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桩与滞回阻尼土相互作用时桩基扭转振动时域响应分析

胡昌斌1，2，张 涛2

(1. 东南大学 交通学院，江苏 南京 210096；2. 福州大学 土木工程学院，福建 福州 350002)

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摘要 考虑桩土相互作用效应，对均质滞回材料阻尼土中弹性支承桩桩顶扭转振动时域响应进行解析理论研究。首先建立桩与滞回阻尼土在谐和振动条件下的定解问题，然后先对土层动力平衡方程进行求解并得到土体振动扭转角形式解，接着依据平衡条件将该形式解耦合进桩身动力平衡方程，并通过对桩动力平衡方程的求解，最终得到桩顶扭转角和速度频率响应解析解和半正弦脉冲激励作用下桩顶速度时域响应的半解析解。通过与其他相关理论解的对比验证该解的正确性和适应性，并对桩土相互作用时桩顶扭转振动时域特性进行分析，重点探讨桩周土滞回阻尼、长径比、模量等常规参数对桩顶时域响应的影响，得到若干结论。

关键词 土力学；桩土耦合作用；时域；扭转振动；滞回阻尼

分类号

TIME DOMAIN TORSIONAL RESPONSE OF DYNAMICALLY LOADED PILE IN HYSTERETIC TYPE DAMPING SOIL LAYER

HU Changbin1，2，ZHANG Tao2

(1. School of Communication and Transportation，Southeast University，Nanjing，Jiangsu 210096，China；
2. College of Civil Engineering，Fuzhou University，Fuzhou，Fujian 350002，China)

Abstract

Considering soil-pile interaction，the dynamic torsional response of a pile in time domain is investigated theoretically. The pile is assumed vertical and with elastic bottom boundaries and the soil is considered as visco-elastic layer with hysteretic type damping. The soil layer alone is solved first and its vibration torsional angle solution with undecided constants is used in the analysis of pile response. Then by solving dynamic equilibrium equation of pile，the pile response to a harmonic load is obtained in a closed form and a semi-analytical solution of the velocity response of pile subjected to a semi-sine wave exciting torsional couple is also given. In comparison with other theories，the correctness and applicability of the theoretical solutions presented herein are verified. Based on the solution，a parametric study is conducted to determine the main features of dynamic response of pile in time domain，and the special influence of hysteretic type damping of soil layer，slenderness ratio，soil modulus are also discussed here.

Key words soil mechanics；pile-soil interaction；time domain；torsional vibration；hysteretic damping

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通讯作者