Case studies
Parkside, South Australia

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The new emerges from the old as sustainable design creates a bright, thermally efficient and environmentally in-tune home that incorporates a property’s heritage past.

The occupants of a stone villa in Adelaide found over the years that it needed major improvement: its thick walls and small windows meant it was dark and cold in winter but it needed robust air conditioning to cool after a run of hot days in summer. It was also subsiding on one side. They called in sustainable designers who came up with a radical plan to transform the house.

New build using some structure of the old house
Medium density
Climate zone: 5. Warm temperate

Topics
- Passive design
- Reducing mains water use
- Adaptive reuse
- Embodied energy reduction
- Greenhouse gas reduction
- Renewable energy production
- Indoor air quality
- Adaptation

Thermal comfort rating
Not available

Sustainability features
- Trombe wall
- Rainwater tanks
- Mechanical dry indirect evaporative cooler
- LED lighting
- Reverse block veneer
- Rammed earth internal walls
- Greywater diverter
- Solar photovoltaic panels
- Evacuated tube solar hot water
- Double glazed windows
- Ceiling fans
- In-floor heating through gas-boosted solar hot water

Project details
Designer: John Maitland, Energy Architecture
Builder: Adelaide Prestige Homes
Size: 220m²
Size of land: 790m²
Cost: $900,000

The sustainable design also incorporates the property’s heritage past.
Site, location and climate

The three-bedroom stone and brick house is in Parkside, an inner southern suburb of Adelaide. Hot and dry for long periods in summer, Adelaide is also subject to ‘cool changes’ when temperatures can drop suddenly from high 30s to low 20s degrees Celsius. Winters can feel cold despite relatively mild conditions. Insulation and thermal mass are priorities in this climate, to keep heat in during cold weather and keep heat out when it’s hot outside.

Design brief

The owners wanted the design team to demolish the house and produce a new building, but were persuaded to keep the front stone gabled façade and ironwork veranda. There would be a new enclosed garden and more space inside, while energy and water efficient features would be incorporated to improve comfort and overall livability. The home’s poor orientation — northern elevation close to the site boundary restricting natural light — also needed to be addressed.

The owners had thought of a standard new home, but the designers came up with a bold idea that at first surprised, then inspired them.

Design response

The roof was taken off, the house hollowed out and a garden courtyard built in its place. An entirely new house was then built around it. The historic front façade and other stone walls were retained because of their beauty, heritage value, high embodied energy and excellent thermal mass.

The aim of the design was to get the house’s orientation right. The new home was pushed towards the property’s southern boundary to open up to the north, with the new front courtyard capturing winter sun. The house’s three bedrooms, two living spaces, study, loft and kitchen were built over the driveway and into the large backyard, to the south and west of the courtyard.

Insulation — Trombe wall

A fascinating aspect of the home’s sustainable design is the Trombe wall installed on the north facing stone wall of the new living room. A steel frame sits slightly off the rendered and painted old stonework and is clad with polycarbonate panels to create a warm cavity, which in winter transmits heat through vents into the living room. In summer, the vent at the top of the Trombe wall can be opened to let the warm air out. A large, retractable shade protects the courtyard and the Trombe wall from the sun. The old stone wall is protected from weathering at the same time.

The Trombe wall makes an insulating layer on the outside of a thermally massive wall. Without it there is nothing to stop the heat flowing out through the wall in winter and in during summer.

Passive heating and cooling

Thermal mass keeps a house warmer in winter and cooler in summer. In this home, a high emphasis has been placed on passive solar design and thermal mass. Much of the incorporated thermal mass comes from the bluestone walls retained from the existing house, as well as concrete slab floors, 300mm-thick rammed earth internal walls and reverse block veneer construction.

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The reverse block veneer consists of 90mm concrete blocks on the inside, and timber cladding with rendered and painted fibre cement sheeting on the outside. The concrete blocks are solid, to maximise on thermal mass, and the external ‘skins’ are fitted to the insulated timber frame.

The home’s internal rammed earth walls in the living areas and bedrooms provide a warm aesthetic and a good sound break between rooms, and hold a large volume of thermal mass that helps to moderate the internal temperature. Rammed earth is a specially designed mixture of sand and rubble from a quarry, mixed with cement and a little water. It has low embodied energy and is very durable.

The R2.5 insulation in all walls and R5 bulk insulation in the ceilings boost the home’s thermal performance.

North facing windows in the new section of the house allow passive solar gain. The windows are double glazed with 12mm argon and a 6mm clear inner pane, in combination aluminium and timber frames. Clerestory windows bring north light into the bedrooms on the southern edge of the property.

A controlled skylight (adjustable solid louvres within the skylight close out the sun when unwanted) is fitted along the passage and living room bluestone wall — part of the original house that has been retained.

For passive cooling, a large retractable shade protects the courtyard and the north facing wall of the house from the summer sun. The house’s living areas open out to a patio covered with adjustable roofing louvres, and eaves shade the north facing windows of the loft.

Active heating and cooling

Solar heated (gas boosted) water is delivered through pipes for in-floor heating and into vertical radiator panels in rooms that don’t have a slab.

To control indoor temperatures during Adelaide’s long hot spells, the owners installed a Climate Wizard indirect evaporative cooler. It uses a modified
evaporative cooling cycle incorporating a heat exchanger that brings cooled, dry air to the home. The cool air is delivered through a series of underground pipes and enters the house through vents in cupboard kickers and some walls at floor level.

This system is more effective than a regular evaporative cooler and can work at higher levels of humidity without making a house uncomfortably humid or excessively dry, as it doesn’t extract or add water to the incoming air as it is cooled. It is particularly efficient in this house. By delivering cool air at floor level and driving warm air up and out through the ceiling vents and clerestory windows, this system maintains lower temperatures in thermal mass during a hot day, so that mass can do the work when the unit is switched off at night. It draws less than 300W running on idle, and less than 6L of water per hour, retaining temperatures of 24°C or less throughout extreme summer conditions. Windows and doors do not need to be open as with evaporative coolers.

Mechanical evaporative coolers are common in low humidity climates. They use less energy than refrigerated air conditioners and work better with doors and windows left open.

Ceiling fans have also been installed in the bedrooms. On still days, mechanical fans can be useful to create breezes. The maximum useful air speed for comfort is about 7.5m/sec.

Water saving

The homeowners installed six rainwater tanks around the property with a total capacity of 60,000L. All tanks are plumbed together and feed the whole of the house and garden. The water supply for the house or garden or both can be manually changed from the tanks to mains. There are also low-flow taps and showerheads.

A greywater diverter delivers bathroom and laundry water for subsurface irrigation to the extensive vegetable garden and fruit trees. Reusing wastewater outdoors can reduce a household’s potable water use by 30–50%. Subsurface drip irrigation systems spread water evenly around the garden, and are safer for spreading untreated greywater.

Solar power and solar hot water

With a 2.6kW grid-connected solar photovoltaic array on the roof, the family produces about half the energy it uses. For hot water, they installed an evacuated tube (array of 60) solar system that heats a 500L custom-made tank, boosted by a gas-powered hydronic boiler.

Energy efficient lighting

Most homes could reduce the amount of energy they use for lighting by 50% or more by making smarter lighting choices and moving to more efficient technologies, such as the light emitting diode (LED). The benefits of LEDs include lifetimes of up to 100,000 hours and potentially very high efficiency levels. The homeowners installed LED lighting throughout the house.

Evaluation

The owners of this home had a realistic budget for the scale of the work and were prepared to prioritise sustainability. This allowed their designers to come up with an integrated system of features for overall energy and water efficiency.

The couple say they could not be happier in their home, even as the house’s unusual façade draws curiosity from passers-by. A lot of people stop and talk to them, giving them encouraging comments about the design.

Comfort levels with temperature, ventilation and light have improved dramatically in the new abode. Lights are now hardly needed during the day and the couple are pleased with the new configuration of spaces, including the courtyard. Before they had a large backyard that was difficult to manage; now the new outdoor spaces are smaller, more purposeful and easier to use.

Author

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