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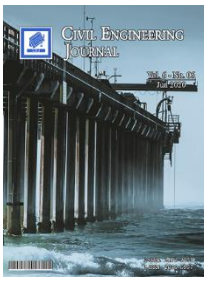

Numerical Analysis of the Influence of Bolt Set on the Shear Resistance of Jointed Rock Masses

Yan-Ping Wang [a], Liang-Xiao Xiong [b*]

[a] *Shandong University of Technology, Zibo, Shandong Province, 255000, China.*

[b] *East China Jiaotong University, Nanchang, Jiangxi Province, 330000, China.*

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Abstract

Bolt reinforcement is a standard reinforcement method for jointed rock masses. However, regarding rock anchoring, the mechanical characteristics of the joint surface, as well as the angle between the bolt and the joint sliding surface, are important factors that affect rock support. Therefore, to understand the influence of a set angle, length, normal load, and other conditions that affect the shear strength of bolt joints, this study uses numerical software to establish the shear sliding model of bolt rock masses and analyzes the influence of the setting conditions of the bolt on the shear strength of a bolt rock mass, which can be done by changing the setting method of the bolt and normal mechanical conditions of the sliding surface. The results show that the shear strength of the anchor joint is not affected after the anchor reaches a certain length. The angle of the anchor strongly influences the shear strength of the anchor joint, and the shear strength curve is V-shaped, where the anchor angle is less than 90°. Moreover, the shear strength curve indicates a downward trend when the anchor angle is greater than 90°, and the shear strength of the anchorage joint increases with the increase of the normal load. Under the same anchor length (4 cm) in the anchor angle and shear strength coordinate system, the shear strength curve of the single anchor is above the shear strength curve of the double anchor, which is exclusively in the local anchor angle section under the condition of a large normal load and a large anchor angle. The shear strength curve of the double anchor is above the shear strength curve of the single anchor.

Keywords: Jointed Rock Mass; Rock Bolts; Numerical Simulation; Shear Strength.

1. Introduction

Jointed rock masses are standard in slopes, water conservancy, hydropower, mining, as well as highway construction, among other projects. Because of disturbances caused by excavations or weathering, the rock mass is often destroyed along the joint surface, resulting in natural disasters, such as landslides or collapses [1]. Therefore, rock bolts are widely used for rock mass reinforcement [2]. The shear resistance of an anchored rock mass can be affected by many factors, and much research has been done on the topic. Liu et al. (2020) [3] proposed an improved method to predict the contribution of the passive full grouting anchor to the shear resistance of jointed rock. Moreover, Wu et al. (2019) [4] found that the influence of a cyclic load on the shear capacity of the bolt is far greater than that of the shear capacity of the bolt itself. Lia et al. (2019) [5] determined that the shear behavior of the bolt on the joint surface of the reinforced rock included the axial shear behavior along with the bolt interface and the local transverse shear behavior of the bolt deflection section. Through numerical simulation analysis, two boundary anchorage lengths were found in the bolt shear test. Chen et al. (2018) [6] conducted direct shear tests on the pre-set joint examples of

* Corresponding author: xionglx1982@126.com

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