Construction of a Watertight Tunnel in Consideration of Environmental Protection for Wetland Registered Under the Ramsar Convention

—The Hokuriku Shinkansen, the Miyama Tunnel —

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1. Introduction

The Hokuriku Shinkansen, which has a 690km route from Tokyo to Osaka, is currently being developed for a 125km route between Kanazawa Station and Tsuruga Station.
The Miyama Tunnel is a mountain tunnel which has 768m length and a double track section. The Shinkansen route was changed since it locates near Nakaikemi Marsh which was registered under the Ramsar Convention in July 2012. The drilling of the tunnel was started by NATM in January 2019 and completed in August 2020 (Fig.1).

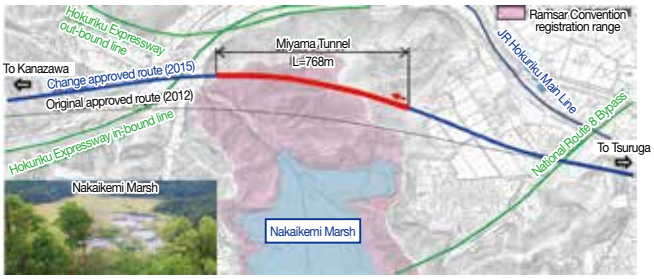

Fig. 1 Miyama Tunnel Route plan drawing

2. Feature and plan of tunnel

A feature of this tunnel is the presence of multiple active faults due to past active fault movements and crustal movements. In terms of the environment, consideration should be given to the diverse waterside environment of Nakaikemi Marsh and the growth of diverse flora and fauna. As for the excavation plan, we approached to preserve the wetland environment. To deal with complex lithofacies changes in which small-scale fracture zones repeatedly appear, we took balance excavation safety and economic efficiency (Fig.2). The following five items are representative examples of environmental protection measures taken for wetlands registered under the Ramsar Convention.
(1) Selection and change of Shinkansen route
We studied the route for two years to reduce the impact of Miyama tunnel construction on the surrounding environment. We concluded to horizontally move the route by around 150m further away from the wetland and vertically move the route by around 20m higher to prevent the lowering of groundwater level. (Fig.1,3)
(2) Continuation of monitoring survey
In order to properly assess the impact on the wetland environment, we are conducting monitoring surveys before, during, and after construction. We disclose the contents and results of the survey and follow up after gathering information such as opinions from stakeholders.
(3) Utilization of circular cross section watertight structure
After the construction of the tunnel, we utilized a watertight structure that covers the entire circumference with a waterproof sheet which has 2.0mm thickness to permanently prevent the ingress of groundwater into the tunnel. Since water pressure acts on the tunnel due to this structure, we used a circular cross section in lieu of horseshoe-shaped cross section which is common in mountain tunnels to reduce the lining thickness. (Fig.3)
(4) Implementation of advanced survey boring
As a countermeasure against sudden spring water, we conducted advanced survey boring to collect cores to grasp ground information and the appearance of spring water in advance. Once spring zone would be discovered, we will study the implementation of water reduction.
(5) Dealing with the impact of tunnel excavation
In case the water level drops during tunnel excavation, we would take an emergency measure to restore the water level. We planned to restore the water level by recirculating the natural flowing water in the downstream area as an alternative water source. We also took into account the contamination of species that may affect the ecosystem,

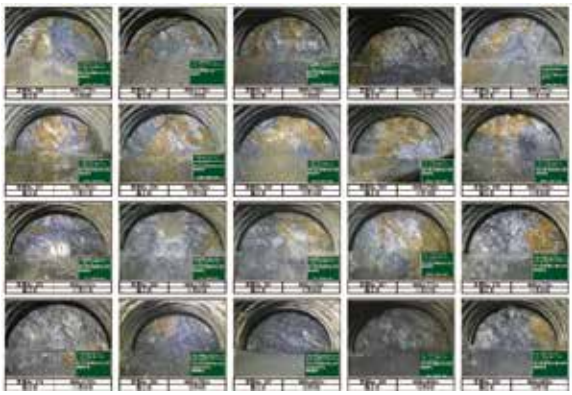

Fig. 2 Complex changes in the lithology of the tunnel face

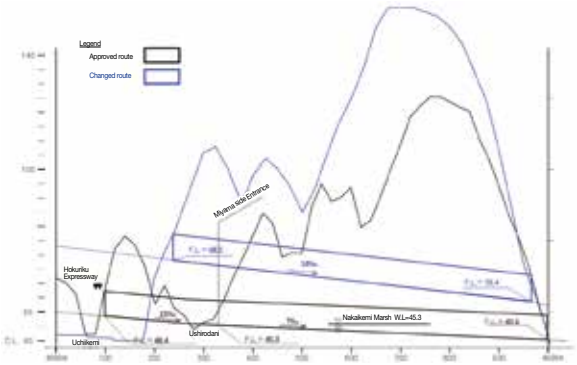

Fig. 3 Longitudinal section of the Miyama tunnel route

3. Construction result

As a result of taking various environmental protection measures, no significant impact on the wetland environment due to the tunnel excavation was confirmed. As of October 2021, we have not conducted the water level restoration. We will continue the post-construction monitoring surveys and do effort to protect the environment of wetlands registered under the Ramsar Convention.

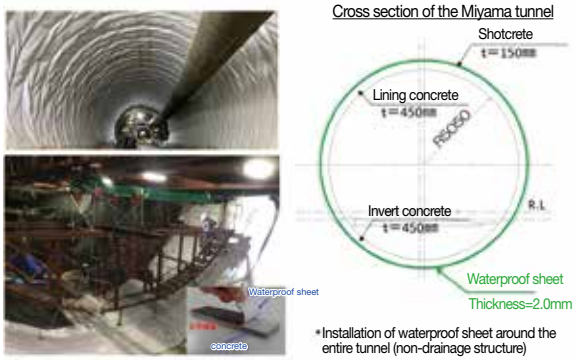

Fig. 4 Waterproof sheet and circular cross section (watertight tunnel)