EGU21-6756
https://doi.org/10.5194/egusphere-egu21-6756
EGU General Assembly 2021

In-plane and out-of-plane shear fracture toughness of rocks

Bahador Bahrami[1,2], Morteza Nejati[1], Majid Reza Ayatollahi[2], and Thomas Dreisner[1]

[1]Department of Earth Sciences, ETH, Zurich, Switzerland (bbahrami@ethz.ch)
[2]Fatigue and Fracture Research Laboratory (School of Mechanical Engineering), Iran University of Science and Technology, Tehran, Iran

Rocks in the subsurface are exposed to high amount of confinement which can potentially suppress the formation or the development of tensile-based cracks and thus, give rise to shear-based fracture growth. However, measuring the shear fracture toughness of rocks have been studied less in the literature, as providing the required confinement to force the shear fracturing precede tensile fracturing is not an easy task. In the current study, two new tests namely the double-edge notched Brazilian disk (DNBD) and the axially double-edge notched Brazilian disk (ANBD) are proposed to measure the in-plane (true mode II) and the out-of-plane (true mode III) shear fracture toughness of rocks, K_{IIc} and K_{IIIc}, respectively. We use the term true to emphasis that not only sustains the crack shear loading, but also the type of fracturing is shear-based. Finite element method is used to study the variations of stress field around the crack tip in these tests and to prove the applicability of the tests in providing mode II and mode III loading conditions. It is argued that both tests are straightforward and have several advantages compared to the existing ones. The effectiveness of the tests is empirically corroborated by conducting some experiments on Bedretto Granite. The pulverized surface of fracture in both the tests denotes the existence of friction which indicate the shear-based nature of fracture. Finally, the measured values of K_{IIc} and K_{IIIc} for Bedretto granite are compared to each other and to the reported values of K_{Ic} in the literature. It is shown that KIIc and KIIIc values are close to each other while both are more than two times greater than KIc.