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Post-print: Analysis of Surrounding Rock Deformation Characteristics and Support Measures Based on Field Monitoring

Authors: On Asia

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Abstract

Using the Hulinjia Tunnel as a case study, an in-depth investigation was conducted on the deformation characteristics of tunnel surrounding rock through field monitoring methods, and corresponding support measures were proposed to ensure the safe, stable, and normal operation of the tunnel. The research results show that: in terms of temporal characteristics, crown settlement exhibits three stages—rapid settlement, slow settlement, and stabilization; the crown settlement during the rapid settlement stage is 23 mm, accounting for 82.1% of the total settlement. Analysis of monitoring data from three different cross-sections reveals that surrounding rock crown settlement increases with increasing cross-section size. The time-dependent variation trend of peripheral convergence is similar to that of crown settlement, with peripheral convergence values following Cross-section 1 > Cross-section 2 > Cross-section 3. There is no obvious correlation between burial depth and deformation, which is attributed to the influence of in-situ stress that renders the effect of burial depth on deformation less pronounced. After implementing combined measures of initial support and advanced support, the crown settlement and peripheral convergence of the three cross-sections were reduced by more than half compared with those before support, achieving significant control of surrounding rock deformation.

Full Text

Preamble

Analysis of Deformation Characteristics of Surrounding Rock Based on On-site Monitoring and Research on Support Measures

TAN Yazhou
China Railway 16th Bureau Group Fourth Engineering Co., Ltd., Beijing 101400, China

Abstract

This paper presents an in-depth investigation of deformation characteristics of tunnel surrounding rock through on-site monitoring at the Hulinjia Tunnel, proposing corresponding support measures to ensure safe, stable, and normal tunnel operation. Research findings indicate that crown settlement exhibits three temporal stages: rapid settlement, slow settlement, and stabilization. The rapid settlement stage contributes 23 mm, accounting for 82.1% of total settlement. Analysis of three monitored cross-sections reveals that crown settlement increases with cross-sectional area. Peripheral convergence shows similar temporal trends, decreasing from Cross-section 1 to Cross-section 3. No significant correlation exists between burial depth and deformation, as geostress effects obscure the influence of burial depth. After implementing combined primary and advanced support measures, crown settlement and peripheral convergence across three cross-sections decreased by over 50% compared to pre-support conditions, achieving significant control of surrounding rock deformation.

Keywords: on-site monitoring; crown settlement; peripheral convergence; deformation characteristics of surrounding rock; support measures

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

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