Marion SA

RENOVATION

ZONE 5: Warm temperate

Topics covered
Passive design
Renewable energy
Energy efficiency
Rainwater harvesting
Sustainable materials
Construction waste avoidance

AccuRate (thermal comfort)	Existing 3.8 (regulatory)
AccuRate (thermal comfort)	Renovation 4.7 (regulatory)

This study shows how a conventional suburban project house has been renovated to provide a comfortable and efficient home that fits within the context of its surroundings.

The aim of the design was to improve the home's liveability, minimise environmental impact during construction and operation, and harmonise with the natural surroundings.

The original budget of about $120,000 was continuously reviewed to balance needs and desired outcomes with 'value for money'. The final cost of the renovation was $155,000.

The clients' idea of cost effectiveness was informed by their environmental awareness, their concern for minimal use of resources, their desired lifestyle, the long-term viability of the building and advice from the architect and council.

Of particular concern was enhancing natural lighting, cross ventilation and linkage to the natural surroundings. The inherent characteristics of the existing building were utilised and improved, along with creative 'grafting' of a low environmental impact addition.

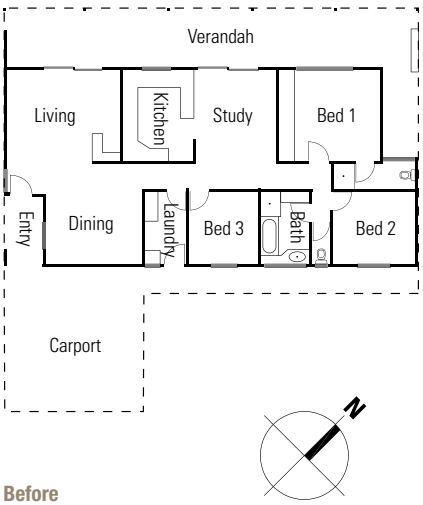
The house has attracted considerable publicity, highlighting its great performance in terms of low energy use and low running cost.

The flow between outdoor and indoor spaces has resulted in a new relationship between occupants and passers-by. Many visitors have been attracted to the house by its appearance and the tangible application of passive and renewable energy measures.

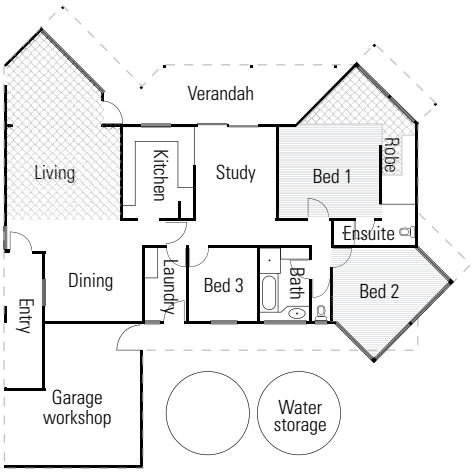
The existing house

The house is a conventional 1970s spec-built double brick home in suburban Marion, SA. It is situated alongside a park reserve, with school grounds across the creek.

It is located in a suburban environment, and surrounded by contemporary typical brown brick dwellings featuring bottle glass and concrete roof tiles.



Before



After

Site and climate

Marion is about 4km inland from the coast, in a mild to warm temperate climate zone, with cool wet winters and hot dry summers. The temperature range is around 15-28° in summer and 3-17° in winter.

Cooling breezes come from the south west in summer. In winter, cold winds come predominantly from the north east.

Solar access to the block is excellent, limited only by tall eucalypts on the east and west boundaries. Open areas to the north and east of the block increase its exposure to wind.

PROJECT AIMS

The main aims of the project are summarised below:

Amenity – Enhance views to the reserve and creek and provide the clients with an improved living space, a more direct relationship with outdoors, and improved cross ventilation and natural lighting.

Energy – Achieve good passive solar design, maximise energy efficiency, use materials with low embodied energy and use renewable electricity.

Water – Harvest rainwater to supply all household uses.

Materials – Use plantation timber, to design for 'long life, low maintenance' and re-use and recycle construction waste.

DESIGN SOLUTIONS

Orientation and windows

The alignment of the original house was 45° to the North-South axis. The additions are angled in plan and elevation to enable the most effective solar access, and to provide interesting spatial relationships between existing 'pokey' spaces and external areas.

The new living area contains a significant amount of north facing glazing. Windows which were not practical to curtain were double glazed for improved insulation.

In winter, the double glazing allows sun through to heat the thermal mass, while preventing conducted and convected heat from escaping back to the outside.

Internal spaces are airy and flooded with natural light during the day. [See: 4.3 Orientation; 4.10 Glazing]

Shading

Eave overhangs and angled western red cedar solar oriented slats in pergolas control sunlight penetration on the north facade.

East and west facing windows are partially screened by the eucalypts along the boundaries. In addition, east facing windows are screened with external blinds and west facing windows are tinted with metallic film. [See: 4.4 Shading]

Thermal mass

Concrete slab on ground has been used as the flooring system for the extensions, to provide additional thermal mass. The existing suspended timber floor in the lounge was also replaced with a concrete slab.

Concrete floors are tiled, not carpeted, to enhance the thermal performance of the concrete. Passive solar design allows as much winter sun as possible into the house to heat up the thermal mass. [See: 4.5 Passive Solar Heating; 4.9 Thermal Mass]

Structure, envelope and insulation

The new roof over the living area was raised and angled to provide the optimal angle for the roof mounted photovoltaic array and solar hot water system. This popped up metal roof also provides a light and airy atmosphere to the internal space.

The new walls are framed with plantation timber and clad in 'eco-ply' pine plywood.

The new floors are concrete slab on ground with a tiled surface.

Reflective insulation is used in the roof, with R2.5 bulk insulation to external lightweight walls and R3.0 bulk insulation to ceilings. [See: 4.7 Insulation]

Ventilation

Narrow louvre windows maximise use of breezes and provide security. Placed in strategic locations, the louvred windows allow controllable natural cross-ventilation.

South facing clerestory windows above the living area provide views of surrounding trees and can be opened for ventilation in summer. They are designed to encourage natural ventilation by exhausting warm air and catch cooling breezes. [See: 4.6 Passive Cooling]

Day lighting

The north facing glazed areas result in vastly improved natural daylight from several different directions at once, which adds to the open, airy feel of the rooms.

The living area has dynamic natural lighting, utilising a mix of small, large and clerestory windows that allow light in from different directions.

South facing rooms have 'solar-tubes' installed in the roof to add more daylight.

Landscape

The house sits well in its context, allowing visual connection to the native vegetation reserve. It 'welcomes' visitors because of its openness, while providing security for its occupants through creative use of the boundary line in the extension, and simple pool type fencing.

A vegetable patch has been cultivated to supply the house occupants with fresh produce.

Pre-settlement native vegetation seedlings have been raised and planted in the garden and along the edge of the reserve. Removal of existing trees was avoided. [See: 2.4 Sustainable Landscapes]

Paths are made of concrete lattice rather than full concrete to minimise run-off. [See: 7.5 Stormwater]

SERVICES AND APPLIANCES

Renewable electricity generation

A 1.05 kW grid-connected photovoltaic array comprising 6 Sharp 175W panels and a 1200W inverter was mounted on the roof. Power exported to the grid (795kWh) was 72 per cent of power imported from the grid (1109 kWh) in 2002 / 2003. [See: 6.7 Photovoltaic Systems]

Hot water

A solar water heater is used to pre heat water, which is then passed through an efficient 5-star gas instantaneous hot water system. [See: 6.5 Hot Water Service]

Heating and cooling

To minimise the need for artificial cooling, louvre windows are placed to maximise cross-ventilation in the house.

An evaporative cooler provides supplementary cooling in summer. The unit is located at ground level in a shady spot on the south of the building. The inlet air drawn into the unit is cooler than if it were on the roof in direct sunlight, and hence requires less energy to cool.

An efficient 5.5-star rated gas space heater is located in the living room for winter use. Yearly gas consumption is around 4700MJ. [See: 6.2 Heating and Cooling]

Lighting

Compact fluorescent lights are used throughout the house. The design allows for plentiful natural lighting. [See: 4.11 Skylights; 6.3 Lighting]

Natural gas is used for all cooking, and energy and water efficient white goods have been selected. Background electricity usage of appliances and consumer electronics in the house, including standby, is approximately 3kWh. [See: 6.4 Appliances]

WATER

Rainwater harvesting

Rainwater is expected to supply the house's water needs for most of the year, depending on the length of the dry spell in summer. In 2003, no mains water was used between March and September.

Enviro-flow gutters prevent leaves and bark from nearby trees entering the system, and an in-line mesh filter is fitted to the 21,000L semi-submerged storage tank. The system uses a 550W multi-stage pump used for low noise and high performance.

Toilets are dual plumbed to enable switching to mains if necessary in summer.

Water efficient fixtures such as WELS rated low-flow showerheads and 3/6 L toilets have been incorporated. The washing machine is a front-loading water efficient model. [See: 7.2 Reducing Water Demand; 7.3 Rainwater]

MATERIALS USE

When selecting materials for the renovation the following issues were taken into account:

> The context and location of the existing house.

> Thermal properties that contribute to the energy efficiency of the building envelope. Double glazing and high mass floors are an example of materials used primarily for their thermal benefit. [See: 4.9 Thermal Mass]

> Low embodied energy of materials. Materials with high embodied energy (such as concrete) have only been used where there is a clear thermal benefit. The new lightweight timber-framed walls have low embodied energy. [See: 5.2 Embodied Energy]

> Sustainable sourcing of materials. Renewable resources such as plantation timber have been used where possible. [See: 5.4 Biodiversity Off-site]

> Impact on health and indoor air quality. Materials with no or low toxicity have been selected where possible. For example, an 'Enviro-pro' finish was used to timber and cork floors in place of conventional polyeurethane.

> Durability and longevity of materials, including reduced need for ongoing maintenance.

> Recycled content of materials. Windows, a sliding glass door, timber flooring and bricks were salvaged from the demolition for use in the renovations. [See: 5.3 Waste Minimisation]

EVALUATION

The lightweight timber additions were effective for simple, quick, low-cost construction, avoiding use of heavy machinery, with minimal disturbance to the surroundings.

This project has contributed considerably to public awareness of ESD. Its site, context and occupants' willingness to welcome onlookers with their direct experience and information is exemplary. Adelaide Greenhouse Office's Solar House Day tours have attracted attention to the renovated building's application of active and passive energy initiatives.

Most importantly, the clients possess a genuine sense of achievement and pride in their new home.

The renovated building and its enhanced performance demonstrate that low impact housing is achievable in the most ordinary situation, affordable, exciting and desirable for a high quality of life.

Awards:

Royal Australian Institute of Architects South Australian Chapter Commendation in Sustainable Architecture 2003

Housing Industry Association GreenSmart Renovation of the Year 2003

PROJECT DETAILS	
Architect:	John Maitland, Energy Architecture
Builder:	Daryl Stanton, Gage Constructions

Principal author:
Geoff Milne