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Northdene Tunnel Pipework Replacement

BACKGROUND

The existing Northdene Tunnel was constructed circa 1927 as part of Durban's very first large water supply from Shongweni Dam to the Northdene Filters. However, Durban's water requirements grew and changed over time, and the water supply from Shongweni eventually became too small to be cost-effective.

When a new water treatment works was constructed at Durban Heights the tunnel was re-used for the Southern Aqueduct by laying a new DN900, "VJ" coupled steel pipe through the tunnel to supply water to the southern areas of Chatsworth and Umlazi. The water demands increased dramatically, however, and in the late 1990s a parallel DN1000 continuously welded steel pipe had to be pulled through the tunnel as an emergency measure to provide additional water supply capacity to Durban's southern areas.

The tunnel barely accommodated these two pipes, and the lack of working space made maintenance or repair of either of the pipes virtually impossible. This posed a significant risk to the continuous supply of water to the southern areas of Durban, and a solution needed to be found.

PROJECT DESCRIPTION

Ethekwini Water & Sanitation (EWS) appointed SSI Engineers to design and

1 Two existing pipes in the tunnel showing lack of space for maintenance and repair
2 Lowering jacking pipes into the jacking pit with the pylon in the background

manage the replacement of the DN900 and DN1000 pipes with a single DN1600 steel pipe in the tunnel, and to replace a 40 m long section of old DN900 "Socea Bonna" pipes (Prestressed Concrete Cylinder Pipe – PCCP) outside the tunnel. A fundamental requirement was that the water supply to the southern areas of Durban should not be disrupted.

The site is severely constrained by various obstructions and impediments, and careful planning was required to ensure the continuous supply of water in the Southern Aqueduct. Before the pipes in the tunnel could be replaced, a bypass pipe had to be installed, in parallel to the tunnel, to maintain the flow of water. This necessitated the construction of a jacked sleeve, approximately 120 m long, through which a DN1400 steel bypass pipe could then be laid. The jacked sleeve passes under the main Durban – Johannesburg railway line, as well as Main Road, and no disruptions were allowed to the movements of trains or motor vehicles. Frequent specialist levelling surveys were carried out on the rails to check that the jacking operations did not affect the rail supports, which could cause derailment of passing passenger and freight trains.

3 Welding of bypass pipeline before incrementally launching through the concrete sleeve
4 Lowering of pipes into the trench beneath the large pylon
5 The tie-in for the cross connection on the bypass pipeline to the existing pipes downstream of the western tunnel portal

The project consisted primarily of the installation of a bypass pipeline in parallel to the pipes in the tunnel, removal of the existing pipes from the old Shongweni tunnel, installation of the new pipeline in the tunnel, replacement of approximately 40 m of DN900 "Socea Bonna" pre-stressed concreted cylinder pipes outside the eastern portal, construction of inter-connecting pipework, valves and various modifications to and construction of new reinforced concrete valve chambers on both sides of the jacked sleeve.

The project was divided into three separate contracts, namely

- Contract 1: Pipe Jacking (awarded to Jacked Pipelines)
- Contract 2: Pipe Supply (awarded to Hall Longmore), and
- Contract 3: Pipe Installation (awarded to Esorfranki Pipelines).

The installation of the pipeline was severely complicated by the confined working spaces, particularly on the eastern side of the tunnel. The contractor had to work beneath one of the largest electricity pylons in Durban. Height restrictions and access problems made the handling and installation of the new DN1600 and DN1400 pipes extremely difficult. The risk of damage to the pylon was an ever present threat, and special precautions had to be observed continuously to prevent catastrophic consequences if the support structure or the foundations were damaged.

In addition, leaking pipes (old "Socea Bonna" PCCP pipes) and groundwater posed further problems, to the extent that the contractor continually had to deal with water inside the trenches and on the working areas adjacent to the trenches.

The DN1400 pipes for the bypass pipeline were welded together outside the jacked sleeve, and then incrementally winched into the sleeve. The DN1600 pipes were winched individually into the tunnel and welded internally. The pipes within both the sleeve and the tunnel were grouted up with a flowable cement grout, and cores were taken to check that the uncoated steel pipes were fully covered for corrosion protection. Circularity of the pipe had to be maintained during installation, and special attention was paid to prevent flotation of the pipe during grouting operations.

CONCLUSION

The project was completed in May of this year, without a single interruption in the Southern Aqueduct bulk water supply to Chatsworth and Umlazi. □

PROJECT TEAM

Client
Ethekwini Water & Sanitation
Project Manager: Andrew Copley
Contractors
Esorfranki Pipelines (Pty) Ltd
Jacked Pipelines
(a division of WK Construction)
Hall Longmore
Consultant
SSI Engineers and Environmental Consultants (Pty) Ltd
Project Manager: Darren van Rooyen
Sub-Consultants
Environmental:
Environmental Planning & Design
Engineering Survey: JC Martin Surveys
Geotechnical: Moore Spence Jones

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