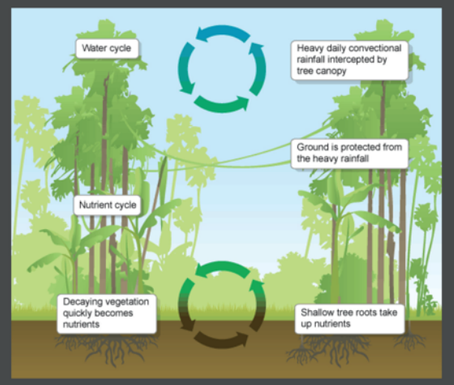
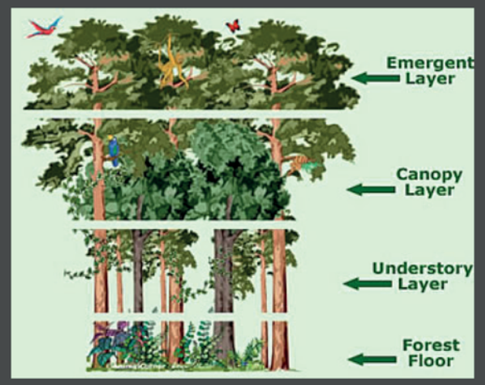
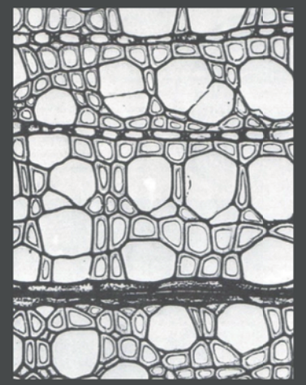


http://www.bbc.co.uk/schools/gcsebitesize/geography/ecosystems

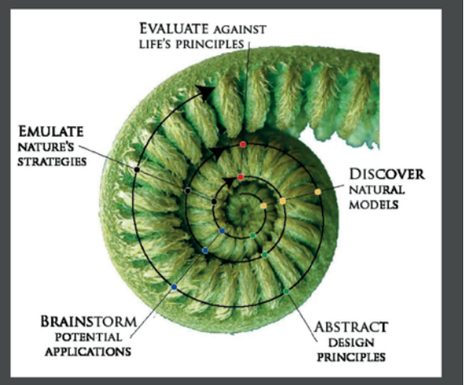


http://abitaboutrainforests.weebly.com/strata-and-diagram.html


Alexander, C. (2004) The Nature of Order 1

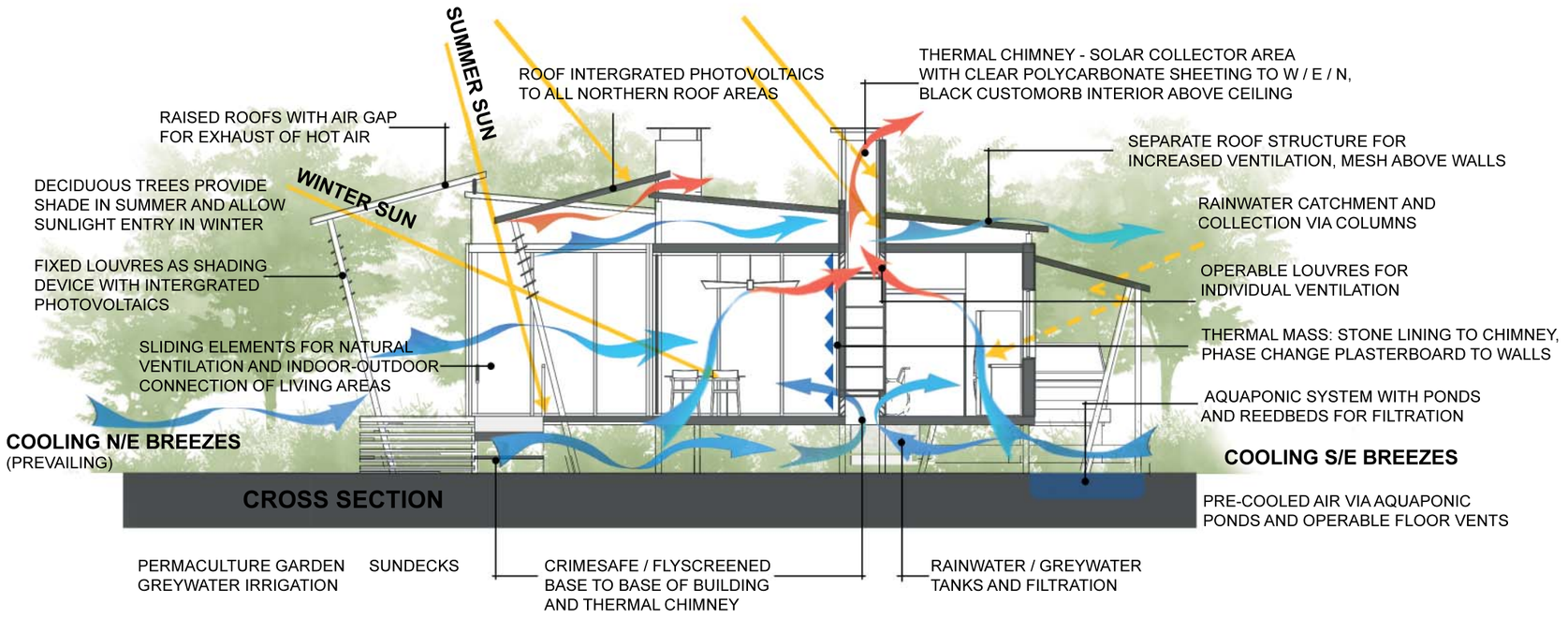

http://www.pimpyourkitchen.co.uk/splashback-designs/tree-canopy.html


CH2 Biomimicry aproach
Webb, S. (2005) Environment Design Guide CAS 36, p.5



http://biomimicryfordesigners.blogspot.com.au

PRECEDENTS IN NATURE



PASSIVE SOLAR DESIGN STRATEGIES

Net zero carbon performance

Despite major improvements in efficiency, buildings leave a negative footprint through material extraction, operational and transport demands. The underlying framework for this design is the concept of net Positive Development (Birkeland, 2008) which suggests that buildings can function as active parts of ecosystems and 'give back more than they take' over their life cycle. Carbon is used as a quantitative measure to demonstrate that net positive life cycle performance is possible through amortization of embodied carbon by renewable energy gains and biomass sequestration. A report by the ESD Consultancy 'Sustainability House' and the author's publications are available on request. The concept is contributing to the Byron Shire Council's initiative to achieve zero emissions within the next ten years.

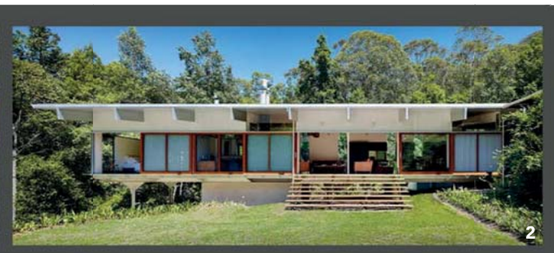
Design principles

- Maximized passive solar design
- Natural materials with minimal embodied energy
- Efficient active technology to meet / exceed resource autonomy (energy, water, waste)
- User engagement / educational experience to optimize comfort and operational performance
- Integration of ecological, social and economic sustainability

Biomimicry inspiration

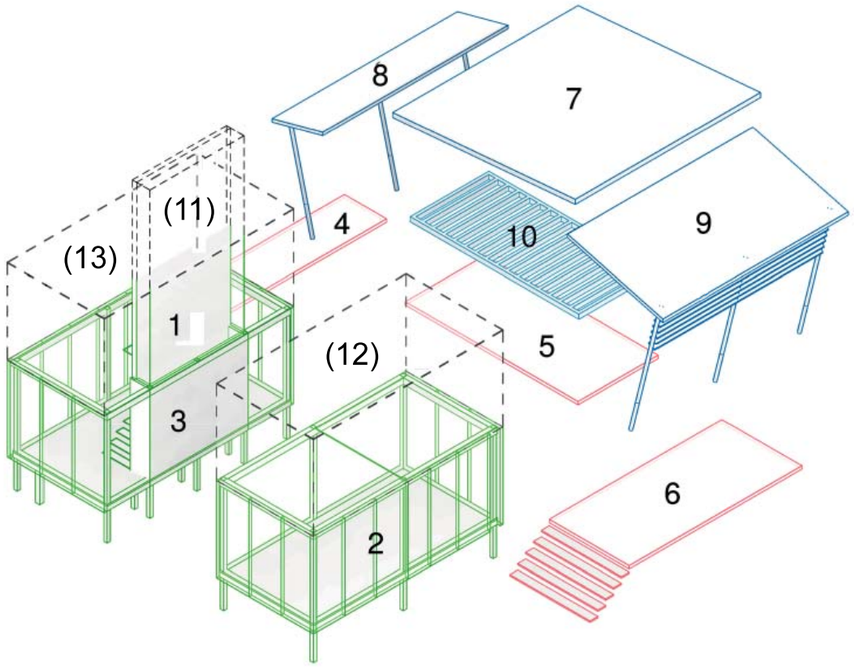
Nature runs on sunlight, fits form to function, uses only the energy it needs and turns waste into resources. Natural systems served as precedents to create closed loop and net positive cycles, including:

- Micro-level: Resilient and self-organizing cell structures such as in wood fibres for modular design approach (Alexander, C. (2004) The Nature of Order 1).
- Macro-level: Water and nutrient cycle in the forest and tree canopy structures for energy, water, carbon and nutrient cycles.



Glenn Murcutt[1], Peter Stutchbury[2], Richard Leplastrier[3]

ARCHITECTURAL PRECEDENTS



1 - Core - Thermal Chimney / services / storage
2 - Module 1: 3.4 x 6.8 x 3.0m h (external measures)
3 - Module 2: 3.4 x 6.8 x 3.0m h (includes core)
4 - Front walkway
5 - Breezeway
6 - Verandah
7 - Main roof - Rainwater catchment
8 - Entry roof - Rainwater catchment
9 - Verandah roof - Rainwater catchment & Photovoltaics
10 - Pergola - connection to Module 3 & 4
11 - Core second level (optional)
12 - Module 1 2nd level (optional)
13 - Module 2 2nd level (optional)

MODULAR CONCEPT

Design principles

- The building footprint is minimized by providing connecting outdoor decks which extend the internal living areas as multifunctional spaces.
- Modules designed around a core with thermal chimney function, storage space and services.
- Each module is autonomous and can include at a minimum a bathroom and a small kitchenette.
- Design for accessibility and equity.
- Local skills in factory and on site.

Modular system

- Module size: 3.4m x 6.8m x 3.0m h to enable transportation without oversize arrangements.
- System chosen: Prefabricated timber frame and panels, allowing a variety of choice initially and to accommodate future changes.
- Separate modular roof and deck structures, connected to prefabricated modules on site.

Benefits

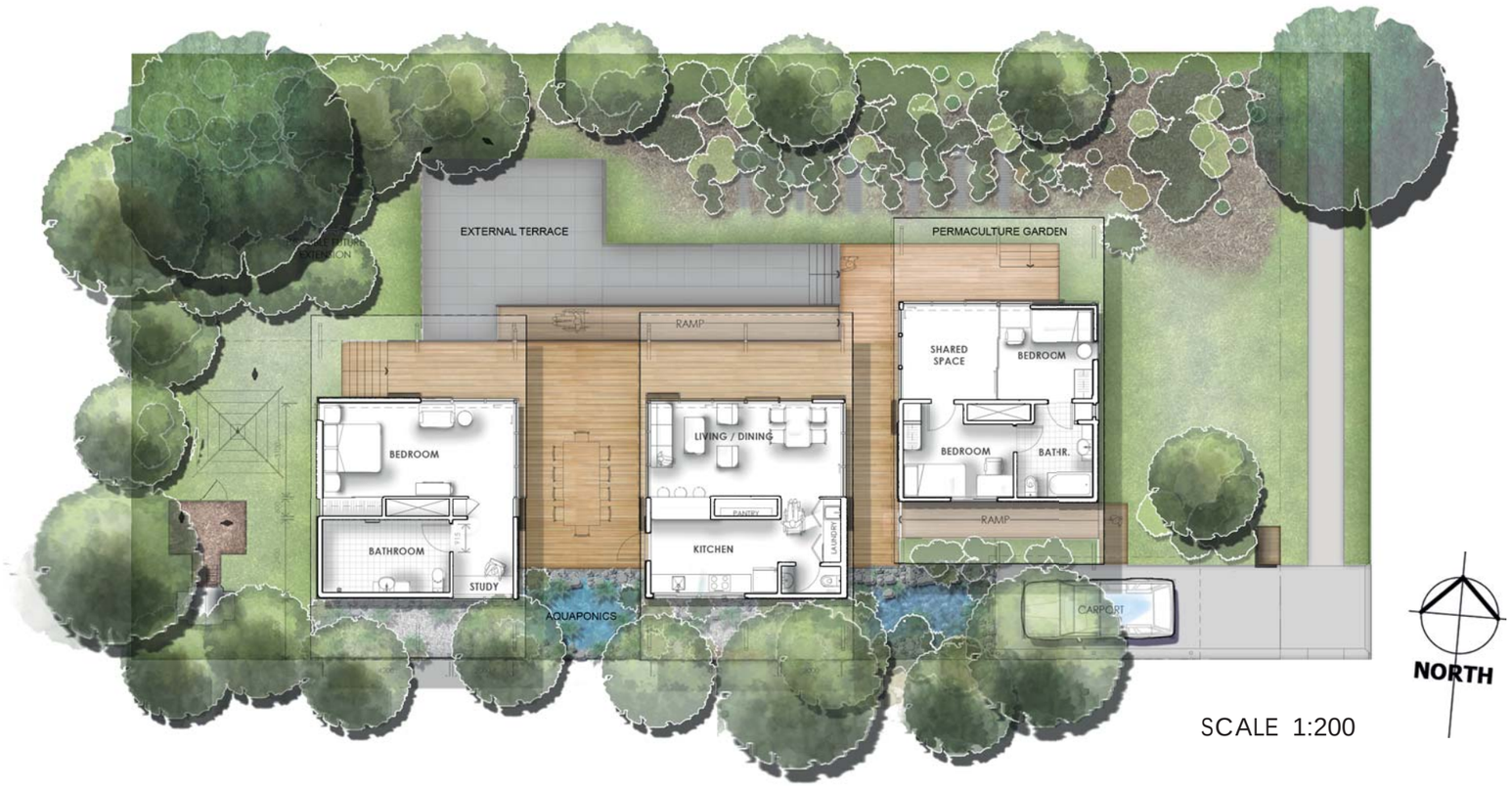
- Minimal material use, waste, downtime
- Efficiency in production and construction
- Quality control and value engineering
- High level thermal performance
- Certification / compliance (fire etc.)
- Accuracy, leakage and sealant control
- Individuality due to flexible panel system, entirely prefabricated as per chosen design.

Flexibility and adaptability

The layout is flexible and adaptable for different social requirements or life stages of the family. Two or more assembled modules can accommodate family members (e.g. kids, parents, grantparents etc.), be rented out or used as home offices. Options include:

- Minimum layout with integrated living and sleeping space and movable walls/foldout bed;
- Living and kitchen module plus any chosen number of bedroom modules, either adjoining or with connecting outdoor space;
- Double story module with sleeping and study/storage area upstairs, void creating spacious living room;
- Possibility for multi-story residential if site amalgamation in the future.

SITE PLAN



SCALE 1:200

Site strategies proposed:

- Optimal orientation with main living areas to the north, minimal openings to east and west.
- Solar water heating via heatpump, located to southwest of building.
- Building integrated Photovoltaics (BIPV) to all northern roofs and sunshades.
- Permaculture gardening, including composting and worm farms, aquaponics, use of grey and surface water, raingardens and linking to the street, benches and fruit box to sell organic produce.
- Use of prevailing winds to cool and ventilate the dwelling.
- Screen planting for protection from cold westerly winds, to provide shade and privacy.

Neighbourhood Planning:

- A sustainable community needs to be planned and implemented on the neighbourhood or suburban scale. The building sets a benchmark in sustainability and net zero carbon performance for the surrounding area.
- Synergies will be developed when neighbours share or compliment facilities, resources and ground space. The exported renewable energy to the grid is used used at the neighbourhood scale. An example in Byron is the innovative virtual net metering pilot project which enables net positive energy buildings.
- A lifestyle connected to the street improves social interaction. An honor box is provided where organic produce is offered. This can be extended to a farmers market to connect with other community members.
-

Minimal ground disturbance

- The lightweight, well insulated buildings are set off the ground to minimize ground disturbance, encourage ventilation, reduce costs initially and in future deconstruction, enabling reconfiguration, relocation and eventually leaving no footprint on the ground.

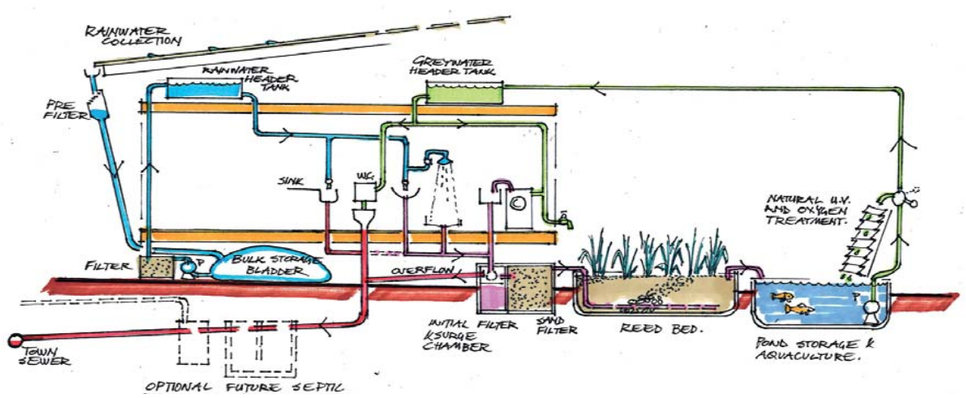
LOCAL MANUFACTURING PROCESS

'Modular Factory'

- Net positive social benefits are also created through a proposed local manufacturing process for the modules.
- In this way local jobs are created both in manufacturing and materials supply, and delivery distances are kept within reasonable limits. It is suggested that for this region Lismore might be a suitable site for the factory, given its central location and larger population.
- Of advantage is the existing thriving local timber industry and the bigger potential markets of the Gold Coast (approx. 100km) and central NSW coast (approx. 200km) could also be serviced.

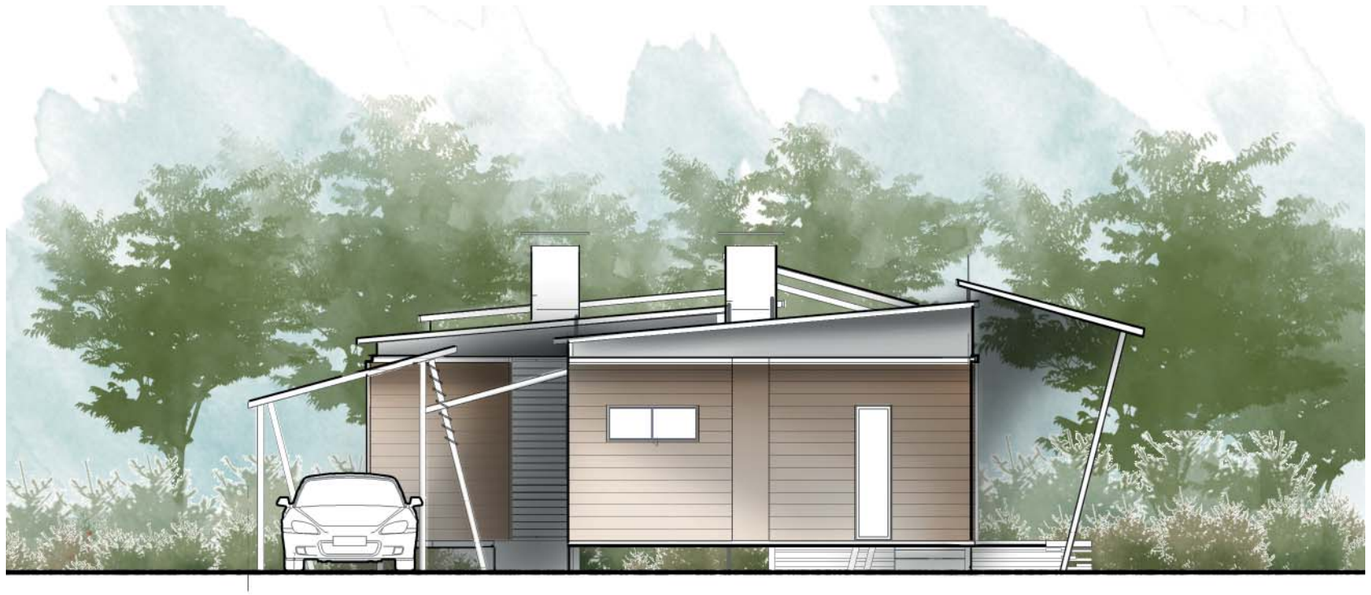
Water cycles (refer diagram below)

- Rainwater - All roofs are used as rainwater collectors. Water flows via columns to storage and filtration tanks underneath each building module. These are located at either eastern or western side to allow adequate cross ventilation to enter the thermal chimneys.
- Greywater treatment naturally via aquaponics with reedbeds to be fit for non potable use.
- Blackwater - not treated on site as it is more viable to use existing infrastructure.
- Stormwater - All surfaces on site are permeable to use stormwater for irrigation.



NORTH ELEVATION

EAST ELEVATION



SCALE 1:100

Orientation

- Northern aspect is maximized in the design, major openings and outdoor decks oriented to the north and in between buildings, extending the internal living spaces.
- East and west facades with minimal openings, limited to providing desired cross-ventilation and views.
- Prevailing N/E and S/E breezes are directed through the buildings, connecting decks and thermal chimney.

Shading

- All openings are carefully shaded to admit only sufficient sunlight.
- Separate roof structures and fixed louvres to northern verandah are designed to provide shading in summer and allow the desirable winter sun to enter the building.
- Manually operable timber sliding elements with adjustable louvres to living areas for individually controlled daylight entry and privacy, creating a pleasant light atmosphere at night.

Building Intergrated Photovoltaics (BIPV)

- Building Intergrated Photovoltaics (BIPV) to north facing roofs provide multiple material functions (envelope and power generation surplus to operational demands).
- The building exceeds resource autonomy in energy production, surplus electricity is exported to the grid and can be used to charge an electric car.
- Translucent Photovoltaic systems create an diffuse light atmosphere on the decks and inside the pavillions, enable views to the sky and make the energy production visible for bulding owners and guests.
- Optional battery storage if owner choses to be independent from the grid.

CROSS SECTION

Thermal Chimney concept

- The solar collector area above the roof consists of black customorb interior with clear polycarbonate sheeting.
- Fresh air is drawn in through operable floor vents at the outsides of the modules to encourage airflow diagonally through the rooms and into the chimney above storage areas (stack effect).
- These actions will be monitored by sensors to make control easier.
- Airflow will be improved by low energy fans at floor level, window and door openings and the solar colector area above the roof with possible integration of wind turbines. Incoming air passes over the water reservoir to pre-cool before entering the living areas.

Aquaponics

- The southern elevation features an aquaponic system adjacent to the raised decks, consisting of fish ponds adjacent to decks, reed filtration basins in front of building modules and food production to the west.
- The waterbody pre-cools the air for ventilation, produces fish and food and creates a pleasant athmosphere.

Material use

- Natural materials with low embodied energy are used throughout, predominantly timber such as Western Red Cedar as a locally sourced and renewable material.
- Materials were chosen with regards to life cycle performance and low maintenance.
- All windows are double glazed to provide comfort with minimal energy use.

SOUTH ELEVATION

SCALE 1:100

sustainable housing for life design competition - net zero carbon house

net Zero Carbon
C.Renger

thomson adsett