Steel framed way speeds Brizzie bridge build

Eleanor Schonell Bridge

Design and Construct Lead Contractor, John Holland selected a steel framed deck for the main and back spans supported by steel cable stays for a new bridge for busy Brisbane as this approach produced a lighter structure requiring less support.

The use of steel also permitted all of the fabrication and most of the assembly to be accomplished offsite that helped to enhance onsite safety, speed and quality and was completed $4 million under budget, the savings being earmarked for other 'green' transport infrastructure.

Opened on 17 December 2006, the Eleanor Schonell Bridge provides a new walkway, bicycle and bus route crossing the Brisbane River between Dutton Park and the University of Queensland.

Known as 'Green Bridge' during construction, bio-retention ponds were established at each end to capture runoff from the bridge, filter it and return the water into the river.

The Design and Construct approach employed on the project also reduced a lot of unwanted side effects, such as 'out of balance' loads, bending moments on the towers and deflections during erection that enabled a simple, fast, efficient, flexible erection method for the deck. In particular, the additional dead load from an all-concrete deck would have substantially increased out of balance moments during erection, costing more for the towers and foundations.

The lengths and arrangement of grillages were symmetrical around each 70-metre-high tower enabling the corresponding main and back span grillages to be erected in either order.

The bridge deck is 20 metres wide and 520 metres long (including approach spans). The main span is 184 metres with back spans of 73 metres. The structural steel deck includes two main longitudinal plate girders in line with the cable stays. Steel cross-beams and cantilevers support thin pre-cast planks.

The 64 cable stays are in a harped configuration, reeved in place, arranged in pairs on the main and back spans of the two river piers at an elevation of about 24 degrees to horizontal.

A pier table was built at deck level between and around each pair of towers. The repetitive deck erection process commenced from the main and back span ends of each pier table. The cable-stayed main and back span deck are of steel and pre-cast concrete made composite by shear studs and narrow strips of in-situ concrete between the pre-cast elements. The longitudinal steel girders are generally 1200 deep, deepening to 2900 to form a strong haunch style connection at piers. Potential congestion and clashes between reinforcement and shear studs of the in-situ joints were successfully prevented by adhering to Australian standards, thorough coordination and careful shop-drawing.

The extra dead load allowance (in the entire bridge structure including stays) for possible future light rail is a 400mm thick concrete overlay covering the full 8.6-metre width of the busway. This is regarded as a critical load case for the design.

After completion of towers and pier tables, the cable-stayed main and back spans were built akin to a balanced cantilever technique from both towers simultaneously, alternately on main and back span sides.

The steel grillages were an innovative design that maximised offsite and off-critical path work, made best use of John Holland's available cranage, simplified construction and minimised the work required at the workface. All grillages were 9.6 m long, except the short 'mating' grillage at mid main span.

Each grillage was fabricated and painted in five pieces, two longitudinal girders complete with cantilever 'wings' plus the three cross beams. This enabled conventional road transport to the site yard.

The grillage was assembled at the yard in a jig using simple bolted connections at both ends of the cross beams, checked for conformance to tolerances and the deck-end cable stay anchorages installed. This assembly work proceeded several grillages ahead of the erection to provide a buffer in case of tolerance issues and also allowed flexibility in the erection sequence. The unloading, assembly and handling to barge were all carried out using John Holland's crawler cranes.

Grillages were barged out and lifted into place by purpose-made lifting beams and bolted on. Over ten days, one grillage (steel, pre-cast, in-situ concrete and cable stays) was erected at all four work faces.

The only steelworks required at the work face were the bolted joints in the two longitudinal girders due to pre-assembly, taking much of the work offsite and off the critical program path, enhancing safety, speed and quality.

Of the remaining site work, assembling the steel grillages was done onsite but away from the workface with similar benefits. Virtually no welding and very little steel painting occurred onsite and the volume of in-situ concrete is so small kibbles were adequate (instead of pumps), further simplifying the process.

Towards the end of the deck erection program, the sequence of main and back segment erection was varied to suit the mating of the main span ends in light of the actual deck deflections during the erection process.

Major benefits of constructing the deck from both river piers simultaneously (about one week lag between) were:

- Shorter overall construction
- Four separate work fronts
- Better labour continuity

The cable stay anchorages were pre-assembled offsite and installed in towers before deck erection started and before in-deck grillages reached the workface. This removed this work from the critical path. No cranage was required for the installation of the cable stays during deck erection. Strands were pre-cut and peeled and stay pipes welded on deck which also removed this work from the critical path. The reeved in place stays provided progressive support and adjusted to the deck erection process.

A partial complement of strands provided an appropriate uplift to the steel grillage during pre-cast installation. The full complement of strands was then stressed to length and forced to bring the deck to its intended level. The project adopted state of the art BBR CONA stay cable technology, with 31 and 37 strand parallel seven wire 15.7 mm strands enclosed in a UV-resistant HDPE stay pipe with co-extruded architectural dark grey colour.

Project Team

Client: Brisbane City Council

Lead Contractor (Design and Construct): John Holland

Fabrication and Coatings: John Holland SMP

Structural Steel: BlueScope Steel

Cable Stays: Structural Systems and BBR VT International

Project Engineers: GHD (Australia) and International Bridge Technologies (USA)

Independent Verifying Engineers: KBR

* An edited version of a paper prepared by Chris M Harris of Structural Systems