BRANZ

build

Supplement

The RIGHT STUFF

Timber decks

Claymark Premium Decking

Claymark Premium decking is manufactured using the specifically milled Radiata Pine timber that is treated to H3.2. Our decking is of an extremely high grade and has a superb planer finish Make sure you demand Claymark Premium decking for your next decking project!

Sizes available:

- 100 x 25mm
- 100 x 40mm
- 150 x 40mm
- Griptread or smooth planer finish

Available at your nearest Carters store

www.claymark.com

claymark®
new zealand
INGRAINED PRECISION™

build
BRANZ
Supplement

The RIGHT STUFF

Timber decks

ISSN: 0110 4381
www.branz.co.nz

GENUINE MAHOGANY DECKING
SUSTAINABLY GROWN!

YOU HAVE OUR WORD ON IT.

Now you can specify hardwood decking with a clear conscience. Because Pinnacle Timber are now supplying timber merchants and retailers throughout New Zealand with sustainably-managed plantation grown Genuine Mahogany decking.

SUSTAINABLE	non-diminishing (unlike most other hardwoods)
AFFORDABLE	costs no more than most other hardwood decking
DURABLE	treated and seasoned for maximum durability
BEAUTIFUL	it's real Mahogany
AVAILABLE	natural or pre-oiled
FINISHED SIZES	140 x 21mm or 90 x 21mm

To find a stockist of genuine mahogany decking in your area contact us directly:
sales@pinnacletimber.co.nz or **phone 09 299 7714**, for more information visit **www.pinnacletimber.co.nz**

ANOTHER SUSTAINABLE PRODUCT FROM

PINNACLE
QUALITY WOOD PRODUCTS

1 Introduction

NEW ZEALAND HOUSES OFTEN HAVE EXTERNAL TIMBER DECKS AND BALCONIES TO ALLOW FOR THE MUCH-DESIRED INDOOR-OUTDOOR FLOW.

THIS COMPILATION OF ARTICLES from *Build* magazine provides comprehensive advice on the design and construction of external, open, slatted supported, cantilevered and free-standing timber decks and balconies, in accordance with NZS 3604:2011 *Timber-framed buildings*.

Included are the:

- legislative requirements
- design of foundations, subfloor framing and bracing
- materials, fixings and fastenings required
- safety barrier requirements.

This information should be read in conjunction with NZS 3604:2011.

The information applies to open, slatted timber decks and balconies for single-unit dwellings only. It does not apply to common or shared areas of apartment buildings, and it does not include waterproof roof decks such as those above a habitable space.

2 Building Code and standards

ANY DECK OR BALCONY 1.5 M OR MORE ABOVE CLEARED GROUND LEVEL REQUIRES A BUILDING CONSENT. HOWEVER, EVEN IF A BUILDING CONSENT IS NOT REQUIRED, CONSTRUCTION MUST STILL COMPLY WITH NEW ZEALAND BUILDING CODE REQUIREMENTS.

Building Code requirements

New Zealand Building Code clauses that apply to open, slatted timber deck and balcony construction are:

- B1 *Structure*
- B2 *Durability*
- D1 *Access routes*
- E2 *External moisture* (waterproofing to the building envelope)
- F2 *Hazardous building materials* (glass barriers)
- F4 *Safety from falling*.

NZS 3604:2011 *Timber-framed buildings* provides an Acceptable Solution for the construction of decks and balconies supported from the main part of a building if they are no more than 3.0 m from the lowest part of cleared ground to the upper surface of decking.

The requirements of foundations, subfloor framing, bracing, decking selection, fastenings and fixings are in NZS 3604:2011 section 7.4.

Other relevant standards referenced by the Building Code include:

- AS/NZS 1170 *Structural design actions*
- NZS 3602:2003 *Timber and wood-based products for use in buildings*
- NZS 3603:1993 *Timber structures standard*
- NZS 3604:2011 *Timber-framed buildings*
- NZS 3605:2001 *Timber piles and poles for use in building*
- NZS 3631:1988 *New Zealand timber grading rules*
- NZS 3640:2003 *Chemical preservation of round and sawn timber.*

Building consent

A building consent is required for any deck or balcony that is 1.5 m or more above cleared ground level. The decks can be:

- attached to the building
- cantilevered
- free-standing.

The consent application must identify the Building Code clauses relevant to the proposed deck. It should cover construction aspects such as structure, durability, weathertightness at the intersection of deck and building, access (stairs), slip resistance and safety from falling.

The application also needs drawings, a specification and supporting documents such as manufacturers' data, engineering and design calculations, product appraisals and technical statements or warranties specific to the project.

The drawings should include:

- a site plan showing:
  - site and boundary locations
  - location and size of buildings on the site
  - location and size of the proposed deck
  - location of services
- deck elevations including:
  - height above ground
  - height of barrier (if required)
  - access steps
- a section through the deck
- details of construction including:
  - foundations
  - bracing calculation and selection
  - sizes, spans and fixings of bearers, joists and decking
  - barrier details and calculations
  - stair details (if relevant).

Even if a building consent is not required, construction must still comply with New Zealand Building Code requirements.

3 Timber treatment and fixings

HERE IS A QUICK GUIDE FOR SELECTING TIMBER, FIXINGS AND FASTENINGS FOR VARIOUS PARTS OF A TIMBER DECK.

TIMBER AND THE ASSOCIATED FIXINGS and fastenings for decks require a minimum durability of either 50 or 15 years, and all fixings and fastenings must have the same durability as the elements they connect.

50-year durability applies to structural deck elements that, if they fail, would compromise safety. Posts, bracing, stairs, bearers, floor joists and guard rails must all have 50-year durability.

15-year durability is required for other deck elements including handrails, balustrades and decking.

Timber selection and treatment

Requirements for timber selection for decks, including species, grade, hazard class and preservative treatment, are set out in Tables 1 and 2 of NZS 3602:2003 *Timber and wood-based products for use in building.*

Radiata pine, treated to hazard class H5, is the only timber permitted in ground contact situations, such as for piles and poles.

Where the timber is not in ground contact, hazard class H3.2-treated radiata pine or a range of other timbers, that do not require treatment may be used.

The species, hazard class and location for deck timbers are in Table 1.

Timber preservatives

The most commonly used timber preservatives for hazard classes H3.2 and H5 are waterborne, copper-based treatments, including copper chrome arsenate (CCA), copper quaternary and copper azole. The last two are highly corrosive to steel fixings.

Fixings and fastenings

To determine fixing and fastening protection, open decks are defined as exposed (NZS 3604:2011 Figure 4.3(b)). The durability requirements for metal fixings and fastenings are given in NZS 3604:2011 Tables 4.1 and 4.3, which include some specific requirements:

- Table 4.1 – all steel fixings and fastenings to be type 304 stainless steel minimum.
- Table 4.1 note (3) references paragraph 4.4.4. This requires steel fixings used in timber treated with copper-based preservative (copper quaternary and copper azole) to be a minimum of type 304 stainless steel.
- Table 4.3 note (2) – stainless steel nails must be annular grooved so that they have similar withdrawal resistance to galvanised nails.
- Table 4.3 Note (5) – nails and screws may be hot-dip galvanised except when the timber has been treated with copper quaternary and copper azole. Then type 304 stainless steel must be used.

Table 1

TIMBER SPECIES AND HAZARD CLASS FOR DECKS

DURABILITY	LOCATION	DECK ELEMENT	SPECIES PERMITTED TO BE USED	TIMBER TREATMENT/ HAZARD CLASS	ADDITIONAL CONSIDERATIONS
50 years	Ground contact timber	Piles, poles	Radiata pine	H5	Round and square piles must be in accordance with NZS 3605:2001 *Timber piles and poles for use in building.* Cut and bored surfaces require in situ treatment in accordance with NZS 3640:2003 *Chemical preservation of round and sawn timber*.
	Exposed to exterior weather conditions and dampness but not in ground contact	Posts, bearers, beams, bracing, joists, stairs, guard rails (deck)	Radiata pine	H3.2	
15 years	Exposed to exterior weather conditions and dampness but not in ground contact	Stair handrails, balustrades, unroofed decking (unfinished or with clear, paint or stained finish)	Radiata pine	H3.2	Protective surface coatings, either paint or surface treatment, should be applied in accordance with AS/NZS 2311:2009 G*uide to the painting of buildings* to provide 15-year durability
			Cypress species* (macrocarpa, Mexican cypress, Lawson's cypress)	No treatment	
			Vitex*		
			Kwila grade*		
			Rimu*		
			Eucalyptus (range of species)*		
			Beech (red, silver, hard)*		

*All dressing heart grade

[4] Slatted decking

GROOVED TIMBER BOARDS ARE GENERALLY USED FOR SLATTED DECKING, BUT SUSTAINABLE COMPOSITE MATERIAL IS ALSO AVAILABLE.

NZBC CLAUSE B2 *DURABILITY* requires that decking and associated fixings must have a minimum 15-year durability. Acceptable Solution B2/AS1 cites NZS 3602:2003 *Timber and wood-based products for use in building*, which identifies timber species, grades, levels of treatment and in-service moisture ranges that meet the durability performance requirements.

For 15-year durability, hot-dip galvanised steel nails and screws may be used to fix decking (NZS 3604:2011 Table 4.3), but note 4 states that, where timber has been treated with ACQ or CuAz preservative, type 304 stainless steel or silicon bronze fixings must be used and that stainless steel nails should be annular grooved to provide sufficient withdrawal resistance.

Choice of decking

The most commonly used decking timbers in NZS 3602:2003 are:

- radiata pine
- kwila
- vitex (also known as vasa)
- cypress species (particularly macrocarpa).

Also popular is jarrah, an Australian hardwood with Class 1 durability and a life expectancy of more than 40 years in situations where it is exposed to the weather above ground.

A sustainable alternative is composite decking, sometimes called plastic wood. These are manufactured from recycled plastic (HDPE) and waste timber fibre, which is heated and pressurised then extruded into a decking timber shape.

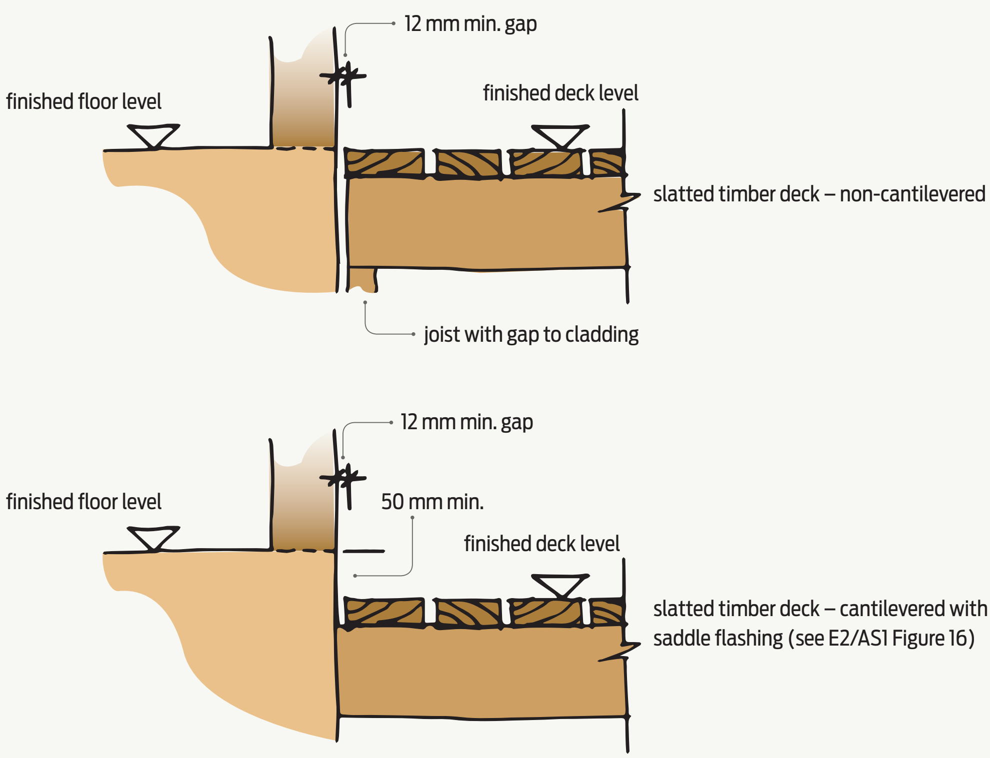


Figure 1 **Finished deck levels.**

Timber grades and treatment

Wet-in-service timber for decking must be SG6 (structural grade) (No. 1 framing in NZS 3603:1993)or SG8 (G8 in NZS 3603:1993) and may be either machine or visually graded (NZS 3604:2011 section 2).

Radiata pine must be treated to hazard class H3.2. Other timber species may not need to be treated if naturally durable. The preservatives for H3.2 treatment are typically waterborne, copper-based preservatives such as copper chrome arsenate (CCA), alkaline copper quaternary (ACQ) and copper azole (CuAz).

Confirm the sustainability

The sustainability of decking timber varies. Check the certification to confirm the sustainability of timber sources (see Table 2).

Composite decking uses recycled materials, so it provides a sustainable alternative to timber decking. It looks like timber but is UV, insect, mildew and moisture resistant, is low maintenance (no rotting, splintering, warping or loss of colour) and comes prefinished so it requires no painting, staining or oiling.

Check the slip resistance

Where a deck is part of the main access route into a building, it must have a slip resistance of not less than 0.4 in accordance with D1/AS1.

Timber decking is typically grooved on one face and smooth on the other. Uncoated, profiled timber has a slip resistance of 0.45–0.6 at 90º to grooves so it meets the requirements of clause D1, while smooth timber only has a slip resistance of 0.2–0.35.

Where the deck is part of the main access into the building, the grooved face must be uppermost and the decking should be laid perpendicular to the direction of the traffic. If a deck is not part of an access route, the smooth side, which is easier to keep clean, may be laid face up.

Step down or gap to deck

The finished level of a slatted, **cantilevered** deck (see Figure 1) must be at least 50 mm below the threshold or internal floor level and the joist penetration through the cladding saddle flashed.

For a non-cantilevered deck, the finished level may be at the same level as the threshold or interior floor level, but a 12 mm gap must be maintained between the exterior wall cladding and the adjacent decking.

Decking sizes

Timber decking boards are typically 90 × 19 mm (ex. 100 × 25 mm) or 90 × 32 mm (ex. 100 × 40 mm) although wider decking is also available.

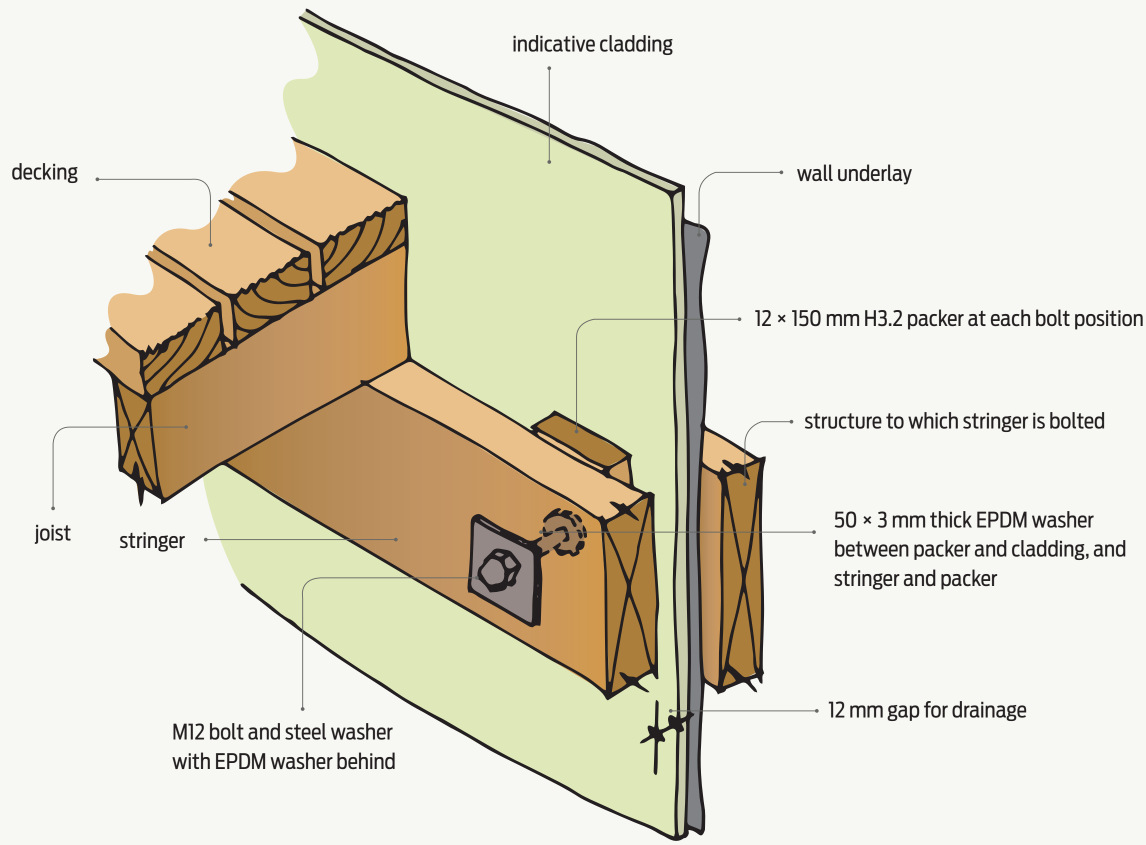


Figure 2 **Connection of deck stringer to cladding – direct-fixed.**

Joist spacings for 19 mm thick boards must be at 450 mm centres maximum and 600 mm centres maximum for 32 mm boards.

Composite decking boards are available in a range of widths and thicknesses similar to timber and in lengths between 4.8 and 5.4 m long, depending on the manufacturer. Joist spacings are in the manufacturer's instructions and are generally between 400 and 450 mm.

Timber decking installation

Install timber decking with:

- a 12 mm minimum gap between the building cladding and decking for drainage and maintenance (E2/AS1 paragraph 7.1.1) (see Figures 2 and 3)
- 3–6 mm gaps between decking timbers lengthways (use appropriate diameter nails as spacers)
- 1–2 mm gaps at butt-jointed ends.

End joints should be butted and must be made over joists. Scarf joints can be used but may leave a sharp edge when the timber shrinks. Sand or arris the ends of the timber to avoid splintering, and when fixing butt joints, skew nails slightly inwards. Joints should be staggered where possible.

NZS 3604:2011 doesn't have a nailing schedule for slatted timber decks. However, it requires sheet decking up to 21 mm thick to be fixed with 60 × 3.06 or 2.8 mm diameter nails, so the same size nails minimum can be used for fixing 19 mm thick boards. BRANZ recommends 75 mm long nails for 32 mm thick timber decking.

Fix decking boards to each joist with two nails. Hand nailing helps pull boards onto the joist. Drive nails flush with the decking – avoid depressions in the timber where water can pool.

Composite decking installation

Install composite decking with:

- a 12 mm minimum gap between the building cladding and the decking for drainage and maintenance
- 5 mm gaps between decking lengthways and at each butt end joint to allow for movement (or according to manufacturer's instructions).

Fixings are generally stated in the manufacturer's instructions.

Range of finishes

Timber decking may be left unfinished or may be protected from weathering and/or UV light by applying:

- deck oil
- timber stain (water or oil-based)
- non-slip paint
- non-pigmented sealer (this does not give UV light protection).

Table 2

QUALITIES AND SUSTAINABILITY OF COMMON DECKING TIMBER

TIMBER	COLOUR	HARDNESS	DURABILITY	STABILITY	SPLINTERING TENDENCY	SUSTAINABLE	OTHER CHARACTERISTICS
Radiata pine (H3.2)	Medium brown	Softwood	Medium	Medium	Some splintering	Yes – NZ sources generally with FSC certification	No leaching
Kwila (dressing heart)	Dark red/ brown	Hardwood	High	High	Low	Limited supplies – check source and obtain certification	Machines and finishes well, bleeds brown stain when first installed
Vitex (dressing heart)	Dark yellow brown, weathers to grey	Hardwood	High	High	Low	Yes – check source and obtain certification	Durable so an excellent decking timber for coastal situations
Macro-carpa (dressing heart)	Light golden brown, weathers to grey	Softwood	Medium	Medium	Low	NZ sources available from shelter belts and plantations	No leaching
Pacific jarrah	Dark red/ brown	Hardwood	High	High	Low	From Western Australian – check source and obtain certification, some recycled available	No leaching or bleeding

Timber decking may also be available with a preapplied finish.

Before applying a finish, check the surface is dry and free from dust, dirt and oil and apply in accordance with the manufacturer's instructions.

Apply stain lengthwise along each board to avoid overlaps that may result in a darker colour at the overlap. Do not apply the stain too thickly as this may also result in uneven colouring.

Do not use natural linseed oil or linseed oil-based finishes on decking timber as the oil facilitates mould and fungi growth.

Storage and handling

If possible, get radiata pine decking timber delivered to site well in advance.

Strip stack the timber off the ground, cover and protect from the weather. A free flow of air around the timber during storage allows it to dry and for initial shrinkage to occur before it is installed.

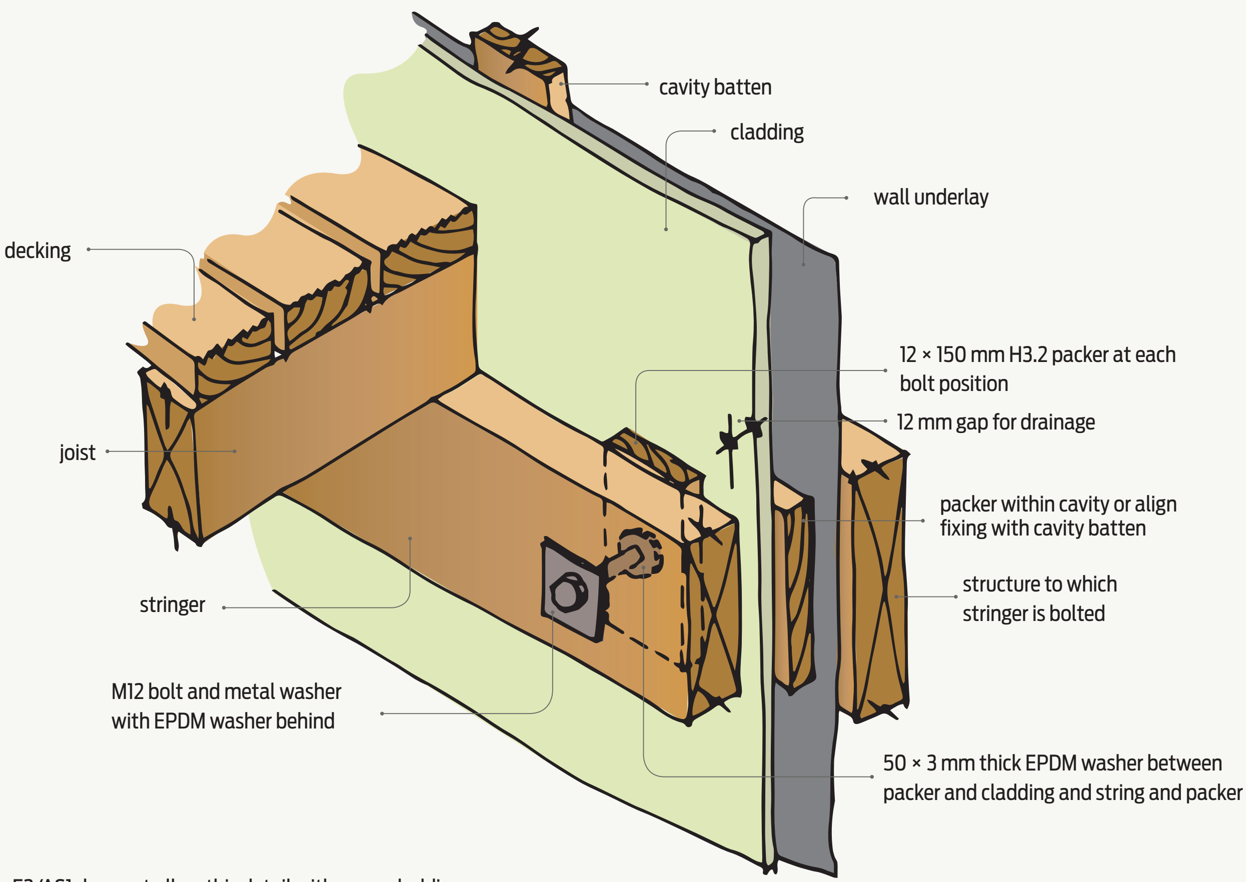
Store composite decking in accordance with the manufacturer's instructions.

Maintenance

Sweep decks regularly to prevent a build-up of dirt and debris, and check the surface of timber decking.

Recoating is likely to be required annually for oils and biennially for stains.

If timber decking has moss or lichen growth, treat with a moss and mould killer to completely remove all growth. Ensure all the treatment is removed before applying a new finish.



Note: E2/AS1 does not allow this detail with some claddings.

Figure 3 **Connection of deck stringer to cladding – cavity.**

[5] Deck bracing design

THE BRANZ HELPLINE IS FREQUENTLY ASKED HOW TO WORK OUT BRACING REQUIREMENTS FOR DECKS. HERE, WE WORK THROUGH THE PROCESS STEP BY STEP.

NZS 3604:2011 *TIMBER-FRAMED BUILDINGS* section 7.4 is the non-specific design standard for timber decks that are supported from the main part of a building and are no more than 3.0 m high from the lowest point of cleared ground to the upper surface of the finished deck. Specific engineering design is required for decks over this height.

Bracing needed if over 2 m from building

Paragraph 7.4.2.1 states that no bracing is required when a deck projects less than 2.0 m from the building and is attached to the building on one or more sides. The bracing provided by the building will satisfy the bracing requirements for the deck.

Decks that project more than 2.0 m from the building must have subfloor bracing (anchor, braced or cantilevered piles) at half the bracing demand required by Table 5.8 for light/light/light cladding, 0° roof slope and subfloor structure (paragraph 7.4.2.2). Decks do not have to be braced for wind.

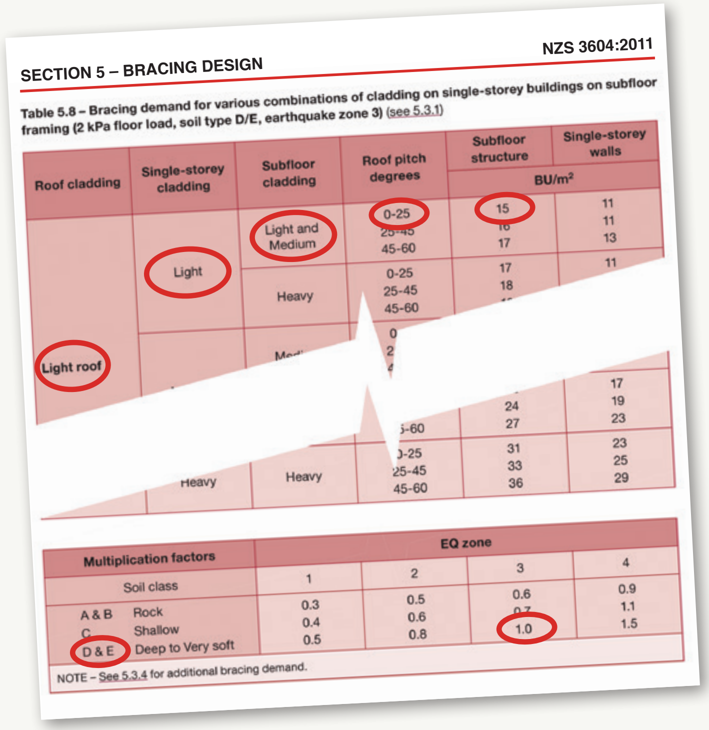
Work it out

Referring to Table 5.8 for light/light/light cladding, 0° roof slope and subfloor structure (circled in Figure 4) and halving this:

15 × 0.5 = 7.5 bracing units per square metre (BU/m²).

The bottom section of Table 5.8 gives the multiplication factor for the appropriate earthquake zone and subsoil classification (paragraph 5.3.1). If no soil classification is available for the site, use soil class E to obtain the multiplication factor.

To work out the bracing demand for a 20 m² deck (say, 5 m wide and projecting 4 m from the building) in earthquake (EQ) zone 3, multiply ➤



SECTION 5 – BRACING DESIGN NZS 3604:2011

Table 5.8 – Bracing demand for various combinations of cladding on single-storey buildings on subfloor framing (2 kPa floor load, soil type D/E, earthquake zone 3) (see 5.3.1)

Roof cladding	Single-storey cladding	Subfloor cladding	Roof pitch degrees	Subfloor structure	Single-storey walls
				BU/m²	
Light roof	Light	Light and Medium	0-25 25-45 45-60	15 16 17	11 11 13
		Heavy	0-25 25-45 45-60	17 18 [illegible]	11 [illegible]
	[illegible]	Med[illegible]	0 2[illegible] 4[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible] [illegible] [illegible]-60	[illegible] 24 27	17 19 23
	Heavy	Heavy	[illegible]-25 25-45 45-60	31 33 36	23 25 29

Multiplication factors		EQ zone			
Soil class		1	2	3	4
A & B	Rock	0.3	0.5	0.6	0.9
C	Shallow	0.4	0.6	0.7	1.1
D & E	Deep to Very soft	0.5	0.8	1.0	1.5

NOTE – See 5.3.4 for additional bracing demand.

Figure 4 **Part of Table 5.8 from NZS 3604:2011 *Timber-framed buildings* is used to work out deck bracing demand. © Standards New Zealand 2011. Reproduced with permission.**

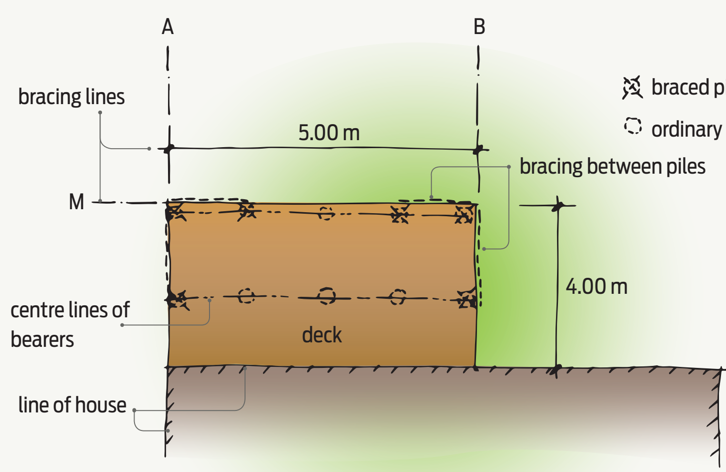


Figure 5 **Plan of deck showing braced piles and bracing lines.**

the bracing units per square metre (7.5) by the multiplication factor from Table 5.8 (1.0) and the area of the deck (20):

7.5 BU/m² × 1.0 × 20 m² = 150 BU.

So the bracing demand for our 20 m² deck is 150 bracing units (see Figure 5).

Distributing bracing units

Next, the bracing units need to be distributed over the deck area. NZS 3604:2011 section 5.5 says:

- bracing lines must be at no more than 5.0 m spacings
- bracing units must, as far as possible, be evenly distributed along lines of bracing.

Bracing lines in perimeter foundation and subfloor framing, or internal lines parallel to these (paragraph 5.5.2.1), require not less than the greater of:

- 100 BUs
- 50% of the total bracing demand divided by the number of bracing lines in the direction being considered (along or across).

External subfloor bracing lines (paragraph 5.5.2.2) require not less than the greater of the two above from paragraph 5.5.2.1 or:

- 15 BUs multiplied by the length in metres of the external wall.

Work it out

In our example, because the bracing lines do not exceed 5 m spacing, bracing is required along external lines only.

What bracing demand is required?

For line A (external line): 50% of the total bracing demand (150/2 = 75) divided by the number of bracing lines (75/2 = 37.5) equals 38 BUs; and 15 × 4 m equals 60 BUs, less than 100 BUs. So line A requires 100 BUs minimum.

For line B (internal line): 50% of the total bracing demand (150/2 = 75) divided by the number of bracing lines (75/2 = 37.5) equals 38 BUs, less than 100 BUs. So line B requires 100 BUs minimum.

For line M: 50% of the total bracing demand (150/2 = 75) divided by the number of bracing lines (75/1 = 75) equals 75 BUs; and 15 × 5 m equals 75 BUs, both less than 100 BUs. But for line M, there is only one bracing line and 150 BUs are required in total, so line M requires 150 BUs minimum.

What bracing to use?

We could use pairs of braced piles at the external corners of the deck along bracing lines A, B and M (see Figure 5). The corner piles will have two braces fixed to the bottom of the piles at right angles to one another.

Bracing lines A and B will provide 120 BUs each (this is more than the minimum 100 BUs required), giving a total of 240 BUs, while bracing line M, with two braces, will also provide 240 BUs (also more than the minimum 150 BUs required).

All other piles could be ordinary timber piles.

Pile and footing design

The subfloor bracing for decks may comprise:

- braced piles (consisting of two piles with 450 mm deep footings and a diagonal brace)
- cantilever piles (see section 6.7 of NZS 3604:2011)
- anchor piles (see section 6.9).

A combination of these pile types may be used. Piles that do not need to meet the bracing demand can be ordinary timber piles.

Pile and pile footing design is in NZS 3604:2011 section 6. General requirements for timber piles are given in section 6.4, including pile sizes (140 mm minimum diameter for round piles, 125 × 125 mm for square piles). They should be treated to hazard class H5.

The maximum permitted height of piles above cleared ground level (CGL) in section 6.4 is:

- ordinary and braced piles – 3.0 m
- cantilever piles – 1.2 m
- anchor piles – 600 mm.

Decks are often built over sloping ground so piles may be relatively tall. Ordinary and braced piles that can be up to 3.0 m high are typically used.

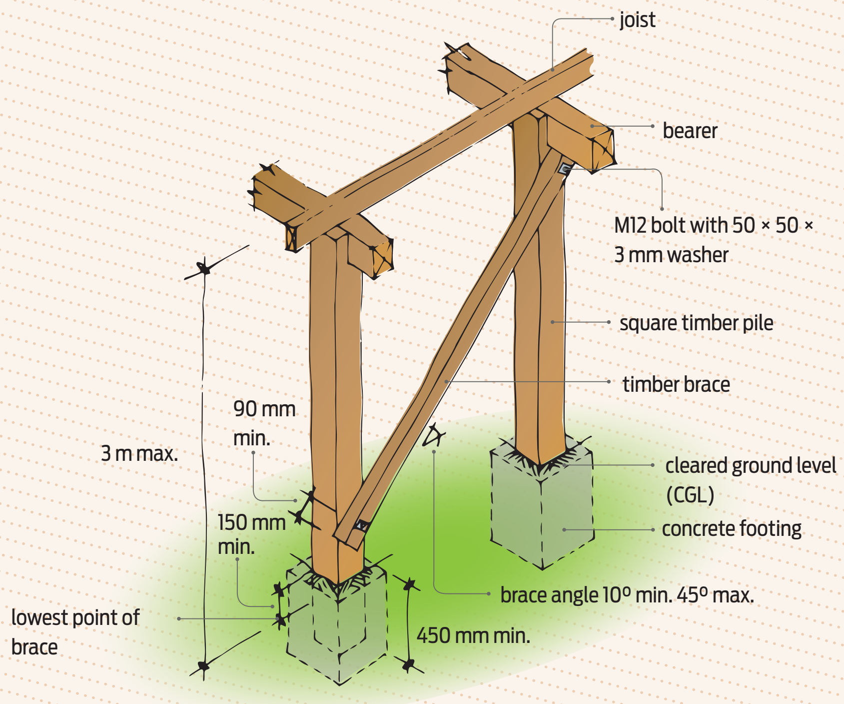


Figure 6 Braced piles.

Ordinary piles

Ordinary pile footings for decks must have a minimum depth of 200 mm and minimum plan dimensions as per Table 6.1 for single storey. Where piles are cast integrally with the footing, there must be at least 100 mm of concrete below the pile.

Braced piles

Braced piles consist of two piles with a diagonal brace between them. Each pile must have at least 450 mm deep footings. The footing size requirements (see Table 6.1) are governed by the bearer and joist spans – minimum plan dimensions are 350 mm square or 400 mm diameter for circular footings, but these may need to be larger as bearer and joist spans increase.

The brace must consist of a single, continuous length of timber fixed to the bottom of one pile and the top of the other pile at an angle between 10–45º to the horizontal (see Figure 6). Alternatively, the top brace fixing may be to a bearer within 200 mm of the other pile or to a joist within 200 mm of the other pile, in which case, the angle may be reduced to 6º to the horizontal.

Brace sizes are either 100 × 75 mm if less than 3.0 m long or 100 × 100 mm if between 3.0–5.0 m long.

Two braces may be fixed at the bottom of a single braced pile, as long as they are fixed at right angles to one another, but only one brace may be attached to the top of a braced pile.

Braces must be connected at both ends to piles with either M12 bolts and 50 × 50 × 3 mm washers or, alternatively, minimum 17 kN capacity fixing in both tension and compression along the brace. These both provide 120 earthquake bracing units per brace. Connection requirements for braces to bearers and joists are given in section 6.8.4.

Anchor piles

Anchor piles must have a minimum footing depth of 900 mm below CGL and a footing size as required in Table 6.1. The minimum plan dimensions are 350 mm square or 400 mm diameter for circular footings. These may need to be larger as bearer and joist spans increase.

The pile tops may be no more than 600 mm above ground level (see Figure 7).

Bearers and joists are fixed with M12 bolts and 50 × 50 × 3 mm washers, 12 mm threaded rods and washers or 12 kN capacity fixings in both tension and compression to provide 120 earthquake bracing units.

Cantilever piles (driven timber)

Cantilever piles are driven timber piles constructed according to section 6.6. They must be driven down to a minimum driving resistance (set out in paragraph 6.6.5) and be not less than 900 mm below CGL in gravel and 1.2 m in other soil types.

Fixing of bearers must be 6 kN capacity in both horizontal directions parallel and perpendicular to the bearer, but this provides only 30 earthquake bracing units per pile.

Driven piles can be used as braced piles.

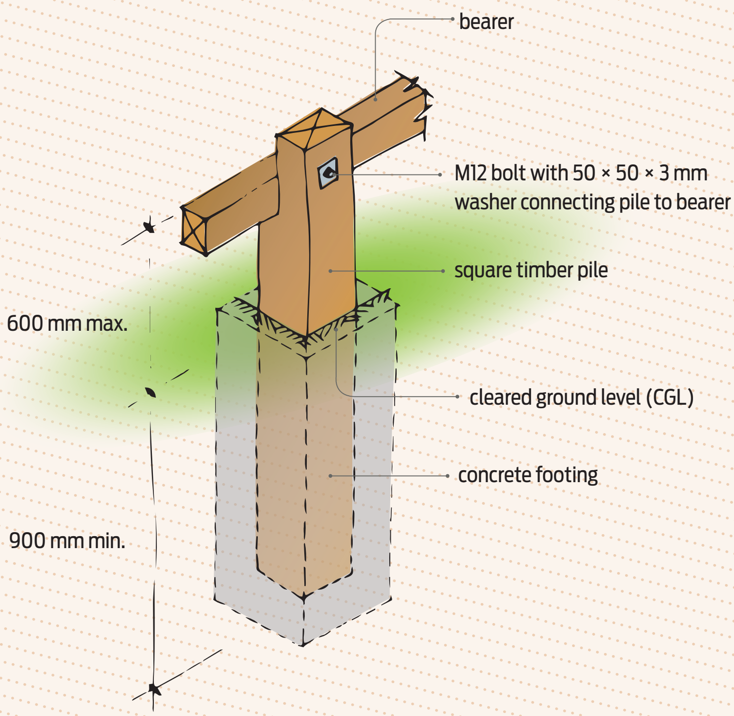


Figure 7 **Anchor pile.**

[6] Designing a deck

NZS 3604:2011 *TIMBER-FRAMED BUILDINGS* PROVIDES AN ACCEPTABLE SOLUTION FOR DECK CONSTRUCTION. WE STEP YOU THROUGH THE PROCESS OF USING IT TO DESIGN AN EXTERNAL, OPEN, SLATTED TIMBER DECK.

AN L-SHAPED DECK addition is proposed for an existing house. It will be 6.3 m long in one direction, project 3.0 m from the face of building and have a total area of 21 m² (see Figures 8 and 9). The finished deck level will be 100 mm below the floor level of the house.

Getting started

The requirements of foundations, subfloor framing, bracing, decking selection, fastenings and fixings are in NZS 3604:2011 section 7.4.

The house is in earthquake zone 3 (NZS 3604:2011 Figure 5.4), and as there is no subsoil classification, E must be assumed and a multiplication factor of 1.0 (NZS 3604:2011 clause 5.3.3 and Table 5.8) used for bracing calculations.

The section slopes away from the house, starting at approximately 1.0 m below floor level adjacent to the house to approximately 2.0 m

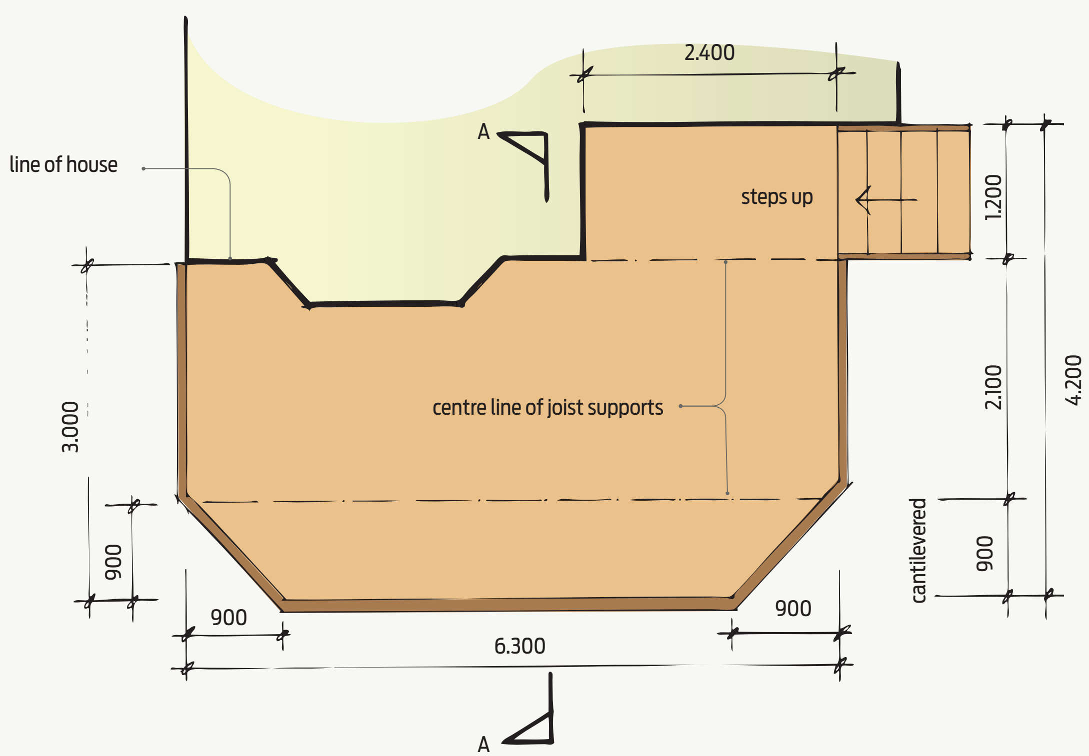
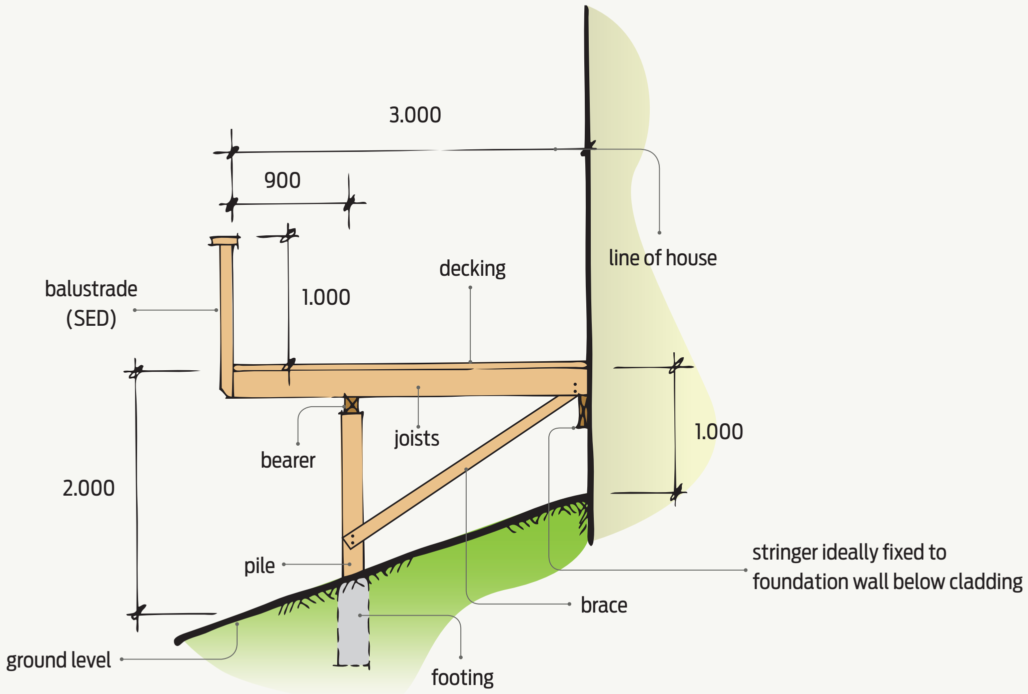


Figure 8 **Proposed deck.**



Note: See *Build* 127 pages 21–22 for maximum cantilever backspan requirements.

Figure 9 **Proposed deck.**

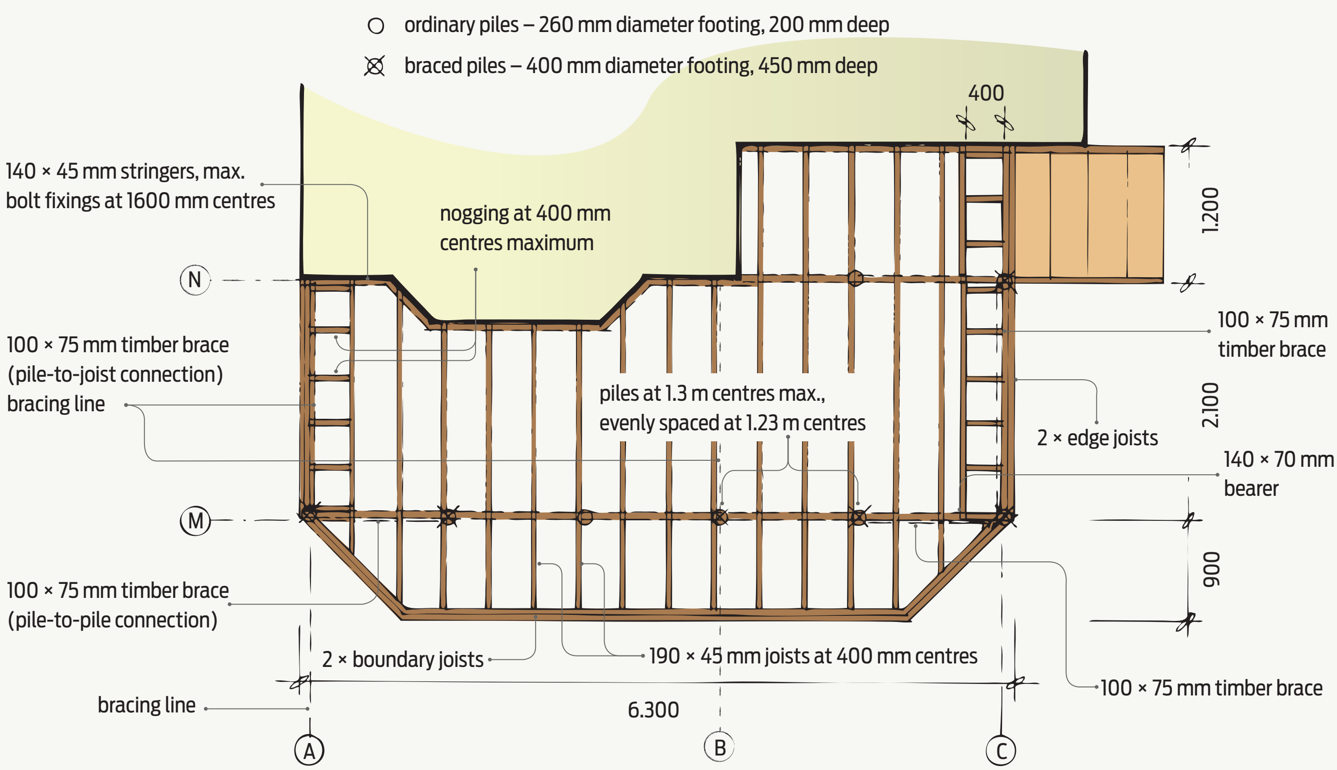


Figure 10 **Proposed subfloor framing for the deck.**

below floor level at the edge of the deck. Joists are to be cantilevered 900 mm beyond the line of the piles and bearer (see Figures 8 and 9).

The building owner would like to use a 32 mm kwila decking, so joist spacings may be up to 600 mm. However, as the deck is to support a cantilevered balustrade, NZS 3604:2011 clause 7.4.1.3 requires that joists must be at 400 centres maximum and be at least 190 mm deep.

Step 1: Select the timber

New Zealand Building Code clause B2 *Durability* sets out the durability requirements for building elements and cites NZS 3602:2003 *Timber and wood-based products for use in building* for timber treatment levels.

Generally, structural elements must have not less than 50-year durability, and stairs, stair handrails and decking require not less than 15-year durability. All structural fixings must have the same durability as the elements with which they are associated and will need to be stainless steel.

So, from NZS 3602:2003 Table 1:

- piles must be H5 treated (ground contact)
- all other structural members, i.e. bearers, stringer, braces, joists and safety barrier support posts, must be at least H3.2 treated (exposed to the exterior but not in ground contact).

NZS 3604:2011 clause 2.3.2 requires SG8 (structural grade) timber for wet-in-service conditions.

Step 2: Calculate the bracing requirement

Using the multiplication factor E for zone 3 = 1.0

15 BU/m² × 1.0 = 15 BU/m²

Paragraph 7.4.2.2 states that decks that project more than 2.0 m from the building require subfloor bracing at half the bracing demand required by Table 5.8 for light/light/light cladding, 0º roof pitch and for subfloor structures. So, divide the number of BUs required by two:

15 BU/m² / 2 = **7.5 BU/m²** are required.

Multiply the number of BU/m² by the area of the deck to obtain the total BUs required for the deck:

7.5 BU/m² × 21 m² = **157.5 BUs** in each direction.

Bracing may be provided by anchor, braced and cantilevered piles. NZS 3604:2011 section 6 *Brace pile* gives the bracing capacity ratings of subfloor bracing elements. Both anchor and braced piles provide 120 BUs per bracing element.

However, as anchor piles may only be 600 mm above ground level and the ground level is 1.0–2.0 m below the deck, anchor piles cannot be used.

Similarly, cantilevered piles may only extend 1.2 m maximum above ground level and also provide only 30 BUs per pile, requiring more cantilevered piles to achieve the BUs needed.

So braced pile systems provide the best solution, providing 120 BUs for earthquake resistance. Subfloor bracing lines are at a maximum of 5 m centres, so this example requires two bracing lines (M and N) in line with the house and three bracing lines projecting from the house (A, B and C). M and N will require a minimum of one braced pile system each and lines A, B and C would also require one braced pile system each.

Braces will be less than 3.0 m long, so the brace size may be 100 × 75 mm (see Figure 10).

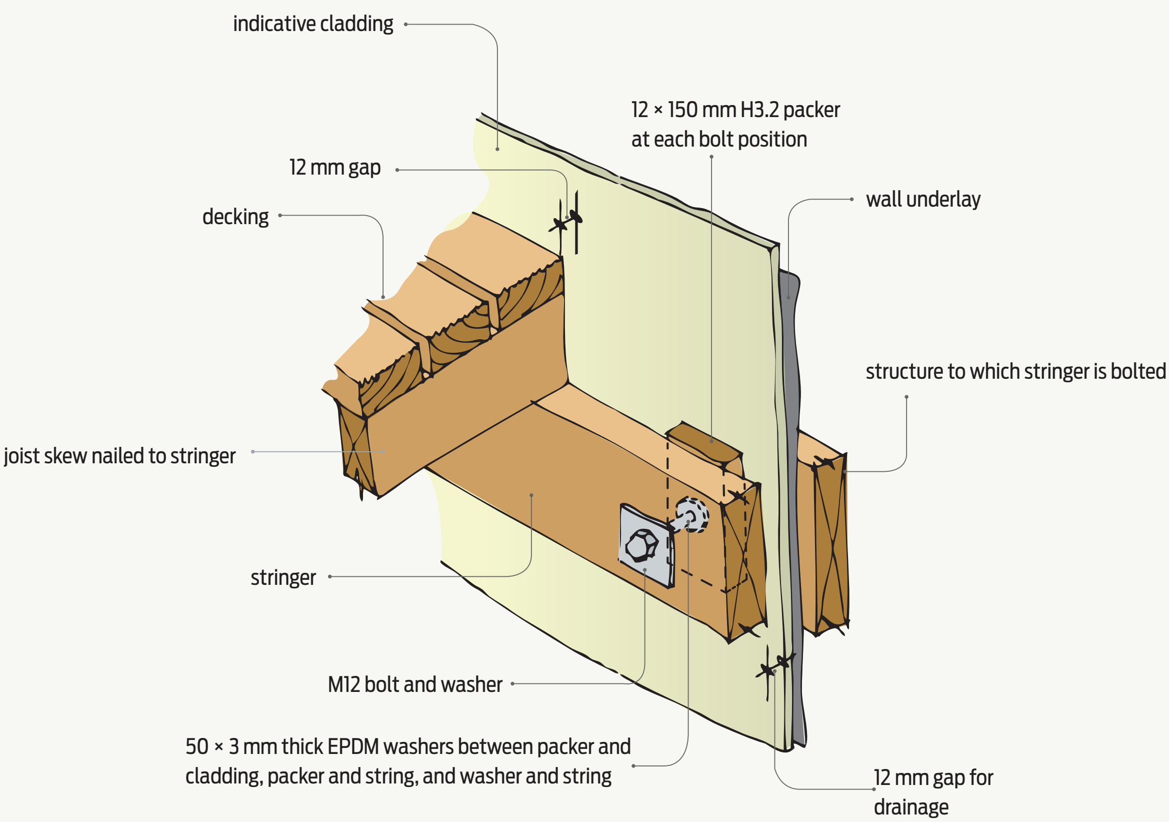


Figure 11 **Connection of deck stringer to cladding – direct-fixed.**

Step 3: Selecting joists

As the line of support (i.e. piles and bearer) is 2.1 m from the house, according to NZS 3604:2011 Table 7.1(b) (2 kPa floor load and wet in service), 140 × 45 mm joists may be used, and Table 7.2 for cantilevered joists allows a cantilever of up to 1150 mm.

However, at the bottom of Table 7.2, a note states that 140 mm joist depth is insufficient where cantilevered balustrades are to be used (as in this situation). So select the next size up, **190 × 45 mm joists**. At 400 centres, these may cantilever up to 1600 mm.

Step 4: Selecting bearers

Select bearers from NZS 3604:2011 Table 6.4(b) (2 kPa floor load and wet in service). To determine the loaded dimension of the bearers, refer to NZS 3604:2011 Definitions.

From Figure 1.3(G), the loaded dimension = (span 1/2) + span 2 (where span 1 = 2.1 m and span 2 = 900 mm) = 2.1/2 + 900 = 1.95 m

From NZS 3604:2011 Table 6.4(b) (2 kPa floor load and wet in service):

- for maximum bearer span = 1.3 and a loaded dimension of 2.3 m, bearer = 140 × 70 mm, or
- for maximum bearer span = 1.65 and loaded dimension 2.7 m, bearer = 190 × 70 mm.

Use 140 × 70 mm bearers with supports at 1.3 m centres maximum.

Step 5: Selecting stringers

Stringers will be used against the house. Ideally, stringers should be packed off and fixed to the foundation wall. Maximum joist span is 2.1 m, so from NZS 3604:2011 Table 6.5, the stringer may be either:

- 140 × 45 mm
- 190 × 45 mm.

Both will need bolt fixings at 1600 mm centres.

Step 6: Selecting piles and footings

A combination of ordinary and braced piles must be used. Select 140 mm diameter timber piles.

For pile footings, use NZS 3604:2011 Table 6.1.

For ordinary piles:

- maximum bearer span = 1.3 m; maximum joist span = 2.1 m
- footings – 260 mm diameter, 200 mm minimum deep (NZS 3604:2011 Figure 6.2).

For braced piles:

- two systems in each direction
- footings – 400 mm diameter, 450 mm minimum deep (NZS 3604:2011 clause 6.8.1.1).

Step 7: String fixing through cladding

When installing slatted timber decking, leave:

- a 12 mm minimum gap between the stringer and the decking
- a 12 mm minimum gap between the cladding and the decking for drainage (E2/AS1 paragraph 7.1.1) – see Figures 11 and 12
- a 3–6 mm gap between decking timbers lengthways (NZS 3604:2011 recommends using a 100 × 3.75 mm nail as a spacer) to allow timber movement due to moisture and temperature changes and for water to drain.

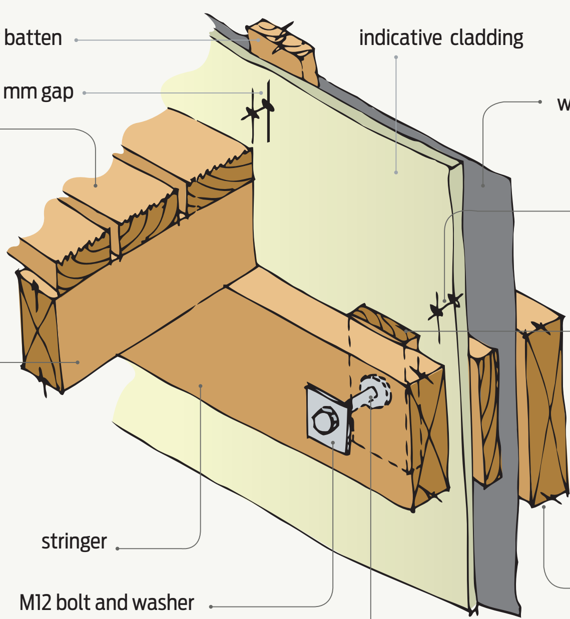


Figure 12 **Connection of deck stringer to cladding – cavity.**

7 Cantilevered decks

THERE ARE A FEW SPECIFIC REQUIREMENTS TO BE AWARE OF WHEN CONSTRUCTING A CANTILEVERED SLATTED TIMBER DECK.

A DECK OR BALCONY CANTILEVERED from a building presents structural and weathertightness issues not encountered with non-cantilevered decks (see Figure 13).

Construction consists of deck joists installed alongside and bolted to the floor joists extending over the external wall framing. The back extension alongside the floor joist must be at least 1.25 times longer than the length of the cantilever (see Figure 14).

The finished level of a cantilevered deck with slatted timber decking must be at least 50 mm below the finished floor level or threshold of the building interior (from E2/AS1).

Joist treatment and fixing

Cantilevered deck joists must be treated to hazard class H3.2 and bolted to the floor joist with two M12 bolts and 50 × 50 × 3 mm washers at the innermost end of the cantilevered joist.

Projections and support

NZS 3604:2011 *Timber-framed buildings* Table 7.2 sets out cantilever projection distances for different sizes and spacings of joists where the floor load is 2 kPa and the timber is SG8 (structural grade) wet in service.

NZS 3604: 2011 paragraph 7.1.5.1 states that cantilevered joists may not support:

- a decking weight of more than 40 kg/m², or
- a balustrade weight of more than 26 kg/m².

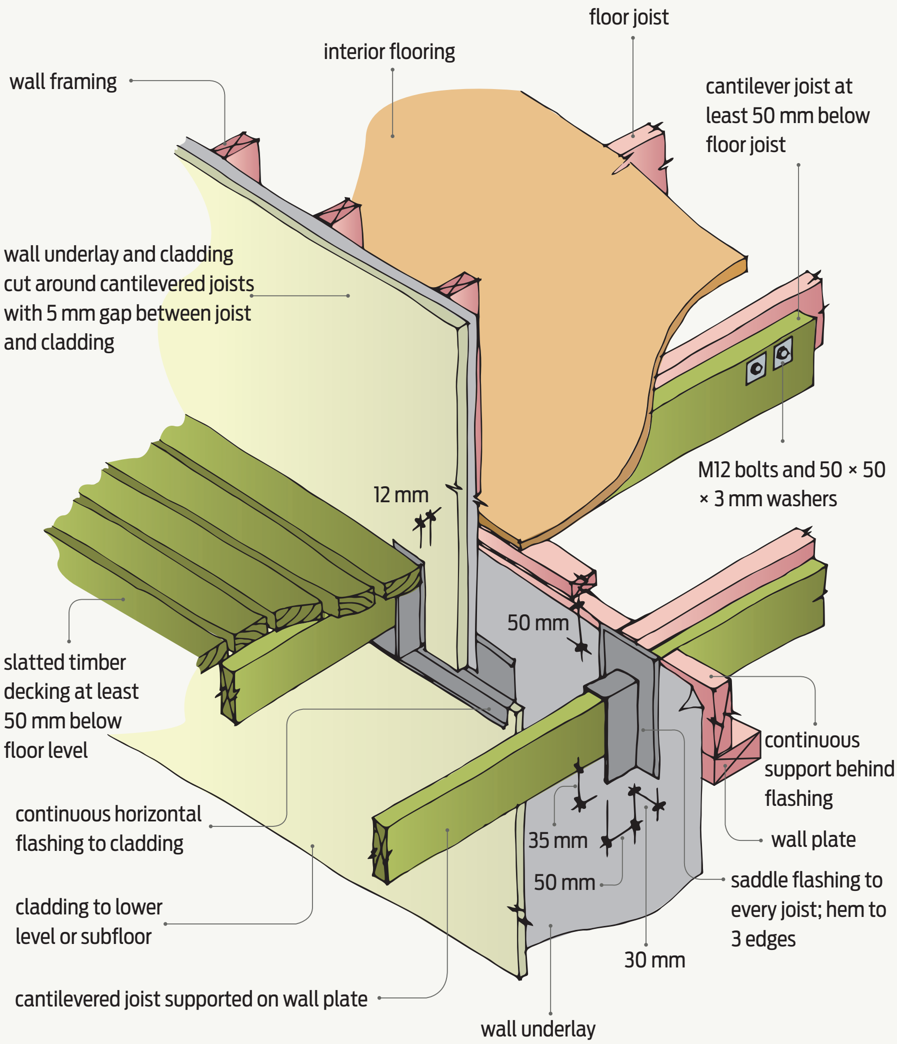


Figure 13 **Lapped cantilevered joists and saddle flashing.**

In addition, a cantilevered deck must not support a roof or other structure.

Cantilevered balustrades

At its outer edges, a cantilevered deck must be able to resist the bending loads of a cantilevered balustrade and have sufficient depth for structural post fixing of the edge barrier.

NZS 3604: 2011 section 7.4 and 'Adjustment to the deck details in NZS 3604' in *Codewords* 54 published by MBIE in December 2012 describe requirements for boundary and edge joists including that they must be the same depth as the deck joists and be screwed, bolted or coach-screwed together.

Durability of fixings and fastenings

Metal fixings and fastenings must have the same durability as the timbers they are connecting. Generally, all fixings and fastenings should be a minimum type 304 stainless steel where exposed, although hot-dip galvanised steel nails and screws may be used in zones B and C with CCA-treated timber.

However, where ACQ and CuAz timber treatment is used, nails, screws, bolts and washers need to be grade 304 stainless steel. Stainless steel nails should be annular grooved to provide a similar withdrawal resistance to galvanised nails (see Tables 4.1 and 4.3 in NZS 3604:2011).

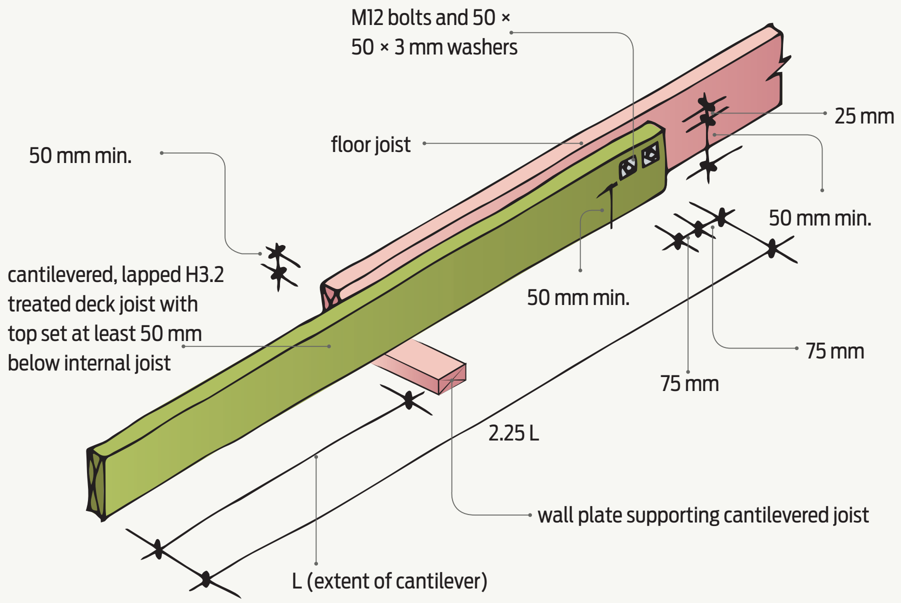


Figure 14 **Cantilevered joist.**

8 Free-standing decks

IN SOME SITUATIONS A FREE-STANDING TIMBER DECK OR PLATFORM MAY BE A SIMPLER SOLUTION THAN AN ATTACHED DECK. ALTHOUGH THE DESIGN REQUIREMENTS FOR BOTH ARE GENERALLY THE SAME, THERE ARE SOME DIFFERENCES TO CONSIDER.

THE DESIGN REQUIREMENTS for decks attached to a building are set out in NZS 3604:2011 *Timber-framed buildings* section 7.4. Where applicable, the structural and durability requirements and the selection of timber, fixings and fastenings are the same for both free-standing and attached decks.

Subfloor bracing

Subfloor bracing requirements are set out in NZS 3604:2011 section 5.

Piles may be braced, anchor or cantilevered, or a combination of these.

Calculate deck bracing demand

When determining bracing, first calculate the bracing demand for the deck.

Step 1: Select the earthquake zone from NZS 3604:2011 Figure 5.4 Earthquake zone maps.

Step 2: Obtain the bracing demand from NZS 3604:2011 Table 5.8. Using half the value for light cladding for wall, roof and subfloor and 0–25⁰ roof pitch, this is 15 × 0.5 = **7.5** BU/m².

Step 3: Multiply the bracing demand by a multiplication factor (given at the bottom of Table 5.8) for soil class and earthquake zone.

Step 4: Multiply the resulting value by the area of the deck to calculate the total number of bracing units (BUs) required in each direction (NZS 3604:2011 5.3.1).

Example: For a proposed 10 m² (5 × 2 m) deck with an earthquake zone 3 and soil class E. From Table 5.8, the multiplication factor is 1.0, so 15 ×0.5 × 1.0 = 7.5 BU/m². Multiply 7.5 BU/m² by the area of the deck to obtain the total bracing units required gives 7.5 × 10 = 75 BUs in each direction.

Applying bracing to a deck design

There are no specific requirements in NZS 3604:2011 for bracing distribution for free-standing decks, but the following rules should be used as far as practicable. Bracing should be:

- provided in two directions at right angles to one another to provide horizontal support
- located in perimeter foundation and subfloor framing

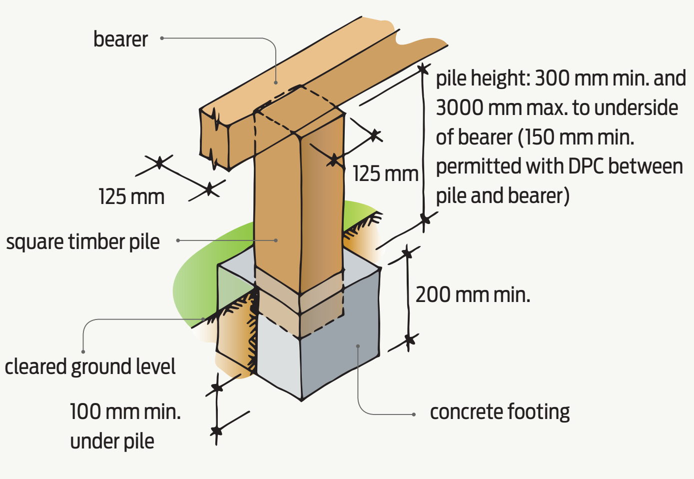


Figure 15 **Square timber (ordinary) pile.**

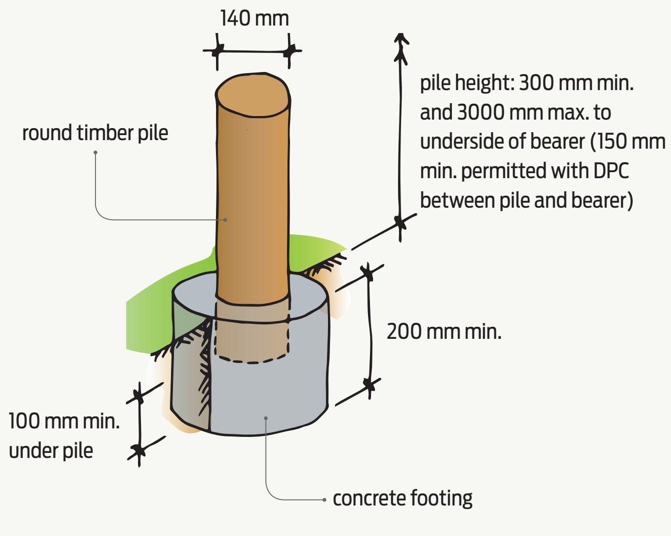
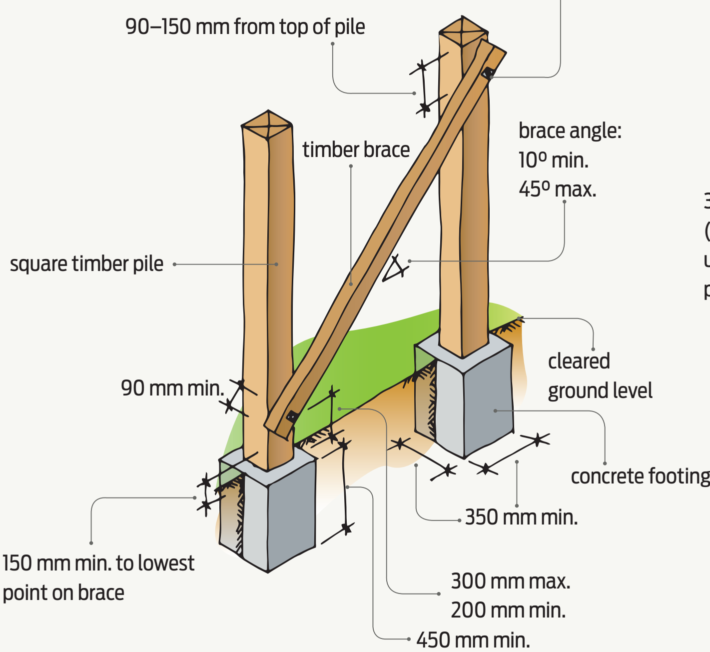
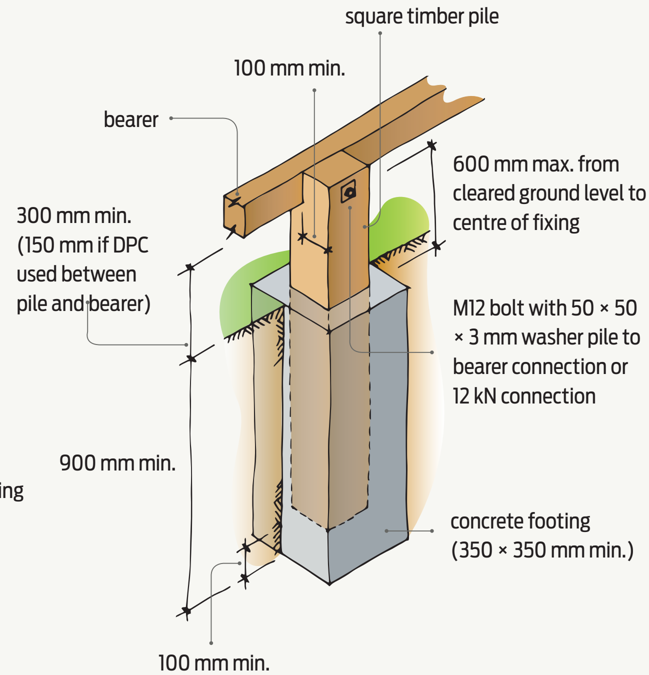


Figure 16 **Round timber (ordinary) pile.**



Note: 120 BUs (earthquake) per pair of piles.

Figure 17 **Braced pile system (pairs of piles).**



Note: 120 BUs (earthquake) per pile in any direction.

Figure 18 **Anchor pile.**

- located in internal lines parallel to the perimeter at a maximum of 5.0 m centres
- distributed as evenly as possible along each line.

Pile height and footings

The maximum height of the piles will influence the choice of braced pile system (NZS 3604: 2011 6.4.4.1 (b)). This is summarised in Table 3 and Figures 15–19.

Except for driven piles, all timber piles must have a concrete footing that is at least 100 mm below the pile and be cast in situ on undisturbed good ground.

Footings below cleared ground level must have a minimum depth of:

- 200 mm for ordinary piles
- 450 mm for braced piles
- 900 mm for anchor piles.

Table 3

MAXIMUM HEIGHTS FOR TIMBER PILES

TYPE OF SUBFLOOR BRACING SYSTEM	MAXIMUM PERMITTED HEIGHT ABOVE CLEARED GROUND LEVEL
Cantilevered piles	1200 mm
Anchor piles	600 mm to centre of fixing
Braced timber piles (when they directly support bearers)	3000 mm

The plan area of the footing depends on bearer and joist spans and is determined from NZS 3604:2011 Table 6.1, except that braced and anchor piles must be a minimum of 350 × 350 mm for square piles and 400 mm diameter for round piles.

Bearers

Bearer sizes are selected from NZS 3604:2011 Table 6.4 Part (b) for a 2 kPa wet-in-service floor load (NZS 3604:2011 6.12). They must:

- be continuous over two or more spans
- be laid in straight lines on edge
- have a minimum landing of 90 mm, except this may be 45 mm where butted over the support
- be jointed only over ordinary pile supports (i.e. they must not be jointed where the bearer is fixed directly to an anchor or braced pile)
- have a connection capacity at joists of:
  - 12 kN minimum capacity in tension or compression along the line of the bearer, or
  - 6 kN minimum capacity each on both sides of a continuous bearer.

Joists

Timber joists for decks are selected from NZS 3604:2011 Table 7.1 Part (b) for a 2 kPa wet-in-service floor load. They must be laid in straight lines on edge with top surfaces set to a common level and have 32 mm minimum bearing over supports.

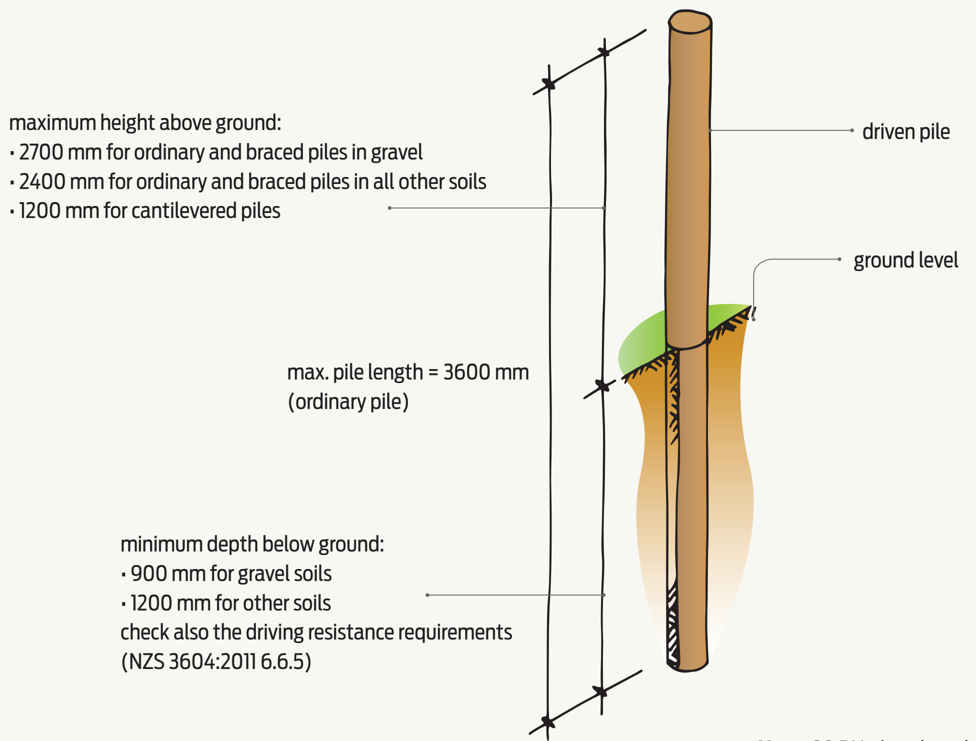
Joist fixings

Joist fixings to piles or bearers are in NZS 3604:2011 6.8.6:

- If the brace is connected to the pile and parallel to the joist direction, the two joists on either side of the brace must be fixed to the bearer with a 6 kN capacity connection in the horizontal direction.
- If the brace is connected to the joist, the joist to bearer connection must have 12 kN capacity in the vertical direction (see NZS 3604:2011 Figure 6.8).
- Bearers and joists connected to anchor piles must be fixed with:
  - M12 bolts with 50 × 50 × 3 mm washers, or
  - 12 mm diameter threaded rod and washers, or
  - 12 kN capacity connections in tension or compression along the joist or bearer.

Trimmers and trimming joists

Where an opening (such as for stairs) is required in a deck, trimmers and trimming joists must be fitted around the opening in accordance with NZS 3604:2011 7.1.6.



Note: 30 BUs (earthquake) per pile in any direction.

Figure 19 **Cantilevered (driven) pile.**

9 Deck barriers

WHERE IT'S POSSIBLE TO FALL 1.0 M OR MORE FROM A DECK, THE BUILDING CODE REQUIRES A BARRIER ABLE TO WITHSTAND ALL IMPOSED, WIND AND IMPACT LOADS. WE LOOK AT SOME OPTIONS.

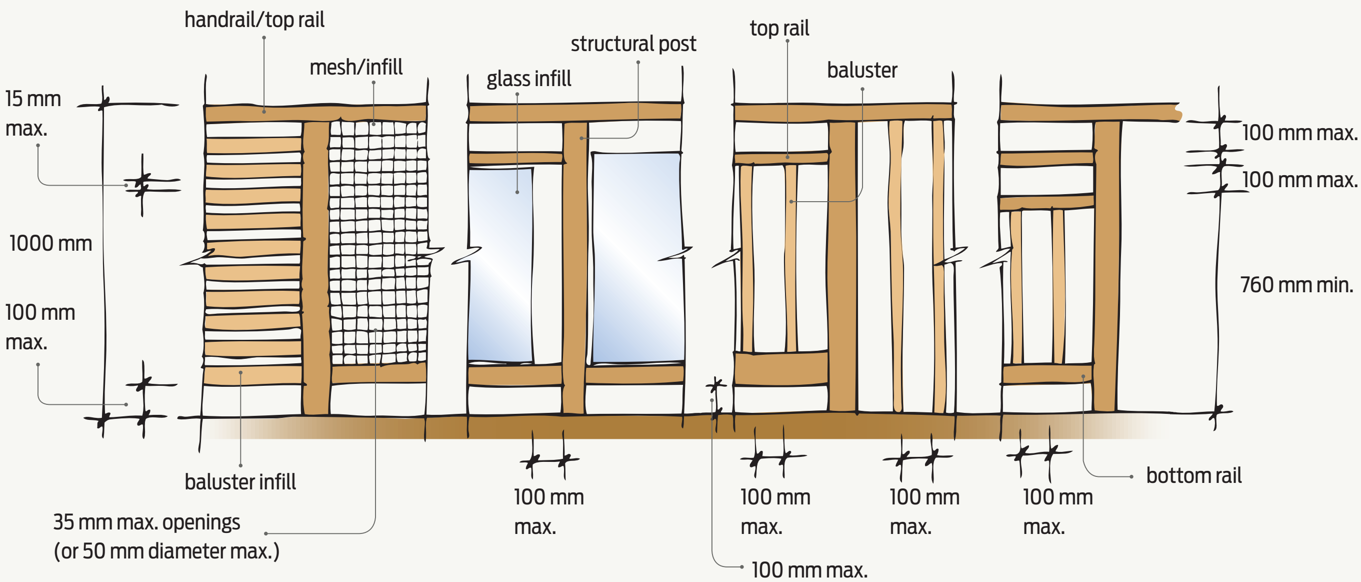


Figure 20 **Elements of barriers.**

IN 2012, the Department of Building and Housing (now Ministry of Business, Innovation and Employment – Building and Housing) published *Guidance on barrier design,* which gives guidance and recommendations on designing and installing Building Code-compliant barriers.

As of December 2012, a timber barrier complying with paragraph 4.2.7 of the *Guidance on barrier design* meets the Building Code clause F4 and B2 requirements. Other barriers will need specific engineering design.

Barrier elements

Barriers for residential decks must:

- be continuous where the fall height is over 1.0 m
- be at least 1.0 m high
- have openings that prevent a 100 mm diameter sphere passing through
- have less than 15 mm gaps between horizontal rails
- have the top of the barrier at least 760 mm above a fixed seat
- have no sharp edges or projections.

Durability

The components of a barrier are shown in Figure 20. Generally, barrier structural components must have not less than 50-year durability, while other components may have not less than 15 years (see Figure 21).

However, if barriers and fixings can be accessed and replaced without difficulty and any failure detected, then the durability may be not less than 15 years. Likewise, baluster infill components that are difficult to access may require 50-year durability.

Design loads of barriers

Barriers must be designed to withstand live (imposed) loads, wind loads and deflection limits from AS/NZS 1170 *Structural design actions*.

Live (imposed) and wind loads

AS/NZS 1170.1 paragraph 3.6 and Table 3.3 and modifications in B1/VM1 paragraph 2.2.7 set out requirements for barrier members and connections for residential decks. The loadings described in AS/NZS 1170.1 Table 3.3 include line (top edge), infill (distributed) and concentrated loads.

AS/NZS 1170.2 sets out the wind loads that barriers must be designed to resist.

Deflection limits

It is recommended that deflection limits do not exceed 30 mm under wind and barrier loads, as described in B1/VM1.

Barrier materials

Barrier materials for timber decks include:

- timber
- glass
- metals – aluminium, mild steel and stainless steel.

Timber barriers

Select timber species and grades for residential deck barriers in accordance with NZS 3603:1993 *Timber structures standard*. The timber grade must be at least SG8 (wet in service) except infill members, which may be SG6 (wet in service).

For durability and treatment, see NZS 3602:2003 *Timber and wood-based products for use in building*. *Pinus radiata* must be treated to H3.2. Select metal fixings in accordance with NZS 3604:2011 section 4.4 to have the same durability as the components they connect.

The supporting structure, that is, edge, boundary and deck joists, must be in accordance with NZS 3604:2011 section 7.4 (see Figure 22) and the 'Adjustment to the deck details in NZS 3604' described in *Codewords* 54, published December 2012 by MBIE.

Guidance on barrier design includes recommended sizes for timber components (see Figure 21 and Table 4).

Glass barriers

Glass for structural barriers must be grade A toughened safety glass complying with NZS 4223.3:1999 *Glazing in buildings* Part 3: Appendix 3A. Infill glass can also be grade A laminated.

There are a variety of support systems for structural glass barriers (see Figure 23) and glass infill barriers (see Figure 24).

Guidance on barrier design includes tables from the Glass Association of New Zealand for both structural and infill glass design.

Aluminium barriers

Aluminium barriers must be designed in accordance with AS/NZS 1664.1:1997 *Aluminium structures* or tested to comply with AS/NZS 1170.0:2002 Appendix B.

Aluminium can have either an anodised or a powder-coated finish. Anodising involves treatment to provide an oxide film over the surface. For an anodised finish, *Guidance on barrier design* recommends anodising thicknesses of:

- 12 microns for sheltered, non-coastal regions
- 20 microns for exposed, inland regions (minimum thickness recommended for balustrades and barriers)
- 24 microns for coastal and geothermal regions.

Powder-coated finishes are heat-applied, electrostatically charged paint pigments that fuse to the metal to give a durable and corrosion-resistant coating. ➤

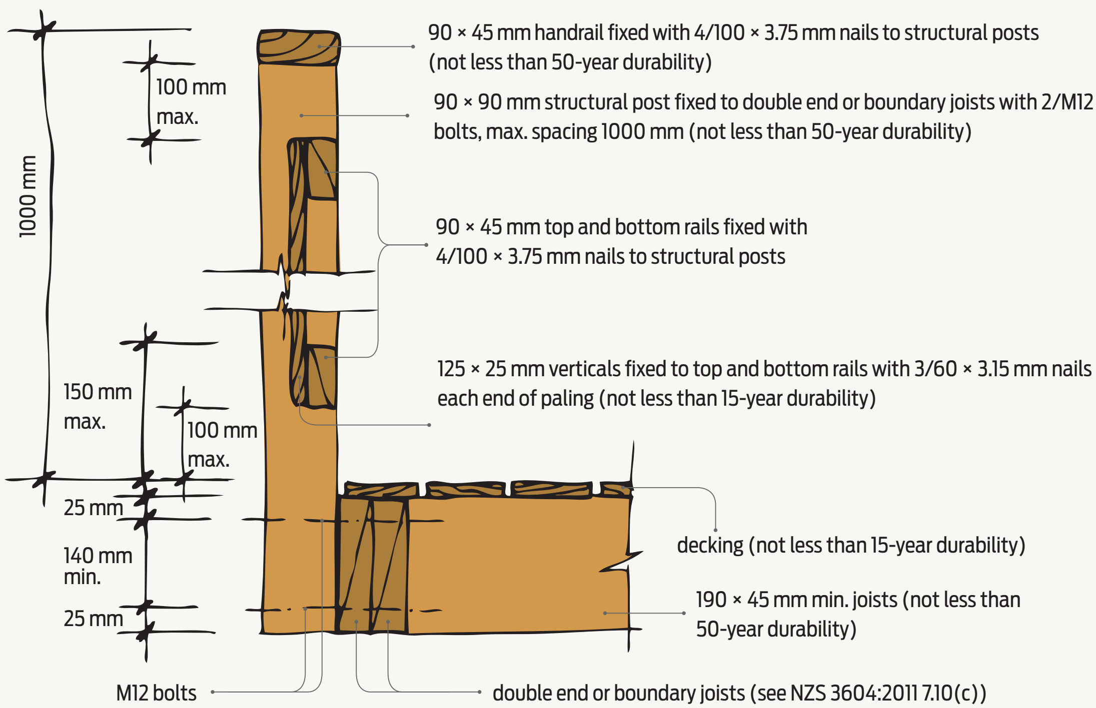


Figure 21 **Durability and timber sizes for cantilevered barrier elements.**

Table 4

RECOMMENDED SIZES FOR TIMBER BARRIER COMPONENTS

COMPONENT	SIZE (MM) AND FIXING
Handrail	90 × 45 minimum fixed with 4/100 × 3.75 nails to each structural post
Structural posts	90 × 90 fixed to double end or boundary joists (as per NZS 3604:2011 7.10(c)) with 2/M12 bolts
Top and bottom rails	90 × 45 minimum fixed with 4/100 × 3.75 nails between or to inner or outer faces of structural posts
Palings	125 × 25 between top and bottom rails fixed with 3/60 × 3.15 nails each end of paling

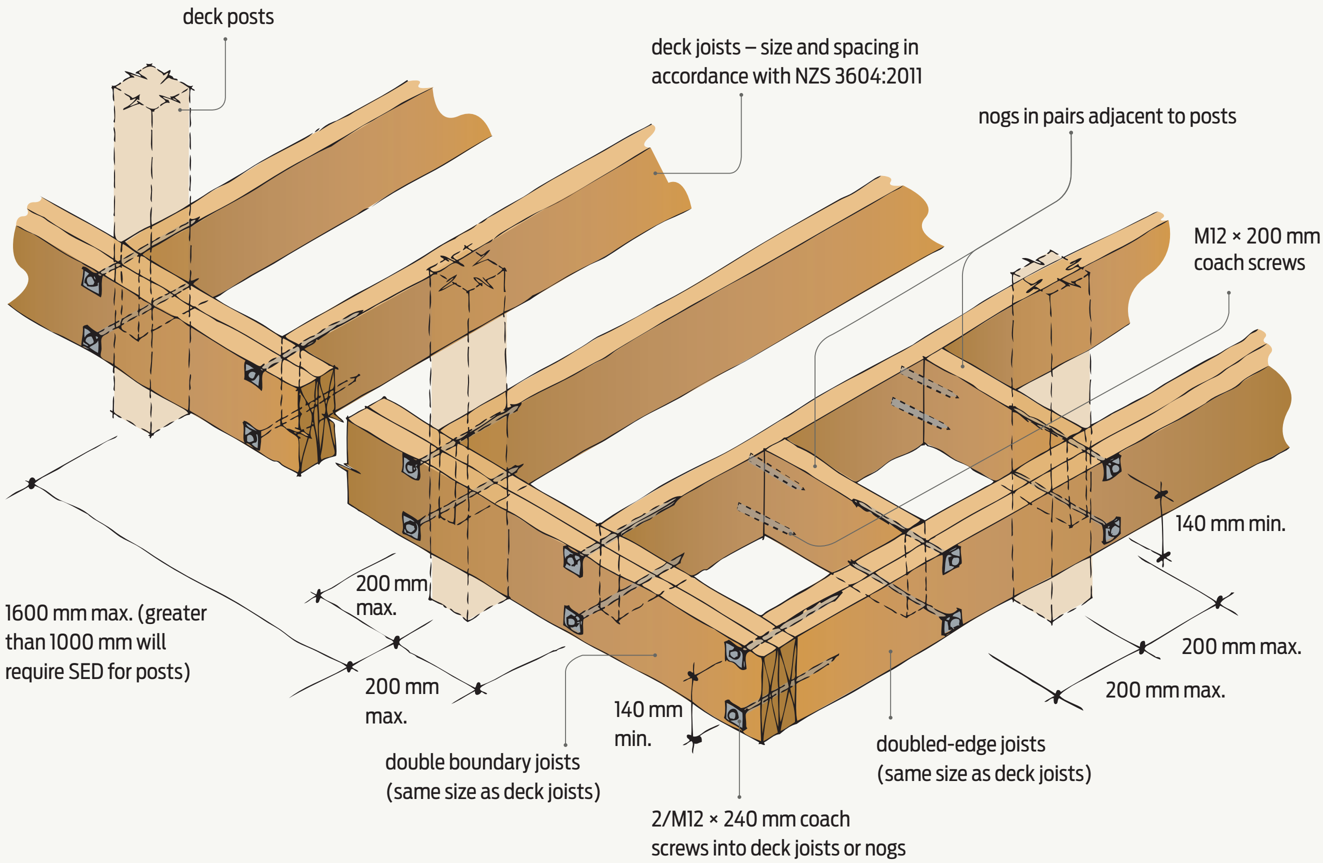


Figure 22 **Alternative solution for deck support for cantilevered face-fixed post support detail.**

Steel barriers

Steel barriers must be in accordance with AS/NZS 3404 *Steel structures standard* or tested to comply with AS/NZS 1170.0:2002 Appendix B.

Mild steel has poor corrosion resistance and requires an applied corrosion protection – guidance is given in NZS 3404.1:2009 section 5.

Stainless steel

Stainless steel barriers must be either grade 304 for use in non-corrosive environments or grade 316 for use in corrosive environments.

Finishes include:

- mill finish – satin
- brushed finish – directional grain finish
- bright finish – mirror or polished.

Wire infill for barriers

Wire mesh or rope is frequently used for the baluster infill as it doesn't restrict the view. Wire infills are usually fixed to a stainless steel structure (main posts and rails), but aluminium or stainless steel may be used. Timber is not recommended as it's likely to creep, causing wires to loosen off.

Wires should be multi-stranded grade 316 stainless steel in all situations, although grade 304 is allowed in sheltered situations. They may be arranged vertically or sloped (see Figure 25) and must be evenly tensioned (typically to 1.1 kN) so they cannot be forced apart beyond the maximum 100 mm spacing.

If bending around tight corners, use 7 × 7 or 7 × 19 wire rope with a maximum diameter of 2.5 mm. Where straight runs only are used, the wire may be 1 × 19 and the diameter greater – it's stronger, stiffer and requires less tensioning.

When a change of direction occurs in a balustrade, the wire run is usually terminated, anchored to the strainer post, then a new cable run started.

Fixing and tensioning should be using turnbuckles with locknuts on to ensure the turnbuckles don't unwind. The fittings used should be the same grade of stainless steel as the wires.

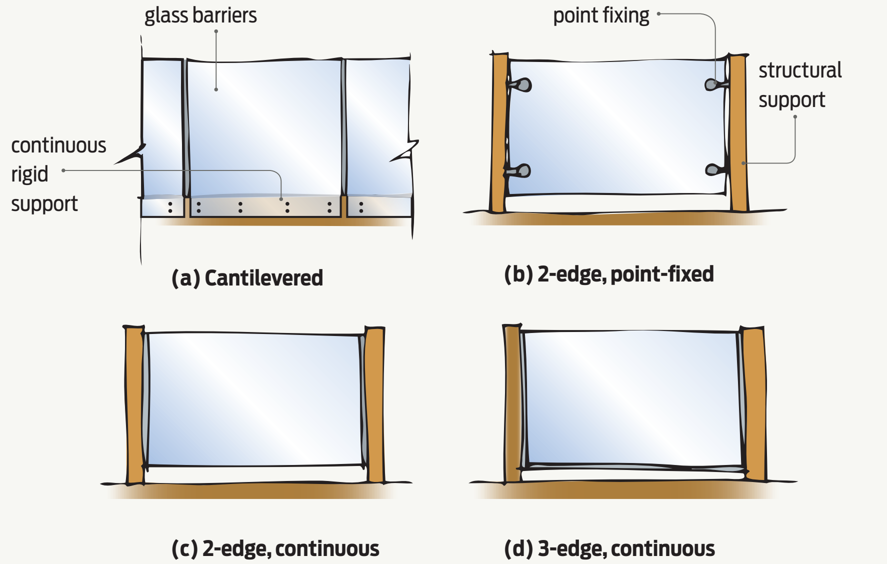


Figure 23 Structural glass barrier support systems.

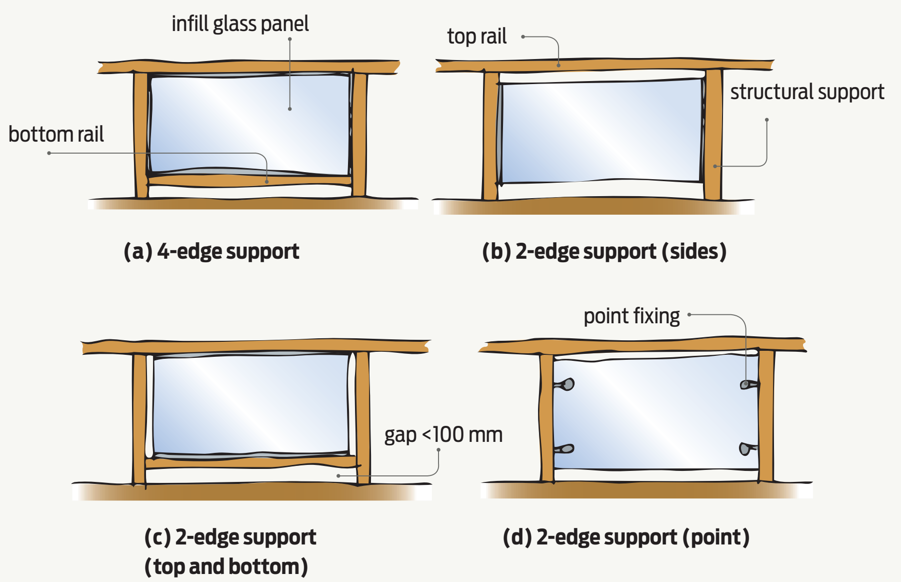


Figure 24 Glass infill options for barriers.

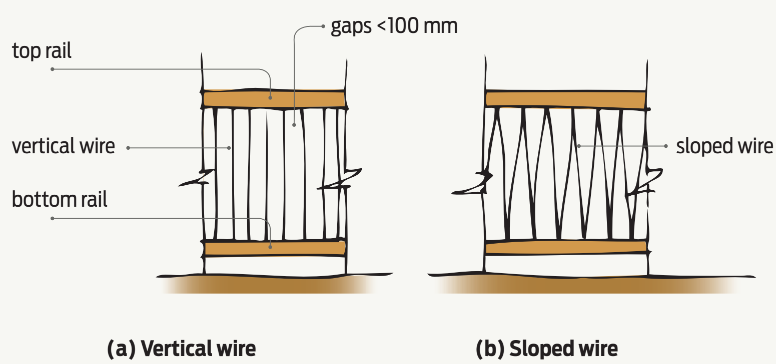


Figure 25 Wire infill options for barriers.

10 External stairs for houses

EXTERNAL TIMBER STEPS CAN FEEL A BIT WOBBLY OR SPRINGY, ESPECIALLY AS THEY GET WIDER. WE REVIEW THE DESIGN RULES AND OFFER SOME IDEAS FOR BUILDING STRONG STAIRS.

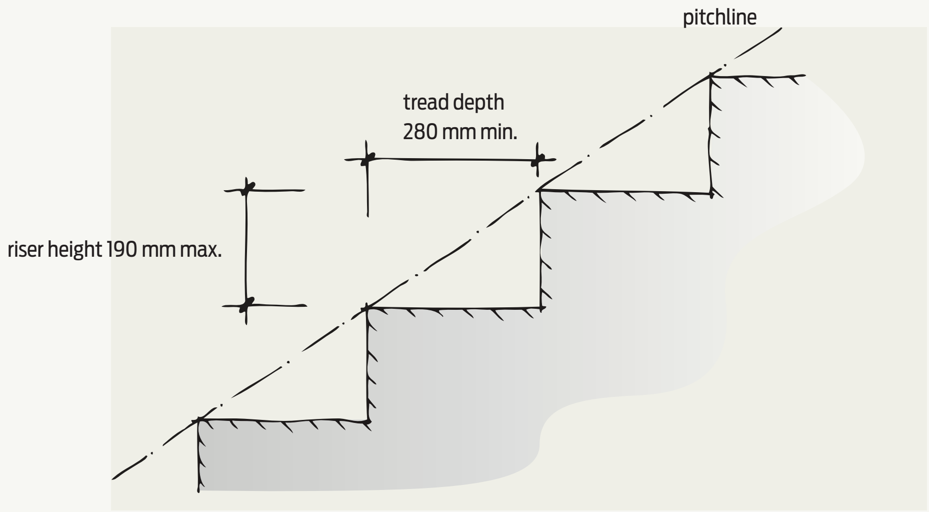


Figure 26 **Pitchline, tread and riser dimensions for common and main private stairways.**

EXTERNAL STAIRS on the access route into a house may provide access to a deck or across a sloping site. If they are part of the main access route to the house, they must comply with NZBC clause D1 *Access routes*.

The Acceptable Solution D1/AS1 is quite prescriptive, including requirements for stair pitch, riser height, tread depth, projections or nosings, where open risers may be used, stair width, handrails and slip resistance.

Design starts with stair type

External stair design should start by determining the classification. D1/AS1 classifies stairs as accessible, common or private according to their use.

A common stairway may be used by the public whether as of right or not. Where an external stairway forms part of the main access route to the house, it must be classified as a common stairway. Otherwise, it may be a main private stairway – one that is used by a single household unit only. Common and main private stairways have the same design requirements.

Work out the design limits

The next stage is to determine the design limits – the pitch, riser height and tread depth of the steps (see Figure 26). These are set out in D1/AS1 Table 6.

For common and main private stairways, the permitted dimensions in D1/AS1 are:

- maximum pitch – 37°
- maximum riser height – 190 mm
- minimum tread depth – 280 mm.

Where different tread, riser and pitchline configurations are required, these can be calculated from D1/AS1 Figure 11.

Tread and riser requirements

All the steps in a flight must be uniform with the same dimensions and no more than 5 mm variation. Uniformity is measured at the centre of straight flights of stairs and at the pitchline for curved stairways.

All stair treads must have a level surface and a wet and dry slip resistance – measured as the coefficient of friction – in accordance with D1/AS1 Table 2.

Open risers are allowed in common and private stairways but the open space between treads must not allow a 100 mm diameter sphere to pass through, and the leading edge of the treads must be a contrasting colour.

The leading edge of closed stair treads may be flush with or project up to 25 mm beyond the face of the riser below. For an open stair, the leading edge must project at least 15 mm over the tread below, up to a maximum 25 mm. For both stair types, the projection is considered part of the overall tread depth (see Figure 27).

While not required under D1/AS1, BRANZ also recommends:

- maintaining a clear view of the whole flight of stairs – avoid obstructions and winders or sharp turns where possible
- limiting the number of risers in a single flight to 17.

Stair width and landings

A common stairway must be at least 900 mm wide between handrails. While there is no minimum width specified for other stairways in household units, D1/AS1 recommends 850 mm as a practical minimum width.

Landings are required at the top and bottom of all flights of stairs and wherever a door opens directly onto a stairway. The only exception is if the rise of the flight is less than 600 mm and no door opens over the steps. Landings must be at least the same width as the stairs and a minimum of 900 mm long.

D1/AS1 Table 7 sets out the maximum height between landings as no more than 2.5 m for a common stairway and 4 m for a private stairway.

Curved, spiral and winder stairways

Curved, spiral and winder stairways are permitted. They must meet the same requirements as straight flight stairs, but the pitchline is measured:

- 300 mm from the outside curve of a stair when the stair is less than 1 m wide
- 300 mm from the inside curve of a stair when the stair is over 1 m wide.

For a winder stair, the pitchline is:

- measured at the centre of the stair when the stair is less than 1 m wide
- 300 mm from the inside curve of a stair (same as for curved stairs) when the stair is over 1 m wide.

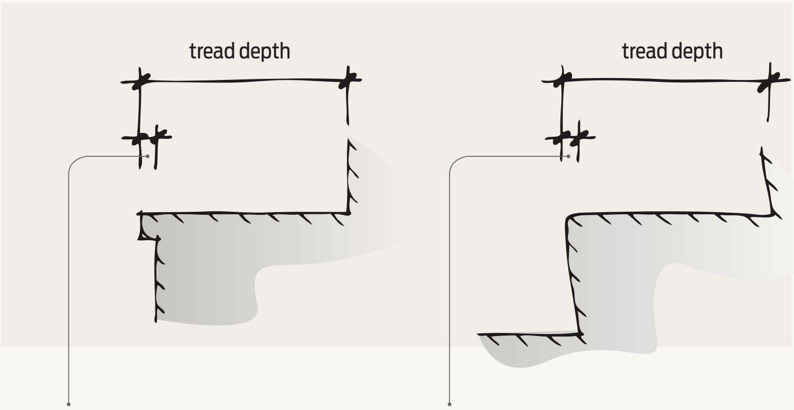


Figure 27 **Examples of tread projections.**

Table 5

BRANZ MAXIMUM SPAN FOR SG8 (H3.2) STRING SIZES

STRING SIZE	MAXIMUM SPAN
290 × 45 mm	4.0 m
240 × 45 mm	3.3 m
190 × 45 mm	2.6 m
140 × 45 mm	1.9 m

Lighting levels

D1/AS1 Table 8 sets out stairway lighting level requirements. For safety, they should be lit, preferably automatically.

Handrails and safety barrier design

Generally, common and private stairs that are less than 2 m wide and have more than two risers must have a handrail. However, a handrail can be omitted on stairs with two or three risers that access a single household unit.

Where required, handrails must have the same slope as the stairway pitchline, be 900–1000 mm high and have a profile as shown in D1/AS1 Figure 26(a).

If a fall of more than 1 m is possible, a safety barrier must be provided – the requirements are in NZBC clause F4 *Safety from falling*. The barrier must be able to withstand all imposed, wind and impact loads without collapsing, becoming unstable or deflecting unreasonably.

There is currently no compliance document for safety barriers, so all safety barriers must be specifically designed. A Ministry of Business, Innovation and Employment Building and Housing Group publication, *Guidance on barrier design*, provides some design and installation guidance.

Timber treatment

External stair timber generally should be graded SG8 (wet in use) *Pinus radiata*, treated to hazard class H3.2. Non-structural balustrade or infill timber may be merchantable grade, and timber in ground contact must be H5 treated.

Construction of treads/risers/strings

Strings span between the top and bottom of a stair flight. When treads are housed into strings, the strings are typically 290 × 45 mm, but other sizes may also be used (see Table 5 for maximum spans).

Cutting steps into a string to support the treads is not recommended – it will compromise the timber treatment.

Treads spanning 900–1000 mm between strings should be nominal 50 mm thick minimum and grooved or have a slip-resistant finish. Boards should have 5 mm gaps between them. Treads may be fixed to strings:

- by being housed into a 13 mm rebate
- on timber or steel brackets/cleats
- on blocks added to the stair string to suit the tread and riser dimensions.

See Figures 29–31 for details.

For a wide stair, add mid-span strings for support. Although stairs up to 1.5 m wide may not need a mid-span string, sagging and deflection will be minimised by adding strings at 1.2 m centres for extra support.

To stiffen stairs and stop the strings from spreading, 12 mm diameter threaded rods tying strings together spaced at 1.2 m maximum should be used.

D1/AS1 allows a common stairway to have open risers as long as the gaps are not large enough for a 100 mm diameter sphere to pass through. The proposed stair (see Figure 29) ➤

Calculating tread and riser sizes

The proposed stair is 2.5 m high (see Figure 28). Divide the height of the flight by the maximum riser height to calculate how many risers are required:

2500 / 190 = 13.16

The maximum allowed riser height is 190 mm, so 14 risers are needed.

Now, calculate the actual riser height:

2500 / 14 = 178.6 mm

There is always one more riser than treads, so for 14 risers, there will be 13 treads. The minimum permitted tread depth is 280 mm, but with ample space for the stairs, 300 mm treads have been selected. Multiply the tread depth by the number of treads to calculate the overall length of the stair:

300 × 13 = 3900 mm

Each tread will also have a 20 mm projection, giving a total tread depth of 320 mm, but the projection does not add to the overall run (going) of the stair.

On site, builders must always check that the total rise is as calculated – if not, adjust the riser dimension.

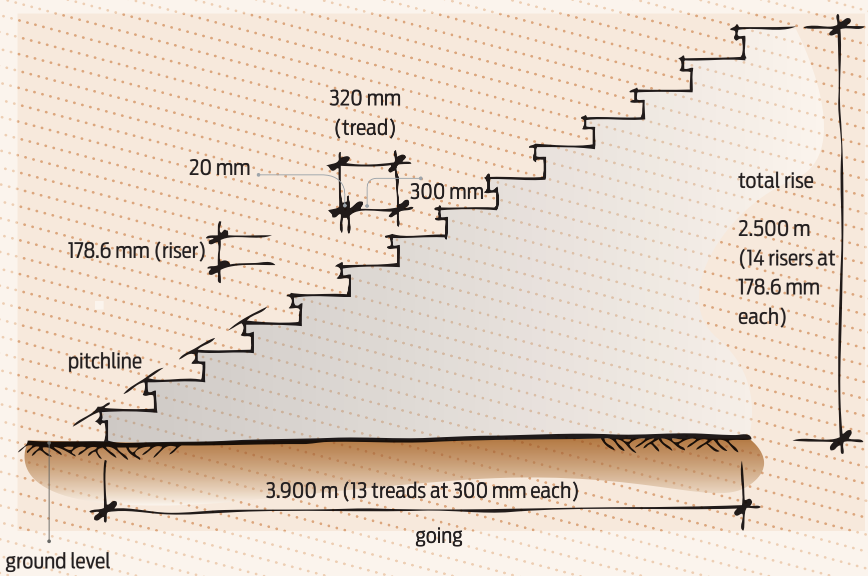


Figure 28 Stair layout example.

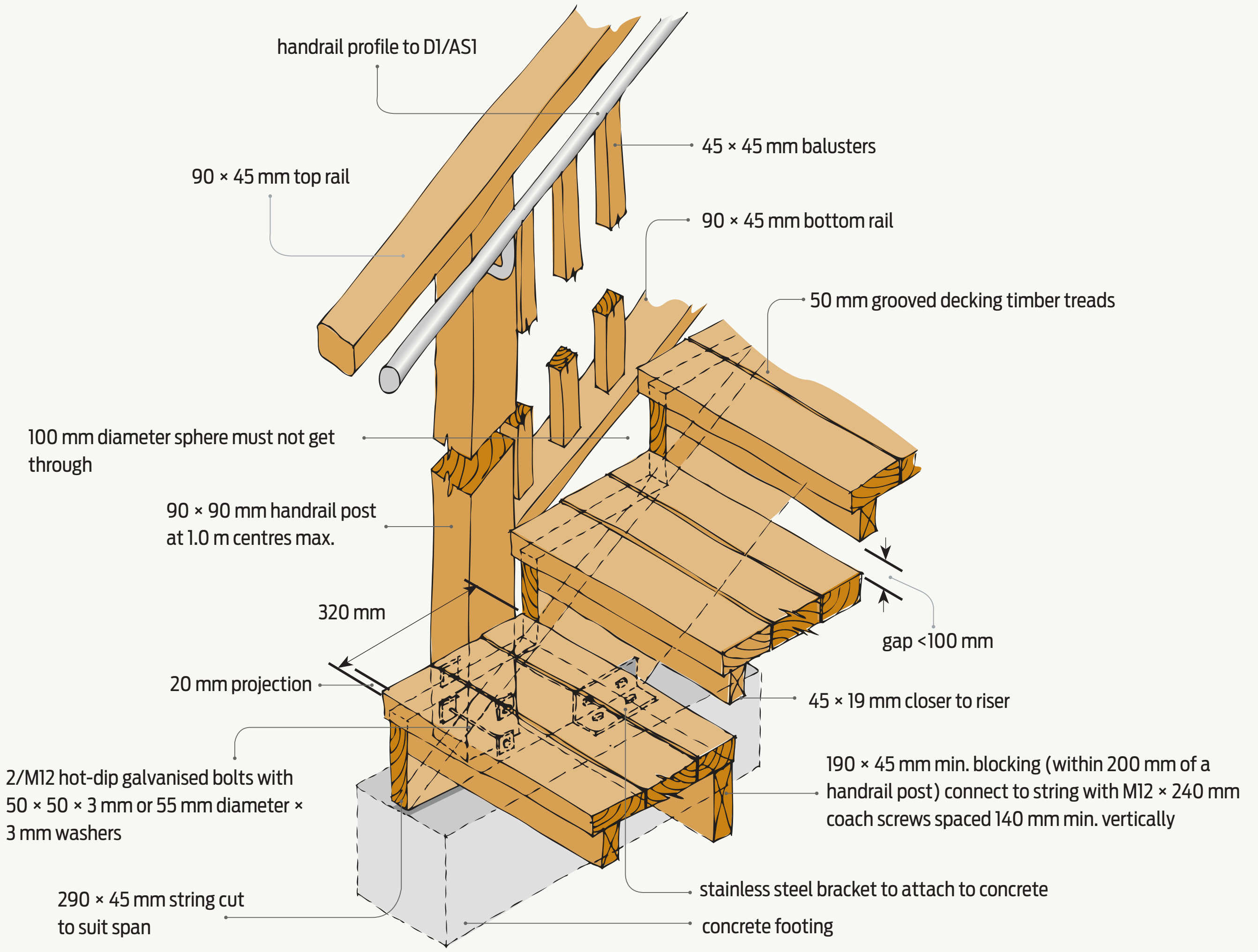


Figure 29 **Stair construction.**

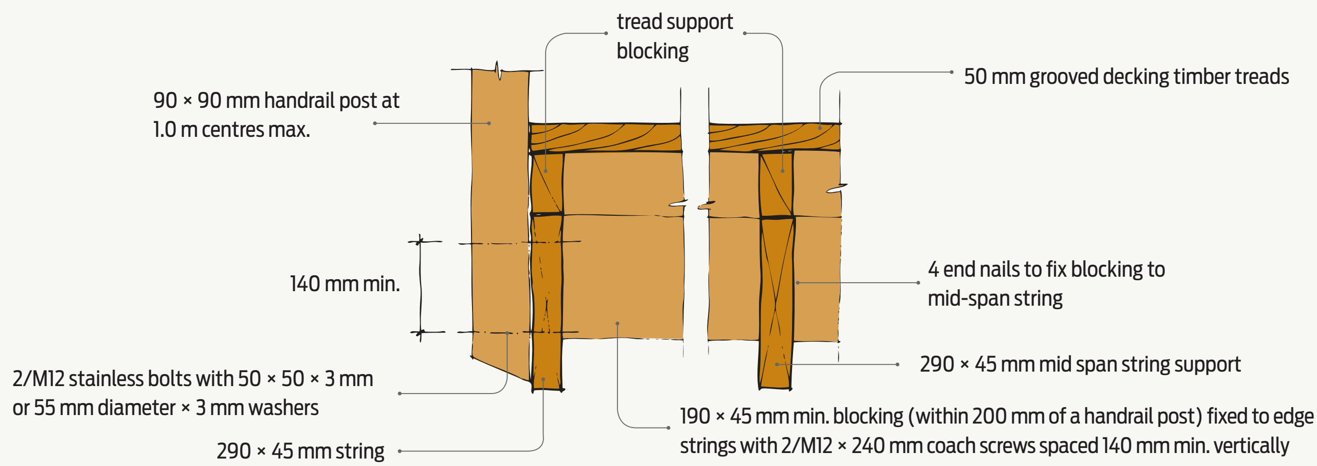


Figure 30 **Handrail post fixing to stair string and mid-span string for wider stairs.**

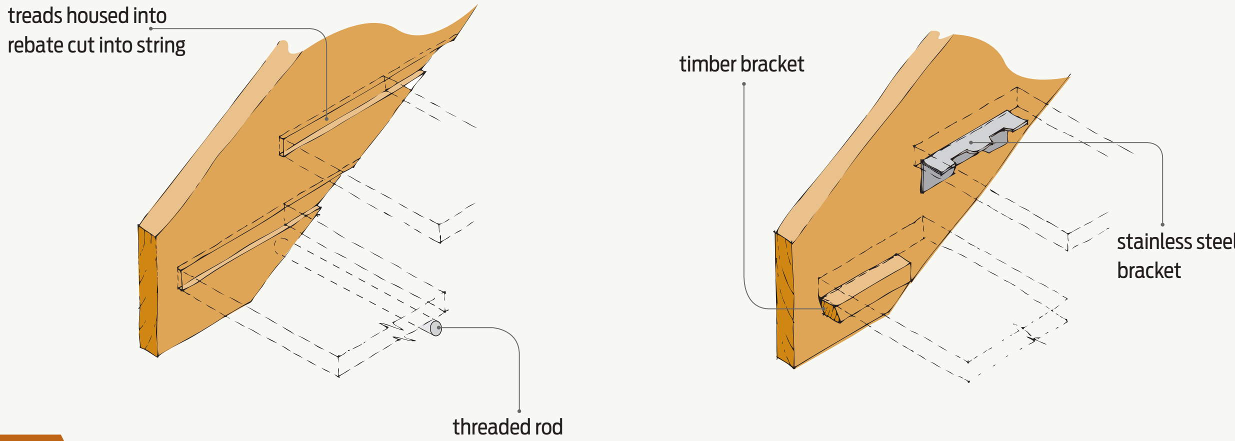


Figure 31 **Alternate tread fixings.**

will need minimum 45 × 19 mm blocking to meet the D1/AS1 requirement.

Support for strings

Strings may be fixed at the top to a boundary or edge joist using joist hangers and supported at the bottom with stainless steel post brackets or timber cleats on a concrete footing (see Figure 29).

Concrete footings should be at least 200 mm square × 200 m deep with cast-in post brackets or bolts for cleat fixing. Alternatively, strings may be supported by being bolted to the timber posts using two M12 bolts per post, with the H5 post set in minimum 200 mm square × 200 m deep concrete footings.

Handrails and handrail posts

Structural posts are 90 mm square and fixed at 1 m maximum centres to each string with two M12 bolts. Give stability to strings and posts with 190 × 45 mm minimum blocking fixed between strings with two M12 × 240 mm coach screws at each end (see Figures 29 and 30). The blocking must be within 200 mm of each handrail post.

Handrails should be to profiles in accordance with D1/AS1 Figure 26.

Top and bottom rails spanning between the structural posts support the balustrade or infill panels. They should be 90 × 45 mm and fixed to the posts with 4/100 × 3.75 mm nails. Balustrades of either 45 × 45 mm or 125 × 25 mm infill timber are fixed vertically to top and bottom rails when they are used or between the handrail and the string.

Stair terminology

Tread – the horizontal surface of the step.
Riser – the vertical component of the step used to connect treads.
String or **stringer** – the inclined timber member on each side of the stairs that supports treads and risers.
Flight – series of steps without a landing.
Landing – a level platform at the top or bottom of a flight of stairs.
Handrail – a rail that is at the same slope as the pitchline to provide support for people ascending or descending the stair. Handrails must be 900–1000 mm above the pitchline.
Pitchline – the line joining the leading edge of successive stair treads in a single flight of stairs.


wattyl®
FORESTWOOD®
Over 30 colours taken from nature
A choice of traditional oil-based and new water-based stains that enhance the look of exterior timber in ways you will absolutely love, while offering superior timber protection. This superb range of colours allows the exterior of your home to be as much a fashion statement as the interior.
FORESTWOOD AQUATECH OIL STAIN
FORESTWOOD TRADITIONAL OIL STAIN
FORESTWOOD WATER BASED DECKING STAIN
FORESTWOOD DECKING STAIN
FORESTWOOD DECK AND FURNITURE OIL