UPGRADE OF

WARDELL ROAD BRIDGE

OVER COOKS RIVER,

DULWICH HILL NSW

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1.0 PROJECT DESCRIPTION

The refurbishment work to the Wardell Road Bridge over the Cooks River involved the installation of an impressed current cathodic protection system to selected reinforced concrete elements, realkalisation of the bridge girders, anti-carbonation coating of the underside of the superstructure and replacement of the existing concrete balustrade with a steel balustrade.

The realkalisation treatment was the first of its kind to be undertaken on an existing bridge within New South Wales.

2.0 CONCEPTS

Wardell Road Bridge suffered extensive concrete deterioration since its construction in 1924 and is currently restricted to a maximum 12T weight limit. Consequently a joint venture by current stakeholders, Marrickville Council, Canterbury City Council and Roads and Traffic Authority was initiated to develop a program of works to rehabilitate the existing structure.

View of the existing bridge structure prior to remedial treatment

An initial assessment was undertaken by Taywood Engineering Limited (now GHD) to determine the type and extent of deterioration to the existing bridge piers and deck and provide a practical and cost effective remedial treatment.The remedial treatment chosen consisted of a mixture of impressed current cathodic protection, conventional repairs and realkalisation.

For design purposes the works were split into two zones, tidal and atmospheric. The bridge piers and tie beams formed part of the tidal zone whereas the edge beams and underside of the bridge deck formed part of the atmospheric zone.

The cathodic protection work undertaken on the tidal zone involved removing areas of dilapidated concrete using high pressure water hoses and attaching electrically charged anode strips to the exposed steel reinforcement. Where the steel had eroded by greater than 20% of its original size it was replaced with new reinforcement steel prior to attaching the anode strips. The dilapidated concrete removed was then replaced with approved concrete material and allowed to cure.

Removal of dilapidated concrete from bridge pier prior to treatment

Pier showing application of anode strips as part of the Cathodic Protection work prior to application of final concrete coating.

One of the existing lower pier tie beams after removal of reinforcement concrete cover. Note the sheered main reinforcement and stirrups.

The conventional repair work applied to the atmospheric zone involved removing areas of cracked or dilapidated concrete from the edge beams and underside of the bridge deck. The process included cutting the existing concrete back behind the outer layer of steel reinforcement to ensure complete removal of any carbonated concrete between the atmosphere and steel reinforcement. The dilapidated concrete removed was then replaced with approved concrete material and allowed to cure.

Since the edge beams are subject to splash from the Cooks River it was decided that the most practical and cost effective way to preserve the integrity of the edge beams was to apply a no-cure realkalisation treatment to each girder after finishing all conventional repair work. This involved applying an alkali soaked Paper Mache, to a steel mesh which in turn was attached to the existing repaired edge beams. A current was then applied to the steel mesh to drive the alkaline solution into the concrete up to the face of the existing steel reinforcement.

Conventional repair work to the underside of the bridge. Sediment sheets were suspended below to trap loose debris which was then dumped into a barge.

Realkalisation treatment to existing edge beams

Core samples showing the extent of realkalisation of concrete (purple) in the edge beams.

As a further treatment to the conventional repair work and realkalisation treatment the main girders, underside of the bridge deck and abutments were coated with anti-carbonation paint.

As part of the initial assessment it was noted that the existing concrete balustrade had undergone substantial deterioration to a point where replacement with a steel balustrade provided a more cost effective and compromising aesthetic solution to repairing the dilapidated concrete in the existing balustrade.

As a supplementary exercise to the repair work the Roads and Traffic Authority were commissioned to undertake a detailed analysis of the bridge integrity to determine the safe working local capacity assuming the bridge is in good condition and built as shown on the original plans.

3.0 OBJECTIVES

The objectives of the refurbishment work to Wardell Road Bridge were as follows:-

1. To increase the remaining life of the bridge in lieu of total reconstruction.

2. Review the existing imposed weight restriction and adjust accordingly.

3. Maintain the bridge character whilst enhancing the aesthetics of the structure to suit the local environment.

The project was initially programmed for completion within six months however, due to an unforeseen increase in scope of works, which included replacement of all three existing pier tie-beams, the project was completed within 8 months.

4.0 PLANNING AND DEVELOPMENT

The project planning was undertaken in the following stages:-

1. Commission consultant to undertake an inspection of the bridge and recommend cost effective remedial measures to minimise further deterioration and increase life cycle.

2. Undertake detailed analysis of bridge structure based on original construction drawings and as built condition.

3. Commission consultant to design the preferred remedial treatment to the main structure and replacement of existing concrete balustrade.

4. Liaise with affected authorities and develop an approved Environmental Management Plan as part of the works.

5. Liaise with the Roads and Traffic Authority to develop a Traffic Management Plan for the works based on the work methodology statement from the successful contractor.

6. Call tenders and award project based on the agreed selection criteria.

7. Commission contractor, prepare Project Management Plan and monitor works.

5.0 ACHIEVING OBJECTIVES

Successful removal of the dilapidated concrete revealed the 75 year old bridge steel reinforcement to be in good condition with only the existing pier tie beams and a small section of steel reinforcement in the piers requiring replacement. This coupled with the successful application and testing of the realkalisation and cathodic protection treatment indicate that the life cycle of the bridge will be increased.

Results from the detailed analysis undertaken by The Roads and Traffic Authority indicated a safe working load of 20T. Therefore, based on the condition of the bridge and success of the treatment to the bridge, it can be concluded that the bridge is working well within its capacity.

Finally, replacing the concrete balustrade with an appropriately painted steel balustrade enhances views and compliments the local environment.

Completed works

Completed works

6.0 SYNOPSIS

The refurbishment of Wardell Road Bridge integrates historical engineering achievement with cutting edge technology to preserve integrity, increase life and enhance aesthetics without serious detriment to its heritage appeal and at minimal cost and disruption to the community and environment.

7.0 EXTERNAL RELATED ORGANISATIONS

Taywood Engineering Limited / GHD - Design of CP System and realkalisation

Connell Wagner - Design of steel balustrade and Environmental Management Plan (EMP)

RTA - structural assessment and TMP guidance/approval and

Transport and Urban Planning - Traffic Management Plan (TMP)

8.0 ENVIRONMENTAL ISSUES

Prior to undertaking the works a Part 5, Environmental Planning Assessment was undertaken to determine the need for a full environmental assessment.

All affected authorities were contacted to discuss the proposed work methodology and impact on the service assets / environment. As part of the works an Environmental Management Plan (EMP) was completed to address all relevant environmental issues. As part of the EMP an action table was produced with checklist proforma to monitor the works in progress.

It should be noted that to minimize impact on the existing Cooks River loose superfluous material from the repair work was collected in sediment sheets suspended under the working platforms. The waste material was then tipped into barges and transported to skips on-shore before being transported to a suitable waste disposal facility.