DESIGN VERIFICATION ON BORED PILE WITHIN KENNY HILL FORMATION VIA STATIC LOAD TEST

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A thesis submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Engineering (Civil-Geotechnics)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

JUNE 2010

For my beloved family members

And all my friends

You're my everything for me

AKNOWLEDGEMENT

I would like to phrase my heartfelt to my project supervisor, Prof. Dr. Khairul Anuar Kassim for guidance and supports that had been given throughout of the duration of this project.

Besides, I wish to express my sincere appreciation to all MegaConsult Sdn. Bhd staffs especially Ir. Mohd Taha Abd. Wahab, Ir. Razali Ahmad, Ir. Farhan and Nurulhusna Mohd Hussin for encouragement guidance, critics during preparing this thesis.

Last but not least, I would like to thanks to my beloved parents, brother and sisters, friends especially Dzul Azmi Abu Samah, Norshida Mhd. Ali Osman, Siti Norazela Hassan and Azhani Zukri for their support throughout my studies.

ABSTRACT

Due to variation in soil layers, it is not easy for engineer to be assured that theoretical design of piles comply with the actual site condition. Thus, every design of piled foundations carries its own uncertainty and risk. This study evaluates the applicability of six methods to predict the ultimate bearing capacity of bored pile by static load test at site. Analyses and evaluation were conducted on six bored piles of different sizes and length. The methods are Chin-Kondner's Method, Brinch Hansen's Method, DeBeer's Method, Butler & Hoy's Method, Fuller & Hoy's and Decourt's Method. The pile capacities determined using the different methods were compared with the theoretical method such as semi-empirical method and simplified soil mechanic method within Kenny Hill formation. Results of the analyses show that the best performing method is DeBeer's Method. Fuller & Hoys's and Butler & Hoy's methods is the recommended method for bored pile design practice as it is consistent in predicting the bored pile capability. Chin-Kondner's method is the over predicted most than the others interpretation methods.

ABSTRAK

Berikutan terdapat perbezaan lapisan tanah, adalah rumit bagi seseorang jurutera untuk memastikan rekaan cerucuk secara teorinya adalah sama dengan keadaan di tapak. Oleh itu, setiap rekaan asas cerucuk mempunyai ketidakpastian dan risiko yang tersendiri. Kajian ini dijalankan bagi menilai kesesuaian enam jenis kaedah untuk menentukan keupayaan muktamad cerucuk gerek melalui ujian beban static di tapak. Analisis dan penilaian telah dijalankan ke atas enam cerucuk gerek yang berlainan saiz dan panjang. Kaedah-kaedah yang digunakan adalah Chin-Kondner's Method, Brinch Hansen's Method, DeBeer's Method, Butler & Hoy's Method, Fuller & Hoy's and Decourt's Method. Nilai yang telah ditentukan oleh kaedah-kaedah yang dinyatakan telah dibuat perbandingan dengan beban maksimum yang telah diukur oleh kaedah teori seperti kaedah separa empirical dan juga mekanik tanah terubahsuai di dalam formasi Kenny Hill. Keputusan daripada analisis menunjukkan kaedah DeBeer's merupakan kaedah terbaik berbanding dengan kaedah yang lain. Kaedah Fuller & Hoy's dan kaedah Butler & Hoy merupakan kaedah yang dicadangkan bagi rekabentuk cerucuk gerek ia agak kerana konsistan di dalam meramalkan keupayaan cerucuk gerek. Kaedah Chin-Kondner pula merupakan kaedah yang member nilai tertinggi berbanding kaedah-kaedah yang lain.

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Q_{ag}	-	Geotechnical capacity (have not included down-drag force, if any)
Q_{su}	-	Ultimate shaft capacity
i	-	Number of soil layers
Q_{bu}	-	Ultimate base capacity
F_s	-	Unit shaft resistance for each layer of embedded soil
F_b	-	Unit base resistance for the bearing layer of soil
A_s	-	Pile shaft area
A_b	-	Pile base area
F_g	-	Global Factor of Safety for Total Resistance
K_{su}	-	Ultimate shaft resistance factor
K_{bu}	-	Ultimate base resistance factor
SPT'N	-	Standard Penetration Tests blow counts (blows/300mm)
$\propto$	-	Adhesion factor
S_u	-	Undrained shear strength (kPa)
$K_{s\sigma}$	-	Effective Stress Shaft Resistance Factor
σ_v	-	Vertical Effective Stress (kPa)
ϕ	-	Effective Angle of Friction (degree) of fined grained soils
N_c	-	Bearing capacity factor
β	-	Shaft resistance factor for coarse grained soils
q_{uc}	-	Unconfined compressive strength of intact rock
ψ	-	Indicator of rocket roughness
p_a	-	Atmospheric pressure for normalization

Q_u - Capacity or ultimate load

C_1 - Slope of the straight line

C_2 - Intercept of the straight line

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CHAPTER 1

INRODUCTION

1.1 Background

Pile foundations are the part of a heavy structure used to carry and transfer its load to the bearing ground located at some depth below ground surface. Depending upon various factors like nature of substrata, depth of ground water table, depth of stronger stratum, type and quantum of load to be supported etc., piles are designed. Pile testing is considered a fundamental part of pile foundation design. It is one of the most effective means of dealing with uncertainties that inevitably arise during the design and construction of piles.

There is much different type of pile in use today, such as timber piles, concrete piles, steel piles, composite piles and others. The choice of pile type for a particular job depends upon the combination of all various soil conditions and the magnitude of the applied load; for example precast concrete piles (spun pile) are usually used in water structure such as jetty and breakwater.

Current practice of pile design is based on the static analysis for example Mayerholf Method, Vesic Method and Coyle & Castello methods. Due to the uncertainties associated the pile design, field tests (pile load test) are usually conducted to verify the designs load and to evaluate the actual response of the pile under loading. Static pile load test are verification tool for pile design and they cannot be a substitute for the engineering analysis of the pile behaviours.

Results of these pile load tests have been compared with the load carrying capacity of the pile computed by empirical relations proposed by different researchers. In addition six (6) different methods to interpret ultimate load from load / settlement relationship have been used with the purpose to select the method most suitable for existing conditions.

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1.2 Importance of Study

The precise prediction of maximum load carrying capacity of bored piles is a complex problem because it is function of a number of factors. These factors include method of boring, method of concreting, quality of concrete, expertise of the construction staff, the ground conditions etc. beside the pile geometry. The performance of pile load tests is, therefore, of paramount importance to establish the most economical design of piles especially where bored cast-in-situ piles are to be provided to support a structure.

1.3 Objectives of the study

The aim of this study is to identify the most appropriate interpretation methods to estimate the ultimate axial bearing capacity of bored pile. The objectives of the study are:

i. To determine the ultimate bearing capacity of bored piles from Soil Investigation test data result used semi-empirical method and simplified soil mechanics method.

ii. To predict the bearing capacity of bored pile by interpretation methods from actual result from pile load tests;

iii. To compare the result from semi-empirical method and simplified soil mechanics method with interpretation methods from the actual result of test pile

1.4 Scope and limitation of the study

This study is only considering the carrying capacity of bored pile of different size and length. Other pile types such as spun pile and steel pipe were not covered in the analysis. Two (2) sets of data were acquired from MegaConsult Sdn. Bhd. Their testing was conducted in Kuala Lumpur area within Kenny Hill Formation.Data acquired includes soil investigation reports and pile load tests reports.

This study focused on the applicability of proposed methods to predict the ultimate axial compression load carrying capacity of bored pile. Data from soil investigation was used in static analysis while pile load tests data is essential in interpretation method. All of methods are described in detail in the literature review section of this report. The predicted capacity was compared with the actual carrying capacity of piles from pile tests on mentioned criteria. The method which ranked number according to mentioned criteria is considered as the most accurate method and is recommended for pile design practice.

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