

损伤岩样强度衰减规律及其尺寸效应研究

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STUDY OF STRENGTH DEGRADATION LAW OF DAMAGED ROCK SAMPLE AND ITS SIZE EFFECT

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摘要

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摘要 损伤岩样的强度衰减规律是岩石力学领域的重要课题。采用一种新的方法预制损伤岩样, 对其分别进行单轴和三轴压缩试验, 并将结果与近似均质的完整岩样试验结果对比。结果表明, 单轴压缩下, 损伤岩样除劈裂破坏外还伴随有斜向断裂破坏; 随围压的增大, 损伤岩样容易在胶结面处出现一种新的近水平破坏。损伤岩样较完整岩样的强度衰减值, 随围压的增大而增大, 但增长幅度逐渐减小。根据室内试验的结果, 借助于PFC数值软件, 对损伤岩样单轴强度衰减的尺寸效应进行探究。研究发现, 随岩样高径比的增大, 单轴强度的衰减值不断减小, 但减小的趋势逐渐平缓。提出单轴强度衰减的理论模型 (其中, σ 为任意损伤岩样的单轴强度衰减值, σ_0 为标准损伤岩样的单轴强度衰减值, H/D 为圆柱体岩样的高径比, a 和 b 均为材料参数), 所得的理论曲线与试验值吻合得很好。计算得出损伤岩样尺寸为无穷大时, 单轴强度衰减的无限趋近值。

关键词: 岩石力学 损伤岩样 强度衰减 围压 高径比 尺寸效应

Abstract: The degradation law of the damaged rock sample is an important task in the field of rock mechanics. A new method to precast the damaged samples was used. The uniaxial compression tests and triaxial compression tests were made on the samples and the test results were compared with that of intact rock samples which were nearly homogeneous. Under the uniaxial compression, splitting failure was accompanied with slant fracture failure. With the increase of the confining pressure, a new nearly horizontal failure was likely to appear at the cementation area. The strength degradation of the damaged sample to the slant sample increased with the increasing confining pressure, but the increasing range gradually fell. Based on the laboratory test and particle flow code(PFC) numerical software, the size effect of the strength degradation under uniaxial compression on the damaged sample was studied. The research shows that the strength degradation of the uniaxial compression fell with the increase of the height-diameter ratio but had a trend to become gentle. The theoretical model of strength degradation under uniaxial compression was proposed as $\sigma = \sigma_0 \left(\frac{H}{D} \right)^{-a} \left(\frac{H}{D} \right)^{-b}$, where σ is the strength degradation value under uniaxial compression of any damaged sample; σ_0 is the strength degradation value under uniaxial compression of the standard damaged sample; H/D is the height-diameter ratio of the column sample; a and b are the parameters of the material. The theoretical curve is consistent with values from the tests. The calculation result shows that when the size is infinitely indefinitely large, the strength degradation value under uniaxial compression is closer to σ_0 .

Keywords: rock mechanics damaged rock sample strength degradation confining pressure height-diameter ratio size effect

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