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Summary

This case study paper describes the design and construction of two road bridge deck replacement schemes in London where value engineering maximized value for the client, minimized costs, and minimized traffic and utilities disruption during the works.

Keywords: road bridge deck replacement, prestress concrete, steel-concrete composite.

1. Introduction

The first section of the East London Line Project (ELLP) was a £400m Design and Construct contract that included significant upgrades of infrastructure along the original East London Line route between New Cross and Whitechapel. Until the upgrade, two busy local roads crossed the ELL route south of Surrey Quays Station on two identical Victorian bridges constructed with hog-backed cast iron girders and jacked arches decks.

The bridges had two 7.5m spans supported on masonry abutments and on a central pier made from cruciform section cast iron columns braced between one another. The 13m wide decks also provided a corridor for a large number of utilities to cross the ELL at street level. A weight restriction had been imposed on the 140 years old structures and the central piers were considered to be vulnerable in any accidental impact from a derailed train; the bridges therefore had to be reconstructed to mitigate this risk.

Transport for London’s initial design proposals were identical for both structures as it was suggested to remove the central piers and to provide simply supported decks spanning between strengthened abutments.

Although the proposed schemes offered clear single spans, the solutions included several disadvantages that had to be addressed at detail design and construction. The removal of the central support increased the abutment loads significantly, which resulted extensive strengthening with piling through existing masonry walls. With a single simply supported span, the new decks would had been deeper than the existing structures, which in turn would have resulted in raising the road levels including their approaches, which were bounded by existing properties. Moreover the outline schemes required major traffic disruptions and services diversions, which extended the construction programme significantly and formed a large proportion of the overall construction cost.

This case study describes how the design and build team reviewed the illustrative design to develop value engineering solution at each bridge with construction methodology that maximized value for the client, as well as minimized impact on stakeholders, who included both the travelling public and utility providers. The implemented schemes avoided the need of major overnight closures and significant traffic diversions with resulting disruptions. The two bridges were reopened to normal vehicular traffic ahead of programme and resulted in significant net cost benefit to the Client.

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One HV cable and a 20,000 pair fibre-optic cable were running through the existing deck. The design and build scheme included a transverse sequence of utility diversion, bridge demolition and bridge reconstruction that reduced the fibre optic cable diversion requirement from two to one, generating a significant saving in cost and programme risk for the client.

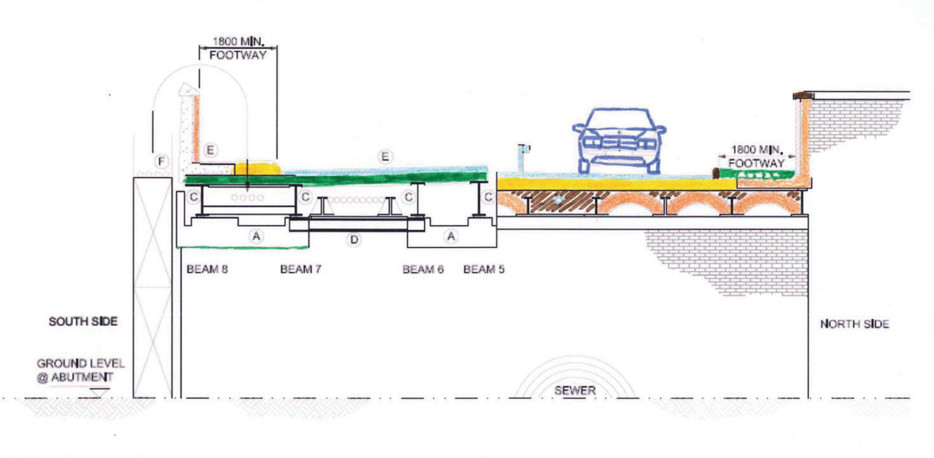
The detailed design revealed that the necessary beam depth for a single span deck (as per the Client's original scheme) would had required the approach carriageways to be significantly reprofiled, which in turn would have significant impact on the properties bounding the bridge. Therefore, the best-value solution reverted to a two-span scheme. Although this entailed construction of a new reinforced concrete pier, the shorter spans meant a lesser beam depth, hence there was no need to reprofile the road along the approaches.

The combination of minimizing the deck dead loads reactions and the provision for a semi-integral articulation meant that the design could accommodate the loads on the existing abutments without the need for substantial strengthening.

3. Rotherhithe New Road Bridge

This structure incorporated a host of duct routes and the local highway authority would not permit full closure of the bridge for anything but a few hours as it lies on a strategic route into London. The services included 8 no strategic 22kV cables. The cost to divert these cables would have been approximately £1.4m.

The design was thus radically reconsidered to save the need to divert the 22kV cables at all. The south side of the deck was partly demolished while leaving intact the two cast iron beams and the concrete between them which housed the cables. When the new steel beams were installed and all dead load deflections induced, temporary hangers were installed to support the existing cast iron beams while the pier underneath was demolished. A permanent hanger was then installed to support the cast iron beams in the long term just as the original pier had done hitherto. The net benefit to the client of minimizing some service diversions and eliminating others was in excess of £0.6m.



Existing North deck carrying traffic during construction of the new deck on the South