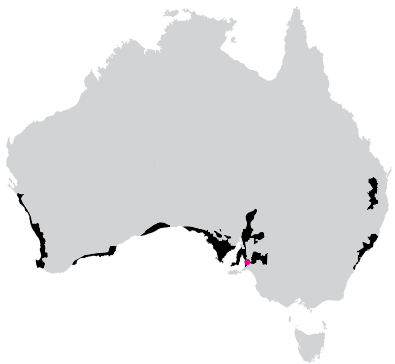
City of Adelaide SA

HIGH DENSITY

ZONE 5: Warm temperate



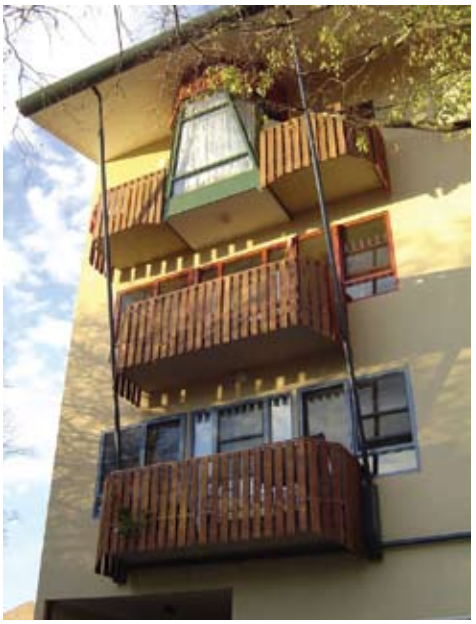
Topics covered	
Passive design	
Rainwater harvesting	
Greywater use	
Renewable energy production	
Greenhouse gas reductions	
AccuRate (thermal comfort)	6.8 (full rating)

This study is of 13 apartments and community facilities in a 5 storey building on Sturt Street in the City of Adelaide. The apartments were opened in January 2007 and are the third and final stage of the Christie Walk development built for the non-profit cooperative Wirranendi Inc. They were designed to be energy and water efficient with a practical, healthy environment, and built to a budget to make them competitive with standard apartments with prices that ranged from $280,000 to $460,000 (in 2006) and included all community areas and facilities. Designed to accommodate up to 28 people, in 2007 its 18 residents ranged from retired individuals to families with young children.

LOCATION AND CLIMATE

The site is within easy walking distance of Adelaide's Central Markets, park lands and CBD, hence car use is minimised. Negotiation with the city council allowed for the provision of just 11 car parking spaces to cater for the needs of the 27 dwellings in the total Christie Walk development with no car spaces at all provided to service this building. [See: 2.2 Choosing a Site; 2.3 Streetscape]

The climate is 'Temperate' with warm to hot summers and cool winters. 'Cool changes' can see temperatures plummet from the high 30s to low 20s (degrees Celcius) 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. [See: 4.2 Design for Climate]



DESIGN

The building faces north and has a more or less square footprint of 260m^2 being about 16m on each side.

The ground floor comprises one apartment, an information centre operated by Urban Ecology Australia Inc., a central, naturally lit and ventilated lobby, and community facilities including; a laundry, common room and library, kitchen and toilets. These facilities are designed for the use of the whole Christie Walk development which includes 14 other dwellings as well as these apartments.

The first, second and third floors each contain 4 apartments, one in each corner of the building. The narrow site and high density of the

development limited options for solar orientation. The apartments surround a stairwell and lift shaft situated at the centre of the building. There is a fourth floor (fifth level) on the southern half of the building which contains the upper levels of penthouse apartments 12 and 13. Apartments 1 to 9 are all approximately the same in area (52m^2 excluding balconies) and consist of 2 bedrooms or 1 bedroom and a study, plus a living/dining/kitchen area and bathroom. They also have balconies facing outwards from the north or south side of the apartment. Apartments 10 and 11 which face north on the 3rd floor have slightly larger second bedrooms which cantilever out to the depth of the balcony.

Apartments 12 and 13 are on two levels and consist of 1 large bedroom plus a living/dining/kitchen area and bathroom on the lower level with a second bedroom, study and additional bathroom on the upper level.

Each apartment is personalised according to the owner's preferences and is slightly different in layout from the others. The interior walls in the apartments are deliberately made easy to shift so that the layout can be changed if required and consideration has been given to disabled access. [See: 3.2 The Adaptable House]

BUILDING STRUCTURE

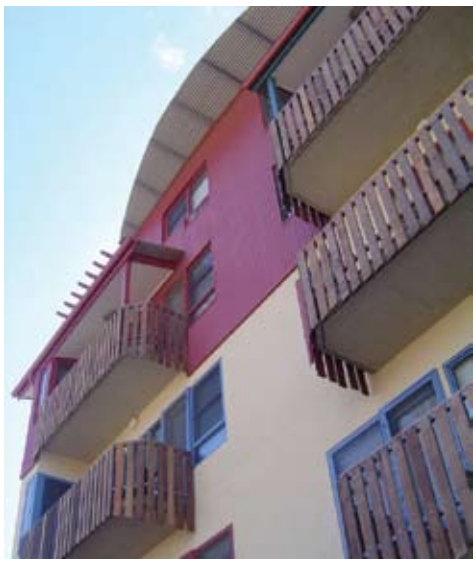
Materials

The apartments are built on a concrete pad with exterior walls of 150mm autoclaved aerated concrete (AAC) blockwork and insulated studwork linings finished with 10mm plasterboard. The roof is steel decking. Steel sheet cladding is used on the upper penthouse levels on insulated steel framing and extends on the south wall of the apartments over the top of the AAC blockwork down to the third floor level.

The interior party walls between apartments are AAC with insulated studwork and plasterboard linings, whilst the interior walls within apartments are plasterboard with polyester acoustic insulation on steel studs. [See: 5.11 Autoclaved Aerated Concrete (AAC)]

The lift shaft and stairwell and an east-west party wall are made from precast concrete for structural strength and thermal mass. Exterior doors to the apartments are solid and fire proof, with timber facing whilst interior doors are solid plantation pinus. The concrete balconies have steel framed balustrades with recycled timber balusters. The floors are concrete slab with insulated suspended ceilings. In the apartments the floors are covered with linoleum or tiles selected by the owners.

There was little opportunity to use recycled materials in the structure except for the capping and columns on the ground floor verandah which were salvaged from the original house on the block and the recycled timber handrails.



Insulation

The steel roof sheets are laid on reflective foil sisalation and insulated with R3 polyester batts; this is extended on the south facing wall down to the bottom of the 3rd floor. The exterior walls of AAC have R1.5 polyester batts with foil backed plasterboard linings. The interior party walls and walls within apartments have acoustic insulation. The floors on the first floor apartments directly above the driveway have R3.5 insulation. The doors to the balconies have seals for draught and waterproofing. [See: 4.7 Insulation]

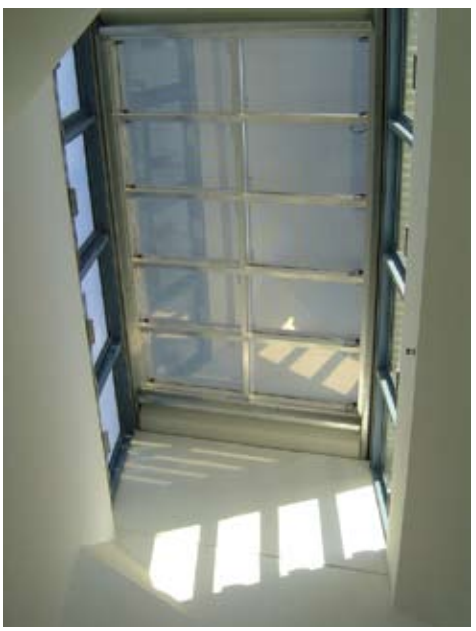
Heating

The apartments were first occupied in December 2006 and at the time of this study had not been through a full winter. They are not supplied with supplementary heating, however up until the end of May most residents have found the passive heating and insulation sufficiently effective to keep the apartments at a comfortable temperature. As an example, the minimum temperature in one of the north facing apartments was found to be approximately 20ºC after an outside, overnight minimum of 11ºC. The exception to this is the ground floor apartment where solar access is reduced by a verandah on the north facing wall and some additional heating is required in winter. (See: 6.2 Heating and Cooling)

Cooling and ventilation

Cooling is provided by two common evaporative cooling systems mounted in the east and west sections of the roof lantern structure which are ducted to each of the apartments. The cooling in each apartment is independently controlled by switching dampers in the ducting. The system then adjusts its fan speed depending on the demand. Internal ventilation is assisted by glazed louvres over the internal doors between the bedrooms and living areas and external sliding, sash windows. Ceiling fans in the living areas assist with the air flow.

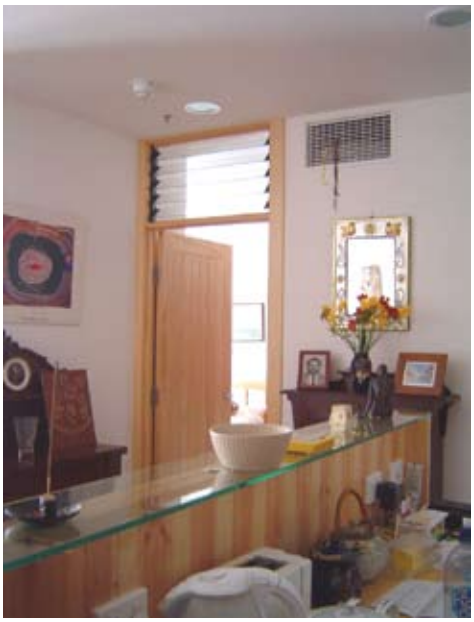
The windows in the lantern above the stairwell are opened automatically to increase ventilation through the core of the building when the temperature exceeds 29ºC and closed to retain warmth when the temperature drops below 25ºC. [See: 6.2 Heating and Cooling]



Lighting

All lights in the building are compact fluorescent with lights in the foyer and stairwell being activated by movement and light level sensors. [See: 6.3 Lighting]

Covered with a semi-transparent layer of built-in photovoltaic cells, the roof lantern above the stairwell provides good natural light during daylight hours. [See: 4.11 Skylights]



Inside the apartments every living space is designed to have direct external light access and the glazed louvres over the doors to the bedrooms and bathroom allow the penetration of some additional natural light.

The north facing apartments on the third floor have additional features including a double glazed skylight in the kitchen area which can be opened to assist with ventilation. The second bedrooms which are extended to the level of the balcony, have a large north facing window which slopes inwards from the top to allow in winter but not summer sun.

Daylight penetration into the living areas of the south facing apartments is assisted by the bay window projections that extend to the depth of the balconies and allow light to enter the rooms through windows facing onto the balcony in an easterly or westerly direction.

The ground floor apartment although facing north has a verandah over the windows and is relatively dark. It is provided with small round clerestory windows in the living and bedroom areas for additional light.

Windows and glazing

All the windows and glass doors have sealed double glazing with untreated clear glass and a 10mm air gap with aluminium frames. The windows on the north facing side are shaded throughout the summer by the very deep eaves of the building and the balconies of the floor above. The window coverings are at the discretion of the individual owners but in most cases retractable double sided shades have been installed for privacy. [See: 4.10 Glazing]

Air quality

A healthy environment is maintained by using low volatile organic compound (VOC) paints and varnishes on interior surfaces. Floor coverings are tiles or linoleum. The interior doors and cupboard doors and skirtings are plantation pinus and the interiors of cupboards are all made from accredited low VOC particle board.

WATER

Hot water

Hot water for all the apartments is piped from communal heat pumps located on the roof of the building. This works like a reverse cycle air conditioner and pumps heat into the water from the atmosphere. The energy consumption of this is included in the total community electricity bill and is supposed to be at a similar level to solar heating but it has not yet been itemized. [See: 6.5 Hot Water Service]

Rainwater harvesting

Rain water from the roof of the apartment is collected, along with rainwater from the rest of Christie Walk, in two 20,000L tanks that were installed under one of the car park/courtyard spaces during the earlier stages of the development. This water is plumbed into stages 1 and 2 of the development for use in the toilets and for irrigating the gardens around the site. The tanks are automatically topped up with mains water. [See: 7.3 Rainwater; 7.5 Stormwater]

Grey and black water

It was planned that by the end of 2007, grey and black water would be taken from the all of the Christie Walk dwellings to an organic composting system located underground at the rear of the building. The outflow from this system would be run to nearby Whitmore Square for irrigation. Although strongly supported by the Christie Walk community and Adelaide City Council, delivery of this innovative cross-sectoral infrastructure provision remains dependent on sponsorship by the SA Water utility.

Appliances

Other than the ovens and cooktops, appliances are chosen by the owners of the individual apartments. Gas is not supplied so all appliances are electric and generally chosen for their energy efficiency. Low water use shower heads are installed in the bathrooms. There is a community laundry on the ground floor of the building which is used by most residents. [See: 6.4 Appliances]

The one lift for the apartments was chosen for its energy efficiency.

Occupant behaviour

The residents of the whole Christie Walk development have formed a supportive community which works together on the gardens and grounds and offers a resource for the exchange of information on energy and water saving initiatives including regular site tours. [See: 2.3 Streetscape]

Energy use and generation

A 5kW grid connected photovoltaic (PV) system is installed on the north facing roof of the building which is inclined at 15º to the horizontal to optimize the solar output in summer. The cells are amorphous (thin film) silicon and produced approximately 3450kWh in their first five months of operation. This is approximately 22kWh/day which is about the expected figure in Adelaide.

A second PV system is integrated into the glazing of the lantern above the stairwell. The thin film cells are spaced onto the glass so that approximately 10 per cent of the incident daylight is transmitted down into the stairwell. This system consists of 10 panels which generate 300W and is the first of its type in South Australia. The modules also have a low heat transfer coefficient to minimise heat transfer into and out of the building through the lantern.

Electricity generated by these systems is first used in the building and any excess exported to the grid. [See: 6.7 Photovoltaic Systems]

The community facilities which include the community room, laundry, air conditioning, lift and hot water system and lighting in the stairwell are metered separately and the bill shared between the residents. The consumption over the first five months including the power taken from the PV systems was approximately 12,500kWh or 81 kWh/day. This was higher than expected because of teething problems with the air conditioning system which had been running for significant periods even when not required. After the air conditioning system was turned off at the end of April, daily communal electricity consumption dropped to approximately 54kWh/day.

To date only one set of electricity bills has been received and these have given consumption figures for individual apartments that range from 2.5 to 8kWh/day, with 10 of the apartments using less than 5kWh/day. This illustrates how important occupant behaviour is in determining the energy consumption. The reasons for the high consumption figures in some of the apartments are being investigated and are possibly due to large or inefficient refrigerators.

The total energy use for the apartments during the early commissioning period averaged out at between 6.7 and 12kWh/day depending on occupant behaviour; this is low to average for an Adelaide apartment.

Garden

There are community gardens including a roof garden which is part of the original development. These include indigenous and native shrubs and trees, some exotics to suit the passive design considerations and a produce garden with herbs, vegetables and fruit trees. These plants are watered from the rainwater system with very little need for additional water. [See: 2.4 Sustainable Landscapes]

EVALUATION

At the time of this study the building had been fully occupied for approximately five months and the residents so far had been very happy with the comfort of the building. As with any new building there have been some initial teething problems; these include difficulty in adjusting when and for how long the sensor lights come on in community areas, and possible difficulty with the air conditioning system which has no readily accessible manual override and has run when not required. These problems were being investigated with the expectation that they would be corrected by the end of 2007.

PROJECT DETAILS	
Architecture and Urban Design:	Ecopolis Architects
Project Architect	Paul F Downton
Structural and Mechanical Engineer:	Dare Sutton Clarke
Builder:	Tagara Builders
Services Engineers:	Lincolne Scott
Developer:	Christie Walk Joint Venture (Wirranendi Inc in association and EcoCity Pty Ltd)

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