World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:17, No:06, 2023

Development of a Large-Scale Cyclic Shear Testing Machine Under Constant Normal Stiffness

Authors : S. M. Mahdi Niktabara, K. Seshagiri Raob, Amit Kumar Shrivastavac, Jiří Ščučkaa

Abstract : The presence of the discontinuity in the form of joints is one of the most significant factors causing instability in the rock mass. On the other hand, dynamic loads, including earthquake and blasting induce cyclic shear loads along the joints in rock masses; therefore, failure of rock mass exacerbates along the joints due to changing shear resistance. Joints are under constant normal load (CNL) and constant normal stiffness (CNS) conditions. Normal stiffness increases on the joints with increasing depth, and it can affect shear resistance. For correct assessment of joint shear resistance under varying normal stiffness and number of cycles, advanced laboratory shear machine is essential for the shear test. Conventional direct shear equipment has limitations such as boundary conditions, working under monotonic movements only, or cyclic shear loads with constant frequency and amplitude of shear loads. Hence, a large-scale servo-controlled direct shear testing machine was designed and fabricated to perform shear test under the both CNL and CNS conditions with varying normal stiffness at different frequencies and amplitudes of shear loads. In this study, laboratory cyclic shear tests were conducted on non-planar joints under varying normal stiffness. In addition, the effects of different frequencies and amplitudes of shear loads were investigated. The test results indicate that shear resistance increases with increasing normal stiffness at the first cycle, but the influence of normal stiffness significantly decreases with an increase in the number of shear cycles. The frequency of shear load influences on shear resistance, i.e. shear resistance increases with increasing frequency. However, at low shear amplitude the number of cycles does not affect shear resistance on the joints, but it decreases with higher amplitude.

Keywords : cyclic shear load, frequency of load, amplitude of displacement, normal stiffness
Conference Title : ICRMRMS 2023 : International Conference on Rock Mechanics and Rock Mass Structure
Conference Location : Oslo, Norway
Conference Dates : June 22-23, 2023