Study on Construction Technology for Tunnel Crossing Highly Water-Rich Strata in Complex Environments: Postprint

Authors: Luo Yuanyu

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Abstract

The Heping Tunnel of the Tai-Xi Railway traverses a fault fracture zone characterized by fractured rock mass at lithological contacts, well-developed intrusive and fault structures, and extremely poor surrounding rock stability; additionally, it is located in a strongly water-rich zone, making it highly prone to water inrush and mud outburst and thus presenting high construction safety risks. To ensure excavation progress and construction safety, Tunnel Seismic Prediction (TSP) and ground-penetrating radar (GPR) technologies were employed during construction through water-rich strata to conduct advanced analysis of surrounding rock conditions, providing technical and safety guidance for tunnel face excavation, while advanced water drainage measures were adopted to overcome challenges such as large water inflow and reverse drainage in long inclined shafts, thereby achieving a dry working environment inside the tunnel. The three-bench seven-step excavation method was utilized for tunnel construction through strongly water-rich strata; this technique, employing advanced and radial water-blocking technologies, effectively controlled surrounding rock deformation and construction challenges, offering valuable reference for future tunnel construction in water-rich zones.

Full Text

Research on Construction Technology of Tunnel Crossing Strong Water-Rich Strata in Complex Environments

LUO Yuanyu
China Railway 16th Bureau Group Fourth Engineering Co., Ltd., Beijing 101400, China

Abstract

The Taixi Railway Heping Tunnel traverses fault fracture zones and lithologic contact belts characterized by highly fractured rock mass, well-developed intrusive and fault structures, and extremely poor surrounding rock stability. As a strong water-rich zone, the tunnel is highly susceptible to water and mud inrushes, posing significant construction safety risks. To ensure excavation progress and safety, advanced detection technologies including Tunnel Seismic Prediction (TSP) and geological radar were employed to analyze surrounding rock conditions ahead of the face, providing technical guidance for excavation operations.

Advanced water drainage measures were implemented to overcome challenges such as large water inflow and drainage from long inclined shafts with adverse gradients, enabling dry working conditions inside the tunnel. The three-bench seven-step excavation method, combined with advanced and radial water blocking technologies, effectively controlled surrounding rock deformation. These comprehensive measures provide valuable experience and a reference for future tunnel construction in water-rich strata.

Keywords: water-rich; construction safety; advanced water drainage; excavation; surrounding rock deformation

Note: Figure translations are in progress. See original paper for figures.