9th International Congress on Civil Engineering, May 8-10, 2012
Isfahan University of Technology (IUT), Isfahan, Iran

Prediction of Undrained Lateral Load Capacity of Piles in Cohesion Soil Using Genetic Programming

A. Johari[1], M. Nakhaee[2]
1- Assistant Professor, Department of Civil and Environmental Engineering, Shiraz University of Technology, Shiraz, Iran
2- Ms Candidate of Geotechnical Engineering, Department of Civil and Environmental Engineering, Shiraz University of Technology, Shiraz, Iran
johari@sutech.ac.ir
m.nakhaee@sutech.ac.ir

Abstract

In many engineering project piles shall be designed for lateral loads due to earth pressure, earthquake or wind forces on the structures. This requires estimation of ultimate loads based on which safe working loads will be assessed. In this research, a genetic programming (GP) approach is employed to predict the lateral load capacity of piles in cohesion soils. The GP model requires an input terminal set that consists of diameter of pile, embedment length of pile, eccentricity of load and undrained shear strength of soil. The output terminal set consists of the lateral load capacity of pile. For developing the genetic model GP software (GPLAB) provided by MATLAB was employed for the analysis. Furthermore, GP simulations were compared with the experimental results as well as the models proposed by other investigators. The comparison of the results indicates that the proposed approach was accurate and robust in representing the lateral load capacity of piles in cohesion soils.

Keyword: Genetic programming, Lateral load capacity of pile, Cohesion soils, Numerical models

1. INTRODUCTION

Using piles in many civil engineering projects such as excavations and foundation on slopes generates lateral load in these elements. Determining the lateral load capacity of pile is a complex problem due to participation of different involved parameters. Since 1960, several researchers studied about lateral load capacity, Poulos and Davis [1] used elastic analysis adopting the Winkler soil model. But such methods are not suitable for the nonlinear soil behavior which can be incorporated in the analysis by considering nonlinear p–y curves as suggested by Matlock and Reese [2]. Portugal and Seco e Pinto [3] used the nonlinear p–y curves and finite element method for prediction of the behavior of laterally loaded piles. Even though the method is most widely used, due to the variability of soil properties there is uncertainty in such predictions. Other semi-empirical methods used for lateral load capacity of piles are due to Hansen [4], Broms [5] and Meyerhof [6].

Recent researches on lateral load capacity of piles can be classified into two major groups. They are pile in cohesive and cohesionless soils. For piles in cohesive soil, Abbas et al. [7] improved understanding of the effect of time factor and intensity of applied loadings to the lateral pile response embedded in clay. Ziaie Moayed et al. [8] considered lateral load capacity of pile in cohesive soils based on soils' failure strength control. Boominathan and Ayothiraman [9] considered static and dynamic lateral load tests on model aluminium single piles embedded in soft clay to study its bending. Zhang and Ahmari [10] presented a method for nonlinear analysis of laterally loaded rigid piles in cohesive soil. The method considered force and moment equilibrium to derive the system equations for a rigid pile under a lateral eccentric load.

Lateral load capacity of piles in cohesionless soil was considered by several researchers. Murugan et al. [11] used finite elements analysis for different L/D ratio by changing the diameter (D) and length (L) of pile and compare with the Broms method. Phanikanth et al. [12] obtained lateral load behavior of single piles in cohesionless soils is attempted, for a range of subgrade moduli representing various soil types loose sand, medium sand and dense sand. Kim et al.[13] described the results of a model testing of the piles embedded in Nak-Dong river sand, located in