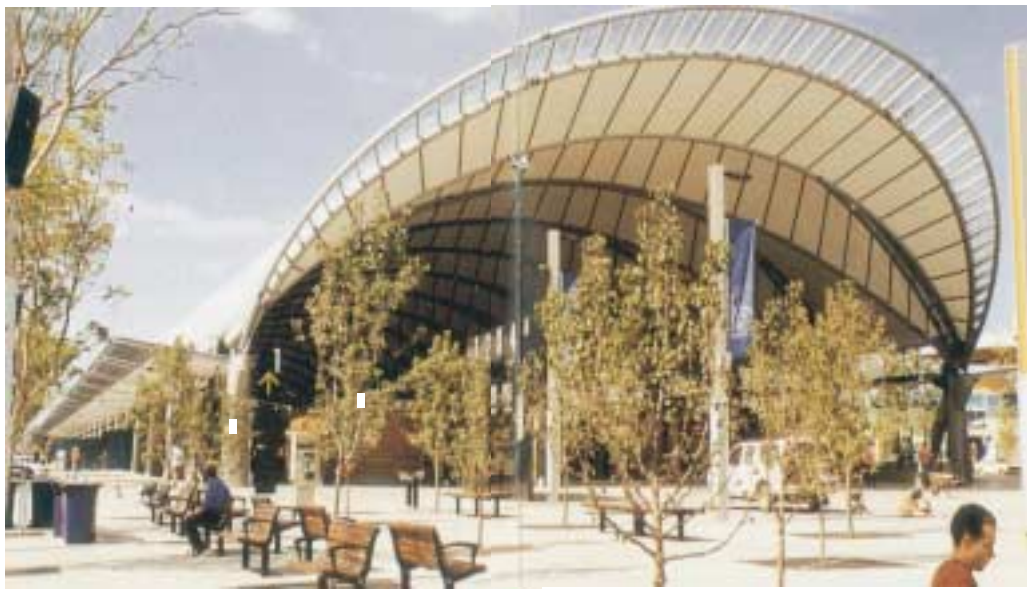
This case study was written at the time when OneSteel was part of BHP. In that context, in some instances within this case study, reference may be made to BHP.



# Leaves envelop Olympic Tracks

*The stunning Olympic Park Railway Station has received much praise and recognition in the past year within the construction industry, throughout the wider community and also through major architectural and engineering awards. Tierney and Partners, the project's structural engineer, recently received the Structural Award of Merit at the Association of Consulting Engineers Australia's Annual Awards Dinner in November 1998. The criteria against which the project was judged included; originality, innovation, quality of engineering, client satisfaction, benefit to the community and value to the engineering profession.*

*Olympic Park Railway Station can be added to the list of previous winners of this prestigious award such as the Cairns Convention Centre (1997) and the Sydney International Aquatics Centre (1995).*

At the heart of Sydney's Homebush Bay is the new Olympic Park Railway Station, centrepiece of the public transport system that serves the Sydney Showground and the sporting venues being constructed for the 2000 Olympic and Paralympic Games. With the New South Wales State Government's emphasis on public transport as the preferred mode of travel to and from Homebush Bay, the new railway station is likely to be the most visited facility on the entire site. It is fitting that the station's architects, Hassell Group, have provided a design for the station which will ensure it becomes one of Sydney's most distinctive and recognisable buildings. The ability of structural steel to convey both strength and beauty, makes the roof the most remarkable element of this new station.

Structural engineers for the design of the entire station, Tierney & Partners, worked closely with the architects to develop a concept design and to produce a completed structure which is unlike any other public building in Australia. The striking feature of the roof is a series of arches which span the width of the entire station, much in the same manner as the huge vaulted roofs of some of the major railway stations in Europe. These giant enclosed stations from past eras create feelings of excitement, expectancy and security for the traveller and they are invariably soaring structures of steel and glass; the Olympic Park station is an example of the way in which modern design, fabrication and construction techniques can be incorporated into a steel structure and still invoke the same sorts of feelings.

## Steel: A Structural 'Natural'

Spanning the 35 metre width of the station and extending for its entire 200 metre length, the station roof rises to a height of 20 metres above the platforms which are located 5 metres below ground.The roof is made up of 18 arch segments, each 12 metres wide and spanning 35 metres. Each segment consists of the main arch formed of twin 355 CHS sections, separated horizontally by a glazed 300 mm aperture providing spectacular curved slots of light.

*Above: View along 200 metre length of railway station.*

*Above, centre: 'Springing point' connecting linking columns to barrel vaults.*

*Left: Cantilevered canopy provides a grand entrance to the Olympic Park Railway Station.*

In addition to these 'upright' arches, in each segment of the roof there are two side or 'leaning' arches composed of single 355 CHS sections which spring from the same points as the upright arches. These side arches lean towards the segment on either side, so that the crowns of adjacent leaning arches touch. Between each upright arch and its two leaning arches run 200 x 100 RHS sections, so that in the analogy of a leaf, the main arch is the spine, the leaning arches form the two edges of the leaf, and the members linking the main and leaning arches are the veins of the leaf. The interior lining of the roof has left all of these members exposed so that the 'leaf' structure may be viewed from within the station.

While the leaning arches of adjacent segments come together at their crowns, other points on adjacent leaning arches are linked by universal beam sections. These sections are hidden by the lining of the roof so that, from the underside, adjacent roof 'leaves' are linked by a barrel vaulted ceiling.

The springing points for the upright arch and two leaning arches in each roof segment are expressed architecturally and are located on the tops of the columns. This springing point is quite complex, consisting of a pin support and a plated assembly that facilitates the connection of the four pipe sections (i.e. the twin main arch and two leaning arches). This point also supports the main members of the side roofs, which project as awnings along the 200 metre-long sides of the main arched roof. Another notable feature of the roof is the cantilevered canopy at the western end which frames a grand entrance to the station from the public plaza. All of these features clearly reveal the intricacy of the steelwork which has made this striking vision possible.

*Top: Erection of the barrel vaults along the length of the railway station.*

*Above: One segment of a barrel vaulted roof, awaiting the final third to be joined in place.*

Tierney & Partners carried out the design of the roof in accordance with AS4100, with the wind loads and dynamic analysis complying with AS1170.2.

## Steel Delivers Precise Vision

The roof 'leaf' components were roll-formed in New South Wales by Rollco, fabricated into arch segments in Melbourne by Alfasi Constructions and then transported to Sydney for painting. A complete prototype 'leaf' was fully assembled and tack welded at Alfasi's premises in Melbourne to ensure dimensional accuracy. The arches were each transported in 3 separate sections, and the two support assemblies for each leaf were also transported separately. Bolted field splices, which are also expressed architecturally, enabled all the sections to be joined with no site welding.

Because of site access limitations and crane capacity, each 'leaf' of the roof was erected in two-thirds and one-third segments. The larger two-thirds segment of the arch and its pinned support assembly was first assembled in a jig on the ground, lifted by the crane, transported over the site, and put into position. The one-third segment was then assembled and erected in the same way. The two segments were then bolted together in-situ. The barrel vaulted roof sections between adjacent 'leaves' were then erected member-by-member.

Cladding and ceiling linings were then added. The ceiling of the station is a light perforated metal panelling supplied by T&M Industries. The roof cladding is a Zincalume Speed Deck 500 by Stramit, installed by Thomas Roofing. Test sheets for the roof cladding were sprung on site to check the ability of the sheets to conform to the curvature and warp of the roof.

## Conclusion

The completed station is an excellent example of the ability of steel products to satisfy architectural and engineering requirements, and to create a building which will be both a landmark and a vital element of Sydney's Olympic infrastructure.

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|---|---|
| Client | Olympic Co-ordination Authority |
| D&C Contractor | Leighton Contractors |
| Architect | Hassell Group |
| Project Manager | GHD Group |
| Structural Engineer | Tierney & Partners |
| Fabricator & Erector | Alfasi Constructions |
| Roll-forming | Rollco |