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Comparison of Crack Initiation, Propagation and Coalescence Behavior of Concrete and Rock Materials

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There are many previously studies carried out to identify crack initiation, propagation and coalescence behavior of different type of rocks. Most of these studies aimed to understand and predict the probable instabilities on different engineering structures such as mining galleries or tunnels. For this purpose, in these studies relatively smaller natural rock and synthetic rock-like models were prepared and then the required laboratory tests were performed to obtain their strength parameters. By using results provided from these models, researchers predicted the rock mass behavior under different conditions. However, in the most of these studies, rock materials and models were considered as contains none or very few discontinuities and structural flaws. It is well known that rock masses naturally are extremely complex with respect to their discontinuities conditions and thus it is sometimes very difficult to understand and model their physical and mechanical behavior. In addition, some vuggy rock materials such as basalts and limestones also contain voids and gaps having various geometric properties. Providing that the failure behavior of these type of rocks controlled by the crack initiation, propagation and coalescence formed from their natural voids and gaps, the effect of these voids and gaps over failure behavior of rocks should be investigated. Intact rocks are generally preferred due to relatively easy side of their homogeneous characteristics in numerical modelling phases. However, it is very hard to extract intact samples from vuggy rocks because of their complex pore sizes and distributions. In this study, the feasibility of concrete samples to model and mimic the failure behavior vuggy rocks was investigated. For this purpose, concrete samples were prepared at a mixture of %65 cement dust and %35 water and their physical and mechanical properties were determined by laboratory experiments. The obtained physical and mechanical properties were used to constitute numerical models, and then uniaxial compressive strength (UCS) tests were performed on these models by using a commercial software called as Particle Flow Code (PFC2D). When the crack behavior of concrete samples obtained from both laboratory tests and numerical models are compared with the results of previous studies, a significant similarity was found. As a result, due to the observed similarity crack behavior between concretes and rocks, it can be concluded that intact concrete samples can be used for modelling purposes to understand the effect of voids and gaps on failure characteristics of vuggy rocks.