

BUILDING MATERIALS & REFLECTIVITY

TECHNICAL BULLETIN TB-28

Rev 2, November 2003

This issue supersedes all previous issues

INTRODUCTION

Good building design requires some thought in the selection and use of materials. Reflective building materials benefit the occupants and the environment. However, in limited cases highly reflective materials or surfaces, if not properly used, can cause some annoyance to immediate neighbours (*note: highly reflective materials could include glazing and swimming pools, amongst other things*). The challenge, therefore, is to develop an understanding of the key issues, to allow a balanced assessment of material choice, in the interests of the occupants, the neighbours and the environment. This note attempts to provide some insight on some of the issues.

INEFFECTIVE POLICIES

All building materials reflect sunlight. Occasionally policies or guidelines are developed with wording such as 'all building materials must be non-reflective'. One implication of such a statement would be that nothing could be built, as all materials are reflective to some extent.

There are several inadequacies in attempting to control the use of building materials based on reflectivity alone. One problem with this approach is that it is well known that materials with high solar reflectivity can offer better thermal performance (*lower energy costs and/or improved comfort*) than materials with lower reflectivity. Placing limits on reflectivity therefore precludes energy efficient design, to the detriment of the occupants and the environment.

Many other problems are introduced with reflectivity limits. For example, it is inappropriate to have such limits if they are not equally applied to all materials. Materials such as glass may have difficulty in meeting any reflectivity limit if assessed for all lighting angles and not just at normal incidence. While this would mean that they could not be used in any building application, these materials may not be a problem if they do not cause sunlight to be reflected directly back to the observer.

CASE-BY-CASE ASSESSMENT

The most effective method of determining which building materials are appropriate is to conduct a case-by-case assessment. Arbitrary approaches that do not account for site conditions will always be to the detriment of the applicants, the neighbours or the broader environment. A case-by-case assessment can be a reasonably simple process.

Important factors to be considered in appraising a building include:

1. The orientation. A simple sketch of the house in question, the typical position of the sun and the position of any neighbouring dwellings (*see Figure 1*) can be a great help in determining whether any neighbours can receive directly reflected sunlight. If they cannot, then glare will not be an issue.

For typical roofing pitches, if a roof is viewed from the north, it is unlikely that it will ever cause glare. If such roofs are viewed from the west, it is unlikely that glare will occur other than for a short period in the morning. If such roofs are viewed from the east, it is unlikely that glare will occur other than for a short period in the afternoon. It is mainly when viewed from the south that roofs can result in glare for any extended period of the day. Furthermore, due to the sun's ever changing path, glare will normally only be present for a small part of the year.

2. Issues such as roof pitch and the slope of the ground (*topography*) need to be considered in drawing a sketch such as that in Figure 1. Any vegetation or other screening that is present or could be used to shield the view of the roof should also be considered (*see Figure 2*). Owners often go to great lengths to screen swimming pools and even glazing for privacy. If these surfaces were not screened, they would often cause annoying glare.
3. The time of year and the effects of weathering. If glare can occur, it will often be worst in summer time, when the sun is at its most intense. New roofs built in summer time cause the most glare for all roofing colours and materials. As the seasons change, the position of the sun will move in

the sky and the observer may no longer receive direct reflection. Furthermore, in the case of a COLORBOND® prepainted steel roof, some weathering will occur over time and by the following year the amount of reflected light will reduce. While this weathering process reduces glare, it occurs in a manner that does not substantially affect the thermal performance of the roofing system. It is important to

consider the effects of weathering, since the tendency for some materials to cause glare will change considerably with time, while others may continue to cause glare for most or all of their life (*terracotta tiles, many types of glazing, swimming pools etc*).

Figure 1: Direction tendency of mirrored sunlight to the North and to the South

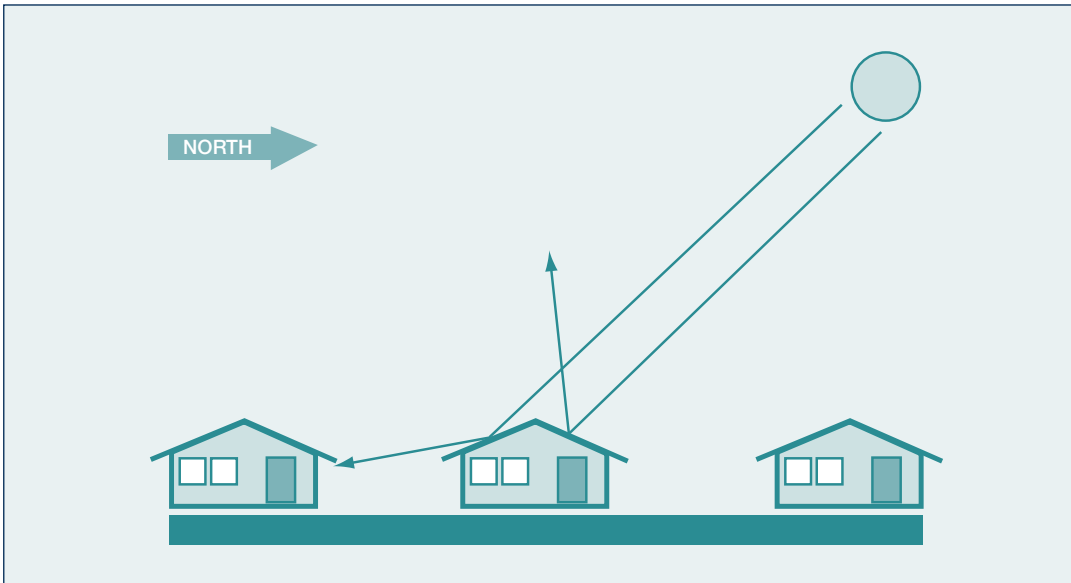
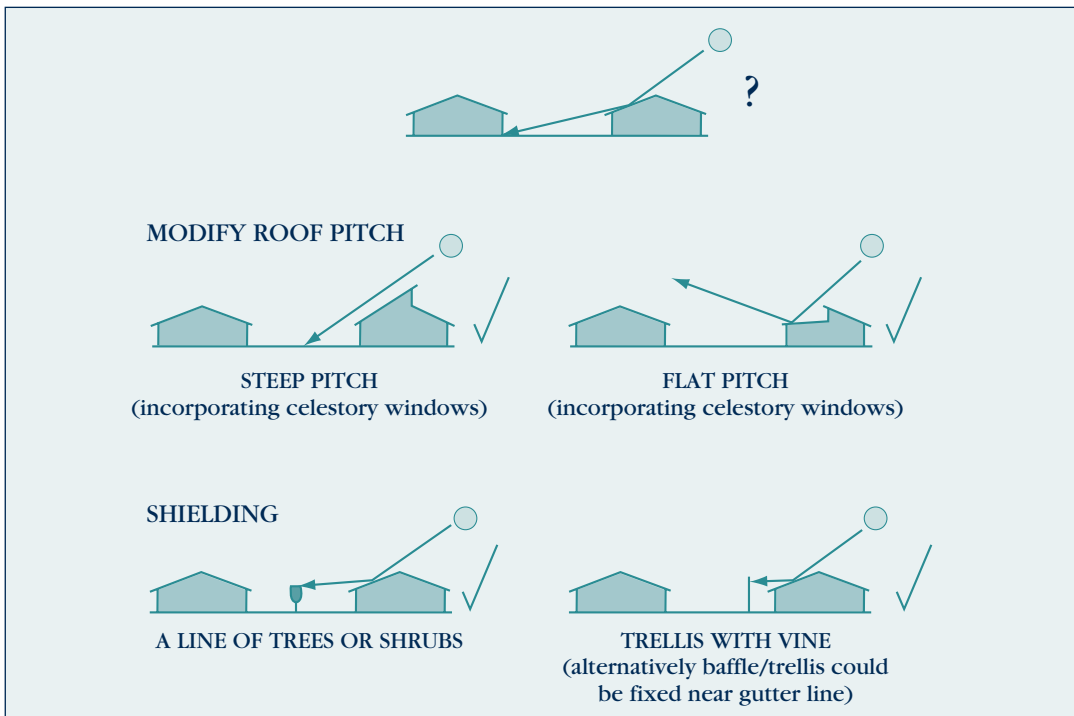


Figure 2: Modifying roof pitch or shielding to avoid directly reflected sunlight



THERMAL EFFICIENCY

Many building materials are designed to be highly reflective. The main benefits centre on the fact that highly reflective materials do not absorb as much heat as other materials and therefore stay cooler. This results in a building that will be more comfortable and not as expensive to cool in warm weather.

As an example, CSIRO was commissioned by BlueScope Steel Limited to perform thermal modelling based on a typical dwelling with a ZINCALUME® zinc/aluminium alloy-coated steel roof, compared to a similar dwelling with a red tile roof. The study was based on a Brisbane climate over a full year. It was found that the ZINCALUME® steel roof reduced the cooling bill to less than half when both dwellings were left uninsulated. Even when both dwellings were insulated, the cooling bill with the roof manufactured from ZINCALUME® steel was approximately 15 % less than the tiled roof.

ENVIRONMENTAL BENEFITS

Steel roofs offer many environmental benefits over alternative materials. For example, the BDP Environment Design Guide includes a paper by Lawson, Partridge and Gelder on 'Assessing the Environmental Impact of Building Materials'. In this paper, a timber frame with a steel roof gets a rating of 5.2 per square metre of roofing, while a similar frame with a clay tile roof gets a rating of 20.6 per square metre of roofing (*the higher the score the more environmentally damaging is the assembly*). The Environment Design Guide is published by the Australian Council of Building Design Professionals Ltd (BDP), which is the peak body for architects, engineers, quantity surveyors, landscape architects and planners.

The cooler surface of a light coloured roof can also offer benefits, not only the occupants of the building but also to the external environment. It has been demonstrated that the use of dark building materials (*particularly high mass materials*) in built up areas is contributing to increased local temperatures causing what is now commonly referred to as heat islands. Heat islands cause increased air-conditioner loads and increased smog, which is contributing to increased greenhouse gas emissions and ozone depletion. In the US a database of reflective building materials is being constructed to encourage the use of such materials. Independent Information about the benefits of choosing reflective building materials can be sourced on the worldwide-web at <http://eetd.lbl.gov/HeatIslands/PUBS>, such as the article entitled 'Painting the town white – and green'.

Irrespective of the roofing material (*COLORBOND® prepainted steel, tiles etc*) most colours in any product range will probably have a similar gloss level and might be expected to give similar amounts of mirrored reflection. Therefore, while the colour will influence the amount of perceived glare to an extent, changing from a lighter to a darker colour in any given material may not have the desired effect of considerably reducing the perceived glare, if indeed direct reflection to the observer is likely to occur.

COMMERCIAL/INDUSTRIAL BUILDINGS

Whilst much of the preceding comments are equally applicable to commercial/industrial buildings, these types of buildings tend not to cause many problems. Commercial/industrial roofs are usually light in colour, to take advantage of the thermal benefits discussed here. The roofs are often also high and flat and surrounding people seldom receive directly reflected sunlight. In fact in many cases the roofs cannot be seen from ground level.

Commercial/industrial walls are not a problem as the direct reflection often goes straight to the ground and is not received by people around the building. The main case where this may cause some concern is with multi-storey buildings. In this case, if direct reflection from walls can be seen by the observer, glare from windows may also be a significant problem as the sun may hit the windows at a low angle and most of the light will be reflected off.

CONCLUSION

It has been shown that the use of reflectivity limits alone has many inherent problems. Products or colours that are likely to be eliminated are those that are the most thermally efficient. Reflectivity limits tend to limit the opportunity to use light colours, which can lead to increased energy use, increased greenhouse gas emission and ozone depletion. There is a growing awareness of this in the United States, with a number of government studies being initiated.

Given the benefits of choosing a reasonably reflective building material, it is suggested that building owners should be encouraged, rather than discouraged in the use of products such as the lighter COLORBOND® prepainted steel colours and ZINCALUME® steel. However, it is acknowledged that they can also cause some concern to neighbours in a limited number of situations. By considering buildings on a case-by-case basis, with a basic understanding of good design, appropriate materials can be used that ensure that the building is thermally efficient and nobody is inconvenienced.

Key Points to Remember:

1. All materials are reflective.
2. A simple case-by-case assessment is the most effective means of ensuring a good environmental outcome while addressing relevant concerns and allowing appropriate materials to be used.
3. Orientation is quite important in the assessment process. The most critical case is a view from the south. A simple sketch of the direction of mirrored sunlight, the slope of reflective surface (*such as a roof*) and the position of the sun at any time, should establish whether there may be an issue.

Alternative assessment methods have shortcomings for the owner, the neighbours and the broader environment.

The information and advice contained in this Bulletin is of a general nature only, and has not been prepared with your specific needs in mind. You should always obtain specialist advice to ensure that the materials, approach and techniques referred to in this Bulletin meet your specific requirements.

BlueScope Steel Limited makes no warranty as to the accuracy, completeness or reliability of any estimates, opinions or other information contained in this Bulletin, and to the maximum extent permitted by law, BlueScope Steel Limited disclaims all liability and responsibility for any loss or damage, direct or indirect, which may be suffered by any person acting in reliance on anything contained in or omitted from this document.

ZINCALUME® and COLORBOND® are registered trade marks of BlueScope Steel Limited.
BlueScope is a trade mark of BlueScope Steel Limited.

Please ensure you have the current Technical Bulletin as displayed at www.bluescopesteel.com.au

BlueScope Steel

Copyright© 2003 BlueScope Steel Limited
BlueScope Steel Limited ABN 16 000 011 058
BlueScope Steel (AIS) Pty Ltd ABN 19 000 019 625



AUSTRALIA	SYDNEY	Telephone: (02) 9795 6700
	MELBOURNE	Telephone: (03) 9586 2222
	BRISBANE	Telephone: (07) 3845 9300
	ADELAIDE	Telephone: (08) 8243 7333
	PERTH	Telephone: (08) 9330 0666

OVERSEAS	BlueScope Steel (Malaysia) Sdn Bhd	Telephone: (603) 3250 8333
	BlueScope Steel (Thailand) Limited	Telephone: (66 38) 685 710
	PT BlueScope Steel Indonesia	Telephone: (62 21) 570 7564
	BlueScope Steel Southern Africa (Pty) Limited	Telephone: (27 21) 555 4265

