CORRELATION BETWEEN UNCONFINED COMPRESSIVE STRENGTH AND STANDARD PENETRATION TEST ON GROUND IMPROVEMENT USING ENHANCED JET GROUTING IN ALLUVIUM SOIL

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ABSTRACT

Ground improvement using cement as a binder to improve the strength and stiffness of the soft soil (e.g. peat, alluvium deposits and silty sand) to prevent any ground water ingress has been widely used in the current subsurface excavation works such as tunnelling, underpass, basement excavation and others. The strength and elastic modulus of the grouted soils have been determined by classical destructive methods. However, the performance of grouted soft soils depends on several parameters such as the distribution of the particulate soil media, grouting pressure, grouting rotation, amount of cement and ground water flow. In this study, we are going to research on the correlation between the Unconfined Compressive Strength of the mixed soil with the Standard Penetration Test and Young Modulus. This research will comprise of the concept of ground improvement using enhanced jet grouting called wet speed mixing method, construction methodology, coring test to determine the compressive strength and Young's Modulus criteria and standard penetration test.

ABSTRAK

Pembaikan tanah menggunakan simen sebagai pengikat untuk meningkatkan kekuatan dan kekukuhan tanah lembut (contohnya gambut, deposit aluvium dan pasir berkelodak) untuk mengelakkan sebarang kemasukan air tanah semasa penggalian bawah permukaan seperti terowong, laluan bawah, bawah tanah penggalian dan lain lain telah digunakan secara meluas di Malaysia. Kekuatan dan modulus elastik tanah akan ditentukan dengan kaedah merosakkan klasik. Walau bagaimanapun, prestasi tanah lembut diturap bergantung kepada beberapa parameter seperti pengagihan media zarah tanah, tekanan grouting, grouting putaran, jumlah simen dan tanah aliran air. Dalam kajian ini, kita akan menyelidik kepada perkaitan antara kekuatan mampatan tak terkurung tanah dicampur dengan Penembusan Test Standard dan Modulus Young. Kajian ini akan terdiri daripada konsep pembaikan tanah menggunakan pertingkatkan grouting jet dipanggil kaedah pencampuran kelajuan basah, kaedah pembinaan, ujian coring untuk menentukan kekuatan mampatan dan kriteria Modulus Young dan ujian penembusan standard.

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m^3	-	cubic meter
mm	-	millimetre
m	-	meter
kg/cm^2	-	kilogram per centimetre square
rpm	-	rotation per minutes
L/meter	-	Linear per meter
P	-	axial load at failure
A	-	corrected area
A0	-	Initial area of the specimen
ε	-	axial strain
qu	-	unconfined compressive strength
cu	-	undrained shear strength
k	-	constant value
N	-	SPT N-value
E	-	Young's modulus
$\Delta\sigma$	-	the change of stress
$\Delta\varepsilon$	-	the change of strain

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CHAPTER 1

INTRODUCTION

Wet Speed Mixing (WSM) is a relatively new method of soil improvement which is catching on in preference in the geotechnical market. The method optimises the use of both the deep soil mixing and jet grouting mechanisms thus providing means of engagement in areas which was deemed not groutable previously. Wet speed columns can be used for all forms of soils including Clay, Silt and Sandy Soils.

The diameter of the columns can be varied by either jetting or no jetting. The jet grouting technique with mechanical mixing blade is described in detail in BS EN 14679:2005 (Clause A.3.5.3).

These machines have a mixing shaft as well as jetting nozzles, capable of creating columns larger than the mixing tool diameter. Jet stirring also makes it easy to create overlapping of the treated columns.

The use of WSM is developing rapidly due to its advantages, such as vibration free and low noise which will play a key role in urban residential areas. WSM can be also used in contaminated land in order to improve the ground because this method does not need any excavation or transportation of soil materials. Wet Speed Mixing, ground improvement technique is accepted in worldwide as used in many projects such as ground improvement for driveways, slope stability, embankments, tunnelling and used as shoring for excavation.

This research outlines the procedure carried out by WSM method and operational parameters adopted in alluvium soil around the area of Hospital Kuala Lumpur, Malaysia.

In addition, in-Situ and laboratory test result is analysed to correlate between Standard Penetration Test (SPT) and Unconfined Compressive Strength (UCS). If an accurate analysis can be represented and produce correlation within acceptable limits of accuracy, either SPT test or UCS test can be reduced in order to save more cost.

1.1 Objectives

This research is to study on the correlation in between Unconfined Compressive Strength (UCS) and Standard Penetration Test (SPT) N- value in order to facilitate the construction of Ground Improvement Works along Tunnel Alignment (From Crossover 1 To Ampang Park Station) For Intervention Blocks and Mandatory Ground Improvement work.

The objectives of this research are:-

a) To find the Unconfined Compressive Strength (UCS) value in alluvium soil treated with cementitious grout.

b) To find the Standard Penetration Test (SPT) N-value in alluvium soil treated with cementitious grout.

c) To establish the correlation between Unconfined Compressive Strength (UCS) and Standard Penetration Test (SPT) N-value in alluvium soil treated with cementitious grout.

1.2 Problem Statements

Soft soil such as alluvium deposits are always a challenge to geotechnical engineer when tunnelling activities are required. Prior to the commencement of the tunnelling works, intervention blocks will be identified at every 100m in order to facilitate the maintenance of the Tunnel Boring Machine Cutter head.

These intervention blocks will be treated with cementitious grout in order to form a water tight block. However, the quality of the jet grout block shall be confirmed by SPT tests and coring comprises of 8 boreholes for each 1000 cubic metres of treated soil.

At the same time, this had caused another issue as the coring and standard penetration test will create a hole in the block which leads to the possible hazards during the tunnelling work.

Therefore, this research is to find the correlation in between the Unconfined Compressive Strength (UCS) to Standard Penetration Test (SPT) N-Value. If the results find favourable thereafter the numbers of testing can be reduced.

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