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大規模崩落の発生と対策（その 2）
―北海道新幹線　野田追トンネル（北工区）―

鉄道・運輸機構　若公　雅敏

北海道新幹線野田追トンネル（北工区）では，2021（令和 3）年 3 月20日にトンネル切羽より後方約12mの範囲で支保工の座屈と土塊の崩落が発生し，その後多量出水を伴う坑内への土砂流入をくり返し，最終的に推定累積土砂量8,000m^{3}に達する大規模崩落が発生した．この大規模崩落の発生とそのメカニズムの推定に関して前報で報告した．本稿では，野田追トンネル（北工区）の第二報として，崩落復旧からトンネル再掘削までに坑内と地上部から実施した各種の対策工の設計・施工について報告する．

Large-Scale Collapse and Measures (Part 2)
―The Hokkaido Shinkansen, the Nodaoi Tunnel (North Lot)―

By Masatoshi Wako, Japan Railway, Construction, Transport and Technology Agency

During the construction of the Nodaoi Tunnel (North Lot) for the Hokkaido Shinkansen, buckling of the steel supports and collapse of the soil mass occurred on March 20, 2021, within a section approximately 12 m behind the tunnel face. Subsequently, repeated inflows of soil accompanied by large volumes of water entered the tunnel, ultimately resulting in a large-scale collapse. In a previous paper, we reported on the occurrence of this large-scale collapse and the estimation of the mechanism behind it. This paper, which contains the second report on the Nodaoi Tunnel (North Lot), reports on the design and the implementation of various measures implemented both underground and on the ground surface from the collapse recovery to the re-excavation of the tunnel.

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住宅密集地での大規模掘割構造物建設における各種取組み
―横浜環状南線（圏央道）　公田インターチェンジ―

東日本高速道路（株）　青木　　直

横浜環状南線は，首都圏 3 環状道路の一つである圏央道の一部を構成する路線で，横浜市金沢区から戸塚区を結ぶ延長約9kmの片側 3 車線の一般有料道路である．そのうち，公田インターチェンジ（仮称）は，栄IC・JCT～釜利谷JCT間のほぼ中間に位置し，開削工法で施工する掘割構造のインターチェンジである．当該地域は住宅密集地であり，施工ヤードが狭小であることに加え，生活道路や埋設物など多数のライフラインが存在する．本稿では，周辺環境に配慮しながら計画段階から施工者のノウハウを取り入れ検討した施工ステップの最適化や土留め構造の合理化など，工事を円滑に進めるための各種取組みについて報告する．

Various Efforts in the Construction of a Large Semi-Underground Structure in a Densely Populated Residential Area
―The Yokohama Ring Expressway South Line (Ken-O Expressway), the Kuden Interchange―

By Nao Aoki, East Nippon Expressway Company Limited

The Yokohama Ring Expressway Minami Line is a part of the Ken-O Expressway, one of the three ring roads in the Tokyo metropolitan area. It is a general toll road with three lanes in each direction that is approximately 9 km long and connects Kanazawa Ward to Totsuka Ward in Yokohama City. The Kuden Interchange (tentative name) is located approximately halfway between Sakae IC/JCT and Kamariya JCT on this route. It is an interchange with a semi-underground structure constructed using the open-cut method. The area is densely populated, and in addition to the construction yard being small, there are many lifelines, such as residential roads and underground facilities. This paper reports on various efforts to ensure smooth construction, such as optimizing construction steps by incorporating the know-how of the contractor from the planning stage, while considering the surrounding environment and streamlining the retaining wall structure.

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小土かぶり斜面下における送電鉄塔基礎杭との水平離隔5.8mでの施工

―横浜環状南線（圏央道） 釜利谷ジャンクションHランプ第二トンネル―

東日本高速道路（株） 横山 智史

Hランプ第二トンネルは，横浜環状南線のうち横浜横須賀道路へ合流する釜利谷ジャンクション内に位置する，延長136mのNATMトンネルである．本トンネルの終点側には，重要構造物である送電鉄塔が最小離隔距離約5.8mで近接していた．さらに，全線にわたり小土かぶりであり，地山は風化が進行したきわめて脆弱な未固結の細粒砂岩層であった．このため，地山の不安定化に伴う送電鉄塔の基礎構造への掘削影響が懸念され，慎重な施工が求められた．本稿では，これらの地山条件を有する本トンネル工事において，送電鉄塔への影響を抑制するために講じた計測管理体制，支保工および補助工法の検討と対策，ならびにその施工結果について報告する．

Construction of a Tunnel with a Transmission Tower Spaced Horizontally 5.8 m Apart Under a Small Overburden of Slope

―The Yokohama Ring Expressway South Line (Ken-O Expressway), the Kamariya Junction H Ramp Second Tunnel―

By Tomofumi Yokoyama, East Nippon Expressway Company Limited

The H Ramp Second Tunnel, a 136-m-long NATM tunnel, is situated within the Kamariya Junction, where the Yokohama Ring Expressway South Line merges with the Yokohama-Yokosuka Expressway. A critical transmission tower is located at the tunnel's terminus, with a minimum clearance of approximately 5.8 m. Furthermore, the entire tunnel section was characterized by a small overburden, and the ground comprised highly weathered, extremely fragile, and unconsolidated fine sandstone. Consequently, concerns arose that the excavation process could potentially affect the transmission tower's foundation due to the inherent ground instability. This necessitated meticulous construction oversight to mitigate any potential risks. This paper reports on the measurement management systems and the examination of support and auxiliary construction methods employed to mitigate the impact on transmission towers during the tunnel's construction under these challenging ground conditions, along with the construction results.

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7か所のシールド急曲線と到達後立坑の施工

―東京電力 北多摩府中洞道―

東京電力パワーグリッド（株） 西田 汐音

東京電力パワーグリッドでは，北多摩変電所から新宿変電所までの約20kmにわたり直接埋設された送電ケーブルの経年対策を計画し実施中である．具体的には，ケーブルを共同溝主体の洞道ルートへ引き換え，電力の供給信頼度向上を図る．本工事は上記計画のルートのうち，北多摩変電所から国道20号の共同溝までの延長2,261mに内径2.55mのシールド洞道を構築するものである．最大土かぶり25mおよび急曲線部7か所のトンネルを泥土圧シールド工法により掘進し，2023年9月に地中到達した．その後，径2mの下水管などの埋設物が輻輳した到達部の共同溝連係立坑の掘削を2025年5月に完了した．本稿では，シールド掘進実績ならびに，到達立坑の施工実績について報告する．

Construction of Seven Sharp Shield Tunnel Curves and the Arrival Shaft

―TEPCO Kitatama-Fuchu Power Cable Tunnel―

By Shion Nishida, TEPCO Power Grid, Incorporated

TEPCO Power Grid is currently planning and implementing measures to prevent the aging degradation of the power transmission cables that are directly buried along a 20 km stretch from the Kitatama substation to the Shinjuku substation. Specifically, the cables will be replaced with a tunnel route mainly consisting of utility tunnels to improve the reliability of the power supply. This project involves constructing a shield tunnel with an inner diameter of 2.55 m along the 2,261 m length of the mentioned planned route, from the Kitatama substation to the utility tunnel of National Route 20. The tunnel, with a maximum overburden depth of 25 m and seven sharp curves, was excavated using the muddy soil pressure-balanced shield method and reached the underground arrival point in September 2023. Subsequently, excavation of the utility tunnel connection shaft at the arrival point, which is congested with underground facilities such as 2 m diameter sewer pipes, was completed in May 2025. This paper reports on the results of the construction of the shield tunnel and the arrival shaft.

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覆工コンクリートに表層埋設した炭素繊維複合材ケーブルの補強効果

ドボクリエイト(株)　森本　真吾

覆工コンクリートは，地山の劣化や地震などの外力により，大きな損傷が生じることもある．本研究では，橋梁の補強技術の一つであるNSM工法を応用し，可撓性を有する炭素繊維複合材ケーブル(CFCC)を覆工表層に埋設する補強工法の効果を評価・検証した．部材の載荷実験を通じて，補強により覆工の延性と耐荷性能が向上することを明らかにした．さらに，外力を受ける状況下の実トンネルを対象とした数値解析を行い，補強による高い耐荷性能が得られることを確認した．

Reinforcement Effect of Carbon Fiber Composite Cables Embedded in the Surface Layer of Lining Concrete

By Shingo Morimoto, Dobocreate Corporation

Lining concrete may suffer severe damage due to deterioration of the ground or external forces such as earthquakes. In this study, the authors applied the NSM method, one of the techniques used for reinforcement of bridges, to evaluate and verify the effectiveness of a reinforcement method in which flexible carbon fiber composite cables (CFCC) are embedded in the surface layer of the lining. Load tests of the members revealed that this reinforcement improves the ductility and load-bearing capacity of the lining. A numerical analysis was conducted on an actual tunnel subjected to external forces, and it was confirmed that reinforcement could achieve high load-bearing capacity.