PERMACULTURE:

Designing for Sustainability

In this issue

Editorial

My apologies for the long delay in producing this issue of the magazine. We have been very busy building our new house, which is a state of the art model of sustainability. We have a straw bale insulated ceiling this time!

As well we have been dealing with the death of both my parents. Sylvia celebrated her 90th birthday in November last year, and died in December, then Harold died in February this year. They were remarkable people, and we were lucky to have them with us for so long. They both received OAMs for community service in totally different areas; Sylvia for fifty years of voluntary work at Royal Perth Hospital, and Harold for his work with Rotary and Legacy, and 32 years of services to the aviation industry in WA. I wish I had paid more attention when Harold tried to teach me to garden, but his frugal upbringing and life time habits were key factors in my interest in Permaculture – doing something cheaper, more efficiently, more effectively was always of interest to him, and now to me. And Sylvia encouraged me to devour books and to write!

This issue on retrofitting your house for summer is timely, but a year late. The circumstances that led to the delay will not occur again. Contributions from others will be a great help in future issues; nominating topics, writing articles, sending in photos.. anything!
The first issue of the magazine (in its recent incarnation) dealt with the almost world-wide problem; the need to remove ourselves from the food “industry” and return to healthy, organic, local food production systems.

This issue is the second of a series, about one of the most immediate things you can do to save energy costs; retrofitting your house. They are written for the majority of our members who live in the southern half of WA; the tropics require different strategies. The first issue was about retrofitting your house to keep it warmer in winter. This issue deals with what looks like being a long hot summer. The proposed theme for the next issue is *Planning for catastrophe at home*.

The article on the more technical aspects of calculating sun angles, and so heights and widths of eaves to allow sun in, or prevent its entry, is available on request; email to warwick.rowell@bigpond.com.

Keeping sunlight and heat out

The major causes of high internal temperatures are the sun hitting poorly insulated walls and the sun penetrating windows, which heats objects in the house - floor, walls, and furniture. To keep the heat off the walls and the light off the windows, houses should have wide eaves and verandahs. The modern trend to no eaves, like Tuscan villas, totally ignores the fact that most Tuscan houses are side by side, with many common north-south walls, in narrow streets which run east-west, so the walls receive very little direct sun. A recent development in Mawson Lakes in NE Adelaide has achieved major heat load reductions by clever placement of the walls on adjacent properties.

If an exposed east or west facing wall is poorly insulated, heat will conduct through the wall, maybe for seven hours, and that heat will radiate into the air in adjacent rooms. If a window is not protected, the light will penetrate and heat the surfaces it falls on. This heat will be absorbed, and then conducted through those objects, and later radiated into the air. If it is not absorbed, it will be reflected (at a frequency that cannot escape back through the glass as easily as it entered) and this heat will be conducted into the air.

These facts give us some broad strategies for keeping heat out:

Keep the sun off walls and windows.
Minimize air exchanges with outside hot air.
Maximize air exchange with any cooler air from outside.

You can use these strategies to guide your assessment of the major sources of heat coming into your house, so your retrofitting efforts will have the most impact. Now, mid October, we are four weeks past the equinox, so we have one month to prepare for the maximum heat loads we experience – the hottest and coldest spells of weather usually come from one to two months behind the sun’s movement from summer to winter solstice and back again.

You can select one or more of the strategies set out below. They are listed here, and later articles give further descriptions, and some examples and pictures of the treatment, and/or how to do it. If you have another or better example or option, or some pictures, send them to the editor, and we can put them into the spring magazine next year.

Short term options for keeping heat off walls and windows:

Long stakes with flexible branches woven through them for shading windows.
Banana fronds or similar thrown up onto a pergola to protect windows.
Shade cloth pinned up or any other temporary barrier to protect windows and walls.
Medium trees, shrubs, bamboos in pots to shade windows.

Longer term options for keeping heat off walls and windows:

More permanent shade cloth structures – shade sails.
Pergolas with glory vine, grapes, or other deciduous vines.
Louvred or solid external shutters.
Extend eaves, or put an external shade over windows.
Off vertical solar slats.
Planting of deciduous trees.
Paint walls with light coloured, solar resistant paint.
Upgrade insulation of walls.

Short term options for keeping hot air out:

Shut curtains, close doors and windows, minimise opening and shutting of doors.
Spray water on any large mass (pavers, concrete) adjacent to house that is exposed to the sun.
Open the highest window on the downwind side to let the hottest air out. See later note on this.

Longer term options for keeping hot air out:

Pergolas or extended eaves to minimise heat loads adjacent to the house.
Replace dark pavers with lighter coloured ones.
Insulate ceilings.
Paint roof with light coloured, heat reflective paint.
Open roof air space so cooler breezes can penetrate.
Install ridge vents so hot air can escape.
Grow bushes and trees.

Getting cool air into the house in short term:

Open windows during cool spells.
Place trees in pots or screens to direct air into house.
Hang soaked hessian bags or sheets in windward openings.

Getting cool air into the house in the longer term:

Conduct cool air into a small volume for extra cooling.
Have a lush moist courtyard on one side, and a hot bare area on the other. (Called a Taktabush by the Persians). See the later plan and comment.
Replace windows with casements that open out to capture cool breezes.

Reducing heat and glare through windows

If you don't want to block all the light or a view, but want to reduce heat and glare coming through an east or west window, there is a simple technology which you can build yourself at minimal cost.

We had a floor to ceiling narrow window between book shelves that faced due west. It was very glary, and allowed lots of heat to enter the room.

At the time, the neighbourhood verges were under siege, as power lines were put underground. We watched carefully, and when they were doing the final cleanup, we recycled lots of 25mm PVC pipe that was otherwise being thrown out. Sandpapering the writing off the pipes, and cutting off the flared ends gave an aesthetic finish. The pipes were cut 3mm shorter than the width of the window, and each length was drilled the same distance in from each end. Strong fishing line was threaded through these holes, from pipe to pipe, with a bead on each line separating each length of pipe.

You might need to experiment with the diameter of the beads, as your issues with light and glare may be different from ours. The local craft shop was more than happy to allow me to change the threadable beads from 11mm diameter to 8mm, when I found that the latter were better at reducing glare and heat entering the room.

The interesting thing was the impact of the circular pipe on the quality of light – it reflected most light and heat back or around, so reducing the glare hugely, while not interrupting the view at all. This property of narrowly spaced materials is most frequently seen in Arabic buildings; the balustre is usually high in a wall, to allow hot air to flow out without allowing glare to enter the building.

This simple technology came from the wonderful book *Natural Energy and Vernacular Architecture* by Hassan Fathy. Thanks to Gary Dorn for letting me know recently that the text was available on line free of charge. http://2020ok.com/index.html

Bob and Pat Dare report on their retrofitting efforts:

When we replaced the roof iron we upgraded the insulation using batts on the ceiling and the insulated sheeting under the iron, and found the house much more pleasant in summer.

When we extended the verandah width to increase the outdoor living area we put insulation under the iron and the area is noticeably cooler in summer than the other verandah areas.

We ventilated the pantry in the same way that Warwick and Gillian did at the Pink House; pulled in the cool air from under the house and it goes out through a smaller pipe through the roof. It is now the coolest room in the house in summer but it is important to keep the door closed in winter.

Reducing glare

On page 179 of Occupational Hygiene by John Malcolm Harrington and Kerry Gardiner, there are a number of strategies for reducing glare, which can be almost as uncomfortable as heat inside the house. The major cause of glare is very uneven lighting – too much contrast between light streaming in through a window, and the rest of the volume being quite dark. Multiple sources of light will tend to reduce the contrast, and so the glare.

“Permanent ways of reducing glare:

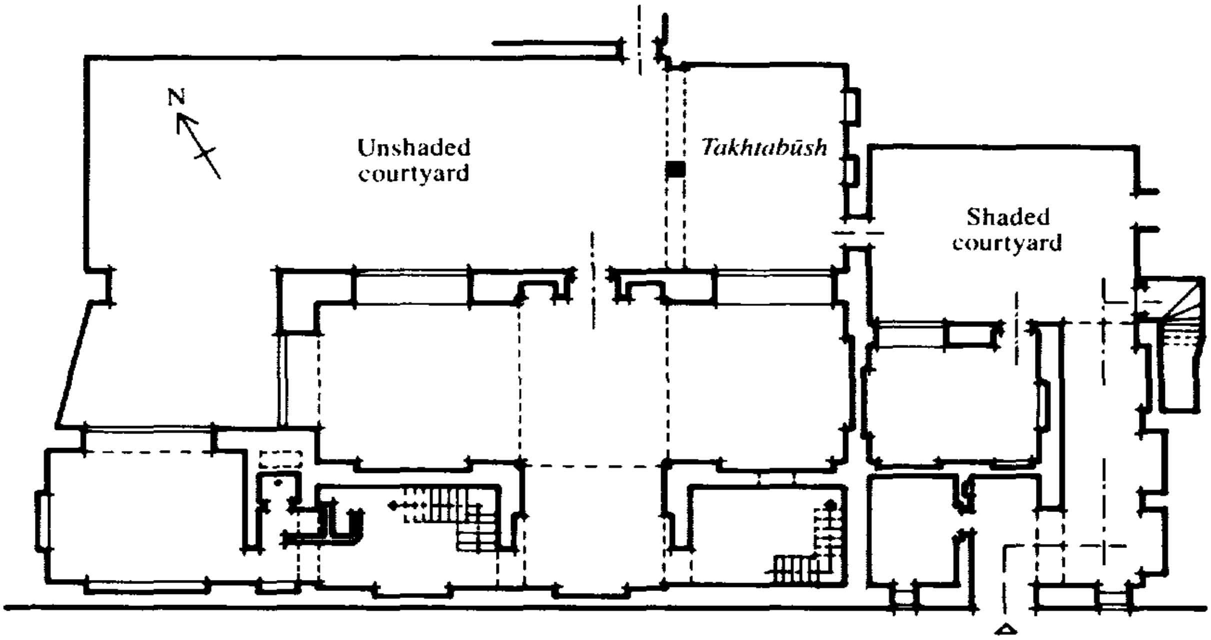
Low sills to increase illuminance of interior.
Increase illuminance of window surrounds by selective siting of luminaires (Lights?) to reduce contrast.
Reduce contrast between window and window wall by splaying window head and window sill.
Overhangs above the window will reduce the view of the sky from the interior.
Increasing interior fabric reflectances will decrease effective contrast.
Use curtains or blinds which may be translucent, louvred, or slatted “

Another way of saying this comes from Chris Alexander’s Pattern 107: Wings of Light:

“Buildings that displace natural light as the major source of illumination are not fit places to spend the day.... no point that is more than 4 – 5m from a window can get good light.... Make buildings no more than 10m wide so all rooms get light from two directions.”

Using evaporation of water for cooling

Many societies over the millennia have used the evaporation of water for cooling, at a wide range of scales. Hassan Fathy’s book talks about takhtabush, fountains and salsabil.



The hot air rising from the unshaded courtyard on the NE drew cool air from the shaded court across the taktabush. Fathy comments that “A similar arrangement can be found in the tablinum of the ancient Roman villas of Pompeii.”

In this country, we are all familiar with the Coolgardie safe, which had an open wire structure covered in hessian, with a water source on the top and a water collector on the bottom, that allowed the water to wick down the hessian, evaporate, and so cool the contents of the safe. We still see a canvas water bag on the front bumper of some country cars, which operates on the same principle. In Kenya, the bags had zips and canvas pockets for the bottles of local beer!

Local buildings in the northwest and Kimberley used to use this principle: there was a Spinifex Room in the old Fitzroy Crossing pub that had 1m thick wads of spinifex between two walls of chook wire, with a drip pipe on the top. One of the pubs in Meekatharra used to have a slow fan blowing through a 200l drum size roll of spinifex that was being dripped on, keeping the saloon bar cool.

They all use what is known as the Latent Heat of Vaporisation – the fact that it takes 2260 joules of heat to change the state of 1 cc of water from liquid to vapour.

A colleague in Shenton Park made very ingenious use of this principle. He had to put a reducing valve between the ordinary house water tap because we had immense water pressure there, only several hundred metres from the King’s Park reservoir. This connected to black poly pipe, which he strung along the top of a west facing wall. He experimented, with water pressure and the size and spacing of holes he put in the pipe, until he achieved what he wanted: the surface of the whole wall of bricks was damp, except the bottom two courses. That is, he was putting enough water onto the surface of the wall to counteract the evaporation caused by the solar incidence on the wall, and so reduce the heat absorption of the bricks. The fascinating thing he found was that this consumed less than forty litres of water for the afternoon period of a summer’s day. But this took 90 million joules of heat out of the brick wall that would otherwise have been conducted into his flat.

You can use this principle on a very short term basis, just by having a damp flannel to wet your face from time to time. You could go further, and have a soaked but rung out towel hanging in a window space. You could have a short burst of watering in the garden in late afternoon, or you could spray the concrete or pavers - or even the wall - on the sunny side.

Fountains and pools are helpful in this regard, but to achieve as much as they might, they need the maximum surface possible for the volume of water, to ensure the largest volume of air is exposed to the cooling effect. This is why the evaporative air conditioners have the filters they do – to maximise the surface area for the best cooling effect.

We have a butter dish that uses the same principle: it is glazed on the inside, but porous on the outside, so a little water can enter the pores of the terracotta, evaporate, and so cool the butter. That is why it says, in the small print, ör on safari"!

Quick and simple screening for east and west walls

A desperate but effective attempt at a quick retrofit was totally focussed on reducing the heat build up in the kitchen cupboard. One evening, at 9.30 pm, it was 37C inside the cupboard! The next day we taped some polystyrene box lids to two old flywire doors and propped them up to stop the afternoon sun falling on the dark, thin wall behind the cupboard.

Following up, I found one of the best books available on retrofitting – *Making Your Home Sustainable - A Guide to Retrofitting*, by Derek Wrigley. For $65.59 I bought 1.1m of 1.8m wide 95% Koolaroo shade cloth, 1.1m of 3.6m wide 95% shade cloth, six pine battens, and some simple fasteners.

The screens have reduced the heat and glare load in our poorly insulated rental house; the east screen is keeping up to two hours of early morning sun, and the western two up to six hours of late afternoon sun off the walls through the summer.

The shade-cloth was fastened to the pine with square fixers (you can just see the top edge of one in the first photo), the cloth was rolled to cover the fixing edge, and then the top piece of pine was drilled to fasten it to the verandah posts. With some weight on the bottom roll of cloth and pine to tension the cloth the bottom edge was fastened. It took less than an hour to fit the three screens.

In winter, you could simply undo the bottom two screws, roll the shade cloth up, and tie it to the top batten, as in the second picture. This will not be necessary here, as the early morning and late afternoon sun will be angling inside these shades to the windows of the house.

Verandahs

A carefully designed verandah (modern term = Alfresco area) can give lots of options, if we make sure we do a sector diagram for winds. Massive alfresco areas to the south seldom get used, as the cold, strong SE and SW winds can be uncomfortable, even on a summer evening! If protecting a bale wall, or roof symmetry or economic roof structure result in verandahs to the south, look at enclosing them for extra storage, a small wood stack, bikes, cars. Verandahs on southern walls are great places for deep freezers – lots of wind (to replace the hot air around the freezer as it chills the inside), no sun, and no winter heating give maximum efficiency, and so minimal power use of one of the most power hungry items in your home .

The use of polycarbonate sheeting gives verandahs multiple options through the seasons– shade in summer and light penetration in winter. See the detailed article mentioned previously for the sun diagram, and plan for polycarbonate sheets to replace colorbond in some areas. Then around this time of the year, plan to rig your 90% shade sails up under the polycarbonate for the shade you want in summer, and take them down say late April – semipassive solar! The example below, with angled polycarbonate to within 1900mm of the north facing wall, allows winter sun to totally penetrate the living room doors and windows, but ensures no summer sun hits the glass at all between November and February.

A key here is to make the verandah at least 3m wide. And this means space between the walls and the columns. Having enough room to seat people on benches either side of a table makes a difference, as does being able to comfortable move around someone stretched out on an easychair! A wall, or some rocks at a comfortable sitting height also help.

Cool rooms and cupboards

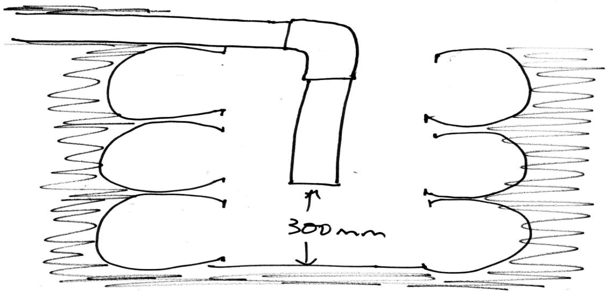
David and Sue Holmgren's lovely house in Hepburn Springs has a sealed cupboard with a vent into the underfloor space, and a vent at the top into the ceiling space. The open racks allow lots of gentle airflow to keep vegetables and fruit in cool conditions. You could replicate this easily if your design allows it, but too many of us have slab floors.

We built a cool room/pantry/cellar of strawbales inside the house, whose surfaces get very little direct sunshine. We double insulated the roof with 2 layers of R3.5 batts over the gyprock. We made sure the door was insulated and a good airtight fit.

After checking out comparative performances with others building at the village who followed our initial experiment, we can say that our first go was the most effective, in terms of getting the ratios of room volume and pipe lengths and diameters right. Our effort enclosed only about 8 cu m of air, but it has consistently achieved lower temperatures than the others, which ranged from about 14 cu m to 24 cu m in volume. We used a min/max thermometer to discover a <u>seasonal</u> temperature range of 2 degrees, from 16 – 18 in winter, and 18 – 20 in summer in our pantry.

We grabbed the opportunity of a back hoe putting in a drain for the dry composting toilet compartment to include 30m of 90mm PVC pipe, from the house wall to an airwell. The backhoe operator also saved us digging here as well; we dug a fairly deep hole, and put 3 truck tyres on top of each other. The 90mm pipe fell all the way from near the house to the airwell, to ensure that there was no possibility of condensation sitting in the pipe, and so creating "legionnaire's disease" type problems. It averaged just over a metre underground, so planting on top of it was not essential. If you had to do the digging by hand, you could save labour by planting over the top of the pipe's route.

With the end of the pipe sticking well over the inner rim of the tyres, we put in a right angle, and then another 300mm of 90mm pipe, which in turn was 300mm off the bottom of the well created by the tyres. This was to ensure that no water in the air well could get into the pipe, and that no rat or mouse could use the pipe as a route into the house.



AIR INLET DETAIL

We then installed a 50mm pipe through the ceiling of the pantry, through the roof, to about 1m about the roof level. We painted the outside surface of this pipe matt black, and capped it with a nipple type cover. Both created a gentle suction, taking hotter air out of the top of the pantry, and drawing cool air in from the air well.

We planted wormwood around the air well, and over time it grew to occupy about 30 cu m of airspace. This ensured that minimal ground heat was conducted into the air going into the pipe. If we had wanted or needed to make the pantry even cooler, we would have rigged a ring or two of trickle pipe around the top of the wormwood and let the drips cool the air even further, like a Coolgardie safe. See the article on using water evaporation.

In our new house, we have a similar pantry system, with about 12 cu m of internal volume. Without the space for the wormwood solution, we found a new one: The end of the inlet vent is where the outlet drains for the storm water collect (bottom left in the photo below); it is sealed with nylon fly wire mesh over fine grating . The planned slight leakage from the four drains drains into a little sealed basin filled with blue metal allows evaporation, and so local air cooling. A blue metal drain ensures water can't get into the air vent pipe.

The hot air vent from the pantry ceiling has minimal angles, and goes to well above the ridge, ensuring more airflow. The blackboard paint heats the air in the pipe for convection, and there is a nipple vent for low pressure for suction. Looking at the next photo, not only does the cowling cover other pipes (for the solar HWS and the fire sprinkler), but it also a trombe wall for the vent pipe, creating even more heat rise to cool the pantry. Note the louvred window on the right, which is opposite the louvres under the window seat in a later photo.

With the door not totally airtight yet, it has ranged from 18 to 19 over the last four weeks at eye level in the centre of the pantry, despite the vents all being at the other end from the door. In this case, the internal wall bales are on edge, so the internal walls are only 400mm thick, and not the 500mm of outside walls. The roof is double batted with R3.5 batts again, but this time we have 21mm jarrah floorboards over the top as well. The short return walls near the door are normal stud walls which are also double batted, but also have a layer of polyair super – the new double aluminium sheeted insulation material – under the gyprock.

Opening windows for cooling:

Assuming you have only the casement of a window to let cool air into the house, make it more effective by having three times the area of windows open on the downwind side. If all your windows and doors are flywired, experiments during a PDC at Murdoch suggested doubling this ratio from 1:3 to 1:6 would increase airflow dramatically. Another longer term strategy - at your basic design stage - is to have two walls of a carport or an entry statement forcing the air into the fly-wired front door, say.. Modern louvres are worth considering; they seal well, do not leak, but allow air into strategic points for quicker cooling. The pictures on the next page show just three louvres below the western window seat, and high in the opposite gable, ten louvres set into a strawbale wall.

Good luck with keeping your house cool over the summer. If you have or find more strategies let us know so we can share them with members in another issue.

To contact any of the committee, email: permaculturewest@gmail.com

For current activities and meetings, details of local groups, refer to the website: www.permaculturewest.org.au

Membership:

To become a member of The Permaculture Association of WA Inc please head to the website and use the BPAY system here . http://permaculturewest.org.au/join-pawa
Or complete this form and forward it, with a cheque or money order for $30, to **PAWA, PO BOX 164, INNALOO, WA, 6918**.

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