Tunnel Widening Construction Considering the Safety of Users and the Living Environment of Nearby Residents

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Outline of Construction

Kuradama Tunnel, located in Kimitsu City, Chiba Prefecture, is a road tunnel with a length of 145 m constructed in 1953 using the sheet pile method. Due to the narrow width of the tunnel, it did not allow normal vehicles to pass each other, so it was necessary to widen the existing tunnel without traffic control. In addition, this project required the selection of construction equipment in consideraction of construction restrictions because two protectors were to be installed sequentially, the movement of the protectors with traffic control only at night to minimize the Impact on general traffic, and the selection of construction methods and safe construction in consideration of the living environment of residents in the vicinity of the tunnel portal on the termical side.

1. Outline of the Road Widening and Tunnel Excavation

The geology around the tunnel consists of alternate layers of mudstone and sandstone, with mudstone-dominated and sandstone-dominated sections appearing repeatedly. The sedimentation environment is estimated to be in the middle to upper part of the continental slope.
Figure 1 shows a summary of the construction procedure.
As an excavator, an erector-equipped shotcrete machine was employed, which can perform the entire process from the first spraying to the construction of tunnel supports and the second spraying without a time lag, even in a section with poor ground conditions. In addition, considering small overburden (maximum overburden: 24 m) along the entire line, the upper bench length was shortened to a minimum of 5 m to minimize tunnel loose areas and stabilize the cutting face (Photos 1 and 2).

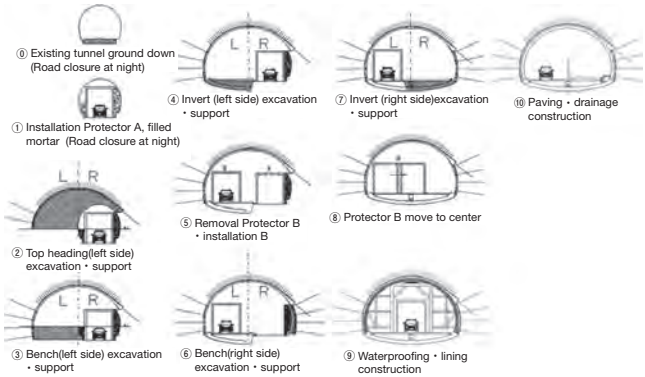

Fig. 1 Construction procedure of the road widening without traffic control

Photo 1 Installation of the tunnel support

Photo 2 Concrete spraying (under tunnel ventilation)

2. Movement of the Protector to the Center and Environmental Measures

Movement of Protector B to the center of the tunnel required extremely strict conditions: the 158-m-long protector had to be moved 3 m in the transverse direction, and the work had to be performed during the nighttime closure period from 9:00 p.m. to 5:00 a.m.
To address these construction conditions, the following measures were taken: (1) the protector was separated into blocks of 10 m each, (2) special rollers were installed at the lower ends of the four corners of each block, and (3) two sets of motorized chain hoists were installed for each block on the day of the movement, and the blocks were towed from one side. As a result, the movement of all the blocks was successfully completed in one night (Photo 3).
As for measures to protect the living environment of the nearby residents, there were concerns about the impact of noise generated during the tunnel construction on two private houses located near the tunnel portal on the terminal side. As a measure against this issue, a sound insulation wall (H = 12 m) was installed at the tunnel portal. In addition, before tunnel penetration, ground (2 m in height) was left at the upper half of the tunnel portal as a bulkhead to provide sound insulation. By implementing the above measures, the lower half excavation of the L side of the tunnel and invert excavation was successfully carried out day and night using a hydraulic tunnel excavator instead of a large breaker, despite the proximity of private houses to the tunnel portal on the terminal side. During the construction period, there were no complaints from residents in the vicinity, and the construction noise and vibration levels met environmental regulations (Photo 4).

Photo 3 The movement of Protector B to the center

Photo 4 Installation of an electrostatic precipitator and a sound insulation wall (H = 12 m)

3. Conclusion

In this project, the two protectors used for protecting normal vehicles until the completion of the lining placement were successfully installed, moved, and removed within the limited time period. Furthermore, the selection of the construction equipment was made in consideration of the safety of third parties and the conditions of construction in the narrow space where the protectors were located. In addition, the road widening work was successfully completed without any complaints or troubles from the surrounding residents as a result of the preliminary construction and measures taken after repeated studies on various issues, such as the change to a tunnel ventilation system using the existing tunnel and noise reduction measures at both tunnel portals.