Open design defies high wind loads

Flinders Street Redevelopment, Townsville QLD

A steel-intensive approach allowed construction of an invitingly open community facility for a popular meeting spot located within one of Queensland's cyclonic zones.

The guiding design principles of the project were to restore the long classical sightlines of Flinders Street in downtown Townsville, open it up more with neighbouring city precincts and create environmentally sound community and commercial spaces.

The undertaking comprised two separate project works; one to create a series of shade shelters and the other to develop a pavilion as focal point of the redevelopment. The shelters involve 23 shade structures spread along Flinders Mall comprising three high and two low gateways and 18 other shade structures.

The intent for the shade shelters and the pavilion roof structure was for the roof elements to appear 'floating' and for the columns supports to be as slender as possible to maintain sightlines and limit obstructions to the street views and views to significant adjacent buildings.

The 865sqm pavilion consists of a café and amenities building nestled below a larger shade roof that form two independent structures acting as a single building.

Welcome without walls

According to the lead project engineer at AECOM, **Phil Latham** the architectural intent for the pavilion was for a roof structure that appears to 'float' allowing air to circulate and daylight in. The roof utilises a two-way portal frame to reduce the need for vertical bracing or shear walls that is common to many steel structures.

"The high level roof to the pavilion building adopts a two-way sway frame, a system that makes use of the stiffness of the columns and rafters in two orthogonal directions," he said.

"Whilst one-way sway frame systems are common place in portal frame structures, two-way sway frames are generally not. This system was chosen to provide a roof that 'floats' without conventional bracing needed.

"Located in a highly cyclonic area, this system allowed for completely open sides so there is no requirement for walls or cladding to hide bracing, dramatically minimising horizontal wind loads."

The structure comprises a number of architectural details such as skylights, cantilevers and visual elements that directly influenced the steel design, yet were incorporated into the overall building without unnecessary structural attention.

Viereendeel frames allow the steelwork to stabilise and support the cantilever structure without interference from cross bracing. Compression/tension struts were employed in lieu of cross bracing and coordinated with building services.

The overall size of the building demanded prudent identification of the primary and visually important elements of steelwork such that splice connections could be located to address the technical, visual and transportation requirements.

The typical problems of two-way portals leading to awkward and difficult connections at the columns was an area that received detailed attention early in the design process to ensure a coordinated and buildable solution was embedded into the design from the beginning.

To produce a suitable column cross-section that is robust in bending in two directions, is amenable to connections for the two-way portal and reveals architectural details, a composite column was adopted.

Each column comprises a central square hollow section (SHS) with prefabricated columns either side to create a thin, yet strong structure which allowed rainwater, electrical and data services to be integrated within whilst adding to the aesthetic appeal of the structure.

Made for the shade

The street shade shelters feature extensive cantilevered overhangs which enhance the 'floating' roof effect. Rigid connections at the base and top of the columns were utilised to achieve the required stiffness and minimise column size. The columns for the shade shelters feature a fabricated composite section utilising rectangular hollow sections (RHS) and plate elements for an aesthetic result satisfying strength and stiffness requirements.

The shade structures were designed and manufactured to a higher than normal loading due to their proximity to adjacent buildings. All fabrication was undertaken at a specialist all-weather site so quality control of the welding could be guaranteed and specific tolerances achieved.

A prototype was built which provided a test bed for materials, stability, jointing, tolerances and cladding. It also allowed the client to sign off on the concept and design, allowing them to see and feel the product they were about to receive.

The structures were transported in two separate portions with no site welding required for work health and safety reasons given the busy pedestrian traffic in the installation area. This process also sped installation to two structures per day and limited use of cranes onsite.

Project Team

Client: Townsville City Council

Architecture: Cox Rayner

Structural Engineering: AECOM

Building Contractors: Hansen Yuncken (pavilion), Watpac (shelters)

Steel Fabricators: Cairns Steel Fabricators (pavilion), Wulguru Steel (shelters)

Steel Detailers: Pryde Drafting (pavilion), Wulguru Steel (shelters)

Finishing Contractors: Cairns Steel Fabricators, Wulguru Steel, Waters Abrasive Blasting

Coatings Suppliers: Dulux, International Paint

Metal Building Contractor: Combined Metal Fabrication

ASI Steel Distributors: BlueScope Distribution, OneSteel Steel & Tube

ASI Steel Manufacturers: BlueScope Steel, OneSteel