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早期閉合と二重支保により中央構造線の断層破砕帯を貫く

―中央新幹線　伊那山地トンネル青木川工区―

東海旅客鉄道(株)　大谷　龍平

中央新幹線伊那山地トンネルは，全長約$L=15.3$kmの山岳トンネルであり，このうち青木川工区は品川方の延長約$L=3.6$kmをNATMで掘削するものである．本工事では日本有数の断層である中央構造線を貫くかたちで掘削する計画となっている．本坑の掘削に先立ち各種地質調査を実施し，地下水状況および地質性状を把握することを目的に小断面の調査坑の掘削を行った．調査坑の施工情報をもとに，本坑では早期閉合と二重支保により中央構造線の断層破砕帯を掘削した．本稿はその施工実績について報告するものである．

Penetrating the Fault Fracture Zone on the Median Tectonic Line Using Early Closure Techniques and Double Steel Supports

—The Chuo Shinkansen, the Ina-Sanchi Tunnel, the Aokigawa Lot —

By Ryuhei Oya, Central Japan Railway Company

The Ina-sanchi Tunnel on the Chuo Shinkansen is a mountain tunnel with a total length of approximately $L=15.3$ km, of which the Aokigawa Lot on the Shinagawa side is to build the tunnel using NATM for a length of approximately $L=3.6$ km. In this project, it was necessary to excavate through the Median Tectonic Line, one of the most prominent fault zones in Japan. Prior to the excavation of the main tunnel, various geological surveys were conducted, and a small exploring drift was excavated to understand the groundwater conditions and geological characteristics. Based on the building information from the exploring drift, the main tunnel was excavated through the fault fracture zone of the Median Tectonic Line using early closure techniques and double steel support. In this paper, the authors report on the construction results.

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深度約110mのニューマチックケーソン工法における急速沈下抑制対策

―中央新幹線　上小山田非常口―

鉄道・運輸機構　神越　俊基

中央新幹線(品川～名古屋)における上小山田非常口は東京都町田市に位置する深さ110.3m，外径41.5mの日本最大級深度・大断面の円形立坑である．本非常口では，高水圧が作用することを考慮し，ニューマチックケーソン工法が採用された．施工時は，沈下掘削対象地質の一部において，固結シルト層が存在し，沈下掘削時に当初想定していた約50cmの急速沈下量を超える最大約95cmの急速沈下が発生した．当初想定を超える急速沈下により，躯体などの損傷や函内作業の安全性，工程，周辺環境などに影響を及ぼす懸念があることから，急速沈下量の抑制，函内気圧上昇に伴う漏気対策などを実施した結果とともに，得られた施工データを解析し，急速沈下の発生メカニズムの解明や有効な急速沈下対策を提案する．

Preventing Rapid Sinking of a Shaft with a Depth of Approximately 110 m through the Pneumatic Caisson Method

—The Chuo Shinkansen, the Kami-Oyamada Emergency Exit—

By Toshiki Kamikoshi, Japan Railway, Construction, Transport and Technology Agency

The Kami-Oyamada emergency exit on the Chuo Shinkansen (Shinagawa-Nagoya) is located in Machida City, Tokyo Metropolitan. It is one of the deepest and largest circular shafts in Japan, with a depth of 110.3 m and an outer diameter of 41.5 m. Expecting high water pressure, the pneumatic caisson method was adopted for construction of this emergency exit. During the construction, consolidated silt was present in part of the ground targeted for excavation to sink the caisson, and rapid sinking of up to approximately 95 cm occurred during the excavation of this ground, exceeding the initial estimate of approximately 50 cm. Since there were concerns that the rapid sinking, which exceeded initial estimations, may damage the structure and affect the safety of work inside the caisson, the process, and the surrounding environment, the construction data were analyzed along with the results of measures to control the amount of rapid sinking and prevent air leakage due to the increase in air pressure inside the caisson. As a result, the mechanisms of the rapid sinking were clarified, and effective measures were proposed.

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泥水式シールドでの礫や粘性土への対応と生産性向上技術を活用した省力化施工

―霞ヶ浦導水事業　石岡トンネル第１工区―

国土交通省　平舘　　治

霞ヶ浦導水事業は，那珂川下流部，霞ヶ浦および利根川下流部をトンネルで結び，それぞれの水を交互に行き来させる流況調整河川を建設し，霞ヶ浦および桜川・千波湖の水質浄化，利根川および那珂川下流部の流水の正常な機能の維持と増進，新規都市用水の確保を図る事業である．本工事は，その一環として石岡トンネルの第１工区（トンネル外径3.9m，掘削延長3.8km）を泥水式シールド工法により築造するものである．昨今，建設業において技術を持った熟練工の確保が困難な状況が続いており，生産性向上技術の活用は建設業全体で取り組むべき重要課題である．このため，本工事においても，バッテリーロコ運転の自動化などの「生産性向上技術」を積極的に採用している．また，本工事では，礫や粘着力の高い粘性土が出現したが，クラッシャーの設置などにより掘進を止めることなく施工を進めることができた．本稿では，それらの概要と施工実績について述べる．

Excavating Gravel and Clay Using Slurry Shield TBM and Labor-Saving Construction Using Productivity-Enhancing Technologies

―The Lake Kasumigaura Water Conveyance Project, the Ishioka Tunnel, the No. 1 Lot―

By Osamu Hiratate, Ministry of Land, Infrastructure, Transport and Tourism

The Lake Kasumigaura Water Conveyance Project involves the construction of flow control channels that will connect the lower reaches of the Naka River, Lake Kasumigaura, and the lower reaches of the Tone River through tunnels to convey each waters mutually. The goal of this project is to purify the water of Lake Kasumigaura, the Sakura River, and Senba Lake, maintain and improve the normal function of the water flow in the Tone River and the lower reaches of the Naka River, and secure new water for urban use. As part of this project, the No. 1 Lot of Ishioka Tunnel (outer diameter 3.9 m, excavation length 3.8 km) is to build the tunnel using the slurry shield method. Recently, it has been difficult to secure skilled workers in the construction industry, and the use of productivity-enhancing technologies is an important issue that should be addressed by the construction industry. For this reason, “productivity-enhancing technologies” such as automated battery locomotive operation were actively employed in this construction project. Although gravel and highly cohesive clay were encountered during the excavation, the installation of crushers allowed construction to proceed without stopping the excavation. In this paper, the authors describe the outline and construction results of these works.

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新たな調査手法による供用中の山岳トンネルの盤膨れ対策範囲把握への取組み

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盤膨れが顕在化している供用中の山岳トンネルにおいて，真に補強対策が必要な範囲の把握を目的として，地盤情報を縦断方向に対して連続的に把握するべく，「リニア微動アレイ探査」と「重錘落下起振」を併用した新たなる取組みを行った．その結果，交通量の多いトンネルにおいて，路面下の深さ10m程度までのS波速度構造を精度よく把握することができた．距離程ごとにS波速度構造を表現することで，トンネル縦断方向における地山の脆弱部の分布を「見える化」でき，その脆弱箇所は現地状況や各種調査結果とも対応するため，補強対策の範囲の絞り込みに有用な根拠資料となる．

Prehension of the Scope to Take Measures against Heaving in In-Service Mountain Tunnels Using New Survey Methods

By Shinya Ueno, Central Nippon Expressway Company Limited

To determine the areas where reinforcement measures are truly necessary for in-service mountain tunnels where floor heave has become apparent, a new approach using a combination of “linear microtremor array survey” and “drop-weight oscillator” was undertaken to continuously obtain ground information in the longitudinal direction. As a result, it was possible to accurately determine the S-wave velocity structure up to a depth of about 10 m below the road surface in a tunnel with heavy traffic. The display of S-wave velocity structures at each location markers can visualize the distribution of weak points in the ground in the longitudinal direction of the tunnel. Since these weak points correspond to the on-site conditions and the results of various surveys, they provide useful evidence to narrow down the scope of reinforcement measures.