TROPICAL SUSTAINABLE DESIGN CASE STUDIES

The Cairns Institute

Project type: Institutional

Location: James Cook University, Smithfield, Cairns, QLD, Australia
Year Completed: 2013

- **Imaginative and integrated design solution**
- **Material choices are robust but also elegant for a university building with civic functions**
- **The building is designed with passive solutions as well as a range of energy saving and management opportunities**

OVERVIEW

The Cairns Institute gives concrete expression to James Cook University's aim to become one of the world's leading research universities in the tropics. As a repository of regional knowledge and research capacity, the institute is perfectly positioned to make a significant contribution to the development of a sustainable quality of life for tropical communities.

The design challenge was to create a building that expressed the university campus as being a unique place in the world as well being a representative building of this university campus – a new type of iconic memory for JCU. The brief called for a unique and identifiable building that was instantly recognizable and memorable in the landscape. The design team had an opportunity to create a building that represented its place and its context in a new and exciting way which has resulted in the delivery of cutting edge design elements.

Attracting the best researchers was the central aim of the university, so it was crucial that the proposed building design would create an environment that optimised the working experience to a point where people would love engaging with the building. The design also endeavoured to make engagement with the research content of the building easy and intuitive – the researchers have the ability to display the work they do to the widest possible audience.

Intrinsic to the design proposition was a concept that celebrated the rainforest setting and enriched the place experience. The potential of an evolving skin, a 'trellis', defines the building and encapsulates aesthetics and sun control, as well as a creating a variety of micro climate ecologies around the building that are suited to their function and orientation.

The design aims to assist in minimising running costs for the university whilst contributing to the

quality of environment, and will be in line with the university's aspirations to achieve a sustainable outcome for the building.

Funding for the project was provided by The Commonwealth of Australia through the Department of Innovation, Industry Science and Research, and further funding by James Cook University.

PLANNING AND MANAGEMENT

The building was planned as three distinctly different areas.

Firstly the Workplace is an ordered office space with a contained and air-conditioned space. The space is highly efficient in terms of space usage and circulation is intuitive.

Secondly, the Public space/foyer is the space people enter into and access either the teaching spaces or the workplace. This space is designed to be deliberately institutional and even includes for the provision if natural ventilation and mixed mode when conditions are suitable. This space is also multi-functional – from breakout spaces to exhibitions to more formal events, this space offers a wonderful protected event space for the campus as a whole.

Lastly, the Teaching space is designed into two distinct 'pods' that are expressed as individual forms on the campus landscape. These spaces are generally enclosed and offer conditioned and focused set of teaching spaces for a range of group sizes.

SITE

The design reflects the beautiful, tropical landscape of far north Queensland. Key to the design was recognizing the topography of the site. Cradled on three sides by rainforested slopes, the site draws the tropical landscape into the heart of the campus, thus making the rainforest and stream that runs through the site the hero of the design.

The existing campus is designed on a related orthogonal grid structure with axial relationships between different precincts within the overall campus. Walking through the creek space is a remarkable experience and the architects endeavoured to capture this, that feeling of walking into a landscape – into the building.

Existing top soils were stockpiled on site and reinstated in the landscaping. Drainage swales are turfed and contoured to allow easy maintenance of erosion prevention vegetation within.

Plant species are native to the region, with some added New Guinea species to make a link with the wider tropical study region of the Institute. Shade trees are broad spreading types to maximize shade with

minimal planting. The major landscape element is turf, in two separate colours and selected for little or no mowing. Mulches are gravel and gibbers requiring very little maintenance. Soils are naturally moisture-retaining clays native to the site.

DESIGN

The most striking visual element is 'the trellis' that is selected as the building's most external feature. By scaling it up and 'draping' it around the building an overall building form that is legible from a distance also provides an armature for landscape interventions (eg creepers) should JCU decide to experiment with 'green wall' ideas later.

Another critical platform to the design was the steel 'knowledge wall' that forms an interface between the workspace and the foyer. The central idea was to create a building that anyone passing through could engage with – one can see knowledge and see it being created. This open framed structure contains a range of pop out offices and studio spaces as well as having display and projection opportunities. It can also be altered and added on through time. The 'knowledge wall' forms a spine through the building and is carefully integrated into the loadbearing form of the structure.

The design also has cantilevering parapets that frame the elliptical wings and conceal eave gutters and the segmented structural forms beyond.

Steel cladding is mounted on a sub-frame with an air-gap ventilating heat and minimising it from penetrating the inner concrete walls. The steel also cools quickly of a night time.

The selected building orientation enables prevailing winds to be captured with ventilation louvres in the foyer space creating a mixed mode building. Thermal control is ensured by high performance glass and well insulated roof spaces minimising heat transfer into the building.

MATERIALS

Material choices are robust and long lived as well as being suitable and elegant for a university building with civic functions. Engineering design solutions considered effective and efficient structure that was optimised to use the minimum amount of material. Careful consideration was given to the corrosion system of the building to ensure an enduring structure requiring only minimal maintenance.

The building has a range of hard wearing materials that relate to different parts of the building.

The base structure primarily consists of reinforced concrete columns and walls supporting 'flat plate' suspended concrete slabs. Composite concrete, pre-cast concrete and structural steelwork also contributes to the load bearing form of the building.

The internal and external corten or xlerplate steel façade is pre-weathered steel. There are 820 panels, the largest scale of use in a tropical cyclonic environment. The steel has a protective oxide film on the surface that provides a unique rustic appearance. It is very long lasting and maintenance free.

The manufacturer of the panels was unable to provide test data, design information, allowable spans or support fixings details for their product and The Cairns Institute had to be designed to withstand wind speeds of up to 263 km/hr with a fire rating of 120 minutes. The engineers designed custom panels and fixings for shadowed jointing, increasing flexibility to dissipate energy and stress in the fixings during large wind events. The cladding is mounted on substructure framing. The fixing spaces varied across the building and screw fixings and support framing was carefully detailed and electrically isolated to account for the diversity of the materials being employed.

The outer steel trellis has a weave of steel mullions and strappings with sections of the trellis curved in three planes. This external steelwork is hot dip galvanised for corrosion protection. The trellis is earthed for lightning protection.

The foyer and public spaces are defined by honed concrete floors and along with the steel and timber elements is robust and hard wearing.

The workspace component is a high performance glazing system with exposed ceilings and a textured carpeted floor. Timber doors create a sense of warmth and scale.

Teaching and Lecture Pods to the western aspect are site cast tilt-up structural concrete, protected from solar heat gain by the steel screen clad.

Curtain walls are variously single and double glazed as dictated by the elevation's insolation, and spandrel panels insulated, to meet BCA SHGC limits.

The roof is trapezoidal profile Colorbond steel in the light colour of surfmist.

The major public space in the building is able to be naturally ventilated when ambient conditions permit, via auto-opening louvers by Safetyline Jalousie JX adjustable louvers and motors. The large ceiling fans are 'Big Ass' fans.

ENERGY

The building is designed with passive solutions as well as a range of energy saving and management opportunities.

To reduce heat loads, the outer Cor-Ten steel panel façade is mounted on a sub frame with an air gap between the panels and the concrete walls to shield the concrete mass from the sun. In addition, the trellis also has a less effective shadowing effect. The steel elements cool quickly of a night-time.

To reduce heat gain glazed areas of the building are protected from sun by wide eaves and overhangs. The entry spaces are particularly wide to ensure that the threshold between outside and inside is wide and comfortable.

Building modelling ensured all facades glazing areas achieved BCA compliance of restricting at least 80% of the summer solar radiation. Low-e glazing is used in order to meet the BCA Section J glazing requirements. Certain building facades required double glazed sections to achieve compliance. This system provides JCU with extremely low thermal impact to the ongoing air conditioning operational costs.

Free daylight is provided by roof lights. Skylights by Dapalon use multicell polycarbonate with low solar heat- gain coefficient and low solar radiation transmission. Domelights are by Solartube.

A Lighting Automation System (LAS) is in place with energy efficient lights. The LAS provides readily controllable lighting modes to all multi-functional areas particularly the large theatre. The LAS also includes motion controlled lights in corridors, automatic shut off lights at a stated light level, daylight

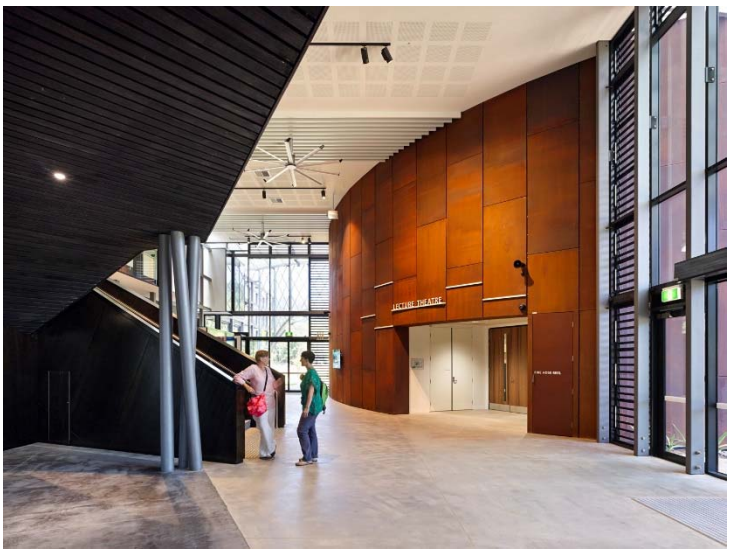
switching of external lights, and the ability to programme master functions into any location. The analysed and modelled lights exceeded the BCA energy levels by 41%, providing the end user with optimum ongoing energy savings.

Energy meters were installed to each areas electrical distribution board for code compliance, but also to allow JCU to monitor the areas electrical energy use in the future.

The building orientation enables prevailing winds to be captured with ventilation louvres in the foyer space, reducing operational electricity costs. The foyer has access to air conditioning throughout the year to provide occupant comfort. However when ambient external temperature and humidity levels are favourable, the foyer is provided with the following modes of cooling:

- Economy Mode – allows for increased outdoor air delivery to the Foyer when the external ambient temperature and humidity levels are lower than the required internal conditions. 'Big Ass' fans are operated to assist air movement.

- Natural Ventilation – allows 'Free Cooling' by opening all of the ventilation louvres, and operation of the 'Big Ass' fans for assisted air movement / comfort.



The buildings air conditioning systems have been designed to include energy saving elements. A zoned air-conditioning strategy, allows optimum occupant comfort. The buildings required outdoor air is pre-conditioned via an energy recovery plate heat exchanger 'Figure 8 systems, removing the airs moisture. Carbon dioxide CO2 sensors are used to provide optimum outdoor air delivery to meet legislation requirements. Motion sensors are provided to the transient used areas such as the lecture theatre and multi-function pods. If unused, the areas temperatures are elevated to conserve operational costs.

All air conditioning units and chilled water pumps are provided with high efficiency motors, and variable speed drives for lowered operational costs and is connected to the site-wide reticulated chilled water system.

The foyers air conditioning system is provided with dew point sensors detecting the moisture content of the air. If during the natural ventilation 'Free Cooling' mode the areas due point exceed the adjacent office spaces level, the foyer A/C is activated to prevent condensation on the adjoining office glazing areas.

WATER

Rainwater is harvested to a storage tank below service driveways and used for toilet flushing. There is provision for connection of the irrigation system to the Cairns City recycled water network in future.

Low water use fittings were chosen as expected by the relevant building codes at the time.

OWNERS/USERS STATEMENT

What is most enjoyed are the design of the front foyer for big meetings, the lecture theatre for its design and visual aesthetics, the light throughout the building.

PROJECT TEAM

Base building architect/ designer: Woods Bagot Architects
Other architect/ designer: RPA Architects
Interior designer: Woods Bagot Architects
Civil engineer (Site and traffic): Flanagan Consulting Group
Structural engineer: Flanagan Consulting Group
Services engineer: (mechanical electrical, hydraulic, fire): Ashburner Francis (Mechanical & Electrical) / H2O Consultants (hydraulic)
Project manager: Hansen Yuncken (Design Managers and Managing Contractors)
Energy efficiency rating consultant: Ashburner Francis

Other consultants:
Landscape Design - Andrew Prowse Landscape Architect
AV Consultant: B&H Australia
Acoustic Engineer: Ron Rumble Pty Ltd
DDA Consultant: Architecture and Access
Signage Consultant: DotDash
Quantity Surveyor: Beacon Consulting
Builder: Hansen Yuncken
Additional structure: Cor-Ten/ Xlerplate screen wall: Contractor- One Steel, folded by Jackson & Jackson Cairns
Other main contractors: Research building glass curtain wall: G James

Photographs courtesy of Woods Bagot

For more information visit: **www.jcu.edu.au/tsd**
www.greenbuild.com.au

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