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Experimental studies on Interactive Failure Characteristics of Jointed Rock

Shichuan Zhang[1],Baotang Shen[2]; Yangyang Li[3]

1. State Key Laboratory of Mining Disaster Prevention and Control, Shandong University of Science and Technology, Qingdao, China

2. CSIRO Energy, Queensland Centre for Advanced Technologies, PO Box 883, Kenmore, Brisbane, QLD 4069, Australia

ABSTRACT

Jointed rock mass is often encountered in rock engineering and has always been a major factor to threat the safety of underground engineering. In this study, a new sub-instability stage of jointed rocks before rock failure is defined to analyze the stress characteristics and their variations, and a new experimental method for investigating the interaction between defects and intact rock of the jointed rock mass during the sub-instability stage is proposed. In this study, the interaction effect between defects and intact parts is investigated on the macro and micro scales by laboratory tests. Firstly, macro characteristics of stress and failure mode are investigated systematically by conducting uniaxial compression tests on red sandstone samples with a set of preexisting open flaws of different sizes, and the interactive damage of intact parts and defects in sub-instability stage was further studied. Secondly, composite rock samples made of bonding gypsum were tested and data collected from stress sensor between strong and weak segments. The transforming processes from independent activity to overall interactive movement of jointed rock before the unstable failure of composite rock were analysed. The test results indicated that the sub-instability stage marked the beginning of interactive failure between intact rock and defects. In the early sub-instability stage, the relatively intact parts bore most of the load in a jointed rock mass, and the defect was damaged firstly which caused high strain around it. The areas of high strain were rapidly increasing, extending and migrating, causing damage to the intact parts. In the later sub-instability stage, the interaction effect reached its maximum, and a large number of cracks appeared in the intact rock and they propagated and coalesced. Intact parts experienced rapid failure and then the jointed rock failed. The experimental method used in this paper to identify the sub-instability stage could be used to identify failure precursors of jointed rock masses and to develop technology for disaster prevention in rock engineering.