Glazing
temperate

This Fact Sheet deals specifically with glazing solutions for mixed climates. These are temperate climates where:

> More than 30 percent of the total space-conditioning energy is used for heating in winter and

> More than 30 percent is used for cooling in summer.

For a general introduction to glass and windows. [See: Glazing Overview]

DESIGN GUIDELINES

A typical house in Sydney (in a mixed climate) may use 57 percent of its total heating and cooling energy for heating and 43 percent for cooling.

This places conflicting requirements on the role of the window. During winter, a low U-value and a high solar heat gain coefficient are ideal to capture useful solar energy and reduce heat loss. During summer, good solar control and/or shading are required.

From the WERS table of 27 generic windows, the window types WIN06 to WIN14 have good heating energy reduction performance in temperate climates. These windows are all double glazed insulating units, with either clear glass or low-e glass. The double-glazing helps to insulate the home and prevent heat loss, while the clear glazing allows maximum solar heat gain in winter. [See: How to use WERS]

The windows WIN19 to WIN27 have good cooling energy reduction performance in temperate climates. These windows are also double glazed for insulation purposes but use solar control glass to reduce the solar heat gain in summer. [See: How to use WERS]

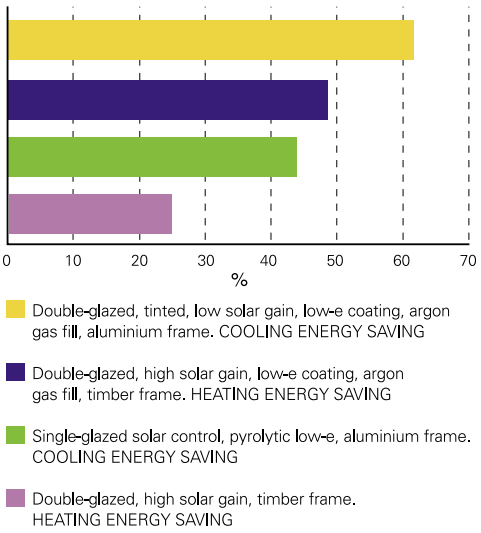
Good design dictates that windows with good heating performance should be used on the north and south elevations and good cooling performance on the east and west elevations.

Correctly sized eaves or other shading should be used to protect north-facing windows. This provides protection from summer heat and glare while still allowing sun penetration in winter. [See: Shading]

ANNUAL ENERGY SAVINGS

The following graph shows energy savings on home heating and cooling energy in temperate climates for four window types compared to a typical clear, single-glazed aluminium-frame windows.

Reduction in heating energy or cooling energy (%) compared to using 3mm single clear, aluminium frame, in MIXED (Temperate) climate.



Overall glazing performance is dependent on a combination of passive design features as well as the performance of the glass. The comparisons above were made using the NatHERS building energy simulation program for a particular house type and orientation.

NatHERS assumes that a house is maintained within typical, thermal comfort ranges in terms of continuity of heating or cooling, desirable internal temperatures, the proportion of heated and cooled areas and the number of people in the home.

In reality, the actual amount of energy that homeowners purchase depends on individual preferences, the design and orientation of the home, the total area of glazing, insulation levels and the efficiency of heating and cooling systems. [See: Rating Tools]

The ratings above do not include the additional benefits of shading. [See: Shading]

CONSUMER CASE STUDIES

Bill Mason – Newport, NSW

When Bill bought his 1960s house at Newport in NSW, he inherited a beautiful view directly up the Midwater. The existing house had grown haphazardly on five levels and extreme winter and summer temperatures made the building very difficult to maintain at a comfortable temperature. The house was also quite dark and took little advantage of the magnificent views. A complete renovation was required.

With the westerly waterfront outlook a view without excessive glare was essential, so "supertoned" glass was chosen. The area could also be noisy, especially with weekend revellers, so good soundproofing and security was required. The windows also needed to provide a high level of year-round insulation.

"I opted for high performance frames and double-glazing to cut down the noise and lock down the heating and cooling… to provide us with a complete weather and sound barrier."

The windows and sliding doors installed are double-glazed. They have timber frames and high performance weather seals with sealed insulating glass. The outer pane of glass is a "supertoned" green solar control glass and the inner pane is clear float glass. This window assembly has been used on all elevations.

In temperate climates, the ideal solution for energy savings is to have appropriately shaded low-e double-glazing on the north and south elevations and adjustably shaded double-glazing including a solar control glass on the east and west.

In this case, Bill preferred to use the "toned" solar control glass on all elevations for aesthetic reasons. As a result, passive solar heat gain in winter will be slightly reduced by the solar control glass on the north elevation and energy use in winter will be slightly higher than the ideal situation.

By installing these windows, Bill has gained increased year round comfort.

Double-glazing helps to maintain a consistent temperature in winter months by several mechanisms. Insulating glass reduces the loss of heat through the windows.

Inside glass surface temperature is closer to room temperature. For anyone near the windows, this enhances comfort because there is less radiant heat loss to those windows.

Discomfort from draughts caused by the movement of warm air towards the colder exterior is reduced.

Rising hot air allows under-floor heating on the lowest level to successfully heat all five floors during the winter for modest outlay. Double-glazing is essential with convection heating. Greatest heat loss occurs at the upper levels where temperatures are highest. The greater the heat loss, the more cool draughts flow back to the lower level heat sources.

In summer the double-glazing reduces conducted heat from high external temperatures entering the cooler interior. The solar control properties of the outer pane of glass reduce some of the unwanted radiated heat gain. To eliminate all summer heat gain by solar radiation, the windows would need to be shaded externally.

Ceiling fans are used to move cooled air through the house, reducing the need to operate the air conditioner.

With a large number of windows and wide sliding doors, natural light floods the interior of the house. Sound is locked out to such a degree that even a fireworks display can be watched in relative quietness. The windows have a light transmission of 60 percent, so the toned glass does not lead to an increased need for artificial lighting.

"Supertoned" glass reduces the transmission of ultraviolet rays which, when combined with heat, are a major cause of fading of furnishings. This type of glass also reduces glare – similar to wearing sunglasses.

The windows exceed the Australian Standard 2047 for low air infiltration and are WERS rated as 3 stars for a heating climate for north and south elevations and 4 stars for a cooling climate for east and west elevations.

[See: How to use WERS]

Theo and Fay Isaacs - Dover Heights, NSW

"Windows were very important. They had to look good and work so there was a balance between aesthetics and function."

Fay and Theo's new Dover Heights home enjoys spectacular views of Sydney Harbour to the west.

The new home is of neo-classical design and sits high on an elevated corner block. The design includes recesses to many of the windows that provide shading. It has two stories with bedrooms on the ground floor and living rooms upstairs that take advantage of the ever-changing vista.

Fay and Theo went to great lengths to ensure the house is as energy efficient and environmentally friendly as possible. All windows are timber framed and double-glazed with a 6.38mm "supertoned" laminated glass outer pane, a 12mm airspace then a 6.38mm clear laminated glass inner pane.

The windows feature the European style 'tilt and turn' mechanism allowing the double-glazing units to be tilted in the frames for ventilation and locked securely in any position. Tilting in from the top admits air and excludes rain.

Deep balconies overhang the west-facing front windows, shading the glass from all but low-angle sunshine late in the day.

Similar glazing has been used in the abundant sliding doors and the windows.

Sliding doors lift on their tracks for sliding then lock down on the tracks for security and draught proofing.

Green "supertoned" glass blends with the sandstone exterior colours of the house to provide a natural and harmonious effect.

In temperate climates, the ideal solution for energy savings is to have low-e double-glazing on the north and south elevations. Double-glazing including a solar control glass should be used on the east and west. Fay and Theo preferred to use the "supertoned" solar control glass on all elevations for aesthetic reasons.

Passive solar heat gain in winter is slightly reduced by the solar control glass on the north elevation and energy use in winter is slightly higher than the ideal situation. Despite this, comfort is improved in both summer and winter.

Shading and the use of solar control glass to reduce heat gain through the west windows allows enjoyment of the view without adding to the cooling requirements for the house.

Air conditioning has not been fitted although ducting was included in the flat concrete roof should natural ventilation not provide sufficient relief from summer heat in the future.

The house is close to a bus route and a school, so noise control was a key factor in selecting the windows. The combination of timber frames, two panes of laminated glass and high performance seals in the windows almost halves noise inside the house compared to conventional windows. [See: Noise Control]

The windows have a light transmission of 55 percent, which is sufficient to ensure that the toned glass does not increase the need for artificial lighting. The "supertoned" glass reduces the transmission of ultraviolet rays that, combined with heat, are a major cause of fading of furnishings.

Security is good and Roman blinds provide added privacy and insulation against heat loss when required. With both panes being laminated glass these windows meet the requirements of AS2208 – Safety glazing materials in buildings, both internally and externally, for Grade A safety glass. This will minimise the risk of injury should the glass ever be broken.

It is estimated that these windows would have a WERS rating of 3 stars for a heating climate for north and south elevations and 4.5 stars for a cooling climate for east and west elevations. [See: How to use WERS]

Rob Tolson – Windsor, NSW

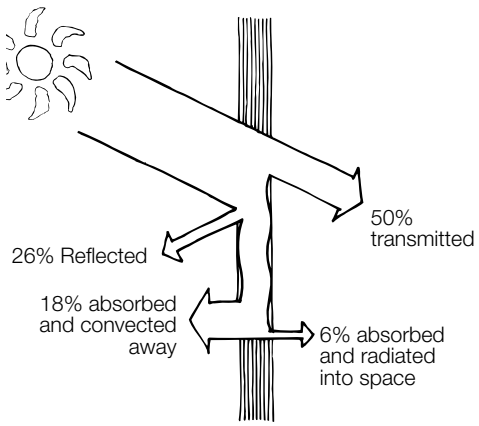
"We overlook the Hawkesbury River to the west and we're close to Richmond Air Force Base so double-glazed windows were a necessity."

Rob's house is a major project on prime Windsor real estate in NSW. Built on two adjacent blocks, the house was built to face the views of the Hawkesbury River and the mountains.

The large two-storey home has a concrete roof with a single glazed cupola referred to by family members as "the solarium". This admits huge amounts of natural light into the centre of the house but allows heat loss in winter and heat gain in summer.

Rob chose to install double-glazed windows with uPVC frames. There are well over fifty double-glazed windows and sliding, bi-fold and normal opening doors.

The double-glazed units consist of a 6mm grey, high performance reflective, solar control exterior glass with a 12mm airspace and a 4mm low-emissivity (low-e) inner glass.



Solar energy transmitted through reflecting glass.

The introduction of low-e glass has a twofold effect: they provide high levels of both solar control and insulation.

By almost eliminating radiant heat transfer, it improves the insulation performance of the double glazing, making it approximately equivalent to a triple glazed unit.

Solar control is improved by reflecting radiant heat built up in the external, heat absorbing glass. The high performance glazing tempers the heat from the sun while making the most of the expansive views to the west.

The uPVC window frames are popular in Europe and do not condense on the inside even in the coldest weather, making them ideal for bathrooms.

With double-glazing, uPVC frames insulate the unit from the elements and the surrounding wall ensuring that minimal heat, cold, vibration and noise is transferred. The windows open in the European style, leaning in or out, and swinging around for easy cleaning from the inside.

Although energy efficiency was a priority, the same product was used on all elevations to maintain the grey colour all around the house. In temperate climates this reduces solar heat gain through north-facing windows in winter, adding to winter heating costs, but double glazing helps maintain a consistent temperature by reducing the loss of heat through the windows.

Draughts caused by the movement of warm air towards the colder exterior will be minimised. The use of double-glazing provides a benefit in summer by reducing the flow of warm air towards the cooler interior. The high performance solar control glass will reduce the heat gain caused by direct solar radiation.

The choice of double-glazed windows reduces the impact of aircraft noise from the Richmond Airforce Base. These windows would have an Outdoor-Indoor Transmission Class (OITC) rating of approximately 30dB, and dramatically improve the sound insulation of the house.
[See: Noise Control]

This window assembly has not yet been rated but is estimated to have a WERS rating of 3.5 stars for a heating climate for north and south elevations and 5 stars for a cooling climate for east and west elevations.
[See: How to use WERS]

ADDITIONAL KEY REFERENCES

Window Energy Rating Scheme *Training Manual*, Version 1.0. Available from the Australasian Window Council Inc. (info@wers.net)

WERS website
www.wers.net

Carmody J, Selkowitz S, Arasteh D K and Heschong L (2000). *Residential Windows, 2nd Edition.* W Norton & Co. ISBN 0-393-73053-0. (Available through the Australian Window Association (info@awa.org.au)

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