

北陸新幹線武生トンネルは、福井県越前市が管理する重要水道施設(西谷配水池)と近接し、市道直下を通過する。西谷配水池付近では土かぶり小さく(約17m)、地山は強風化花崗岩であり、トンネル掘削の影響による地表面沈下や配水池(タンク)の沈下により、構造物の安定性および機能の低下が懸念された。そこで、事前の数値解析による影響予測をもとに補助工法や一次インバート工などの対策工を選定し、掘削時は地表面とタンクの沈下測定を中心とした計測結果を活用して段階的な補助工法の追加や支保のランクアップを実施して対応した。その結果、切羽の接近に伴うタンクおよび地表面の変位が減少する傾向を確認しながら、沈下を管理レベル値内で収め、機能を損なうことなく当該区間を通過した。

Avoiding Impact on an Important Waterworks Facility by Utilizing Auxiliary Methods and Other Measure Works

—The Hokuriku Shinkansen (Between Kanazawa and Tsuruga), the Takefu Tunnel—
By Yusuke Takano, Japan Railway, Construction, Transport and Technology Agency

The Takefu Tunnel on the Hokuriku Shinkansen passes under the city road in close to an important water supply facility (Nishitani water distribution reservoir) managed by Echizen City, Fukui Prefecture. The depth of the tunnel near the Nishitani water distribution reservoir is small (approximately 17 m), and the ground consists of weathered granitic rock. There were concerns that the stability and function of the structure would be compromised due to the settlement of the ground surface and the water distribution reservoir (tank) caused by tunnel excavation. Based on the results of the preliminary numerical analysis to predict the impact, measures such as auxiliary methods and primary inverters were selected. During the excavation, the settlement of the ground surface and the tank were monitored, and the results were used to gradually add auxiliary methods and upgrade the supports. As a result, it was confirmed that displacement of the tank and ground surface tended to decrease close to the face. The settlement was kept within the control level and the section passed through without any loss of functionality.

現在、松山自動車道伊予IC～内子五十崎IC間は4車線化事業を実施中であり、明神山トンネルⅡ期線工事は、延長2,545mのトンネルを構築するものである。本トンネルの地質は、中央構造線の影響を受け、硬質な安山岩と不良地山である地すべり堆積物から構成されている。供用トンネルへの近接施工となるため、各々の地山における影響と管理手法が重要課題となっていた。本稿では、地山状況に応じた発破振動予測にもとづく分割発破、また供用側の覆工応力増分から求めたⅡ期線の掘削管理などを用い、影響を軽減できた結果を報告するものである。

Proposal of Management Method of In-Service Tunnel Using Blasting Vibration Prediction and Lining Stress Increments

—The Matsuyama Expressway, the Myojinsan Tunnel Phase II—
By Takaaki Ishii, West Nippon Expressway Company Limited

Currently, a four-lane road construction project is underway between the Iyo IC and the Uchiko Ikazaki IC on the Matsuyama Expressway. The Myojinsan Tunnel Phase II Project involves the construction of a 2,545 m long tunnel. The geology of this tunnel is affected by the Median Tectonic Line and is composed of hard andesite and landslide deposits of unstable ground. Because of the proximity of the construction to an in-service tunnel, the impact and management methods for each of the grounds were important issues. In this paper, the authors report the results of mitigating the impact of the works by using split blasting based on the prediction of blasting vibration according to the ground conditions and the excavation control of the phase II tunnel obtained from the lining stress increments of the in-service tunnel.

東京電力リニューアブルパワーが所有する原町発電所から下流の発電所では、国土交通省のハッ場ダム建設により減水が生じ、発電量が減少することとなった。したがって、恒久的な発電量の回復を目的に内径3.0m、全長約2.4kmの新導水路が計画された。このトンネル工事ではNATMを採用し、近接するハッ場ダムの仮排水路などの周辺への振動の影響を最大限回避するために制御発破や機械掘削を取り入れた。また、早期の運転開始を実現するために中間作業坑を設け、上口と下口の2切羽で同時に掘削および覆工を行った。本稿では、これらの対応策により周辺設備に影響なく、工事期間を3か月短縮することができたトンネル工事の施工実績を報告する。

Anti-vibration Measures for the Construction of a Small Headrace in Close to a Temporary Drainage Channel of an Existing Dam

—TEPCO Haramachi Power Station—

By Yuma Tamura, TEPCO Renewable Power, Inc.

The construction of the Yamba Dam by the Ministry of Land, Infrastructure, Transport and Tourism caused a reduction in water flow and a subsequent decrease in power generation at the power plants located downstream from the Haramachi Power Station owned by TEPCO Renewable Power. Therefore, a new headrace with an inner diameter of 3.0 m and a total length of approximately 2.4 km was planned to permanently restore the power generation. The NATM was adopted for the construction of this tunnel. Controlled blasting and mechanical excavation were used to avoid vibration effects on the temporary drainage channel of the nearby Yamba Dam and other nearby areas to the maximum extent possible. In order to realize the early start of the operation, an intermediate working tunnel was constructed, and excavation and lining were carried out simultaneously on the upper and lower faces. In this paper, the authors report on the results of the tunnel construction project which allowed to shorten the construction period by three months without affecting the surrounding facilities using these measures.

土木学会トンネル工学委員会の部会では、2007年からシールドトンネル築造技術の改良・伝承を目的として、工事竣工までの情報をデータベース化して残すシールドトンネルデータベース(SDB)の構築を目指し、①SDBに保存する情報、②SDBシステムの制度設計および運用方法の検討、③工事に関する情報の登録と利用、を推進した。2018年からは日本建設情報総合センターの小委員会と共同で、SDBとBIM/CIMモデルの連携手法を開発し、2021年にはSDBシステムによる情報提供がなされ、目標としたSDBシステムの機能が一通り達成されたことから、SDBの利活用によるトンネルの耐久性向上と建設・維持管理コストの低減に期待し、SDBの概要について紹介する。

Overview of the Shield Tunnel Database Constructed by Tunnel Engineering Committee of the Japan Society of Civil Engineers

By Mitsutaka Sugimoto, Tunnel Engineering Committee of the Japan Society of Civil Engineers

Since 2007, a subcommittee of the Tunnel Engineering Committee of the Japan Society of Civil Engineers has been promoting the construction of the Shield Tunnel Database (SDB) to improve and pass down shield tunnel construction technology by (1) studying the information to be stored in the SDB, (2) studying the Institutional design and operation method of the SDB system, and (3) registering and using the information on construction projects. Since 2018 we have developed a method of linking SDB and BIM/CIM models in collaboration with a subcommittee of the Japan Construction Information Center. The SDB system provides information since 2021, and its targeted functions have been generally achieved. The SDB is expected to improve the durability of tunnels and reduce construction and maintenance costs. In this paper, we present an overview of the SDB.

近年、山岳工法によるトンネル建設においては、山間地での脆弱地山や市街地での重要構造物への近接など、困難な施工事例が増加してきている。このため、早期に変形を抑制し、地山と構造の安定性を高めることを目的に早期閉合が適用されてきている。本稿では、高速道路や一般国道などにおいて早期閉合で大変形を抑えて安全を確保したトンネルの事例を収集し、それらの支保構造の特性を整理するとともに、計測データから支保工に生じる荷重を分析し支保効果について考察した。その結果にもとづき、設計上の配慮すべき事項について提案する。

A Study on the Support Effectiveness of Road Tunnels With Large Deformations Controlled by Early Closure

By Kiyoto Nakano, Nippon Expressway Research Institute Company Limited

In recent years, the construction of tunnels using mountain tunneling methods has become increasingly difficult due to the weak ground in mountainous areas and the proximity of important structures in urban areas. For these reasons, early closure has been applied to control deformation at an early stage and to increase the stability of the ground and structure. In this paper, the authors collect examples of tunnels constructed on expressways and national highways where large deformations were controlled by early closure to ensure safety, summarize the characteristics of the support structures, analyze the loads on the support structures using measurement data, and discuss the supporting effect. The authors propose design considerations based on the above results.