Alteration
Inner west sydney

In this addition, passive solar orientation and courtyard living transformed an existing worker's cottage on a small inner city block.

BUILDING TYPE: Existing home addition CLIMATE: Warm temperate - New South Wales	
Topics Covered	Success Level
Passive solar heating	Excellent
Passive cooling	Good
Orientation	Excellent
Natural ventilation	Excellent
Re-use of an existing building	Excellent
NatHERS rating – 3.5 stars	★★★½

The owners, a young couple, purchased a four room worker's cottage in Sydney as a first home with the intention of renovating it.

The brief was to design and build alterations and additions to improve the layout of the home including a bedroom, living area and kitchen.

The budget was limited and the owners were keen to keep the good features of the existing cottage intact but decided to build the additions in a contemporary way.

The existing house is free standing, fibro clad and set back several metres from the street. It extends almost boundary to boundary and had some old lean-to additions at the rear.

The streetscape consists of single and two storey houses, some terraces and a larger civic building in an irregular grouping of buildings.

The site is long and narrow (8 metres by 30 metres). It is relatively flat. The longest axis is east west. There are no views into or out of the site but there is some noise from a major link road about 100 metres to the north.

Solar access is good on the longest north side boundary but a two storey house to the north restricts solar access to the front third of the site.

Access to cooling breezes from the north-east is restricted by the surrounding narrow streets and dense built form.

Solution: An unusual courtyard plan form was used to achieve optimum thermal comfort in summer and winter and reduce energy bills for heating and cooling. The roof shape is designed to maximise available solar gains and to collect breezes and direct them through the house.

DESIGN RESPONSE

Planning controls include a two storey limit on houses and controls on floor space ratio and site coverage to restrict the size and bulk of the houses in the area. The controls are numerical rather than performance based and do little to promote good solar design. Instead they restrict the bulk in a way that does not promote good design relative to site and climate.

Solar and Breeze Access

The design intent was to integrate inside and outside spaces to optimise use of the small site in good weather conditions. In addition to its mechanical role in modifying climate extremes, the house is designed as an adjustable envelope that increases awareness of daily and seasonal weather conditions. This encourages the occupants to take maximum advantage of the benign climate and to interact with the weather rather than being isolated from it.

The owners reported that this climate conscious architecture increased their awareness and use of seasonal changes and weather patterns to create comfort. They “do far more living outside”. The architect sees this as an important additional dimension to the usual mechanistic approach to “making a solar house”.

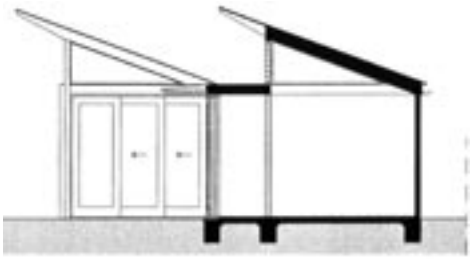
The usual method of altering and adding to an inner city single storey house is to remove the roof and convert the house to two storeys. This has the disadvantage of isolating half the rooms from the ground and allows overviews to houses on either side with consequent loss of privacy.

A radically different concept was employed to retain the single storey form. The house was extended into a courtyard arrangement to maximise the east – west length and provide north facing glass to single depth rooms. This allows deep winter sun penetration, controlled summer shade and optimum summer cross ventilation.

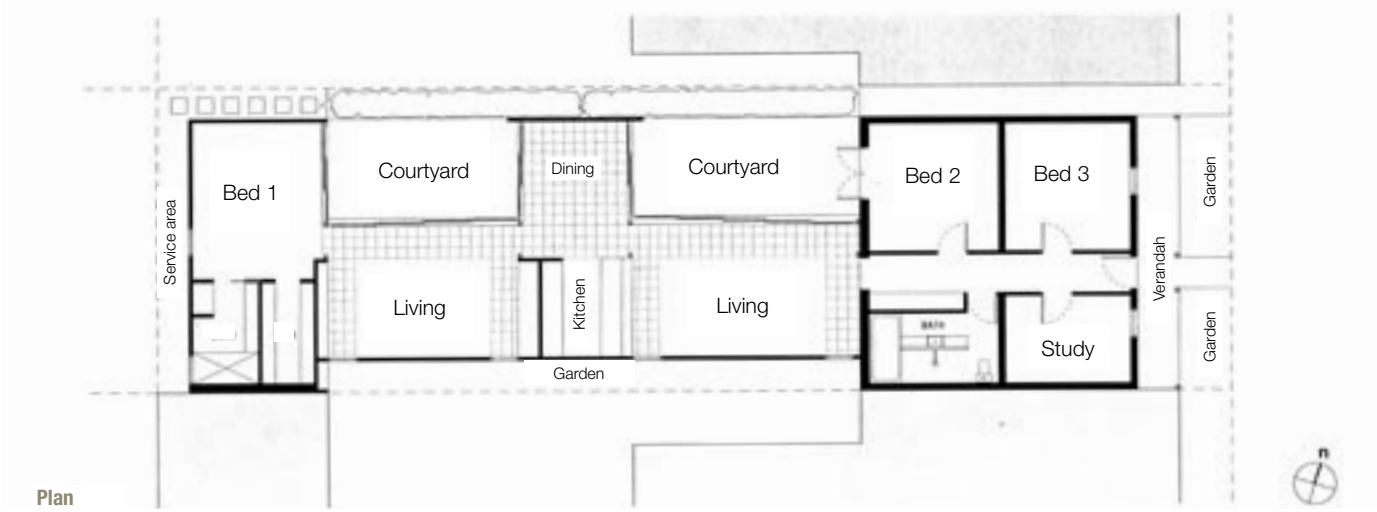
A “traditional backyard” becomes disconnected from the majority of rooms on narrow blocks. In this solution, the yard was replaced with two courtyards. Although smaller, each sunny courtyard is used regularly, facilitating more effective overall use of the limited site.

DESIGN SOLUTIONS

The existing cottage is retained and the house additions are laid out in an `F’ shape, creating two courtyards. This provided 3 zones for the house: the front cottage provides bedrooms for guests and children; the central courtyard provides living, dining and kitchen areas and the rear courtyard is used as a private parents area adjoining the main bedroom.



Cross Section



Orientation and windows

The house is oriented to maximise the north facing wall area along the long axis of the site.

Full height sliding glass doors form the north walls of both living areas maximising solar heat gain to living areas in winter. Narrow depth rooms allow high level summer cross ventilation.

Thermal mass

A concrete slab floor provides thermal mass. Surfaces exposed to direct solar radiation in winter or cooling breezes in summer are tiled.

Insulating carpet finishes are restricted to rooms on the south wall. The floor plan was designed to achieve this with tiled walkways being located inside north facing glass areas.

Structure, envelope and insulation

The house is built using a steel frame infilled with steel and timber frame cladding.

Embodied energy in the steel frame is offset by reduced structure.

Low embodied energy fibre cement sheeting is used externally and plaster board internally. The lightweight shell reduces wall thickness and allows flexible planning for openings.

Insulation to all external walls is R2.0.

Timber and steel rafters support a skillion roof.

Roof insulation: 150 mm thick R3.5 batts sandwiched between light coloured steel roof sheeting and plasterboard or plywood ceilings.

R1.0 blanket insulation with a 25mm air gap under the downward facing reflective foil was placed on the underside of the steel roofing.

Sliding doors are timber framed with single laminated glass.

Passive shading

Upward raked eaves on the 3 metre high glazed north wall provide summer shading to highlight windows whilst allowing winter sun in.

Pre formed horizontal metal louvres over the doors are set to an angle that allows deep winter sun penetration whilst excluding summer sun. More sun is gradually allowed into the house as winter approaches, providing an interesting pattern across the floor and walls as a reminder of the time of year.

The raked roof allows maximum solar access on the narrow site without impacting on solar access of the neighbour to the south.

Unshaded east and west facing glass areas allow heat gain in summer. This could be overcome with adjustable shading (eg. sails).

Ventilation

Sliding doors to north, east and west elevations open into the courtyards.

Multiple sliding tracks allow up to 6 doors to stack creating maximum opening area in warm weather. The doors can be opened a small amount and locked into place or the whole north side of the house can be completely opened.

A series of tall louvre windows along a setback from the southern boundary provide cross ventilation.

Highlight windows beneath the skillion roof provide further ventilation and exhaust heat by convection. The house can be adjusted to provide optimum air-flow and make good use of summer afternoon north easterly breezes.

Landscape

Courtyards are finished in paving and permeable gravel. Planting around the edges provides screening and a pleasant green outlook. Plants are watered from soakage from the paving which reduces evaporation.

A small water feature in each courtyard provides evaporative cooling in summer.

The rear, western side is heavily screen planted to shade the service courtyard.

APPLIANCES AND SERVICES

Heating and cooling systems

No cooling system.

Gas space heater with thermostat and time controls.

Off peak electric resistance heating in the floor slab is used to remove the chill from the floor when long sunless periods allow the thermal mass to cool. It is slow to respond and causes significantly more greenhouse gas emissions than the gas heater.

Water heating

A gas instantaneous water heater is located at the rear of the house.

Lighting and daylighting

Natural daylighting levels are high in the new section.

The house is lit at night in three ways. In the main rooms fluorescent and incandescent uplighting reflects off the ceiling, turning the whole ceiling into a diffused light source.

Down lights are used in the work areas, garden, kitchen and corridors.

Task specific lighting is used in the study, bedroom and living areas.

Energy and appliances

The house is connected to the electricity grid and natural gas.

All new appliances are 5 star rated.

WATER USE

Rainwater: Provision was made for a rainwater tank to be connected to new gutters for drinking and garden water.

Wastewater: Sewer connected.

AAA rated showerheads are fitted and basins and sinks have aerators to reduce consumption.

The WC is a dual flush system.

EVALUATION

Overall, the house works extremely well. It is warm in winter and cool in summer. The courtyard design is ideally suited to the lifestyle of the occupants in Sydney's benign climate.

The upper level windows provide deep sun penetration on winter days but are a source of heat loss during winter nights. Insulating glass units and/or tight fitting drapes with pelmets would overcome this problem but are not currently fitted.

East and west facing doors in the dining area allow heat loss in winter and are inadequately shaded for summer conditions. Summer heat gains could be eliminated by fitting removable, adjustable shading, such as sails.

PROJECT DETAILS	
Architect	Tone Wheeler, Environa Studio.

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