Gold Coast QLD

NEW HOME
ZONE 2: Warm humid summer, mild winter

Topics covered	
Passive design	
Lifestyle modification	
Rainwater harvesting	
Waste reduction	
Recycled/renewable material use	
Greenhouse gas reductions	
Indoor air quality	
Reducing water use	
AccuRate (thermal comfort)	4.8 (regulatory)

This home was designed and built to be good for the environment and avoid possible building related impacts on the health of its occupants. It has succeeded by reducing energy, water and non-renewable resource consumption, minimising waste output and use of toxic substances and materials.

The Healthy Home Project brought together Queensland's leading Universities and Government Departments in a joint venture with industry partners. For more information see www.healthyhome.com.au

This two storey, part reinforced fibre cement (FRC) and part corrugated steel-clad modern Queenslander was built as a sanctuary to nurture children in a healthy environment. It was designed to consume less energy in construction and operation. In construction this was through strategies such as using low embodied materials – timber and FRC as well as using recycled materials – hard wood timber from demolished buildings. High performance passive design provides comfort for most days of the year and negates the need for mechanical air conditioning.

Located on the Gold Coast just 200m from the beach, this healthy home demonstrates what can be achieved in sustainable housing in a sub tropical climate and where issues of overshadowing, reduction of airflow, and glare create a significant challenge for passive design.

The house was designed to work with the climate and respect the site. Due to the challenging nature of the site and associated mesoclimate some compromises were made – for instance orientation for solar heating in winter.

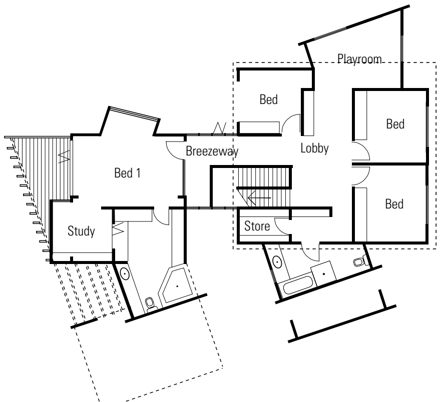
The house is designed to significantly reduce impacts on resources, both in construction and during the life cycle of the building.

Centre for Sustainable Design, University of QLD

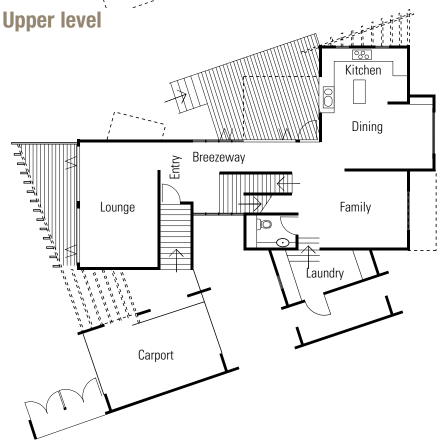
DESIGN SOLUTIONS

The house has its longest façades orientated south-east and north west creating the need for appropriate shading to provide solar access in winter and solar exclusion in summer. Two pavilions are linked by a common louvred breezeway.

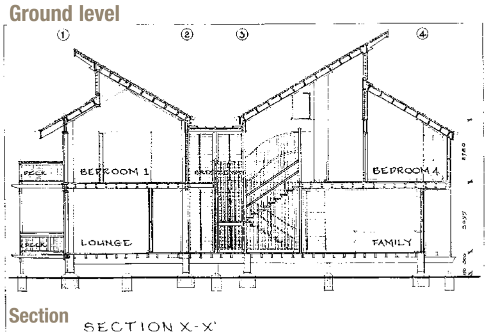
Raised, suspended timber decks are used at the entry and elsewhere for outdoor living. The pavilion plan with its open section provides good cross ventilation. The factory prefabricated skeletal laminated timber frame system has been used to provide internal planning flexibility and maximises openings for ventilation.



Upper level



Ground level



Section

The downstairs open plan kitchen, dining and family areas are also linked through entry and breezeway to a formal downstairs lounge. All have 2.7m ceilings with cathedral ceilings for the bedrooms. The use of the breezeway and a water feature promotes ventilation and evaporative cooling between the pavilions.

Suspended timber floors are used on the lower storey; FRC skirts are used around the perimeter to prevent air movement and enhance ground connectivity. The aim is to achieve similar thermal effect to mass construction which evens out day/night temperatures.

Detached utility, bathrooms and storage areas buffer living areas from westerly sun and associated heat gain.

Interior atrium space with recycled timber and stainless steel wire balustrades promotes convective cooling in calm summer conditions, mitigates overheating and allows ample light into living areas without glare. [See: 4.2 Design for Climate; 4.3 Orientation; 4.6 Passive Cooling]

INSULATION

Thorough draught proofing (including door and window seals) exclude sound, rain, cold draughts, dust, light, insects and vermin. This reduces overall heat loss by 12 per cent which is a cost effective method for saving energy.

Two forms of insulation are used – radiant (aluminium foil backed felt) and bulk insulation to address extreme solar conditions of the site.

For walls, radiant barriers are used on all walls- not just east and west which is common. A high performance specification was used comprising these layers. The outside layer behind the FRC comprises a ‘breather wall’ radiant insulation layer which allows free passage of air and water vapour through the breather sheet to avoid condensation. An additional radiant layer in a concertina configuration provides two reflective air spaces for efficient insulation.

The aluminium foil insulation shown above with a 25mm reflective air gap each side stops 97 per cent of radiant heat. It is economical, efficient, non-irritant, non-allergenic and recyclable. An under roof insulation blanket provides condensation insulation to the steel clad roof and walls. [See: 4.7 Insulation]

WINDOW

Casement and louvre windows are used with plantation timber frames pretreated with penetrating timber stain for high durability and low maintenance. Louvre windows provide maximum ventilated window space, controlled indoor airflow and air exchange. Window glazing systems were carefully analysed early in the design stage and also adapted during early occupancy. Some louvre blades where changed from glass to timber to improve privacy and assist with glare reduction.

Casement windows are mainly used on the north east facing facade and comprise timber frames, timber bifolds, and french doors.

All windows are fitted with body tinted blue tint glazing to reduce ambient solar radiation and for visual effect. The body tinted glass whilst less effective than some glasses for mitigating direct solar radiation, does reflect and absorb a significant amount of infra-red heat energy and reduces the transfer of heat into the home, whilst also admitting daylight. [See: 4.10 Glazing]

Excellent quantities of daylighting are necessary for energy conservation (avoiding the need for electric lights to be kept on during the day) but the quality must be carefully controlled. The blue body tinted glass controls the visible light transmission and combined with the shading and window design creating an interior which is effectively illuminated by natural light. Electric lighting is not needed in daytime.

Central to the daylighting is strategy. North exposed window hoods provide passive solar control for summer cooling and winter warmth. Pelmeted roman and roll blinds are equivalent to R0.5 insulation on windows reducing winter heat loss. They also reduce summer glare and direct light penetration.

Adjustable shade cloths maximise daylighting whilst providing solar control on east and west exposures.

MATERIALS USE

The pre-painted steel roof with clerestory pop-outs is resilient, versatile, light and corrosion resistant. It is 70 per cent recycled, has superior strength and collects drinking water quality rainwater. It is also thermally efficient and has a very good product life span.

FRC cladding is manufactured with minimal environmental impact, has low embodied energy and an excellent lifespan. The ingredients (cellulose fibre, portland cement and sand) are non combustible and termite resistant, easy to work with, durable, low maintenance, versatile, flexible, easy to paint and resistant to weathering.

The volume of concrete was minimised though selection of the skeletal structural system, only pad footings were need as compared to a slab. Further efficiencies in embodied energy and water were achieve by using recycled aggregate and low embodied energy cement.

Solid recycled and plantation timber cabinets were used to minimise off-gassing.

Recycled Australian hardwood timbers were also used throughout to re-use resources. Tongue and groove flooring, posts, railings, stairs, floor and decking timber and joinery were all remilled.

De-nailed, stress graded, recycled structural hardwood and decking timber was used to reduce embodied energy. Timber doors and windows from sustainable forest plantation hoop pine were installed throughout the home.

The engineered timber structural frame was prefabricated in a factory. This reduced waste and site impact, limited excavation and sped up the construction.

INTERNAL FINISHES AND INDOOR AIR QUALITY

Lime wash paints were used because they are made from natural pigments with low environmental impact in manufacture. The amount of harmful off-gassing, does not exceed detectable limits which provides optimum indoor air quality for a low life-cycle cost.

Natural oil timber finishes were used externally and internally as well as non VOC emitting waterproofing also helped maintain optimum indoor air quality.

A ducted vacuum system effectively cleans the carpets; the system is quiet – dirt and dust are deposited into the unit dustbin and not recirculated throughout the home. It provides clean air and has four-stage filtration for more efficiency and longer machine life.

WATER

A water flow control system reduces water use by up to 50 per cent and controls the amount of hot water used, saving heating energy. This system eliminates dangerous and annoying temperature fluctuations in the shower, balancing the hot and cold water system.

The triple filtered rainwater storage system has a self-cleaning filter. Dirt and pollutants bypass the tank and pass through a 30 micron filter. The storage system is food-grade ‘aquaplate’, with a patented diversion system and 20 year warranty.

A 22,500L concrete rain water tank is installed for storage and utilisation of rain water in the laundry, kitchen, bathrooms and garden sub-surface watering system.

The first flush device using a treatment and water filter ensures drinking water quality and has a manually controlled mains refill capacity for when the stored rainwater runs low.

Ultraviolet water disinfection ensures pure, healthy drinking water. Polypropylene piping ensures a high quality uncontaminated water supply for life.

High-density polyethylene plumbing and ducting used is highly durable, highly recyclable and contains no heavy metal stabilisers.

A greywater treatment system allows for greywater re-use and will reduce the load on the council treatment plant when fully operational. [See: 7.2 Reducing Water Demand; 7.4 Wastewater Re-use]

ELECTRICAL SYSTEM

Energy and water efficient white goods are used. They are 95 per cent recyclable, create less greenhouse gas and have a low life-cycle cost. They conform to the best energy and water conservation standards.

A grid connected photovoltaic array has been installed and is being monitored. The system aims to supply the home and export surplus energy to the grid while producing no greenhouse gases.

Electrical cables are made from HDPE. These are self extinguishing and reduce the intensity and toxicity of smoke generated in a fire. Energy efficient lighting was used to save energy, reduce costs and hazardous material content.

LANDSCAPING

Rock paths linking balconies meander through a permaculture garden that provides fresh herbs and fruit. Native plants attract fauna and complement the landscape. The free form rock paving and pebbles used in landscaping have a low environmental impact and are functional, durable, low maintenance and have low embodied energy. These materials are readily available, recyclable and cost effective.

A recycled tyre, subsurface drip-filter irrigation system in the garden minimises water usage for maximum benefit and may be connected to the greywater system in the future. [See: 2.4 Sustainable Landscapes]

EVALUATION FROM CLIENT

The client “aimed to produce a benchmark blueprint residential development with the help of experts in order to research and inform people about environmentally friendly and energy efficient design and building techniques”.

They concluded that they “now benefit from optimum indoor air quality in a passively controlled, comfortable and functionally aesthetic house that has low running costs and low environmental impact. We have become more aware of our daily habits and use of energy, water and other resources.

It has given us great pride in our achievements and an ability to encourage others to follow in our footsteps”.

PROJECT DETAILS	
Architect:	Professor Richard Hyde. University of Sydney,
Designer:	Ted Gardner, Department of Natural Resources Queensland.
Builder:	Chelbrooke homes

Principal author:
Professor Richard Hyde

Photos:
Courtesy of the Centre for Sustainable Design, University of QLD