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Effect of Surface Roughness on Shear Behavior at the Rock–Soil Interface

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ABSTRACT

Understanding the shear behavior at the rock–soil interface is crucial for various underground engineering applications, including pile foundations, tunnel linings, and retaining structures. Among the influencing factors, the surface roughness of the rock interface plays a pivotal role in mobilizing shear strength by affecting mechanical interlocking and frictional resistance at the contact surface. This study investigates the influence of interface roughness on shear behavior, quantified using Barton's Joint Roughness Coefficient (JRC). However, obtaining natural rock specimens with controlled JRC values remains a challenge. To address this, specimens with varying JRC (i.e., profile No. 1, 5, and 10) were fabricated by casting gypsum into molds produced via 3D printing, enabling idealized and repeatable control over surface roughness. Direct shear tests were then conducted to evaluate the corresponding shear strength. Experimental results reveal that shear strength increases with increasing JRC due to enhanced mechanical interlocking and frictional resistance. The outcomes of this study are expected to provide a more quantitative understanding of interface shear behavior, thereby supporting more reliable design of tunnels and underground structures.

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