Construction of a Subway within a Short Period by Overcoming Underground Obstacles in Soft Reclaimed Land

— Infrastructure Maintenance Work of the Hokko Techno-Port Line —

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1. Features of This Construction Work

This work comprises the construction of a shield tunnel section (760 m, two single-track shields) from the Yumesaki Tunnel section to the Yumeshima South Track section, as well as cut-and-cover tunnel sections (190 m for the South Track section and 190 m for the Station section) at the Yumeshima South Track section and Yumeshima Station on the Hokko Techno-Port Line between Cosmosquare and Yumeshima stations (Figure-1).
In addition to the technical challenges unique to reclaimed land, this project had a short project period of approximately five years from design to the start of business. Early Contractor Involvement method, in which technical cooperation is provided by the builder from the design stage, was adopted to start construction at an early stage and prevent rework due to design changes during construction. The construction is proceeding at a rapid pace, with the aim of opening the in FY2024, the year before the Osaka–Kansai Expo 2025 is scheduled to be held.

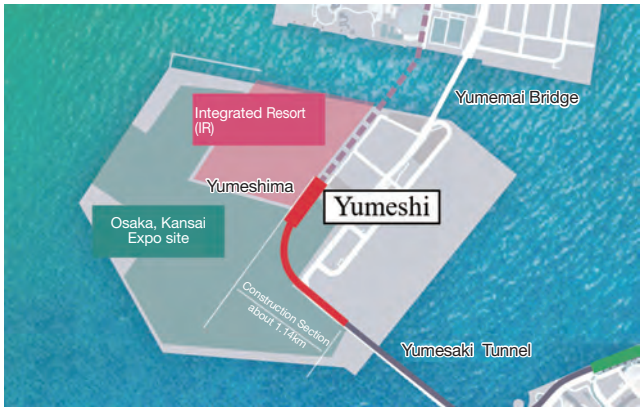

Fig. 1 Construction location map

2. PBD Cutting by Extrusion Cutter

Plastic board drains (PBDs) were buried along the entire shield tunnel section. Initially, it was planned to use a rotary cutter; however, the cutter would be subject to severe wear and may require replacement, thereby affecting the process. Therefore, a newly developed extrusion-type cutter was adopted (Figure-2). This technology has the advantage that the PBD to be buried in the next ring drilling range can be cut in advance during segment assembly by simply pushing out the cutter bit for a length equivalent to the segment width. This results in less wear on the cutter, facilitating reliable cutting without affecting the process (Figure-3).

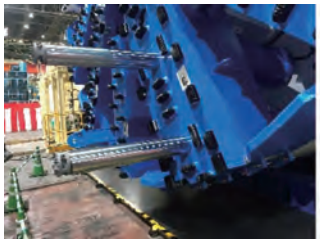

Fig. 2 Extrusion cutter bit

Fig. 3 PBD cut piece

3. Rational Basis for Temporary Structures and Construction

Diagonal struts are generally used to reduce the design span of the retaining wall, but they require several members to be attached and take time to erect. Furthermore, they interfere with the excavation work directly under the retaining wall, the loading and unloading of materials and equipment, and the construction of the structure. Therefore, the "hammer strut" was applied to the cut-and-covert tunnel section as an alternative structure to help remedy the above issues. This method, installation of H-section steel parallel to waling strip at connecting part of strut and waling strip, eases the installation process, and it can be composed of highly versatile members (Figure-4).

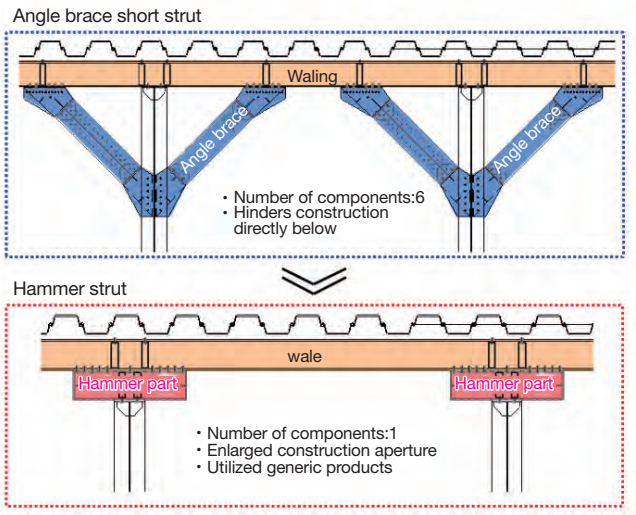

Fig. 4 Hammer strut structural drawing (plan view)

Photo 1 Application of the system on site

The subway tunnel was constructed within a short project period on reclaimed land through the introduction of the aforementioned new technologies.