NUMERICAL SIMULATION OF BEARING CAPACITY FOR RIGID FOOTING ON COHESIVE SOIL

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Especially dedicated to:

My parents

Yusof bin Abdullah & Esah@Azizah binti Ali

Who give motivation and loves...

My beloved supervisor, Dr. Nazri bin Ali

Who give the guidance with continuously in finishing this thesis...

All my friends

For their helping and loyalty of this friendship...

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ABSTRACT

Foundation is one of the main component structures in civil engineering construction. It is crucial to make sure that the load distribution on the soil is adequate to prevent soil failure.. Foundation transfers the loads from superstructure to substructure or soil. A foundation plays an important role as an interface between the load carrying components of a structure to the ground. Foundations can be classified into two categories. Those are shallow foundations and deep foundation. To make sure that the load distribution is sufficient, the size and type of foundation should be well determined. The increases size of footing which compared with the column supports gives and increased contact area between the footing and the soil. Besides that the increasing of friction angle will increase the value of bearing capacity factor. So, the increasing of bearing capacity factor will increase the ultimate bearing capacity and automatically increasing the value of allowable or safe loading to the footing. In this study have two methods to analysis the value of bearing capacity which is Terzaghi's equation and Meyerhof / Hansen's equation. Therefore, a computer programming is to be developed using Visual Basic 6.0 which is able to analyze and design the foundation or footing such as strip, square, circular and rectangular footing. Plaxis 2D will validate the computer programming to make sure the computer programming can be used. The comparison between both computer programming is discussed in this study. The computer programming is expected to reduce time and its nature is easy to use and understand.

ABSTRAK

Penapak adalah salah satu struktur komponen utama dalam pembinaan kejuruteraan awam. Ia adalah penting untuk memastikan bahawa pengagihan beban pada tanah adalah mencukupi untuk mencegah kegagalan tanah. Penapak memindahkan beban dari struktur untuk substruktur atau tanah. Asas memainkan peranan penting sebagai antara muka di antara beban dibawa komponen struktur ke tanah. Asas boleh diklasifikasikan kepada dua kategori. Kategori itu adalah asas cetek dan asas dalam. Untuk memastikan bahawa pengagihan beban yang mencukupi, saiz dan jenis asas perlu juga ditentukan. Saiz kenaikan kedudukan yang berbanding dengan ruang menyokong memberikan dan meningkatkan kawasan sentuhan antara asas dan tanah. Selain itu peningkatan sudut geseran akan meningkatkan nilai yang mengandungi faktor kapasiti. Jadi, peningkatan faktor keupayaan galas akan meningkatkan keupayaan galas muktamad dan secara automatik meningkatkan nilai beban dibenarkan atau selamat untuk kedudukan itu. Dalam kajian ini mempunyai dua kaedah untuk analisis nilai keupayaan galas iaitu persamaan Terzaghi dan persamaan Meyerhof / Hansen. Oleh itu, pengaturcaraan komputer akan dibangunkan dengan menggunakan Visual Basic 6.0 yang mampu untuk menganalisis dan mereka bentuk asas atau asas seperti jalur, persegi, kedudukan bulat dan segi empat tepat. Plaxis 2D akan mengesahkan pengaturcaraan komputer untuk memastikan pengaturcaraan komputer itu boleh digunakan. Perbandingan antara kedua-dua pengaturcaraan komputer dibincangkan dalam kajian ini. Pengaturcaraan komputer dijangka akan mengurangkan masa dan sifat adalah mudah untuk digunakan dan difahami.

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B	-	Width of footing
c	-	Cohesion of soil
Df	-	Depth of footing
F_{cd}, F_{qd}, $F_{\gamma d}$	-	Depth factor
F_{cs}, F_{qs}, $F_{\gamma s}$	-	Shape factor
F_{ci}, F_{qi}, $F_{\gamma i}$	-	Inclination factor
L	-	Length of footing
Nc, Nq, Nγ	-	Bearing capacity factor
q	-	Overburden at the base leveled footing
q_u	-	Ultimate bearing capacity
q_{nett}	-	Nett bearing capacity
q_{all}	-	Allowable bearing capacity
q_{safe}	-	Suitable or safe loading
ϕ	-	Friction angle
γ	-	Unit weight of soil

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CHAPTER 1

INTRODUCTION

1.1 Background of the study

The lowest part of a structure that transmits its weight to the underlying soil or rock is the foundation. Foundation transfers the loads from superstructure to substructure or soil. A foundation plays an important role as an interface between the load carrying components of a structure to the ground. Foundations can be classified into two categories. Those are shallow foundations and deep foundation. A shallow foundation is a type of foundation which transfers building loads to the earth very near the surface. The shallow foundation is rather than to a subsurface layer or a range of depths as does a deep foundation. Meanwhile a deep foundation is a type of foundation that is distinguished from shallow foundation by the depth that is embedded into the ground. The reasons use the deep foundations that are because very large design loads a poor soil at shallow depth or site constraints.

There are different terms used to describe different types of deep foundations including piles, drilled shafts, caissons and piers. The function foundations are if the soil of sufficient bearing capacity lies immediately below the structure then the load

can be spread by footimg. Footing are range from isolated pads supporting individual columns through strips supporting walls or closely space columns to raft footing supporting the whole structure. However, if the soil has insufficient bearing capacity then it is necessary to use deep foundations such as piles to transmit the load to deeper firmer strata.

The increases size of footing which compared with the column supports gives and increased contact area between the footing and the soil. The increased area serves to reduce pressure on the soil to an allowable amount, thereby preventing excessive settlement or bearing failure of the foundation. The footing are has four different type of shape. Those are strip footing, square footing, circular footing and rectangular footing. This is when use Terzaghi's equation. Meyerhof / Hansen's method only has a general equation for bearing capacity. Figure 1.1 show the example of individual footing.

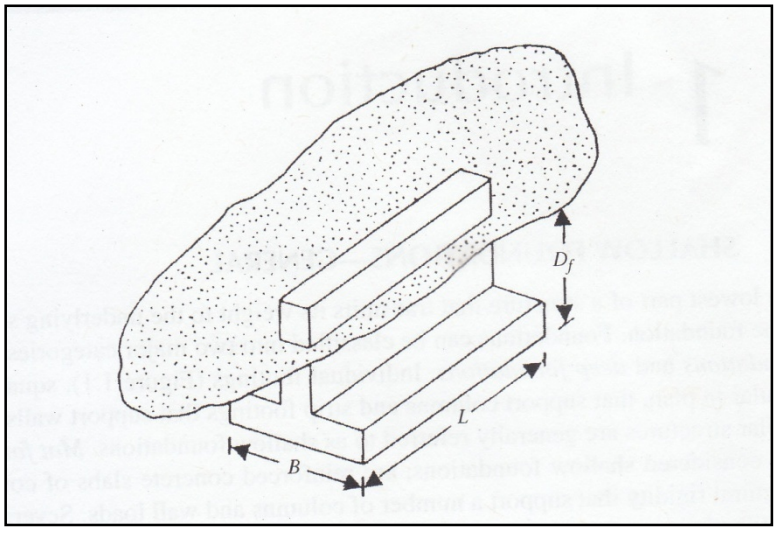

Figure 1.1 Individual footing

1.2 Statement of the Problem

There are two methods to calculate the ultimate bearing capacity. Those are using Terzaghi's equation and Meyerhof / Hansen's equation. Terzaghi's equation has four different equations for four different shapes of footing that are strip footing, square footing, circular footing and rectangular footing and for Meyerhof / Hansen's only have a general equation to find the ultimate bearing capacity.

The ultimate bearing capacity, q_u is the maximum bearing pressure that the soil can withstand. Besides that, the ultimate bearing capacity also is the load per unit area that will cause a shear failure of the soil immediately below foundation. The values are established from the principles of soil mechanics on the basics of load tests and other experimental determinations. The factors that influencing the bearing capacity are unit weight of the soil, shear strength of soil, soil deformation, characteristic of the soil, size of the footing, shape of the footing, depth of footing and the ground water table. Nowadays many design process of the footing are using the computer programming to make the design easy and faster with all factor needed.

1.3 Objectives of the Study

The aims of this study are:-

a) To determine the value of the ultimate bearing capacity using computer programming.
b) To analyzed the appropriate design with all variables involve using computer programming
c) To verify the design calculation using Visual Basic with Plaxis.

1.4 Scope of the Study

The study is to calculate or to determine the size of footing design by considering the type of soil that is cohesive soil, shape, depth, and inclination factor of the footing and the ultimate bearing capacity. The analysis and the result obtained by using computer programming that are Visual Basic with Plaxis and the parameters required will obtained from the case study.

1.5 Significance of study

The significance of study about the bearing capacity of rigid footing on cohesive soil using the computer programming are want to know or to calculate the result more quickly and easy. It is because before this we calculate or determine the design of the footing using manual. So, it will take much time to finish it.

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