Skylights

Skylights can make a major contribution to energy efficiency and comfort, and can be installed in both existing and new homes. They are an excellent source of natural light: they can admit more than three times as much light as a vertical window of the same size, distributing it evenly, saving energy and improving your visual comfort levels.

Skylights can also increase the amenity of internal spaces that might otherwise require supplementary artificial lighting or ventilation, such as windowless rooms. They allow additional flexibility in architectural design. Even under overcast conditions the use of skylights can ensure spaces are predominantly lit by natural light, with little or no supplementary artificial lighting required.

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Design principles

A variety of factory manufactured skylight shapes exist for sloping or flat roofs. Most include shafts (also called light wells) that can potentially exert as much influence over the energy properties as the skylight itself. Skylighting may also take the form of general glazed areas such as roof lights for atria, attached conservatories or sunrooms. In this form they are less likely to be factory manufactured and more likely to be constructed on site.

Skylights are a good alternative when you are restricted by the size of windows that you can use, where there are privacy issues, or when you want to create a different architectural outlook. The ‘right size’ skylight admits just enough light for the job and no more.

Several methods can help to decide on the size and spacing of skylights. The size of the skylight impacts on its solar heat gain and its conduction gains and losses. Typically for roof windows and skylights, a 3–5% floor to skylight area ratio is used and for some high performing tubular skylights 1–2% is sufficient.

_rule_of_thumb_for_spacing_skylights_to_help_achieve_uniform_lighting_

The illustration above shows a rule of thumb for skylight spacing that promotes even light distribution: the distance between skylights should be approximately 1.5 times the height between floor and roofing. Skylight spacing is critical in large spaces.

The principles of delivering daylight differ between windows and skylights. Top lighting increases the potential for uniform light distribution. Under an unobstructed, overcast sky the amount of light, or luminance, from directly above (the zenith) is about three times as much as from the horizon.

Energy efficient technologies used for windows may be applied to skylights. (see Glazing)
Skylight types

Roof windows

Roof windows are popular for attic rooms where there is a cathedral ceiling but little roof space, as well as other living areas with a conventional flat ceiling where a plaster light well and no diffuser is used to bring the outside in. Almost all roof windows use sealed double insulating glass units (often referred to as IGUs) to reduce heat losses while minimising condensation. Typically they are operable, i.e. can be opened, which is highly recommended in summer conditions, especially in two storey houses where heat would otherwise tend to concentrate in the upper level.

Frames are typically timber, with external weatherproof cladding, but may be aluminium or steel. In cool and alpine climates, uninsulated metal frames are not recommended because of the condensation they create. Roof windows, whether operable or not, are usually combined with open light wells (shafts) in homes that have flat ceilings. Ceiling level diffusers are rarely used with roof windows.

Skylights

Skylights (also known as roof lights) are typically acrylic, single glazed ‘opal’ (i.e. light diffusing) moulded units. Top glazing can also be in clear or tinted acrylic, polycarbonate or glass. Skylights typically have long white coloured or flexible light wells and a diffuser panel fitted at ceiling level.

Tubular skylights

Tubular skylights reduce absolute heat loss and heat gain because of their small cross-sectional area. Sometimes called tubular daylighting devices (or TDDs), their daylighting effect relies on their ability to capture direct-beam sunlight, transmit it down a highly reflective light well and diffuse it at ceiling level around the room.

They work best in climates with a high incidence of clear, sunny days. On cloudy days the amount of daylight admitted is considerably less than for a conventional, large area skylight.
Passive design
Skylights

A reflecting tube is used to direct sunlight downward. Best results are achieved by a straight tube with a silvered lining. Flexible tubes are effective provided their internal reflectance is high and the material is kept taut. Diffusers should be fitted to tubular skylights to reduce glare and throw the light over a broad area.

Solar control
All skylights are more vulnerable to direct sunlight when the sky is clear, and there is no overshading from trees, so additional shading or other solar control measures must be considered.

*Glazing can be designed to reduce, block or facilitate light transfer according to sun angles.*

Glazing can be designed to reduce, block or facilitate light transfer according to sun angles. For example, it is possible to reject direct sunlight from above in summer while light from nearer the horizon may be admitted. Skylights can have a higher solar heat gain than vertical windows due to the lower angle of incidence of the sun hitting the glazing. (see Glazing)

Skylight manufacturers may further reduce their products’ solar heat gain coefficient (SHGC) and increase their thermal insulation (reduce their U-value) through the use of shafts, tubes, ceiling diffusers and supplementary blinds or integral shades. These may assist in meeting codes and standards requirements.

Skylights can use diffuse (opal) glazing in glass or acrylic to achieve the twin goals of even light distribution and solar control. Diffuse glazing has a back-scattering effect on incoming solar radiation. This slightly reduces overall transmittance of visible light but also reduces the solar heat load on the space below. At the same time, diffuse transmission scatters light over a wide range of angles. This promotes soft, glare-free lighting.

In Australia, the main limit on skylight size comes from the need to minimise unwanted solar heat gain. Skylights should also be selected to prevent undue heat loss or heat gain by conduction. The thermal transmittance, from the inside to the outside of the building fabric, of sloped glazing is greater (typically by 40%) than that of vertical glazing because the heat loss in winter is in the same direction (up) as the buoyancy effect that drives convection (hot air rises).

Refer to Section 3.12 of the Building Code of Australia (BCA), Volume Two, for further information on maximum allowable aggregate areas of roof lights and the SHGC and U-value requirements.

Energy ratings
Skylight products are required to meet minimum performance standards set out in the BCA. To allow skylight manufacturers to provide third party certified performance ratings of their products, the Window Energy Rating Scheme (WERS) maintains a comprehensive, independent database of energy-rated skylight products called WERS for Skylights (WERSfs). This database contains ratings that are conducted according to protocols set by the Australian Fenestration Rating Council, to ensure that all products are compared evenly.

The Window Energy Rating Scheme also applies to skylights.

The database of products includes ratings of U-value and SHGC as well as an easy-to-use star rating system that ranks performance of each product when heating and cooling your home, and the potential the system has for providing natural lighting. This star rating system allows you to compare each different product based on a zero to 10 star rating.
Effect of skylight shaft on light and heat gain

Major advances have occurred in the last few years in our understanding of the effect of shafts and reflective tubes on the performance of skylights. The shape and dimensions of the shaft affect both the light transmission and actual solar heat gain obtained from the skylight.

The longer the shaft or tube, the less light transmitted by the skylight system. Less solar heat is also admitted. A skylight with poorly performing top glazing may be improved thermally by using a long shaft, provided adequate overall light transmission is maintained. Best practice includes additional thermal insulation in a shafted skylight. This prevents unwanted heat loss or gain from the roof space or attic and is highly recommended.

Making the most of local sky conditions

Effective delivery of daylight depends on the following factors:
- sun’s altitude and azimuth
- relative occurrence of overcast versus sunny weather
- season
- levels of air pollution and haze
- roof aspect
- shading from trees.

In Australia it is possible to predict average sky conditions, including relative amounts of clear and overcast sky, because most populated locations, such as our cities, are less afflicted by heavy air pollution than many overseas locations — except on isolated occasions such as during severe bushfires or dust storms.

Locations with a high incidence of cloudy skies are better served by roof windows or conventional skylights with large areas and diffuse glazing systems. In sunny locations tubular skylights deliver very high illumination levels when the sky is clear.

Maintenance and long-term performance

Maintenance should include regular cleaning of the external roof and visible internal surfaces, especially if exposed to a harsh environment. In such locations (e.g. close to the sea or industrial pollution, or in heavily wooded areas) skylight exteriors should be cleaned at six-monthly intervals. In benign settings, once every 24 months should be adequate. Operable and ventilating skylights (e.g. openable roof windows and combined skylight/roof ventilators) may require occasional lubrication of moving hardware.

Leaf debris should not be allowed to pile up on skylight materials since rainwater leaches decomposed chemicals out of the leaf litter and causes severe staining. Leaf debris can also be a cause of corrosion and subsequent roof damage.

Skylights are made from a variety of materials including plastics (ABS, acrylic, polycarbonate and others), glass, aluminium (plain and powdercoated), steel and stainless steel. Generally these materials have a long life in Australian conditions.

Fire safety

Fire safety requirements under the BCA specify that if roof lights are deemed combustible, the aggregate area of the roof lights must not exceed 20% of the roof or part of the roof.

In addition, the BCA specifies minimum distances such roof lights must be from property boundaries and adjacent buildings, from separating walls on adjoining buildings, and from any other roof lights. See Clause 3.7.1 of the BCA, Volume Two.

For skylights in bushfire areas, AS 3959-2009, Construction of buildings in bushfire-prone areas, applies. To comply, a product needs to be tested or demonstrate that it complies with the Bushfire Attack Level requirement of your home. Check with the supplier that your preferred product meets with the standard.

References and additional reading

Australian Fenestration Rating Council. www.afrc.org.au

Authors

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