

单轴拉伸条件下细观非均匀性岩石变形局部化分析及其应力-应变全过程研究

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摘要 岩土工程的开挖卸荷往往产生拉应力,因此研究单轴拉伸条件下细观非均匀性岩石的变形局部化和全过程应力-应变关系具有重要的理论和现实意义。利用损伤力学理论研究了岩石在线弹性阶段、非线性强化阶段、应力跌落、应变软化阶段的拉伸应力-应变关系,并分析了产生应力跌落和应变软化的主要原因是损伤和变形局部化,将损伤和变形局部化引入本构模型是和以往模型的重要区别。通过与实验成果的对比分析,验证了模型的正确性和有效性。

关键词 [岩石力学,拉应力,细观非均匀性,损伤力学,损伤和变形局部化,应力-应变全过程](#)

分类号

ANALYSES ON STRAIN LOCALIZATION AND COMPLETE STRESS-STRAIN RELATION OF MESOSCOPIC HETEROGENOUS ROCK UNDER UNIAXIAL TENSION

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Abstract

Stress redistribution induced by excavation results in the tensile zone in parts of the surrounding rock mass. A micromechanics-based model is proposed for brittle rock undergoing irreversible changes of microscopics structures due to microcrack growth. The influences of all microcracks with different sizes and orientations are introduced into the overall compliance tensor by using the statistical average method. Overall compliances of damaged brittle rock are nonsymmetric and anisotropic. Micromechanical kinetic equations for microcrack growth characterizing the 'process domains' of active microcracks are introduced. These 'process domains' together with 'open microcrack domains' completely define the integration domains of ensemble averaged constitutive equations relating macro-strain and macro-stress. Special attention is paid to the transition from structural rearrangements on the microscale to the macroscopic inelastic strain. Analyses are made on the localization of strain and damage. Results show that the onset of localization is very sensitive to the details of a constitutive law. The complete stress-strain relation including linear elasticity, non-linear hardening, rapid stress drop and strain softening is established. The behaviour of rapid stress drop and strain softening are due to localization of strain and damage. The constitutive model to analyse the localization of strain and damage is distinct from the conventional model. An illustrative example is worked out to show the capability of the presented model to predict experimentally observed reponse of brittle rock. It is emphasized that no fitted phenomenological material parameter is employed in the proposed damage model.

Key words [rock mechanics,uniaxial tension,mesoscopic heterogenous rock,damage mechanics,localization of damage and strain,complete stress-strain relation](#)

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