Quality standards

Quality standards

BS EN 12326 ensures that all roofing slates sold in the UK are tested in the same way, regardless of their origin. The CE mark carried on the packaging or accompanying commercial documentation (DoP), confirms that the slates have been tested and conform to UK Building Regulations.

The T1, T2 and T3 guides within the BS are based on test results for 100 slates selected at random from the quarry, however this may be deemed as not an absolute true representation of a natural slate when vast numbers are being extracted yearly. Oxidation cases within a T1 and T2 slate would be classed as an aesthetic issue rather than something that is detrimental to the performance of the product.

Oxidation/thermal cycling

This will occur due to the presence of reactive iron-sulphur minerals, and is usually evidenced by the thermal cycling tests, but not always. The results are classified into 3 categories:

T1
Inert, may be some discolouration around the inclusion.

T2
Inclusions present within the slate may leach in the form runs of discolouration, but are unlikely to cause structural changes.

T3
Holes, structural changes and runs of discolouration will occur due to oxidation of the inclusions.

Carbonate content

The higher the carbonate content the higher the potential for rapid material loss under acidic conditions. It is generally safe to assume slates with a lower carbonate content will weather more slowly unless reactive iron-sulphurs are present.

Proven performance

Testing in controlled conditions gives an indication of quality. However, the best method to long term behaviour of roofing slate is to look at installations and establishing proven history of performance in the UK.

Design work

Design considerations

Effective design of a slate roof must take into account a number of in factors including site exposure, the pitch of the roof, the type of slate selected and the slate lap.

Environmental conditions

a Rain exposure

The degree of exposure of a building to driving rain determines the minimum lap which should be specified.

The anticipated degree of exposure is given in Figure 1 (taken from BS 5534: Part 1: 2014).

Localised factors such as high buildings, buildings on the slopes or tops of hills and coastal sites, can increase the exposure grading which should be applied in a specific project. Table 1 shows the recommended lap for moderate and severe exposure sites.

For more detailed information on exposure to rain refer to BS8104 1992.

b Wind uplift

Adequate resistance to wind load and wind lift can be provided by following the application details shown on pages 8 to 21 taking into account minimum lap recommendations in Table 1.

Design calculations for wind load and wind uplift are given in BS 5534: Part 1, BR E Digest 346: Parts 1 to 7 and BS 6399: Part 2: 1990, Code of practice for wind loads, which replaces BS CP3: Chapter 5: Part 2: 1972.

Pitch of roof

In general the lower the pitch of the roof the greater the lap. This will help to resist both capillary action and wind uplift.

For exposed sites, wide slates with a greater lap should be used (see BS: 5534: 2014)

Lap

The lap in calculated by taking account of wind uplift, exposure to driving rain and the roof pitch. Table 1 gives the recommended minimum laps for various roof pitches and building exposures. **Please be aware that our slates are pre holed at a 100mm lap which will give ranges from 75mm – 110mm. Our 500x300 are holed at a 128mm lap.**

Figure 1 categories of exposure to driving rain

Exposure Zones	Approximate wind driven rain (Litres/m^2 per spell
	Less than 56.6 (Moderate exposure)
	Equal to or greater than 56.5 (Severe exposure)

Table 1

ESCO
THE EUROPEAN SLATE COMPANY

Moderate Exposure (Less than 56.51/m2 per spell)

The recommendations below apply to rafter lengths of 9m or less. The specifier should also take into account any abnormal local conditions that might apply.

Pitch deg	Slate size mm x mm	Minimum headlap no/m2 mm	Slates gauge	Batten gauge mm	Holing weight mm	Average kg/m2
45	600 x 300	54	12.21	273	337	33.24
	500 x 300	54	14.95	223	287	33.91
	500 x 250	54	17.94	223	287	33.91
	450 x 250	54	20.20	198	262	34.38
	450 x 220	54	22.96	198	262	34.38
	400 x 200	54	23.12	173	237	34.97
	400 x 200	54	28.90	173	237	34.97
40	600 x 300	60	12.35	270	340	33.61
	500 x 300	60	15.15	220	290	34.38
	500 x 250	60	18.18	220	290	34.38
	450 x 250	60	20.51	195	265	34.90
	450 x 220	60	23.31	195	265	34.90
	400 x 250	60	23.53	170	240	35.59
	400 x 220	60	29.41	170	240	35.59
35	600 x 300	67	12.51	267	344	34.05
	500 x 300	67	15.40	217	294	34.93
	500 x 250	67	18.48	217	294	34.93
	450 x 250	67	20.89	192	269	35.54
	450 x 220	67	23.74	192	269	35.54
	400 x 250	67	24.02	167	244	36.34
	400 x 200	67	30.03	167	244	36.34
30	600 x 300	77	12.75	262	349	34.70
	500 x 300	77	15.76	212	299	35.76
	500 x 250	77	18.91	212	299	35.76
	450 x 250	77	21.45	187	274	36.49
	450 x 220	77	24.37	187	274	36.49
	400 x 250	77	24.77	162	249	37.46
	400 x 200	77	30.96	162	249	37.46
27.5	600 x 300	83	12.89	259	352	35.11
	500 x 300	83	15.99	209	302	36.27
	500 x 250	83	19.18	209	302	36.27
25	600 x 300	91	13.10	255	356	35.66
	500 x 300	91	16.30	205	306	36.98
	500 x 250	91	19.56	205	306	36.98
22.5	500 x 300	101	16.71	200	311	37.91
20	500 x 300	113	17.23	194	317	39.08

Severe Exposure (Greater than or equal to 56.51m2 per spell)

The recommendations below apply to rafter lengths of 9m or less.
The specifier should also take into account any abnormal local conditions that might apply.

Pitch deg	Slate size mm x mm	Minimum headlap mm	Slates no/m2	Batten gauge	Holing gauge mm	Average weight mm	kg/m2
45	600 x 300	69		12.55	266	345	34.18
	500 x 300	69		15.47	216	295	35.09
	500 x 250	69		18.56	216	295	35.09
	450 x 250	69		21.00	191	270	35.73
	400 x 250	69		24.17	166	245	36.56
	400 x 200	69		30.21	166	245	36.56
40	600 x 300	76		12.72	262	348	34.64
	500 x 300	76		15.72	212	298	35.67
	500 x 250	76		18.87	212	298	35.67
	450 x 250	76		21.39	187	273	36.40
	400 x 250	76		24.69	162	248	37.35
	400 x 200	76		30.86	162	248	37.35
35	600 x 300	86		12.97	257	353	35.31
	500 x 300	86		16.10	207	303	36.53
	500 x 250	86		19.32	207	303	36.53
	450 x 250	86		21.98	182	278	37.40
	400 x 250	86		25.48	157	253	38.54
	400 x 200	86		31.85	157	253	38.54
30	600 x 300	98		13.28	251	359	36.16
	500 x 300	98		16.58	201	309	37.62
	500 x 250	98		19.90	201	309	37.62
	450 x 250	98		22.73	176	284	38.67
	400 x 250	98		26.49	151	259	40.07
	400 x 200	98		33.11	151	259	40.07
27.5	500 x 300	106		16.92	197	313	38.39
25	500 x 300	116		17.36	192	318	39.39
22.5	500 x 300	128		17.92	186	324	40.66

Tables based on a nail hole positioned 25mm in from the side of the slate. It may be possible to use certain slates at a lower pitch by holing the slates nearer to the edge under factory conditions. An allowance should be made for cutting and wastage**. Please be aware our slates are preholed to suit 75mm-110mm Headlap except the 500mmx300mm which is holed to suit 128mm headlap.**

Battens

Recommended timber batten sizes for natural slate roofs are 50 x 25 mm, up to 600 mm rafter spans.

Battens should be set out horizontally across the roof at a guage calculated for the formula:

$$\text{Gauge} = \frac{\text{length of slate} - \text{lap}}{2}$$

Battens should be nailed at maximum 600mm centres, with the end of each length fully supported and be not less than 50 mm wide by 25 mm thick.

Note: If used, counter battens should be a minimum 38-25mm.

Underlay

Underlay should be selected to meet the requirements of BS 5534.

Ventilation

To comply with the Building regulations F2: 1995 and BS 5250: 1989 (1995), Code of practice for control of condensation in buildings, ventilation equivalent to a 10mm continuous vent must be provided at the eaves on both sides of the roof when the roof is of cold roof construction and 25 mm if of warm roof construction.

Additional ventilation at or near the ridge equivalent to a 5mm continuous vent is required in the case of warm roofs and is also recommended if the case of cold roofs if pitch of the roof is greater than 35°, or if the span is greater than 10 metres.

Cold roofs are defined as being those where the insulation is at ceiling level and warm roof where the insulation is in the plane of the roof (rafter level).

Nails

Nails should be copper to Part 2: 1974 or Alluminium to part 3

The gauge of the nail shall be 3.00mm minimum and shall have a head of no less than 10 mm diameter.

They should be 20 to 25 mm longer than two thicknesses of slate, but longer nails should be used at the eaves course especially if a sprocket is used.

Coverage of slates

See Table 1

Total weight of slate roof

The total weight of slates on a roof can be calculated as follows.

Example

Slate Type	Merayo
Slate size (mm- mm)	500 x250
Weight of slates (kg/1000)	1745
Exposure	Severe
Roof Pitch	40 °
Roof Area m^2	150
Length of Roof Slope (m)	9.5

The headlap can be found from Table 1 by reference to slate size, roof pitch, and exposure = 76mm.

The slate coverage per m^2 can be found from Table 1= 18.87

The total weight of slates on roof can be found from the formula:

$$\frac{\text{Weight of slates (kg)}}{1000} \times \text{area of roof } (m^2) \times \text{slate coverage}$$

Therefore, the total weight =

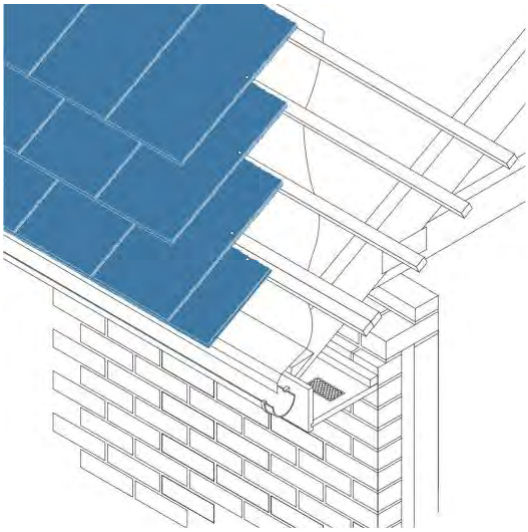
1745/1000 X150 X18.87

= 4939kg

Holing

The position of the hole is measured up from the tail of the slate at a position calculated from this formula.

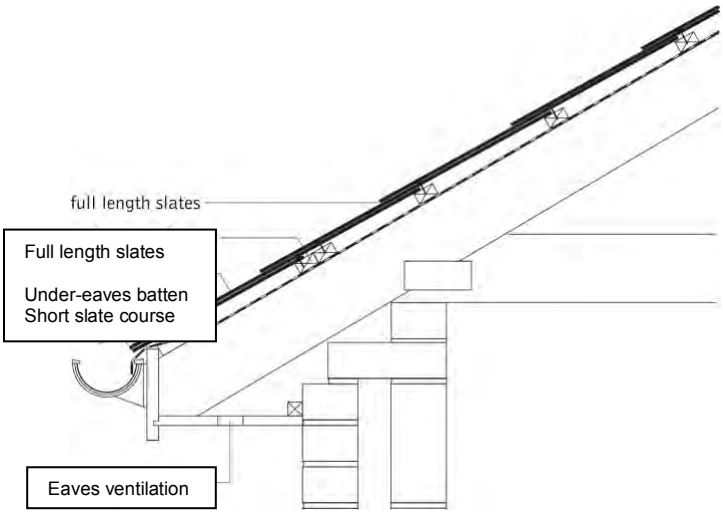
Holing = batten gauge + lap + 10mm



Eaves

At all eaves, a double course of slates is required, comprising a course of short slates over which the first course of full length slates is fixed.

The length of the eaves slates should be gauge + lap

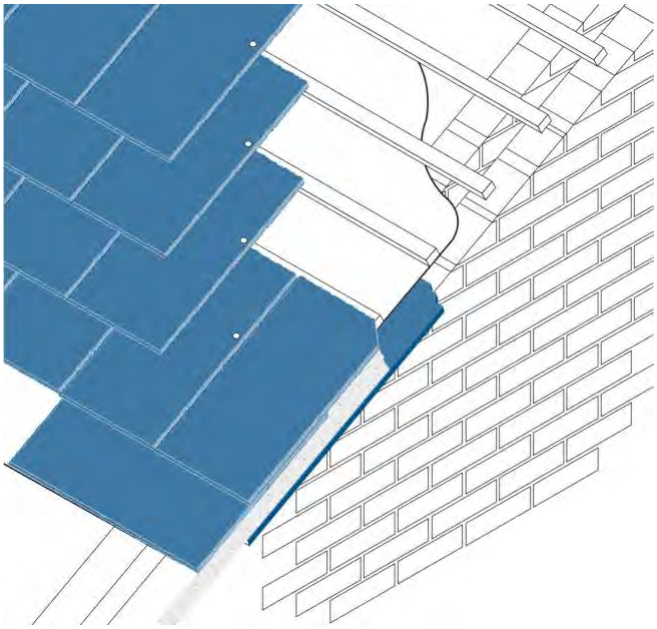


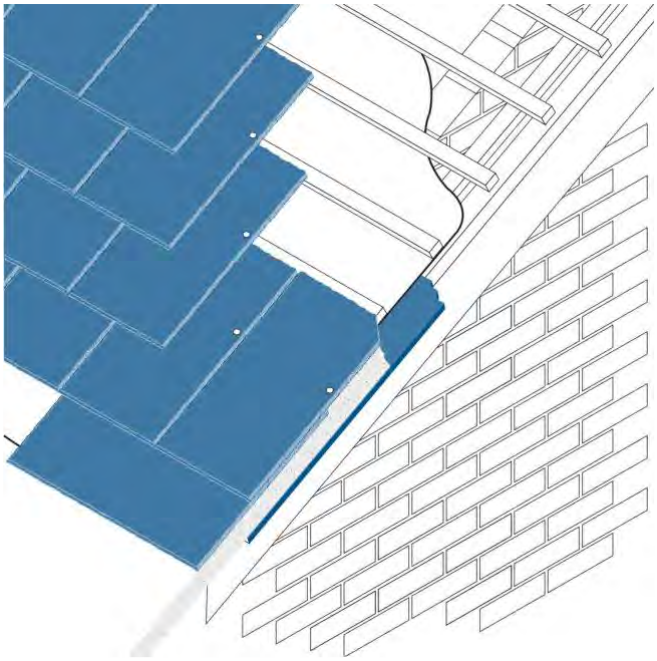
Fixing sequence at eaves

1. Fix the underlay to extend over the tilting fillet and fascia board into the gutter. The underlay should overhang the fascia board by 50mm
2. Fix the full course batten (the eaves batten) so that the tails of the slates in the eaves and the undereaves courses align, ensuring that they will overhang 40 to 50 mm into the gutter. Fix the undereaves batten immediately below the eaves batten.
3. Lay the slates forming the undercourse on their backs and head-nail them to the undereaves batten.
4. Fix the eaves course with the tails of the slates aligning with the tails of slates in the undereaves course.

Eaves Ventilation

When an over facia vent is installed the facia depth needs to be reduced by the depth of the ventilator. This will accommodate the vent and will not change the lay of the roof and will avoid a change of pitch detail at the eaves.





Verges

Where an undercloak is fixed it should consist of one or more courses of slates not less than 4.5 mm thick, laid riven side up and closely butted.

If more than one course is used, joints should be staggered.

Verges can be finished with slate and slate-and-a-half in alternate courses if available, if not, cuts are acceptable. Provision may be made for a slight inward tilt from the verge.

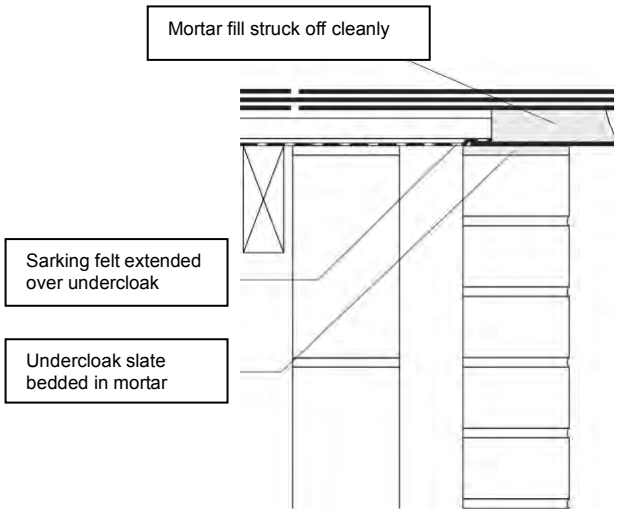
Mortar for bedding and pointing; 1:3 cement/sand pigmented to match colour of slates.

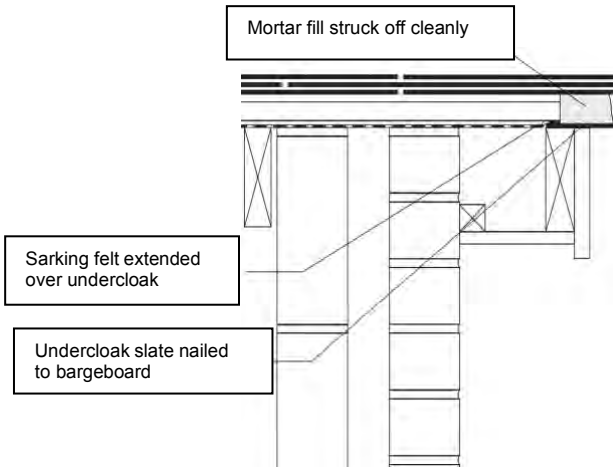
Fixing sequence at verge on brickwork

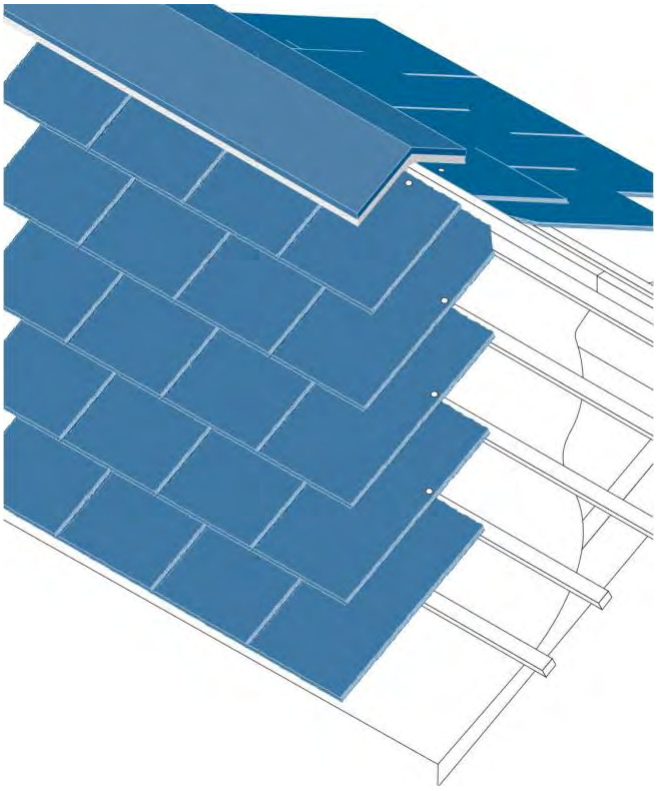
1. Bed the undercloak in mortar so that it extends 40 to 50 mm from the face of the wall.
2. Fix verge slates flush with the undercloak.
3. Fill the gap between the undercloak and the slates with mortar and strike off smoothly to provide a flush joint.

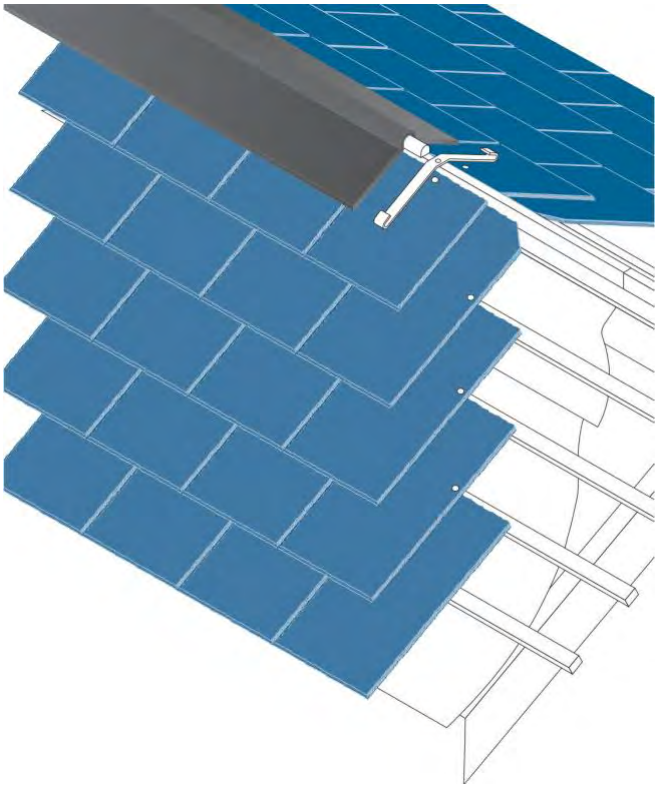
Fixing sequence at verge on bargeboard

1. Fix the undercloak with nails so that it over hangs the face of the bargeboard by 40 to 50 mm.
2. Fill the gap between the undercloak and slates with mortar and strike off smoothly to provide a flush joint.









Ridges

The length and gauge of slate in the top courses at the ridge must be sufficient to ensure that the appropriate lap is maintained.

Shouldered slates should be used in the course below the top course to enable the short top course slates to be nailed directly to the batten. Shouldered slates shall be rectangular, but the head corners may be shouldered within one-quarter of the width and one quarter of the length.

Fixing sequence with tiled ridge

1. Fix underlay over the ridge so that it overlaps the main underlay by at least 150 mm. When using ventilated ridges, a gap of 50 mm should be allowed between the top of the underlay of each pitch.
2. Fix the top course of slates to maintain gauge.
3. Lay ridge tiles true. Joint ridge tiles in mortar and firmly bed the edges along the roof slope in mortar. Where ridge tiles meet, squeeze up the bedding to fill the joint and strike it off smoothly; no separate pointing is necessary.
4. Fill the ends of the ridges at the gables with mortar and slips of slate finished flush with the tile.

Fixing sequence with sheet metal ridge (not illustrated)

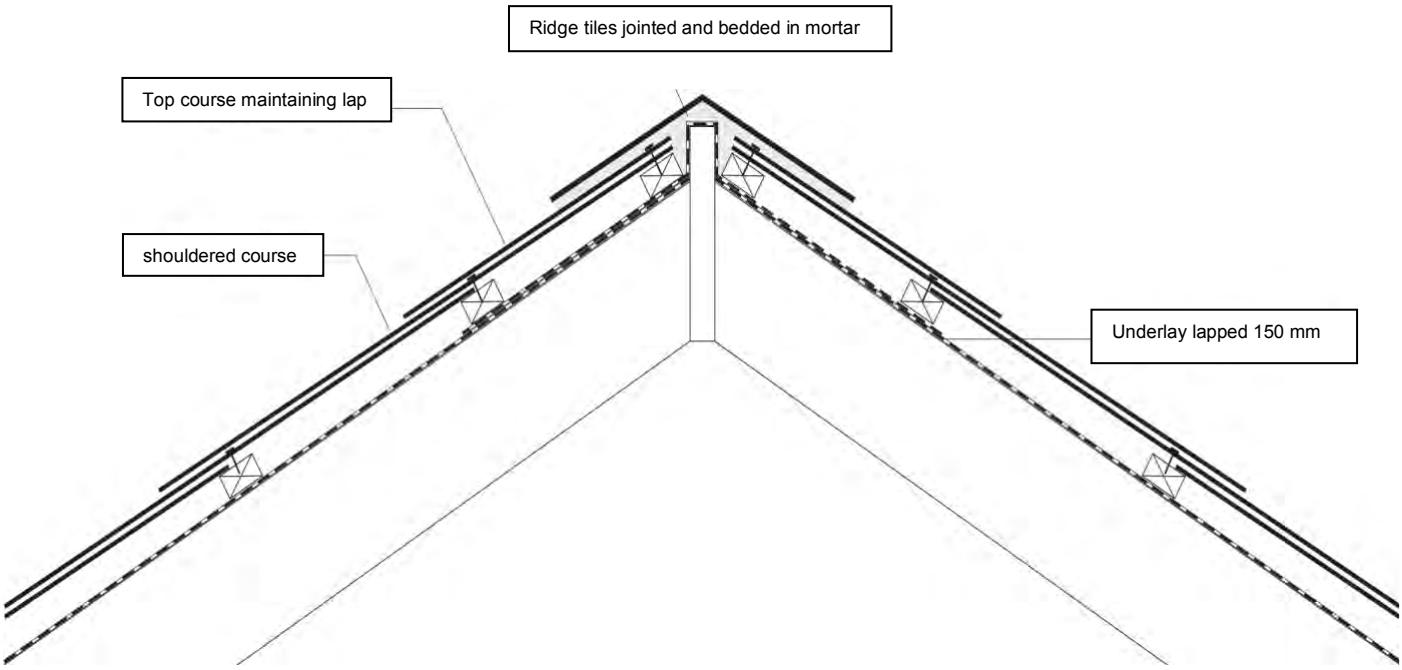
If required, stainless steel, copper or zinc ridges can be made by the roofer on site.

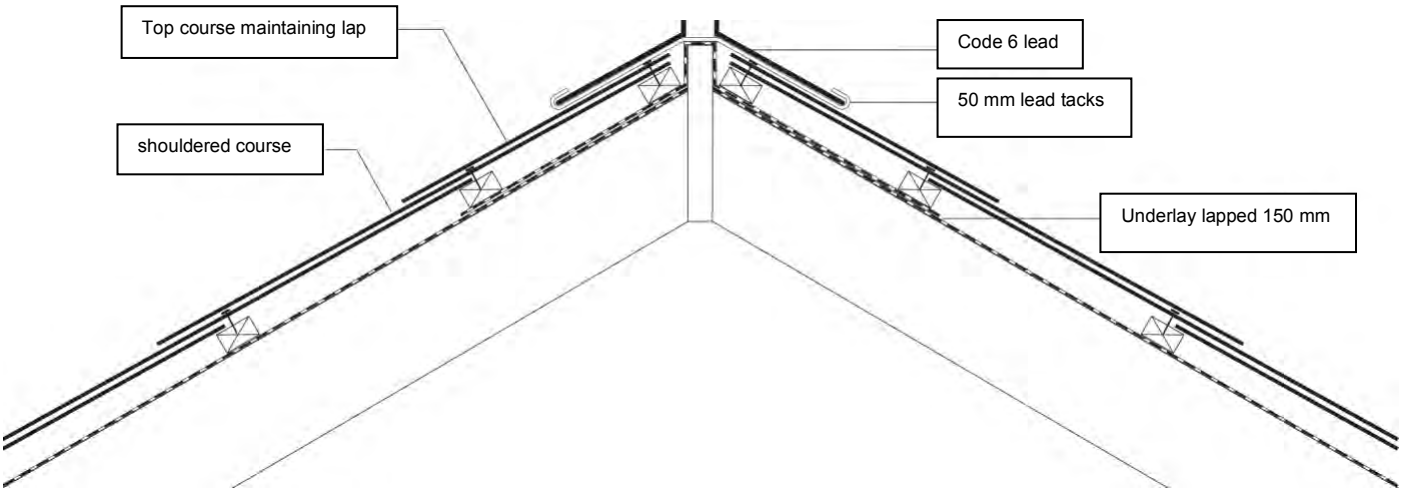
1. Fix 150 mm wide board in lieu of battens at the ridge.
2. Fix underlay over the ridge so that it overlaps the main underlay by at least 150 mm. When using ventilated ridges, a gap of 50 mm should be allowed between the top of the underlay of each pitch.
3. Fix the top course of slates to maintain gauge.
4. Fix 50 mm zinc tack at 500 mm intervals
5. Fix the sheet metal ridges on the board, overlapping each ridge piece by 100 mm and nailing it to the board with two clout nails on each pitch wherever an overlapping end of the ridge with pre-bonded clips. At verges, hips etc.; cut and shape the ridge accordingly.

Note To ensure resistance to wind pull-out, the length of the ridge pieces should not exceed 1 m

Fixing sequence with lead roll ridge.

1. Fix underlay over the ridge so that it overlaps the main underlay by at least 150 mm. When using ventilated ridges, a gap of 50 mm should be allowed between the top of the underlay of each pitch.
2. Fix the top course of slates to maintain gauge.
3. Cover the timber roll with Code 6 lead strips 450 to 500 mm wide and 1.5 to 1.8 m long. Lap the strips 75 mm at the joints; secure the lead with screws; top sealed with a lead dot under the overlap. Fix 50 mm lead tacks at 750 mm.


Ridge tiles jointed and bedded in mortar
Top course maintaining lap
shouldered course
Underlay lapped 150 mm


Top course maintaining lap
shouldered course
Code 6 lead
50 mm lead tacks
Underlay lapped 150 mm

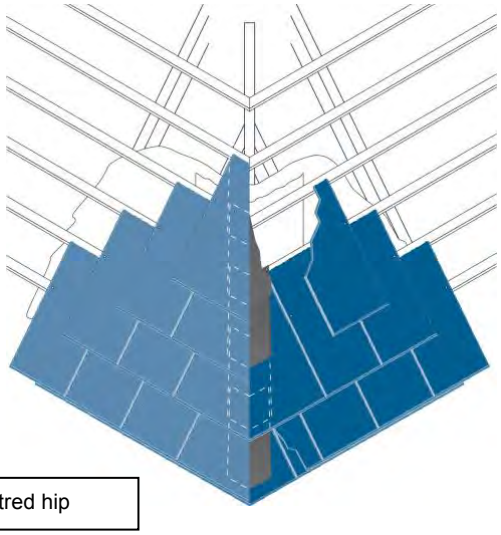
Hips

In cutting slates for hips, care must be taken to preserve an adequate bond, using slates and half slates.

Where pitches at hips are almost vertical, the hips can be treated in the same way as verges.

Fixing sequence at mitred hip

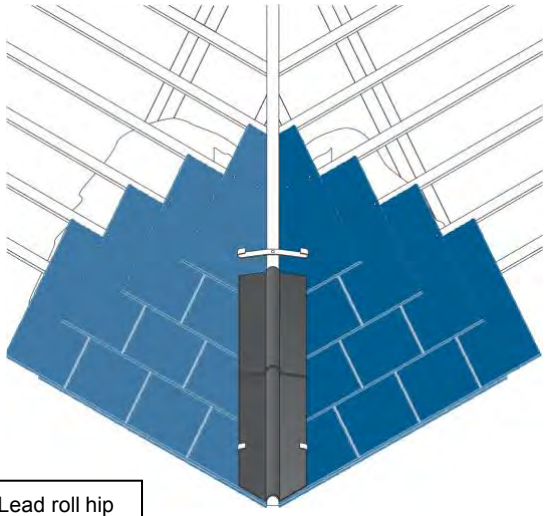
1. Fix 600 mm wide underlay, overlapping the main underlay
2. Cut slates carefully, ensuring that the adequate width is maintained at the head. Esco do not recommend the fixing of mitred hips on roofs where the angle of the hip is 30° or less.
3. Hip slates must have an even size and shape at every course.
4. Fix hip slates interleaved with lead soakers-nailed to battens at the top edge - to provide a weathertight close-mitred joint.
5. Cut slates of adequate width to connect with main roof slates and hip slates. The slate nearest the hip slate must remain a full slate.



Mitred hip

Fixing sequence with lead roll hip

1. Fix 600 mm wide underlay, overlapping the main underlay.
2. Finish slating as close to timber roll as possible.
3. Cover the timber roll with the Code 6 lead strips 450 to 500 mm wide and 1.5 to 1.8 m long. Lap the strips 75mm at the joints equal to the lap of the slates. Fix the 50 mm lead tack to 500 mm centres, under the timber roll.

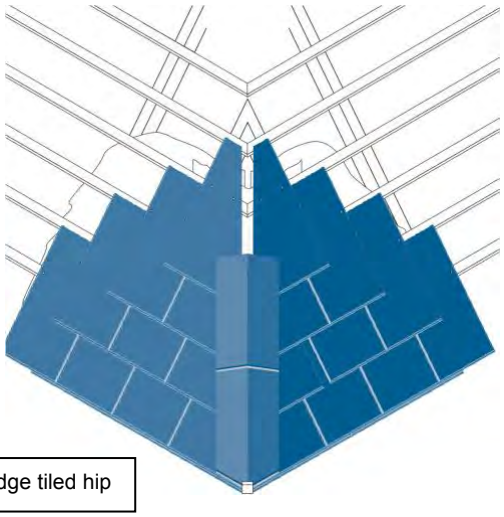


Lead roll hip

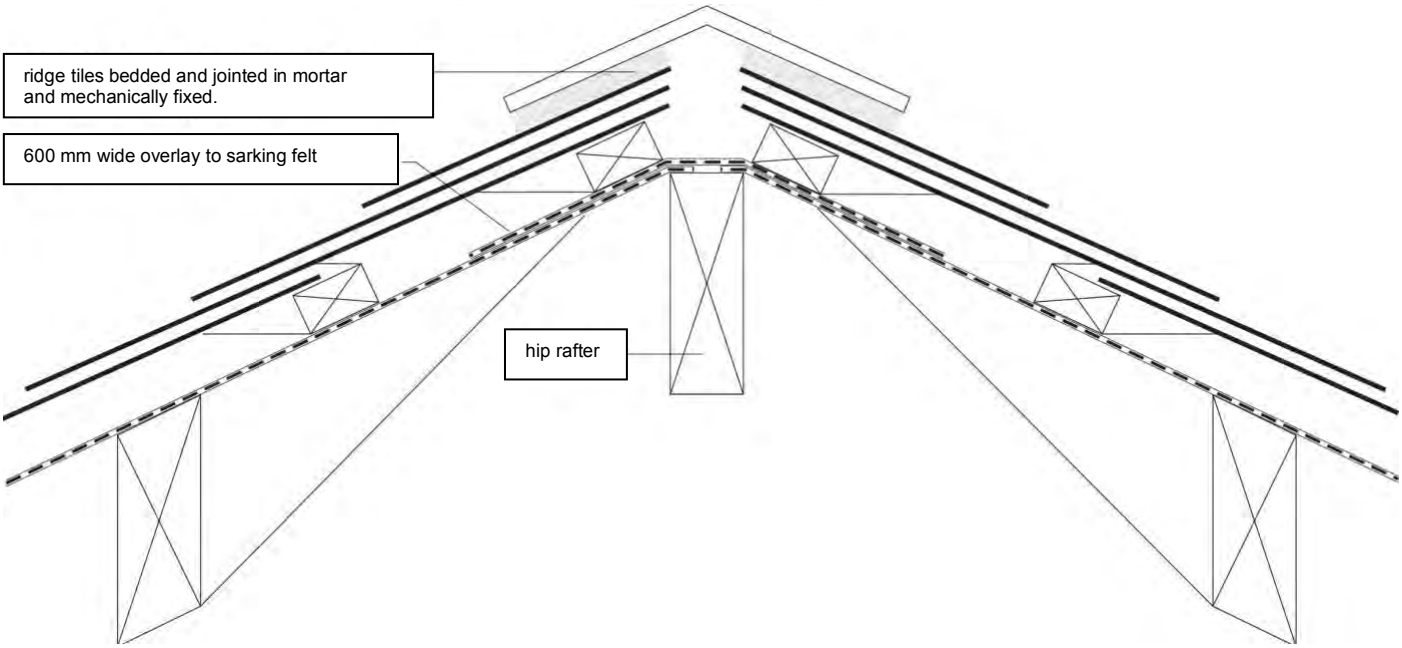
Fixing sequence with ridge tiled hip

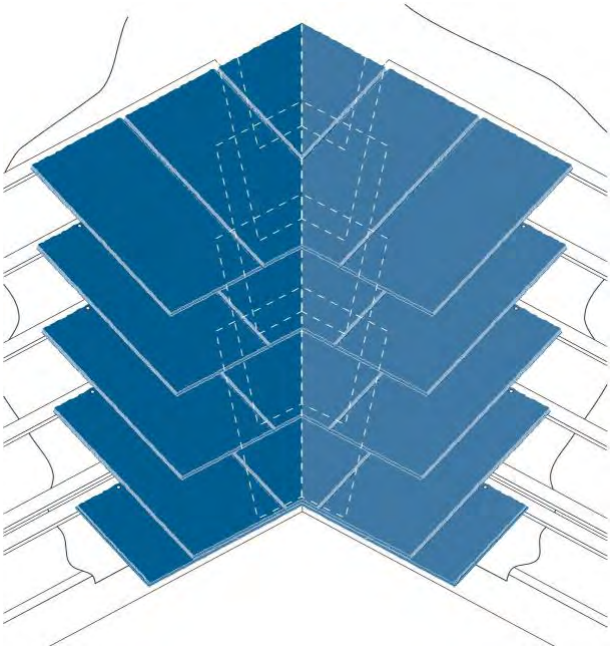
Mortar 1:3 cement/sand pigmented to approved colour

1. Fix 600 mm wide underlay, overlapping the main underlay
2. Fix hip to iron (to BS 5534: Part 1) to hip rafter.
3. Cut slates to fit closely at junction
4. Lay hip ridge tiles true and bed edges and joints firmly in mortar, struck off smoothly to provide a flush finish.
5. Cut first tile to align with corner of eaves.
6. Fill end of hip with mortar and slips of slate finished flush.



Ridge tiled hip


ridge tiles bedded and jointed in mortar and mechanically fixed.
600 mm wide overlay to sarking felt
hip rafter



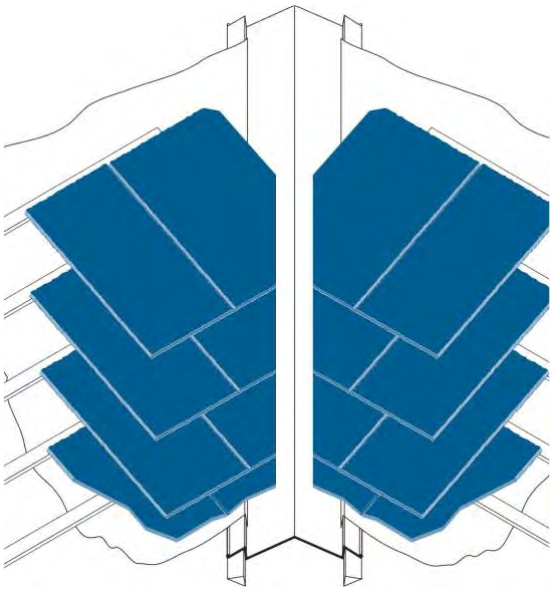
Valleys

Special care should be taken to ensure that valleys feature a clear unobstructed channel, at least 100 mm wide. Increased kerbing may be required to accommodate mass flow where the pitches on either side of a valley are unequal.

For more information on open lead valleys, please contact the Lead Development Association.

Fixing sequence at mitred valley

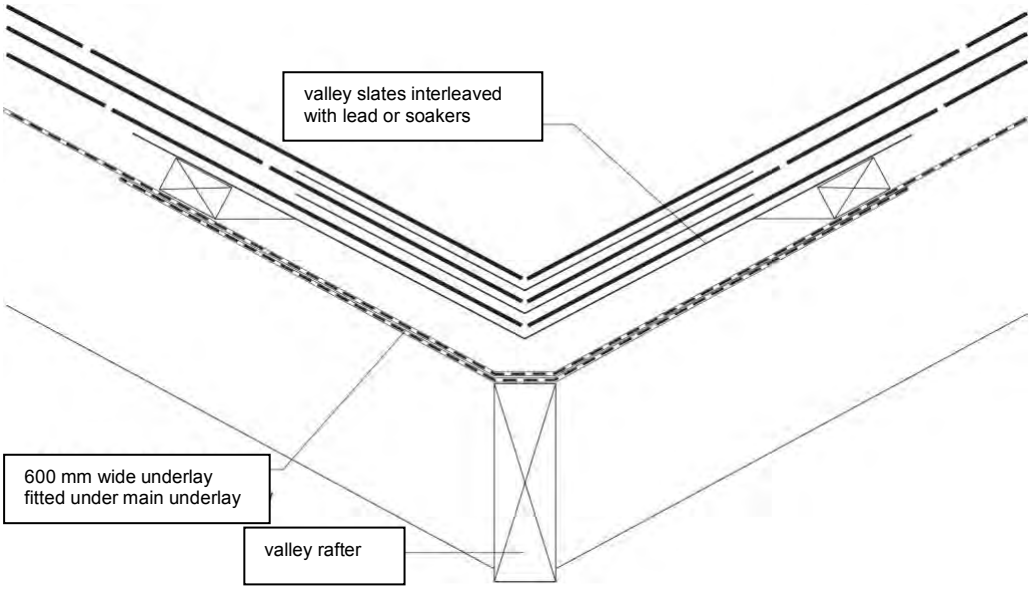
1. Lay a strip of underlay 600 mm wide over the valley, underlapping the main underlay.
2. Cut slate-and-a-half carefully, ensuring that adequate width is maintained at the tail.
3. Fix slates to interleave with Code 3 lead or stainless steel soakers – nailed to battens at the top edge – to provide a straight, weathertight, close-mitred joint. The size of the soaker must be not less than one slate in length; in width it should be at least a slate on both sides at the head and at least half a slate on both sides at the tail.

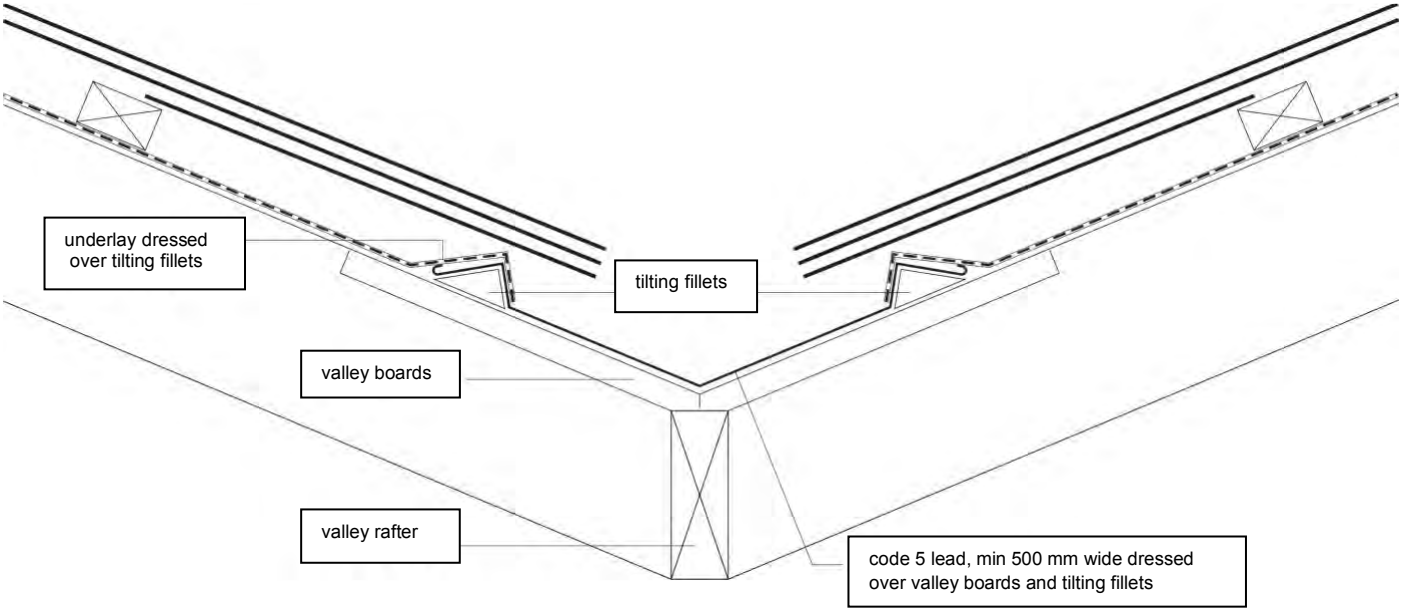


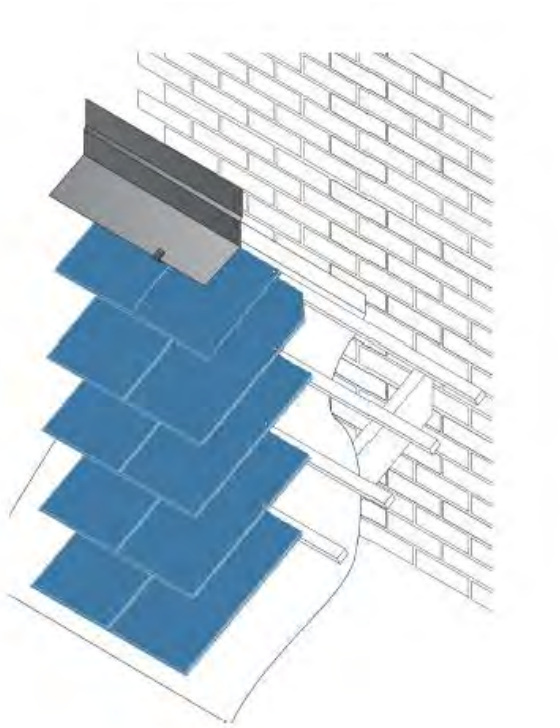
Fixing sequence at valley gutter and open valley

1. Fix valley boards down length of gutter.
2. Fix tilting fillets on either side of the valley board and dress underlay over these tilting fillets
3. Dress Code 5 lead strip at least 500mm wide, into the gutter and over the tilting fillets, extending at the 40 mm beyond each tilting fillets.
4. Cut slates accurately, ensuring sufficient width is retained at the tail, to overhang the tilting fillet but leave a minimum of 100 mm clear width of valley.

Note The edges of the slating should not be tilted up over open valleys.


valley slates interleaved with lead or soakers
600 mm wide underlay fitted under main underlay
valley rafter

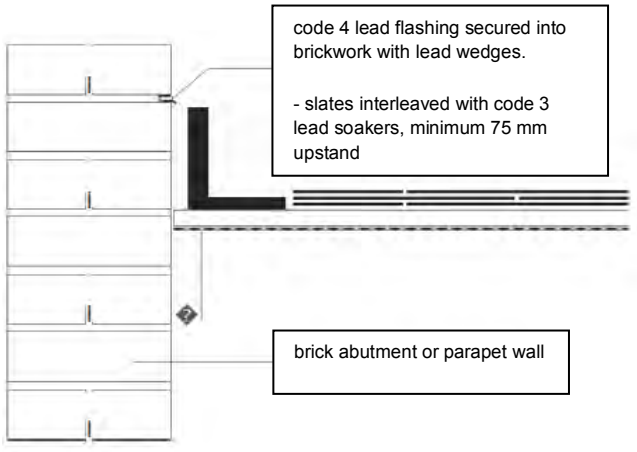

underlay dressed over tilting fillets
tilting fillets
valley boards
valley rafter
code 5 lead, min 500 mm wide dressed over valley boards and tilting fillets

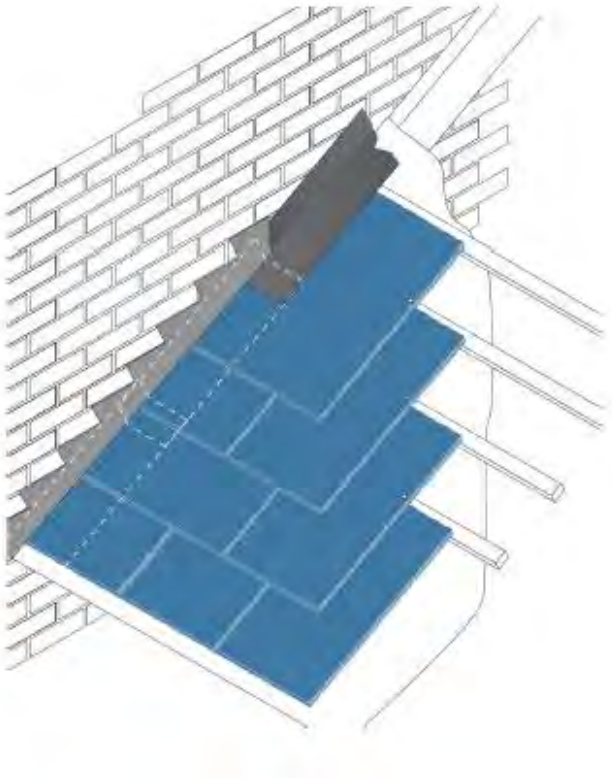


Abutments and parapets

a At top of roof slope

1. Turn underlay 100 mm up abutments
2. Fix short slates as the top course to maintain gauge.
3. Fix Code 6 lead tack, 50 mm wide, at 300 to 500 mm centres and laps
4. Fix Code 4 lead apron flashing in 1.5 to 2.0 m lengths, wedge at the laps and at 450 mm centres and secure into the brickwork joints to a depth of at least 25 mm, dressed down 150 mm over the slates.





Abutements and parapets

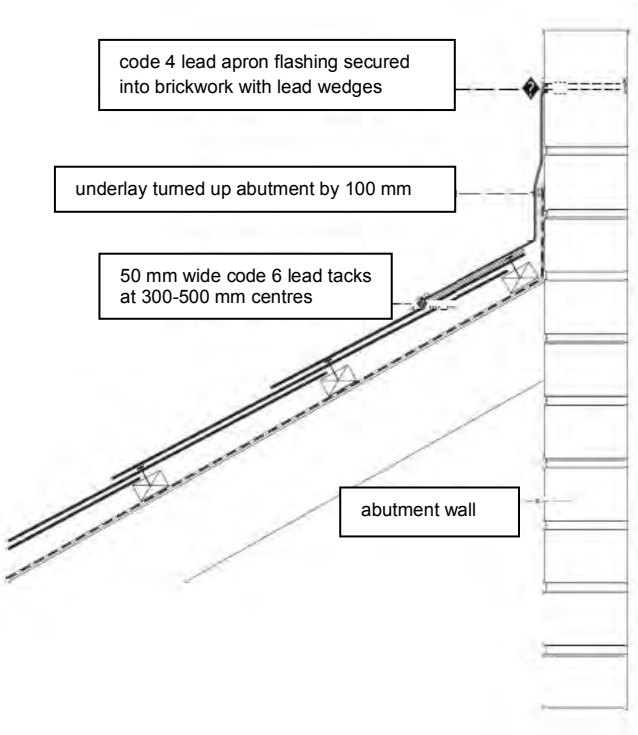
b At the roof slope

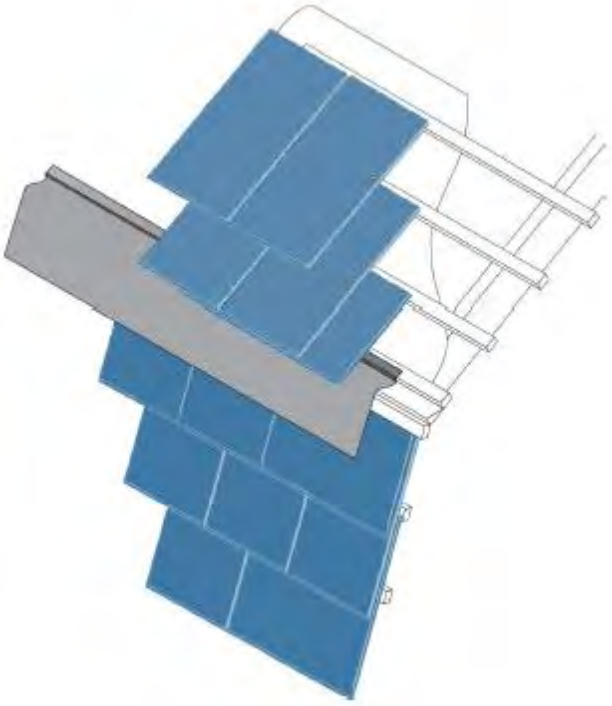
As nearly as possible, the abutment slates can be slate and slate-and-a-half or cuts in alternate courses.
Soakers should be equal to slate length plus 15mm.
The width should be equal to half the standard slate width.

Note To avoid staining when lead is used, a coat of patination oil should be applied to the surface of the lead before fixing.

Fixing sequence

1. Cut slates as required and interleave with Code 3 lead soakers, dressed to provide at least 75 mm upstand to form a close, weathertight abutment, fix soakers by turning down over the head of each slate.
2. Fix Code 4 lead flashing over soaker. Welt top edge, secure into the brickwork joints, to a depth of at least 25 mm, with lead wedges and point in mortar.

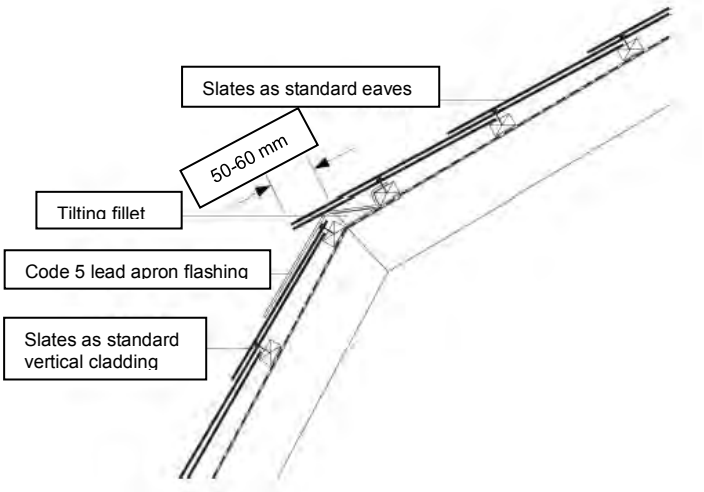


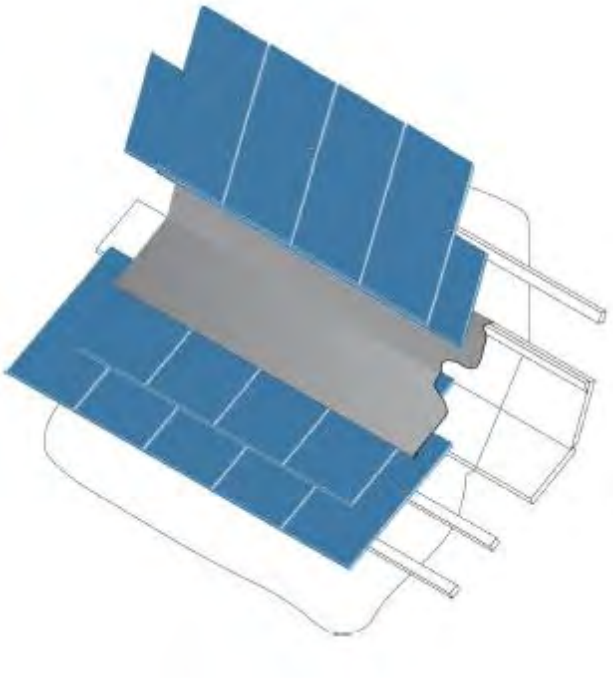


Change of pitch roof

Fixing sequence at Mansard

1. Slate lower slope as for standard vertical cladding (see pages 22-23).
2. Fix a tilting fillet to the upper slope to form an upstand equal to the batten thickness.
3. Fix first batten to the upper edge.
4. Fix code 5 lead apron flashing over the first batten and tilting fillet and dress down over the heads of the slates below at least 150mm.
5. Slate the upper slope as standard eaves with the bottom edge of the upper slates overhanging the flashing by 50 to 60 mm.

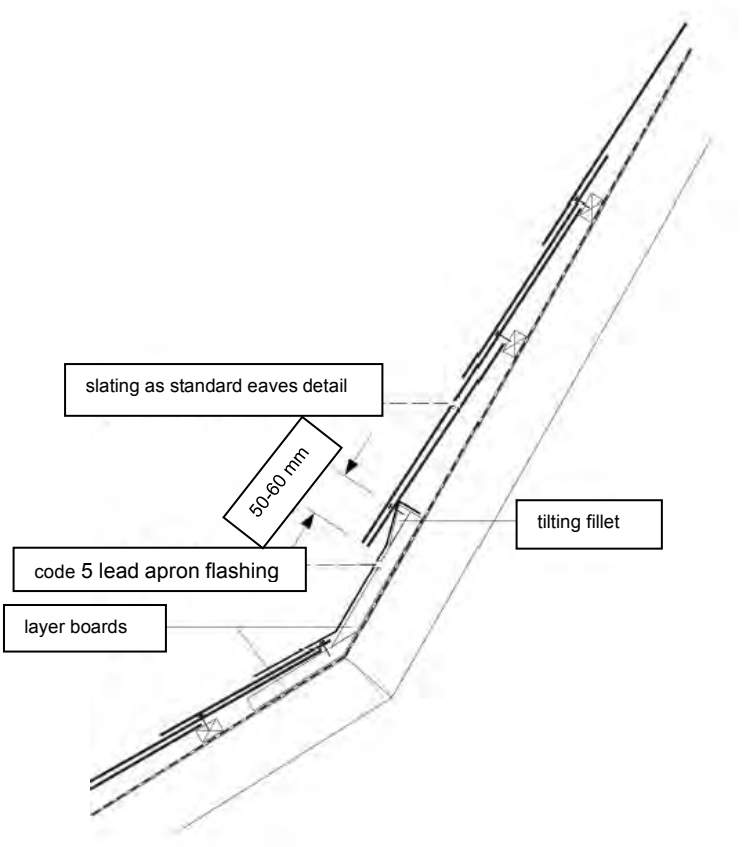




Change of pitch roof

Fixing sequence at reduced change of pitch

1. Complete slating lower slope as for standard roof upper edge.
2. Fix layer boards to the rafters at the intersection of the two roof slopes, equal in thickness to the battens.
3. Fix tilting fillet to the top edge of the upper layer board, equal in thickness to the battens.
4. Fix Code 5 lead apron flashing over the tilting fillet and dress down over the heads of the slate below by at least 150 mm.
5. Slate and batten upper slope as standard eaves, with bottom course projecting below tilting fillet by 50 – 60 mm.



Sitework

Storage of site

Slates should be stored in pallets whenever possible. Slates should be stacked in their long edge on dry, level ground. Two battens should be placed under each row of slates. Open pallets should be covered.

Preparatory work

Sorting and stacking slates

Each slate should be inspected and the thicker end selected for the tail. After being holed, they should be stacked into three separate stacks.

Thick slates should be used on the lower roof (eaves), medium slates on the middle roof and thin slates on the upper roof (ridge) section.

Dressing and holing slates

Slates can be holed by hand or machine

When holing by hand, the slate must be laid flat over a narrow iron and holed from the reverse side (bed) towards the face, thus leaving a small countersunk hole which allows for the head of the fixing nail.

Each slate should be holed twice at a distance from the tail equal to the holing gauge (gauge+head lap + 8 to 15 mm) and between 20 and 25 mm from the long edge of the slate.

When holing by machine, a boring method is recommended. If a machine with a punching method is used, care must be taken to ensure proper maintenance and adjustment of the holing machine to prevent excessive breakage. If slates are drilled, do not drill more than one at a time.

Cutting slates

When using a slate cutting machine for cuts to hips and valleys etc, proper adjustment and maintenance is required.

To maintain adequate laps and allow proper fixing, slates must not be cut too narrow. As a general rule no slate should be less than one half the width of the slate.

At verges and abutments, the alternate course must be started with a slate-and-a-half or a slate if this is not less than 145 mm.

At valleys, hips and other angled surfaces, the slates must be cut on the rake using wider slates to maintain an adequate width of head or tail of no less than 95 mm.

Traditional holing and nailing method

When holing and nailing it is imperative that slates are fixed in accordance with BS 5534, Code of practice for slating a tiling.

Reference should also be made to BS 8000, Workmanship on Building sites: Part 6. ESCO will not entertain claims for loss or damage where this has not been strictly adhered to. The main stages are outlined below.

1. Hole slates to the correct gauge, measuring from the tail of the slates. The position of the holes can be calculated using the formula:
   Holing gauge = gauge + lap + 8 to 15 mm
   Holes should be between 20 and 25 mm from the long edges of the slate. At the same time, sort the slates into three or four groups of equal thickness.
   See BS 8000: Part 6: Section 4. 3. 1.
2. Fix underlay as specified.
3. Mark out the roof to the correct batten gauge.
   The gauge may be adjusted to provide equal numbers of courses up the slope length, provided that the specified lap is not reduced.
4. Fix battens.
5. Check width of slates and mark out the slate joints (perpends) on battens. It is generally necessary to mark out only every second perpend.
6. Load slates on roof so that the thickest slates are used in the lowest courses and the thinnest slates near the ridge.
7. Fix slates to perpend lines, laying to give an overall appearance, with the tails of the slates aligned.

Use slates of consistent thickness in any one course, laid with the thicker end as the tail. Form verges by using slate-and-a-half slates and full slates in alternate courses to maintain bond. Fix each slate with two nails through prepared holes.

Vertical cladding

A wide range of cladding patterns can be achieved, which can offer particular benefits of economy and weather resistance as well as allowing versatility in design.

Fixing sequence for vertical cladding

1. General
   Vertical slating or cladding may be fixed either directly to batten or to battens and counter batten soundly fixed on the wall face (see BS 5534: Part 1: 2014). The minimum recommended head lap is 50 mm.

   If vertical slating or cladding us used as a facing for timber framed construction, a suitable underlay is required to act as a breather membrane.

2. At lower edge
   Fix slates at the lower edge of vertical work in the same way as roof slating.

   At external corners, or next to openings, full slate and half width slate should be used on alternate courses and soakers should be fixed at every course.

3. At top edge
   Cut slates for the top course to maintain gauge.

4. At abutments
   Form abutments with full slate and half slate on alternate courses.

5. At angles
   Cut the slates as appropriate and interleave with lead soakers fixed by nailing the battens at the top edge, which is formed with full slate and half slate in alternate course.

6. At abutments adjacent to openings
   Fix full slate and half slate on alternate courses, interleaving with lead soakers. Fix flashings, suitable for the particular window installations, around all openings.

7. At gable ends
   Splay cut slates at the ends of courses to fit closely under the verge, either by cutting wide slates to leave a 5 mm gap adjacent to the abutment or cutting the last two slates at the end of every course so that the tail of the end slate is almost at right angles to the verge.