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TECHNICAL BULLETIN 03

HOOKS FOR SLATING

INTRODUCTION

This Technical Bulletin contains recommendations for the specification of hooks to be used with both natural and fiber-cement slates in the UK. Recommendations for hook fixing of slates in the UK were first published in 1984 in NFRC Technical Bulletin 3 (TB3). This was revised and republished in 1991. Since then detailed guidance and recommendations have been included in BS5534: 2003 Code of Practice for Slating and Tiling. This expands on the TB3 recommendations for selection of suitable hooks for UK weather conditions and provides a method of determining their resistance against wind uplift. This bulletin explains the BS5534 criteria for hook selection. It does not cover the methods for using hooks for which reference should be made to the latest version of BS5534.

Two main types of hook are available: those that are driven into the batten and those which wrap around it (Fig 1). Battens vary in thickness so the grip of wrap hooks to the battens cannot be guaranteed. Also wrap hooks cannot be used at rafters and other obstructions. For these reasons only drive hooks are recommended in BS5534. The following sections refer only to drive hooks.

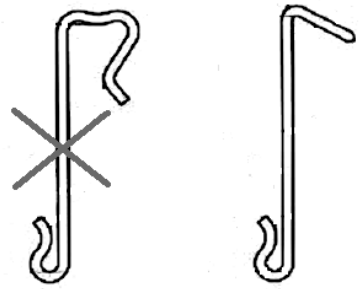

Figure 1. Wrap hook and drive hook.

Hooks are available in a variety of materials including copper, galvanised steel and stainless steel. They are supplied self coloured or black coated but, because the coating obscures the material, care is needed when making a selection. Only stainless steel type AISI 316 is recommended for use in the UK.

HOOK PROPERTIES

To provide a satisfactory roof covering slate hooks must perform four functions. They must:

- be durable;
- hold the slates securely without damaging them;
- resist wind forces acting on the slate and
- not impair the resistance of the slating to water penetration.

DURABILITY

Hooks should have a life in use as long as that of the slate. To achieve this they must be made from a material which is inherently durable and which will not be worn away by friction against the slate. They are made in a number of materials but only austenitic stainless steel can satisfy both these criteria. Galvanised steel is not suitable because the protective zinc coating will be worn away by contact with the slate leading to rusting and early failure. Copper is also likely to be worn away and become weakened and eventually break.

Stainless steel is the preferred material but not all types are equally durable and BS5534 recommends only those conforming to grades AISI 316-S11 or 316-S19 to BS1554:1990 should be used. Hooks in AISI 304 stainless steel are manufactured but are not as durable as the 316 grades and should not be used. It should be noted that the British Standard for stainless steel BS1554, which included the 316 stainless, was replaced in June 2005 by EN10088-3:2005 and the grade designations have changed. EN10088-3 Grade 1.4404 is similar to AISI 316-S11 and 1.4401 is similar to 316-S19. Manufacturers and suppliers are using both terminologies.

SECURITY OF THE SLATES

Hooks hold the slates in position in three ways. Figure 2 illustrates how each hook (1) holds down the tail of one slate; the head of the slate above (2) and prevents lateral movement of the slates on either side (3 & 4). At the ends of courses, at verges and abutments, it is not possible to fix a hook at the free side so, to prevent lateral movement here, slates should be nailed or hooked and nailed. Under eaves slates also have to be nailed.

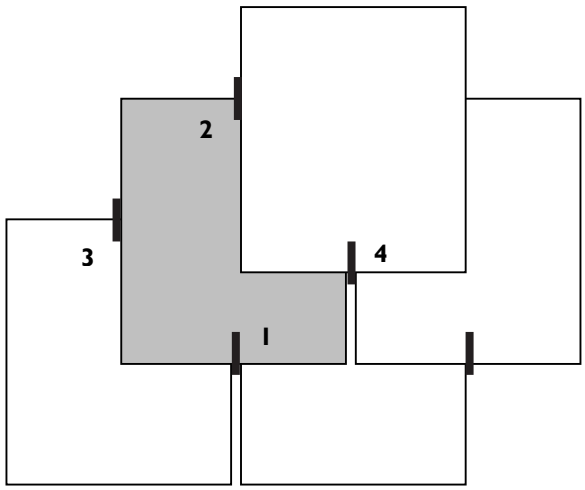

Figure 2. The shaded slate is held by hooks 3 and 4 which reduce lateral movement and 2 and 1 which hold down the head and tail respectively

Potentially hooks could damage slates in three ways:

1. They could be overdriven causing a crack at the head of the slate. To reduce this risk and to ensure the minimum head lap is achieved the shank length should be not less than 5mm and not more than 10 mm longer than the specified head-lap of the slate and they should be driven in slightly above the head of the slate.

2. The lower end which grips the slate could be too tight and cause a crack at the slate's tail. This gap does not need to be tight fitting to the slate because it is held by virtue of the shank sitting slightly low in the perpendicular gap. So when the tail of the slate is inserted into the hook (Fig 3 at A) the shank bends upwards slightly to grip the tail of the slate (B). However, if the gap is too large the hook may not make contact with the top surface of the slate and it would be free to lift in the wind. To take account of the variation in the thickness of natural slates in a consignment it may be necessary to check that the gap is suitable for all the thicknesses. Where there is a large variation it may be necessary to use different hooks for the thicker and thinner slates.

3. If the shank is too thick resulting in the overlying slate resting on it rather than on the two underlying slates there is a risk of breakage (Fig 4). The shank diameter should always be less than the thickness of the two adjacent slates.

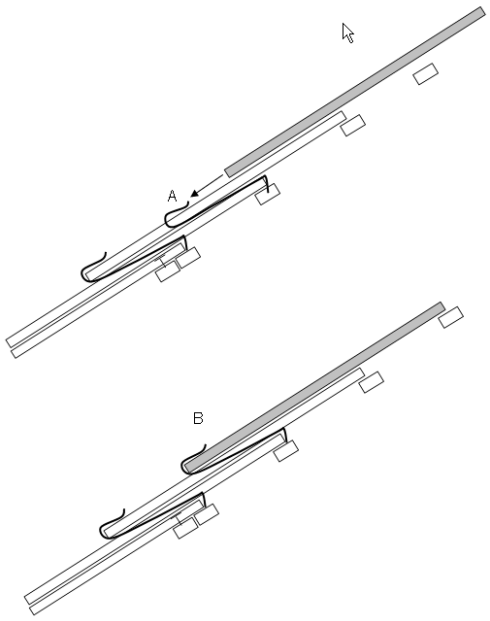

Figure 3. When the slate is inserted into the hook (A) the shank bends upwards allowing it to grip the slate (B)

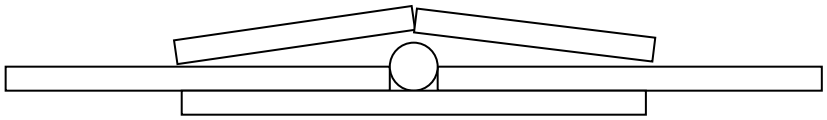

Figure 4. If the shank diameter is too big the overlying slate will crack.

WIND UPLIFT RESISTANCE

Hooks need to be stiff enough to resist the uplift forces acting on the slate. These forces are larger for larger slates and lower pitches. Also regardless of each slate being in contact with four hooks, over the whole roof there is only one hook per slate. Consequently, for larger slates each hook has to resist more uplift force.

Typically stock sizes of hooks are 2.5 to 3.5mm diameter but BS5534 recommends that that the diameter should be not less than 2.7mm. Shank lengths range from 50 to 160mm. Unfortunately hooks cannot be simply specified by selecting a suitable gauge and type of stainless steel wire because the inherent stiffness of the wire depends on the conditions under which the wire is drawn as well as its chemical composition. For this reason BS5534 provides a method for testing a hook's resistance to bending forces. Hook manufacturers should be able to supply evidence from this test which demonstrates the suitability of their products. Because there is only one hook per slate and the force acting on the slate is proportional to the size of its exposed area, larger slates need stronger hooks. Therefore the test evidence should apply to the size of slate and head lap applicable to the roof in question. In practice, manufacturers might provide test evidence for the largest slates and worst wind conditions on the assumption they will be suitable for all other situations. Provided the shank diameter is not greater than the slate thickness this will be satisfactory.

ROOF PITCH

There is a temptation to specify hook fixed slates at lower pitches than would be normal for nailing. This is possible because the effective width of hook fixed slates is greater than centre-nailed slates and so a given size of slate can be used at a lower pitch or with a smaller head lap. (The effective width of centre-nailed slates is reduced by the distance of the nail holes from the slate's sides – typically 25mm less for each side.) This can be satisfactory but care is needed to ensure the hooks can resist the wind uplift. As the pitch reduces larger slates and larger head laps are necessary to resist driving rain. These both require a stronger hook: the former because the uplift force is greater and the latter because the hook will be longer which, for a given shank diameter, will bend more easily. Even worse, as the pitch decreases the wind uplift force acting on the slates increases. So it is critically important to check that the hook is suitable for the specific slates and roof pitch and head lap.

BS5534 provides a method for calculating the uplift forces acting on slates and worked examples for nails and hooks.

RESISTANCE TO WATER PENETRATION

As explained above the effective width of hook fixed slates are greater than for a nailed ones and consequently they are more resistant to leaks due to lateral spread of water. However the resistance to water driving over the head of the slate is no better than for nailed slates so normal minimum head laps will be required. Unfortunately because the shank of the hook lies in the perpendicular joints between the slates it can dam the flow of water and increase the spread between the slates. This risk is greater for lower pitches. To overcome this problem crimped shank hooks (Fig 5) can be used (also known as wave, crossinus, wave or ondule hooks). The following limits apply to hook fixing:

- Hooks should not be used below 25° pitch.
- Crimped shanks are suitable for all pitches between 25° and 90°;
- Straight shank hooks should not be used below 30° pitch;

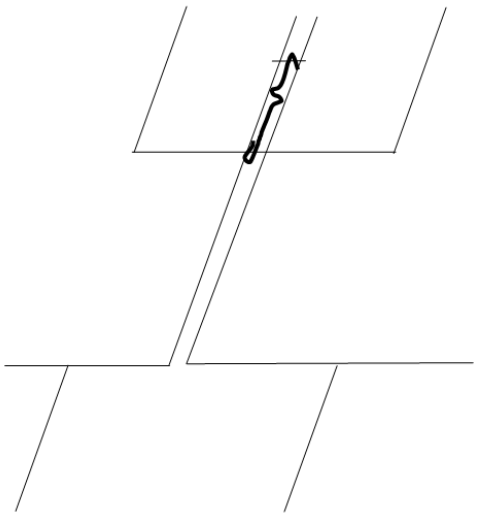

Figure 5. At pitches of less than 30º hooks with crimps in the plane of the slate should be used.

SUMMARY

- **Check and have written confirmation that the hooks are made of the correct specification of austenitic stainless steel – AISI 316-S11 or 316-S19 to BS1554:1990 (Grades 1.4404 or 1.4401 are the nearest equivalents in EN10088-3.) DO NOT USE ANY OTHER MATERIAL**

- Select the correct hook – straight or crimped – for the roof pitch.

- Check that the hooks provide sufficient uplift resistance for the slate size, head lap and wind uplift forces for the roof, its pitch, location and building height.

- Check that the hook's shank diameter is suitable for the full range of natural slate thicknesses or the standard fiber-cement slate thickness (typically 4.5mm).

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