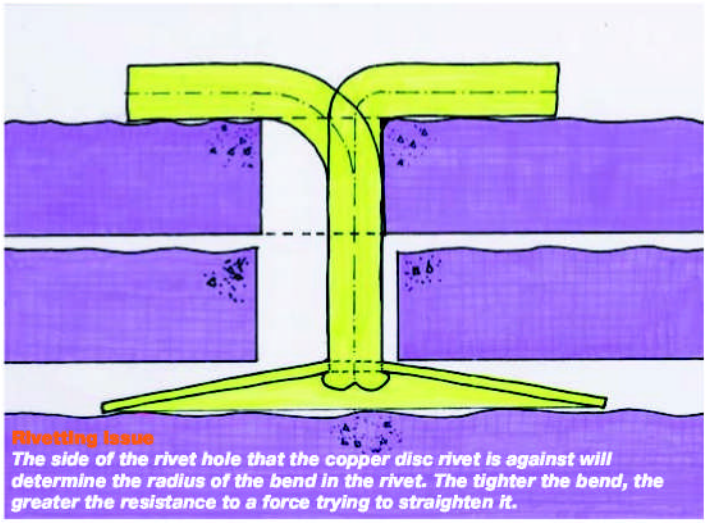
Slating & Tiling

TIPS 61

copper tail rivet fixings 2



Rivetting issue
The side of the rivet hole that the copper disc rivet is against will determine the radius of the bend in the rivet. The tighter the bend, the greater the resistance to a force trying to straighten it.

Slating and Tiling Tips 20 *(RCi August 2003)* dealt with the general subject of copper disc rivets. Part 2 expands on the subject.

Background

The design of copper disc rivet used in the UK is very consistent in terms of quality and performance, although they are manufactured by few companies worldwide. Copper is used as it is easy to bend and rivet, while remaining resistant to corrosion over the life of the roof. However, due to the rising cost of copper, the thickness and size of the rivet has been pared down to the minimum, leaving no further room for savings without affecting the performance.

Rivet function

The copper disc rivet has several functions. Firstly it is there to resist wind suction loads on the slates. Fibre cement slates that are about 4mm thick are not as rigid as natural slate and, if only centre-nailed, will bend under wind suction. At between 35N and 50N suction load, the slate will snap between the centre nail fixings, which are far stronger than the fibre cement material.

With the copper disc rivet located close to the leading edge of the slate, the load that can be resisted increases to 100N-140N. This is done by load-sharing between the nails and the rivet. The rivet transfers 73%-82% (depending on the exposed surface area of the slate) of the wind suction load. The remaining load is transmitted directly to the two centre nail fixings, meaning the total load (less the deadweight resistance of the slate) is transmitted to the nail fixings. As the rivet is below the exposed surface of the slate and the centre nails are above, the tendency for the material to bend under load is almost eliminated.

The second function of the copper disc rivet is to restrain the forces generated in the material under wetting and heating cycles. Like most materials, if you heat one side and cool the other, the expansion and contraction of the fibres on opposing sides generate a bow or curl in the material. Once the moisture content and temperature of the matrix has equalised, the material should return to its original position.

Early in the curing process of the cement, the ability of the material to bend and recover is greater than after a few years. If the cement matrix is allowed to deform and not return to its original shape, the matrix will set into that shape permanently. The force that bowing or curling generates is around 17N, or approximately 12% of a correctly installed copper disc rivet.

Design considerations

It is essential that each fibre cement slate is installed with a rivet, including the small cuts adjacent to a valley. At verges and side abutments, where slate-and-a-halves are used to maintain the half bond, two rivets are needed. The edge slates need to be drilled before they are fitted, to accommodate the additional rivets. If lead soakers are specified at side abutments, the rivet pin length should be increased to accommodate the additional thickness.

Length and bend

The slate should be aligned and centre-nailed before the two layers of slate are compressed, to extend the maximum pin length through the rivet hole in the slate being fixed (preferably between 9mm and 10mm).

The pin may be in the centre of the rivet pin hole, but is more likely to be to one side. The exact position of the pin will determine the radius of the bend in the rivet that will be achieved;the greater the radius, the weaker the fixing.

The pin should be bent through 90° so that it is parallel with the surface of the slate. To achieve the correct bend in the pin, it should be tapped twice with a hammer: once at approximately 45° to the pin, and then onto the surface of the slate. It is possible to fold the rivet down onto the slate in one action with the face of a flat tool, but this is slower than using a hammer.

Rivets that are not bent to within a few degrees of 90° will straighten out at a reduced tensile load. A pin bent through 80° will have approximately 50% of the tensile load capacity; a 70° bend will have 42%; and a 45° bend will have no tensile load capacity, as it will pull straight through the 4.5mm rivet hole. The direction the pin points, once bent, makes no difference to its performance.

Rivet hole

The size of the rivet pin hole in the slate is critical. The smaller the hole, the harder it is both to locate the pin and for it to be pulled back through under tensile load. The larger the rivet hole, the easier the rivet will pull through the hole under tensile load.

The tensile load resistance is also a function of the length of pin that has been bent over. With 8mm-10mm of pin bent onto the surface of the slate, the maximum tensile load is achieved. By shortening the pin length to less than 8mm, the resistance is reduced to less than 43%.

If the length of the bent top section of the rivet pin is the same as the diameter of the rivet pin hole, it can pull through without any tensile load being applied. If the slate is damaged during the installation of the rivet by hitting the pin too hard and fracturing the surface of the slate, the performance of the rivet will be severely affected.

Repairs

Fibre cement slates that have lifted due to poor installation can be pulled back down flat by using a plate and screw fixing such as Fixaslate, which has a tensile load strength in excess of 300N. Rivets that are loose can be tightened up by straightening the rivet and then bending it in the opposite direction. If this is done, in combination with rotating the whole rivet through 180°, it will recentre the rivet pin and may provide a little more pin length.

Correctly installing a copper disc rivet is an efficient method of transferring wind uplift loads from the surface of the slate to the centre nail fixings. It will also discourage the tendency of the material to bow and curl in the early stages of its life.

Tips

- If the nails need to be replaced with ring shank nails or screws, the rivet should be replaced with a stronger tail rivet fixing.
- In exposed locations, smaller slates should be used, to increase the number of fixings per square-metre of roof surface.

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