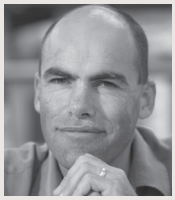

SOLAR CONTROL GLAZING

This is the second article in a series looking at the thermal performance of residential window systems. The focus this time is solar control glazing and WERS (Window Efficiency Rating Scheme).

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Windows are sometimes thought of as a weak link in the thermal performance of a house since they have lower insulation values than a solid wall. However, windows allow free light and heat (from solar gain) to enter homes, which a solid wall does not.

Specifically designing the size, properties and location of windows is vital for the efficient operation of a house and can reduce energy use.

High sunshine hours

Many New Zealand locations have high sunshine hours, which provides the opportunity for free heating energy in winter, particularly if it heats a thermal mass material, and free lighting year round. The average sunshine hours around New Zealand varies from 1,200 hours per year (3.3 hours per day at Franz Josef glacier) to over 2,400 hours per year (6.5 hours per day) in Nelson (see Table 1).

The intensity of the sun on the ground during these sunshine hours depends upon many factors. At midday in mid-summer in New Zealand, the intensity can be over a kilowatt, but in winter it's only a few hundred watts.

The amount of solar gain in a house is also dependent upon:

- window orientation and size (which direction windows face)
- amount of shading (from trees, eaves and structures)
- roof windows (that admit more light)
- cleanliness of the glazing (dirt reduces light)
- the solar heat gain coefficient (SHGC).

Measuring solar heat gain

The SHGC is a measure of how much of the sun's energy passes through a window. The value varies from 0 to 1. A rating of 0 means that there is no solar gain, for example a solid wall, and a rating of 1 means that there is maximum solar gain, for example, a hole in the wall.

Different SHGC values can be achieved using tinted glazing, reflective glazing or advanced coatings on single glass or as part of an insulated glazing unit. The SHGCs of some common glazing systems are presented in NZS 4218:2009 Thermal insulation – Housing and small buildings. Some SHGC values for products available in New Zealand are shown in Table 2, where a value between 0.84 (high solar gain) and 0.2 (low solar gain) is typical.

Balancing daylight and solar heat gain

If specifying a low solar heat gain to prevent summer overheating, consider the impact of the glazing selection on daylighting and the implications for getting free heat in winter.

Daylight and solar gain are different. Only some of the sun's energy is visible light (with some being heat) – there is also ultraviolet, infrared, x-rays, gamma rays and radio waves.

This is where the visible transmittance (VT) or the amount of daylight that passes through the window becomes important (see Table 2). A good option for winter is a window with a high SHGC and a high VT (lots of solar gain and lots of daylight), but for summer, a good option may be a low SHGC and a high VT (not a lot of solar gain but lots of daylight).

Unfortunately, windows with an adjustable SHGC are not readily available, so a compromise must be made, depending upon whether heating or cooling is more important.

There are several other ways of specifying the proportions of light and solar gain for windows, which includes the light to solar gain (LSG) ratio. A competent supplier can advise on these.

Table 1: Average annual sunshine hours for selected New Zealand and international locations.

Location	Annual average sunshine hours
Franz Josef glacier	1,199
Antarctica, Scott Base	1,432
London (UK)	1,500
Invercargill	1,614
Palmerston North	1,734
Masterton	1,915
Queenstown	1,921
Whangarei	1,973
Hamilton	2,008
Toronto	2,050
Auckland	2,060
Wellington	2,065
Christchurch	2,100
Melbourne	2,100
Gisborne	2,180
New Plymouth	2,182
Napier	2,188
Tauranga	2,260
Nelson	2,405
Florence	2,500

WERS helps balance winter and summer demands

There is also a trade-off between the SHGC and R-value, where high R-value (thermal resistance) is always wanted, but high SHGC is wanted in winter but not in summer (see Table 2). Remember the SHGC is about letting the sun in and the R-value is about stopping the movement of heat in or out.

It is difficult to accurately specify the appropriate mix of SHGC and R-value without modelling or calculating the annual energy

Table 2: Solar heat gain coefficient and visible transmittance figures for typical glazing systems with typical R-values when installed in an aluminium frame.

Type of glazing	Solar heat gain coefficient	Visible transmittance	R-value
Clear 4 mm glass	0.84	0.89	0.15
Grey 4 mm glass	0.68	0.56	0.15
Clear double glazing	0.74	0.80	0.26
Double glazing with grey tint	0.5	0.49	0.26
Double glazing with advanced tint	0.45	0.65	0.26
Double glazing with solar control glass	0.30	0.45	0.31
Advanced dark tint	0.2	0.1	0.28

Table 3: Generic WERS ratings for climate zones 1 and 2. (Courtesy of Window Association of New Zealand.)

		Winter heating stars	Summer cooling stars
Single grey standard tint	Aluminium frame	★	★★½
Single advanced tint	Aluminium frame	★	★★★
Double grey reflective/clear	Aluminium frame	★½	★★★★★
Single clear	Aluminium frame	★★	★½
Double bronze tint/clear	Aluminium frame	★★½	★★★★½
Double advanced tint/clear	Aluminium frame	★★½	★★★★½
Double grey tint/clear	Aluminium frame	★★½	★★★★
Double clear laminated/clear	Aluminium frame	★★½	★★★★
Double tint/low-E	Aluminium frame	★★★	★★★★½
Double clear	Aluminium frame	★★★½	★★
Double clear/low-E clear	Aluminium frame	★★★★	★★½
Double clear/low-E clear and argon	Aluminium frame	★★★★½	★★½

balance of a home. This is where the Window Efficiency Rating System (WERS) can be useful. The WERS rating combines the SHGC and the R-value to compare the amount of space heating or cooling that is needed, dependent upon the choice of glazing.

WERS allocates star ratings to glazing systems for their summer and winter behaviour to allow a choice to be made about the best option for typical situations. The WERS ratings are available on the Window Association of New Zealand website (www.wanz.co.nz). Table 3 shows some of the ratings for climate zones 1 and 2 – most of the North Island, excluding the Volcanic Plateau. Ratings for the rest of New Zealand are almost identical.

If you want to reduce the cost of winter heating, the window option with the most red winter heating stars may be best. For concerns about overheating in summer, look for a window option with the most blue summer cooling stars. For the best year-round performance, choose a mid-range option with high stars for both winter and summer.

The WERS system is not used by all window companies, but it is a very useful rating system to compare the generic performance of window systems and can be used to help design homes to use less energy.

The next article in this series will look at replacement of glazing, safety glass, fading, acoustics and condensation.

LOW-E GLASS HAZE

The article on low-emissivity (low-E) glass in *Build* 123 (April/May 2011, pages 58–59) didn't mention the potential for a faint bluish haze to be visible with low-emissivity glass under certain lighting conditions. This is a recognised issue with hard-coat low-emissivity glass and is not a fault. It appears to be more prevalent in New Zealand than in other countries.