AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF STRUCTURAL ENGINEERING

INVESTIGATION OF THE PERFORMANCE OF SKIRTED FOUNDATIONS IN COHESIVE SOIL

THESIS

Submitted in partial fulfillment of the requirements
for Degree of Master of Science in Civil Engineering
Structural Engineering Department
(Geotechnical Engineering)

BY

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AIN SHAMS UNIVERSITY
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Thesis : Investigation of the performance of Skirted foundation in Cohesive soil

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, from June 2015 to October 2018.

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

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Hesham Gamal

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Ain Shams University
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Abstract of the M.Sc. Thesis submitted by:

Hesham Mohamed Gamal Ahmed

Title of Thesis:

Investigation of the Performance of Skirted Foundations in Cohesive Soil

Supervisors: **Prof. Dr. Yasser M. El-Mossallamy**

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Abstract

One predominant challenge faces the geotechnical engineers is to evaluate of the behavior of shallow foundations subjected to inclined and eccentric loads (i.e. horizontal loads, H, and moments, M, in addition to central vertical loads, V). This sort of shallow foundations practice is encountered in various applications, especially the offshore structures. The foundations of offshore structures are often subjected to substantial horizontal loads and moments resulting from the frequent environmental loads acting laterally on the superstructure, e.g. wind and wave forces consequent to a storm. In some cases, however, the subsoil below the sea bed can be of highly compressive cohesive soils, e.g. marine deposits. In such conditions, the soil load carrying capacity may be insufficient to resist the imposed inclined and eccentric loads, besides considerable foundation settlements may occur. In such a case, therefore, in last a few pervious decades a new technique was developed in offshore engineering, called skirted foundation.

Skirted foundations have been widely used for offshore structures as a temporary foundation system to fix the jacket structures and tension leg platforms until constructing the permanent deep foundations. Generally, a skirted foundation is a conventional surface footing rounded, however, with circumferential vertical skirts. Sometimes, additional internal skirts are used. The skirts penetrate the soil vertically creating a plug of confined soil beneath the footing and, thus, the soil lateral movement is constrained. Due to the encountered fully constrained soil plug beneath the footing, the majority of vertical loads are transferred to the depth of the skirt tip. Accordingly, the soil bearing capacity is markedly increased. Furthermore, the increased drainage path length (i.e. from beneath the footing to the skirt tip level and then to the free surface) will lead to longer times for dissipating the excess pore water pressure below

the footing compared with a conventionally embedded shallow foundation. Therefore, full stability analysis required for analyzing its behaviour in short and long term.

Two different case studies are applied to represent skirted foundations under short time loading (Undrained behaviour of soil) and on long term loading. The first study case includes field test results of mini models for skirted foundations rested in clay soil at the Aalborg University clay test site, Denmark and other case includes laboratory tests of soft clay soil. Numerical analyses using two dimensional finite element method applying different constitutive models are used to investigate the performance of skirted foundation under different loading conditions. Parametric study was conducted to investigate the effect of some parameters on the bearing capacity and consolidation response of skirted foundations such as: embedment depth, skirt roughness and load inclination. The results confirmed that the bearing capacity of skirted foundations under centric or eccentric inclined loads increased magnificently with increasing the embedment depth and skirt roughness. Moreover, these also contribute to a decrease of settlement values and accelerate the consolidation rate of skirted foundations.

Keywords: Skirted foundation; Cohesive Soil; Finite Element Analysis Constitutive Models; Undrained Bearing capacity; Consolidation; Parametric Study.

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