

论文

岩石钻掘过程钻头受力动力学解析模型

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摘要:

为深入研究钻头在岩石钻掘这一动力学过程中的受力变化规律, 对钻头的钻掘过程进行了系统的动力学分析, 建立了描述钻头在岩石钻掘过程中力与运动间关系的微分方程组, 归纳了运动条件下影响钻头受力变化的各种影响因素。在对钻头钻掘岩石的运动过程进行解析的基础上, 提出了运动条件下钻头压入力和切削力的解析计算方法, 并分别给出了压入力和切削力的动力学解析方程。进行岩石钻进力学测试实验, 结合相关实验结果对动力学计算模型和静力学计算模型进行了对比分析, 研究表明: 钻头在钻掘岩石过程中的受力与其运动状态密切相关; 在其它条件一定情况下, 钻头所受的压入力和切削力均随钻头推进速度V的增加而增加。计算结果显示动力学解析模型比传统静力学计算方法更接近实验测量值, 而且更有利于直观方便地指导工程实践。

关键词: 岩石; 钻掘; 动力学; 解析模型

Analytical dynamic model of the drill bit in rock drilling

Abstract:

In order to study the force variation of the drill bit in the dynamic process of rock drilling deeply, systematical dynamics analysis was presented in the paper. Differential equations which described the force fluctuations in the process of rock drilling were established and various factors which affect the force fluctuations of the drill bit were also analyzed. Based on the analysis of the process of movement in rock drilling, analytical method for force computation of the drill bit in the dynamic process was given. Analytical calculation model of penetrating force and cutting force in the dynamic process was derived respectively. Studies show that the force of drill bit is closely related to its motion state; the average penetrating force and cutting force in the dynamic process increase with the increasing of penetration speed V in the case of the other conditions remain unchanged. Calculation results show that the analytical dynamic model is more precise than the traditional method of static calculation model compared with experimental measurements, and more conducive to be a intuitive and laconic guidance in engineering practice.

Keywords: rock; drilling; dynamics; analytical model

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