Construction of Large Section Shield Tunnel at a Location with Sharp Curve, Steep Slope, and Adjacent to Important Structures

— Baba Ramps of Kanagawa Route No.7 Yokohama North Line of Metropolitan Expressway —

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Baba Ramps is found at around the middle of Kanagawa Route No.7 Yokohama North Line of Metropolitan Expressway, which opened in March 2017. There are four ramps connecting the main tunnel to the streets on the ground level, and a large part of ramps is tunnel structure. The area near Baba Ramps is a heavily populated residential area, with the main tunnel connecting at a great depth with overburden of 31-51m. This is the reason why TBM was used. The four shield tunnels were constructed from two launching shafts build within the site and connected to the main tunnels' underground enlargement, which was constructed using the piperoof method when the Expressway was built.

1. Features of the Baba Ramps Tunnel

The four ramp tunnels' diameters were set at the minimum with consideration to construction gauge, evacuation routes, inner section conditions and curve widenings.Large section shield machines with outer diameters of ϕ 10.13m - 11.13m were used. The B ramp tunnel had a sharp curve (minimum curve radius 50m) and steep slope (maximum grade 7.6%), measures were taken to control the position of the shield machine while excavation. Also, the shield machine excavated through an overburden of minimum 1.3m, so measures were taken to prevent the segments from rising.
Construction of ramp tunnels have excavations with small overburden right below streets and residential areas. The ground under residential areas consisted of alluvial cohesive soil layer with humus soil. A pilot excavation was done within the site right after the shield launch to preset the excavation management values.

2. Excavation Near Important Structures

There was a transmission tower 15m ahead of the start of the D ramp tunnel, with the minimum separation to the tower foundations being 4.7m (0.48D). Effects of excavation to the tower was assessed, and the tower foundations were reinforced to restrain changes of the tower. Measurement control and excavation management values of the tower base were set along with measures to prevent loosenes of natural ground during construction.

The A ramp tunnel was constructed near to the main tunnel, with the minimum distance 1.2m. Construction had to be finished without affecting the main tunnel, which was in use at the time. Construction data obtained from the three ramp tunnels excavated before the A ramp tunnel was used to preset excavation management values, and the main tunnel's real time measurements and inspections were conducted. The shield machine was dismantled after taking safety measures by protecting the vehicles going through the main tunnel with a temporary wall built up beforehand. The temporary wall was taken out after the A ramp tunnel's excavation was finished.

3. Conclusion

With adequate measures taken, any influence of the construction to houses on the ground and important structures such as the transmission tower and main tunnel (which was in service) nearby were reduced, and the four-ramp tunnel was completed safely.

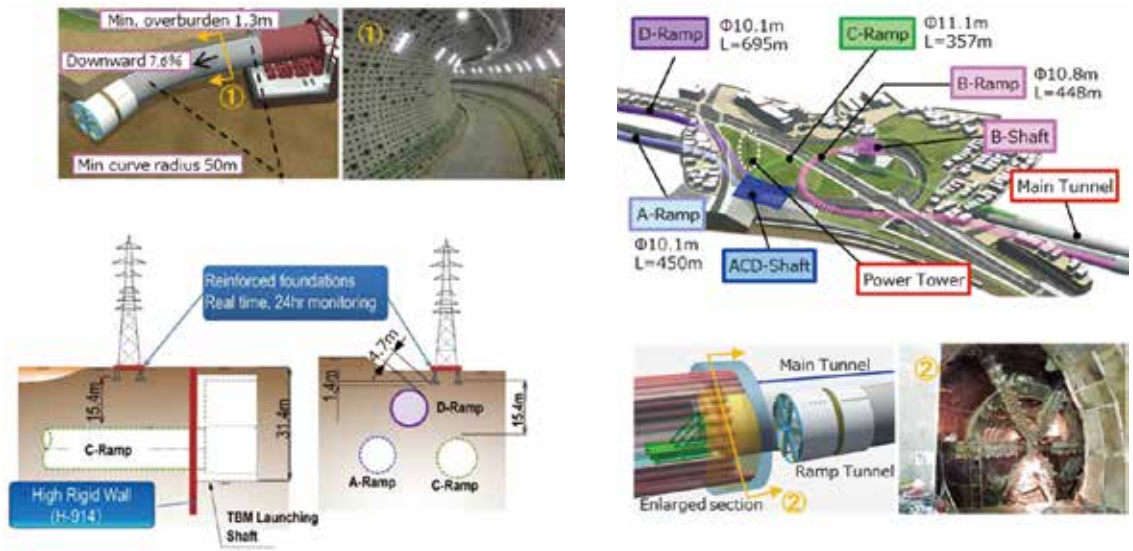

Fig. Features of the Baba Ramps Tunnel