab is laid. Joints should be taped and the DPM protected from damage during the placing of reinforcing and concreting.
- Have the finished floor level at least 100 mm above the highest adjacent ground level. This should be high enough to prevent groundwater flowing into the garage. BRANZ believes that 100 mm is sufficient for garages, but it will not comply with the NZBC should the garage be converted to a habitable space, and it is less than the minimum clearances to ground required for certain cladding materials. (Check with the manufacturer to ensure that their product can be used where the clearance is less than that given in E2/AS1.) While E2/AS1 does not include detached garages within its scope, it does allow a minimum level change between the interior and the exterior paving of attached garages of 50 mm at the vehicle access doorway.
- Have a minimum specified concrete strength for the in-use environment in accordance with NZS 3604.
- Have concrete well vibrated and free of voids and cavities, as these are potential weak spots when the floor is loaded.
- Have a minimum slab thickness of 100 mm.
- Be specifically designed where vehicles heavier than 2.5 tonnes are to be housed.
- Be laid over a minimum of 75 mm thick (maximum permitted 600 mm) well compacted hardfill. When over 150 mm thick, compact in 150 mm maximum layers using a vibrating plate compactor.

### 3.2 FOUNDATIONS

**3.2.1** The most common garage floor option is a concrete slab on ground incorporating a thickened edge to the slab, but in situ concrete or concrete masonry foundation walls can be used. Reinforcing and minimum widths for perimeter foundation walls are given in Table 2. Foundations must also:

- be taken down to a depth of 200 mm minimum or to good ground, whichever is greater
- have provision made for fixing down the bottom plate (cast-in bolts or proprietary post-fixed anchors in accordance with NZS 3604 clause 7.5.12)
- for thickened edge slabs, have the damp proofing terminated as shown in Figure1.

TABLE 2: FOUNDATION WALL REINFORCING AND MINIMUM WIDTHS

| | | Timber frame | Masonry veneer |
|---|---|---|---|
| Foundation wall | | 1 or 2 storeys | 1 or 2 storeys |
| In situ concrete | Reinforcing | 3 x D12 | 3 x D12 |
| | Width | 200 mm | 240 mm |
| Concrete masonry (20 series) | Reinforcing | 3 x D12 | 3 x D12 |
| | Width | 240 mm | 240 mm |

**3.2.2** The detail in Table 2 is based on section 7.5 of NZS 3604 as modified by Amendment 11 to B1/AS1. For further information, consult NZS 3604 and apply the modifications published in B1/AS1 section 3.

**3.2.3** Important changes to concrete slab-on-ground detailing that apply to this bulletin include:

- all slabs are now required to be reinforced with higher ductility grade 500E steel including welded steel mesh
- slab reinforcing must be tied to reinforcing in the perimeter foundation with R10 starter bars at 600 mm centres (Figure 1).

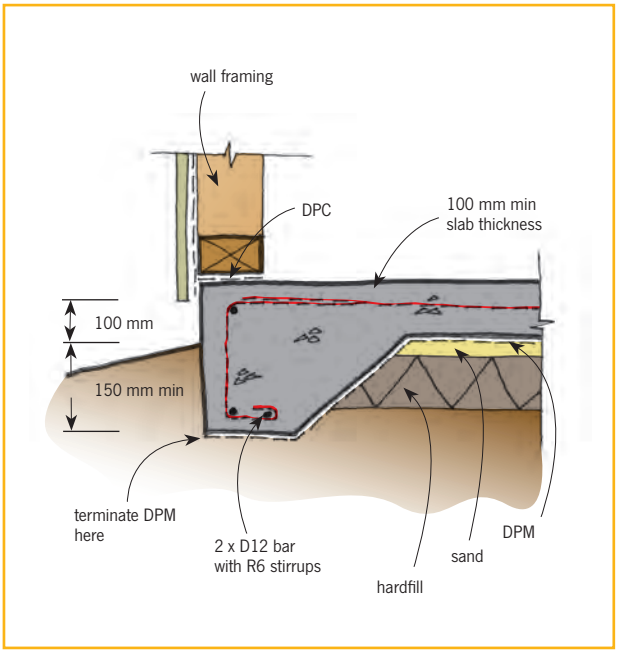


Figure 1. Thickened edge slab

## 4.0 WALL CONSTRUCTION

### 4.1 FRAMED WALLS

**4.1.1** Wall framing sizes and spacing must be selected from NZS 3604 to suit the wall height and wind zone.

**4.1.2** When selecting the size and spacing of wall framing where it is not intended to install interior linings, consider:

- closing up the framing spacing when using lightweight claddings such as plastic or vinyl weatherboards and rusticated timber weatherboards as they have greater deflection under wind loads, which increases the risk of leak paths occurring through the cladding
- the height of the studs (to accommodate taller vehicles) as this may require closing up the stud spacings or increasing stud thickness in high, very high and extra high wind zones
- the roof weight – light (steel) or heavy (clay or concrete tile)
- the type of roof structure, for example, for trusses, it is recommended that studs be located directly under each truss
- the wind forces, particularly when building on exposed sites
- the maximum stud spacing recommended by the cladding manufacturer.

**4.1.3** Fix bottom plates in accordance with NZS 3604 clause 7.5.12 and install a damp-proof course (DPC) under the plate.

## 4.2 BRACING

**4.2.1** Garage structures must be braced in accordance with NZS 3604 to withstand the wind and earthquake forces. Bracing requirements are determined using the calculation methods in section 5 of NZS 3604 for the particular garage site.

**4.2.2** The main area of bracing concern is the wall with the main door opening. Often there is insufficient wall area remaining to allow the installation of an effective amount of conventional bracing. The situation is made worse:

- where an upper storey or part storey is planned
- in high, very high and extra high wind zones
- with heavy wall and/or roof claddings.

**4.2.3** For walls containing the main door, the easiest solution is to make the garage wider so that a narrow bracing element 600 mm or 900 mm wide can be incorporated on one or both sides of the doorway. Narrow bracing elements can be constructed from any sheet bracing material for which there are verified bracing values (in bracing units) when used in a wall less than 900 mm long. Where there is insufficient wall length to obtain enough bracing, a specifically designed solution such as a plywood or steel portal is required.

**4.2.4** Ways to reduce the bracing demand on the main door wall:

- Use a ceiling or roof diaphragm of plywood, gypsum-based sheet material, other wood-based products (such as hardboard or particleboard) or fibre-cement products in accordance with NZS 3604 section 13, which contains the minimum thickness and density requirements for each material.
- In the absence of a ceiling diaphragm and where bracing lines exceed 6 m centres, install dragon ties diagonally across the top plates at the corners of the building, particularly in double garages. This provides additional stiffness to the garage door wall and assists in transferring bracing load to the remainder of the structure.
- In situations where the density of the ceiling lining material is less than 600 kg/m$^3$ (for example, softboard sheet), installation of an additional 140 x 35 mm top plate strengthening member is required.

**4.2.5** Dog-leg or cut-in bracing is not an acceptable method of bracing.

**4.2.6** For other walls (as garages are often not lined), bracing to meet the calculated number of bracing units must be provided by:

- claddings such as plywood or fibre-cement that have been tested and rated according to their bracing value
- sheet material bracing (that has been tested and rated) installed either behind the cladding or to the inside of the framing for claddings that do not provide any bracing, such as weatherboard, planks or board and batten.

**4.2.7** Obtain the amount of bracing provided for a given wall length from the material manufacturer.

## 4.3 DOOR LINTELS

**4.3.1** The sizes of lintels over garage doorways are given in Tables 8.8–8.13 of NZS 3604. The table used depends on the loads the lintel is carrying. Specific design is required for spans outside the limits of the tables.

**4.3.2** Connections at the end of the lintel must be designed to resist uplift by having mild steel straps installed at floor and lintel level (Figure 2), as required by Table 8.14.

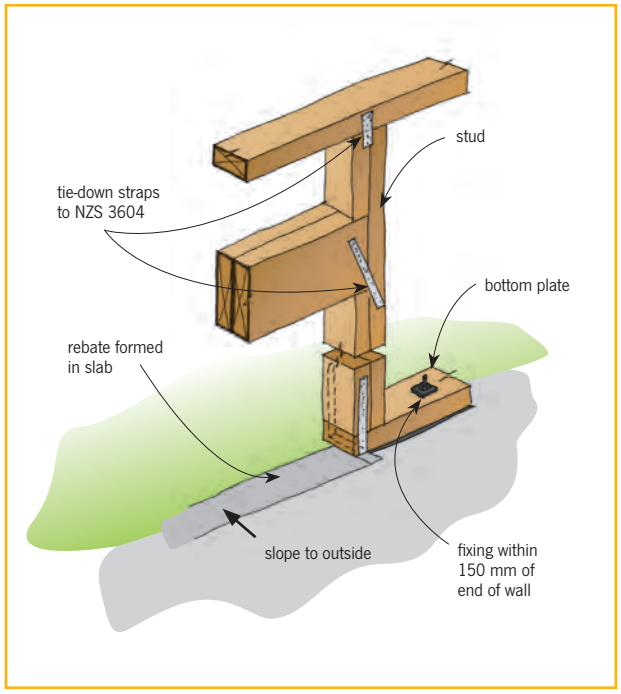


Figure 2 Fixing lintels to prevent uplift

**4.3.3** For non-loadbearing walls, such as a gable end wall of a garage with a trussed roof, a lintel is not required, but the wall must be supported to prevent it deflecting under wind loads. Anchoring options are:

- ensuring the wall is securely fixed to the bottom chord of the truss and either:
  - installing dragon ties to transfer the loads to the side walls, or
  - bracing the wall to a ceiling diaphragm
- installing a lintel sized from Table 8.9 of NZS 3604
- adding a stiffening member to the bottom chord or top plate.

### 4.4 FIRE RATING OF BOUNDARY WALLS

**4.4.1** Walls of garages that are on or within 1 metre of the property boundary generally require a fire resistance rating (FRR) to prevent a fire within the garage spreading to the adjacent property. The level of protection required by the NZBC is usually 30/30/30 if the roof can collapse in the event of a fire or 60/60/60 if it is not likely to collapse.

**4.4.2** To meet the requirements of NZBC clause C6 *Structural stability*, garage walls must be designed to fall inwards, away from the adjacent property, when collapse conditions are reached.

**4.4.3** A fire resistance rating can be provided by:

- constructing the boundary wall from concrete masonry
- for timber-framed construction, using fire-resistant sheet materials.

**4.4.4** Some manufacturers of fire-resistant products and proprietary garages have standard designs available for fire-rated boundary walls of garages.

**4.4.5** For garage walls closer than 1 metre to the boundary, the external cladding needs to meet ignitability requirements (timber claddings will not meet these requirements), and window areas and door locations within these walls must be specifically designed.

## 5.0 ROOF CONSTRUCTION

**5.0.1** Rafter sizes and their fixing types are given in Table 10.1 of NZS 3604.

**5.0.2** Trusses must be specifically designed to suit the span, roof pitch and roof weight. Truss details must be included with the building consent application. The fixings for a roof truss at its support must be provided by the truss fabricator but must not be less than that required by Tables 10.14 and 10.15 and Figure 10.21 of NZS 3604.

## 6.0 WALL CLADDINGS

### 6.1 CLADDING TYPES

**6.1.1** Although outbuildings such as stand-alone garages and other unlined structures are outside the scope of E2/AS1, the cladding types in E2/AS1 can be used on garages.

**6.1.2** For pre-finished coil-coated metal claddings (and garage doors), ensure the grade of cladding chosen is suitable for the environment. Refer to NZS 3604 section 4 for exposure zone classification, and consult product manufacturers' technical literature.

**6.1.3** Areas of cladding under the eaves and areas of metal doors sheltered by the head of the door are often not regularly rain washed. These should be washed down at a maximum of 6-monthly intervals.

**6.1.4** Where garages have a masonry veneer cladding, for example, to match an adjacent dwelling, a foundation complying with NZS 3604 or to a specific design is required. Drainage/vent openings must be provided at the base and top of the veneer, and the veneer must be tied to the structure according to NZS 4210:2001 *Masonry construction: Materials and workmanship* and E2/AS1.

### 6.2 WALL UNDERLAY

**6.2.1** Installing a wall underlay behind the wall cladding is recommended. E2/AS1 Table 23 and NZS 2295:2006 *Pliable, permeable building underlays* set out the properties of roof and wall underlays that vary according to the type of cladding material.

**6.2.2** Aluminium foil must not be used behind the cladding for any reason.

### 6.3 DETAILING AROUND THE MAIN GARAGE DOOR

**6.3.1** Provide a water trap to stop water blowing under the door by stopping the slab at the door or putting a 20–25 mm rebate in the floor for the door to close into (Figure 3). Slope the trap to the outside to drain any water that gets under the door.

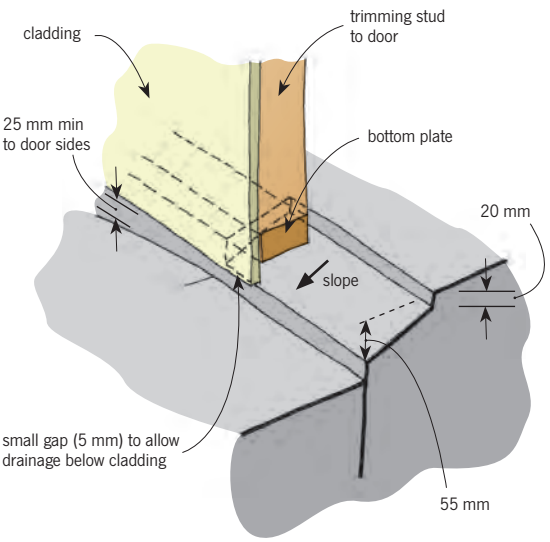


Figure 3. Door rebate detail

**6.3.2** Where the driveway slopes down to the garage, install a drain across the front of the garage to intercept surface water, as a water trap will not provide a sufficient barrier.

### 6.4 WINDOWS

**6.4.1** Garage windows must be detailed to keep out the weather. Actual details vary with the cladding and window type, but all windows should have a head flashing unless butted and sealed to a soffit lining.

## 7.0 ROOF CLADDINGS

### 7.1 CLADDING TYPES

**7.1.1** As with wall claddings, there are a wide range of roof claddings to choose from. The weight of the cladding will have an impact on the bracing required.

### 7.2 ROOFING UNDERLAY

**7.2.1** Roofing underlay is required under all forms of metal roofing to absorb any condensation and prevent it dripping on items in the garage. It is also advisable under clay or concrete tiles to reduce the airflow between the tiles and therefore reduce the risk of leaking. (See E2/AS1 Table 23 and NZS 2295 for specific roof underlay requirements.)

**7.2.2** Roofing underlay is either:
- type R1 (See NZS 2295), fully supported with a corrosion resistant material, or
- type R2, self-supporting and laid to a maximum 1.2 metre span between supports – see E2/AS1 clause 8.1.5.1 for further detail.

## 8.0 FURTHER READING


**BRANZ publications**
*Good Practice Guide Concrete Slabs and Basements* (2nd edition)
*House Building Guide* (3rd edition)

**Ministry of Business, Innovation and Employment Building and Housing website**
New Zealand Building Code Handbook and compliance documents
Compliance document B1/AS1 section 3.0
Compliance document E2/AS1

**Standards New Zealand, Wellington**
NZS 2295:2006 *Pliable, permeable building underlays*
NZS 3603:1993 *Timber structures standard*
NZS 3604:2011 *Timber-framed buildings*
NZS 4210:2001 *Masonry construction: Materials and workmanship*
NZS 4229:1999 *Concrete masonry buildings not requiring specific engineering design*
AS/NZS 1170 *Structural design actions*

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