BUILDING PERFORMANCE

BRANZ

GUIDE

Constructing a sleepout that does not require building consent

Building to Schedule 1, Section 3A of the Building Act 2004

DECEMBER 2023

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

Ministry of Business, Innovation and Employment (MBIE)
Hīkina Whakatutuki – Lifting to make successful

MBIE develops and delivers policy, services, advice and regulation to support economic growth and the prosperity and wellbeing of New Zealanders.

This guide covers a hands-on approach on how to construct a sleepout that does not require a building consent. This covers only a single-story detached building with a 10-30 m² floor area and built with lightweight building products, as described in Schedule 1 section 3A of the Building Act 2004.

The guide also provides a worked example per section and links to relevant regulations and resources.

More information

Information, examples and answers to your questions about the topics covered here can be found on our website: www.building.govt.nz

Disclaimer

This document is a guide only. It should not be used as a substitute for legislation or legal advice. The Ministry of Business, Innovation and Employment is not responsible for the results of any actions taken on the basis of information in this document, or for any errors or omissions.

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Contents

Figures

Tables

Introduction

From 31 August 2020, additional building consent exemptions for low risk building work were added to the Building Act 2004. This guide covers the building consent exemption for designing and constructing a single-storey detached sleepout with 10–30 m² floor area and built with lightweight materials. You can find more details on this exemption and others on the Building Performance website.

The sections of the guide cover:

1. Legal requirements before commencing
2. Planning
3. Health and safety
4. Site, foundations and floor
5. Wall framing
6. Roof style and framing
7. Roof cladding
8. Wall cladding, doors and windows
9. Insulation, lining and finishing

It contains links to key resources throughout as well as a glossary and resources section at the end.

This guide gives example construction details for a single-storey 5 x 4 m timber-framed sleepout. The example sleepout is described at the end of Section 3. It has a timber floor on timber framing and foundations, lightweight walls, and a lightweight monopitch roof.

The guide refers to the NZS 3604:2011 Timber-framed buildings. This standard is not a legal document, but a pathway of choice to be able to meet Building Code requirements. You should check for the latest version of this standard on the Standards NZ website.

Limitations of this guide

The guide does not cover sleepouts that include bathrooms, toilets or kitchens. If you want to build a sleepout with any of these facilities, you will need to apply for a building consent.

This is a guide only, before planning or starting building the sleepout, you should undertake due diligence to understand the build process and the risks involved. You may wish to talk to building professionals for advice.

01

Legal requirements before commencing

This section covers the legal requirements you need to consider before you begin the design work on any sleepout.

There are rules that local councils apply to any building work in their area. Check these first to see if a sleepout is even possible. There are also rules around the exemptions that allow some sleepouts to be constructed without a building consent, and there are general rules covering all construction undertaken in Aotearoa/New Zealand.

Check if you need a building consent

A building consent from your local council is needed for most types of building work. Building consents are required by law for most construction in Aotearoa/New Zealand and are set out in the Building Act 2004.

Schedule 1 of the Building Act lists the different types of building work that might not need a building consent. Under certain conditions, some sleepouts do not need a building consent.

Some rules apply to all types of sleepout that do not require a building consent. The sleepout:

- cannot include cooking facilities or have any sanitary facilities such as a toilet, hand basin or shower, or a tank for storing drinking water
- cannot be more than a single storey
- cannot include a loft or mezzanine floor
- can only have a floor level that is no more than 1 m above the ground and a height (the highest point of the structure) up to 3.5 m above the floor level (Figure 2)
- must be used in conjunction with a dwelling that has sanitation facilities (toilet, shower etc.)
- must be no closer than its own height to any boundary or residential building (Figure 3)
- must have a smoke alarm installed as it is a habitable space.

Taking the above into consideration, four categories of sleepout can be built without needing a building consent:

- Single-storey detached sleepouts with no more than 10 m² floor area (Figure 1).
- Single-storey detached sleepouts with 10–30 m² floor area and built with lightweight building products (such as weatherboards and corrugated metal roofing). This guide provides more information about this exemption. You can find more details about this exemption on the Building Performance website.
- Kitset/prefab sleepouts with 10–30 m² floor area designed or reviewed by a chartered professional engineer. You can find more details about this exemption on the Building Performance website.
- Sleepouts with 10–30 m² floor area where Licensed Building Practitioners (LBPs) with the appropriate licences carry out or supervise design or construction. These LBPs can be building designers or trades such as bricklayers, carpenters, plasterers or roofers. You can look for someone who has an LBP licence in the public register.

Sleepouts constructed from materials that are not lightweight (such as bricks, concrete blocks, solid concrete, earth, stone, clay or concrete roofing tiles) are not covered by this guide.

Even if your sleepout doesn't need a building consent, you still need to follow both local council requirements for construction and the New Zealand Building Code to make sure the building is safe, healthy and durable for people to use.

Sleepouts built with lightweight building products

Buildings such as sleepouts need to use 'lightweight building products' when they are constructed without a building consent. These building products must be:

- lightweight framing that is either timber or steel framing
- lightweight wall and ceiling lining products such as plasterboard panels
- lightweight cladding products such as weatherboards and profiled metal roofing.

In technical terms, the wall cladding cannot weigh more than 30 kg/m^2 and the roofing cannot weigh more than 20 kg/m^2. To find out more about the weight of building products to see if they are suitable, ask your building material supplier or check the manufacturer's documentation.

Light timber framing, light wall cladding and light roofs are all described in the New Zealand building design standard NZS 3604:2011 *Timber-framed buildings*.

A number of options for light wall cladding and light roofs for these buildings are described in the Acceptable Solution E2/AS1 for Building Code clause E2 *External moisture*.

See the National Association of Steel Framed Housing (NASH) design standards (https://nashnz.org.nz) for more information about light steel framing. These need different tools and skills to those needed for timber framing. As with timber, you could order preassembled frames rather than building them yourself.

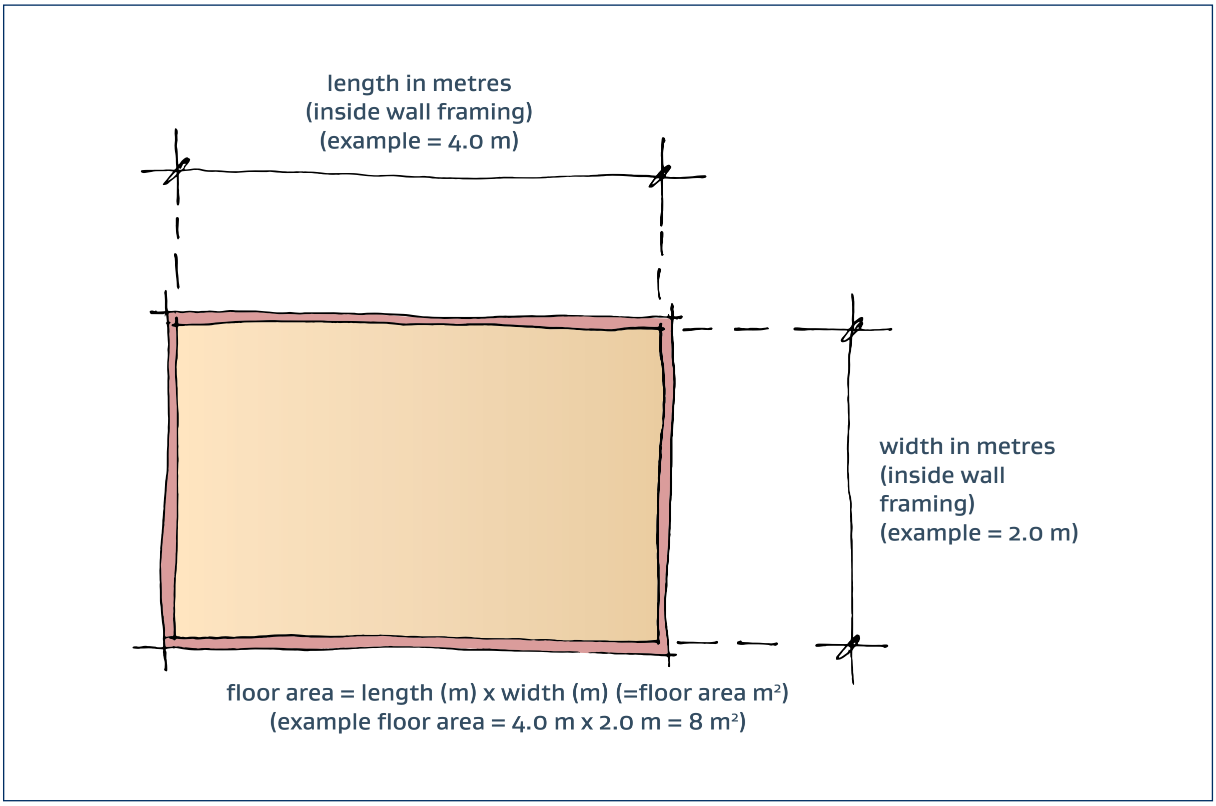


Figure 1. Floor area is measured to the inside of the enclosing walls or posts/columns

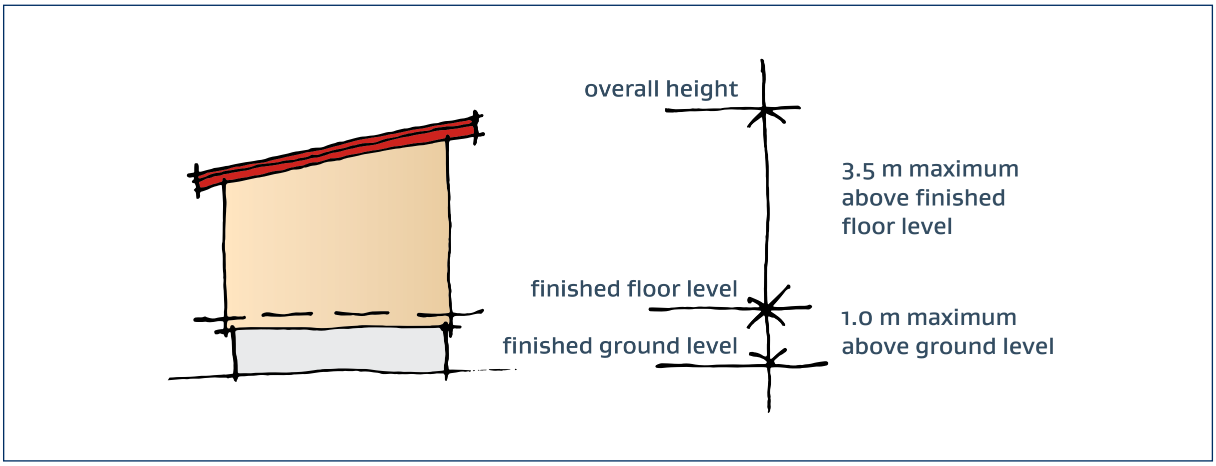


Figure 2. Height limits for an exempt sleepout

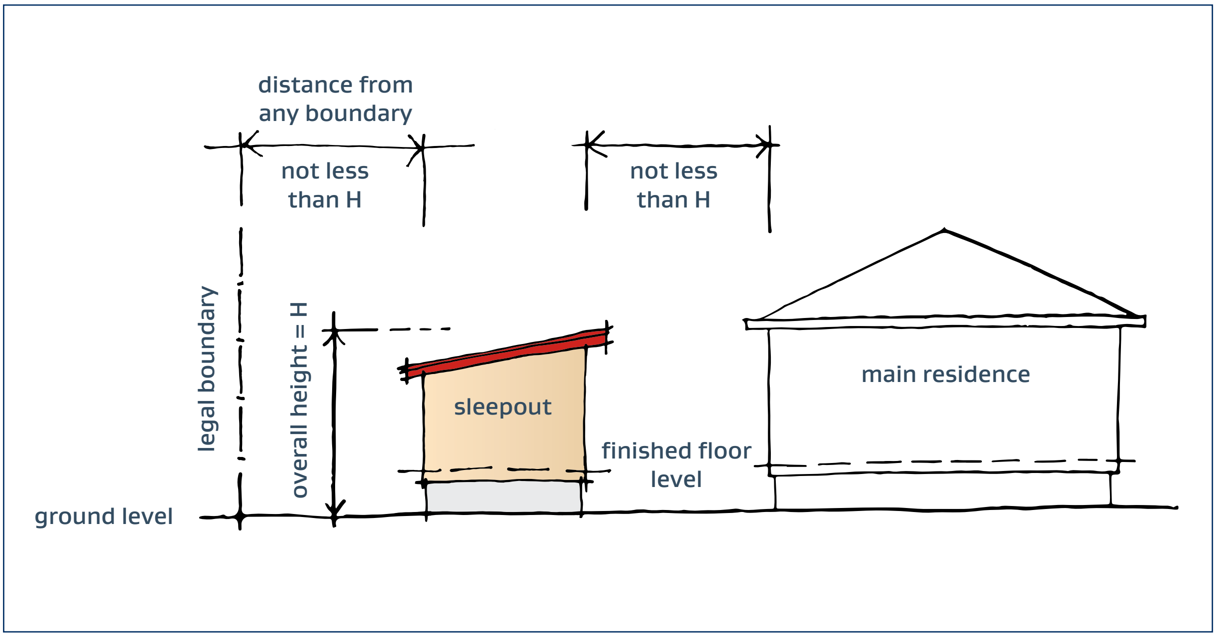


Figure 3. The exterior cladding on the sleepout must not be any closer than its own height to any residential building or any legal boundary

More information on building consents

- Find out more about buildings that don't need a building consent.
- Download a copy of the Ministry of Business, Innovation and Employment (MBIE) guidance document Building work that does not require a building consent.
- Use the CanIbuildit interactive tool to see if your building work needs a building consent and what you need to do before starting physical work.
- If you find you need to apply for a building consent or you're unsure, contact your local council. You may be able to get a discretionary exemption from the council (clause 2 of Schedule 1 of the Building Act). If you are asking your council for information or advice, they will need to know the size of sleepout you are planning (including the floor area and height), the materials you plan to build it with and where you want to position it on the property.

Local council requirements for building work

District plan rules

There are rules that affect sleepouts, like all buildings, in each local council's district plan. Some district plans include rules to determine whether or not you can build a sleepout on a property and, if so, where it can be located on the property. Some of these rules are described in the below examples.

Be aware that, even for a sleepout that is exempt from building consent under Schedule 1 of the Building Act, there may be cases where a resource consent is required from your council. For example, a sleepout that takes site coverage over the percentage limit your council has set, or your design does not comply with the recession planes.

Also, more general rules in the district plan can affect your construction. A good example is noise – typically, you cannot use a power saw or other noisy equipment in a residential neighbourhood late at night or very early in the morning.

Find out the district plan rules before starting work. Many councils have guidance about this on their websites or contact them directly.

Other council requirements

In addition to the rules found in their district plan, councils often have other requirements that affect construction within their area of jurisdiction or construction that could impact infrastructure networks within their control. Check with your local council whether any such requirements will apply to a sleepout at your property.

Examples of local council requirements

Below are some examples of typical local council requirements and the technical terms they use.

Site coverage

This is the proportion of the land area on a property that is covered with buildings. It often needs to be less than 40 per cent or 50 per cent but can be as little as 30 per cent or as much as 60 per cent. For example, if you already have a 140 m^2 house on a 320 m^2 section and the limit in your area is 50 per cent, you can add a sleepout up to 20 m^2 but not up to 30 m^2.

Minimum permeable area

Many councils have a minimum area of the property that needs to be permeable (with grass, planting or permeable paving) so rainwater can soak into the ground (Figure 4).

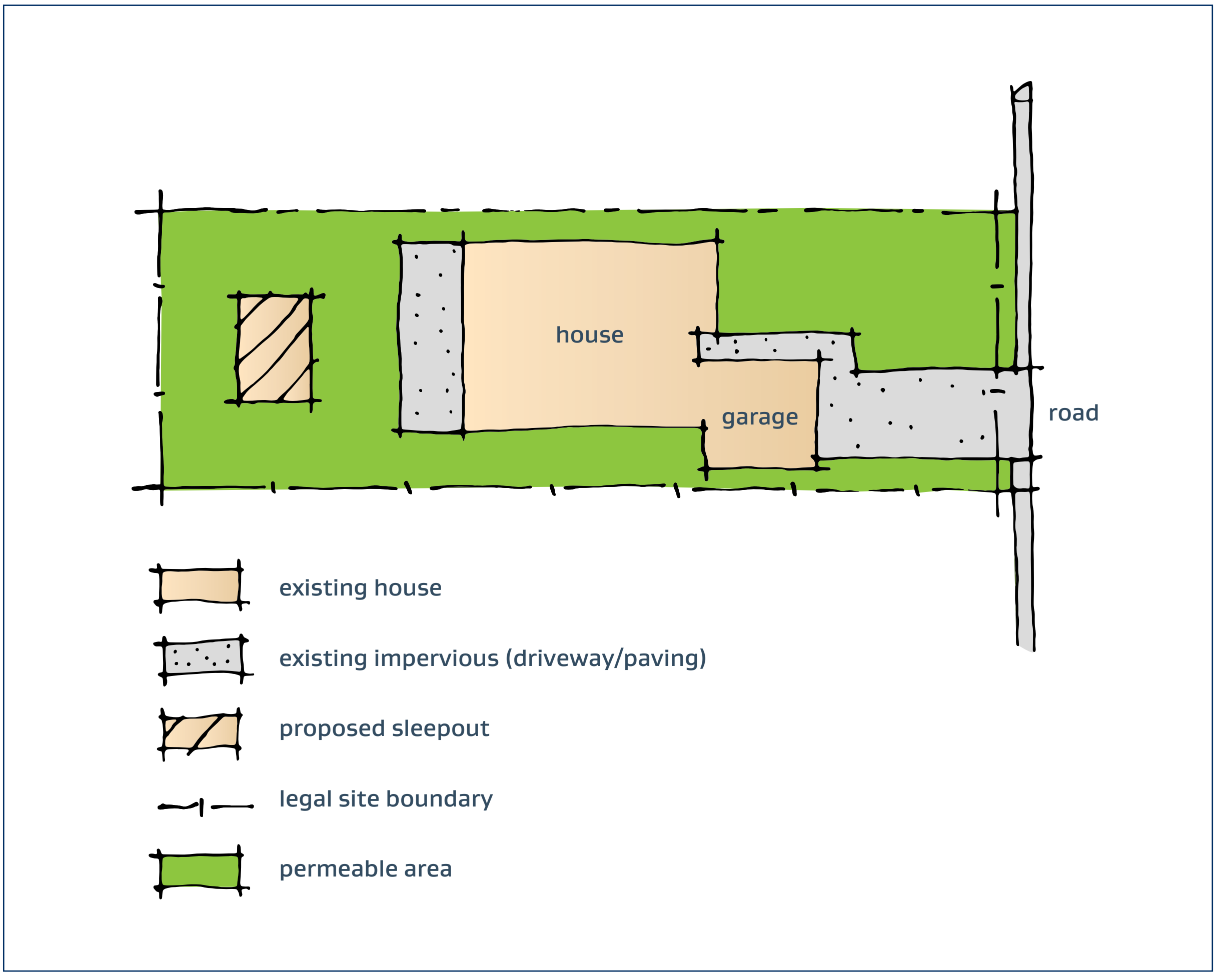


Figure 4. Councils often require a minimum area of the property to be permeable so rainwater can soak away

Stormwater disposal

Check whether the water collected from the roof of new buildings is able to be piped directly into the existing private stormwater drains and into the public stormwater drain (the stormwater system). Public stormwater drains are not available in all areas. Some councils and network utility operators do not allow additional stormwater to be discharged into their networks, particularly where there are capacity constraints.

If the stormwater cannot be piped directly, you will need to make arrangements to dispose of the water on the property, to retain it for use on the property, or to reduce flows into the public stormwater network. Most of these methods of disposing of stormwater should be discussed with your council or network utility operator and may need a building consent.

Stormwater drainage off the sleepout must not affect existing neighbouring properties or buildings.

All stormwater drainage work must be undertaken by an authorised drainlayer. You can find more details about this from the Plumbers, Gasfitters and Drainlayers Board.

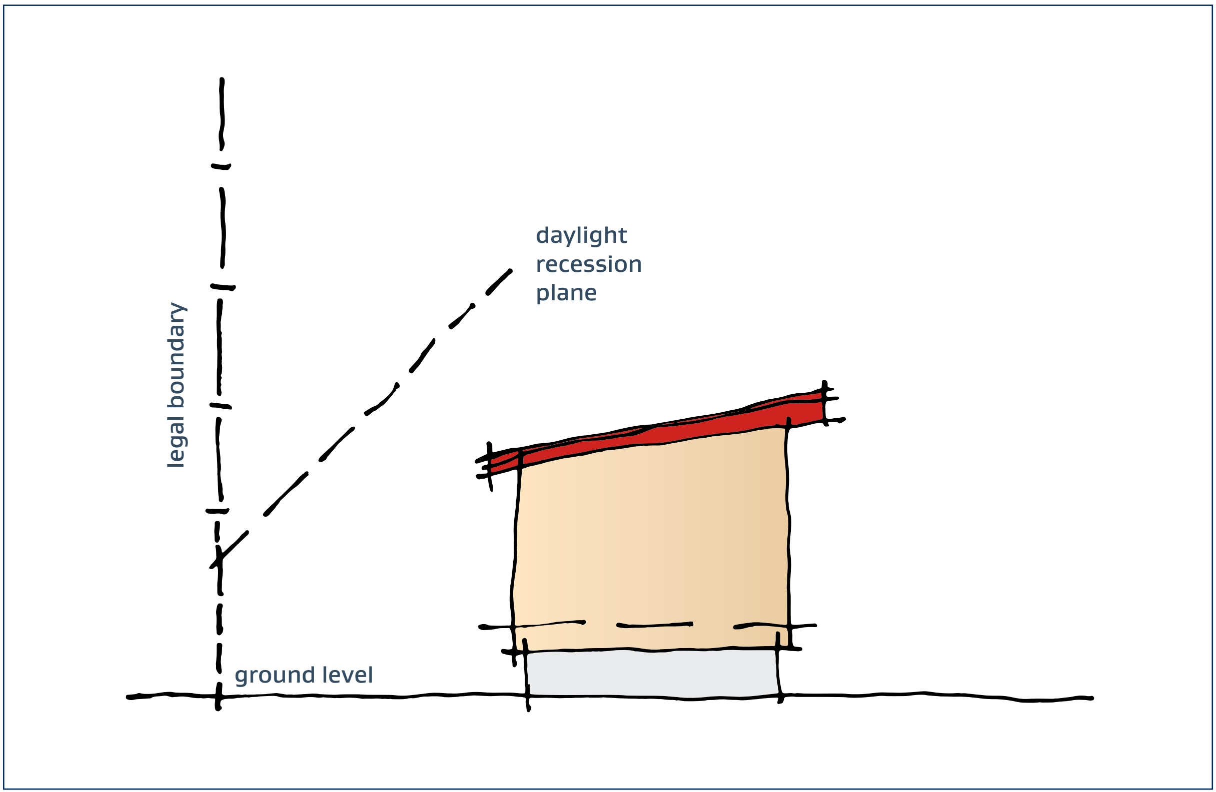


Figure 5. No part of the sleepout can be above the daylight recession plane

Set-backs and recession planes

District plans limit how close buildings can be to a boundary (a yard or set-back) and their maximum height (a recession plane – Figure 5). Among other things, this is to avoid buildings blocking out neighbours' sunlight.

Sleepouts that don't need a building consent must be at least their height away from a boundary (and to any residential building) so they may already comply with set-back and access plane rules, but you still need to check.

Outdoor living space

Some urban residential zones require minimum areas of continuous outdoor living space. A common requirement is a minimum of 30–60 m^2 that is directly accessible from the house. Some councils also require this area to have a minimum length or width such as at least 5 m across.

Proximity to underground services

There are rules covering how close you can build to drains, water mains and other underground services. You must check with the asset owners before building over or near any underground services. Use the free *BeforeUdig* service (see the Resources section at the end of this document) to find the locations and other information about cables, pipes and other utility assets in and around your property.

Flood areas

In locations vulnerable to hazards such as flooding or rising sea levels, the minimum floor levels for new buildings may need to be higher than normal, or new construction may not be allowed at all. Building in an existing overland flow path could cause flooding of your property or a neighbouring property. Check the flood maps in the district plan for your area or ask your council for guidance.

Property title check

Check your property title. There may be an easement on the title. This typically covers a neighbour or local authority running an underground service through a property and limits how you can use the affected land. Some titles, especially in new subdivisions, have restrictive covenants that limit what you can do on the site. They can rule out sleepouts.

Government regulations that apply to all building work

Even if you don't need to apply for a building consent for your sleepout, all building work in New Zealand must meet the performance standards of the Building Code, even if it doesn't require a consent. Your sleepout must also comply with other regulated matters such as electrical and drainlaying work.

The Building Code sets out the minimum levels of performance that a building must meet. The Building Code has 38 clauses covering specific types of performance such as structural safety, durability, moisture management, energy efficiency, fire safety and services such as the provision of light and ventilation.

This guide gives a high-level explanation of the Building Code, but if in doubt, ask a builder or an architect or designer to help you find out what you need to do.

Because a sleepout is a habitable space, the Building Code says it must have, among other things, fresh air ventilation, natural lighting, thermal insulation, a safe escape path and a smoke alarm. You will have to comply with a number of Building Code clauses as explained in the construction sections of this guide.

Complying with the Building Code

There are methods you can use to design buildings that will comply with the Building Code through acceptable solutions. For example, Acceptable Solution E2/AS1 shows the construction of cladding systems for timber-framed buildings that will meet the weathertightness requirements in the Building Code in clause E2 *External moisture*.

Verification methods provide more advanced technical ways of complying with the Building Code that require calculations or tests. These methods are not covered by this guide.

The main documents that can be used to demonstrate compliance with the Building Code can be downloaded from the Building Performance website.

This section explains the Building Code clauses that your sleepout must comply with.

Geographic zones

Many of the design rules for sleepouts depend on the geographic zones they are being constructed in. There are different zones for earthquakes, corrosivity, wind, climate and snow. You can find which of these zones apply to your property using the BRANZ Maps zone information tool.

Sections 4–9 of this guide explain the design rules used by the acceptable solutions for specific circumstances and zones.

This guide gives construction details that could be used for a sleepout. The worked examples provided could be used to construct a lightweight sleepout suitable for use in the following zones:

- **Earthquake zone 1** – this includes the northeast of the North Island, including Northland, Auckland, Coromandel, Waikato and Taranaki, and part of the eastern South Island running from Rakaia down to Invercargill.
- **Exposure zone B/C** – all of mainland New Zealand that is at least 500 m from the coastline.
- **Wind zone** – low, medium or high.
- **Snow zone N0** – that part of the North Island to the northeast of a line approximately from Ōpōtiki to Tūrangi to New Plymouth, including those towns.

You can find the earthquake and exposure zones for your location using BRANZ Maps. You can also find your wind zone with this tool, or you could ask your local council for this. You can find the snow zone in NZS 3604:2011.

Sections 4–9 of this guide show where you can find information when you need to build a sleepout in zones that are not covered by the worked examples. For example, buildings:

- in zones that have stronger winds or earthquakes will need stronger foundations, wall and roof framing
- in coastal zones will need metal elements such as fixings to be made from stainless steel to protect against corrosion
- in colder zones of the country will need higher levels of insulation to keep them warm in winter.

Building Code clauses relevant to sleepout building projects

Clause B1 *Structure*

The main objective of this Building Code clause is to keep people safe from injury if the structure fails by, for example, having the roof blown away during a storm or some walls fail during an earthquake.

This clause sets out minimum requirements for how buildings need to perform during extreme events. For example, a single-storey detached sleepout with a floor area of 10–30 m² using lightweight materials will comply with the requirements in clause B1 if it is designed using Acceptable Solution B1/AS1. This means it will be designed using either light timber framing (following NZS 3604:2011) or light steel framing (following the NASH standards). Sections 4–6 give more details.

The extreme events that could affect the structure vary across the country. The design for the bracing in your sleepout will be based on the wind and earthquake zones you are in. An area with extreme winds and high earthquake risk such as a Wellington hilltop would need to be more strongly built to be able to cope with those risks. There are additional rules around building on ground that is prone to liquefaction (where liquid below the ground is forced to the surface by an earthquake).

NZS 3604:2011 divides the country into zones based on the risks associated with earthquakes and wind.

Earthquake zones

There are four earthquake zones, from 1 to 4, with 1 being the lowest-risk area.

Use the BRANZ Maps online tool to find out which earthquake zone your sleepout will be in. Local councils can help identify liquefaction-prone ground in their areas – many councils have produced online maps showing this.

Wind zones

There are five different wind zones:

- **Low** – below 32 metres/second (m/s) or 115 kilometres/hour (km/h).
- **Medium** – 37 m/s or 133 km/h.
- **High** – 44 m/s or 158 km/h.
- **Very high** – 50 m/s or 180 km/h.
- **Extra high** – 55 m/s or 198 km/h.

Where the wind is over 55 m/s – a property in a zone with the strongest winds – an engineer must be consulted. Knowing the wind zone is important because it tells you how strong the framing needs to be and how much bracing you will need to put into your foundations, walls and roofs. The higher the wind zone you live in, the more bracing your sleepout will generally need to avoid it being blown over.

Some councils hold wind zone maps that show you the zone you are in.

Calculating the wind zone yourself takes a bit of work – this *Build* article explains how to find the correct wind zone for your site.

You could also ask a draughtsperson or designer to work out the wind zone and prepare a bracing design for you. Depending on who you ask, the cost of this could be 1–3 per cent of your total budget.

Clause B2 *Durability*

All the components of a building, with appropriate maintenance, must continue to comply with the Building Code for at least 50, 15 or 5 years, depending on whether the particular part of the building provides structural stability, how easy it is to access or replace and how likely its failure would be spotted.

- At least 50-year durability is required for foundations, floor framing, exterior wall framing, roof framing and bracing because these give a sleepout stability, would be difficult to see if they were deteriorating, and would be difficult to replace.
- At least 15-year durability is required for wall and roof claddings and flashings.
- At least 5-year durability is required for things like wall linings and paint that are reasonably easy to see and replace.

Acceptable Solution B2/AS1 shows ways to achieve this. For example, it shows the different types of timber treatment required within different parts of a building – timber used for decking that is exposed to the weather needs a higher level of treatment than timber used in the roof space that is protected from the weather.

For a sleepout, the timber treatment typically required will be:

- timber piles – H5
- bearers – H1.2 if the base is fully enclosed or else H3.2
- joists – H1.2
- wall and framing timber – H1.2
- timber cavity battens – H1.3
- timber weatherboards – H3.2
- particleboard flooring – H3.1 if within 550 mm of the ground.

There are different risks of metal corrosion in different locations – for example, coastal buildings exposed to sea salt have a higher risk of corrosion. NZS 3604:2011 has a map that is reproduced in this [BRANZ sustainable building map showing three exposure zones]. If you want to build a sleepout close to the sea in zone D, which has a higher corrosion risk, you will need to use stainless-steel fixings whereas in some zones, galvanised steel fixings would be satisfactory on a site that is well inland.

Exposure zones defined in NZS 3604:2011

Zone B (lowest risk) – inland areas with little risk from wind-blown sea-spray salt deposits.

Zone C (medium risk) – coastal areas with relatively low salinity and with medium risk from wind-blown sea-spray salt deposits.

Zone D (high risk) – coastal areas within 500 m of the sea including harbours or 100 m from tidal estuaries and sheltered inlets. Includes all offshore islands.

The durability of cladding materials and components is covered by E2/AS1, which also includes zone E – severe marine – breaking surf beachfronts.

Sites in zone E, sites near geothermal hot spots and sites that are exposed to industrial contaminants, agricultural chemicals, or fertilisers will require expert specialist advice.

Clause C *Protection from fire*

C

BUILDING CODE

This clause aims to keep people safe if there is a fire, to protect surrounding buildings, to ensure that firefighting and rescue operations can be carried out, and to reduce the likelihood that fire will break out.

Some requirements (such as how close the building is to a boundary) may already be covered by the building consent exemption rules. This includes a sleepout being no closer to a boundary or residential building than a distance equal to its height.

There are rules for the types of materials that can be used and rules for things such as installing solid fuel burners (which would require building consent).

A sleepout is required to have a working smoke alarm. More information can be found in NZS 4514:2021 Interconnected smoke alarms for houses.

There are many overlaps with rules for other clauses such as B1 *Structure*, D *Access routes*, F7 *Warning systems* and G9 *Electricity*.

Clause D1 *Access routes*

For sleepouts, this clause requires people to be able to safely and easily get in and out of the sleepout and move around inside and around it. Walking surfaces should be slip-resistant, and if the floor is raised and there are steps, there are certain rules for making these obstructions safe.

D
BUILDING CODE

Clause E1 *Surface water*

Surface water (typically rainwater) must be safely removed through a drainage system to avoid injuring people or damaging property.

E
BUILDING CODE

Buildings must be positioned so that they are not affected by flooding and do not adversely affect existing overland flow paths for surface water through a property.

Acceptable Solution E1/AS1 gives acceptable minimum floor levels and methods for sizing downpipes, roof gutters and stormwater drainage systems.

Verification Method E1/VM1 gives a practical (although very technical) method for designing soak pits that will allow water to soak slowly into the ground. Soak pits should be designed by suitably qualified and experienced professionals, and, where associated with a building, a building consent is required.

Clause E2 *External moisture*

Buildings must be constructed so that external water cannot get in, damage the building, or harm the occupants. Roofs must shed water and melted snow. Roofs and walls must prevent water getting into a building. Parts of the building that are close to or touching the ground must not absorb or transmit moisture. Buildings must also be constructed to deal with the possibility that water might get in.

Clause E2 contains rules for the performance of roofing, walls, windows and flashings. E2/AS1 gives the practical details, showing how things should be constructed to reduce the risk of water getting into the building.

In particular, E2/AS1 has a method for assessing weathertightness risk. The level of risk is assessed by considering things such as the wind zone the building is in (driving wind can force moisture into cracks and gaps). The assessment also considers other features of the design such as the junctions between the roof and walls and the width of the eaves (the part of the roof that overhangs the walls). The risk score produced by the weathertightness risk assessment will be between 0 (low risk) and 20 (extremely high risk).

This risk score guides you in choosing wall claddings that are suited to the building and where it is being built. For example, a sleepout with a low score (of 6 or less) can have most cladding materials directly fixed to the framing, while a sleepout with a high score of 13–20 has only one option that can be directly fixed to framing – corrugated vertical profiled metal.

Wall cavities are often used to improve weathertightness by making it easier for rainwater that gets through the cladding to run down the back surface and to evaporate into the air flowing through ventilation gaps. A cavity can allow a cladding to be used on a higher-risk building than if it was directly fixed to the framing.

To build a cavity, battens are fixed to the wall framing and then the wall cladding is fixed through the battens into the framing. This leaves a drainage and ventilation space of around 18–20 mm behind the cladding.

In extra high wind zones, E2/AS1 requires all wall claddings to have a cavity.

Clause E3 *Internal moisture*

A sleepout's construction must provide protection against occupant harm and building damage caused by moisture generated in the building that condenses on wall and roof surfaces, particularly on cold nights.

Sleepouts covered by this guide will not include cooking or sanitary facilities and so are not expected to contain plumbing systems that could be sources of internal moisture.

Occupant activities such as breathing are also sources of internal moisture.

A sleepout that meets the minimum requirements for ventilation and insulation (see below) will comply with requirements for controlling internal moisture and should perform satisfactorily as long as suitable heating is provided.

Clause F2 *Hazardous building materials*

F

BUILDING CODE

Building materials that are hazardous must be selected, designed and installed in a way that reduces the risk of people being hurt or becoming ill. For example, if someone could accidentally fall or walk through some types of windows or glazed doors, those windows and doors must be made with safety glass. A window or door supplier can usually provide advice on whether safety glass is needed once window and door positions have been decided.

Clause F4 *Safety from falling*

Buildings must be constructed to reduce the likelihood of accidental falls. Barriers must be constructed everywhere that people could fall 1 m or more. Buildings constructed using this guide will comply with this clause as the floor can only be up to 1 m above the supporting ground.

Clause F7 *Warning systems*

Buildings must have a way of warning people so they can escape to a safe place in an emergency. This means each sleepout needs to have a working smoke alarm.

Clause G4 *Ventilation*

G

BUILDING CODE

Sleepouts are occupied spaces so there must be a way to ventilate them with fresh outdoor air. Acceptable Solution G4/AS1 allows a space in a sleepout to have natural ventilation provided by a net area of openable windows (or other openings to the outside) that are at least 5 per cent of the floor area.

Clause G7 *Natural light*

Sleepouts must provide windows for natural light to enter and so people inside can look out. In technical terms, natural light must provide an illuminance of at least 30 lux at floor level for 75 per cent of the year. (This is a not a high level – lighting in a typical living room is around 50 lux, in an office 350–500 lux.) Acceptable Solution G7/AS1 allows windows with a glazed area of at least 10 per cent of the floor area to be used to meet this requirement as long as provisions are met in relation to the type of glass (its transmittance), the window head and ceiling heights and avoidance of obstructions in front of or overhanging the windows.

Clause G8 *Artificial light*

A sleepout must have enough artificial light for people to safely move between inside spaces when there is no natural light. In technical terms, the illuminance at floor level needs to be at least 20 lux.

Clause G9 *Electricity*

Electricity must be supplied to a sleepout in a way that prevents fire and personal injury. Connecting a sleepout to the power supply of a house must be carried out by a registered electrician, and they need to provide a certificate of compliance when they complete their work.

Clause H1 *Energy efficiency*

The walls, roof and floor of the sleepout must contain thermal insulation to keep the indoor space at a comfortable temperature, and there should be no draughts. Windows are also a key part of the thermal performance of the building as a whole.

Good design can play a role here – positioning and orienting your sleepout and designing its windows so the sun provides warmth in winter. This is known as passive or solar heating.

The minimum level of thermal insulation for walls, roof, floor and windows depends on how they will be constructed and which of six climate zones your property is in. These are detailed in Acceptable Solution H1/AS1. The colder the zone you live in, the more insulation is required.

Zone boundaries align with territorial authority boundaries:

- Zone 1: Northland, Auckland, Coromandel and Bay of Plenty.
- Zone 2: Hamilton, East Coast and New Plymouth.
- Zone 3: Manawatū, Horowhenua, Wellington, Nelson, Marlborough and the Chatham Islands.
- Zone 4: Central Plateau, Wairarapa and the West Coast.
- Zone 5: Canterbury and coastal Otago.
- Zone 6: Inland Otago, Southland and Stewart Island.

You can find your climate zone in H1/AS1 or use BRANZ Maps.

The consequences of not following the law

The costs of not following the requirements can be high.

If you don't comply with the Building Act or the building does not comply with the Building Code, your local council can issue you with a notice to fix. This could require you to apply for a building consent if what you are doing requires you to fix the building to bring it into line with the law. You could receive an instant fine of $1,000 if you don't comply with a notice to fix.

If you keep ignoring a notice to fix and the council takes you to court, you could be fined up to $200,000 if you were found guilty of breaking the law and then up to $20,000 for each day you are in breach of the law. In many cases, council action will follow complaints from neighbours – a good reason to talk with your neighbours at an early stage.

Not following the requirements could have other consequences too – insurance cover for the sleepout may be void, for example.

Checklist

Do you need a building consent for your sleepout?

Step 1

Does it meet the general requirements for an exempt sleepout?

- It will not contain a kitchen or cooking facilities or sanitary plumbing such as toilet, shower, hand basin or kitchen sink.
- It will only be a single storey with a floor level no more than 1 m above the ground and a height of no more than 3.5 m above floor level.
- It will be no closer than its own height to any residential building or any legal boundary.
- If it is to include sleeping accommodation, it will be used in connection with a dwelling.

NO

YES

Step 2

Does it fit one of the four categories for exemption?

- A single-storey detached building less than 10 m^2 in floor area.
- A single-storey detached building of 10–30 m^2 built with lightweight materials.
- A kitset or prefab building of 10–30 m^2 that is designed or reviewed by a chartered professional engineer.
- A building of 10–30 m^2 where licensed building practitioners with the appropriate licences carry out or supervise design or construction.

NO

YES

Step 3

Does it comply with local council requirements?

- It complies with district plan restrictions around maximum site coverage, minimum permeable area, setbacks and recession planes, minimum outdoor living areas, flood plain or coastal building limitations.
- The building work will avoid adversely affecting any existing overland flow paths for surface water through the property.
- There are no underground pipes or services in the proposed site.
- The plans met council requirements for stormwater disposal.

NO

YES

Use this guide for your sleepout

Building consent required

02

Planning your sleepout

Before you start buying materials, setting out the foundations and inviting the relatives to stay, you need to plan what you are doing. Planning helps you get a realistic idea of the work and will help the construction go more smoothly.

While you may do most of the work yourself, you will need to know when to get expert help. In some cases, this will be a legal requirement (for example, a registered electrician to connect electricity in the sleepout to the power board in the house or an authorised drainlayer to install stormwater drainage to dispose of roof water). Getting professional help may also make life easier in areas such as calculating the bracing necessary in foundations, wall and roof framing.

Thinking through what is required well in advance is particularly important for getting a realistic idea of costs. You may want to hold off buying your construction materials and get a quote so you understand the full costs of your project before you begin. You will need to get quotes – for example, from a Registered Electrician. Having a contingency fund for unexpected costs is crucial.

Read through this guide to get a clear picture of what is necessary, particularly the mandatory Building Code requirements.

Develop your ideas

Work out how you plan to use the sleepout. Will it be a bedroom for a teenager? A bedroom for visitors? A hobby room? A home office? How much space will the purpose require? What storage will be needed? Will there be beds and, if so, where will they go?

This will help guide the building's size, shape and design. Should it have a single large space or be divided into two? Would it benefit from lots of natural light – a hobby room might – or does it need at least one wall without windows for extensive shelving? Make the space as versatile as possible – you may want to use the space for other purposes in the future. A space that allows different uses will also be an asset if/when you sell your property.

Do your ideas meet the requirements?

Once you know the purpose, size and shape of your sleepout, the next step is to check that what you want to do meets all of the requirements in section 1 – there is a checklist that can help. If what you want to do is outside one of the council rules by a very small amount, talk to your council for a discretionary exemption. This allows the council to use their discretion to exempt any proposed building work if it complies with the Building Code or is unlikely to endanger people or buildings.

Check your property boundaries closest to the sleepout. There may be boundary pegs to work from. Never assume a fence runs exactly along the boundary. In some cases, you may need to call in a land surveyor.

Ask your lawyer for advice if your home is held under cross-lease ownership or is built on leasehold land. On a cross-lease section, you jointly own the site with other owner(s) and each party cross-leases their house from the other owner(s). You will need the other owners' consent to build a sleepout.

Location and orientation

The rules for sleepouts covered in section 1 will most likely play a large part in determining where the building can sit on the property. Beyond this, there are other considerations:

- **Access** – it should be easy to get in and out of. Can occupants of the sleepout, including those with limited mobility, easily get to a bathroom in the house in heavy rain?
- **Orientation for the sun** – it is much more pleasant occupying a building that allows direct sun in the windows in winter and avoids summer overheating.
- **Orientation of windows for outlook** – can the sleepout have a pleasant outlook?
- **Privacy** – would it matter if a sleepout window looks directly into a window in the adjacent house (or neighbouring house), or would people in each of the buildings want privacy?
- **Water from the roof** – where will the rainwater go? Would it cope with a heavy storm?
- **Future changes** – are there trees on the same site or a neighbouring site that could grow to be a problem? Could the neighbours erect a building that would block the winter sun?

Finalise your building design

Choose a building form appropriate for the location. For example, a flat-roofed design is not a good option for areas of high rainfall, such as the Waitākere Ranges where there can be 1,500 mm or more of rainfall each year.

Complex designs are harder and more expensive to build. More things can go wrong and they may be harder to maintain. Keep the roof as simple as possible (Figure 6). Try to use as few different types of materials as you can – ideally one type of roof cladding and one type of wall cladding.

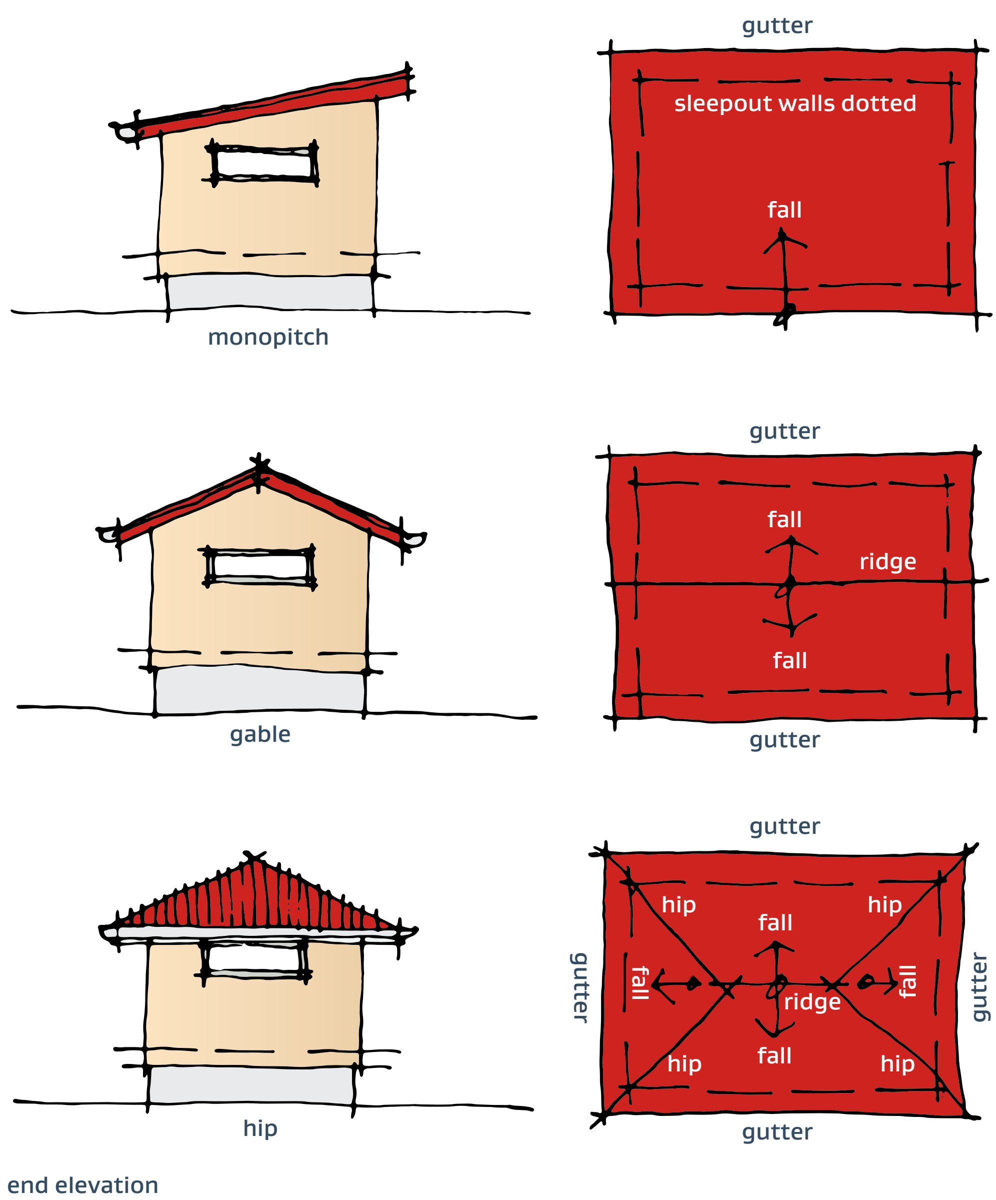


Figure 6. Three simple types of sleepout

Drawing your plans

Keep your plans as simple as possible while still ensuring they cover all the essentials.

Your sleepout will be a single storey detached building – with a floor level that is no more than 1 m above ground and a height of no more than 3.5 m above floor level. The floor area must be no bigger than 30 m² (see section 1).

A site plan, set of drawings and construction details for the sleepout are not legal requirements, but having them will make for faster and more accurate construction and help reduce confusion and potentially expensive mistakes.

Site plan

The main reason for drawing a site plan is to show where the sleepout walls will be located in relation to other buildings and the boundary (Figure 7).

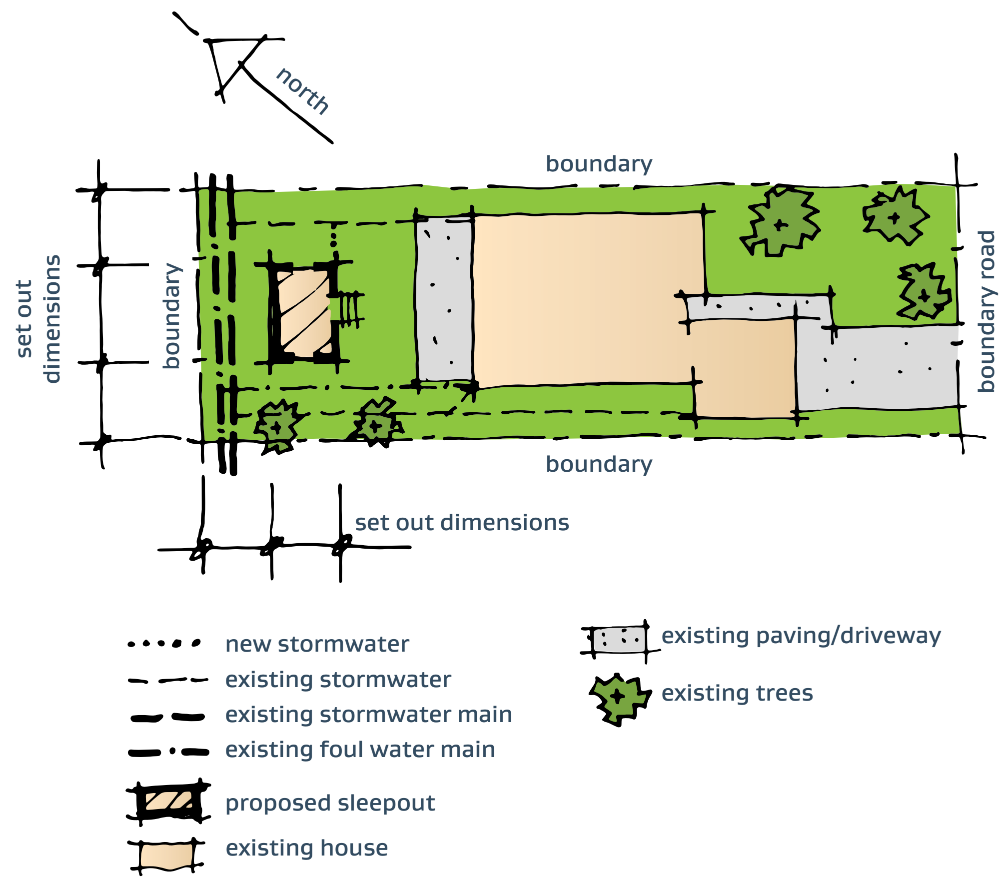


Figure 7. Simple site plan showing the location of the sleepout on the property with all key elements of the site included

The below items should be considered when drawing a site plan:

- the legal boundaries
- easements
- the outlines of all existing buildings on the property, with doorways and windows marked
- driveways and pathways
- any underground services running through the property
- any large trees, retaining walls or other significant features
- the outline of the proposed sleepout, with doorway(s) and windows marked
- the measurements that the sleepout must comply with – the distance from the house and from the closest boundary
- the north direction
- proposed stormwater drainage and connections.

You may want to draw your site plan to the exact scale such as 1:200 or 5 mm per metre. If you are not confident, ask for help from a suitable expert such as an architect or building designer.

Construction drawings

The construction drawings serve multiple purposes as they:

- detail how your sleepout will be put together and how building products and materials are installed
- help confirm that you have met legal requirements
- help you to work out exactly what materials you will need.

Take time to get the drawings right and check all measurements at least twice.

Architects and designers largely work on computer screens, and if you have the equipment, the software and the inclination, this is a good option. Most people building a sleepout are likely to prepare drawings on paper. Work on larger sheets of paper. Give every drawing the scale it is drawn at, a title and a date.

If you are not confident in producing the construction drawings to scale, ask for help from an expert.

The construction drawings will normally be precisely to scale (such as 1:50 or 20 mm per metre) and include the following:

- **Foundation plan** – for a suspended floor, this will show overall dimensions and the type and location of all piles, bearers and joists and subfloor bracing elements. For a concrete floor, it will show the overall dimensions, thickness, foundations and reinforcing.
- **Floor plan** – showing the locations of walls, wall bracing elements, all interior and exterior joinery (e.g., doors and windows), and the lights, switches and wiring. Decks, steps and/or ramps, and the outline of the roof, should be included.
- **Exterior elevations** – a straight-on view of each wall from the outside showing wall and roof claddings, window and door locations, stairs, guttering and downpipes etc.
- **Roof plan** – showing roofing materials, bracing elements, gutters, downpipes and roof pitch. If you plan to use a frame-truss manufacturer, they may help with this plan.
- **Cross-section** – a section through the building showing all construction materials, linings and claddings. This will identify the locations of all construction details.
- **Construction details** – showing junctions and interfaces such as wall/roof junctions, soffit details, window and door head/sill/jamb etc.

You need to carry out bracing calculations for the subfloor, wall and roof. These calculations (explained in sections 4, 5 and 6) help you to ensure that your design and the materials you select will make the sleepout resilient in strong winds and earthquakes and will meet Building Code requirements. The calculations provide the information that goes into the foundation plan, floor plan and roof plan. You can make the calculations yourself, or ask a draughtsperson or designer to help.

To ensure the information about your property is kept up to date, it is recommended that you notify the council of any exempt work you carry out (like the sleepout) and provide them with your construction drawings and any other supporting information. Councils may charge for this.

Choosing foundations – concrete slab or suspended timber?

There are many considerations that guide the type of foundations you will use:

- **Cost** – having a concrete slab constructed will often, but not always, cost less than a suspended timber floor.
- **Speed of construction/occupation** – concrete slabs require several months to dry sufficiently for flooring such as vinyl to be laid.
- **Building height** – a suspended floor will make the sleepout higher, and therefore it will need to be further from boundaries and other buildings.
- **Building entry level** – suspended floors typically require steps or a ramp.
- **Resilience** – in some locations, a sleepout with a suspended timber floor 600 mm above ground may be at less risk of flood than a sleepout on a concrete slab. The carbon footprint is also typically smaller for timber foundations than a concrete slab.
- **Future-proofing** – if you choose to install sanitary plumbing later on (which will require building consent), the plumber will have more piping options with a suspended floor. You can also relocate a building with a suspended floor.
- **Slope of the site** – a concrete slab on a sloping site would need excavation to make the area level, while a suspended timber floor on piles can be built over a slope.
- **Access** – you may be limited by whether a concrete truck can access the site.

Choosing framing, roof and wall cladding

If you plan a sleepout built with lightweight materials, this means using either light timber framing (following NZS 3604:2011) or light steel framing (following the NASH standards).

Section 5 covers timber framing. This also links to resources you can use if you would prefer to use light steel framing.

If you are using the building consent exemption for single-storey detached sleepouts with 10–30 m² floor area and built with lightweight materials (see section 1), the cladding must meet definitions of light wall cladding and light roof in NZS 3604:2011. The wall cladding cannot weigh more than 30 kg/m² and the roofing cannot weigh more than 20 kg/m².

Light wall claddings include:

- weatherboards made of timber, fibre-cement or PVC
- sheet metal claddings
- sheet and panel materials made from plywood and fibre-cement.

Light roof claddings include:

- sheet metal (typically a steel alloy) in various profiles and coatings
- metal tiles
- asphalt or fibreglass/asphalt shingles (usually fixed over plywood sarking)
- sheet membranes on plywood sheet.

Getting expert help

It is technically possible to construct a sleepout almost entirely by yourself without getting any expert help, but in many cases, paying for some outside assistance, even for a small part of the project such as working out bracing calculations, can help your project develop faster or more smoothly. In a few cases, you will have no choice but to get outside help.

It is common practice to discuss requirements with several different electricians, drainlayers or draughtspeople/designers (for things like bracing calculations) and asking for quotes. Do this well in advance of when you would like the work to be done.

Design and construction work

If you want to build a sleepout bigger than 10 m² with materials that aren't lightweight (see section 1), you have a couple of options under the building consent exemptions as outlined in section 1:

- using an LBP with the appropriate licence to carry out or supervise the design or construction of a sleepout of 10–30 m² floor area
- using a kitset/prefab sleepout with 10–30 m² floor area designed or reviewed by a chartered professional engineer.

Even if you are building a sleepout with lightweight materials, a designer could still be useful in drawing up the plans, calculating bracing requirements or calculating materials needed.

With some types of construction materials such as membrane roofs, manufacturers typically require their products to be installed by trained and approved practitioners – this is not DIY work.

Plumbing and drainlaying work

If you build a sleepout that is exempt from building consent requirements, you cannot include sanitary facilities such as a toilet, hand basin or shower – anything that connects to the water supply and sewerage systems. If you want these in your sleepout, you must get a building consent for the whole sleepout.

Gutters and downpipes are required to dispose of roof water. An authorised drainlayer is required to connect these to a suitable stormwater drainage system. Discuss your plans with a drainlayer (and the council) well in advance of construction, and be aware that some options – such as constructing a soak pit – will almost certainly require building consent.

If you want to fix a tap to an outside wall for gardening use and the tap will be connected to the mains supply water, that must be done by a registered plumber. If you want to collect water from the sleepout roof into a tank for garden use, you can install that yourself. However, the tank will require an overflow that discharges into the stormwater drainage system.

You can check that a plumber is registered on the public register (see the Resources section at the end of this document).

Electrical work

Connecting your sleepout to the house power supply so your sleepout has lights and power points is not DIY work. The connection must be carried out by a registered electrician, and a certificate of compliance must be provided on completion.

The Electricity Act 1992 (section 79) and the Electricity (Safety) Regulations 2010 (regulation 57) allow homeowners to do a very limited amount of other electrical work on domestic property they own and live in. You should only consider this if you have the knowledge, experience and skills to do the work safely. Unsafe work is both illegal and likely to affect your property insurance.

You can check that an electrician is registered on the public register.

Designing and planning for maintenance

You will need to maintain your sleepout after it is built, ensuring it remains safe and usable.

All parts of the building must continue to meet Building Code performance requirements. In practical terms, you must make sure that the building remains weathertight and safe and that the materials and elements remain in good condition and do their job.

You can make life easier by giving the building a simple design and shape and choosing materials and finishes that are more durable.

Building products must comply with all New Zealand regulations and standards. New Zealand-based manufacturers and importers are required to provide a minimum level of information about certain building products, and make sure this information is available online and free of charge. Visit the Building Performance website for more information.

Choosing the right material will help with the overall performance of the building by not making it rely on maintenance.

The basic exterior maintenance work you will need to do includes:

- clearing roof gutters of leaves
- inspecting roof flashings/claddings to ensure they remain weathertight
- cleaning roof claddings if necessary and repainting if necessary
- cleaning wall finishes and repainting as necessary
- inspecting window and door flashings and glass seals for weathertightness
- inspecting and replacing sealants as necessary
- keeping subfloor ventilation clear for sleepouts that stand on piles.

See the BRANZ Maintaining My Home website for more information.

Construction sequence

Work is carried out in a sequence that ensures nothing is forgotten and the final building will be weathertight and durable. This guide follows this sequence that is usually:

- setting out
- foundations and subfloor framing (piles, bearers, joists)
- flooring
- subfloor insulation and ground moisture barrier
- wall framing
- roof framing and fascia
- roof underlay
- roof cladding and roof flashings
- wall underlay
- windows and doors
- soffit lining
- wall cladding, including all battens, timber trim etc.
- baseboards around subfloor
- prewire (wiring for lights, power sockets)
- PEF rod/expanding foam air seals around exterior joinery
- wall and ceiling thermal insulation
- interior wall and ceiling linings
- architraves and skirting
- interior wall and ceiling plasterboard stop and paint
- electrical finish – interior (fitting light switches and sockets)
- exterior paint/stain
- stormwater system and possible connection to existing stormwater drainage system
- gutters and downpipes
- electrical finish – exterior (outdoor lighting)
- floor coverings.

However, you will need to make many of the decisions about how your sleepout will be constructed in a different sequence to the sections of this guide. For example, while the wall framing needs to be constructed before the roof, you need to understand how the roof system works and decide how it will be constructed before you can construct the wall framing.

Worked example

The remainder of this guide provides a worked sleepout example that shows how to use NZS 3604:2011 to find the sizes of the framing and the bracing that are required.

The example has the following specifications:

- single-storey 5 x 4 m
- a timber suspended floor on timber subfloor framing
- side walls are raked to the slope of the roof
- a monopitch roof constructed with sloping rafters that span from the higher front wall to the lower back wall
- a sloping ceiling that is fixed to ceiling battens that are in turn fixed to the underside of the rafters
- the building is in a high wind zone.

The example sleepout would only be suitable for use in the following zones:

- **Earthquake zone 1** – this includes the northeast of the North Island, including Northland, Auckland, Coromandel, Waikato and Taranaki, and part of the eastern South Island running from Rakaia down to Invercargill.
- **Exposure zone B/C** – all of mainland New Zealand that is at least 500 m from the coastline.
- **Wind zone** – low, medium or high.
- **Snow zone N0** – that part of the North Island to the northeast of a line approximately from Ōpōtiki to Tūrangi to New Plymouth, including those towns.

03

Health and safety

All building sites, even areas used for do-it-yourself (DIY) projects, come with health and safety risks. The risk of things going wrong is significantly higher when working with power tools, with strong chemicals or on a roof.

You should identify every possible risk at the start and then work out plans for handling each of them. Avoid them completely wherever possible or at least isolate them and reduce the chance of them affecting you.

For useful online information about health and safety, see the BRANZ Level and WorkSafe websites.

A tidy building site

A well-organised building site with everything in the right place helps work progress faster and reduces the risk of injury. Make sure there is a first aid kit and keep your mobile phone nearby, particularly if nobody is likely to hear you calling out if you need help. Because the sleepout will be close to a house, you may be able to use the toilet and other facilities such as clean running water if there is an emergency. If not, ensure you have access to these nearby.

On the building site for your new sleepout:

- maintain a tidy site
- put away dangerous or valuable equipment at night
- always have clear access for people and vehicles
- designate areas for delivery and storage of materials and waste bins (and ensure you follow the council rules for disposing of the waste)
- depending on circumstances, the construction site may need to be fenced off
- keep interested family members (especially children and pets), neighbours and friends at a safe distance when work is under way.

Personal protective equipment (PPE)

Ensure you have the right protective equipment for the job.

You need to protect your:

- **eyes and face** – wear safety glasses, goggles or a face shield when cutting, sanding, drilling or grinding materials
- **uncovered skin** – use sunscreen
- **hearing** – use earmuffs or ear plugs for all noisy power tools and equipment
- **airways** – use masks of different types when you are sanding, cutting, spray painting or carrying out other tasks that produce dust or fumes – a disposable P1 dust mask is enough for dusts or sprays that are non-toxic or very low in toxicity, a valved P2 mask is better for cutting/sanding treated timber and a half-mask respirator with changeable filters protects against paint mists and vapours
- **head** – wear a hard hat where things could fall on you
- **body** – wear overalls
- **hands** – wear gloves
- **feet** – wear steel-capped boots or capped safety shoes.

Some use of products require PPE as well, always read the relevant labels or instructions. You can find more information about PPE on the BRANZ Level website and from WorkSafe.

PPE should fit properly. Ask suppliers for advice and ask if you can try things on in the shop.

Tools and machinery

Using the right tools and machinery and keeping them properly maintained will help the job run more smoothly and safely. Tools should be:

- kept clean and in good working order, with cutting edges sharp
- only used for the job they were designed for
- operated following the manufacturer's instructions
- used with safety guards if supplied
- used with the right PPE – safety glasses, earmuffs, masks
- only used by people who have experience using them
- only used in properly ventilated spaces
- kept in a secure place at nights and weekends.

You can find more information about safety with tools and machinery on the BRANZ Level website.

Electrical safety

Take care using power tools and equipment outside:

- Use a residual current device (RCD). This detects whether electricity is leaking to earth and breaks the circuit automatically.
- Ideally, do not work in wet conditions. If essential, use cordless tools or an isolating transformer instead of an RCD.
- Do not overload extension cords or wall sockets.
- Check flexible extension cords for damage before using them.
- Keep flexible extension cords away from sharp edges.
- Avoid laying extension cords where people or equipment need to pass over them.

Confirm the location of underground cables and other services before you start digging.

You can find more information about electrical safety on the BRANZ Level website.

Materials handling

Be aware of any hazards associated with the materials you are using. Make sure you understand how to lift heavy or bulky materials properly. Have someone help with lifting where needed.

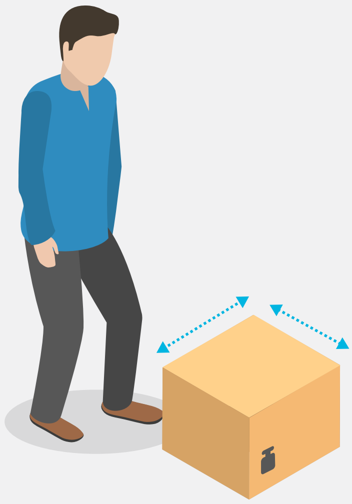
Many building materials and products can be harmful if they contact the skin, splash into eyes or produce dust or fumes. Read the warnings on material containers or wrappings and any safety data sheets from the manufacturer (these explain the hazards associated with a product).

Take particular care with materials treated with chemicals (such as treated timber) and materials containing solvents (paints, thinners, adhesives). Check what PPE is required and whether you need to work in a ventilated space.

When working with treated timber:

- take more care with treatments used for hazard classes greater than H1.2 – pink H1.2 is usually less hazardous
- wear gloves and long sleeves, safety glasses and a mask when cutting or sanding
- work in a well-ventilated space or outside
- don't compost, mulch or burn waste – dispose of it an approved waste facility
- after work and before eating or drinking, wash your hands, face and other skin that may have been in contact with the wood and any sawdust.

When manually lifting an object:



- assess the load – confirm that it is of a weight/size/shape that you can safely lift yourself
- stand close to it, centre yourself over it and have your feet set a shoulder width apart for balance.

- bend your hips and knees but keep your back straight
- firmly grasp the object with both hands.

- keep the load close to your body
- raise your head to look ahead
- straighten your legs while keeping your back straight
- ask for help and lift the item with someone else if needed.

If you have the experience, appropriate training and equipment to lift a load mechanically:

- warn anyone nearby to keep clear
- check that slings, ropes or chains are securely attached to the load and the hook
- start slowly to take the slack
- raise steadily until the load is just off the surface it is being lifted from
- check that the load is stable
- don't let anybody go underneath a suspended load.

You can find more information about materials handling on the BRANZ Level website.

Working at height

Falls from as low as 3 m can cause a serious or fatal injury.

Always let someone know when you are working at height such as on a roof.

When using a ladder:

- set the ladder on a solid level base, 1 m out from the wall for every 4 m of height – the treads should be horizontal
- leave 1 m of the ladder above the level being climbed to
- secure the top of the ladder to the building if possible
- reposition the ladder rather than stretching to reach
- face the ladder and use both hands when climbing up or down
- only move one leg or hand at a time so you always have at least three points of contact.

Consider whether scaffolding would allow safer, faster work.

Take great care if there are overhead power lines close by – treat all lines as live.

You can find more information about working at height on the BRANZ Level website and from WorkSafe.

Accidents, illness and injuries

A first aid kit and clean running water will be enough to treat most small cuts, scrapes and other minor injuries.

If a health problem persists – for example, someone who felt ill while working with a solvent is still unwell even after 15 minutes in fresh air – seek medical help without delay.

Always seek medical help when someone has inadvertently swallowed a chemical substance, gets something in their eye or falls from a height greater than 2 m.

In cases where someone has suffered a serious injury, has difficulty breathing or has lost consciousness, dial 111 and ask for an ambulance.

If you suspect someone has been exposed to or ingested a poison:

- dial 111 if the person is unconscious or having difficulty breathing
- otherwise call the National Poisons Centre on 0800 POISON (0800 764 766) for first aid advice.

Trades on site

If you have hired a licensed builder, electrician or drainlayer, the sleepout is a worksite for them and they must comply with specific regulations. Knowing what the requirements are and complying with them is their responsibility. The laws and regulations include:

- **Health and Safety at Work Act 2015** – they must ensure, as far as is reasonably practicable, the health and safety of them and their employees, contractors, subcontractors and other workers
- **Health and Safety at Work (General Risk and Workplace Management) Regulations 2016** – there are specific duties around things like identifying hazards and putting control measures in place, ensuring adequate first aid equipment and ensuring workers have personal protective equipment
- **Health and Safety at Work (Hazardous Substances) Regulations 2017** – all businesses are required to manage their risks with hazardous substances such as paints, adhesives and solvents.

04

Site, foundations and floor

Foundations do more than just hold a building up – they help keep it together and protect the occupants in strong winds and earthquakes.

There are two main types of foundation. This guide covers piles set in concrete in the ground with bearers and joists above and the floor fixed over the joists.

The other type – a concrete slab on ground – isn't covered here, but you can find some key requirements for a concrete slab at the end of this section.

The site

Good ground

A building must be constructed on "good ground" – soil or rock capable of supporting it. You cannot build on ground:

- that is easily compressed such as soft peat or clay you can mould with your fingers; or
- that is uncompacted gravel; or
- with expansive soils that experience groundwater levels change or seasonal effects such as swelling and shrinking as they get wet and dry out (building frames can distort, doors and windows can jam); or
- that could move from things like land instability, ground subsidence, liquefaction, erosion or the effects of tree roots.

If you are in doubt about any of these, ask a chartered professional engineer for help.

Setting out the building site

You need to work out the exact location and dimensions of the proposed building on the site and prepare for construction. You can find more details in Figure 7 and section 3.

Section 1 explains the restrictions for sleepouts exempt from building consent – for example, that they can be no closer than their own height to a residential building or legal boundary. There may be boundary pegs to work from. Never assume a fence runs exactly along the boundary. If there are no boundary pegs, you may need to call in a land surveyor.

Begin setting out by installing timber profiles about 1,200 mm outside the sleepout perimeter (Figure 8) to help mark its location on the property. Make sure the horizontal parts of the profiles are level, then fix tight string lines to run above the outside line of the foundations. Mark the position on the profiles. Remove loose debris or vegetation within the profiles – close-cropped grass is fine.

Check that right-angle corners are 90° (sometimes expressed as that they 'are square'). With a rectangular or square building, the two diagonal measurements across the building shown in Figure 8 should be the same length.

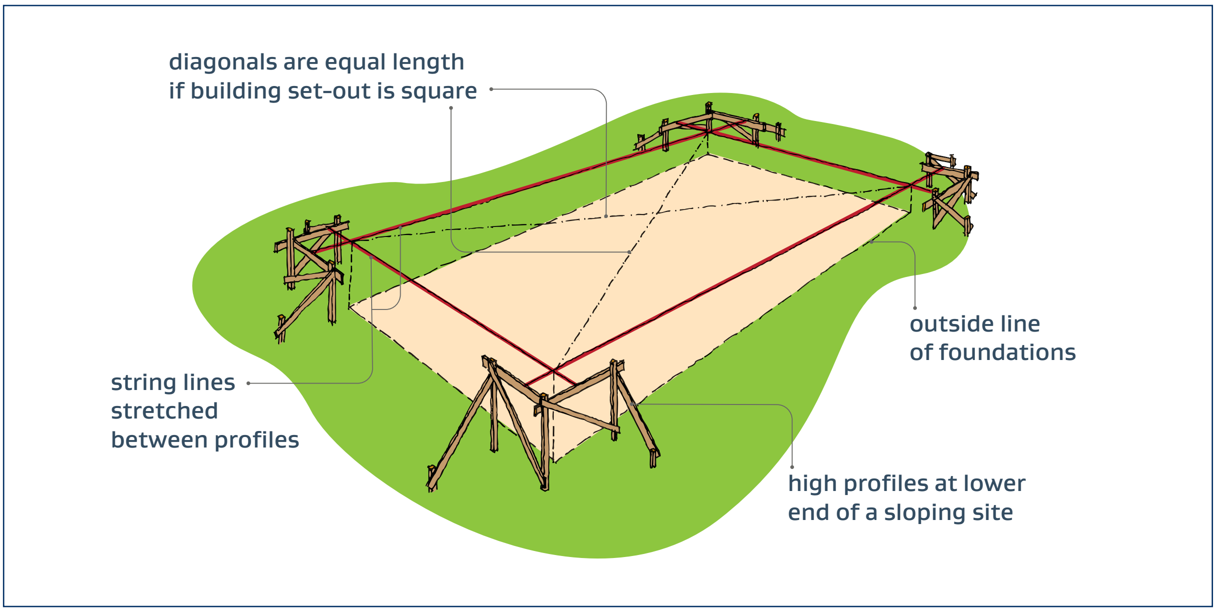


Figure 8. Setting out the site

The foundations

Although you are still a long way from the construction stage, you need to have a clear idea of how the foundations will look. Piles are located in each corner of the building and in rows along the building length to directly support the bearers (Figure 9). Joists span across the building between bearers. A central row of piles/bearers is often required under the joists. Blocking is added over the outer bearers to prevent floor joists rolling over. It is also added at mid-span to prevent long joists rolling over and where additional timber is needed for the flooring fixings (Figure 9).

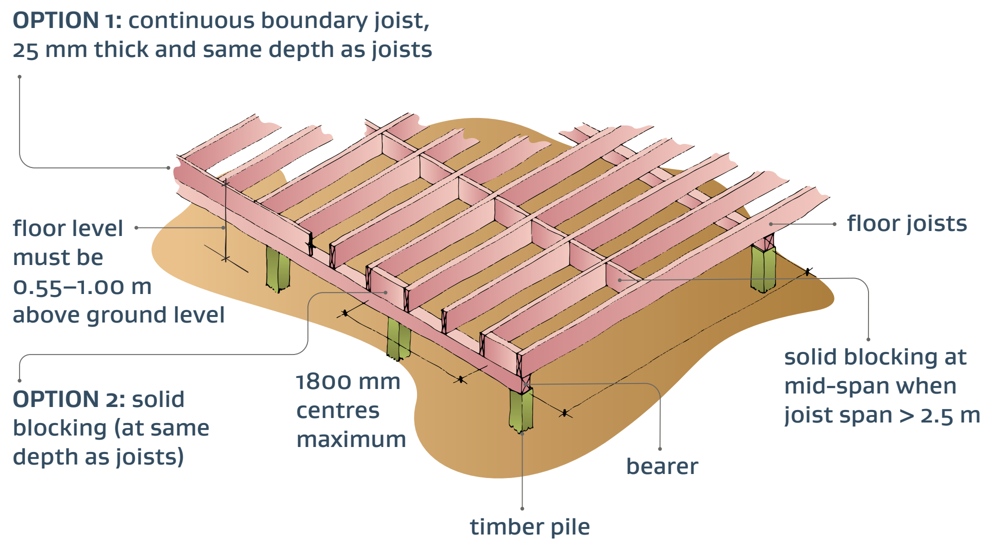


Figure 9. Foundation framing showing the floor joists and the blocking used to prevent these rolling over

The sizes of the piles, bearers and joists are all found using the directions and tables in NZS 3604:2011. There is a fully worked example at the end of this section.

When you are working out the sizes from the tables in NZS 3604:2011, you will see they are a combination of:

- how far a particular size of joist can span between bearers – this tells you how many lines of piles/bearers you need across the width of your sleepout
- how far a particular size of bearer can span between piles –this gives you the distance between piles and thus the number of piles you need along the length of your sleepout.

With sloping ground, the piles will be longer as they go down the slope. However, be aware that the sleepout covered under this exemption can only have a floor level up to 1 m above the ground (on sloping ground, this will be measured at the lower end of the slope).

How many lines of piles/bearers?

NZS 3604:2011 Table 7.1(a) (Table 1 below) shows the maximum spans for joists of particular sizes. These allow you to work out the most cost-effective arrangement of joists, bearers and piles.

Floor joist size	Maximum span of joists at a maximum spacing (mm) of:		
	400	450	600
(mm x mm)	(m)	(m)	(m)
90 x 45	1.45	1.40	1.25
140 x 35	2.10	2.00	1.80
140 x 45	2.70	2.60	2.00
190 x 45	3.55	3.45	3.15
240 x 45	4.40	4.30	3.90
290 x 45	5.20	5.05	4.60

Table 1. Floor joists – 1.5 kPa floor load SG 8 (dry in service)
Source: NZS 3604:2011 Table 7.1 (a)

Let's look at a couple of examples:

- If you choose a joist that is 140 x 45 mm (a readily available size), at 600 mm centres the maximum span of joists across the building is 2 m. If your sleepout is 4 m wide, you will therefore need one extra line of piles/bearers down the middle of the building. This is because each joist can only span 2 m across the building – the distance from the perimeter piles/bearers to a line of piles/bearers down the centre. The span is less than 2.5 m so blocking would only be required above the centre row of joists if the flooring needs to be fixed to it.
- If you choose smaller joists, such as 90 x 45 mm joists at 600 mm centres, the joists can only span 1.25 m. If your sleepout is 4 m wide, you will need four lines of piles/bearers.
- For a 4 m wide sleepout, it is possible to have just two lines of piles/bearers – one along each side of the building. One way to achieve this is with 290 x 45 mm joists – although these may not always be practical and would require blocking at mid-span.

If you have a particular type of flooring in mind, check the manufacturer's requirements – some recommend a joist spacing that is closer than 600 mm.

How far apart should the piles be and how many piles are required?

The distance between piles (and therefore the total number of piles you will need) is determined by the distance that the bearers can span. This is found in NZS 3604:2011 Table 6.4(a) (Table 2 below). It gives three possible options for bearer spans/pile spacings: 1.30 m, 1.65 m and 2.00 m. The bigger the bearer, the longer the possible span between piles.

Maximum span of bearer continuous over 2 or more spans	Loaded dimension of bearer	Bearer size (width x thickness)
(m)	(m)	(mm x mm)
1.30	1.5	90 x 70
	1.9	90 x 90
	3.6	140 x 70
	4.6	140 x 90
	6.6	190 x 70
1.65	2.2	140 x 70
	2.8	140 x 90
	4.1	190 x 70
2.00	1.5	140 x 70
	1.9	140 x 90
	2.6	190 x 70

Table 2. Bearers – 1.5 kPa floor load SG 8 (dry in service)
Source: NZS 3604:2011 Table 6.4

One concept in NZS 3604:2011 Table 6.4(a) might be new to you: loaded dimension. This is easy to grasp if you think of it as working out the weight that the bearer needs to support. The loaded dimension for a bearer is half of the total distance to the bearers either side of it. You can find more about this in NZS 3604:2011 Figure 1.3.

Here is an example of how to use NZS 3604:2011 Table 6.4(a) if you opt for 140 x 90 mm bearers (widely available around the country):

- The maximum span you can have for bearers between piles is 2.0 m (at the left of the bottom panel).
- If your sleepout is 6 m long, you would therefore need four piles in each bearer/pile row (because the piles can be 2 m apart) or nine piles altogether.
- If your sleepout is 4 m wide, like the worked example, and you opt to have three bearers (one along each side and one down the centre), this means the span of the joists will be 1.865 m (from the face of each bearer).
- For a 6 m long, 4 m wide sleepout you will need twelve piles altogether.

You see the maximum loaded dimension for the centre 140 x 90 mm bearer is 1.9 m with a bearer span of 2.0 m pile to pile so 1.865 m works (see the bottom panel in NZS 3604:2011 Table 6.4(a)).

There is a complete example of choosing the sizes of joists at the end of this section.

Calculating bracing

The foundations need to be braced to withstand wind loads and earthquake shaking. The bracing demand for foundations is greater than the bracing demand for walls (described in section 5).

Bracing calculations express the quantities of bracing units (BUs) required to meet the demand and provided by the bracing system.

Wind bracing demand is based on wind acting both along and across the building, which results in different demand figures, while earthquake bracing demand is based on an earthquake acting both along and across the building to the same extent, which results in one demand figure (Figure 10).

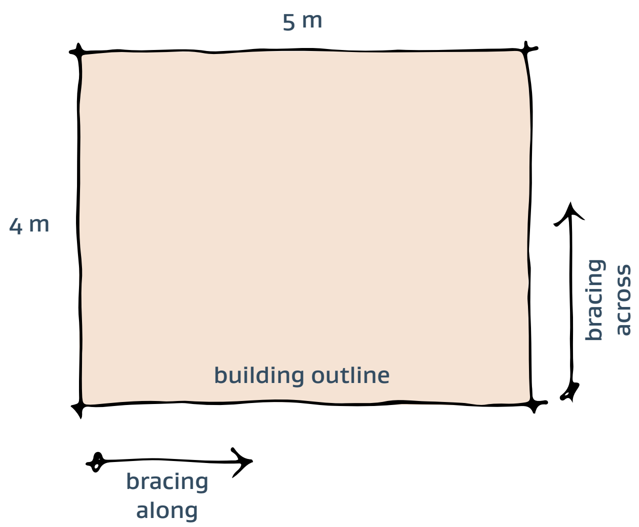


Figure 10. Bracing along and across the building

Bracing calculations should be made following NZS 3604:2011 Section 5 to work out the types of piles required.

An anchor pile provides 160 BUs for wind bracing and 120 BUs for earthquake bracing (NZS 3604:2011 Figure 6.9). A braced pile system provides the same figures along the line of bracing (NZS 3604:2011 Figures 6.6 and 6.7). (Ordinary piles do not provide bracing).

To provide the required bracing, you could choose to use just anchor piles or just braced pile systems (but not both). Under NZS 3604:2011 section 5.5.6, you must have a minimum of four anchor piles or braced pile systems in each direction and symmetrically around the building perimeter. In practical terms, this means that, if you chose to use anchor piles, you would need one at each corner of the building.

The most practical approach to calculating the bracing demand is to use BRANZ bracing calculation sheets. You can see a worked example in the bracing calculation sheets at the end of this section.

If you don't want to calculate the bracing yourself, you could engage an engineer, experienced draughtsperson or designer to do this job for you.

Durability

Structural timber components such as piles that are in direct contact with either concrete or the ground need to be treated for use in hazard class H5. The figures in this guide use dark green shading for components that need to be hazard class H5.

Timber components that are protected from the weather by being fully enclosed such as bearers, floor and roof joists only need to be H1.2 treated. The figures in this guide use pink shading for H1.2 components. Timber components that are exposed to the weather such as timber wall cladding or fascia or barge boards need greater protection – H3.1 or H3.2 treated timber, as explained later in the guide. They are coloured light green in the guide.

There is more information about timber durability and how to use and identify the right timber in Section 5.

If your sleepout is in exposure zone D (within 500 m of the coast and all offshore islands), all structural fixings should be stainless steel:

- All exposed treated timber pile connections within 600 mm of the ground must be minimum type 304 stainless steel.
- Subfloor connections more than 600 mm from the ground must be minimum type 304 stainless steel in an exposed location subject to rain wetting but could be hot-dip galvanised steel in a sheltered location (Figure 11).
- All other structural fixings (except fabricated brackets) must be minimum type 304 stainless steel in an exposed location but could otherwise be hot-dip galvanised steel.
- Galvanised steel and stainless steel components shouldn't be in contact with each other.

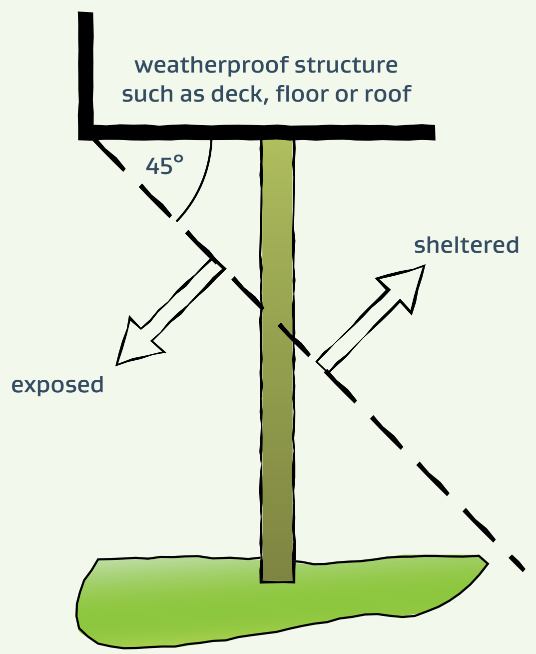


Figure 11. Exposed locations are exposed to the outdoor air and can also be rain wetted. Sheltered locations are exposed to the air but do not get washed by the rain

Installing the piles

Once you have worked out the location, number and type of piles required, you can use string lines to mark the locations. Dig all the holes before installing any piles, but don't dig too far ahead of installation to avoid the holes filling in during bad weather. The hole depths depend on the type of pile as described below. Make sure you have everything ready – piles, concrete, string lines, any additional timber for profiles – before starting installation.

Remember that the heights of the piles should allow a minimum 450 mm crawl space to the underside of the joists, and the floor level can only be up to a maximum of 1 m above ground.

Ordinary piles

Each ordinary timber pile must sit on a concrete footing at least 100 mm thick (Figure 12), which can be either precast or made on site. The bottom of a concrete footing for an ordinary pile must be at least 200 mm below cleared ground level. Ensure piles are square on to the building perimeter marked with the string lines. Use a level to ensure each pile sits upright – use temporary bracing if necessary. NZS 3604:2011 Table 6.1 shows the actual footing size required relative to bearer and joist span. For more information about ordinary piles, see NZS 3604:2011 section 6.5.

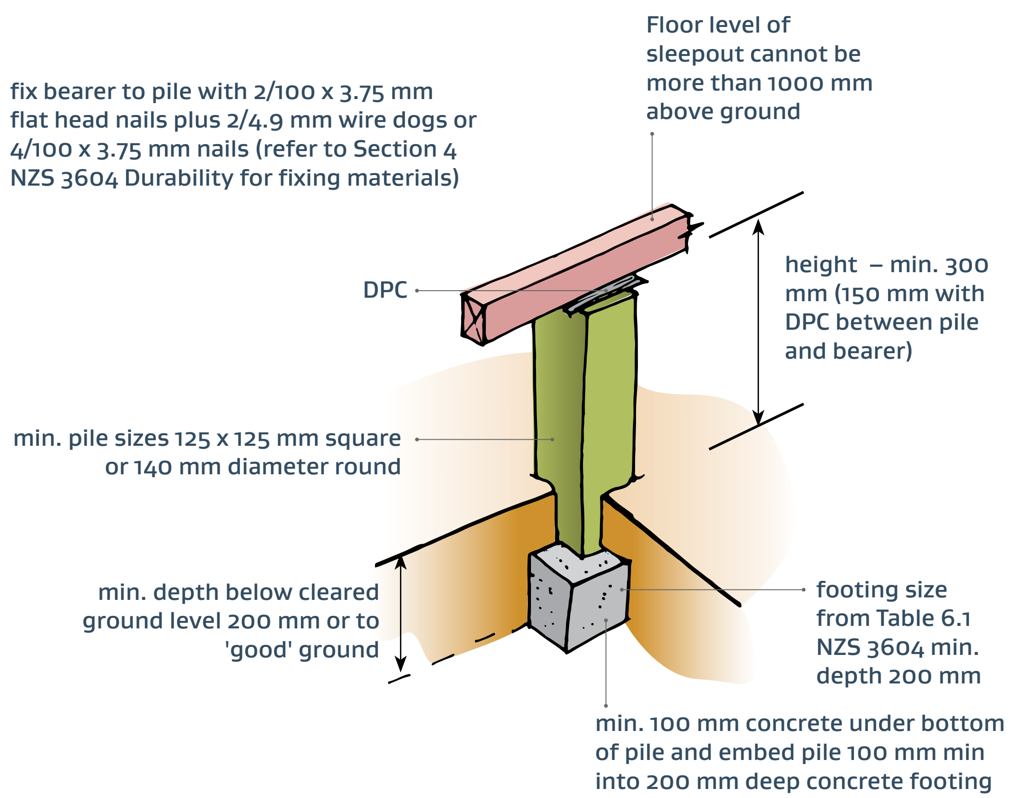
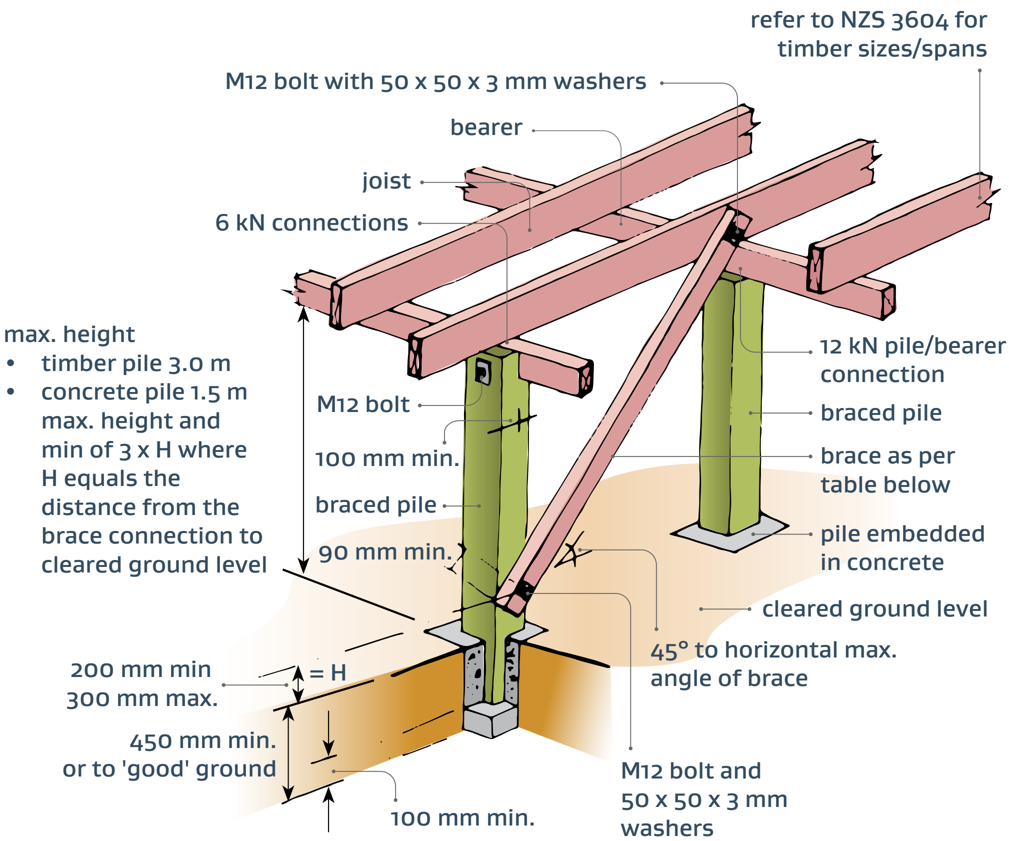
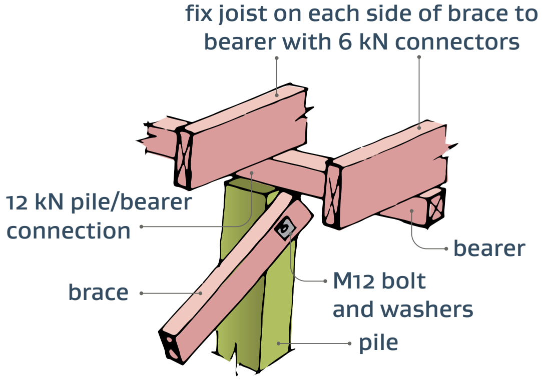


Figure 12. Ordinary timber pile

Braced piles

A braced pile system has two piles with a diagonal brace between them (Figure 13). If the tops of the piles are less than 600 mm above cleared ground level, an anchor pile will need to be used instead. The brace (minimum 100 x 75 mm) is fixed to the bottom of one pile and to either the top of the other pile or to a bearer or a joist. The brace cannot be steeper than 45° from horizontal.





Braces	
Max brace length	Brace size
3.0 m	100 x 75 mm
5.0 m	100 x 100 mm

Figure 13. Braced piles

In the ground, each braced timber pile must sit on a concrete footing at least 100 mm thick. The bottom of the footing must be at least 450 mm below ground level. Ensure the piles are plumb and square on to the building perimeter before concreting. Temporary bracing can help. For more details about the footing, see NZS 3604:2011 section 6.4.5.

The diagonal timber brace must be connected to the piles at each end using M12 bolts with 50 x 50 x 3 mm washers. The bolts must pass through the centreline of the brace and be at least 90 mm from each end.

At the lower end, the bolt must go through the centreline of the pile and be between 200 mm and 300 mm above the cleared ground level. If the top of this pile is between 600 mm and 900 mm above the cleared ground level, this bolt cannot be more than one-third of the pile height above the cleared ground level.

Where the top of the brace connects:

- to a pile, the bolt must pass through the centreline of the pile within 90–150 mm from the underside of the bearer
- to a bearer, the bolt must go through the bearer centreline and be within 200 mm of the centre of the nearest pile
- to a joist, the bolt must pass through it no less than 50 mm from its lower edge and not more than 200 mm from the centreline of the nearest pile.

For more details about braced piles, see NZS 3604:2011 section 6.8.

Anchor piles

Anchor piles are set at least 800 mm into the ground (with 100 mm footing under them) and have a maximum height above ground to the top bolted connection of 600 mm (Figure 14).

In the ground, each anchor timber pile must sit on a concrete footing at least 100 mm thick. Ensure the piles are plumb and square on to the building perimeter marked with string lines before concreting. Temporary bracing can help. For more details about anchor pile footings, see NZS 3604:2011 section 6.4.5 and section 6.9 for anchor piles in general.

Installing bearers

The tops of piles must each be at the right height to support the bearers. In some cases, this may mean cutting off the top of an installed pile. The tops of cut timber piles cannot be lower than 300 mm above the cleared ground level. Do not put cut pile ends into the ground.

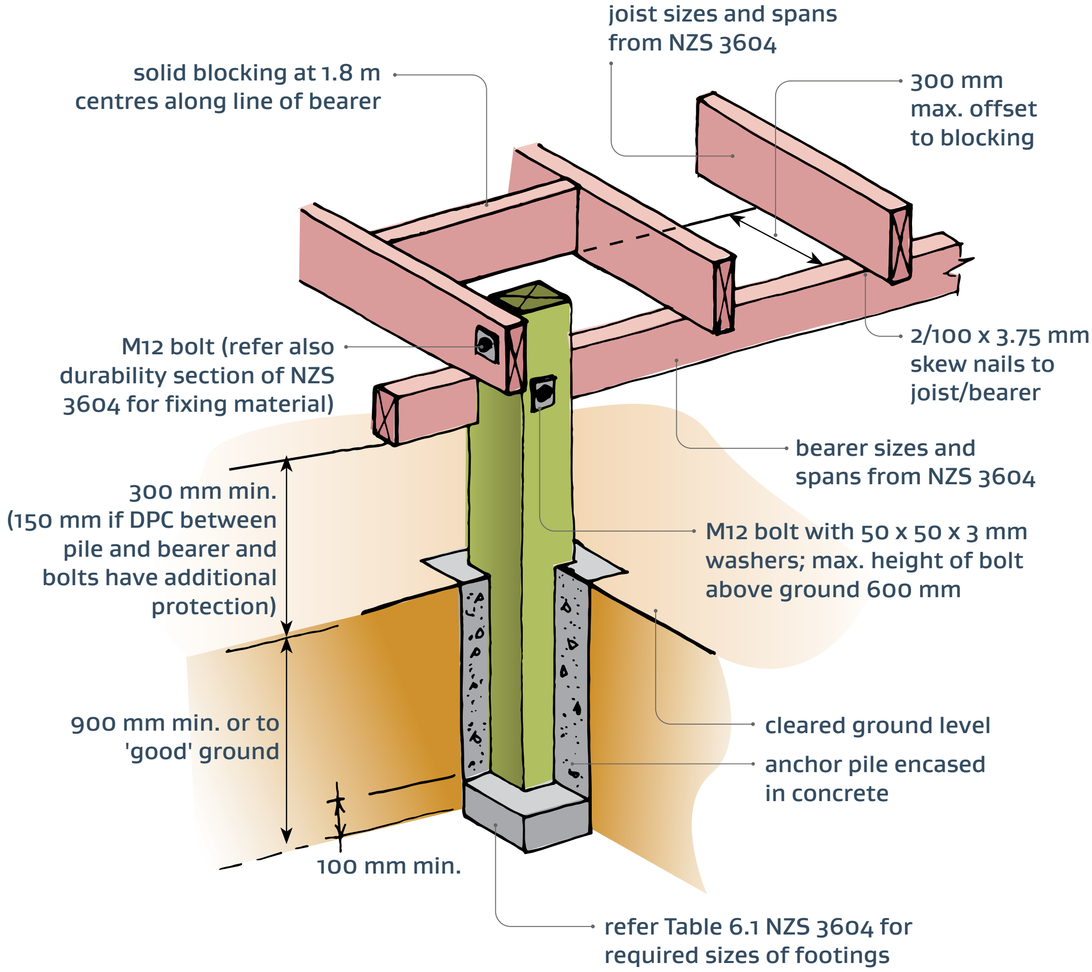
Bearers that are sheltered from the weather (enclosed within the base cladding) only need to be H1.2 treated. Bearers that are exposed to the weather must be H3.2 treated timber.

Start installing bearers from one outside wall, laying out the bearers on the piles, sitting on their edge, checking they are level and straight with string lines. Outside bearers are aligned with the outside faces of the piles (the two surfaces are aligned or flush) while internal bearers sit directly above the centres of the piles.

Bearer and fixing options are shown in NZS 3604:2011 section 6.12 and Table 6.4.

Bearers are fixed to ordinary piles with 2 wire dogs and 2/100 x 3.75 mm nails or 4/100 x 3.75 mm nails skew-driven into the piles (Figure 15).

Bearers can be fixed to braced or anchor piles with an M12 bolt that has 50 x 50 x 3 mm washers (see Figure 13 and Figure 14).



Notes:

1. Bearers must not be joined at an anchor pile.
2. Proprietary connectors to give a 12 kN rated connection may be used in lieu of the M12 bolts for pile/bearer and joist/pile intersections.

Figure 14. Anchor pile

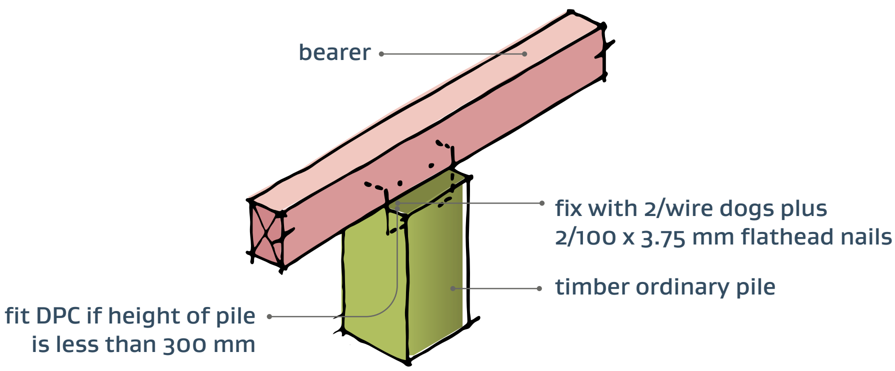


Figure 15. Fixing a bearer to an ordinary pile

The floor

Floor joists

Floor joists are installed on the bearers at right angles sitting on their edges in straight lines. Options for joists, including span and spacing, are given in NZS 3604:2011 section 7.1 and Table 7.1(a) (Table 1 above). Joists should be treated to a minimum H1.2.

Start with the outer joists accurately set to height, line and level (the tops of all joists must have a common level to support the flooring). You can use string lines set on spacer blocks above the bearers. Install intermediate joists at the appropriate spacings. Joists are fixed to bearers with 2 skewed 100 x 3.75 mm nails or 3 skewed 90 x 3.15 mm power-driven nails.

Joists can only be joined where the ends of both pieces are supported on a bearer. The end of each joist can be butted over the support except:

- joists that have a brace attached
- every third joist at a line of support except where sheet flooring extends more than 600 mm on each side of the joint.

Joints in flooring joists must:

- be butted, and supported with pieces of timber the same dimensions as the joists nailed to each side, extending at least 150 mm beyond the joint
- be lapped not less than 150 mm on each side of the centreline of the support and nailed together from both sides or
- have a nail plate with a fixing capacity of 6 kN in tension. (Manufacturers provide this product information).

Solid continuous blocking must be added between floor joists (Figure 9) to prevent them rolling over. The tops of the blocking should be flush with the tops of the joists. There are two options:

1. A continuous boundary joist that is at least 25 mm thick, is the same depth as the joists and is fixed to each joist with either 2/100 x 3.75 mm nails (end nailed) or 2/90 x 3.15 mm power-driven nails (end nailed).
2. Solid blocking between adjacent joists at no more than 1.8 m centres. The solid blocking is the joist depth and is often joist off-cuts. Solid blocking is also required between each pair of joists at the joist ends. Solid blocking is fixed with either 2/100 x 3.75 mm end nailed or 4 /75 x 3.15 mm (skew nailed).

Some flooring manufacturers recommend additional support for concentrated loads from the legs of heavy items such as pool tables and pianos.

Installing the flooring

These are some flooring options:

- **Particleboard** – thickness is typically 20 mm and is available untreated or treated to H3.1. The treated flooring gives greater durability where there is a risk of it being exposed to moisture. The underside of untreated particleboard flooring must be at least 550 mm above ground.
- **Plywood** – CCA treated to H3, a minimum 15 mm thick for joists spaced up to 450 mm or 19 mm thick for joists spaced up to 600 mm. Lay plywood with the surface grain across the direction of the joists.
- **Strand board** – with some strand board products, the manufacturers recommend that the underside of the flooring be at least 550 mm above ground. Thickness is typically 20 mm. Strand board is available untreated or treated to H3.1. The treated flooring gives greater durability.

Particleboard and strand board sheets are available with a square edge or with grooved edges and plastic tongues.

Lay the flooring in complete sheets as far as possible, staggered across the joists. Each panel should span over at least three joists. Joints should only be made over timber supports. There should be continuous edge support around the perimeter with an 8–10 mm expansion gap around the flooring edge to allow for moisture movement.

Flooring is typically fixed to joists and blocking with both glue and screws, but follow the recommendations of the flooring manufacturer.

Underfloor insulation

Select materials designed specifically for use under floors. Options are:

- polystyrene panels fitted tightly between floor joists
- glass wool (fibreglass), wool or polyester sheets fitted tightly between floor joists and strapped in place.

Make sure that the insulation touches the underside of the flooring to prevent any airflow. Follow the insulation manufacturer's instructions.

The R-value of insulation materials is a measure of their insulation value. The higher the R-value, the greater the insulation effectiveness is. Insulation rated R2.8 keeps the flooring warmer than insulation of R2.0.

The minimum level of underfloor thermal insulation depends on which of the six climate zones your property is in. As detailed in H1/AS1, the requirement for suspended floors is a minimum construction R-value of R2.5 in zones 1–3, R2.8 in zone 4 and R3.0 in zones 5 and 6. You can work out the R-values of your construction using NZS 4214:2006 *Methods of determining the total thermal resistance of parts of buildings*, which you can download at no cost from the Standards NZ website. You could also use the BRANZ House insulation guide (6th edition).

Preventing subfloor dampness

When the subfloor is enclosed, some air must still be able to flow under the building to dry out any moisture. An easy solution is to fix baseboards around the foundation perimeter with a 20 mm air gap between the boards.

Sheet material (such as fibre-cement) around the base must have vents that are no less than 3,500 mm² of net open area for every 1 m² of floor area.

Make sure there is an access point into the crawl space under the sleepout – the crawl space needs a minimum height of 450 mm.

Cover the ground under the sleepout with polythene sheets (held down with bricks or concrete blocks that are arranged to avoid puncturing the sheets) to help keep the subfloor space dry. NZS 4246:2016 *Energy efficiency – Installing bulk thermal insulation in residential buildings* provides detailed guidance for installing polythene sheets to the subfloor space.

Make sure the ground around the sleepout slopes away (with a minimum slope of 1:25) for at least the first 1 m beyond the building perimeter so rainwater will not run under the sleepout.

Concrete slab-on-ground floors

Constructing a concrete floor slab requires more skill than a timber-framed floor. It is best to get professional help with preparing the site, setting up the boxing, selecting and placing the reinforcing mesh and steel and pouring the concrete. Here are some key requirements based on NZS 3604:2011:

- For light wall claddings, the finished slab floor level must be a minimum 225 mm above unpaved ground and 150 mm above permanent paving.
- Formwork around the slab edge will create a footing to support exterior walls. The formwork will sit above a small trench that is a minimum 200 mm deep.
- The base of the slab must be supported by at least 75 mm of compacted hardfill that is covered by sand blinding that is 5–25 mm thick.
- A damp-proof membrane (DPM) such as 0.25 mm polythene is installed over the sand.
- Insulation (typically 50 mm polystyrene) is installed over the DPM.
- The concrete must be reinforced with grade 500E steel reinforcing mesh and with two D12 steel bars in the slab edges. Overlap the mesh by 225 mm if you need more than one sheet. Overlap the D12 bars by at least 500 mm – see NZS 3604:2011 Figure 6.15(a).
- A concrete floor slab that is longer or wider than 6 m needs shrinkage control joints to reduce cracking as the slab dries.
- Concrete slab thickness will typically be 100 mm, with a minimum 30 mm concrete between the reinforcing and the slab top surface.
- Bottom plates (the timber along the wall base) are fixed to the slab by either cast-in M12 anchor fixings or proprietary post-fixed anchors.
- Concrete should be vibrated to remove trapped air.
- A float finish is suitable for tiles or carpet. A steel-trowelled finish is better for vinyl.
- Concrete slabs must be kept moist for several days after pouring.

The New Zealand Concrete Contractors Association (see the Resources section at the end of this document) provides guidance on good concreting practice in a domestic environment.

Worked example

Calculating timber pile foundations, bearers, joists and bracing

Our worked example sleepout is described in Section 2. The worked example is a 5 x 4 m building in a high wind zone and in earthquake zone 1.

In this paragraph, we calculate:

- the number of bearer/pile lines we need along the length of the building for our preferred choice of joist and bearer sizes
- the spaces required between piles and therefore the number of piles
- the types of piles needed to provide bracing.

NZS 3604:2011 provides most of the information you will need.

This worked example uses BRANZ bracing calculation sheets.

Calculating how many bearer/pile lines we need

Bearers on piles run along the two longest exterior walls (Figure 16). Lines of additional bearers/piles may be needed between these.

The number of bearer/pile lines required is based on the span of the floor joists that span across the bearers taken from NZS 3604:2011 Table 7.1(a) (Table 3 below).

Floor joist size	Maximum span of joists at a maximum spacing (mm) of:		
	400	450	600
(mm x mm)	(m)	(m)	(m)
90 x 45	1.45	1.40	1.25
140 x 35	2.10	2.00	1.80
140 x 45	2.70	2.60	2.00
190 x 45	3.55	3.45	3.15
240 x 45	4.40	4.30	3.90
290 x 45	5.20	5.05	4.60

Table 3. Floor joists – 1.5 kPa floor load SG 8 (dry in service)
Source: NZS 3604:2011 Table 7.1 (a)

This worked example uses 140 x 45 mm H1.2 treated joists, which are readily available in Aotearoa /New Zealand. Using NZS 3604:2011 Table 7.1(a), joists of this size can span 2.0 m if the joists are 600 mm apart (Figure 17).

As the building is 4.0 m wide, the 2.0 m span means one additional bearer/pile line is needed along the middle of the building (Figure 16).

Therefore there are three bearer and pile lines in total.

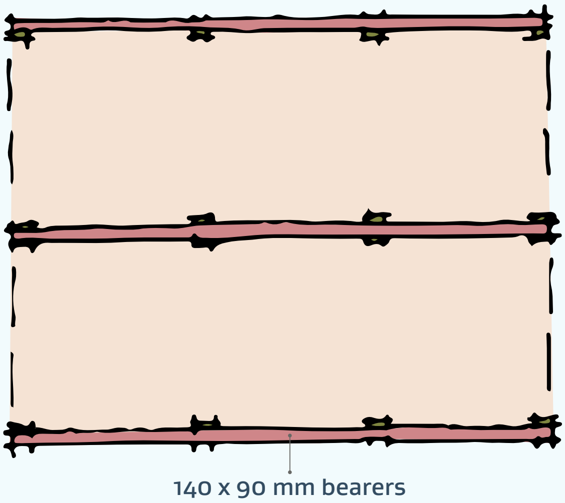


Figure 16. Bearer layout

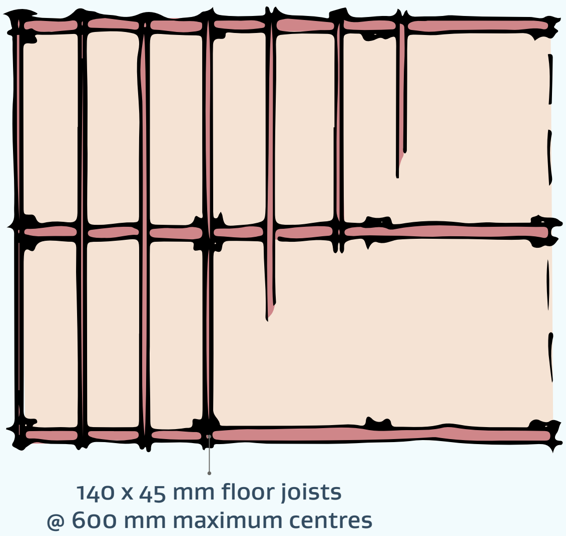


Figure 17. Floor joist layout

Calculating the spacing between piles and therefore the number of piles

There is one pile at each corner of the building, one at each end of the intermediate row and then rows of piles between these along the building. You'll then need to determine the spacing distance required between the piles.

This (and therefore also the number of piles required) is based on the span of the bearer because bearers span from pile to pile.

In NZS 3604:2011 Table 6.4(a) (Table 4 below), there are bearer span options (approximate pile spacing options) of 1.3 m, 1.65 m and 2.00 m. The bigger the bearer, the longer the possible span.

Maximum span of bearer continuous over 2 or more spans	Loaded dimension of bearer	Bearer size (width x thickness)
(m)	(m)	(mm x mm)
1.30	1.5	90 x 70
	1.9	90 x 90
	3.6	140 x 70
	4.6	140 x 90
	6.6	190 x 70
1.65	2.2	140 x 70
	2.8	140 x 90
	4.1	190 x 70
2.00	1.5	140 x 70
	1.9	140 x 90
	2.8	190 x 70

Table 4. Bearers – 1.5 kPa floor load SG 8 (dry in service)
Source: NZS 3604:2011 Table 6.4

Remember that, with this table, the loaded dimension of a bearer is half of the total distance to the bearers either side of it. So, for the 4 m wide sleepout with the three lines of bearers/piles, the loaded dimension of the outside bearers is approximately 1 m and approximately 2 m for the centre bearer/pile line.

Opting for the maximum 1.65 m bearer span between piles and 140 x 90 mm bearers (a size readily available around Aotearoa/New Zealand), this allows a maximum loaded dimension of up to 2.8 m. This is well above the 2.0 m in our sleepout so is a relatively conservative choice.

If the sleepout is 5 m long, the piles are evenly spaced along the length and they can be no more than 1.65 m apart, there will be four piles in each line (12 piles altogether) and each pile in a line will be 1.25 m apart.

Calculating the subfloor bracing

The subfloor needs bracing to resist the loads from wind and earthquake. How much bracing is required is based on the earthquake zone and the wind zone of the location where the sleepout is being built.

In practical terms, there are three options for working out the amount, types and positions of bracing:

- work these out yourself by following NZS 3604:2011 section 5
- use a resource such as the BRANZ bracing calculation sheets
- get an expert to do the calculations and position the bracing for you such as an architectural draughtsperson or designer who is a Licensed Building Practitioner (LBP), or an architect or engineer.

The subfloor bracing demand for our sleepout is measured in bracing units (BUs). These are calculated using of NZS 3604:2011 section 5 assuming the sleepout is in earthquake zone 1 and a high wind zone.

Wind bracing demands are different for wind acting along and across the building, which results in two different BU demand figures.

Earthquake bracing demands are the same both along and across the building, which results in one BU demand figure.

Using NZS 3604:2011 and BRANZ bracing calculation sheets (Figure 13 and Figure 14) for the dimensions and location of our 20 m² sleepout, we come up with:

- for earthquake demand – 120 BUs across and along the building
- for wind demand – 375 BUs across the building and 320 BUs along the building.

SUBFLOOR FOUNDATION - HIGH WIND

SHEET A

BRANZ

Name of Applicant: ______________________ **Site Address:**

City/Town or District: ______________________

Street and Number ______________________

Or Lot and D.P. Number: HIGH WIND ZONE VERSION

Box 1

LOCATION OF STOREY / BLOCK BEING ASSESSED

FOUNDATION	SINGLE STOREY or UPPER STOREY	LOWER STOREY	LOCATION IN BUILDING
Use one sheet for each and circle the appropriate location			

Box 2 Wind Bracing Demand (Table 5.5 , 5.6 or 5.7)

Wind zone (Table 5.1) L / M / H / VH / EH

Building height to apex (H) 4.2 m

Roof height above eaves (H) 1.2 m

Note: Tables 5.5, 5.6, 5.7 relate to High wind zone.
In other wind zones, multiply the value by the appropriate factor.

	(value from tables)		(multiplication factor)			
W_{across} =	75	x	L 0.5 M 0.7	=	75	Bu/m
W_{along} =	80	x	VH 1.3 EH 1.6	=	80	Bu/m

Transfer to Box 5

Box 3 Earthquake Bracing Demand (Table 5.8, 5 9, 5.10)

Earthquake zone (Figure 5.4)	1 / 2 / 3 / 4	Concrete slab	(Table 5.10)	YES / NO
Weight of roof cladding	Light / Heavy	Part storey in roof space	(Cl. 5.3.4.3)	YES / NO
Roof pitch (degrees)	0-25 / 26-45 / 46-60	/ Part storey basement	(Cl. 5.3.4.4)	YES / NO
Weight of upper (or single) storey cladding	Light / medium / heavy	Chimney	(Cl. 5.3.4.5)	YES / NO
Weight of lower storey cladding	~~Light / medium / heavy~~	Wings / blocks	(Cl. 5.1.5)	YES / NO
Weight of subfloor cladding	Light / medium / heavy	Deck projecting more than 2 m	(Cl. 7.4.2.2)	YES / NO

(value from tables 5.8, 5.9, 5.10) (multiplication factor below)

E = 15 x 0.4 = 6 BU /m² Transfer to Box 5

NOTE: Tables 5.8, 5.9, 5.10 relate to soil type D/E in Earthquake zone 3, for multiplication factors for other soil types see below

Soil Class	Earthquake Zone			
	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 / Soft	0.5	0.8	1.0	1.5

Box 4 Building plan dimensions (Figure 5.3)

Roof or building length for wind across ridge	(L)	=	5	m	Transfer to Box 5
Roof or building length for wind along ridge	(W)	=	4	m	
Gross Floor Area	(GFA)	=	20	sq m	

Box 5 Calculation of demand

			(Value)		(Box 4 Dimension)				
Wind Load Across	(from box 2)	=	75	x	5m	=	375	BU	Transfer to Sheet B
Wind Load Along	(from box 2)	=	80	x	4m	=	320	BU	
Earthquake Load (both directions)	(from Box 3)	=	6	x	20m²	=	120	BU	

MONOPITCH - USE 375 BV
FOR ALONG / ACROSS

Figure 18. Subfloor bracing calculation for example sleepout – sheet A

SHEET B

LOCATION OF STOREY / BLOCK BEING ASSESSED

FOUNDATION	SINGLE STOREY or UPPER STOREY	LOWER STOREY	LOCATION IN BUILDING

Use one sheet for each storey / block and circle the appropriate location

ACROSS

1	2	3	4	5	6	7	8	9	10	11
				Wind				Earthquake		
Wall or Bracing Line	Bracing Element Identification	Bracing Type	Length of Element (m)	BU's/m (Wind)	BU's Achieved	Total for Bracing Line	Minimum Bracing Demand	BU's/m (Earthquake)	BU's Achieved	Total for Bracing Line
A	1	ANCHOR	—	160	160	320		120	120	240
	2	ANCHOR	—	160	160			120	120	
B	3	ANCHOR	—	160	160	320		120	120	240
	4	ANCHOR	—	160	160			120	120	
C										
D										
E										
				Total Bracing Achieved		640		Total Bracing Achieved		480
				Total Bracing Demand for Wind Across		375	120	Total Bracing Demand for Earthquake		

ALONG

1	2	3	4	5	6	7	8	9	10	11
				Wind				Earthquake		
Wall or Bracing Line	Bracing Element Identification	Bracing Type	Length of Element (m)	BU's/m (Wind)	BU's Achieved	Total for Bracing Line	Minimum Bracing Demand	BU's/m (Earthquake)	BU's Achieved	Total for Bracing Line
M	5 (1)	ANCHOR	—	160	160	320		120	120	240
	6 (2)	ANCHOR	—	160	160			120	120	
N	7 (3)	ANCHOR	—	160	160	320		120	120	240
	8 (4)	ANCHOR	—	160	160			120	120	
O										
P										
Q										
				Total Bracing Achieved		640		Total Bracing Achieved		480
				Total Bracing Demand for Wind Along		375		Total Bracing Demand for Earthquake		120

Figure 19. Subfloor bracing calculation for example sleepout – sheet B

An anchor pile provides 160 BUs for wind bracing and 120 BUs for earthquake bracing (NZS 3604:2011 Figure 6.9). Two anchor piles in each direction would therefore be enough to meet the highest demand (375 BUs). However, when the building just uses anchor piles or braced pile systems for bracing, you must have a minimum of four in each direction (NZS 3604:2011 section 5.5.6).

Therefore, in this case you should choose to have an anchor pile in each corner (Figure 20). The balance of piles along the sides of the building and along the intermediate line in the middle of the building are ordinary timber piles.

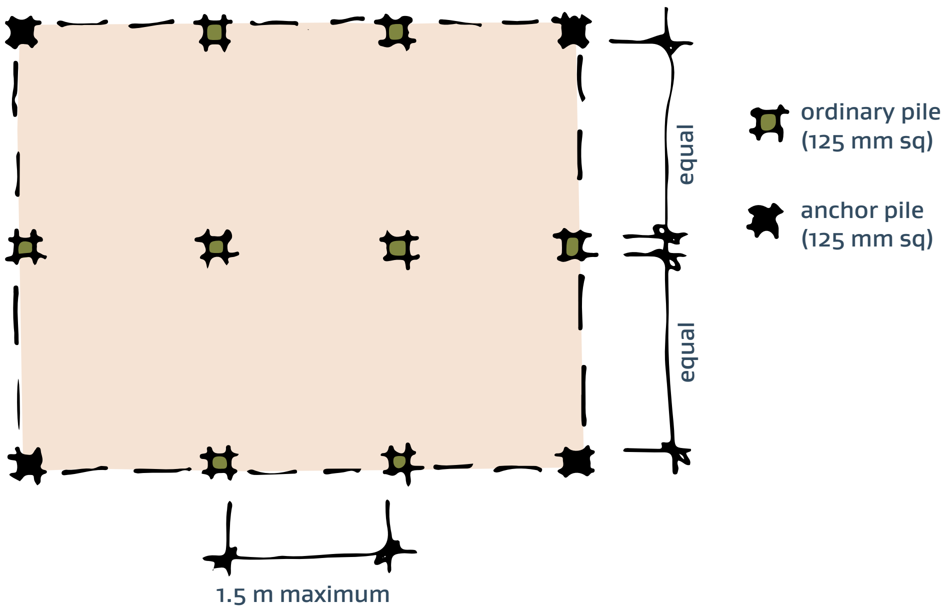


Figure 20. Pile layout

For more about bracing, download the BRANZ *Build* supplement (see the Resources section at the end of this document).

05

Wall framing

As well as holding up the roof, walls must cope with wind and earthquakes. There are rules around timber sizes and spacings and how the wall framing is fixed together.

The sleepouts up to 30 m² that DIYers can build without a building consent must use lightweight materials. For framing, this means either timber or light steel framing. This guide covers timber framing. You can find information about light steel framing in National Association of Steel Framed Housing (NASH) Standard Part 2: May 2019 *Light Steel Framed Buildings*.

Most new house framing is made by frame and truss manufacturers. You could ask a frame and truss company for a quote to provide preassembled frames for your sleepout. However, this guide gives all the details you need to know to construct it yourself.

To fully understand this section, you also need to understand how the roof system works because the roof will be sitting on the wall framing. Consulting this section and section 6 together will give you the full picture.

The guidance that follows can be used for most sleepouts. At the end of this section is a worked example.

Framing requirements

The key requirements around timber wall framing are set out in in NZS 3604:2011.

To design the wall framing for your sleepout, you will need to know the earthquake zone and wind zone that apply to your location and work out the bracing required. If you can't use NZS 3604:2011 to work these out, you could ask your council for the information or use BRANZ Maps to find the zones. You could ask a draughtsperson or designer to help you with the bracing calculations if you don't want to do these yourself.

If snow is likely where you live, potential snow load on the roof and the sizes of window and door lintels in the wall framing also need to be considered. Find out your snow loading and check the requirements that may apply in NZS 3604:2011 section 15.

The Building Code requires wall framing to last a minimum of 50 years. One part of achieving this is using the right timber. If you are using radiata pine for wall framing, it must be at least:

- treated to a minimum level of H1.2 to protect against rot and borer; and
- structural grade (SG) – we use SG8 in this guide, which will normally have SG8 branded along the length of each stick you purchase; and
- free from bows, twists and warps; and
- kept dry and not left exposed to the weather for long periods (the maximum is 12 weeks).

If kiln-dried timber gets wet, let it dry before using it. Framing timber should have a moisture content no more than 18 per cent before being enclosed with wall cladding and linings.

Timber is branded or labelled to identify any treatment. Timber used in a building has different treatment requirements depending on things like its level of exposure to rain or groundwater. The level of treatment is described by specific hazard classes such as H1.2 (a low level of treatment, used for structural framing timber) and H5 (a high level of treatment, used for timber piles). Some timber is also coloured to identify its treatment level (Figure 21). The treatment and grade of timber will be marked along the length or on the end.

- H1.2 framing timber is dyed pink.
- H3.1 timber is sometimes dyed light green.
- H5 foundation piles can be dark green.

Figure 21. Timber treatment identification. (A) H1.2 timber colour and tag. (B) H3.1 timber colour and marking. (C) H3.1 treatment marked on end. (D) Tag indicating H.5 treatment

Sizing the wall framing and spacing

You can work out the size of the studs and dwangs you need from tables in NZS 3604:2011:

- Table 8.2(a) (Table 5 below) is for loadbearing walls in a single-storey sleepout constructed in accordance with this guide. The loadbearing walls carry roof loads – where the truss or rafter lands on the top plate of a wall. This may include internal walls where a rafter may be designed to span across the building and sized to be carried on an internal wall as well as the exterior walls. Trusses are generally designed to span from outside wall to outside wall.
- Table 8.4 (Table 6 below) is for studs in non-loadbearing walls.

Wind zone	Loaded dimension of wall (m)	Stud sizes for maximum length (height) of: (m)								
		2.4			2.7			3.0		
		At maximum stud spacing (mm) of:			At maximum stud spacing (mm) of:			At maximum stud spacing (mm) of:		
		300	400	600	300	400	600	300	400	600
		(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)
		(width x thickness)								
Extra high	2.0	–	90x45	90x70	90x45	90x70	90x90	90x70	90x70	140x45
	4.0	–	90x45	90x70	90x45	90x70	90x90	90x70	90x70	140x45
	6.0	–	90x45	90x70	90x45	90x70	90x90	90x70	90x70	140x45
Very high	2.0	–	90x45	90x70	90x35	90x70	90x70	90x45	90x70	90x90
	4.0	–	90x45	90x70	90x35	90x70	90x70	90x45	90x70	90x90
	6.0	–	90x45	90x70	90x35	90x70	90x70	90x45	90x70	90x90
High	2.0	–	90x35	90x45	90x35	90x45	90x70	90x35	90x70	90x70
	4.0	–	90x35	90x45	90x35	90x45	90x70	90x35	90x70	90x70
	6.0	–	90x35	90x45	90x35	90x45	90x70	90x35	90x70	90x70
Medium	2.0	–	90x35	90x35	90x35	90x35	90x45	90x35	90x35	90x70
	4.0	–	90x35	90x35	90x35	90x35	90x45	90x35	90x35	90x70
	6.0	–	90x35	90x35	90x35	90x35	90x45	90x35	90x35	90x70
Low	2.0	–	90x35	90x35	90x35	90x35	90x35	90x35	90x35	90x45
	4.0	–	90x35	90x35	90x35	90x35	90x35	90x35	90x35	90x45
	6.0	–	90x35	90x35	90x35	90x35	90x35	90x35	90x35	90x45

Table 5. Studs in loadbearing walls for all wind zones – single storey

Source: NZS 3604:2011 Table 8.2(a)

The loaded dimension in the table is 50 per cent of the total rafter span – see NZS 3604:2011 Figure 1.3.

Wind zone	Maximum length (height) of stud	Stud sizes for maximum spacing of studs (mm) of:		
		300	400	600
	(m)	(mm x mm)	(mm x mm)	(mm x mm)
		(width x thickness)		
Extra high	2.4	90 x 35	90 x 45	90 x 70
	2.7	90 x 45	90 x 70	90 x 90
	3.0	90 x 70	90 x 70	140 x 45
	3.3	90 x 90	140 x 45	140 x 45
	3.6	140 x 45	140 x 45	140 x 70
	3.9	140 x 45	140 x 70	190 x 45
	4.2	140 x 70	140 x 70	190 x 45
	4.8	190 x 45	190 x 70	–
Very high	2.4	90 x 35	90 x 35	90 x 70
	2.7	90 x 35	90 x 45	90 x 70
	3.0	90 x 45	90 x 70	90 x 90
	3.3	90 x 70	90 x 90	140 x 45
	3.6	90 x 90	140 x 45	140 x 45
	3.9	140 x 45	140 x 45	140 x 70
	4.2	140 x 45	140 x 70	190 x 45
	4.8	140 x 70	190 x 45	190 x 70
High	2.4	90 x 35	90 x 35	90 x 45
	2.7	90 x 35	90 x 35	90 x 70
	3.0	90 x 35	90 x 45	90 x 70
	3.3	90 x 70	90 x 70	140 x 45
	3.6	90 x 70	90 x 90	140 x 45
	3.9	90 x 90	140 x 45	140 x 70
	4.2	140 x 45	140 x 45	140 x 70
	4.8	140 x 70	190 x 45	190 x 45

Table 6. Studs in non-loadbearing walls for all wind zones

Source: NZS 3604:2011 Table 8.4

Figure 22 shows the different parts of a wall frame.

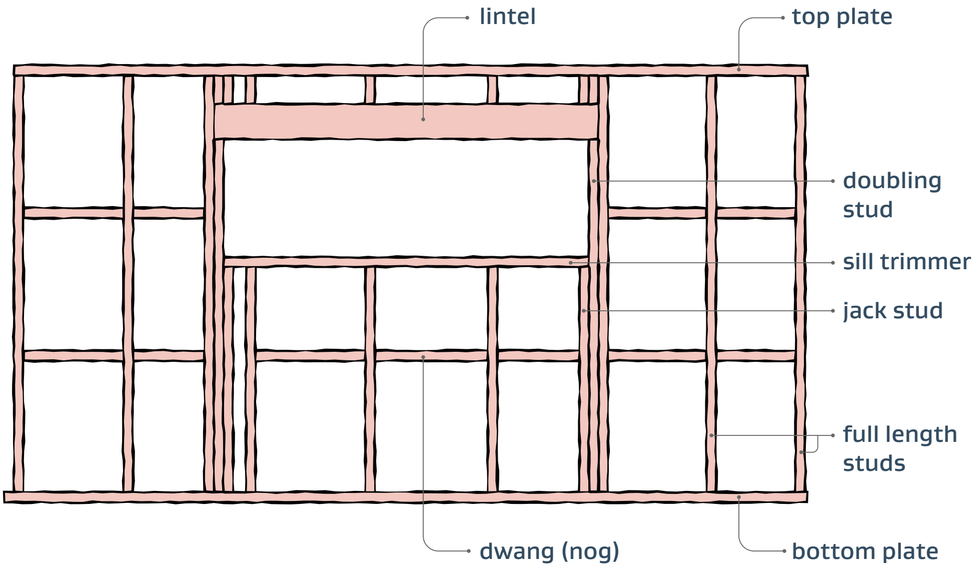


Figure 22. Names of the timber components within wall framing

In some cases, you have a choice of stud sizes and spacings. Not all sizes of timber are readily available around the country, so it makes sense to choose the sizes that are available. Studs that are 90 x 45 mm (or 140 x 45 mm) are more readily available and are easier to attach linings and claddings to than the narrower 90 x 35 mm studs. The worked example at the end of this section shows how NZS 3604:2011 Table 8.2(a) and Table 8.4 are used.

If dwangs (also known as nogs or nogging) are needed, these will be spaced between the studs at not more than 1.35 m centre to centre (Figure 22). NZS 3604:2011 does not specifically require dwangs in all wall framing, but including them makes the walls easier to construct and lift into position.

Dwangs may be required for fixing lining or cladding or to support shelves or other heavy features installed on the inside walls. If you expect to have shelves or other heavy features, it is best to install the dwangs (or solid blocking) needed to support them when the framing is being assembled.

Although the dwangs are shown lined up in Figure 22, they may be able to be staggered (some slightly lower and some slightly higher) to makes it easier to nail through the studs into the ends of the dwangs. They are not be able to be staggered when they are needed to fix linings or claddings.

Calculating lintels for window and door openings

Windows and doors in the sleepout require openings in the framed walls. These are framed by lintels at the head (above the opening), doubling/trimmer studs at the jambs (the side of the opening) and a trimmer at the sill (under the opening) – see Figure 22 and NZS 3604:2011 section 8.6.

To find the size of lintel required, see NZS 3604:2011 Table 8.9 (Table 7 below).

	Loaded dimension of lintel (m)	Maximum span for lintel sizes listed below (m) width x thickness (mm)									
		90x70	90x90	140x70	140x90	190x70	190x90	240x70	240x90	290x70	290x90
Light Roof	2	1.2	1.4	2.0	2.1	2.7	2.9	3.4	3.6	4.0	4.2
	3	1.1	1.2	1.7	1.9	2.4	2.6	3.0	3.3	3.7	3.9
	4	1.0	1.1	1.5	1.8	2.1	2.4	2.7	3.1	3.2	3.7
	6	0.8	1.0	1.3	1.6	1.8	2.1	2.2	2.7	2.7	3.3

Table 7. Lintel supporting roof only for all wind zones
Source: NZS 3604:2011 Table 8.9

For example, if a window is 1.2 m wide and the loaded dimension is 2 m, a lintel that is 90 x 70 mm will be sufficient for the job. A window that is 2 m wide will require a lintel that is 140 x 70 mm.

To work out if you need to consider snow loading, which affects the lintel size, refer to the snow loading map in NZS 3604:2011 Figure 15.1. If your sleepout roof needs to support snow, you can then use the relevant lintel tables in NZS 3604:2011 section 15 to work out lintel sizes.

Once again, look for timber sizes that are readily available. Bear in mind that you can create a specific size by nailing two thinner pieces of timber together to provide the required width. For example, nailing two 190 x 45 mm framing timbers together (in accordance with in NZS 3604:2011 section 2.4.4.7) will give you a 190 x 90 mm lintel. While the thickness can be built up like this, the width always has to be one piece.

Setting out the wall framing

Panels of wall framing are constructed by positioning each of the framing timbers on a flat surface and fixing them together. The completed framing panels are then lifted into position. Framing that is constructed on site is best done on a flat level floor surface. You may be able to do this on the floor platform of the sleepout once it is constructed.

The ideal is to build each wall around the sleepout as a complete framing panel rather than a series of panels that have to be connected together. This generally makes the top and bottom plates continuous and makes the panels more robust. It is also easier to erect a complete panel for each wall rather than a series of smaller panels that then need their plates and studs joined together. For sleepouts, making one panel per wall is very feasible.

The wall panels could be constructed on top of each other, with the longer and heavier wall panels at the bottom of the stack arranged so they only need to be tilted up and slid into position.

To start, lay the top plate on top of the bottom plate and mark the positions of the studs on the edges of both plates (Figure 23). Also mark the positions where rafters, trusses and ceiling joists (taken from section 6) will sit on top of the wall top plate.

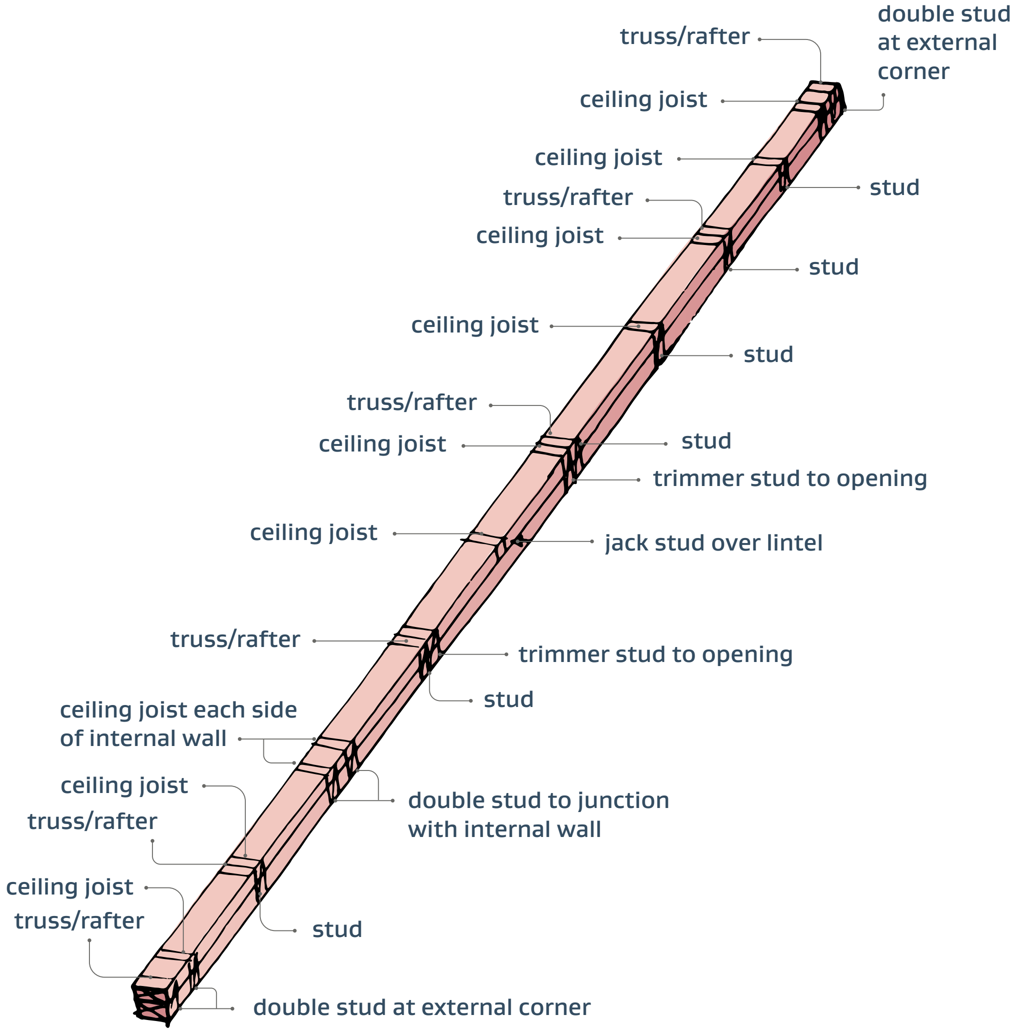


Figure 23. Marking the positions of other framing timbers on top and bottom plates

Once the plates are marked out, they are rolled over and separated and the studs and other framing timber cut to the correct lengths can be laid in place. When cutting studs to length, remember to subtract the thickness of the plates from the floor to ceiling height to give the correct panel height (confusingly called stud height).

When ordering timber and setting out, remember to allow for:

- three studs at corners
- additional studs at any other junctions between walls (or panels)
- doubling studs to the sides of openings and under beams
- the location of roof structure (rafters, trusses or beams) landing on the top plate or within the wall
- stud spacings to suit:
  - stud height
  - stud dimensions
  - the type of claddings and linings being used (plywood cladding and plasterboard lining) – you could use lining and cladding of similar dimensions to avoid needing extra studs and dwangs.

When setting out the openings for windows and doors in a framing panel, allow for these things:

- The widths and heights of the aluminium window or exterior door unit.
- A fitting tolerance for the window/door of 10 mm all around the window or door. This allows the fitting of the window plus flashing tape to the opening to the window between the window frame or reveal and the framing to meet flange cover for standard aluminium window sections. It also allows for installation of an expanding foam air seal on a PEF backing rod all around the window/door.
- Full-height jamb battens for the window sill tray with direct-fixed cladding (not where wall cladding is installed on a cavity). These sit on the sill trimmer and run vertically at either side of the window (Figure 22).

The squareness of the openings for windows and doors is critical. A faster build will require doors and windows to be preordered, which means precision when constructing the openings. The slower option is to measure the opening and then order the windows and doors to suit. In a lot of new construction, suppliers do the measuring themselves to avoid disputes over mistakes, but for a small sleepout, it is reasonable for the DIYer to do it.

Avoid making inline joints in anything but top and bottom plates. For example, wall studs should always be a single length of timber, never multiple pieces joined together.

Assembling the wall framing

Each framing panel will be fixed together with a combination of different fixings including nails and metal straps. The nailing guidance here applies to hand-driven nails. A framing nail gun is obviously faster but should only be used by a trained and experienced operator.

Before starting the fixing, double check all the measurements and check that everything is square. You can test if the frame is square by making sure diagonal measurements are of equal length (Figure 24).

STEP 1 – BRACING

While the framing is still on the floor, temporarily brace the framing to maintain squareness during fixing and erection (Figure 26 shows temporary braces fixed diagonally across the frame). Use timber or metal diagonal braces but leave the nails protruding to allow for adjustments and to remove it later. Wall lines only need one temporary brace along their lengths, even if they have two or more panels (Figure 27).

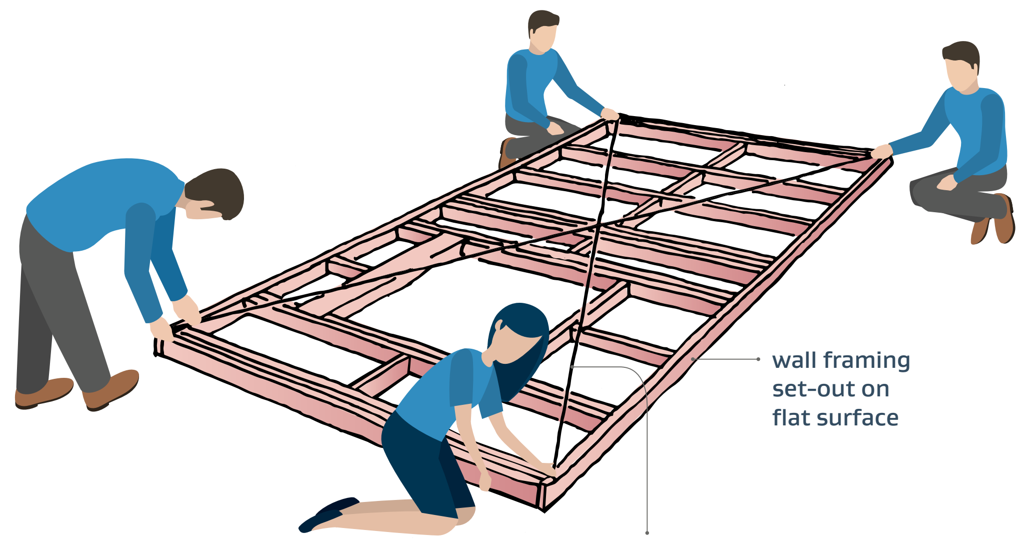


Figure 24. Checking that a framing panel is square

STEP 2 – FIXING THE ELEMENTS

After confirming that the framing panel is square and everything is in its correct position, the elements of the framing can be fixed in place (Figure 25 shows some of these). The fixings should be hot-dip galvanised steel. These are the specific fixing requirements for each part of the framing panel:

Connection	Fixing requirement
Top plate to studs	2/100 x 3.75 mm nails (end nailed)
Lintel to trimming stud	4/75 x 3.15 mm skewed nails, or 2/100 x 3.75 mm nails (end nailed)
Trimming studs at openings, blocking and studs at wall intersections	100 x 3.75 mm nails at 600 mm centres
Dwang to stud	2/100 x 3.75 mm nails (end nailed), or 2/75 x 3.15 mm nails (skew nailed)
Bottom plate to floor framing (after the framing panel is lifted into position)	2/100 x 3.75 mm nails at 600 mm centres
Stud to lintel	Metal straps 25 x 1 mm fixed with 6/30 x 2.5 mm nail
Top plate to jack studs/trimming studs	Metal straps 25 x 1 mm fixed with 6/30 x 2.5 mm nail

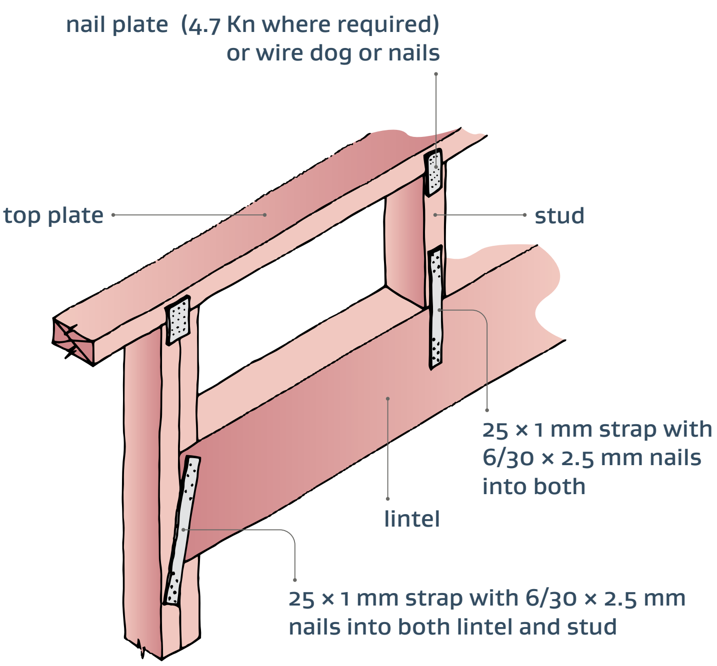


Figure 25. Examples of fixing straps/nail

STEP 3 – ADDING PROPS AND ERECTING THE FRAME

Once the first framing panel has been completed, the panel can be lifted into its final position (Figure 26) and propped to keep it in position (Figure 27).

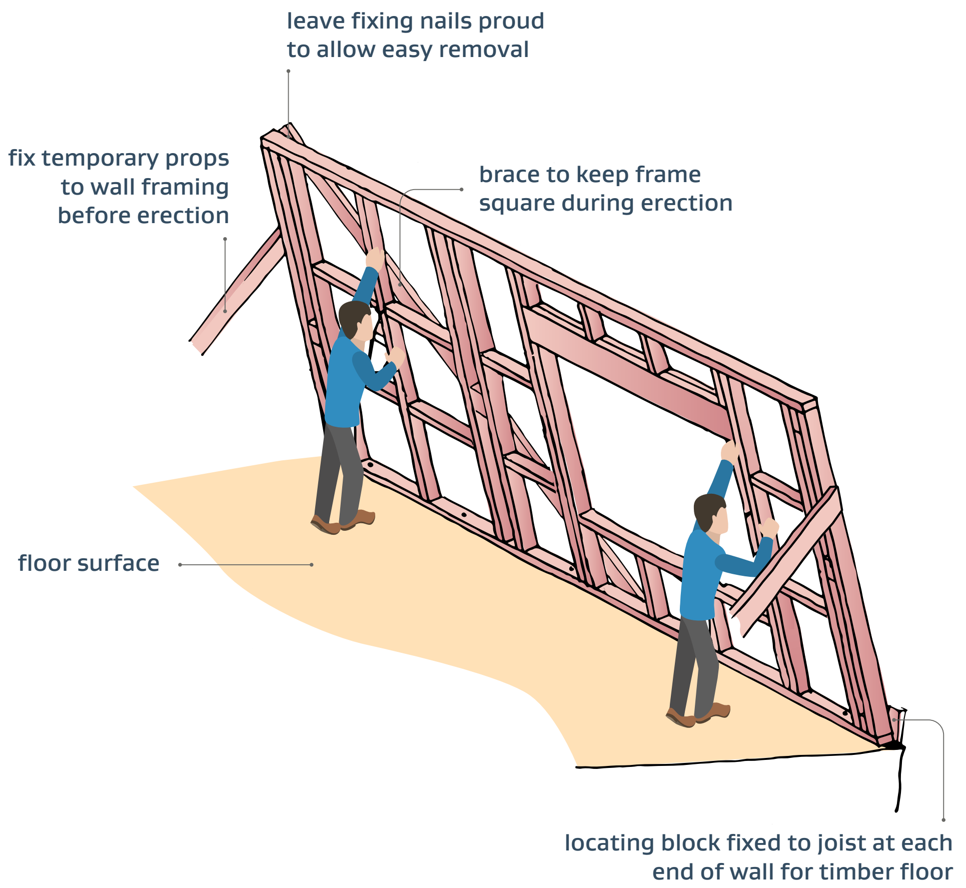
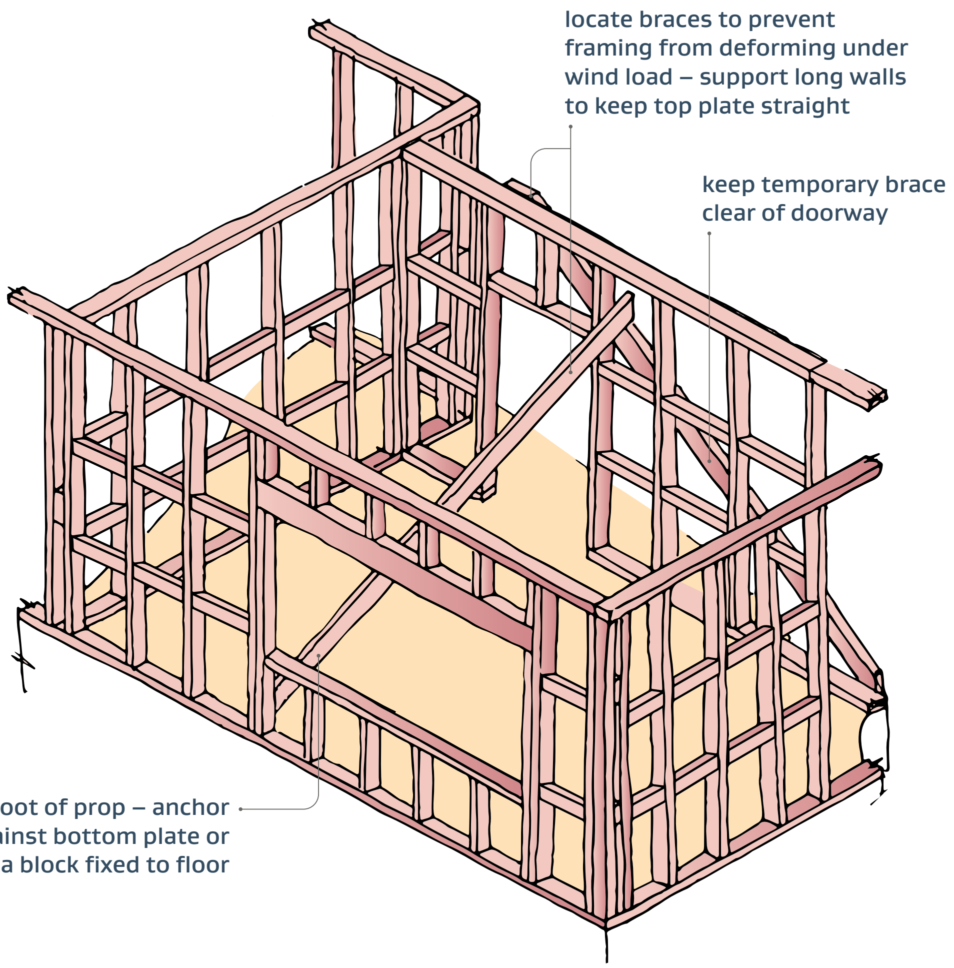


Figure 26. Fix temporary props to the wall framing before lifting the framing panel into position

There are safety risks involved in lifting framing panels. Have a clear plan in advance of how you will make the lift and attach temporary props at each end before you start. Ensure you have enough people to provide the support required (this also reduces the risk of twisting the panel as it is lifted).

Make sure to wear appropriate safety gear and lift the frame carefully and safely.



Notes:

1. Keep temporary bracing in place as long as possible – remove when fixing lining or sheet bracing.
2. Temporary prop may need to remain in place until the ceiling lining is installed.

Figure 27. Temporary bracing and propping for the framing during construction

Diagonal timber props are installed between the end studs and the floor joists to temporarily hold the wall panel vertical. Ensure that the base of the wall is in its final position before fixing the bottom plate to the floor. Fix temporary blocks to the floor joists that will allow the panel to be properly positioned when it is lifted up and to stop it sliding off the floor platform. Props may also be used to keep a top plate straight (Figure 27).

Temporary bracing should be left in place on the framing panels as long as possible – remove it when fixing the lining or sheet bracing to the walls. Standing walls are plumbed and squared up by loosening off the temporary props and then refixing them to hold the walls true.

Temporary props that are keeping frames vertical at the corners of the building will be replaced by braced framing panels during construction. Temporary props that keeping top plates straight may need to remain in place until the ceiling framing or lining have been installed.

There are particular requirements around fixing the frames together at the corners (Figure 29). Straps are required at certain key points (Figures 25 and 45).

STEP 4 – FIXING THE FRAME PANELS TO THE GROUND AND OTHER PANELS

The below fixings must be used at the following locations:

Connection	Fixing requirement
Stud to floor joist or solid blocking (after the framing panel is lifted into position).	Metal straps 25 x 1 mm fixed with 6/30 x 2.5 mm nail
Bottom plates to floor joists at trimming studs to doors and windows (after the framing panel is lifted into position).	Metal straps 25 x 1 mm fixed with 6/30 x 2.5 mm nail

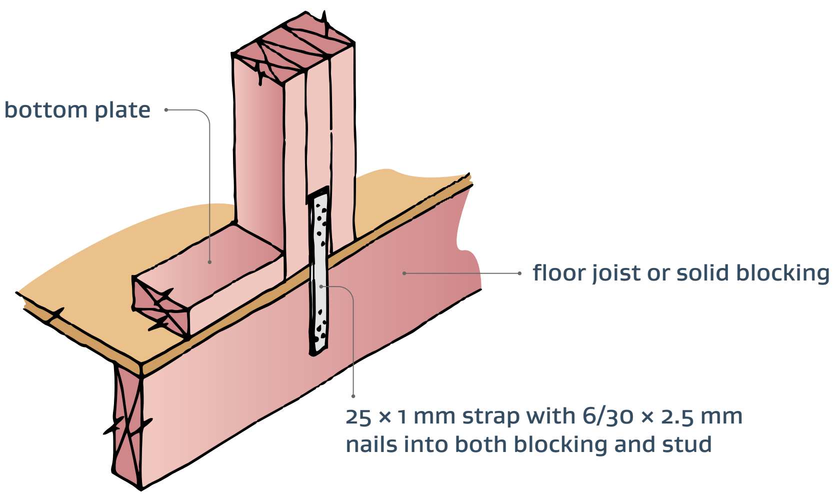


Figure 28. Fixing of the frame on the bottom plate

First fixing to be within 300 mm of corner.

Fix bottom plate into floor joist with:

- 2/100 x 3.75 mm nails at 600 mm crs for external walls
- 1/100 x 3.75 mm nails at 600 mm crs for internal walls

Some bracing elements require additional bottom plate fixings.

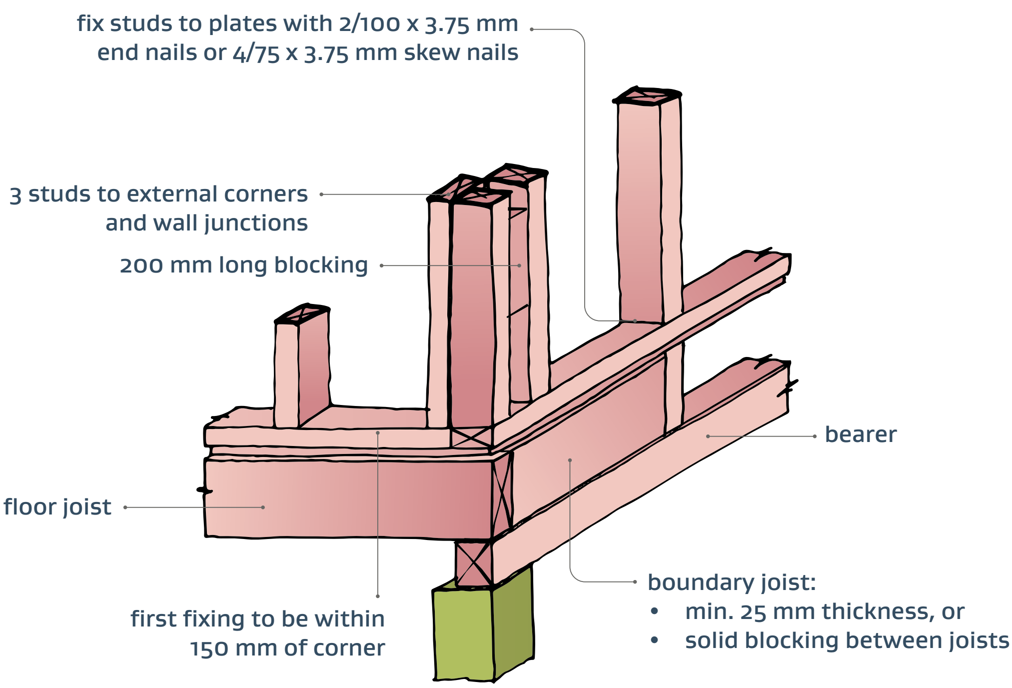


Figure 29. Fixing walls panels together at the corner (note three-stud corner)

Connections of the roof framing to the wall framing are covered in section 6.

Calculating and installing bracing

All four walls need permanent bracing to resist the loads from wind and earthquakes. How much bracing is required is based on the earthquake zone and the wind zone of the location where the sleepout is being built.

In practical terms, as for the foundation bracing, there are options for working out the amount, types and positions of bracing:

- Work these out yourself by following of NZS 3604:2011 section 5.
- Use a resource such as the BRANZ bracing calculation sheets.
- Get an expert to do the calculations and position the bracing for you such as an architectural draughtsperson, designer, architect or engineer.
- Follow the calculation methods and requirements that plasterboard manufacturers provide when using plasterboard linings as bracing.

Wind bracing demand is based on wind acting both along and across the building (giving different demand figures) and is expressed in bracing units (BUs) required to meet the demand in each direction.

Earthquake bracing demand is based on an earthquake acting both along and across the building to the same extent (which results in only one demand figure) and is again expressed in BUs.

Once you have determined the total BUs required to resist the greater of either the calculated earthquake or wind load bracing demand, choose wall bracing systems that will meet or exceed the highest demands.

Bracing is typically provided by sheet cladding on the outside and/or plasterboard lining on the inside. Proprietary wall bracing systems are commonly used to brace buildings.

When installing bracing, ensure:

- the fixings around the perimeter and at intermediate fixing points follow the manufacturer's specifications for the material and bracing rating
- the ends of the bracing elements (sheets and framing) are fixed down through the bottom plate as specified by the manufacturer for the material and the bracing rating to be achieved.

Worked example

Calculating wall framing and bracing

The worked example sleepout as described in section 2 is a 5 x 4 m building in a high wind zone and in earthquake zone 1.

This part will calculate:

- the sizing of the back wall framing
- the sizing of the front wall framing
- the sizing of the side wall framing
- dwangs
- windows and door openings
- the wall bracing.

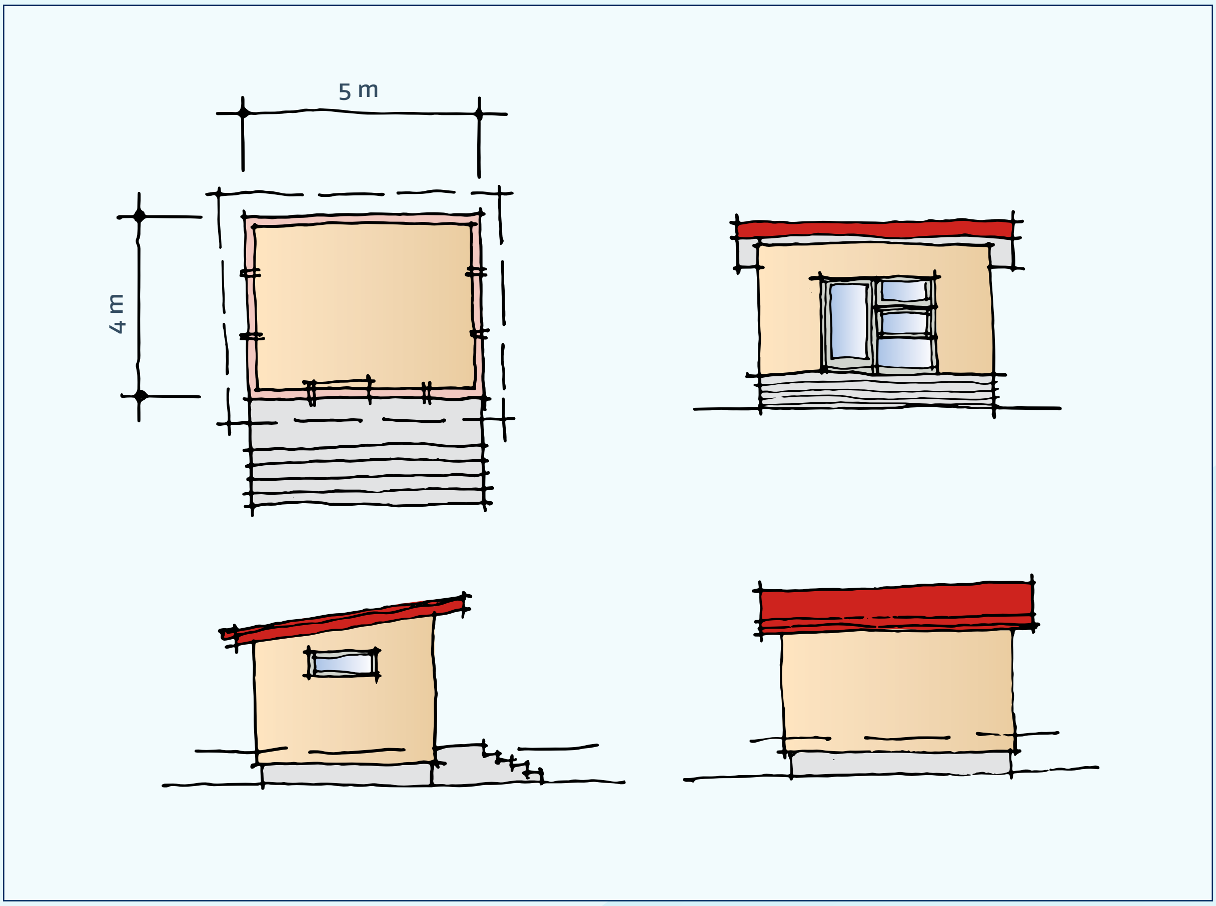


Figure 30. The sleepout used for the worked example

Sizing the back wall framing

The back wall is 2.42 m in overall height – an industry standard that allows standard length (2.4 m) plasterboard interior wall linings to be fixed to the wall 10 mm above the floor and 10 mm below the ceiling framing. The back wall consists of timber studs, dwangs, ceiling plate and top and bottom plates. The wall supports one end of the roof rafters and cladding so is loadbearing. Framing sizes for the studs and centres at which the studs are placed is taken from NZS 3604:2011 Table 8.2(a) (Table 8 below).

Wind zone	Loaded dimension of wall (m)	Stud sizes for maximum length (height) of: (m)								
		2.4			2.7			3.0		
		At maximum stud spacing (mm) of:			At maximum stud spacing (mm) of:			At maximum stud spacing (mm) of:		
		300	400	600	300	400	600	300	400	600
	(m)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)
		(width x thickness)								
Extra high	2.0	–	90x45	90x70	90x45	90x70	90x90	90x70	90x70	140x45
	4.0	–	90x45	90x70	90x45	90x70	90x90	90x70	90x70	140x45
	6.0	–	90x45	90x70	90x45	90x70	90x90	90x70	90x70	140x45
Very high	2.0	–	90x45	90x70	90x35	90x70	90x70	90x45	90x70	90x90
	4.0	–	90x45	90x70	90x35	90x70	90x70	90x45	90x70	90x90
	6.0	–	90x45	90x70	90x35	90x70	90x70	90x45	90x70	90x90
High	2.0	–	90x35	90x45	90x35	90x45	90x70	90x35	90x70	90x70
	4.0	–	90x35	90x45	90x35	90x45	90x70	90x35	90x70	90x70
	6.0	–	90x35	90x45	90x35	90x45	90x70	90x35	90x70	90x70
Medium	2.0	–	90x35	90x35	90x35	90x35	90x45	90x35	90x35	90x70
	4.0	–	90x35	90x35	90x35	90x35	90x45	90x35	90x35	90x70
	6.0	–	90x35	90x35	90x35	90x35	90x45	90x35	90x35	90x70
Low	2.0	–	90x35	90x35	90x35	90x35	90x35	90x35	90x35	90x45
	4.0	–	90x35	90x35	90x35	90x35	90x35	90x35	90x35	90x45
	6.0	–	90x35	90x35	90x35	90x35	90x35	90x35	90x35	90x45

Wind zone	Loaded dimension of wall (m)	Stud sizes for maximum length (height) of: (m)								
		3.6			4.2			4.8		
		At maximum stud spacing (mm) of:			At maximum stud spacing (mm) of:			At maximum stud spacing (mm) of:		
		300	400	600	300	400	600	300	400	600
	(m)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)
		(width x thickness)								
Extra high	2.0	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	190 x 45	140 x 90	190 x 90	190 x 90
	4.0	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	190 x 45	140 x 90	190 x 90	190 x 90
	6.0	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	190 x 45	140 x 90	190 x 90	190 x 90
Very high	2.0	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	190 x 45	140 x 90	190 x 45	190 x 90
	4.0	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	190 x 45	140 x 90	190 x 45	190 x 90
	6.0	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	190 x 45	140 x 90	190 x 45	190 x 90
High	2.0	90 x 90	140 x 45	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	140 x 90	190 x 90
	4.0	90 x 90	140 x 45	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	140 x 90	190 x 90
	6.0	90 x 90	140 x 45	140 x 45	140 x 45	140 x 90	140 x 90	140 x 90	140 x 90	190 x 90
Medium	2.0	90 x 70	90 x 70	140 x 45	90 x 90	140 x 45	140 x 90	140 x 45	140 x 90	140 x 90
	4.0	90 x 70	90 x 70	140 x 45	90 x 90	140 x 45	140 x 90	140 x 45	140 x 90	140 x 90
	6.0	90 x 70	90 x 70	140 x 45	90 x 90	140 x 45	140 x 90	140 x 45	140 x 90	140 x 90
Low	2.0	90 x 35	90 x 70	90 x 70	90 x 70	90 x 90	140 x 45	140 x 45	140 x 45	140 x 90
	4.0	90 x 35	90 x 70	90 x 70	90 x 70	90 x 90	140 x 45	140 x 45	140 x 45	140 x 90
	6.0	90 x 35	90 x 70	90 x 70	90 x 70	90 x 90	140 x 45	140 x 45	140 x 45	140 x 90

Table 8. Studs in loadbearing walls for all wind zones – single storey
Source: NZS 3604:2011 Table 8.2

The loaded dimension of the back wall is 2.0 m (half of the rafter span) so that line of figures is used. The overall wall height is 2.42 m so the maximum stud lengths are 2.33 m after deducting the 45 mm top and bottom plate thicknesses from the overall wall height. Therefore use the 2.4 m maximum stud length section of the table.

Using the line for high wind zone, 2.0 m loaded dimension and 2.4 m maximum stud length, this gives the choice of 90 x 35 mm studs at 400 mm centres or 90 x 45 mm studs at 600 mm centres. For this example, the 90 x 45 mm studs are selected. This is a standard industry size and 600 mm centres suit 1.2 m wide standard sheet sizes for plasterboard wall lining and plywood exterior cladding. Top and bottom plates and dwangs will also be 90 x 45 mm to align with the stud size.

Sizing the front wall framing

Heights for the walls that support the monopitch roof are based on the minimum roof pitch for corrugated profiled metal of 8°. They are also based on the maximum height allowed in this building consent exemption – a floor level of up to 1 m above the supporting ground and a height of up to 3.5 m above the floor level.

The front wall is 3.02 m in overall height. This allows for a suitable roof pitch, formed by rafters spanning from the front to the back wall. It also allows for the installation of plasterboard interior wall linings, fixed to the wall 10 mm above the timber floor and 10 mm below the ceiling framing. As this wall also supports roof rafters and cladding, it is loadbearing and constructed similarly to the back wall.

For this wall, because overall height is 3.02 m, the stud lengths are less than 3.0 m long (after deducting the 45 mm top and bottom plate thicknesses from overall height) but longer than 2.4 m or 2.7 m (the other options in the table). Therefore, use the 3.0 m section in NZS 3604:2011 Table 8.2(a).

Using the same line of the table as was used for the back wall (high wind zone and 2.0 m loaded dimension) but for 3.0 m maximum stud length, it will give the choice of using 90 x 35 mm studs at 300 mm centres, 90 x 70 mm studs at 400 mm centres or 90 x 70 mm studs at 600 mm centres.

Because 90 x 35 mm and 90 x 70 mm sizes are not common industry framing sizes and there is no 90 x 45 mm option in the table, use 140 x 45 mm studs at 600 mm centres. This size is from the same line of the table but for 3.6 m maximum length studs – this is longer than the studs so is acceptable to use. Top and bottom plates and dwangs will also be 140 x 45 mm framing to align with the stud size. This allows the stud centres to stay as 600 mm for the sheet lining/cladding. While 140 x 45 mm studs generally cost more than 90 x 45 mm, they are a readily available and a commonly used stud size.

Sizing the side wall framing

The side walls run between the 2.42 m high back wall and the 3.02 m high front wall. This means each stud is a different length as the top plate of the wall will rake to the roof pitch between the back and front wall. The studs in the side walls will range from maximum 2.4 m long to maximum 3.0 m long. However, they do not support any roof rafter/cladding load so they are non-loadbearing. For this example, refer to NZS 3604:2011 Table 8.4 (Table 9 below).

Wind zone	Maximum length (height) of stud (m)	Stud sizes for maximum spacing of studs (mm) of:		
		600	400	600
		(mm x mm)	(mm x mm)	(mm x mm)
		(width x thickness)		
Extra high	2.4	90 x 35	90 x 45	90 x 70
	2.7	90 x 45	90 x 70	90 x 90
	3.0	90 x 70	90 x 70	140 x 45
	3.3	90 x 90	140 x 45	140 x 45
	3.6	140 x 45	140 x 45	140 x 70
	3.9	140 x 45	140 x 70	190 x 45
	4.2	140 x 70	140 x 70	190 x 45
	4.8	190 x 45	190 x 70	–
Very high	2.4	90 x 35	90 x 35	90 x 70
	2.7	90 x 35	90 x 45	90 x 70
	3.0	90 x 45	90 x 70	90 x 90
	3.3	90 x 70	90 x 90	140 x 45
	3.6	90 x 90	140 x 45	140 x 45
	3.9	140 x 45	140 x 45	140 x 70
	4.2	140 x 45	140 x 70	190 x 45
	4.8	140 x 70	190 x 45	190 x 70
High	2.4	90 x 35	90 x 35	90 x 45
	2.7	90 x 35	30 x 35	90 x 70
	3.0	90 x 35	90 x 45	90 x 70
	3.3	90 x 70	90 x 70	140 x 45
	3.6	90 x 70	90 x 90	140 x 45
	3.9	90 x 90	140 x 45	140 x 70
	4.2	140 x 45	140 x 45	140 x 70
	4.8	140 x 70	190 x 45	190 x 45

Table 9. Studs in non-loadbearing walls for all wind zones

Source: NZS 3604:2011 Table 8.4

The process is similar to that used for the back and front wall framing. The studs range from 2.4 m maximum to 3.0 m maximum, so to ensure there is a strong enough wall, the 3.0 m maximum length for this calculation is selected. Using a high wind zone section and the 3.0 m maximum stud length, this gives the choice of 90 x 35 mm studs at 300 mm centres, 90 x 45 mm studs at 400 mm centres or 90 x 70 mm studs at 600 mm centres.

Because 90 x 35 mm and 90 x 70 mm sizes are not common industry framing sizes, use 90 x 45 mm studs at 400 mm centres, which also works well with the sheet lining/cladding sizes.

Dwangs

NZS 3604:2011 does not require the use of horizontal dwangs unless they are required for the lateral support of studs or for fixing/support of the cladding or lining.

Cladding and lining can both provide lateral support of studs – as this example has sheet cladding/lining, this will provide adequate lateral support for the studs.

Where dwangs are required, they can be 45 x 45 mm. If they are required to allow fixing of interior lining, they are installed flush with the inside edge of the studs. If required for fixing wall cladding, they can be fixed flush with the outside edge of the studs.

Window and door openings

The example sleepout has a 1.38 m wide by 0.38 m high window in each side wall and a 2.0 m high by 2.38 m wide ranchslider door/window unit in the front wall (these are the outside dimensions of the window and door units). The ranchslider is in the middle of the front wall and the windows on the horizontal centres of the side walls (and with the tops of their sill trimmers both 1.62 m above the floor).

These require suitably sized openings in the framed walls, formed by lintels at the head, doubling/trimmer studs at the jambs and a trimmer at the sill (NZS 3604:2011 section 8.6).

The door opening head is framed with a lintel that spans across the width of the opening (2.38 m in our sleepout). The door opening is 2.0 m high (from floor level to the underside of the lintel), which is a common door/window head height, and obviously there is no framing under the door unit.

The window openings are 1.38 m wide by 0.38 m high with the head framed by a lintel spanning across the 1.40 m opening at 2.0 m to the underside of the lintel. The sill is framed by a sill trimmer 0.38 m below the underside of the lintel.

Sizing the lintels

The window lintels are made up of two thicknesses of 45 mm framing nailed together to form a 90 mm thick lintel. The ranchslider lintel is made up the same way, but because it is framed into a 140 mm deep wall panel, it requires 90 x 45 mm framing nailed on the flat to the face of the lintel to make up the total wall thickness.

The lintel in the front wall is in a wall supporting the roof, so the lintel size is calculated from NZS 3604:2011 Table 8.9 (Table 10 below). The lintels in the side walls are not supporting any load – as this is the lowest load case table, use this for calculating the size of the window lintels.

	Loaded dimension of lintel (m)	Maximum span for lintel sizes listed below (m)									
		width x thickness (mm)									
		90x70	90x90	140x70	140x90	190x70	190x90	240x70	240x90	290x70	290x90
Light roof	2	1.2	1.4	2.0	2.1	2.7	2.9	3.4	3.6	4.0	4.2
	3	1.1	1.2	1.7	1.9	2.4	2.6	3.0	3.3	3.7	3.9
	4	1.0	1.1	1.5	1.8	2.1	2.4	2.7	3.1	3.2	3.7
	6	0.8	1.0	1.3	1.6	1.8	2.1	2.2	2.7	2.7	3.3

Table 10. Spans for lintels that only support a roof (for all wind zones)
Source: NZS 3604:2011 Table 8.9

As this example has a light roof cladding and a loaded dimension of the front wall lintel of 2.0 m, use the top line of the table for the lintels. The 2.4 m wide ranchslider opening requires a 190 x 70 mm lintel. As this example uses 45 mm thick framing to form the lintels, for practicality, select the next lintel size up, which is 190 x 90 mm (two 190 x 45 mm framing timbers nailed together).

Use the same line of the table for the window lintels – the 1.4 m wide window openings require a 90 x 90 mm lintel (two 90 x 45 mm framing timbers nailed together).

The lintels are supported at each end by doubling studs – see NZS 3604:2011 Figure 8.12.

Therefore use:

- **studs** – 90 x 45 mm at 600 mm centres and 140 x 45 mm at 600 mm centres for the wall framing (NZS 3604:2011 section 8.5)
- **window and door lintels** – 2/90 x 45 mm and 2/190 x 45 mm timber for the window and door opening (NZS 3604:2011 section 8.6).

All the framing timber is H1.2 SG8 radiata pine.

Sill trimmer

A sill trimmer is a horizontal framing timber that runs along the bottom of a door or window opening, supporting the door or window frame.

As the ranchslider is full height, this does not require a sill trimmer.

The sill trimmers for the windows span 1.4 m across the width of the opening – this is calculated from NZS 3604:2011 Table 8.15 (Table 11 below). While the table only calls for a 35 mm thick trimmer, this example uses a 45 mm thick trimmer to match the rest of the framing (therefore a 90 x 45 mm sill trimmer).

The sill trimmers are supported at each end by 90 x 45 mm understuds – see NZS 3604:2011 Figure 8.12.

Maximum clear width of opening	Minimum thickness of sill and header trimmers
(m)	(mm)
2.0	35
2.4	45
3.0	90 (or 2/45 mm)
3.6	135 (or 3/45 mm)
4.2	SED

Table 11. Sill and head trimmers for all wind zones

Source: NZS 3604:2011 Table 8.15

Lintel fixings

Lintels supporting rafters need to be fixed to the timber wall framing to resist potential wind uplift acting on the roof. The front wall lintel will therefore need these fixings (the side wall lintels do not support rafters so do not require them).

Using the high wind zone and 2.0 m maximum loaded dimension line of NZS 3604:2011 Table 8.14, the 2.4 m ranchslider lintel will require uplift fixings in line with NZS 3604:2011 section 8.6.1.8. This requires the lintel to be fixed to the framing and the framing to be fixed to the timber floor structure with the fixings shown in NZS 3604:2011 Figure 8.12.

Calculating the wall bracing

All four walls need to be braced to withstand wind and earthquake loads. The bracing demand has been calculated for the building based on it being located in earthquake zone 1 and a high wind zone. The bracing demand for walls is less than the bracing demand for the foundations.

Bracing calculations are expressed in bracing units (BUs) required to meet the demand.

Wind bracing demand is based on wind acting both along and across the building (which results in different demand figures).

Earthquake bracing demand is based on an earthquake acting both along and across the building to the same extent (which results in one demand figure).

A worked example using BRANZ bracing calculation sheets can be found in Figure 31 and Figure 32.

Bracing elements are required to meet the wind demands on the building. The demands on these elements have been calculated as 250 BUs across the building and 220 BUs along the building.

As the building has a monopitch roof, this requires wind bracing to meet the highest demand (250 BUs) both along and across the building (NZS 3604:2011 Figure 5.3).

The bracing elements are also required to meet the earthquake demands on the building. These demands have been calculated as 88 BUs across and along the building.

WALLS - HIGH WIND

BRANZ

SHEET A

Name of Applicant: WORKED EXAMPLE **Site Address:**

City/Town or District: HIGH WIND ZONE VERSION

Street and Number

Or Lot and D.P. Number:

Box 1

LOCATION OF STOREY / BLOCK BEING ASSESSED

FOUNDATION	SINGLE STOREY ~~or~~ UPPER STOREY	LOWER STOREY	LOCATION IN BUILDING
Use one sheet for each and circle the appropriate location			

Box 2 Wind Bracing Demand (Table 5.5 , 5.6 or 5.7)

Wind zone (Table 5.1) L / M / H / VH / EH

Building height to apex (H) 4.2 m

Roof height above eaves (H) 1.2 m

Note: Tables 5.5, 5.6, 5.7 relate to High wind zone.
In other wind zones, multiply the value by the appropriate factor.

TABLE 5.6

	(value from tables)		(multiplication factor)			
W_{across} =	50	x	L 0.5 / M 0.7 / VH 1.3 / EH 1.6	=	50	Bu/m
W_{along} =	55	x		=	55	Bu/m

Transfer to Box 5

Box 3 Earthquake Bracing Demand (Table 5.8, 5 9, 5.10)

Earthquake zone (Figure 5.4)	1 / 2 / 3 / 4	Concrete slab	(Table 5.10)	YES / NO
Weight of roof cladding	Light / Heavy	Part storey in roof space	(Cl. 5.3.4.3)	YES / NO
Roof pitch (degrees)	0-25 / 26-45 / 46-60	/ Part storey basement	(Cl. 5.3.4.4)	YES / NO
Weight of upper (or single) storey cladding	~~Light / medium / heavy~~	Chimney	(Cl. 5.3.4.5)	YES / NO
Weight of lower storey cladding	Light / medium / heavy	Wings / blocks	(Cl. 5.1.5)	YES / NO
Weight of subfloor cladding	Light / medium / heavy	Deck projecting more than 2 m	(Cl. 7.4.2.2)	YES / NO

(value from tables 5.8, 5.9, 5.10) (multiplication factor below)

E = 11 x 0.4 = 4.4 BU /m² Transfer to Box 5

NOTE: Tables 5.8, 5.9, 5.10 relate to soil type D/E in Earthquake zone 3, for multiplication factors for other soil types see below

Soil Class	Earthquake Zone 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 / Soft	0.5	0.8	1.0	1.5

TABLE 5.8

Box 4 Building plan dimensions (Figure 5.3)

Roof or building length for wind across ridge	(L)	=	5	m	Transfer to Box 5
Roof or building length for wind along ridge	(W)	=	4	m	
Gross Floor Area	(GFA)	=	20	sq m	

Box 5 Calculation of demand

SO 250 ALONG/ACROSS

			(Value)		(Box 4 Dimension)				
Wind Load Across	(from box 2)	=	50	x	5m	=	250	BU	Transfer to Sheet B
Wind Load Along	(from box 2)	=	55	x	4m	=	220	BU	
Earthquake Load (both directions)	(from Box 3)	=	4.4	x	20	=	88	BU	

HEIGHT OF WIND ALONG AND ACROSS USED FOR BOTH DEMANDS WHEN MONOPITCH ROOF

Figure 31. Wall bracing calculation for example sleepout – sheet A

GIB EZYBRACE USED

SHEET B

BRANZ

LOCATION OF STOREY / BLOCK BEING ASSESSED

FOUNDATION	SINGLE STOREY or UPPER STOREY	LOWER STOREY	LOCATION IN BUILDING

Use one sheet for each storey / block and circle the appropriate location

ACROSS BUILDING

1	2	3	4	5	6	7	8	9	10	11
				Wind				Earthquake		
Wall or Bracing Line	Bracing Element Identification	Bracing Type	Length of Element (m)	BU's/m (Wind)	BU's Achieved	Total for Bracing Line	Minimum Bracing Demand	BU's/m (Earthquake)	BU's Achieved	Total for Bracing Line
A	1	GSI-N	1.2	70	84	168	125	60	72	144
	2	GSI-N	1.2	70	84			60	72	
B	3	GSI-N	1.2	70	84	168	125	60	72	144
	4	GSI-N	1.2	70	4			60	72	
C										
D										
E										
				Total Bracing Achieved		336		Total Bracing Achieved		288
				Total Bracing Demand for Wind Across		250		Total Bracing Demand for Earthquake		88

ALONG BUILDING

1	2	3	4	5	6	7	8	9	10	11
				Wind				Earthquake		
Wall or Bracing Line	Bracing Element Identification	Bracing Type	Length of Element (m)	BU's/m (Wind)	BU's Achieved	Total for Bracing Line	Minimum Bracing Demand	BU's/m (Earthquake)	BU's Achieved	Total for Bracing Line
M	5	GSI-N	1.2	70	84	168	125	60	72	144
	6	GSI-N	1.2	70	84			60	72	
N	7	GSP-H	1.2	120	144	144	125	120	144	144
				(018)				(018)		
O										
P										
Q										
				Total Bracing Achieved		312		Total Bracing Achieved		288
				Total Bracing Demand for Wind Along		250		Total Bracing Demand for Earthquake		88

Figure 32. Wall bracing calculation for example sleepout – sheet B

To meet these bracing demands, this example uses plasterboard internal wall lining and exterior plywood cladding as sheet bracing. There are several proprietary bracing systems and methods of calculating bracing demand that are readily available and could be used. Bracing elements are not able to have a window or door anywhere within their length. This could affect where the windows and doors can be located.

This example selects a combination of GS1-N bracing elements with standard plasterboard lining and GSP-H bracing elements with standard plasterboard lining and structural plywood on the exterior. The ratings for these proprietary bracing elements exceed the wind and earthquake bracing demands in both directions.

You will note that the bracing capacity – or bracing units per lineal metre (BUs/m) – provided by these proprietary braces (stated in BUs/m in column 5 in Figure 32) is different for wind bracing and earthquake bracing.

The total bracing units provided by each brace are calculated by multiplying the bracing capacity of the brace by the length of the bracing element. The total bracing units achieved on each bracing line in the building (for bracing lines along and across the building) are calculated by adding up the bracing units achieved by each brace on that line.

The overall total bracing units achieved are calculated by adding up the totals of each line to reach totals for bracing achieved both along and across the building for both wind and earthquake. The total bracing achieved along and across the building for both wind and earthquake must exceed the relevant total bracing demand.

06

Roof style and framing

A roof doesn't just provide shelter from the rain, it must be strong enough to handle winds and earthquakes too – and even snow loads in some parts of the country.

The forces acting on roofs are not just downwards (from gravity) and sideways (from winds and earthquakes). There is also upwards suction in certain wind conditions, so design, construction and fixing all have to ensure the roof will be held down.

Most roof framing for new houses is made by frame and truss manufacturers. You could ask a frame and truss company about providing the roof trusses for your sleepout. This guide covers the key details you need to know when constructing roof framing yourself.

Roof styles

The three main roof styles (Figure 33) that are most likely to be used with a sleepout are:

- monopitch roof (sometimes called a single-plane roof on a slope)
- gable roof
- hip roof.

It is best to select the style that makes the roof simple to construct and maintain. The easiest (and usually cheapest) style for a sleepout is a monopitch roof. The more complex gable and hip styles usually require more materials and are more difficult to construct.

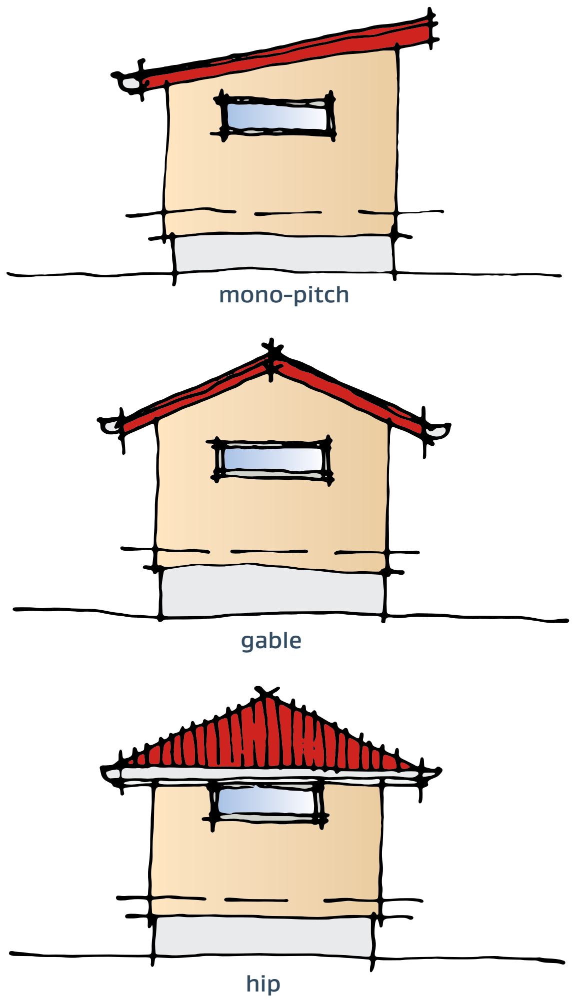


Figure 33. Monopitch roof, gable roof and hip roof styles

Designing the roof

When you are designing the roof framing, have the whole finished roof in mind and keep the design as simple as possible.

These are some things you need to consider:

- **Finished height** – for an exempt sleepout, the highest point of the roof must be no more than 3.5 m above the finished floor level. The building must also be no closer than its own height to any residential building or legal boundary (see section 1).
- **Roof cladding** – roof cladding manufacturers typically require a minimum pitch (slope) for their products so they will shed water. As an example, the pitch of corrugated metal usually needs to be at least 8° (141 mm rise for every 1 m of sleepout width). The cladding manufacturer will also state the minimum spacing required for the purlins that the roof cladding is fixed to (see Figure 46 for how purlins are set out), how the roofing is to be fixed and flashed and whether roofing underlay is required (see section 7).
- **Insulation** – where the thermal insulation will be installed and how thick it will be. Some high-performing insulation is 200 mm thick (or more). There needs to be a minimum ventilation gap of 25 mm between the top surface of the roof insulation and the underside of the roofing that will also accommodate any sagging within flexible roofing underlays (section 9 gives more details about insulation).
- **Ceiling** – flat or sloped – and the type of material. If the ceiling material requires ceiling battens, these need to be installed with a spacing that will suit the span and fixing requirements of the ceiling material.
- **Bracing** – how you will meet the roof bracing requirements. Whoever designs the roof bracing should also design the bracing for the foundations and walls.
- **Eaves overhang** – how far you want the eaves to overhang on each side of the building.
- **Gutters and downpipes** – where the gutters and downpipes will be located.

Going into more detail, the most likely design options for a sleepout roof will be one of these three:

- A skillion roof, where the roof cladding and ceiling run parallel. This can only be a skillion monopitch roof (Figure 34) or skillion gable roof (Figure 35).
- A couple-close gable roof with a ceiling (Figure 36). Each pair of rafters is tied together below the ridge board by cleats and are also linked at their feet.
- A roof truss fixed together with nail plates (Figure 37). Under NZS 3604:2011, a roof truss must be made by an accredited fabricator (a company accredited by a nail plate manufacturer to make roof trusses using nail plates and construction details supplied by that manufacturer). While this is a possible choice for a sleepout if ordered from a fabricator, building the trusses is not a DIY option.

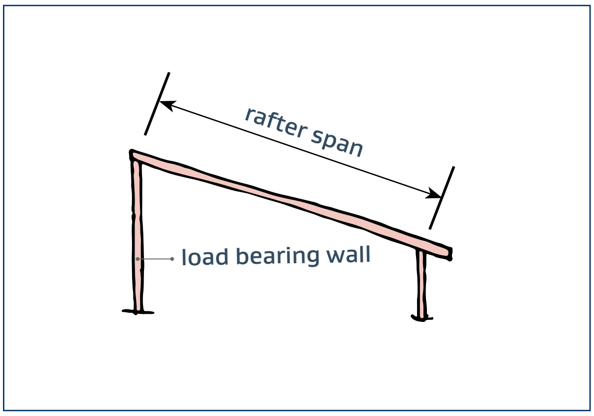


Figure 34. Skillion monopitch roof

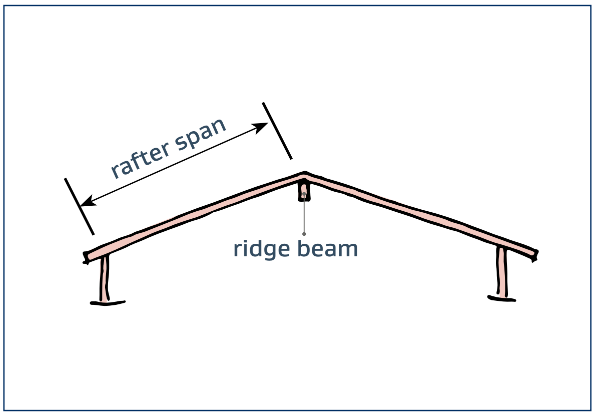


Figure 35. Skillion gable roof

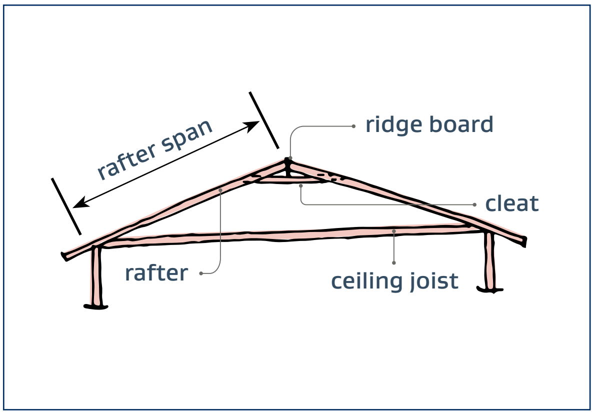


Figure 36. Close-couple gable roof

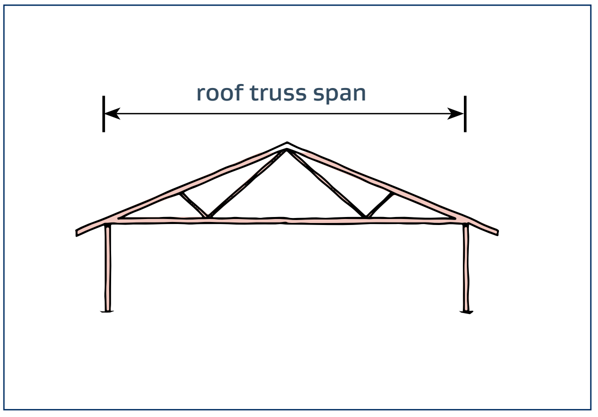


Figure 37. Roof truss

Ceiling battens

Sloped ceilings can be fixed to ceiling battens fixed to the underside of skillion roof rafters (Figure 38) – the ceiling is not fixed directly to the underside of rafters.

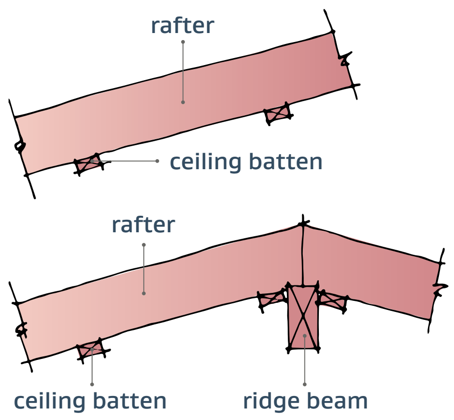


Figure 38. Sloped ceiling fixed to battens on the undersides of skillion monopitch and gable roof rafters

With a close-couple gable roof, ceiling joists and battens fixed to their underside are installed to support the ceiling (the ceiling is not fixed directly to the underside of ceiling joists).

Ceiling battens are fixed to the bottom chord of the roof truss (Figure 39).

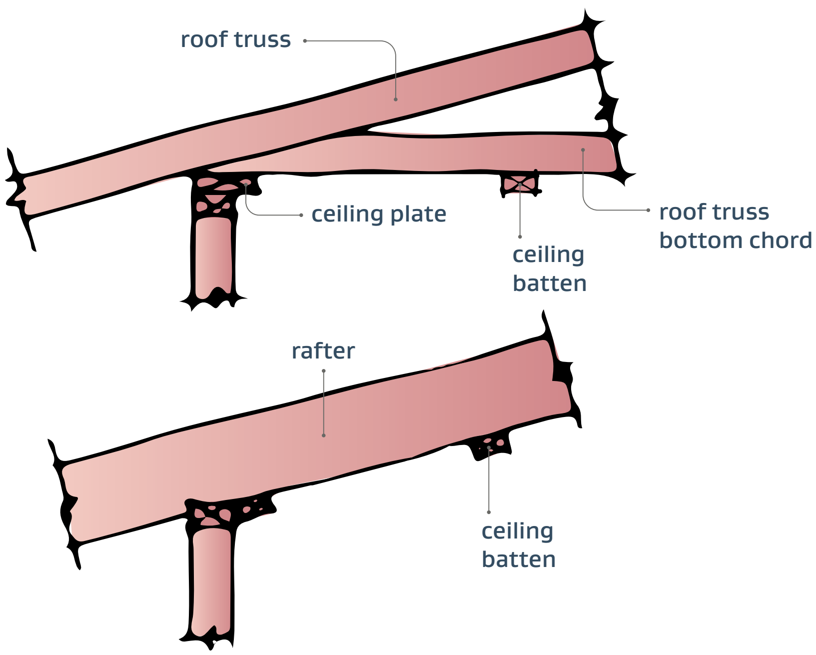


Figure 39. Ceiling battens on the bottom chords of roof trusses and on ceiling joists (of couple-close roofs) and on the undersides of rafters

Couple-close roofs have ridge boards whereas skillion gable roofs are supported by ridge beams. Couple-close roofs can have a thinner ridge board as this type of roof is supported by the triangle formed by the ceiling joists and rafters and the strong connections that the cleats provide at the ridge. A skillion gable roof incorporates a ridge beam. This beam needs to be sized to span the length of the building.

Ridge boards in couple-close roofs must be at least 19 mm thick and at least the same depth as the rafters. To support eaves at each end, a ridge board can project beyond the outer supporting walls for a distance up to one-quarter of its span in each direction.

Ridge beams support the top ends of each pair of rafters. The lower rafter ends are not tied to ceiling joists or other framing.

Selecting the timber framing

Once you have selected the roof and ceiling style that you want, there is other timber framing that you require:

- For a monopitch roof, you will need rafters, purlins and fascia boards. You may also need ceiling battens if you want a traditional ceiling. Ceiling battens, commonly around 70 x 35 mm, are fixed below rafters or ceiling joists and the ceiling lining is attached to these.
- For a skillion gable roof, you will need rafters, purlins, fascia boards and a ridge beam and possibly ceiling battens if you want a traditional ceiling.
- For a close-couple gable roof, you will need rafters, purlins, fascia boards, a ridge board, cleats and ceiling joists. You may also use ceiling battens. It is possible that ceiling joists can be installed on rafter centres and ceiling battens fixed to the underside of ceiling joists.

Whatever type of roof you choose, the framing timber sizes and spans and fixings will be taken from NZS 3604:2011 section 10.

The Building Code requires roof framing to last a minimum 50 years. Where radiata pine roof framing is used, it should be:

- treated to a minimum level of:
  - H1.2 (pink) to protect against rot and borer
  - H3.1 (light green or uncoloured) for fascia boards that are exposed to weather
  - H3.2 (dark green) for rafters that have any part exposed to the weather
- structural grade (SG) – we use SG8 in this guide
- free from bows, twists and warps
- kept dry and not be left uncovered and exposed to the weather for long periods.

If kiln-dried timber gets wet, let it dry before using it or enclosing it.

Timber is usually marked, and some of it is coloured, to identify its treatment level (Figure 21). For example, H1.2 framing timber is pink, H3.1 timber can be a light green and H5 foundation piles can be a dark green. The treatment and grade of timber will be marked along the length or on the end.

Rafters

For a sleepout, rafters will usually span from one top plate or lintel to the other top plate (for monopitch roofs) or between the top plates and the ridge board/ridge beam. A rafter must span the whole distance without joints.

To provide eaves, rafters can extend beyond the outside face of the top plate. The maximum rafter extension is normally 750 mm measured horizontally. The maximum extension is less than 750 mm for 90 x 45 mm rafters and other rafters where the rafter extension would be more than 40 per cent of the rafter span. The 40 per cent maximum and the span are both measured along the slope of the rafter.

The 750 mm horizontal extension with an 8° slope gives a (sloped) span of 1.89 m. The 90 x 45 mm is the only rafter size that has a shorter span. The next smallest span is 2.2 m, which corresponds to a (sloped) overhang of 0.88 m. The extension only reduces below 0.75 m horizontally when the slope exceeds about 31.5°.

Rafters are chosen from NZS 3604:2011 Table 10.1 (Table 12 below). The longer the span you require, the larger the rafter needs to be. For a sleepout, the most commonly used rafter sizes are likely to be 90 x 45 mm, 140 x 45 mm and 190 x 45 mm. These will typically be spaced at 900 mm centres. However, the span you have may require the rafters to be spaced at closer centres.

Rafter size (width x thickness)	Rafter spacing (mm)							
	480		600		900		1200	
	Span	Fixing	Span	Fixing	Span	Fixing	Span	Fixing
(a) Ordinary rafters for light and heavy roofs								
(mm x mm)	(m)	(type)	(m)	(type)	(m)	(type)	(m)	(type)
90 x 45	1.3	E	1.3	E	1.2	E	1.3	E
140 x 45	2.7	E	2.5	E	2.2	E	2.2	E
190 x 45	3.5	E	3.3	E	2.8	E	2.5	E
240 x 45	3.8	E	3.5	E	3.1	E	2.8	E
290 x 45	4.1	E	3.8	E	3.3	E	3.0	E
140 x 70	3.2	E	2.9	E	2.6	E	2.8	E
190 x 70	4.3	E	4.0	E	3.5	E	3.7	E
240 x 70	5.4	E	5.1	E	4.4	E	4.3	F
290 x 70	6.4	E	5.9	E	5.1	E	4.6	F
140 x 90	3.4	E	3.2	E	2.8	E	3.0	E
190 x 90	4.7	E	4.3	E	3.8	E	4.1	F
240 x 90	5.9	E	5.5	E	4.8	F	5.1	F
290 x 90	7.2	E	6.7	E	5.8	F	5.9	F

Table 12. Rafter span and fixings for extra high wind zone
Source: NZS 3604:2011 Table 10.1

The table gives spans for the extra high wind zone. These spans could be used for any zone. For low and medium wind zones, you can multiply the span length by 1.3. For high and very high wind zones, multiply by 1.1.

Fixing type E in the table is 2/90 x 3.15 mm skew nails and 2 wire dogs. Fixing F is 2/90 x 3.15 mm skew nails and strap fixing (see NZS 3604:2011 Figure 10.6).

To give an example of how the table works, let's say you want to space the rafters 600 mm apart and they have to span 3.2 m from the centreline of the top plate to the centreline of a ridge beam (Figure 35). You will need to use 190 x 45 mm rafters that can span up to 3.5 m.

If you live in an area with snowfall, you need to consider this too in the size the rafters need to be. Use the tables in NZS 3604:2011 section 15 to work out the size of rafters required to carry the relevant snow load.

Ridge board

A ridge board runs along the top of a close-couple gable roof with the top of each rafter fixed to it (Figure 40). For close-couple roofs, cleats must be fixed under the ridge board between pairs of rafters at every third rafter pair or maximum 1.8 m centres.

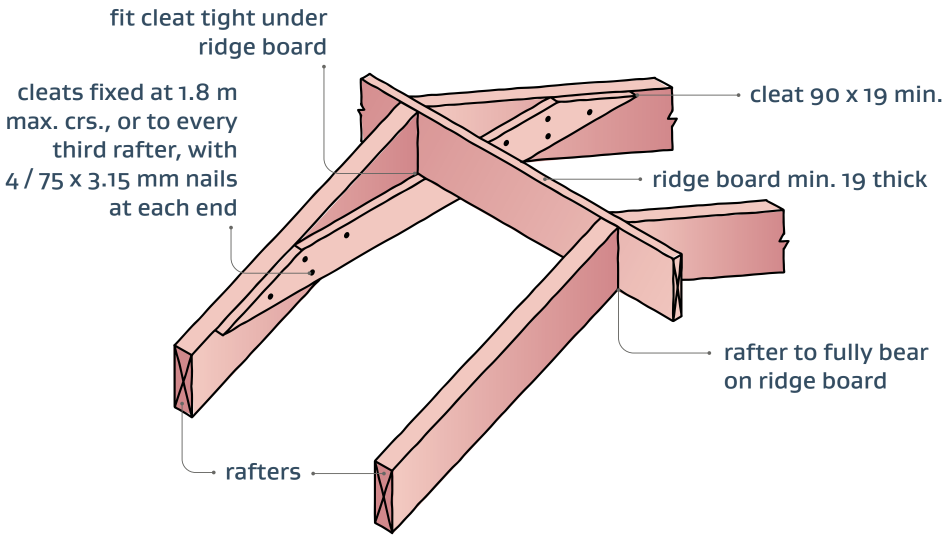


Figure 40. A ridge board, rafters and a cleat

Ridge boards must be a minimum 19 mm wide and need to be deep enough to allow the rafter to fully bear on the ridge board. For a sleepout, the most commonly used ridge board sizes are 140 x 19 mm, 180 x 19 mm or 230 x 19 mm.

To make the eaves overhang at either end of the roof, a ridge board can extend by up to one-quarter of its length beyond the end support.

Ridge beam

A ridge beam is a horizontal timber member that the top of each rafter is fixed to and where the lower ends of rafters are fixed to and supported by a top plate.

The size of ridge beam is chosen from in NZS 3604:2011 Table 10.2 (Table 13 below).

Ridge beam size	Loaded dimension of ridge beam (m)							
	1.8		2.7		3.6		4.2	
	Span	Fixing	Span	Fixing	Span	Fixing	Span	Fixing
(mm x mm)	(m)	(type)	(m)	(type)	(m)	(type)	(m)	(type)
240 x 45	2.3	H	1.9	H	1.7	H	1.6	H
290 x 45	2.4	H	2.1	H	1.9	H	1.8	I
190 x 70	2.7	H	2.4	H	2.1	I	1.9	I
240 x 70	4.3	I	3.8	I	3.4	I	3.2	I
290 x 70	4.8	I	4.1	I	3.7	I	3.5	J
190 x 90	3.7	H	3.2	I	2.9	I	2.8	I
240 x 90	4.7	I	4.1	I	3.7	I	3.5	J
290 x 90	5.7	I	5.0	I	4.5	J	4.3	J

Table 13. Ridge beam spans for all wind zones
Source: NZS 3604:2011 Table 10.2

For a sleepout, the most commonly used ridge beam sizes are likely to be 190 x 90 mm, 240 x 90 mm or 290 x 90 mm.

To find out what size of timber beam you need for your sleepout, you need to know the loaded dimension. This is an easy calculation to make – it is the sum of the span of the rafters each side of the ridge beam divided by two. For example, in Figure 37, if the rafter spans from top plates to the ridge beam are 2 m on each side (the sloped dimension), the loaded dimension is 2 m.

To give an example of how NZS 3604:2011 Table 10.2 works, let's say the loaded dimension is 2 m and the ridge beam is 5 m long. You have to look in the table column for the 2.7 loaded dimension and choose a ridge beam size that works for the 5 m span, where the last row gives a beam of 290 x 90 mm.

The fixings required to resist uplift of the ridge beam (shown as H, I and J in NZS 3604:2011 Table 10.2) are based on the span and the ridge beam size. These are explained in Table 14 below and NZS 3604:2011 Figure 10.8. Strap nails are to be 30 x 2.5 mm.

Fixing type	Fixing to resist uplift	
	Base connection for built-up studs	Ridge beam to built-up studs
G	6 / 90 x 3.15 skew nails into bottom plate	10 / 90 x 3.15 nails (5 each side)
H	25 x 1 strap with 12 nails to stud	1 / M12 bolt
I	2 / 25 x 1 straps with 6 nails to stud and plate. 24 nails total	2 / M12 bolts
J	3 / 25 x 1 straps with 12 nails to stud and plate. 36 nails total	1 / M16 bolts

Table 14. Fixings to resist beam uplift
Source: NZS 3604:2011 Table 10.2

If you live in an area where it snows, this will affect the size of the ridge beam required. Use the tables in NZS 3604:2011 section 15 to work out the size of the ridge beam required to carry the snow load for your area.

Purlins

Purlins are laid directly over the rafters or top chords of trusses, parallel to the ridge and eaves line, and the roof cladding is fixed to them. Their size is found in of NZS 3604:2011 section 10.2.1.16.1, Table 10.10 for purlins on their flat (Table 15 below) and Table 10.11 for purlins on edge. For a sleepout, the most commonly used purlin sizes are likely to be 70 x 45 mm or 90 x 45 mm.

The spacing of the purlins is whatever suits the spanning capability of the roof cladding (as well as being relative to the maximum spacings shown). Never choose a spacing beyond what the roof cladding manufacturer recommends.

Purlin size	Max. span	Maximum spacing and fixing in the following wind zones									
		Low		Medium		High		Very high		Extra high	
		Spacing	Fixing	Spacing	Fixing	Spacing	Fixing	Spacing	Fixing	Spacing	Fixing
	(mm)	(mm)	(type)	(mm)	(type)	(mm)	(type)	(mm)	(type)	(mm)	(type)
70 x 45	900	900	S	900	T	900	T	900	T	900	U
70 x 45	900	1200	T	1200	T	1200	T	1050	U	900	U
70 x 45	900	1800	T	1800	U	1400	U	1050	U	900	U
70 x 45	1200	1200	T	1150	T	800	T	600	T	500	T
70 x 45	1200	1300	T	1150	T	800	T	600	T	500	T
90 x 45	1200	1700	T	1450	U	1000	U	750	U	650	U

Fixing type	Description	Alternative fixing capacity (kN)
S	2 / 90 x 3.15 gun nails	0.8
T	1 / 10g self-drilling screw, 80 mm long	2.4
U	1 / 14g self-drilling type 17 screw, 100 mm long	5.5

Note – All fixing types are determined as required for the higher uplift loads at the periphery of the roof (based on local pressure factors in AS/NZS 1170.2).

Table 15. Spacings and fixings for purlins that are used on their flat
Source: NZS 3604:2011 Table 10.10

Purlins can extend beyond the edge of the building to form eaves. Purlins on their flat that span over at least three rafters can extend beyond their end supports for up to 300 mm (70 x 45 mm purlins) or 450 mm (90 x 45 mm purlins).

If you live in an area with snowfall, you need to consider this because it affects the size of purlins required. Use the tables in NZS 3604:2011 section 15 to work out the size of purlins required to carry the relevant snow load.

Ceiling joists

Ceiling joists support the ceiling in a close-couple roof (Figure 36). The size of the ceiling joist is determined from NZS 3604:2011 Table 10.3 (Table 16 below).

Ceiling joist size	Maximum span* of ceiling joists at a maximum spacing (mm) of:		
	480	600	900
(mm x mm)	(m)	(m)	(m)
90 x 35	1.9	1.8	1.8
90 x 45	2.4	2.3	2.0
140 x 35	3.5	3.3	2.8
140 x 45	3.8	3.6	3.1
190 x 35	4.9	4.6	4.0
*May be increased by 10% for joists continuous over 2 or more spans. Note – This table is applicable for all wind zones.			

Table 16. Ceiling joist spans
Source: NZS 3604:2011 Table 10.3

To give an example of how this works, if you want to have the ceiling joist spacing as 480 mm and have them span 3.3 m, the joists must be 140 x 35 mm.

Ceiling joists must run the full span – joints can only be made over supports.

Ceiling battens are fixed below rafters or ceiling joists, and the ceiling lining is attached to these. Ceiling battens are commonly around 70 x 35 mm.

Fascia board

The fascia (or barge) board is fixed horizontally to the ends of the rafters and also runs up the slope of the roof for monopitch and gable roofs. The horizontal fascia is the timber member that rainwater gutters are fixed to. Fascia boards are available in a range of sizes to suit the rafter dimensions. Fascia boards must be treated to H3.1.

In designs where there is no soffit (eaves), the wall cladding must be completed (including painting) before installing the fascia to fully protect the cladding from moisture penetration.

Construction of the roof framing

Because of the importance of getting the angles and the cuts right, constructing a roof can be time-consuming. This is not a job to rush at – spend time carefully understanding how everything will fit together and double-checking the measurements before picking up a saw or hammer. Where possible, a good option is to set the roof out on the floor of the sleepout to determine rafter lengths and cuts.

In section 5, it was recommended that you mark the positions of rafters, trusses and ceiling joists on top of the wall top plate (Figure 23). If you didn't do that as part of constructing the wall framing, do it now.

Mark the positions of the rafters to each end of the ridge. Mark the position of the ridge on the top plate. Transfer rafter positions from the top plate to the ridge board (where there is a ridge board/beam).

Cutting the rafters

The top cuts of the rafters are straight plumb to fit the rafter to the ridge board or beam (Figure 41). (Plumb means the cut will be vertical when it its final location).

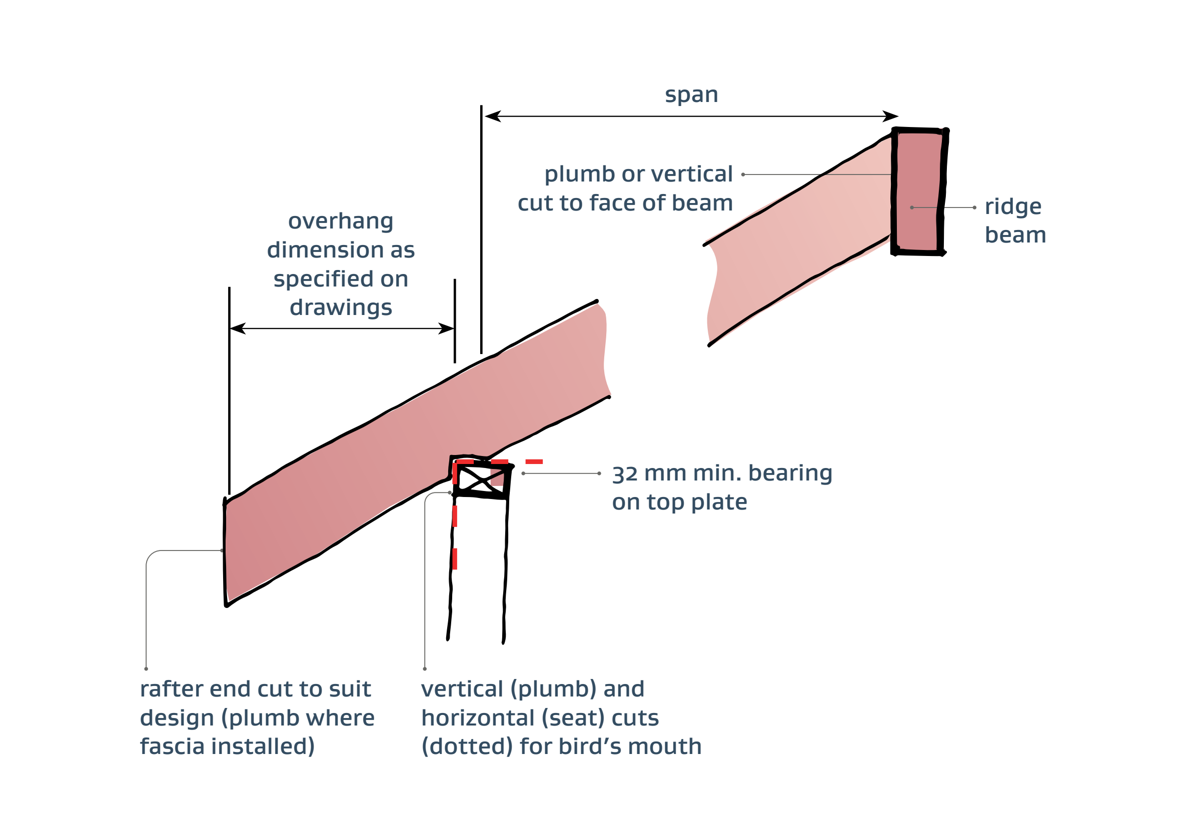


Figure 41. Rafters butting (face fixed) to ridge beam

At the bottom end of each rafter, make another plumb cut and a seat cut to fit the top plate into the rafter – this cut-out is often called a bird's mouth (Figure 42).

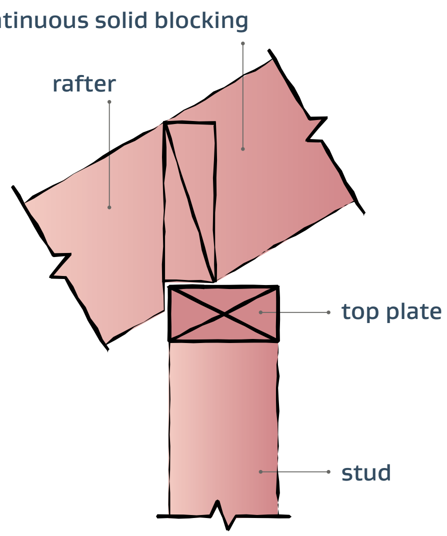


Figure 42. Rafters on a top plate must sit on a bird's mouth joint

Rafters will commonly overhang the wall as a soffit (Figure 41), helping give shelter to the wall and windows. The end of the overhanging rafter will typically be cut plumb so a fascia board can be fixed to the ends of the rafters. The guttering will then be fixed to the fascia board.

Once the first rafter has been cut and checked for accuracy of fit, it can be used as a template for other rafters. Check periodically the ridge remains parallel to the top plates.

If you would like to make the ridge beam an internal feature, you will need to make the rafters sit on top of the beam. In this case, a different cut is required as Figure 43 shows:

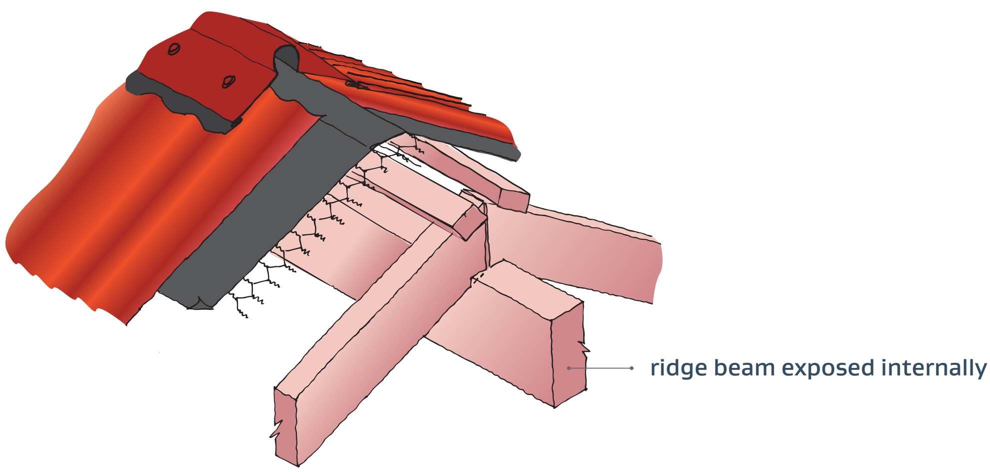


Figure 43. Rafters sitting on ridge beam showing the plumb cut

Construction sequences

Monopitch roof

1. Check the wall framing (walls are parallel at the top plate), the top plate is straight, walls are plumb and adequately braced. Adjust any of the temporary braces that are generally used to hold the tops of walls in their correct positions (true) and straight.
2. Install/fix ceiling plates to the top plates if required. Put in place and temporarily support an end rafter spanning from the front wall ceiling plate to the rear wall ceiling plate and fix the rafter to the ceiling/top plates (usually a two-person job).
3. Install the remaining rafters the same way at the spacing marked on the top plates.
4. Fit end nogs between rafters at each end of the rafters once they are fixed into final position.
5. Install ceiling battens to the undersides of the rafters at right angles to the rafters and at the required centres.
6. Fit the bracing.
7. Check the roof is square, adjusting the bracing if necessary.
8. Install the purlins to the top of the rafters at right angles to the rafters and at the required centres and locations.

Gable roof

1. Check the wall framing (walls are parallel at the top plate), the top plate is straight, walls are plumb and adequately braced. Adjust any of the temporary braces that are generally used to hold the tops of walls true and straight.
2. Install the ridge board or beam before the rafters. It will likely need temporary support/bracing/propping. Ensure the ridge board/beam is straight.
3. Put in place and temporarily support a rafter and fix the rafter to the top plate and to the ridge board or ridge beam at the apex of the roof. See Figure 40 for the ridge board/rafter junction or Figure 41 and 43 for the rafter/ridge beam junction (usually a two-person job).
4. Erect the opposing rafter and fix to the top plate and to the ridge board or ridge beam at the apex of the roof.
5. Do the same at the other end of the roof.
6. Plumb and temporarily brace both pairs of end rafters.
7. Install remaining rafters.
8. When incorporating a ridge board, fix cleats to the rafters as per Figure 40.
9. Install the ceiling joists in the locations set out on the top plates.
10. Install ceiling battens to the underside of the ceiling joists at right angles to the rafters and at the required centres.
11. Fit the bracing and check the roof is square.
12. Adjust the roof bracing if necessary before removing the temporary bracing for the ridge board/beam.
13. Install the purlins to the top of the rafters at right angles to the rafters and at the required centres and locations.

Truss gable roof

If you have ordered roof trusses from a frame and truss company, follow the company's instructions (if provided) or erect them following this sequence:

1. Check the wall framing (walls are parallel at the top plate), the top plate is straight, walls are plumb and adequately braced. Adjust any of the temporary braces and props that are generally used to hold the tops of walls true and straight.
2. Erect the first truss in the gable end.
3. Plumb and square the truss and prop its apex back to the peg (as shown in Figure 44).
4. Erect the last truss (as per steps above).
5. Attach a stringline from the apex of the first truss to the apex of the last truss to guide/check intermediate trusses.
6. Erect the rest of the trusses using temporary ties to brace the top of each truss back to the previously installed trusses in order to hold each truss plumb (Figure 44).
7. Check each bottom chord for straightness.
8. Securely fix each truss to the top plate as required to resist wind uplift.
9. Fit the roof bracing and check the roof is square.
10. Adjust the roof bracing if necessary before removing the temporary propping for the end gable trusses.
11. Install the purlins to the top of the truss top chord at right angles to the trusses and at the required centres and locations.

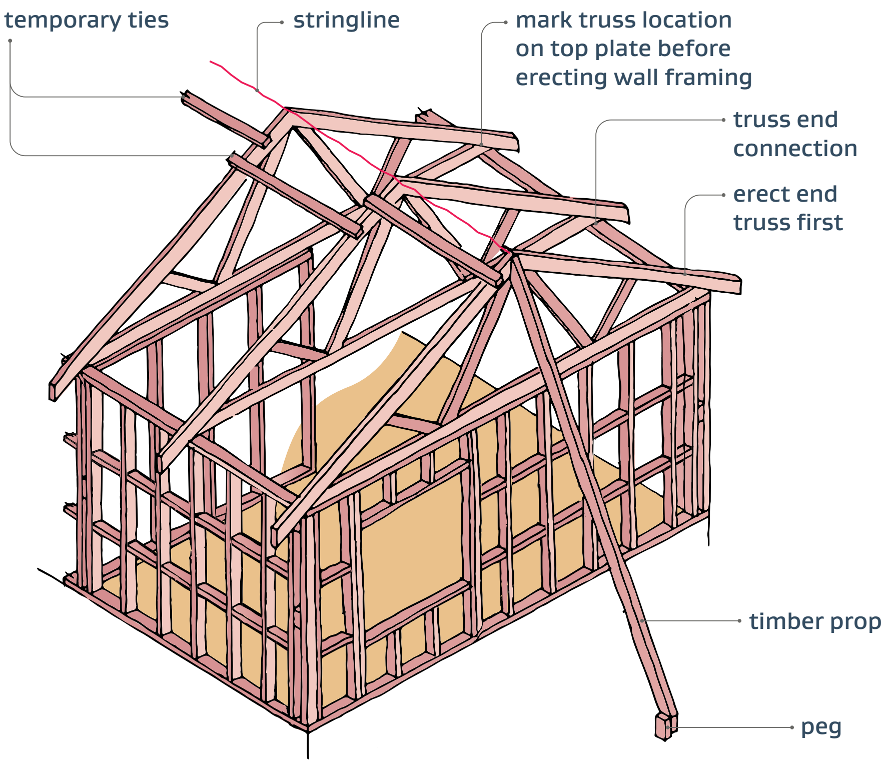
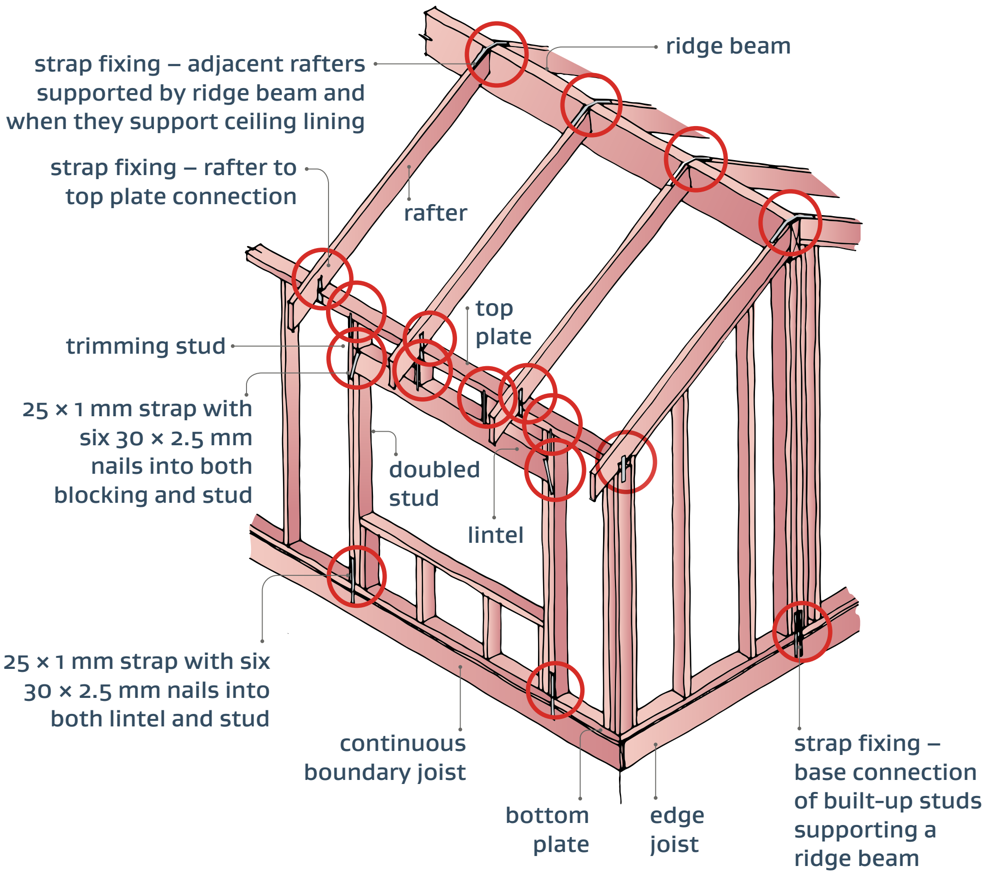


Figure 44. Installing roof trusses

Fixing

The rules around fixing of roof framing are set out in NZS 3604:2011. They are well illustrated with drawings that refer to the accompanying tables.

- Rafter to ridge beam – Figure 10.5 and Figure 10.7 for a skillion roof.
- Rafter to ridge board (cleats) – Figure 10.15.
- Rafter to top plate – Figure 10.6.
- Ridge beam to wall – Figure 10.8.
- Purlins fixed directly to rafters – Figure 10.18.
- Truss connection to top plate – Figure 10.21.



Note:
Circles indicate strap fixing locations to resist uplift.

Figure 45. Locations of strap fixings

Ceiling framing

Framing for ceilings must be installed true and straight. It should be framed out with trimmer joists to provide a usable access point for maintenance in the ceiling space (Figure 46). The ceiling joists are connected to both the top plate and immediately adjacent rafter, but the ceiling joists do not support and are not supported by roof framing members.

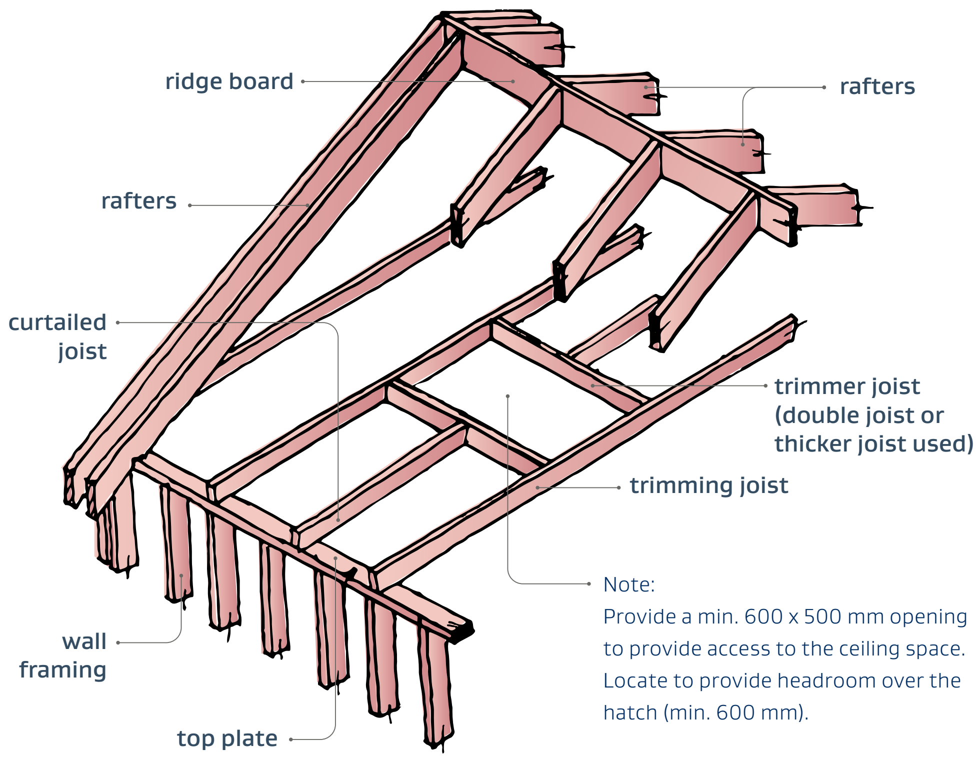


Figure 46. Ceiling framing with an access opening

Installing purlins

Purlins are fixed over the rafters or trusses and parallel to the ridge board or ridge beam (Figure 47). The spacing must match the requirements specified by the roof cladding manufacturer. Purlins on their flat can be butt jointed over a rafter, but two adjacent (side by side) purlins cannot be joined over the same rafter.

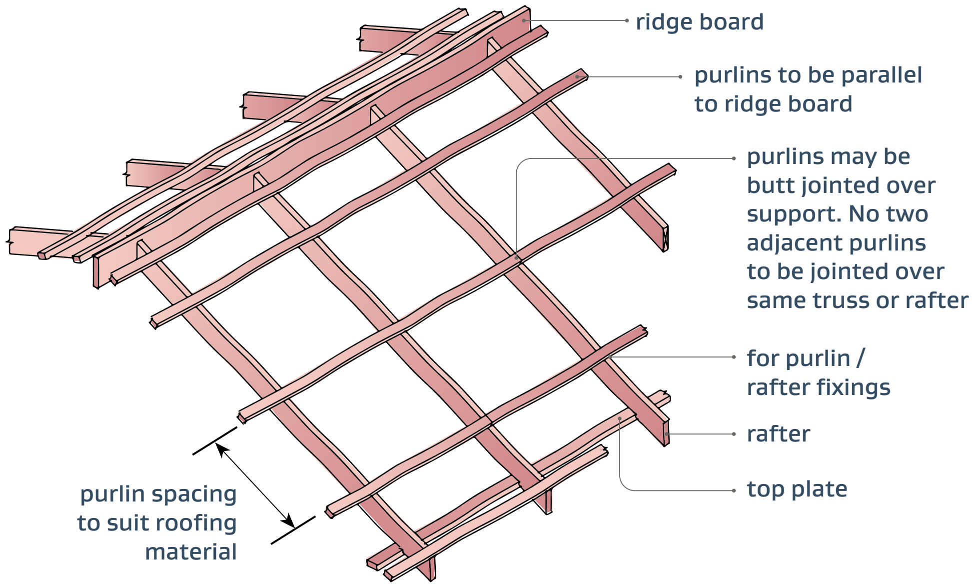


Figure 47. Purlins fixed to rafters

For purlin fixings, see Table 15 above.

Eaves/overhangs

To provide for eaves/overhangs:

- rafters can extend beyond the top plate for up to 40 per cent of their maximum permitted span or 750 mm, whichever is the lesser, to form a soffit – in a similar fashion, a gable end overhang can be formed by outriggers (Figure 48)
- purlins on their flat spanning over at least three rafters can extend up to 300 mm (70 x 45 mm purlins) or 450 mm (90 x 45 mm purlins) beyond their end supports to form a gable end overhang (Figure 49).

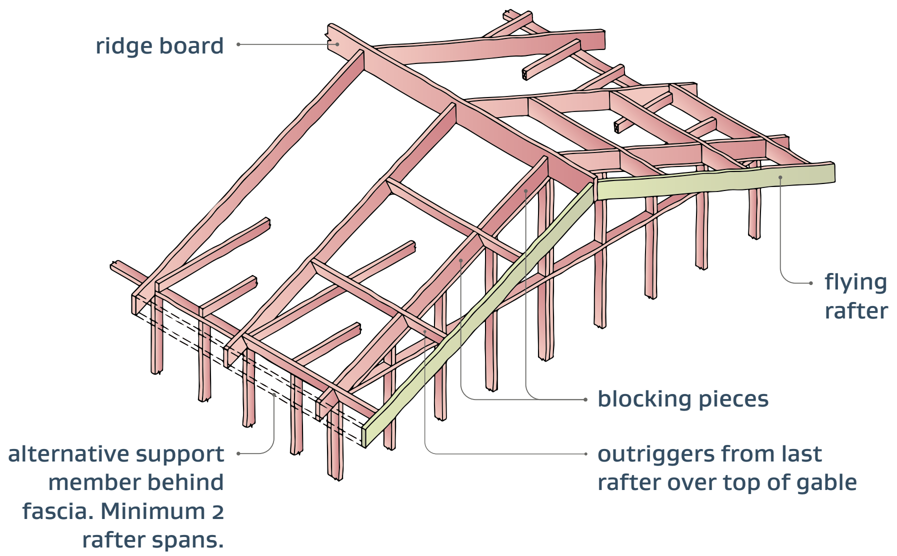


Figure 48. Gable end roof overhang formed by outriggers

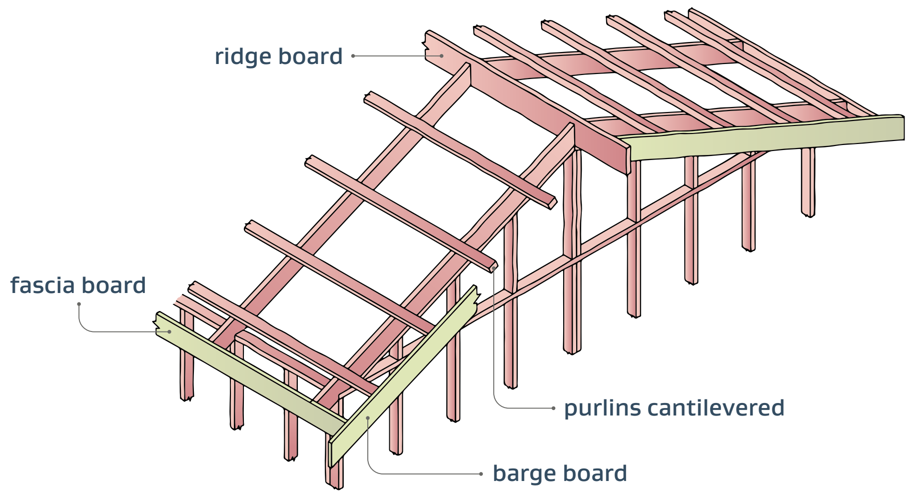


Figure 49. Gable end roof overhang formed by purlins

Bracing

The roof must be able to transfer horizontal wind and earthquake loads to the walls and foundations. Like foundations and walls, roofs must be braced. A common way to brace a roof is to use a steel strap roof plane brace as described in NZS 3604:2011 section 10.4.2.2(b). One steel strap roof plane brace can provide bracing for up to 50 m² floor area for a light roof. However, there needs to be a minimum of two braces for each ridge line (NZS 3604:2011 section 10.3.2). One brace is made up of two diagonally opposed steel straps (Figure 50).

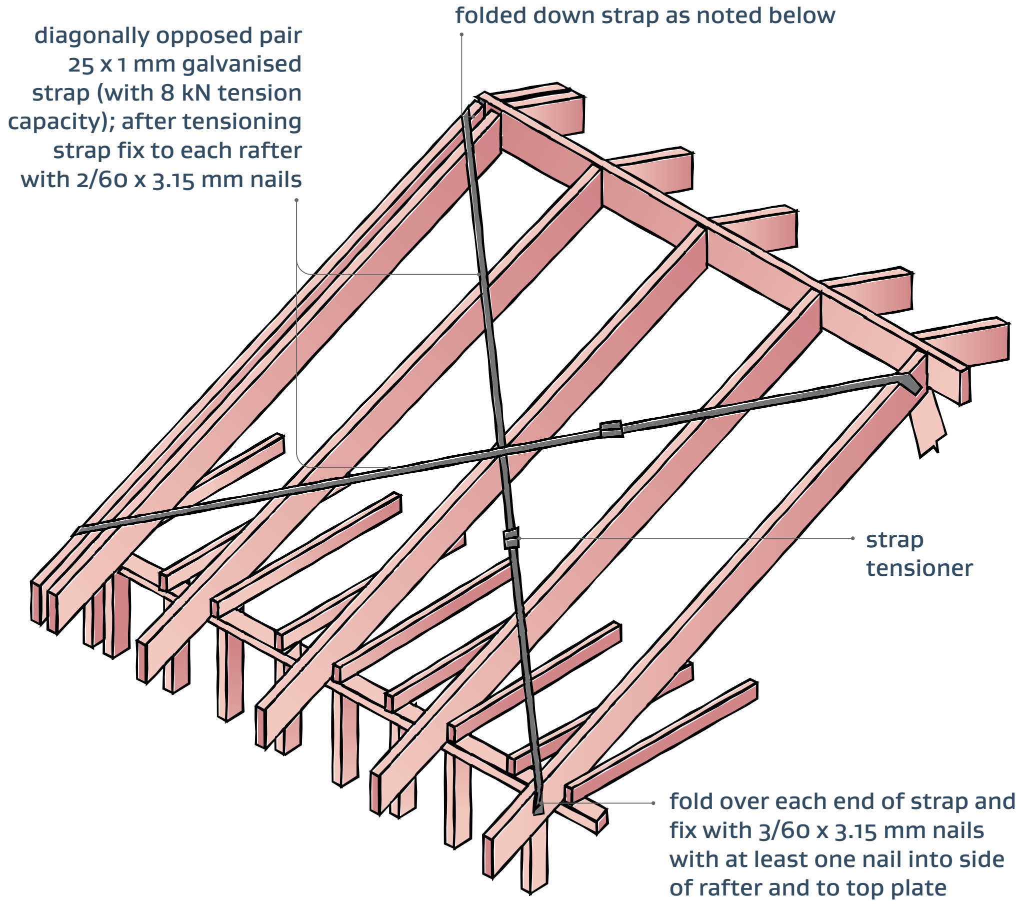


Figure 50. Brace on one side of a gable roof made up of two diagonally opposing continuous steel bracing strips

A monopitch roof on a building of less than 30 m² floor area like a sleepout therefore requires two braces (four straps in total) on the single roof plane. A gable roof on a building of less than 30 m² floor area only requires one brace on each roof plane (also four straps in total).

If you choose a hip roof or more complex roof design, you will need to calculate the roof bracing requirements directly using NZS 3604:2011 sections 10.3 and 10.4.

Fascia/bargeboards and eaves

The fascia/bargeboards are installed after the roof framing and bracing are both completed. They are fixed horizontally to the end of the rafters/trusses and also run up the slope of the roof for monopitch and gable roofs.

The eaves/soffit construction is not finished until after the wall underlay, windows and doors have been installed. The eaves lining details are given in section 8. The gutters and downpipes are installed as the last part of the exterior construction work.

Roof underlay and roof cladding

Roof underlay is used with almost all roof cladding types other than membranes. For long-run profiled metal roofing, underlay is installed directly over the roof purlins. With tiled metal roofs, underlay is installed over the rafters before installing the tile battens. Details around roof underlay and roof cladding are covered in section 7.

Insulation

Thermal insulation will typically be installed after the roof and wall cladding are both installed, after the prewire (for lights and power sockets) and just before the ceiling and wall linings go up. You can find more details about insulation in section 9.

If there are ceiling joists and a plasterboard ceiling in the sleepout, the roof insulation will sit immediately above the plasterboard with no air gap between them. With skillion roofs, the insulation will also be installed to sit immediately above the plasterboard.

07

Roof cladding

After all the calculations required to design the roof framing, installing the cladding on it can appear a much simpler job, but it is crucial to get all the small installation details right, especially the fixings and flashings. Pay close attention to these and you will have a weathertight and trouble-free roof.

The roof cladding and roof underlay are often proprietary branded products unique to a particular manufacturer as opposed to more generic products such as concrete or timber framing. It is important to read through and follow the manufacturer's installation recommendations. Failing to do this may void a product warranty.

Above all, take care with the safety of anyone working on the roof. Falling off a roof is easy to do and can be fatal. Plan your safety precautions in advance (see section 3) and tell someone you'll be working on the roof before you climb the ladder.

Preparation and cladding selection

Roof cladding (including gutters and flashings) must:

- keep out rain and wind
- drain rainwater quickly to a stormwater discharge point
- meet the Building Code requirement of being durable for not less than 15 years (you will probably expect your sleepout to last much longer)
- be able to cope with the local environmental conditions – sites close to the sea and in geothermal areas require cladding and fixings with a higher level of corrosion resistance
- be constructed of materials compatible with each other
- be securely fixed to resist wind and earthquake forces and live loads (people walking on the roof)
- be laid and fixed in accordance with the roof cladding manufacturer's instructions
- be undamaged on completion.

Before selecting the cladding, flashings and fixings you will need to determine the wind zone and exposure zone you live in.

Cladding options

The building consent exemption covered by this guide only applies to sleepouts that use lightweight roof claddings. NZS 3604:2011 defines this as roofing material having a mass not exceeding 20 kg/m² of roof area.

These are some examples:

- **Long-run profiled metal** – such as factory-painted zinc/aluminium alloy-coated corrugated steel. This is the most commonly used roof cladding on New Zealand domestic buildings. Roof pitch (slope) for corrugated metal must be not less than 8°.
- **Pressed metal tiles** – typically zinc/aluminium alloy-coated steel with either a stone/ceramic chip protective coating or a prepainted finish. The minimum pitch is generally 15° for pressed metal tile roofs (check with the manufacturer for actual pitch). Many manufacturers of pressed metal tiles require or prefer their products to be installed by trained, authorised installers. They are likely to be more difficult for a DIYer to install than long-run profiled metal.
- **Membrane roof** – on H3.2 CCA-treated plywood (a minimum 17 mm thick). BRANZ recommends all membrane roofs have a minimum slope of 3°. Most manufacturers require membranes to be installed by approved applicators, so these roofs are not a DIY option.

Other lightweight roof claddings on the market include copper or aluminium sheeting and timber shingles. These can be installed on a sleepout but may be more expensive than profiled metal, and some require installation by approved applicators and are therefore not DIY options.

Some other options have distinct benefits. For example, warm roof sandwich panels (a rigid panel with insulation sandwiched between roof cladding above and a board below) do not require roof underlay or separate insulation to be installed.

You will have designed and constructed the roof framing so that the purlin spacings suit the cladding you want (see section 6). Table 17 gives an example of some typical purlin spacings. The roof must have sufficient pitch for the roof cladding and profile you have chosen. You can find the minimum pitch for roof claddings and profiles in E2/AS1, but also check the recommendations/requirements of the manufacturer of your preferred roof cladding.

Type	Thickness (mm)	End span (mm)	Internal span (mm)
Corrugated	0.4	600	900
	0.55	800	1200

Table 17. Example of some typical profiled metal roofing purlin spacings

Ensure the material is appropriate for your environment. Metal roof claddings on buildings close to surf beaches or geothermal features should have extra protection to cope with the corrosion risk. Manufacturers often have products that offer more corrosion resistance.

When it comes to placing your order for roof cladding, show the materials supplier your plans. They will often be able to calculate the roofing materials and accessories that you need.

Roof cladding delivery and handling

Many roof claddings come to site prefinished and must be handled carefully so they can be installed without scratches or other damage. Designate an area where the cladding can be unloaded and kept on delivery pallets, covered and protected from the rain until it can be moved to the roof.

Packs must be lifted off the truck, not tipped or slid off. Metal sheets being stored must be stacked topside up, horizontally on a firm level surface. Position the materials on evenly spaced supports to prevent deformation under a waterproof cover. Take great care to ensure that water does not penetrate between the sheets. Tie everything down.

Work out how many people you need to help. Installing roof underlay and roof cladding typically requires at least two people. Make sure everyone involved knows how to lift materials safely. You can find information about manual lifting on the BRANZ Level website.

Roof underlay

Roof underlay is used with almost all roof cladding types other than membranes. For long-run profiled metal roofing, underlay is installed directly over the roof purlins. With tiled metal roofs, the underlay is installed over the rafters before the installation of tile battens.

The underlay gives extra protection against water entry, absorbs condensation on the underside of roof cladding and reduces air movement.

For long-run profiled metal roofing, the two main types of underlay available are:

- self-supporting breather-type roofing underlays designed to span between supports where their spacing is not more than 1,200 mm
- fully supported breather-type roofing underlay – these must be supported against sagging by using polypropylene tape or 0.9 mm minimum galvanised steel wire mesh.

Installing underlay

Obtain and follow the installation instructions that come with the underlay you are using. What follows is general guidance.

Make sure you have everything on hand to install the roof cladding before you start installing the underlay. Ideally, underlay should be covered with roof cladding the same day. Don't let roof underlay be exposed for more than a few days and try to avoid exposure to rain or dew.

Before starting work, check:

- the roof is square and the top and bottom corners of the roof framing are level
- the pitch is sufficient for the roofing material and profile
- the materials are undamaged
- you have all necessary tools, fixings and flashings
- everyone working on the roof has clean, soft-soled footwear
- you have securely set up ladders and someone knows you will be on a roof
- there is a mat at the base of the ladder for people to clean their shoes before going up
- people on the roof only walk along lines of framing
- you have installed a safety barrier to stop falls – self-supported underlay does not provide a suitable barrier.

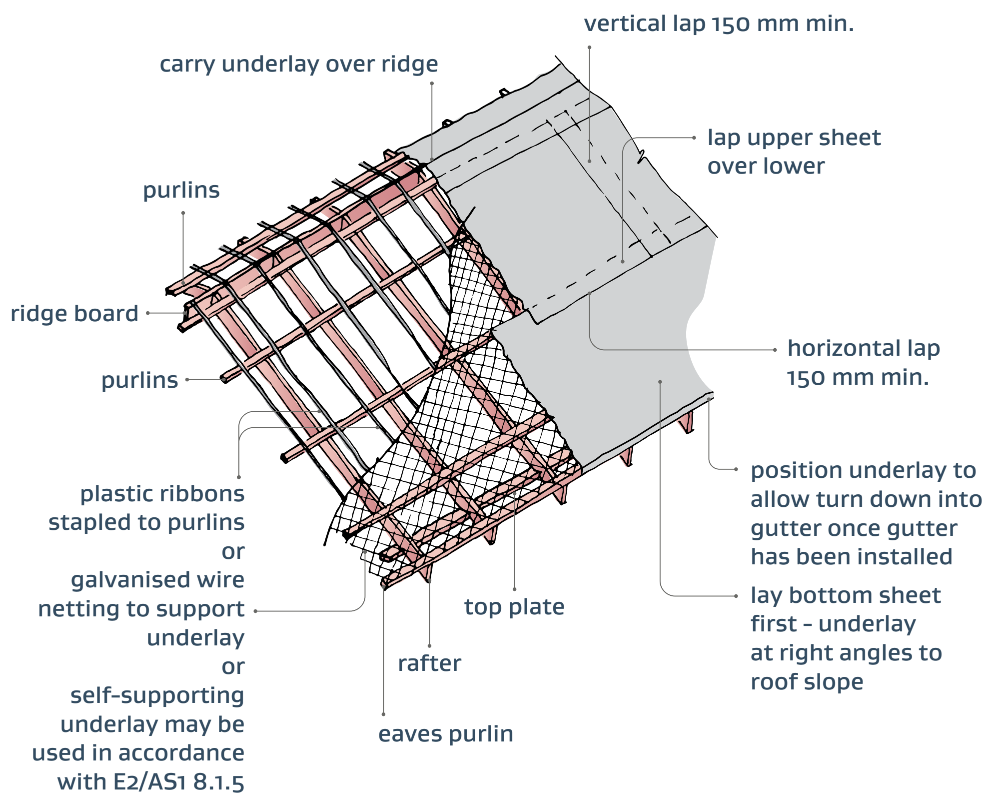


Figure 51. Installing underlay horizontally over the roof (view from above)

BRANZ and several manufacturers recommend laying underlay horizontally. Where this approach is chosen, runs must be installed from the bottom up so upper layers overlap lower layers (Figure 51). Make sure the lowest level of underlay is installed so it can be turned down into the gutter at the eaves when the gutter is installed. Overlaps of subsequent layers should be 150 mm minimum (some roof underlays actually come with 150 mm measurements marked on the top side).

Underlay can be installed vertically where roof pitches are 10° or greater. End laps made over framing should be no less than 150 mm.

The methods by which the underlay is finished around the edges of the roof are illustrated in the other figures within this guide.

Fix underlay to roof framing according to the manufacturer's instructions.

As you lay the underlay sheets, ensure lap distances are maintained and keep the underlay taut, so water cannot pond on it and it will not be closer than 25 mm to the insulation when that is installed later (this is only an issue when the insulation is installed within the roof framing on the rake of the roof). Tape up small tears. Patches on larger tears or holes should be full height, lapped in the correct direction, with 150 mm overlaps.

Ensure the supporting tape or mesh and the sheets of fully supported underlay are fully and securely fixed to minimise the risk of shrinkage and joints opening up.

Installing the roof cladding

Once the underlay is on, install the cladding without delay. Don't let the underlay get wet or leave it exposed to sunlight for more than a few days.

Once you have unwrapped the roof cladding, don't let it come into contact with dirt, cement/concrete/lime/mortar, sunscreen or other chemicals. With long-run profiled metal sheets, peel and lift the sheets – never slide them over each other. Sheets longer than 3 m should be handled by two people and carried on edge to avoid buckling. Any plastic film on the top surface of the cladding should be left in place until just before or after the cladding is fixed.

Only lift enough materials onto the roof for 3–4 hours' work. If you want to mark sheets of long-run metal, use chalk and not black lead pencil.

For the installation of the roof cladding, follow the specific installation details provided by the cladding manufacturer. The details here are general guidance.

Accurately mark purlin positions by using a chalk line before beginning to fix roofing to prevent fixing misses.

With sheet roofing, install the first sheet parallel to the barge board. Ensure that sheet ends project over the back edge of the guttering no less than 50 mm and project high enough to achieve the minimum coverage required by the apex or ridge flashing. In some situations, the troughs at the top ends of sheets need to be turned up to form a stop-end to help prevent the entry of any water that blows under the lap with the apex or ridge flashing – specific tools are needed for this. Sheet side laps should face away from the prevailing wind (Figure 52). Make regular checks as work progresses to ensure roofing is still aligned parallel to the barge board. Fix at the laps before fixing the centre of the sheet. Laps over an adjoining sheet must be made over a full crest (Figure 53).

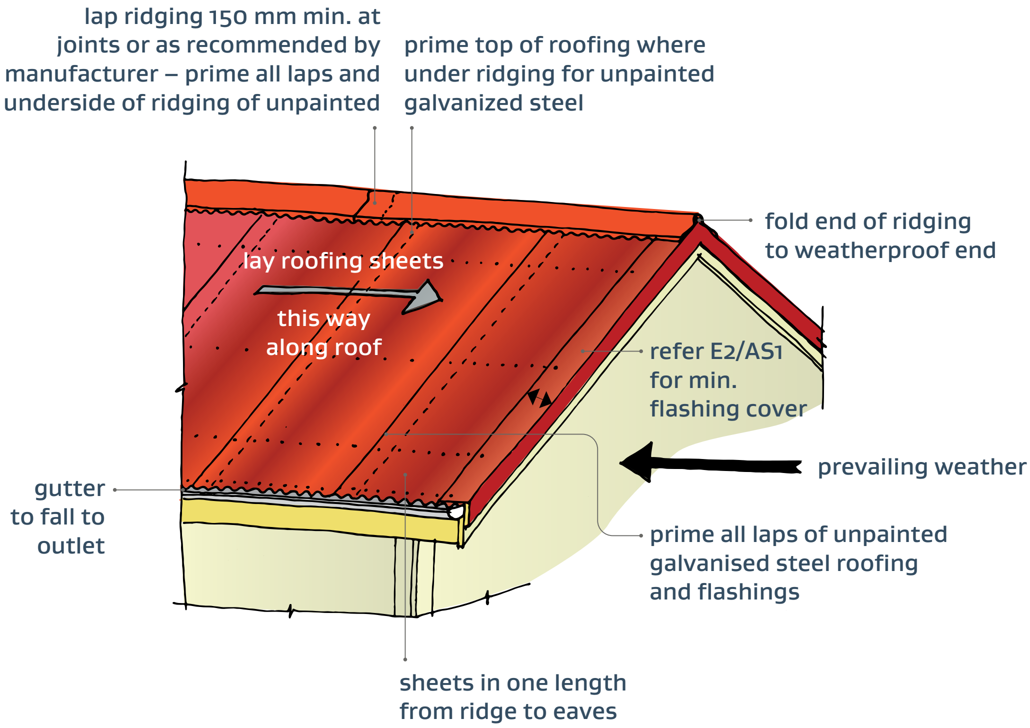


Figure 52. Installing long-run corrugated roofing

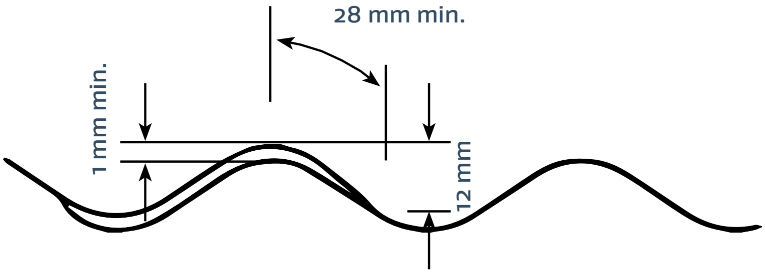


Figure 53. Laps of corrugated profiled metal roofing

With long-run roofing, only use full lengths of roofing so they span the whole distance of a monopitch roof or from ridge to gutter of a gable roof. Don't join shorter sheets together.

Fixings

Use fixings recommended by the cladding manufacturer. For corrugated profiled metal roofing, these will typically be screw fixings, which must be a minimum of 12 gauge and include a sealing washer. Fixings should be a minimum of class 4. Use class 5 in very severe environments such as close to a surf beach. Manufacturers of factory-coated profiled metal roofing do not recommend using stainless steel fixings in coastal areas as they increase the risk of corrosion.

Install fixings to give a good seal without distorting the profile of the roof by overdriving or overtightening the fixings.

Table 18 gives the fixing requirements for given spans and wind zones for corrugated long-run steel with a base metal thickness (BMT) of 0.40 mm. Table 19 give the requirements for steel with a BMT of 0.55 mm. The fixings must be through the crests (tops) of the profile, and screws must penetrate the purlins by a minimum of 30 mm.

Steel corrugate profiled roofing – 0.4 mm BMT and minimum profile height 16.5 mm Maximum spans and fixing patterns. Refer to Paragraph 8.4.6 in E2/AS1				
Purlin spacings (metres)		**Wind zones**		
End span	Intermediate span	Low and Medium	High and Very High	Extra High
0.4	0.6	C2	C2	C2
0.6	0.9	C2	C2	C1
0.8	1.2	C2	C1	C1
Note: **C1** fixing pattern is – Hit 1, miss 1... **C2** fixing pattern is – Hit 1, miss 1, hit 1, miss 2...				

Table 18. Maximum span and fixing patterns – 0.4 mm profiled metal roofing

Source: E2/AS1 Table 11

Steel corrugate profiled roofing – 0.55 mm BMT with minimum profile height 16.5 mm Maximum spans and fixing patterns. Refer to Paragraph 8.4.6 in E2/AS1				
Purlin spacings (metres)		**Wind zones**		
End span	Intermediate span	Low and Medium	High and Very High	Extra High
0.4	0.6	C3	C3	C3
0.6	0.9	C3	C3	C3
0.8	1.2	C3	C3	C3
1.15	1.6	C3	C3	C2
Note: **C2** fixing pattern is – Hit 1, miss 1, hit 1, miss 2... **C2** fixing pattern is – Hit 1, miss 2, hit 1, miss 3...				

Table 19. Maximum span and fixing patterns – 0.55 mm profiled metal roofing

Source: E2/AS1 Table 12

Flashings

Flashings play a critical role in keeping the roof weathertight, so getting their locations, dimensions, fixing and general installation right is essential. Many cladding manufacturers supply all the flashings with their roof cladding, purpose-made from the same material as the roofing. Keep to one system. Take your time to install flashings properly, and under no circumstances use sealant instead of the appropriate flashing.

For corrugated profiled metal roofing, each flashing up to 8 m in length should be obtained as a single length without intermediate joints. E2/AS1 section 4.5.2 and Figure 6 provide information on where and how joints in longer flashings can be made.

How and where the flashings are fixed depend on the roof design and pitch, cladding material and wind zone. If you are in an extra high wind zone, pay particular care to the requirements to reduce potential damage from wind-blown rain.

The flashings likely to be required on a sleepout include to the apex of a monopitch roof (Figure 53), the ridge of other roof styles (Figure 54), the barges (Figure 55) and the eaves (Figure 56).

Exposed flashings such as apex/ridge/barge flashings must be fixed along both edges. Minimum flashing cover to corrugated roofing (excluding the soft edge or turn-down) is two crests where measured across the roofing corrugations. E2/AS1 Table 7 shows the general dimensions for metal flashings. Where measured along the roofing, the minimum cover depends on the roof pitch and the wind zone:

- 130 mm for low, medium and high wind zones where the roof pitch is 10° or more.
- 200 mm min for all other situations.

As Figure 54 shows the apex flashing for a monopitch roof with a soft edge that is dressed to the corrugated profile of the metal cladding.

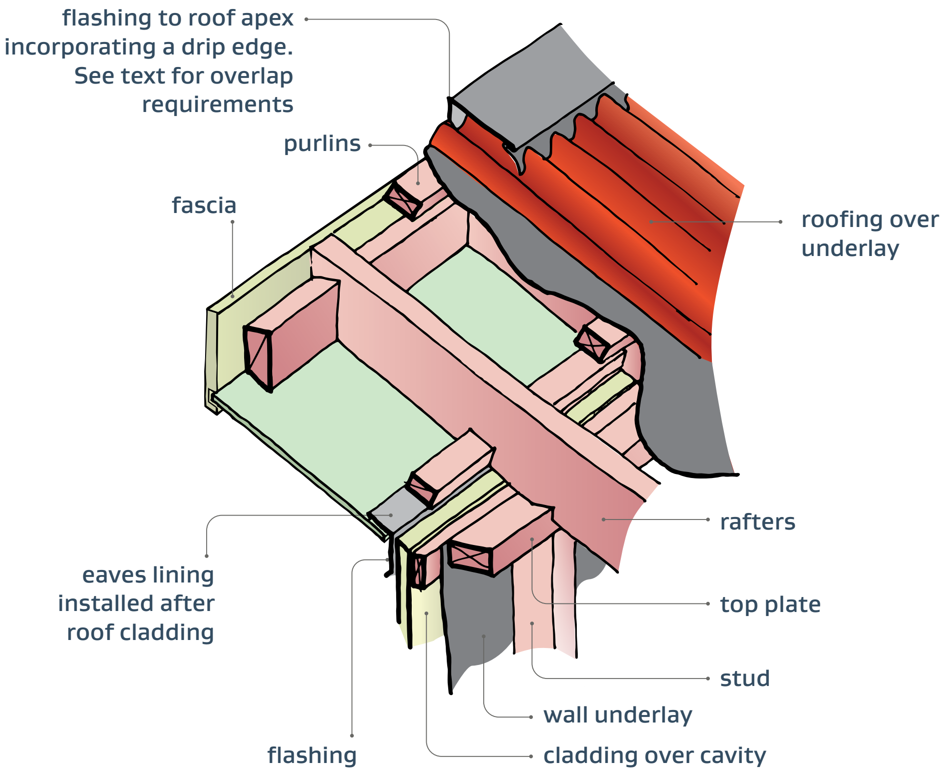


Figure 54. Flashing roof apex for monopitch roof (profiled metal)

The flashing must have a kick-out at the bottom for the rain to drip off. The minimum distance this flashing needs to overlap the fascia board is:

- 50 mm (plus the kick-out) for low, medium and high wind zones where the roof pitch is 10° or more
- 70 mm (plus the kick-out) for low, medium and high wind zones where the roof pitch is less than 10°
- 70 mm (plus the kick-out) for all roof pitches for very high wind zones
- 90 mm (plus the kick-out) for all roof pitches for extra high wind zones.

Figure 54 includes a flashing that extends a minimum 50 mm behind the soffit lining, laps a minimum 35 mm over the wall lining and has a kick-out at the bottom. This flashing is only required with reverse slope eaves at the top of a monoslope. It is used to prevent water being driven and up into the soffit/cladding junction by the wind and then running down the soffit lining.

Gable roofs require flashing along the ridge (Figure 55). Again, where the roofing is corrugated profiled metal, the flashing must have soft edges dressed to the corrugated profile.

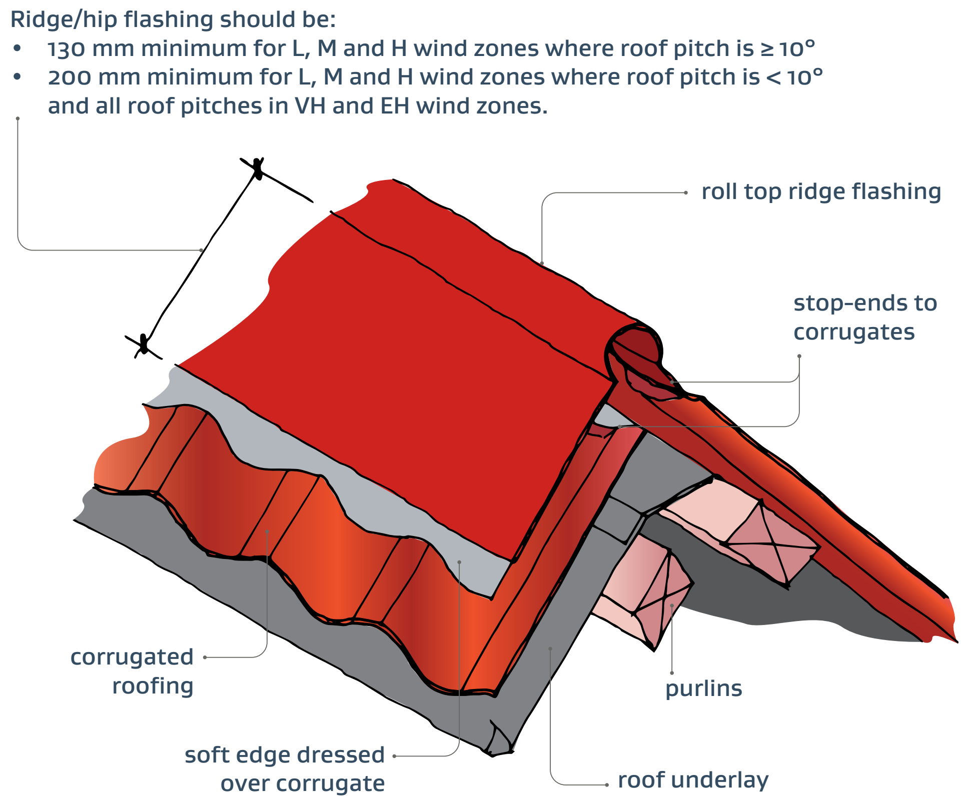


Figure 55. Roll-top ridge flashing

Barge flashing

If your profiled metal roofing ends at a barge board, you will need to install a barge flashing (Figure 56). Paint the bargeboard before installing this flashing. The barge flashing must cover at least two full crests of the cladding. The minimum distance this flashing needs to overlap the barge or fascia board is:

- 50 mm (plus the kick-out) for low, medium and high wind zones where the roof pitch is 10° or more
- 70 mm (plus the kick-out) for low, medium and high wind zones where the roof pitch is less than 10°
- 70 mm (plus the kick-out) for all roof pitches for very high wind zones
- 90 mm (plus the kick-out) for all roof pitches for extra high wind zones.

To ensure maximum protection against water entry, install barges immediately adjacent to an area of wall cladding after the wall cladding is completed (including painting).

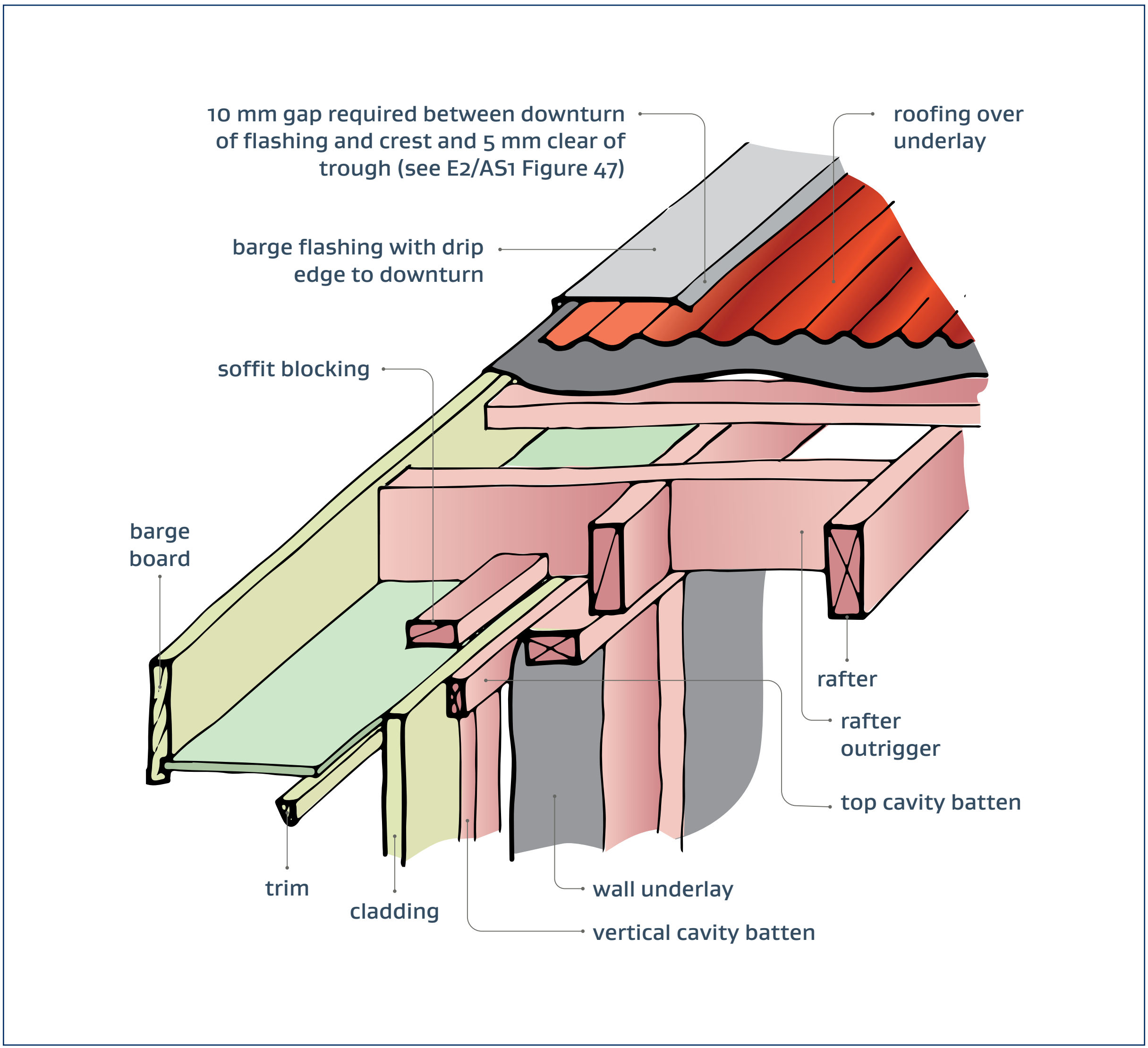


Figure 56. Barge flashing with eaves

Eaves flashing

If your sleepout has long-run profiled metal roofing in a very high or extra high wind zone, the roof slope is 10° or less and the soffit width is 100 mm or less from the cladding, you need to install an eaves flashing to prevent water being blown up under the roof (Figure 57).

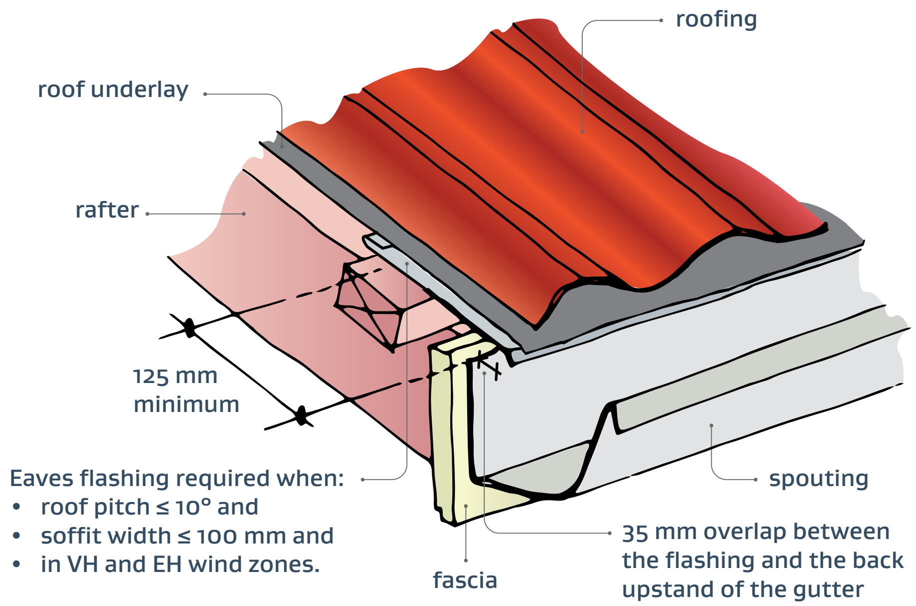


Figure 57. Eaves flashing

The flashing must extend 125 mm back up under the cladding and have a 35 mm overlap to the back upstand of the gutter.

Edge treatments of flashings

The exposed bottom edge of an apex, barge or soffit-to-wall cladding flashing must have a kick-out edge treatment to stiffen the flashing and to form a drip edge for positive drainage. Do not use flashings without a kick-out edge treatment.

When the roof work is complete and at the end of each day working on the roof, gently clean the new cladding of all debris. Never use solvent or abrasive cleaners or high-pressure water blasters.

Thermal insulation

Thermal insulation in the roof space is mandatory. How and when insulation is installed depends on the roof construction and ceiling type. For more details, see section 9.

Rainwater management

Gutters and downpipes are typically permanently installed on a sleepout quite a few steps after installing the roofing. These steps include installing windows and doors, soffit linings, and wall claddings and painting or staining the fascia and wall cladding.

However, it can be useful to temporarily install fix guttering and downpipes to remove rainwater from the building site and prevent the ground turning to a quagmire in heavy rain.

As we explain in section 1, you need to find out the specific requirements your local council has around managing stormwater. Some councils allow or require stormwater from a new building to be discharged into the council stormwater system, but an increasing number do not, in which case you will need to make other arrangements such as having a soak pit or a detention tank designed for you. A soak pit will most likely need building consent. You may find water collected in a tank could be useful for garden irrigation. Any new drainage work must be undertaken by an authorised drainlayer, and the council may require you to obtain approval before making a new connection into the stormwater system.

Installing gutters and downpipes

Gutters and downpipes are most likely to be uPVC or factory-coated steel. There are proprietary guttering/downpipe systems that are easy to install and come with simple instructions.

Here is some general advice:

- Install gutters with sufficient fall so water runs to the downpipe. The Building Code has no minimum fall for external gutters. Follow the manufacturer's recommended minimum fall, which is typically 0.5–1.5 mm per metre of length for uPVC gutters and 2 mm/m for metal gutters. Follow the manufacturer's installation recommendations. Work out where the water will drain to before you install the guttering so that you can locate downpipes at the most appropriate points.
- Install a sufficient number of brackets to hold the guttering to the fascia. Brackets should be no greater than 500 mm apart (or 300 mm in areas of high wind or where snowfall is possible). Fix with the manufacturer's recommended fixings.

08

Wall cladding, doors and windows

Wall claddings, doors and windows are key elements in the defence against water entering a building.

Pay careful attention especially to how windows, doors and their flashings are installed.

Rainwater getting in at these points can cause problems for years to come if the work is not done correctly.

Installation sequence

After the roof cladding and flashings are installed, work continues on the exterior walls.

For construction where a horizontal weatherboard wall cladding is fixed over a cavity, the sequence is:

- install the wall underlay (if this wasn't done earlier)
- prepare the door and window openings
- with cavity fixed cladding systems, install drained/vented cavity battens and cavity closers
- install windows and doors with all of their required flashings and sill support bars
- prepare the soffit lining (under the eaves)
- install the wall cladding.

For construction where a horizontal weatherboard wall cladding is fixed directly to the framing, the sequence is:

- install wall underlay (if this wasn't done earlier)
- prepare door and window openings
- install windows and doors with all of their required flashings and sill support bars
- prepare the soffit lining (under the eaves)
- install the wall cladding.

The Window and Glass Association New Zealand has produced a window installation guide that you may find helpful. See for more information on https://www.wganz.org.nz/guide-to-window-installation.

General requirements

Wall cladding and underlay must:

- stop rainwater getting through to the wall framing
- meet the Building Code requirement of being durable for 15 years minimum
- be able to cope with any local salt-laden or sulphur-laden winds
- be securely fixed to resist wind forces.

The building consent exemption covered by this guide only applies to sleepouts that use light wall cladding. NZS 3604:2011 defines this as a wall cladding having a mass not exceeding 30 kg/m². Examples of lightweight wall cladding include weatherboards, fibre-cement sheets, plywood sheets and profiled metal sheets. Heavier claddings have additional requirements.

Will wall cladding be direct-fixed or installed over a cavity?

As well as choosing the cladding you want, you also have to choose how it will (or must) be installed. There are two possibilities:

- **Direct-fixed** – the cladding is fixed over wall underlay directly to the framing timber. This is only an option where there is a lower risk of rain penetrating the cladding.
- **Drained and vented cavity** – cavity battens are installed between the cladding and the wall underlay. The battens are fixed through the underlay into the wall framing timber and the cladding is also fixed all the way through the battens and underlay into the framing. The battens provide an air cavity behind the cladding that is at least 18–20 mm deep. This gives an extra line of weathertightness defence should rain get through the cladding. This allows water to run down the back of the cladding and drain out, protecting the framing. Air movement through the cavity helps to dry out any moisture that hasn't drained out.

Cavities are a requirement where there is a higher risk of rain penetrating the cladding and are always required when the cladding is horizontally fixed profiled metal.

A risk matrix in E2/AS1 helps you work out the weathertightness risk and determine whether you must use a cavity for your design, choice of wall cladding material and location.

E2/AS1 Table 1 defines six risk factor categories related to the building design and severity of risk: wind zone, number of storeys, roof/wall junctions, eaves width, envelope complexity and decks. Each of the risk severities within each category is given a number (a risk score). The higher the number, the higher the risk.

To identify the weathertight risk of a building you need to complete the E2/AS1 Table 2 Risk Matrix Scoring Template for each side of the building.

You can see a worked example using the risk matrix at the end of this section. Given the minimal extra work and cost involved in providing a cavity, it is generally a good idea to have the extra level of protection that it provides should water ever penetrate the cladding.

Final cladding choice

As well as the risk matrix, the choice of cladding should also consider issues such as maintenance. Will you be happy to repaint the cladding regularly (typically about every 10 years in most New Zealand environments), or do you want a proprietary cladding with a coating that only requires cleaning instead of repainting? Another point to consider is that, if bracing will not be provided by other components such as internal wall linings, some sheet claddings can also provide structural bracing.

These are some commonly used cladding options:

- **Timber weatherboards** – usually radiata pine that must be treated to minimum H3.2 but can be H3.1 if a three-coat paint finish is applied. Weatherboards need repainting every 10 years or so in most New Zealand environments.
- **Plywood sheets** – a minimum 12 mm thick and (assuming it is radiata pine) treated to H3.1 (or H3.2 if it is to be left uncoated). Paint finishes are more durable than stains that will need to be reapplied more frequently.
- **Fibre-cement weatherboards or sheets** – must always be coated for weathertightness. These will require repainting around every 10 years.
- **Profiled metal sheets** – often come with a factory-finish coating. The sheets and coatings must be selected for the right level of corrosion protection – for example, an inland rural location or opposite a surf beach.
- **Proprietary cladding systems** – usually come as weatherboards or sheets with a factory-finish coating. Examples include fibre-cement, timber and uPVC. They have their own installation instructions.

While there are many light wall cladding options available, not all can be installed by DIYers. Some manufacturers require that their products only be installed by trained and approved installers.

Door units and windows

It is a good idea to get quotes from several manufacturers as early as possible – 3–4 months before you plan to build the sleepout is not too early.

Delivery, storage and handling

Ideally, the cladding will be delivered to site just before it is installed. If the cladding is delivered early and stored, ensure it remains clean and dry. Wet cladding must be allowed to dry thoroughly before installation. Some claddings come preprimed, but when sheets and weatherboards that are to be painted come without a primer coat, they need to be primed immediately. Always carry sheet claddings and weatherboards in the vertical position to avoid excessive bending. Store fibre-cement sheets, weatherboards, planks and trims flat on a smooth level surface with edges protected.

Work out how many people you need to help. Installing doors, windows and cladding typically requires at least two people. Make sure everyone involved knows how to lift materials safely. You can find information about manual lifting on the BRANZ Level website.

Installation steps

Wall underlay

A wall underlay must be installed over the framing and beneath the wall cladding. Wall underlays act as a secondary defence that can help protect the wall framing and insulation if minor amounts of water get behind the cladding. Two types of wall underlay are available – flexible and rigid.

Flexible wall underlay

For flexible wall underlays, there is a choice of synthetic underlay or kraft paper options. Synthetic wall underlays are generally more resistant to tears and puncturing and more tolerant of dampness. Some synthetic flexible underlays also have particular air barrier properties and can be used in spaces such as attics where internal linings will not be installed.

A kraft paper underlay (or a synthetic underlay that has been specifically appraised as suitable for this purpose) must be used with direct-fixed vertical profiled metal claddings. A flexible kraft paper underlay (or strips of it or an appropriate synthetic) must also be used to separate horizontal profiled metal wall claddings and any metal parapet cap flashings from any timber components that have been treated with a copper-based timber preservative (used in H3.2 and some H3.1 treatments).

Rigid wall underlay

In extra high wind zones, a rigid wall underlay is required. In any wind zone, if you think there may be a delay in installing the cladding, you could install a rigid wall underlay to give some temporary weather protection. This will increase the cost of the project – installing the cladding without delay is a better idea.

Some rigid wall underlay systems can also provide structural bracing, if this will not be provided by other components such as internal wall linings.

Rigid wall underlays consist of sheet materials that help perform the same function as a flexible underlay but also act as a barrier to airflow, minimising air movement that could carry moisture to the framing or insulation.

Rigid underlays can be formed from minimum 7 mm plywood treated to a minimum of H3 or 6 mm fibre-cement sheets. They must be installed with sheet edges fixed over solid framing and overfixed with a flexible wall underlay. Some proprietary rigid underlay systems are also available. These have coated and/or impregnated sheet materials and proprietary jointing tapes that avoid the need for an additional flexible overlay.

Installing flexible underlays

Flexible wall underlays are installed horizontally around the exterior of the wall framing (E2/AS1 section 9.1.7 gives details). Begin installation so the bottom edge hangs 35 mm below the bottom plate (for concrete floors) or bearer (for timber floors) (Figure 58). The wall underlay should go right to the upper side of the top plate. It should be held tautly across the framing and securely fixed to studs and dwangs at 300 mm centres horizontally and vertically. The underlay manufacturer may supply fixings or may recommend using 6–8 mm staples, 20 mm large-head galvanised clouts, or similar.

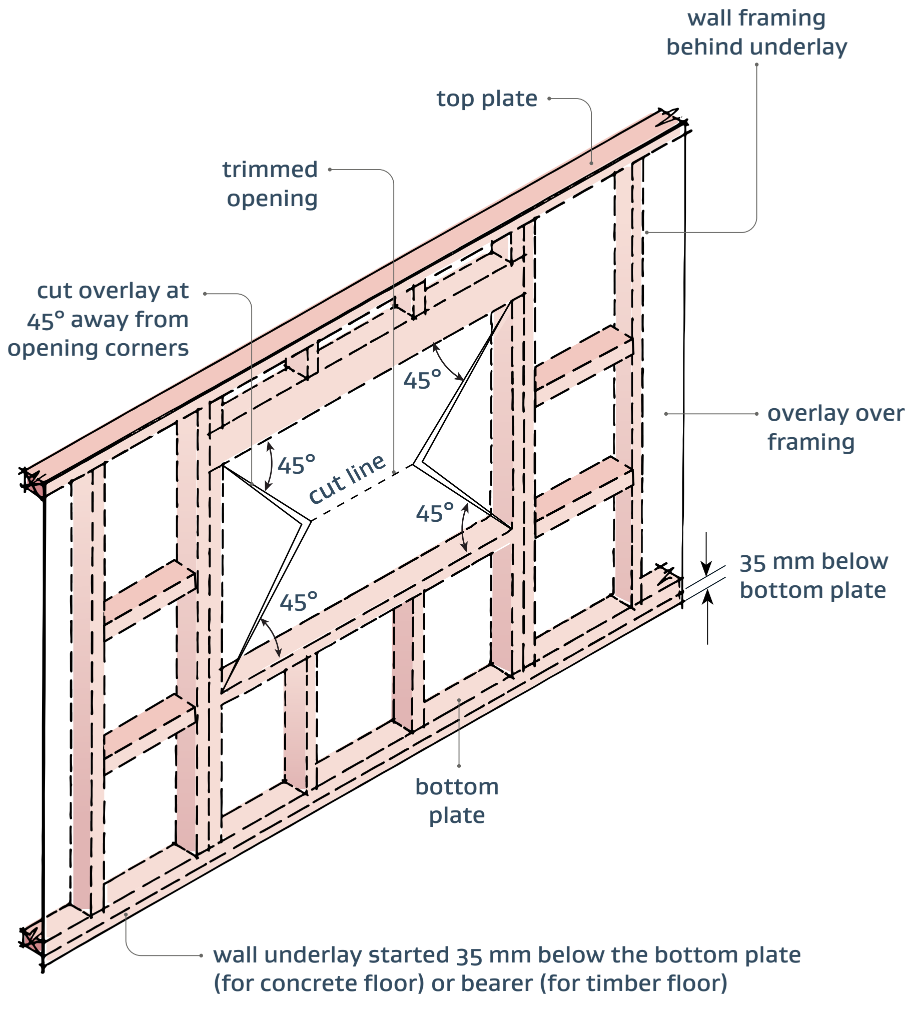


Figure 58. Installing wall underlay and trimming the openings (steps 1 and 2)

Where battens will be installed to form a cavity and the studs are spaced at more than 450 mm centres, install horizontal polypropylene straps at 300 mm centres across the outer side of the framing to prevent the flexible underlay from bulging and reducing the cavity depth after the insulation is installed (Figure 59).

Where more than one width of flexible underlay is required, the upper layer must overlap the lower by at least 75 mm, allowing water to be shed to the outer side of the lower underlay.

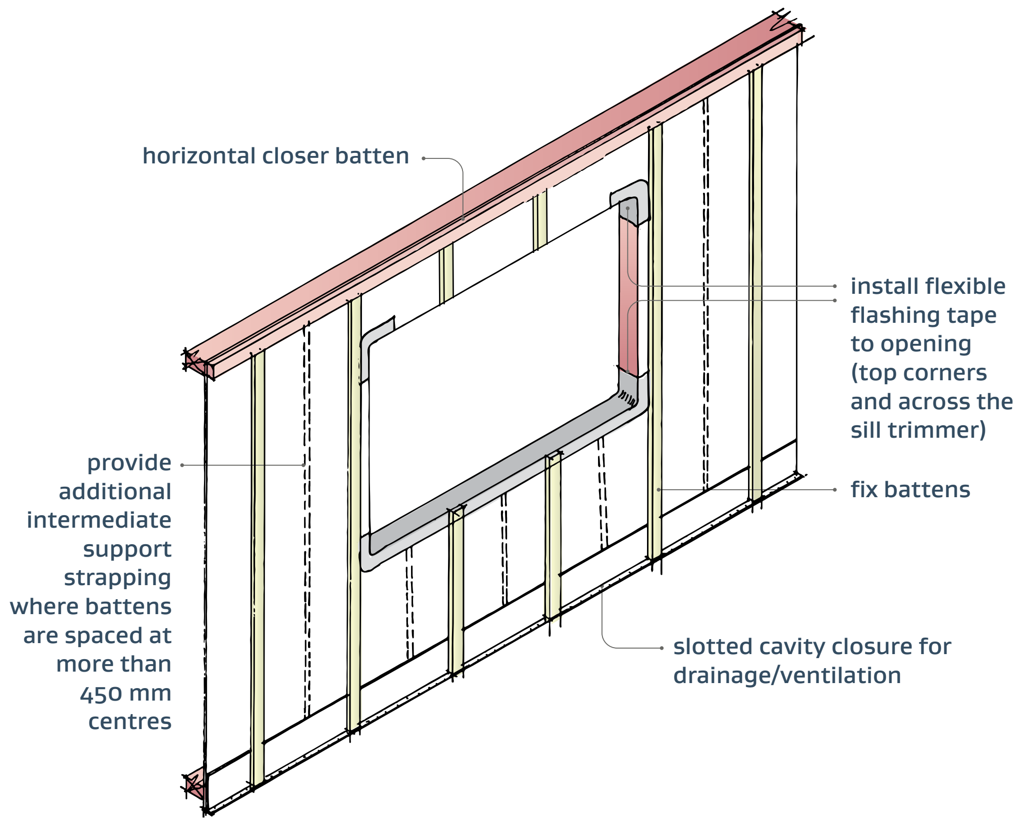


Figure 59. Installing flexible flashing tape to the opening, fixing vertical battens and strapping support for the underlay (steps 3, 4 and 5)

At the ends of runs and in other situations such as up gable walls, laps should be made vertically with a 150 mm end lap over studs. Tape vertical joints with a suitable joint tape if recommended by the manufacturer.

The whole vertical exterior of the sleepout should be completely wrapped and sealed – cover all door and window openings with underlay (Figure 60). Don't cut or prepare the openings until the window and door joinery is on site and ready to be installed. Tape closed any tears or holes in the wall underlay before installing the cladding.

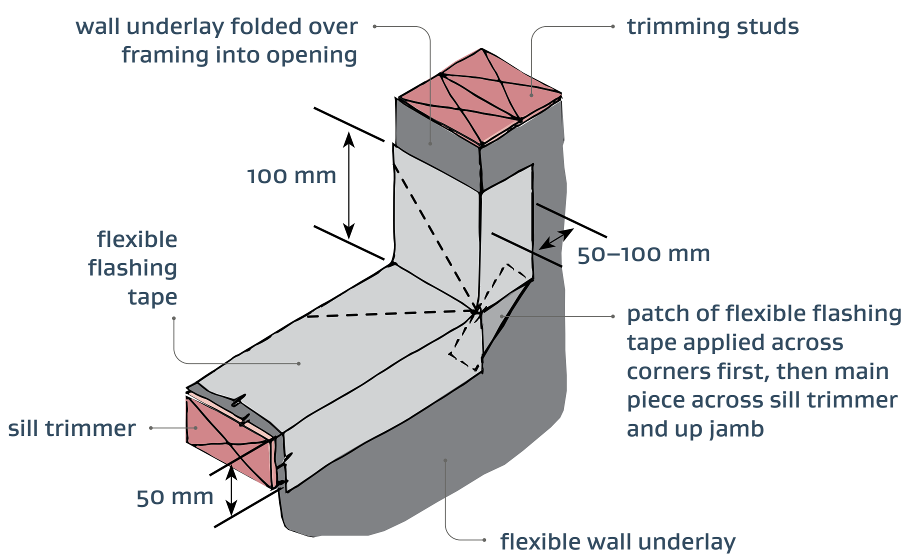


Figure 60. Flexible flashing tape to the windowsill (step 3 below)

Installing cavity battens

Where there is a cavity, it must be constructed following E2/AS1 sections 9.1.8–9.1.9.4. Cavity battens are generally installed before the window joinery is installed except above the window head. Battens are fixed vertically over the wall underlay (Figure 58). Wall claddings are fixed through the cavity battens into the wall framing. A slotted vermin-proof cavity closer is installed along the bottom to allow water to drain out from behind the cladding and to allow air to circulate within the cavity. Air from the subfloor space must not be allowed to get into these wall cavities.

Cavity battens are a nominal 20 mm thick and a minimum 45 mm wide (E2/AS1 section 9.1.8.4). They are typically radiata pine treated to a minimum H3.1 although proprietary battens made from other materials (such as polypropylene) are also available. Fix all the vertical battens except above openings where they will be fixed after the head flashing is installed. Because the battens will be secured by cladding fixings going through the batten and into the wall framing, they only need temporary fixings that will hold them in place until the cladding is fixed.

Where a horizontal batten is needed to fix the top or bottom edge of a sheet cladding or for intermediate fixings to dwangs, install a cavity spacer (a short length of batten) on a slope of at least 5° (a 9 mm drop for every 100 mm in length). There must be a minimum 50 mm gap between the spacer ends and the vertical battens to provide drainage and ventilation within the cavity.

Preparation for window and door installation

The construction sequence for installing wall underlay on a wall with drained/vented cavity cladding with a door or window penetration is a 9-step process.

1. Start installing the wall underlay over the framing from 35 mm below the bottom plate, carrying it up to the top of the top plate and across all window and door opening. If laps are necessary, lap higher layers over the lower layer.
2. Trim the openings for doors and windows just before they are being installed by cutting at 45° away from each corner and folding the wrap around the opening and secure (Figure 59 and Figure 60). Cut off excess underlay.
3. Install a small patch of flexible flashing tape across corners (Figure 60). An alternative to a patch is conformable tape that can be stretched around the corners on the face of the underlay. Install flexible flashing tape in the corners:
   - at the top corners 100 mm along the head and down the jamb and turned out 50–100 mm out over the face of the wall underlay
   - at the bottom corner across the sill trimmer with 100 mm return up the jambs and turned out 50–100 mm out over the face of the wall underlay.
4. Install the sill support bars (Figure 61) – all windows in cavity construction need these to carry the weight of the window back to the frame (E2/AS1 Figure 72B). Fix cavity battens as required around the entire building except above doors and windows. Install cavity closers where required for edge and intermediate fixings of sheet claddings and a vermin-proof cavity closer at the cladding base.
5. Install the head flashings to the wall underlay (for horizontal weatherboard claddings, this step typically occurs after the doors and windows are installed). Ensure there are 10 mm stop-ends at each end that stop at the back face of the cladding line and there is a minimum 15° fall to the exterior.
6. Use flexible flashing tape to seal the head flashing upstand to the wall underlay or install a second layer of wall underlay lapped over the head flashing upstand and extending up to the top of the wall or to beneath a horizontal lap joint in the underlay above the window (E2/AS1 Figure 71 (a) and (b)).
7. Cavity battens and a vermin-proof cavity closer are installed above the window head once the head flashing upstand has been taped to the wall underlay or the second layer of underlay installed.
8. If cavity battens are more than 450 mm apart, provide additional strapping support over the underlay to prevent it from bridging the cavity after the insulation is installed.
9. Repair any cuts and tears in the underlay.

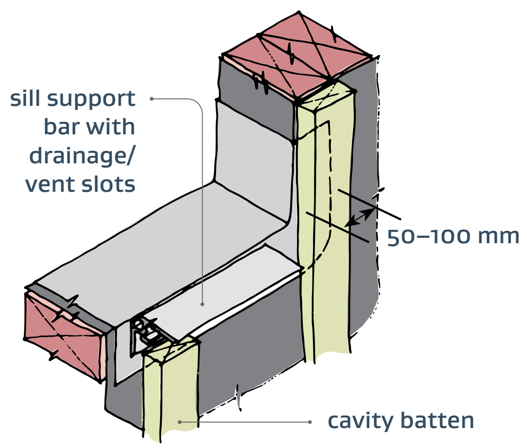


Figure 61. Installing sill support bar and cavity battens

For direct-fixed cladding, things are trickier. Windows must have a sill tray flashing the full width of the opening with an 8 mm back upstand, tapered end upstands and 35 mm minimum cover to the cladding (Figure 62). This method also incorporates jamb battens and sill support packers (E2/AS1 Figure 72(a)).

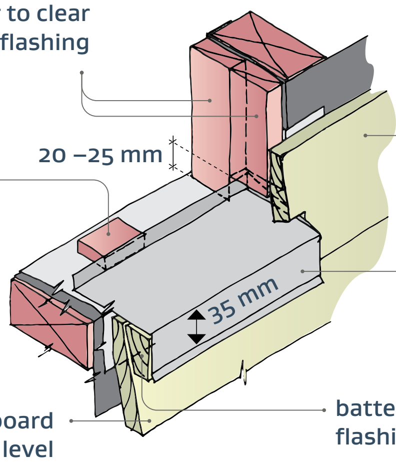


Figure 62. Installing sill tray flashing for direct-fixed wall cladding

For horizontal weatherboard claddings, windows and doors are usually installed before the wall cladding. This has the benefits of:

- easier installation of the head flashing above windows and doors
- the head flashing upstand can be taped accurately to the wall underlay
- the wall cladding can then be accurately fitted to the window or door.

If not using preordered window and door joinery, these must be ordered to suit the overall site-measured completed dimensions of the rough openings, the selected wall framing, the wall cladding and interior lining and components such as flashing tapes, sill flashings and jamb battens. This ensures that, once the doors and windows are installed:

- the internal timber reveals will align with the interior lining
- the external face of the joinery will be positioned off the face of the wall framing to suit the selected wall cladding.

The joinery is installed and fixed in place to the framed opening through the interior timber reveals. For horizontal weatherboard cladding, the head flashing is usually installed once the joinery is completely fixed in place. The flashing upstand is then accurately taped to the underlay or a second layer of underlay is installed above the window. Cavity battens above the window head are then installed (E2/AS1 Figure 72 (a) and (b)).

Window details and installation instructions specific to particular claddings are given in E2/AS1:

- Timber weatherboards.
- For fibre-cement weatherboards.
- For fibre-cement sheet.
- For profiled metal.
- For plywood sheet.

Installation details are also available from the Window and Glass Association of New Zealand (see the Resources section at the end of this document) and window manufacturers.

Soffit lining

With a typical soffit lining, fibre-cement sheet is slotted into a groove in the back of the fascia and fixed to the undersides of the rafters or soffit framing. This is done before the wall cladding is fixed. The sheets are butt-joined with plastic jointers. Once the wall cladding is in place, a timber soffit mould can be installed to the junction of the soffit lining and cladding.

The air within a cavity will sometimes be damp, which could be a cause of damaging condensation if it can enter a roof space. The soffit lining and/or its supporting framing must fit tightly against solid wall framing members (such as a row of dwangs) to provide a barrier that prevents air within the cavity from reaching the roof space.

Installing the wall cladding

Before starting the installation, check that:

- the wall framing is straight
- the wall underlay is in good condition with no holes or tears
- for cavity construction, the cavity battens and cavity closers are installed
- the exterior joinery is at the right stage of installation with the head flashings installed and taped to the underlay
- the cladding and wall framing are both dry (below 18 per cent moisture content)
- where required, the backs and edges of the cladding have been primed
- you have all the fixings and flashings you need
- for fixing weatherboards, you have a string line and level
- you have the installation instructions from the cladding manufacturer – read these carefully as failure to consult them may result in the warranty being void.

Typically, claddings are supported by framing at 600 mm maximum centres. Claddings must finish 50 mm below the bottom edge of a bearer to give protection to subfloor framing (Figure 63).

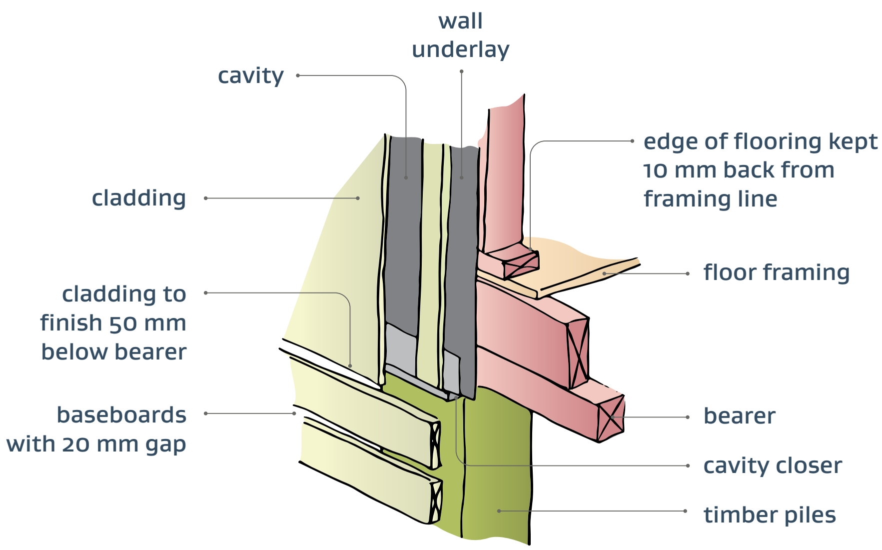


Figure 63. Cladding installation over cavity

For installation guidance on different materials, refer to E2/AS1:

- Timber weatherboards – section 9.4.
- Fibre-cement weatherboards – section 9.5.
- Fibre-cement sheets – section 9.7.
- Plywood sheets – section 9.8.
- Profiled metal sheets – section 9.6.

As always, you should also refer to the cladding manufacturer's installation instructions. Where cladding is selected to provide bracing, follow the manufacturer's instructions for this (wall bracing is more commonly provided by internal plasterboard linings – again, refer to the manufacturer's proprietary bracing systems).

Flashings

Flashings are a critical part of protection against rain – they discharge rain to the outside face of the cladding. For sleepouts covered by this guide, flashings are generally required:

- across the tops of windows and doors (head flashing)
- at the sills of doors and windows in direct-fixed cladding and for profiled metal claddings over a cavity
- down the jambs of windows and doors where profiled steel is used
- to the junction between a reverse-slope soffit and the wall cladding
- behind or over internal and external corners of weatherboard and profile claddings (PVC, steel) unless the joint is protected by timber cover boards or, for weatherboards, soakers
- at all roof/wall junctions – for example, sloped or horizontal apron flashing
- to gable ends of roofs to protect the bargeboard/roofing junction.

All flashings to wall cladding must either have a hem or hook to the top edge of the upstand or must have the upstand increased by 25 mm beyond the minimum dimensions shown in E2/AS1. In extra high wind zones, both the hems or hooks and the 25 mm increase in upstand dimension are required (unless the upstand dimension is specifically stated as applying to extra high wind zone situations).

The requirements around flashings are given in of E2/AS1 section 4.0.

Baseboards around the subfloor

If required, horizontal baseboards can be installed around the base of the sleepout. These are fixed to the subfloor framing (Figure 63) or to framing between timber piles. Ensure the bottom baseboard is well clear of the ground and there is a 20 mm gap between the horizontal boards to allow for subfloor ventilation. Ensure there is an opening that allows access under the sleepout. If required, a polythene ground cover could also be installed on the ground under the sleepout to keep the subfloor area dry.

Fibre-cement sheeting is another material commonly used around the subfloor. Again, ventilation must be provided for. A clear opening area of 3,500 mm² (100 x 35 mm) should be provided for every 1 m² of floor area.

Note that, in some situations, a subfloor whose perimeter has clear openings of more than 7,000 mm² per 1 m² of floor area (including most subfloor spaces with no perimeter enclosure or with baseboards enclosing the perimeter) may require stainless steel subfloor fixings in situations where a subfloor with between 3,500 mm² and 7,000 mm² of clear openings would not. This is because the greater area of openings allows greater quantities of wind-blown contaminants to contact subfloor components.

Worked example

Using the E2/AS1 risk matrix

Different types of wall cladding and building design have different risks for weathertightness. Assessing these risks will confirm how the cladding is installed.

For low-risk buildings, most claddings can be fixed directly to the wall framing. For higher-risk buildings, the cladding may need to be fixed over a cavity (through cavity battens attached to the wall framing.

To assess weathertightness, you need to complete the building envelope risk matrix from E2/AS1. Working through the risk matrix, looking at different features of the sleepout, ultimately gives you a risk score. The risk score confirms how the cladding will be fixed.

The risk assessment is carried out for each side of the building. Most sleepouts will only have four sides. You will need to complete a risk assessment for each one as they may give different risk scores.

Definitions of risk levels

E2/AS1 Table 1 (Table 20 below) defines six risk factor categories related to the building design and severity of risk within each category that is classified as low, medium, high, very high or extra high.

The risk factor categories are wind zone, number of storeys, roof/wall junctions, eaves width, envelope complexity and decks.

Each of the risk severities within each category is given a number (a risk score). The higher the number, the higher the risk.

Risk Factor	Score(5)	Risk severity	Comments
A: Wind zone	**0**	**Low risk**	Low *wind zone* as described by NZS 3604
	0	**Medium risk**	Medium *wind zone* as described by NZS 3604
	1	**High risk**	High *wind zone* as described by NZS 3604
	2	**Very high risk**	Very High *wind zone* as described by NZS 3604
	2	**Extra high risk**	Extra High *wind zone* as described in NZS 3604 (4)
B: Number of storeys	**0**	**Low risk**	One *storey*
	1	**Medium risk**	Two *storeys* in part
	2	**High risk**	Two *storeys*
	4	**Very high risk**	More than two *storeys*
C: Roof/wall junctions	**0**	**Low risk**	Roof-to-wall intersection fully protected (e.g. hip and gable roof with *eaves*)
	1	**Medium risk**	Roof-to-wall intersection partly exposed (e.g. hip and gable roof with no *eaves*)
	3	**High risk**	Roof-to-wall intersection fully exposed (e.g. *parapets, enclosed balustrades* or *eaves* at greater than 90° to vertical with soffit *lining*)
	5	**Very high risk**	Roof elements finishing within the boundaries formed by the exterior walls (e.g. lower ends of aprons, *chimneys, dormers* etc)
D: Eaves width (1)(2)	**0**	**Low risk**	Greater than 600 mm for single storey
	1	**Medium risk**	451–600 mm for single storey, or over 600 mm for two storey
	2	**High risk**	101–450 mm for single storey, or 451–600 mm for two storey, or greater than 600 mm above two storey
	5	**Very high risk**	0–100 mm for single storey, or 0–450 mm for two storey, or less than 600 mm above two storey
E: Envelope complexity	**0**	**Low risk**	Simple rectangular, L, T or boomerang shape, with single *cladding* type
	1	**Medium risk**	Moderately complex, angular or curved shapes (e.g. Y or arrowhead) with no more than two *cladding* types
	3	**High risk**	Complex, angular or curved shapes (e.g. Y or arrowhead) with multiple *cladding* types
	6	**Very high risk**	As for High risk, but with junctions not covered in C or F of this table (e.g. box windows, pergolas, multi-storey re-entrant shapes etc)
F: Decks(3)	**0**	**Low risk**	None, timber slat *deck* or porch at ground floor level
	2	**Medium risk**	Fully covered in plan by *roof*, or timber slat *deck* attached at first or second floor level
	4	**High risk**	*Enclosed deck* exposed in plan or cantilevered at first floor level
	6	**Very high risk**	*Enclosed deck* exposed in plan or cantilevered at second floor level or above

Table 20. Definitions of risk scores

Source: E2/AS1 Table 1

E2/AS1 Table 2 (Table 21 below) tabulates the risk factors and risk severity and the relevant risk scores. To identify the weathertight risk of a building you need to complete the E2/AS1 Table 2 Risk Matrix Scoring Template for each side of the building.

Risk factor	Risk severity								Subtotals for each risk factor
	LOW	score	MEDIUM	score	HIGH	score	VERY HIGH (1)	score	
Wind zone (per NZS 3604)(1)	0		0		1		2		
Number of storeys	0		1		2		4		
Roof/wall intersection design	0		1		3		5		
Eaves width	0		1		2		5		
Envelope complexity	0		1		3		6		
Deck design	0		2		4		6		
(Enter the appropriate risk severity score for each risk factor in the score columns. Transfer these figures across to the right-hand column. Finally, add up the figures in the right-hand column to get the total risk score.)							**Total risk score for use in Table 3:**		

NOTE: (1) For *buildings* in Extra High *wind zones*, refer to Tables 1 and 3 for rigid *underlay* and *drained cavity* requirements.

Table 21. Building envelope Risk Matrix Scoring Template

Source: E2/AS1 Table 2

Completing E2/AS1 Table 2

Complete an E2/AS1 Table 2 scoring template for each side (elevation) of the sleepout (Figure 63). Enter the risk score into each of the six risk factor categories based on the risk severity (low – very high) relative to the building design. You will end up with a total risk score for each side of the sleepout.

Risk Matrix for **Model Sleepout – Elevation 1** Wall Type: **Standard**					
Risk Factor	*Low*	*Med*	*High*	*Very High*	*Score*
Wind (NSZ 3604)	0	0	**1**	2	**1**
Storeys	**0**	1	2	4	**0**
R/W Intersection	**0**	1	3	5	**0**
Eaves Width	0	1	**2**	5	**2**
Complexity	**0**	1	3	6	**0**
Deck Design	**0**	2	4	6	**0**
Total Risk Score: **Low**					**3**

Risk Matrix for **Model Sleepout – Elevation 2** Wall Type: **Standard**					
Risk Factor	*Low*	*Med*	*High*	*Very High*	*Score*
Wind (NSZ 3604)	0	0	**1**	2	**1**
Storeys	**0**	1	2	4	**0**
R/W Intersection	**0**	1	3	5	**0**
Eaves Width	0	1	**2**	5	**2**
Complexity	**0**	1	3	6	**0**
Deck Design	**0**	2	4	6	**0**
Total Risk Score: **Low**					**3**

Risk Matrix for **Model Sleepout – Elevation 3** Wall Type: **Standard**					
Risk Factor	*Low*	*Med*	*High*	*Very High*	*Score*
Wind (NSZ 3604)	0	0	**1**	2	**1**
Storeys	**0**	1	2	4	**0**
R/W Intersection	**0**	1	3	5	**0**
Eaves Width	0	1	**2**	5	**2**
Complexity	**0**	1	3	6	**0**
Deck Design	**0**	2	4	6	**0**
Total Risk Score: **Low**					**3**

Risk Matrix for **Model Sleepout – Elevation 4** Wall Type: **Standard**					
Risk Factor	*Low*	*Med*	*High*	*Very High*	*Score*
Wind (NSZ 3604)	0	0	**1**	2	**1**
Storeys	**0**	1	2	4	**0**
R/W Intersection	**0**	1	3	5	**0**
Eaves Width	0	1	**2**	5	**2**
Complexity	**0**	1	3	6	**0**
Deck Design	**0**	2	4	6	**0**
Total Risk Score: **Low**					**3**

Figure 64. Risk scores for the four elevations of the example sleepout

Using the completed Table 2 scoring template for elevation 1 as an example (Figure 64):

- **Wind** – our sleepout is in a high wind zone so it scores 1 risk factor point.
- **Storeys –** it is single storey so scores 0.
- **Roof/wall intersection** – our roof to wall junctions are fully protected by eaves so scores 0.
- **Eaves width** – our building eaves overhang is 450 mm at the front and back and 300 mm at each end so scores 2.
- **Envelope complexity** – we have a simple rectangular building with one cladding type so this scores 0.
- **Decks** – our sleepout has a small slatted deck at ground floor level so this scores 0.

This results in a total risk score for elevation 1 of 3 points – very low risk score. Elevations 2, 3 and 4 also score 3 points. (For risk scores over 20, the best option is to change the design to bring the risk score down).

Selecting suitable wall claddings

E2/AS1 Table 3 (Table 22 below) sets out the claddings that you can use and how they should be installed relative to the risk score you have calculated for each side of the building.

Risk Score from Table 2	Suitable wall claddings(1)	
	Direct fixed to framing	**Over nominal 20 mm drained cavity**
		Claddings on *parapets*, *enclosed balustrades*, and in Extra High *wind zones* shall be installed over *drained cavities*.(5)(6)
0 – 6	a) Timber weatherboards – all types b) Fibre cement weatherboards c) Vertical profiled metal – corrugated and symmetrical *trapezoidal* (3) d) Fibre cement sheet(4) (Jointed finish) e) Plywood sheet	a) *Masonry veneer* (2) b) *Stucco* c) Horizontal profiled metal(3) – corrugated and *trapezoidal* only d) Fibre cement – *flush-finished* e) *EIFS*
7 – 12	a) Bevel-back timber weatherboards b) Vertical timber board and batten c) Vertical profiled metal – corrugated only(3)(6)	a) *Masonry veneer* (2) b) *Stucco* c) *Horizontal* profiled metal – corrugated and *trapezoidal* only d) Rusticated weatherboards e) Fibre cement weatherboard f) Fibre cement sheet – flush and jointed finish g) Plywood sheet h) *EIFS*
13 – 20	a) Vertical profiled metal – corrugated only(3)(6)	a) *Masonry veneer* (2) b) *Stucco* c) Horizontal profiled metal – corrugated and *trapezoidal* only d) Rusticated weatherboards e) Fibre cement weatherboards f) Fibre cement sheet – flush and jointed finish g) Plywood sheet h) *EIFS* i) Bevel-back weatherboards

Table 22. Wall cladding options for different risk scores
Source: E2/AS1 Table 3

We look at E2/AS1 Table 3 to confirm how our cladding (plywood sheet) needs to be fixed to the framing.

A risk score of 3 fits into the 0–6 risk score, which confirms plywood sheet can be direct-fixed to the framing (or fixed on cavity – you can always opt for a more conservative choice if you wish).

There are online calculators that can help you work through the risk matrix. You can find one on the Design Navigator website.

09

Insulation, lining and finishing

The final work on a sleepout is largely around adding wall and roof insulation, electrical systems, stormwater management, linings and painting.

None of the interior work should be done until the sleepout is weathertight – the roof and wall cladding, windows and doors must all be installed first.

Careful advance planning is required around three areas in particular:

- **Prewire for the electrical services of lights, light switches and power outlets** – think about where you want to locate these (and the switchboard/circuit breakers) before installing the wall and ceiling linings.
- **Connecting the sleepout lights and power points to the main house electricity supply** – this cannot be done by a DIYer. You need a registered electrician who must also, by law, provide a certificate of compliance for the work.
- **Managing the stormwater off the roof** – discuss this with your council. Different councils have different policies. Some options and some councils will require a building consent for this work. Only registered drainlayers can make connections to existing stormwater drainage systems and construct soak pits.

Installation sequence

After the exterior doors and windows and the wall cladding are installed, the final work sequence is usually:

- prewire for lights and power sockets (and hard-wired smoke alarm if that type of alarm is preferred) and install switchboard
- air seals around exterior door and window joinery
- thermal insulation
- interior wall and ceiling linings
- architraves, scotia and skirting
- interior wall and ceiling plasterboard stopping and painting or staining or clear finishing of plywood
- light switches and power sockets installation
- smoke alarm installation
- exterior paint or staining
- stormwater system – gutters and downpipes and a possible connection to existing stormwater drainage system, storage tank or soak pit
- electrical finish – exterior (outdoor lighting)
- floor coverings.

The order of these final work steps can change according to the weather. For example, the exterior painting and gutters may need to have a higher priority when the weather is warm or fine so the exterior cladding doesn't get soaked and then need to dry again before it can be painted or stained.

If you want to install a small solid fuel heater in the sleepout, that will require building consent and is beyond the scope of this guide.

Electrical work

It is common practice to give a document setting out your requirements to several different electricians and asking for quotes. Do this during the planning stage of when you would like the electrical work to be done.

Once you have determined who will do the work, discuss with them at what stage they need to be involved and how much advance notice they require. The work in the sleepout itself will require at least two visits. These are the separate pieces of work:

- **Supply installation –** a flexible pipe is installed in a trench dug between the house and the sleepout. This will have a cable installed later that runs between the power supply (usually the switchboard in the house) and a new switchboard in the sleepout.
- **Prewiring –** decisions around the location of lights, switches, socket outlets and so on need to be made at an early stage. Wiring for these will be installed after the sleepout is weathertight (the wall and roof claddings, doors and windows must all be installed) but before the insulation and plasterboard wall linings and ceiling are installed.
- **Finishing work –** such as fixing socket outlets, light switches, lighting etc. This is done after the wall and ceiling plasterboard is installed and stopped and painted. Using plywood as a lining instead of plasterboard is also an option.

Most people will have all the electrical work done by a registered electrician. The Electricity Act 1992 (section 79) and the Electricity (Safety) Regulations 2010 (Part 5, Regulation 57) only allow homeowners to do a very limited amount of electrical work on domestic property they own and live in. You should only consider this if you have the knowledge, experience and skills to do the work safely. Unsafe work is both illegal and likely to affect your property insurance.

Connecting the sleepout to the power supply and work on switchboards is not part of the exemption and cannot be done by DIYers.

At the same time that you are thinking about electrical cables for power and lighting, consider any other types of wiring or cabling that you might require such as for a hard-wired smoke alarm, television aerial, computer networking or other services.

Air seals around doors and windows

Air seals need to be installed around the insides of doors and windows (Figure 65) before the plasterboard lining is installed. Air seals block the potential flow of air (and moisture) into a sleepout when the air pressure outside a building is higher than it is inside such as during wind gusts.

Install the backing rod and then the expanding foam sealant against a backing rod from the inner face of the wrapped framed opening. This will create a complete airtight seal between the framed opening and the window or door timber reveal. The backing rod (usually made of closed-cell polyethylene foam or PEF) is installed first to ensure that the gaps around window and door joinery are not overfilled with foam sealant.

The installation instructions from the window/door supplier will usually include guidance on air seals and sill support bars. You can also find details in E2/AS1 section 9.1.6 and Figure 81.

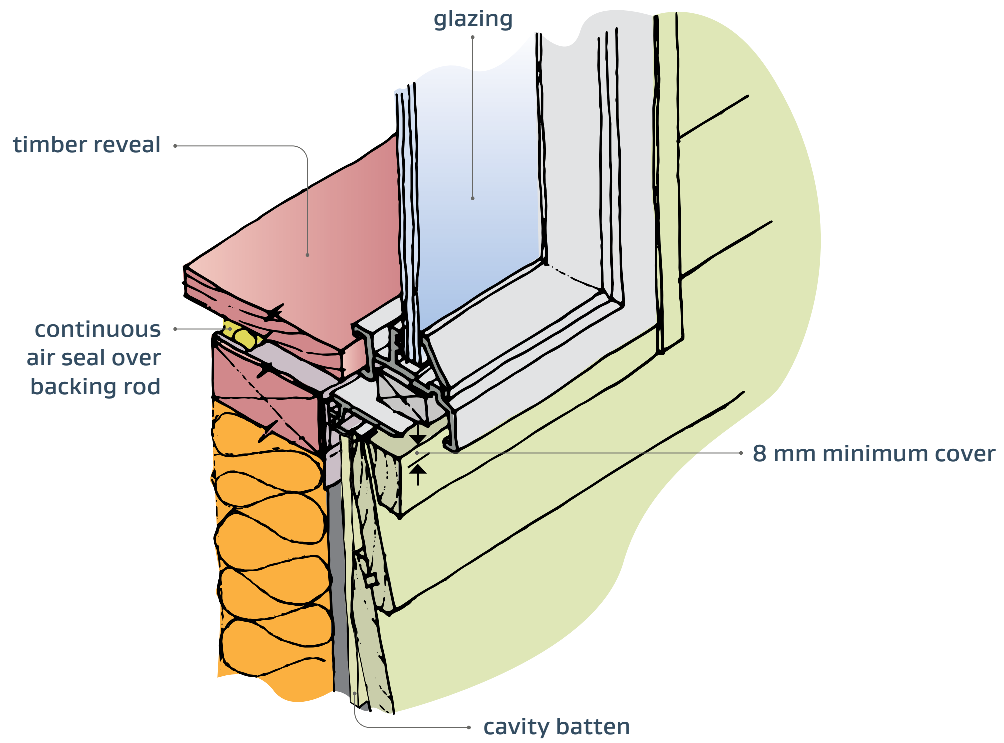


Figure 65. Air seal over backing rod in a window

Wall, ceiling and underfloor thermal insulation

Your sleepout must be insulated. There are minimum levels of thermal insulation required to comply with the Building Code.

Be aware that the minimum R-value figures in the Building Code apply to construction R-values and not the R-value of the insulation material. The construction R-value is a measure of the ability to resist the transfer of heat in the whole building element. With roofs as an example, this includes roofing, insulation, ceiling lining etc. It can be higher or lower than the R-value of the insulation material itself depending on the type of construction.

There are several ways of complying with the Building Code requirements for this. One is to follow the schedule method in H1/AS1 5th edition amendment 1. You can also find help in the BRANZ House insulation guide (6th edition).

Roof insulation

Where there is a horizontal plasterboard ceiling with accessible roof space above, insulation typically sits directly on the plasterboard, fitting snugly and with no gaps between the framing members. It may be installed before the plasterboard, supported by strapping, or afterwards if there is sufficient space for access.

Insulation must also be installed in a skillion roof in using strapping before or at the time that the plasterboard ceiling lining is being installed.

The most commonly installed roof insulation materials in roofs are blankets or mats of glass wool (fibreglass), wool, polyester, wool/polyester mix or mineral wool.

Underfloor insulation

Underfloor insulation will usually be rigid polystyrene panels or be blankets or segmented mats of fibreglass, polyester or wool. Some materials may require strapping stapled to the underside of joists to hold them in place. The insulation should be pushed hard against the underside of the floor so there is no air movement between the floor and the insulation.

Wall insulation

Most domestic wall insulation comes as blankets or segmented mats of fibreglass, wool, polyester, wool/polyester mix or mineral wool (Figure 66). The material must not crushed, creased or forced into gaps that are too small. It must not push a flexible wall underlay out into the drained and vented cavity.

Figure 66. Installing wall insulation

Most insulation products are proprietary and come with their own installation instructions.

A useful standard to consult is NZS 4246:2016.

Installing wall and ceiling linings

There are several possible materials for sheet linings on the inside faces of the sleepout walls. Plasterboard, plywood or MDF/particleboard could all be used. Prefinished panels are also available.

Before starting to install the wall and ceiling linings, you need to do a few important checks on the sleepout to ensure that everything that these linings will hide has been finished. This includes checking:

- the framing is straight and square
- nuts to all holding-down bolts (such as may be in the bottom plate) are tight
- fixing-down points for bracing are installed and properly fixed
- holding-down straps or bolts are fitted to the bottom plates of braced panels
- holding-down straps or Z nails are fitted to prevent rafter or truss uplift
- all structural and framing members are securely fixed
- lintels are strapped down
- all dwangs that are needed to provide fixing to sheet edges, support to fixtures, power outlet boxes, light fittings, cabinetry etc. are installed
- all internal finishing work that must be installed before the linings (such as doors with slimline or rebated jambs) is completed

- wiring is installed for power sockets and lighting and that flush boxes are fitted
- the insulation has been correctly installed
- the framing timber is sufficiently dry (generally below 18 per cent moisture content). If you ordered kiln-dried timber and it has been kept completely dry since delivery, you are unlikely to have a problem, but timber that has got wet must be allowed to dry out – ventilate the building every day, closing it up at night. Don't use guesswork for moisture content – moisture meters can be easily hired.

If you chose at the planning stage to use the lining to provide bracing for the sleepout, you will also need to ensure that the fixings are all appropriate for this purpose. The major plasterboard manufacturers provide good guidance around this.

Before starting the installation, you also need to check that you have:

- the installation instructions from the material manufacturer
- all the required tools and fixings
- one or two extra people to help.

A poor-quality installation of ceiling and wall linings will be very visible for the life of the sleepout, so plan things carefully and take your time. Read the manufacturer's installation guidance several times so everything is clear. Major manufacturers/suppliers of plasterboard in particular have excellent well-illustrated guidance on their websites. Some provide instruction videos.

Fixing often requires both adhesive and mechanical fixings (screws).

With plasterboard linings, the joints and corners are most commonly taped and flush-stopped with stopping compound in new construction because, after finishing work and painting or wallpapering, the joints are no longer seen. It requires considerable care and skill to achieve a quality result, however. Beginning in less visible areas, if there are any, is probably a good idea. This is one of those areas that bringing in a skilled practitioner could be a good investment, providing a faster and better-quality finish.

Installing architraves, skirting and scotia

Architraves are the moulded timber strips surrounding the interior reveals of a door or window. Skirting is the finishing timber that runs along the base of a wall at floor level. Scotia or cornice can be used around the tops of the walls at the junction with the ceiling. These elements are typically made of radiata pine, MDF or (only for the cornice) paper-faced plaster. They should be installed in single lengths as far as possible and be cut very slightly overlength to give a tight fit. They should have sufficient fixing to pull them tightly against the wall/ceiling lining.

Well-made mitre joints are used at the corners of architraves around doors and windows (Figure 67) and with moulded skirting boards at internal corners. Some of the larger building supply merchants have good videos online showing how to do this.

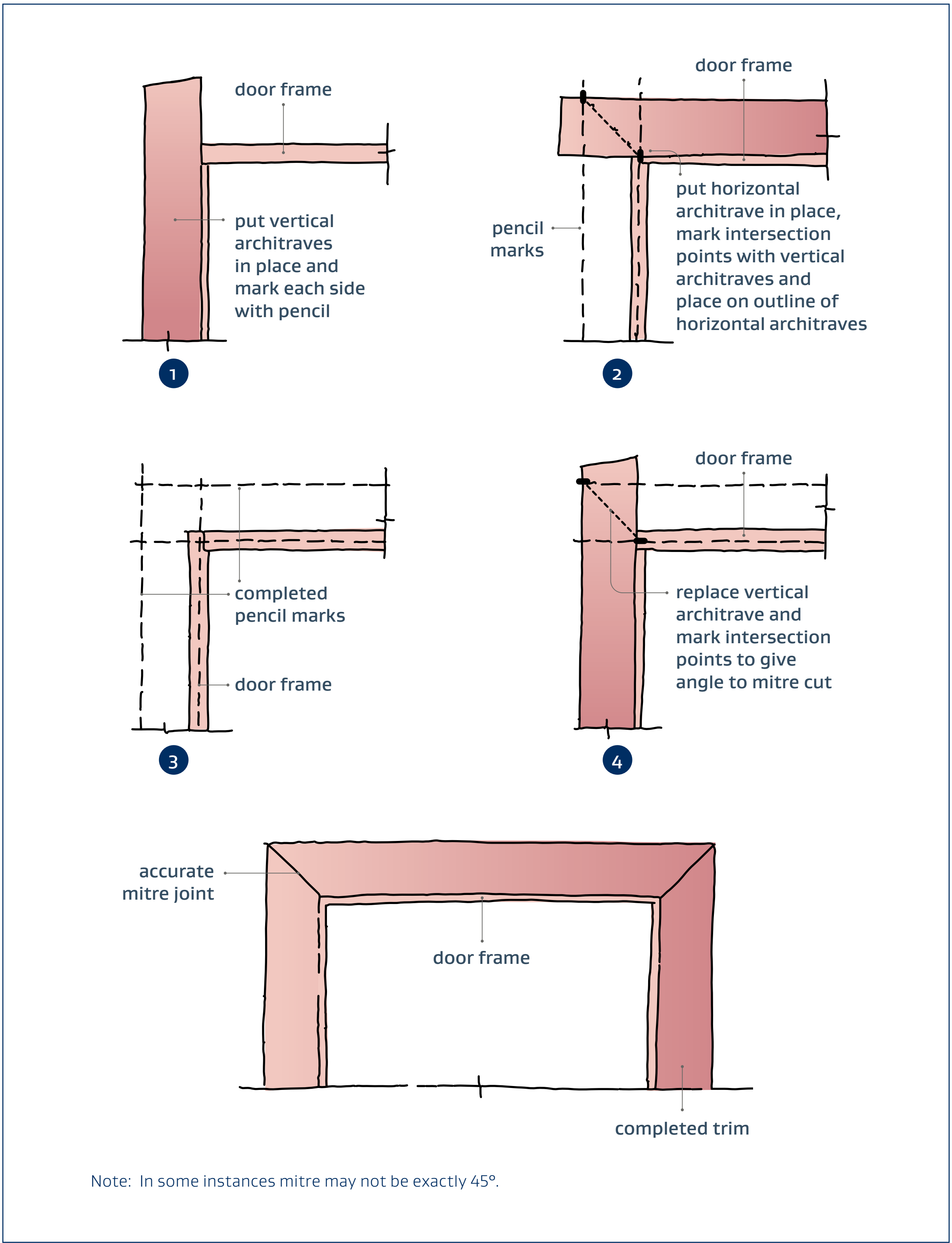


Figure 67. Setting out mitre joints in architraves around windows and doors

The junction of a plasterboard wall lining/ceiling lining does not require a scotia to be fitted – it is also possible to have a square-stopped finish. This does not work with plywood or MDF/particleboard.

Interior painting

For plasterboard wall and ceiling linings, make sure surface imperfections have been filled and gently sanded and that the surface is clean and dry. Apply a sealer coat especially designed for plasterboard, then two finish coats. You may wish to lightly sand the sealer coat before applying the first finish coat. Low-sheen paints, such as those for ceilings, are good for making surface imperfections less visible, while light glancing across gloss and satin finishes can highlight imperfections in a surface. Most good-quality paints today are easy to clean.

As a rough guide, typical coverage rates are:

- 10–12 m^2/litre for sealer coats
- 12–16 m^2/litre for top coats.

For trims such as architraves and skirting boards, fill and sand small holes or cracks. Make sure every surface to be painted is clean and free of contaminants such as dust or grease. Apply a primer and two top coats. Window and door frames can be painted with water-based enamel paint.

Paint can be applied by brush, roller or spray. For large areas such as ceilings and walls, rollers are a good option. Rollers with a short pile give a smoother finish and are best used on smooth surfaces. Spray painting may seem a faster way of getting the job done but it requires experience to get an even and unblemished surface. Spraying also requires masking and protecting nearby surfaces.

Exterior painting/staining

Paint is usually a more durable exterior coating than stain. While a good quality paint may not require recoating for 10 years, a stain is more likely to require more frequent recoating to maintain a good appearance. There are huge variations in performance across different types of stain, largely dependent on exposure.

Among the biggest influences on the durability of a coating are the preparation work that is done before the coating is applied and the quality of the coating itself. Better-quality paints have more solids in them giving better paint thickness and performance.

Water-based paints have the advantage of being quick drying, having lower odour and obviously being able to clean up in water. Where a very hard, durable finish is required, such as on the frames of opening doors and windows, water-based enamels are available.

You can find more details about painting on the BRANZ Maintaining My Home website.

Smoke alarms

A sleepout is required to have a working smoke alarm. More information can be found in Building Code clause *C Protection from fire* and NZS 4514:2021 Interconnected smoke alarms for houses.

Electrical finishing

Electrical finish work includes:

- installing lights and switches inside the sleepout
- installing electrical power sockets inside the sleepout
- installing a wired-in smoke alarm if that is the type of alarm chosen
- installing an outdoor light above the door to allow safe access at night
- connecting the power in the sleepout to the main power board of the house. This connection must be carried out by a registered electrician who will also, by law, provide a certificate of compliance when finished.

Gutters and downpipes, stormwater system

Your sleepout will need to have gutters and downpipes installed to manage rainwater and a system for collecting or disposing of the stormwater. This may be to a council stormwater system or to a soak pit or may include a water storage tank for garden purposes. The intended stormwater system should be discussed with the council before work on the sleepout begins.

Building Code clause E1 *Surface water* must be complied with. Water must be kept away from building foundations, for example.

If a soak pit is chosen as the means of disposing of stormwater, it should be designed and constructed according to E1/VM1. This is likely to require professional help – there are complex calculations required, and in almost all cases, the council will require a building consent. Soak pits are often not allowed within fixed distances from easements, building foundations, retaining walls or property boundaries and are not looked on favourably at all by some councils.

Depending on the disposal option chosen and the council, a stormwater system may require a building consent – it certainly will if the plan is to connect to a council stormwater system. In some cases, a resource consent may also be required. Your council will be able to advise on this.

The guttering and downpipes are most likely to be a PVC proprietary system. These systems come with well-illustrated installation instructions. The positions of the downpipes should be decided based on the direction that the stormwater will be draining.

Floor coverings

Sheet floors of plywood, particleboard, strand board or similar can be sanded and sealed and then left uncovered.

If you prefer a floor covering, there is a very wide choice available. Vinyl is easily cleaned, while carpet can help make a sleepout in a cold location feel warmer inside.

Glossary and Resources

Glossary

Term	Definition
bird's mouth	A seat cut to fit the top plate into the rafter.
close-couple roof	Each pair of rafters is tied together below the ridge board by cleats and are also linked at their feet.
construction R-value	A measure of the ability to resist the transfer of heat in the whole building element.
cross-section	A section through the building showing all construction materials, linings and claddings.
elevation	Straight-on view of each wall from the outside showing wall and roof claddings, window and door locations, stairs, guttering and downpipes.
expansive soils	Soils that experience seasonal swelling and shrinking as they get wet and dry out or groundwater levels change.
good ground	Any soil or rock capable of permanently withstanding an ultimate bearing capacity of 300 kPa with some exceptions. (NZS 3604:2011).
impervious	Not allowing liquid to pass through.
LBP	Licensed Building Practitioner.
monopitch roof	A roof having only one slope with a regular gradient.
PEF	Closed-cell polyethylene foam.
permeable	Allowing liquid to pass through.
PPE	Personal protective equipment.
profile	Used to transfer the plan outline of a building onto the ground.
RCD	Residual current device.
recession plane	Rules about how near you can build to the property boundary and how high.
R-value	A measure of how a building material, such as insulation, resists heat flow.
set-back	How close a building can be to a boundary.
site coverage	Proportion of the land area on a property that is covered with buildings.
skillion roof	Where the roof cladding and ceiling run parallel.

Resources

New Zealand Legislation

- New Zealand Building Code

Standards New Zealand

- NZS 3604:2011 *Timber-framed buildings*
- NZS 4246:2016 *Energy efficiency – Installing bulk thermal insulation in residential buildings*
- Other New Zealand building-related standards for free download

BRANZ

- Bracing – *Build* supplement April 2014
- BRANZ Appraisals – products with a BRANZ Appraisal (for example, some roofing products) typically include some installation guidance
- BRANZ bracing calculation sheets
- BRANZ Facts *Roof design*
- BRANZ Maps – zone information tool
- Building Basics *Lightweight steel framing* (2nd edition)
- Level website
- Maintaining My Home website
- Wind zones and NZS 3604 – *Build* February/March 2012

Building Performance, MBIE

- Building Code compliance
- E2/AS1 – Acceptable Solution for Building Code clause E2 *External moisture*
- H1/AS1 – Acceptable Solution for Building Code clause H1 *Energy efficiency*
- Building work that does not require a building consent
- CanIbuildit – interactive tool to see if your building work needs a building consent
- Exempt building work guidance

Building site services

- BeforeUdig.co.nz

Design Navigator

- E2/AS1 risk matrix calculator

Electrical Workers Registration Board

- Public register

Licensed Building Practitioners

- Public register

National Association of Steel Framed Housing (NASH)

- NASH Standard Part 2: May 2019 *Light Steel Framed Buildings* – can be used to achieve and demonstrate compliance with Building Code clauses B1 Structure and B2 Durability

New Zealand Concrete Contractors Association

- Good concreting practice

New Zealand Metal Roofing Manufacturers Association

- New Zealand Metal Roof and Wall Cladding Code of Practice – if you are using a profiled metal roof cladding or pressed metal tiles

Plumbers, Gasfitters and Drainlayers Board

- Advice for consumers
- Public register

Window and Glass Association New Zealand

- Guide to window installation

WorkSafe

- Personal protective equipment (PPE)
- Working at height

Te Kāwanatanga o Aotearoa
New Zealand Government