Slating & Tiling

TI PS 73

weight

All materials and components have a different weight and depending upon who you talk to, they will tell you that weight is either good, bad, or indifferent to the performance of the roof covering.

Generally products that are lighter are easier to lift, transport and install and therefore make the product prior to installation cheaper than heavy products. But once installed weight is less of an issue and often weight can be an advantage. Often heavy things are thicker and therefore take up more space, but this may be offset by other properties that are inherent in the material such as sound deadening. By looking at the effect of weight and the factors that are affected it can be seen where weight is good or bad.

Different types of materials have varying densities that are fairly constant throughout the life of that material. Density is easiest to understand as the weight of one cubic metre of material. One cubic metre of pure water weighs 1,000kg, therefore we refer to it as being 1,000kg/m^3. But what about the other materials we use in roofing?

Lead is 11,389kg/m^3, more than 11 times heavier than water.

Steel is 7,480-8,000kg/m^3 depending upon the grade of steel.

Slate is 2,691-2,800kg/m^3, depending upon the deposit.

Aluminium alloy is 2,560-2,800kg/m^3 depending upon the alloy.

Concrete is 2,162-2,403kg/m^3 depending upon the mix.

Glass is 2,000-8,000kg/m^3 depending upon the type of glass.

Plastic is 1,380-2,300kg/m^3 depending upon the type of plastic.

Fired clay is 1,362kg/m^3.

Wood is 350-1,370kg/m^3 depending upon the species.

From this list we can see that slate and aluminium are heavier than concrete, and plastic is heavier than fired clay, which seems a little strange. We think of concrete as being heavy and aluminium as being light. The truth is that metals and slate have a greater strength for their weight than concrete, and therefore we tend to use much less aluminium, or slate, to achieve what would be possible with concrete. Because concrete is made from abundant and relatively cheap materials, we can afford to use more of it to achieve the same strength. Therefore the overall product weights more because it is thicker.

It is fair to say that strength is also a function of design, and therefore by designing in ribs and flanges, strength can be induced where it is needed. With plastics, air bubbles are often introduced to reduce weight without impairing the strength. Often other materials are introduced as fillers to reduce the total content of the plastic materials such as pvc, which, being a petrochemical product, is expensive. But for this discussion we are looking at materials in their basic form.

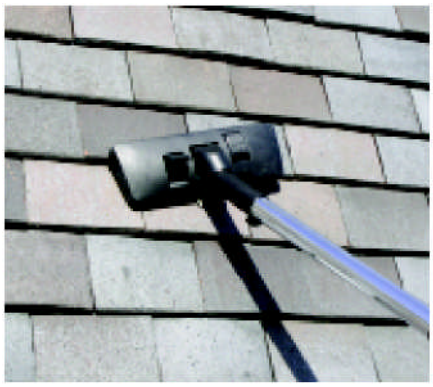
Thickness

Products that are thin can bend easily while products that are thick are generally more rigid. There are exceptions to every rule, such as roof slates which are very rigid for their thickness of 4-10mm. Solid plastic, or steel, of the same thickness would be less rigid. Rigidity in this instance is the deflection over a given span for a given load. Some materials, such as lead sheet, are unable to span over any distance, unless they are fully supported, as, over time, they deform.

Performance

There are many climatic conditions that act on a roof and need to be resisted, from sunshine to wind and rain. But as far as weight is concerned the two major factors are dead load (+), which is the total weight of the roof on the structure below, and wind uplift (-), which is the effects of wind trying to suck the roof covering off.

For dead load, weight is bad as the more weight there is the stronger the structure below has to be. For wind uplift the situation is the opposite, the more weight the better. Think of the effect of a light breeze on the papers on a desk if the window is left open. If the pages are loose they will blow around, if they are bound together as a book then the pages may flutter but the book is unlikely to blow away. If the book is replaced with a block of wood of the same size it will not move unless there is a storm force wind. If a steel plate of the same dimensions replaces the block of wood, higher winds would be needed to move it. The higher the wind speeds the heavier the component needs to be to resist the wind pressure and suction. As the wind gets stronger and faster, so the aerodynamic effects of the shape of the product on the roof, and the shape of the roof itself becomes more important.



The wind blowing over a roof acts like a giant vacuum cleaner trying to suck the tiles and slates off the roof. The heavier the tiles, the better they are at resisting the suction.

A lightweight product can be given more resistance to wind uplift by fixing the tile or slate to the roof structure using mechanical fixings in the form of nails, screws or clips. Whilst minimal dead load can be supplemented by mechanical fixings, maximum dead load can only be resisted by a substantial roof structure, which costs extra money.

Earlier we said that thicker components tend to be more rigid. But thickness has other effects. Firstly thicker tiles and slates need longer nails or screws to fix them to the battens as in most cases the fixing needs to penetrate the batten between 15 and 23mm to achieve the maximum holding down force.

The thicker a tile or slate, the more each course of tiles or slates will kick up on the course below. Long thin slates may lay at only 3° less than the rafter pitch, while short thick plain tiles may lie at between 10-13° less than the rater pitch. Whilst all manufacturers quote rafter pitch parameters in their literature, the critical figure is always the true tile pitch. It is true that variations in head-lap will alter the true pitch angle, but not significantly and this is accounted for in the manufacturer's recommendations.

In addition to the tiles or slates lying at a shallower angle, thicker slates and tiles have an increased step height on the leading edge. Whilst visually this can make a big difference, in high winds the step height of the tiles or slates, facing the wind will create a rougher surface for the wind to blow over and can create more turbulence, which can create some uplift.

Conclusion

Weight and thickness are interrelated, and using them in the right place is important when deciding what material, fixing, or component should be used. In most instances this experience has been determined through custom and practice, but for new products, systems and materials this has to be carefully considered.

Tips

- Lightweight slates or tiles need more fixings to resist wind uplift.
- Expensive materials are generally formed into the thinnest and lightest shape possible to keep the weight and cost down.
- If you change the thickness of a component you will affect the fixing length as well.

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