SLOPE STABILIZATION INFLUENCED BY UNSATURATED SOIL

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Master of Science

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science in Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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LIST OF SYMBOLS

c'	Effective cohesion
e	Void ratio
g	Gravity = 9.81 m/s^2
G_s	Specific gravity
n	Porosity
μ_a	Pore-air pressure
μ_w	Pore-water pressure
$(\mu_a - \mu_w)$	Matric suction
χ	Parameter related to the soil degree of saturation
ϕ'	Effective friction angle
ϕ^b	Angle indicating unsaturated
π	Osmotic suction
ρ_b	Bulk density
ρ_d	Dry density
σ	Total normal stress
σ'	Effective normal stress
τ_f	Shear stress at failure

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ABSTRAK

Kajian ini merangkumi kaedah-kaedah yang digunakan untuk kestabilan cerun melibatkan tanah yang tidak tepu. Dua kaedah iaitu kaedah mudah Bishop dan kaedah Fellenius digunakan untuk menentukan faktor keselamatan (FOS) cerun tanah tidak tepu. Oleh kerana kedua-dua kaedah tersebut hanya boleh digunakan untuk menetukan kestabilan cerun melibatkan tanah tepu, pengubahsuaian terhadap formula perlu dilakukan. Formula asal kaedah mudah Bishop perlu diubahsuai dengan menambah elemen sedutan matrik, $(\mu_a - \mu_w)$ dan juga sudut geseran tidak tepu, ϕ^b supaya kaedah ini dapat diguna pakai untuk mengira kestabilan cerun melibatkan tanah tidak tepu. Kaedah Fellenius telah diubahsuai oleh penyelidik terdahulu. Kajian ini melibatkan beberapa pendekatan seperti pengumpulan sampel, kajian makmal, dan juga analisa cerun. Sampel tanah diambil dari Kolej Matrikulasi Pahang melibatkan sampel terganggu dan tidak terganggu. Kajian makmal dilakukan untuk menentukan ciri index dan juga ciri kejuruteraan tanah. Hasil analisis menunjukkan tanah di kawasan Matrikulasi Pahang boleh dikategorikan sebagai tanah lumpur berpasir dengan kadar keplastikan yang tinggi. Hasil keputusan ujikaji ciri kejuruteraan memberi nilai perpaduan sebanyak 9kPa, sudut geseran tepu, ϕ' sebanyak 25º, manakala sudut geseran tidak tepu, ϕ^b sebanyak 21º. Analisa cerun untuk mereka bentuk ukuran cerun dilakukan dengan menggunakan SLOPE/W. Pengiraan faktor keselamatan (FOS) dilakukan menggunakan kaedah mudah Bishop dan kaedah Fellenius. Untuk permulaan, faktor keselamatan ditentukan menggunakan SLOPE/W, setelah itu menggunakan pengiraan biasa untuk memastikan hanya perbezaan yang kecil terhadap faktor keselamatan (FOS) apabila pengiraan menggunakan perisian dan juga pengiraan biasa. Akhir sekali, faktor keselamatan (FOS) untuk cerun tanah tidak tepu yang ditentukan menggunakan kedua-dua kaedah akan dibandingkan untuk menetukan kaedah yang memberi faktor keselamatan yang lebih tinggi ketika ada atapun tiada sedutan. Dari hasil keputusan analisa cerun, secara kesimpulannya, faktor keselamatan akan lebih tinggi untuk kedua-dua cerun dengan jenis tanah tepu dan tidak tepu jika dikira menggunakan kaedah mudah Bishop jika dibandingkan dengan kaedah Fellenius.

ABSTRACT

This study provides the exploration of methods for slope stabilization influenced by unsaturated soil. Two methods known as Bishop's Simplified method and also Fellenius's method are use in order to determine the factor of safety (FOS) of unsaturated soil slope. Since these methods were only applicable to determine the FOS value of saturated soil slope only, some modifications need to be done. The original formula of Bishop's Simplified method will be modified by adding the elements of matric suction, $(\mu_a - \mu_w)$ and unsaturated friction angle ϕ^b so that it is applicable to calculate slope stability of unsaturated soil slope. Fellenius's method was already modified by previous researcher. The research employed several approaches i.e sample collection, laboratory experimental and slope analysis. The soil sample was collected at Pahang Matriculation College involving disturbed and undisturbed samples. The laboratory works were conducted to determine both index properties and engineering properties of soil. From the analysis, the soil at Pahang Matriculation College can be considered as Sandy SILT with high plasticity. From the result of engineering properties, the cohesion value is 9 kPa, the saturated friction angle ϕ' is 25º and the unsaturated friction angle ϕ^b 21º. The slope analysis to design the slope measurement was conducted using SLOPE/W. The FOS calculation involved both Bishop's and Fellenius's methods. The FOS values were determined from SLOPE/W first, and then using manual calculation to make sure there was only little percentage of difference of FOS value when calculating using both software and manual calculation. Finally, the FOS values for unsaturated soil slope for both methods were compared to determine which method gave higher FOS value with and without suction. From the result of analysis, it can be concluded that, the FOS value for both saturated and unsaturated soil slope is much higher when calculated using Bishop's Simplified method compare to Fellenius's method.

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