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IMPROVED STRENGTH OF PEAT SOIL BY USING KAOLIN AND QUICKLIME STABILIZER

HAZRIM BIN ABDUL KARIM

Thesis submitted in fulfilment of the requirements
for the award of the degree of
B.Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

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LIST OF SYMBOLS

S_u	Shear strength
K_o	Pressure coefficient
G_s	Specific gravity
E	Strain
Σ	Stress
qu	Unconfined compressive strength
e_o	Initial void ratio
kPa	Kilo pascal
m	Metre
Tons	Tonnes
°C	Degree Celsius
MPa	Mega pascal
kN/m^2	Kilo newton per metre square
kN/m^3	Kilo newton per metre cubic
mm	Millimetre
x	Times
%	percent
Cc	Compression index

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
BS	British Standard
i.e.	That is
e.g.	For example

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ABSTRACT

Due to tropical climate and topographical conditions, peat soil or organic soil is abundant in Malaysia. Peat soil is also known as problematic soil due to low in shear strength and high compressibility. This research focus on shear strength and the objective was to find out the effectiveness of kaolin and quicklime as stabilizer to enhance the shear strength of peat soil. The study area of this research was at Indera Sempurna, Pekan, Pahang while the kaolin and quicklime used were S300 and plaster mix A1. To achieve the objective, test specimens of both untreated and stabilized peats were tested in laboratory in order to evaluate its unconfined compressive strength. Peat soil that passes through 2 mm sieve size was used to mix with kaolin and quicklime. Amount of stabilizers used consist of 2%, 5% and 8% for kaolin and 3%, 7% and 10% for quicklime. The correlation between the amount of stabilizer and shear strength of peat soil was determined using the kaolin and quicklime. All samples cured for 7, 14 and 28 days respectively. The expectation from this research was to increase the shear strength of peat by adding kaolin and quicklime as stabilizer.

ABSTRAK

Iklim tropika dan keadaan topografi merupakan antara sebab mengapa tanah gambut atau tanah organik banyak terdapat di Malaysia. Tanah gambut dikenali sebagai tanah bermasalah kerana kekuatan ricih yang rendah dan mampatan yang tinggi. Fokus penyelidikan ini tertumpu kepada kekuatan ricih dan objektifnya adalah untuk mengetahui keberkesanan kaolin dan kapur sebagai penstabil untuk meningkatkan kekuatan ricih tanah gambut. Kawasan kajian penyelidikan ini di Inderasempurna, Pekan, Pahang manakala kaolin dan kapur yang digunakan adalah S300 dan plaster campuran A1. Untuk mencapai matlamat tersebut, specimen diuji di makmal dalam keadaan tidak dirawat dan selepas dirawat dengan penstabil dan dinilai melalui kekuatan mampatan tak terkurung. Tanah gambut yang melalui 2mm saiz ayak telah digunakan untuk dicampur dengan kaolin dan kapur. Jumlah penstabil yang digunakan terdiri daripada 2%, 5% dan 8% untuk kaolin dan 3%, 7% dan 10% untuk kapur. Hubungan antara jumlah penstabil dan kekuatan ricih tanah gambut telah ditentukan dengan menggunakan kaolin dan kapur. Semua sampel dirawat selama 7, 14 dan 28 hari. Jangkaan daripada penyelidikan ini adalah untuk meningkatkan kekuatan ricih tanah gambut dengan menambahkan kaolin dan kapur sebagai penstabil.

CHAPTER 1

INTRODUCTION

1.1 Overview

The structure of the land is made up of mixture of soil organic matter and minerals. Non organic soil or mineral soil is formed from rock that contains mineral. Otherwise, organic soil is formed from the condensation of organic material degraded. Peat soil is the type of organic soil available in Malaysia. Peat soil is a various mixture of more or less decomposed plant (humus) material that has collected in a water-saturated environment and in the absence of oxygen. It's significantly higher volumetric water content at higher water tensions.

In the US, peat is found in 42 states with a total acreage of 30 million hectares. Canada and Russia are the two countries with a large area of peat, 170 and 150 million hectares respectively. In other words, peat signifies an accumulation of disintegrated plant remains, which have been preserved under condition of incomplete aeration and high water content. For the case of tropical peat or tropical peat lands, the total world coverage is about 30 million hectares, two thirds of which are in Southeast Asia. Malaysia has around 3 million hectares - about 8% of the land area is covered with tropical peat. While in Indonesia peat covers about 26 million hectare of the country land area, with almost half of the peat land total is found in Indonesia's Kalimantan (Huat., 2006).

In agriculture industry, peat soil is very famous among farmers and agriculture developer. This is because peats contain higher organic content that increase plant growth fairly quickly. Oil palm plantation is one example of agriculture industry that uses peat soil area for plantation. Since palm trees absorb a

lot of water, the yield potential of oil palm planted on peat land has always been a controversial subject. Most past soil research on oil palm yield on peat land was mainly based on the depth and drainability (Veloo et al., 2014). Besides that, pineapple entrepreneurs also tend to choose peat as pineapple cultivation site because peat can supply their needs in order for the plant to grow well.

Kaolin or china clay is a subgroup of clay mineral having polytypes called kaolinite, dickite and nacrite and a polymorph called halloysite (Wong et al., 2013). Kaolin can be used as a natural pozzolanic to mix with cement that can enhance the strength and durability of mortars and concrete in building construction. It is commonly identified as white and soft clay that exhibits plasticity with the composition of fine-grained plate like particles. In feldspar-rich rocks such as granite, kaolin formed from anhydrous aluminum silicate alteration by weathering or hydrothermal processes.

Limestone is a naturally occurring and abundant sedimentary rock consisting of high levels of calcium and/or magnesium carbonate, and dolomite (calcium and magnesium carbonate), along with small amounts of other minerals. Also, it was found in several geotechnical laboratory investigations that lime can effectively improve the mechanical properties of kaolin when intimately mixed with the saturated clay (Wong et al., 2013). Normally, limestone available at hardware shop in various forms such as soft rock and powder. Quicklime, hydrated lime and carbide lime are examples of type limestone in powder form at hardware shop.

1.2 Problem Statement

Based on study review, higher volume of moisture content affects the strength and decreases the ability load capacity. The water content of peat soil studied in west Malaysia ranges from 200% -700% and unit weight of peat soil is lower compared to inorganic soil. Shear strength is important parameter in soil mechanics. Shear strength always play a vital role when engineering decision comes across with any soils including peat.

In construction industry, low shear strength is the main problem of the peat soil which is often results in difficulties during construction works. Peat soil is also considered as unsuitable for supporting foundations in its natural state. Consequently, there are many problems of construction that built on peat soil. It will affect the condition of the building after a period of time if no maintenance is carried out.

Road construction on peat soil may have difficulty because the bearing capacity is low and the settlement is high. The road will easily to crack and sedimentation will happen because of the inability of the soil to accommodate loading from the surface of road. Other than that, subsidence and drainage potential are important factors of road construction on peat soil. Usually, excavation and replacement method is used when dealing with peat soil (Aldrino et al., 2014).

1.3 RESEARCH QUESTION/HYPOTHESIS

i. The higher the addition of kaolin in peat soil, the higher the shear strength of peat soil
ii. The higher the addition of quicklime in peat soil, the higher the shear strength of peat soil
iii. The mixture of kaolin and quicklime can improve the peat soil strength
iv. The optimum dosage of kaolin, quicklime and mixture of kaolin and lime to improve strength of peat soil

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