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论文

三轴不等应力场下剪切破裂趋势面方向探析

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摘要:

文章在弹性力学和库仑 摩尔破裂理论基础上,用数学解析方法剖析三轴不等应力状态,以及三轴全拉、三轴全压和最大最小主应力一拉一压三种情况下,斜截面上剪应力与抗剪阻力之差——“剪切差函数”的极值。进而探讨了剪切破裂趋势面方向与三主应力轴,及岩石(体)内摩擦角φ和内聚力C的关系。给出了不同应力状态下发生剪切破裂面的可能方向。在全压状态下,剪切破裂趋势面与最大主压应力轴夹角γ=±(45°-φ/2),即共轭角χ=±(90°-φ)。在一拉一压状态下,±(45°-φ/2)≤γ≤±45°,具体数值视拉主应力与压主应力比值确定。以上三种不等主应力下的剪切破裂面都是平面,且平行于中间主应力轴。构造拉张力的存在是无可争议事实,通过一拉一压状态下剪切破裂面趋势面分析,给出了构造地质实践中为什么有时剪切面共轭角χ>±(90°-φ),甚至接近90°的理论分析。

关键词: 三轴不等应力场;剪切破裂趋势面;剪切差函数;库仑 摩尔方程式;法向拉压应力转换角

Analysis of the direction of shear fracture trend surface in triaxial unequal stress fields

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Abstract:

Abstract: Based on elastic mechanics and Coulomb Mohr fractural theory, we discussed the extremum of shear difference function, i.e., the difference of shearing stress and shearing resistance on an oblique section, in a triaxial unequal stress field by mathematical analysis We set the stress field in three different states: the triaxial tensile force, the triaxial compressive force and the maximum and minimum principal stress with one tension and one compression, respectively Then, we discussed the relationship of trend surface direction of shear fracture to the three principal stress axes and to the inner friction angle and the cohesion of rocks The potential direction of shear fracture surface was obtained in different stress states In the state of triaxial tensile force, the angle between the shear fracture trend surface and the maximum principal stress axis γ=±(45°-φ/2) and the conjugate angle χ=±(90°-φ) In the state of one tension and one compression, ±(45°-φ/2)≤γ≤±45° and the actual value is determined by the ratio of the tensile principal stress to the compressive principal stress The shear fracture surfaces under the three kinds of unequal principal stresses are plane surfaces parallel to the intermediate principal stress axes The existence of tectonic tension stress in geological structures is indubitable Through the analysis of shear fracture trend surface in the state of one tension and one compression, we could solve the question about the fact that the shear surface conjugate angle χ>±(90°-φ) or even close to 90° encountered in the structural geologic investigation.

Keywords:

Key words: triaxial unequal stress fields; shear fracture trend surface; shear difference function; Coulomb Mohr equation; conversion angle of normal tensile and compressive stress

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