Abstract

In this study, anisotropic shear behavior of mated rock joint replicas are investigated under constant normal load condition (CNL). To conduct the study, three different natural joint roughness is transferred to silicon rubber molds and these molds are used to make joint replicas of 90 mm diameter and 50 mm height. The mated joint replicas are made with mixture of cement, sand, and water in the ratio of 1:1.5:0.45 by weight. Total 144 direct shear tests are conducted on joint replicas which include 4 variations of normal stresses (0.25, 0.5, 1, and 1.5 MPa), 3 variations of roughness, and 12 variations of shearing direction. All direct shear tests are performed up to 10 mm of shear displacement at a shearing rate of 0.2 mm/min. Further, roughness quantification of replicas are carried out using 3D non-contact type profiler.

Based on experimental results, distinct models for peak dilation angle and shear component of asperities are developed. Then, new anisotropic peak shear strength criterion incorporating basic friction angle, peak dilation angle, and shear component of asperities is proposed based on compressive strength and two morphological parameters i.e. maximum asperity angle (θ_{max}) and average asperity angle (θ_A) in shearing direction. Proposed model shows that as ratio of normal stress to compressive strength increases peak dilation angle decreases exponentially whereas shear component increases in power function. Further, predictive model for joint roughness coefficient (JRC) and peak shear displacement is also developed.

Keywords: Anisotropic shear strength, Direct shear test, Joint roughness coefficient, Constant normal load condition