TB - 28
Technical Bulletin

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Building materials and reflectivity

Introduction

Good building design requires some planning in the selection and use of materials. Reflective building materials can benefit the occupants and the environment. However, in limited instances, highly reflective materials or surfaces, if not properly used, can cause some annoyance to immediate neighbours.

Therefore, the challenge 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. The purpose of this Technical Bulletin is to provide insight on some of these issues.

Ineffective Policies

All building materials reflect sunlight. Occasionally policies or guidelines are developed based around a reflectivity limit or with wording such as “all building materials must be non-reflective”. These policies or guidelines can lack a definition around how to determine reflectivity or quantification to enable compliance.

There are inadequacies in attempting to control the use of building materials based on reflectivity alone. One problem with this approach is that in most Australian climate zones materials with high solar reflectivity can offer better thermal performance than materials with lower reflectivity by way of lower cooling energy costs and/or improved thermal comfort. Placing limits on reflectivity therefore may preclude energy efficient design, to the detriment of the occupants and the environment.

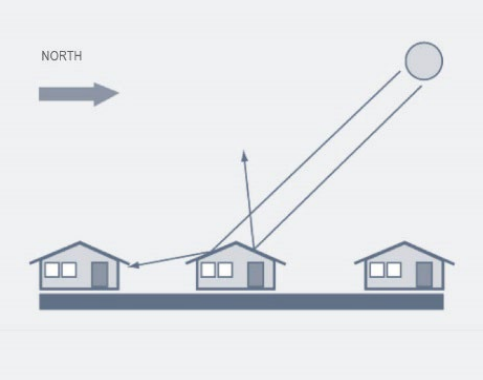
Other problems may be introduced with reflectivity limits. For example, it is inappropriate to have such limits if they are not equally applied to all materials. Materials such as glass may have difficulty in meeting a reflectivity limit if assessed for all lighting angles and not just at normal incidence. While this could mean that some building materials may not comply, they may not pose 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. Important factors to be considered in appraising a building include:

1. 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 could be affected by directly reflected sunlight. For typical roofing pitches in the southern hemisphere, if a roof is viewed from the north, it is unlikely that it will cause glare. If viewed from the west, it is unlikely that glare would occur other than for a short period in the morning. If viewed from the east, it is unlikely that glare would occur other than for a short period in the afternoon. However, if viewed mainly from the south, roofs may result in glare for extended periods of the day. Furthermore, due to the sun’s ever-changing path, glare will typically only be present during particular seasons representing a minority of the year.

Figure 1. Direction tendency of mirrored sunlight to the north and to the south.

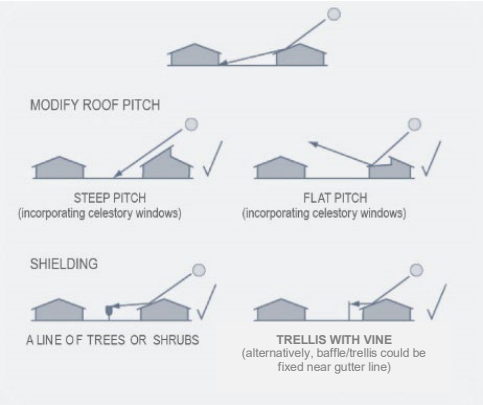


2. Roof Pitch and Topography: Issues such as roof pitch and the slope of the ground (topography) need to be considered in drawing a sketch such as that in Figure 1. Any vegetation or other screening that is present or could be used to shield the view of the roof should also be considered (see Figure 2).

3. Seasons and Weathering: The effects of glare will often be worse in summer when the sun is at its most intense. New roofs built during summer that have not undergone any weathering have the potential to cause the most glare regardless of roofing colours and materials used. As the seasons change, so does the orientation of the sun in the sky and the observer may no longer receive direct reflection. Furthermore, in the case of roofing made from prepainted steel, some weathering will occur over time and the amount of reflected light will be reduced. While this weathering process reduces glare, it occurs in a manner that has minimal effect on 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 reduce with time (e.g. prepainted steel), while others may continue to cause glare at a consistent level over time (e.g. many types of glazing, solar panels and swimming pools).

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



4. Choice of Colour and Finish: Choosing a darker colour over a lighter colour can reduce the brightness of a material, however, may not have the desired effect of reducing glare. Problem glare is commonly associated with directly reflected sunlight, which can be primarily impacted by material gloss level or finish. Colour has a much smaller secondary impact on direct reflection. COLORBOND® steel in a Matt finish provides for more diffuse reflection compared to COLORBOND® steel in a Classic finish, due to its textured surface.

Benefits of high solar reflectance materials

Many building materials are designed to be highly solar reflective. High solar reflectance materials do not absorb as much heat as lower solar reflectance materials and therefore stay cooler. Staying cooler can provide benefits to the building and broader environment, as well as community comfort and health benefits associated with Urban Heat Island (UHI) mitigation.

Benefits to the Building: During hot sunny weather, the temperature of a light-coloured roof can be up to 35°C cooler than a dark coloured roof[1]. This results in a significantly lower cooling load to the building from the roof. In warm and temperate climates, this can translate into energy savings, and improved thermal comfort, particularly during heatwaves.

Broader environment/community benefits: *Urban Heat Islands* (UHI) is a term used to refer to the fact that cities and urban areas are often significantly warmer than the rural or undeveloped areas that surround them. The use of dark building materials (particularly high mass materials) in built-up areas contributes to increased local temperatures which contributes to UHI formation. UHIs can cause a multitude of impacts upon energy consumption, comfort and heat related health conditions. Overall, choosing higher solar reflective cooler building materials surrounded by trees and vegetation – to provide shade and water movement to the atmosphere – is one of the best design scenarios to help mitigate UHIs.

For further information on the benefits of high solar reflectivity (or low solar absorptance) roofing visit: BlueScope Technical Bulletin TB-39 Thermal performance of roofing materials. For information on Urban Heat Islands visit: BlueScope Sustainability Technical Bulletin STB-2 Urban Heat Islands and their mitigation.

Commercial and industrial buildings

Whilst most of the preceding comments are equally applicable to commercial/industrial buildings, these types of buildings are less prone to cause glare disturbance as commercial/industrial roofs are usually of low pitch, high set, in flat terrain and typically elevated above pedestrian and neighbourhood line of sight. As many commercial and industrial roofs are not easily seen, roof colour is usually of less importance and higher solar reflectance materials are often preferred on the basis of their thermal performance. Consequently, BlueScope developed COLORBOND® Coolmax® steel for commercial roofing having the highest solar reflectance of the COLORBOND® steel range.

Conclusion

Key points to remember:

1. All materials are reflective.
2. A case-by-case assessment is the most effective means of managing reflectivity and thermal efficiency concerns with appropriate choice of building materials.
3. Reference to reflectivity limits alone can restrict the opportunity to use thermally efficient light colours, which can have inherent environmental benefits including reduced energy use, reduced greenhouse gas emissions, and mitigation of UHI.

Given the benefits of choosing solar reflective building materials and the effective ways to manage glare issues, it is suggested that building owners should be encouraged to consider their use.

Related BlueScope Technical Bulletins

Technical Bulletin TB-39 Thermal performance of roofing materials

Sustainability Technical Bulletin STB-02 Urban Heat Islands and their mitigation

References

1. Pisello, A.L. (January 2017). *State of the art on the development of cool coatings for buildings and cities*, p664.