工程地质学报 2010, 18(5) 589-595 DOI:
ISSN: CN:

灾害地质

关于脆性岩体岩爆成因的理论分析

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摘要:

大型工程开挖中,高地应力环境下高储能脆性岩体通常会通过脆性破裂快速释放应变能,产生岩爆。针对这类岩爆现象进行了一系列理论探讨,认为:(1)开挖条件下脆性岩体的岩爆破坏主要为张破裂或者张剪性破裂,破裂角一般较小,呈薄片状或刀口状。笔者认为开挖产生次生张应力和压剪应力条件下微裂纹裂尖出现张应力是可能的,因此采用格里菲斯强度理论研究开挖岩体破裂是有效的; (2)以格里菲斯强度理论为基础,分析了岩体在二维和三维情形下的岩爆破裂应力判据和破裂角,指出在有张应力的条件下,岩体的剪破裂角会减小,直至为零,这就解释了开挖面附近薄片状、刀口状破裂现象的原因; (3)分析了脆性岩体岩爆破裂的能量过程,指出张性破裂所耗能量较小,而张剪性和压剪性破裂耗能较高。认为岩爆破裂消耗的能量主要转化为新生裂纹的表面能和破裂碎片的动能,并指出表面能所占比例较动能为小。由此解释了脆性岩体岩爆破坏以动力效应为主的特征; (4)本文理论分析成果的工程应用价值在于:可以预示开挖脆性岩体破裂部位、破裂方式和破裂范围; 提出岩爆破裂的张性应力控制依据。

关键词: 岩爆 破裂判据 破裂角 动能

THEORETICAL ANALYSIS ON THE MECHANISM OF ROCK BURST OF BRITTLE ROCK MASS

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Abstract:

Brittle rock mass generally reserves high strain energy under high ground stress condition.As it is excavated,rock burst will take place with a rapid release of reserved energy.This paper explores the mechanism of rock burst and obtained the following points: (1) Phenomena have shown that rock burst is possibly a kind of tensile and tension-shear failure and the failure angle is relatively small.It is pointed out that excavation can induce tensional stress state in rock mass.(2) Two and three dimensional criterions for rock burst based on Griffith theory have been proposed,and the theoretical analysis has confirmed that the failure angle will be reduced with the occurrence of tensional stress state,till zero while pure tensional state. (3) The energy analysis has shown that the energy consumed for pure tensional failure is relatively less than that for tension-shear failure or compressive-shear failure.And the strain energy dissipated in failure will mainly transferred into surface energy for newly created cracks and the kinetic energy of the failure pieces of rock.Theoretical analysis has proved that the proportion of kinetic energy is much bigger than that for surface energy. (4) The probable applications of this theory include: predicts the failure mode,location and size of rock burst; and theoretical basis of stress control for excavation design.

Keywords: Rock burst Failure criterion Failure angle Kinetic energy

收稿日期 2010-09-01 修回日期 2010-09-21 网络版发布日期

DOI:

基金项目:

国家自然科学基金重点项目(41030749)、铁道部重大科技攻关项目(2009G005-A)资助

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