STOCKBRIDG

A handsome new Stockbridge footway has been built over the Ovens River for the City of Wangaratta in North Eastern Victoria, providing a far safer northern link for pedestrians and cyclists to the central business district than the old one.

For many years after the old Stockbridge became superseded by another bridge carrying the Hume Highway, the major route between Sydney and Melbourne, it continued to be used as a pedestrian bridge. It provided an important means of access for local people and also supported two large pipes carrying sewerage across the Ovens River to treatment works.

The old timber Stockbridge began life in 1935 and was the main route for bringing stock to the saleyards, which are now the site of a local park. Its condition had deteriorated in recent years to the extent that it was unsafe for pedestrian use and had to be closed.

Design criteria

In 1994 the City of Wangaratta called for proposals for a replacement bridge. The criteria set for the bridge included:

- long, clear spans because of water-borne debris during floods
- girders to be well above the 100 year flood level
- minimal disturbance to the river bed and banks during construction
- minimum cost, but not to the exclusion of historical and aesthetic values
- minimum construction time due to the condition of the 'old' Stockbridge and the essential sewerage service it provided and pedestrian access especially with the holiday season approaching.

A proposal by Waldren Bridges was accepted in October 1994 and 12 weeks later in January 1995 the new bridge was open.

Conceptual design

Early in the design process it became apparent that a three span bridge with a large central span would best satisfy the design criteria, because:

- uneven numbers of spans are visually preferable
- opportunity for debris accumulation is minimised
- piers would be close to the banks enabling them to be constructed with minimal disturbance to either river bed or banks.

"The highly visible location in the City and the historical significance of the site inspired the look of the bridge with its traditional steel lattice girder styling as seen in old-fashioned riveted girders" said Mr Rob Wallace, Managing Director of Waldren Bridges.

The two girders vary in depth to form a pleasing curved shape within each span. The lattice arrangement adopted for the haunches in the vicinity of the piers was repeated within the railing and the two main piers to give consistency of style.

Girder depth at midspan and abutments is just enough to hide the sewerage pipes between the girders.

Piers are bolted to concrete pile caps supported on steel piles. The reinforced concrete conical shaped pile caps protrude just above the fairly constant (except in times of flood) water level, thus the bridge has the appearance of resting on small footings, enhancing the light and slender appearance of the whole structure.

Design philosophy

From the outset prefabrication was seen as the key to achieving speed, quality and economy. Almost every component was prefabricated so that construction would be

Above: 310UC97 steel piles driven from the riverbank.

Right: Finished steelwork displays timeless design.

GE FOOTWAY

mainly an assembly operation, eliminating the delays that normally occur in site construction.

Advantage was also taken of the high degree of accuracy that is possible with factory manufacture. Components were designed to fit exactly without needing adjustment on site.

Structural design and detailing

The bridge has been designed for a live load of 5kPa in addition to maintenance and emergency vehicles and two heavy sewerage pipes.

The challenge for the designers was to achieve the desired appearance and function at minimum cost. This was cleverly achieved through a number of innovative features:

1. Girders were designed to be fabricated and erected in two halves of around 30 metres length, with a central splice welded on site. The four girder segments were packaged in one unit for secure and economical transport and erection.
2. Girders were fabricated with T-sections cut from 250UC89 standard sections welded to an overlapping web plate of varying depth using fillet welds. The low bending stiffness of the T's enabled easy curving to the desired parabolic profile. The web plate was easily cut, fitted and welded on the inside face of the girders.
3. Steel piers were fully fabricated in the workshop, quickly erected on site and secured to the pile caps by bolting.
4. The deck consisted of 125mm thick precast reinforced concrete slabs, 2215 x 3300mm wide, laid on rubber pads and clamped to the girder top flange by bolted cleats. Slabs were erected using a mobile 'lift and carry' crane working progressively from previously erected units.

Steelwork fabrication

Fabrication of girders was a relatively simple task in spite of the elaborate shape and detailing. Bending of the T's was done mostly by cold bending with heat being applied on small sections with the most severe curvature. For the girder portions having solid webs, the web plates were designed to overlap the stems of the T's on the inside faces, welded in place with small fillet welds on both sides. This ensured a sound connection with the practical advantage of simplifying the boilermaker's task of cutting and fitting. In the lattice regions flat bars 30 degrees to the vertical were fitted and butt welded between the stems of the T's. Steel angles, 30 degrees to the vertical in the other direction, were placed on the inside faces, overlapping the stems of the T's and fillet welded. Care was taken in the welding specification and sequence to minimise distortion.

Footings

Preparations for pile driving began on site while the steelwork was being fabricated and concrete components were being manufactured.

310UC97 steel piles were driven by a drop hammer operated from a pin jib crane. Crane reach was sufficient to enable pier piles to be driven from the river bank. By the time all piles were driven and cut off to precise levels the precast abutments and piers had arrived on site.

For the abutments it was a simple task of lowering the unit onto the piles which fitted into apertures provided for this purpose. Care was taken to accurately adjust their positions and level prior to grouting. This was all that was necessary to construct the abutments which incorporated all features including hold-down bolts and fender wall with circular holes for the pipe services.

Steelwork erection

Steelwork was erected in two main sessions from each river bank. Firstly the western steel pier was placed on the pile caps and secured by hold down bolts. The first 30m long girder half was lifted directly from the transport vehicle and placed in position, one end landing on the abutment, the haunch landing on the steel pier, bolted down and stabilised by a diagonal brace at the haunches.

Top: Steelwork erection was achieved in one day, lifting directly from transport vehicle.

Left: The footbridge complete, over a swollen Ovens River.

The other girder half was then lifted into position alongside, and similarly bolted down. Cross members were placed next, beginning with the two main lattice cross-frames followed by the galvanised cross members/pipe supports.

The crane then shifted to the other bank and the process repeated. Before day's end all steelwork was in place with girders meeting in the centre with very little mismatch. The girder ends had been prepared in the workshop ready for splicing, including holes punched in the webs for temporary alignment plates. Splices were welded next day, while all cross members and hold down bolts were fully tightened, finishing by touching up any damaged paintwork, ready for placement of the pipes.

Although each girder half weighed less than 4t, the reach required was around 20m, beyond the capacity of the biggest hydraulic cranes available locally. Fortunately the old fashioned pin-jib crane used for the pile driving was equal to the task, but had the disadvantage inherent with this type of crane in that the jib cannot be telescoped.

Deck slab placement

Slabs were placed one at a time by means of a mobile 'lift and carry' crane, working progressively from the eastern end.

Surface treatment

All steelwork was sandblasted to class 2.5 and painted with one coat of high-build epoxy mastic, coloured dark green. An additional coat of enamel was applied to the guardrail which is exposed to direct sunlight, and an anti-graffiti coating was applied to the outside faces of the girders, all of the one matching colour.

All crossmembers and pipe fixings were hot dip galvanised to provide long life surface protection.

Project participants

Client:	City of Wangaratta
Design:	Waldren Bridges
Steel Fabrication:	Yackandandah Engineering Pty Ltd
Pre-Cast:	Antonello Concrete Products Pty Ltd
Pile Driving:	Haring Constructions Pty Ltd
Structural Analysis:	Noel Ransome & Associates

Testing time with steel

The first galvanised rail bridge in NSW, Stewarts River Rail Bridge on the North Coast, has passed the test of time with flying colours.

After a service life of 12 years the galvanised bridge had negligible coating loss.

Stewarts River Rail Bridge is the second bridge featured in "Steel Structures" to determine the current condition of the corrosion protection systems. In the previous issue we featured the Nepean Bridge at Camden.

In 1979, Industrial Galvanisers began a development programme with engineers from NSW State Rail Authority to determine the feasibility of hot dip galvanising bridge span components for transom topped bridge spans. These spans had been developed to replace the inventory of ageing timber bridges, particularly on the north coast of NSW.

The two main beams making up a span assembly were, at the time, among the heaviest items ever processed through a galvanizing plant. The fabricated plate girders being nearly 15m long, weighing up to 9 tonnes and requiring double dipping because their length exceeded the bath length.

In addition to developments in the galvanizing process, Industrial Galvanizers commissioned TUNRA Ltd, the University of Newcastle's commercial research operation, to determine whether the galvanized coating provided the coefficient of friction required for bolted connections used on the structure. The research verified that satisfactory (over 0.35) coefficients could be obtained.

The Australian standard for hot dipped galvanizing (AS 1650-1989) requires a minimum coating mass of 600 gm/m^2 for steel sections over 5mm in thickness. This is equivalent to an average thickness of 85 microns. However, because of the mass of the beams and their metallurgical composition the average coating mass was typically in excess of 1400gm/m^2 or 200 microns average.

The NSW State Rail Authority's original requirement was that the galvanising coating should provide a maintenance free life of 25 years (Zinc Today No 44 – April 1981).

After a service life of 12 years, in February 1993 the bridge was inspected and coating measurements were taken in accessible areas of the bridge spans. The coating thickness surveys indicated that the average coating thickness was 190 microns, varying from 160 microns in localised areas on the webs and up to 250 microns on the flanges. During the galvanizing process the flanges were horizontal and retained more free zinc during withdrawal from the galvanizing bath.

The good drainage and ventilation characteristic of the bridge spans was also a factor in ensuring that there were no localised areas of higher rates of corrosion detected during the inspection. Overall coating loss has been negligible during the 12 years of exposure and is in the order of 1 micron per year.

Because the corrosion rate of zinc in atmospheric exposure is linear, accurate predictions of coating life can be made based on corrosion rate and coating thickness. Therefore the results of this inspection indicate that the life of the hot dip galvanized coating remaining is well in excess of 100 years at present rates of corrosion.

More information is given in Corrosion Management, Vol 2 No 1 – February 1993.

Stewarts River Rail Bridge – built to last.