COMPARISON OF SOIL INDEX PROPERTIES VALUE FOR DIFFERENT PRE-DRYING CONDITIONS ON CLAYEY SOIL

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I dedicate this project report to my beloved family members, my lecturers, study mates, colleagues and friends for being there for me, guiding, supporting and encouraging me.

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ABSTRACT

Pre-drying of soil samples prior to index properties testing plays an important role in order to obtain accurate and reliable results. Most of the soil engineering properties are correlated with index properties values for investigation of soils behavior and characteristics. According to British Standard, BS1377:1990-Part 1, soil shall be dried by either air drying or oven drying before testing. However, for some soils, their physical properties may change permanently under high temperature especially plasticity index and shrinkage limit. Permanent alteration of soil physical properties will eventually influence the characteristic and behavior of the soil. Many definitive procedures require that soil should be used at its natural state, not be allowed to become dry before testing. Hence, effect of pre-drying conditions on the soil index properties is studied on three number of disturbed clayey soil samples pre-treated in five (5) different pre-drying conditions at different temperatures and drying duration. Soil specimens were tested based on index properties including moisture content, Atterberg limit, linear shrinkage, particle size distribution and specific gravity accordance to BS1377:1990-Part 2. The results obtained revealed that increase of pre-drying temperature and duration has significant effect on the plasticity index of about 13% and shrinkage limit of about 4% on the clayey soil consisted higher percentage of fine particles which also influence the classification of the clayey soils. Conclusively, oven drying method should not be used in soil preparation for plasticity and shrinkage testing.

ABSTRAK

Pra-pengeringan sampel tanah sebelum ujian sifat indeks memainkan peranan yang penting untuk mendapatkan keputusan yang jitu dan boleh dipercayai. Kebanyakan ciri-ciri kejuruteraan tanah dikaitkan dengan nilai-nilai sifat indeks untuk siasatan sifat dan ciri-ciri tanah. Menurut piawaian British, BS1377: 1990-Bahagian 1, tanah hendaklah dikeringkan sama ada dengan pengeringan udara atau pengeringan ketuhar sebelum ujian. Walau bagaimanapun, bagi sesetengah tanah, ciri-ciri fizikal mereka mungkin berubah secara kekal di bawah suhu yang tinggi terutamanya indeks keplastikan dan had pengecutan. Pengubahan tetap sifat fizikal tanah akhirnya akan mempengaruhi sifat dan ciri-ciri tanah. Banyak prosedur muktamad memerlukan tanah digunakan pada keadaan semula jadi, tidak dibenarkan menjadi kering sebelum ujian. Oleh itu, kesan daripada keadaan pra-pengeringan pada sifat-sifat indeks tanah dikaji pada tiga sampel tanah liat terganggu sebelum diuji dalam lima (5) keadaan pra-pengeringan yang berbeza, iaitu pada suhu dan jangka masa pengeringan yang berbeza. Spesimen tanah setelah dikeringkan, diuji berdasarkan ciri-ciri indeks termasuk kandungan lembapan, had Atterberg, pengecutan linear, taburan saiz zarah tanah dan graviti specifik dengan merujuk kepada piawai British, BS1377: 1990 - Bahagian 2. Keputusan yang diperolehi menunjukkan bahawa peningkatan suhu dan tempoh pra-pengeringgan mempunyai kesan yang besar ke atas indeks keplastikan kira-kira 13% dan had pengecutan kira-kira 4% ke atas tanah liat yang mengandungi peratusan partikel halus yang lebih tinggi, yang juga mempengaruhi klasifikasi tanah liat. Kesimpulannya, kaedah pengeringan oven tidak patut digunakan dalam penyediaan tanah untuk ujian keplastikan dan had pengecutan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

All soils are consist of three different components that are solid particles, water and air. The inter-relationship of the different components is important to define the condition or the physical properties of the soil.

Generally, index properties of soils are determined by laboratory testing on soil sample obtained from the site. Most of the testing parameters determined from the laboratory testing are linked for correlation with descriptive data acquired from in-situ testing (field testing) by geotechnical engineers. The data obtained is used to study the subsurface investigation of a particular site for preliminary design, to verify the validity of design assumptions made based on engineering judgment and as additional data to enable engineering properties of the soils to be analyzed in numerical term for failure analysis.

The index property testing is simple and low cost laboratory testing compared to engineering testing which required complex preparation and higher cost

of testing. The types of laboratory required to determine the index properties include moisture content, Atterberg limit, particle size analysis, specific gravity (particle density) and linear shrinkage.

Sample preparations play an important role to the above laboratory testing especially pre-drying conditions as drying at high temperature and longer duration will cause the physical properties of soils experience permanent changes to the fine grained soil especially clayey soil (Murthy,2003). However, many commercial laboratories will oven dried the soil sample in certain duration prior to the testing due to time limitation and other factors. Assumptions are always made that the drying conditions have no influence to the soil plasticity results. On the other way, air drying is not sufficient for moisture content and particle size distribution analysis due to strong bonding of water molecule and soil solid particles. Therefore this study is to be carry out to compare the soil index properties value obtained from five different pre-drying conditions with regards to the temperature effect and duration of drying.

1.2 Problem Statement

In this study, the pre-drying condition is the main factor to influence the results of the soil index properties testing especially plasticity and shrinkage testing. As discussed, the temperature applied during soil sample drying having significant impact on the soil plasticity as high temperature may alter the soil physical properties permanently. However, lower temperature applied will not able to eliminate the water content sufficiently or it may take longer time to achieve the dry condition. Longer duration used for dying the soil sample prior to testing would be non-cost effective. Hence, the comparison on the soil index properties at different pre-dying temperature and duration was analyzed in order to determine the best pre-dying condition with cost-effective.

Besides pre-drying condition, there are various factors affect the soil index properties testing results included soil sample mass, soil grain size, water content, chemical contamination, relative humidity in the laboratory, testing apparatus and tester reliability. The above factors are disregarded to make sure the variation of result is due to the temperature and duration. Hence, the soil samples retrieved from site were stored properly and testing were carried out by adopting standard procedure to eliminate other factors other than pre-drying conditions.

1.3 Objective of the Project

This study is aim to compare the soil index properties value for different pre-drying conditions. To achieve the above aim, the following objectives were set out at the beginning of the study -:

a. To determine the index properties of clayey soils

b. To study the effects of drying temperature (i.e oven-drying at 50°C and oven drying at 105°C).

c. To study the effects of duration of drying (i.e 12 hours, 24 hours and 48 hours of drying).

1.4 Scope of Study

A total of 3 nos. of disturbed clayey soil samples are used for this study, one soil sample was from a hill site in Kajang, Selangor and two numbers of samples were from the sea bed in Kerteh, Terengganu. All the soil samples were collected by third parties and used for this study with consent. The soil samples were prepared as per BS 1377:1990- Part 1 and the testing were carry out as per BS 1377: 1990 – Part 2.

Each of the soil sample collected was evenly divided in to 5 section for moisture content determination and pre-dried in five different conditions as the followings -:

i. Oven drying at 50°C for 12 hours before testing
ii. Oven drying at 50°C for 24 hours before testing
iii. Oven drying at 50°C for 48 hours before testing
iv. Oven drying at 105°C for 12 hours before testing
v. Oven drying at 105°C for 24 hours before testing

After the drying, each section of the soil samples would be divided for different testing as per followings -:

a) Atterberg limit (Plastic Limit, Liquid Limit)
b) Linear Shrinkage
c) Soil particle density (Specific Gravity)
d) Particle size distribution analysis

1.5 Structure of Thesis

There are 5 chapters covered in the thesis with the following descriptions:

Chapter 1 presents the introduction to the project, problem statement, objectives in the study carried out and scope of the study of this project.

Chapter 2 presents the literature review of the project, including relevant research associated with the pre-drying and oven drying of soil sample.

Chapter 3 presents the methodology and procedure used for soil sample preparation, pre-drying of sample and laboratory testing.

Chapter 4 consists of analysis of data collected and presentation of the result obtained from the testing. Discussion is also included.

Chapter 5 presents the summary of findings and recommendations for the future research.

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