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Home for life

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report

Category: Building Design, Sustainable House Day 2011

by KenS (August 4th) (rank 500+)

In 2007, we returned after six years in the UK, to our house in the north-eastern suburbs of Melbourne. The house, built in the late 50's, was starting to show its age and needed considerable work including painting, pool repairs and general maintenance. But all around us we could see that there were other, bigger issues to deal with.

It was clear to us that we needed to prepare for a future world very different to the one we were living in. We needed to manage our water usage, energy usage and CO2 emissions and increase our self-sufficiency.

The first big decision was where to live. Should we continue to invest in our current home or elsewhere? We had always toyed with the idea of moving to a country home and started to look at that more critically. We decided the best option was to stay in our existing home till we die – some 30 years or more away we hope. Having made that decision we could focus on long term investments in our home.

If we were to stay in the house for another 30 or more years it would need some refreshing ands even structural work. To be a sustainable house it would need a lot of work to be more energy efficient. This was going to take more than just more insulation. We would also need to add some passive heating, more efficient heating systems and some thermal mass. For water, if we wanted to grow our own food we would need much more water storage. To reduce energy use further we should increase the occupancy of our house. Given the ever decreasing chances for our children to own a house in this suburb we wanted to design it to house multiple generations. Designing all this was beyond us so we engaged NowArchitecture who came up with some very innovative solutions.

We worked out early on that double glazing would be essential. But what sort of windows? PVC frames are not eco-friendly PVC as PCBs are produced in its manufacture. Timber frames are expensive and require regular treatment to keep them durable. Aluminium suffers form poor thermal performance, a dearth of true thermally broken frames and aluminium itself is little more than "congealed electricity".

We chose fibreglass because it is reasonably eco-friendly, is strong and has excellent thermal properties. On the downside, it costs a bit more than PVC, there is only one supplier in Australia and it is not widely used here, although it is more prevalent in North America.

Our research indicated that for thermal comfort in all situations a U-value of 1.3 is ideal for Melbourne. With this value, no matter what temperature outside the internal window surfaces would never be less than about 3.5C from ambient room temperature. This is important because human comfort is tightly liked to variations in the surrounding temperature. Even if the room temperature is 20C, cold windows will make you feel uncomfortable. But the cost of U1.3 windows is prohibitive. In fact, triple glazing would probably be needed to achieve that. We compromised on U1.7 because the number of times the temperature falls to the level where U1.3 needed is small. Indeed, it only occurs overnight when we could draw curtains.

We replaced all of our old aluminium single glazed windows, external doors and aluminium sliding with double glazed fibreglass windows which are also airtight to stop the draughts we had been getting.

All but one west facing windows were eliminated to also reduce heating in summer from the afternoon sun. Those walls are clad with Bondor cladding which is a colorbond steel with polystyrene insulation to further reduce heat from the sun. The insulated walls have additional benefits of improving the insulation of the walls overall and place the thermal mass of the brick veneer walls inside the thermal envelope of the house. This is a form of Reverse Brick Veneer construction which helps stabilise the temperature inside the house.

Part of our renovations included installation of R3.0 polyester batts into the top section of the external walls around the entire house. This extends down to the tops of the windows and doors to maximise the benefit.

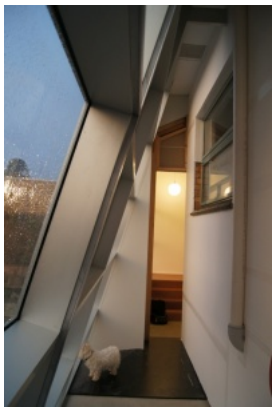
Our house is built on a moderately steep block and about thirty years ago the owners extended and were able to fit in some basement rooms under the extension. These were used as a bedroom and storage space. The new design converts this area into a granny flat with its own bathroom, laundry, kitchenette and living room. My elderly mother has moved in which increases our occupancy – an easy way to become more energy and space efficient. Longer term, the granny flat could be used by ourselves while either of our children, hopefully with a family of their own, occupy the main house.

Our architects designed the solar wall (aka the thermal chimney) for passive heating. The north face of the house had very little window space, so the amount of heat captured during winter for passive heating was minimal. In addition, the wall itself was not very attractive as it was the "back" of the house – even though it was the main street frontage.

The solar wall is essentially a trombe wall. A wall of glass outside the brick veneer wall facing north to capture the heat of the winter sun which can then be drawn into the house.

The former pool

Installing the underground matrix tank



Inside the solar wall

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In summer, the air inside the wall will become very hot. As the air rises it escapes through vents in the roof which creates a strong convection current that draws air through the house. The moving air helps to keep you cooler and also draws in cooler air from beneath the house. This was the reason for being called a thermal chimney.

A layer of foam insulation on the bricks prevent the hot air from heating the house through the brick veneer wall. The glass wall and the air inside also acts as further insulation in winter.

Some of the panes of glass on the solar wall are substituted with solar panels. These provide a bit of privacy for the rooms behind the wall, they are visually stunning and they generate some electricity. We have another set of panels on the roof in a more conventional configuration to give a total of 3.0 kW of capacity. The solar changes are capped off with an Apricus solar hot water unit. This is boosted with an instantaneous gas hot water unit which also feeds the hydronic heating that replaces the old gas ducted heating.

For rainwater we had a modest 5000 litre tank connected to our garage. But we soon realised that we would need more. Given the size of our block and the number of fruit trees and vegetable plots we could sustain we would need something like 70,000 litres of water storage to see us through an extended dry period of 3 months.

We had already decided that the pool itself was a burden and would have to go. Our architects produced a design which involves using the pool as a tank and covering it with some 500mm of soil which recovers some 60 square metres of land for growing vegetables. In hot weather, water from the pool pipes is pumped through a heat exchanger to deliver coolth through fan coil units in the house. Despite having 70,000 litres capacity, for engineering reasons only half the pool water is available for use. Our water storage is supplemented with an underground matrix tank of 30,000 litres. By locating the tank underground it takes up no valuable growing space and can also capture water that infiltrates through the soil in addition to the rainwater from the roof. This tank overflows into the pool which in turn overflows to storm water. One pump services both tanks, controlled by a pair of gate valves.

With a block of land the size of ours we have great potential for growing enough fruit and vegetables, plus a few chooks for eggs, to be largely self-sufficient. Our permaculture design by Very Edible Gardens, which is work in progress, has a main cropping area of 45 sq.m in our western yard. The covered pool has six raised garden beds made of cypress for growing more vegetables on 41 sq m of beds. A chook shed and straw yard sit above the underground tank and there is a chook run along the boundary, beneath the fruit and nut trees. A water pond and rockery, also on top of the underground tank, encourage frogs and lizards to take up residence and keep pests under control. The northern yard of 21 sq.m will be terraced and used for more vegies like lettuces and rapid growth crops.

Our renovations have only just been completed and our measurements of energy use are so far very encouraging . Certainly the house is more comfortable but we are really hoping to see a substantial reduction in our energy use.

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