Construction Notes - No 4 valley (Part 1)

In a series of articles on interlocking concrete roof tiles, experts from the **Concrete Tile Manufacturers Association** have pooled their knowledge. This Construction Note discusses lead lined valleys.

Inclined valley

An inclined valley is the junction between two roof slopes at an internal corner. In most instances the angle of the internal corner will be 90 degrees on plan, but could be any angle up to 179 degrees. The true valley pitch is always slightly less than the rafter pitch. This is important when specifying the lap in the valley sheet material.

Valley width

Regardless of the construction of the valley, the open width of the valley trough, measured between the cut faces of the adjacent roof tiles or slates, is a function of the quantity of rainwater flowing off the roof into the valley trough. This will vary with the area of roof that drains into the valley trough, the pitch of the roof and the anticipated rainfall rate.

For the worst case, once in 50 years, the rainfall rate should be 225mm per hour. Depending upon the three design factors, so the width of the valley needs to vary from 100mm to 200mm (see Table 1).

Valley width

To allow for the valley construction to be formed between the underside of the tiles and the top of the rafters, it is essential that the water-resistant layer of the valley is supported on timber boards **(A)** that are set between the rafters. The top surface of the support board needs to be flush with the top of the rafters and supported on noggins **(B).**

The width of the support board needs to be wider than the lead sheet by 100mm to allow the ends of the tile battens to rest on the support board by 50mm on either side and be nail-fixed to the support board. The support board should be stiff enough to resist the dressing of the lead sheet and the weight of the plumber or tiler standing on the valley. Depending upon the rafter spacing, the support board should be 18 20mm plywood or softwood boarding.

At the bottom of the inclined valley between shallow rafter pitches the support board should be run through to the back of the fascia board, rather than flatten out and discharge over the fascia board. In this situation the fascia board needs to be cut down approximately 50mm for the width of the valley.

The location of the gutters will also need adjusting. On roofs with steep rafter pitches the bottom of the valley could be made shallower to allow discharge over the fascia, provided the bottom section has a fall of at least 11 degrees.

To form a tilting fillet in the lead sheet, a triangular batten **(C)**, (normally a tiling batten cut on the diagonal) is nailed to the support boards 75m away from the edge of the open valley on either side, running the full length of the inclined valley. The top of the tilting fillet should not be higher than the main tiling battens, once the lead has been dressed on the fillet.

Between the tilting fillets it is common to lay smooth sheets of 4mm plywood **(D)** to give a suitable surface for the lead to lie on and allow the lead to slide up and down in expansion and contraction. There are geo-textile materials sold by lea sheet suppliers that will achieve the same purpose. However, the use of bituminous felt under lead sheet is not recommended, as the bitumen is known to melt and stick the lead to the support board, thus preventing the lead expanding and contracting. This will result in stress cracks forming in the lead sheet and its early failure as a water-resistant layer.

Lead sheet

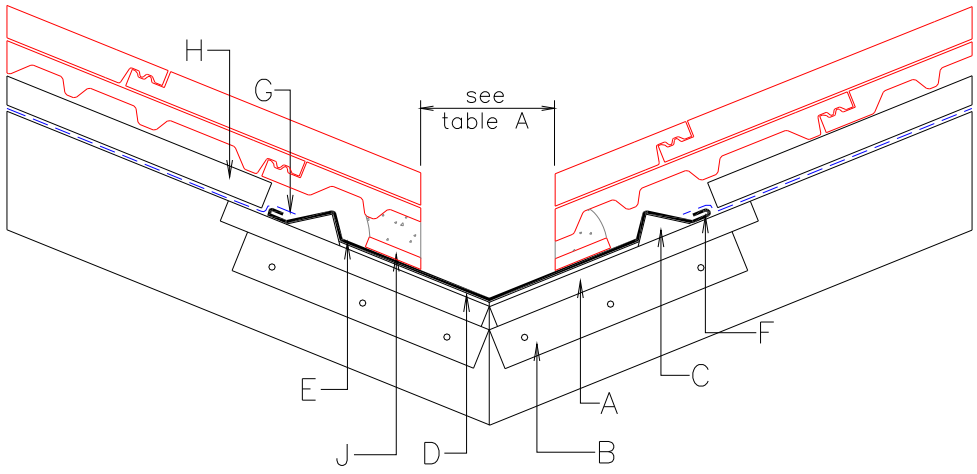
Milled lead sheet to BS 1178 *Specification for milled lead sheet for*

TABLE 1:Variations in widths of valley gutters and girths of lead lining according to roof pitch

Roof pitch (degrees)	Width of valley gutters (mm) for rainfall rate 225mm/h draining		Girth of lead to line valley gutter (mm)	
	25m² and less on plan	over 25m² up to 100m² on plan	25m² and less on plan	over 25m² up to 100m² on plan
12½–17	150	250	550	650
17½–22	125	200	525	600
22½–29½	100	150	500	550
30–34½	100	125	500	525
35+	100	100	500	500

See BS 6367: 1983

FIGURE 1: Valley with metal lining



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building purposes is a long-lastingmalleable metal that is very heavy and therefore tends to be less affected by strong winds than other lighter materials such as zinc or aluminium. Its ability to be dressed into shape, or welded, makes it ideal for forming inclined valleys. However, it expands more than its competitors and so the valley construction needs to allow for this. Code 4 lead is suitable for valleys for most buildings, but for larger buildings, Code 5 lead is often used.

The lead sheet **(E)** should be laid in lengths no longer than 1.5m. This is to reduce the overall amount of expansion at the laps and prevent tearing of the lead sheet at nail fixings. Each sheet should be nailed at the head, under the head lap and one third down the side edges.

The width of the lead sheet will depend upon the open width of the valley, plus 200mm on each side to allow for the width of the mortar bedding, 25mm gap, the tilting fillet, a 25mm gap and then the welt (F) on the outside edge.

The lead needs to bent and dressed into position with the correct amount of lap with the sheets above and below it. The amount of headlap will depend upon the true pitch of the valley. At a true valley pitch of 30 degrees and steeper the lap should be 150mm, according the Lead Sheet Association. At below 3 degrees the amount of lap will increase up to 390m at 11 degrees (see Table 2). The welt should be formed away from the tilting fillet, not on top or at the side of the tilting fillet, as it would be ineffective and may cause the tiles to kick up.

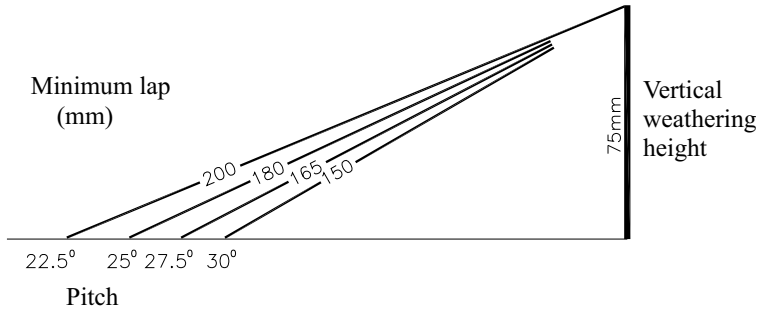
Valley junctions

At the bottom of the valley the whole lead sheet should dress into the gutters or onto the roof tiles where the valley forms part of a dormer. This may require the tilting fillets and welts to be flattened. At the top of the valley where it meets another valley or a hip junction, there should be a lead saddle. At the junction of two valleys and a ridge, as with a dormer, the ridge tile should stop on the edge of the valley.

Roof underlay

The roof underlay **(G)** should finish on the edge of the sheet valley, on the welt. The underlay should not finish under the edge of the lead valley, as any water on the underlay will drain out under the valley. The underlay should not dress over the apex of the tilting fillet, as it will allow any water held behind the mortar bedding (which is the first line of defence), to track over the second line of defence (ie the welt) on the underside of the underlay.

TABLE 2: Minimum laps according to pitch



Battens

The tiling battens **(H)** should be cut in line with the valley, approximately 10mm short of the lead welt, to allow any moisture on the underlay to drain down the eaves uninterrupted. The 10mm gap also helps to prevent the ends of the battens puncturing the underlay where it rises onto the welt.

Where the ends of the battens rest on the valley support board they should be nailed into the support board to prevent them from springing about. This facilitates nailing or clipping the tiles.

Tile cutting

The tiles, when laid on the battens, will need to be cut to a rake to form the faces of the open valley width. The cut on each course of tiles will be different and will result in some pieces being very small. The use of half tiles one tile in, tile-and-a-half tiles, or double tiles, where available, can help to alleviate this problem.

It is tempting to rough-cut the tiles into position and then cut them in one pass of a disc cutter, but this practice is not advisable for the following reasons:

- It will be difficult to hold some of the smaller cuts while you cut them.
- The resulting dust will settle all over the roof and valley and reduce the bond of the mortar.
- Contact from the disc cutter can damage the lead sheet.

Each piece of tile should be cut individually to a chalk line or board secured to indicate the sides of the open valley.

Mortar Bedding

When all the tiles have been cut the pieces should be lifted away and an undercloak, such as slate, 75mm wide, laid on the lead as a surface to receive the mortar bedding. Mortar laid directly onto the lead would prevent the lead from expanding and contracting. Restricting the movement of the lead under mortar will result in the mortar bed failing and also cracking in the lead sheet.

The mortar should be 1:3 cement/sand ratio, stiff enough to stand up in a bed 50mm wide on the undercloak slip plane without slumping. Each of the cut pieces of cut tile should be replaced and bedded into the mortar. Care should be taken not to block the interlocks with mortar when bedding the cut tiles, as this will prevent the interlocks from acting as small gutters. Where a piece of tile hangs on a tile batten it should be nailed and/or clipped. Where it is unavoidable to have small cuts into the valley the mortar should be used to hold them in place.

Pointing up the valley, or pushing mortar in under tiles horizontally, will push mortar off the edge of the undercloak slip plane onto the tilt fillet and render it ineffective as a second line of defence. The mortar should be flushed up to a smooth finish ensuring that the width at the bottom of the open valley is no greater than that at the top of the tiles.

Summary

- Water on the tiles and underlay flows towards a valley. Do not block its path but channel it towards the eaves.
- Specify the correct open valley width and corresponding lead sheet width for the area of roof draining into the valley.
- The three lines of defence against water ingress are: 1) mortar, 2) tilt fillet and 3) welt. These need to be properly formed and kept separate from each other.
- The most critical part of any inclined valley is where it discharges into the gutters. Ensure these are capable of coping with the volume of rainwater.

CTMA members are:

Cemex
Forticrete
Lafarge
Marley Eternit
Sandtoft