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弹塑性矩阵Dep的特性和有限元边坡稳定性分析中的极限状态标准

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摘要 证明了关联流动条件下的弹塑性矩阵在硬化、理想塑性和软化情况下分别为正定、半正定(亏一秩)和不定矩阵, 然后利用理想弹塑性矩阵的奇异性证明当边坡达到极限平衡状态时, 坡内必存在一个由坡底贯通到坡顶的单元层, 该单元层内的所有单元全都进入塑性状态, 从而为利用等效塑性应变或塑性功的等值线图来判别边坡的极限状态找到了力学依据。还定性分析了利用有限元法在分析边坡问题时塑性区往往被夸大的本质原因, 也给出了克服这一缺陷的技术性办法。

关键词 [岩土力学; 弹塑性矩阵; 有限元; 边坡失稳判据](#)

分类号

PROPERTIES OF ELASTO-PLASTIC MATRIX Dep AND A CRITERION ON LIMITING STATE OF SLOPE STABILITY BY FEM

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Abstract

It is proven that under assumption of the associated flow rule, the elasto-plastic matrix Dep is positive definite for hardening materials, positive semi-definite (the rank deficiency being one) for perfectly plastic materials and indefinite for softening materials, respectively. Based on the fact that Dep is singular for perfectly plastic materials, it is stated that if a slope arrives at the state of limit equilibrium, a layer of elements must go through the slope from the bottom of the slope to the top, each element in the layer being in plastic state. Hence, it is rational that the contour plots of the equivalent plastic strain or the plastic work are used to judge if slopes reach the limit equilibrium state. The paper makes a qualitative analysis for the abnormal phenomenon in which the plastic zones are usually overestimated in analyzing slope problems by FEM. The skill for overcoming such an abnormal phenomenon is proposed as well.

Key words

[rock and soil mechanics; elasto-plastic matrix; finite element; criterion of the instability of slope](#)

