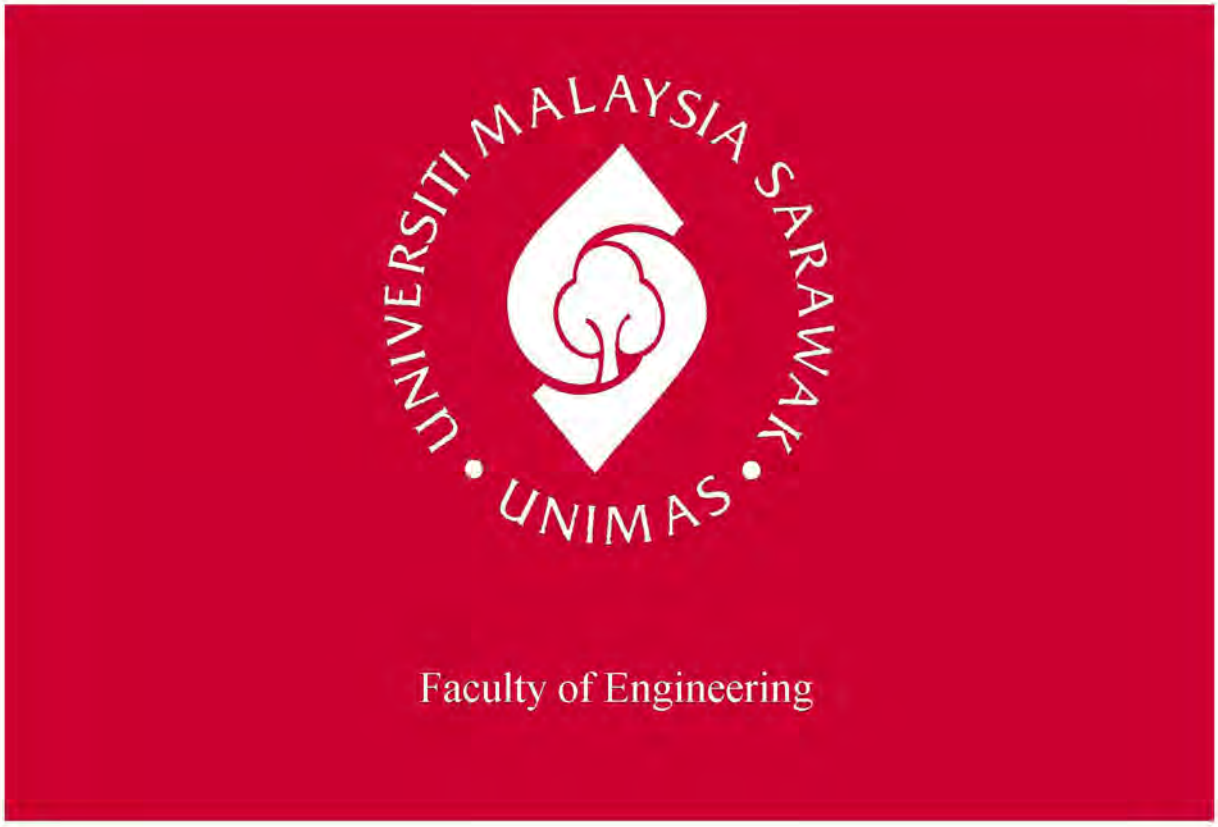

INVESTIGATION ON THE EFFECT OF DIFFERENT LEVELS OF PEAT SAMPLING ON OEDOMETER TEST

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Bachelor of Engineering with Honours
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INVESTIGATION ON THE EFFECT OF DIFFERENT LEVELS OF PEAT SAMPLING ON OEDOMETER TEST

BELINDA ANAK MASON

This thesis is submitted in partial fulfilment of the requirements for
Degree of Bachelor of Engineering with Honours
(Civil Engineering)

Faculty of Engineering
Universiti Malaysia Sarawak
2009

Dedicated

To

Almighty GOD for HIS Glory

To

My Supervisor, Dr.Siti Noor Linda bt Hj Taib

To

My Beloved daddy, mummy, siblings, Kenny and friends

Thank you for your support

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First of all, I would like express my sincere appreciation to my supervisor, Dr.Siti Noor Linda for her encouragement, guidance and critics. Without her continuous support and interest, this final year project would have not been presented here.

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ABSTRACT

Peat which is considered as a problematic soft soil due to its high water content and compressibility and low bearing capacity. Generally, higher percentage of moisture and organic content are likely to influence the consolidation and settlement of the peat soil. This study was focused on the effect of different levels of peat sampling on one-dimensional consolidation test. Oedometer consolidation test are conducted for samples taken from Matang at different level of depths. Several parameters such as coefficient of consolidation, C_v, compression index, C_c, and the coefficient of volume compressibility, m_v were determined. Apart from that, the physical and chemical properties were also determined. The result shows that the coefficient of consolidation, C_v and the coefficient of volume compressibility, m_v show decreasing value when subjected to increment of consolidation pressure with time. Meanwhile, the compression index, C_c is found to have a good correlation between moisture content and void ratio. However, the properties and characteristics of peats vary with their depths, locations and conditions of that particular area.

ABSTRAK

Secara umumnya tanah gambut dianggap sebagai tanah yang kurang kualitinya untuk menampung pembinaan, disebabkan oleh kandungan air, dan juga mampatan serta tekanan galas yang rendah. Secara umumnya, tanah gambut yang dikatakan mempunyai kandungan air dan kandungan organik yang tinggi akan mempengaruhi sifat pengukuhan dan pengenapan tanah. Kajian yang dijalankan ini akan memberikan tumpuan kepada kesan penyediaan sampel pada kedalaman yang berbeza terhadap Ujian Pengukuhan Satu Dimensi. Ujian Pengukuhan ini telah dijalankan ke atas sampel tanah yang diambil dari Matang mengikut kedalaman yang berlainan. Beberapa parameter seperti pekali pengukuhan, indeks kemampatan dan pekali isipadu kemampatan telah ditentukan. Selain daripada itu, ujian bagi menentukan sifat-sifat fizikal dan turut dijalankan. Melalui ujian yang telah dijalankan, keputusan telah menunjukkan bahawa sampel tanah tersebut mempunyai kadar pengenapan tanah yang hampir sama. Selain itu, pekali pengukuhan dan pekali isipadu kemampatan menunjukkan pengurangan disebabkan oleh peningkatan beban bersama masa. Sementara itu, indeks kemampatan jua menunjukkan hubungkait yang baik di antara kandungan air dan nisbah lompang. Walau bagaimanapun, ciri-ciri dan sifat-sifat tanah gambut adalah bergantung pada kedalaman, kawasan dan keadaan tanah tersebut.

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LIST OF SYMBOLS

H_{dr}	-	Average longest drainage path during consolidation
a_v	-	Coefficient of compressibility
C_v	-	Coefficient of consolidation
m_v	-	Coefficient of volume compressibility
C_c	-	Compression index
σ'	-	Effective pressure
FC	-	Fiber content
w_f	-	Final moisture content of sample
H_s	-	Height of solid
w_i	-	Initial moisture content of sample
e_o	-	Initial void ratio
N	-	Loss on Ignition
M_s	-	Mass of dry sample
w	-	Moisture Content
H	-	Organic content
Gs	-	Specific gravity

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Peat is an organic soil which consists more than 70% of organic matters. Peat deposits are found where conditions are favorable for their formation. In Malaysia, some 3 million hectares of land is covered with peat. The total area of tropical peat swamp forest or tropical peat land in the world amounts to about 30 million hectares. Sarawak has the largest peat area of the country covering about 1.66 million hectare which is 13% of the state. About 1.5 million hectare of peat in Sarawak was classified as deep peat, the remainder being organic clay and muck (MARDI, 2004).

Peat soil is a representative material of soft soil and classified as highly organic. In general, peat is mainly composed of fibrous organic matters which are partly decomposed plants such as leaves and stems. Therefore, it has been said that peat shows

unique geotechnical properties in comparison with those of inorganic soils such as clay and sandy soils which are made up of only soil particles.

Furthermore, peaty soils consist of two layers, namely the younger and older layers that were deposited at two different geological times. The younger peaty soils are located at much shallower depths and have poorer engineering properties compared to the older peaty soils (Tan et al., 2001).

Peat poses serious problems in construction due to its long term consolidation settlements even when subjected to a moderate load. Hence, peat is considered unsuitable for supporting foundations in its natural state. Various construction techniques have been carried out to support embankments over peat deposits without risking bearing failures but settlement for these embankments remains excessively large and continues for many years. Besides settlement, stability problems during construction such as localized bearing failures and slip failures need to be considered. Despite of the problems associated with peat soil, more infrastructure facilities development has been carried out on peat ground.

Peat has certain characteristic that sets it apart from mineral soils and it also requires special consideration. These special characteristics include:

- High natural moisture content (up to 800%).
- High compressibility including significant secondary and tertiary compression.
- Low shear strength (typically 5-20kPa)

- High degree spatial variability.
- Potential for further decomposition as a result of changing environment conditions.

Peat in general are easily distinguished by their dark brown to black colour, high organic content, high moisture content and lightweight nature, especially when dried. When significant inorganic particles such as extraneous sediments are present, the soil are referred to as organic soil rather than peat. Peat soil, compared with mud, have low dispersion which, together with the presence of the fibrous framework, gives them a higher strength at very high void ratios. The coefficient of consolidation,C_v generally decreases as the liquid limit of soil increases. The range of variation of C_v for a given liquid limit of soil is wide. The summarization of peat properties are as follows given by (Landva et al., 1983).

Table 1.1: Classification of peats and organic soils (After Landva et al., 1983)

Soil Type	Peats	Peaty Organic Soils	Organic Soils	Soil with Organic Content
Group Symbol	Pt	PtO	O	MO or CO
Ash Content (%)	< 20	20 - 40	40 -95	95 -90
Organic Content (%)	> 80	60 - 80	5 – 60	1 - 5
Particle Density (%)	< 1.7	1.6 -1.9	> 1.7	> 2.4
Moisture Content (%)	200 – 3000	150 – 800	100 -500	< 100

Liquid Limit (%)	Difficult test to perform		> 50	< 50
Fiber Content (%)	> 50	< 50	Insignificant	-
Degree of Decomposition (Von Post)	H1 –H8	H8 –H10	H10	

1.2 PROBLEM STATEMENT

Various researchers have stated general problems associated with development in peat soils in Malaysia. Generally, consolidation test using Oedometer are used to determine the characteristics of consolidation settlement. All Oedometer tests were performed on carefully sampled and prepared specimens which were either 19.05mm or 20.00mm in height, and had diameters of either 75.00mm, 76.20mm or 100.00mm. This Final Year Project is being undertaken to investigate on the Geotechnical properties of peat from depth of 0.5m to 2.0m and to analyse the effect of size of fiber in peat on consolidation properties.

1.3 OBJECTIVES

In order to reach the aims of the study, the following objectives are set for this final year project:

1. To investigate on the Geotechnical properties of peat from different depths.
2. To analyze the effect of size of fiber in peat on consolidation properties.

1.4 SCOPE OF WORKS

These studies focus on the effect of peat fiber size on oedometer test. For the experimental test, samples will be taken from the chosen area namely, Matang. Several samples will be prepared. Then the peat samples will be examined by using oedometer rig. A number of proposed sizings of fiber will be investigated. Hence, the sizing will depend on the exact physical properties of peat from the respective depth. While testing the peat of different sizing is of concern, the sample preparation procedure is also observed.

1.5 THESIS STRUCTURE

This project was divided into 5 chapters. The project background, the objectives and the scope of study were elaborated in this Chapter 1. The literature review will be elaborated in Chapter 2, which will discuss more on information related to this study. While Chapter 3 will discuss on methodology; consists of methods and materials used in the laboratory test. Chapter 4 will cover the results and analysis. This chapter analyzes and discusses the data obtained from the experiments. Conclusions and recommendations of the project will be presented in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Peat soils are formed by disintegration of plant and organic matters and are characterized by very high void ratio and water contents (Kulathilaka, 1999). Peat is a mixture of fragmented organic material formed in wetlands under appropriate climatic and topographic conditions. The deposit is generally found in thick layers on limited areas. The soil is known for its low shear strength and high compressibility which often results in difficulties when construction work has to take place on peat deposit. The low strength often causes stability problem and consequently the applied load is limited or the load has to be placed in stages. Large deformation may occur during and after construction period both vertically and horizontally, and the deformation may continue for a long time due to creep.

The term peat is described as a naturally occurring highly organic substance derived primarily from plant materials. It is formed when organic (usually plant) matter accumulates more quickly than it humidifies (decays). This usually occurs when the organic matter is preserved below a high water table like in wetlands. Peats are therefore superficial deposit or soils with high organic matter content. However, the cut-off value of the percentage of organic matter necessary to classify a superficial deposits or soil as peat varies throughout the world, usually depending on the purpose of classification. This cut-off value also serves to differentiate peat from superficial deposits or soils with lesser amounts of organic matter content (Singh et al., 2003).

On the other hand, the fibrous peat can be divided into coarse fibrous and fine fibrous peat. In general, fibrous peat has an open structure with the interstices filled with a secondary structural arrangement of non-woody fine fibrous material. Besides, in fibrous peat, most water occurs as free water rather than viscous adsorbed water. Theoretically, fibrous peat exhibits different consolidation characteristics if compared to amorphous peat. For instance, fibrous peat is compressible at its fiber, and it is highly porous, which makes it contains high initial settlement.

Soil classification for peat soil is done according to the Unified Soil Classification System, which was developed by Casagrande, and was adopted by the American Society for Testing and Material (ASTM) in 1969 as the Standard Method for Classification of Soils for Engineering Purposes (ASTM D2487). According to ASTM D2487, peat soil is under the division of Highly Organic Soils, with the symbol Pt., and there is no specific

grain size for peat soil. Besides, Malaysian Soil Classification for organic soils includes the two factors, which are organic content and degree of humification as shown in Table 2.1.

Table 2.1: Organic Soils and peat section of Malaysian Soil Classification System (IKRAM and Jarrett, 1995)

Soils group (See note 1)		Sub-group and laboratory identification						
		Description	Group Symbol	Sub-group symbol	Liquid Limit %	Degree of Humification	Sub-group name	Field Identification
ORGANIC SOILS and PEATS	SLIGHTLY ORGANIC SOILS Organic Content 3% - 20%	Slightly Organic SILT Slightly Organic Clay	Mo Co	Mo Clo Clo Cho Cvo CEo	<35 35-50 50-70 70-90 >90		Slightly Organic SILT (Sub-divide like Co) Slightly Organic CLAY of low plasticity Slightly Organic CLAY of intermediate plasticity Slightly Organic CLAY of high plasticity Slightly Organic CLAY of very high plasticity Slightly Organic CLAY of extremely high plasticity	Usually very dark to black in color, small amount of organic matter may be visible. Often has distinctive organic smell.
	ORGANIC SOILS Organic Content 20% - 75%	ORGANICS SOILS	O				Subdivision of Organic Soil is difficult, as neither the plasticity tests nor the humification tests are reliable for them. As such a "best attempt" is the probable outcome of subdivision leading to descriptions such as "Fibrous ORGANIC SOILS" or "Amorphous ORGANIC SOIL of Intermediate Plasticity"	
	PEATS Organic Content	PEAT	Pt	Ptf Pth Pta		H1-H3 H4-H6 H7-H10	Fibric or Fibrous Peat Hemic or Moderately Decomposed Peat Sapric or Amorphous Peat	Dark brown to black in color. Material has low density so seems light. Majority of mass is organic so if fibrous the whole mass will be recognizable plant remains. More likely to smell strongly if highly humified.

2.2 PEAT IN SARAWAK

In Sarawak, the basin peat swamps are classified as dome-shaped whereas in Peninsular Malaysia and Sabah, the general topography of the peat land tends to be flat. Generally, peat swamps are usually situated 2 to 4 km from the coast. The coastal and deltaic peat swamps in Sarawak also have convex surfaces with the convexity of the swamp surfaces becoming more pronounced with distance from the sea. Maximum heights recorded in the Daro Forest Reserve and Loba Kabang Protected Forest was 4 m. The swamp surface is like that of an inverted saucer with almost flat bog plain at the centre (MARDI, 2004).

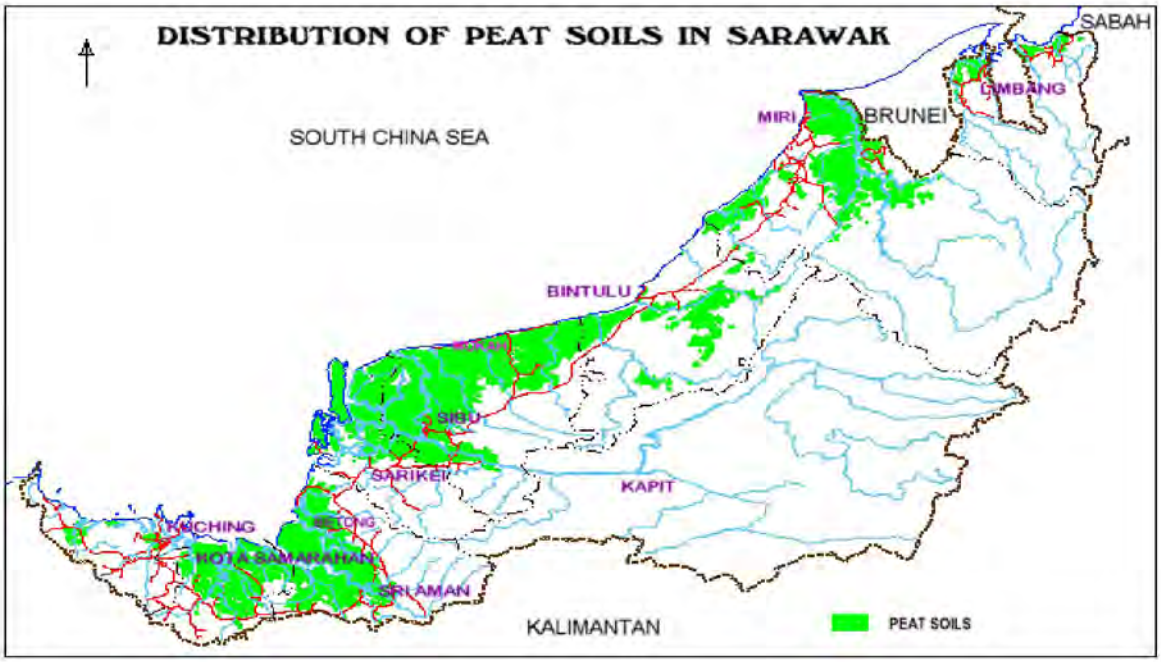

Figure 2.1: Distribution of Peat Soil in Sarawak (MARDI, 2004)