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ZHONGNAN DAXUE XUEBAO(ZIRAN KEXUE BAN)

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非线性破坏准则下法向受力条形浅锚抗拔力上限计算方法

赵炼恒，李 亮，杨小礼，但汉成，邹金锋

(中南大学 土木建筑学院，湖南 长沙，410075)

摘 要：在上限定理、相关联流动法则基础上，根据非线性破坏准则对法向受力条形浅锚极限抗拔力上限进行计算，其方法是：通过“切线法”引进变量，把锚板上填土的非线性抗剪强度指标c_t和φ_t作为变量参数，对锚板上部填土建立含有变量的速度场，根据外力功率与内部耗能相等原理获得极限抗拔力的目标函数与约束条件；基于MATLAB软件平台，利用“序列二次规划算法”对该问题进行优化求解。计算结果表明：当非线性破坏准则变为线性破坏准则时，计算结果与实际结果相符；非线性参数对锚板的极限抗拔力有重要影响，对非线性岩土体进行线性简化不利于正确评价抗拔基础的承载性能，恰当引入岩土体破坏准则的非线性更加符合工程实际；提高岩土抗剪强度，加大锚板埋深，提高锚板板面粗糙度和锚板倾斜埋置均有利于提高法向受力浅埋条锚基础抗拔承载力。

关键字：法向受力条形锚板；极限抗拔力；上限定理；非线性M-C强度准则；关联流动法则；序列二次规划法

Calculating method of upper bound for ultimate pullout capacity of vertically loaded strip plate anchors based on nonlinear Mohr-Coulomb failure criterion

ZHAO Lian-heng, LI Liang, YANG Xiao-li, DANG Han-cheng, ZOU Jin-feng

（School of Civil and Architectural Engineering, Central South University, Changsha 410075, China）

Abstract: Based on the upper bound limit analysis theorem, the associated flow rule and the nonlinear M-C failure criterion, the ultimate pull-out capacity (UPC) of vertically loaded strip plate anchors were studied by means of the kinematical approach of limit analysis theory. The procedures were as follows: the nonlinear shear strength parameters, i.e., internal friction angle φ_t and cohesive force c_t, were treated as variable parameters for the calculation schemes. The objective function of UPC was obtained by equating the work rate of external force to internal dissipation along the velocity discontinuities, and the upper bound solutions were presented by applying a nonlinear sequential quadratic programming (SQP) algorithm. The results show that the nonlinear failure parameter exerts a significant effect on UPC, and if the nonlinear M-C yield criterion turns into a linear M-C yield criterion, the results presented here agree well with the real ones. The density of soil mass, the embedment ratio, the interface properties, the inclined angle and the geometric properties have significant effects on UPC and the region of failure modes.

Key words:vertically loaded strip plate anchors; ultimate pull-out capacity; upper bound theorem; nonlinear M-C failure criterion; associated flow rule; sequential quadratic programming

地 址：湖南省长沙市中南大学 邮编： 410083
电 话： 0731-88879765 传真： 0731-88877727
电子邮箱： zngdxb@mail.csu.edu.cn 湘ICP备09001153号