BRANZ

ISSUE 648 BULLETIN

TIMBER SHINGLE AND SHAKE ROOFING

April 2020

- Timber shingles and shakes are a distinctive and durable roof cladding material when they are specified, installed and maintained appropriately.
- This bulletin outlines the selection, design and installation of timber shingle and shake roofing for New Zealand conditions.
- This bulletin updates and replaces BRANZ Bulletin 443 *Timber shingles and shakes.*

1 INTRODUCTION

1.0.1 Timber shingles and shakes have been used as a lightweight roof cladding in New Zealand for around 200 years. They are mentioned in current design guides for many heritage areas, but they are also found in contemporary styles of housing.

1.0.2 Shingles are sawn and have relatively smooth faces. They usually have random widths and taper in thickness.

1.0.3 Shakes are usually hand split (although some are also sawn) and usually have a rougher textured surface on at least one side. Widths are generally random. While shakes also taper from a thick to a thin end, they sometimes have a thicker butt end than shingles. This creates a more visible shadow line.

1.0.4 Shingles and shakes are usually manufactured from residual timber left over from the main forest log production. They have a relatively small carbon footprint compared to some other roofing materials. Many of the plantation forests they are sourced from are certified by the FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification).

1.0.5 This bulletin outlines the selection, design and installation of timber shingle and shake roof cladding. It updates and replaces BRANZ Bulletin 443 *Timber shingles and shakes*.

2 BUILDING LAW, BUILDING CODE AND STANDARDS REQUIREMENTS

2.0.1 Designing and installing roof cladding is restricted building work under the Building Act and must be carried out or supervised by those with the appropriate licences in design and roofing (Roofing area of practice 7: Shingle or slate roof).

2.0.2 Timber shingles and shakes are not covered by New Zealand Building Code Acceptable Solution E2/AS1, so they must be consented as an Alternative Solution.

2.0.3 Acceptable Solution B2/AS1 specifies a durability of not less than 15 years for roof cladding.

2.0.4 NZS 3602:2003 *Timber and wood-based products for use in building* states that timber not exposed to weather or ground atmosphere but with a risk of moisture content that could lead to decay must achieve 50-year durability. The standard specifically includes "Sarking and framing not protected from solar driven moisture e.g. through absorbent roofing materials such as shingles". Table 1D in the standard requires plywood under shingles to be treated to a minimum H3 and radiata pine to H3.1. (A revised version of the standard was being prepared at the time this bulletin was published.)

2.0.5 NZS 3602:2003 also states that *Pinus* species timber shingles must be treated to H3.2 to achieve the required 15-year durability.

2.0.6 Roof and wall claddings are not covered in detail in NZS 3604:2011 *Timber-framed buildings*, but shingles and shakes fall within the definition of a light roof in this standard.

3 TIMBER SPECIES, TREATMENT AND AVAILABILITY

3.0.1 Timber used externally must be either a naturally durable species or be treated with preservative to make it sufficiently durable.

3.0.2 The majority of timber shingle and shake roofs currently installed in New Zealand are western red cedar or Alaskan yellow cedar that is grown and processed in Canada. (Testing of New Zealand-grown western red cedar shingles found them to be less durable and stable than the imported product.) Historically, redwood shingles and shakes were sometimes used too.

3.0.3 Western red cedar has an inherent resistance to decay. However, preservative treatment is often recommended by cedar roofing suppliers in this country, especially in areas with higher rainfall. Most suppliers stock cedar shingles treated to H3.2 with CCA (copper chrome arsenate).

3.0.4 Rainwater cannot be collected for human consumption from treated shingles because they can leach preservative chemicals into the water. Untreated western red cedar shingles that have been allowed to weather are suitable for collecting rainwater. Untreated shingles are available from some suppliers. Where homeowners require untreated shingles to allow rainwater collection, this should be discussed with the shingle supplier and building consent authority (BCA) at an early stage of design.

3.0.5 Unless they are coated and maintained specifically to retain colour, cedar shingles and shakes normally weather to a silvery appearance.

3.0.6 The most readily available length of cedar shingle is approximately 450 mm, but shingles with lengths around 406 mm and 610 mm are also manufactured. Widths are random and can range from 55–350 mm. Shingles are usually 10–13 mm thick at the butt end, tapering to around 2 mm.

3.0.7 Shakes are generally around 450 mm or 610 mm long, with thicknesses typically 9–19 mm tapering to around 2 mm. Widths can vary from 75–270 mm.

3.0.8 Shingles are also available in New Zealand-grown radiata pine. These are treated with ACQ (alkaline copper quaternary). They are 405 mm long, with a butt end thickness of 10–13 mm tapering to 2 mm. Widths are random, around 55–200 mm. Radiata pine shingles eventually weather to a similar silver finish to shingles made from other species.

3.0.9 New Zealand kauri, tōtara and kaikawaka timbers were used by European settlers for shingles or shakes, but these timbers are not now available in sufficient quantities for commercial manufacture. Small production runs may be possible for specialist historical restoration work.

3.0.10 Shingles and shakes are often available in different grades. A manufacturer's top grade (premium or No.1 grade) should be used for roofing on houses. Lower grades may be suitable for sheds or outbuildings. (If lower grades are used on a residential roof, the proportion of each shingle/shake exposed to the weather must be reduced.)

3.0.11 Testing in New Zealand has confirmed overseas research that quarter-sawn heartwood shingles have greater durability than sapwood or other types of saw cuts. Most of the top-grade cedar shingles from different manufacturers fall into this category.

4 MATERIAL LIMITATIONS

4.0.1 Timber shingle and shake roofs have some limitations:

- Manufacturers/suppliers do not recommend them for roof pitches of less than 18°.
- Acidic resins that leach out from cedar can corrode unprotected non-ferrous metals such as zinc, and CCA and ACQ-treated roofs can attack aluminium and mild and galvanised steel.
- Painted surfaces can be stained by rainwater run-off from cedar.
- They can suffer surface deterioration from sun and rain exposure, becoming brittle at the end of their lives.
- Shingle/shake roofs require more maintenance than materials such as factory-coated profiled metal.
- Coatings have limited durability and usually require reapplication every 2–5 years.
- Weathering may not give an even colour over the roof.

5 DESIGN CONSIDERATIONS

5.0.1 Good design is vital for maximising the lifespan of timber shingle and shake roofs.

5.0.2 Manufacturers and suppliers generally recommend that shingles and shakes should not be installed on roofs with a pitch below 18°. Pitches steeper than 18° (such as 25–30°) shed water more effectively.

5.0.3 The design must consider ventilation to deal with solar-driven moisture transfer. This process occurs when absorbent roofing materials such as timber shingles dry in the sun after rain. While most of the moisture evaporates and dries to the outside, vapour pressure and diffusion can push some of the absorbed moisture inwards towards the substrate or battens. Good ventilation allows the backs of the shingles/shakes to dry out, which extends their service life.

5.0.4 The risk of solar-driven moisture is addressed in standards and Building Code documents. Table 1A in B2/AS1 notes that: "Timber shakes and shingles … absorb moisture that can be driven in frame cavities by evaporation. Unless the cavities are adequately drained and ventilated, continuing condensation caused by solar-driven transfer increases the moisture content in the cavities and timber framing requiring a higher level of timber treatment to resist decay." A similar note is found with Table 1 of NZS 3602:2003.

5.0.5 It is important to obtain and follow any specific instructions on roof ventilation from the shingle or shake supplier. Passive roof ventilation elements need to provide an air channel into the roof space. These elements are usually installed at the eaves/soffit and the ridge of a roof construction – air enters through the eaves/soffit vents and, through temperature differences and/or wind action, is expelled at the top (Figures 1 and 2). As a rule, designated inlets should be dimensioned slightly larger than the outlet vents to avoid an increased driver for air from downstairs to move up into the roof space. The design of these elements needs to ensure that weathertightness is not compromised.

5.0.6 The weight of a shingle/shake roof varies by the pitch of the roof and the area of each single/shake exposed. Manufacturers or suppliers can provide calculations for specific designs. As a general guide, where recommended exposure figures are followed, the weight is:

- 11–12 kg/m^2 for pitches of 18–45°
- 9–10 kg/m^2 for pitches of 45–60°
- 8–9 kg/m^2 for pitches over 60°.

5.0.7 While shingles/shakes are usually fixed in straight single courses, other options are available for particular effects.

5.0.8 Give careful thought to rainwater management. Rainwater from roof gutters should ideally run to a downpipe rather than onto a lower shingle/shake roof surface. Where it is not possible to run a pipe direct to the ground at a particular location, the water should run into another gutter.

5.1 SUBSTRUCTURE

5.1.1 Timber shingles and shakes may be fixed to treated timber battens, timber sarking or plywood. The supporting timber must achieve 50-year durability.

5.1.2 Battens can provide more effective ventilation of the roof space, allowing the backs of the shingles/shakes to dry faster. Radiata pine battens must be treated to a minimum H3.1. The spacing of battens will depend largely on the dimensions of the shingle/shake specified and the area of each single/shake exposed.

5.1.3 Batten size must be sufficient to ensure effective fixing and will partly depend on rafter spacings. Shingle/shake suppliers can provide details. As an indication, one shingle supplier recommends battens of 50 x 25 mm for rafter centres up to 600 mm. Another recommends:

- 50 x 40 mm for rafter centres up to 900 mm
- 50 x 50 mm for rafter centres 900–1200 mm

5.1.4 Plywood must be treated to minimum H3 (although in practice, a lot of plywood is treated to H3.1 or H3.2). Shingle suppliers typically recommend plywood a minimum of 12 mm or 15 mm thick. Part of the decision on thickness will be based on the recommendations of the plywood manufacturer based on rafter spacing. Thicker plywood will ensure better nail holding.

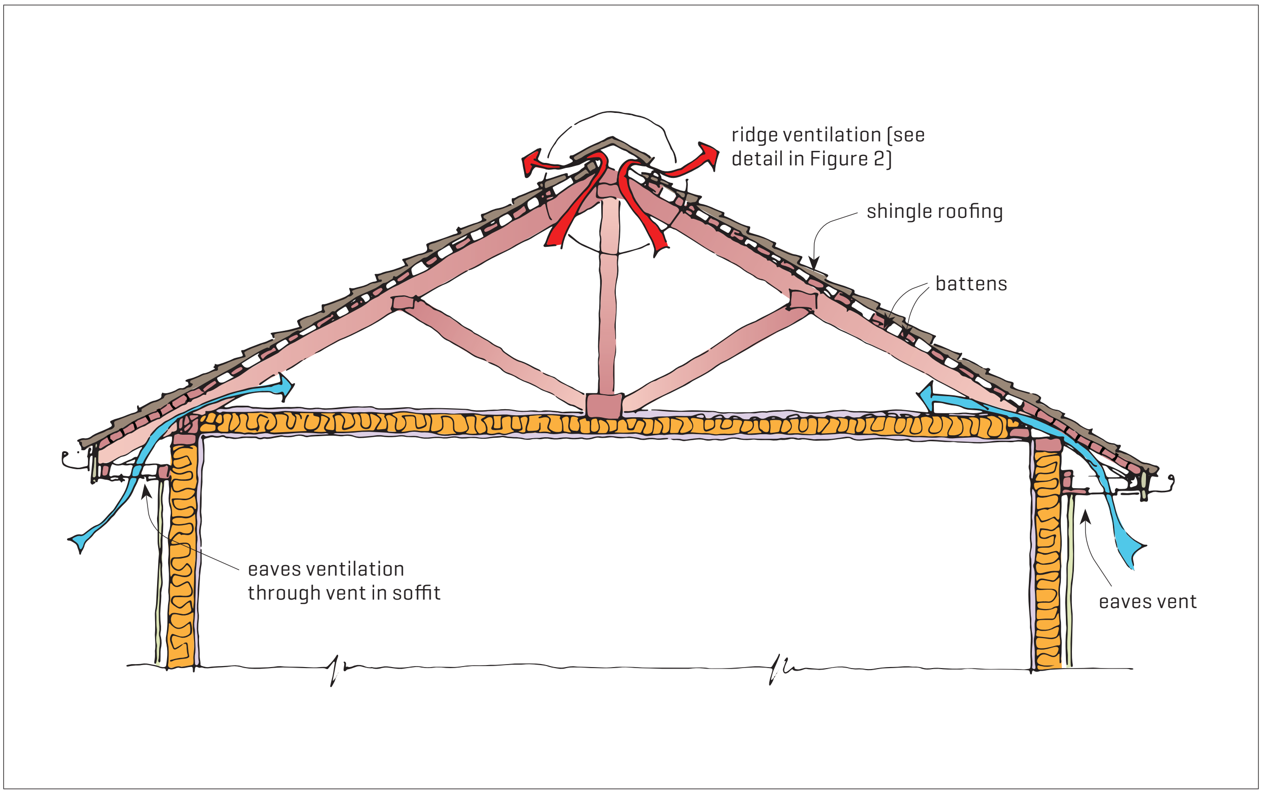

Figure 1. Principles of eaves to ridge ventilation.

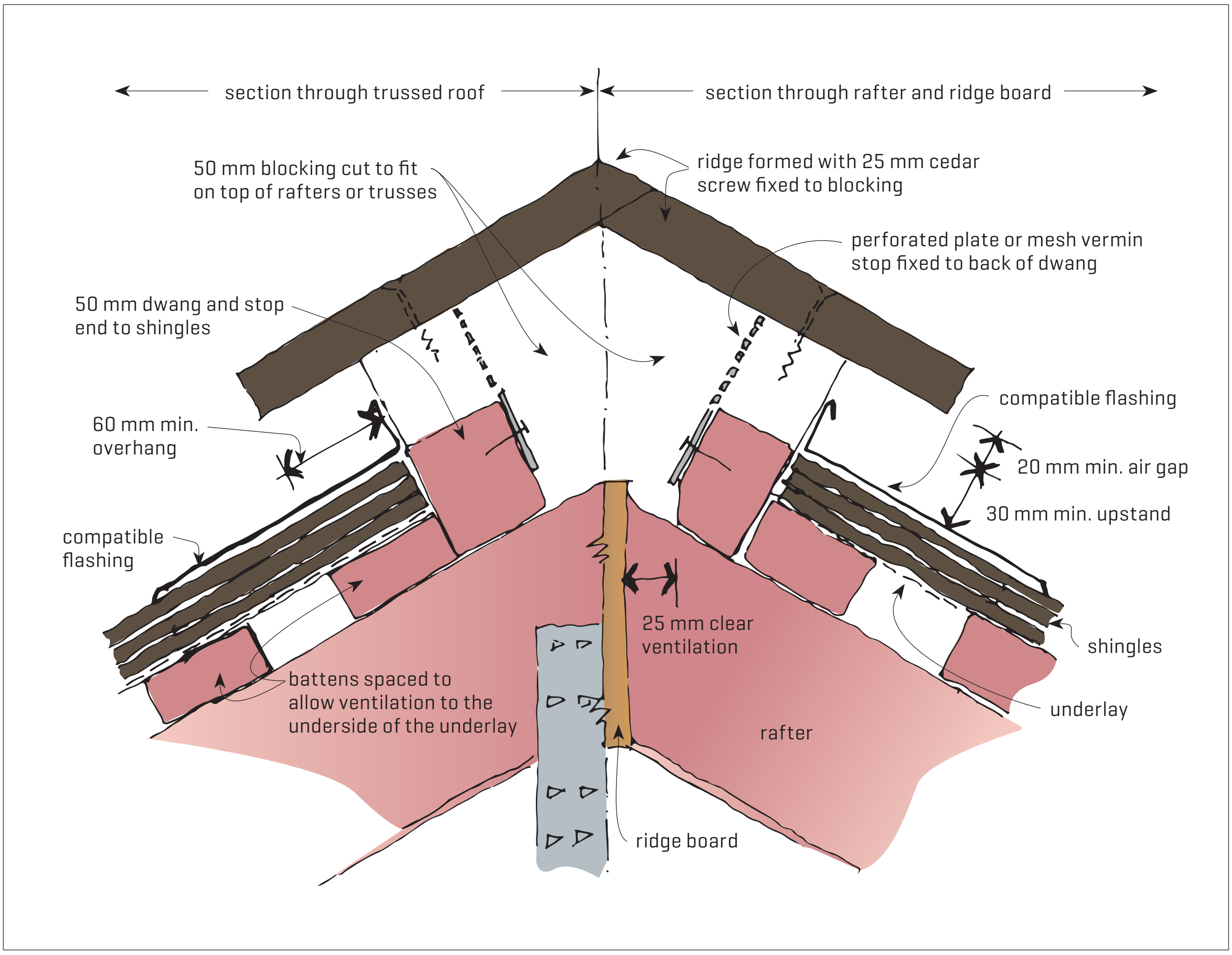

Figure 2. Ventilated ridge detail.

5.2 UNDERLAYS

5.2.1 Absorbent roof underlays are required under all timber shingle and shake roofs.

5.2.2 AS/NZS 4200.2:1994 *Pliable building membranes and underlays – Part 2: Installation requirements* states that underlay should be laid horizontally. Start from the bottom, with the bottom edge turned down into the gutter at the eaves, running at least 25 mm beyond the fascia. Upper layers should overlap lower layers by a minimum 150 mm. The standard requires underlay to extend over the top of the ridge. Check with the shingle/shake supplier whether additional roof cavity ventilation such as ridge vents is required – refer to BRANZ Bulletin 630 *Roof space ventilation* for further information.

5.2.3 Shingle and shake suppliers provide different instructions and recommendations around what roof underlay should be used with their products and how it should be installed. Some recommend a continuous layer of underlay while others say that each shingle/shake should be interleaved with underlay (particularly on roof pitches 18–30°). In some cases, interleaving is recommended for particular types of product – for example, shakes rather than shingles. Some instructions refer to underlays not commonly used in New Zealand. BRANZ recommends discussing interlay details with the shingle/shake supplier, underlay supplier and building consent authority to ensure that what is installed and how it is installed will meet the warranty requirements of the suppliers and comply with Building Code requirements.

5.2.4 Some New Zealand shingle and shake suppliers provide Canadian/American installation instructions that include the use of felt underlay. Where a locally available kraft-based bitumen impregnated underlay (but not felt) is specified, it should meet or exceed the physical specifications of the felt underlay. The shingle/shake suppliers and the New Zealand underlay suppliers can provide guidance.

5.3 EXPOSURE DIMENSION

5.3.1 The terms 'exposure' or 'exposure dimension' refer to the part of each shingle or shake that remains exposed to the weather. Typically this is a maximum of one-third of the shingle/shake length.

5.3.2 The Cedar Shake and Shingle Bureau (CSSB) in Canada/USA recommends a maximum exposure length of 140 mm for top-grade 457 mm shingles on roofs with a pitch above 18°. The maximum exposure length is 127 mm for 406 mm shingles and 190 mm for 610 mm shingles. The maximum recommended exposure length reduces as the grade of product reduces.

5.3.3 For shakes, CSSB recommends a maximum exposure of 190 mm for 457 mm shakes and 254 mm for 610 mm shakes.

5.3.4 One supplier of radiata pine shingles in New Zealand recommends maximum exposure of 125 mm for 405 mm shingles where the roof pitch is 18–45° and 135 mm for a pitch of 45–60°.

5.4 RIDGES AND HIPS

5.4.1 Ridges and hips (Figures 3 and 4) can be formed from shingles or shakes. Early in the installation process, the roofer should set aside enough that are 150 mm wide. Other ridging materials (such as tiles or metal) or a prefabricated cedar taper-sawn ridge cap may also be used. A flashing of butyl rubber or other suitable material must be installed first. With hips, butyl flashing should be interleaved between each course and not laid as a continuous flashing over the top of the shingles.

5.4.2 The edge of each shingle/shake is cut on a bevel and installed by interlacing and overlapping them with alternate overlaps and concealed nailing with stainless steel nails. The exposure dimension should be 75–125 mm for shingles and 100–200 mm for shakes. Ideally, the butt end will face away from the prevailing weather.

5.4.3 Ridges may include vents that allow air movement under the roofing to reduce the risk of condensation and moisture damage (see 5.0.5). Proprietary ventilation products are available.

5.5 VALLEYS

5.5.1 A traditional open design of valley will make cleaning and maintenance easier, extending the serviceable life of the roof.

5.5.2 Valleys may be formed in two ways:

- The traditional manner of spacing the valley shingles/shakes apart and using corrosion-protected metal or butyl rubber valley lining under flashings. The valley should reach a minimum of 200 mm either side of the centre.
- Close cutting the shingles at the valley and interlaying butyl rubber between each course as the roof is laid. When forming valleys like this, it is important that a recognised wood preservative is applied to cut edges of shingles and shakes.

5.5.3 The valley opening between the edges of the shingles on either side should be a minimum 125 mm clear.

5.6 VERGES AND GABLES

5.6.1 Gable ends should be terminated with at least 300 mm wide eaves (Figure 5). The shingle/shakes project 40 mm over the barge board with a sealed foam interlayer.

5.6.2 Alternatively, for particularly exposed sites, butyl soakers can be interlaced in the shingle/shakes, turned over the barge board and finished with a barge cover flashing (Figure 6).

6 INSTALLATION

6.0.1 Once delivered to site, shingles and shakes should be stored under cover (or well covered with waterproof materials) and kept clear of the ground until installation begins. Minimise handling to reduce the risk of damage.

6.1 HEALTH AND SAFETY

6.1.1 The chemicals that are used to preserve timber

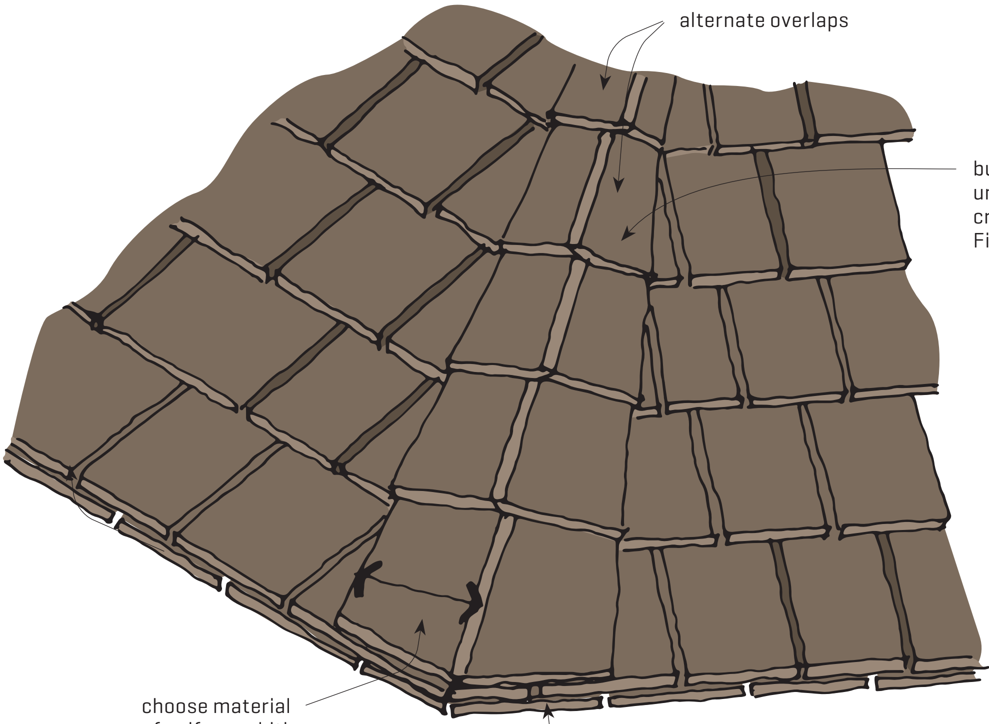

Figure 3. Hips and ridges.

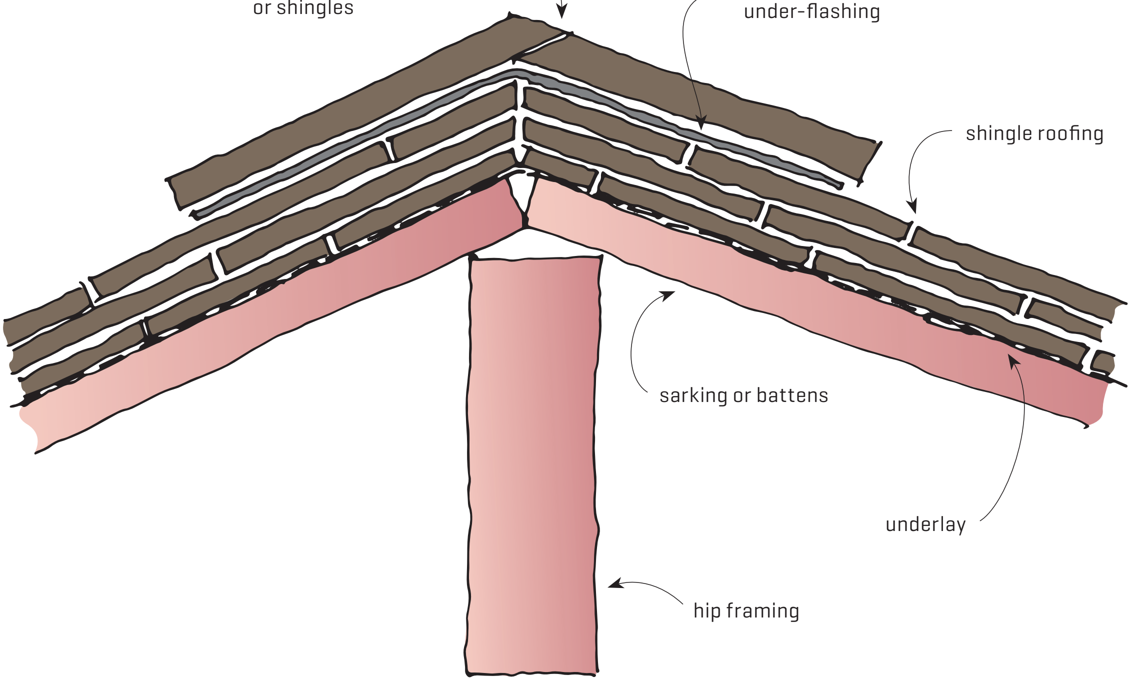

Figure 4. Cross-section through hip.

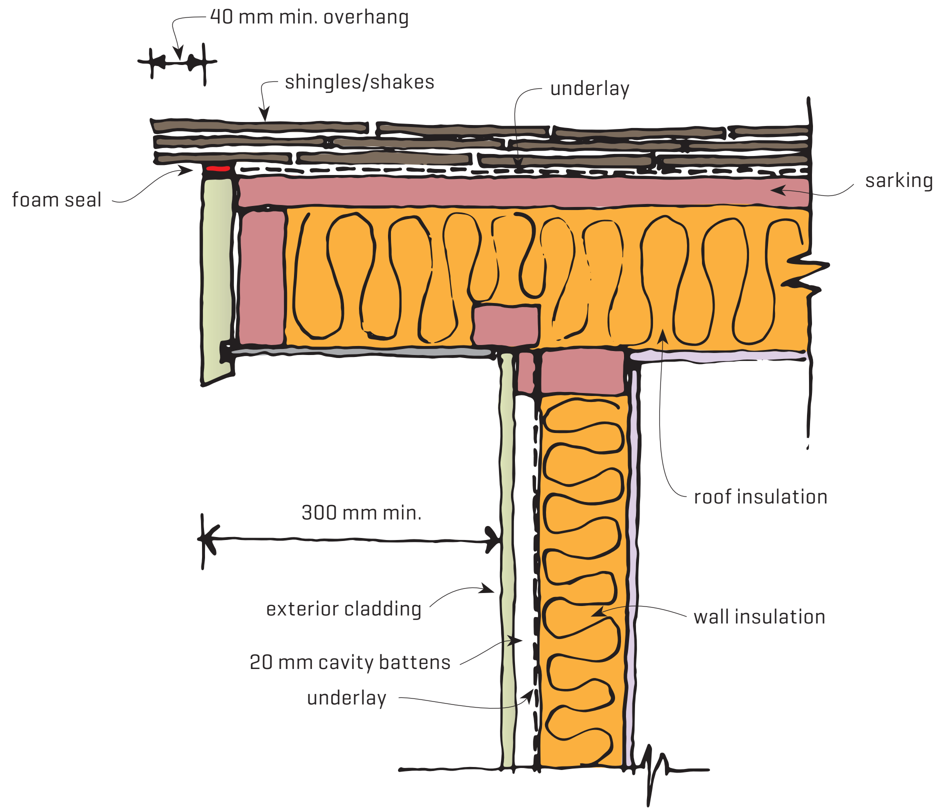

Figure 5. Shingles/shakes at gable ends.

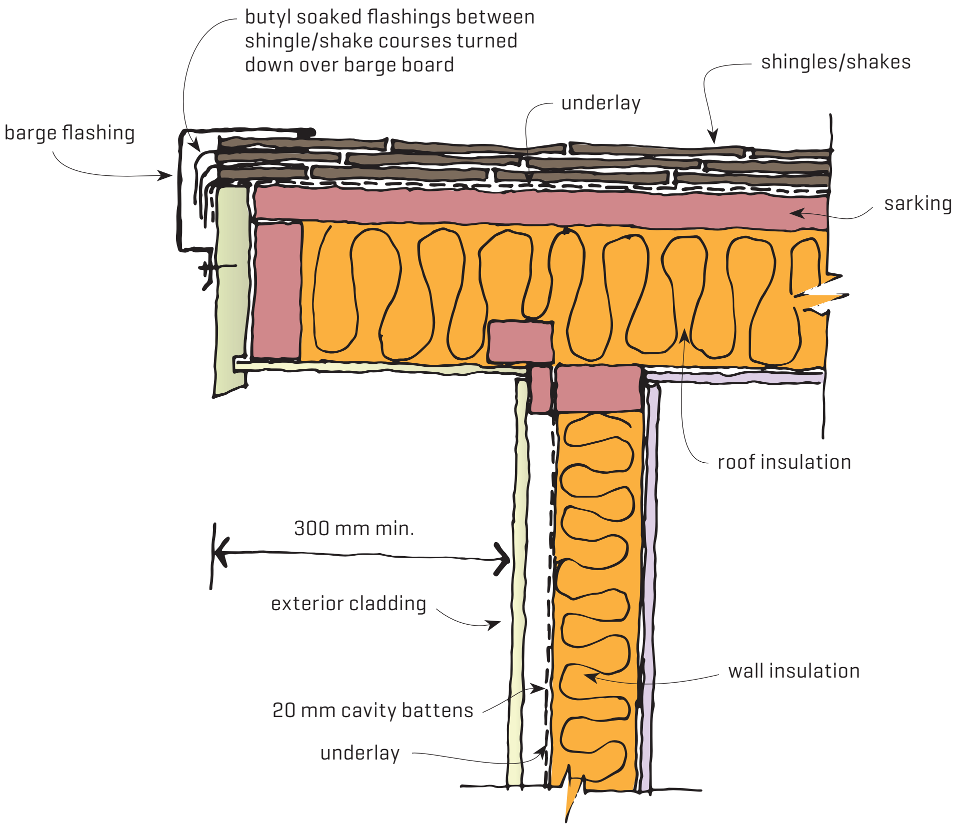

Figure 6. Shingles/shakes at gable ends for exposed sites.

can be harmful to health. When sawing/machining treated timber, wear gloves, a mask and eye protection.

6.1.2 Obtain safety data sheets from the producer or supplier of the product to determine the requirements around storing, working with and disposing of treated timber products.

6.1.3 Take care when working at height. You can find more information at www.level.org.nz/health-and-safety/working-at-height and www.worksafe.govt.nz/topic-and-industry/working-at-height.

6.2 GENERAL LAYING PROCEDURE

6.2.1 Shingles and shakes are installed by overlapping successive units, starting at the eaves and working up the roof to the ridge. There is generally a minimum of three layers of units at any point on the roof slope (Figures 7, 8 and 9).

6.2.2 The first courses (double or triple layered) should overhang the fascia board by a minimum of 40 mm to ensure rainwater drains to the guttering.

6.2.3 Shingles should be installed approximately 6–10 mm apart and shakes approximately 10 mm (but no more than 16 mm) apart. Insufficient space may result in units buckling when they swell.

6.2.4 Make sure that the gaps between the shingles/shakes in one course do not align with those of the next course – there should be a minimum offset of approximately 40 mm.

6.2.5 About half-way between eaves and ridge, measure the distance from the butt edge of the last course to the ridge. Fine-tune the exposure dimension on the next courses so that the last course (at the ridge) will have the same exposure dimension as lower courses.

6.2.6 To determine the overall length of the last course, add the exposure dimension to the cover of the ridge. For example, if preceding courses have a 125 mm exposure dimension and the ridge unit has 75 mm cover, the last course should be 200 mm long.

6.2.7 When setting out the roof, save wider units for use in hip or valley sections of the roof. Any pieces less than 150 mm wide should not be used because of the difficulty in achieving adequate fixing.

6.3 FIXINGS

6.3.1 Follow the fixing requirements set out by the manufacturer/supplier of the shingles or shakes.

6.3.2 Manufacturers generally recommend using silicon bronze or stainless steel nails or stainless steel staples.

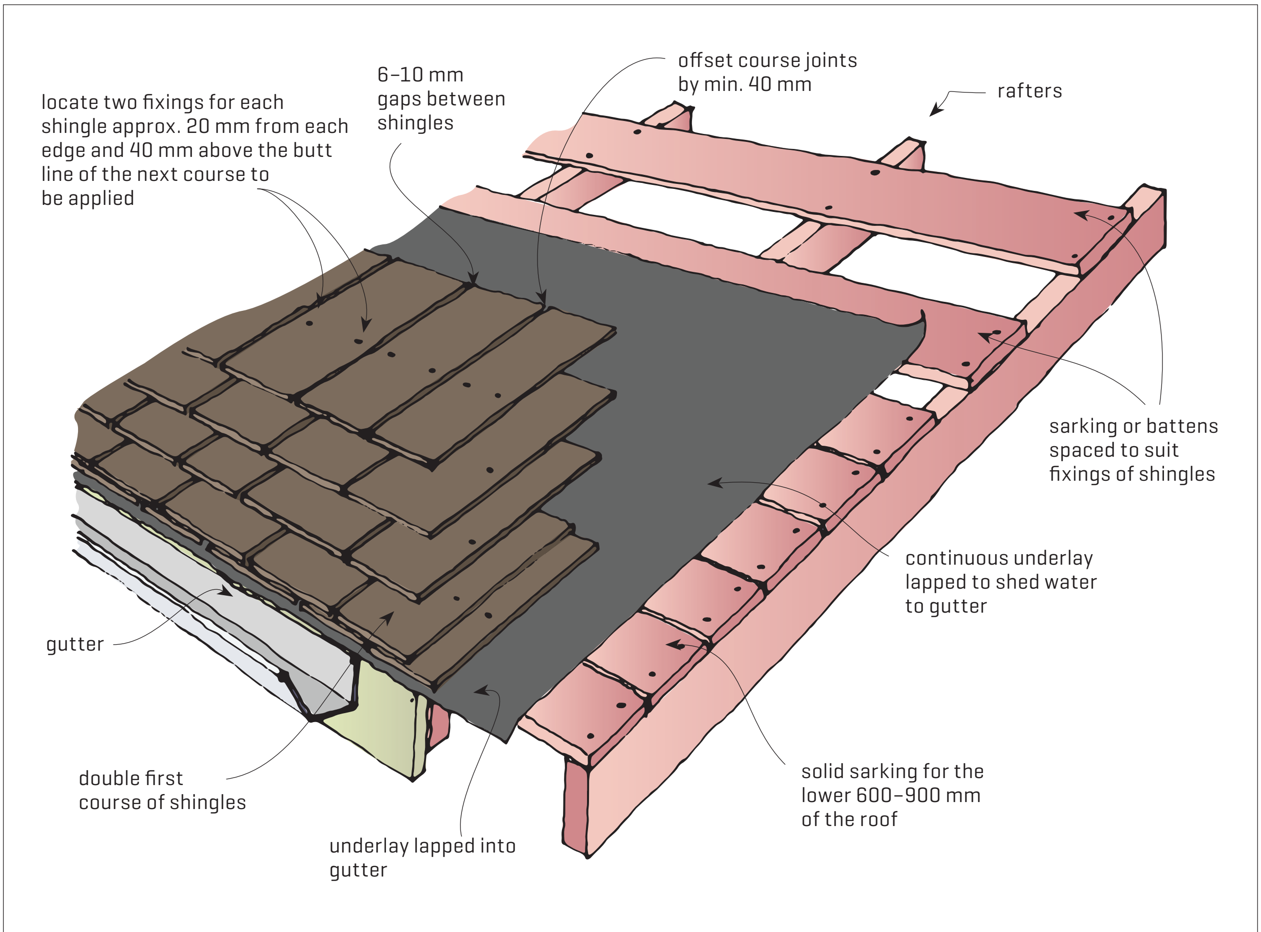

Figure 7. Shingle application.

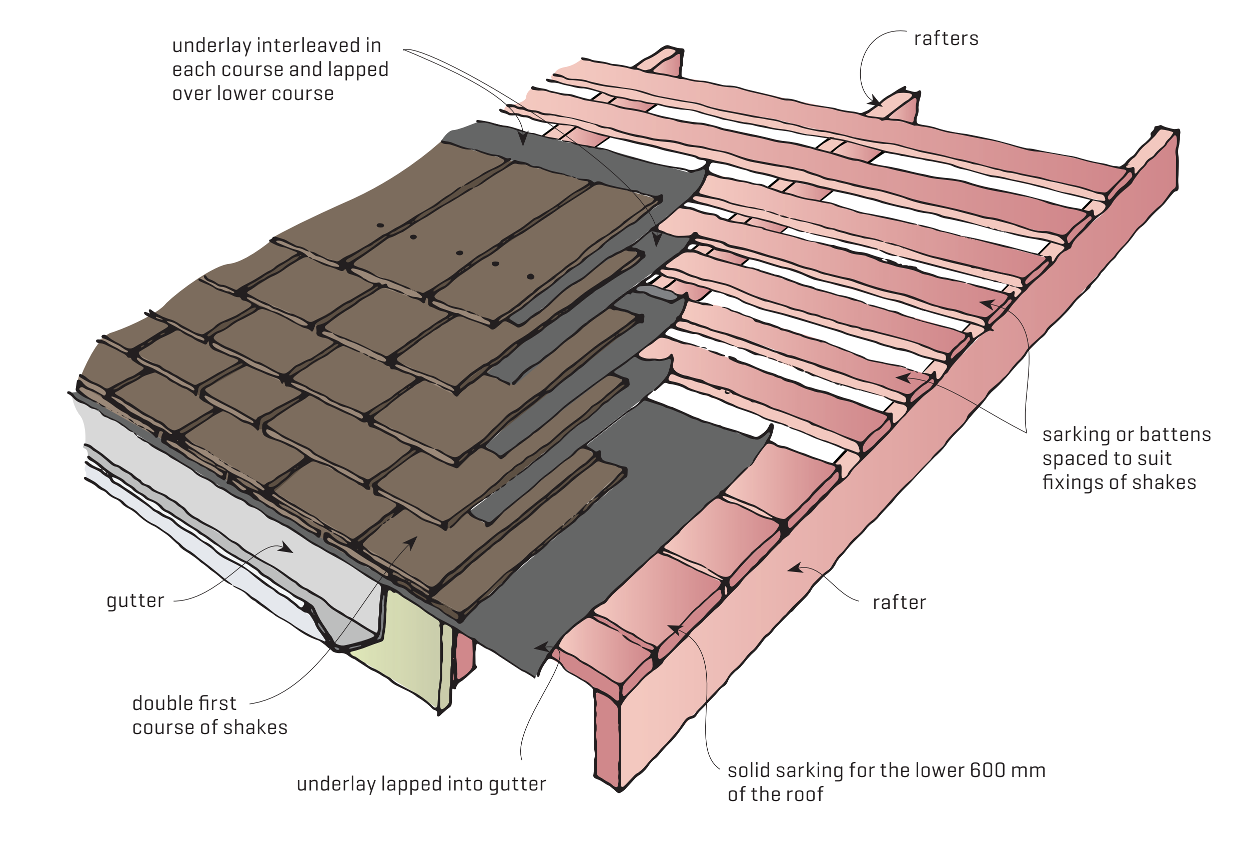

Figure 8. Shake application.

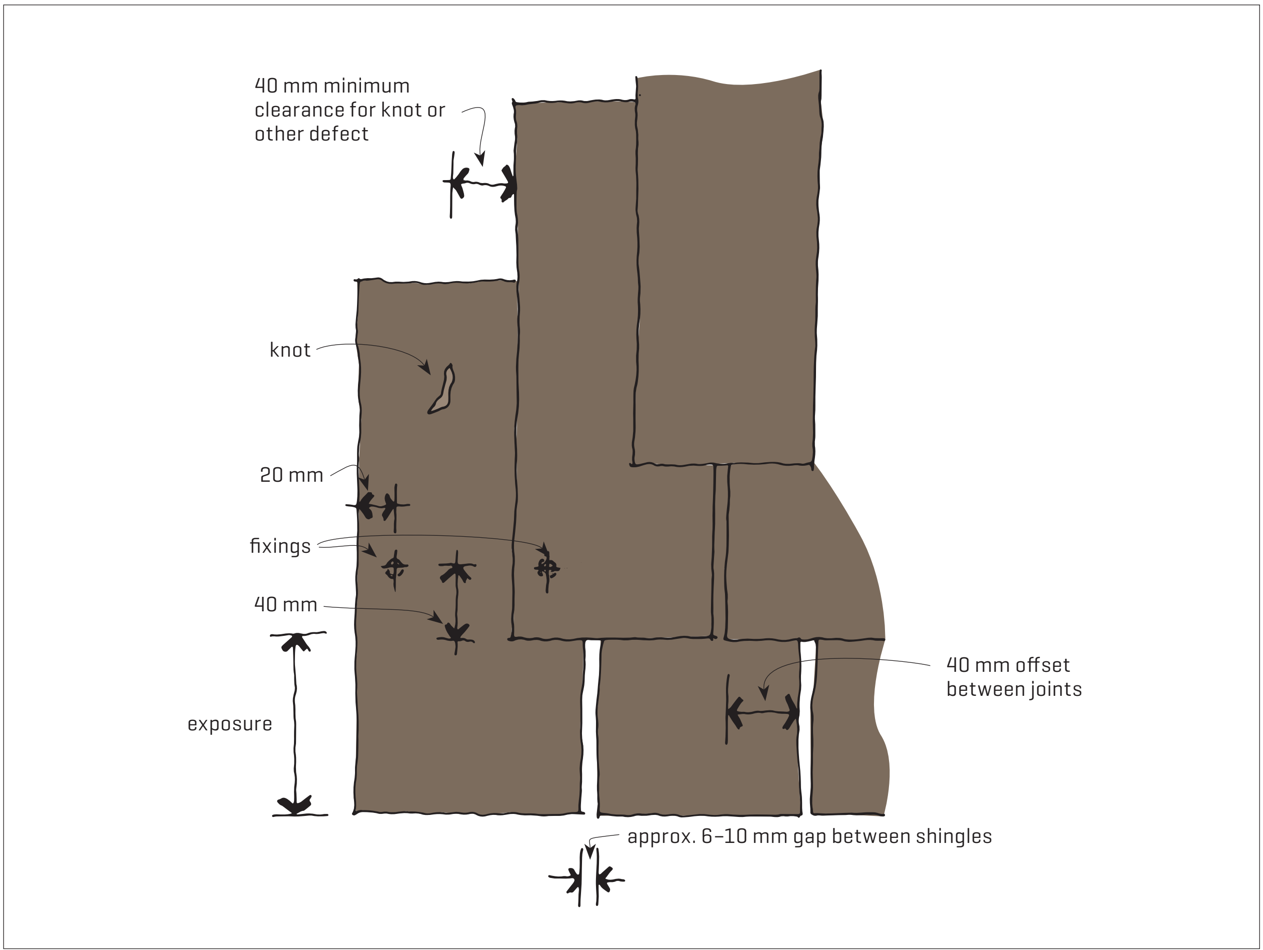

Figure 9. Set-out and fixings.

In coastal or geothermal locations, stainless steel fixings should be 316 grade. Some manufacturers also require 316 grade stainless steel fixings on their treated products. (Many shingle roofs in New Zealand are fixed using a 316 grade stainless steel staple with 32 mm or 36 mm staple length and a 10 mm crown.)

6.3.3 E2/AS1 says for wall claddings (Table 24) that, where the cladding is a corrosive timber such as western red cedar or is treated with copper based ACQ or CuAz preservatives, use stainless steel fixings. (Western red cedar shingles are available either untreated or treated with CCA.) NZS 3604:2011 recommends in Note 4 of Table 4.3 the use of stainless steel or silicon bronze fasteners with western red cedar claddings. It is reasonable to assume from this that there is a preference in the Building Code and standards for stainless steel or silicon bronze fasteners to be used with western red cedar.

6.3.4 Western red cedar should never be fixed with mild steel, brass or copper fixings.

6.3.5 Where nails are used, they should be flathead with annular grooves for good holding. A diameter of 2 mm or 2.8 mm is appropriate – thicker may cause splitting. Nails should be long enough for the nails to penetrate at least 19 mm into the substrate – 30 or 50 mm nail length is sufficient for most shingles and 50 or 65 mm for shakes.

6.3.6 Fix each shingle/shake with two fixings. Drive fixings square to the surface of the roofing without crushing or cutting into the timber. Overdriving or underdriving nails can damage the roof and affect durability and lifespan.

6.3.7 Locate the fixings so that each successive course covers the fixings of the preceding course. Place nails approximately 19–25 mm from the side edge of the shingle/shake and approximately 40–50 mm above the bottom edge of the top shingle/shake (the butt line).

6.4 FLASHINGS

6.4.1 The material used for flashings on cedar shingle/shake roofs must be compatible with that species of timber.

6.4.2 The acids contained in cedar and copper in CCA and ACQ-type preservative treatments will attack many metals. Lead and copper will not be affected, but galvanised steel and aluminium should be post-form coated – for example, with epoxy or a bituminous paint (where it is not exposed to sunlight). In some cases, suitable prefinished flashings may be available.

6.4.3 When installing flashings on shingle/shake roofs (Figure 10), ensure that:
- those following the slope of the roof are stepped flashings, interleaved with each shingle/shake course.
- flashings installed across the roof slope are conventional apron types (similar to those used for most roofing types)
- butyl rubber flashings are not bonded to the shingle or shake but are held in place for satisfactory weatherproofing.

7 COATINGS AND FINISHES

7.0.1 The natural durability of western red cedar and the treatment of radiata pine means that coating the finished roof is not essential. Both cedar and radiata pine will age to a silver-grey when left to weather. Colour differences may occur across a roof due to its differing exposures. The growth of mould or mildew (also affected by different exposures) may also affect the colouring.

7.0.2 A range of possible coatings is available, however. Some shingle/shake manufacturers recommend that, if a coating is selected, it is applied to all surfaces before installation. Coatings, whether stain or oil, typically require reapplication every 2–5 years.

7.0.3 Check the suitability of specific types of coating with both shingle/shake and coating manufacturers. The tannins in newly installed cedar mean that standard exterior waterborne primers and paints are usually not suitable. Coatings that form a film on the surface (especially clear finishes) typically degrade quickly under ultraviolet light and flake off. Any coating that traps moisture in the wood will shorten its service life.

7.0.4 Penetrating wood oils are available for exterior timbers including western red cedar. The oils are applied for their water-repellent and anti-fungal properties. By reducing the speed of water absorption, they enhance the stability of the timber, helping reduce the potential risk of warping, cupping and twisting. The oils are available in different colours as well as clear. In each case, the timber grain is still visible. The clear option provides no protection from ultraviolet light, so the timber will weather to a silver-grey colour. The manufacturers usually recommend a second application around 12–24 months after the first application. After this, these oils need to be regularly recoated as appearance or reduced water-repelling ability indicates.

7.0.5 Where the homeowner intends to collect rainwater from the roof, before specifying or applying a coating, check with the coating manufacturer whether this will be possible. Some manufacturers say that water should not be collected from roofs treated with their product, while others recommend waiting for 50 mm of rainfall or 2 weeks to pass before collecting water.

8 MAINTENANCE

8.0.1 Maintenance is crucial for satisfactory performance of shingle/shake roofs.

8.0.2 The householder should trim back overhanging tree branches to reduce the debris that falls on the roof and to allow the roof to dry properly.

8.0.3 Debris and moss should be removed from the roof surface and the spaces between shingles and shakes by sweeping with a stiff non-metallic bristle broom or brush. Accumulated debris retains moisture and supports the growth of lichens and mildew, which can accelerate decay.

8.0.4 Dirt can also be removed with low-pressure washing, with the water stream directed down the roof.

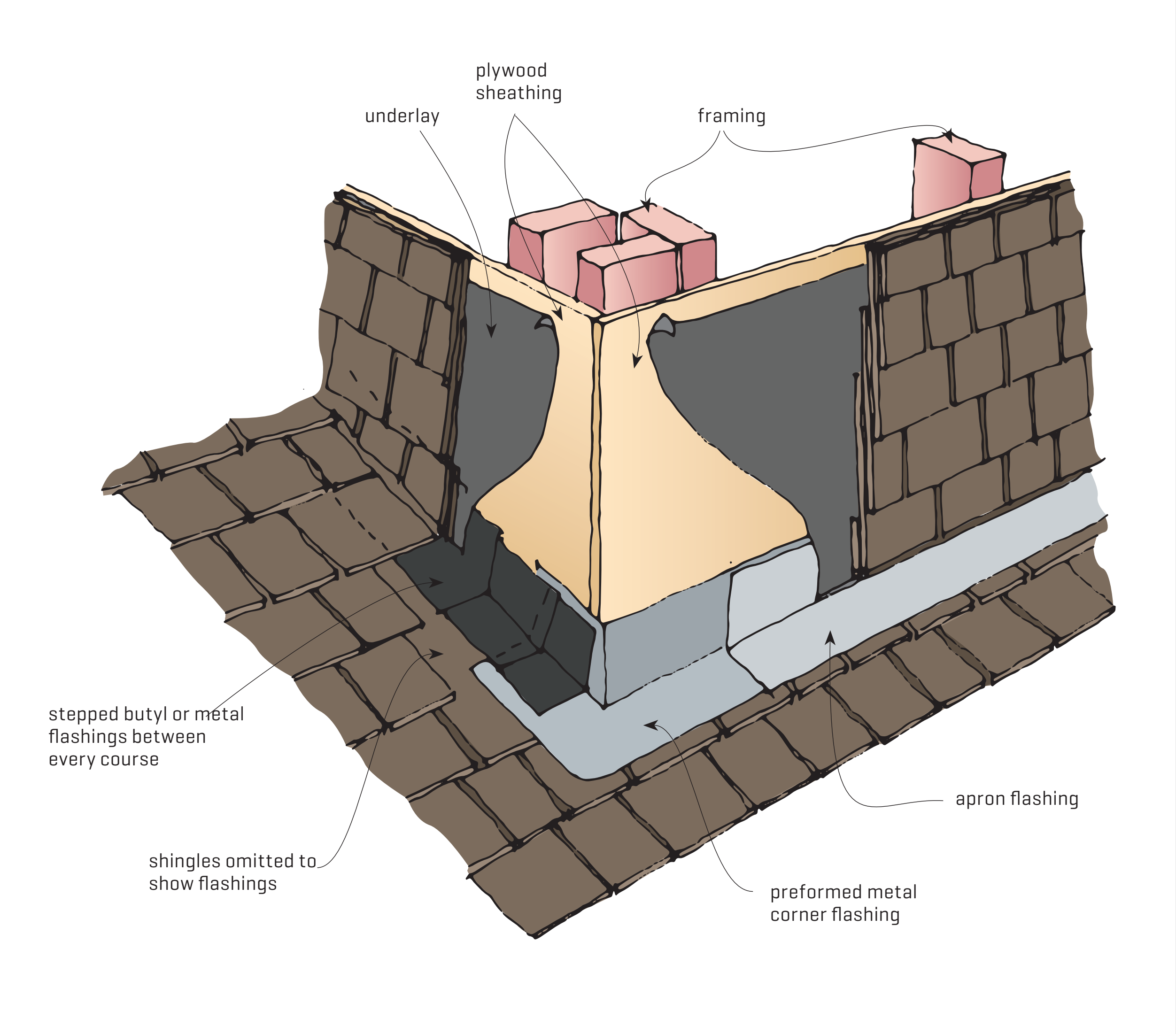

Figure 10. Flashings on roof penetration/dormer.

8.0.5 Never use high-pressure waterblasting or wire-bristled brushes or brooms. High-pressure waterblasting can damage the timber surface and drive moisture into the roof space. Steel bristles that fall out of wire brushes can react with chemicals in western red cedar and stain the wood.

8.0.6 Ensure the roof gutters are kept clear so rainwater drains effectively and the shingles/shakes can dry.

8.0.7 An oxygen bleach solution can be used to kill surface mould, but start with a relatively weak-strength solution and apply with a sponge, soft brush or spray. Strong cleaners can damage the surface of the timber.

8.0.8 Copper salts can suppress moss growth. CCA and ACQ-type treated roofs – especially those that are relatively new and leaching copper-bearing salts – can suppress moss formation. On older roofs, a copper or zinc strip fixed at the top of the roof will promote rainwater and metal salt run-off across the roof to suppress moss and mould growth.

8.0.9 Older shakes and shingle roofs can become brittle and can be damaged when someone carelessly walks on the roof. Care is needed with maintenance. Hiring an experienced contractor with the appropriate equipment to avoid damage may be a good solution.

9.0 MORE INFORMATION

New Roof Construction Manual, Cedar Shake and Shingle Bureau http://www.cedarbureau.org/cms-assets/documents/roof-manual-full-09-2014.pdf

Installation, Care, and Maintenance of Wood Shake and Shingle Roofs, Forest Products Laboratory, Forest Service, United States Department of Agriculture https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr201.pdf

Roof space ventilation, BRANZ Bulletin BU630.

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