



Perth tower agape to grand views

An external structural steel 'mega frame' has allowed a major new Perth office tower clear views of the Swan River and the city's breathtaking hinterlands directly from the building's central core.

A key ask from major tenant, BHP Billiton for the City Square Development was to allow for sweeping views of Rottness Island, Swan River and the Perth hills as befitting one of the CBD's premier locations, not interrupted by a traditional building core.

The project's principal structural engineer from Aurecon, **Angus Leitch** explained that the requirement was met by incorporating an offset concrete core on the northern side of the tower that includes an open back so that the lifts installed can be seen going up and down the building.

"But the offset core and the resulting torsional response or mode of vibration presented significant challenges for the building," he said.

"The external 'mega frames' and 'mega columns' on the east and west ends of the building are pivotal in the performance of the building to alleviate that concern."

He said that the use of concrete-filled steel tube columns and un-propped steel beams also avoided the need for temporary propping during construction.

The external 47-level structural bracing system on the east and west elevations was clad to achieve a distinctive and impressive external feature as well as provide structural stability.

City Square comprises a 72,750sqm office tower with four basement carpark levels surrounded by a landscaped podium and retail and heritage buildings. The tower structure has 47 levels which rise approximately 200m above the podium and a capital approximately 37m high crowns the structure. The tower is linked to a four-storey building on the north side by a glass roofed atrium. This structure has a combined footprint at the podium level of about 4000sqm.

The tower structure required around 9500 tonnes of structural steel made up of 2500 tonnes of spiral tube columns ranging from 1350mm to 500mm diameter, 4900 tonnes of floor beams and bracing and 950 tonnes of connections, and 1200 tonnes of fabricated reinforced cages which had to be shop fitted into the columns prior to delivery to site.

Project Director with Brookfield Multiplex, **Tony Hodder** said a composite steel solution was chosen primarily due to speed and ease of construction through reduced crane time onsite.

"Considering the resources available within the construction industry at the time of beginning this project and aligned with time (constraints) and difficult site access, a decision was made to construct the structure using a reinforced concrete core, tubular steel columns which are reinforced and concrete-filled, and a composite



metal deck floor slab supported on structural steel beams," Mr Hodder said.

But the speedier construction time afforded through the use of structural steel could only be achieved through sound coordination of all the consultants' and subcontractors' requirements. The whole building frame needed to be project managed to take advantage of the fast floor cycle times, programmed at a six-day cycle per floor. The core had to achieve the same rollout rate.

This meant appointing sub-contractors capable and experienced enough to work accurately and meet cycle times, through adequate craneage, and the use of four high-speed Alimak hoists and two jump lifts. Protective self-climbing screen systems covering three floors and specialised access platforms were purpose-designed to facilitate the speed required in the cycle times.

The floor plate required 76,000sqm of steel decking site-fixed to the floor beam with shear connectors. A further 500 tonnes of fabricated steel was necessary for the capital, complete with internal access in the columns for ease and safety of erection, access to signage and for maintenance and periodic structural inspections.

"The decision to use structural steel framing was strengthened by the excellent fabrication facilities around Perth ensuring that the highest quality of work would be achieved," Mr Hodder said.

"By designing the fabrication and erection methods to utilise the available fully-automated computer-controlled beam lines, profile cutters and welding machines, a program of fabrication could be proffered to ensure that all construction target dates would be achieved."

He added that the decision to use structural steel was further endorsed by the success of other steel framed buildings built in Sydney by Brookfield Multiplex in recent years; namely the Latitude East building and Australian Taxation Office at World Square and the iconic Macquarie Bank building at King Street Wharf.

Brookfield Multiplex has viewed the design and documentation to be of paramount importance and set up a regime for cooperation between consultants, steel detailer, fabricator and subcontractors (mechanical, electrical, hydraulic, fire, lift and façade).

"This allowed a holistic coordination of the structure to minimise errors and site rectification and optimise safety onsite," he said.

"Many ideas and processes were incorporated into the design through this consultation and coordination with advantages to all through mutual cooperation and timely implementation.

"Some of the advantages of this coordinated approach can be seen in the design of mechanical and fire penetrations through floor beams where each floor was examined and penetrations placed in the optimum position to help keep the beam sizes to a minimum and allow ready repetition in fabrication."

Another significant decision was to use single and double bolted angle cleats for the beam to beam connections.

"This took advantage of the beam line process allowing the beams to be cropped, notched and drilled and placed straight into a stillage for delivery in the order required for the erection sequence," he said.

"Staggered column splices were introduced into the planning which allowed the cycle of beam erection, decking, reinforcement and concrete placement to be continuous with each floor being completed in a six-day cycle.

"Basically, we took full advantage of a vibrant and competitive steel fabrication industry to achieve an iconic building for the Perth skyline."

The building is due for completion in 2012.

Project Team

Builder: Brookfield Multiplex

Structural Engineering: Aurecon

Architect: HASSELL Architects and fitzpatrick+partners

Steel Fabrication: Pacific Industrial Company and Steelpipe Australia

Steel Detailing: Detailed Design Drafting

Coatings: Total Corrosion Control

Cladding: Yuanda Australia