PIPE JACKING CASE STUDY

Thames Tideway | Putney Embankment Foreshore

PIPE JACKING ASSOCIATION

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PROJECT	**Thames Tideway Putney Embankment Foreshore**
CLIENT	**Balfour Beatty, Morgan Sindall, and Bam (BMB) JV**
CONTRACTOR	**Ward & Burke**
PIPE SUPPLIER	**Tracey Concrete**
TUNNELLING MACHINE	**Herrenknecht AVN**
VALUE	**£14.6million**

PROJECT OVERVIEW

Ward & Burke were engaged to assist in the redesign & subsequent build of the Putney Bridge site on the west section of the Thames Tideway Scheme. The scheme requirement was to connect in to the two combined sewer overflows (CSO's) beneath the bridge (listed structure), transport the flows ~120m along the foreshore to a series of penstock/flap valve chambers. From there the flows are dropped down a 35m deep drop shaft before a 50m long tunnel connects them to the main Tideway Tunnel beneath the river Thames. The redesign included eliminating a series of large-scale temporary works beneath Putney bridge and redesign of the permanent works to eliminate the requirements for secondary linings in shafts & tunnels.

DESCRIPTION OF WORKS

Ward & Burke led this process through technical knowledge of its micro tunnelling capacity & caisson type shaft design. The tunnel pipe under the foreshore was driven on a 300m radius curve at shallow cover (~3m) beneath the bed of the river Thames. W&B proposed to use a single pass reinforced concrete pressure pipe to eliminate the requirements for an in situ secondary lining in the tunnel connections. This pipe has a 5mm thick mild steel "can" running through the wall which is welded at each joint. This "can" acts as the primary layer of waterproofing in the pipe, as it is impermeable and continuous within the pipe wall and is welded at each joint. It increases the durability of the pipe & it's ability to resist accidental loading. This has meant that it was possible to remove a reinforced concrete cover slab that was originally required to protect the pipe in the shallow tunnel drive from accidental loading from ship impacts or settling loads on the riverbed above.

Further to this W&B proposed the removal of a large connection chamber beneath Putney Bridge. The chamber was intended to connect the two CSO's beneath the bridge to the tunnel running beneath the foreshore. W&B proposed to replace this large chamber with two small connection ducts that connects the CSO outlets, at the face of the bridge abutment, to the sidewall of the tunnel pipe. These ducts had to meet all requirements allowing for access and emergency egress from the tunnel, as well strict limitations on the flow conditions within the ducts. These ducts removed the requirements for a large Temporary cofferdam & subsequent excavation beneath Putney bridge. This cofferdam was both a significant risk and cost to the project.

The change required physical hydraulic modelling of the whole interception structure from the bridge to the drop shaft entry. W&B approached the National University of Ireland (Galway) to undertake the project in partnership. The model was constructed at 1:9.5 scale and was used to assess the viability of the W&B Proposal. The model demonstrated that the W&B proposal was acceptable and meets all the works information requirements. Further to this a preliminary CFD modelling report was also commissioned as a proof of concept for the scheme.

DESCRIPTION OF WORKS

Finally, W&B have changed the design of the permanent chambers and drop shaft within the foreshore structure to be contained within caisson structures which are sunk from ground level. 3D modelling of these shafts (and all other works) was required using Bentley AECOsim Building designer.

These caissons have eliminated the requirements for large excavations on the foreshore of the river whilst providing a robust and durable solution to the WI requirements for waterproofness & durability. Due to the thick-walled nature of these shafts (700mm-1100mm) the requirement for a secondary lining has been omitted from the works information. This means that the shafts can be installed in a single pass utilising top-down construction in a controlled environment. In turn this has made significant savings to both the cost of these shafts & the time required to construct them.

Overall Ward & Burke have led the redesign of the scheme through use of technical knowledge and previous experience to try to eliminate construction, durability, and health and safety risks wherever possible. As such they have reduced the overall cost of constructing the scheme as well as the programme length required.

The redesigned scope of works included:

- Temporary Piles – Installation of 523no temporary piles, ranging from 2m to 11m.
- Permanent Piles - Installation of approximately 170no PU32 piles, 16m long.
- Bulk Fill Foreshore – Place approximately 19,000 tonne of fill to foreshore.
- High Level Tunnel – Curved Microtunnel, 135m drive length, 2.286mID, 2.980mOD.
- Low Level Tunnel – 40m tunnel drive with open face Back Actor Machine, 2.286mID, 2.980mOD.
- Drop Shaft – Construction of 6m ID dia. shaft, 41.5m deep, including roof slab.
- Drop Shaft Internals - Construct Vortex Generator, S/S pipe, and access platforms.
- Foreshore Structure – Construction of 15.25m x 7.8m chamber, 9.1m deep including roof slab.
- Foreshore Structure Internals – Construction of tunnel isolation chambers and overflow chambers within the foreshore structure including internal walls.
- Air Treatment Chamber – Construction of 6 m x 2.64m chamber, 3.85m deep, including installation of all associated below ground pipework.
- CSO Connection - Construction of new connection manifolds from existing openings in bridge abutment to new tunnel pipe.
- Main Tunnel Connection - Construction of a temporary connection works to facilitate the main connection works by others.
- Foreshore Cladding Works - Construction of approximately 188m^2 of granite cladding along the northern face of the foreshore structure, and 250m^2 of timber cladding along the eastern and western faces of the foreshore structure.

HERRENKNECHT Tunnelling Systems

WARD & BURKE