High-Speed Construction with Large Section Slurry Shield Method

— Kanagawa Route No.7 Yokohama Northwest Line of Metropolitan Expressway —

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Yokohama Ring Expressway North-West Line is an car-only, 7.1km-long expressway (including a tunnel area about 4.1km) that runs through the northwest region of Yokohama City, Kanagawa Prefecture. The two shield tunnels (inner diameter 11.5m, outer diameter 12.4m, segment width 2m) partially runs under railways and rivers with a maximum overburden of 67m, and the length of excavation was about 3.9km. As the total produced earth was 1.16 million m3, slurry shield method was adopted for stable disposal. The following technical measures were taken to quickly complete the project, especially to increase the speed of shield tunnel construction.

1. Technical Measures Taken to Increase Construction Speed

1) Simultaneous Excavation and Assembly of Segment

Among the four steps, namely: 1) preparation, 2) excavation 3) segment assembly, and 4) pipe extension, standard construction time per ring was reduced 20% by conducting parts of 2) and 3) simultaneously. Assembly time per ring was reduced also by increasing the turning speed of the erector and the excavation speed.

2) Increasing Pumps, Muddy Water Treatment and Facilities to Carry Out the Soil

The number of sludge discharge pumps was increased to two from the usual one on the succeeding cars, which increased transport capacity. Also, the initial and secondary treatment filter presses were added to take out soil that was beyond expectation (for example, soil of 100% sand or clay), so the maximum excavation amount planned (24m per day) could be actually conducted. The soil pit capacity was increased to 1.5 times more than usual, so the excavation could be done at times when the discharge could not be carried out. This resulted in increased number of working days.

3) Stable Treatment of Produced Earth

With increased excavation speed, the amount of produced earth also increased up to 7,000m^3 per day at maximum. The soil was reused widely between the construction sites, and construction sludge was recycled after administrative procedures. Twenty sites were found to carry out the soil and construction sludge, which ensured steady treatment of produced earth.

4) (MSV) Multi-Service Vehicles

Multi-Service Vehicle (MSV)s were used to transport segments inside the tunnel. This eliminated the need to build a railway for the conventional vehicles used for shield tunnel constructions. This also helped in quickly starting the next phase of construction. MSVs were also proven as a safe transport device when running through longitudinal slopes of maximum 5%.

Photo 1 (MSV) Multi-Service Vehicles running on Tires

5) Using Composite Segments

Parts of open-cut from the shield tunnel and low overburden parts (areas under ventilation devices) are especially loaded parts, which need segments with high rigidity. This project reduced the step of adding a refractory panel by using a "composite segment with steel and concrete mixed with organic short fiber" instead of attaching refractory panels to steel segments.

6) Using Precast Products

Precast products of inverts and floor slabs were used to ensure quality management and reduce construction work. These contributed in avoiding the risk of delay in construction.

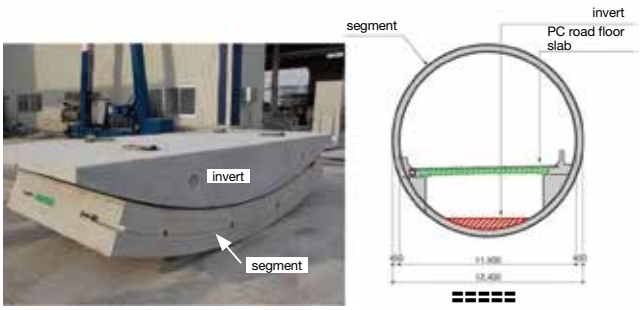

Fig. 1 sectional plan in one of two shield tunnels

2. Conclusion

With this Large Section Slurry Shield Method Construction, high-speed excavation was established at a maximum of 450m per month. The excavation of approximately 3.9km was completed in about an year and a half.

Photo 2 Arrival of the Shield