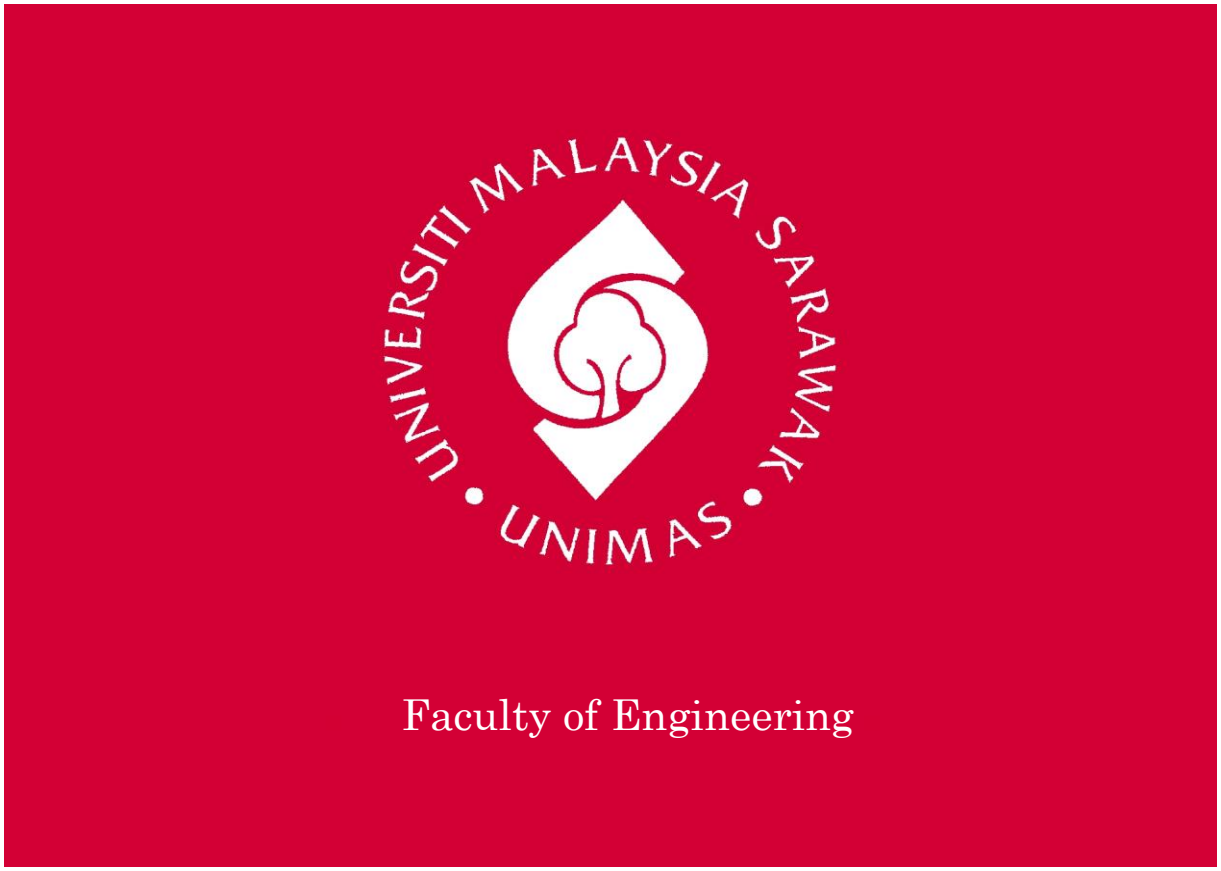

PARAMETRIC STUDY OF RETAINING WALL USING PLAXIS

Maqueline Cyndi Anak Nap

Bachelor of Engineering with Honours
(Civil Engineering)
2010

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PARAMETRIC STUDY OF RETAINING WALL USING PLAXIS

MAQUELINE CYNDI ANAK NAP

This report is submitted to

Faculty of Engineering, Universiti Malaysia Sarawak (UNIMAS)

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…To my love and special ones…

Mummy and Daddy – thanks for your never end care, support, understanding and concern. I will always love you

Sisters – thanks for your support and attention

Jimmy – thanks for your love, understanding and for always be by my side

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All of you inspire my effort and achievement

Even thousand words could not express my gratitude

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ABSTRAK

Tembok penahan adalah sejenis struktur kejuruteraan generik yang digunakan untuk menahan daya ufuk bumi yang disebabkan oleh permukaan tanah atau kambusnya yang tegak atau hampir tegak. Tanah di belakang tembok mungkin sama ada benteng semula jadi atau tanah yang dikambus balik yang diletakkan bersebelahan dengan tembok penahan. Tembok-tembok penahan harus direka dengan berhati-hati agar mampu menahan daya ufuk bumi yang cenderung menyebabkan kegagalan kepada struktur tersebut. Jenis tembok penahan yang sesuai digunakan adalah bergantung kepada keadaan sebenar di tapak atau keadaan tanah, interaksi antara jisim tanah dan tembok penahan, magnitud, dan taburan tekanan tanah sisi. Dalam kajian ini, analisis dan kajian parameter untuk tembok cerucuk keping dijalankan dengan menggunakan perisian elemen terhad, PLAXIS V8. Satu model elemen terhad telah dibuat untuk menganalisa tembok cerucuk keping dengan nilai yang berbeza bagi setiap parameter seperti kepaduan tanah, sudut geseran dalam, panjang tembok cerucuk keping, kedalaman korekan tanah dan beban tambahan. Perbezaan nilai parameter itu boleh menjejaskan momen lentur dan sesaran tembok cerucuk keping seperti yang disampaikan dan dibincangkan dalam kajian ini.

ABSTRACT

Retaining wall is a type of generic engineering structure that is employed to restrain lateral forces exerted by a vertical-faced or near-vertical-faced mass of earth. The earth behind the wall may be either the natural embankment or the backfill material placed adjacent to the retaining wall. Retaining walls must be design carefully to withstand lateral pressure of the earth, which tends to cause a failure of the structure. A suitable type of retaining wall to be used depends on the site or soil condition, reciprocal action between soil mass and the retaining wall, magnitude, and the distribution of the lateral earth pressure. In this study, the analysis and the parametric study of a sheet pile wall is done by using finite element software, PLAXIS V8. A finite element model has been developed to analyze the behaviour of sheet pile wall with different value of each parameter such as soil cohesion, angle of internal friction, length of the sheet pile wall, depth of excavation and surcharge load. The different value of the parameter may affect the bending moment and the displacement of the sheet pile wall which are presented and discussed in this study.

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LIST OF SYMBOLS

c	-	Cohesion
D	-	Depth of excavation
E	-	Young's modulus
H	-	Height
K	-	Lateral earth pressure coefficient
L	-	Length of sheet pile wall
q	-	Surcharge load
u	-	Pore water pressure
V	-	Total volume of soil
v	-	Poisson's ratio
W	-	Total weight of soil
z	-	Depth
OCR	-	Overconsolidation ratio
PI	-	Plasticity index
ϕ	-	Angle of internal friction
γ	-	Unit weight
ψ	-	Dilatancy angle
$FS_{(bearing\ capacity)}$	-	Factor of safety against bearing capacity failures
F_d	-	Horizontal driving force
$FS_{(overturning)}$	-	Factor of safety against overturning
F_R	-	Horizontal resisting force

$FS_{(sliding)}$	-	Factor of safety against sliding
K_o	-	Coefficient of earth pressure at rest
K_a	-	Coefficient of earth pressure at active state
K_p	-	Coefficient of earth pressure at passive state
M_O	-	Moment causing overturning
M_R	-	Moment resisting overturning
P_a	-	Total active earth pressure force
P_p	-	Total passive earth pressure force
q_{max}	-	Maximum contact pressure
q_u	-	Ultimate bearing capacity
W_s	-	Weight of soil solids
W_w	-	Weight of water
σ'_a	-	Active earth pressure
σ'_h	-	Horizontal effective stress
σ'_p	-	Passive earth pressure
σ'_v	-	Vertical effective stress
γ_w	-	Unit weight of water
σ'	-	Effective stress

CHAPTER I

INTRODUCTION

1.1 General

Infrastructure development in Malaysia has grown up as the population increases and development becomes a priority. With the blooming development on hill-sites, slope failures can be seen especially during raining seasons or after heavy prolong downpours. Slope failures not only will cause economic loss to the public but also may result in loss of life. Effective remedial works can then be designed and carried out. In selecting the most suitable remedial measure, it must be able to rectify the problem and can satisfy other constraints such as the site condition, constructability, cost and time.

Various remedial measures can be used for a failed slope. Amongst the various slope repair measures, retaining structures measure is generally more suitable when there are certain site constraints in particular when the available space is limited.

Retaining wall, an earth retaining structure is one of the important structures widely used in many constructions in Malaysia, in areas that commonly involve in cutting or backfilling slopes. Retaining walls are structures that support soils at

slopes of a few steeper than their angle of repose. These slopes may be capable of self-support, but in other instances lateral-retaining structures will be required to provide adequate support to the slope.

If adequate space exists, consideration of slope can be taken, whereas a retaining wall is required if adequate space is not available. Maximum slope steepness is dictated by the quality of fill soil available and whether or not the slope will be protected with riprap to eliminate the need for mowing and other maintenance.

To design retaining walls properly, an engineer must know the basic parameters (the unit weight, angle of internal friction, and cohesion) of the soil retained behind the wall and the soil below the based slab. The most important consideration in proper design and installation of retaining walls is that the retained material is attempting to move forward and downslope due to gravity. Lateral earth pressures are typically smallest at the top of the wall and increase toward the bottom. Earth pressures will push the wall forward or overturn it if not properly addressed. Also, any groundwater behind the wall that is not dissipated by a drainage system causes an additional horizontal hydrostatic pressure on the wall. Knowing the properties of the soil behind the wall enables the engineer to determine the lateral pressure distribution that has to be design for.

1.2 Problem Statement

The designs of retaining wall and construction methods which involve cut and fill as well as compaction, contribute significantly to the development of lateral earth pressure and its distribution. Therefore, appropriate design analysis is of great importance to be conducted. Before this time, there are few fundamental theories and formulas or rules by Coulomb (1776), Rankine (1857), Terzaghi and Peck (1967), and Casagrande (1973). All these theories and formulas are until now being used to analyze and designing the retaining wall. The earlier researches have recognized an importance for consistent understanding and application for retaining wall analysis for construction and remediation projects. These analyses are generally carried out at the beginning of a project, and sometimes throughout the life of a project during planning, design, construction, maintenance and rehabilitation.

Design of retaining wall has traditionally been carrying out using simplified method of analysis such as Limit Equilibrium Method and empirical approaches. All of these methods are based on simplified analysis. Thus, they cannot provide the engineer with all the desired design information and only provide very limited indications of soil movements.

The introduction of numerical or finite element software has resulted in considerable advances in the analysis and design of retaining structures. Therefore, it is of great encouragement to study and understand the use of this software in solving practical problem of retaining wall. The water table is assumed to be at considerable depth below the bottom of the wall. Therefore, its effect could be neglected.

1.3 Objective of Study

In this study, the objectives are including:

a) To understand the types of retaining wall, their stability and failure that may occurs to the structure.

b) To familiar with geotechnical engineering software, PLAXIS in solving geotechnical problems.

c) To use geotechnical engineering software, PLAXIS to simulate and analyze the behavior of retaining wall structure.

d) To solve a parametric study of retaining wall using finite element software, PLAXIS.

1.4 Scope of Study

The scope of this research is to study and understand the behavior of retaining wall structure and the application of finite element method in solving retaining wall problem. The analysis done is based on research and reports obtained, from publish literature and also from relevant party and authority.

The main focus of this study will be on the use of PLAXIS software to do the analysis of the retaining wall. The effect of the properties of soil and other parameters such as length of retaining wall, depth of excavation and surcharge load to the retaining wall is also taking into account.