Large-Section Shield Tunnel Excavated Directly Beneath Runway in Service Tokyo International Airport Tunnel

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1. Introduction

This project involved constructing a road tunnel that can be used by large buses using a shield tunneling method in order to improve the convenience and punctuality of connections between international and domestic flights at Tokyo International Airport. The outer diameter of the shield tunnel was about 12m, and a mud shield was used. The shield tunnel passed directly under airport facilities such as runways, taxiways, aprons, monorails, and highways in service in the heterogeneous and extremely soft ground of the reclaimed land, so one of the most important issues in this project was to minimize the impact on these critical structures. Fig. 1 shows a bird's-eye view of the tunnel.

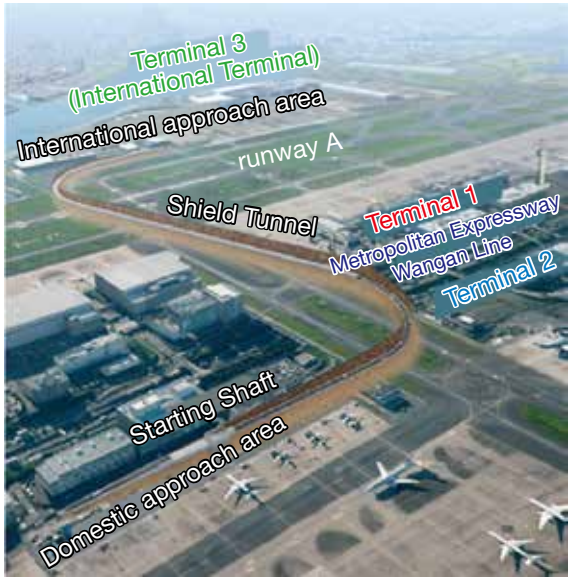

Fig. 1 Bird's eye view (image)

2. Measurement and Control of the Ground and Critical Structures in the Construction Area

Fig. 2 shows the ground in the construction area and the longitudinal alignment of the tunnel. The ground is very soft, with the upper sand layer (As1 layer) dredged and filled with sludge (Ac1 layer) and construction soil (Bs layer) dredged from the navigation channel in Tokyo Bay. In addition, the excavation cross section has obstructions such as drainage material used during ground improvement and steel pipe piles left over from the construction of the Tokyo International Airport Offshore Development Project.
The volume of deformation was measured by level surveying during the night when the airport facilities were closed, and by ground-mounted synthetic aperture radar to determine the deformation trend when the airport was inaccessible. The ground-mounted radar was used to determine subsidence trends because the radar has a small angle of incidence and low reflection intensity, which results in large variations in measurement accuracy. In addition, the excavation data was monitored in a central control room to manage the deformation in a comprehensive manner.
In order to instantly detect deformations that exceed the permissible values, measurement methods such as dynamic observation using a non-prismatic total station and road surface monitoring using a high-sensitivity telephoto camera were used in combination within the influence zone of Runway A. Measurement management was conducted 24 hours a day, 7 days a week.
As a result of these measurements, the construction work was completed with the maximum settlement of 11 mm, which was lower than the primary control value (12 mm).

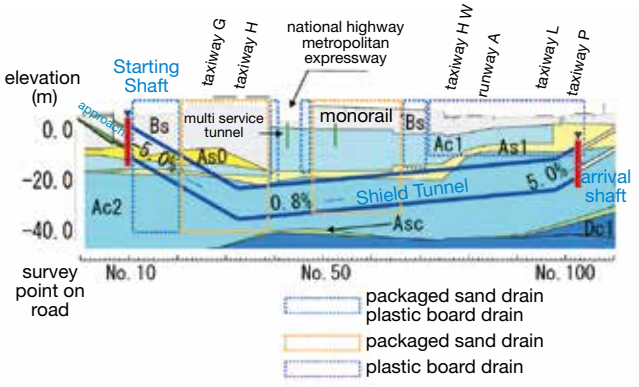

Fig. 2 Longitudinal image

3. Summary

In this project, it was necessary to control ground deformation caused by shield tunneling because the shield tunnel had to pass directly under critical structures such as the runway, which was in service. Various deformation measurement methods were used to monitor deformation in real time during shield tunneling. As a result, the shield tunneling was carried out without causing any problems with aircraft operations.

Photo 1 Domestic flight approach area (at starting shaft)