岩石力学与工程学报 2007 26 (08): 1645 ISSN: 1000-6915 CN: 42-1397/O3

二维波穿过非线性节理面的透射性能研究

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收稿日期 2006-11-7 修回日期 2007-3-6 网络版发布日期 2007-8-20 接受日期 2006-11-7

摘要 二维波穿过非线性节理面是一个复杂的问题，量纲一的刚度、射线角、径向距离、节理参数、入射波频率等都是影响节理后透射率的重要因素。采用非线性节理本构研究单条垂直节理下二维波的透射性能，结果发现：二维波穿越垂直节理面的透射率，不仅与节理面法向刚度与切向刚度有关，还直接受节理面黏聚力和内摩擦角的控制；节理面黏聚力和内摩擦角的数值反映节理面的闭合程度，从而使透射率呈现不同的变化规律。内摩擦角不变，黏聚力提高可以提高透射率；黏聚力不变，节理面内摩擦角引起透射率变化有两种形式：低黏聚力下内摩擦角的升高可使透射率增大；高黏聚力下透射率反而从一较高水平下降到较低水平。最后，根据单节理作用下透射率的研究成果对多条节理分布下的透射性能进行对比研究，对复杂节理分布下的动力响应计算进行尝试。

关键词 岩石力学；二维波；透射率；节理；振动

分类号

RESEARCH ON TRANSMISSION BEHAVIORS OF NONLINEAR JOINTS WITH 2D WAVE PROPAGATION

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Abstract

Two-dimensional wave propagation through joints is a complicated problem. The important factors influencing the transmissivity of joint include normalized stiffness of joints，ray angle，radial distance，joint parameters，incident wave frequency，etc.. Under help of 3DEC，the propagation of 2D wave through single joint with nonlinear joint model，the rules of transmissivity under different strength parameters and geometric positions are studied. According to the research results of single joints，transmissivity of 2D wave through straight joint interface is not only associated with normal and shear stiffness of joint，but also controlled by the joint strength parameters，cohesion and inner friction angle. Values of joint cohesion and inner friction angle reflect the closure degree of joint，which causes transmissivity to take on different tendencies. If the inner friction angle keeps constant，transmissivity will increase with the increase of cohesion strength until it reaches to a superior limit. While if the cohesion keeps constant，transmissivity is different in response to cohesion. If the cohesion is at a low level，the transmissivity will increase with the increase of inner friction angle until it reaches to a superior limit. However，the transmissivity will initiate at a high value then decrease rapidly to a lower level with the increase of the inner friction angle if the cohesion is at a high level. Finally，calculations of transmissivity under the condition of multiple joints are tentatively conducted according to the single joint research results；and some useful comparison works are achieved in dynamic response under complicated joints distribution.

Key words rock mechanics；two-dimensional wave；transmissivity；joint；vibration

DOI:

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