



# Evaluation of the Pile Group under Vertical Harmonic Vibration in Layered Soil

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## Abstract

In general, piles are used as pile groups in foundations of structures. In this paper, an analytical model is presented for evaluation of response of pile-pile interaction in pile groups under vertical harmonic vibration. It is assumed that no slip occurs between soil and pile and the pile is vertical and elastic, and the soil behavior is linear visco-elastic with hysteric type damping. Interaction of pile-soil and pile-pile obtained from studies of Nogami and Novak and then pile group interaction is evaluated. While the stiffness and damping of the pile group subjected to harmonic vertical vibration in stratified soils are obtained through extension of equations. It should be noted that (SSM) method which was initiated for single pile by second author and then developed is used for evaluation of pile group interaction in stratified soils.

**Keywords:** Layered soil, vertical harmonic vibration, pile-pile interaction, group pile, stiffness and damping.

## 1. Introduction

Evaluation of the dynamic responses of pile groups under vertical harmonic vibrations can be used in designing foundations of machinery, pile driving or structures affected by the wind or earthquake waves. Piles are generally used as a group under the structures. Therefore, evaluation of the soil and pile group interaction has lead to obtaining the interaction factor. It can be said that Poulos (1968) proposed the static interaction factor for the first time, assuming that the soil is a homogeneous and elastic medium. Interaction factor is used for calculation of the dynamic responses, stiffness and damping of the pile group. Various methods have been proposed by researchers for calculation of the dynamic response of pile groups. Some of these methods are mentioned here. Using the "BEM" for calculation of stiffness and damping of the pile group under the vertical harmonic loads by Kaynia and Kausel (1982). Dobry and Gazetas (1988) proposed an analytical method and for calculation of the stiffness and damping of the pile group. Yan and Wang (2008) extended the finite element matrix method and developed an easy solution for calculation of soil-pile interaction factor under vertical harmonic vibrations in stratified soils. Then, stiffness of the dynamic response of the pile group was calculated. Ghazavi (2006) proposed an analytical SSM method for calculation of the pile-soil interaction in stratified soil. In this paper, an analytical method has been proposed for calculation of the stiffness and damping of the pile group in stratified soil under the vertical harmonic vibrations with using the SSM method.

## 2. ASSUMPTIONS