Post-Tensioned Steel Trusses for Long Span Roofs

The Achievement
Telstra Stadium (formerly Stadium Australia) was reconfigured in 2003 to remove the temporary seating in the north and south terraces, which had been used for the 2000 Olympic Games and Paralympic Games. Two new 3,500m² roofs for all-weather accommodation were constructed over the stadium ends. The seating stands on the East and West sides of the playing field were placed on moving frames so that the arena could be quickly adjusted for rectangular and oval settings. The reconfiguration cost $80 million (AU), with the roofing component being around $10 million, and was completed without disruption to the scheduled events at the stadium. The post-tensioned system for the roof was adopted to overcome difficulties that a business-as-usual design was likely to cause.

The construction system for the new roofs allowed the project to be completed on time and budget, keeping loss of seat revenue during construction to a minimum. The project was completed in time for the 2003 Rugby World Cup, despite a tight timeline for design and construction. The truss members were prefabricated and assembled on the ground outside the stadium, so the concourse around the ground was relatively unobstructed on match days. The two main trusses were erected in a single week, within a six month construction program that saw no serious injuries to workers. The end result is what is believed to be a world-first post-tensioned steel roof for a sporting stadium. The project was awarded the 2004 ASI Structural Engineering Steel Design Award for NSW and the ACT.

The Innovation
A post-tensioned roof was adopted to avoid problems likely a conventional steel roof that would have required every connection node to be shored until the roof was completed. A forest of roof shores would block sightlines, reducing seating capacity by 9,000 seats at each end of the stadium during construction. The client gave high importance to the new roof looking like a natural extension of the existing roof.

The Benefits
The main benefits of the post-tensioned roof design and lean construction methods at Telstra Stadium, compared to a more conventional steel roof include saving 50% weight of steel needed to span the roof opening, with associated transport costs, $3m to fabricate and erect structural steel, 25% in erection time, and 40% in steel fabrication time. Chief benefit to stadium management was minimizing loss of seat revenue during the 2003 NRL, AFL and Rugby Union football season. Conventional approaches would have required some seating areas to be fenced off during six months. Revenue from the 18,000 seats kept available for the six month construction period was $2.7m. The sporting public benefited from continued stadium use during construction sightline obstruction, and people had continued access to most public areas during construction, an important recreational resource for Sydney. The roof has been compared to the shape of the brim of an “Akubra” hat and is widely accepted as an aesthetically pleasing solution to a difficult geometric problem. The client gave high importance to the new roof looking like a natural extension of the existing roof.
The seats were unobstructed while the roof was under construction.

Trusses fabricated from small sections.

Completed southern end of the Stadium.