Hawthorn VIC

RENOVATION	
ZONE 6: Mild temperate	

Topics covered
Orientation
Design for climate
Passive heating
Passive cooling
Insulation
Thermal mass
Glazing
Shading
Reduced water demand
Water harvesting
Water re-use
Material selection
Energy use
Hot water
Lighting

AccuRate (thermal comfort)	5.6 (regulatory)

This project is an excellent example of how the performance of an ordinary Victorian terrace can be transformed while still working within the tight parameters of a small site with stringent heritage regulations. The post-renovation house achieves self-sufficiency in terms of energy use, incorporates low embodied energy materials and generates a large portion of its own water needs.

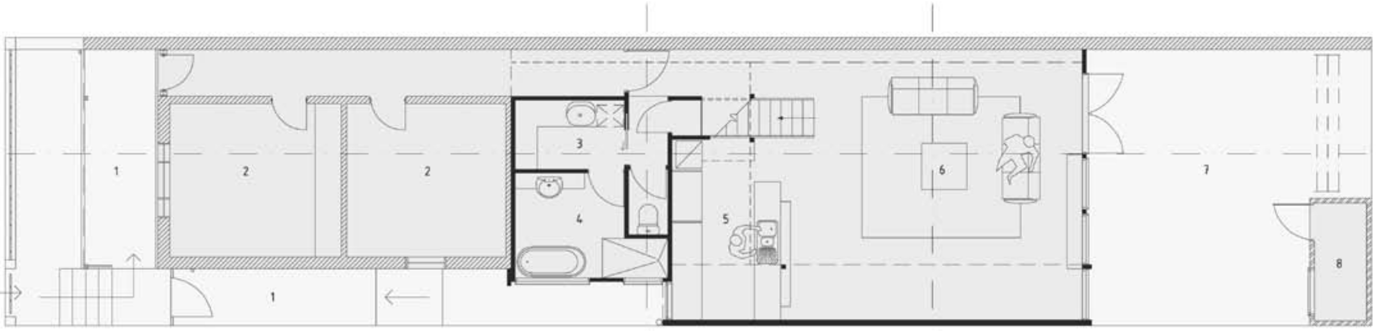
PROJECT BACKGROUND

The clients, both professionals in an environmental field, had a high level of awareness of sustainability issues. Their brief was to renovate their semi detached single fronted Victorian home in an inner city Melbourne suburb in a way that considered not only the rearrangement of functional areas and the local planning and heritage codes, but also the delivery of outstanding environmental, occupant health, energy and water efficiency.

An initial feasibility study was commissioned to accertain water catchment potentials, as well as the extent of the sustainable features and their costs. A two bedroom small family home with a study, north-facing living room and kitchen were the specified spatial requirements.

Heritage overlay

The property is covered by heritage overlay control. The streetscape has a local significance as an illustration, of the influence of the brick industry, workers housing and of the garden suburb ideal for the less affluent. The new design restores the 1890's style verandah and picket fence and includes appropriate heritage colours. The solar panels and solar hot water service, water collection and greywater systems had to be hidden from the streetscape. This was quite a challenge for a very small site of 203m^2.



Ground floor

Upper level

PLANNING PROCESS

The planning approval was prolonged, with the application process taking eleven months. Not all of the delay was due to the environmental features proposed by the design. One issue was the neighbours' concerns about the noise that might be associated with the pumps and the way in which the greywater was treated on site. The council health officer was also initially concerned about potential health risks with the use of greywater, but persistence from the design team was successful in allaying these fears.

Overlooking was also a major issue for the neighbours and it was solved with cleverly designed screens and louvers and extensions to fence heights. There appeared to be no concern about the PV power system on the roof. The height of the building was kept to a minimum so that the extension was not visible from the street.

The council's planners were initially ambivalent towards the project as an example of best practice sustainable design for a difficult inner city block. However, persistence eventually made the overall benefits of the innovative design features apparent to the authorities and planning approval was achieved. So successful was the project that the council recognised the renovation with an environmental award.

DESIGN SOLUTION

A warm, comfortable small family home was provided that works both spatially and environmentally for the clients. The rear wall of the house faces north on its short axis.

The original unrenovated house had a rear wall with a smattering of outhouses and no north facing windows. The new rear wall had to be setback sufficiently from a neighbouring 8 metre high tree that would have interfered with northern sun entering the building.

A mezzanine level was created to house a generous study with roof storage access. The additional height was used as an inlet point for a heat shifter that takes additional warmth from the north rooms via a fan into the south rooms that receive no sun.

Highlight windows were created on the east facade to provide additional heat gain and natural day lighting. These windows had to be sufficiently high to avoid overlooking of neighbour's private open spaces.

The extension was constructed on an on ground slab and the old timber floors to the front 2 rooms and hallway were insulated with reflective foil insulation under the external joists to improve thermal performance.

The active sustainable features designed into the home include a grid interactive PV system, greywater treatment and recycling, water catchment tanks, a gas boosted solar hot water system, and use of recycled and plantation timbers.

Cladding: the external walls are a combination of rendered fibre cement sheet, cypress macrocarpa weatherboards and AAC block work. Cypress macrocarpa is sustainably sourced from windbreaks. Both products were chosen for their low embodied energy and in the case of the AAC block work its inherent insulation properties. The unique nature of AAC also contributes to some thermal mass. The external walls were bagged and painted with a cement-based paint with a minimum 20-year life.

Recycled materials: the internal timber posts were made from recycled ironbark. Recycled jarrah and mountain ash was used on bench tops in the kitchen with New Age Veneer in Tassie Oak on the cabinets. The mezzanine floor is recycled messmate. Three thousand bricks were cleaned and re-used for the party wall and rear battery room. The original house Baltic pine floorboards were also re-used. The turned verandah heritage posts were custom made from recycled ironbark because off the shelf heritage posts are made from virgin imported rainforest or native timbers.

ARC steel was used for slab reinforcement which is 100 per cent recycled and the concrete was Slag Blend used for its recycled content.

The sewage pipes are made from PVC and the metal roof has a component of recycled scrap steel.

A porus piping, made from recycled car tyres, has been adapted into the greywater tank as part of the aerator system.

The kitchen also has a recycling system installed for compost and general garbage.

Thermal mass and insulation

Thermal mass is provided by the concrete slab, AAC and recycled brick walls from the demolished section.

Wool/polyester batts were installed in the walls and ceiling to provide R1.5 to walls and R3.5 to ceiling. Reflective foil insulation was used as a roof blanket, and due to its excellent reflective properties, increased the R rating by up to R1.5.

Reflective foil insulation was also used under the existing joists in the old section of the house. [See: 4.7 Insulation Installation]

Glazing

All windows and glazed doors are double glazed with 6-10mm argon gas space between panels and weather stripped to prevent draughts. The existing front Victorian windows were reglazed with higher performing laminated single glazed units. The existing traditional frames could not accommodate double-glazing so the nearest equivalent product in single glazing was used. A fixed eave shades the east facing windows in summer. The west wall is a party wall and has no windows. [See: 4.10 Glazing]

Shading

The PV panels and solar hot water collectors on the roof also provide significant heat reductions. Sail shades have been provided to the north facing deck. They are removed in winter to allow maximum solar gain. A fixed eave on the east shades the windows from summer sun.

Ventilation

Maximum cross-flow ventilation has been allowed through strategic window placement and by most windows utilising casement mechanisms that increase the size of the openable space. [See: 4.6 Passive Cooling]

APPLIANCES AND SERVICES

The home is heated with a flued gas space heater, a gas wall console heater and a smaller unit for the bathroom/laundry area. This system emits only 1.0 nanograms of NO^2 per joule of gas compared with 5.0ng/j for a typical unflued gas heater. No supplementary cooling is required for summer. After one year there has been a ten per cent reduction in gas consumption compared to the pre-renovated house. The occupiers were most surprised to discover that the old house used 11,000MJ of gas to heat one 14.5m^2 room, compared to the sustainable design of 15,000MJ to heat four rooms with total floor area of 103m^2.

All light fittings have been designed to accommodate compact fluorescent globes to reduce energy usage. Low voltage halogen lights have been avoided. [See: 6.3 Lighting]

Photovoltaic system

18 x 75 watt photovoltaic modules were installed to generate electricity to the local grid (net metering allows the electric meter to run forwards and backwards). After one year the system has produced about 1,600kWh of renewable electricity, which equates to 88 per cent of the total household use. The owners have signed a contract with an electricity retailer for 30c cash in hand for every kWh generated in excess of onsite consumption. [See: 6.7 Photovoltaic Systems]

Greywater

A Garden Saver 1,000L greywater system has been installed to take all greywater from shower/bath and washing machine and is used for non-edible garden use and to flush the toilet cistern. The tank is hidden under the rear deck.

The problem of water odour was overcome with an air blower. The water is clear and odour free and can be stored for months. The owners have applied for a grant to monitor the water usage and savings over a 12 month period as well as testing of water quality in both the greywater and rainwater tanks. WELS rated water efficient appliances and showerhead have been installed and the best available dual flush toilet. [See: 7.4 Wastewater Re-use]

Rainwater collection

The house has a roof area of 120m^2 and rainwater is channelled into storage tanks hidden under the front verandah and tanks down the side of the building. The optimum water storage capacity was calculated in relation to annual rainfall statistics. So far this roof harvesting, combined with the greywater system, has provided 65 per cent of domestic water needs. In an average (non-drought affected) year this is expected to be more than 75 per cent, a great result for such as small roof area.

Toxicity studies on the type of metal roof used indicated it was the best choice for catching rainwater used for drinking. A specially designed guttering system was also installed to minimises debris and pollution and its compatibility with the chosen metal roof contributes to maintaining quality drinking water. The system includes a first flush process with a twin water filter on the kitchen tap. Due to the restricted nature of the site nine smaller tanks were installed under the front verandah and down the side of the house particually innovative response to a tight space situation. [See: 7.3 Rainwater]

Solar hot water

A solar hot water unit with three panels and 14 risers was installed. The electric element was removed. The system is now boosted by an instantaneous natural gas unit in winter. Due to limited roof space to accommodate the PV panels and the hot water service it was installed facing west and an extra panel was installed to compensate for the reduced efficiency. The position was also limited by heritage visibility issues from the street, but despite this, solar energy has provided 90 per cent of hot water needs for a family with young baby.

Low toxicity finishes

The new concrete floors are covered in marmoleum sheet flooring which is a totally biodegradable product made from natural fibres. It also has low allergen properties. The walls are painted with low toxic paints, commonly available at hardware stores.

Conclusion

Overall, the project demonstrates a considerable enhancement to an otherwise ordinary performing building, despite the considerable constraints placed on the design process by minimal site space and other regulations. The renovated house not only provides excellent health benefits for its occupants but also has a significantly smaller impact on the environment.

PROJECT DETAILS	
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