Retrofitting Your House for Winter in South West Western Australia

Editorial

We agreed on the topic for this issue of the PAWA magazine - "Retrofitting your house in SW Western Australia" - because this area encompassed the vast majority of PAWA membership. But we discovered that putting a boundary around anything can create difficulties, and immediately you have to make exceptions to what you can say generally about the area.

Much of what we might say about the Southwest (SW) can apply, at some time of the year, to much larger areas of Australia, particularly those that share a similar latitude. There are some things that we might do with great benefit in some areas of the SW which could create more problems than they solve in other areas. See the article Misapplying Principles.

The other issue is that over any one year, we have to design for a variety of different weather patterns. In most areas except the south coast, you need to plan for eight months without substantial rain: September to May. To deal with these conditions we need to consider hot arid strategies - houses with low mass, and lots of ventilation, so they are easy to cool.

But in some areas, such as Williams, and similar small towns and farms surrounded by hills, or suburbs just under the edge of the scarp, we need to allow for frosts. To deal with colder winter temperatures, we want high mass, draft proofing, small windows, and massive insulation.

It is unlikely that we can afford to build one house for the summer, and another for the winter. The resolution is probably what oldies call the verandah, but if we are up to date we call it an alfresco area! It is such a versatile feature that we can easily take it for granted. Another factor we find as we get older as that our tolerance of variations of temperature diminish, and so we need a more even, benign temperature. Insulation needs vary considerably, depending on design and materials.

To do the subject justice, we have split the analysis into two different issues of the magazine: In Spring, we will do an issue on retrofitting for cooling your house. In the second article here, we set out the categories we might need to deal with these personal/site variations – macroclimate, microclimate, aspect, and personal needs – that would lead you to choose one strategy over another for making your house easier to live in through this winter. Then we give as many examples as we can. Thanks to all our contributors; if you have other ideas or have worked out other adequate technologies, we would be happy to include more articles in another issue or on the web-site.

Working out the sun's impact throughout the year

Many doing a long term retrofit to increase or decrease sunlight penetrating a window will have others do the design and installation. One factor in the selection of your contractor should be their clear understanding of how the sun's AZIMUTH and DECLINATION vary through the year, and the impact of your house's ASPECT. If you are rigging a temporary or short term solution, like some shade cloth, you can adjust its final position if necessary; "mark 1 eyeball" – careful observation, in Permaculture language – may well be sufficient. If you want to use a graphic or computer based system to achieve precise control of sunlight penetration into windows yourself, there is a separate paper available; email or call the editor.

Keeping the sun and the heat in

The major causes of low internal temperatures are the sun not penetrating glazing, so it can't heat objects in the house – the floor, walls, furniture – or the internal air. Poorly designed eaves and verandahs can be a huge disadvantage.

If an exposed wall is poorly insulated, heat will conduct through the wall from the inside out, and your efforts at internal heating will be negated. If a window is not protected, the heat will escape even faster than through a wall. The windiest sides of the house are more vulnerable, because there is a continual replacement of air and so the temperature differential is greatest.

Some broad strategies for keeping heat in:

- Let the sun in, through windows.
- Have heat masses inside to store heat.
- Minimize air exchanges with outside cold air.
- Maximize air exchanges with hotter air from anywhere.

Different strategies are listed below. Articles that follow give further description, with examples, methods and pictures. If you know of other strategies, please pass them on to the editor.

Short term options for getting heat and light in through windows:

- Reflection from white, shiny surfaces.
- Large, dense, dark materials just inside windows.
- Sash window solar heater.

Longer term options for getting heat and light in through windows:

- Polycarbonate sheets to replace colorbond on verandahs.
- Careful placement of water surfaces.
- Plastic or more permanent solarium.

Short term options for keeping hot air in:

- Wear more clothes, keep active.
- Shut curtains, close doors and windows, minimise opening and shutting of doors.
- Short term draught proofing; sausages for doors, stick on seals for windows.
- Window quilts, better curtains.

Longer term options for keeping hot air in:

- Longer term draught proofing; door and window seals.
- Enclosing most used doors to create an air lock.
- Upgrade insulation, particular in ceiling.
- Films on windows.
- Double glazing.
- High quality dense curtains in pelmets.
- Thermoshutters.

Generating heat within the home:

- Short term: heaters, hot rocks from the hob of the fireplace to under or even in the bed, jumpers, beanies, ugg boots, scarves, doonas, quilts.
- Long term: solarium, trombe wall, masonry stove, slow combustion stove, ducting and fans.

Short term strategies

Reflection from white, shiny surfaces:

The light and heat into a room can be increased dramatically by an appropriately placed mirror, or a gloss white surface. One of the most relevant and practical books on Retrofitting is by Derek Wrigley: *Making Your Home Sustainable - A Guide to Retrofitting*. In Canberra, he makes much use of mirrors to reflect light into southern windows. He has simple flat mirrors rigged up around gutter height on the south side of the roof, and larger more distant solar sculptures that comprise many mirrors. You can achieve some effect simply from using light coloured paint on walls and fences. Remember that if you are painting a sheetrock corrugated fence you will save lots of paint and so money by first spraying the fence with water, and then painting while it is still damp. Otherwise the paint is quickly absorbed into the depths of the material, and one brushful of paint covers about six inches...

Large, dense, dark materials just inside windows:

This only works for very large or dense materials that are permanently in the window space, or that are insulated. If you had windows to the floor and the space beside the window was not used, you could stack solid bricks, or concrete blocks, or even pavers there to store heat. The slow release of their stored heat into the colder evening and night air is what you are wanting.

Sash window solar heater:

This is a DIY project, so you need some skills with tools, and the ability to make a sketch, or to understand one. It also needs sash windows, which are becoming rarer in new houses; a window that has part of the window (normally the top half) fixed, and the bottom half that unlocks, and can be lifted in runners to allow air in. You might also need to remove the flyscreen. See the article later in this issue.

Longer term strategies

Polycarbonate sheets to replace colorbond on verandahs:

Old verandahs were designed to keep the sun off walls and windows, to keep houses cool in summer. The availability of different materials can now allow light and heat penetration into windows in winter. Installing polycarbonate to replace Colorbond sheeting or even tiles can be a good solution, and summer light and heat can be kept out with 95% shade cloth suspended under the sheets. Install enough sheets to have one sheet width either side of the window's width. This will allow up to five or six hours of winter sun in each day.

Careful placement of water surfaces:

The winter sun is low in the sky; in the SW, through June, it does not get more than 40 degrees above the horizon. So the strategy above might only increase the light and heat into a window by fifty percent. If you had the option to put a pond close to the north face of the house, you could increase the light reflection from its surface into your windows below the eaves. A country holiday house with lots of space has security shutters that lowered to flat. Their pale gloss internal finish acted as light reflectors in winter.

Plastic or more permanent solarium:

Solaria were features of Roman and Greek house design, and even before that. The best caves faced the winter sun!

Check out the web-site *http://ZeroEnergyDesign.com*. One of Larry Hartweg's main ideas is that "two delta Ts are better than one". What he means is that it will be easier to manage heat losses if you have two barriers between your living area and the outside than one. One of the major issues for using solar heating in WA is the difficulty of using your living space as your heating space in winter. We are watching, with some amazement, the construction of a house near us with 3.5m of glass along the whole of the north frontage (as well as the whole of the east wall!). At

4.30pm on a May afternoon, the sun was 1.5m up the back wall, some 14m from the glass wall. We imagine they will require windows open all year round.

Building a solarium can be as simple or as complex as you want to make it. The best example we have seen recently was the simple installation of some cheap floor-to-ceiling cafe blinds along the front edge and sides of a north-facing verandah. Even without blocking the low triangles under the verandah above the blinds, the heat generated is immense, and you can feel the hot air flowing through the tops of the doors into the house when the two sets of French doors to the living area, and another door into the guest bedroom are opened each winter afternoon.

Beyond that low cost approach, the sky is the limit. The whole space could be enclosed in glass, rather than cafe blinds. Two small sets of strategically placed louvres would allow inlet and exhaust in summer. The heat flow into the house could be increased by installing a vent between the very top of the heating space and the house. Some designs have low vents into the house, to allow cold air from the floor level of the house back into the heating space.

Increasing the heat mass can reduce the space required–the ultimate is a trombe wall, which is a glass wall around 150mms outside a dark brick wall, with vents into the house at top and bottom, and a vent to outside, so unwanted heat generated can be diverted. The earlier article on the solar sash window heater is another example of using this principle.

The cafe blind example above was hugely effective because the bare concrete was a reddish-blue, which absorbed massive amounts of heat. Having lots of carpet and furniture can reduce a floor's heat absorption. Going the other way, some put more heat sinks into their solaria; some have installed a five tonne rock. Michael Corbett included large steel columns filled with water in the designs for houses at Village Homes, in Davis in California. Even a food grade plastic 200 l drum full of water can help. See the article by Ron Shannon later in this issue.

Careful design maximises the heat generation in winter and minimises any impact in summer. One plan we have seen has a 4m x4m solarium on the NW corner of the house, with a screen to shade the western side in summer. Louvres low in the SW corner and high in the NE corner allow venting when needed.

Keeping Hot Air In: Short Term Options

Wear more clothes, keep active.

This strategy acknowledges that our impression of how hot or cold we are is affected by internal and psychological factors as well as the external temperature, wind chill, and humidity. But the strategy is also based on the same principle as that used in breadmakers – they use less power than ovens because they are heating the minimal amount of air around the bread container. The same applies to us; if we are busy, and have the right clothes on, we will be warm enough. We are blessed in most areas of the SW most of the time. Seldom is it penetratingly cold for more than a few hours. But we also have a greater temperature variation each day than many other areas, so we can actually feel the hourly variations in temperature. Having a jumper available (and a beanie for those deficient in hair) can be a good strategy. If you are stationary, think about a quilt for your favourite chair, and an extra doona on the bed.

Shut curtains, close doors and windows, minimise opening and shutting of doors.

This sounds very obvious, but do you shut the doors of unused bedrooms and the like, to minimise the air volume you are trying to heat or keep warm?

Short term draught proofing; sausages for doors, stick on seals for windows.

Simple sausages – cylinders of sturdy cloth filled with sand - are a cheap means of sealing the bottom of doors that are cut high to allow for floor treatments. More expensive manufactured items can be installed on the bottom of doors. In the same area of the hardware store will be many variations of stick-on rubber seals to attach to door and window frames.

Window quilts, better curtains.

Window quilts are useful if you are not relying on the light through the windows. They can be made from any material; the key design feature is that they have a tight fit around the frame of the window, so no air can pass through to the space between the ordinary window and the quilt. Quilts make use of the "2 dT" principle. The sealing is made easier by the use of stick on Velcro, and clear plastic or bubblewrap would allow some light to enter. More expensive yet more aesthetic are well made curtains. They will only be really effective if they too create a good seal between the room and the window or door. Small pelmets with the top of the curtains rubbing against the underside of the pelmet; curtains right to the floor and touching the side walls are all needed. Loose curtains away from the wall will only be useful for light control.

Keeping Hot Air In: Longer Term Options

Draught proofing; door and window seals. Enclosing most used doors to create an air lock.

Floor to ceiling shelving with solid backs can create useful storage as well as air locks if there is a lot of traffic from a heated area to the outside. It can be inside or outside the relevant door. The entrance porch can become a useful place for storage of boots, rain coats, umbrellas, as well as sitting down while you get into or take off your wet weather gear. The broad principle here could be called "entrance transition" – design your most used entry to make the activities of entry and exit easier or less problematic.

Upgrade insulation, particular in the ceiling.

Insulation of ceilings can have the most impact on keeping your living spaces warm, as it is here that the inside air will be hottest, and so you will have the greatest dT. The government grant that is currently available recognises this, but do the sums carefully. One recent test found that it was cheaper by several hundred dollars to buy the R3.5 batts and install them yourself! Insulation of floors if your house is on piles or posts is next in importance. DIY methods might be enough – fastening foil to the bottom of the joists. Stopping the wind from racing under the house could also be a strategy. Think about something like bush rosemary, lavenders or coprosma to completely surround a house on stilts. See the excerpt from Bill Mollison's lecture on this in the box below. Thanks to Jeff Nugent for providing his notes.

Films on windows.

There are now a number of films that you can install on windows that reduce the thermal conductance of the windows. They can also increase security, and reduce risks for children.

Double glazing.

Double glazing is being increasingly used as people realise the immense heat losses that are possible through the large glazed areas that are becoming more and more common. Think about the purpose of the window and save costs. If it is only for light and view, there is no need for the much more expensive opening windows; fixed double glazing is much cheaper.

High quality dense curtains in pelmets.

Already mentioned above, but think about the use of well placed Velcro to improve/guarantee the complete closure of the air space on the inside of the window.

Thermoshutters.

A variation on curtains detailed by Derek Wrigley. They are constructed (possibly) insulated screens that hinge back against the wall, but fold out to fill the window space in the wall.

Generating heat within the home

Short term: Heaters, hot rocks from the hob of the fireplace to under or even in the bed.

An electric heater can be quite effective in a small volume and close up, where the radiant heat from the electrical element is used as much as the heat conducted into the air from the element. The immediacy of the radiant heat is the key here – a bathroom or dressing room where a short sharp burst of heat might be needed for comfort for a few minutes. We have been distributing the heat from slow combustion stoves, fireplaces, and the like to our bed for years now by putting smoothed rocks from a NZ river bed into the oven or onto the top of the stove, wrapping them in old towels and placing them in strategic places. No more cold feet in the middle of the back!

Long term: Solarium, trombe wall, slow combustion stove, masonry stove, ducting and fans.

We have already mentioned the solarium, and its narrow cousin, the trombe wall. Slow combustion stoves are especially designed for room heating – they have large mass, not such good insulation as an ordinary stove, and have careful design to minimise fuel use. Much colder climates than here justify the cost and space taken up by masonry stoves, where rather than steel, the heat mass is stone or bricks or clays that hold huge amounts of heat from small fires. They have been used for centuries in really cold climates. In central Asia the sleeping mats are often placed on the top of such masonry masses, with a small cooking stove off to one side of the fire box. Masonry stoves are very elegant features in modern American and Canadian homes – many are made out of soapstone, which can be beautifully worked, and can take the heat of a fire.

Relying on the natural circulation of heated air can be problematic in wide sprawling houses with flat ceilings. Insulated ducting can take heat from above a fireplace through the ceiling space to a grill in a bedroom. There are various products available that use heat capturing systems from outside and duct that air into the house. You may recall the solar lizard that won an Australian Inventor of the Year Award recently. Ross Mars installed a large system on his and Jenny's house in Hovea. David Holmgren has found that it is better to have your fan at the outlet end of the duct pipe, sucking the warm air through, rather than having it at the input end, blowing the air through.

We discovered a design solution at the Pink House: the slow combustion stove was central to the large open space, but close enough (1m) to the slope of the eastern gable to move the hot air along the pitched ceiling to the western gable nearly 20m away, which pushed the hot air down into the bedroom.

Bill Mollison on Retrofitting

If you want to double glaze and don't want to have condensation between the sheets of glass the sensible thing to do is to drill a hole here and put a pipe through with a balloon on the end with silica gel in the balloon.

Another strategy could be to fully insulate one room in the house that is a room of high usage. Often the best way is to reline the room. You've got your old lining with paint and it's usually not all that good. It is just as easy to reline with the insulation underneath it and for a small room that is less expensive than insulating the whole house. That's the room you live in at night.

Misapplying Principles

The best example is applying the principle of "Lots of glass to the sunny side". It is a good example because many modern houses have acres and acres of glass facing north which cost a fortune in curtaining, blinds, screens and other solutions to what shouldn't be a problem – with good design!

There is a clear band across the SW where that principle is sensible, and it doesn't create too many other problems. But north of a line from Ravensthorpe to Margaret River, (roughly from 119 E 37 S to 115 E 36 S), it can create too much heat entry, and too much glare, even in the middle of winter. This is because north of that line we have (mainly) the Mediterranean winter weather pattern of fronts separated by four or five days of clear, crisp weather. The insolation after the front has gone through can be fantastic. A friend in Mount Claremont had her telephone melt when she forgot to draw the curtains!!

In high latitudes, with cloudy winters, the prime application of the principle - which is often restated as "long EW, short NS walls" - is to maximise the access to the sun on the long side. But in latitudes like ours, the more important reason is to minimise the sun's impact on the East and West walls and windows in summer. You could have the sun belting onto an unprotected east or west wall for seven hours.

You might even have the sun on a south wall for up to eight hours a day. Do I hear "Huh? But we're south of the sun; the earth moves so the sun doesn't get below the tropics, and we're south of the tropics, so ... what are you saying..??"? Well, you're partly right, but that familiar S curve of the sun's movement between the tropics over a year shows the path of the sun AT MIDDAY. What we're talking about is the sun's movement from dawn to dusk each day, and how that varies through the year.

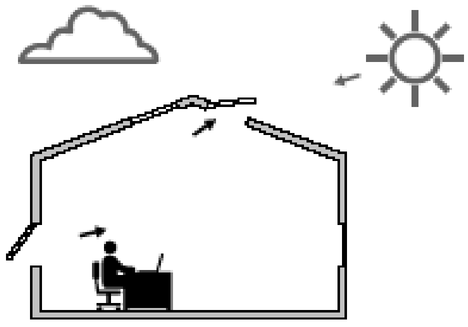
The second argument against the application of this principle is that it assumes poorly insulated walls, which transmit that morning or afternoon heat load into the living space. If you have well insulated walls – such as straw bales – then a long east west wall is no longer a design restraint.

There is a need for careful thinking about the relevance and detailed application of any principle that will frequently lead to its refinement, and occasionally, its abandonment. And so we lead to more accurate and better and more helpful principles.

Installing a skylight

Modern skylights have overcome their biggest problem of excess glare, with blinds, some between the double glazing. These two features give you control over both light entry and heat loss.

Modern skylights can contribute to better design in two major ways. One is based on the fact that skylights can provide three times the light of a vertical window of the same size. A well-placed skylight, particularly in some older homes, can reduce light use from 1,500 to 3,000 hours per year, with reduced usage costs as well as subsequent cooling needs from the heat they emit.



The major advantage is achieved by venting skylights, which allows easier removal of excess heat, moisture, and odours from your home.

Their positioning high in the roof allows rising hot air to escape, and this allows cooler air into the building.

In response to my enquiry, Stephen Quinn, the State Manager of Velux, gave me the following information about their efforts to increase the sustainability of their products:

> *"The large percentage of our products are made from aluminium components which contain 95% recycled material. Our glass products contain 60-65% recycled content, and our Blockout Blinds have 15% pre-consumer vinyl content. Our packaging has 53% recycled content and is 100% recyclable. Post-production, our recycling program sends 100% of aluminium, copper, acrylic, PVC and Santoprene to be recycled. In addition, all timber we use is certified, and 100% of surplus is either incorporated back into the product or reclaimed for use as animal bedding and palletized fuel."*

Skylights utilize high-performance, energy efficient materials which assist you to adjust and control light, ventilation, and solar heat gain or loss.

A Photographic Case Study in Multiple Retrofitting

Sue Hartley lives in a 60 plus year old house in Mount Claremont, which is poorly aligned on a 1/4acre block, as the house's long side faces east/west. There is only one window in a rear room facing north.

The first project after she bought it in 2000 was planting out the hottest sides with deciduous plants. This was quickly followed by installing a grey water kit, solar panels, insulation, and drip irrigation onto the verge vegetable patch. Filling in an 80,000l swimming pool saved half of the total energy costs.

The ceiling insulation is plastic bags, treated with vermin proofing and filled with mulched paper (Thermobatts). Sue comments: "The house temperature in summer usually

West frontage; (hottest side) blinds, vegetation, water tank yet to be plumbed into house.

maxs out at 27 degrees which is a bit high. I think this could be because the light wells are letting in a lot of outside heat."

West side; pergola covered with grapevines and espaliered fruit trees.

The fruit tree on the east side is carefully placed to protect the window.

Rear of house where pool filled in and orchard planted. Verge garden showing drip reticulation.

East side facing Lisle Street: sail fitted, deciduous planting to shade windows. Inside: pelmet blinds installed and venetian blinds. The Sacred spiral inspired the mosaic of recycled bath tiles.

Solar-powered air heater in a window

If you have an old sash window facing roughly north, you can easily build a simple structure that can provide heat in winter and venting in summer, which is totally self contained.

The concept of a solar window heater is a simple extension of the idea of a trombe wall. Instead of putting glazing in front of a vertical heat mass, you construct a double-chambered rectangular box of a width that will fit snugly into the width of your sash window. The two chambers are connected by a gap in the central partition, at the external lower edge of the box, and the end inside your window is open.

The slope downwards depends on your latitude. In the SW, an angle of about 25 degrees from vertical would work well.

The top of the box is a layer of glass which lets the sun through to heat the air in the top chamber. This warm air is less dense, so it flows up and into your room. If your air seals are reasonably tight, this draws cooler air from the room into the bottom chamber, giving a continuous flow of solar-heated air into the room.

You can improve this thermo-siphoning effect by: insulating between the two chambers; insulating the bottom box from the cold outside air; if it is really cold outside on sunny winter days, you might double-glaze; fastening a series of dark painted metal angle to the floor of the top chamber will increase both heat mass and air turbulence.

In summer, for ventilation and so potential cooling, install a hinged door in the top chamber, immediately outside the window. Open this, and block the upper inlet into the house, to allow the solar-heated air to exhaust and draw air from inside your room for enhanced airflow from other sources.

Additions to consider might include an extension of the cool chamber on the inside of the room, down to near the floor, to pick up the coldest air in the room. You might need a support for the external end of the box, to either the ground or the exterior wall.

If you didn't have a sash window, you could remove any other sort of window, install the heater, and then cut and fit a new fixed window above it.

Change heat mass of material to north

Ron Shannon told us: "The most surprising addition to the performance of the house was unintended. What started out as a place for an aquaponics system ended up with a few other serendipitous pluses."

Ron and Lyn Shannon installed a new covered and paved area along the northern side of the house for use with an aquaponics system and for entertaining. It runs the full length of the house and is 5 m deep. There is some 18,000 litres of water storage below the paving.

It has dropped the summer temperature in the house by an average of around nine to twelve degrees. In addition, the house temp does not begin to rise until quite late in the day at around five pm.

Part of the roof is clad with polycarbonate to let in light for the plants and in winter this light will warm the thermal mass of the paving and underground water tanks. In summer, the angle of the roof pitch allows the polycarbonate to reflect a lot of the heat away from the area but lets in light sufficient to grow vegetables and salad greens plus some herbs. In winter the lower sun angle prevents this reflection because the sun is more perpendicular to the plane of the roof cladding so most of the light passes through.

When asked for more detail on this difference between summer and winter sun penetration, Ron replied: “”The roof pitch angle of 22.5 degrees very nicely works with our latitude of 32-odd degrees to maximise and minimise sunlight, as required. The polycarbonate sheeting has a special one-side coating that purports to block UV (it does block a little bit .. about 12%) but this coating has an assymetric angle of reflection Co-bonded polymers cause light impinging at acute angles to 'slide' off, and this is the basis of the UV blocking capability. Oddly, if the sheet is incorrectly laid upside down, the stuff doesn't work."

Retrofitting to optimize the performance of your residence

There are many ways to renovate or retrofit your home to make it more comfortable, to save money on energy costs as well as to minimize your ecological foot print. An eco-friendly home has been designed, constructed and is operated to reduce its impact on the overall environment; to create a healthy and enjoyable environment to live in and to fit your lifestyle. Key green building strategies include passive solar design, sourcing sustainable products and materials and the use of renewable energy.

Designers *Solar Dwellings* specialise in energy efficient, passive solar and sustainable design. They see the main considerations for a passive solar building as; orientation, air flow, insulation, shading, glazing, landscaping and appropriate use of thermal mass.

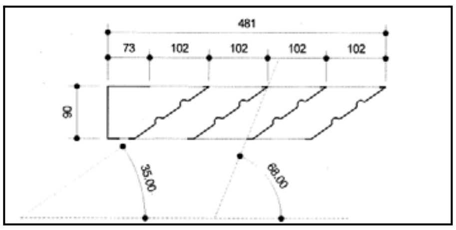
A sustainable building will provide you with a healthier home, lower energy and water bills and reduces greenhouse gas emissions. In Western Australia cavity brick construction is the most cost-effective and widely used form of constructing a home. Bricks provide protection, thermal mass and they are readily recyclable. Cavity walls can be insulated where appropriate to reduce heat transfer.


Air-Cell insulation

Solar Dwellings designer Pernille Stent said "We prefer to use Air-Cell insulation mainly in walls facing East and West because of the ease of installation, the efficiency of the material and cost-effectiveness". Air-Cell in the cavity provides a protection of R1.7 as opposed to an un-insulated double brick wall which rates at R0.7. We prefer to use a light-coloured metal roof as it reflects heat rather than absorbing it as a tiled roof would.

Under the roof cover we recommend an R1 bulk/foil insulation and in the ceiling an R3 bulk insulation to give us a better thermal performance all year round.

North facing windows allows winter sun to penetrate deeply into the home for natural heating. A tiled floor or other thermal mass materials such as polished concrete in the northern zones will allow heat from the winter sun to be absorbed. Correctly placed summer shading such as solar louvres, shade sails or a deciduous vine or tree will prevent the sun penetrating the home in summer, keeping it cool. The solar-louvre panels consist of blades in either metal or timber at an angle and set apart within a frame where the angle gives the openings full protection at the peak of summer but allows the winter sun to penetrate deeply into the residence. Ms Stent said "We use the static model simply because they are cost effective and longer lasting." Appropriately located openings will promote summer breezes though the home for natural cooling.



Louvre Detail

For the green renovator Ms Stent recommends the following:

1. Design within a 15 degree North orientation, good cross ventilation and provide protection to the east, north and west elevations. Protect by insulating your walls where applicable, ceiling and under the roof,

and creating microclimates by use of trees, ponds and a water-wise ground cover around your residence.

2. Install water efficient appliances, taps and toilets. Consider a rainwater tank and possibly a grey-water and/or black water reuse system.
3. Install energy efficient white goods and lighting such as LED's or compact fluorescent lights.
4. Replace the electric hot water system with a solar hot water system, preferably gas boosted. This is the single biggest energy saving a normal household can obtain.
5. Use low Volatile Organic Compounds (VOC) paints and floor finishes. Normal paints and floor finishes have a high solvent content which can contribute to the "sick house syndrome"
6. Leave the good looking carpet in the shop; they generally contain VOC's which are bad for our health. Buy a rug instead and make sure it is made from natural fibres.
7. Use low VOC particle boards for your cabinetry.
8. Use sustainably sourced or recycled timber, or even better, bamboo, which is very efficient as a carbon sink, as well as readily available.
9. When in doubt, consult a specialist.
10. Less is always best, however remember, a cheap option could cost you more in the long run!
11. Seal any drafts in your home.
12. Turn your hot water system down. This can be a big saver!
13. If you have an air-conditioner, set it at 24 degrees rather than 21 degrees.
14. Install pelmets with snug fitting double or heavy drapes, particularly to living area windows, to minimize heat gain in summer and heat loss in winter.

Get informed on the process, visit homes and identify the attributes you like, use the internet to gather information, speak to industry people. The most important tool in the process of retrofitting and renovation is your knowledge.

(Thanks to Pernille Stent for this article.)

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