

"A recent ECCA report argues the case for metal roofing in European energy-efficient housing"



in cooling energy is around 9% by using a metal roof instead of a tile one.

## THE CASE FOR METAL

An OISD study for ECCA has shown that the choice of a metal roof for a residential building can have significant advantages

**O**ne issue which is bringing Europe closer together is the need to reduce its dependence on fossil fuels and the consequent effect on climate change. Since the energy used in buildings accounts for the largest single use of energy in Europe, it needs to take a critical approach to building design for the future.

The use of metal roofing has a long tradition in some parts of Europe but, across most of Europe, it is not as popular as the various forms of tile roofing (made from clay, stone, slate or, more recently, concrete). The choice of roof covering can be made on purely aesthetic grounds, but it is important to understand the effect that this choice may have on the thermal comfort and energy efficiency of the dwelling.

ECCA (European Coil Coating Association), in partnership with the Oxford Institute for Sustainable Development (OISD) at Oxford Brookes University in the UK, has undertaken a major study to understand the effects of roofing choice on the thermal comfort and energy efficiency of dwellings in Europe.

Where less insulation is used, mostly in warmer parts of Europe, a metal roof can provide a more comfortable internal environment than a tile roof.

Three important variables were considered in this study – insulation, thermal mass and solar reflectivity.

### THERMAL MASS

Since the major differences between a metal and tile roof (thermal mass and reflectivity) involve their reaction to heat, modeling was restricted to Southern Europe where the effects of such differences will be the greatest.

A tiled roof has significantly greater thermal mass than a metal roof. During the day, the tiled roof will absorb heat which it will re-emit gradually during the night when the air temperature is lower. A metal roof responds much more quickly to temperature variations since it does not absorb nearly as much heat.

Taking the full cycle of day-night, overall the building with the metal roof is marginally cooler than that with the tile roof. The net effect is that the building with the metal roof spends less time at elevated temperature than that with the thermally massive tile roof. Importantly, for the modeled case of a bedroom, the metal roof consistently gives a lower summer-time temperature during the evening and night-time than the tiled roof, making sleeping conditions much more comfortable.

If cooling is used to reduce the bedroom temperature to a comfortable temperature of no more than 24°C, the OISD study shows that, in a modeled house in Athens, over 11% more cooling energy is required for a house with a tile roof than for one with a metal roof. Repeating this study in Naples, where thermal insulation is slightly lower, but the summer sun is slightly less fierce, the saving

In Southern Europe, metal roofs provide better night-time comfort in upper-storey bedrooms than tile roofs and, where air conditioning is used, this can reduce energy usage by up to 11%. Where internal day-time temperature is important, highly-reflective metal roofs can significantly improve thermal comfort in Southern Europe, with tile roofs giving over 20% more hours over an internal temperature of 32°C than reflective metal roofs.

Beyond the direct effect on internal comfort,

### SOLAR REFLECTIVITY

Solar reflectivity is a property which is often ignored, but can be very important in determining the thermal behaviour of a surface. A solar reflective roof covering will maintain a much lower exterior surface temperature than a thermally absorbing roof. This means that less heat is transmitted to the inside of the building and there can also be benefits to the surrounding environment.

With a coated metal roof, the solar reflectivity can be chosen, either by choosing the colour of the roof or by modifying the pigmentation for a given colour to meet the requirements of the location.

From the OISD study, it can be seen that the peak external temperature of the high-reflectivity metal roof can be up to 20°C lower than that of a tile roof on a summer's day. This translates into a noticeably lower internal peak temperature on each day within the summer.

Unlike the peak-opping effect of thermal mass, the high-reflectivity metal roof maintains a lower internal temperature throughout the entire summer day. Since the reflectivity is only an issue during day-time, the highly reflective metal roof behaves just like the normal metal roof during night-time, again giving the benefit of thermal responsiveness.

The effect of the high-reflectivity metal roof is limited to the day-time, so in the case discussed earlier of night-time cooling for a bedroom it makes very little difference. However, if the room were used in the day, for example for an office, then the reflective metal roof would provide a much more comfortable environment and significantly lower cooling requirements.

metal roofs, particularly when coated with a solar reflective coating, can help to minimise the urban heat island effect and can play their part in minimising the greenhouse effect which is behind global warming.

PHOTOS COURTESY OF CORIUS

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