DESIGN RIGHT

Windows for energy efficiency

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A WELL DESIGNED GLAZING SYSTEM CAN IMPROVE INTERNAL DAYLIGHT, LOWER GLARE, HELP MAINTAIN THERMAL COMFORT AND IMPROVE ENERGY EFFICIENCY.

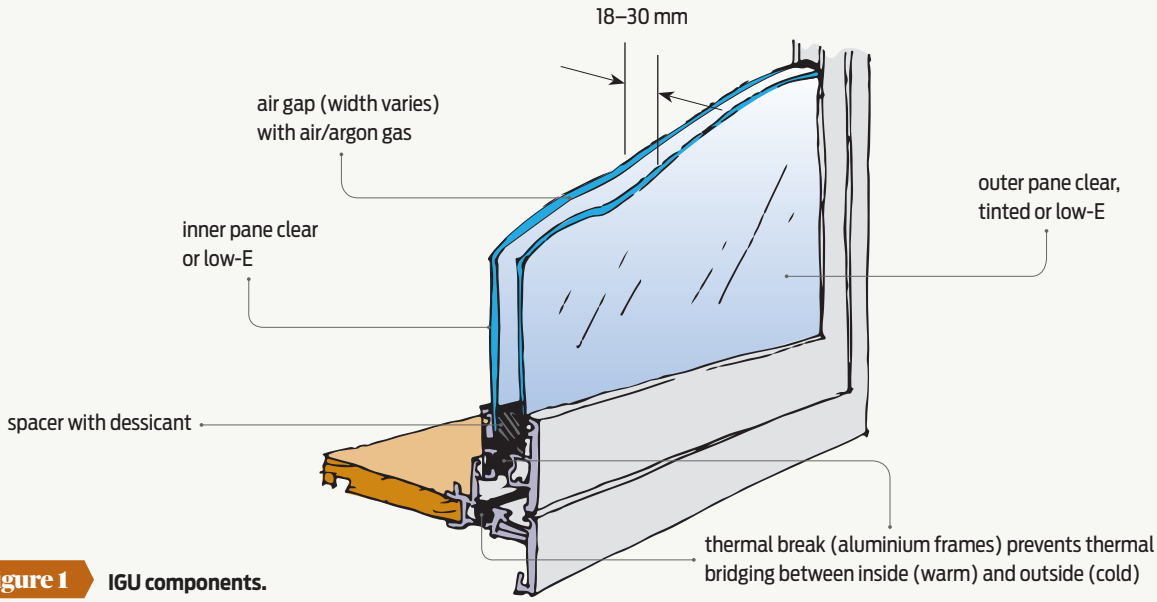

Figure 1 **IGU components.**

A designer considers many factors when selecting and positioning glazing, such as the site – its orientation, views, exposure and shading – the design brief and budget.

Building Code clause H1 *Energy efficiency* calculations define the minimum glazing requirements, considering orientation and insulation levels in the thermal envelope. The schedule method of NZS 4218:2004 requires the use of insulated glass units (IGUs).

Basic design guidelines

Design guidelines recommend:

- limiting west-facing glazing (to minimise late afternoon overheating) and south-facing glazing (to minimise heat loss)
- some east-facing glazing to maximise early morning light
- glazing is concentrated on the north-facing elevation to maximise winter heat gain
- sufficiently insulated glazing to minimise heat loss
- shading or solar control glass to prevent overheating.

Although 2 m² of north-facing single glazed window can deliver as much energy as a 1 kW bar heater, they can lose more than this over a year. Also, too much heat can cause overheating.

Range of glass types

New Zealand imports all glass for construction purposes, although processing is carried out locally. Types available include:

- standard clear glass, known as 'float' glass, in thicknesses from 3 mm up
- low-emissivity (low-E) glass that lets light in and is used in IGUs to help prevent heat from escaping or, by flipping the pane, to prevent some heat from entering
- reflective, tinted and spectrally selective glasses that reduce the amount of heat, light and ultraviolet light (which causes fading)
- laminated glass – two sheets of glass bonded with an interlayer to hold the glass together if broken – PVB laminates absorb ultraviolet light, and some types (acoustic laminates) can reduce noise
- toughened safety glass that shatters safely into small harmless pieces if broken.

Understand insulating glass units

IGUs reduce condensation and halve the heat loss of the same size single-glazed window.

They are made of two glass panes separated by a 6–12 mm gap filled with air or an insulating gas such as argon.

Argon gas can improve the thermal performance of many IGUs by 6%, and should always be used in IGUs with gaps less than 10 mm wide.

The air or gas in the sealed unit is kept dry by incorporating a desiccant – moisture-absorbing material – in the perimeter spacers. Aluminium spacers are the most common, but warm-edge spacers are also available with better thermal performance.

Know your R- and U-values

The R-value measures the resistance to the flow of heat through a given thickness of glass. A higher R-value indicates higher resistance or better insulating properties.

The U-value is the inverse of the R-value and measures the heat transmission, with lower numbers indicating better insulating properties.

When comparing window system performance, use the overall window R-value (R_{window}), which is the thermal resistance of the glazing and frame together. Do not use the R_{cog} – the centre of glass R-value.

The thermal properties of imported products may be expressed as a U-value in imperial units. Divide the imperial unit R-value by 5.678 to convert to metric R-values.

First decide on R-value

When specifying windows, decide on the R_{window} required before considering other requirements, such as visible light transmission (VLT), UV elimination, solar heat gain coefficient (SHGC), durability, safety, security, privacy, noise control and ease of cleaning.

Tools to understand glazing systems

Heat is gained and lost through both the glazing and the frame, so it's important to consider both together.

Timber, uPVC, thermally broken aluminium and composite aluminium and timber frames provide better thermal insulation than non-thermally broken aluminium or steel but may not have the structural strength.

WERS (Window Efficiency Rating System) from the Window Association of New Zealand provides a useful comparison of different window systems for winter heating, summer cooling and fading (see www.wanz.org.nz/StarCharts). It is currently being updated to WEERS (Window Energy Efficiency Rating System).

The BRANZ ALF3.2 (Annual Loss Factor) online program can analyse insulation requirements for windows in any New Zealand location (see http://alf.branz.co.nz). It lets designers optimise the window and frame design, then provides the theoretical annual heating and cooling costs to weigh up against the cost of insulating the total building envelope, including windows and doors.

How much will it cost?

IGUs reduce the energy required to heat and cool a home but have higher upfront costs. Thermally broken frames can add 10–45% to the overall window cost. However, they can also increase the window's thermal performance by 20% and reduce condensation.

Less expensive options

If cost is an issue, there are other choices for renovations:

- Most modern aluminium-framed single glazing can be replaced with IGUs without replacing the whole window, but seek advice from the window manufacturer about the extra weight of the IGUs.
- Timber windows can be modified to accommodate IGUs. Check the dimensions of the existing sashes to ensure adequate rebates. Draught-seal strips may be needed to get the best effect from the IGUs.
- Secondary glazing – installing a second pane or sash on the inside of the window – may be cheaper and can help with noise reduction. However, it may obstruct operating sashes and furnishings and trap condensation and may not be permanent.
- Various films and coatings can be applied to the glass to reduce glare, fading, heat loss or solar heat gain, for privacy or to reduce the risk of injury from breakage. Although less expensive, it is not the most effective for thermal insulation.