Interwoven ways create elegant venue for big events

Carrara Stadium, Gold Coast Queensland

The combination of a well-established design and construct team and integrated technologies tightened re-development of the old AFL football ground on Queensland's Gold Coast as a lightweight structure sturdy and smart enough to host world-class events.

As well as being home of the new Gold Coast Suns AFL Club, the 25,000-seat stadium will be able to also host Twenty-20 and international cricket matches and major outdoor concerts. It has also been designed to accommodate the State's bid for the 2018 Commonwealth Games.

Everything from the old grounds was flattened to create the new Carrara Stadium except for just six light towers with a fifth of the facility's power to be generated by solar panels.

The project benefited from the long-term relationship between steel fabricator, Beenleigh Steel Fabrications (BSF) and, builder Watpac from their work on Brisbane Cricket Ground (Gabba), Suncorp Stadium, Pat Rafter Arena and the Gold Coast's Skilled Park.

And this time they were able to draw from engineer Arup's international experience in designing iconic stadia structures too.

Lead engineer **Josh Neil** from Arup's Brisbane office said the majority of the lessons learnt on how to develop better structural efficiencies were considered at the early stages of the project and throughout the design and construction process.

He said that the steel frame approach allowed for larger panels of the polytetrafluoroethylene (PTFE) roof fabric to be supported for the roof to be completed shortly after the erection of the roof steelwork. The roof panels of approximately 12 by 32 metres each were installed generally within a day.

"And the seating bowl will have some of the best sight lines in Australia due to minimising the number of support columns due to the decisions made in the selection of a larger structural grid," Mr Neil said.

He said that 3D modelling was adopted throughout all phases of the project using readily integrated systems to streamline development.

"The project was modelled and designed by Populous and Arup in Revit® and complex geometrics and curves were form found in Rhinoceros® and then imported back with information exchanged using this platform rather than paper format," he said.

"We imported the final curved 3D roof forms from Revit® directly into structural analysis package GSA for final analysis and determination of structural steel sizes once the final shape and form was confirmed.

"The shop detailer, TD Drafting was able to utilise the Revit® model at the formative stages of the design to assist in creating a ProSteel 3D model. The ProSteel model was used to assist in coordinating steel, precast and membrane roof trades."

He said that as the design progressed, Arup was also able to utilise Revit® to create 3D steel as connections embedded in standard 2D Adobe PDF documents that simplified the interpretation of complex 3D details within the building.

As the project accelerated, minor architectural and structural changes as well as coordination issues were easily modified often directly by the shop detailer on the ProSteel model which enabled swifter delivery of steel from the fabrication yard to site.

The original plans were for two main grandstands on either side with uncovered seating behind both goals, however additional funding allowed for the roof to continue around the southern end forming a horseshoe canopy over the main seating areas.

Throughout the design process, BSF provided valuable input into the availability of steel for the project ultimately reducing the need to source overseas product, reducing potential waiting times and program risk.

"The boundaries between designers, shop detailers and fabricators continue to overlap with this project being an indicator that the days of two dimensional drawings are numbered with 3D tools becoming predominant in all aspects of project delivery," Mr Neil said.

He said that one of the principal lessons learned from previous projects was to simplify the fabrication process of the roof steel structure via the adoption of simple planar roof trusses, located on the main structural grid.

"A lightweight 23 metre cantilevering solution was found through maximising the structural depth of the roof trusses," he said.

"Wind modelling by CPP considered various configurations of the ground for future proofing purposes and structural design that incorporated roof membrane loading, optimising the roof steel to achieve minimum weight for design loading and structural configuration."

He said the roof trusses and the two rear double-rolled hoops called for the most complex fabrication on this project as the exact positioning of the fabric connection brackets to the top chord of the trusses and hoops was critical for the positioning/tensioning of the roof fabric. The tightness of the radii to the two rear double-rolled hoops meant the CHS required hot induction bending. The majority of steelwork was exposed and painted with a polysiloxane system.

Mark Finney of BSF said the finish of the fabricated article was paramount and required additional attention by the fabricator, painter and erector.

BSF supplied and erected approximately 2700 tonnes of structural steel encompassing raking seating beams, columns and bracing for the east, west and south bowl (1823t); 30m by 4.8m CHS trusses, CHS fabric support hoops and bracing for the east, west and south roof (653t); columns, rafters and bracing for miscellaneous satellite structures on the stadium grounds (144t); CHS columns, ties, camera platforms, walkways and screens for the north and south scoreboards (49t); and 12m x 5.4m RHS frames for the solar panel support frames (40t).

Fabrication started in March 2010 progressing in tandem with erection onsite. The roof trusses and solar panel frames were fabricated in BSF's two workshops at Crestmead and Rocklea involving a workforce of 90 including boilermakers, welders and apprentices, transported to painter and then to site in one piece.

The $144 million redevelopment is due for completion in May 2011 and remains on time and budget. Data provided by the AFL predicts that this project will generate $415 million of economic activity over a 10-year period as well as a direct tourism impact of $34 million every year through day trips and overnight stays for AFL matches.

Project Team

Builder: Watpac

Architect: Populous

Structural Engineer: Arup

Steel Fabricator: Beenleigh Steel Fabrications

Steel Detailer: TD Drafting Services

Steel Processing: BSF Metal Centre

Protective Coatings: Tranzblast Coating Services

Profile Cutting (lacing and chord members): Pipe Profiling Services

Hot Induction Bending (CHS): Inductabend

ASI Steel Manufacturers: BlueScope Steel and OneSteel

ASI Steel Distributors: BlueScope Distribution (welded beams, hot rolled structural sections, line pipe and plate); OneSteel (welded beams, hot rolled, structural sections, line pipe and RHS tube)