JAPAN

Name of Association: Japan Tunnelling Association
Type of Structure: Non-profit, association
Number of Members: Total number 1446, number of corporate members 203

ASSOCIATION ACTIVITIES DURING 2023 AND TO DATE

WGs: JTA consists of the following four committees and each committee has WGs and task forces. Technology/ International Communication/Events/ Public Relations. In each committee, the main activities are:

- Investigation, research and information interchanges on general techniques and on subjects of specific projects.
- Meetings such as online lectures, online symposiums and online workshops and online training: "Two-days online seminars" and "Online lectures on topics of the year" (organized by Events committee)
- Publication of reports and documents: Monthly journal "Tunnels and Underground"
  Biyearly magazine "Tunnelling Activities in Japan"
- International cooperation

CURRENT TUNNELLING ACTIVITIES

Repairing the pilot tunnel of the Seikan Tunnel Tappi Pilot tunnel Repair Works

The Seikan Tunnel is a long undersea tunnel with a total length of 53,850m. The undersea section of 23,300m consists of three tunnels (the main, working, and pilot tunnels). The deepest part of the tunnel is 240m below sea level and is subject to strong water pressures. Due to the unique environment of the Seikan Tunnel, various measurements have been continuously implemented since its opening. A wide range of measures are taken including the displacement of the inner space of the main, working, and pilot tunnels, the amount, pressure, and quality of water inflow, the neutralization and strength of the concrete, and the deterioration of the injection material. Significant changes were discovered in the pilot tunnel which had to be controlled via various measures.

To fix the reduction in the inner space cross-section and a rise in the roadbed, the effect of rock bolts and invert concrete was verified by reproducing the deformation using numerical analysis. As a result, the placing of six rock bolts per section following the removal of the roadbed concrete was decided upon as the best method for minimizing the amount of internal air displacement. As a result, the existing roadbed concrete was removed, and the invert concrete reconstructed after the rock bolts were placed on the uplifted roadbed concrete. The concrete was manufactured on site as it took 90 minutes to transport the concrete 23km from the above-ground plant to the project. Since the tunnel is too narrow to install the plant, the concrete was mixed on site using a small mixing machine.

As a result, the work was completed safely without any internal air displacement. Three years have passed since the repair work was completed, and no deformation - such as internal air displacement or uplift of the roadbed - has occurred. We will continue to conduct follow-up investigations on the repaired roadbed in the future.

Mountain Tunnel Construction Using ICT

The Shin-Tomei-Nagoya Expressway Kawanishi construction project was designated to make full use of ICT to improve productivity through the joint efforts of the contractor and the client. ICT technology is being actively utilized in the construction of the Yagayama Tunnel at each stage of the work process.

A ground-based laser scanner was used to acquire point cloud data before and after the lining concrete was placed, which was superimposed on a 3D model to create a cross sectional drawing, and the thickness of the lining concrete and the tunnel interior were measured for use by the client in the formwork inspection.

We acquired point cloud data for the entire underground tunnel line, creating a 3D model, adding traceability such as construction information and inspection records to the BIM/CIM model as attribute information, and updated the data at each stage of construction. Centralizing and upgrading data in 3D in all processes from survey and design to construction, inspection, maintenance management, and renewal was expected to improve productivity.

FUTURE TUNNELLING ACTIVITIES

The Chuo Shinkansen is a line

This Line will be built to create a dual transportation system of Japan's main arteries, which have long been carried by the Tokaido Shinkansen (Tokyo to Osaka). The plan is to construct shield tunnels deep underground (depth of 40m+) in urban areas that are already highly urbanized. The launch shaft for the shield tunnel nearest to Nagoya Station is situated at the Meijo Emergency Exit. This emergency exit is used for ventilation and maintenance work in the tunnel under normal operation, and as an evacuation route for passengers in the case of an emergency. The Meijo Emergency Exit is a cylindrical shaft with a depth of approximately 89m and a diameter of approximately 38m.

The construction was carried out using the open-cut method with an RC diaphragm wall of approximately 130m length.

After excavating to a depth of approximately 50m, water inflow occurred from around a blocked observation well, but excavation was successfully completed after water sealing work was carried out. The water sealing works are described here:

It was planned that the groundwater level would be lowered by pumping out the pore water in the aquifer just below the diaphragm wall. To reduce the amount of pumping, a single row of injection holes - with a spacing of 0.8m - was placed into the aquifer just below the diaphragm wall, and chemical grouting was carried out.

When the excavation proceeded to approximately 50m, water inflow occurred around the observation well, which was already blocked. To estimate the cause of the water inflow, an acoustic tomography survey was conducted.

This found that the unevenness and inclination of the stratum was larger than expected, leading to the disagreement of the watertight packing of the well closure, thus forming the water path.

It was decided to construct a cutoff wall inside the diaphragm wall using chemical grouting, because the water path was considered to exist just below the diaphragm wall due to the unevenness of the stratum. The purpose of chemical grouting was not to reduce the water inflow into the shaft, but to stop it. The volume per step was increased compared to that of normal chemical grouting because of the large depth and high artesian water pressures. In addition, thorough construction management was carried out by drilling the injection hole by two stage excavation and confirmation of the drilling position by gyroscopic survey to accurately inject the chemical solution into the deep area and confirm the injection effect via check injections to maximize the effectiveness of the chemical grouting. In particular, the injection pressure of all the holes located in the middle of the three rows were checked, and check injections were carried out in the steps where no pressure increase was observed. The check injections ware able to compensate for the lack of improvement, and the upward trend of pressure was confirmed in all of the injection areas. As a result of the pumping test, the amount of pumping required for drawdown was 1.2 L/min on average, which was very small, and it was considered that a good quality cutoff wall could be constructed by chemical grouting. After excavation resumed, the excavation was completed to approximately 89m without any water inflow.

STATISTICS

1. Length or volume excavated – 27.5% mechanized /57.9% conventional during 2023
2. Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2023 About US$29B

EDUCATION ON TUNNELLING IN THE COUNTRY

Hokkaido University,
Muroran Institute Of Technology,
Kitami Institute Of Technology
Iwate University,
Tohoku University,
Akita University,
Ibaraki University,
Nagaoka University Of Technology,
Tokyo Institute Of Technology,
Yokohama National University,
Niigata University
Kanazawa University,
University Of Yamanashi,
Gifu University,
Nagoya University
Nagoya Institute Of Technology,
Toyohashi Universityo Of Technology,
School/Graduate School Of Engineering,
Osaka University,
Tottori University,
Ehime University Faculty Of Engineering,
Kumamoto University,
Kagoshima University,
University Of The Ryukyus,
Maebashi Institute Of Technology,
Osaka City University,
Hokkai-Gakuen University,
Tohoku Gakuin University,
Tokyo University Of Science,
Nihon University,
Hosei University,
Tokyo City University,
Ritsumeikan University,
Setsunan University,
Fukuoka University,
Ashikaga University,
Kindai University,
Okayama University,
Kyushu Institute Of Technology,
Nagasaki University,
University Of Miyazaki,
Kanazawa Institute Of Technology,
Meijo University,
Aichi Institute Of Technology,
Osaka Institute Of Technology,
Osaka Sangyo University,
Kanazawa University,
Kansai University,
School Of Science And Technology
Graduate School Of Science And Technology
Gunma University,
Saitama University,
Kyushu Sangyo University,
Shibaura Institute Of Technology
Chubu University,
Tokyo Denki University,
Tohoku Institute Of Technology,
Nagaoka University Of Technology,
Hachinohe Institute Of Technology,
Hiroshima University,
University Of Fukui,
National Institute Of Technology,
Kagawa College,
National Institute Of Technology,
Kochi College,
National Intstitute Of Technology,
Toyota College
National Institute Of Technology (Kosen),
Kure College
The University Of Tokyo,
Tokyo Metropolitan University,
Waseda University,
Kokushikan University,
Yokohama National University,
Chiba Institute Of Technology,
Ustunomiya University,
Osaka Institute Of Technology,
Kyoto University,
Kobe University