Outstanding steel project

Melbourne Sports & Aquatic Centre

The Melbourne Sports and Aquatic Centre (MSAC) located north west of Albert Park Lake has undergone a major upgrade, enabling it to host swimming, table tennis and squash events for the 2006 Commonwealth Games.

The centrepiece of the upgrade, and the focus during the Commonwealth Games, is a 52 metre by 25 metre roofed outdoor competition pool, a 3,000 seating capacity grandstand which incorporates amenities for officials, athletes and spectators, all part of the infrastructure legacy for hosting the Commonwealth Games. Thanks to innovative design, the seating was expanded for the Games and retains that expandable capacity for future special events. Other new facilities include:

- new hydrotherapy facilities
- new amenities, function, office and retail space
- enhanced public transport access
- a multi-level 300-space car park
- an extensive refurbishment of the former South Melbourne Technical School to accommodate the School of Sport and Recreation.

The new facilities complement the existing integrated sports complex which has squash and badminton courts, lap pool, wave pool, table tennis hall, 75 metre, 10 lane swimming pool, waterslide, café and bar, crèche and children's activity centre.

The temporary roof has a different fabric for economy and speed of erection/ dismantling. They have conical forms with internal push–up masts and parametre mast catenary cable supports.

Long span welded steel beams 1,000 millimetre deep dominating the concourse. Castellated style penetrations have been cut into the beams to lighten the visual impact.

The new Stage 2 structure had to be assimilated into the existing building while keeping disruption to a minimum. One of the construction challenges was that all these facilities had to remain open and functioning during building operations of Stage 2.

Another major challenge was the number and complexity of stakeholders involved in the project. Major Projects Victoria managed the project for the client, the Department for Victorian Communities. The project team, which included Peddle Thorp Architects, consulting engineers Connell Wagner, builders John Holland Group (JHG) and steel fabricator and detailer Samaras Structural Engineers, also needed to liaise with numerous other groups including the Sports Centre, Sport and Recreation Victoria, Albert Park users, public transport travellers and suppliers, residents and property owners, the Grand Prix Corporation and Parks Victoria. The project team worked in harmony as a close knit group to deliver a project of style and excellence for all these stakeholders.

Design challenges included a restriction on the roof height, spectator sightline considerations and the need to design a permanent roof structure which was light but had adequate strength capacity to support the significant loads from the temporary roofs. The limiting height and spectator sightline constraints forced a relatively flat roof solution.

Connell Wagner Associate, Dean Armstrong said that the final geometry of the exposed roof structure was developed by Connell Wagner in close consultation with the architect. The resulting reference 3D model was used for the structural analysis model and also within the background of the structure and the architectural drawings to ensure that design was accurate and coordinated at every stage during the development of the roof design.

Slender cigar shaped tapered columns were connected to the roof structure at a third of their height.

A highly translucent roof was selected to maintain the outdoor ambience and minimise the visual impact of the new pool on the existing complex and the Albert Park site. Two additional temporary roofs were needed to cover the additional seating during the Commonwealth Games.

Expressed steel and glass facade at the enterance to Stage 2. Cable stays connecting the new structure to the existing building can be seen.

Rob Normand, JHG's Project Manager explained that the complex permanent roof structure consists of cable stayed structural steel masts supporting primary and secondary prefabricated three dimensional steel roof trusses.

According to Dean "large areas of tensioned PTFE fabric span between the roof trusses with glazed skylight sections provided above the secondary trusses over the pool. The double curvature of the fabric is formed by "push-up" steel arches, some of which span up to 26 metres. Connell Wagner carried out "form-finding" of the fabric areas in house in order to accurately determine the fabric loads transmitted to the steel structure. The design was confirmed by the specialist subcontractor, Taiyo Membrane Corporation."

The cable stayed primary roof trusses over the pool span 70 metres. These roof trusses are cable stayed for downward acting loads, gravity and wind loads, while upward acting wind loads are resisted by arching action in the primary trusses, which are tied at each end with additional cables to facilitate this resistance.

One of the challenges was to design the 35 metre high cable stayed masts at each corner of the pool roof to be as slender as we possibly could. These cigar shaped tapered columns were connected to the roof structure at a third of their height. The columns were slotted and formed around the outside of the vertical plane of the primary trusses. Pinned connections were adopted at the base of each mast and at each "knuckle joint" connection to the roof trusses in order to prevent the columns from picking up bending loads. A buckling analysis was carried out for these key elements.

"A permanent grandstand roof is attached on the west of the pool roof and the temporary roofs on the north and west. The temporary roofs provided shelter to an additional 7,000 spectator seats in the Commonwealth Games mode," Dean said.

"These temporary roofs have a different fabric concept selected for economy and speed of erection/dismantling. These roofs use conical forms with internal "push-up' masts and perimeter mast catenary cable supports. Complicated load paths were necessary in order to transfer the tensile fabric and cable loads from temporary roof structure, via the pool roof and the surrounding building down into the foundation structures" Dean concluded.

Pinned connections were adopted at the base of each mast and at each "knuckle joint" connection to the roof trusses in order to minimise bending action in the masts.

A cable stayed steel frame of the pool roof spans 70 metres and supports three tensioned fabric panels. Temporary seating is to the right and centre.

Rob said "the building structure consists of bored CFA (Continuous Flight Auger) type piles supporting a suspended ground slab. A mixture of precast and structural steel columns were adopted with composite steel floor beams typical in the amenities and grandstand areas. Long-span racking fabricated steel beams were used to support the precast concrete seating plats."

Dean advised that: "the precast seating plats and supporting steel beams were checked for dynamic performance to ensure there was no perceptible vibration to the spectators."

Brett Diprose, Peddle Thorp's project architect on MSAC said that: "The glass encased steel structure forms the entry to the new aquatics and presents a northern address to the facility off Albert Road. The ground floor entry opens to the reception desks, ground level public amenities, elite sports amenities, the 52 metre outdoor pool and links to the existing 75 metre indoor pool and leisure water facilities."

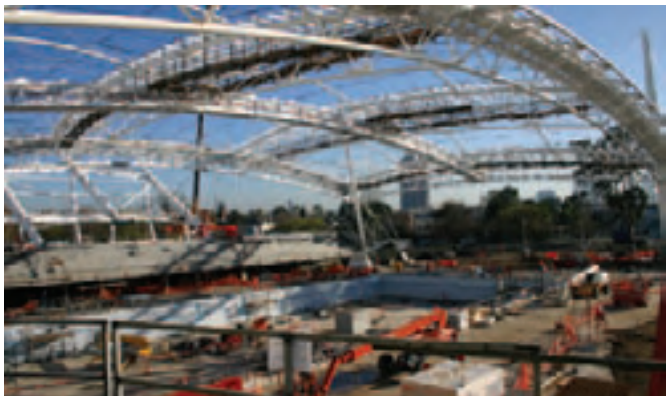
"A lift and generous staircase provide access to the level 2 concourse overlooking the new pool and connecting the function spaces, access to existing indoor spectator seating, the outdoor permanent grandstand and the link bridge to the multi-level car park."

"The external rear wall of the grandstand concourse is raked outwards and made up of expressed structural steel framing, encased in glass, louvres and insulated steel panels. The white steel beams supporting the plats are 1000 millimetres deep and dominate the concourse. Large castellated-style penetrations have been cut out of these beams to lighten their visual impact," Brett concluded.

Two walkway bridges link the amenities and hydrotherapy buildings to the upper level of the carpark. These bridges have been constructed using structural steel beams, a concrete slab and metal deck roof.

Adelaide based Samaras Structural Engineers fabricated and erected more than 900 tonnes of structural steel including secondary components.

The Victorian Government's investment of over $50 million in Stage 2 of the Melbourne Sports and Aquatic Centre has created a world class integrated sports complex. The realisation of this investment was made possible through the outstanding expertise and close teamwork of the project team. The Premier Steve Bracks officially opened the new facility on 20 December 2005.



The permanent frame of the pool roof is supported by four space-trusses, to which the grandstand roof is attached on the west and the temporary roofs on the north and west.

Detail of construction work. Samaras Structural Engineers fabricated and erected more than 900 tonnes of structural steel including secondary components.

Project team
Client: Department of Victorian Communities
Project Management: Major Projects Victoria
Architects: Peddle Thorp Architects
Structural Engineers: Connell Wagner
Building Contractor: John Holland Group
Steelwork Contractor: Samaras Structural Engineers
Steel Detailing: Samaras in House Detailing
BDS Technical Services
Fabric Roof Contractor: Taiyo Membrane Corporation
Protective Coating: Ameron Coatings