medium density

Adelaide

This case study shows how a mixed density community housing project addressed the lifestyle and environmental impact features listed below within a modest budget. These homes, like other case studies, cost less to run whilst providing year round thermal comfort and a healthier environment for the occupants.

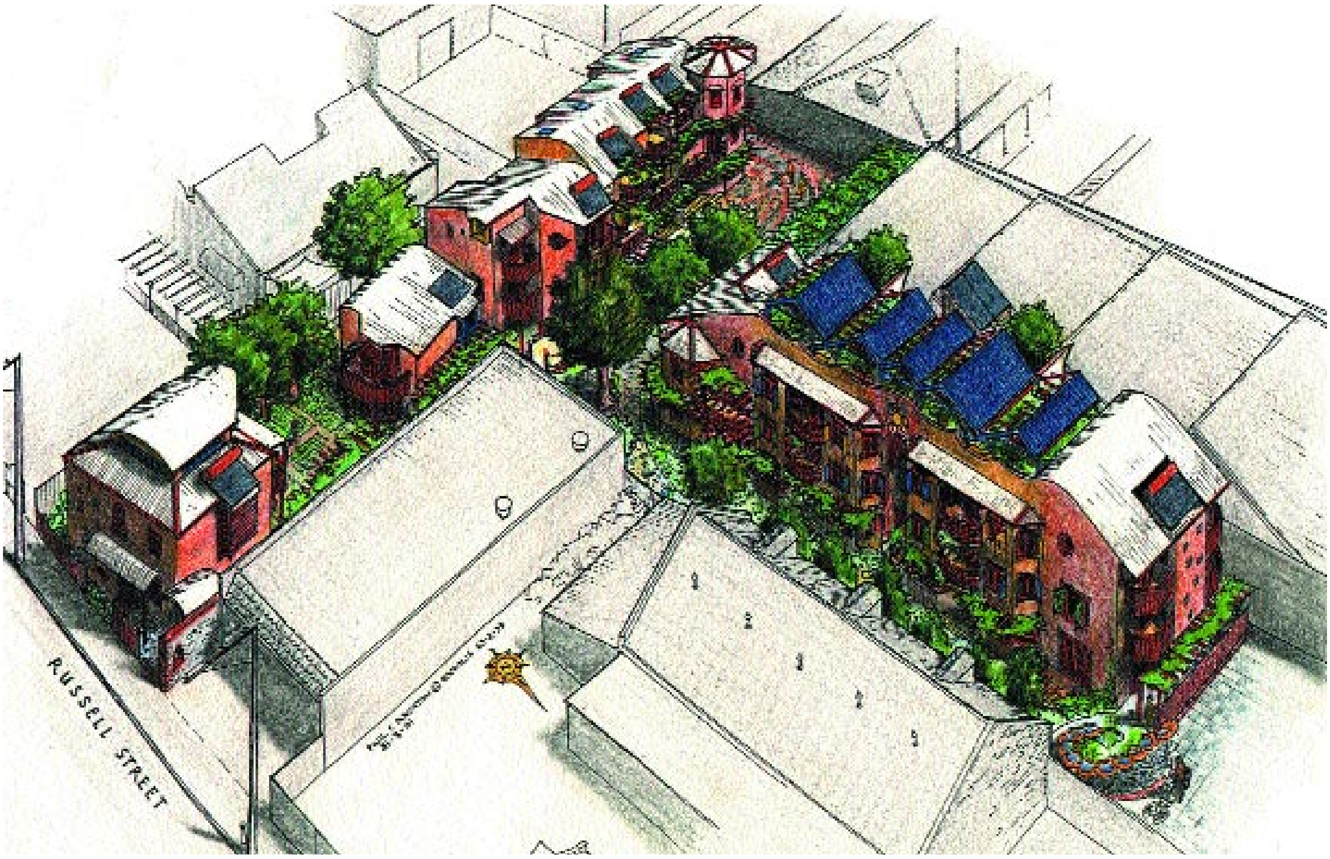
Building Type:	Mixed density housing Mixed construction
Climate:	Cool temperate South Australia
Topics Covered	Success Level
Passive design	Excellent
Lifestyle modification	Excellent
Rainwater harvesting	Very Good
Waste reduction	Very Good
Wastewater recyc.(proposed)	Very Good
Greenhouse gas reductions	Excellent
Indoor Air Quality	Excellent
Reducing transport impacts	Very Good
Embodied Energy reduction	Very Good
Renewable Energy production	Very Good
Food Production	Good
HERS Rating (estimated)	★★★★★

This Study is of 14 dwellings that include linked three-storey townhouses with full solar orientation, a three storey block of six apartments with east-west orientation coupled to three-storey townhouses, two stand-alone two-storey cottages and a 'community house'.

The project was designed for a group of clients represented by a development cooperative, Wirranendi Inc., and created by the non-profit educational association, Urban Ecology Australia Inc. The purpose of the cooperative is to create community-based projects that maximise environmental performance and energy efficiency. The cooperative structure provides a means for people to build for themselves in urban environments where single house blocks are rarely available. The clients included first-time home buyers, investment purchasers, experienced home owners seeking the advantages of an urban lifestyle and older people wanting to retire in an active, mixed community.

With reduced car park provision and no internal traffic, the site was developed to take advantage of its inner-urban location in walking distance of Adelaide's Central Market and public transport services.

The project is on a T-shaped site the size of two quarter-acre blocks in inner-city Adelaide, South Australia. The site is small, awkwardly shaped and severely constrained, with buildings hard on or close to most of the boundaries. The constraints of the site made it impossible to provide all the buildings with ideal passive solar orientation.



Adelaide's climate is 'Mediterranean' with warm to hot summers and cool winters. It is subject to 'cool changes' when temperatures can plummet from the high 30s to low 20s in less than an hour. Although the City of Adelaide rarely experiences freezing temperatures it can feel very cold. Buildings need insulation to keep heat in during cold weather and keep heat out in hot weather.

The land was owned by the Wirranendi development cooperative during construction and individual properties were then sold on a community title. Each purchaser owns their own dwelling but also shares ownership and responsibility for the landscaped community areas. These include a community garden, and a community house with a kitchen, a laundry and a small, general purpose hall for parties that won't fit in small apartments.

House prices include all the community areas and facilities and range from $120,000 to $350,000. The non-profit structure of the development cooperative and building company played an essential role in keeping house prices in a range comparable to conventional inner-city properties in Adelaide.

DESIGN BACKGROUND

The brief demanded energy efficiency and high overall ecological performance. User participation in the development process and an ethical investment funding base was also important. It was intended to demonstrate and trial both the problems and possibilities of ecological, 'community-driven' development on urban sites.

Concerns ranged from broader issues of community participation to the detail of specifying materials to create non-toxic, healthy homes.

The site was purchased cheaply and this helped to keep development costs down, but because the buildings are relatively innovative and possess exceptional levels of insulation, etc., they each cost a little more. An individualised approach to each dwelling design also added costs.

The structure of the first completed building, a straw bale cottage, was built by volunteer labour. This helped reduce 'start up' costs in the building program. Most of the construction has been via a conventional building contract augmented by volunteer labour. The timeline for the development was stretched by a series of unforseen circumstances but the relatively low percentage rate of much of the ethical investment funding assisted the cooperative to withstand resulting financial pressures. The building program for the townhouses was about 20 percent longer than for conventional construction.

STRATEGY

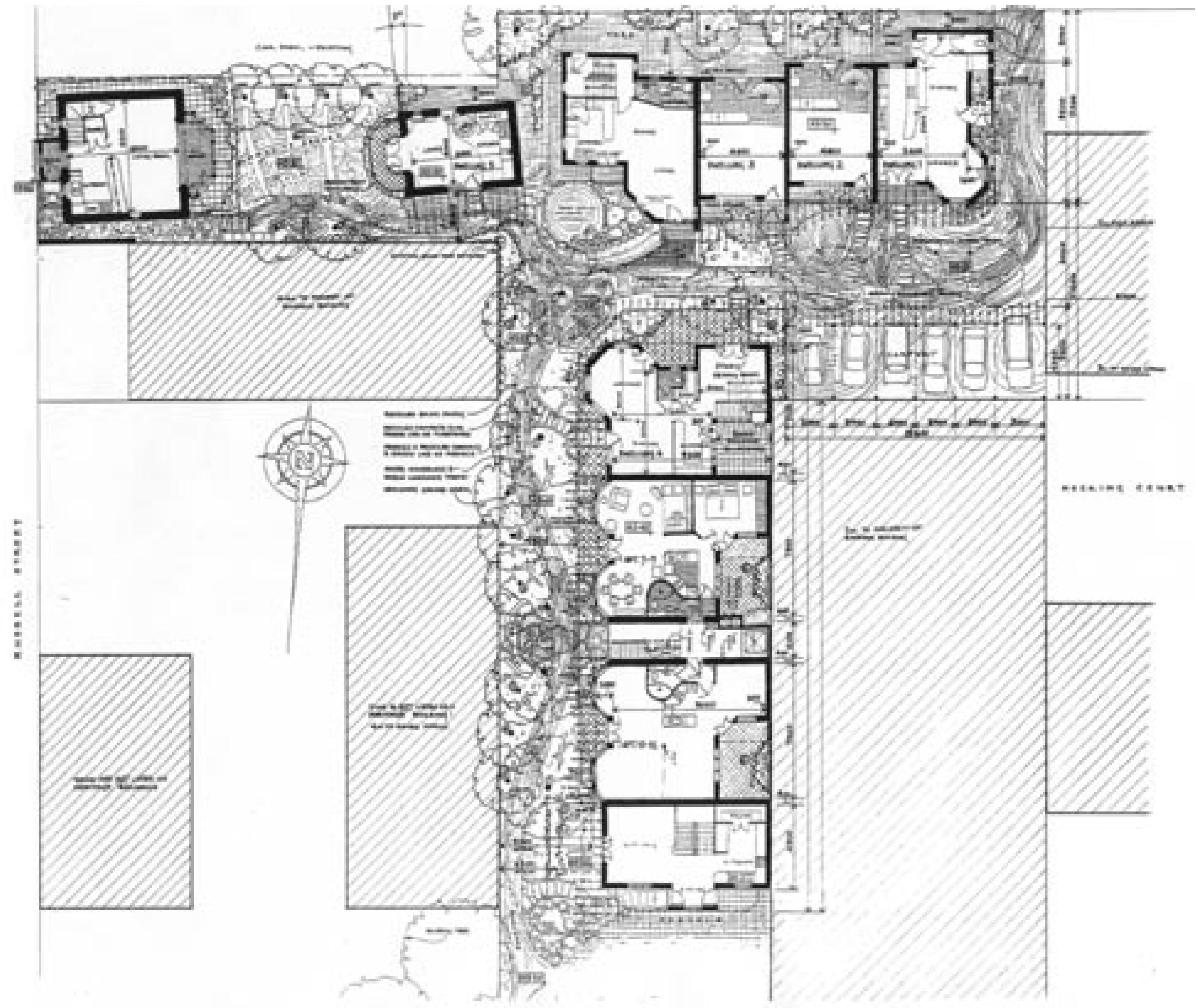
The overall strategy was to use high internal mass within highly insulated envelopes with multiple user-controlled ventilation options and thermal flues. Vegetation and outdoor spaces were included as an integral part of the passive house design approach. Smaller house plan areas were favoured with quality of space more important than mere quantity. This is most clearly demonstrated in the first cottage built on the site, a two-storey, two bedroom straw bale house of just 55 square metres.

A range of dwelling types are represented in the project with differing configurations, orientations and construction systems that demonstrate the effectiveness of environmental design for various conditions and lifestyles.

The 2 and 3 storey cottages are detached structures but the 3 storey townhouses are linked. The 3 storey apartment building is also linked to townhouses, set like bookends on its north and south ends. Solar control for the cottages and the apartments with their southern adjoining townhouse is limited to controlling east/west sun penetration. The other dwellings have ideal solar orientation. Solar access angles dictated building heights and form within the site. Solar access to the neighbouring childcare centre was protected by careful design of roof profiles.

Plan and orientation: Each dwelling was individually designed but also planned to fit with its neighbours to create an urban environment of secluded gardens. Balancing privacy with shared community space was a requirement addressed by the creation of an internal pedestrian street based on the theme of a walled garden.

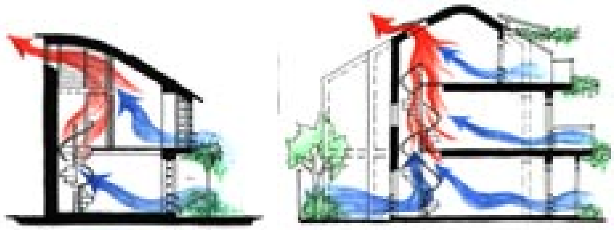
Shell fabric: Construction includes 300mm thick load-bearing autoclaved, aerated concrete (Thermalite) for all external walls on the apartments and townhouses. 400mm



load-bearing, low-strength concrete ('earthcrete') was used for the internal mass party walls between townhouses. There is some steel framing in the apartment building construction and these have reinforced concrete slabs on all floors. Timber-framed load-bearing, rendered 500mm straw bale walls were used for the cottages.

Pinus radiata proprietary trussed joists are used in the townhouses with plantation pinus or recycled timbers for joists in the cottages. Floor decking is generally Ecopanel, a compressed straw equivalent to particle board, containing no woodchips or formaldehyde. Unfortunately, the Australian company that made the sheets no longer operates and any equivalent product would now have to be imported.

All the buildings are set on stiff reinforced concrete slabs designed to resist the effects of Adelaide's notoriously unstable clay soils. The high volume of material content of the slabs was necessary to carry the townhouses and apartments and is justified by the small building footprints and their long life span.



Each house works as a 'thermal flue' allowing controlled release of warm air whilst drawing in filtered, cooled air from the vegetated, landscaped surroundings. In a real sense, the development is not complete until the accompanying landscaping is complete. The apartments rely on good cross-ventilation and high thermal mass for cooling with the roof garden adding a thermal buffer to the upper floor apartments.

The planned life of the buildings is in excess of 100 years. During this time the shells – made from mined materials – are expected to remain much the same but internal partitions, doors and windows – made mostly from renewable materials – may be changed.

Thermal mass: The concrete slabs provide substantial internal mass, particularly to the cottages and apartments. With no freezing days, perimeter insulation of the slabs was not regarded as necessary. The 'earthcrete' walls place additional thermal mass between the townhouses and assist in noise reduction between dwellings. The cost and logistical problems associated with poured concrete technology prompted a change to thick masonry walls in the apartment and townhouse buildings.

Ventilation: Good ventilation is critical to the performance of these buildings. Fresh air is filtered and cooled by surrounding vegetation and landscaping and drawn through the dwellings by convection. Many opening windows are small, top-hung and set low in sets of two or three to draw in the low lying cooler air. Purpose designed vents, high level louvres, or ventable skylights exhaust warm air at the top of the dwellings. They create outlets for the thermal flues formed by the stairwells of each dwelling.

Windows and glazing: Windows are all purpose-made from recycled timber with aluminium flyscreens, justified on the basis of long life, low maintenance and almost 100 percent recyclability.

All fixed windows are double-glazed. Opening windows are single glazed because they are expected to be open most of the year and only lose a small amount of heat during cold periods. Sealed units are used throughout except for double timber beaded double glazing to the 2 storey cottage.

Materials: Non-toxic construction and finishes are used throughout, avoiding formaldehyde and PVC. Timbers are plantation Pinus radiata or recycled (typically, oregon). The environmental plus cost criteria for materials led to unexpected choices with aesthetic benefits, eg. purpose-built spiral stairs in steel and recycled jarrah.

All concrete in slabs and mass walls contains the maximum percentage of flyash that the engineers and suppliers (Pioneer Concrete) would allow. Flyash is a waste product from power stations and its use reduced the amount of new cement used in the construction. Cement production is one of the largest contributors to global greenhouse gas emissions.

Insulation: Insulation is provided to the townhouses and apartments by 300mm Thermalite walls. 450mm straw bales insulate the cottages. A basement in one of the townhouses is insulated by earth berming and provides additional 'coolth' to that dwelling. Ceilings generally follow the roof-lines and are insulated with reflective foil sarking and 200mm Tontine polyester batts, which contain a high percentage of recycled PEP plastic. The preferred option of cellulose fibre (recycled paper) insulation was not appropriate due to the sloping ceilings.

Floorings and finishes: Flooring throughout is generally Marmoleum by Forbo, a modern variant of linoleum that was selected on its aesthetic merit and environmental credentials. It consistently tops the list of 'green' proprietary flooring materials in studies around the world and allows a rich design palette of colour and pattern. Wet areas are tiled with ceramic tiles with local products preferred. Some clients, including the owner of the first straw bale cottage, chose bamboo flooring in some areas. This attractive and environmentally promising material is currently only available as an imported product but Australian plantations and production are imminent.

All finishes are chosen on the basis of environmental and non-toxic criteria. Paints, varnishes and stains are all by BioProducts, produced in Bridgewater, SA under license from a German company.

Lighting: Considerable effort was made to ensure naturally well-lit rooms and spaces. Light fittings are conventional, with a mixture of compact fluorescent and incandescent globes.

Heating and cooling systems: Some ceiling fans are included to assist in maintaining air flow on still days, but there are no heaters or air-conditioners and the expectation is that none will be needed to supplement the passive heating and cooling of the houses.

Stormwater: All water shed by the roofs, balconies and other impervious surfaces is collected for use on site in two 20,000 litre underground tanks situated beneath the carports. After filtering, the water is used for irrigation and toilet flushing, thus reducing total water importation to the site.

Greywater & Blackwater: Chlorine-free sewage treatment is planned. Composted solids will be taken to rural sites as fertiliser every few years whilst the filtered effluent will be returned to the second-class water supply through the on-site stormwater system.

Hotwater and fittings: All dwellings have solar hot water with electrical backup heating – gas backup was not practical for multi-storey use. The apartments have a shared system with banked solar panels and a single pump and backup heater. Low water use shower heads and in-line flow restrictors control the water supply. Under bench filters provide drinking water at low flow rates.

Energy supply: Mains electricity is drawn from the grid but photovoltaic panels set on pergolas over the apartments' roof garden will generate electricity for sale to the local energy utility. The expectation is that the site will export energy for much of the year because the dwellings require little energy for space and water heating, cooling or lighting.

Major appliances: AEG was the preferred supplier for the project and all new appliances have high energy efficiency ratings. Companies with a recycling program were favoured when specifying appliances. 5 of the dwellings have gas cooktops, all dwellings have high efficiency electric ovens. Gas was initially favoured for its energy efficiency but the improved efficiency of electric cookers and concerns regarding indoor air quality led to the developer specifying electric-only appliances in the latter stages of the project.

Site impact: The site was occupied for predominantly commercial and some residential use prior to redevelopment. The overall site impact might be regarded as positive as the project will be retaining all stormwater on-site and there will be considerably more productive and vegetated landscape after redevelopment than before.

Landscaping: Native and indigenous species and plants with low water requirements were used. Some exotics were used where appropriate to suit passive design considerations (the largest tree will be a deciduous Jacaranda). Exotics and productive food plants are supported by on-site water recycling that maintains minimal overall water consumption.

Waste minimisation: Paving, carports and feature elements incorporate bricks, stone, steel and timber retrieved from demolition of pre-existing structures on the site.

Noise control: The highly insulated external skins, double glazed windows and massive party walls make this a much better acoustic environment than might be expected in a dense urban setting. The passive cooling strategy requires windows to be open much of the time but the baffling effect of vegetation and absence of hard road surfaces contribute to relatively good noise control.

Transport and food: Reduction of transport demand and provision of food production capability were part of the strategy for this project. The site's location within walking distance of good public transport meant fewer cars were needed so Council planners supported a lower than usual car park provision, initially 10 spaces for thirteen 2 or 3 bedroom dwellings. Despite extreme site limitations it was possible to include a small community garden to demonstrate that even the tightest urban site can produce food.

EVALUATION

There were no major problems obtaining development and building approvals and the development process was very flexible. During construction, one of the most active people involved in the project died. This meant that, for his partner to stay in the project, rapid and substantial redesign was achieved to reduce the size of that dwelling. The non-profit development structure, ethical investment base and community involvement enabled this experimental project to proceed and withstand delays and personal tragedies. It survived where a conventional development would probably have been abandoned or changed beyond recognition.

The 'earthcrete' wall was difficult to construct and cost more than anticipated. As an attempt to provide affordable high-mass construction and as an alternative to rammed earth, it is moderately successful.

The building designs are yet to be proven through occupation and use over more than a few months but the signs are that they will be successful. There is a tremendous sense of ownership and understanding about the designs that both reflects and reinforces the community basis of the development approach. People have been able to purchase much more than just a house in the city.

The community house is an important part of the project as a community meeting place that also includes a laundry, which was essential for building approval of apartments with no individual laundries. Its construction was contingent on a voluntary self-build, cooperative approach that may not be easy to replicate in all situations. This would be reflected in overall purchase prices for any comparable development.

The use of recycled material and the requirement that residents lay the external paving may result in a creative, attractive environment. Any project not able to tap the same level of commitment and goodwill from its clients would be more expensive.

Rigorous cost planning requires good information that was not available the first time around but details and costs associated with the innovative approaches to construction and design have now been tested and refined. It is now much easier to predict programming and costing for future developments.

More financial resources would make it possible to accelerate the development process so that it was competitive with conventional development. It would assist in maintaining the active engagement of a wider community with the design and development program. More time would make community engagement more effective and easier to maintain.

All clients have so far expressed satisfaction with both the processes and results.

DESIGN TEAM	
Architecture and Urban Design	Ecopolis Pty Ltd.
Project Architect	Paul F Downton.
Project Manager	Wirranendi Inc. (Ed Wilby)
Structural & Mechanical Engineer	Sagero Consulting, Adelaide.
Builder	EcoCity Developments Pty Ltd, with sub-contractors.
Community processes	Urban Ecology Australia Inc.
Landscaping	Ecopolis (Chérie Hoyle) with Jacqui Hunter.
Documentation architects	ADS Architects, Adelaide.