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Numerical method Study of Single Pile Behavior under Lateral Loads in Saturated Clay Soil using FLAC 3D

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INTRODUCTION

There are several factors affecting the behavior and response of a pile under lateral loads. These factors can be divided into two main categories: geometrical factors (e.g. dimensions of the pile, soil, and mesh scheme) and material properties (e.g. shear modulus, bulk modulus, soil elasticity, soil density, and shear strength). Studying the effects and importance of these factors in the final response of the pile (i.e. ultimate forces and displacements) can help design engineers in optimization of their designs. Given the importance of the subject and the possibility of using numerical methods and computer technology to evaluate the behavior of piles, this research attempts to use finite difference numerical method and case study of single piles to analyze their behavior under lateral loads and determine the effects of different factors in their response. The software used in this study is FLAC 3D Version 3.00-261.

MODEL VALIDATION

The results of the model were compared with the results of experimental tests of a lateral loading of a tubular steel pipe pile [1]. Studying these results indicates a very good compatibility of response of the model and the experiments. Maximum tolerable force for the pile head, and moving ultimate displacement and moment distribution in the depth of the pile is matching very well with the measured response and even provides better response than using finite element numerical analysis. (Figure 1)

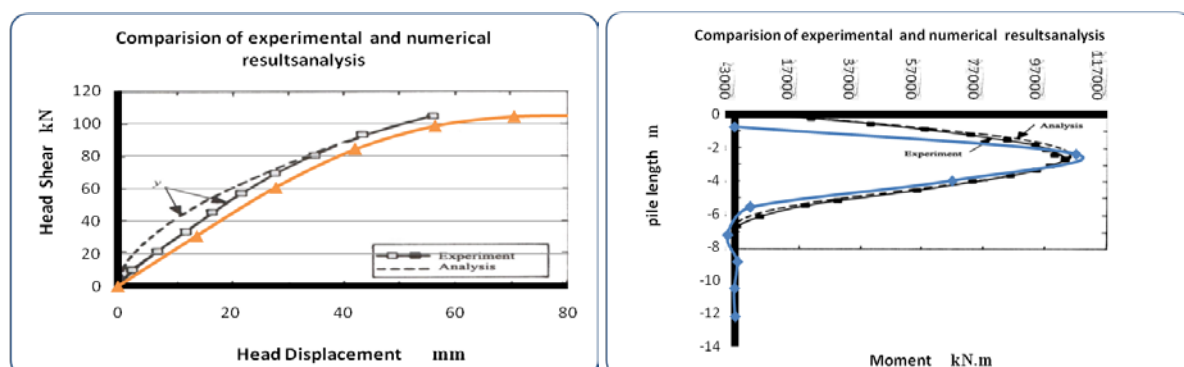


Fig. 1) Comparison of the results measured on the spot with the results obtained from numerical model in FLAC

EFFECTS OF VARIOUS SOIL PARAMETERS ON THE RESPONSE OF THE PILE

After validation of model, effective soil parameters were discussed. The objective was to separate the effective parameters on the behavior of piles under lateral loads in clay soil. Parameters divided to two categories of effective soil parameters and effective pile structure parameters. Parameters of the soil modulus, Poisson's ratio, density and adhesion of soil modulus from the first group, and the pile length and diameter from the second group were selected and the effects of these parameters on the amount of bearing capacity and the moment created distributed over the structure of the piles was separately investigated. For comparison, two samples are listed in this section.

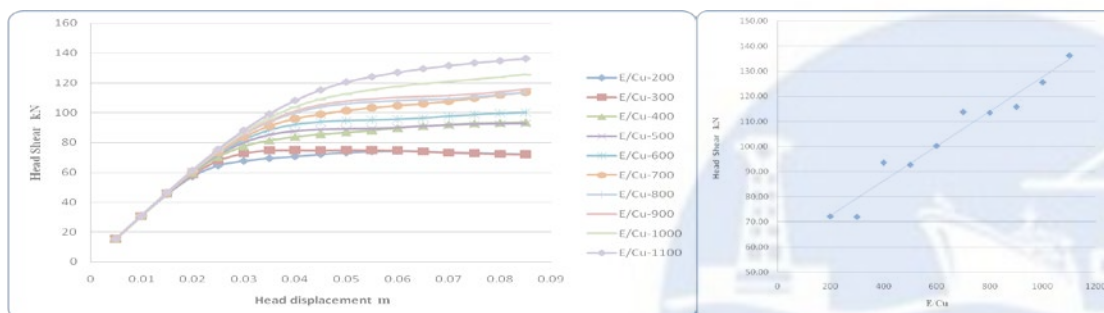


Fig. 2) Comparison of the effects of soil elastic modulus changes on the response of the pile obtained from FLAC

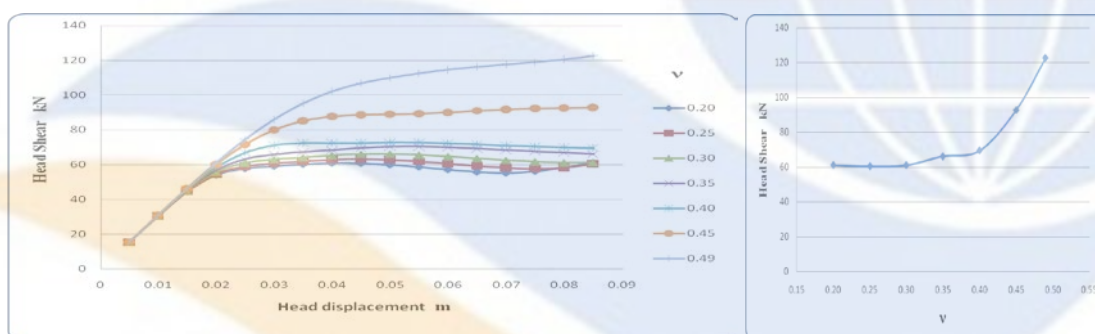


Fig. 3) Comparison of the effects of Poisson's ratio changes on the response of the pile obtained from FLAC

CONCLUSION

After investigating the discussed parameters, soil elastic modulus, soil adhesion, and geometrical dimensions of the structure of the pile are chosen as the most effective factors on the changes of the ultimate responses of the structure.

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