BULLETIN

BRANZ
THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

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ASPHALT SHINGLE ROOFING

❑ Asphalt shingle roofs provide a relatively low maintenance, corrosion-resistant roofing system. There are a number of specification and installation steps to follow to achieve maximum serviceability from these roofs. This bulletin outlines the design and installation criteria for achieving a successful asphalt shingle roof.

This bulletin replaces Bulletin 289 of the same name.

1.0 COMPOSITION

1.0.1 Asphalt shingles currently marketed in New Zealand are generally imported from the United States and are made from glass fibre mat or mesh and asphalt. The glass fibre gives strength and structure to the shingle. Asphalt used can be a standard grade or, in some cases, a polymer-modified grade to improve overall performance.

1.0.2 Older style organic (cellulose, rag, cotton or wood) fibre-reinforced shingles are still manufactured in Canada but are not usually marketed in New Zealand. (They may still be in use on a number of New Zealand houses.)

1.0.3 The finish on the upper or exposed face is a coating of stone or ceramic granules plus a factory-applied, heat activated, self-adhesive fixing strip. The underside has a fine sand coating. In some cases the surface finish and the adhesive incorporates zinc and/or copper particles to minimise the growth of algae and mosses.

1.0.4 Shingles are available as:

- single-thickness strips in a range of weights. The shingles most commonly used have pre-cut tabs in either a regular or an offset pattern, with the number (3 to 5) and shape of tabs dependent on the manufacturer and shingle style. Shingles without formed tabs are also available
- laminated (multi-thickness) strips, where the finished shingle consists of two or more layers of material bonded together to improve the rigidity and durability and offer a different appearance
- strips with an interlocking tab, designed to provide improved immediate resistance to wind uplift.

2.0 DESIGN AND SELECTION CRITERIA

2.1 Roof Pitch

2.1.1 Asphalt shingles can be laid to pitches as low as 10^0, but the minimum pitch recommended by the suppliers varies between 15 and 18^0.

2.1.2 Roofs with pitches of between 10 and 18^0 require special installation practices (supplied by the manufacturer) to reduce the risk of poor roof performance.

2.2 Roof Weight

2.2.1 The unit weight (kg/m^2) of the shingles is approximately:

- 9 - 12 for single layer shingles
- 10 - 18 for double layer laminated shingles
- 20 - 22 for triple layer laminated shingles.

2.2.2 In terms of NZS 3604 an asphalt shingle roof can be considered a light roof when the weight of the shingles and the timber sarking or plywood sheathing is less than 20 kg/m^2. Roofs over 20 kg/m^2 are classified as heavy roofs. For BRANZ -appraised asphalt shingles the Appraisal Certificate allows a roof with a mass of 20 to 22 kg/m^2 to be considered as a light roof provided a number of modifications, as outlined in the certificate, are made to the framing and bracing. Note that these are engineered solutions for specific products and must not be used for non-appraised products.

2.3 Wind Exposure

2.3.1 For sites classified as high wind zones the number of mechanical fixings must be increased by 50%. Site-applied adhesive must also be placed under the toe of each shingle tab.

2.3.2 Asphalt shingles are not usually suitable for use where the site is classified as a very high wind zone, but shingles suitable for cyclonic areas have recently been developed by some manufacturers. Always check with the supplier as to the suitability of the shingle for use in wind zones above high.

2.3.3 There is always a risk of wind lifting shingle tabs in the days immediately after installation until the self-adhesive strip has been sufficiently heated to achieve full bond strength. Adding site-applied adhesive, to the supplier's instructions, may avoid wind-lift problems until the full bond is achieved.

2.4 Size and Coverage

2.4.1 Individual asphalt shingles are strips approximately 900 to 1000 mm long and 300 to 350 mm wide, notched to give the appearance of individual shingle tabs. The number of tabs per unit, their shape and their size, depends on the manufacturer.

2.4.2 They are supplied in packs, each of which will cover 3 to 3.2 m^2 of roof.

2.5 Durability and Serviceability

2.5.1 Under New Zealand climatic conditions fibreglass-based asphalt shingles can be expected to remain serviceable for at least 15 years.

2.5.2 Product warranties of up to 30 years are available, the actual warranty

period depending on the grade of shingle and the supplier.

2.5.3 Factors that may affect the performance of asphalt shingles are:
- insufficient roof cavity ventilation
- the self-adhesive strip on fibreglass-based shingles not properly adhering
- poor quality workmanship during installation
- loss of the chip coating due to scuffing from excessive or careless walking on the roof surface or from ageing
- fungal and algal attack causing discolouration of shingles, particularly those installed in warm moist climates
- surface cracking, particularly in older organic-fibre shingles — a number of suppliers don't recommend using organic-fibre shingles in New Zealand
- thermal splitting or tearing where the shingle is subjected to large temperature swings.

2.5.4 Ridging or deformation of the asphalt shingles can occur when:
- the substructure is installed wet and subsequently shrinks as it dries
- the substructure is not rigid
- diagonal timber board sarking is used (diagonal movement makes the shingle deformation more noticeable)
- incorrect fixings are used or fixings are not properly installed
- movement in the underlay occurs
- the roof space has a high level of moisture due to insufficient ventilation.

2.6 Colour

2.6.1 A wide range of shingle colours is available, with the range varying according to the manufacturer. Some brighter colours may need to be specially ordered.

2.6.2 The colour of the shingle can directly influence its durability. White or lighter-coloured shingles will usually last better than darker-coloured ones because they absorb less heat. There are difficulties in producing a white shingle due to the potential for asphalt to bleed between the granules as they are pressed into the asphalt during manufacture. Generally 'white' shingles are surfaced with grey granules or a blend of white granules with other colours such as light blues, greens or browns.

2.6.3 Lichen or moss growth and damage to the shingle will be more obvious when a lighter colour is used.

2.7 Climate

2.7.1 The durability of shingles is influenced by the climate of the area they are used in. Lower average daily temperatures will increase the life of a shingle roof.

2.7.2 In areas where there is significant snowfall, protection against the possible ponding of water behind the eaves line (due to the forming of ice dams) must be provided.

2.7.3 Additional adhesive, as for high wind installations, is usually required when installing the roofs in winter or in colder areas of the country.

2.8 Exposure and Weatherproofing

2.8.1 Shingles provide a waterproof roof by overlapping successive units from the eaves upwards. There must be a minimum two layers of shingle at any point on the roof slope to provide adequate weather protection.

2.8.2 The portion of the shingle exposed to the weather is described as the exposure. This amount varies between manufacturers and with the slope of the roof but falls within the range of 120 to 150 mm.

2.9 Roof Space/Cavity Ventilation

2.9.1 The combination of asphalt shingles and roofing underlay acts as a significant barrier to water vapour movement. Experience in the United States has shown that high levels of roof space moisture, generally as a result of insufficient roof cavity ventilation, significantly increase the risk of shingle ridging.

2.9.2 To avoid condensation or possible shingle buckling problems, the roof space MUST be adequately ventilated to remove excessive moisture.

2.9.3 American design and installation manuals for asphalt shingles recommend a minimum nett free ventilation area of 0.1 m^2 for every 14 m^2 of ceiling space.

2.9.4 Maximum ventilation is achieved when eave-to-ridge through-ventilation is provided.

2.9.5 For skillion roofs ensure there is adequate ventilation space (25 mm minimum) between the top of the insulation and the underside of the timber sarking or plywood sheathing.

2.9.6 Reduce the possibility of moisture accumulation in the roof space by specifying:
- dry framing, sarking and sheathing materials
- perforated soffit linings
- ridge and soffit vents
- an effective air barrier behind the ceiling lining or painting the ceiling with an oil-based paint
- gable end vents.

2.10 Underlay

2.10.1 All asphalt shingle roofing systems require the installation of a roofing underlay (Figure 1). The underlay used varies between suppliers but is generally described as a roofing felt (classified by weight) or asphalt-saturated felt. In most instances the shingle supplier will also supply the underlay. Underlays must be a breather type specifically manufactured for use under asphalt shingle roofing.

2.10.2 Ordinary building paper, synthetic building paper and materials that form a vapour barrier are not suitable.

2.10.3 Additional layers of underlay are required on low slope asphalt shingle roofs to provide sufficient defence against water entry between the shingles (Figure 2).

3.0 INSTALLATION METHOD

3.0.1 The following is a general guide for laying asphalt shingles. When selecting and/or laying a specific make of shingles follow their particular installation requirements. Failure to do so may negate any guarantees the manufacturer or supplier may offer.

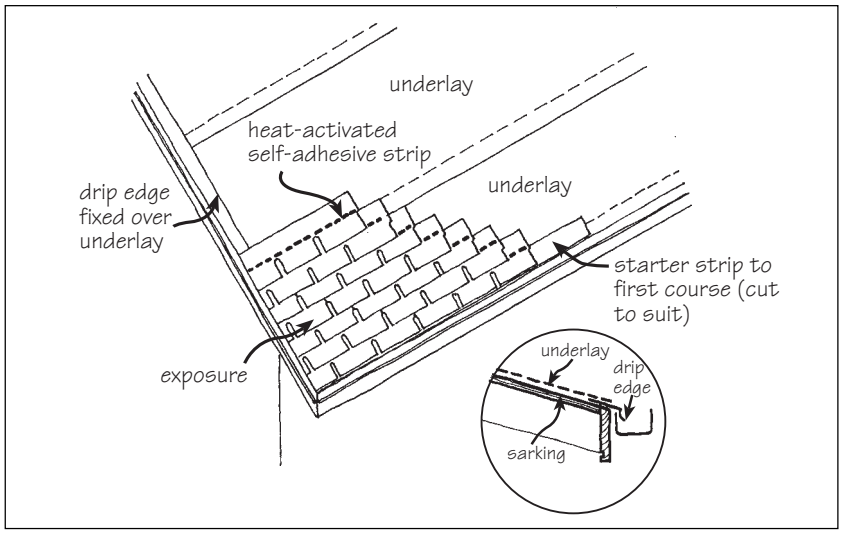

Figure 1: Standard underlay and shingle layout showing offsets.

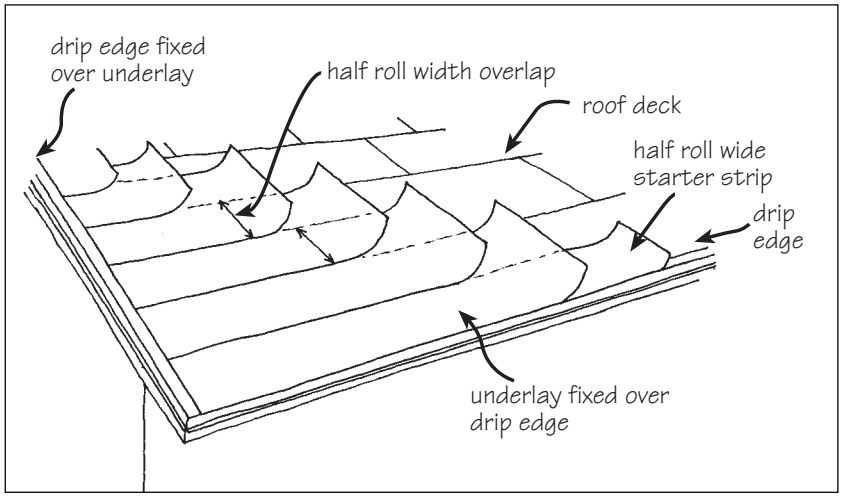

Figure 2. Underlay to low pitched roof.

3.1 Storage

3.1.1 Store shingles before use on a flat, dry area, stacked clear of the ground and protected from sun, heat and the risk of damage, particularly puncture damage.

3.1.2 Store bundles of shingles in stacks less than 1200 mm high, to prevent the self-adhesive strips bonding the shingles together.

3.1.3 When laying the roof:

- do not store shingles on the roof by laying them across the ridge because the shingle can heat up, take a set from being bent, and not lie properly when laid
- store only enough shingles for the immediate work period on the roof. The sun's heat can activate the adhesive strips on the shingles and bond them together if left exposed too long.

3.2 Substructure

3.2.1 Always lay asphalt shingles over a dry (18% maximum moisture content), fully sarked timber boarding or plywood sheathed roof structure.

3.2.2 Plywood sheathing should be at least D-D grade, 12 mm thick. Rafter spacing for 12 mm plywood should not exceed 400 mm. Wider rafter spacings require the use of thicker plywood. Lay sheets lengthways across the rafters with the perimeter fully supported and joints staggered. Fix sheets with 60 x 2.8 mm hot-dipped flat head galvanised nails at 150 mm centres around the perimeter and at intermediate supports, or as required by the manufacturer. The use of 15 mm T&G plywood eliminates the need for dwanging along the long edge.

3.2.3 Leave a 2-3 mm gap for expansion and contraction between sheets as they are laid.

3.2.4 Timber sarking should be well seasoned, stable, gauged 150 x 25 mm, with end joints staggered and side joints close butted.

3.2.5 Do not use diagonal sarking because movement in diagonal sarking deforms the shingle more than movement in straight sarking.

3.2.6 Defects, or movement in the substructure, will show as ridging in the finished shingles.

3.3 Drip Edges

3.3.1 Drip edges, installed along the

eaves and gable or barge ends of the roof, are supplied prefabricated from PVC, galvanised steel, copper, stainless steel or aluminium — the choice depending on the corrosion environment.

3.3.2 Fix the eaves drip edge before laying the shingles. Project the drip edge 12 mm out from the line of the fascia board to allow water to enter the spouting. The underlay must be lapped over the drip edge so that any moisture caught by the underlay is not trapped by the drip edge as it drains down the roof slope.

3.3.3 At gable ends place the underlay before installing the drip edge. Fixing the drip edge over the underlay prevents moisture getting behind the underlay. An alternative gable end detail uses an angle fillet with a factory-coated galvanised steel purpose-bent flashing, as shown in Figure 3.

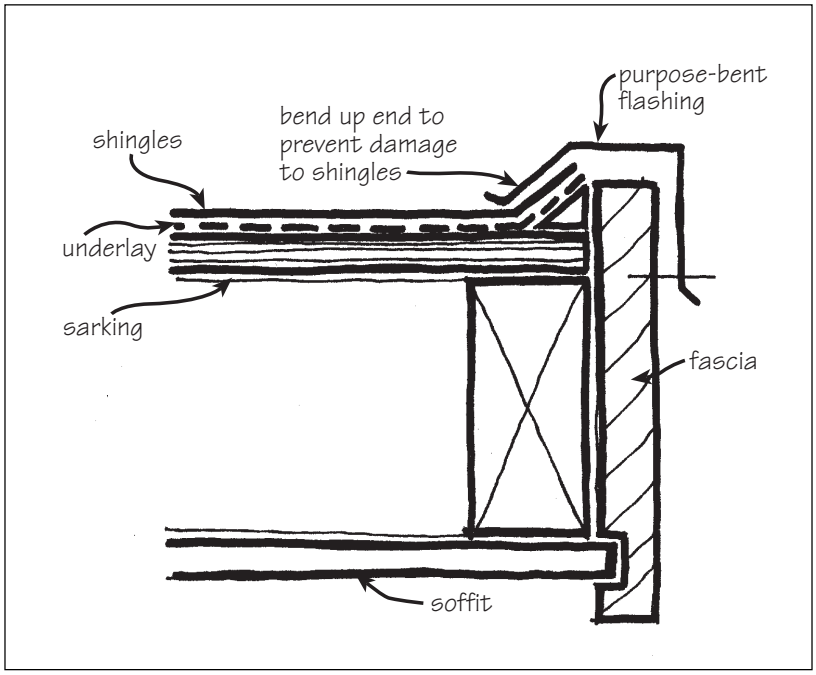

Figure 3. Alternative gable detail.

3.4 Underlay

3.4.1 The sarking/sheathing must be dry (18% maximum moisture content) before the underlay is laid.

3.4.2 Underlays must be laid across the roof slope. Horizontally lap underlay 50 mm minimum for roof pitches over 18^0 and by half a roll width to provide double coursing (refer Figure 2) for pitches between 10 and 18^0. End laps should be at least 100 mm (refer Figure 1).

3.4.3 Shingle suppliers generally import the underlay for asphalt shingles with the shingles.

3.4.4 Obtain specific installation advice from the supplier when installing asphalt shingles in areas subject to snow loadings.

3.5 Laying Procedure

3.5.1 Check that the sarking/sheathing and underlay is dry before laying the shingles.

3.5.2 The initial course consists of a starter sheet or short-cut units with the first course of shingles laid directly over the starter sheet. The first courses should be cut flush with the projecting drip edge.

3.5.3 Lay shingles across and up the roof slope to the ridge, offsetting the shingle notches in adjacent rows (refer Figure 1). Mix shingles from different bundles to minimise patterning and colour shading problems.

3.5.4 Strike chalk lines at every fourth or fifth course to maintain alignment. This also allows discrete adjustment of the shingle rows where the ridge and verge are not parallel or the roof is not square. Periodic checks, to maintain alignment, are also recommended.

3.5.5 At barges and verges the shingle edges can be:

- cut flush with the outer face of the drip edge, or
- projected past the drip edge by 10-12 mm, or
- constructed as shown in Figure 3.

3.5.6 When setting out the roof covering ensure that:

- cut pieces less than 150 mm wide are not used because adequate fixing is difficult to achieve
- shingle notches are offset by 75 mm minimum between courses. Shingle notches that are not sufficiently offset can give the impression of a poorly installed roof.

3.6 Fixings

3.6.1 Asphalt shingle manufacturers recommend using hot-dipped galvanised or stainless steel flat head nails (9 mm minimum diameter head), or 22 mm x 16 g stainless steel staples to fix shingles. Fixings must penetrate at least 18 mm into the sarking/sheathing. The number of fixings depends on the size and make of shingle. For high wind exposure locations increase the number of fixings by 50%.

3.6.2 The shingles also have a self-adhesive strip, activated by the sun's heat, to provide fixing along the toe of the shingle.

3.6.3 Locate fixings so that each successive course covers the fixings of the preceding course (Figure 4). The

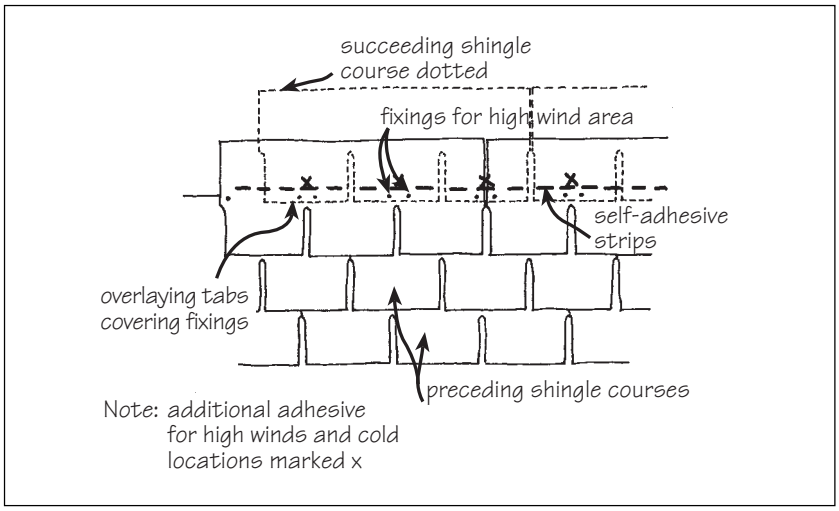

Figure 4. Shingle fixings.

mechanical fixings should be immediately below the adhesive strip.

3.6.4 Drive fixings square with the nail head firmly against the surface of the roofing. The fixing head must not cut into or through the shingle.

3.6.5 When fixing the shingle, start from the end nearest to the shingle just applied, and proceed along the length of the shingle. This will help prevent buckling.

3.6.6 Applying additional asphalt-compatible adhesive under the centre of each tab is required:
- in high wind areas
- for all roofs installed between April and October inclusive
- where roofs are shaded from the sun
- when light-coloured shingles are used
- when the roof has a steep pitch.

3.6.7 Carefully place the adhesive so that notches and butt joints in preceding shingles are not blocked. Wrongly placed adhesive can stop water draining freely from the roof, which may cause leaking.

3.6.8 Adhesive should be used in a continuous strip:
- on top of all drip edges within 20 mm of the edge
- to seal under and hold shingles at ridges, hips, upstands and around penetrations.

3.7 Ridges and Hips

3.7.1 Form ridges and hips by folding caps, cut from a shingle, over the ridge and bed into adhesive. The adhesive acts as both a sealer and adhesive.

3.7.2 The procedure for laying ridge caps is to:
- use a half tab as a starter sheet
- have the long dimension of the cap parallel to the ridge
- overlap successive layers as laying proceeds.

3.7.3 Ensure that the underlay covers the hips and ridges, where ridge ventilators are not being used, before laying the ridging.

3.7.4 Lay ridging so that laps face downwind from the direction of the prevailing wind.

3.8 Valleys

3.8.1 Valleys may be formed using corrosion-resistant or protected metal, or asphalt-compatible roofing membrane in the traditional manner. However, because asphalt shingles are flexible, valleys can be formed by interleaving the shingles to form a closed cut or woven valley. Always install an impervious material such as butyl rubber sheet behind the shingles (see Figures 5a & 5b).

3.8.2 Woven valleys must be carefully constructed to ensure that the shingles are properly fixed or adhered in place.

3.8.3 Keep mechanical fixings of valley shingles 150 mm clear of the impervious layer behind the shingles so that weathertightness is not compromised.

3.9 Flashings

3.9.1 Use corrosion-protected or corrosion-resistant flashings, formed to suit the particular application.

3.9.2 Flashings in the slope of the roof **must** be stepped to fit under each roofing unit (ie provide an individual flashing at each shingle course).

3.9.3 Flashings installed across the roof slope are similar to other roofing types.

3.10 Installation Hints

3.10.1 When installing asphalt shingles:
- use tin snips to cut the shingles as they allow neater, more precise cuts to be made
- approximately 1.5 kg of nails are needed (in a high wind location) for each 10 m^2 of roof area
- use blue chalk to set out courses because red chalk may stain the shingles
- periodically measure from the last course laid to the ridge line to ensure courses are not running out
- straighten courses that are running out, by gradually adjusting the line over several courses to minimise the visual effect of the correction
- allow up to 10% of the roof area, depending on the complexity of the

roof, for shingle wastage. Wastage rates will be higher with a complex roof form
- ensure that shingle installers, and other tradespeople who may work on the roof, wear soft-soled footwear and that walking on the roof is kept to an absolute minimum, particularly in hot weather.

3.10.2 Where walking on the roof will occur after the roof is laid or for later maintenance, carefully lay scaffold planks over it to provide protection from scuffing.

3.10.3 When using asphalt roofing remember:
- edge adhesion of fibreglass asphalt shingles is temperature sensitive. Additional adhesive may be necessary to ensure adhesion and stop shingles being blown off
- shingles become brittle at temperatures below 10^{0}C, crack easily and are hard to cut
- shingles can be easily disfigured and scuffed during handling, especially in warm weather
- the presence of water vapour on the underside of the shingle can lead to curling, cupping and shrinking
- during warm windy summer periods shingles can be blown off more easily because the adhesive may soften with the heat.

4.0 MAINTENANCE

4.0.1 The life of an asphalt shingle roof can be increased by regular maintenance. Remove debris and moss by sweeping with a very soft broom or brush. Accumulated debris retains moisture and promotes the growth of lichens and mildew, which may accelerate decay.

4.0.2 Moss can also be removed by chemical applications such as a 10% solution of zinc napthanate or a mix of one part household bleach (sodium hypochlorite) to four parts water (do not use this solution where drinking water is collected from the roof unless downpipes can be disconnected during cleaning and washing down).

5.0 STANDARDS

American Society for Testing and Materials
ASTM D3462. Standard specification for asphalt shingles made from glass felt and surfaced with mineral granules
ASTM D3018. Standard specification for Class A asphalt shingles made from glass felt and surfaced with mineral granules

Standards New Zealand, Wellington
NZS 4408. Specification for asphalt roofing shingles made from glass felt and surfaced with mineral granules

6.0 CREDITS

BRANZ acknowledges the following people who reviewed this bulletin during its preparation:

Brian Pudney: Natural Roofing Products
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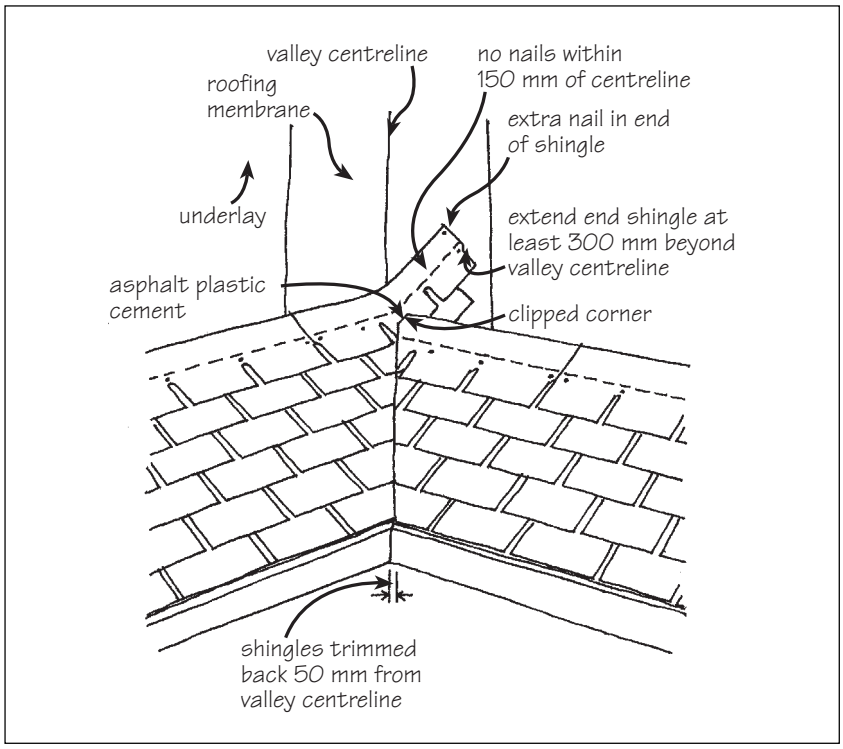

Figure 5a: Closed, cut valley.

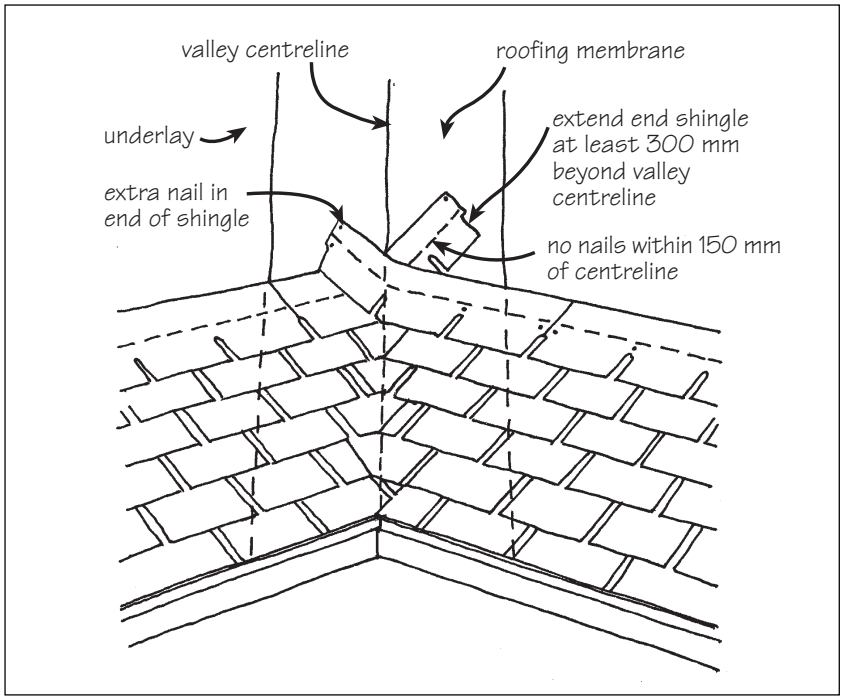

Figure 5b: Woven valley.

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