CONTENTS

1. GEOLOGY OF SLATE.

What is slate?

Slate is a *metamorphic* rock. This means that it has changed from one form of matter into another and is not as originally laid down by nature.

The most important characteristic of slate is “cleavage”, which means that it will always split in the same plane. This unique characteristic of “cleavage” has enabled slate to be used as a roof covering for several centuries.

The process started many millions years ago. The mud buried beneath the earth was subjected to intense heat and pressure and changed to clay, then shale and finally slate. The “cleavage” was caused by immense lateral pressure exerted by the earth’s gradual cooling and shrinking. The particles which were horizontal, due to downward pressure in the original bedding-place, changed their direction and finished up at right angles to the direction of the lateral pressure. This process usually means that the cleavage plane is very different from the original bedding plane.

The oldest quarry in the United Kingdom is situated at Ballachulish, Scotland (now closed) which originated from the Azoic era more than 500 million years ago. It was a difficult slate to work and was mainly produced in random sizes and was of variable thickness. It has a high mica content (pyrites); is light in colour and is extremely durable. Ballachulish is a unique slate which cannot be compared to any other.

Samaca slates can be compared directly to the Festiniog Welsh slate. Both are from the Ordovician system (400/500 million years old) and have virtually the same chemical properties, texture and performance characteristics. The geological age of different types of slate is as follows:

Era	**System**	**Approx. age of system millions of years**
Palaeozoic	Devonian (Delabole, Sth West England)	310 Upper Palaeozoic
	Upper Silurian (Burlington,Lake District)	330 Lower Palaeozoic
	Ordovician Ffestiniog (Wales) Samaca (Spain)	400 Do
Azoic	Pre-Cambrian (Ballachulish)	500 +

2. PRINCIPLES OF SLATE ROOFING.

DESIGN CONSIDERATIONS.

Principles of Slate Roofing:

The traditional form of slate roofing comprises individual pieces of slate which are laid in accordance with precise but variable rules. The slates are laid on their length following the line of the roof pitch. The shorter eaves course is laid first so that, as work progresses, the slates on the top row covers those on the one underneath covering the joins. The butt joint between adjacent slates would allow water to get between them. To prevent this a second row of slates, positioned sideways by half a slate, is laid on top to seal off the joins between the slates in the lower row. A third row is then laid to cover the join in the second row. This third row is vertically aligned with the first. Because the third row is positioned higher, a fourth row is needed to prevent water getting through the gap between the third row and the top of the second row.

This technique (bond) is the basic principle of slate roofing

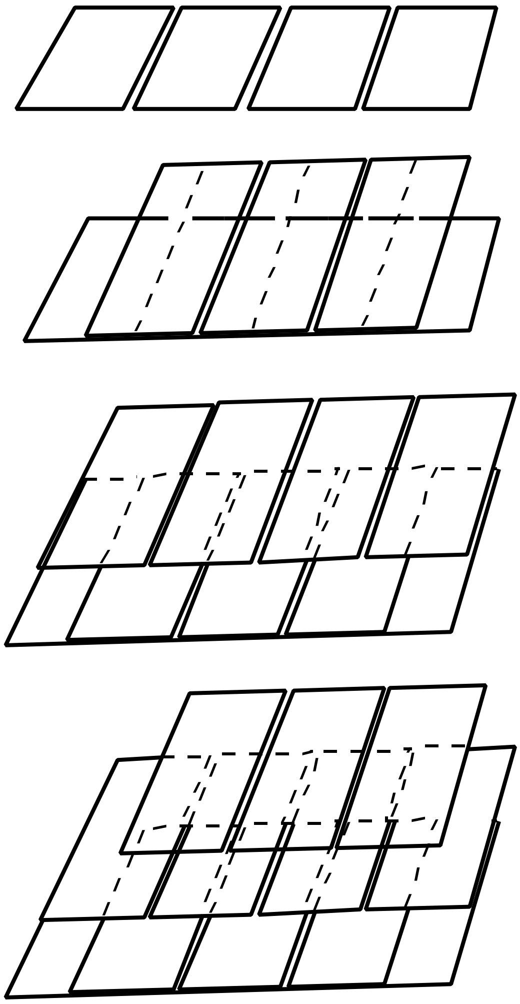


Fig. 1

When laid one on top of each other in this way, each slate can be said to have three parts:

1. The *headlap is* the upper part covered by two thickness' of slate which never receives water directly, thus ensuring that the roof is watertight.

2. The *margin* is the visible part of the slate on the roof.

3. The *gauge* which receives water directly through the gap between the slates in the same course.

The gauge and the margin are the same dimension. The dimension of each part is calculated by subtracting the headlap from the overall length of the slate and dividing by two ((L-HL)÷2).

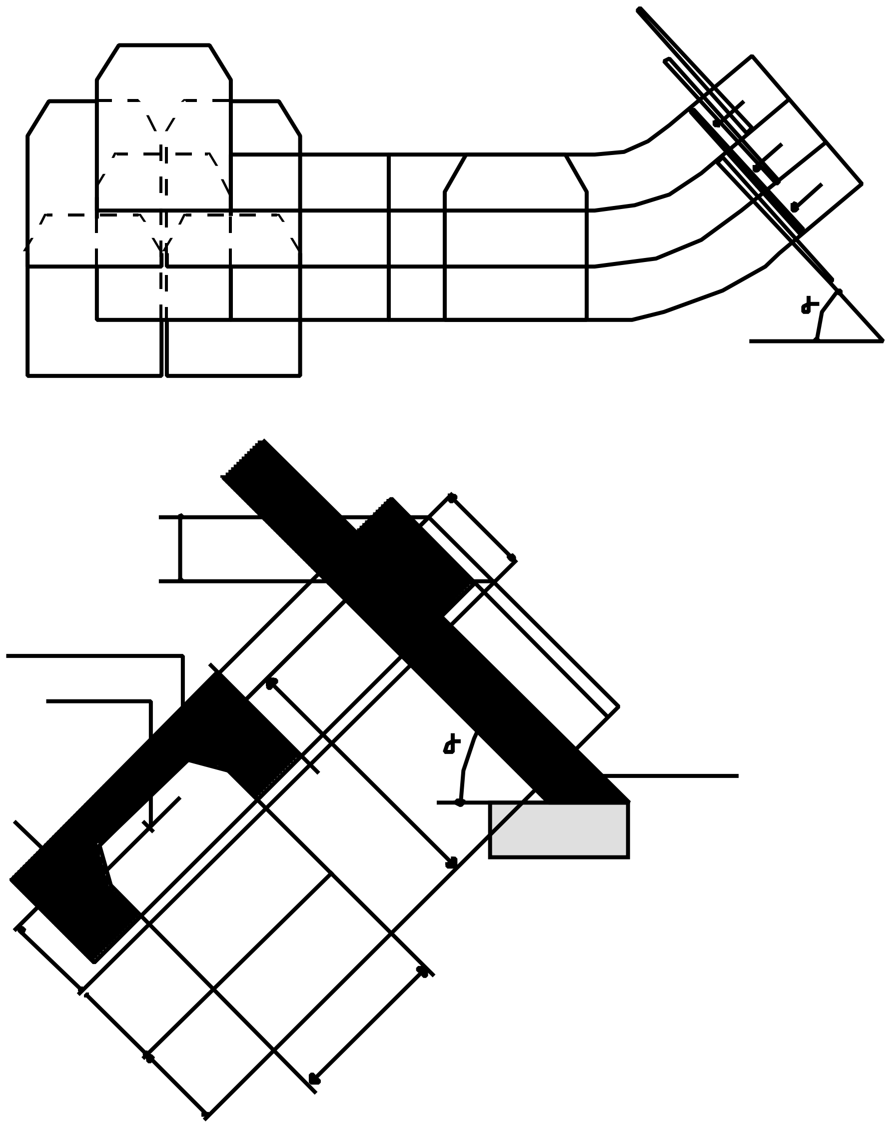


Fig. 2

3. DESIGN ELEMENTS FOR A SLATE ROOF

Correct design of a roof must take into account a number of inter-related factors. The advice given on the following pages cover most of the common roof shapes. However, even the most complicated pitched roof design is an ideal medium for natural slate and we can provide specialist advice where necessary.

The art of slating is an ancient craft, and the experience gained over the years, often from father to son, has lead to the evolution of working methods which are in general use throughout the UK. However, in Scotland, certain local practices have evolved which may differ from the details shown. It should be remembered however, that slating practice in Scotland came about as a direct result of the characteristics of the local Ballachulish slate, which, as mentioned in the Geology section of this manual was a unique stone, supplied in random widths and lengths and in varying thickness'. Both Spanish and Welsh slate are usually supplied in a regular size, thickness and shape. It is therefore recommended that the details described in this manual are followed.

However, Samaca does produce special thick slates for Scotland, which, due to their thickness (7 / 9mm) can be fixed in accordance with local practice if this is preferred.

4. HEADLAP CALCULATION: NAIL FIXING.

To determine the correct amount of headlap which will ensure the water - tightness of the roof, the following factors must be taken into account:

- **Site exposure**
- **The Roof Pitch**
- **The length of verge as a horizontal projection (horizontal measure from the ridge to the eaves)**

The length of verge is not covered under BS recommendations but it can be an important element to consider especially when an upper roof is depositing water on to a roof below or, if the roof itself is unusually large, would mean a build - up of water on the lower slope Historical data indicates that when the projection of the pitch is greater than 5.5 metres, leaks appear near the eaves even if the theoretical headlap area is properly calculated on the basis of capillarity. This means in practice that the theoretical headlap must be correct empirically to balance these eventualities.

We suggest that Samaca is consulted for further advice on this point.

5. CAPILLARITY.

Capillarity is the property possessed by water rising up slate which are placed together. The height to which water rises is greater the purer the water and the smoother the surface involved. This can easily be seen by placing two panes of glass together and standing them in a bowl of water. On rougher materials such as natural slate, the irregularity of the surface prevents water from rising so high. Tests performed simultaneously on several pairs of slate standing in water, have shown that the height in all of them is practically the same; around 25mm above the surface level of the water.(Fig. 3)

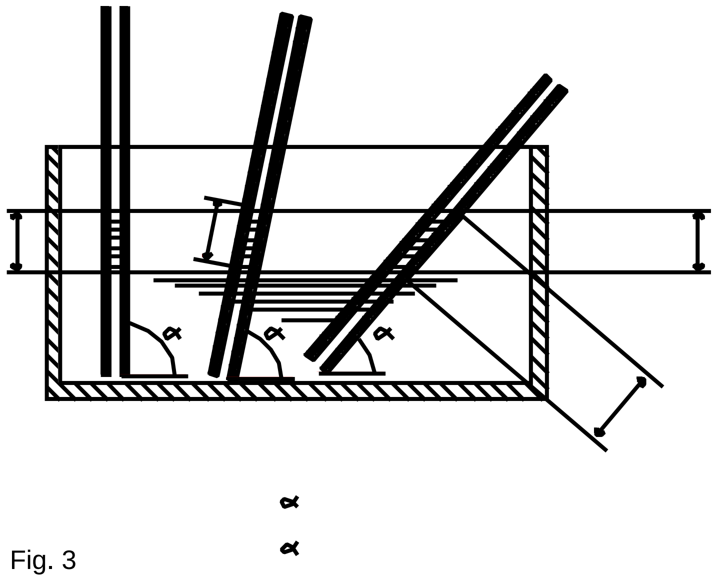


Fig. 3

In tests carried out at different inclinations, the rise of water increases corresponding to the angle of the slate. This demonstrates that the lower the roof pitch, the greater is the water spread on the slate. This means that longer slates must be used on the lower roof pitches.

There is also lateral capillarity, though in practice it is less extensive than rising capillarity. (Fig. 4.) This is called the angle of creep. In reality other factors such as dust in the joins between slate and the wind, which retains water at the base of the slate, plus the pitch of the roof, all effect the amount of capillarity. Laboratory tests cannot reproduce the real conditions and monitoring on the roof itself after rain, storms, snow and ice has, over the years, established a set of “norms”. However results differ according to climate, roof pitch, slate proximity on the roof, slate roughness, type of fixing (nails or hooks) and the length of the verge as a horizontal projection. A properly laid roof must have slates which are not too close together but no more apart than 5mm.

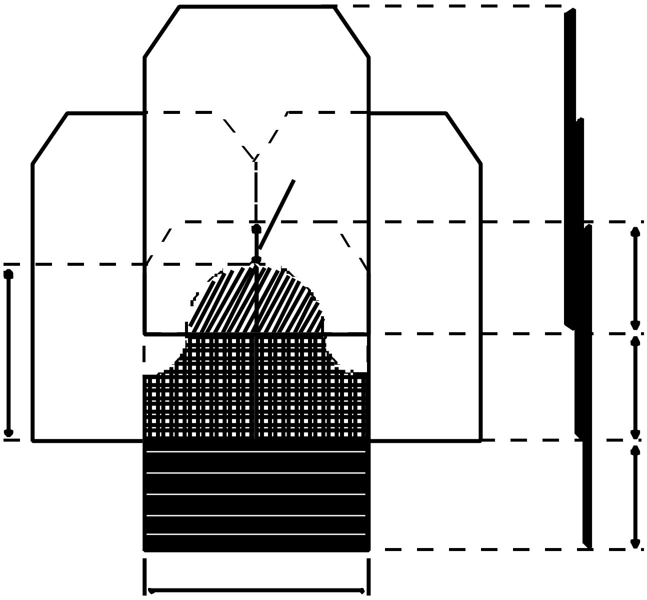


Fig. 4

When hooks are used to fix slates there is also a rising spread of water. The gap between the slates is filled by the top of the hook in the headlap area. Much less water runs over the tail of the slate because the shank of the hook diverts it. (Fig. 5) Here another form of capillarity occurs: tube capillarity. The parabola shape filled by the wet area is longer and narrower with hook fixing than on slates which are nailed. Fig. 6 superimposes the two outlines.

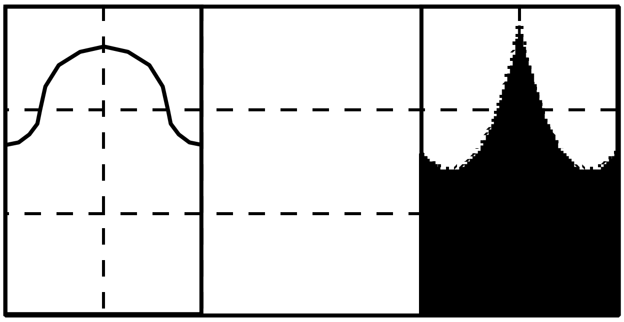


Fig. 5

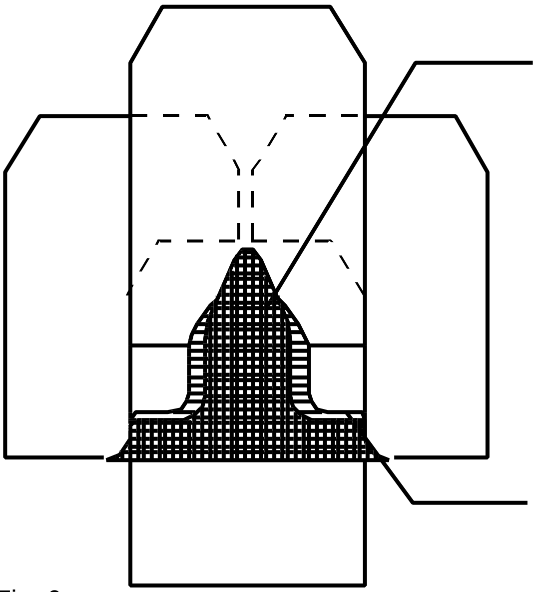
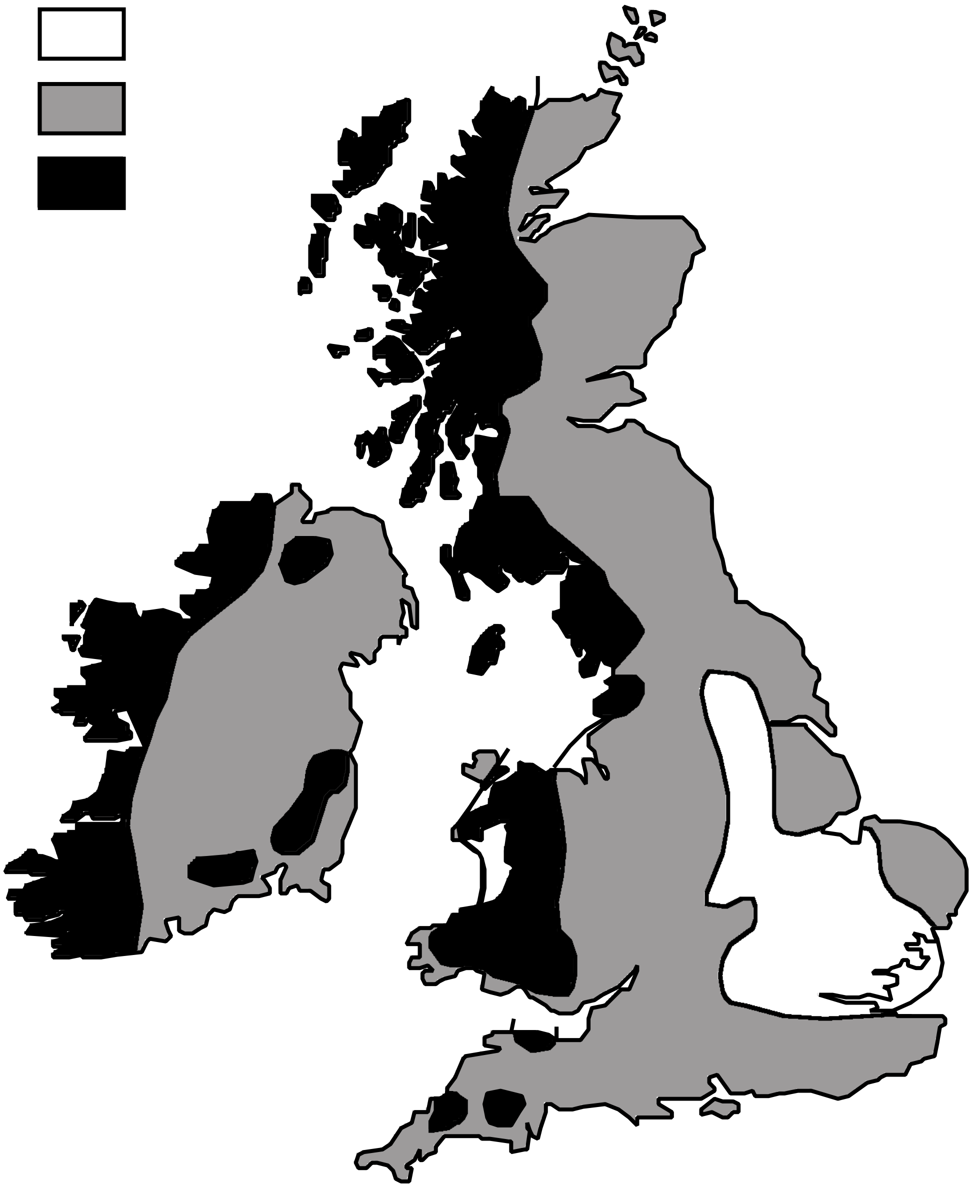


Fig. 6



Annual driving rain index and exposure.

The map data is based on long periods of observation of rainfall and wind and the amount of rain which would be driven on to a vertical surface in an average year. The amount of rainfall is expressed in millimetres divides by 1000 and average wind speed in metres per second. Therefore the index is expressed as m2/second.

7. MINIMUM RECOMMENDED HEADLAP: B.S. 5534.

Slate Size Nominal mm	Moderate Exposure: Driving Rain index less than 7m2/s Minimun rafter pitch									Severe Exposure: Driving Rain index greater than 7m2/s Minimun rafter pitch								
	20	22.5	25	27.5	30	35	40	45	85	20	22.5	25	27.5	30	35	40	45	85
600 x 300	130	115	90	80	75	75	65	65	-	-	120	120	115	110	90	80	70	-
500 x 300	115	105	90	80	75	75	65	65	50	-	125	100	95	85	75	75	65	-
500 x 250	125	110	90	80	75	75	65	65	50	-	135	115	110	110	90	75	65	65
450 x 300	115	105	90	80	75	75	65	65	50	-	-	110	95	85	75	75	65	65
450 x 250	125	110	90	80	75	75	65	65	50	-	-	115	110	100	85	75	65	65
450 x 220	125	115	100	80	75	75	65	65	50	-	-	120	115	105	95	85	65	65
400 x 250	-	-	-	85	75	75	65	65	50	-	-	-	-	100	95	75	65	65
400 x 220	-	-	-	85	75	75	65	65	50	-	-	-	-	100	100	85	65	65
400 x 200	-	-	-	90	75	75	65	65	50	-	-	-	-	105	100	90	65	65
350 x 250	-	-	-	80	75	75	65	65	50	-	-	-	-	80	75	75	65	65
350 x 200	-	-	-	80	75	75	65	65	50	-	-	-	-	90	85	75	65	65
300 x 200	-	-	-	80	75	75	65	65	50	-	-	-	-	75	75	75	65	65

8. TABLE OF QUANTITIES.

Samaca Traditional Slating - Nail Fixing

Slate quantities, batten and holing following laps and weight of slate per m2 for different thickness of slate.
Table 3

Slate Size mm	Lap mm	Battening Gauge mm	Slate Qty m^2	Holing Gauge mm	Batten per m2	Weight per m2/kgs 4/6 mm	5/7 mm	7/9 mm
600 x 300	145	227.50	14.65	387.50	4.40	32.56		
500 x 250	145	177.50	22.54	337.50	5.63	37.30		
450 x 250	145	152.50	26.23	312.50	6.56	38.20		
600 x 300	140	230.00	14.49	385.00	4.35	32.20		
500 x 250	140	180.00	22.22	335.00	5.56	36.80		
450 x 250	140	155.00	25.81	310.00	6.45	37.60		
600 x 300	135	232.50	14.34	382.50	4.30	31.90		
500 x 250	135	182.50	21.92	332.50	5.48	36.30		
450 x 250	135	157.50	25.40	307.50	6.35	37.00		
600 x 300	130	235.00	14.18	380.00	4.26	31.50		
500 x 250	130	185.00	21.62	330.00	5.41	35.80		
450 x 250	130	160.00	25.00	305.00	6.25	36.40		

Slate Size mm	Lap mm	Battening Gauge mm	Slate Qty m^2	Holing Gauge mm	Batten per m2	Weight per m2/kgs		
						4/6 mm	5/7 mm	7/9 mm
600 x 300	125	237.50	14.04	377.50	4.21	31.20		
500 x 250	125	187.50	21.33	327.50	5.33	35.30		
450 x 250	125	162.50	24.62	302.50	6.15	35.80		
450 x 220	125	162.50	27.97	302.50	6.15	34.20		
400 x 250	125	137.50	29.09	277.50	7.27	36.70		
400 x 220	125	137.50	33.06	277.50	7.27	35.40		
600 x 300	120	240.00	13.89	375.00	4.17	30.90		
500 x 250	120	190.00	21.05	325.00	5.26	34.80		
450 x 250	120	165.00	24.24	300.00	6.06	35.30		
450 x 220	120	165.00	27.55	300.00	6.06	33.70		
600 x 300	115	242.50	13.75	372.50	4.12	30.60		
500 x 250	115	192.50	20.78	322.50	5.19	34.40		
450 x 250	115	167.50	23.88	297.50	5.97	34.80		
450 x 220	115	167.50	27.14	297.50	5.97	33.20		
400 x 250	115	142.50	28.07	272.50	7.02	35.50	43.50	56.10
400 x 220	115	142.50	31.90	272.50	7.02	34.20	46.20	55.80
600 x 300	110	245.00	13.61	370.00	4.08	30.23		
500 x 250	110	195.00	20.51	320.00	5.13	33.90		
450 x 250	110	170.00	23.53	295.00	5.88	29.90		
450 x 220	110	170.00	26.74	295.00	5.88	32.70		
400 x 250	110	145.00	27.59	270.00	6.90	34.80	42.80	55.21
400 x 220	110	145.00	31.35	270.00	6.90	33.60	45.50	90
350 x 250	110	120.00	33.33	245.00	8.33	38.10	45.00	57.50
350 x 220	110	120.00	37.88	245.00	8.33	34.50	44.90	55.50
600 x 300	105	247.50	13.47	367.50	4.04	29.90		
500 x 250	105	197.50	20.25	317.50	5.06	33.50		
450 x 250	105	172.50	23.19	292.50	5.80	33.70		
450 x 220	105	172.50	26.35	292.50	5.80	32.30		
400 x 250	105	147.50	27.12	267.50	6.78	34.30	42.00	54.20
400 x 220	105	147.50	30.82	267.50	6.78	33.00	44.70	54.00
350 x 250	105	122.50	32.65	242.50	8.16	37.30	44.10	56.30
600 x 300	100	250.00	13.33	365.00	4.00	29.63		
500 x 250	100	200.00	20.00	315.00	5.00	33.10		
450 x 250	100	175.00	22.86	290.00	5.71	33.30		
450 x 220	100	175.00	25.97	290.00	5.71	31.80		
400 x 250	100	150.00	26.67	265.00	6.67	33.70	41.30	53.30
400 x 220	100	150.00	30.30	265.00	6.67	32.50	43.90	53.00
400 x 200	100	150.00	30.30	265.00	6.67	32.40	43.80	52.90
350 x 250	100	125.00	32.00	240.00	8.00	36.60	43.20	51.20
350 x 220	100	125.00	36.36	240.00	8.00	33.10	43.10	48.90
350 x 200	100	125.00	40.00	240.00	8.00	35.00	43.00	48.80
300 x 200	100	100.00	50.00	215.00	10.00	35.10	47.50	56.70
600 x 300	90	255.00	13.07	360.00	3.92	29.00	40.00	
500 x 250	90	205.00	19.51	310.00	4.88	32.30	42.50	51.60
450 x 250	90	180.00	22.22	285.00	5.56	32.30		51.30
450 x 220	90	180.00	25.25	285.00	5.56	30.90		
400 x 250	90	155.00	25.81	260.00	6.45	32.60		
400 x 220	90	155.00	29.33	260.00	6.45	31.40		
400 x 200	90	155.00	32.26	260.00	6.45	30.70	41.90	51.60
350 x 250	90	130.00	30.77	235.00	7.69	35.20	41.50	53.00
350 x 200	90	130.00	38,46	235.00	7,69	35.00	41.30	52.80
300 x 200	90	105.00		210.00	9.52	33.40	45.20	54.00

Slate Size mm	Lap mm	Battening Gauge mm	Slate Qty m^2	Holing Gauge mm	Batten per m2	Weight per m2/kgs 4/6 mm	5/7 mm	7/9 mm
600 x 300	85	257.50	12.94	357.50	3.88	28.80		
500 x 250	85	207.50	19.28	307.50	4.82	27.90		
450 x 250	85	182.50	21.92	282.50	5.48	31.90		
450 x 220	85	182.50	24.91	282.50	5.48	30.50		
400 x 250	85	157.50	25.40	257.50	6.35	32.10	39.40	50.80
400 x 220	85	157.50	28.86	257.50	6.35	30.90	41.80	50.50
400 x 200	85	157.50	31.75	257.50	6.35	30.20	41.30	50.90
350 x 250	85	132.50	30.19	232.50	7.55	34.50	40.75	52.10
350 x 200	85	132.50	37.74	232.50	7.55	34.30	40.55	51.90
300 x 200	85	107.50	46.51	207.50	9.30	32.70	44.18	52.80
600 x 300	80	260.00	12.82	355.00	3.85	28.50		
500 x 250	80	210.00	19.05	305.00	4.76	31.50		
450 x 250	80	185.00	21.62	280.00	5.41	31.50		
450 x 220	80	185.00	24.57	280.00	5.41	30.10		
400 x 250	80	160.00	25.00	255.00	6.25	31.60	38.80	50.00
400 x 220	80	160.00	28.41	255.00	6.25	30.40	41.20	49.70
400 x 200	80	160.00	31.25	255.00	6.25	29.80	40.60	50.00
350 x 250	80	135.00	29.63	230.00	7.41	33.90	40.00	51.10
350 x 200	80	135.00	37.04	230.00	7.41	33.70	39.80	50.90
300 x 200	80	110.00	45.45	205.00	9.09	31.90	43.20	51.60
600 x 300	75	262.50	12.70	352.50	3.81	28.20		
500 x 250	75	212.50	18.82	302.50	4.71	31.10		
450 x 250	75	187.50	21.33	277.50	5.33	31.00		
450 x 220	75	187.50	24.24	277.50	5.33	29.70		
400 x 250	75	162.50	24.62	252.50	6.15	31.10	38.20	49.20
400 x 220	75	162.50	27.97	252.50	6.15	30.00	40.60	48.90
400 x 200	75	162.50	30.77	252.50	6.15	29.30	40.00	49.20
350 x 250	75	137.50	29.09	227.50	7.27	33.20	39.30	50.90
350 x 200	75	137.50	36.36	227.50	7.27	33.00	39.10	50.70
300 x 200	75	112.50	44.44	202.50	8.89	31.20	42.20	50.40
600 x 300	65	267.50	12.46	347.50	3.74	27.70		
500 x 250	65	217.50	18.39	297.50	4.60	30.40		
450 x 250	65	192.50	20.78	272.50	5.19	30.20		
450 x 220	65	192.50	23.61	272.50	5.19	28.90		
400 x 250	65	167.50	23.88	247.50	5.97	30.20	37.00	47.80
400 x 220	65	167.50	27.14	247.50	5.97	29.10	39.30	47.50
400 x 200	65	167.50	29.85	247.50	5.97	28.40	38.80	47.80
350 x 250	65	142.50	28.07	222.50	7.02	32.10	37.90	48.40
350 x 220	65	142.50	31.90	222.50	7.02	28.40	36.90	45.60
350 x 200	65	142.50	35.09	222.50	7.02	28.30	36.80	45.50
300 x 200	65	117.50	42.55	197.50	8.51	29.10	40.40	48.30
600 x 300	60	270.00	12.35	345.00	3.70	27.40		
500 x 250	60	220.00	18.18	295.00	4.55	31.10		
450 x 250	60	195.00	20.51	270.00	5.13	29.80		
450 x 220	60	195.00	23.31	270.00	5.13	28.50		
400 x 250	60	170.00	23.53	245.00	5.88	29.70	36.40	47.10
400 x 220	60	170.00	26.74	245.00	5.88	28.60	38.80	46.80
400 x 200	60	170.00	29.41	245.00	5.88	28.00	38.20	47.10
350 x 250	60	145.00	27.59	220.00	6.90	31.60	37.20	47.60
350 x 220	60	145.00	31.35	220.00	6.90	28.60	37.10	45.90
350 x 200	60	145.00	34.48	220.00	6.90	28.50	37.00	45.80
300 x 200	60	120.00	41.67	195.00	8.33	29.20	39.60	47.30

9. DESCRIPTION OF ROOF PARTS.

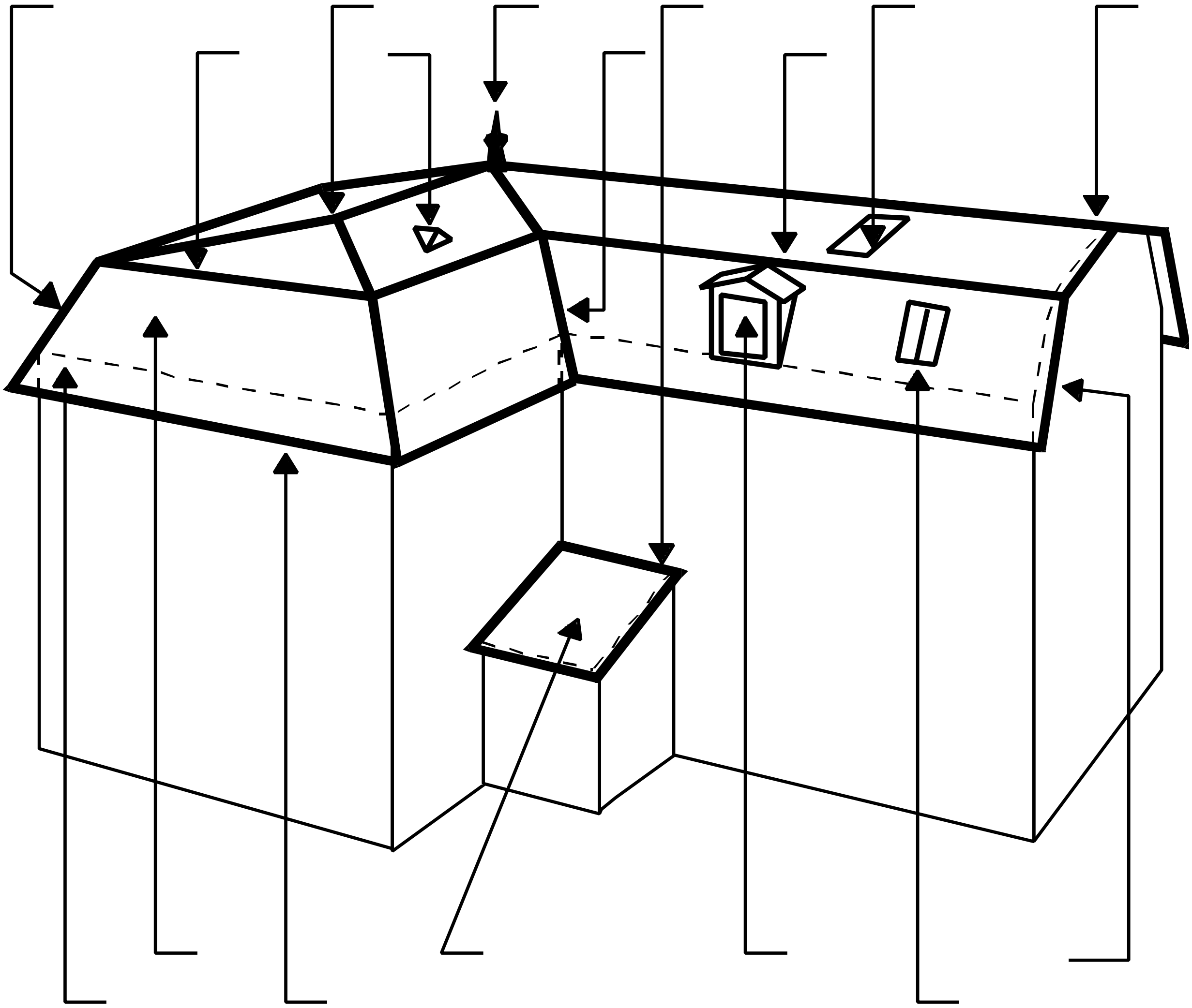


Fig. 7

10. TYPES OF ROOF.

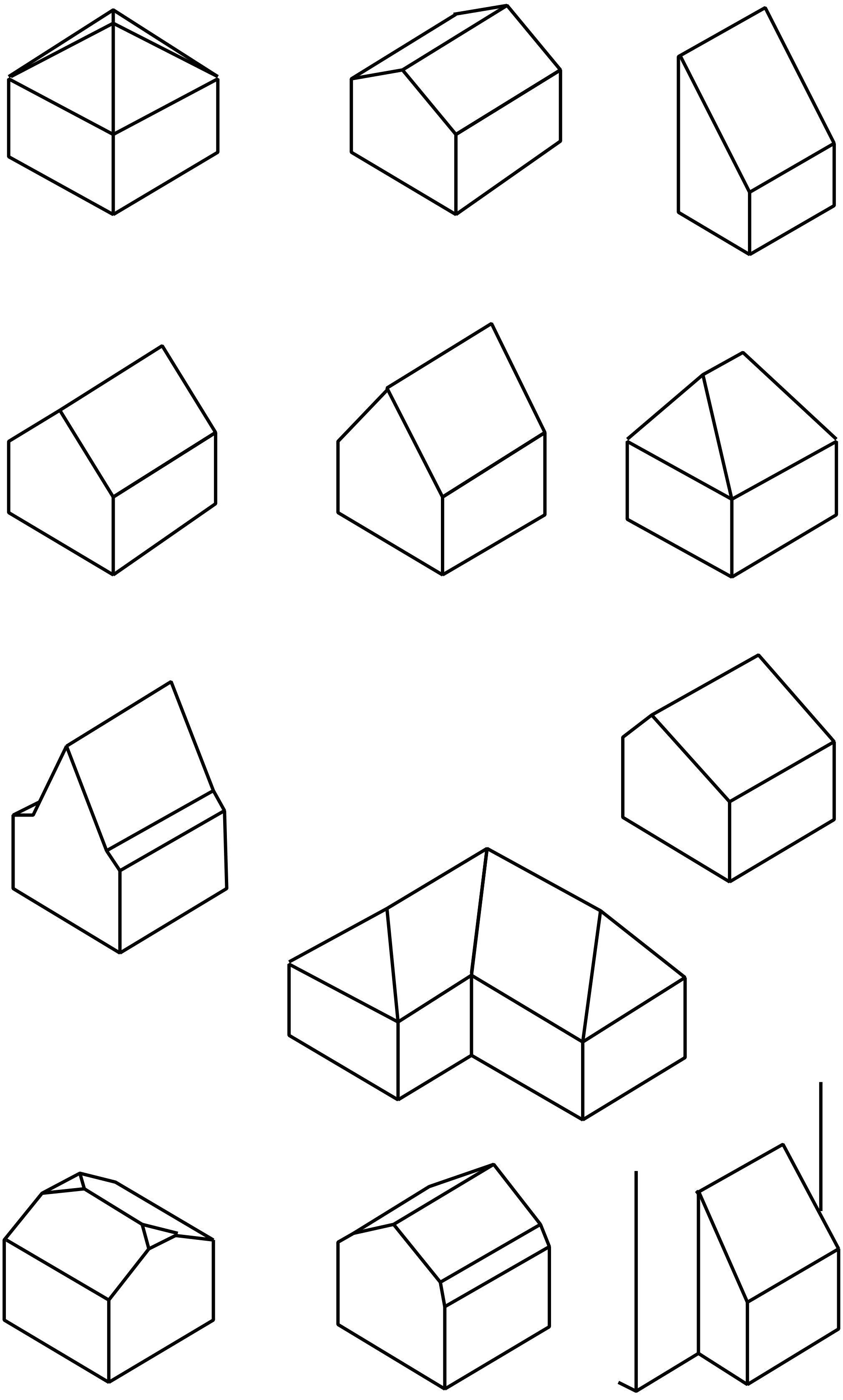


Fig. 8

11. TERMINOLOGY

The diagram and the common terms used in slate roofing will serve as a general guide to terminology. Further information on this subject can be obtained by reference to BS 6100 Building and Civil Engineering Terms.

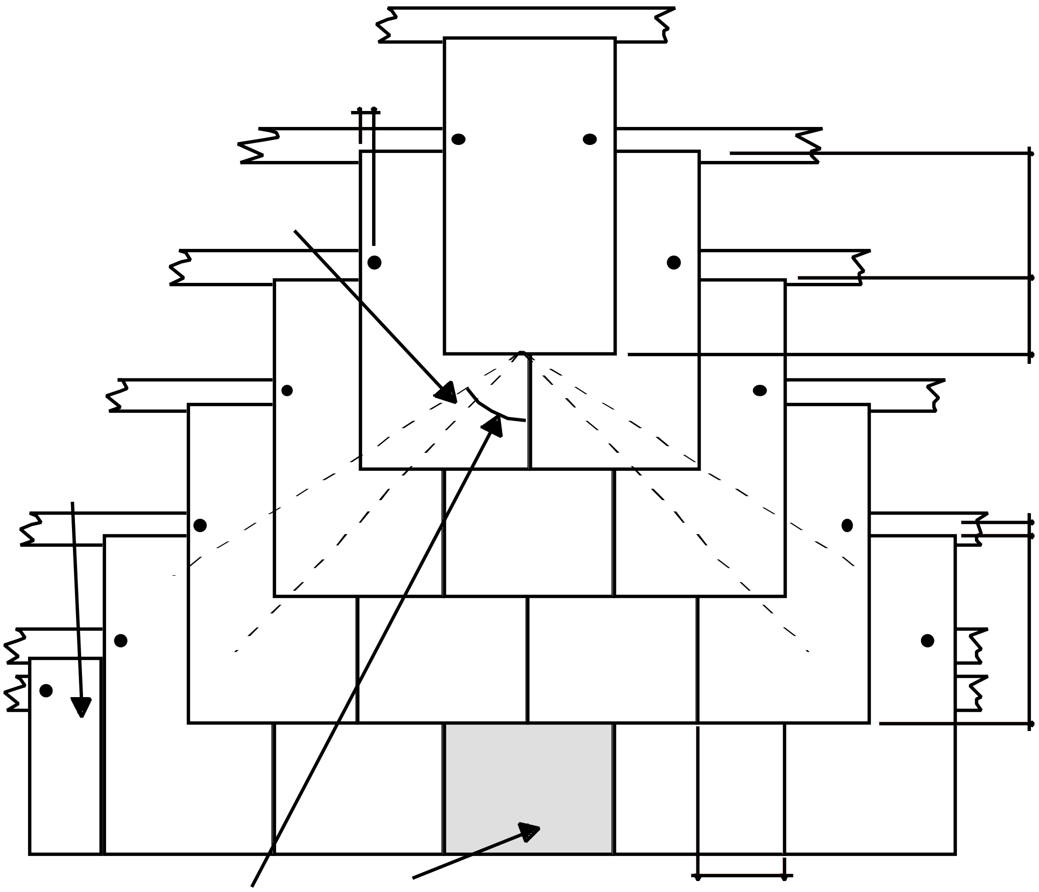


Fig. 9

Common terms used in roofing.

- **Abutment** The edge of a roof surface meeting a part of a building which rises above it.
- **Abutment Flashing** Flashing used to weatherseal an abutment joint.
- **Angle of Creep** The angle to which water will spread on a sloping roof due to capillary attraction.
- **Apron Flashing** A flashing that is dressed into or under vertical walling, down the wall face and over the joint on to the roofing material, or where a chimney penetrates a roof.
- **Back Face** The hidden part of the slate when laid.
- **Back Gutter** This is used in a slated (or tiled) roof where a projection extends through the roof to weather the upper slope surfaces.
- **Barge Board** The inclined roof component on the gable of a building covering the ends of the roof - also called verge or gable boards.
- **Batten** A section of sawn timber used as the contact support and fixing points for slates (may be termed Laths).

- **Bedding** Laying slates in mortar.
- **Bond** The arrangement, alternating with successive rows of slates on a roof, which ensures that roof water cannot penetrate the roof surfaces.
- **Bonnet Hip Tile** A rounded hip tile designed to allow room for bedding to fill the space at the lap.
- **Capillarity** The attraction or repulsion that water has for the surface of a material.
- **Capping** Materials used to cover a joint at a high point (see ridge capping, parapet capping).
- **Centre Nailing** Nailing of slates along a line slightly above the head of the slate in the course below.
- **Cladding (Wall)** External weatherproofing wall material of slate.
- **Condensation** Water formed from moisture laden air in contact with building materials colder than the air.
- **Corner Piece (Flashing)** Accessory forming the junction between vertical cladding at external or internal angles of the wall.
- **Counter Battens** Timber members of small section fixed at right angles to the direction of the battens bet ween them and the surfaces below.
- **Course** A horizontal row of slates.
- **Cover Flashing** A flashing used in conjunction with other components, such as soakers, the vertical parts of which it overlaps.
- **Diamond Slating/Diagonal Slating** A roofing slate having six sides and intended to be fixed with one corner uppermost.
- **Dormer** A vertical window or opening formed in a roof slope.
- **Double Skin Roof Covering** Roof sheeting formed of two layers, separated by insulation or a cavity, either formed on site or manufactured.
- **Double Slate Down Pipe (RWP)** Double width slates to allow for cutting at roof features.
- **Down Pipe** Pipe used to convey rain-water downward.
- **Dry Ridge** A ridge capping fixed without mortar.
- **Dry Verge** A verge formed without mortar.
- **Eaves** The lower edge of a roof.
- **Eaves Course** The first row of cut slate at the eaves.
- **Eaves Flashing** Flashing at lower edge of a roof dressed into a gutter over the wall below.
- **Eaves Ventilator** A special eaves filler designed to allow ventilation of the roof voids without allowing water penetration.
- **Electrolysis** Chemical decomposition in the presence of moisture between dissimilar metals due to a small electric current created between the metals.
- **Fascia (Board)** A component fixed at or just below the eaves to mask the edge of the roof or wall cladding.
- **Filled End** Mortar filled end of a ridge or hip.
- **Finial** A decorative fitting at the end of a ridge, the junction of a ridge and hip or at the top of a conical, pyramidal or domed roof.
- **Fire Break** A means of complying with fire regulations that require roof or wall constructions to act as separating walls or roofs in the event of fire.
- **Flashing** A strip of pre-formed impervious material used to exclude water from the junction between any two materials.
- **Gable** The shaped part of a wall above the eaves level at end of a ridge or partially hipped roof.
- **Gambrel Hip** A hip at the peak of a gable.
- **Gauge** The distance from the line of fixings of one course of slates to the fixings of the course below.

- **Gauge Stick** A marked piece of batten made by the roofer with measurements equal to the established gauge of the roof.
- **Gutter** Any form of horizontal or near horizontal channel for conveying rain water.
- **Gutter Board** A board on which waterproof material is laid to form the base (sole) of a gutter.
- **Head Flashing** Flashing used with cladding over an opening.
- **Head Nailing** Fixing with nails approx. 30 mm below head of the slate.
- **Hip (Piend Scottish)** The sloping intersection of two inclined surfaces which meet at a salient angle.
- **Hip Capping** A weather resistant covering over the hip joint.
- **Hip Hook (Iron)** A metal strap, bent to form a stop for the hip covering and screwed to the lower end of the hip rafter.
- **Hipped End** Roof surface, usually triangular, bounded by hips at the sides and an eaves at the base.
- **Hip Rafter** The timber inserted between the eaves level and the ridge level at a hip on a roof to coincide with the pair of adjacent roof slopes.
- **Hip Tile** A roofing tile formed into a hip capping, e.g. bonnet, close fitting.. A clip to secure or join lengths of flashings or capping.
- **Holing** Punching or drilling holes in the back of the slate to form countersunk holes on the top part to allow nail fixing.
- **Insulation** Material usually specially designed to reduce the heat losses from a building or to minimise sound entry to or from a building.
- **Laced Valley** A valley in which the courses are not horizontal. each course being swept up to a slate-and-a-half, laid obliquely on a wide board valley.
- **Lap A** 1. Generally the distance that one course of slates covers the course next but one below it.

  2. Slates head-nailed with a single nail: the distance that one course of slates covers the course next but one below it less the distance of the nail hole from the slate head.
- **Lap B** The distance or cover, that slate overlap:

  Side lap the cover at the sides.

  Head lap the cover at the head.
- **Lead Slate** A flashing used where a pipe or other section passes through a wall or roof, it comprises a base to course in with the roofing and a sleeve to enclose the section.
- **Lead Wedge** Folded piece of sheet lead used in a masonry chase (groove) to secure a flashing.
- **Mansard** A roof with two pitches on each side of the ridge. the steeper commencing at the eaves and intersecting with a flatter pitch finishing at the ridge. The term is sometimes applied to a roof with steeply pitched slopes surmounted by a flat roof.
- **Margin (Gauge)**The distance from the lower edge of a slate to the lower edge of the course immediately above.
- **Mitred Hip** A covering of roof tiles or roofing slates cut to form a mitred joint at the hip and laid with soakers.
- **Mitred Valley** A valley in which the tiles or slates of each course are mitred and laid with soakers.
- **Mortar** A mixture of sand and lime and/or cement, made into a wet mix and used to bed some roofing components and to secure flashings into masonry walls.
- **Mortar Fillet** A triangular strip of mortar applied to abutments, top edges, under verges and in similar positions.
- **Nail Sickness** The deterioration of the fixings of slates or tiles due to electrolysis or chemical attack.
- **Open Slating** Slating with a space between the edges of adjacent slates in the same course often used for vertical slating.

- **Open Valley** A valley where roofing is cut and laid so that the valley lining is visible in the space between the two slopes.
- **Outlet** A box formed in a gutter or flat roof to collect rain-water before it discharges into a rain-water pipe.
- **Overhang** Any part of a roof that projects beyond the line of the walls beneath it.
- **Parapet** That part of a wall or wall cladding continuing vertically above the level of roof eaves or gutter, so that both sides of the wall are exposed to the outside. Generally this makes the gutter a concealed gutter behind the parapet.
- **Patina** Thin natural chemical compound formed on metal surfaces exposed to the air. These are not necessarily harmful, but can be both protective and decorative.
- **Pipe Flashing (Soaker)** The circular flashing around a pipe which passes through a roof or wall.
- **Pitch** The angle of inclination of a roof to the horizontal.
- **Pointing** The final filling of mortar joints in masonry, requiring a smooth, water resistant finish.
- **Porosity** The degree to which roofing materials may absorb water vapour through microscopic spaces or voids in the material.
- **Rainwater Pipe (RWP)** A vertical pipe for carrying rainwater, generally from a roof.
- **Raked Flashing** A flashing covering the joint between a roof slope at its inclined edges and the vertical surface or wall projecting vertically above it. Securing the flashing into or under the wall surface is generally horizontal; the flashing has to be in short lengths as it progresses down the slope.
- **Ribbon Course** A course that has a different margin than other courses on a slate roof.
- **Random Slating** Random sized slates laid in graduated courses, the margin diminishing from eaves to ridge.
- **Ridge** The intersection of two inclined surfaces at the apex of a roof.
- **Ridge Capping** A protective capping at the ridge.
- **Ridge Rafter (Board)** The timber member which runs along the ridge of a roof to which the top ends of the roof rafters are fixed.
- **Roof Decking** Components forming a continuous horizontal surface, spanning between beams and covered with the weatherproofing roofing material and/or insulation.
- **Roofing** Upper layer or layers of a roof providing a weatherproof surface.
- **Roofing Felt** Thin, flat, flexible sheet used for roofing, particularly products based on matted fibres and treated to restrict the passage of water.
- **Saddle Piece** A flashing dressed to cover the triple joint at the end of the ridge where it meets a hip or valley.
- **Sarking** A term used in Scotland to describe roof boarding up to 25 mm thick.
- **Secret Gutter** A gutter between a roof and a wall, not visible from the ground, generally behind a parapet wall.
- **Side Lap** The distance laterally by which parts of a roof covering overlap adjacent parts.
- **Skirting** A portion of a roof or flashing, turned up against a vertical surface.
- **Slate Bed** The upper surface of a slate as normally laid.
- **Slate Edge** The side edge of a slate.
- **Slate and a Half** A width of one slate and a half used to close the half bond.
- **Slate Hanging** Roofing slates fixed to a vertical surface.
- **Slate Hook** A method of securing roof slate without nails. Much used in Europe.
- **Slate Tail** The lower edge of a slate.

- **Soaker** A flashing used in conjunction with another flashing which laps over it (e.g. cover flashing), to enable movement to take place between the construction protruding through the roof and the roof covering.
- **Soaker Flange** A soaker used around pipes incorporating a purpose-made base to make the watertight joint on to or under the roofing or cladding sheet. A soaker flange is generally fabricated as one piece as a sleeve with a skirted base.
- **Soffit** The externally exposed ends of eaves or fascia.
- **Soffit Board** The board or other material fixed on a soffit.
- **Step and Cover Flashing** See Raked Flashing.
- **Stepped Flashing** Cover flashing used at an inclined intersection, with its top edge shaped to step up from course to course of masonry and be secured into horizontal joints.
- **Swept Valley** A valley in which tiles or slates, made or cut to taper, sweep round in horizontal joints.
- **Tack** A narrow strip of metal that secures the free edge of flashings, etc.
- **Tilting Fillet** A fillet usually of wood. used at the eaves or at open valley gutters, to support the slates in the correct position relative to the roof surface.
- **Top Edge** The upper edge of a roof surface finishing at a ridge or against a part of the structure which rises above the roof surfaces.
- **Top Face** The visible part of the slate when laid.
- **Truss** A structural roof frame spanning large distances from column to column or wall to wall. Trusses are made up from many members of steel or timber. A truss is generally triangular in shape, following the two slopes of a pitched roof.
- **Undercloak** The bottom layer of built up roofing or a course, or courses of slates, laid under the bedding of slating at the verge.
- **Undereaves Course** A course of roofing slates, below the eaves course, finished flush with its lower edge and of a length to give correct lap.
- **Valley** The meeting line of two slopes in a pitched roof, forming a re-entrant angle.
- **Valley Board** A wide board, either side of the valley line, set into the roof rafters, to provide support for the valley linings.
- **Valley Gutter** A gutter laid to falls between any two roof slopes that drain into it.
- **Vapour Barrier (Check)** A layer of material intended to restrict the transmission of water vapour.
- **Ventilated Eaves** A pierced component at eaves level, allowing natural ventilation to the roof space.
- **Ventilated Ridge** A ridge tile providing ventilation.
- **Ventilation** The movement of air in and out of a building by natural or mechanical means, used to control condensation, odours or heat within the building.
- **Verge (Skew Scottish)** The edge of a roof surface at a gable, or the edge of vertical slating at windows reveals, ends of walls and dormer cheeks.
- **Wedge (Lead)** See Lead Wedge.

12. SLATE SHAPES.

The most common shape of roofing slate is rectangular. However, because Samaca make slates for so many different countries, each with their own local preferences, we are able to offer a wide range of shapes, sizes and thickness. As these are standard production sizes for Samaca they cost no more than rectangular models, it is therefore possible to have decorative roof patterns, in part or in whole, at no greater cost than a standard roof.

We show below the range of slate shapes we can offer but have described in detail the format for rectangular models which are most commonly used in the UK. It should be noted that “shouldered” slates, that is to say slates that have had the top and bottom corners removed, is permissible within certain guidelines, and these are illustrated.

The visible part of a slate when laid is known as the top face, while the hidden part is the back.

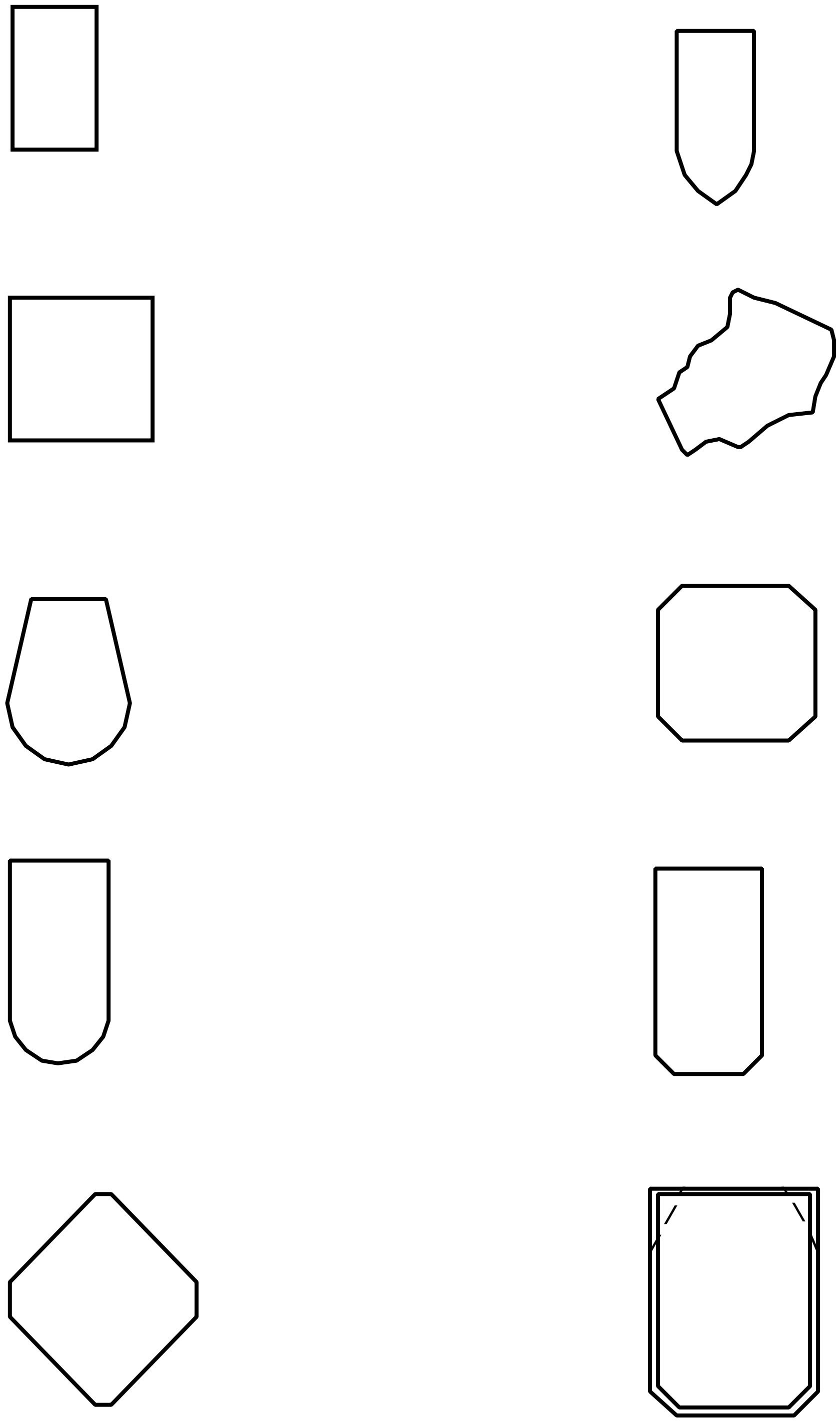


Fig. 10

13. UNDERLAY.

Underlay reduces the air flow through the roof and this increases the thermal insulation of the roof space. It also helps to exclude moisture, snow and dust entering the roof void as well as helping the roofer get the roof reasonably watertight, very quickly.

When the underlay is draped over rafters it should be type 1F and type 5U reinforced bitumen felt to BS 747 and BS 5534. The horizontal laps for underlay draped over rafters is between 100 - 225 mm depending on roof pitch. Nails should conform to BS 1202: part 2, part 3: specification for nails and BS 5534. They should be extra large felt nails of copper, aluminium, alloy or galvanised steel 3.35 mm diameter x 20 mm long.

When underlay is used with boarding or sarking, it should be fixed on counter battens to increase ventilation under the slates or the underlay can be laid directly onto the sarking with battens. In the latter case ventilation under the sarking is necessary.

Always have a 5 mm gap between the boarding to allow for ventilation and movement of the wood.

Fixing

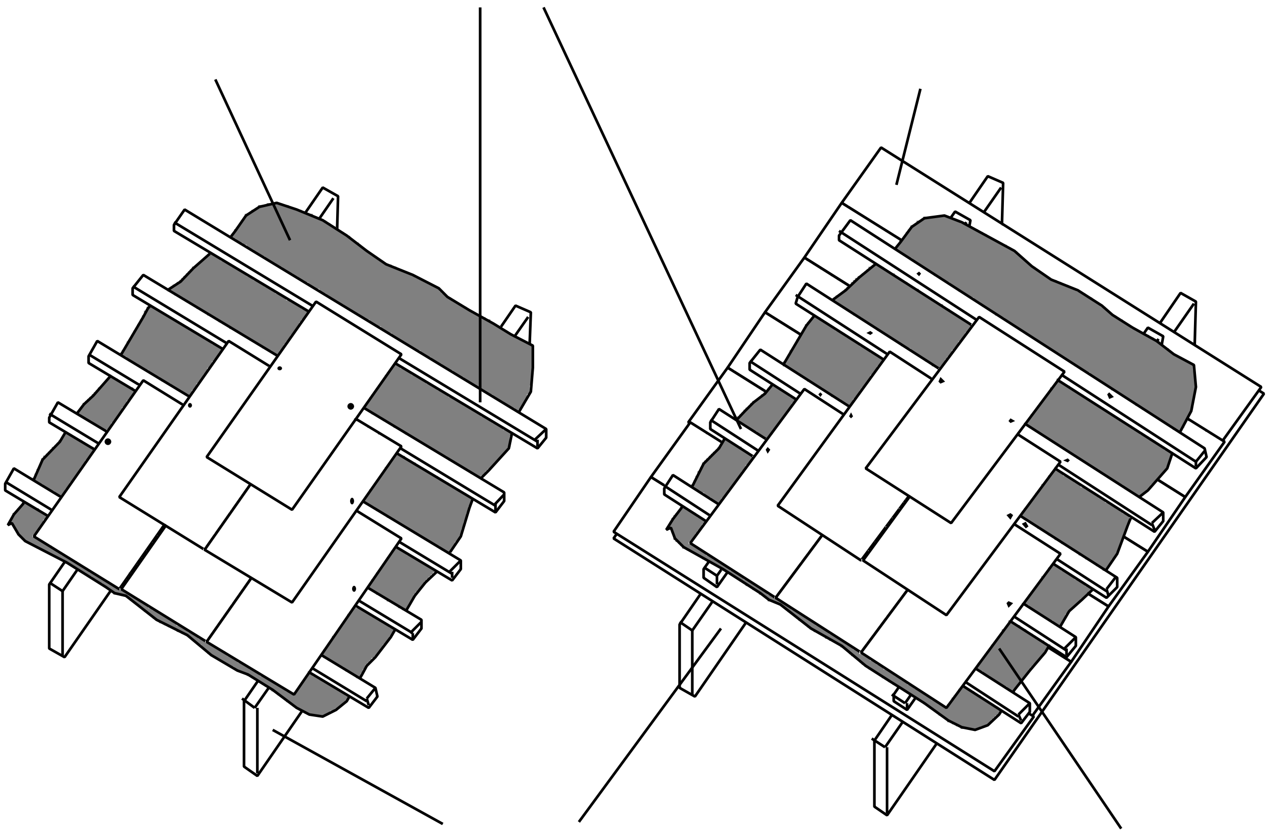


Fig. 11

14. BATTENS.

The recommended batten sizes for pitched and vertical slating using slates 4/5 mm thick and rectangular in shape are:

A) Rafter span up to 400 mm = 38 mm wide x 19 mm deep
B) Rafter span 450 mm = 38 mm wide x 25 mm deep
C) Rafter span 600 mm = 50 mm wide x 25 mm deep

To avoid splitting of battens the maximum nail diameter should not exceed one-tenth of the batten thickness for nails fixed on the centre line of the batten width.

Battening on boarded roofs (sarking) with underlay, should be supported on counter battens to increase ventilation under the slates and to allow free drainage of water that might reach the underlay. Alternatively counter battens can be omitted but it is necessary to have ventilation under the roof boards.

15. NAILS.

The recommended sizes of nails for fixing slate battens, boarding and underlay to rafters is:

Material	Diameter	Length	Type
Battens	2.65/3.35 mm	65 mm but must penetrate rafter by at least 40 mm	Smooth angular ringed shank, or vertically barber shanks
Boarding	3.35 mm	65 mm as above	Cut nails, wire nails, oval bradhead
Underlay	3.35 mm	20 mm	Copper, aluminium, or alloy large felt nails

The recommended nail size and type for fixing slate to battens is:

Batten Size	Diameter	Length	Type
19 mm batten	3.35 mm	Not less than 25 mm but long enough to penetrate batten by at least 15 mm	Aluminium, copper, and silicon bronze
25 mm batten	3.35 mm	Long enough to penetrate batten	Aluminium, copper, and silicon bronze

16. FIXING SAMACA NATURAL SLATE.

Samaca take great pride in the quality of it´s product. As one of the largest slate quarry groups in the world we want to ensure that the finished roof is a source of pride and security to the building owner.

The extraction and production of natural slate, although a labour of love for us, is hard work. The difficult mountain terrain and the constant challenge of nature does not allow us to relax for a moment. We want to make sure that the craftsmanship of our splitters and dressers and the rigorous quality control standards which we have, are not jeopardised by poor quality fixing on site.

It is not the intention of this manual to provide an explanation of how to physically set out and slate a roof. Slating is a job for skilled craftsmen and should not be confused with the relatively easy task of tiling. We therefore recommend that an experienced roofing firm is employed to carry out the slating works.

Sitework

1. Samaca slate is delivered to site in wooden pallets. We recommend that the slate is stored in their pallets whenever possible. When they are stored loosely on site they should be stacked on their long edge on dry level ground under two rows of battens.

2. Check pallet labelling which will show:

- Quarry reference number.
- Producer's name (not a brand name).
- Quantity of slate in pallet.
- Quality of slate i.e. 1st Quality (Primera) 2nd Quality (Eco or Standards).
- Producer's quality control label (this identifies important production information).
- Check that the delivery complies with order details in every respect.

3. Sorting the slates. Each slate should be inspected and the thicker end selected for the tail. The use of shouldered slates (those with top corners removed) is permissible providing they are hidden by the course above.

4. Determine the headlap to be used. The method of choosing the correct headlap (dependent on the roof pitch and site exposure). Is shown on page 8.

5. Hole the slates to the correct gauge (the correct gauge will depend on the amount of lap being used). Each slate should be holed twice at a distance from the tail equal to the holing gauge.
The holing gauge is the gauge and lap + 8-15 mm (The calculations used by Samaca in the table of quantities is + 15 mm). Each hole should be 25-30 mm from each edge to the hole centre. If head nailing is used the centres of the holes are usually 25 mm from the head of the slate. Sort the slates into three or four grades of thickness as, being a natural material there will be variations in thickness.

6. Holing should be made from the back face of the slate so as to provide a countersunk hole on the top face for the nail head. We recommend that holing is done using a suitable holing machine. This can either be drilling or punching. Ideally the holing and grading can be done at the same time. Holing, which has to be done during fixing, can be made with the spiked end of the slaters hammer. However thicker slates, more than 4mm, should be holed by machine.

7. During fixing, the thickest grades should be used for courses nearest the eaves, decreasing in thickness progressing towards the top of the roof.

8. For efficient use of labour, accuracy of cutting, and to minimise wastage we recommend the use of a slate cutting machine. This type of cutting work would normally be for hips and valleys. To maintain adequate laps and to allow proper fixing we recommend that slates should not be less than 145 mm wide.
At verges and abutments the use of slates less than 145 mm wide is to be avoided. In such cases use "slate and a half".

9. Marking out the roof (Perping). This should be done before commencement of slating.

   The sequence is :

- Fix underlay as specified.
- Keeping to the specified lap, mark out to the correct batten gauge. The gauge can be adjusted to provide an equal number of courses.
- Fix battens.
- Check widths of slate and mark out the slate joints on the battens. Every roofer will have their own method for doing this but we recommend the marks are made at least every third course.

10. Load slates on the roof, placing the thickest batches nearest to the eaves and the thinnest near the top of the roof.

11. Fix slate to marked lines, making sure that thick and thin slates are not laid next to each other, as this will cause unsightly cocking up across the roof surface.

Note:

Regional variations in the way of fixing slates, especially in Scotland, would be different to the manner described above. However, unless Samaca thick slates, which are more than 6mm thick, are being used, we recommend that the fixing method described is followed.

We recommend the use of genuine 1st quality slate at all times. If seconds, also known as Economy, Standard and Merchant grade, are used then the roof appearance will normally have an inferior finish. Second quality slates are characterised by an uneven surface, inconsistent thickness from top to bottom of the slate, broken corners and possibly a twist in the slate. The amount of slate wasted during fixing can be double that of selected 1st quality material.

Roofing contractors who wish to obtain a more comprehensive step by step fixing procedure should contact our sales department.

17. SARKING (BOARDED ROOF).

Sarking as a base material is widely used in Scotland and is recommended in areas of high winds and snow. Local custom should be taken into account when preparing drawings. However, certain basic rules should be followed when sarking is used.

Tongue and groove boarding is not recommended as ambient moisture can warp the boards causing them to lift and move the slates. The same principle applies to sheet material such as plywood.

Butted boarding, as figure 12, is recommended. A gap of around 5 mm is left between the boards to facilitate ventilation. Boards should be at least 19 mm thick but where rafters are 600 mm apart we suggest 25 mm thick boards are used. Rafters should never exceed 600 mm centres. Boards are nailed to the rafters with a nail near each edge.

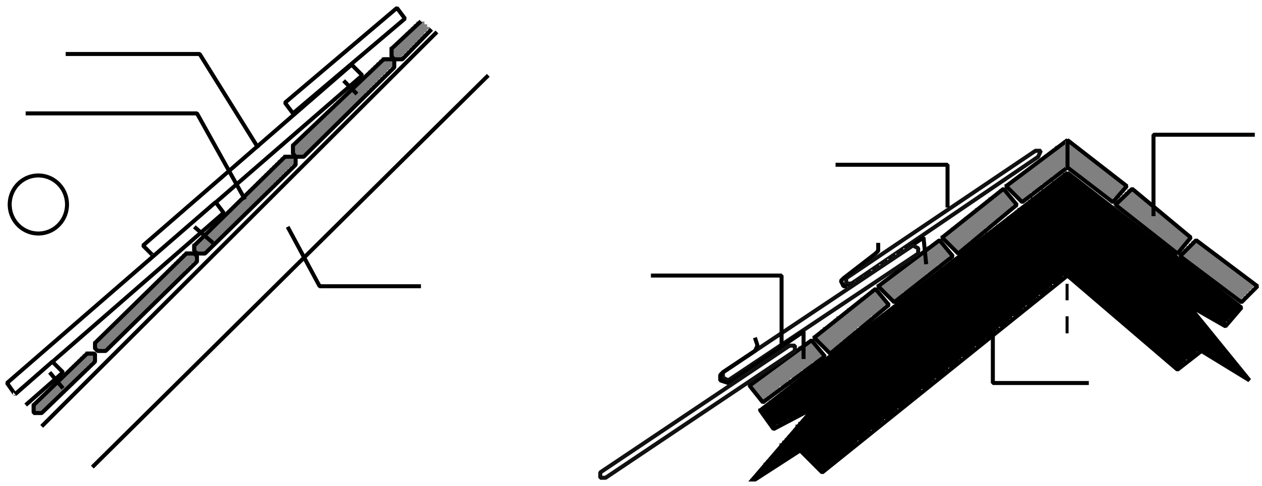


Fig. 12

18. EAVES.

Eaves are the lower edge of a roof and receive water from the pitched roof which usually runs into a gutter. It may be horizontal, raked or curved. Curved eaves may be concave or convex. The horizontal eaves is the starting point for roof slating, and all the courses of slate should be parallel to them. The undercourse eaves slate size is calculated by adding the visible gauge to the slate lap. For overhanging eaves, invert the slate and head nail this to project by at least 50 mm over the fascia, ensuring that the flow of water from the roof falls into the gutter.

The fascia board, or tilting fillet, should be raised by a slate batten thickness above the roof line, so that the eaves slate sit flat and the tails are tight. This compensates for the reduced thickness, as only two slates instead of three is used on the eaves course.

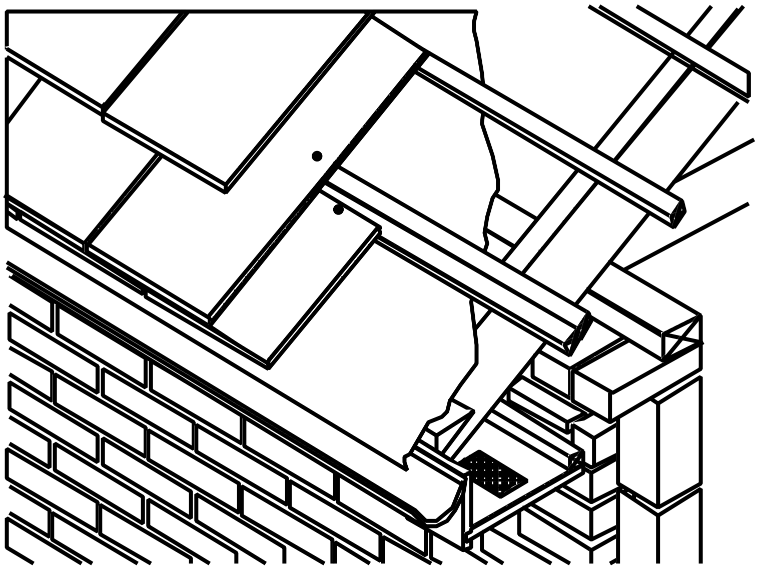


Fig. 13

For information on raking and curved eaves, please consult the Samaca technical department.

Eaves Fixing Sequence

1. Fix the underlay to extend over the tilting fillet and fascia board by 50 mm.
2. Fix the first full course batten so as to allow the tails of slates in the under eaves and top eaves course to align, and to project 50 mm into the gutter. Fix a further batten or boarding immediately below the eaves batten to allow the smaller under eaves slate to be nailed down.
3. Fix the under eaves slate on their backs and head nail to batten to overlap the gutter by 50 mm. The length of the under eaves slate is determined by adding together the holing gauge and lap. The holing gauge is calculated by adding together the gauge + lap + 8 to 15 mm (Samaca has used +15mm in the table of quantities).
4. Fix the upper eaves course to the eaves battens so that their tails align with the under eaves.

19. VERGES.

These are the edges of the roof and can be straight raked or concavely or convexly curved (86-134^0). Straight verges are parallel to the rafter pitch and to the sides of the roofing slate. It is traditional for straight verges to have alternating slate and slate and a half courses to close the half bond. However, it is possible in most circumstances, to use a half slate instead. Many consider this approach more aesthetically pleasing. It is certainly much less expensive. A half slate detail is shown in Fig. 14 and a slate and a half in Fig. 15.

We show details of straight forward verge situations. For more complex raked and curved verges please contact Samaca.

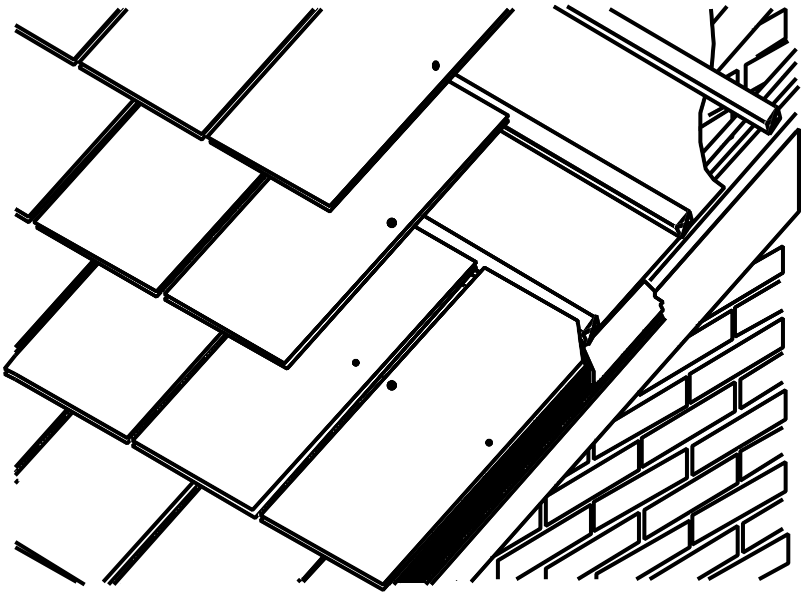


Fig. 14

The slate heads can be shouldered to make water run off the external edge and the tails shouldered to bring water back from the edge of the external wall. This also improves their appearance.

When slates do not overhang the wall they should be tilted up with a fillet or mortar, to direct water back onto the roof to prevent it running down the wall.

When the dry verges are used they should be fixed in accordance with the manufacturer's instructions.

Verges on brickwork

1. The verge should be finished with either a full slate and a slate and a half in alternative courses, or with a full slate and a half a slate. The slate heads should be shouldered to make water run off the external edge, and the tails shouldered to bring water back from the edge of the external wall. This also improves their appearance. Provision can be made for a slight inward tilt from the outside edge to direct water back onto the roof slate.

2. Bed the undercloak slates smooth face down, so that they overhang 50 mm off the face of the wall. The undercloak slates should not be less than 150 mm wide.

3. Fix the top verge slates flush with the undercloak slates.

4. Fill the gap between the two slates with mortar and smooth off to provide a flush joint. Clean off any mortar that may have got onto the roof slate.

Note: Mortar for bedding and pointing 1:3 cement/sand pigmented to match the colour of the slate.

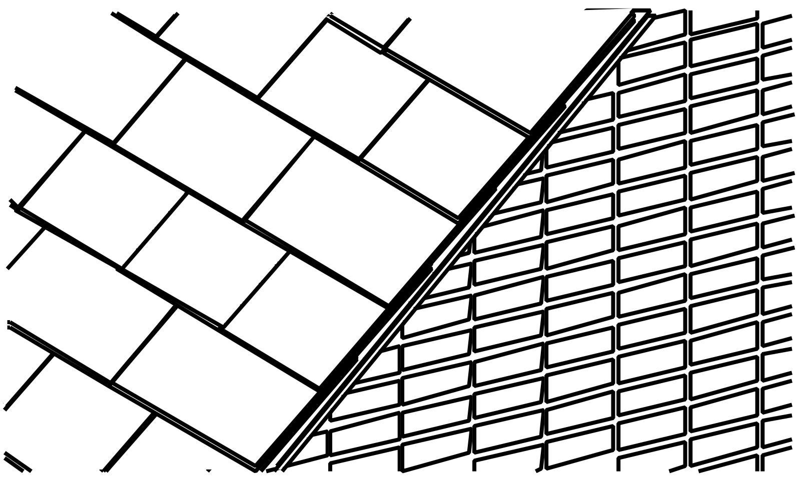


Fig. 15

20. RIDGES.

A ridge is the intersection of two slopes which form the apex of the roof. Ridges are unusually straight and water runs from the ridge onto the roof slopes. Optional ridge finishes to a natural slate roof is possible such as matt black clay to blend in with the slate, terracotta, concrete, zinc, lead etc. The more common finishes are shown but please consult Samaca for special applications.

Tiled Ridge

1. Fix 150 mm minimum underlay over the main underlay and down each side of the ridge. When ventilator ridges are used ensure that the underlay is trimmed so that it does not obstruct the air flow.
2. A board or extra battens is nailed on each side of the rafter head. The ridge courses are laid on these boards.
3. Fix the top course of slates to maintain the gauge. The full sized slates, in the course below the top course, should be heavily shouldered to allow the short top course slates to be nailed directly to the battens.
4. The clay, or concrete ridge sections, are then firmly bedded into a mortar mix 1:3 cement/sand pigmented to approved colour which also fills the joints. As work continues, the mortar should be smoothed off and the ridge and slates kept clean.

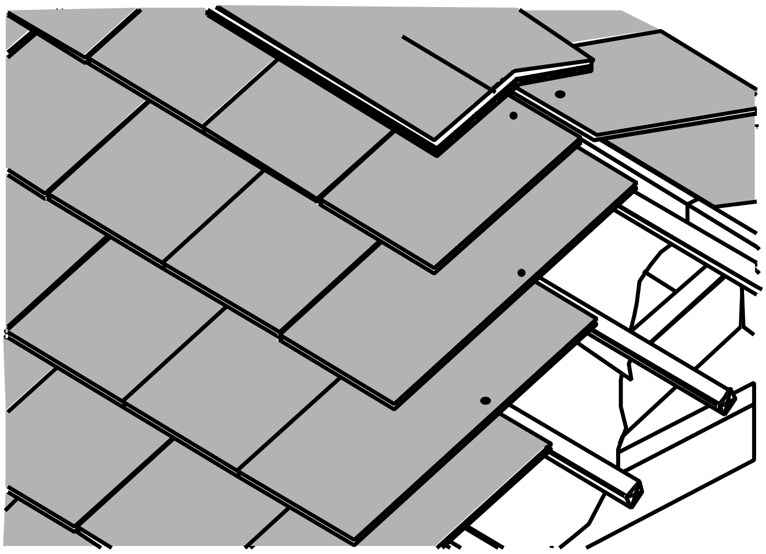


Fig. 16

Lead Roll Ridges

1. Fix 150 mm minimum underlay over the main underlay down each side of the ridge. When ventilator ridges are used, ensure that the underlay is trimmed so that it does not obstruct the air flow.
2. Fix the top course of slates to maintain the gauge. The full sized slates in the course below should be shouldered to allow the short top course slates to be nailed directly to the batten.
3. Fix the wooden roll onto the final ridge timbers. This should be notched so that the lead tack can be fixed every 300-500 mm.
4. Fox code 6 lead strips, 450-550 mm wide x 1500-1800 mm long, over the timber roll and secure with copper or stainless steel nails. Seal holes with lead washers but whenever possible make these holes under an over-lap of the lead strip. The overlap should be 75 mm.

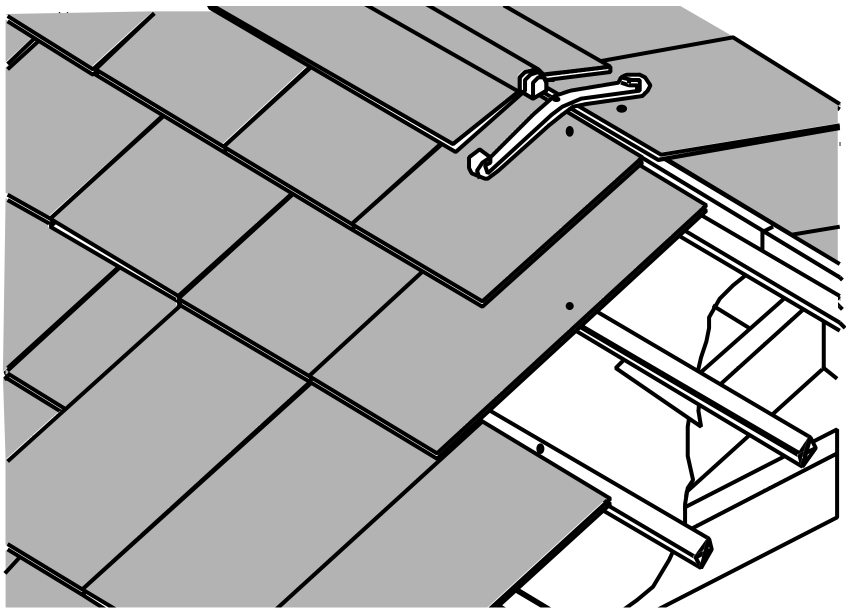


Fig. 17

Sheet Metal Ridges

These can be made from zinc, stainless steel, tern coated stainless steel (Uginox) or copper. These can be made by the roofer on site, or bought pre-formed.

1. Fix 150 mm board each side of the ridge head in place of battens.
2. Fix 150 mm underlay, over the main underlay, down each side of the ridge taking care not to obstruct any ven tilation points.
3. Fix the top course of slates to maintain the gauge. The full sized slates in the course below should be shoul dered to allow the short top course slate to be nailed directly to the batten.
4. Fix 500 mm strips of metal, identical to the ridge material.
5. Place the metal ridge onto the board, overlapping each piece by 100 mm and nail down using large headed

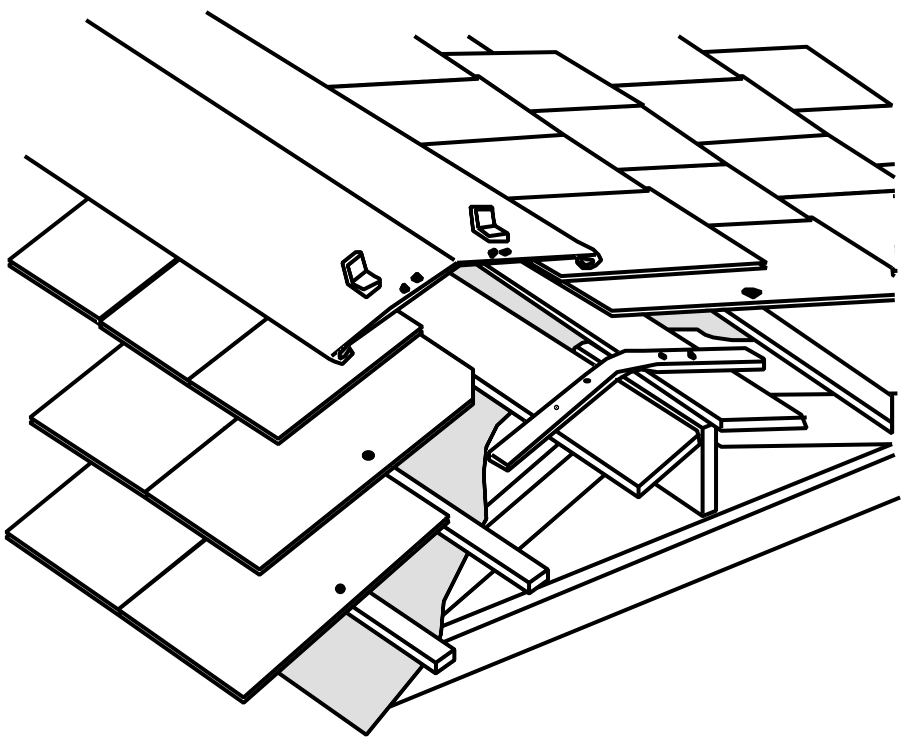


Fig. 18

copper or stainless steel nails. Seal the holes and try to cover with an overlap section. The overlapping end of the ridge is secured with pre-bonded clips. The overhang of the metal sheet either side of the ridge, should be long enough to maintain the lap, and cut and shaped to fit in with verges, hips, etc.

21. HIPS.

A hip is a side edge from which water runs off, and which forms an angle of between 11 and 89^{o} with the horizontal. Hips are susceptible to wind damage and ingress of water and great care should be taken in their design and construction.

The inclination of a hip edge depends on the angle it forms with the horizontal on the plane of the roof pitch. This should not be confused with the roof pitch itself or with the hip pitch with regard to the plan view. For further information on calculations of hip edges according to the angle of inclination please refer to the Samaca technical department.

Details for the different types of hip most commonly used are illustrated below.

Clay/Concrete Hip Fixing Sequence

1. Fix 600 mm wide underlay to overlap the main underlay.
2. Fix a hip iron to the hip rafter.
3. Cut and fix the slates as closely as possible to the junction maintaining the lap and bond between courses.
4. Fit hip tiles to a true line. The edges and joints should be bedded in mortar 1:3 cement/sand pigmented to approve colour and smoothed off to provide a flush finish.

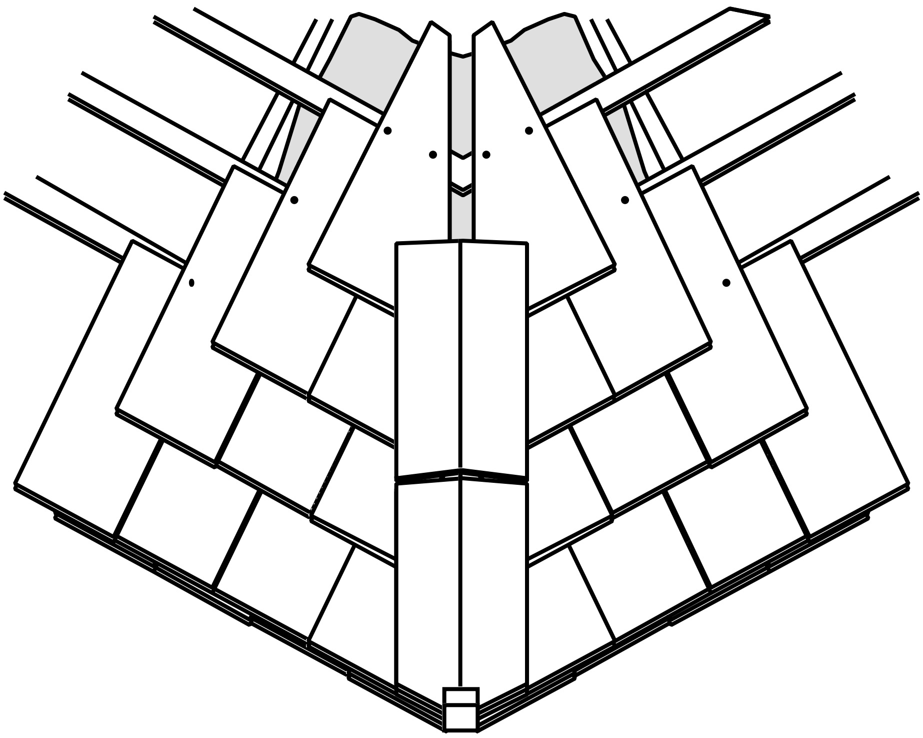


Fig. 19

5. The hip tile should be cut to align with the corner of eaves, ridge and other intersections.

Fill the eaves end of the hip with mortar and slips of slate and smooth off a flush finish. Clean mortar off the hip tile and surrounding slate.

Lead Roll Hip

1. Fix 600 mm wide underlay to overlap the main underlay.
2. Notch the timber roll, before fixing, at between 500 mm-750 mm centres(depending on exposure) to allow for fixing of the clips. The clips should be long enough to allow dressing back over the lead sheet.
3. Fix the slate as close as possible to the timber roll maintaining the lap and bond between the courses.
4. Place code 4 or code 6 lead strips 450-550 mm wide and 1500 mm long over the timber roll lapping joints by 150 mm.
5. The lead should be fixed to the timber roll with copper or stainless steel nails. Seal the nail holes with lead.

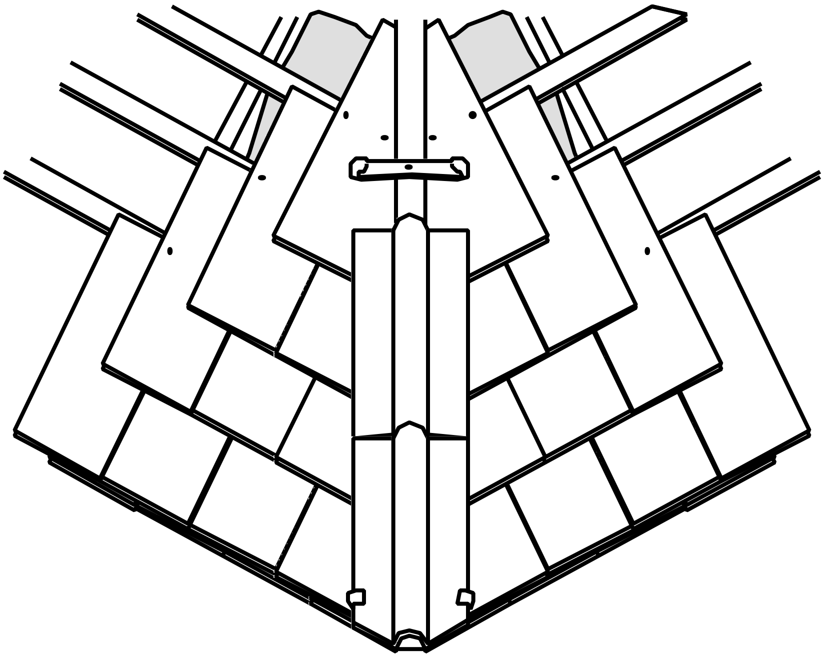


Fig. 20

6. Dress the lead tightly at all junctions keeping the 150 mm lap.
7. Treat the lead with patination oil to prevent staining of the slate.

Mitred Hip

1. Fix 600 mm underlay to overlap the main underlay.
2. Cut slates carefully making sure that, at no stage, the slate is narrower than 50 mm-100 mm at the top. If necessary use “slate and a half” and adjust the width of the “approach” slate (the slate next to the hip slate) to regain the bond.
3. Interweave code 3 lead soakers, treated with patination oil, with the hip slates and secure by nailing to battens at the top edge. The soakers should extend down by 150 mm each side of the mitred joint. It may sometimes be necessary to screw through the tail of the slate in which case use watertight washers and

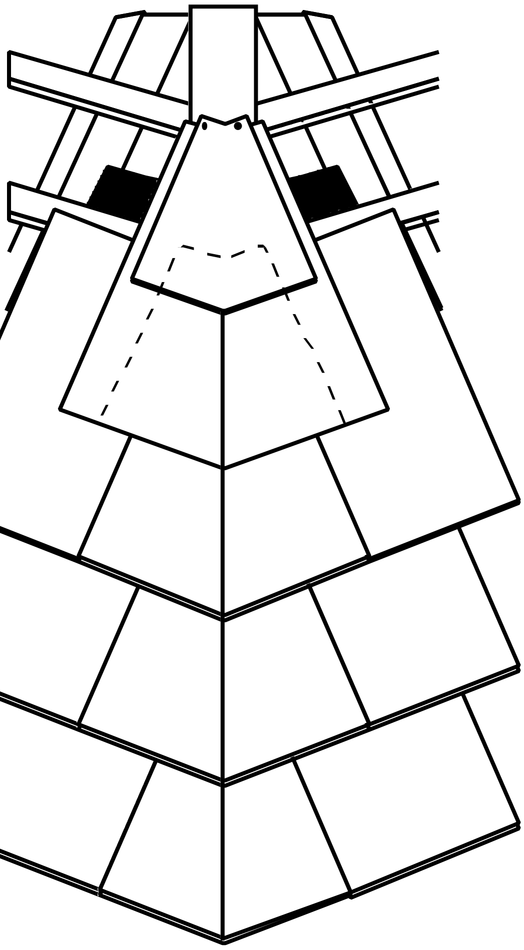


Fig. 21

caps.

Note: We do not recommend the fixing of mitred hips where the angle of the hip is 30^0 or less.

22. VALLEYS.

Valleys may be straight or curved and are formed by the intersection of two slopes in a pitched roof. After the eaves these are the areas which receive most water and, as such, are extremely vulnerable. They must be constructed with great care and are, in effect, gutters which carry water from the two pitches to the eaves.

The edges of the two slopes must have a wide board fitted either side of the valley line, set into the roof rafters, to provide support for the valley lining and to enable the slate to be nailed down.

There are several different ways to construct valleys and some examples are shown. Some of the more artistic valleys, for example, swept and laced valleys considerably enhance the beauty of a roof. However an experienced slater must be used for such work and will need to be recompensed accordingly. For more information please consult the Samaca sales office.

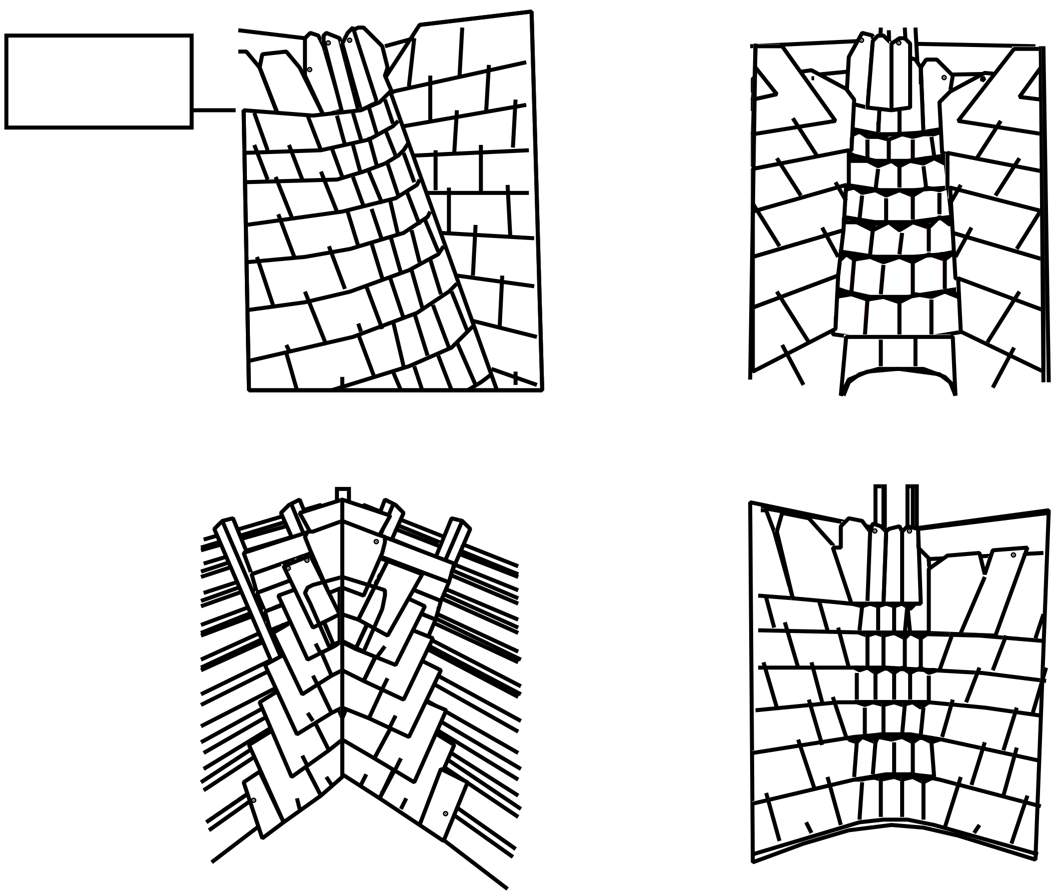


Fig. 22

In general terms an open valley is the more secure option but is not as aesthetically pleasing as a close mitred valley. However, a close mitred valley should not be used in areas of high windfall or low pitches at it is more vulnerable to the ingress of water. As a guide the roof pitch should not be less than 27.5^{o}, nor should the valley length be more than 6 metres.

Mitred Valley Fixing Sequence

1. Fix 600 mm underlay to overlap the main underlay.

2. Cut slates carefully to fit into the valley bottom ensuring that adequate width is maintained at the tail.

3. Interweave code 3 lead soakers (stainless steel or zinc is also suitable) nailed to battens at the top edge, to provide a straight, watertight, close mitred joint. The soakers must be at least half a slate width on each side of the bend. The soakers are roughly trapezoid in shape with flat tops and of the same length as the slates used for raking cut when matched courses meet on different pitches the length of the larger slate is taken.

4. If the mitred valley finishes at tilted eaves, the last soaker should have a sufficient height raised top edge to prevent the wind from blowing water up it. To maintain the slate course on the same level it is necessary to keep the minimum lap.

Open Valley

1. Fix valley boards down the intersection of the two roofing planes to match the width of the open valley. The supporting battens underneath should be no more than 250 mm apart.

2. Fix tilting fillets either side of the valley and cover with underlay.

3. Fix code 5 lead into the gutter and extend over the tilting fillets by at least 40 mm. The width varies according to the amount of water to be collected which in turn depends on the pitch, the roof area and the length of the valley itself. Normally these are 300, 400, or 500 mm in width + 40 mm either side. Treat with patination oil. For extra long valleys it may be necessary to use more than one piece because of expansion problems. In this case an overlap of 150 mm must be maintained.

4. Joins are connected be bending the top of each length onto the bottom of the one above it, to prevent capillary spread or wind from blowing the water up. The overlay depends upon the pitch of the valley and it should be remembered that on smooth surfaces such as lead capillary spread is extensive.

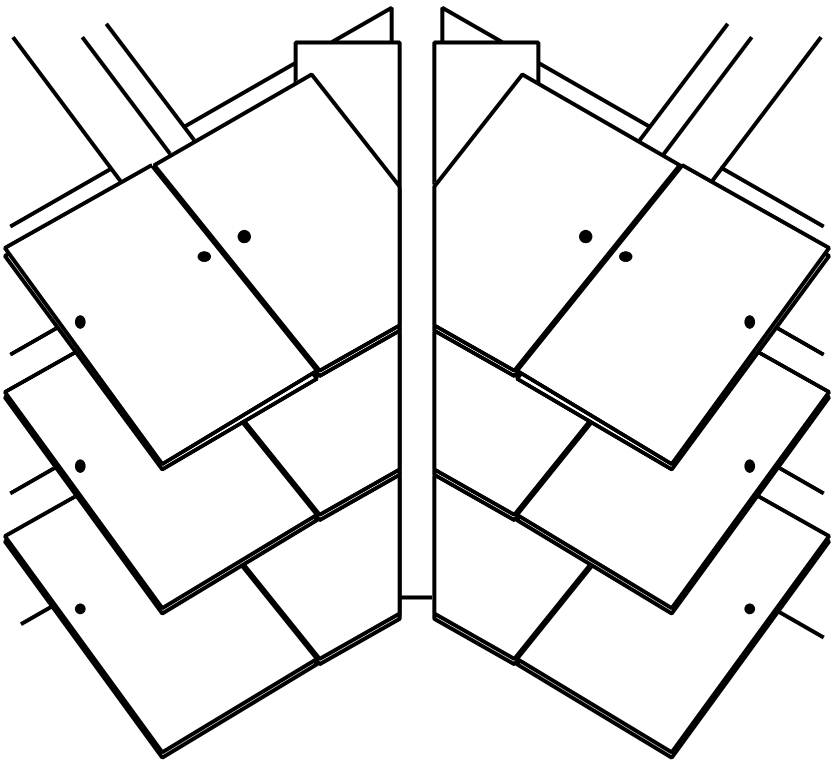


Fig. 23

5. Cut slates according ensuring sufficient width is left at the tail to overhang the tilting fillet. The slates on each side of the valley should overhang by 50-60 mm but leave a clear 100 mm minimum width of the valley.

23. ABUTMENTS.

An abutment can be described as the edge of a roof meeting a part of a building which rises above it. Metal flashings are used as a seal, where the roof abuts with another feature such as vertical walls, chimneys, dormers etc. Sometimes they are fully visible and sometimes they are partly or completely concealed.

It is traditional in the UK for code 3 or 4 lead to be used in these situations, but less expensive metals such as zinc and tern coated stainless steel can also be used.

Fixing Sequence at Roof Slope and Vertical Abutment

1. Cut and fix slates maintaining the lap and bond between courses and interleave with code 3 lead soakers (or similar). The soakers are fixed by turning the lead down over the batten at the head. They should be wide enough to provide a 75 mm upstand so forming a weather tight butt joint and to give 125 mm under the slate. The length of the soaker is gauge + lap + 25 mm.

2. Fix code 4 lead or similar flashings over the soakers and cut to secure into brickwork to a minimum depth of 25 mm. Secure the flashings by lead wedges and point with mortar. A suitable damp proof course

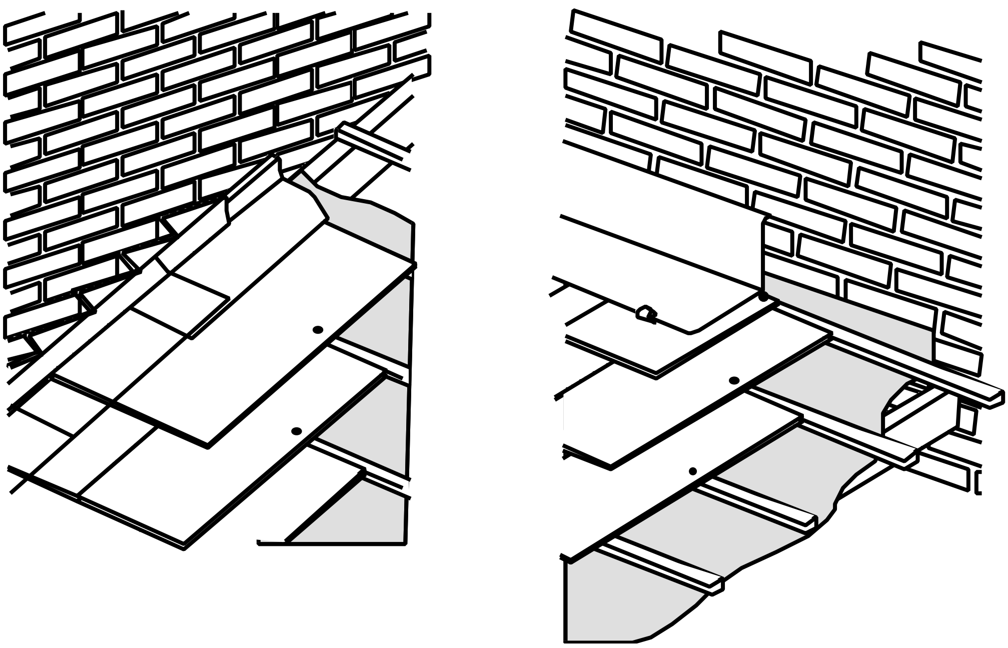


Fig. 24

should be installed to prevent wind blown rain from getting down below the roof.

3. Treat lead with patination oil to prevent staining of the slate. Clear off any mortar from the slates.

Fixing Sequence at the Top of Roof Slope and Vertical Abutment

1. Extended the underlay 100 mm up the abutment.

2. Shoulder the full size slates on the perimeter course to allow the shorter top course to be nailed to the top batten.

3. Place code 4 lead flashings to the abutment leaving 150 mm dressing over the slates. Bend the top edge and fix into the brickwork joints with lead wedges to a depth of 25 mm. Point in mortar and clean off slates if necessary.

4. Apply patination oil to prevent staining of the slate.

24. CHANGE IN ROOF PITCH.

Breaks are lines where two planes meet on the same roof forming an angle. The break line receives water from the upper pitch and passes it to the lower one.

A *convex* break is typical of a **Mansard** roof. It is necessary to follow approved design details at the change of pitch. The last course slate on the upper roof overhangs the lower slope by 50 mm. The angle between the upper and lower pitches must be less than 170^{o}.

These breaks can also be built without overhanging slate. A lead flashing covering the line of the break can be laid directly under the slates of the upper pitch and over the short course slates on the lower pitch. Lead flashing in this instance is preferable as it is easy to lift for repair work.

Concave breaks are used for pitches with tilted eaves and dormers. If the break is not pronounced roofing continues as if it did not exist with the necessary adjustment to the visible gauge caused by the change of angle.

For pronounced breaks the roof must be cut with metal flashing protecting the change of angle. This is the more traditional way of dealing with this detail.

Fixing Sequence for Mansard Roof (Convex Breaks)

1. Fix a tilting fillet on the bottom of the upper pitch which will serve to raise the tail of the slate on the bottom course. This should be equal to the batten thickness.

2. Fix a top course of slate on the lower slope to form an upstand equal to the batten thickness. The slate in the penultimate course should be shouldered to allow fixing of the final course which are head nailed to the top batten.

3. Dress code 5 lead flashing (or similar) over the bottom batten of the upper slope. The flashing should extend down the lower slope by 150 mm and 200 mm up over the bottom of the lower slope. If overlaps are necessary these should be a minimum of 150 mm.

4. Secure the flashing with large headed copper or stainless steel nails.

5. Apply patination oil to avoid staining of the slate.

6. Continue slating as normal ensuring that the bottom eaves course slate on the upper slope overhangs the roof by 50 mm.

Fixing Sequence for Change in Pitch (Concave Breaks)

1. Fix boards along the length of the junction wide enough to provide fixing for the slates and support for the metal flashing. Fix a tilting fillet on the lower edge of the upper slope.

2. Fix slates to the top of the lower slope maintaining the gauge and bond. The penultimate course slates should be shouldered so as to allow fixing for the top course of slates.

3. Fix code 5 lead flashing of sufficient width to be dressed 150 mm down over the lower slate and 200 mm up over the tilting fillet on the upper slope. Fix with large headed copper or stainless steel nails. Any horizontal overlaps in the flashing should be a minimum of 150 mm.

4. Apply patination oil to the lead flashing.

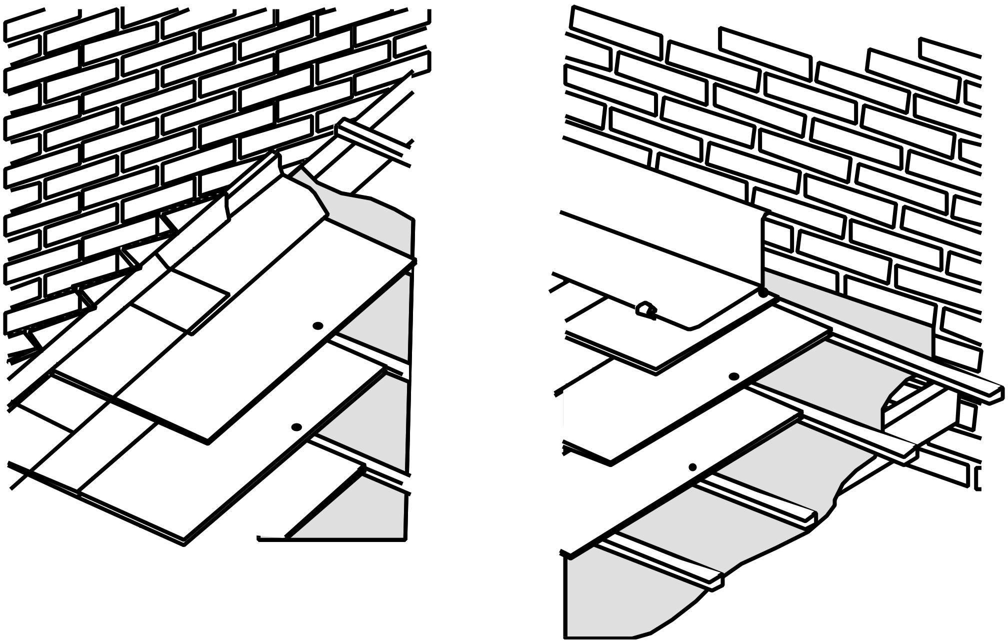


Fig. 25

25. MANSARD ROOF.

26. VERTICAL SLATING.

Cladding walls with slate is a highly efficient and economical way of protecting them; as well as direct protection from rain and damp, this system provides an air cavity which also helps prevent moisture and condensation. This cannot be achieved by plastering.

Slate cladding does away with the need for plastering which means that it is not that much more expensive to apply. It also gives a highly attractive, impermeable and durable finish.

Wood is normally used in the form of 50 x 25 mm counter battens spaced at 450 mm centres and 38 x 19 mm slate battens.

It is also possible to use adjustable metal brackets fixed directly to masonary. This system allows insulation such as rock wool between the cavity and the adjustment on the bracket allows a true vertical line to be achieved even though the masonary may not be true. It is therefore ideal for refurbishment applications. It is also possible to use a full metal frame using 35 x 35 x 3.5 mm angle pieces using special hooks to fix the slate.

A number of attractive cladding patterns are possible, two of which are illustrated. The use of underlay is unnecessary.

We recommend that stainless steel hooks (18% chromium, 10% nickel minimum quality) are used as they provide support at four different points. Therefore even if the slate is broken it is unlikely they will fall off causing possible injury to persons below. It also makes repair work extremely easy.

Samaca hooks are available in either natural stainless steel or with a black/matt coating.

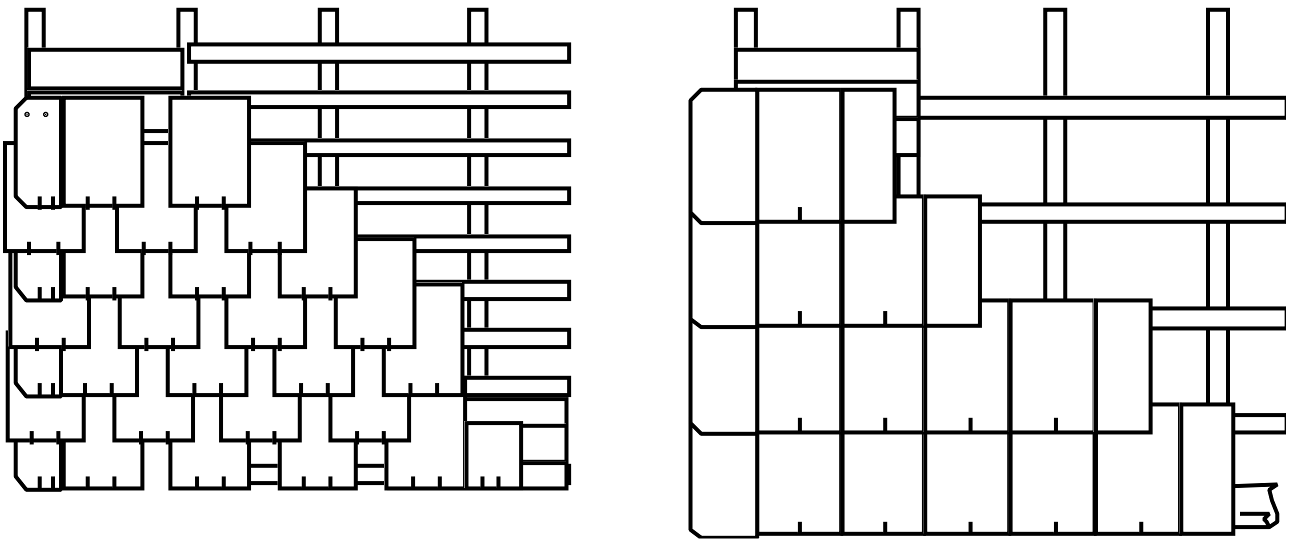


Fig. 26

Please contact the Samaca sales office for further information.

27. HOOK FIXING METHOD.

The use of hooks to fix slate has been widely used in Europe for the last 50 years, and is becoming increasingly popular in the UK.

Hooks can be used in the most exposed locations and because the slate is supported at four points, the resistance to wind uplift is extremely effective. The top edge of the slate is gripped under the top part of the hook. The shank of the hook runs down along the side of the slates in the next course, and the return grip at the bottom of the hook holds the tail of the slate on top. This means that each slate is held in place by four hooks; one at the head, one at the tail and one on each side. The one at the tail stops the hook from sliding down, the ones at the side prevent it from turning and the one at the head holds it at the batten.

Hooks are therefore more functional, quicker to work with and perfectly safe. Repair work is also much easier.

As mentioned in the section on capillarity, when hooks are used the slates are not tightly pressed together. The hooks positioned at the side of the slate form two fine channels, up which there is considerable rising capillarity. Slates still need to be three times the headlap, but width can be less than twice the headlap, because there is less creep of water and no nail holes.

The preparation for the roof carpentry is exactly the same as for laying with nails. Only the method of fixing is different. Because of the increased rising capillarity when hooks are used the headlap value will change and these are set out on the tables which follow.

Two types of hooks are used, usually called *cramp hooks* and *pointed hooks.*

Cramp hooks are used to clip over the battens and the head of the hook, (the clip on part) must be the same thickness as the batten (usually 25 mm). When sarking forms the support, pointed hooks are usually used and driven directly into the boards. The boards should be 19 mm thick but in very windy areas a thickness of 25 mm may be required.

Hooks should be made of stainless steel 18/10 grade (18% chromium, 10% nickel) and can be supplied in a matt black finish if required.

When a hook position on a battened roof coincides with a rafter, a pointed hook needs to be used. This means that around 15-20% of the hooks used will be pointed hooks, even when cramp hooks are chosen as the main

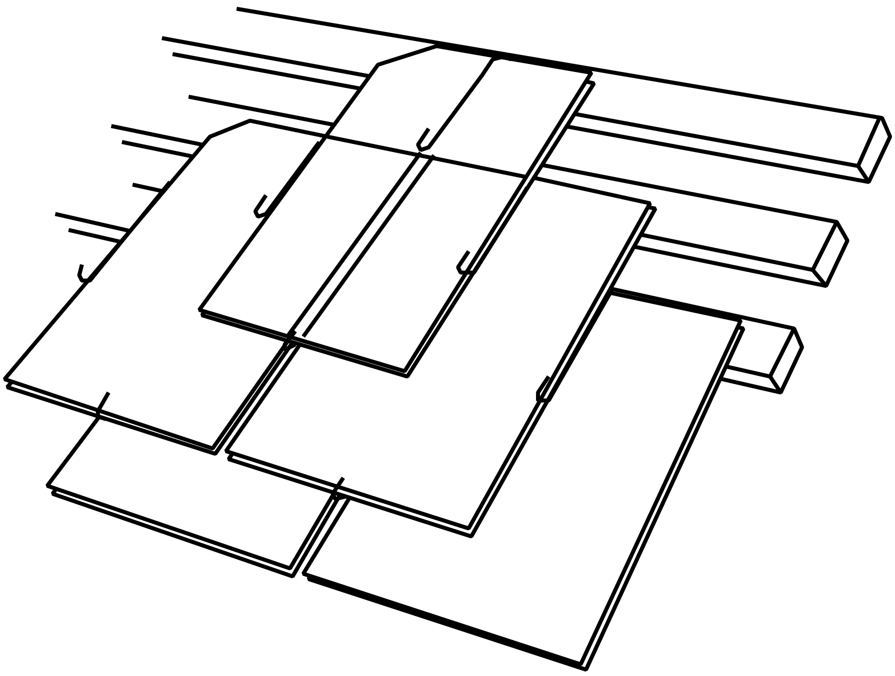


Fig. 26a

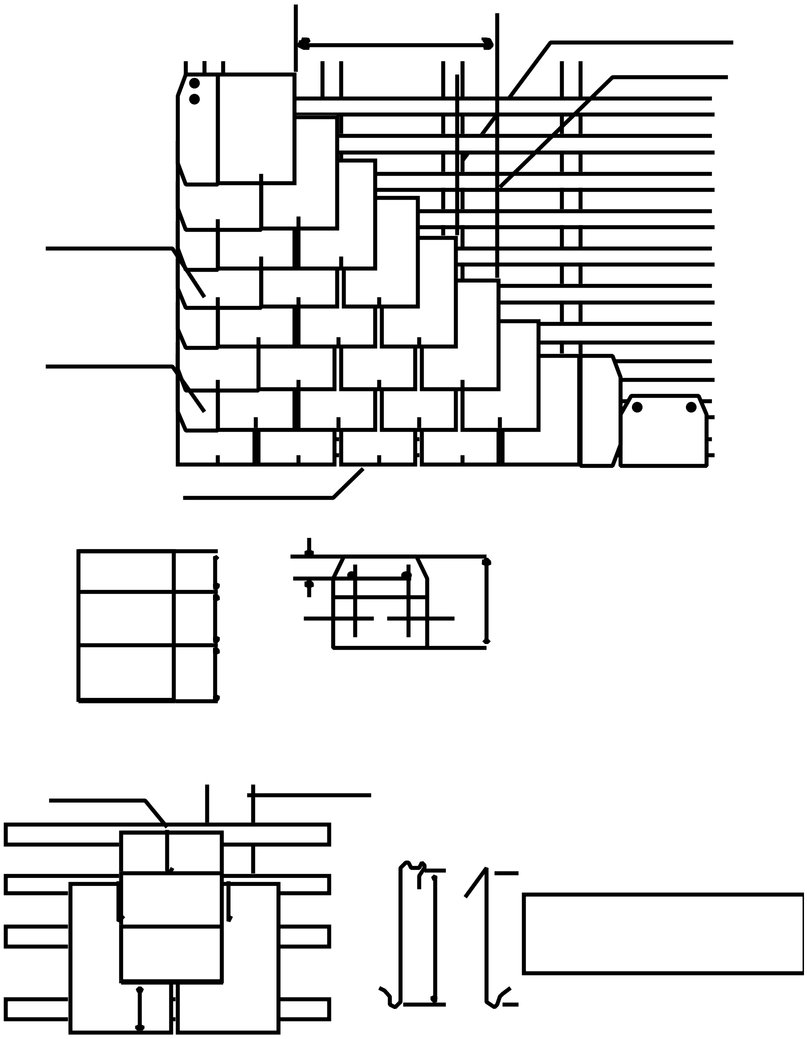


Fig. 27

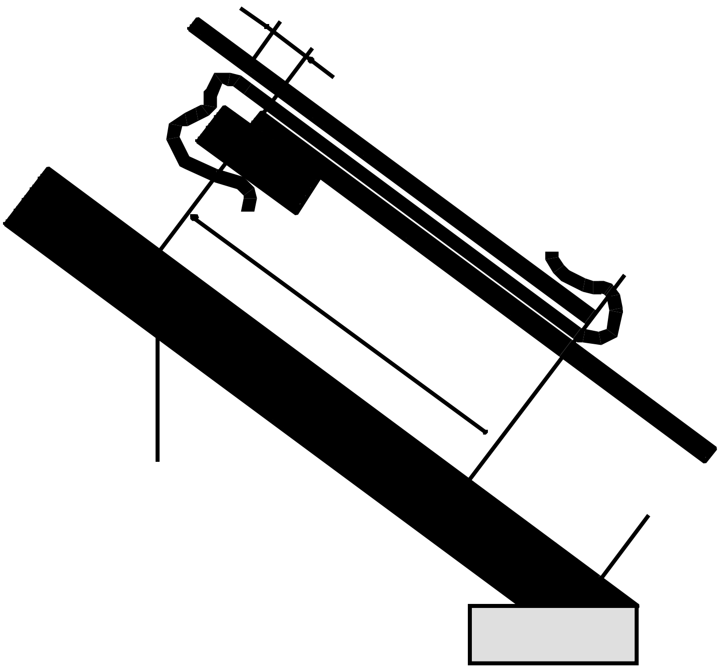


Fig. 28

method. It should be remembered that slates on verges and under eaves, must be nailed down even if the rest of the roof is fixed with hooks.

28. HEADLAP CALCULATION: HOOK FIXING.

Roof Pitch		Roof Slope following the pich per metre on the horizontal	Lap in MM								
			Region 1			Region 2			Region 3		
			Horizontal Projection of Roof slope in metres			Horizontal Projection of Roof slope in metres			Horizontal Projection of Roof slope in metres		
In cm per metre	In degrees		0 to 5.5	5.5 to 11	11 to 16.5	0 to 5.5	5.5 to 11	11 to 16.5	0 to 5.5	5.5 to 11	11 to 16.5
20	11.30	1.020	153								
22.5	12.66	1.025	147								
25	14.00	1.030	141	153							
27.5	15.33	1.037	136	147		153					
30	16.67	1.044	131	142	153	147					
32.5	18.00	1.051	126	136	147	141	153				
35	19.33	1.059	122	131	142	136	147		153		
37.5	20.50	1.068	118	127	137	132	142	153	147		
40	21.67	1.077	114	123	132	127	137	147	142	153	
45	24.00	1.096	107	115	124	119	128	138	133	143	153
50	26.50	1.118	102	109	117	113	121	130	126	134	142
55	29.00	1.141	97	103	111	107	115	123	119	127	135
60	31.00	1.166	92	99	106	103	109	117	113	121	128
70	35.00	1.220	86	92	98	94	101	107	104	110	117
80	38.67	1.280	80	86	91	88	94	100	97	103	108
90	42.00	1.345	76	81	87	84	89	94	92	98	102
100	45.00	1.414	73	78	83	80	85	91	88	93	97
120	50.00	1.562	69	73	78	75	80	85	82	87	91
140	54.50	1.720	65	70	74	72	77	81	79	83	87
170	59.50	1.973	62	67	71	69	73	77	75	80	84
200	63.50	2.237	61	65	69	67	71	75	73	77	81
250	68.00	2.692	59	63	67	65	69	73	71	75	79
300	71.50	3.162	58	62	66	63	68	72	70	74	78
375	75.00	3.880	58	61	65	62	67	71	69	73	76
Vertical	Vertical		58	-	-	60	-	-	65	-	-

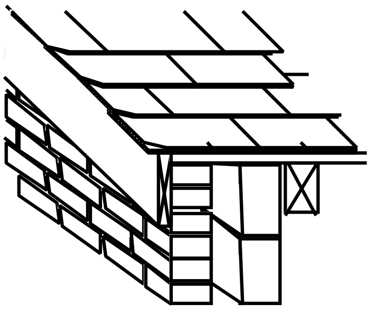
Table 4

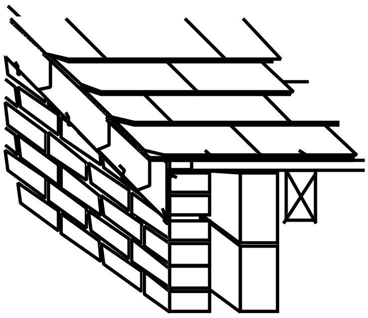
Minimum Recommended Headlaps When Fixing Roof Slate With Hooks.

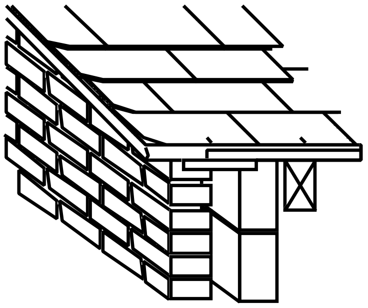
Notes:

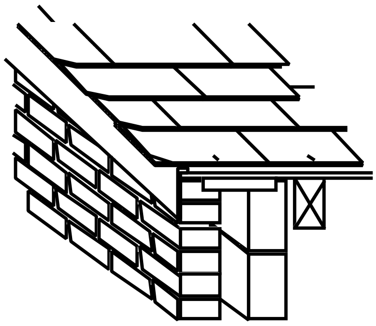
1. The minimum laps indicated above are given for a normal site within the given region
2. In the case of the lowest pitch for an exposed site the lap of 153 mm is a maximum. Therefore it is advisable to increase the roof pitch.
3. For a lap greater than 110mm, the calculation given above assumes the use of a hook with a wavy shank to limit the amount of capillary attraction.
4. The lap calculations have been arrived at by many years of observation in Europe and laboratory studies notably by the French experts Messers Brandilly, Rochette and Sangue.

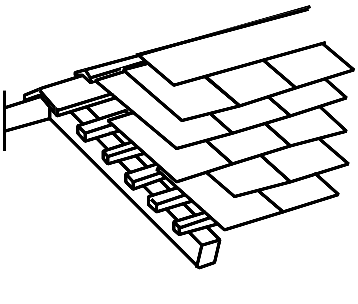
5. Hooks are available in cramp type (to clip over the battens) and nail type for use on sarking, eaves,

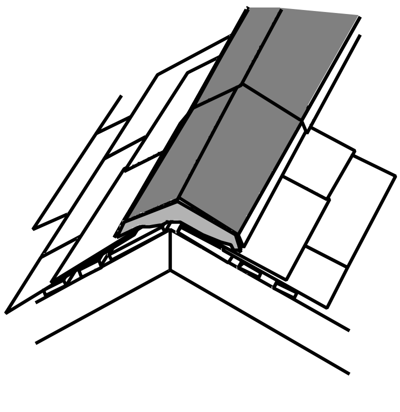


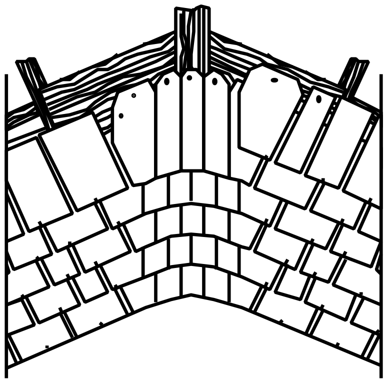


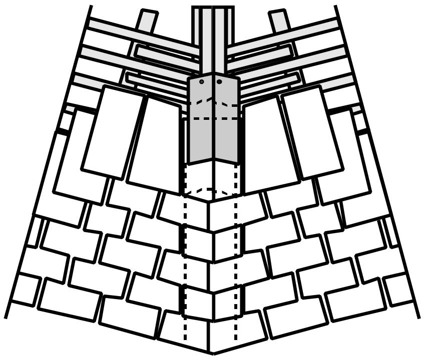


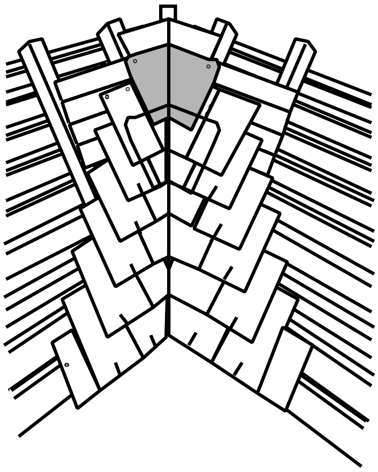


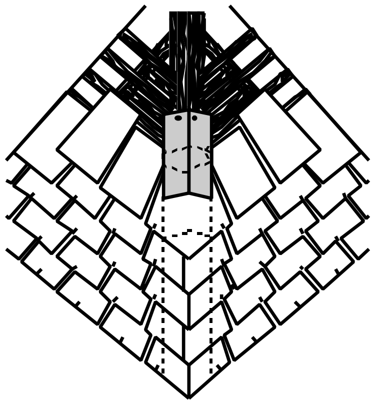


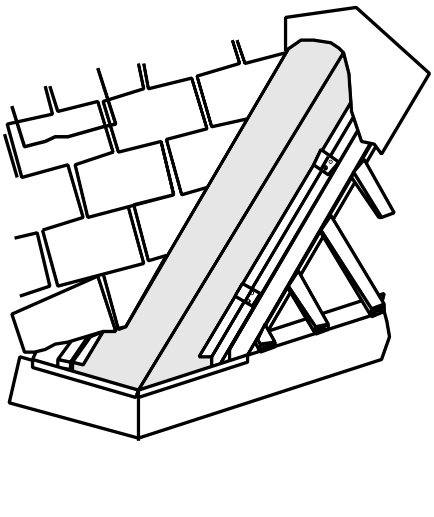


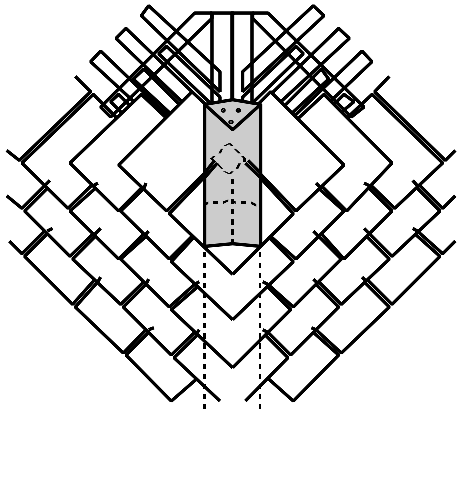


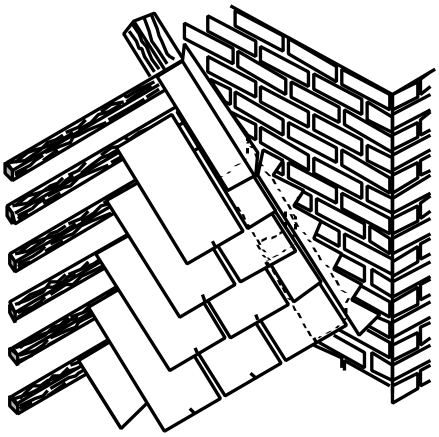


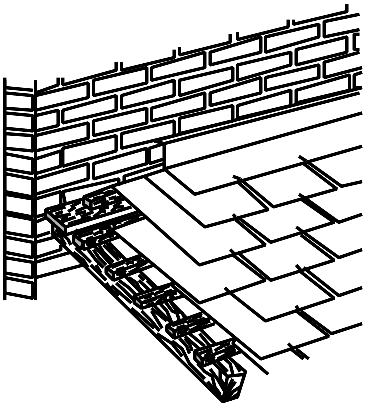


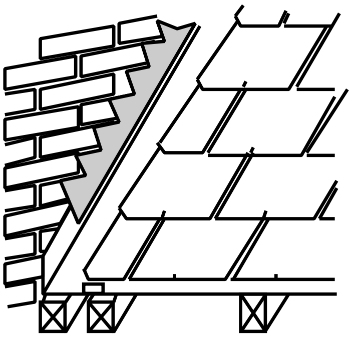


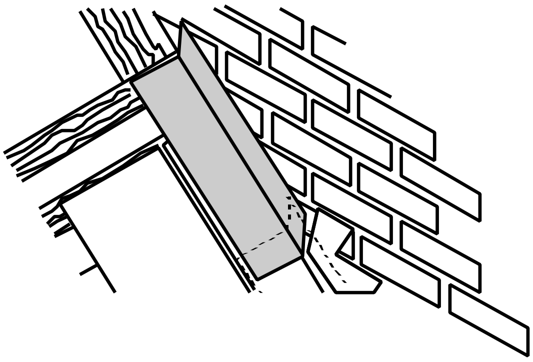


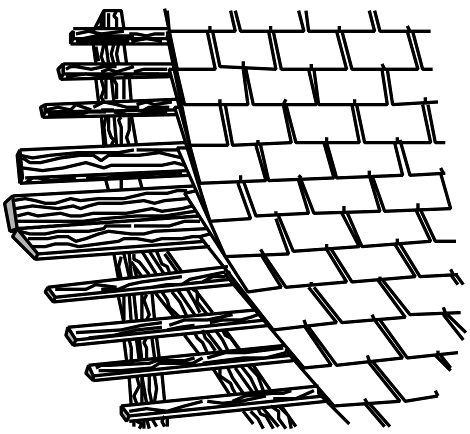


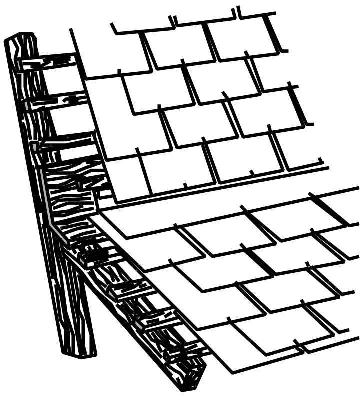




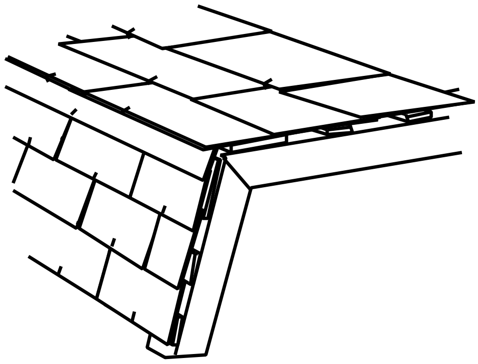


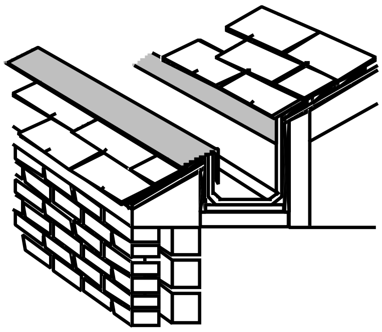


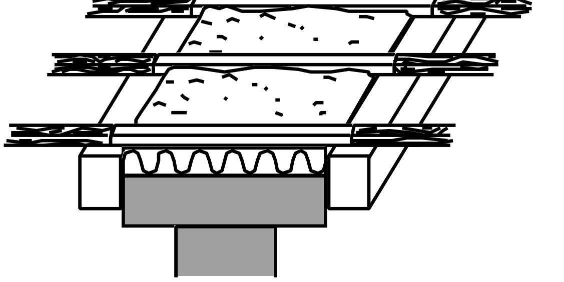




29. TECHNICAL DETAILS: HOOK FIXING.







DRIVING RAIN INDEX & EXPOSURE MAP.
30. HEALTH & SAFETY.

The following information is based on recommendations issued by the Health and Safety Executive who can be contacted at the following address:

The HSE Information Centre
Broad Lane, Sheffield,
South Yorks.S3 7HQ
Telephone: 01142892345
Facsimile: 01142892333

1) Safe Use of Ladders
Any work that cannot be safely done from a ladder should be carried out from secure access equipment or scaffolding. The ladder should rest against a secure surface and strapped to the structure.
For further information on this point refer to BS 1129:1982, BS 2037:1984, HSE Guidance Note GS31.

2) Safe Use of Scaffolds
It is the responsibility of the contractor to provide a safe working environment for operatives. It is particularly important that the right type of scaffolding is used and that this securely connected to the work area of the building. The various types of scaffolding ties are clearly set out in the following documents:
HSE General Access Scaffolding Guidance Note 5
Scaffolders' and Users Guide to Access Scaffolding BEC Publications
BS5973: 1990 Code of Practice for Access and Spacial Caffold Structures in Steel
Tower Scaffolds are covered in the following Documents
HSE Tower Scaffolds Guidance Note GS42
Operators Code of Practice Prefabricated Aluminium Scaffolding Manufactures' Association

3) Working on Pitched Roofs:
Working on a pitched roof surface is an extremely dangerous environment. As well as providing adequate scaffolding, the operative should wear an approved harness if at all practicable, and have use of roof ladders and boards.
For further information reference should be made to the following documents:
NS1397: 1979 Specifications for Industrial Safety Belts, Harnesses and Safety Lanyards
BS 5062: Part 1 : 1985 "Roofing and Cladding in Windy Conditions"

Health and Safety Statement
This information is provided in compliance with the Health and Safety at Work Act 1974 Section 8 (as amended by Consumer Protection Act 1987) and Control of Substances Hazardous to Healt (COSHH) 1988.

1. The product is natural roofing slates used as a weathering seal for roofs and wall claddings.

2. The slate is composed of various mountain sites in Galicia, north west Spain and originates from the Ordovician system The slate is composed of various minerals such as quartz, sericite, chlorite, feldspar and calcite.

3. If dust is inhaled in excessive quantities, over many years, during the manufacturing process it can, without proper controls, possibly create a long term health hazard. In the context of site work the only potential hazard is sharp edges and splinters. Precautions to be taken in areas of restricted ventilation are dust masks to BS 2091. Eye protection during cutting to BS 2092 grade 2.

4. Wear gloves during handling to avoid slate splinters and knee protectors during fixing.

5. Store pallets no more than two high.