INFLUENCE OF SUCTION INDUCED BY GRASS ROOT

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To My Beloved Mother, Hjh. Norati Binti Hj. Narib,

Family & Friends

In Memory of Hj. Ya'acob Bin Hj. Awang

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ABSTRACT

Slope failures problems nowadays are often receive some attention from various parties, especially from the local authority. Although many studies have been conducted to improve slope failures, most studies often ignore the influence of matric suction of vegetation or plants. The conservative solution to prevent the slope failure is by planting grass at the slope. Grass can be classified in many different types and appearance, but for this project, original grass at study area which is known as Cow grass will be used as a study to determine the matric suction due to grass water uptake. The scope of this study will only include grasses and residual soil within the location in the Universiti Teknologi Malaysia (UTM) campus. Any kind of tree would not be involved in this study. Verification of the simulation results for this study will be carried out by conducting measurements at different level of depth of soil to see the pattern of the matric suction. The factor of safety of the soil also has been considered by using parameters data from laboratory testing. The percentage comparison between saturated soil and soil that originally covered by grass is about 64.7% difference. It has shown that vegetation contributes more stability to slope analysis.

ABSTRAK

Masalah kegagalan cerun pada masa kini sering mendapat perhatian dari pelbagai pihak terutama daripada pihak berkuasa tempatan. Walaupun banyak kajian telah dijalankan untuk memperbaiki kegagalan cerun, kebanyakan kajian seringkali mengabaikan pengaruh sedutan matrik daripada tumbuhan dan tanaman. Penyelesaian secara konservatif untuk mengelakkan kegagalan cerun adalah dengan menanam rumput di cerun. Rumput boleh diklasifikasikan dalam rupa bentuk dan jenis yang berbeza tetapi untuk projek ini, rumput asal di kawasan kajian yang dikenali sebagai "Cow grass" akan digunakan bagi menentukan kadar sedutan matrik dengan kehadiran rumput sebagai agen pengambilan air. Skop kajian ini hanya merangkumi rumput dan tanah baki dalam lokasi Universiti Teknologi Malaysia (UTM). Sebarang jenis pokok tidak akan terlibat dalam kajian ini. Pengesahan keputusan simulasi untuk kajian ini akan dilakukan mengikut kedalaman tanah yang berbeza untuk mendapatkan corak sedutan matrik. Faktor keselamatan tanah juga telah diambil kira dengan menggunakan parameter data hasil dari ujian makmal. Perbezaan peratusan perbandingan antara tanah tepu dan tanah asal yang diliputi rumput adalah kira-kira 64.7%. Ini menunjukkan bahawa tumbuh-tumbuhan menyumbang lebih kepada kestabilan cerun.

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LIST OF SYMBOLS

□$_T$	-	Total Suction
u_a	-	Pore-Air Pressure
u_w	-	Pore-Water Pressure
π	-	Osmotic Suction
θ	-	Volumetric Water Content
ω	-	Gravimetric Water Content
G_s	-	Specific Gravity Of Soil Solids
e	-	Void Ratio
z_{max}	-	Depth At Maximum
n	-	Porosity
k_{sat}	-	Permeability
c’	-	Effective Cohesion
ϕ’	-	Effective Friction Angle
ϕ^b	-	Unsaturated Friction Angle
W	-	The Total Weight Of A Slice (k*n*)
N	-	The Total Normal Force On The Base Of The Slice (k*n*)
S_m	-	The Shear Force Mobilized On The Base Of Each Slice (*kn*)
O	-	Centre Of Rotation
x	-	Horizontal Distance From The Centreline Of Each Slice To The Centre Of Rotation
l	-	Length Of The Each Slice (*m*)
b	-	Width Of The Each Slice (*m*)

h	-	Vertical Distance From The Centre Of The Base Of Each Slice To The Uppermost Line In The Geometry (*m*)
R	-	Radius For A Circular Slip Surface (*m*)
β	-	Angle Between The Tangent To The Centre Of The Base Of Each Slice And The Horizontal (*degrees*)
θ	-	Angle Between The Slip Surface And A Centre About Which It Rotates (d*egrees*)
τ	-	Shear Strength Of Unsaturated Soil
m	-	Length in Meter
kn	-	Kilo newton

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The rapid development makes the environment more polluted with various threats. Most development today involves a hilly area. The higher the area of development, the higher the value it will be sales. There are some developers sometimes forget about the environment that cause a variety of environmental degradation effects of the development. Cutting down of trees (and plants) that often occurs in hilly areas will cause landslides. Any construction work in the area will produce man-made slopes that require rigorous control. Once the slope or natural landscape has been altered, it would encourage to the erosion which can remove the valuable topsoil, damage property and pollute environment (i.e. water supplies).

Slopes can be categorized as unstable slopes. This instability can cause ground movement to the downward known as slope failure. Slope failures can cause in property damage and loss of life. The risk area that has to become landslide must be maintained with the appropriate slope stabilization so that it is safe. The cost and effectiveness in the process of stabilizing slope should be taken in to account to implement the method of strengthening the slope.

There are various methods for the slope stabilization nowadays that has been used widely. One of the popular method is by using vegetation. Vegetation can be classified as multifarious neutral cultivar. One of the popular vegetation that commonly use is grass. Grass can be classified as a neutral prevention for slope failure.

Planting grass is not only for slope stability, but can also use for landscaping to reduce the rate of soil erosion due to heavy rains or flooding. Soil erosion can be divided into natural erosion and accelerated erosion. Natural or geological erosion and formation of soil act naturally and occurs slowly involving the entire surface of the earth (the surface thickness remains fairly constant over time). Accelerated erosion occur when there is interference (disturbance) or alteration to the landscape caused by flood, earthquake, or construction activities.

Vegetation increases the strength of the soil by reinforcement from fibrous roots and anchoring from tap roots, thereby contributing to its stability (Morro et.al, 2007). Evapotranspiration also gives rise to an increase in the effective soil cohesion due to soil suction, and the reinforcement effect of the root matrix further enhances the effective soil cohesion (Freer, 1991). According to Ishak (2014), vegetation prevents collapse by reducing water pressure (increasing suction through water uptake) due to suction produced by vegetation and acts to stabilize the slopes by increasing effective stress, thus leading to an increase in soil shear strength. A general review from previous researchers stated that the effect of vegetation in slope stability can improve the situation in terms of the factor of safety. The conventional methods that has been used and chosen widely is a method of slices which is based on the concept of limit equilibrium.

1.2 Problem Statement

The incident of landslides, soil erosion, etc. nowadays are all can be caused by man-made or natural. Sometimes it might be happened due to the lack of awareness of the community to the surrounding environment. They are too busy with their work until did not realize that the dangerous might be happened with various threats in terms of lives or property damages. It can also effect in term of social, economic and political to national development. The increasing soil moisture or pore water pressure can be seen as the main contributing factor for decreasing soil shear strength thus leading to the weakening of the slope stability, resulting in factor of safety reduction (Ishak, 2014).

The previous study from other researchers had mentioned that grass can prevent from soil erosion due to the occurrence of flood and heavy rain. Type and vegetation coverage indirectly enhance the water movement from soil to the atmosphere and directly enhance slope shear strength and ultimately influence the stability of the slope (Normaniza and Barakbah, 2006). Greenwood et.al (2004) also mentioned that appropriate properly maintained vegetation can have the same significant influence to help provide additional stability to soil slopes. Slope failure usually occurred directly after or during the rainfall. The only way to make the things from getting worst is by preventing the soil erosion at slope or flat area. The use of vegetation for preventing and controlling erosion to stabilize slopes has been defined as the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both (Normaniza and Barakbah, 2006). The researchers also mentioned that the soft approach of stabilizing slope confers numerous advantages, including high biodiversity, low maintenance, self-sustainability as well as being environmental-friendly.

1.3 Objectives

The aim of this study is to find out the suction due to grass water uptake. The changes of matric suction were analyzed and compared with the different depth at the study area. To achieve this aim, several objectives have been identifying as follow:

1. To determine the matric suction due to grass water uptake

2. To validate site measurement with computer mathematical simulation result

3. To analyze factor of safety of slope due to present of grass

1.4 Scope of Study

This study would consider the effect of existing common grass (Cowgrass or scientific name is Axonopus Fissifolius) on soil water content changes with site measurement for depth up to 0.5m-2.0m. The measurement includes the important parameter potential transpiration and weather condition. The approach to obtain the soil water content and other results were based on field instrumentations (Ishak, 2014) monitoring works.

The study focuses on investigating the suction due to the grass water uptake. There would not be any of tree involve during this measurement. The location of the site measurement was held at Faculty of Electric Engineering, Universiti Teknologi Malaysia. The data was collected about one month field measurement monitoring.

Commonly, type of the soil within the chosen location is tropical residual soil. The measurement data will be used to validate the matric suction of different depth of soil by using Microsoft Excel. The collected data hence would be plotted on the graph to see the pattern of the matric suction that has been induced by the grass root for different depth of soil.

Lastly, the data is analyzed to get the factor of safety due to the unsaturated and saturated soil data. The highest and lowest matric suction along one month data collection also presented in this study to show how the weather condition effected the suction measurement.

1.5 Significant study

The outcome of the study would provide information on the matric suction at different depth of soil, within one month duration monitoring. The more increasing suction would be produced during dry season and decreasing during the wet season. The effect of moisture content changes due to grass might increase the stability of slope and produce suction. Besides that, this study also represent the hydrological condition that has been shown and contributing due to the grass water uptake by transpiration on unsaturated soil slopes. At the same time, this study would encourage more studies to be conducted on the different depth of soil with the existence covers vegetation at site.

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