بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

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MONA MAGHRABY

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL ENGINEERING DEPARTMENT

BEARING CAPACITY OF DRIVEN OPEN ENDED PIPE PILES IN WEAK SOIL FORMATIONS

By
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B.Sc. Civil Eng. - 2015 – Al Shorouk Academy

A Thesis
Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Civil Engineering
Department of Structural Engineering

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بسم الله الرحمن الرحيم

"قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ"

صدق اللّه العظيم

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FACULTY OF ENGINEERING
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Thesis : Bearing Capacity of Driven Open Ended Pipe Piles in Weak Soil Formations

Degree : Master of science in civil engineering (Structural)

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Date: 14 / 10 / 2020

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Postgraduate Studies

Authorization stamp: The thesis is authorized at / / 2020

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STATEMENT

This thesis is submitted to Ain Shams University for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author at the Department of Structural Engineering, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis has been submitted for a degree or a qualification at any other University or Institution.

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ABSTRACT

Steel tube piles have been increasingly used as deep foundations for offshore structures or onshore structures in weak soil formations. These piles are usually open-ended and installed to their final level using suitable hammers or vibrators relying on the subsurface conditions. Meanwhile, soil plug (SP) forms inside the employed tube pile during driving or installation; moreover, it affects the bearing behavior and the total pile resistance. The forming of plug relies on different factors, e.g., pile thickness, diameter, length, and soil condition. The experimental tests have been performed on a single pile and also pile groups. All tube piles were tested using the well-graded sand collected from the Egyptian desert, and the sand was prepared at medium density (Dr=55%) using a raining technique in lap. Different parameters are considered: different pile thickness, different pile diameter, different pile length/diameter ratio (L/D), and soil condition. Also, a study of the influence of pile length/diameter ratio (L/D) and submerged state on group efficiency (η).

Additionally, single pile resistance has been studied using numerical simulations and analytical approaches and an assessment between the mentioned techniques and the experimental results. The model pile tests showed that the value of plug resistance in open-ended tube pile is typically in the order of 50% to 70% the ultimate load capacity of open-ended tube piles. And is influenced by pile thickness, pile diameter, pile length, and submerged conditions. Simultaneously, the plugging influence of open-ended tube piles increased with increasing pile thickness and embedded pile length. But, the plugging influence decreased with increasing pile diameter.

The ultimate load capacity of open-ended tube piles increased with increasing the embedded pile length. It must be noted that the influence of pile length on the ultimate pile capacity is greater than the influence of pile diameter; this refers to the pile length has a significant effect on ultimate pile capacity. This is due to an increase in the influence of SP. The ultimate load carrying capacity for tube pile under dry conditions is almost more significant than those of submerged conditions. It must be noted that the influence of the submerged state decreases the ultimate pile capacity to equals from 50% to 60% of ultimate pile capacity in the dry state for the same pile diameter and pile length. This means that the submerged state has a significant effect on the ultimate group capacity. The ultimate group capacity is increased with increasing the pile embedded length, and the group efficiency (η) is decreased with increasing the pile embedded length. It may be due to an arching action effect of sandy soil on the piles.

Keywords: Steel tube pile, soil plug (SP), pile resistance, single pile, piles group.

SUMMARY

In this thesis, an experimental study is performed to evaluate the total pile capacity of driven open-ended tube pile, due to external friction, internal friction, and base resistance load resulting from the SP and thickness of the tube, based on the different pile thickness, different pile diameter, different pile length, and the submerged conditions. The primary study's objective is to investigate SP's influence inside the tube pile on the total pile capacity. The study will extend to cover the conduct of pile group; and the influence of the submerged conditions and pile length on the efficiency of a group of piles performed in sand soil. In this research, laboratory, analytical studies will be performed, and the numerical model is generated using FE analysis program ABAQUS 6.17. An assessment between experimental test results and the numerical results was already employed. Moreover, the outcomes of the experimental program are presented in the form of figures and tables.

The thesis consists of six chapters

Chapter (1) presents a general primer into the problem, its objectives, and the thesis's organization.

Chapter (2) reviews the available theoretical and experimental methods, describing the SP's conduct and its effect on the total pile capacity of open-ended tube pile.

Chapter (3) reports a complete characterization of a testing model, showing the details of the used apparatus, measurement technique, and preparation of a soil model. This chapter includes the outcomes of the used soil identification tests, either physical or mechanical.

Chapter (4) analyzes and discusses the results obtained from laboratory tests for sand soil after introducing the laboratory testing program. The influence of many parameters such as pile thickness, pile diameter, pile length, and the submerged conditions on pile capacity and the conduct of a tube piles group.

Chapter (5) simulates setup and verification, this chapter gives out with numerical analysis. In this chapter, the three-dimensional 3D FE models are presented, and their implementation in such a study is elaborated. Then, the accuracy of 3D FE models is checked and verified.

Chapter (6) summary of this work, conclusions of this research, and recommendations for future research on this topic are presented.