Granite Island Causeway (Bridge) Replacement

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Summary
McConnell Dowell and WGA were engaged by the South Australian Department for Infrastructure and Transport (DIT) for the Design and Construction of a replacement causeway (suspended jetty structure) linking the Iconic Granite Island to the mainland (Victor Harbor) on the Fleurieu Peninsula. The causeway serves as link for pedestrians and the iconic horse drawn tram. The new causeway constructed of high durability materials to achieve a 100year design life, serves as a replacement alongside the alignment of the deteriorated timber causeway. This paper will focus on some of the key design and construction methodology features for the design and construction of the new causeway.

Keywords: causeway, jetty, prestressed concrete, construction, sensitive environment

Introduction

The Granite Island Causeway is a key piece of South Australian infrastructure of cultural and heritage significance. It is an iconic landmark for local tourism, used for the historic horse drawn tram services and for recreational pedestrian and fishing activities. It is also the only link connecting Granite Island with the mainland at Victor Harbor, providing a link for the ~700,000 pedestrian visitors to the Island a year, along with access for vehicles that service the island.

The existing timber causeway was at the end of its useful service life, having already undergone numerous repairs to address storm damage and natural deterioration. A feasibility study identified that an upgrade of the structure was not viable, warranting full replacement.

Key features of the $43 million project include a new 620 m long causeway jetty designed to achieve a 100 year design life; boat landing facility; new track and tram stops; foreshore urban design improvements, historic storytelling and interpretive signage, and public art viewing areas and partial retention of the existing causeway.

Design

The 6m wide causeway is constructed with 2off x 3m wide integral beam and deck concrete units with FRP balustrading, rails and horsematting. The deck units are supported on jetty bents at 15.2m centre, consisting of two driven steel piles and a precast concrete headstock. Some of key design features of the causeway include the following:

- **Prestressed deck units**. The 3m wide deck units consisted of integral prestressed concrete beams and deck slab, with a conventional reinforcing cage surrounding the prestressing strands to increase cover to the strands and early warning signs of chloride ingress. The top surface of the deck had sand blasted patterns developed by local indigenous artists.
- **Precast headstock to steel pile connection**. In order to expedite construction program, a novel steel cruciform arrangement was developed that was welded on site to the pile, which in turn was used to tie down the headstock to the steel pile without the need for an in-situ concrete plug.

- **HDPE pile sleeve**. In order to achieve a minimum maintenance solution to the piles, a HDPE sleeve was placed over the steel pile and grouted in place, avoiding the need for painting of the pile which otherwise would have required repainting throughout the design life.

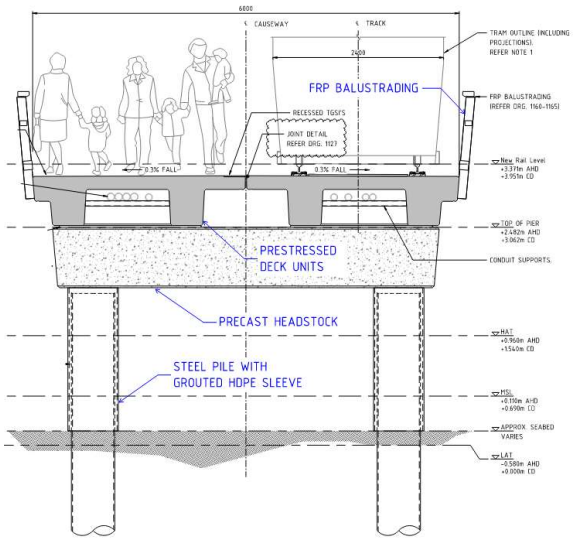

Figure 1 Typical Causeway Cross-Section

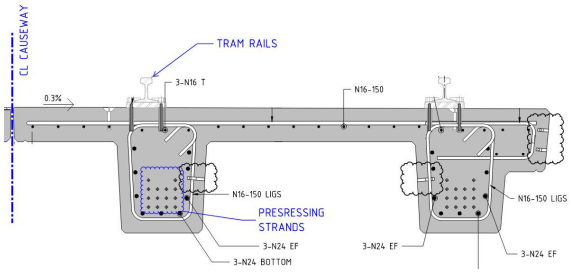

Figure 2 Typical Prestressed Deck Unit

Construction Method

The geometric and structural designs were heavily dictated by the leap-frog span by span construction methodology, temporary works and craneage limits. Crane demobilisation off the completed causeway was also critical.

A number of items presented challenges to the construction, including; sensitive shallow marine environment, busy popular tourist destination with numerous affected stakeholders and a tight delivery timeframe.

The construction method adopted was a hand over hand method engaging three concurrent work fronts to construct the Causeway with the method differs from traditional techniques and was selected from a range of methods as the only one to achieve completion by the target date. Work front 1 installed the permanent piles, work front 2 installed the grouted HDPE sleeves and the precast headstock and work front 3 installed the precast longitudinal girders. Each work front shared a similar duration of work per bent ensuring maximum effectiveness of the methodology. The work fronts utilized two sets of temporary works and cranes.

The marine environment was considered sensitive, with regular nearby whale visits being on a migration path and breeding area, in addition to a fairy penguin colony on Granite Island. To minimize impacts to the environment, pile installation works incorporated a piling gate design that included a highly innovative noise curtain to reduce underwater piling noise. Furthermore, the design solution had very little in situ concrete construction over water, reducing the risk of spillage.

Figure 3 Hand over Hand Construction Method

Result

The new Granite Island Causeway provides a holistic, authentic design solution with a 100-year design life that creates an elegant local landmark, respectful of heritage and place. The solution is considered a ‘whole of life’ solution that minimises maintenance costs over the design life.

The new Causeway provides ongoing access to Granite Island with a modern structure that accentuates, reflects, and respects its historical significance. The successful innovative partnership between asset owner (DIT), Contractor (MCD) and the design partners (led by WGA) ensured the delivery of this complex multi-disciplined project was completed on time and within budget allowing the community to enjoy the new Causeway over the 2021/22 summer period.