JAMES COOK UNIVERSITY
AUSTRALIA

TROPICAL GREEN BUILDING NETWORK
A Far North Queensland Initiative

TROPICAL SUSTAINABLE DESIGN CASE STUDIES GUIDE DOCUMENT

Contents

Photo courtesy of Tony Lawson, Building Designer.

1.0 INTRODUCTION

Purpose and aim:

With ever increasing environmental, economic and social pressures globally, the need for sustainable building and development is stronger than ever. Sustainable built environments use resources more efficiently, are economical to operate, are more climate resilient and deliver new technology using world best practice.

Designing sustainably for the tropics is vastly different than designing for sub-tropical or temperate climates. The tropical sustainable design case studies project aims to capture and share the knowledge of best practice tropical expertise in our built environment.

The aim is to include all or part of completed new or retro-fitted tropical sustainable built environments encompassing the planning, design and delivery processes.

The project is a joint initiative of the Tropical Green Building Network (TGBN) and James Cook University (JCU) and has been funded by the JCU Sustainability Fund. It is being supported by a Working Group whose members can assist you when required. The Working Group members are from architecture, design, engineering, surveying, planning, education and environmental backgrounds.

What this guide document is:

This guide provides information on the content we anticipate you may include for each case study. It provides an outline of six primary focus areas of sustainable tropical design that our Working Group deemed critical to best practice sustainable tropical design. These focus areas include:

- Planning and management
- Site
- Design
- Materials
- Energy
- Water

Specific considerations relating to these areas are provided within each section.

Outcomes:

The project will record key features of selected tropically adapted sustainable environments in the Cairns and Far North Queensland (FNQ) region. Some of the selected projects have Green Star or other sustainability ratings which are typically based on models suitable for regions other than our own. Part of the task of the case studies project Working Group is to analyse, augment and consolidate our understanding of specific features that deliver successfully in our tropical environment.

The project will document over 40 case studies that showcase tropical building and design expertise in FNQ. The building types span residential, commercial, industrial and civic, with retrofitted/renovated buildings also included.

The final case study documents will be made available online as a freely available resource that will not only help disseminate the knowledge and technical expertise of the industry but also help create a benchmark to work from. It will be a key resource for those in the construction industry, researchers and students of the tropical built environment, the TGBN network, government bodies and interested residents of the region.

Timescales:

The DATA COLLECTION process period is during July 2013. During the later months of 2013, the data will be reviewed and formatted and a draft turned around for proof reading and approval before final publication. Case studies will be made available on the JCU and TGBN websites early in 2014.

2.0 DEFINING TROPICAL EXPERTISE:

Tropical sustainable design expertise plans, designs, specifies and builds to deliver the following:

- The design and construction of sustainable, resilient communities and infrastructure for tropical climates.
- The development and application of building materials and technologies for extreme heat, cyclones, humidity and heavy rainfall.
- Sustainable environmental practices through the efficient use of renewable natural resources and protection of natural assets.

The following are key focus areas for the purpose of this study

3.0 PLANNING AND MANAGEMENT

3.1 General Planning and Management Sustainability Considerations

Sustainable planning and management of the building process, from site selection and project inception through design and construction to building commissioning and occupation.

Initiatives may include:

- Engaging professionals with expertise in sustainable building delivery.
- Effective collaboration with project stakeholders to establish, prioritise and agree on sustainable environmental, economic and social initiatives for the project.
- Planning to minimise the life cycle cost of a building.
- Implementing an environmental management plan to minimise pollution during construction, including protecting site soil and water quality.
- Implementing a waste management plan that includes design strategies and collecting, separating and recycling demolition and construction waste.
- Providing a building user guide, along with user training for building systems.
- Building tuning post-occupancy to ensure systems are running optimally.
- Data monitoring of building systems to ensure systems continue to operate optimally.

3.2 Tropical Planning and Management Sustainability Considerations

- Managing construction sequencing to allow for wet season impacts.
- Procuring building materials with care, particularly for products that are not stocked locally, leading to possible delivery delays or freight and storage damage.
- Knowledge and expertise on suitability and durability of materials and construction detailing for tropical conditions, eg: seasoning materials for humidity, detailing to minimise condensation, moisture traps and mould.
- Managing the construction workforce, including risk of sun stroke, skin rashes and tropical sores, mental health issues caused by high heat and wet season work, remote work, difficult building and site conditions.
- The research, development and testing of new products, in collaboration with suppliers, to increase suitability, availability and uptake in the tropics.
- A sharing of knowledge relating to both successful and poor project outcomes in the tropics, where the experience can be used to promote better outcomes for future buildings.
- Tropical health considerations including pest and disease control in communities and around buildings.
- Planning for safe and resilient buildings in areas prone to severe tropical weather events.
- Respectful consideration for and appropriate design response to cultural imperatives, as required in specific locations and communities.

4.0 SITE

4.1 General Site Considerations

Site considerations involves choices that will impact site ecology and biodiversity, and choices that will contribute to achieving sustainable communities. Sustainable site choice, location and management will minimise harm to the ecology, and will enhance site amenity and promote healthy communities.

Initiatives may include:

- Selecting previously developed or degraded land and improving its ecological value.
- Select a site that will allow optimal orientation for effective passive design.
- Minimising site and ecology disturbance.
- Minimising vegetation clearing.
- Protecting site topsoil quantity and quality.
- Selecting a location to minimise reliance on private transport, and to provide easy amenity to infrastructure, services and supplies.
- Proximity to interconnecting foot/ cycle paths.

4.2 Tropical Site Sustainability Considerations

- Controlling volume and quality of wet season stormwater run-off to minimise erosion and sediment/nutrient loss to waterways.
- Expertise and understanding of micro-climates relating to coastal, rainforest, highland and savannah locations.
- Select site location to maximise resilience and to minimise isolation, disruption and loss of property during floods, storm surges and cyclones.

5.0 DESIGN

5.1 General Design Considerations

Sustainable building design will reduce user reliance on non-renewable energy. Sustainable design will maximise user accessibility, comfort and wellbeing, and will contribute positively to urban spaces and community. Choices made in building design and detailing will impact on building resilience, durability and maintenance.

Initiatives may include:

- Correct building orientation to maximise passive design function.
- Individual comfort control. (light, temperature, ventilation)
- Noise level control from external sources and within parts of a building (eg air-conditioning unit placement).
- Incorporating views well to enhance user comfort and wellbeing.
- Designing flexible spaces and structure to maximise building functionality with minimal area, and to allow for future adaptability and growth.

5.2 Tropical Design Considerations

- Effective passive design for hot, humid climates to minimise solar heat gain, and to maximise natural ventilation (cross ventilation and thermal venting) to reduce reliance on non-renewable energy, and support our wellbeing in a hot, humid climate.
- Design to allow resilience, adaptability, safety and security in severe tropical weather events and to assist with swift recovery from disaster.
- Design to facilitate comfortable outdoor living in all seasons.
- Design to reduce mould, condensation, pests and insects.
- The use of light colours to reflect heat.
- Subdivision design to support the correct orientation of buildings to allow for optimal passive design and reduce reliance on non-renewable energy sources for building cooling.
- Careful specification of doors and windows that maximises cross ventilation when open, protects the opening from rainfall, provides a good seal when closed, has glass that minimises conduction and radiant heat transfer and is designed and installed to meet high cyclonic wind speeds.
- Innovative design solutions suited to tropical climates.

6.0 MATERIALS

6.1 General Material Selection Considerations

Material selection should consider life cycle cost implications with regards to embodied energy, carbon footprint, durability and maintenance requirements of materials. Indoor air quality can significantly affect human health.

Initiatives may include:

- Specification of sustainably produced, locally sourced materials.
- Use of sustainably sourced timber (eg: local, recycled, FSC certified timber).
- Use of materials with high recycled content (eg: concrete aggregates, recycled composite materials, steel, floor coverings).
- Specification of materials that can be readily recovered and recycled when demolished.
- Reusing and adapting existing buildings elements, such as structure and façade, in renovations or conversions.
- PVC reduction (vinyl finishes, conduits, cables).
- Formaldehyde reduction (eg: can be present in MDF sheet).
- Life-Cycle Analysis of material selection, including consideration for embodied energy, longevity, maintenance considerations.
- Specifying low VOC paints, glues and finishes.
- Specifying materials, such as insulation, that are low irritant.

6.2 Tropical Material Selection Considerations

- Careful specification and detailing of materials that may absorb moisture.
- Careful specification of products, materials and finishes to minimise corrosion, deterioration and maintenance in the heat and moisture of tropical environments.
- The specification and installation of appropriate insulation to minimise condensation and moisture traps.
- Specification of cladding systems and glass that is resistant to cyclonic wind and impact from flying debris.
- Careful specification of proprietary systems and materials that rely on rubbers, adhesives, sealants, silicones, resins and binders, as these products may be subject to deterioration or delamination faster in the tropics due to high heat, humidity and mould.
- Avoiding specification of materials that may out-gas VOC's, as high humidity and heat may accelerate its release.
- Application of building technologies suitable for use in hot humid climates with attributes that may include: condensation control, mould control, heat and UV light resistance.
- Innovative use of technologies or materials, suitable for tropical climates.

7.0 ENERGY

7.1 General Energy Considerations

A well designed building will be naturally cool through passive design, have low solar heat gain and will have good levels of natural light. This will result in an overall reduced reliance on electrical energy. Alternative, renewable sources of energy are readily available to further reduce or even negate the need for non-renewable energy in a building.

Initiatives may include:

- Indirect, evenly dispersed natural light to reduce the need for artificial lighting during the daytime.
- Separate metering for tenancies to allow monitoring of usage.
- Designing electrical layouts (zones) that allow greater individual user-control to monitor and minimise the amount of energy consumed.
- Specifying and installing low energy fittings and fixtures, such as fluorescent or LED lights and appliances.
- Designing outdoor lighting to minimise light pollution to neighbouring properties (encouraging night time use of openings)
- Adopting renewable energy sources.

7.2 Tropical Climate Energy Considerations

- Design buildings to function well passively for tropical climates to minimise need for mechanical cooling.
- Careful design of efficient mechanical ventilation, dehumidification and air-conditioning suitable for hot humid climates.
- Include ceiling fans to increase evaporative cooling, and to reduce reliance on air conditioning.
- Take advantage of great solar access in tropical latitudes with PV energy sources and solar water heating.
- Innovative use of energy technologies, fittings or applications suitable for tropical climates. For example, the wet tropics have an abundance of water to produce hydroelectricity and water sources may also be used for heat transfer technology.

8.0 WATER

8.1 General Water Use Considerations

Clever design and use of technology around water demand and supply can provide a significant reduction in mains water usage. An increased awareness also results in a positive contribution toward alleviating the growing water problems in many areas. As our population grows we will continue to face the challenge of the rising cost of providing infrastructure. For instance, the use of rainwater tanks and onsite recycling can produce benefits such as a reduction in the use of pipe quantities, reticulation energy and waste treatment.

Other benefits may be the increased lot yields in subdivisions where land may be otherwise required for water containment ponds. Another benefit may be reduced erosion through a reduction of water flows that are diverted from water courses in peak rainfall periods as well as reduced flooding risks in urban areas.

Initiatives may include:

- Reduced requirement for landscape irrigation.
- Rainwater collected and reticulated for use in buildings and landscapes.
- Recycling and re-use of water including grey and black water.
- Low volume water fittings, beyond legislated requirements in NCC.
- Design landscape to suit local microclimate to reduce need for irrigation.
- Separate water metering to better enable monitoring use.
- Fire Services water supply: ability to store test water for reuse.

8.2 Tropical Water Use Considerations

- Designing for water supply and management for up to 1:8 dry/wet season volumes (temperate climates generally manage 1:3).
- Management of tropical pests and water borne disease.
- Tie-down of water tanks for cyclonic winds.
- Innovative use of water related technologies or applications suited to tropical climates.