Cooks River Cycleway Upgrade Bridges

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Kendrick Park Cycleway Tempe

BACKGROUND

The heavily used Kendrick Park Cycleway in inner suburban Sydney was regularly at the mercy of the tidal Cooks River with the path inundated at peak high tides and during heavy rainfall.

Regularly covered with up to 300 millimetres of salt water for up to three hours, the path would be temporarily blocked for use by cyclists and pedestrians.

Constructing a new path and levee wall in its place provided an engineering challenge for Inner West Council due the limited clearance under the Illawarra line railway bridge and gas lines under the existing path.

The shared path is located about 10 kilometres from Sydney's CBD is part of the Homebush Bay to Sydney Airport regional cycleway and also forms part of the Cooks River Cycleway.

The cycleway is located at the railway underpass at the Northwest end of Kendrick Park, Tempe. 200m South of Tempe Station on the Northern bank of the Cooks River.

The shared pathway is part of the Homebush Bay to Sydney Airport regional cycleway and also forms part of the Cooks River Cycleway.

PROJECT DETAILS

- Contractor: Land & Marine Pty Ltd
- Design: Lucas Consulting Engineers Pty. Limited
- Value: $400,000
- Duration: 6 months (March – September 2016)
- Funding Source: Department of Planning and Environment Metropolitan Greenspace Grants

THE PROBLEM

- Limited vertical clearance
- Frequently inundated at peak high tides or during periods heavy rain.
- Regularly covered with 300mm salt water for up to three hours blocking the path for pedestrians/cyclist.

THE PROJECT

- Construction of a new concrete levee wall
- New footpath
- Associated drains and pumping equipment to alleviate drainage issue.

THE DESIGN

The south wall has deep footings to bear the load of the concrete pathway and retaining wall.
Total loading is reduced / transferred by installing deep footing foundation and wall on the river side. By building it first it eliminates tidal loading on the gas main. The path acts like a cantilever structure reducing the load on the gas main, fewer than original condition.

ORIGINAL DESIGN ISSUES

Cladding would not adhere to the Dincel system.
The Dincel system could not produce curved walls.
Outer levee wall did not provide adequate horizontal clearance from the gas main and subsequently the outer wall alignment was changed.
Constructability/buildability issues.

SITE PROBLEMS

- To maintain the 500mm separation from the railway embankment wall the retaining wall is directly above the gas main.
- The original construction method imposed an unacceptable stand alone load directly borne by the pipeline concrete slab.
- Environmental consideration
- Cycle/pedestrian detour

DESIGN CHANGES

We changed the wall finish to coloured off form concrete using 50 Mpa Envisia lower carbon concrete supplied by Boral. A new low carbon concrete called 'Envisia' was used to the resistance to cracking and chloride ingress, both important characteristics in sea wall construction.

We changed the wall alignment to go around the gas main. We also structured the activities sequence so that less than 5 KPa loading on the main during construction.

We enhanced the foreshore to prevent erosion and provide biodiversity by planting saltmarsh and creating inter-tidal habitat for birds, fish, crabs and oysters using the demolished sandstone blocks.

Low Carbon Concrete

Inner West Council sought low carbon concrete for its low shrinkage qualities - an important characteristic in sea wall construction, resistance to chloride ingress in a marine environment, high early strength, off-white colour, and resistance to sulphates due to its lower permeability, lower carbon levels, quality finish and high durability to lower life cycle costs.

The initial cost is higher than a more conventional concrete in real terms, but due to the high durability and lower shrinkage of low carbon concrete the life cycle cost of the asset is reduced. It also presents a sustainable advantage with lower carbon levels.

For the supply of the low carbon concrete, Council sourced it from Boral. This product is called Envisia which is a lower carbon concrete with excellent performance benefits and plastic, placement and finishing properties similar to conventional concretes. The advantages are:

- High early strength
- Light colour, making less coloured oxide required hence reducing the urban heating effect.
- Good resistance to sulphates due to its lower permeability
- Lower carbon levels
- Low shrinkage advantage- Less likely to crack with low shrinkage which is an important characteristic in sea wall construction
- High Durability - Lower life cycle cost due to enhanced durability.
- Resistant to chloride ingress in a marine environment.

The stable mix improves workability and is more resistant to segregation at higher slumps in comparison to more conventional concrete. Ultimately resulting in a quality finished end product.

The initial cost is 25% higher than a more conventional concrete blend and Council is happy to pay the difference for the following reasons;

- Due to the higher durability and lower shrinkage it has an extended life. In real terms the life cycle cost of the asset is reduced.
- Also with shrinkage and cracking resistant characteristics, maintenance cost is also reduced.

Council hopes to be a leading Council promoting the use of Lower Carbon Concrete. As the site is adjacent to the Cooks River and is subject to tidal inundation, this renders the pathway inaccessible at high tide. It is anticipated that the cycle way will become more popular and will improve accessibility by providing a dry thoroughfare.

It reduces the consumption of Portland cement by up to 65% without trade-offs in concrete performance which leads to lower carbon emissions.

Cooks River Biodiversity

To help improve the water quality in the Cooks river we made the following design changes during construction.

We enhanced the foreshore to prevent erosion and provide biodiversity by planting saltmarsh and creating habitat using the demolished sandstone blocks. The reused sandstone blocks and saltmarsh tubestock planted (propagated by Council's Nursery) created inter-tidal habitat for birds, fish, crabs and oysters.

Sandstone blocks from the old wall were also reused to construct a stone bund wall for water retention in the landscaped area and we added sandstone rock armour protection around the main pump out pit, again to prevent scour.

COOKS RIVER UTILITY BRIDGE MODIFICATIONS INTO SHARED PATH

INTRODUCTION

In 2014, Marrickville Council and Rockdale City Council identified the need to design and construct a safer pedestrian and cycle path for travel across the Cooks River, allowing for an alternative option away from the Princes Highway. The existing path across Princes Highway Road Bridge is unsafe in its current form. The route is becoming increasingly popular for recreational and commuting purposes. The new bridge will connect with existing paths on the southern and northern sides of the bridge. It also allows for the use of a utility bridge that was otherwise not being fully utilised. This will replace the use of footpaths on the existing Princes Highway road bridge and provide a safer crossing.

The new Tempe Cooks River Bridge which provides a crossing of the river completely separated from traffic, improving connectivity and safety. Using Wagner' composite products we utilised an existing utility bridge and converted it into a pedestrian/cycle connection across the river.

PROJECT DETAILS

- Contractor: Fleetwood Urban Pty Ltd
- Design: GHD Pty Ltd
- Value: $600,000
- Duration: 5 months (May – September 2016)
- Funding Source: 50:50 Inner West Council – Bayside City Council
- Owner: Inner West Council – Bayside City Council
- Project: To convert the existing utility bridge into a shared pedestrian and cycle path. Design approach pathway, pavement, decking and barriers.

Council received grant funding from the Roads & Maritime Services to fund the modification of the bridge with construction works were carried out in September 2016.

BACKGROUND

The Bridge is a purpose built reinforced concrete structure with locked fencing at both ends of the Bridge and was constructed in the late 1970's for electricity purposes associated with the establishment of the 330 kV Sydney South to Beaconsfield West Underground Cable and Telecom Australia's (Telstra's predecessor) cable. TransGrid infrastructure installed within the Bridge are critical to the supply of electricity to the Sydney CBD and surrounding suburbs.

An Agreement was made between Rockdale City Council and Marrickville City Council and TransGrid to open and develop use of the surface of the utility bridge as part of Rockdale City Council's cycleway network. Rockdale City Council and Marrickville City Council were granted approval to carry out works on the surface of the Bridge aimed at providing a smooth and safe surface for cyclists and pedestrians.

The bridge structure comprises of four-three span concrete and steel truss composite beams, which are laterally restrained by concrete members. The two end spans are approximately 25m and mid span 40m giving a total span of 90m between each abutment.

EXISTING UTILITY BRIDGE

The public utility bridge across the Cooks River, Tempe is owned by Transgrid and carries high voltage electricity cables and Telstra cables below the deck surface.

The utility bridge is located immediately to the east of the Princes Hwy road bridge across the Cooks River, Tempe. The existing bridge is a three span, concrete bridge, approximately 98.5m in length with a 4.4 metres wide deck. The existing utility bridge is managed by Transgrid and has three hollow chambers across its section which serve to carry a Transgrid high voltage cable on the west side, a Telstra cable on the east side and the central cavity is currently empty.

The beams are also connected by a concrete slab above mid-level, which runs along the full length of the structure. The top surface of the bridge is enclosed with removable concrete lids (500mm x 1100mm) on the west and central chambers, and cast-in-situ concrete capping on the eastern chamber, which creates a box cavity for utility cables to run through.

The existing utility bridge construction drawings provided suggest the bridge superstructure consists of a steel truss encased in concrete.

STRUCTURAL CAPACITY ASSESSMENT

In order to assess the strength for use of the bridge as a shared pedestrian and cycle path Council have completed a structural capacity assessment of the bridge superstructure through GHD. The bridge structure comprises of four - three span concrete and steel truss composite beams, which are laterally restrained by concrete members.

The top surface of the bridge is enclosed with removable concrete lids 500mm x 1100mm.
The concrete lids were checked for a concentrated design loading of 20kN. The concrete lids failed therefore no vehicles shall access the bridge for maintenance or construction purposes. Subsequently bollards were installed on both approaches to the bridge.

At the end of the structural analysis the bridge was found to be capable of supporting a 4 kPa universally distributed load. Therefore the bridge was deemed suitable for use as a shared pedestrian and cycle path.

BRIDGE DESIGN

The bridge design required to comply with the following standards.

- AS5100 Bridge Design Code
- Austroads, Guide to road design: Part 6A Pedestrian and Cycle Paths
- Austroads, Guides to traffic management
- AS 1158 Lighting for roads and public spaces
- AS 1428 Design for access and mobility
- AS 4100 Design for Steel Structures
- AS 3600 Design of Concrete Structures
- Roads and Maritime Services Technical Directions and Bicycle guidelines.

In order to be functional as a shared bicycle and pedestrian path the bridge required installation of hand rails, removable decking and pavement to lead into each approach from the existing pathway.

For the barrier design Council have consider a number options which each have their advantages and disadvantages in regards to cost, maintainability and constructability requirements.

One option GHD have considered is composite fibre plastic (CFP) hand railing. CFP hand railing is 100% corrosion resistant and thus requires low –nil maintenance. CFP handrailing can be supplied by Perma-Struct or Wagners along with their removable Composite fibre decking.

GHD have considered two options for the removable decking design.

Again Council considered the capital costs as well as the long term maintenance costs based on the design life of each option.

Comparing the two decking options, the most appropriate option to fit the councils criteria is a composite fibre decking due to its riding quality, ability to be removed for maintenance and + 50 year design life. Two composite fibre suppliers were invited to produce a concept option.

Beaman Park Bridge

BACKGROUND

The existing footbridge over the Cooks River between Marrickville Golf Club and Beaman Park crosses the boundary of former Canterbury Council and Marrickville Council and is jointly owned by both Councils. The footbridge was built in the early 20th Century and refurbished in 1980, 2000 and 2010.

INTRODUCTION

In response to development and increased pedestrian activity in the area in the 1920s, Canterbury Council, as part of their provision of services in the district, adopted an intention to provide pedestrian bridges at locations between the major road crossings over the Cooks River. Marrickville & Canterbury Councils currently own and maintain the existing bridge. Regular inspections indicated it is in poor condition and coming to end of its life time.

Flinders Road (Beaman Park) Bridge was erected in the early 1920’s. The original footbridge was built to by day labour under the supervision of Canterbury Council Engineer's. The type of users changed over the years from industry workers commute to leisure and cycle along the Cooks River.

One timber beam span to four timber beam spans. This is likely to have occurred in relation to the various river realignment and bank stabilisation works that occurred in the 1940s and 1950s. The Flinders Road Bridge has served as an important link between Earlwood and Marrickville since this time and is still an important recreation link for local residents.

PROJECT DETAILS

- Contractor: Fleetwood Urban Pty Ltd
- Design: Fleetwood Urban Pty Ltd
- Environmental Consultant: Cardno
- Value: $1,000,000
- Duration: 5 months (January – May 2016)
- Funding Source: 50:50 Inner West Council – City of Canterbury Bankstown
- Owner: Inner West Council – City of Canterbury Bankstown
- Contract: AS 4902-2000 (General Conditions of Contract for Design and Construction)

The Fleetwood Pedestrian Arch Bridge at Beaman Park provides a new and more accessible crossing across the Cooks River path for all users increasing its attractiveness and popularity.

LOCATION

An existing footbridge over the Cooks River is located between Illawarra and Wardell Roads and spans between Marrickville Golf Club in Marrickville and Beaman Park in Earlwood. The nearest road on the western side is Flinders Road, Earlwood and, on the east, Wharf Road, Marrickville. The bridge crosses the boundary of Canterbury City Council and Marrickville Council and is jointly owned and managed by both Councils.

EXISTING BRIDGE CONDITION ASSESSMENT

The bridge was recently refurbished in 1980, 2000 and 2010, however with increasing maintenance requirements and the associated increase in cost, it is evident the bridge is nearing the end of its serviceable life. The existing bridge also currently does not provide adequate service to cyclists or meet current standards for access and mobility.

The existing footbridge is in a poor but serviceable condition and nearing the end of its serviceable life. A moderate degree of corrosion was seen at every node of the truss. This appears to be the result of detailing that does not allow for easy drainage of water off the members at the point of connection.

BRIDGE REPLACEMENT

Following a condition assessment it was recommended that the existing footbridge over the Cooks River connecting the Marrickville Golf Club and Beaman Park is in poor condition and coming to the end of its life.

Tenders were advertised for the design and construction of a new bridge.

Design considerations include:

- Lower maintenance costs
- Comply with modern standards and accessibility requirements
- Shared bridge to enable both cyclist and pedestrian use
- Review the bridge alignment to improve accessibility

COMMUNITY CONSULTATION

Both Councils have decided to demolish the existing timber bridge and build a new bridge to current industry standards.

The community engagement indicated 51% of the community liked a curved bridge, 33% liked a beam bridge, 19% liked a truss bridge and 4% liked none of the proposed designs (Note these percentages do not sum to 100% as respondents could have more than one response). Important issues which were identified included accessibility, wide path and radii for bikes, visual appeal and increased native vegetation.

Marrickville Heritage Society has also expressed a desire to retain or reuse the main steel element from the existing bridge. Although the steel was produced by Dorman Long, who was a major supplier of steel to Sydney, the bridge is formed from simple, off-the-shelf, steel angle sections cut to size and riveted in place.

The main truss element is nearing the end of its life and its condition is the primary reason for the replacement of the footbridge. The new footbridge must also meet modern standards for accessibility which requires a width greater than the existing truss. Therefore the main truss element cannot be reused in the proposed new footbridge. Maintaining the truss in its current location would require ongoing inspections and maintenance at significant cost to Council. Given its poor condition and minimal heritage value, the truss was demolished as part of the bridge replacement contract.

Contractors were asked to provide at least one concept design of either a beam or arch bridge with a minimum width of 2.5m in line with community feedback.

BRIDGE LOCATION

After considering five potential locations it was considered that the best location for the new bridge was 30m upstream from the existing bridge.

- Considerations included:
- Vehicular access and electricity supply
- Compatible with existing and future uses
- Minimise impacts on existing vegetation
- Space for approach ramps
- Users are familiar with the bridge location and the existing bridge can be used during construction
- A site survey was taken on both sides of the Cooks River.

- Geotechnical investigation to determine depth of rock on both sides of the Cooks River.
- Hydraulic assessment to determine the depth and velocities the bridge would be subject to in a flood event.
- Various bridge approaches were considered and by moving the first tee of the golf course forward this enabled the approach ramp and path to travel behind the first tee allowing safe access to the bridge.

Review of Environmental Factors, heritage assessment and community consultation was undertaken prior to the Design, Specification and Tender Documents.

DESIGN CRITERIA / REQUIREMENTS

The works are to replace the existing footbridge with a modern footbridge and approach ramps for shared use by pedestrians and cyclists. The proposed bridge location is approximately 30m north-west of the existing bridge.

The primary scope of work considered essential for the project includes:

- The deck level is above 20 year food level approx. the same height as the existing bridge.
- A max of five spans
- Deck to be a minimum of 2.5m wide shared footbridge to allow pedestrians & cyclist
- Comply with accessibility standards
- Incorporate lighting of the bridge and approach ramps
- A 20m approach ramp on the Earlwood side tying into the existing shared path
- A 10m approach ramp and associated paths behind the first tee
- A landscaped screen on the approach of the Marrickville side.
- Retain the two piers of the existing bridge.
- Handrails incorporated on the bridge and approach ramps
- Stairs and approach ramps
- Civil works and landscaping on each side of the river with plants from the local nursery
- Demolition of the existing footbridge.

The works also include associated civil works on each side of the Cooks River, ancillary works such as paving, fencing, lighting and landscaping and demolition of the existing footbridge.

SELECTED DESIGN

Fleetwood Urban’s conforming offer includes a four span curved bridge which has a simple and slender form incorporating a graceful arc. The bridge is based on their ‘Sandford’ prefabricated bridge units. The selected steel arch bridge with timber piling has a design life of 100 years. The bridge location and alignment was selected based on the following engineering parameters; river flow velocity, high tide, soil characteristics, easy access & Golf Course existing TEE areas etc. The selected design consist of 4 span each 13.5m and both side access ramps.

The bridge has hot dipped galvanised steel structural members on hardwood timber pier foundations. The handrails and balustrades are also hot dipped galvanised steel while the decking is fibre reinforced plastic decking. The curved bridge was unanimously preferred by the Tender Assessment Panel.

Decking material Fibre reinforced plastic (FRP) decking is a low maintenance, free draining surface with good slip resistance. Micromesh FRP decking has 11mm apertures compared to Minimesh which has 20mm apertures. Provision of Micromesh in lieu of Minimesh would improve bike ride quality and ostensibly provide a more solid walking surface. Although Modwood provides a similar low maintenance, free draining surface with good slip resistance to FRP decking, it was discounted due to potential reduction in riding quality.

Hot dip galvanised finishes provide good protection to steel but will likely need maintenance every 15 years or so. A solely painted finish alone would be more maintenance intensive in an estuarine environment, requiring painting every 10 years or so, and should not be considered. Galvanising and painting, known as a duplex system, will provide optimum performance requiring first maintenance after 50 years or so. Given the difficulty of periodic painting all steel members insitu after installation, a duplex finish offers a low maintenance finish for the bridge structure and balustrades. This would also allow a more aesthetic finish to be selected.

TENDER REQUIREMENTS

Tenderers must submit a concept design for a curved bridge or beam bridge with a minimum clear width of 2.5m as part of the Tender.

Tenderers may submit up to two additional alternative concept designs as part of the Tender. Style of the bridges and types of construction for alternative concept designs are open to the Tenderer.

All concept designs submitted with the Tender must comply with the requirements set out in the Technical Specification.

Tenderers should also refer to community consultation feedback provided in the Tender package when considering bridge styles and elements.

For each concept design, the Tenderer must submit:

- An illustration or illustrations of the concept bridge at the site.
- A plan of the concept bridge at the site including approaches and associated works.
- Details of the type of bridge
- A description of the materials and finishes for all components.
- The guaranteed life expectancy for all components.

- A whole of life costing including maintenance and refurbishment over the entire design life of the bridge
- A description outlining benefits of the concept.
- A separate Schedule of Works, Prices and Rates for each bridge.

Bridge Design Standard Unless otherwise specified, design of the bridge shall be governed by AS5100 Bridge Design. Design life of the bridge shall be 100 years. The bridge shall be designed as a low maintenance structure. The design shall minimise all maintenance required to be undertaken from specialty watercraft.

Designers should refer to Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW (RTA 2003) for guidance.

Geometry Total span, excluding approach ramps, shall be a minimum of 54m to ensure piles on the banks of the Cooks River are a minimum of 2m clear or the existing sheet pile walls. Span length(s) shall be at the Tenderers discretion. A minimum length of 15m at the centre of the bridge must have a bridge soffit at a minimum level of 2.95mRL. The bridge and approach ramps shall have a minimum clear width of 2.5m; a clear width of3.0m is preferred.

Barriers and handrails Barriers and handrails shall be in accordance with AS5100 Bridge Design, A81428 Design for access and mobility and Austroads Guide to Road Design Pail 6,4: Pedestrian and Cyclist Paths.

Approach ramps Approach ramps shall be designed to meet the dual requirements of A81428 Design for access and mobility and Austroads Guide to Road Design Part 6k Pedestrian and Cyclist Paths. The minimum radius of horizontal curves on approach ramps shall be 5m or a design bicycle speed of 10km/h shall be adopted for cyclists in the determination of horizontal curves. Sharp bends will not be accepted.

Decking For surface finishes other than concrete, certification shall be provided from the manufacturer demonstrating the surface finish complies with the recommendations of 1119 197 An introductory guide to the slip resistance of pedestrian surface materials (CSIRO 1999)

Delineation and signage of the bridge, approach ramps and adjoining path segments shall be undertaken in accordance with A51742.9 Manual of uniform traffic control devices - Part 9:Bicycle Facilities and NSW Bicycle Guidelines (RMS 2012). This is deemed to included regulatory, warning and guidance, and general directional signage Tactile ground surface indicators shall be provided at the top and foot of stairs and at other locations required by .451428.1 Design for access and mobility and as agreed by the Superintendent.

The lighting shall be designed in accordance with ASMIZS 11583.1 Lighting for roads and public spaces - Pedestrian area (Category P) lighting - Performance and design requirements. A minimum lighting category ofP4 shall be adopted.

BIOGRAPHIES

Paul Lunniss has completed a Master of Engineering and worked in Local Government for the past 10 years maintaining, renewing and upgrading pedestrian/cycle and road bridges in both metropolitan Sydney and regional NSW. He has diversified experience with the ultimate aim of enhancing the quality of life of our communities through excellence in public works and services.

William Truong is a project engineer working in local government with experience in managing the construction and maintenance of civil infrastructure. He has worked on the construction of two new shared path bridges which are located along the Cooks River path providing improved access and connectivity to the Sydney community.