

Steel cycle bridge swoops over Auckland highway

A slender steel bridge due to open in Auckland, New Zealand next month (December) is set to become a vital link in the city's network of cycle routes. The Canada Street Cycle Bridge is a seven-span, 160m-long structure that will carry a new cycleway link over one of the city's main highways. It has taken just one year to complete, from concept to delivery.

Design of the new bridge has been carried out by Novare Design and architect Monk Mackenzie for client New Zealand Transport Agency; lead contractor Hawkins Construction is building the bridge with steel fabrication by PFS Engineering and contract administration and engineering by GHD.

At its north end the slender cycle bridge begins on the deck of the old Nelson Street off-ramp, then spans the busy southbound carriageway of State Highway 1, weaving between buildings and the highway to connect to Canada Street. It has a 4m-wide, curving, triangular-shaped, orthotropic steel box girder deck on sculpted steel piers, each of which is supported by a bored reinforced concrete pile socketed into East Coast Bay's formation soft rock. The longest of the seven spans is 39m.

Due to the complex geometrical requirements of the space available, the bridge has five horizontal curves of different radii; two vertical curves; two spans which taper in depth from 800mm up to 1400mm at the main pier; and a varying longitudinal gradient.

A slender, triangular shape for the deck was agreed from the start by the bridge designer and architect in order to provide a clean sculptural architectural form that expressed the structural forces flowing through the bridge.

In cross-section, the triangular

deck has a central vertical I-girder with a web thickness of 20mm and 600mm wide by 25mm thick top and bottom flanges. The remainder of the steel plate forming the deck is 12mm thick. The central I-girder provides the majority of the vertical bending and shear capacity, while the 12mm skin provides the cycleway surface and torsional stiffness and strength.

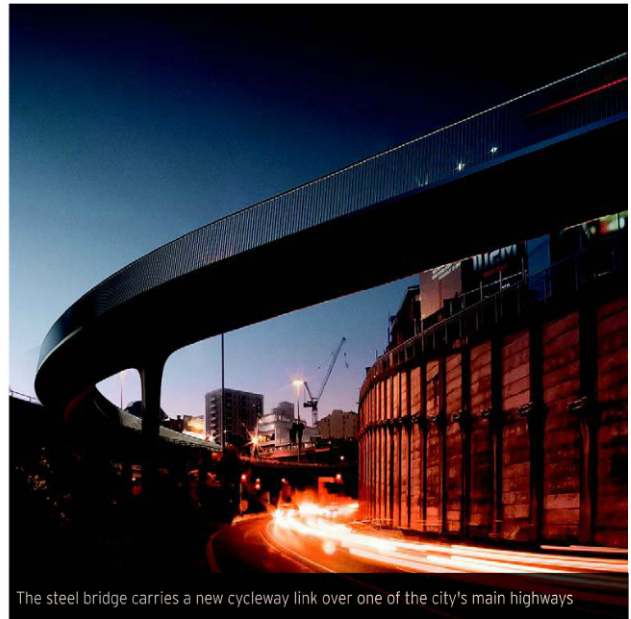
The deck and inclined soffit surfaces of the deck cross-section are stiffened by a series of 12mm-thick longitudinal stiffeners with 12mm transverse diaphragms spaced at 3m intervals.

Structural steel is also used for the piers; both the slender tapering diamond-shaped main pier and the other piers, which have a diamond-shaped stem that opens up into a Y-shaped cradle. A pair of elastomeric bearings on the cradle provide both torsional support for the curved deck and lateral seismic restraint.

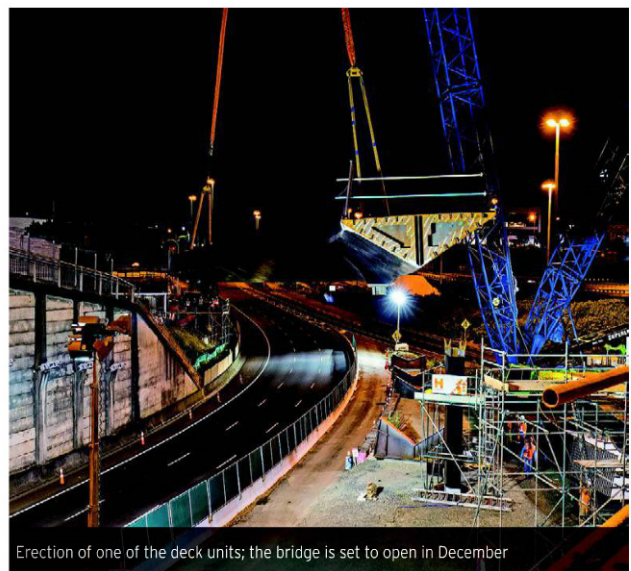
Fabrication and erection of the structural steelwork was facilitated by the supply of technical and architectural drawings that were turned into 3D solid works models by the steel fabricator, enabling computer-controlled cutting of the curved steel plates.

Beam models and 3D finite element models were developed to analyse the linear, dynamic and buckling behaviour of the bridge; the staged construction; the precamber requirements and the erection forces on the deck and piers.

The steel deck and piers were sealed and pressure tested to eliminate the need for any corrosion protection inside the structure; externally the primary corrosion protection is provided by zinc metal spray. A high-gloss black surface finish is used in order to accentuate the shape of the bridge and a polysiloxane-based final coat has also been applied to address the high level



The steel bridge carries a new cycleway link over one of the city's main highways



Erection of one of the deck units; the bridge is set to open in December

of UV exposure in New Zealand.

The running surface of the bridge consists of a proprietary epoxy with buff-coloured bauxite chip chosen to provide a contrast to the black colour of the bridge as well as to reduce the solar radiation heating the top of the deck.

The bridge design is also economical, costing US\$3,900/m² and having an average mass of structural steel of 1.35t/m run of deck. The urban cycle network is being jointly delivered in two phases by the New Zealand Transport Agency, Auckland Council and Auckland Transport.