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大深度・大断面・長距離の中央新幹線のシールド工事を始めるまでの取組み

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中央新幹線は，大都市圏では大深度・高水圧の地下に大断面のトンネルを長距離にわたってシールド工法で構築する．この難題を抱えた工事の実施にあたっては，発進時の出水リスクの回避と切羽の安定性の確保を重要な課題と捉え，2つの新たな技術「円筒内からのシールド発進」「土砂サンプリング装置」を創り出して解決を図るなどした．さらには，他事業で起きた地表面陥没事故を受け，安全対策の強化や周辺影響の確認などの「安全・安心の取組み」を定めた．そして，それら取組みの実効性を本掘進に入る前の初期段階で確認し，その結果を沿線住民に示すため，中央新幹線のシールド工事は「調査掘進」から始めることにした．本稿ではこうした経緯を紹介する．

Strenuous Efforts to Commence the Excavation of Large-section, Long-distance Shield Tunnels Deep Underground for the Chuo Shinkansen

By Naoyuki Yoshioka, Central Japan Railway Company

Shield tunnels with a large section and a long distance are excavated deep underground in urban areas for the Chuo Shinkansen project. To minimize the flooding risk attributable to high water pressure during the shield departure and to ensure excavation quality by stabilizing the tunnel face, two unique technologies have been developed and adopted: an envelope cylinder for launching the shield machine and a device for sampling mud from the chamber under high pressure. Furthermore, in response to a cave-in incident at a different project, safe and sound strategies were decided to be implemented, such as enhancing safety protocols and studying the impact of excavation on the area nearby. To confirm the effectiveness of these measures at an early stage prior to the main excavation and to demonstrate a commitment to local residents, the excavation began with careful concurrent investigations. This paper introduces the background of these efforts.

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最大土かぶり87mの硬岩地盤を外径12.8mの泥水式シールドで掘進
―シンガポールMRTクロスアイランド線CR202工区―

大林シンガポール　山下　健司

MRTクロスアイランド線CR202工区建設工事は，シンガポール陸運局(Land Transport Authority：LTA)発注のシンガポールを横断するMRTクロスアイランド線の第2期工区のうち，地上からのアクセスが許可されない自然保護区直下でのシールド掘進を含むトンネル工事および換気立坑を構築する工事である．大断面シールド(セグメント：外径ϕ12.2m，内径ϕ11.3m，幅2.0m)に加え，掘削対象地盤は主に硬岩(花崗岩)で，最大土かぶり87mの大深度から最小土かぶり7m(約0.6D)の区間を含む約5kmの長距離トンネルである．到達部では，高層マンションに囲まれた狭隘な道路下を土砂と硬岩の互層かつ小土かぶりで掘進し立坑に到達させる．2025年5月にシールドの組立てを完了し，12月現在，本掘進を行っている．本稿では，このような条件下での掘進を実現するためのシールド計画について報告する．

Hard Rock Excavation Using a 12.8-m Outer Diameter Slurry Shield TBM at a Maximum Soil Cover of 87 m
―Singapore MRT Cross Island Line CR202―

By Kenji Yamashita, Obayashi Singapore Private Limited

The design and construction of bored tunnel between Fairways Drive and Sin Ming Walk and associated works is part of the Cross Island Line MRT Project, which crosses Singapore and is commissioned by Land Transport Authority (LTA). It consists of tunnel construction, including a Large-diameter single-bored tunnel directly beneath a nature reserve where access from above ground is not permitted, as well as a facility building construction. In addition to the large diameter TBM (segment outer diameter ϕ12.2 m, inner diameter ϕ11.3 m, width 2.0 m), the ground to be excavated is mainly hard rock (Bukit Timah Granite), and the tunnel length is approximately 5 km long, including section from a high overburden 87 m to a shallow overburden 7 m (approximately 0.6D: D = TBM outer diameter). At the arrival point, TBM will go through under a narrow road surrounded by high-rise condominiums through alternating layers of highly weathered rock and non-weathered hard rock with shallow overburden to reach the retrieval shaft. TBM assembly was completed in May 2025, and as of December 2025, the main drive is in progress. This paper introduces TBM planning for achieving tunnelling under these conditions.

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送泥管リニューアル事業での長距離・急曲線シールド施工

―東京下水道　落合～みやぎ水再生センター間その３工事―

東京都　都築　弘晃

東京都下水道局では，送泥ネットワークの信頼性強化と効率化のために送泥管をリニューアルする再構築事業を順次進めており，新宿区上落合一丁目の落合水再生センターから足立区宮城二丁目のみやぎ水再生センターに至る全長約10.2kmを管廊方式で整備している．本工事は，４つに分割した工区のうち，約4.1km区間を外径φ3,120mmの泥水式シールドでトンネルを築造するものである．工事路線は，最大土かぶり47mの高水圧下であり，７つの急曲線を含む長距離を中間立坑なしで施工する．また，事前の土質調査により，高濃度の水溶性メタンガスや礫質土層の存在が確認されたことから，本稿では，各種課題への対応と結果について報告する．

Long Distance, Sharp Curve Shield Construction for Sludge Transfer Pipe Renewal Project

―Tokyo Metropolitan Government, Bureau of Sewerage: Construction of Section 3 between Ochiai and Miyagi Water Reclamation Center―

By Hiroaki Tsuzuki, Tokyo Metropolitan Government

The Tokyo Metropolitan Government’s Bureau of Sewerage is gradually carrying out renovation work on its sludge transport pipes to improve the reliability and efficiency of its sludge transport network. The Bureau is currently constructing a pipeline gallery system covering a total length of approximately 10 km, from the Ochiai Water Reclamation Center in Shinjuku Ward to the Miyagi Water Reclamation Center in Adachi Ward. This project involves constructing a tunnel using a slurry shield with an outer diameter of 3.12 m over a section of approximately 4.1 km, divided into four sections. The construction route was under high water pressure with a maximum soil cover of 47 m, and the plan was to construct long distances, including seven sharp curves, without intermediate shafts. In addition, preliminary soil surveys confirmed the presence of high concentrations of water-soluble methane gas and gravelly soil layers. This paper reports on how various issues were addressed and the results.

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塩害環境下のシールドトンネルの挙動予測に関する実験的研究

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臨海部や感潮河川近傍に位置するシールドトンネルでは，漏水中に含まれる高濃度の塩分の影響により，継手金物の鋼材腐食が進行している．本稿では，塩害劣化させた覆工模型の載荷実験を通して，将来的なシールドトンネルの変形挙動を予測する手法に関する研究結果について報告する．具体的には，既設のシールドトンネルで広く用いられているボルト継手を対象として，塩害劣化させた覆工模型の載荷実験に対するシミュレーション解析を実施した．ボルトのみならず，ボルトボックスの腐食やコンクリートとの付着力低下も考慮した継手ばねモデルを構築し，解析精度の向上を図った．

Experimental Study on Predicting the Behavior of Shield Tunnels in Salt Deterioration Environments

By Kaho Kinoshita, Railway Technical Research Institute

The corrosion of steel joints is progressing, caused by the high concentration of salt in leaking water in shield tunnels located in seaside areas and under tidal rivers. This paper presents the results of an experimental study aimed at developing a method to predict the long-term deformation behavior of shield tunnels subjected to salt deterioration. Specifically, simulation analysis was conducted on load tests performed on lining specimens exposed to salt deterioration, focusing on bolted joints widely used in existing shield tunnels. A joint spring model was developed that considers not only the bolts but also the deterioration of bolt boxes and reduced bond strength with concrete to improve the accuracy of the analysis.