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岩土材料最大主剪应变破坏准则的推导

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摘要 屈服和破坏是2个不同的概念，是材料变形过程中的2个不同阶段。在应力空间中，理想塑性的屈服面在材料变形过程中始终保持不变，而在应变空间中，后继屈服面与初始屈服面大小相同，但中心位置随着塑性变形的增大而移动。所以传统的基于应力空间的各种准则无法判断材料破坏与否，而基于应变空间进行表述则能克服这一局限。据此，建立基于最大主剪应变的岩土材料延性剪切破坏应变准则；根据正常固结饱和土排水和不排水三轴试验结果，分析应力和体积应变(排水)或孔隙水压力(不排水)随应变的变化规律，并利用ANSYS对上述三轴试验进行数值模拟，计算结果与试验结果所得规律一致，表明取试样进入临界状态起始点的应变作为破坏极限应变容许值是合理的。最后，详细推导出最大主剪应变的计算公式，并针对几种常用屈服准则给出计算示例。

关键词 岩土力学；破坏；最大主剪应变；临界状态

分类号

DEDUCTION OF FAILURE CRITERION FOR GEOMATERIALS BASED ON MAXIMUM PRINCIPAL SHEAR STRAIN

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Abstract

Yield and failure are two different conceptions，and they are two different steps in the deformation processes of materials. In the stress space，the failure surface of perfect plastic materials keeps unchangeable. In the strain space，however，with the constant size of failure surface，its center location moves with the increase of plastic deformation. So the traditional criteria built in the stress space cannot determine whether the material is destroyed. On the contrary，the criteria built in the strain space can properly deal with the problem. The strain criterion for ductile shear failure based on the maximum principal shear strain is established. On the basis of triaxial compression test results of normally consolidated saturated clay，the development laws of stress and volume strain(drained) or pore water pressure (undrained) with strain are analyzed；and the results of numerical simulation with ANSYS are in consistent with the test results. So it is rational to take the shear strain of initial critical state as the limit failure strain. The formulas of the maximum principal shear strain are deduced；and the calculation cases for several commonly used yield criteria are presented.

Key words rock and soil mechanics；failure；maximum principal shear strain；critical state

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