Windows

Window problems and solutions seen on Carbon Cops

- Specialist glass, skylights and south-facing windows at the Barries
- North facing windows and a deciduous creeper pergola at the McKinney-Lelliots
- Magnetic retrofit double glazing and reflective foil shading at the McSweeney-Glenwrights
- Temporary double glazing, curtains and pelmets at the Renters'

Window shades

North facing windows get the most light – and the most heat – all year round! West facing windows let in the next most heat in summer, as they look straight into the sun as it descends through long hot afternoons. This house had several unshaded west facing windows upstairs, and there was so much radiant heat coming through them that the upstairs bedrooms were up to fifteen degrees warmer than the rest of the house.

The reason for shading windows is to prevent that radiance entering the building. The more reflective a shade is, the more radiance is bounced away, and the less reflective it is, the more radiance it absorbs. A completely reflective shade would let no light or heat through at all.

The Cops solved the problem by installing highly reflective light-weight shades made of perforated aluminium foil over card. Light will pass through the holes but around 85% of the radiant heat is reflected. This will help to keep the rooms cool in summer, but should allow the rooms to stay bright. These shades can be removed and replaced as desired, so they also make a good temporary solution for renters.

- *Window orientation and incoming heat*
www.sustainability.vic.gov.au/resources/documents/Window_placement.pdf
- *Renshade*
www.concertinafoilbatts.com/renshade.htm

Window glazing

We remember to insulate our ceilings and sometimes our walls, but windows act as a large hole in the wall for heat to move through. The amount of heat lost through normal single glazed windows can be as much as ten to fifteen times more than through the wall next to them. Double glazing puts a sealed air gap between the window glass and the second layer of glazing, and the air acts as an insulating layer to keep heat from passing between.

Double glazing can stop around 35% of heat loss in winter and around 10% of heat gain in summer, compared to a normal single glazed window. This means it's a good choice for windows in cold climates, or windows that are south-facing or highly shaded. These percentages can be increased by using special kinds of glass.

Double glazing is a good choice when replacing a window or building a new home or extension. However, if you're not planning to replace windows it can be an expensive change. Retrofitting double glazing is a simpler option and uses the windows that you already have. There are several ways of retrofitting glazing, including cutting and permanently installing a second layer of new glass, making removable glass panels that can be lifted in and out of the window frame, sealing a new top surface across the window with heatshrink plastic or even taping on a layer of bubble wrap. The best choice for each situation will depend on your budget as well as your windows and how they are used.

In this house we chose removable panels held in place with magnetic strips, so that the large feature windows retained their original look as closely as possible and could be easily opened and closed.

- *Magnetite Windows*
www.magnetite.com.au
- *Magic Seal*
www.magicseal.com
- *Your Home glazing overview*
www.greenhouse.gov.au/yourhome/technical/fs18a.htm
- *Sustainability Victoria – window treatments*
www.sustainability.vic.gov.au/resources/documents/Window_protection.pdf

Glass products and window choices

Glass doesn't stop most heat transfer on its own – it's not an insulating material. Most of the (very small) insulation value provided by a normal window comes from the very thin layer of still air that sits next to the glass on either side. Still air is a very good insulator.

Double glazing is a good way to reduce heat transfer through windows, because it traps a layer of still air between two panes of glass, and the air does the insulating. If, instead of air, there's a layer of special-purpose gas, the insulation and sound-proofing qualities can be increased further.

The glass itself can also be engineered to have better properties. Some types of glass are designed to block high percentages of incoming heat energy while only reducing the visible light by a small amount. These glasses are useful on any windows that are exposed to regular sunlight but are hard to shade. Thermochromic glass is a kind of glass that gets better at stopping heat the hotter it gets.

There are also types of glass designed to stop heat loss from inside. These are called low-emittance or "low-e" glasses. Low-e glass has a special coating on one side that reflects radiant heat. In cold climates the coating's set facing into the room to keep the heat in, and in warm climates it's set facing outside to stop the heat entering. They will also reduce the amount of sun entering in both winter and summer, so aren't recommended for reducing incoming summer heat on north windows.

The three qualities you may want to look at when choosing glass for a window are the U-value, the shading coefficient and the solar heat gain coefficient.

- The U-value is the inverse of the R-value used in insulation – it's a measure of how quickly heat will pass through a material. Look for a low U-value - the lower the U-value, the better the window is at trapping heat inside in winter.
- The solar heat gain coefficient is a measure of how well the window blocks heat from sunlight, as compared to an open hole in the wall. It's a number between 0 and 1, and the lower the number, the less it transmits. Look for a low number if you live in a warm climate, and a high number if you live in a cold climate.
- The shading coefficient is similar to the solar heat gain coefficient, but compares the window's heat blocking to an ordinary thin glass window (the windows you probably have in your house already) instead of an open hole in the wall.

The frame a window's in is also important in reducing heat loss. Timber frames are much better insulators than aluminium frames, as aluminium has virtually no heat transfer resistance. Thermally-improved or thermally-broken aluminium frames have a better performance than plain aluminium frames.

Windows are now being sold with an energy rating, that will help you compare the energy efficiency of different types of windows and select the best kind for the different parts of your house. The rating means that for every star it's got, the window can save you 9% of the energy for heating or 12% of the energy for cooling. So a five star window can save 60% of cooling energy and 45% of heating energy that would normally be lost through the window.

- *Your Home Technical Manual – Glazing*

www.greenhouse.gov.au/yourhome/technical/fs18a.htm

- *Window protection measures and selection*

www.heat.net.au/pdf/Windows%20Fact%20Sheet.pdf www.sustainability.vic.gov.au/resources/documents/Window_protection.pdf

- *Window Energy Rating Scheme*

www.wers.net

- *The Australian Glass and Glazing Association*

www.agga.org.au

- *The Australian Window Association*

www.awa.org.au

- *The Window and Door Industry Council (timber windows only)*

www.wadic.asn.au

South-facing windows

South facing windows like the Barries' have the lowest incoming energy year-round of all window directions, due to the sun's changing angle and position.

In winter they receive no direct light at all. This means that heat will be drawn out through them, creating a cooling effect. In summer they don't receive any midday sun because it's to the north, but they will get direct morning and afternoon sun which will make them a heat source – and that steeply angled sun is much harder to shade against with awnings or other window covers.

These two things mean that a large wall of south-facing windows will make a room quite cold in winter, and keep it too hot on summer afternoons. Sustainable design suggests controlling this effect by limiting the size of the south-facing windows. The recommended size is usually expressed as a percentage of the floor space inside, and varies with climate and how much cooling or heating is needed in that climate.

The above applies to all of temperate Australia, but changes if you are anywhere north of the Tropic of Capricorn (such as Darwin, northern Queensland or the tropical regions of Western Australia). Homes north of this line will have the sun to their south at midday at midsummer instead of to their north, meaning they will need to plan their windows differently. Tropical homes may choose shading techniques such as awnings on southern windows the same way that temperate-region homes do with their northern windows. This is one reason why the traditional Queenslander or outback house had shady verandahs on two or more sides, not just the northern.

- **www.sustainability.vic.gov.au/resources/documents/Window_placement.pdf**
- **www.sustainability.vic.gov.au/resources/documents/Siting_and_solar_access.pdf**

Temporary double glazing methods

The purpose of double glazing is to trap a layer of still air next to the window glass so that heat cannot cross from inside to outside or vice versa. There are several permanent methods of double glazing, but renters are unlikely to install these.

Two simple temporary and low-cost methods of double glazing are plastic shrink-wrap and bubble wrap.

Bubble wrap is readily available new or re-used. It contains still air trapped in many little bubbles against a plastic sheet. Place it so that the bubbles are against the glass and the flat side is facing away from the window, to create that sealed layer of still air against the glass. Tape it in place on all sides to form a seal.

The Carbon Cops are also installing a temporary glazing called Clear Comfort. This is a sheet of heat-shrink plastic. It can be installed with permanent tape, or temporary tape for renters who might want to remove it at the end of their lease. The sheet is cut to size, taped in place, and then shrunk with a hair dryer until the sheet is taut.

- *Clear Comfort*
www.clearcomfort.com.au

Pelmets and curtains

Curtains will absorb some of the heat entering a room, and block light, depending on how heavy they are. So they can be used to keep a space cool in summer. However, they need to be sealed at top or bottom to be fully effective. Air between a curtain and a window will warm up. That warm air rises, escaping out of the top of the curtain. This sucks cool air in from the rest of the room, creating a draught. That cool air is then also warmed, and rises, keeping the convective process going. This means that the heat from the window is still getting into your room.

Pelmets are a seal over the top of the curtain that prevent the hot air escaping. This means that you don't get that convective circulation starting up. Pelmets can be made of any material as long as it creates an air barrier. Temporary pelmets could be made with laminate, cardboard, acrylic, polycarbonate, bubble wrap or even a thick and solid scarf. They simply need to be fixed to the wall and reach to or past the curtain. Most pelmets reach over the curtain, however you can also build a hidden or near-invisible pelmet as a single flat strip that sits behind the top of the curtain and just reaches its back edge.

An alternative to sealing the top of the curtain is to seal the base and sides, to prevent cold air being drawn in. Floor length curtains will stop air entering at the base. The curtains can be held in place by weighting the hems so that they stay in contact with the floor. If your curtains are just short of floor length, two heavy fabric-and-sand "sausages" such as those used to block gaps under doors can hold the lower curtain edge trapped between them. Temporary tape, magnetic tape or Velcro can hold the curtain sides in place.

- *Sustainability Victoria – window protection*
www.sustainability.vic.gov.au/resources/documents/Window_protection.pdf

The sun's movement and north-facing windows

The sun doesn't just move from east to west. It appears to move in a circle through the sky, and depending on your latitude and the season you see different amounts of that circle. In winter, our part of the Earth is pointing away from the sun, so we see less of the circle. Our days are shorter, the sun seems further to the north, and the sunlight comes in on a lower angle. In summer, our part of the Earth is pointing towards the sun, so we see more of the circle. Our days are longer, the sun seems less far north, and sunlight comes down from over our heads instead of in front of our faces.

In Australia, the sun will be directly to the north at local midday on every day of the year, as long as you are south of the Tropic of Capricorn. This means that north is the best direction for windows to face in order to maximise their heat gain in winter and minimise their heat gain in summer. A north-facing window will be facing the low midday sun in winter, so that heat and light can come in to warm your rooms. In summer, the sun can still shine in the window, but on a much steeper angle so that less heat is coming directly inside. That steeper angle also makes a north-facing window very easy to shade in summer.

This is why rooms with north facing windows are warm and sunny in winter, while rooms with west facing windows get too hot in summer.

You can tell where the sun will be in the sky precisely at any time of day or year for your location using Geoscience Australia's website: **www.ga.gov.au/geodesy/astro/smpos.jsp**

Read more information on solar orientation and climate at the Bureau of Meteorology's website: **www.bom.gov.au/climate/environ/housedesign/solar_access.shtml**

Solar pergolas, eaves and awnings, and deciduous solutions

When a window is hit by direct sunlight, heat comes in and the window is a source of heat gain. When a window is in shade, heat from inside will leave, and the window becomes a source of heat loss. Ideally, this means you want your windows shaded in summer and in full sun during winter. There's three straight-forward solutions that will do this.

A fixed eave or solid awning will shade a north-facing window – but the trick is to not make it too big or too small. Setting the width of the eave correctly will block sunlight in summer but not in winter. Typically, in southern Australia, a fixed eave needs to be about as wide as 45% of the window's height, and set about 16% above the top of the window. Some places in the north of Australia may need eaves on south-facing windows instead of north-facing windows, because the sun has moved to the south during the height of summer.

Another type of awning that will give winter sun and summer shade is called a solar pergola or solar awning. These shades are made with slats set at a fixed angle towards the north. The angle and spacing of the slats determines how much sun can come through at different times of year. In winter when the sun is lower, it shines between the slats and the pergola provides only a minimum of shade. In summer when the sun is higher, it shines onto the top of the slats, and the pergola provides complete shade for the windows underneath. This solution works best when windows face north or nearly north, like the McKinneys'.

A third solution is to use deciduous plants. A deciduous plant is any plant that loses its leaves in winter. Using deciduous creepers or trees means that they will shade an area thickly in summer, but provide no shade in winter when the leaves have dropped.

The McKinneys already have a deciduous creeper in place – a much-loved wisteria that grows rampantly. So the most logical solution for them is a small pergola that the wisteria can grow over and spread across, which will make their garden more of an extension of their living space. The wisteria will need to be pruned back hard to encourage growth across the pergola, and then trimmed as needed to avoid the area becoming too shady.

- *Eaves in Canberra*
  www.heat.net.au/pdf/Eaves in Canberra.pdf
- *Windows and shading in Western Australia*
  www1.sedo.energy.wa.gov.au/pages/windows.asp
- *Windows in Tasmania*
  www.tasmanianenvironmentcentre.org.au/content/documents/Windows.pdf