For Information

LegCo Panel on Environmental Affairs

Strategic Sewage Disposal Scheme Stage I
Building Deep Tunnels

Introduction

At the Panel meeting on 25 November 1999, members raised concerns about the recent incident of settlement recorded at the new reclamation in Tseung Kwan O, and asked the Administration to give assurance that construction of the deep tunnels under the Strategic Sewage Disposal Scheme (SSDS) Stage I would not cause widespread ground settlement at built up areas over the tunnels. This paper is to inform members of the methodology used in building the deep tunnels and the safeguards in place to control ground settlement.

Background

2. As part of the SSDS Stage I, there are six deep sewage collection tunnels with a total length of 23.6 km and a submarine outfall tunnel. The submarine outfall tunnel, which is 1.7 km in length and at a depth of about 100 m underneath the harbour, has already been completed and commissioned. The alignments of the tunnels are shown in the plan at Enclosure 1. The six sewage collection tunnels are built at depths of 80 to 150 m below sea or ground surface to ensure a minimum rock cover of 30 metres. Excavation for these tunnels is carried out using tunnel boring machines except for the tunnel from Kwai Chung to Tsing Yi for which drill and blast method was employed.

3. Two contracts for the construction of the six sewage collection tunnels were first awarded in 1995 for completion in mid 1997. Unilateral suspension of works by the contractor led to the forfeiture of the two contracts in December 1996. The completion contracts for the tunnels were awarded in July 1997 and January 1998. Active tunnel excavation work for the six tunnels progressively re-started from end 1997 to end 1998.

Assessment on Possible Ground Settlement

4. Before tunnelling works were carried out, we conducted a detailed assessment of the risk of excessive ground settlement at developed areas.

5. Since the tunnels are built deep underground in rock with a minimum rock cover of 30 metres, the risk of surface ground subsidence resulting from tunnel collapse during tunnelling is practically eliminated.

6. Surface ground settlement may however occur due to consolidation of soil layers overlying the bedrock if groundwater is lost to the tunnel and not adequately replenished from the surface. To limit such settlement in developed areas, we have imposed very stringent requirements on the amount of groundwater allowed to enter into the tunnels when the tunnels are being excavated under developed areas. The maximum amount of settlement that may occur at the developed areas is assessed to be in the order of 20 millimetres. Settlement of such magnitude would not impose any risk of damage to buildings, structures, road or public utilities at ground surface.

7. For the section of the tunnels being built underneath the sea or undeveloped areas where no structures are likely to be affected, groundwater inflow is controlled to the extent that would allow tunneling works to be safely and practicably carried out. It has been envisaged that ground settlement resulting from water inflows into the tunnels at these locations would be local along the tunnel alignment, and such settlement would not affect any structures or utilities.

8. No groundwater will enter the sewage collection tunnels after they are put into operation as these tunnels will be permanently lined with concrete and will carry sewage at the same hydrostatic pressure to that of the external groundwater. Therefore no further settlement will be caused by operation of the sewage tunnels.

Settlement Monitoring

9. At present, about 70% of the total 23.6 kilometres length of the six sewage collection tunnels have been bored through. As tunneling proceeds, we have been monitoring closely the ground settlement at all developed areas along the tunnel alignment. The tunneling progress achieved and results of ground settlement monitoring for each tunnel are described below :-

Tunnel from Kwai Chung to Tsing Yi

The tunnel passes deep under Tsing Yi South bridges and was bored by drill and blast method. Excavation was complete in January 1999 and no settlement has been recorded at

the bridges.

Tunnel from Tsing Yi to Stonecutters Island

About three-quarters of the tunnel in length have been excavated and the tunnel cutting face is at present under the container terminal. We have set up hundreds of monitoring stations at the terminal and commenced extensive settlement monitoring since early this year. Monitoring record indicates that the terminal has not experienced any settlement of significant nature. Almost all monitoring stations register no or little ground settlement of less than 20 millimetres. The maximum settlement recorded at the terminal is about 40 millimetres and is limited to a very small area. We are in close liaison with the operators of the terminal and the overall operation has not been affected.

Tunnel from To Kwa Wan to Stonecutters Island

As shown in the attached plan, the tunnel has traversed the built up areas of To Kwa Wan, Ho Man Tin and Mongkok and in particular, the MTRC and KCRC lines at the central part of Urban Kowloon. We have been monitoring ground settlement at hundreds of survey stations and have not recorded any settlement of measurable magnitude.

Tunnel from Kwun Tong to To Kwa Wan

The tunnel is mostly underneath the harbour. At present, more than half of the tunnel length has been bored through. When tunnelling works were carried out in November 1998 in Kwun Tong, slight settlement (of an average amount of about 30 millimetres) were recorded at some road pavements at the bus terminus next to the public pier. Ground subsidence ceased almost immediately and no overlying facilities were affected.

Tunnel from Chai Wan to Kwun Tong

About 2 kilometres of this tunnel has been excavated starting from the Chai Wan end. The tunnel face is now underneath Shau Kei Wan. In March 1999, when tunnelling works were carried out underneath the cargo handling basin of Chai Wan, the tunnel face met some fractured rock bands and more groundwater had entered into the tunnel. This had caused some subsidence to a section of Ka Yip Street and the average amount of settlement recorded from March to October 1999 is about 90 millimetres. Upon discovering the subsidence phenomenon, we immediately instructed the contractor to carry out grouting work within the tunnel and re-charge the groundwater from ground surface. We also contacted the utility undertakers for ensuring that the utilities were not

affected. The rate of settlement stabilised very quickly. Except that some walkways needed to be repaved, there were no reports that utilities had been damaged.

Tunnel from Tseung Kwan O to Kwun Tong

Tunnel boring for this 5.3 kilometre length tunnel commenced from the Tseung Kwan O side in November 1998; crossed the Tseung Kwan O Bay and ended at the seafront of Kwun Tong on 9 November this year. Heavier water inflows into the tunnel did occur especially when the tunnel was underneath the Tseung Kwan O Bay. The location is about one kilometre away from the Tseung Kwan O town centre where surface settlement greater than expected has recently been recorded. Investigation on the cause of the unusual settlement is being carried out and will take four months. Whilst there is insufficient information at this time to conclude that water inflows into the tunnel is contributing to this settlement, it is considered prudent to halt the inflow of groundwater into the tunnel. Accordingly, the lining of the tunnel at locations with relatively heavy inflow will be carried out in advance of the scheduled programme, and we aim to complete the work by February/March 2000.

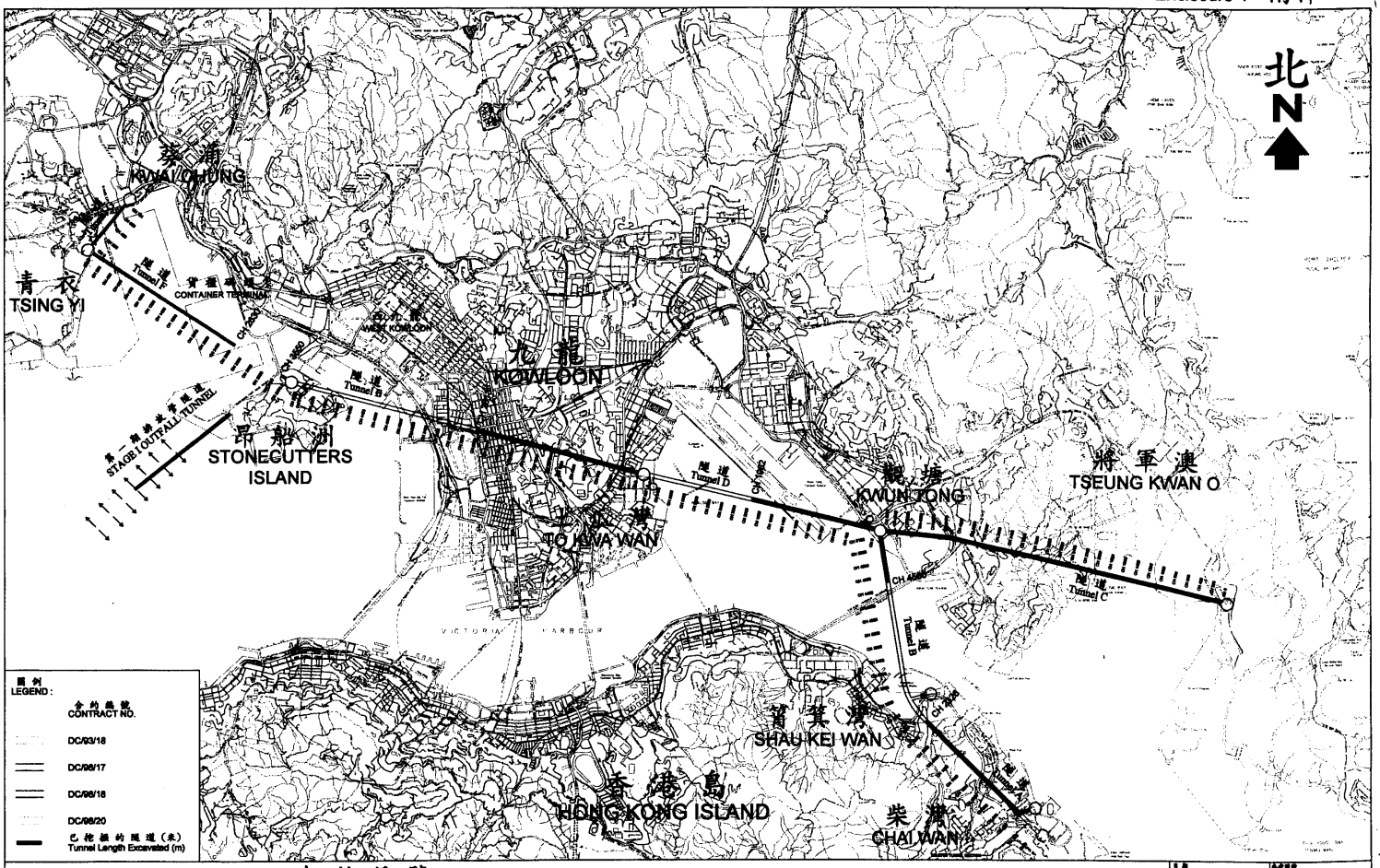
The Remaining Tunneling Works

10. 16 kilometres out of the total 23.6 kilometre of sewage collection tunnels under the SSDS Stage I have been successfully mined. We have successfully tunneled through densely populated areas and have also passed underneath the MTRC and KCRC lines on several occasions already. Apart from the situation that is under investigation in Tseung Kwan O, the incidents where ground settlement has been caused by the tunneling works have been relatively minor in nature. Prompt mitigation measures have been implemented in these cases and they have not affected any overlying buildings or facilities.

11. At present, there remains less than 8 kilometre of tunnels yet to be excavated. It can be noted from the attached plan that the majority of the tunnel sections through developed areas have already been excavated. With the experience gained from the 16 kilometres of tunnels constructed to date, we are confident that the remaining tunnels will be completed safely.

Drainage Services Department
December 1999

Enclosure 1 附件一



合約編號 CONTRACT NO. DC/93/18, DC/96/17, DC/96/18 & DC/96/20

策略性污水排放計劃第一期 - 污水隧道系統
STRATEGIC SEWAGE DISPOSAL SCHEME STAGE I - SEWAGE TUNNEL SYSTEM

日期 19.11.99 圖號 DSS/99/001M

渠務署
DRAINAGE SERVICES DEPARTMENT