

Countermeasures against swelling of in-service tunnels using precast inverts

— Kashi Tunnel, National Highway No.289 —

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1. Introduction

The Kashi Tunnel is a 4,345 m long tunnel that was opened in September 2008.

In addition to overcoming the severe conditions of having only 9 hours during the night for operations before lifting restrictions in the morning, the tunnel is an in-service tunnel on a major road connecting two cities that plays an important role in the local economy, and the impact on road users must be taken into consideration. The tunnel inverts were reconstructed in consideration of the impact on road users.

2. Construction of precast inverts

In selecting the construction method for the reconstruction of the tunnel invert, the precast invert construction method was adopted in consideration of construction costs and economic losses during construction. (Photo 1)

This construction work was carried out during weekday nighttime traffic closures to avoid heavy traffic hours. The construction procedure consisted of excavation, demolition of the existing invert, and base leveling in preparation for the installation of the precast invert. The nighttime closure began at 21:00, a rough terrain crane was set inside the tunnel, and the precast inverts were picked up from the transporter and installed. Each precast invert has a length of 0.5m in the longitudinal direction of the tunnel. In this project, four precast inverts were installed in one night, totaling 2m in length. The tunnel was then backfilled, etc., and the traffic restrictions were lifted at 6:00 a.m. the next morning.

This process was repeated for approximately 90m of the construction section, and the inverts were reconstructed. Various measurements were taken in the tunnel for safety management. As a result of the measurements, the settlement of the tunnel arch and displacement of the inner space due to the demolition of the existing invert were observed, but the fluctuations were within the expected values at all locations. In addition, data was obtained that indicated the effects of the invert reconstruction.



Photo 1 Construction scene

3. Results of precast inverts and future challenges

The precast inverts made it possible to construct high-quality inverts.

In addition, productivity of in-tunnel construction was improved by saving labor for concrete casting and curing. Furthermore, construction could be carried out by closing the tunnel to traffic during weekday and night hours, when traffic volume is extremely low, greatly reducing social losses, including the economic impact of the construction. Future issues include shortening the construction period and reducing road closure time by increasing the amount of precast inverts installed per day.

In addition, we plan to continue observing displacements and stresses in the tunnel after the precast invert is installed and to verify the future stresses used in the design of this project.



Photo 2 Invert damage status