Steelwork supports resilient river crossing

Laura River (South) Crossing, Far North Queensland

The ability to supply lighter weight components for a remote location and construct continuous superstructure to achieve structural efficiency also lending itself to slimmer design less prone to water flows during extreme floods prompted the new bridge over the Laura River to be built predominantly in steel.

This final project aimed at satisfying the Federal Government's promise to seal the road from Lakeland to Laura used a steel-intensive approach to provide immunity to peak flood levels encountered over 100 year periods (Q100) as the crossing is highly flood prone during wet seasons experienced in Queensland's Far North.

The roadworks component of the project involved the realignment and reconstruction of approximately 2.2km of road approaches on the Peninsula Development Road that connects the tip of Cape York and the mining town of Weipa, local communities and agricultural production to the remainder of Queensland.

The project required the development and implementation of a detailed Environmental Management Plan to ensure that the complex environmental issues anticipated onsite including rare flora were adequately protected.

The new $13.7million high level bridge is a 180-metre, two-lane structure built in response to prolonged closures due to flooding. The new higher and stronger bridge replaced the existing low-lying structure to minimise disruptions.

This was achieved by using steel beam girders with spans up to 30 metres. The substructure design incorporates cast-in-place piles and reinforced concrete pile caps, columns, headstocks and abutments. The superstructure involves six spans of 1200mm galvanized steel beam girders with cross bracing. The girders support a cast-in-situ concrete deck with kerbs and DTMR steel bridge rails.

The girders were lifted into position and connected with splice plates and bolted joints. There were typically 118 bolts per joint. The concrete deck is connected to the deck with shear studs.

All road and bridge works were designed to Queensland Department of Transport and Main Roads (DTMR) design standards with the bridge designed to AS 5100:2004 and live loading at SM 1600 and HLP 400.

The steel plate was specified to Australian Standards with material test certificates reviewed to demonstrate conformance to the Standard. The specification had a requirement that testing of the steel would be required if the steel plate could not be matched with the relevant test certificate. Sections encompassed 1200 WB 342 and 1200 WB 278 Grade 400, Intermediate Bracing Grade 300, Steel Plates Grade 350, Bridge Rail SHS and RHS Dual Grade C450, all fabricated to MRTS78 (Main Roads Technical standard 78).

The bridge deck level was set to that of the high river bank to provide maximum flood immunity. The bridge was designed for flood loading in accordance with the AS 5100 Bridge Code.

The high piers were secured into rock by three 1200mm diameter cast-in-place piles using steel liners.

Deputy Chief Engineer (Structures) of Engineering and Technology at DTMR, **Ross Pritchard** said the factors that worked in steel's favour as the main structural material for the infrastructure included the weight of the steel girders compared to concrete for long distance transport from Cairns, the weight of the girders during construction for easier handling, making higher piers possible whilst maintaining the ability to construct a continuous superstructure to achieve structural efficiency.

All connections were bolted so no site welding was required.

"The bolts were a critical item in the construction," Mr Pritchard said.

"High strength grade 8.8 bolts were used and in addition to the requirements of AS 1252 there was a requirement that the bolt and nut were tested as a complete assembly to ensure that load capacity was achieved.

"The bolt assembly test was undertaken on a batch basis. Tightening of the bolts was considered a critical operation."

The Manager of the project's contracted steel fabricator Australian Infrastructure Manufacturing (AIM), **Chris Wilson** said all splice joints utilised Tensioned Fasteners (TF) and Load Indicating Washers in conjunction with a torque multiplier to achieve correct tension.

"Over 6000 bolts with some beams pre-spliced before erection and some mid span splices were conducted in situ," he said.

"There was found to be a great variance in the friction coefficient of each bolt due to the galvanized bolts used and the use of just the torque wrench alone was not producing accurate indication of tension.

"The visual indication of tension achieved through the use of 'squirter' washers was invaluable in the bolting process and found to be very accurate."

"The steel bridge also offered larger spans that saved cost from not having another two or three piers that would have been required for the concrete supported option."

He said the steel design offered less risk from severe flood waters than a concrete option as the surface area of the steel structure is significantly less than a concrete option reducing the drag on flowing water and thus lowering risk of the bridge being washed away.

"The steel bridge also offered larger spans that saved cost from not having another two or three piers that would have been required for the concrete supported option," he said.

"This also meant less transport movements compared to concrete. Four beams were fitted on each truck requiring 18 to 20 loads for the project whereas a concrete option would have meant three times as many trips."

Being a Level 2 DTMR Accredited Supplier with an in-house galvanizing facility helped AIM win the work.

All steelwork was hot dip galvanized to AS 4680 to achieve the design life. Mouse holes were processed in all the bracing plates. Beams were galvanized with the camber down to maintain camber during the galvanizing process. The longest beam was 18 metres which was a double rollover dip.

AIM developed a close working relationship with McIlwain Civil Site Engineer, **Mark Stone** who Mr Wilson said understood the intricacies of the project enabling a successful installation program. Weekly production meetings were held with McIlwain Civil, Civform and DTMR representatives to report progress.

"This worked well to keep everyone informed in relation to any challenges and progress of the job," Mr Wilson said.

Beam cambers were measured three times; once received into store, post-fabrication and post-galvanizing. Each measurement was recorded exactly the same way to ensure the camber was present and retained.

Each beam was stamped with heat number upon receipt and tracked throughout the fabrication and galvanizing process to ensure complete traceability. Sections were programmed to coincide with crane movements. For instance, particular assemblies had to arrive at predetermined times to allow for assembly of TF splice joints.

The bridge has performed satisfactorily since opening in December 2012.

PROJECT TEAM

Client: Queensland Department of Transport and Main Roads

Principal Subcontractor: McIlwain Civil

Steel Fabricator: Australian Infrastructure Manufacturing (AIM)

Steel Detailing: GHD (design drawings), AIM (workshop detailing)

Hot Dip Galvanizing: Australian Professional Galvanizing

Steel Distributor: Tonkin Steel

ASI Steel Manufacturer: BlueScope (plate), OneSteel (welded beams)