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岩土材料能量屈服准则研究

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摘要 比较岩土类材料与金属的材料特性的差异及由此导致的力学性质差异认为，岩土类材料属于多相体的摩擦型材料，具有内摩擦性质。分析两类材料的力学单元，认为摩擦体力学单元中存在摩擦力。从能量角度对岩土材料的屈服进行研究，分别将Tresca准则和Mohr-Coulomb准则进行推广，推导出只考虑单一剪切面的两类材料单剪能量屈服准则，证明Tresca准则既是金属材料的单剪应力屈服准则，也是金属材料的单剪能量屈服准则，而Mohr-Coulomb准则既是岩土材料的单剪应力屈服准则，也是岩土材料的单剪能量屈服准则。对考虑3个剪切面的能量屈服准则进行探讨，建立适用于岩土类材料的三剪能量屈服准则及其相应的Drucker-Prager准则。结合岩石真三轴试验结果，分别采用Mohr-Coulomb准则及三剪能量准则进行验证。结果表明，三剪能量准则比Mohr-Coulomb准则误差小，更接近试验结果，证明能量准则是可行的。最后利用一个简单的算例进行验证，计算结果表明，只考虑单剪切面的Mohr-Coulomb准则比考虑三剪切面的能量准则偏于保守。

关键词 岩土力学；岩土材料；摩擦特性；能量；单剪；三剪；屈服准则

分类号

STUDY ON ENERGY YIELD CRITERION OF GEOMATERIALS

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Abstract

After comparing the difference of materials properties and the induced difference of mechanical characteristics between metals and geomaterials，it is concluded that geomaterials are frictional materials with multiphase and have frictional characteristics. By analyzing the mechanical elements of two kinds of materials，it is considered that there are frictional stresses in the mechanical elements of frictional materials. By generalizing the Tresca yield criterion and the Mohr-Coulomb yield criterion，the energy yield criterion considering only simple shear surface is deduced，which proves that the Tresca yield criterion and the Mohr-Coulomb yield criterion are the simple shear energy yield criteria of metals and geomaterials，respectively. The energy yield criterion about three shear surfaces is discussed；then the triple shear energy yield criterion and corresponding Drucker-Prager yield criterion of geomaterials are established. The Mohr-Coulomb yield criterion and the triple shear energy yield criterion are used to validate the true triaxial test data. The errors show that the results of the triple

shear energy yield criterion are more close to the test data than those of the Mohr-Coulomb yield criterion，which proves that the energy yield criterion is correct. At last，a simple slope is computed using the Mohr-Coulomb yield criterion and the triple shear energy yield criterion respectively；and the results indicate that the Mohr-Coulomb yield criterion is more conservative than the triple shear energy yield criterion.

Key words rock and soil mechanics；geomaterial；frictional characteristic；energy；simple shear；triple shear；yield criterion

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