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节理岩体复合型多弱面软化模型的研究及实现

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Mixed multi-weakness plane softening model for jointed rock mass

摘要 岩土工程中经常遇到受多组密集定向节理面切割的破碎岩体，对该类岩体的力学行为展开研究则需建立合理的本构模型。针对含有不超过三组节理弱面斜交切割的节理岩体，将其考虑为一种广义宏观复合材料，建立了复合型多弱面软化模型。设定不同的屈服因子可使岩体材料满足Mohr-Coulomb和受拉破坏的复合屈服准则或Hoek-Brown强度屈服准则。节理面服从Mohr-Coulomb和受拉破坏的复合屈服准则，并且具有双线性特性。软化参数描述为与塑性应变和拉应变相关的变量，通过软化参数可描述节理岩体各种软化特性曲线。基于FLAC3D本构模型的二次开发平台，成功实现并嵌入该复合型软化模型，并通过双节理面斜交岩体的单轴压缩试验进行验证，计算结果与试验比较吻合，符合岩石的宏观破坏机理，表明了该模型的正确性。

关键词： 节理岩体 本构模型 软化 二次开发 FLAC3D

Abstract： Fractured rock mass with densely distributed joints is often encountered in geotechnical engineering field. So it is necessary to develop a reasonable constitutive model to conduct studies on mechanical behavior of such kind of rock mass. A mixed multi-weakness planes softening constitutive model is established for the rock mass with less than three sets of joint weakness planes, which is considered as a macroscopic composite material in a broader sense. The rock mass satisfies composite the Mohr-Coulomb criterion with tension cutoff or the Hoek-Brown failure criterion by setting yield factor. Joint plane with bilinear characteristics follows the composite Mohr-Coulomb criterion with tension cutoff. Softening parameters, which are variables correlated to plastic strain and tensile strain, are used to describe the softening characteristics of materials. Based on the secondary development platform of constitutive model in FLAC3D, this mixed softening model has been successfully developed and embedded. It is verified by simulating the uniaxial compression test on rock mass that is obliquely cut by double joint planes. The calculated results agree with the related tests fairly well, and satisfy the macro-destruction mechanism of rock. Thus, it is shown that this model is correct and can be applied in practical projects.

Keywords： jointed rock mass constitutive model softening secondary development FLAC3D

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