East London Line Phase 2

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Summary

The paper describes the civil engineering works needed to bring back into use a section of railway originally opened in 1871 as part of the East London Railway providing steam hauled services through Brunel's Thames tunnel. When the railway was first built, there was a flat junction with the main line, after which the tracks passed beneath a succession of older railway viaducts, climbed up onto a bridge over the Grand Surrey Canal and thence continued on embankment to join the suburban line to Clapham Junction. The train service was withdrawn in 1911 and the tracks dismantled two years later. Fortunately the ownership of the track bed was retained and in the 1990's proposals could be developed for a southern extension of the East London Line to reconnect with the suburban rail line and so allow trains to run through to Clapham Junction once more.

Keywords: Secant piles; reinforced soil; railway bridge; piled slab; derailment protection.

1. Introduction

The East London Line extension is one of the most intensive railway reconstruction projects undertaken in the UK. Much of the Phase 2 extension runs on Network Rail's existing operational South London Line, however a 1,3 km length of old railway infrastructure that had fallen into disuse had to be upgraded and refurbished. Delivery of this section was funded, procured and managed by Transport for London. The detailed design of the civil engineering works was carried out in 2010, construction of the civil works was substantially completed in February 2012, and the railway opened for passenger service in December 2012.

This paper describes the particular challenges in providing a grade separated junction with the main East London Line; re-use and raising of existing earth embankments, gaining sufficient headroom to cross over the Surrey Canal Road, making provision for a new station at Surrey Canal Road, and mitigating the risk of impact by a derailed train where the new railway passes beneath existing brick arch railway viaducts, the oldest dating back to 1836, that carry mainline train services into London Bridge Station.

2. Silwood Underpass

The underpass structure was designed to be constructed top down, thereby avoiding the deep open excavation needed for a conventional bottom up box structure, and also permitting laying of the ballasted track over the top of the structure much earlier in the construction programme. The underpass comprises secant pile walls with alternate 900 dia hard piles and 600 dia firm piles at 2400 mm centres. The walls support a 750 mm deep cast insitu reinforced concrete deck slab with piled approach aprons so that the transition from embankment to structure is square to the track. Within the underpass the SL Down track is laid directly on the 600 mm deep insitu floor slab that acts as a strut between the secant pile walls.

3. Reinforced Soil Structures

In total 630 linear metres of reinforced soil walls were built on this project with heights varying

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from 1,0 m to 7,0 m. For all these walls, the new railway track is less than 2 m behind the top of the wall. The form of construction is Class 6I/6J granular fill with Tensar horizontal geogrids typically at 200mm to 600mm intervals depending on the wall height. All the walls have Forticrete Keystone block concrete facing. Because of the large wall area and the important role that the railway will have in triggering regeneration in the locality, particular consideration was given to appearance. A split "rockface" concrete masonry block was specified with the blocks laid to create horizontal bands of contrasting 'flint' and 'pewter' colour. These walls proved eminently buildable, the contractor's men quickly learnt how to assemble the components and were able to build to a high quality very quickly.

4. Surrey Canal Road Bridge

The new bridge superstructure is based on the current Network Rail Standard E-type underbridge, with high strength steel plate I girders spanning longitudinally and a filler beam floor spanning transversely between the main girders. However because the Standard E-type underbridge has a minimum construction depth of 1148 mm, it had to be modified. A reduction to 1080 mm was achieved by using smaller sections in the floor and reducing the space between the filler beam floor cross girder soffits and the top of the main girder bottom flange.

5. Surrey Canal Road Station Piled Slab

This piled slab solution comprises a pair of 2,0 m cast insitu reinforced concrete deep beams each supported on a row of CFA piles parallel to the tracks, and a 0,6 m deep cast insitu reinforced concrete slab spanning between the deep beams supports the two tracks (Figure 9). The design of the piled slab has been tailored to facilitate the future construction of the station platforms whilst the railway is operational. The front walls for the future platforms have already been constructed, and these both retain the track ballast and act as noise walls. Projecting from the sides of the deep beams are a series of regularly spaced 2 m long cast insitu reinforced concrete cantilevers that will support the future platform structure. The platforms themselves will be built using a bespoke modular system that has been designed to be erected in short night time possessions.

6. Derailment impact protection for the Silwood Arches

Reinstatement of the railway tracks through the openings between the piers of three existing Network Rail viaducts at Silwood required a Quantitative Risk Assessment to be carried out to determine appropriate protection for the viaduct piers. These viaducts, one of which dates back to 1836, carry the mainline train services into London Bridge Station delivering 68,000 passengers in the morning peak hour; hence the financial risk from loss of railway services over one of the viaducts following a train impact was high. The assessment required a calculation of the risk from derailed trains impacting on the piers, an allowance for the effectiveness of the options to prevent train impacts and a comparison with the costs of the protection measures.

7. Conclusions

Considerable effort was expended by the project team at the detailed design stage to develop innovative designs that met exacting project requirements, that had a high degree of buildability, that were very good value for money and would deliver significant time savings in the construction programme. It is significant that the biggest cost saving was delivered through retention of a prime element of the existing infrastructure, namely the old railway embankment. Construction of the civil works was delivered to time and budget. The structures described in this paper have undoubtedly provided economical and buildable solutions for the upgrading, refurbishment and return to use of infrastructure that was over one hundred years old, and they will be a testimony to the engineering that went into their realisation.

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