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National Timber Development Program

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Environmental Benefits of Building with Timber

Climate change is one of the most important global environmental issues today. The challenge now facing countries around the world, including Australia, is how to respond to this issue.

In recent times, growing pressure to design for energy efficiency has impacted on all aspects of the building industry. Construction design can contribute greatly to maximising comfort and to minimising non-renewable energy consumption.

Photo: Brett Boardman

Timber frame buildings are now being designed to meet low energy construction standards as timber has a high standard of thermal comfort while consuming minimal non-renewable energy.

A principal objective for responsible design of environmentally friendly timber construction is to minimise life cycle energy consumption. Timber in lightweight construction is a superior material compared to manufactured material such as steel, concrete and masonry as it uses a comparatively small amount of non-renewable energy in its extraction and manufacture.

Environmentally friendly timber construction should also consider design for longevity by recognising the natural durability of individual timber species.

Using Timber as an Insulator

Lightweight timber buildings have a faster responsiveness to temperature changes in comparison to heavy masonry buildings.

This is evident in the summer months, as the timber building can be opened up when a cool change arrives and respond immediately, due to its minimal thermal mass. Air spaces between building elements (e.g. studs in a framed wall) act as effective heat barriers.

Timber framed buildings also permit additional insulation materials to be placed in spaces between framing members without increasing wall, ceiling, roof or floor thickness. Timber also maximises the efficiency of insulation materials because the wood never gets cold or dissipates heat, therefore less energy is required to maintain warmth in a building, and the less energy used, the less damage to the environment.

The Timber Promotion Council of Victoria recently initiated a study on timber flooring and R-values. R-values express the thermal performance in timber framed construction - a higher R-value indicating a higher thermal resistance. Results from the study demonstrated that 19 mm timber floorboards (and an enclosed sub-floor perimeter) achieved a R-value of 1.5, equivalent to a 10 cm concrete slab on the ground. The R-value can be improved to 2.0 by adding reflective foil insulation between the joists.

In winter a residential building loses an average of 10% of heat through the floor, 60% through the roof, and 30% through the walls. With the improved performance of timber floorboards demonstrated in the study, focus can now be effectively placed on roof and wall insulation. Results from this study have been adopted by the Building Code of Australia (BCA) revisions for minimal overall R-values.

(www.timber.org.au/ThermPerf/R-valuesfortimberframedbuildingelements.htm)

Although timber is a natural insulator, the benefit of its thermal specifications is largely underestimated

Timber's Embodied Energy

Embodied energy is the energy used to extract and process raw materials into finished building components, calculated to include energy required for transportation at all stages, as well as energy used in construction.

The greater the energy needed to make a useable product, the more fossil fuels, such as oil, gas or coal, are burnt and the greater the emission of 'greenhouse gases' into the environment, contributing to global warming. Timber is highly efficient in terms of its low energy requirements during manufacture, having one of the lowest embodied energies in production, and is therefore the most environmentally friendly construction material when material when compared to steel, brick, concrete and aluminium building components.

The table below gives an indication of the embodied energy in various common building elements expressed as the primary energy input value. While the list of different building products is only illustrative, it is useful to show the relativity that exists between various options.

Less energy is used in the manufacturing, transportation and construction of timber

Element	Description	MJ/m^2
Floors (including flooring, framing, footings, reinforcement, DPC, membranes, etc.)	Timber suspended, timber sub-floor enclosure	740
	Timber suspended, brick sub-floor wall	1050
	Concrete slab-on-ground	1235
Walls (including as appropriate, framing, internal lining, insulation)	Weatherboard, timber frame	410
	Brick veneer, timber frame	1060
	Double brick	1975
Windows (including 3mm glass)	Timber frame	880
	Aluminium frame	1595
Roofs (including plasterboard ceiling, R2.5 insulation, gutters, eaves)	Concrete tile, timber frame	755
	Concrete tile, steel frame	870
	Metal cladding, timber frame	1080
	Clay tile, timber frame	1465

Source: *"Environmentally Friendly Housing Using Timber – Principles"*, by School of Architecture, Landscape Architecture and Urban Design – University of Adelaide. (www.timber.org.au/ThermPerf/environmentally_friendly_housing.htm).

Natural Durability

Natural durability of timber refers to the capacity for timber species to resist decay and subterranean termite attack in in-ground and above-ground service. Natural durability of a particular timber species influences its service performance, with the performance of timber products being remarkably robust. However, not all species are alike. Designing timber buildings requires developing superior design, workmanship, finishing and maintenance, together with the selection of species of high natural durability. This is necessary to ensure timber remains a permanent and viable structural material in construction.

Natural durability rating or classes are assigned with respect to in-ground service in an adverse environment, (i.e. high moisture content, temperatures and subterranean termite presence). The ratings do not necessarily provide an accurate assessment of above-ground durability or resistance to certain insects such as drywood termites but provide a fairly reliable guide.

In Australia, durability classes are assigned using a broad four class system with reasonable in-ground life expectancies. So that designers make best use of materials and improve their lifestyle energy analysis, understanding the four durability classes of timber is imperative, especially for exterior applications. Reasonable service life means life with minimal, if any replacement. An alternative is the use of timber that has been preservative treated.

A new Australian standard AS5604 (Timber Natural Durability Ratings) will be available later this year. The standard pulls together all the durability ratings into one concise reference.

(www.timber.org.au/Timber_Manual/ProductsPropertiesandPerformance.htm).

Natural durability of a particular timber species influences its service performance

Lifestyle Home Project - A life-size example of good house design using timber

The Timber Advisory Centre of Western Australia, seed funded by the National Timber Development Program, approached architect Paul Odden of Odden Rodrigues Architects to design a home that promotes timber in a 'Lifestyle' manner to expose some of the less obvious advantages of timber. The purpose of the project was to present a life-size example of good house design using timber, based on understanding the environment now and how to improve environmental conditions for the benefit of future generations

The concept of the Lifestyle display home is to address issues impacting on the future directions of building design. In particular the designers considered:

- The condition of the environment, exemplified by the Kyoto Protocol
- Revision to the BCA which will significantly improve a building's thermal insulation and regulation of minimum energy performance requirements.

Odden Rodrigues Architects already utilise timber as an integral component of their designs, and agreed to the proposal to explore some less obvious advantages of the wonderful timber resource. The architects believe timber is not only an environmentally friendly resource with properties that are unmatched by any other building material, but a flexible and durable material that has the added benefit of being aesthetically 'beautiful'.

The finished display home is a strong yet lightweight home, designed around a 2.4 m module. The module can be prefabricated and meets the Department of Transport width requirements for a standard truck. This allows economies of factory prefabrication, economical transportation and rapid erection. However, most importantly, the home is flexible in design and forward thinking in approach.

Decking in the display house consists of Alaskan Yellow Cedar with Class 1 durability rating. Radiata Pine has been used throughout the house in the wall, roof and floor frames and has been improved by the application of preservative treatment CCA H2 to protect the pine against termites.

The Lifestyle Home has all the advantages of substantial factory pre-fabrication, variable planning layouts of single, two or three storey, and choice in colours.

The architects are pleased with the completed house, and they are working to further this underdeveloped area in timber design. The performance of the Lifestyle Home Project has also proved to be very successful, as the use of timber against bricks in Western Australia has significantly lifted to a 10% marked share.

For further information, contact the Timber Advisory Centre of Western Australia on 08 9380 411.

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Casuarina Beach House - incorporating timber into beachside development for sustainable living

Photo: Brett Boardman

Lahz Nimmo Architects have designed the winning house in a short-listed competition to search for the 'Ultimate Beach House'. The house, built at Casuarina Beach Development, near Kingscliff in northern NSW has become a prototype to test the application and marketability of 'Sustainable House Packages' and to set the standard for quality design throughout the beachside development.

The Casuarina Beach House has been designed to perform as a self-sufficient house, incorporating all aspects of Ecologically Sustainable Development in its design. Lahz Nimmo Architects employed passive design principles along with an extensive use of recycled materials and careful selection of energy efficient appliances.

The architects designed the house with a simple strategy – that of an open breezy relaxed and extroverted 'Living Pavilion' adjacent to a two storey shuttered timber 'Sleeping Box'. The design aims to integrate the house onto the whole site by pushing parts of the building fabric to the extremities of the site and capturing external space within various levels of enclosure.

"In the tradition of the beach house, and as the most appropriate material for the coastal sub-tropical climate – we believed that light-weight construction over masonry was appropriate" said architect Annabel Lahz.

Timber was favourably used as the primary building material for its associated texture and warmth benefits.

Re-cycled Blue Gum timber was sourced from Australian Architectural Hardwoods at Kempsey to build the timber cladding for the Sleeping Box**,** pergola and batten elements. Hoop pine plywood ceiling panels were sourced from plantation timbers.

Selection of these timber materials required consideration of the housing development's proximity to the beach, and associated environmental conditions. The drying effect of the sun and wind combined with salty air creates a tough environment in coastal areas. "All the external timbers are recycled and oiled Australian hardwoods, which will fade gracefully, or maintain their warmth if re-oiled every year or two years" said Ms. Lahz.

The aim of the 'Sustainable Home Package' is to achieve the following:

- *No sewerage to leave the site*
- *No water to be imported to the site, mains water only as a back up*
- *All rainwater to be collected and used on site*
- *No stormwater to leave the site*
- *Electrical energy to be sustainably provided by photovoltaic cells*
- *All cooking, hot water and heating to be by gas*
- *The performance of the completed system will be maintained as part of its function as a prototype system*

Water tanks and solar collectors used in the Casuarina Beach House were designed by Michael Mobbs Sustainable Projects.

Photo: Brett Boardman

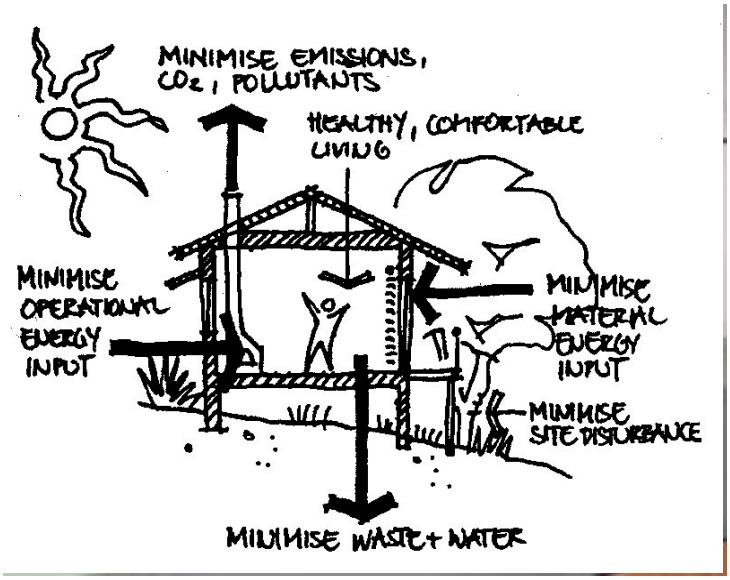
Design for Energy Efficiency

Responding to the dynamic climate of the beach environment, the Casuarina Beach House has been designed to open and close where appropriate to adapt to changeable weather patterns. The whole house design has been specifically arranged to exploit the cooling beach breezes and temperate/sub-tropical climate, allowing the house to breathe, utilizing many of the passive cooling techniques typical of sub-tropical vernacular architecture. A central breezeway acts as a thermal chimney that continually draws fresh air into the house. In winter this central breezeway can be sealed off from the rest of the house allowing the house to be effectively zoned into three areas – the Living Zone, the sleeping Zone and the Breezeway Zone.

Environmental factors on the Australian eastern seaboard result in a low diurnal temperature range and warm night due to high humidity. Sea breezes also allow houses to be flushed of hot air during the early evening. Architect Andrew Nimmo, believes that lightweight construction (low thermal mass) with good insulation, a strong emphasis on cross ventilation, and the ability to expel hot air at ceiling level (through high-level openings or wind turbines), makes for a more comfortable environment in summer in these locations.

For winter the architects incorporate thermal zoning into their design to allow certain rooms to be heated — the Living/Dining/ Kitchen area at night — but leaving other rooms unheated as winters on the Australian eastern seaboard are not so severe that the whole house needs to be heated.

For further information contact Lahz Nimmo Architects on 02 9211 1220, or visit thier website at www.lahznimmo.com.



Benefits of environmentally friendly housing

Photo: Brett Boardman

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The National Timber Development Council is a federation of Australian Forest Industry Associations, managing the National Timber Development Program in partnership with the Forest and Wood Products Research and Development Corporation (FWPRDC).

NTDP WEBSITE:
www.timber.org.au

Contact Details

To assist designers, architects and builders, expert assistance is available from local Timber Advisory organisations, providing support information, advice on material use and construction technology:

Queensland

(TRADAC) - 07 3358 1400

New South Wales

(TDA) - 02 9360 3088

Victoria

(TPC) - 03 9665 9255

Tasmania

(TTPB) - 03 6224 1033

South Australia

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