شبكة المعلومات الجامعية

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بسم الله الرحمن الرحيم

جامعة عين شمس

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HANAA ALY

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL ENGINEERING DEPARTMENT

PERFORMANCE OF PILED RAFT IN CLAY

Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

In

CIVIL ENGINEERING

STRUCTURAL ENGINEERING DEPARTMENT

By

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Degree : Master of science in civil engineering (Structural)

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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

The piled raft foundation is one of the most economic foundation systems for many cases especially for high rise building supported on stiff clay when this layer is deeply extended. In the piled raft system, the position and geometry of the piles are optimized in order to minimize settlement, differential settlements and consequently the sectional forces in the raft. North Delta characterized by normally consolidated soft clay with a relatively low stiffness extended down to about 50 m below ground surface in some cases. The purpose of this study is to investigate the behavior of piled raft as a foundation system for Frankfurt over-consolidated clay using a well-monitored "Messeturm" building. The foundation system was very complex; moreover, the design of the piled raft system will be investigated. The application of piled raft system in soft clay will be also investigated in terms of settlement, differential settlement and the negative skin friction along the piles to be compared with the traditional raft on piles. The numerical program used in analysis is Plaxis 3D finite element software using two constitutive laws: Mohr-Coulomb and Hardening soil model. The results show the suitability of Hardening soil model more than Mohr-Coulomb model. It was concluded that using piled raft solution in soft clay can be a smart solution to achieve serviceability and stability requirements by applying limited number of floating piles. The study predicts the negative skin friction along the floating piles and also presents an engineering evaluation for piled raft foundation technique. Finally, it is concluded that traditional piled deep foundation is not the optimum solution for many cases in soft clay.

Keywords: Piled raft, Frankfurt, Port said, Soft clay.

SUMMARY

The piled raft system is one of the most important systems in the last decades. The purpose of this research is to check the application of piled raft system in stiff clay as well as in soft clay after introducing the available methods for analysis of piled raft system for different case studies.

The methodology of analysis is the finite element method using Plaxis 3D software implementing Mohr-Coulomb and Hardening Soil constitutive models. The numerical model has been calibrated using a well monitored “Messeturm” high rise building in Germany supported by Frankfurt over-consolidated clay. A study of the application of piled raft in soft clay compared with traditional piled raft system in view of settlement, differential settlement, piles type and capacity and the engineering value will be discussed.

The thesis consists of six chapters:

Chapter (1) is an introduction to this research; it discusses the importance, the scope and the main objectives of the research.

Chapter (2) is a literature review which briefly summarizes the different methods of analysis piled raft system; also, it presents the previous monitored piled raft systems in different soil conditions.

Chapter (3) presents a brief discussion about finite element method and the different constitutive laws to simulate the different elements of the piled raft foundations system.

Chapter (4) presents the verification of the numerical modeling using two cases: conceptual simplified case and “Messeturm” high rise building in Frankfurt, Germany.

Chapter (5) discusses a characterization of North Delta clay; with a static pile load test in Port Said soft clay. It presents also application of piled raft system compared with the traditional raft on piles for a water treatment tank exist east of Al Tafreah-Port Said.

Chapter (6) discusses the conclusions conducted from this research and the recommendations for the future studies.

TABLE OF CONTENTS

LIST OF FIGURES