

Low Amplitude Fatigue Performance of Sandstone, Marble, and Granite under High Static Stress

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Abstract

Fatigue tests under high static pre-stress loads can provide meaningful results to better understand the time-dependent failure characteristics of rock and rock-like materials. However, fatigue tests under high static pre-stress loads are rarely reported in precious literatures. In this study, the rock specimens were loaded with a high static pre-stress representing 70% and 80% of the UCS, and cyclic fatigue loads with a low amplitude (i.e., 5%, 7.5% and 10% of the UCS) were applied. The results demonstrate that the fatigue life decreased as the static pre-stress level or amplitude of fatigue loads increased for all rock types, and the high static pre-stress affected the fatigue life greatly when the static pre-stress was larger than the damage stress of rocks in uniaxial compression test. The accumulative fatigue damage exhibited three stages during the fatigue failure process: crack initiation, uniform velocity, and acceleration, and so the fatigue modulus showed an “S-type” change trend. The lateral strain and volumetric strain had a much higher sensitivity to the cyclic loading and could be used to predict fatigue failure characteristics, and it was found that volumetric strain “ ϵ_v ” = 0 is a threshold for microcracks coalescence and is an important value for estimating the fatigue life.

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