house – cool temperate

Home Design for lifestyle & the future

Launceston

The design for this home arose from the desire to find a poetic building form that was also very responsive environmentally. The basic principles of passive solar design underpin its free organic shape.

Building Type:	Renovation of an existing home. Composite construction
Climate:	Cool temperate, Melbourne
Topics Covered	Success
Passive heating & cooling	Very Good
Efficient envelope design	Very Good
Renewable energy use	Excellent*
Efficient water use	Good
Efficient services and appliances	Very Good
Greenhouse gas reductions	Excellent
Indoor air quality	Good
First Rate score	★★★★½

* Tasmania uses renewable Hydro-generated electricity

PROJECT BACKGROUND

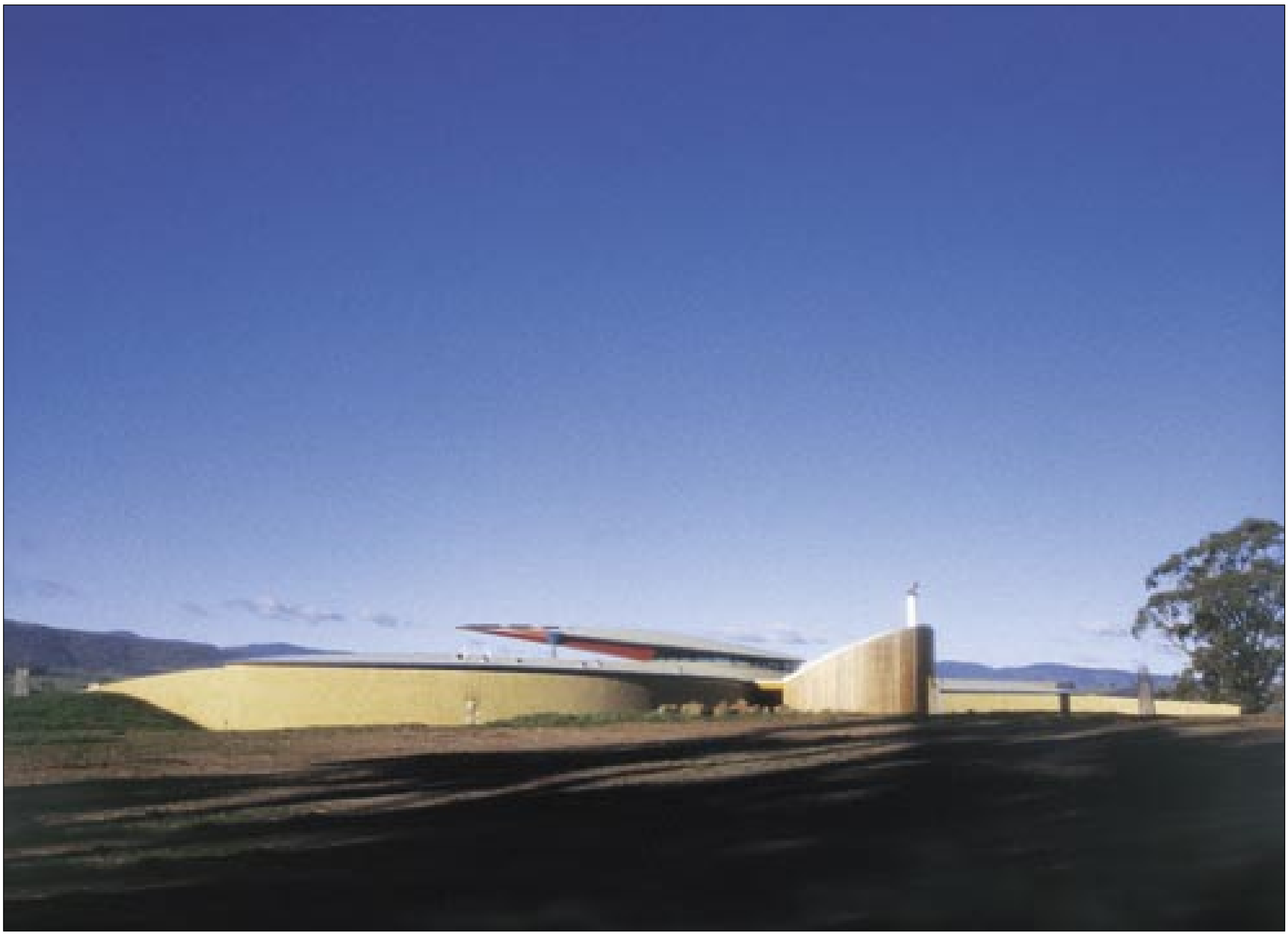
The client is a doctor who spends most of his professional life inside sterile operating theatres. He and his wife bought this land because of the broad landscape vistas which they wanted to live closely with, and literally be out in as much as possible, but in a protected way.

There was also a definite formal requirement from the clients that the house be very responsive from a passive solar, energy saving perspective. The resulting design is an integration of these two desires.

THE SITE

The house is sited on a large open north-west sloping hillside near Launceston Airport, Northern Tasmania. The site was unusual in that it was a completely open grassy paddock visually free from all the traditional constraints of houses or other signs of conventional urbanity.

Transport to and from the site for the owners is by vehicle, because the house is out in the country. Availability of alternative modes of transport should be taken into consideration when choosing a site, as it can have a significant environmental impact. [See: Choosing a Site]



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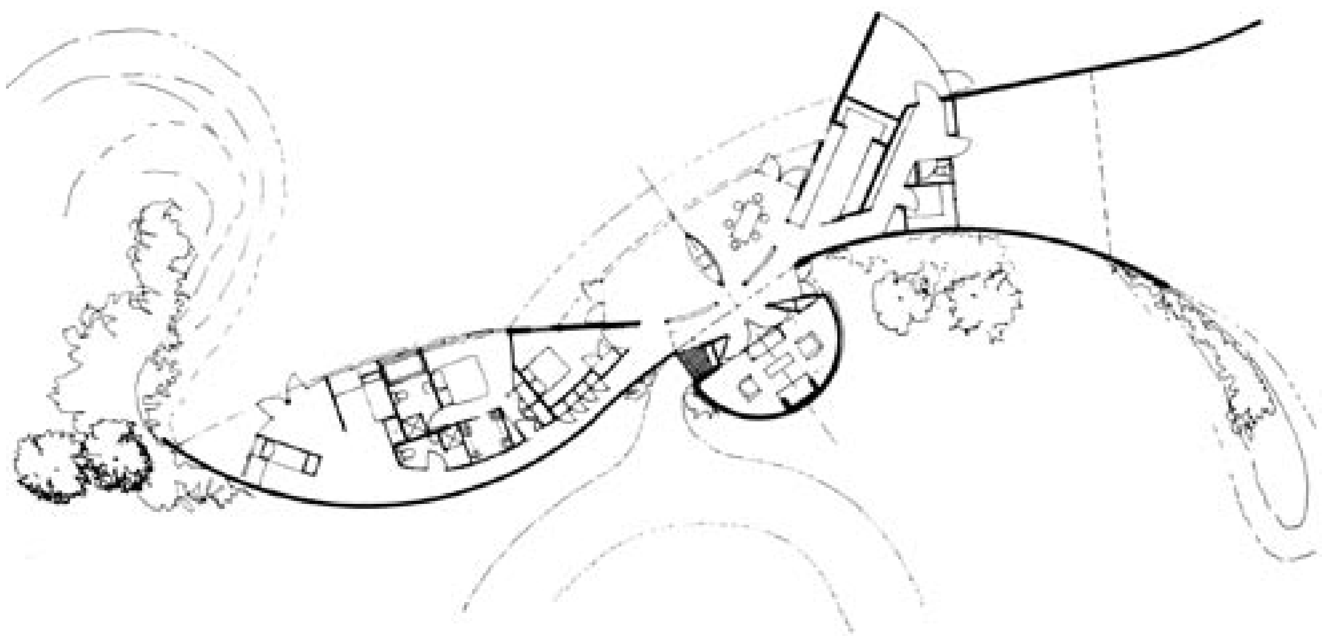


The site represented a chance to design a building form which really engaged with the natural landscape, and in particular to make visible one transient part of it which is very powerful in this particular place... the wind.

CLIMATE

The prevalent wind pattern in this part of Tasmania is winds blowing from the north west, created by powerful currents in Bass Strait. The house site is at the end of a long valley that directs and intensifies these general local winds to such a degree that it is often very unpleasant to sit outdoors in the open.

As the site is inland (south of Launceston, over 40 km from the sea), it loses the moderation or 'evening out' of the daily temperatures that occurs when close to a large body of water.

The average winter maximum temperature is 12 degrees Celsius, but temperatures drop to around minus 2 degrees at night, with frosts but no snow. In summer the temperatures rise to 25 degrees or over, but generally cool down at night to about 10 degrees. An unusual aspect of Launceston winters is the bright sunny days that often occur, even after heavy frosts. [See: Design for Climate]

DESIGN RESPONSE

The house consists of two separate wings joined by a main living space in the centre. Nearly all of the habitable rooms face north and have large areas of glass. The rear southern side is completely windowless and has a very high thermal mass.

GENERAL PLANNING

The main living space is divided into two areas.

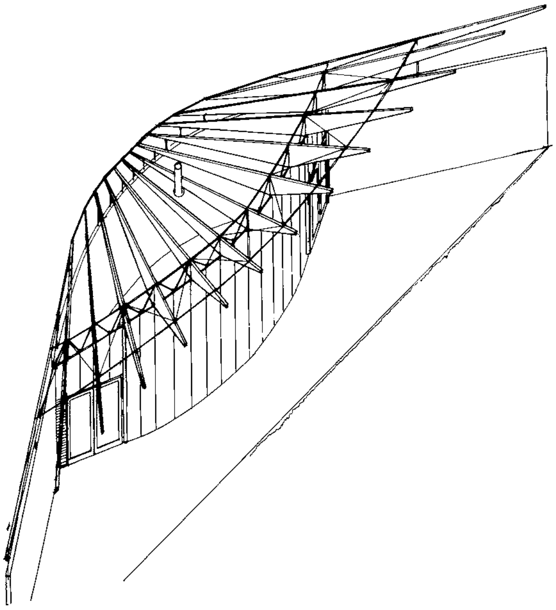
The first living area is visually open, with an unbroken north-facing glass wall looking out to the expansive rolling vista. This space feels like it is outdoors, and has been designed for informal daytime living. The roof is a curved wing, which thrusts itself out against the prevailing gales and protects the glass wall from summer heat.

The second living area is completely internal, located south of the first living space and lit only by a skylight above. This room is a 'true inner sanctum' and parental evening retreat which allows complete separation from the world outside.

The two very separate wings are located on either side of the main living space.

Both wings are completely hidden by the sweeping curved walls, one of which is concave, the other convex in form. The 'formal entry' to the south is the only element that visually breaks these two grand curved walls. Both wings are lit from above by small roof-mounted dome skylights.

The first wing houses the three bedrooms and two bathrooms, with the children having their own very separate world at the far end of this wing.



The second wing houses a separate study, which backs onto the pantry, kitchen, laundry, mudroom and garage. The garage, adjacent to the kitchen, acts as a general under-cover access to the house for deliveries, etc.

The house is designed to work with the climate, trapping solar energy during the day and storing it to re-release at night. The north facing glazed areas act as solar 'collectors' while the high-mass concrete block walls and ground slab work as thermal 'storage'.

ORIENTATION, GLAZING AND SHADING

Nearly all of the habitable rooms face north. The first living area faces north, receiving solar gain and the ever-changing northern light through a large faceted glass wall. The bedrooms, housed in the first wing, face north to north-east. In the second wing, the kitchen faces north and the study faces east towards its own private view. [See: Orientation]

On the southern side of the building, service areas and the second living area are located. The second living area is designed to be a cosy 'inner sanctum' and has no traditional windows as such, lit instead by a double glazed north-facing Velux skylight in its skillion timber-lined roof.

All but one of the windows face north, within the range of north-west to north-east (the ideal orientation for windows is within 30 degrees east to 20 degrees west of solar north). There are no south facing windows except for the narrow upper highlight fixed glazing which allows the main wing roof to 'float' above the walls. [See: Glazing]

The east facing glazing to the study lets in early morning sun to provide a cheery start to the morning. In Tasmania the morning sun is mild, and in this case shading of the glass was not considered necessary.

Passive shading is provided by the overhang of the roof, which was calculated to completely protect the glass wall in summer yet allow maximum sun penetration in winter. [See: Shading]

A north-facing outdoor space, well protected from the wind, connects with the far end of the wing. The family's two children have direct access to this area via glass doors.

THERMAL MASS

Heat from the sun is stored when it is available, and re-radiated when it is not, by building elements with high thermal mass. [See: Thermal Mass]

Thermal mass is provided by the concrete ground slab and by concrete-filled block walls on the southern side of the building, which hold down the flying roof. The high thermal mass of the concrete-filled block walls create an ideal storage area for receiving solar gain. Linked with the paved concrete floor slab, this space forms the passive solar heating element for the whole house. [See: Passive Solar Heating]

The concrete ground slab in the large north-facing living room, where the floor will receive direct solar gain in winter, is finished with terracotta quarry tiles to transfer the energy directly into the slab. The slab is insulated along its perimeter to prevent the warmth stored in the slab from being dissipated.

Low-mass wall materials are used on the northern side of the house. Lightweight insulated timber framed walls, clad with timber board, are used for their 'quick thermal response'. Heat transfer through these low mass walls is much faster than heat transfer through high mass walls, allowing solar energy into the interior where it can be absorbed by high mass materials.

High-mass wall materials are used on the southern side of the house. Reinforced core-filled blockwork walls indirectly absorb the warmth of the sun's energy and store it in their mass. Thus the interior temperature is kept even throughout the year. The walls are bagged internally to increase their surface area, which improves the rate of transfer of thermal energy to and from the interior of the house. The walls are insulated on the outside rather than the inside, as the thermal mass needs direct contact with the interior air in order to be effective.

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MATERIALS & INSULATION

Materials with high thermal mass are generally higher in embodied energy but essential for good passive solar performance. The combination of high and low mass materials minimises embodied energy whilst maximising passive solar performance.

FLOOR

The floor for the entire building is a concrete slab on ground. The edge of the slab is insulated along its perimeter to prevent heat loss. [See: Thermal Mass, Insulation Overview, Insulation Installation]

WALLS

The wall materials used in the construction of the house vary depending on whether they are on the northern or southern side of the house.

On the southern side of the house, the walls are 190mm thick reinforced core filled blockwork, bagged internally. The external side of these walls has rigid polystyrene insulation, and outside that either vertical timber boarding (the inner sanctum) or else a skin of 90mm thick hollow blocks to form an outer weather-protective layer.

On the northern side walls are far simpler, being essentially stud frames lined with timber boards externally, insulated with R2.0 batts and reflective foil. Some thermal mass on the solar-heated side is an advantage for direct absorption, but not essential- especially when there's a paved concrete floor.

WINDOWS

All windows are single glazed, apart from the double glazed Velux skylight. Single glazing was chosen to allow maximum solar gain, however this is not the optimum solution.

In a cool climate like Tasmania's, reducing heat loss is a critical design consideration.

Solar heating periods are short in Tasmania's winter (around 5 hours maximum per day, compared with heat loss periods of around 19 hours minimum). Glazed areas are the main pathway for both passive solar gain and heat loss. [See: Passive Solar Heating]

Double glazed windows reduce radiant heat gain by around 10% compared to single glazed windows, but this marginal reduction is more than offset by the reduced conductive heat loss (around 50%), depending on the system due to the insulating effect of double glazing. [See: Glazing Overview, Glazing- Cool Temperate]

Double glazing gives an insulation value equivalent to R0.5. The addition of a snug fitting heavy drape or blind with a pelmet box adds a further R0.5. The total insulation value of the window can approach R1.0, which, in combination with its passive solar heat gain potential (when north facing), helps to keep warmth inside and reduce the overall household energy consumption.

Large areas of single glazed windows can increase overall energy consumption - even when north facing, due to night time heat loss.

ROOF

The gently curving roof is either steel or timber roof framing, sheeted with colorbond-finish corrugated steel. The blades of the roof over the living area are steel framed ply-clad trusses, which carry the roof out to form a sunscreen.

The roof is insulated with R3.0 batts and reflective foil batts. And because the ceiling in all cases follows the shape of the roof, there are no spaces which have ceiling voids. [See: Insulation Installation]

VENTILATION

In Tasmania, summer cross-ventilation is not the necessity it is in hotter climates. Ventilation here is achieved through opening louvres at the ends of the glass facade, and as well there are openable glass doors. Other rooms have traditional awning sash windows with chain winders. Because the design is essentially a single sided corridor layout, the rear corridors act as air ducts. [See: Passive Cooling]

DRAUGHT SEALING

An airlock against draughts and heat loss is formed by the enclosed two-car garage at the rear of the house. This is used as an informal entry. [See: Passive Solar Heating]

Well sealed sliding, awning or double hung windows provide adequate ventilation in Tasmania's climate. Louvre windows, whilst constantly being improved, do not provide an airtight seal and allow heat loss through penetration of cold air. They are most useful in hotter climates where high ventilation levels are required.

SERVICES

ENERGY USE

100 percent-renewable electricity is supplied from the grid, as electricity in Tasmania is Hydro-generated. This makes Tasmania unique in Australian terms and allows consideration of a different approach to energy sources. However, it should be remembered that increased use of electricity will create demand for new dams. Which can impact on river ecology, the water cycle and Tasmania's pristine wilderness.

SPACE HEATING

Whilst it is possible to design a home requiring zero heating energy in such a climate (through use of super-insulation and very high levels of thermal mass), most Australian homes built in these climates require auxiliary heating to supplement passive solar heating. [See: Hockerton Case Study]

A large central slow combustion stove is used to supplement the passive solar heating. This stove is situated in the second living area, in the middle of a high semicircular concrete wall, and acts as the winter 'heart' of the home. The concrete wall is well insulated to prevent heat loss.

The stove's location near the centre of the home optimises heat distribution whilst minimising drafts. [See: Heating and Cooling]

Slow combustion wood-burning stoves are relatively efficient and make no net contribution to greenhouse gas emissions (wood is a renewable energy source). However, firewood harvesting can have biodiversity impacts, wood burning can be detrimental to air quality. Only the most efficient, well operated wood heaters fuelled by sustainably sourced firewood should be considered. Wood heating should be minimised in urban areas where it can diminish air quality. [See: Heating and Cooling; Biodiversity Off Site]

Electric in-slab heating has been installed but is rarely used. [See: Heating and Cooling]

HOT WATER

A solar hot water unit mounted on the roof of the second living area provides domestic hot water. [See: Solar Hot Water]

LIGHTING

Natural daylight levels are high throughout the house, due to the roof domelights and skylights.

For night lighting, most light fittings are 12 volt recessed downlights or Masson 12 volt surface mounted fittings.

The current range of low voltage lighting is quite energy inefficient and downlights require ceiling penetrations that need careful detailing to avoid heat loss and draughts. More energy efficient replacement globes for these lighting systems are currently being developed in the US. [See: Lighting]

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WATER USE

Water-saving fittings and fixtures such as 3/6L dual-flush toilets and AAA-rated showerheads and mixers were used. [See: Water Use Introduction]

NATHERS RATING

The home received a 4.5 star NatHERS rating. In a cool climate like this, the majority of the energy consumed by the house will be for winter heating, so minimising heat loss through the building envelope is critical. While a 4.5 star rating is good, improvements could have been made with the use of double glazing. The addition of close-fitting window drapes would also improve performance.

The elongated shape of the house (high external surface area compared to internal volume) results in greater opportunity for heat transfer through the building envelope. In cool climates, minimising the ratio of external surface area to internal volume (using compact building forms) helps to minimise winter heat loss. [See: Rating Tools, Passive Solar Heating]

EVALUATION

'For me as the architect, the overriding interest was achieving an appropriate poetic expression of the landscape and the forces of nature. Passive solar houses do not need to be uptight and boring.'

Robert Morris-Nunn

The request for a house that was energy efficient and environmentally responsive came from the clients, and illustrates an important point. The best outcomes are achieved when ideals are shared by designer and client alike.

Although energy performance would be further improved by the use of double glazing, the home is a testimony to clients whose generosity allowed such a design to be evolved, and the final results speak for themselves. The building was built for a cost of $1200 per square metre in 1995, and the overall building cost was approximately $250,000.

The name 'Well Blow Me Down' was given to their home by the clients themselves.

It says it all.