An Approach to Predicting the Compressive Strength of Reinforced Broken Rock Mass (Post-print)

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Abstract

Grouting is a common technical measure to improve the mechanical properties of broken rock mass and ensure the stability of underground excavation. The strength characteristics of reinforced broken rock mass are important parameters in geotechnical engineering design. However, due to the complex structure of broken rock mass, the strength characteristics of reinforced broken rock mass are influenced by various factors, making quantitative studies of its strength extremely complex. To establish a reasonable approach for predicting the compressive strength of reinforced broken rock mass, this paper examines how various properties of broken rock mass (i.e., strength, volumetric block proportion, degree of fragmentation, shape, and angle) and the characteristics of cement stone body (i.e., cement stone body strength and interface strength) influence the reinforcement strength, and quantifies these effects. It reveals the mechanisms by which these factors influence the reinforcement strength. Considering factors such as rock shape, orientation, and intrinsic angle, a dimensionless quantitative method to describe rock structure is proposed. On this basis, a prediction model for the compressive strength of reinforced broken rock mass is established by comprehensively considering the properties of both the broken rock mass and the grout stone body. The prediction equation is validated using data from the literature, confirming the accuracy of the prediction model. The research findings provide a valuable reference for refining the reinforcement theory of broken rock mass.

Full Text

Preamble

An Approach to Predicting the Compressive Strength of Reinforced Fractured Rock Mass

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Abstract

Grouting represents a widely employed technical measure for enhancing the mechanical properties of fractured rock masses and ensuring the stability of underground excavations. The strength characteristics of reinforced rock masses constitute critical parameters in geotechnical engineering design. However, owing to the intricate structure of fractured rock masses, their reinforced strength is influenced by numerous factors, rendering quantitative strength analysis exceedingly complex.

To establish a rational methodology for predicting the compressive strength of reinforced fractured rock mass, this study systematically investigates the effects of various rock mass properties—including rock strength, volumetric block proportion, degree of fragmentation, block shape, and orientation angle—as well as grout stone characteristics, specifically grout stone strength and interface bond strength. This research quantifies these influences and elucidates the underlying reinforcement mechanisms. Furthermore, by incorporating factors such as block shape, orientation, and intrinsic angle, a dimensionless quantitative method for characterizing rock structure is proposed. Building upon this foundation, a comprehensive prediction model for the compressive strength of reinforced fractured rock mass is established through integration of both rock mass and grout stone properties.

The predictive equation is validated against published experimental data, confirming its accuracy and reliability. These findings provide a valuable reference for advancing the theoretical framework of rock mass grouting reinforcement.

Keywords: Fractured rock mass; Grouting reinforcement; Compressive strength; Prediction equation

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