



Faculty of Engineering

GEOTECHNICAL PROPERTIES OF PEAT SOIL

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This project report is dedicated especially to my beloved father and mother, Mr. Ramli and Mrs. Che Munah. My dearest brother and sisters, Rozvin, Norlizawati and Norziana and my dearest friends. Thanks for all your supports.

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ABSTRACT

Different and excessive settlements are the principal problem confronting engineers working on peat soils. These impose difficult designs and construction conditions, thus it is necessary to know the geotechnical properties of these soils to enable more practical designs to be carried out. Peat and organic soil represent the extreme form of soft soil. They are subject to instability such as sinking and slip failure, and massive primary and long-term settlement when subjected to even moderate load increase. Buildings on peat are usually suspended on piles, but the ground around it may still settle. This study will focus on the properties and consolidation test on peat soils from two areas. Oedometer consolidation test are conducted for both samples taken from Kota Samarahan and Kuching. Several laboratory tests were also conducted for physical, chemical and engineering properties to determine parameters such as coefficient of consolidation, C_v , compression index, C_c and coefficient of volume compressibility, m_v . Prior to the experimental tests conducted, the result showed the similar deformation for both areas. The coefficient of consolidation, C_v showed decreasing value when subjected to increment of consolidation pressure with time. Meanwhile, the compression index, C_c was found to have a strong correlation between moisture content and void ratio. However, the properties and characteristics of peat varied with their locations and conditions.

ABSTRAK

Pengukuhan tanah yang terlampau dan berbeza adalah masalah prinsipal yang dihadapi oleh jurutera yang bekerja di atas tanah gambut. Ini disebabkan kesukaran untuk mereka dan pembangunan. Oleh itu, ciri-ciri geoteknik tanah gambut perlu diketahui untuk membolehkan banyak kerja pembangunan dijalankan. Tanah gambut dan tanah organik diumpamakan sebagai tanah yang wujud dari pembentukan tanah yang lembut. Ia menjurus kepada ketidakstabilan seperti termendap dan kegelinciran, dan pengukuhan tanah dalam jangka masa yang lama walaupun apabila dikenakan penambahan beban yang sedikit. Bangunan yang dibina di atas tanah gambut adalah kebiasaannya bergantung kepada cerucuk, tetapi keadaan tanah di sekelilingnya mungkin akan termendap. Kajian yang dijalankan ini akan memberi tumpuan kepada sifat pengukuhan tanah gambut yang diperolehi daripada Ujian Pengukuhan Satu Dimensi. Ujian pengukuhan ini telah dijalankan ke atas sampel tanah yang diambil dari Kota Samarahan dan Kuching. Beberapa ujian makmal telah dijalankan seperti ujian fizikal, kimia dan kejuruteraan untuk menentukan parameter seperti pekali pengukuhan, indeks kemampatan dan pekali pemampatan isipadu. Melalui ujian yang telah dijalankan, keputusan menunjukkan bahawa kedua-dua kawasan mempunyai kadar pegenapan tanah yang hampir sama. Melalui kajian yang dijalankan juga, pekali pengukuhan menunjukkan pengurangan disebabkan oleh peningkatan beban bersama masa. Sementara itu, indeks kemampatan juga menunjukkan hubungkait yang baik antara kandungan air dan nisbah lompong. Walau bagaimanapun, ciri-ciri dan sifat-sifat tanah gambut adalah bergantung kepada kawasan dan keadaan tanah tersebut.

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LIST OF SYMBOLS

Φ'	-	Effective internal Friction
C_v	-	Coefficient of consolidation
C_c	-	Compression index
e_o	-	Initial void ratio
H_{dx}	-	Average longest drainage path during consolidation
w	-	Moisture Content
m_1	-	Mass of container, Mass of crucible
m_2	-	Mass of container and wet soil, Mass of crucible + dry soil
m_3	-	Mass of container and dry soil, Mass of crucible + dry soil after ignition
N	-	Loss of Ignition
H	-	Organic content
SG	-	Specific gravity
w_i	-	Initial moisture content of sample
w_f	-	Final moisture content of sample
M_s	-	Mass of dry sample
H_s	-	Height of solid
σ'	-	Effective pressure

Cu	-	Copper
Bo	-	Boron
Zn	-	Zink
δ_c	-	Settlement of consolidation
σ'_{zf}	-	final vertical stress
σ'_{zo}	-	Initial vertical stress
σ'_{zc}	-	Preconsolidation stress of the soil
$C\alpha$	-	Secondary compression index
C	-	Carbon
N	-	Nitrogen

CHAPTER 1

INTRODUCTION

1.1 General

Peat and organic soils represent the extreme form of soft soil. They are subject to instability such as sinking and slip failure, and massive primary and long-term settlement when subjected to even moderate load increase. Buildings on peat are usually suspended on piles, but the ground around it may still settle, creating a scenario as depicted in Figure 1. In addition, there are discomfort and difficulty of access to the site, a tremendous variability in material properties and difficulty in sampling. These materials may also change chemically and biologically with time. For example further humification of the organic constituents would alter the soil mechanical properties such as compressibility, shear strength and hydraulic conductivity. Lowering of ground water may cause shrinking and oxidation of peat leading to humification with consequent increase in permeability and compressibility. Peat actually represents an accumulation

of disintegrated plant remains, which have been preserved under condition of incomplete aeration and high water content.

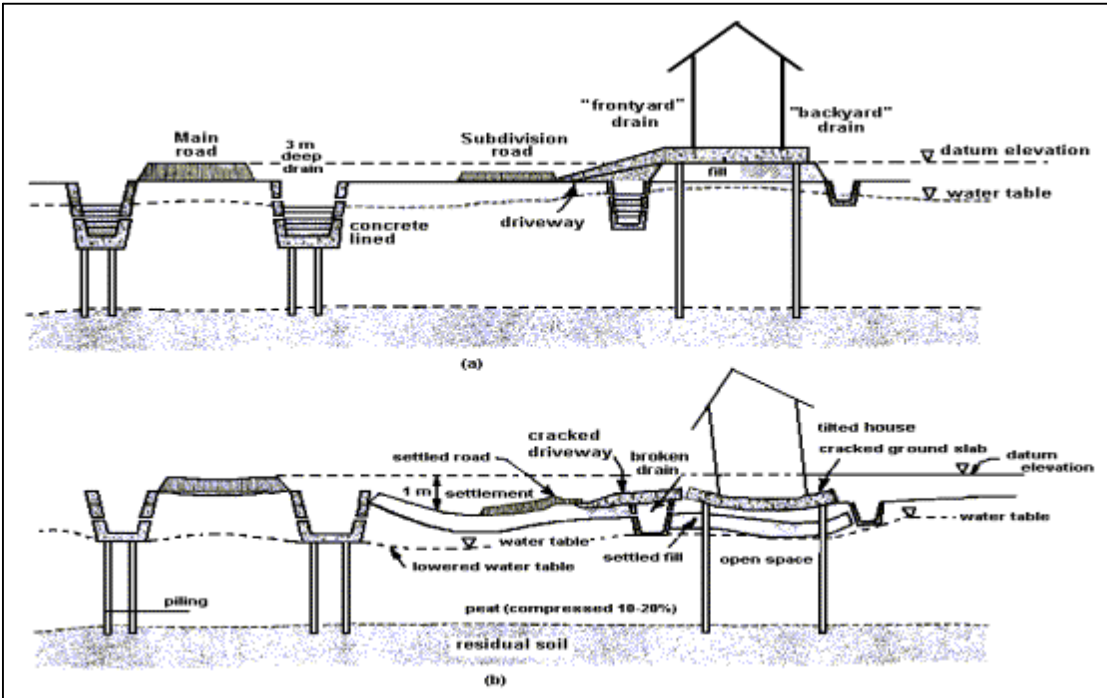


Figure 1 : (a) Typical section of a housing estate on peat (immediately after completion of construction)

(b) Several years after completion of construction (scale exaggerated)

According to Huat (2006), peat was considered as an unsuitable material for engineering construction because of its difficulty to access since the water table is often near, at or above the ground surface as usually found on wetland. Liu (2000), stated that the construction of heavy building over peat soil should be avoided as it is not only costly but also risky.

Generally, there are two types of peat soils in Malaysia which was amorphous granular peat and fibrous peat. Although these types of peat have different properties and characteristics, they still possess close similarities in terms of consolidation behaviour. The process of load transfer to the soils as pore water escape is the consolidation process. Theoretically, consolidation behaviours are classified into three stages which are initial compression, primary consolidation and secondary consolidation settlement is likely to occur. An alternative method such as preloading or surcharge, chemical stabilization, pre-fabricated vertical drains, sand or stone column and surface reinforcement will be applied in order to reduce post construction settlement.

1.2 Problem Statement

Peat which is classified as soft soil has become a major concern of construction problem. It is known that construction on peat is difficult due to its nature and characteristics. Engineers are trying to avoid constructions over peat soils as it is subject to problems like high compressibility, low shear strength and long term consolidation settlement. The study on the “Consolidation of Peat Soil” is being undertaken to understand and learn more about unique properties and characteristics of peat soil from various disciplines as well as to determine the various types of consolidation behaviour.