

非线性库仑主动土压力分析理论

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摘要 应用突变理论方法, 研究当挡墙背垂直、光滑, 且墙后土体由应变硬化介质与应变软化介质组成时, 两种介质相互作用产生主动土压力的非线性理论。给出主动土压力产生的必要力学条件判据, 发现主动土压力的产生与两种不同介质的刚度比 k 和材料的均匀性指标有极大关联性。当填土面水平且只有应变软化介质时, 经典库仑和朗肯土压力理论只是非线性理论 $k = 0$ 的特例。研究表明: 土压力强度 s_a 随深度 z 的变化是非线性的关系: 当 $k = 0$ 时, s_a-z 的关系是线性的; 当应变硬化介质的剪切模量 G_h 较小时, s_a-z 关系呈近似线性关系; 当 G_h 较大时, s_a-z 关系为明显的非线性关系。 s_a-z 关系理论曲线与土压力模型试验和实测结果具有很好的一致性。

关键词 [土力学; 主动土压力; 应力 - 应变性质; 刚度比; 材料均匀性指标; 非线性](#)

分类号

NONLINEAR THEORY ON COULOMB'S ACTIVE EARTH PRESSURE

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Abstract

The nonlinear theory of the active earth pressure produced by the interaction of two media, which are composed of strain-hardening medium and strain-softening medium for the soil masses behind the retaining wall, is studied by using catastrophe theory when the wall back is vertical and smooth. The necessary and sufficient conditions leading to the active earth pressure are presented. It is found that the formation of the active earth pressure relies mainly on both the stiffness ratio k of the media and the homogeneity index. It is also illuminated that the classical Coulomb's and Rankine's theory on the earth pressure is a special example of $k = 0$ when the backfill surface is horizontal and the backfill is composed of a strain-softening medium. It is shown that the relation between the earth pressure strength s_a and the depth z is nonlinear, i. e. the s_a-z relation is linear for $k = 0$. The s_a-z relation is approximately linear for the relatively small shear modulus G_h of the strain-hardening medium, and the s_a-z relation is obviously nonlinear for the relatively large value of G_h . By making contrast between the theoretical curves and experimental or in-situ monitored data, the nonlinear earth pressure theory is proven to be effective.

Key words [soil mechanics; active earth pressure; stress-strain property; stiffness ratio; homogeneity index of material; nonlinearity](#)

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