

论文

巷道围岩渗流场和应力场各向异性特征分析及应用

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摘要:

依托范各庄煤矿12号煤层底板的砂岩巷道工程实际, 应用岩体结构面非接触测量(ShapeMetriX3D)系统, 对巷道开挖面进行岩体结构面数字摄影测量及识别, 得到岩体结构面的几何分布参数; 在此基础上, 利用Mont-Carlo方法生成裂隙网络, 分别利用离散介质渗流方法和几何损伤理论计算岩体的渗透张量和弹性张量, 研究了岩体力学参数各向异性和尺度效应; 最后, 建立了平面应变情况下的巷道围岩各向异性渗流力学模型, 采用COMSOL Multiphysics多物理场分析软件, 计算得到了可以考虑节理分布特征的巷道围岩应力场和渗流场, 并讨论了岩体力学性质主方向对围岩应力场、渗流场及损伤区的影响。研究表明, 岩体的各向异性对数值模拟结果影响显著, 等效连续介质的各向异性模型能考虑岩体结构面的影响, 更符合工程实际。

关键词: 巷道围岩; 渗流场; 应力场; 各向异性; 裂隙岩体

The anisotropic properties analysis of the rock mass surrounding the roadway' s in seepage and stress field

Abstract:

Depending on the sandstone roadway on the floor of No.12 coal seam in Fangezhuang Coal Mine, a 3D contact-free measuring system, named as ShapeMetriX3D, was employed to capture discontinuities on the face of the roadway and obtain statistical parameters for each set of discontinuities. And then, fracture network was generated by Mont-Carlo method. Permeability tensor of rock mass was calculated by the discrete medium seepage method, and the elasticity tensor of rock mass was obtained by geometrical damage theory. Then, scale effect and anisotropic behaviors of rock mass were studied. Finally, an anisotropic percolation mechanics model of surrounding rock mass of the roadway was built under plane strain condition. Using COMSOL multiphysics code, the stress field and seepage field surrounding the roadway were obtained, which can take into account the influence of orientation of discontinuities. Furthermore, the influences of principal direction of rock mass properties on stress, seepage and damage zone were discussed. The results show that the anisotropic properties of rock mass have a great influence on simulated results, and the anisotropic model based on equivalent continuum mechanics can reflect the effect of discontinuities, which is agree with engineering practice.

Keywords: surrounding rock; seepage field; stress field; anisotropy; fractured rock mass

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