

深山トンネルは、北陸新幹線(金沢・敦賀間)の福井県敦賀市に位置する延長768mの複線断面山岳トンネルである。付近には、ラムサール条約に登録されている中池見湿地があることが特徴であり、工事にあたっては湿地環境への影響を最小限に抑える必要があった。そこで工事の計画段階、実施段階、完了段階の各段階において、国内初となる環境管理計画の策定など、適切な環境保全措置を講じることで、湿地の環境保全とトンネル工事の両立を図った結果、工事による湿地環境への影響を最小限に抑えることができた。本稿では、深山トンネル工事において講じた環境保全措置について報告する。

Environmental Conservation Efforts for Wetlands Registered under the Ramsar Convention and Their Results

—The Hokuriku Shinkansen, the Miyama Tunnel—

By Atsufumi Kameyama, Japan Railway, Construction, Transport and Technology Agency

The Miyama Tunnel is a 768 m long double-track cross-section mountain tunnel located in Tsuruga City, Fukui Prefecture, on the Hokuriku Shinkansen (between Kanazawa and Tsuruga). During the construction work, it was required to minimize the impact on the wetland environment, which included a wetland registered under the Ramsar convention in the vicinity. The construction of the tunnel minimized the impact of the construction on the environment around the wetland with the aim of both preserving the wetland environment and promoting the tunnel construction by implementing appropriate environmental protection measures during each stage of the construction (planning, implementation, and completion), including the formulation of Japan's first environmental management plan. In this paper, the authors report on the environmental protection measures taken during the construction of the Miyama Tunnel.

朝日温海道路1号トンネルは日本海沿岸東北自動車道の朝日まほろばICより北へ10kmの地点に位置するトンネルである。その工事において、当初想定されていない膨張性を示す泥岩が出現し、施工中のトンネルに大きな変位が発生した。変状初期には吹付けコンクリートによるインバート施工での早期閉合や、摩擦式ロックボルトによる増しボルトを施工したが変状を止めることはできなかった。変状区間のFEM解析を実施し、その結果から対策として、縫返し区間はインバートストラットや二重支保工を採用、新規の掘削箇所ではAGF工法による先受け、長尺鏡ボルトの施工を行いながらのインバートストラット、早期閉合と二重支保工の施工を採用し、最終的には健全な支保を構築することができた。

Breaking through Squeezing Ground Using Early Closure and Double Steel Support

—The Nihonkai-Engan Tohoku Expressway, the Asahi-Atsumi Road No.1 Tunnel —

By Hiroaki Terasawa, Ministry of Land, Infrastructure, Transport and Tourism

The Asahi Atsumi Road No.1 Tunnel is located 10 km north of the Asahi Mahoroba IC on the Nihonkai-Engan Tohoku Expressway. During the construction works of the tunnel, mudstone that showed initially unanticipated swelling characteristics appeared, causing significant displacement of the tunnel under construction. In the early stages of the deformation, we tried to close it early by constructing an invert concrete using sprayed concrete and reinforcing it with additional friction rock bolts, but these measures did not stop the deformation. Based on the results of the FEM analysis of the deformed section, invert struts, and double steel supports were adopted for the rebuilding section. For the newly excavated areas invert struts, early closure, and double steel supports were adopted, while installing presupport using the AGF method and long facebolts. Eventually, these measures allowed us to construct sound tunnel support.

東京メトロでは、東西線の輸送力改善施策の一環として朝ラッシュ時の運行本数を増加させるため、都道8号線下の東西線飯田橋・九段下駅間にある既存の折返し設備を改良し、平面交差支障の解消および折返し線の本線化を目的とした営業線改良工事を行っている。本工事は、約390mを工事範囲とし、列車運行を確保しながら飯田橋方は約100m、九段下方は約80mの範囲で、開削工法により行う。工事範囲は、供用中であり、多くの工種は営業線に近接した作業となるため、周辺地盤や既設躯体の変位抑制対策が必要となる。本稿では、飯田橋方の既設躯体直下に位置する新設下床版を築造する際の営業線への安全対策を目的とした、事前検討および施工結果について報告する。

Construction of Basement of Tunnel Directly under Operating Metro Line during Metro Improvement Construction

—Tokyo Metro Tozai Line Reversing Siding Facility between Iidabashi Station and Kudanshita Station—

By Atsushi Hase, Tokyo Metro Co., Ltd.

Tokyo Metro is improving the existing reversing siding facilities between Iidabashi and Kudanshita stations on the Tozai Line under the Tokyo Metropolitan Road Route 8 to increase the frequency of service during morning rush hours as part of its measures to improve transportation capacity on the Tozai Line. The improvement construction is carried out on an operating line to eliminate level crossing obstructions and convert the reversing siding track into a main track. The construction covers an area of approximately 390 m. It will be carried out using the open excavation method while preserving train operation, covering approximately 100 m in the direction of Iidabashi station and approximately 80 m in the direction of Kudanshita station. Since the track in the construction area is in service and most of the work will be delivered close to the operating track, it is necessary to take measures to control the displacement of the surrounding ground and existing structures. In this paper, the authors report on the preliminary investigations and results of the construction of a new basement of tunnel located directly under the existing tunnel at the Iidabashi side to ensure the safety of the operating track.

本工事は、岡山市の重要水道幹線管路の1系統である半田山線のうち、約3.5kmを泥土圧シールド工法により更新・耐震化するものである。当初は、2方向発進立坑から南北へ2路線を順次掘進していく計画であったが、隣接する先行工事の実績から工期遅延の可能性が高いと判断したため、2路線を同時掘進する計画へと変更を行った。立坑の形状変更や立坑下作業床の工夫、地上設備の2路線間での共有などのほか、シールド面板閉塞への対策やビット摩耗対策などを計画した。その結果、先行工事の日進量の実績を上回り、無事工期内に工事を完了することができた。本稿では、2路線同時掘進に向けた計画やシールドトラブルへの事前の対策、実際に施工した際の効果について報告する。

Simultaneous Boring from Two-Directional Starting Shaft Using Mud Fluid Transport System

—The Okayama City Waterworks Bureau, the Handayama Line Shield Tunneling—

By Kouta Shiraishi, Toda, Art Corporation and Eiko Techno Specified JV

The goal of this construction project is to renew and seismically reinforce approximately 3.5 km of the Handayama Line, one of Okayama City's important water supply trunk lines, using the muddy soil pressure balanced shield method. The original plan was to excavate two lines north and south sequentially from a two-directional starting shaft, but this plan was changed to two lines being excavated simultaneously because of the high possibility of construction schedule delay based on the results of the adjacent preceding construction work. The project included changes to the shape of the shaft, a new working floor of the shaft, sharing ground facilities between the two lines, and other measures to prevent the cutter of shield TBM from being clogged and abraded. As a result, the daily progress of this tunneling exceeded the daily progress of the preceding work, and the construction was completed within the construction period. In this paper, the authors report on the planning for the simultaneous tunneling of two lines, the measures taken in advance to prevent troubles on the shield TBMs, and the effect of the actual construction.

施工

地下構造物が輻輳する都市部を支障物対応型の泥濃式推進工法で施工

—大阪市下水道 島屋北幹線—

大阪市 東野 洋士

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大阪市では、おおむね10年に1回の大雨(1時間あたり60mm)でも浸水しないことを目標に抜本的な浸水対策を進めている。南西部の此花処理区の雨水を排除するφ3,000mmの排水幹線計画では、鋼矢板やSMW、鋼管矢板など13か所の支障物に対応する難工事が想定された。2008年の計画時点ではこの工事に適用できる非開削工法は存在しなかった。その後の推進工法の実績より、2016年に金属切削用ビットを Cutterヘッドに搭載し、超低速掘進で鋼製支障物を切削する技術を本工事に適用した。また本工事には、地下埋設物が輻輳する工事条件から急曲線掘進や切削を伴う掘削のための長期間の施工となり、それらに対応できる掘進機、到達・回収の方法などの多くの課題があった。本稿では課題解決の過程を報告する。

Tunneling in Urban Areas Congested with Underground Structures Using High-Density Slurry Type Pipe Jacking Method That Can Deal with Obstacles

—The Osaka City Sewerage, the Shimaya North Sewer Main—

By Yoji Higashino, Osaka City

Osaka City is taking drastic measures against inundation even in heavy rainfalls (60 mm per hour) that occur approximately once every 10 years. Difficult construction work dealing with 13 obstacles such as steel sheet piles, SMW, and steel pipe sheet piles was expected for the planned 3,000 mm diameter drainage trunk line to remove rainwater from the Konohana treatment area in the southwestern part of the city. At the time of planning in 2008, there was no trenchless technique applicable to this plan. Based on the subsequent experience with the pipe jacking method, metal cutting bits were mounted on the cutter head in 2016, and the technique to cut steel obstructions at very low digging speeds was utilized for this construction project. This construction project took a long time due to construction conditions with congested underground structures, which required driving through sharp curves and cutting obstacles, and there were many issues to be solved, such as finding a boring machine that could handle these conditions and methods for arriving and dismantling the machine. In this paper, the authors report the process of solving the problems.