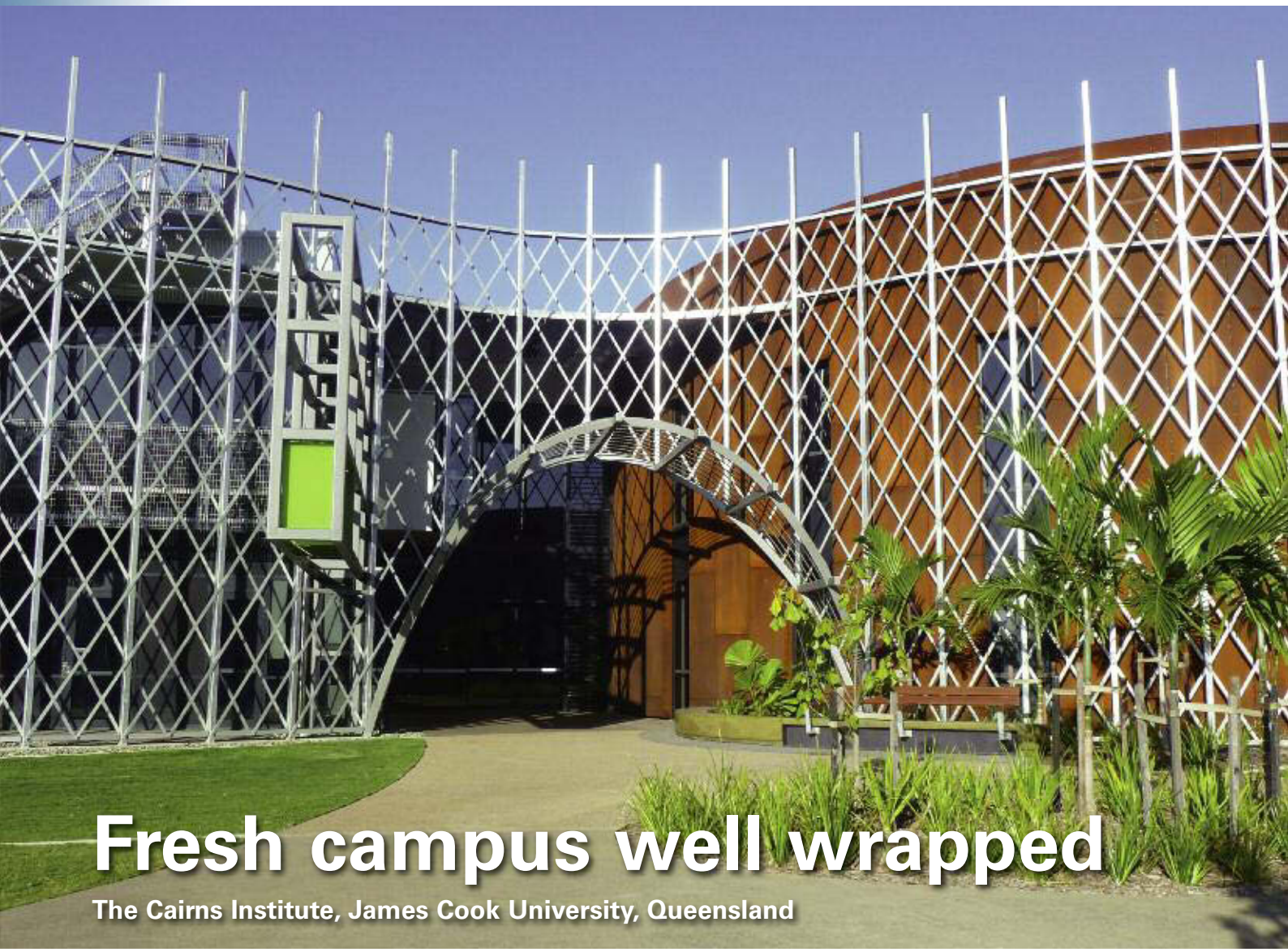

Fresh campus well wrapped

The Cairns Institute, James Cook University, Queensland

A distinctive double-layered and steel-based façade envelopes James Cook University's recently completed and Commonwealth funded Cairns Institute building from the climatic extremes of Queensland's tropical north.

Inside the two-storey structure is essentially three buildings: a long rectangular research and office wing and two oval 'pods', the lecture theatre and seminar pods, all linked together by a two-storey high exhibition and display foyer.

The project's structural engineer and Associate of Flanagan Consulting Group, **Liam Kenny** presented an efficient and cost effective structure to suit the winning building design submission by Woods Baggot and RPA Architects. This design reduced each building wing back to basic, easily constructible skeletons from which complicated layers of steel façade and trellis framing were readily mounted.

"The detailing for the precast panel fixings, suspended slab connections as well as all concealed steelwork was kept as simple as possible to reduce construction time and cost," he said.

"The inner façade and outer trellis framing had completely different structural demands but required an integrated support system to align with the sheeting joints and the substructure framing."

The inner façade consists of 780 individually detailed weathering steel panels supported by a framework of light gauge framing carefully detailed to reduce corrosion and provide the maximum degree of tolerance onsite. The project is the first time weathering steel has been used on such a large scale in a tropical, cyclonic environment in Australia. Weathering steel is protected from corrosion by a patina of stable oxide.

"Each panel was shop drawn for cutting on a CNC machine and individually shop drawn for the folding machine. Internal panels were pre-weathered onsite and external panels weathered in situ," Mr Kenny said.

"A custom lifting clutch bracket was engineered and manufactured by the steel fabricator to lift panels into place.

"Unique, adjustable RHS 'T' brackets with slotted base plates were fabricated allowing multi-directional adjustment through a 'hit and miss' methodology for the masonry anchor fixings into the precast wall panels.

"Tolerance was provided throughout every step of the façade assembly with adjustable bolt holes off the wall panels, lateral field adjustments of the RHS, plastic wedges to shim and suit the angle of the support mullions, rebated returns on the sheets to enable them to 'flex' and pull into position and predrilled oversized holes in the sheets to provide further adjustment to suit the mullion alignment."

He said that the outer, latticed 'trellis' structure comprises a forest of RHS mullions with over five kilometres of steel plate strapping with over 10,000 bolted connections through the mullions. A curved PFC

ring beam provides lateral support to the top of the mullions and is braced back at selected points to the main building (positioned to align with sheeting joints). The mullions were in turn utilised for vertical support to the PFC which enabled the frequency and size of the fixings back to the building to be minimised which delivered the 'floating effect' sought by the architect.

"The most challenging aspect of the trellis design was the entry 'eyebrow' structures at the north and south entries to the building," Mr Kenny said.

The opening arch bridges a 10 metre curved (in plan and elevation) opening in the trellis structure that is subject to both lateral and uplift loads (supporting a section of the roof). The final structural system for the eyebrows consisted of a pinned based arch supported by a modified vertical vierendeel truss (framed from the RHS mullions) and braced laterally by a curved (in plan and elevation) horizontal vierendeel truss (framed from the welded outriggers to the overhanging awning). Rigid connections were achieved through an innovative spigot arrangement that utilised epoxy injected into the connection to 'lock up the joint' and reduce rotation or slip.

Cairns Steel Fabricators (CSF) developed several full-scale prototypes of the trellis structure in the early stage of the design. CSF Director, **Sean Adams** said initial prototypes started with fabric for the trellis before the flat bar option was selected.

"The prototypes enabled the consultants to confirm connection details and material type and sizes prior to final documentation. We set up temporary columns and fabricated several of the curved 'eyebrow' sections as if they were in their finished position," he said.

"We liaised very closely throughout the detailing phase as some assemblies were curved in three planes and extremely difficult to fabricate. We ensured that the most cost effective option was documented taking advantage of repetitive types of connections."

He said that a large lay down area at the construction site had been established and CSF sequenced deliveries and installation with the builder to minimise the impact to other trades as the façade effectively removed access for large machinery into and out of the building.

All external steelwork was hot dip galvanized which presented logistical challenges (the nearest galvanizing plant is 400km away) and detailing issues (limitations on member sizes and a requirement for no site welding).

Mr Kenny said a defining aspect of the Cairns Institute is the knowledge wall which effectively cuts the building in half and cantilevers 7.2 out of each end of the complex. The knowledge wall consists of two modular, welded frames 0.8m apart and welded together at regular nodes to provide a 'box' like structure. The structure is penetrated randomly to support cantilevering rooms and offices.

"The most significant cantilever is for the main boardroom which extends three metres beyond the research wing slab with only a 0.8m back span and a 150mm structural floor depth," Mr Kenny said.

"This arrangement was rigorously analysed with pre-cambering and partial restraint from the roof being introduced to ensure the floor was dynamically serviceable. The knowledge wall also provides support to the first floor slab, the roof structure and the heavy plant room enclosure mounted at roof level.

"To limit the expense of fire rated paint, multiple load cases and partial failure analysis were undertaken on the knowledge wall steelwork to determine the minimum elements that had to be fire rated to achieve the desired fire rating."

The foyer bridge connecting the building wings comprises a jointed, polished concrete Condeck-suspended slab that was saw-cut at regular intervals to ensure a crack free finish. The slab is supported by a grid of steel beams with the sawn joints being cut directly above and perpendicular to the supporting beams to provide a joint grid that matches the ground floor foyer slab below.

Project Team

Managing Contractor: Hansen Yuncken

Architecture: Woods Baggot and RPA Architects

Structural and Civil Engineering: Flanagan Consulting Group

Steel Fabricators: Cairns Steel Fabricators (exterior trellis work and sub-frame), Fitzroy Fabrications (main building, internal façade panels and sub-frame)

Steel Detailing: DRB Drafting, Fitzroy Fabrications

Hot Dip Galvanizing: Australian Professional Galvanizers

ASI Steel Distributors: BlueScope Distribution (Townsville), OneSteel Metalcentre (Cairns)

ASI Steel Manufacturer: BlueScope Steel