August 2006 • Cas 40 (Edited 29.09.2018)
This note was reviewed and approved for currency in September 2018

Clovelly House, East Sydney, New South Wales

Jason Veale

Sydney is not short of terraces and semis that have been completely reworked with a modernist treatment. They are filled with light, planned for contemporary living on small sites and are generally great for dinner parties. However, they are not always comfortable or sustainable. The award winning Clovelly House shows that contemporary design can be seamlessly integrated with benchmark sustainable design and an innovative approach to accessibility.

1.0 Project Outline

1.1 Project Details

Architects

Kennedy Associates Architects – Steve Kennedy, Simon Anderson, Erin Owens

Environmental Engineer

ENVDS – Environmental Design and Solutions Pty Ltd – Toby Gray

Builder

All Time Construction Pty Ltd – Grant Jefford

Year of Completion

2004

Project type

Two-storey, semi-detached terrace in east Sydney

Site Area

234m²

Construction Costs

Construction costs were similar to other contemporary renovations in Sydney's eastern suburbs. The 'Sun Lizard' added approximately $2,500 and additional costs associated with water reuse and treatment were approximately $20,000.

Location and Climate

The house is located in Sydney's eastern suburbs approximately 700m from the coast at Clovelly Bay. This proximity to the ocean results in relatively mild winters, and warm summers which are moderated by cooling sea breezes. The coast of Sydney receives approximately 1200mm of rainfall compared to the Sydney average rainfall of 1094mm. The Building Code of Australia classification for this climate type is BCA Zone 5 (warm temperate).

The site is 39m x 6m running east-west with the rear to the west. The dwelling to the north is a two-storey terrace extending to just over half the length of the northern boundary.

2.0 Project Brief

One of the clients uses a wheelchair for mobility and therefore accessibility and the ability to monitor the dwelling with minimal movement was a key component of the brief.

The clients were keen to save water and energy; however it was crucial that the strategies be elegantly integrated into a modern building. The brief included popular inner-city requests such as opening up the rear of the home to the yard, making the house full of light and improving ventilation, while maintaining visual and acoustic privacy.

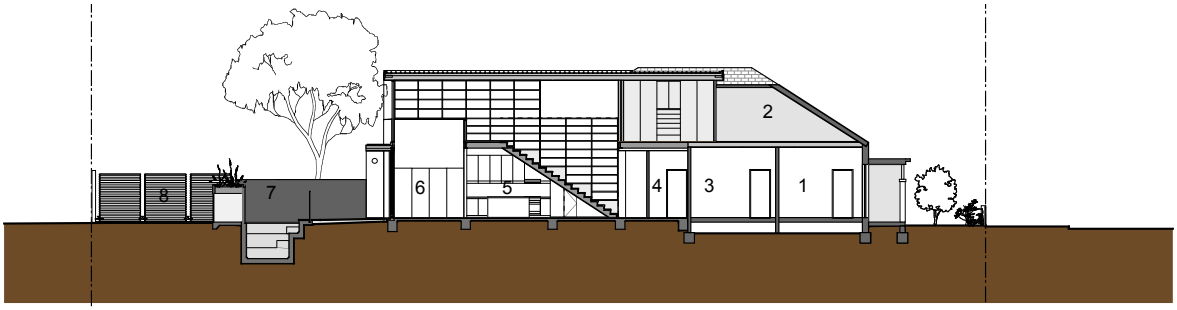
The existing two bedrooms at ground level were to be retained with the rear remodelled to include living, kitchen, study/library and a new bedroom.

Figure 1. Clovelly House

3.0 Building Design

The design retains the front portion of the house and remodels the rear with a first floor addition at the rear. A study and library on the first floor are arranged around a two-storey void with the kitchen and living spaces on the ground floor.

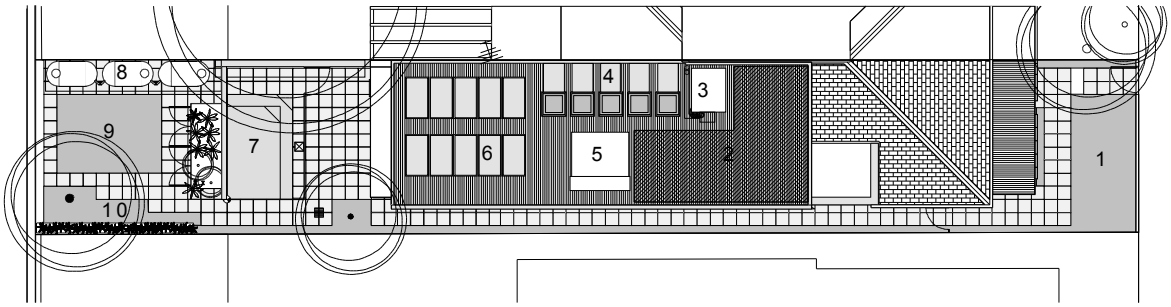
These spaces flow out to the courtyard, which is further divided into two sections around a therapeutic pool and garden area/rear parking space. The strong modernist geometry defines spatial relationships clearly and tends to increase the sense of space by avoiding clutter or finicky details. The void and immediate courtyard become almost one space with the low wall behind the pool subtly extending the views to the garden space beyond.



Site section

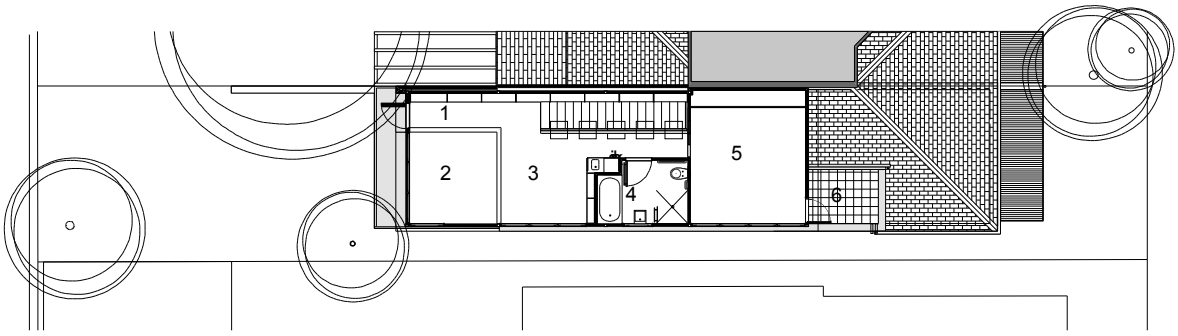
1. Bedroom 1
2. Bedroom 2
3. Bedroom 3
4. Bathroom 2
5. Living/kitchen
6. Laundry
7. Pool
8. Rainwater tanks

Figure 2. Site Section



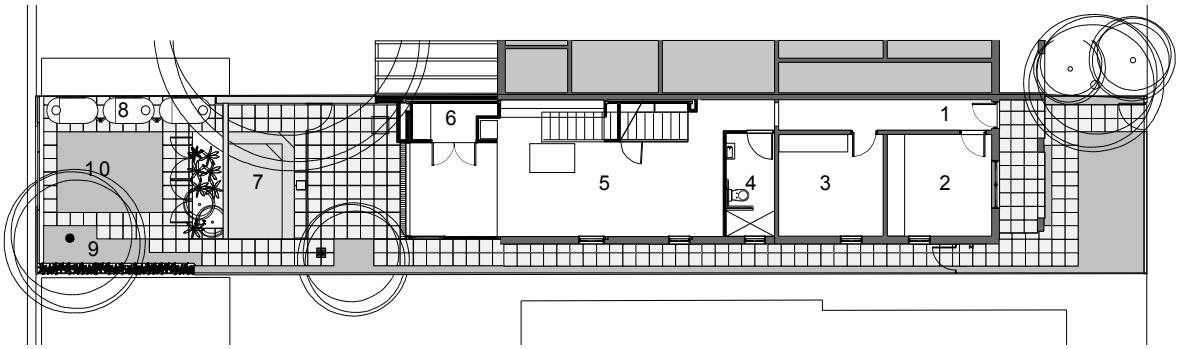
Roof plan

1. Stormwater infiltration zone
2. Solar poolheating
3. Skylights
4. 'Sun Lizard' solar space heater
5. Solar water heater
6. Future solar array
7. Pool
8. 9000L rainwater tanks
9. Stormwater absorbtion
10. 'Greenwall' grey wall treatment



First floor plan

1. Library
2. Void
3. Study
4. Bathroom
5. Master bedroom
6. Deck



Ground floor plan

1. Entry
2. Bedroom 2
3. Bedroom 3
4. Bathroom 2
5. Living/kitchen
6. Laundry
7. Pool
8. Rainwater tanks
9. Stormwater absorption
10. Parking/stormwater absorption

Figure 3. Roof, First Floor, Ground Floor Plans

Diagonal sight lines are used to increase the sense of space on a small site. This tends to also enhance cross ventilation and improve daylight access to the deeper parts of the house away from windows.

Randwick Council approval for the design was relatively straightforward given the design's respect for urban issues of privacy, scale and spatial planning.

After some initial problems with obtaining Sydney Water approval of the green-wall water treatment system, a senior manager took an interest in the project and it was subsequently approved after being assessed on the merit of the engineering design.

4.0 Construction

The retained portion of the existing semi containing two bedrooms is uninsulated double brick construction with suspended timber floors. These rooms face east and are not over-glazed and are therefore generally cool for comfort on summer nights – the period most people nominate as critical for thermal comfort.

New construction comprises standard systems for many architects. Floors are concrete slab on ground with battened timber floors fixed over. In winter this reduces late afternoon heat storage potential. However, this means that the living spaces, which don't receive winter sun until late in the day, can be warmed up to comfortable condition with less heat being drawn into the slab. In summer, it reduces the ability of the slab to keep temperatures lower through the early to mid part of the day. However, given that it receives some direct western sun, it will also cool down quicker than a polished or tiled slab.

New walls are light coloured insulated brick veneer, framed with metal cladding. The upper ceiling is flat under a light coloured 2.5 degree pitched metal roof. Insulation is provided under the roof and above the ceiling to provide adequate heat control. Acoustic insulation around bathrooms is also provided.

5.0 Energy Efficiency

5.1 Thermal Performance

The east-west orientation of the site reduces the potential for northern solar gain. Most of the glass faces west onto the courtyard with some to the south for natural light. Afternoon winter sun floods into the living/kitchen and upstairs study.

Summer sun is protected from the upper western glazing by adjustable external louvres and an overhang provides protection for the lower bi-fold doors until late afternoon.

Voids combined with large glass areas facing west can be problematic for overheating in summer and too hard to heat in winter if not treated carefully. In this house, the size of the void, careful placement of southern clerestory windows, the 'Sun Lizard' drawing out high level heat (refer section 5.3) and the opening of the front door allows cool sea breezes to flush hot air out of the house when it warms up on a hot afternoon.

Figure 4. Void in Rear of House

Figure 5. Rear and Void

An opaque panel on the western wall of the library can be opened to enhance ventilation in the evening once there is no danger of direct solar radiation to the extensive book collection. This solid panel has proved useful in allowing ventilation and light without the higher conductive losses of a window, and is being incorporated into other buildings Kennedy Associates are currently designing.

Figure 6. Interior

Given the regular cooling see breeze on summer afternoons, the ventilation, combined with projection from solar gain, a well insulated fabric and a ceiling fan above the void provides for comfortable conditions most of the time. The capacity to shift large volumes of air throughout the house is very important to providing comfort. The pool provides some additional evaporative cooling by humidifying air (when humidity is low) as it flows into the living space.

Kennedy says the occupants' experience of living in the house suggests they could have had less south facing glass without compromising natural light and some double glazing would have been useful to improve winter performance.

5.2 Daylighting

Provision of natural light in this renovation has completely transformed the dark and damp semi that existed on the site. Despite the challenges of achieving direct gain, the living, kitchen and study receive excellent natural light from west facing windows, clerestory glazing to the south and skylights above the stair.

5.3 Systems and Appliances

Solar gain in winter is supplemented with an innovative 'Sun Lizard' solar air heater located on the roof and angled to receive maximum winter sun. The heater is a flat rectangular box constructed of metal and 'SunPlus' glass (by Pilkington) used for solar air and water heating panels. It measures 1520mm by 1220mm and is180 mm deep.

Air is heated in the panel and recirculated via a solar powered pump down into the living areas. This provides heating to that space well before the sun hits the western glazing. One panel is not a complete heater

Figure 7. 'Sun Lizard' Solar Air Heater

replacement but it lifts temperatures noticeably during the day, even when there is some cloud.

In summer the hot air is vented off and draws up warm air from inside the dwelling through the return air duct. This enhances the cross ventilation through windows and doors, and draws off hot air from the dwelling when there is no breeze. The house has a ceiling fan in the large void and is not air-conditioned.

The 'Sun Lizard' is a commercially available product. One panel was installed in this house as a trial. Generally more than one would be necessary for a dwelling of this size with no north facing glazing and the architects are currently considering one for each bedroom for another project.

A solar hot water system shares the roof space with the 'Sun Lizard'. Low-wattage and compact fluorescent lighting is used throughout the dwelling. The refrigerator was the highest efficiency model available on the market in 2004.

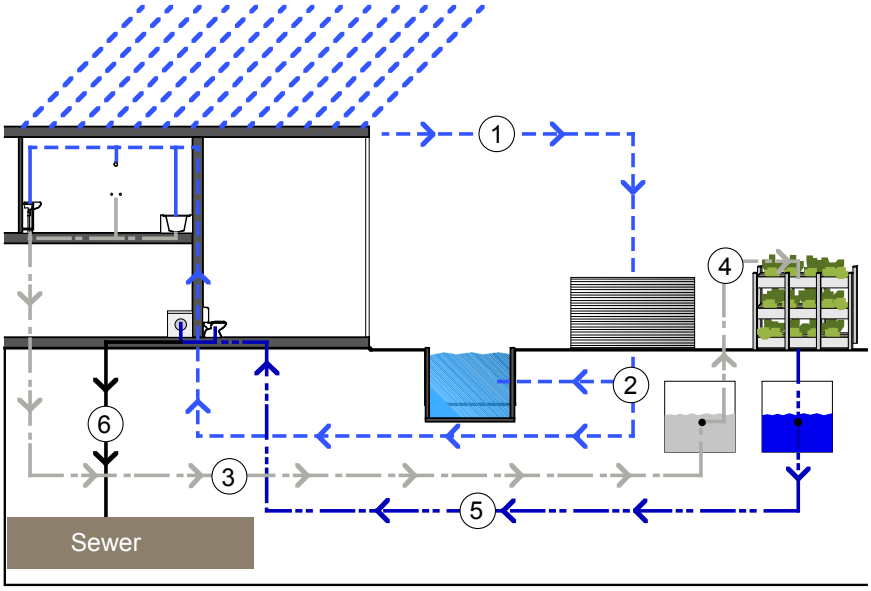
The 7500-L pool, utilised for therapeutic benefits by the client, is solar-only heated.

6.0 Water Collection, Re-use and Treatment

In this project, water collection, re-use and treatment technology goes well beyond simply collecting rainwater for non-potable use. The client was keen to push the boundaries of sustainability for the project and the architect suggested water re-use and recycling was a good place to start.

The systems are carefully designed around the clients', space and water usage in the house. No aspect is larger than necessary and each is an architectural component in addition to its water saving features.

Rainwater is stored in three 3000-L tanks and used for showers, baths, hand-basins, garden taps and the pool.



1 Rainwater collected from 100sqm roof area is directed to 3 x 3 000L storage tanks.

2 Water from tank supplies:
- pool
- shower
- bath
- basin

3 Greywater collected from shower, bath and basin is directed to holding tank 1.

4 Water from holding tank 1 pumped to top of 'greenwall treatment system'.

5 Polished water supplies washing machines & toilets.

6 Blackwater discharged to sewer.

Figure 8. Greywater Cycle

The tanks were made in Queensland to a particular shape so they would form a wall in the rear garden/ parking space. They have an external clear pipe gauge to easily determine the water level. High efficiency taps and showerheads further reduce water use.

Greywater is taken from the hand-basins, shower and bath. It is treated in the green-wall (refer section 6.1) and returned to the washing machine, toilets and garden taps. The system isn't large enough to treat the volume of nutrient laden water that is generated by the washing machine; however, the washing machine is supplied by treated water. Blackwater from the kitchen and toilet are diverted to the sewerage system.

The inclusion of the greywater system has meant the rainwater tank capacity could be reduced while still maintaining high water savings.

A triple-pipe system delivers the rainwater, utility supplied water and treated greywater to the relevant outlets. This is relatively easy when major renovations are being undertaken but difficult to distribute to multiple outlets for minor renovations.

Stormwater overflow from the rainwater tanks is directed to the stormwater system via rear and front absorption tanks.

The first plumber engaged for this project was not initially receptive to this system, and ultimately one of the first 'Green Plumbers' in New South Wales, who was excited by the challenge, was engaged to contract the works.

Figure 9. Backyard includes Swimming Pool, Grey Water Treatment and Watertanks

6.1 Green-Wall

The green-wall forms a lush landscaping wall against the rear garden space. It was designed by Toby Gray, as three galvanised steel planter-boxes stacked above each other to save space and allow water to trickle down from top to bottom.

Gray contacted Kennedy Associates by chance during the project with an idea about a 'green wall'. They instantly knew it was right for the project; however the actual design of the system for this specific project took a long time to develop and finalise.

Greywater is pumped in to the top box and slowly trickles down through to the bottom box via filtering materials that progressively treat and 'polish' the water. Water is stored in a tank underneath the lowest box. Plants in each box have been selected partially to enhance the treatment process but mostly on the basis of being able to survive in a nutrient rich sand base. The sand filter does most of the water treatment work.

The system was required to have an ultra-violet filter, however, monitoring has shown it to be unnecessary. The water coming from the system is of potable quality but is not used for this purpose.

The system is believed to be a first-of-its-kind in Australia. Now in operation, Gray believes the system is larger than it really needed to be for the amount of water it currently treats. Toby's involvement and sign-off on water quality assisted with getting council approval for the system and it is regularly tested to ensure appropriate water quality. Currently, the system is not off-the-shelf and needs to be designed by an environmental scientist.

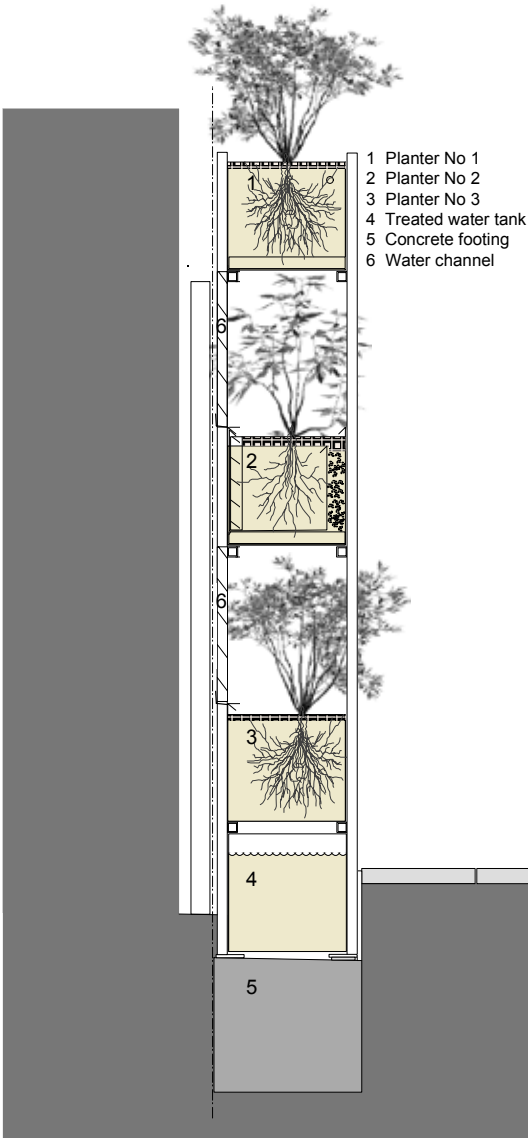


Figure 10. Green-Wall Section

7.0 Materials

Zero VOC (volatile organic compounds) bio-paints are used on internal surfaces and vegetable based oils are used on the spotted gum timber floors.

Figure 11. Green wall

The timber selection was based on the architect's investigation that the environmental credentials of the logging practices of the supplier were acceptable. Kennedy says timber continues to be one of the most difficult and time-consuming materials to specify confidently from an environmental perspective; there are very few certified timbers and some sources that promise certification turn out to be inadequate when investigated.

8.0 Accessibility

The client, who had lived in the unrenovated house on the site for many years, had systems and methods of using spaces and generally getting around with limited mobility. These methods were incorporated into the design of the house in terms of benches, layouts and handle locations.

On a practical level, one of the bathrooms has door widths and a general layout complying with AS1428.1 and the stair is more gradual than usual and fitted with a stair climber. The study upstairs is where the client spends most of the time when working from home. It has a front door control, telephone and kitchenette.

An interesting aspect is the way the study and library above the void are designed to act as a hub to reduce the need for physical movement. By overlooking the living area and the garden, little or no movement is required to provide a spacious and interesting environment connected to the rest of the house. This feature explores the well-being aspect of accessibility beyond simple standards compliance.

The gradual stair does take up precious space in the kitchen; however it becomes a more significant feature in the void. The island bench in the kitchen is on castors so it can be moved.

9.0 Post-Occupancy Evaluation/Feedback

The client has been monitoring water usage since occupying the house in November 2004. A saving of at least 80% has been achieved compared to average Sydney consumption of potable water, even with the small pool which can be a large water user due to evaporation. The rainwater tanks have not emptied, even during Sydney's recent (and ongoing) drought.

Conclusion

It would be easy to come to this house for a dinner party and hardly notice the sustainable technologies. You might notice a couple of unusual rainwater tanks and a rather interesting planter box out the back. If it was a warm day, you would probably just be glad that the breeze was keeping you cool but few would actually think about why.

The integration of effective ESD strategies (in particular, the potable water savings) integrated with contemporary design sets this house apart and is summarised as follows:

- rainwater tanks and the green-wall are landscaping features in the garden space at the rear
- the galvanised steel tanks complement the material and colour selection of the dwelling
- external shading and overhangs provide depth and variety to the western wall
- the void provides excellent ventilation and a sense of space.

This careful integration shows that being green isn't necessarily a challenge to a particular design aesthetic. Further, it very clearly says there is no excuse for not embracing ESD into all designs.

References and Products

'Sun Lizard' http://www.sunlizard.com.au

Photographic References

Photos by Bart Maiorana: Figures 1, 4, 5, 6 and 11

Photo by Nick Bower: Figure 9

Illustrations and photo by Kennedy Accociates: Figures 2, 3, 7, 8 and 10

Acknowledgement

Information provided by Steve Kennedy, Kennedy Associates Architects.

Biography

Jason Veale, BArch (UNSW), is a director of SHACK Design, an architectural and environmental consulting firm. He has worked as a researcher at the University of New South Wales Centre for Sustainable Built Environments (CSBE incorporating SOLARCH). Jason also works for the NSW Department of Planning as the coordinator of the BASIX Thermal Comfort Index.