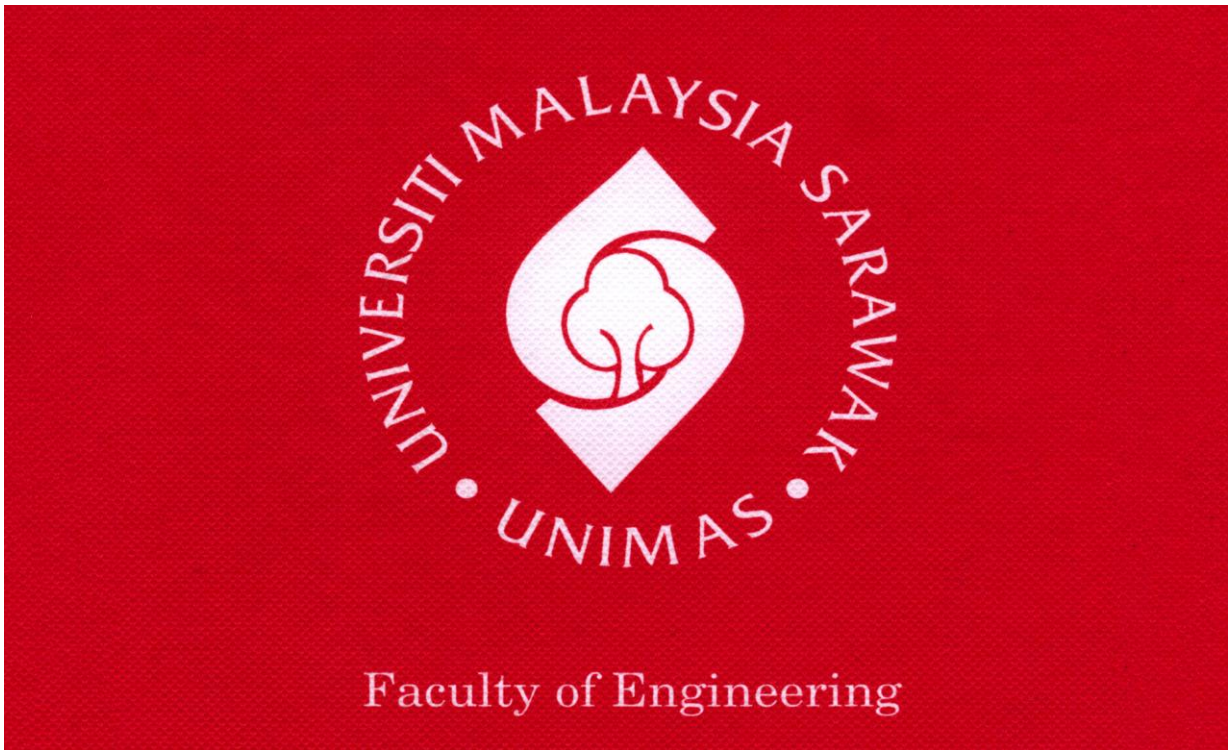

IMPROVEMENT OF GEOTECHNICAL PROPERTIES OF LOCAL CLAY BY USING FLY ASH

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Bachelor of Engineering with Honours
(Civil Engineering)
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This project report attached here to, entitles "**IMPROVEMENT OF GEOTECHNICAL PROPERTIES OF LOCAL CLAY BY USING FLY ASH**" prepared and submitted by **MUHAMMAD WAZIZI HAMZAR BIN ABDUL AZIZ** (**14628**) as a partial fulfillment of the requirement for the Degree of Bachelor of Engineering with Honours in Civil Engineering is hereby read and approved by:

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This Thesis Is Proposed To

Faculty of Engineering, University Malaysia Sarawak

For Fulfilment of The Requirements for Bestowal

The Degree of Bachelor of Engineering with Honours

(Civil Engineering)

2009

DEDICATION

Dedicated to my beloved family, friends and all the people that have supported, encouraged and inspired me through good and hard times.

Thanks for everything.

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First of all, I would like to express my gratitude to Allah S.W.T, for His Blessings for me that this final year project can be completed successfully, and for giving me patience to go through hard times during the completion of this project.

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ABSTRAK

Penambahbaikan dan penstabilan tanah jenis lembut sudah lama dipraktikkan dengan mencampurkan bahan seperti kapur, simen dan 'pond ash' untuk meningkatkan kekuatan tanah tersebut. Terdapat banyak bahan yang dapat juga digunakan sebagai penstabil untuk meningkatkan kekerasan dan kekuatan tanah liat. Objektif kajian ini dibuat demi mengkaji perubahan dalam sifat tanah liat tempatan apabila dicampurkan dengan 'fly ash' dari kilang arang batu tempatan. Kajian dimulakan dengan mengkaji sifat-sifat asas tanah liat tersebut. Selepas itu sampel disediakan dengan berhati-hati untuk mendapatkan hasil yang konsisten kerana data daripada kajian ini harus berkaitan antara satu sama lain supaya kesan perubahan yang ketara dapat dikesan. Standard Proctor Test dan Unconfined Compressive Strength (UCS) Test adalah method utama yang digunakan dalam kajian ini. Merujuk kepada data yang telah dianalisis, terdapat peningkatan ketara dalam kekuatan sampel apabila dicampur dengan 'fly ash' sehingga 20 peratus. Sampel mengandungi 20 peratus fly ash ini mampu bertahan lebih lama dengan muatan tertinggi dalam ujian tersebut. Kekuatan sampel meningkat sehingga ke hari yang ketujuh ketika proses 'curing' dilakukan, kemudian menurun perlahan-lahan sebelum kembali meningkat sehingga ke hari yang ke-28. Kesimpulannya, tanah liat tempatan juga dapat distabilkan dengan mencampurkan 'fly ash', dan kajian ini boleh menjadi langkah pertama dalam kajian penambahbaikan tanah bagi tanah-tanah dalam Malaysia.

ABSTRACT

Soft soil improvement and stabilization has been widely practised for a long time by mixing admixtures such as lime, cement and pond ash to increase the strength of the soil. Different types of admixtures were also used as stabilizers to improve the stiffness and strength of a clay soil. As for this study, the objective is to analyze the improvement in local clay soil when being stabilized by using fly ash from the local coal plant. Tests were first made to study the characteristics of the clay soil. Then samples are prepared carefully to prevent inconsistencies between them since the outcome of each tests must be related to each other in order to produce a significant results. Standard Proctor Test and Unconfined Compression Strength (UCS) Test are the main tests used in this study. From the analyzed data, there is a significant increase in strength when the clay sample were mixed with fly ash and the trend continues until the addition of 20 percent fly ash to the sample. The sample containing 20 percent fly ash tends to sustain more loads during the compression tests. The strength of each samples increased until the seventh day of curing, before gradually decreasing. However, the strength of the samples regained after the fourteenth day. As a conclusion, local clay can also be stabilized or improved by using fly ash, and this may become as a starting step for future assessments that could lead to more soil improvement for ground soil in Malaysia.

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UCS	Unconfined Compression Strength
CFBC	Circulating Fluidized Bed Combustion
OMC	Optimum Moisture Content
MDD	Maximum Dry Density
ASTM	American Society for Testing and Materials
rpm	Rotation Per Minute
µm	Micrometer
mm	Millimeter
ml	Mililiter
g	Gram
R_h	True Reading
R'_h	Hydrometer Reading
C_m	Meniscus Correction
PI	Plasticity Index
LL	Liquid Limit
PL	Plastic Limit
L_D	Oven-Dried Sample Length
L_O	Initial Sample Length
q_u	Unconfined Strength
C_u	Undrained Cohesion
kPa	Kilo-Pascal
ρ_s	Particle Density

%	Percent
kN	kilo-Newton
S_g	Specific gravity

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CHAPTER 1

INTRODUCTION

1.0 General

Clay is the common name for a number of fine-grained earthy materials that become plastic when wet. As one of the principle types of soil, clay can be easily found in the local area. It has an individual size smaller than 0.002 mm compare to other types of soil. Clays often form colloidal suspensions when immersed in water, but the clay particles will flocculate and settle quickly in saline water. Clay can easily molded into a form that they retain when dry, and they become hard and lose their plasticity when subjected to heat (Grim, 1971).

Clay plays an important role in architecture, industry and agriculture. Nowadays, in architecture section, clay is still being used to form brick, manufacture tile for wall or floor coverings. Other uses include pipes for drainage and sewerage. Expanded clays are used as a lightweight aggregate in the manufacture of expanded clay blocks used for

insulation. However, the major use of clay, after brick manufacture, is in the manufacture of cement.

In Sarawak, clay be easily found and generally, it can be categorized into two classes; residual clay and transported clay. Residual clay is clay that is found in its place of origin while transported clay is clay that was removed from its original place by agent of erosion and then deposited to a new distant position. Residual clays are most commonly formed by surface weathering, that includes the chemical decomposition of rocks such as granite-containing silica and alumina; the solution of rocks, such as limestone-containing clayey impurities, which are deposited as clay when being insoluble; and by the disintegration and solution of shale. One of the commonest processes of clay formation is the chemical decomposition of feldspar.

One major problem related to clay is its high compressibility because of its fine particle size. Any foundation constructed on the clay subgrade has risk of failure when the clay layer suddenly settled due to moisture and load.

An improvising of clay properties can be made by mixing it with fly ash as a replacement to lightweight coarse aggregates which will be useful in the construction practice. Fly ash is produced from coal-fired thermal power plants which are considered as waste. In order to reduce the increasing amount of these wastes, they were reused in

many productions of materials and also in construction. Both possess finer particle size and usually used as a replacement to aggregates in concrete and road sub-base.

The usage of fly ash has been done for a long time in concretes which results in lighter concrete self-weight, while also reducing costs when producing optimum concretes. While they were widely used as admixtures in concrete, its effect on clay is still need to be defined. A study of the usage of both fly ash and bottom ash on clay could also be made to investigate the changes in its properties to improve the usage of clay in industrial and construction sector.

1.1 Problem Statement

The mixture of fly ash to clay soil could affect the clay in its main properties. This is because, theoretically, the fine particle size of fly ash will fill the void between the clay's particles and may change the composition's density, permeability, workability and also its strength. From the various amount of the mixtures used, there might be at some percentage where the clay product will possess the optimum strength.

When the proper mixture of the admixtures are determined, which gives optimum strength to the harden clay, the mix proportion can be used in the industry as to provide higher service level of clay product. Besides that, natural resources can also be preserved while industrial wastes, which are fly ash and bottom ash, can be recycled instead of being disposed to the nature.

1.2 Aim of study

Since the changes in clay properties with mixtures of fly ash and bottom ash are still not yet well defined, there is a need to study its behavior with different mixture of those materials through lab experiments.