



Faculty of Engineering

**CORRELATIONS BETWEEN BASIC GEOTECHNICAL PROPERTIES
OF PEAT SOIL IN NEW STUDY AREA IN SARAWAK**

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**CORRELATIONS BETWEEN BASIC GEOTECHNICAL PROPERTIES OF
PEAT SOIL IN NEW STUDY AREA IN SARAWAK**

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*This project report is dedicated to my beloved mother and father,
my dearest brothers and sisters
for their love and support*

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ABSTRAK

Dalam istilah kejuruteraan, tanah gambut adalah salah satu contoh daripada tanah lembut dan menimbulkan masalah serius ketika pembinaan disebabkan ketidakseimbangan dan pengukuhan jangka masa panjang walaupun apabila dikenakan beban yang sederhana. Jurutera-jurutera menghadapi masalah dalam memahami ciri-ciri tanah gambut dan disebabkan permintaan yang banyak, mereka terpaksa mencari kaedah yang sesuai untuk membina struktur di atas tanah gambut. Oleh itu, adalah penting untuk memahami ciri-ciri tanah gambut secara mendalam supaya teknik yang sesuai untuk pembinaan tapak akan ditentukan. Sarawak merupakan negeri yang mempunyai kawasan tanah gambut terbesar di Malaysia iaitu 16,500km² yang menyumbang 13% daripada keseluruhan negeri. Secara umum, tanah gambut “fibrous” dan “amorphous” paling banyak dijumpai di Sarawak. Kajian ini adalah untuk membentuk korelasi antara ciri-ciri asas tanah gambut di kawasan kajian yang baru dan membandingkan kajian dengan hasil kajian terdahulu. Kajian menunjukkan bahawa tanah gambut di Sarawak tidak sama ciri-cirinya dengan tanah gambut di Pantai Barat Semenanjung Malaysia. Keputusan juga menunjukkan ketumpatan kering mempunyai hubungkait yang rapat dengan kandungan air semulajadi. Tambahan pula, kajian menemui had cecair dan kandungan organik berkurangan dengan peningkatan kandungan air tetapi kajian terdahulu di Pantai Barat Semenanjung Malaysia menunjukkan sebaliknya.

ABSTRACT

In engineering terms, peat is one of examples of soft soils and it poses serious problems in construction due to instability and long term consolidation settlement even when subjected to a moderate load. Engineers are facing problems in understanding the properties of peat and due to demands they have to find suitable ways to construct structures on peats. Therefore it is essential to have deep understanding of peat properties so that a suitable technique for foundation will be selected. Sarawak has the largest peat area in Malaysia with 16,500 km² that makes up 13% of the state. The most types of peat in Sarawak are fibrous and amorphous with high organic content. This study is to develop correlation of basic properties of peat in new study area in Sarawak and to compare the correlation made with correlations that already made from previous findings. It was found that the peat soil in Sarawak is not similar to that in West Coast Peninsula Malaysia. The result indicates that the dry density correlates well with natural moisture content. Furthermore, it was found that the liquid limit and organic content decreasing with increasing moisture content but the findings from West Coast Peninsula Malaysia shows contradiction of it.

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LIST OF SYMBOLS

$^{\circ}\text{C}$	-	Degree Celsius
%	-	Percent
γ_b	-	Bulk Density
γ_d	-	Dry Density
e	-	Void ratio
S	-	Degree of Saturation
G_s	-	Specific Gravity
kPa	-	kilopascal
cm	-	Centimeter
m	-	Meter
km	-	Kilometer
g	-	Gram
w	-	Moisture content / Water Content
m_w	-	Mass of Water
m_s	-	Mass of Soil / Solid
V_s	-	Volume of Solid
ρ_w	-	Unit Weight of Water
LL	-	Liquid Limit
PL	-	Plastic Limit
SL	-	Shrinkage Limit
I_p or PI	-	Plasticity Index

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CHAPTER 1

INTRODUCTION

1.1 Overview

One of the problematic soils is peat and it is subjected to instability and long term consolidation settlement. Peat is an organic soil which consists more than 70% of organic matters. Peat deposits are found where conditions are favorable for their formation. Most countries with tropical climate are covered with peat. In Malaysia some 3 million hectares of land contain greater area of peat soil and 13% of Sarawak land covers with peats amounting around 16,500km². Peat soil is representative material of soft soils and classified as highly organic. Generally, peat composed from organic matters from decomposed plants such as stem and leaves. It has largely deposits of plants, decomposed incompletely through lack of oxygen.

Peats and organic soils are studied by scientists and engineers in the field of horticulture, agriculture, geotechnical, chemical and environmental engineering, and in alternative energy supply. The increase in population and economic activities in the Southeast Asian countries will, in time, make large scale disposal of peaty soils

unacceptable resulting in a demand for adequate solutions to improve the engineering characteristics of these peaty soils.

Peat causes serious problems in construction due to its long-term consolidation settlements even when subjected to a moderate load (Jarret, 1995). Hence, peat is considered unsuitable for supporting foundations in its natural state. Engineers are facing problems in understanding the properties of peats. The properties of peat in different region are differing with each others.

1.2 Problem statement

For any construction project, it is essential for any involved parties such local authorities, engineers and contractors to obtain a deep understanding of peat properties with more concerned. It is necessary to avoid any uncertainties occurs in implementation of project on peats and pollution due to elimination of this soils.

One of the issues that peat engineering facing is that there are not-well established correlations between peat index properties that call for more correlations between geotechnical properties of peats should be developed. This study is carried out to help future engineers in more understanding and to develop the geotechnical properties of peats and the correlations between properties.

1.3 Objective

The main objective of conducting this research is to get more understanding on peats properties. Thus, the specific objectives of this study are:

- i. To develop correlations between basic geotechnical properties of peats in new study area in Kota Samarahan with other literatures.
- ii. To compare the correlations from this study with the previous findings.

1.4 Scope of work

The study limits its scope on basic physical properties of peat at new study area in Sarawak specifically loss on ignition and organic content, water content, dry density, bulk density, specific gravity, soil pH, liquid limit. These data then compared with previous researches from various sources.

CHAPTER 2

LITERATURE REVIEW

2.1 General Overview

In Malaysia geotechnical engineers are facing with construction on soft soils. When possible, construction on peat soil must be minimized. But due to the development, they have to find the way to build a structure on a weak soil such as peats. Peaty soil is not suitable as structures foundation as it is weak and high compressibility. Peat soils are less understanding by geotechnical engineers and contractors. This situation causes them difficult to firmly decide towards implementation of any project on peats soils. Some cases occurred on peat soils is it would consolidates more even moderate loads are applied. This dilemma causes the engineers and contractors feel uncomfortable to decide for development projects. The first approach which is able to implement is suggestion to shift the site location to the other place (Jarret, 1995).

If project implementation on the site can not be avoided, then the engineers will take approach to excavate and transfer the peat soil and replace with inorganic soil or sand. This approach is something simple and usually applicable even though

sometimes not economical to assist the job of engineers. If the location displacement and soil replacement is not applicable, thus the other alternatives will be thought by engineers to let the project is implemented. They will identify new method using recent technology in order to solve the problems. Provide that the new method and current technologies will involve large cost. Those statements are quotes by Jarret (1995).

2.2 Introduction on Peat

The accumulation of partially decayed vegetation matter is called peat. Peat form in wetlands or *peatlands*, normally called *bogs*, *moors*, *muskegs*, *mires* and *peat swamp forests*. There is about 4 trillion m³ peat all over the globe covering a total of around 2% of global land mass about 3 million km² (World Energy Council, 2007). Approximately 60% of the world's wetlands are peat and there are about 7% of total peatland have been developed for agriculture and forestry.

Most of geological investigations on organic soils and peats the main problem created by their classification in generalising the properties which involve complex determination. The classifications have not been standardised yet, and, even though there are many attempts, the problems still unresolved. Two tendencies of organic soils which are: genetic and non-genetic classification. Engineering geologist consider further study on classification can be carried out based on properties of soils (Myselińska, 2003).