Numerical Pile Driving Analysis for Non-Uniform Piles

By Mahmoud Ghazavi,[1] S.Ali Ghoreishian Amiri [2]

[1]Associate Professor, Civil Engineering Department, K.N.Toosi University of Technology, Tehran, Iran. Tel. +98 21 88779623; Fax. +98 21 88779476; Email: ghazavi_ma@kntu.ac.ir

[2]Graduate student, Civil Engineering Department, K.N.Toosi University of Technology, Tehran, Iran. Tel. +989111135424 ; Email: sa_ghoreishian@yahoo.com

ABSTRACT: This paper focuses on the effect of pile shape in the penetration of pile and magnitude of stress in pile body. For this purpose, concrete tapered piles of the same volume and length is considered. All piles have conic shape with different slopes along the shaft. In all analyses, the hammer impact is modeled using a single function which obtains from current literatures. The subsoil is assumed as normally consolidated clay. The soil is assumed to be saturated and undrained. Linear elastic behavior is assumed for the pile whereas the Mohr-Coloumb failure criterion is considered for clay. Interface elements are used to allow the slip between the pile and the soil. To ensure the correctness of the constructed numerical pile driving models, the results obtained from this proposed model is compared with numerical data obtained from an available sophisticated analysis. Parametric studies have been carried out to determine the influence of contributing factors such as tapered angle and soil stratification on pile driving phenomenon. The effect of taper angle on permanent pile penetration and driving stresses will be presented.

KEYWORDS: non-uniform piles; pile driving; finite element method; set; driving stress; undrained condition; normally consolidated clay

1. INTRODUCTION

The bearing capacity of deep foundation is a major task in foundation design. To this aim, an appropriate modification of the pile geometry may be chosen. Recent research work carried out on tapered piles subjected to various loading has shown that that such piles may be superior to prismatic piles of the same volume and length (Ghazavi, 2000; Ghazavi, 2003; Ghazavi and Ahmadi Bidgoli, 2002; Ghazavi, et al., Hashemolhosseini, 2003; Ghazavi and Etaati, 2001; Ghazavi et al., 1996; Ghazavi et al., 1997a; Ghazavi et al., 1997b).

2. NUMERICAL ANALYSIS

Finite element method is a powerful technique to examine various options in foundation design before the construction stage is started. For this purpose, the procedure uses an axisymmetric discreitization and takes into account the nonlinear behavior of the soil by Mohr-Coloumb model. Linear elastic elements are assumed for the concrete pile