Window selection balancing act

Installing windows that only meet the minimum Building Code performance requirements is common. Specifying higher-performing insulated glazing units and window frames could help us lift our game.

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WINDOWS PROVIDE more than just a view on the world outside. They need to multi-task, bringing in light, allowing solar gain as free winter heat, admitting fresh air and limiting heat loss in winter.

Weak link in thermal performance

Window area and specification has a huge influence on the overall energy efficiency of a building, and often this is underestimated. Windows can contribute significantly to a building’s heat losses and, for north-facing windows, winter heat gain, and the figures are more than you might think.

Typically, the window area of a dwelling is about 8-10% of the total area of a building’s thermal envelope, yet windows can be responsible for up to 40% of the heat losses. This is because homes are typically built to meet the minimum standards required by the New Zealand Building Code.

The resistance of the heat transfer through a window - the R-value - is poor at R0.26 m².k/W for an aluminium frame with an air-filled insulating glass unit (IGU).

The other key elements of the thermal envelope - the wall, roof, and floors - can be specified to achieve much higher R-values. For the schedule method in NZS 4218:2009 Thermal insulation - Housing and small buildings, a framed wall must have a minimum insulation R-value of 1.9 in climate zones 1 and 2 and R2 in climate zone 3. Installing R2.8 insulation is possible for a 90 mm thick wall.

IGUs offer benefits

Windows with IGUs (Figure 1) provide a lot of benefits. They:
• reduce the heat loss through glazing
• improve thermal comfort in the home
• reduce external noise (when opening windows are closed)
• reduce condensation build-up on the glazing in cold weather by increasing the surface temperature of the glazing.

There are a range of glazing types to choose from when considering thermal performance including low-E, reflective and tinted glazing.

Making the better choice

To get the best out of your windows, look further into the specifications:
• The frame - thermally broken aluminium, thermally broken steel, uPVC, fibreglass or timber frames are best thermally. Aluminium and steel frames without thermal breaks are highly conductive. An unbroken aluminium frame with an air-filled IGU has an R-value of R0.26 while a timber frame with single glazing has an R-value of 0.27.

Even though the thermal performance of an IGU is several times better
than single glazing, the aluminium frame will perform much worse than a timber frame, cancelling the benefits gained of having the IGU.

- **Thermal spacer** - specify a thermal spacer with a lower thermal conductivity than a standard aluminium one to reduce the heat loss. This is also known as the warm edge spacer and separates the two glass panes of a double glazed window.

- **Low-emissivity (low-E) glass** - this has a microscopically thin, transparent coating that reflects long-wave infrared energy (or heat). This enables light and heat to pass in one direction but not the other and allows glazing to be selected that will keep you warmer in winter or cooler in summer. Low-E coatings also reduce the impact of UV light, such as carpet and furniture bleaching by sunlight. A laminated pane performs better again.

- **Multiple layer air seals** - these help to keep draughts, moisture and noise out. Some European-style windows have at least a double seal within the frame, providing better airtightness and therefore less heat loss.

- **Gas filling** - specifying an inert gas filling, such as argon, between the glass layers reduces the heat loss through the IGU. Argon is a better insulator than air, reducing window heat loss by 3–9% compared with an air-filled IGU. Krypton, if available, is even better than argon.

- **Air gaps** - a wider gap (12 or 16 mm) between the glass panels will give a small increase in R-value for both air and argon fill. Table 1 gives the R-values for a range of frames, gaps and IGU fill.
Skylights

Skylights must have good thermal performance characteristics to minimise heat loss in winter and overheating in summer. Triple-glazed units are becoming more common. Installing an openable skylight or roof window that provides passive ventilation in summer days is a plus. However, skylights always lose more energy than they gain and are typically used for increasing daylighting.

What’s happening overseas?

Europe and America are leading window innovations, so what’s new there?

- The thermal break is located deeper in the window frame to reduce conductivity. This is called a recessed window.
- The window’s framing is insulated, including extra thermal breaks in aluminium window frames.
- There are more seals between the opening and fixed glazing of the window’s frame for improved airtightness.
- Triple-glazed insulated units (see Figure 2) have become the norm in some northern countries, and there are options of quadruple and quintuple glazing units. The performance of low-E panes has also improved dramatically, with some now performing twice as well as older low-E types. This means that double glazing with the new low-E panes can perform as well as some triple glazing but without the extra weight and size.

Window ratings matter

If you are still uncertain, ask for the window rating. The Window and Glass Association of New Zealand in association with BRANZ has developed the WEERS rating tool that is specific to New Zealand climate conditions and gives the actual performance of windows.

### Table 1

Comparison of typical window R-values (frame and glass)

<table>
<thead>
<tr>
<th>WINDOW FRAME</th>
<th>SINGLE GLAZING</th>
<th>IGU – 4 MM GLASS AND 8 MM AIR SPACE</th>
<th>IGU – 4 MM GLASS AND 12 MM AIR SPACE</th>
<th>IGU – 4 MM GLASS, 12 MM AIR SPACE AND LOW-E PANE</th>
<th>IGU – 4 MM GLASS, 12 MM AIR SPACE, LOW-E PANE AND ARGON GAS FILL</th>
<th>TRIPLE-GLAZED IGU WITH LOW-E PANES AND ARGON GAS FILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>R0.15</td>
<td>R0.25</td>
<td>R0.26</td>
<td>R0.31</td>
<td>R0.32</td>
<td>R0.53</td>
</tr>
<tr>
<td>Thermally broken aluminium</td>
<td>R0.17</td>
<td>R0.30</td>
<td>R0.31</td>
<td>R0.39</td>
<td>R0.41</td>
<td>R0.77</td>
</tr>
<tr>
<td>Timber</td>
<td>R0.19</td>
<td>R0.34</td>
<td>R0.36</td>
<td>R0.47</td>
<td>R0.51</td>
<td>R1.00</td>
</tr>
<tr>
<td>uPVC</td>
<td>R0.19</td>
<td>R0.34</td>
<td>R0.36</td>
<td>R0.47</td>
<td>R0.51</td>
<td>R1.00</td>
</tr>
<tr>
<td>Fibreglass</td>
<td>R0.19</td>
<td>R0.34</td>
<td>R0.36</td>
<td>R0.47</td>
<td>R0.51</td>
<td>R1.00</td>
</tr>
</tbody>
</table>

Does your glass have a low-E coating?

TO FIND OUT if an IGU has a low-E coating, look at the reflection of a flame in the window’s layers (from the inside of the building). You will see four main reflections:

- If a low-E coating is present, the second reflected flame should appear with another colour – usually greenish.
- Any coloured reflections are the location of the low-E surface. To keep heat in, the low-E should be the second surface from the inside. To keep heat out, the low-E should be the third reflection.