

论文

压缩载荷作用下分支裂纹断裂与扩展的数值和实验研究

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摘要:

材料中裂纹形态比较复杂, 有弯曲, 交叉或者分支等等, 通过数值和实验的方法研究了在压缩载荷作用下分支裂纹的断裂问题, 考虑分支裂纹倾角和长度对应力强度因子和裂纹扩展的影响。结果表明: 裂纹倾角的增加使I型应力强度因子减小, 而裂纹长度的增大使应力强度因子增大, 长度较大的分支裂纹对长度较小的有一定的抑制作用。通过对张开型分支裂纹和弯折裂纹砂岩试件的单轴压缩试验, 发现砂岩试件的破坏形式主要是以I型翼型裂纹扩展为主, 其起裂位置距离裂纹尖端的距离随着分支裂纹角度的增大而减小; 分支裂纹倾角越大, 其翼型裂纹起裂角就越小但相应的起裂载荷却越大。还对张开型裂纹和闭合型裂纹做了一定的比较, 发现张开型裂纹的起裂角要大于闭合型裂纹的起裂角, 但其起裂载荷却正好相反。

关键词: 分支裂纹; 张开裂纹; 应力强度因子; 翼型裂纹; 起裂角; 起裂载荷

Numerical and experimental research on the fracture and propagation of the branch crack under compression

Abstract:

The cracks in the material are in varied forms, such as bend, cross and branch. The numerical and experimental methods were applied to study the fracture problem of the branch crack under compression, considered the influence of different branch crack inclination and length to the stress intensity factors and the wing crack propagation. The results show that the increase of the crack inclination stress intensity factor K_I decreases, and the stress intensity factors increase with the crack length increases, the branch crack with a large length may inhibit the smaller one. The sandstone specimens containing open branch cracks or kink cracks subjected by uniaxial compressive loads were used to analysis the wing crack propagation, the experimental results find that the forms of the destruction of the sandstone specimen are mainly type I wing cracks, and its distance from the crack tip decreases with the increase of branch crack inclination; the bigger branch crack inclination, the smaller wing crack initial angle but the bigger wing crack initial load. The comparison was also made between open and closed cracks, wing crack initial angle of the open crack is greater than the closed one's, but its wing crack initial load is just the opposite.

Keywords: branch crack; open crack; stress intensity factor; wing crack; initial angle; initial load

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