TROPICAL SUSTAINABLE DESIGN CASE STUDIES

HP Treehouse

Project type: Residential

Location: Edge Hill, Cairns, QLD, Australia
Year completed: 2010

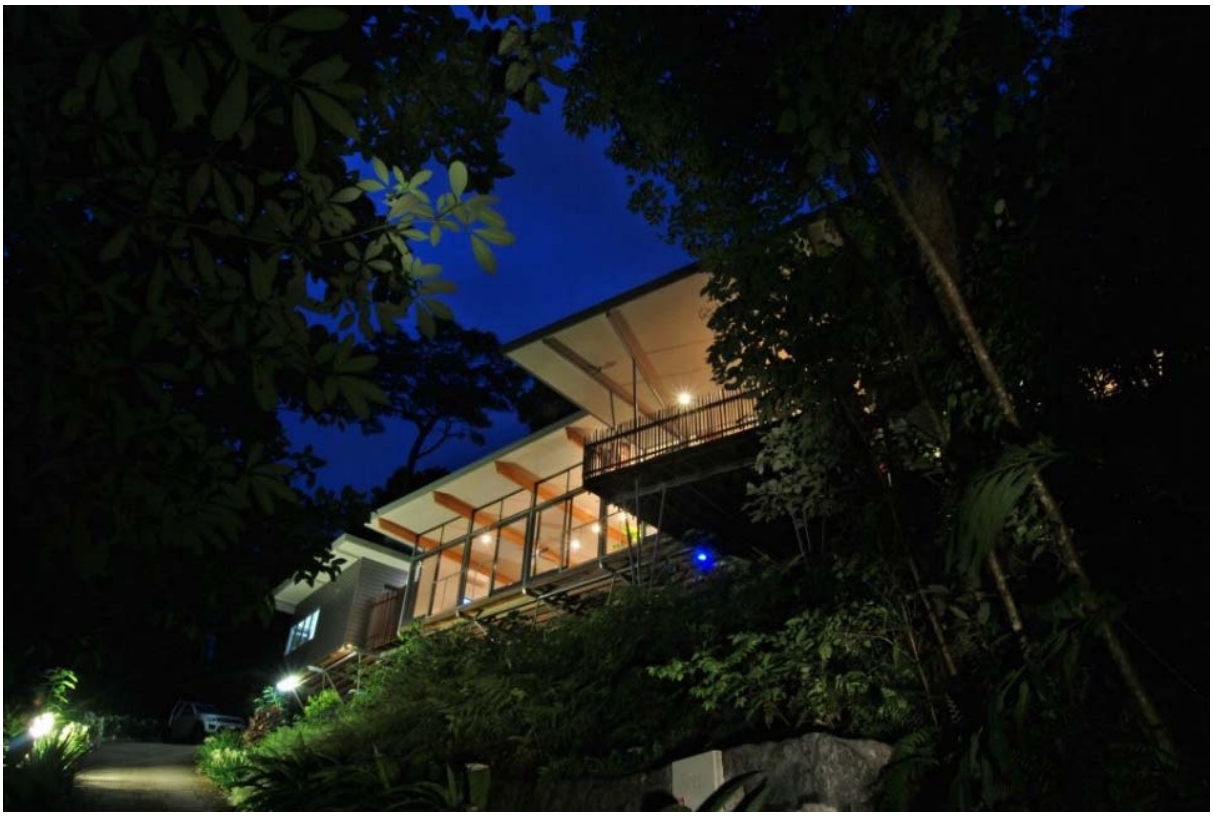
- **Extensive use of passive design for shade and natural ventilation**
- **Sustainably sourced materials suitable for durability and low maintenance in the tropical climate**
- **Minimal site impact**

OVERVIEW

Set on a secluded and private lot on the flanks of Mt Whitfield in Cairns, this is the architect's own home. The principle aims of this low budget project included simple, elegant and unpretentious form, easy access, minimum site impact, sustainability and low maintenance.

The house is suspended above the natural slope and is comprised of three pavilions separated by breezeways. The central living pavilion opens to the forest outlook through a full glass wall, and also connects seamlessly to the outdoor living breezeway. Outdoor dining overlooks the slightly lower lounge 'treehouse' which rests under a large canopy roof and is open on all sides. The main bedroom and ensuite pavilion is accessed across this breezeway and features framed views of the adjoining rock face which becomes a wet season cascade. Guest bedrooms and shared ablution facilities comprise the west pavilion which is separated from the living area by the entry breezeway and laundry/drying area.

Easy care and low maintenance is achieved with a flat roof for easy access to the PV installation, solar hot water, membrane canopy and gutters. Also, Colorbond steel external cladding, aluminium windows and galvanised exposed structure all reduce maintenance demand.



Sustainability is enhanced with long term low maintenance materials, low VOC paints, sustainably harvested or plantation grown timber, locally sourced natural stone retaining walls and a PV installation which provides most power requirements.

Suspended above the forest floor, living in this home is akin to life on a roofed platform within the rainforest canopy. A relaxed and easy ambience contributes to a harmonious relationship between the house and its occupants.

Overall, this home was designed to be low tech, economical and sustainable as possible within the bounds of a modern urban lifestyle and a small budget.

PLANNING AND MANAGEMENT

The project's objective was to deliver a home requiring minimal external energy and outstanding liveability for many years into the future. As this home is intended to be the retirement home of the owners, life cycle cost was also an important consideration.

Council officers were engaged to advice on retention of significant trees, landscaping and minimising site impact.

Construction was planned for the dry season and commenced in July and completed before the wet the following January. Despite this, erosion control was implemented at all stages of the construction.

Problems of limited site access and storage were considered during the design and resulted in a home of relatively small and light components which could be delivered to site in batches as appropriate. Also the building was staged to allow efficient use of the available area. Small cranes were only required a couple of times, and scaffolding was kept to a minimum thanks to the steel frame design.

SITE

This site was chosen for its location and natural state.

Located within 10 minutes of most of the city of Cairns, travel is quick and economical. Also the local area provides most goods and services needed for everyday life.

Development of the site during the subdivision of the land was limited to minimum work to construct a concrete driveway and a small clearing. No earthworks had been completed for a building pad and hence the optimum structure with the minimum disturbance to accommodate the needs of the occupants could be designed. This is a critical advantage on steep hillsides when compared with the typical subdivision which provides predetermined building pads which the home must then be designed to fit into.

The other significant advantage of minimising disturbance to natural vegetation is minimum landscaping and ongoing landscaping maintenance, as well as the shading benefit from existing forest.

No fencing has been used, allowing natural movement of the forest wallabies, goanna's, scrub fowls and bush turkeys among others.

Rainwater is channelled to natural gullies either side of the house site. All landscaped areas had erosion protection installed prior to establishment of planting, and all external trafficable areas are either hard surface or pebble, ensuring all runoff is clean.

DESIGN

The orientation of the home was dictated by the contours of the site. This resulted in the long axis of the building running east-west and minimum exposure to the morning and afternoon sun. Despite this, large areas of glass to the north and south facades, together with strategically placed dome lights allows plentiful daylight to penetrate, ensuring minimal need for artificial light.

Airflow is deliberately concentrated by the use of 'breezeways' between the three pavilions, as well as ample open-able windows. Together with casement windows which open beyond 90 degrees this provides excellent control over air movement through the home and outdoor living areas. A great benefit of this constant supply of naturally moving cooling air is air conditioning is mostly unnecessary. Mould growth endemic to the wet tropics is also minimised. Ceiling fans are used throughout to assist when necessary.

Roof overhangs are very large and decks are well protected contributing to a relaxed living experience in inclement weather. Windows and doors don't need to be closed and decks stay dry. Suspended off the hillslope, the living areas are somewhat removed from the impact of mosquitoes as well as ants and other wildlife without the need for screens.

MATERIALS

Galvanised steel framing from ground to roof is used for its relatively high embodied energy offset by extremely low maintenance and very long life (when protected from weather as in this instance) as well as low weight (when all spans are kept small as in this design). Steel has very low life cycle cost and is ultimately recyclable, and is good solution for this steep site. The erection of the steel frame required minimum scaffolding and site disturbance particularly as most elements did not require cranes to be used.

Infill walls are of plantation timber frame that has low embodied energy, long life and low cost. External cladding is Colorbond coated steel that is high in embodied energy and offset by low weight, long life and negligible maintenance requirements.

Hardwood floor framing, balustrades and decking is sustainably harvested 'spotted gum' from Queensland and this ensures low embodied energy. Durability and economy are key features of this 'low tech' material, particularly when well protected from sun and rain as in this instance.

Internal hardwood flooring is 'messmate', a sustainably harvested Queensland timber that has low embodied energy, very long life and minimal maintenance. This flooring choice also negates the need for any other floor covering, and has minimum maintenance requirements.

Paint is high quality premium grade Dulux, which has very low VOCs and a long life.

ENERGY

Energy use in this home is approximately 60% of the neighbourhood average. This is achieved in a number of ways:

Daylight illumination is achieved naturally.

Artificial lighting is mostly LED and some CFL. With a strategic set out of lights the design and specification of lighting ensures minimum energy consumption. Fans and lighting are all located to suit designed furniture layouts, resulting in night time 'zoned' use.

The hot water supply is from a central solar system with an 'on-demand' electric boost. The linear design of the system wastes water while as the hot water is delivered and we are currently investigating alternatives to address this. Energy consumption is negligible as boosting is rare.

Electricity is made on site by a 5.5 kw solar PV system installed on the roof. We are a net exporter of electricity. Despite some morning, afternoon and winter shading from surrounding forest this system is still very viable.

Cooking is combination of gas and electricity.

In hot weather passive cooling is aided by ceiling fans strategically placed directly over beds, sitting and working zones. Air conditioning, though rarely needed, is installed to reduce humidity for an asthma suffering occupant. It is installed as individual inverter systems and is also carefully zoned to minimise energy usage. The passive cooling is very effective and some of the units have never been run since the home was occupied. Heating is not required.

WATER AND WASTE

The natural forest remaining on the site has been supplemented with durable endemic species, now mostly established and requiring negligible ongoing irrigation.

Rainwater is stored and reused in a 5000 litre tank and reticulation to toilets and laundry is as per legislation at the time of construction. In our opinion, we are not convinced of the sustainability benefits of stored rainwater being distributed via small electric automatic pumps (which operate every time a tap is opened), particularly in small installations, as opposed to the economy of scale which comes from large community owned systems, big reservoirs and efficient pumps. These systems will always need to exist in urban communities and are therefore duplicated by the small residential systems.

Water use in the home is via efficient tap ware and outlets according to legislation.

Reduced pressure due to elevation is tolerated in preference to boosting via electric pump.

OWNERS/USERS STATEMENT

"Living in this home is a joy. Other than the benefits of a living environment crafted to the users specific needs and lifestyle the pleasure comes from - Privacy provided by the layout and site – no curtains or blinds are required. Convenience of living close to the city and all it offers, in a home which is efficient and convenient to use.

Layout which contains no waste spaces, no 'family rooms' or 'formal dining rooms' or any spaces which are not used every day.

Connection to site – large areas of opening and glass connect the living spaces with the surrounding forest (and the city lights at night). We always feel part of the location, its seasons and moods.
Protection from the elements – means almost never having to close windows or doors to keep the weather out.

Satisfaction of knowing this extremely energy efficient home is augmented by solar power.
Minimum maintenance requiring little time and effort or input from others to keep the home and gardens in good condition.

Comfort ensured by all the above is augmented by a layout which is convenient and communal as well as providing privacy for individual occupants." *Peter and Helen*

PROJECT TEAM

Project manager/Base building architect/ designer/ Interior designer: mmp Architects
Structural engineer: G &A Consultants
Energy efficiency rating consultant: Nero Building solutions

For more information visit: **www.jcu.edu.au/tsd**
www.greenbuilom.au

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