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WINDOW PROTECTION

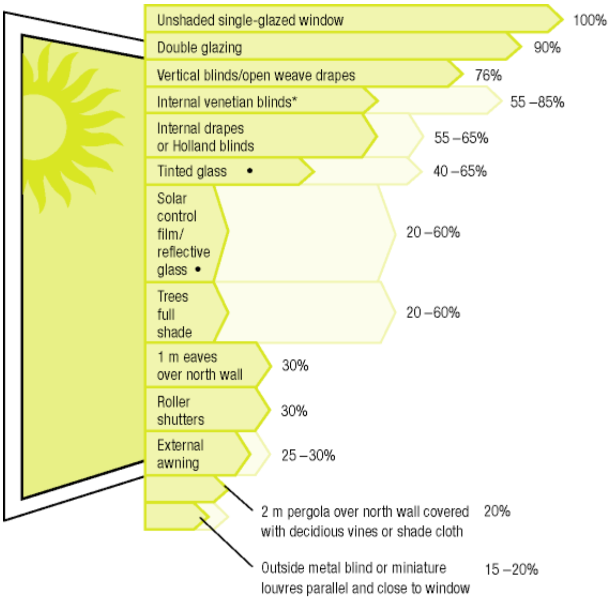
This fact sheet contains details on how to maximise winter sun penetration, while minimising excessive summer heat gain and winter heat loss.

Reducing summer heat gain

External shading devices are an effective way to reduce heat gain through windows in summer and keep a home cool. They provide much better protection from heat gain than internal window coverings. External shading reduces heat gains by 70–85%, whereas internal coverings can reduce heat gains by as little as 15% (see figure 5.13).

Shading devices should allow for ventilation on the outside of the window. If shading is fitted too closely to the window, warm air can be trapped and heat conducted into the room.

If external shading is not feasible, internal shading devices such as close-fitting blinds, lined curtains or internal shutters are preferable to no shading at all.



* Effectiveness is reduced as the colour darkens

• Solar film, tinted glass and reflective glass of varying effectiveness is available. They significantly reduce light levels all year round.

Figure 5.13: Comparison of heat gains through different window treatments in summer

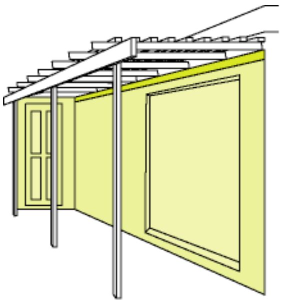


Figure 5.14: Fixed shading

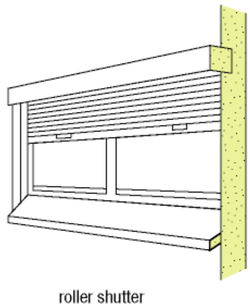


Figure 5.15: Adjustable external shading devices

Fixed or adjustable shading

Fixed shading includes structures such as eaves, pergolas or verandahs—i.e. usually a part of the building structure (see figure 5.14). They are only appropriate for use over north-facing windows. Although fixed devices provide effective protection from heat gain, they lack flexibility in situations where shading may be needed one day but not the next. However, fixed shading is durable and does not require ongoing adjustment. It is important to allow an adequate distance between the top of the window and the underside of the shading device. This avoids partial shading of the window in winter. This should be about one sixth or 16% of the height of the window (see figure 5.17).

Adjustable shading devices can also be used. These include canvas blinds, conventional or roller shutters, angled metal slats and shadecloth over pergolas. Such devices permit greater flexibility to make adjustments on a day-by-day, or even hour-by-hour, basis, in response to changing weather conditions and individual comfort levels. They can be completely retracted to maximise winter solar access. However, the user is required to respond to climatic conditions (see figure 5.15).

In general, it is a wise idea to choose adjustable shading wherever possible and convenient.

Choosing shading devices to suit window orientation

North windows

> Use adjustable shading devices such as external blinds or shutters, or removable shading over pergolas. These allow full winter sun access, in addition to full summer sun protection.

> As an alternative, horizontal overhangs such as eaves or shade battens on pergolas can be used. The depth of such overhangs can be calculated using the methods described in the following section.

> Shade battens on pergolas are a commonly used horizontal shading device. The amount of shading they provide depends on the spacing between them. This spacing should be no greater than one-third of the battens' width (see figure 5.18).

> Avoid the use of deciduous trees and vines, as these block large amounts of autumn and spring sun from entering a home.

> Avoid using fixed, angled louvres on pergolas. Although these can be designed to allow midday sun penetration in winter, earlier morning or later afternoon sun is lost.

East and west windows

> Use adjustable external shading. For horizontal shading to be effective at blocking low angled morning and afternoon summer sun, it needs to have a depth of around twice the window height. This will significantly reduce solar gain and daylight in winter.

> Windows that face north-east or north-west are also best shaded by adjustable vertical shading devices such as awnings or blinds.

Calculating the size of north-facing shading devices

There are two methods for calculating the required overhang for north windows.

Method 1: Rule of thumb

To provide full shade from late October to late February in Victoria, the depth of the horizontal overhang should be approximately 45% of the vertical height to be shaded, measured from the sill of the window to the underside of the shading device (see figure 5.17). This depth represents an acceptable compromise between shading in late summer and direct solar gain in late spring, while providing full penetration of winter sun.

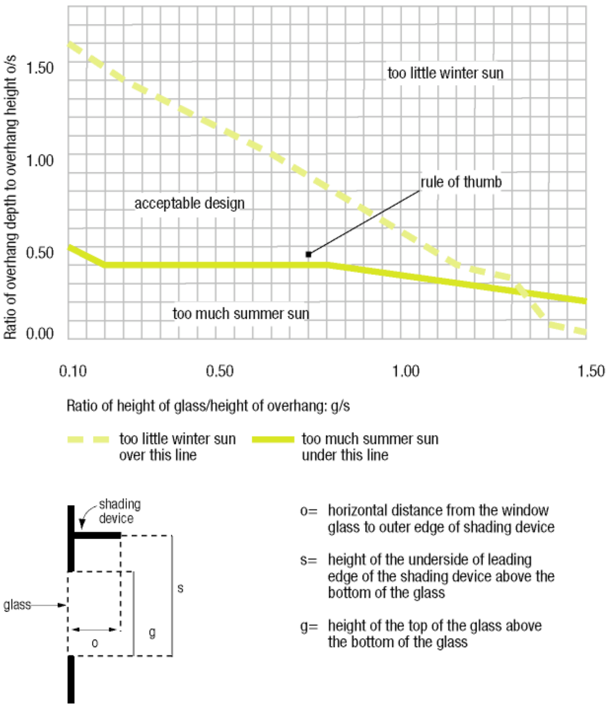


Figure 5.16: Ratio chart for north window overhang

Note that, if possible, the window should not extend fully to the underside of the overhang, as this will create an area of glass in perpetual shadow (and thus permanent heat loss).

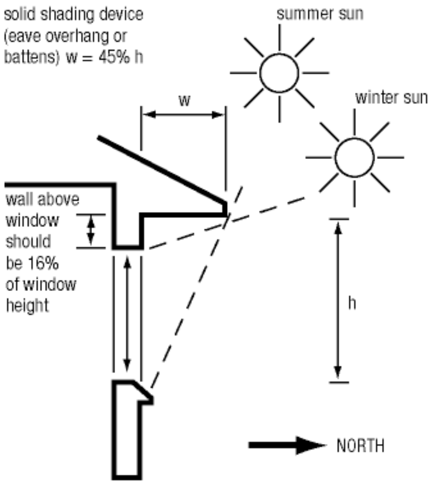


Figure 5.17: Rule of thumb for sizing north window overhang

Method 2: Ratio chart

Figure 5.16 shows the impact of shading on summer and winter sun. The chart can be used to determine how much summer and winter sun a particular overhang will require.

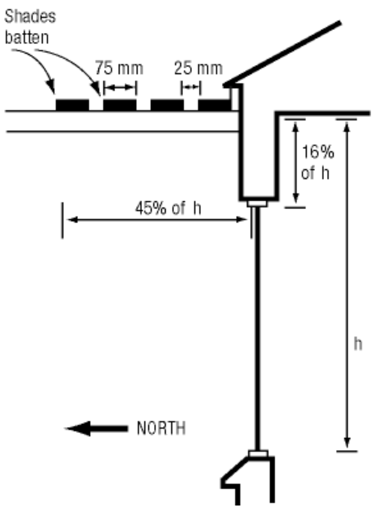


Figure 5.18: Use of shade battens on pergolas

Width of shading device

For horizontal shading to be effective, it should extend past the edges of the window for at least the same distance as its depth (see figure 5.19).

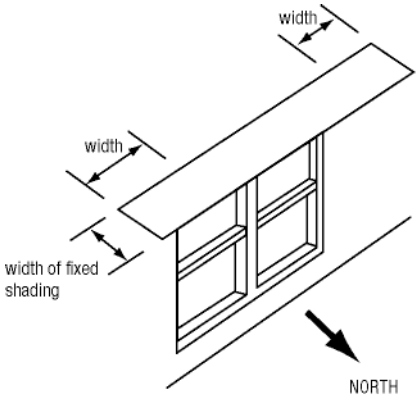


Figure 5.19: Extend shading beyond the window edges

Toned glass and reflective films

Glass can be treated to reduce the amount of solar energy transmitted through it. This can be an alternative method of preventing summer heat gain where external shading devices are inappropriate, such as for windows which are inaccessible, or have views which must be maintained. However, treated glass must be used with caution, as it reduces heat gain and light in winter as well as summer.

Toned glass

Toned glass has a tint applied to the glass during manufacture, to reduce the amount of heat transmitted through it. There are two main types of toned glass available:

1. Basic tones, usually bronze, grey and green; and
2. Super tones which offer a higher level of performance, such as EverGreen™, SuperGrey™, SolarGreen® and Azurlite®.

Reflective coatings

Reflective coatings can be applied to new and existing windows. They tend to stop greater amounts of heat gain than some toned glass, and increase privacy by stopping vision into a home. To ensure optimum performance, films should be applied professionally.

Low emittance glass

Low emittance (Low-E) glass is sometimes used for summer sun control. Emittance is a measure of how much radiant heat a material absorbs and emits. As Low-E glass reduces solar gain in winter as well as summer, it is not recommended for sun control in Victoria. It is more appropriate at complementing double glazing to reduce winter heat loss through windows.

Advanced technology glazing systems

New glazing technologies can change the physical characteristics of glazing in response to external conditions. They include:

> **photochromics:** which cause glass to darken on exposure to sunlight;
> **thermochromics:** which reduce solar energy transmission through glass in response to increasing temperature; and
> **electrochromics:** which cause glass to become opaque in response to an electrical charge across the coating.

In general, these technologies are relatively expensive, and as yet, have not made a significant impact on the residential construction market.

Reducing winter heat loss

Glazing is often the weakest link in a dwelling when it comes to winter heat loss. In fact, a single-glazed, three-millimetre-deep pane of glass can lose from ten to 15 times more heat than an insulated wall of the same area. In winter, all windows require protection from heat loss.

To reduce winter heat loss, it is necessary to trap a layer of insulating still air between the window and the room. Savings of up to 40% can be achieved with heavy, lined curtains and pelmets, while double glazing can provide savings of around 35%.

Thickened and/or laminated glass has a negligible effect on stopping heat loss. This is because around 98% of the window's resistance to heat flow comes not from the glass itself, but by naturally occurring air films on either side of it (see figure 5.21).

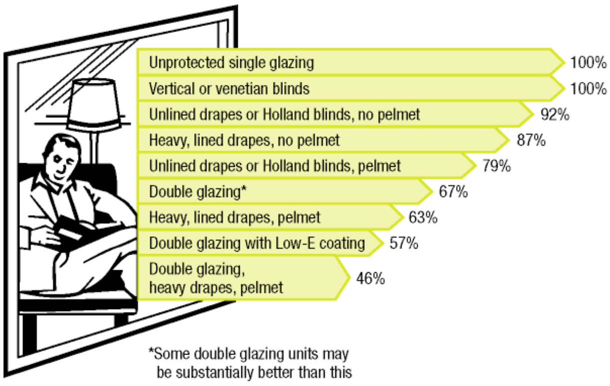


Figure 5.20: The effect of window treatments on winter heat loss

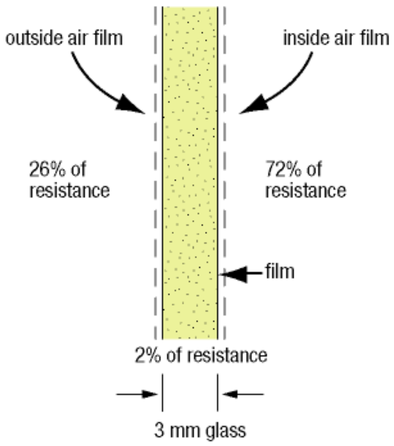


Figure 5.21: Resistance of air films and glass to heat flow

Glass effect on winter comfort

Warm room air cools as it contacts the cold glass surface and falls to the floor as a cool draught. This lowers the room temperature and produces draughts near unprotected glass. Further discomfort is experienced as a person near a window loses body heat to the cooler surface of the glass (see figure 5.22).

The relative effectiveness of various window treatments in reducing winter heat loss is shown in figure 5.20.

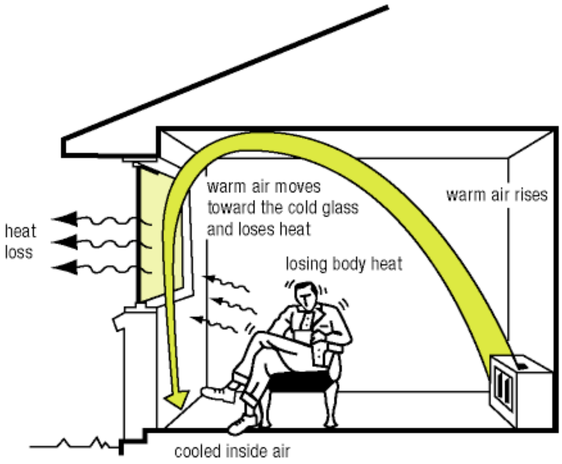


Figure 5.22: Unprotected glass and winter discomfort

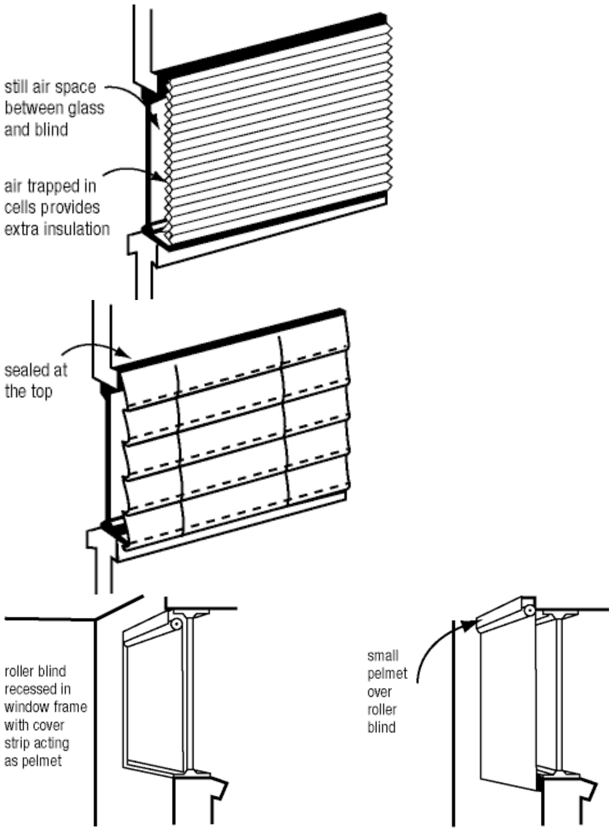


Figure 5.23: Features of effective window coverings

Internal window coverings

Internal window coverings are used to trap a layer of still air between the glass surface and the covering, reducing heat flow through the glass (see figure 5.24). To maintain the still air layer, coverings must be opaque and closely woven, be fitted completely over the window and have a barrier at the top, such as a boxed pelmet. Alternatively, they should be recessed into the window reveal (see figure 5.23).

Appropriate coverings include drapes, Holland blinds, Roman blinds and Austrian blinds. Avoid vertical blinds, conventional or timber venetians which do not give a good air seal. Thin or lace curtains should be used in conjunction with appropriate coverings.

Double glazing

Double glazing is a second alternative to stop heat loss through windows. Although useful for any window, it is vital that it be used if internal coverings are not desired or are inappropriate, such as the kitchen, highlight or clerestory windows, or simply those where unobstructed views are desired.

Double glazing does not impede solar heat gain. Therefore, it will still allow winter sun penetration. Unprotected double-glazed windows will still require appropriate summer shading.

Double glazing can incorporate most types of glass and is available with toned, laminated and toughened glazing.

For optimum performance, the space between the two panes should be at least nine millimetres. However, increasing it above 15 millimetres will not provide any extra significant thermal benefits.

Double glazing can be used in most situations, but is particularly appropriate:

- in cold or alpine climates;
- in skylights, clerestory windows and roof glazing;
- for large areas of glazing;

- > where curtains or other window coverings are not used; and
- > where energy costs are high.

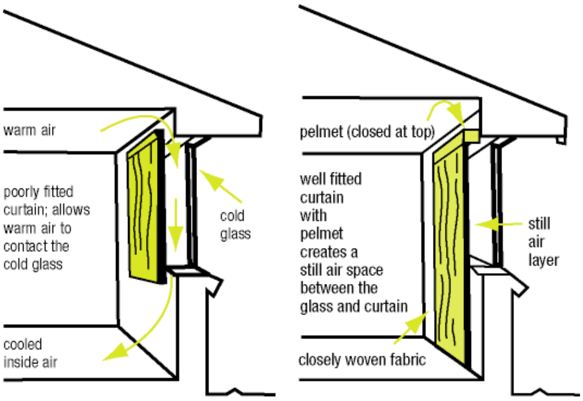


Figure 5.24: Features of effective window coverings

Types of double glazing

Double glazing is most commonly produced as a factory-sealed unit where two panes of glass are separated by a still air layer of between six to 20 mm. These are then fitted into window frames, which are usually made wider to accommodate the double-glazed unit. Factory made units contain dry air between the layers of glass, a desiccant (silica gel) to absorb any moisture likely to cause condensation and are usually double sealed (see figure 5.26). These are usually manufactured to order.

Some manufacturers offer alternative gases for filling double-glazed units, with the most common being argon and SS6 gas. Argon increases the performance of units by around 20% due to its lower conductivity than air while SS6 gas is used to help reduce noise transmission.

Low emittance glass

Another method of reducing heat loss through glazing is to use low emittance (Low-E) glass. This glass has a special coating which reflects radiant heat back into the room. The coating is located on the glass inside the air space, and reduces transmission of radiant heat from the warmer glass to the colder glass. Low-E glass is generally only used in conjunction with double glazing.

Depending on the direction the coating is facing, Low-E glass can be used to reduce either heat loss from inside a building or heat gain from outside (in hot climates). The use of Low-E glass to control heat gain is not recommended for Victorian conditions as it also reduces the amount of solar gain in winter.

Window frame material

The material of the window frame can affect overall window performance. Materials with high heat conductance cause more rapid heat loss from the heated interior in winter and higher heat gain in summer. PVC and timber frames generally perform better than metal frames, unless metal frames have thermal breaks to decrease conductance across them (see table 5.4). Figure 5.25 compares the percentage in energy savings of different window frames and glazing when compared to single-glazed aluminium frames.

FRAME MATERIAL	U VALUE OF GLAZING TYPE (W/m^2/°C		
	SINGLE GLAZING	DOUBLE GLAZING	DOUBLE AND LOW E-COATING
PVC/timber	4.5	3.0	2.4
Aluminium	5.5	4.0	3.3
Aluminium–with thermal break	4.6	3.1	2.5

Table 5.4: Total heat transfer through windows

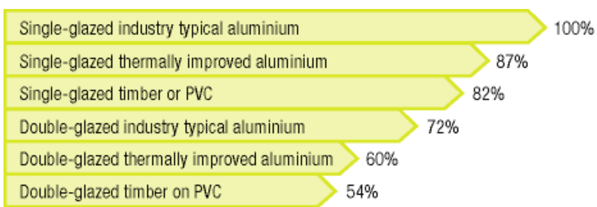


Figure 5.25: Comparison of heat loss through different window frames

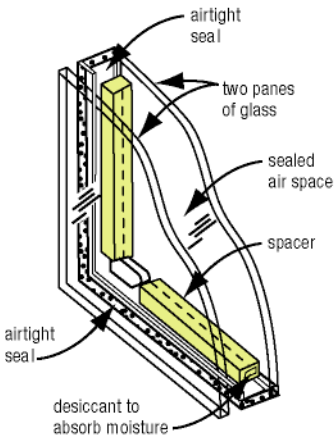


Figure 5.26: Typical double-glazing system

WINDOWS TO KEEP YOU COOL		WINDOWS TO KEEP YOU WARM	
NUMBER OF STARS	INDICATIVE IMPROVEMENT	NUMBER OF STARS	INDICATIVE IMPROVEMENT
NIL	0%	NIL	0%
★	12%	★	9%
★★	24%	★★	18%
★★★	36%	★★★	27%
★★★★	48%	★★★★	36%
★★★★★	60%	★★★★★	45%

*Based on the amount of energy required to heat or cool a typical house, when compared with using clear, single glazed aluminium windows

Figure 5.27: Percentage improvement in heating and cooling is represented by the number of stars

Window Energy Rating Scheme

The Window Energy Rating Scheme (WERS) is a program implemented by the Australasian Window Council Inc. (AWC) with the support of the Australian Greenhouse Office. The AWC rates a window's energy performance in terms of stars. No stars means the window is a very poor performer while 5 stars indicates an excellent performer (see figure 5.27). The aim of the scheme is to help consumers evaluate the relative energy performance of different types of windows to make an informed decision suited to their needs. The window manufacturer can display a label that shows the star rating for its heating and cooling performance. The label shows an indicative percentage reduction in the home's heating and cooling needs compared with using clear single-glazed aluminium framed windows and also the AWC Certified Performance Data (see figure 5.28).

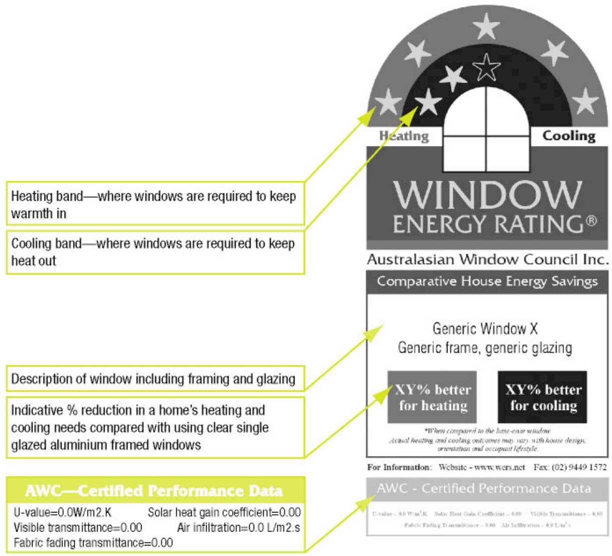


Figure 5.28: Window Energy Rating label

Skylights and roof glazing

Skylights and roof glazing can cause serious problems of heat gain in summer and heat loss in winter. The larger the glass area, the greater the potential for excessive heat loss and gain. It is vital to design and size these types of glazing correctly, as they can be difficult and expensive to correct once installed.

Roof glazing should only be installed where it is absolutely necessary and kept as small as possible. As it admits, on average, around three times as much light as the same area of vertical glazing, there is no reason for it to be excessively large. Australian Standard AS4285 provides recommended sizing guidelines for skylights, e.g. toilet, ensuite or walk-in wardrobe requires 400 mm x 400 mm shaft or one 250 mm tube type.

Summer heat gain

Angled or horizontal skylights and roof glazing admit significantly more radiation than vertical glazing. A typical 900 mm x 900 mm skylight can admit heat equivalent to turning on a three-bar radiator for six hours a day throughout summer. Unprotected north-facing roof glazing admits 50% more radiation in summer than the same area of unprotected west-facing vertical glazing.

Where possible, install skylights to face south, to reduce direct summer heat gain. Avoid them facing north or west unless absolutely necessary.

Skylights and roof glazing can be shaded using specialist products. However, these are not readily available. It is far better to keep roof glazing as small as possible, and avoid facing it north or west. To provide protection from summer heat gain, tinting and/or internal blinds or louvres can be used.

Winter heat loss

Winter heat loss through high-level windows is greater than through ground-level windows, owing to stratification of the heated air inside a home. Glazing at ceiling level loses 30% more heat than glazing at eye level. All roof glazing should be double glazed or fitted with ceiling diffusers to reduce winter heat loss (see figure 5.29).

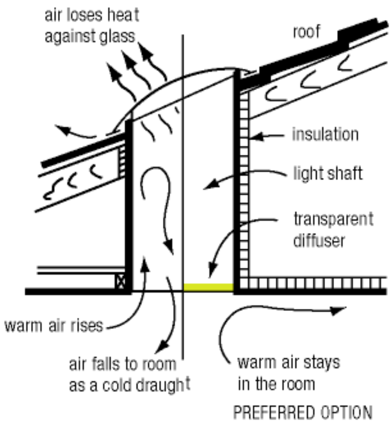


Figure 5.29: Skylight diffuser

Daylight tubes

Daylight tubes can be a more energy efficient alternative to conventional skylights. They consist of a clear, hemispherical dome, a smooth highly reflective tube and a diffuser at ceiling level (see figure 5.30). As they require a smaller area of roof glazing than a traditional skylight, heat gain in summer and heat loss in winter is significantly reduced. They are best suited for use in smaller rooms such as bathrooms, hallways and entry areas. Note that types with textured, flexible ducts can deliver significantly less light than those with smooth shiny ducts.

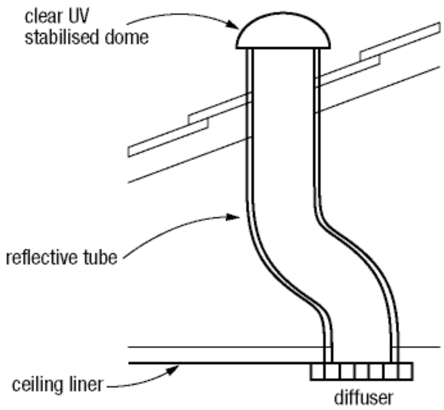


Figure 5.30: Daylight tube