

考虑桩体几何特征的压桩挤土效应理论解答研究

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Theoretical solutions of soil-squeezing effect due to pile jacking considering geometrical characteristics of a pile

摘要

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摘要 现阶段基于能量原理的桩土作用理论解答研究仍存在较多不完全合理的假设或急需解决的难点, 包括桩土接触面边界处理方法、分层沉积土层界面连续性条件和桩体几何形状等。特别是, 桩体几何形状对桩土作用的剧烈程度、桩周土体的位移形式和桩孔边界的几何特征有很大的影响。重点对孔壁边界曲线的几何形状及其曲线方程的假定方法展开研究, 并应用四次多项式模拟孔壁边界曲线。然后, 以四次孔壁曲线方程的求解结果为基础, 综合考虑桩长有限、地面自由、终孔孔壁形状、孔壁位移边界条件以及土体材料非线性, 应用变分原理推导沉桩挤土位移、应变和应力场解答。研究方法可作为压桩挤土的进一步理论研究的基础, 理论解答对压桩挤土的施工、相应防护措施的选择和设计有一定的指导作用。

关键词: 压桩挤土 空间轴对称 孔壁边界曲线 位移变分法

Abstract: There are still many imperfect hypotheses or theoretical difficulties needed to be solved in the current energy-principle-based solutions of soil-squeezing effect due to pile jacking. The difficulties are as follows: boundary conditions of interface between pile and soil, continuity conditions for interface in stratified soil and different geometrical shapes of a pile, etc. Especially the geometrical shapes of pile have great influences on the severity rate of soil-squeezing effect and displacement mode of soil around the pile and geometrical characteristics of pile holes. The curvilinear equation of quartic polynomial is used to simulate the boundary of the pile hole to improve the presumption of previous research results which are not well suitable. Then, the soil squeezing model due to pile jacking is constructed, considering the effect of the final shape and displacement boundary of pile wall, the stress free ground surface, the finity of pile length and the non-linearity of soil materials. Finally, soil displacement, strain and stress solutions are obtained based on the variational principal. The present research method can be the basis for further theoretical studies on soil-squeezing problems, and the results are valuable for the engineering design and construction of pile foundation.

Keywords: soil-squeezing effect due to pile jacking space axis symmetry boundary curve of pile hole variational principal

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