

Construction of the Deep Tunnel Sewerage System (DTSS) in Singapore

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1. Introduction

A Deep Tunnel Sewerage System (DTSS) is now under construction in Singapore, which aims to release land for higher value development such as residential and commercial development with additional benefits of increasing the water quality in the Strait of Johor and enhancing the operational reliability of the sewerage system. The existing sewerage system consisting of six centralized water treatment plants and 134 pumping installations, serving the whole of Singapore, will be replaced with the DTSS by 2015.

This paper introduces the details of the DTSS project and reports technical issues on the tunneling by TBM at DTSS T-02 construction site which is now under progress.

2. Outline of the DTSS Project

The DTSS, a long term project to be implemented in stages over the next two decades, consists of two large, deep tunnels crisscrossing the island of Singapore, two centralized water reclamation plants, deep sea effluent pipelines right into the Straits of Singapore and a link- sewer network initiated by Public Utilities Board (PUB) of Singapore as shown in Fig-1.

Approximately 80km of tunnels with diameters of up to 6.5m will be built at 50m below ground and another 170km of smaller

link-sewers will also be built as part of the DTSS. The deep tunnels and link-sewers will convey sewage from the existing network of sewers to two new centralized water reclamation plants to be built on reclaimed land in Changi and Tuas. The treated effluent from the new treatment plants will be discharged through deep sea outfalls into the Straits of Singapore.

The DTSS will be constructed in two phases. The first phase, which is currently in progress, comprising 48km of sewer tunnels stretching from Kranji to Changi (North & Spur tunnels); a 800,000m³/day water reclamation plant with a 5km long deep sea outfall at Changi and some 60km of link-sewers are scheduled for completion in 2008. The second phase will consist of about 17km of tunnel sewers, ranging from 4 to 5.2m in diameter; a 800,000m³/day water reclamation plant with another 5km long deep sea outfall in Tuas and an extension to the Changi water reclamation plant and some 40km link-sewers are scheduled for completion in 2015.

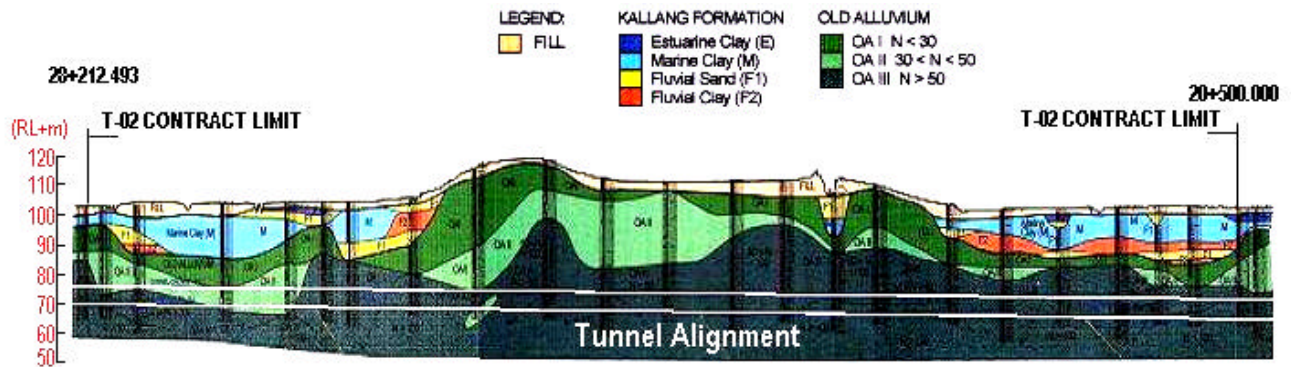


Keywords : Singapore, Sewerage, Deep Tunnel, TBM, Old Alluvium

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3. Tunneling by TBM at T-02 Construction Site

As a part of the first phase of the DTSS project, the North Tunnel and Spur Tunnel construction commenced in December 1999. The T-02 contract, which is one of six such contracts to construct the main trunk sewer, will be highlighted in this section. Fig-2 shows the soil profile through the T-02 contract, which comprises a main tunnel length of 7.7km. The internal diameter of the tunnel is 6m and it is being constructed at a depth of approximately 40m to 45m. The duration of the construction period is 50 months from January 2000 to February 2004. The soil at tunneling elevation is mostly classified as Old Alluvium, however an unexpected granite rock intrusion has also been found at a part of the tunneling route. An earth pressure balance (EPB) type of tunneling boring machine (TBM) is adopted for the project.



The key factors of the project success are the following;

- 1) To complete the 7.7km long tunnel within two years, using only one EPB type TBM. This schedule constraint requires a 13m/day advance rate as average.
- 2) To overcome the extremely abrasive Old Alluvium soil strata and the difficult conditions associated with the hard rock layer granite. The TBM must be designed and manufactured with high durability and high wear resistance. The machine should have sufficient capacity to enable operation at pressures approaching full overburden and to overcome the conditions associated with the granite layer.
- 3) To consider the well-balanced TBM backup facilities and logistics, with planned preventative maintenance to avoid any major breakdowns and interruptions of progress.
- 4) To design and erect the rigid and water-tight segmental lining under the condition of high overburden.

4. Postscript

Tunneling for the T-02 tunnel is currently in progress with the current length excavated at approximately 4,700m as of the end of March 2002. The average daily progress to date has been 18m a day. The project is proceeding relatively smoothly, without any major problems, and should be completed as scheduled. It is a great pleasure, as an international contractor, to introduce new technology and contribute to the construction of a new sewerage system in Singapore.

Reference : <http://www.pub.gov.sg/dtss.html>