

**SHEAR STRENGTH OF KERTEH BEACH SAND  
BASED ON DIRECT SHEAR TEST**

By

**NOOR EZLYN BT OTHMAN**

Report is submitted as  
the requirement for the degree of  
**Bachelor Engineering (Hons) (Civil)**

**UNIVERSITI TEKNOLOGI MARA  
NOVEMBER 2005**

## **ACKNOWLEDGEMENT**

In the name of Allah, the most gracious and most merciful, with His permission, this thesis has been successfully completed. Praised to Prophet Muhammad, his companions and those who are on the path as what he preached upon, may Allah almighty keep us blessing and tenders. Alhamdulillah, I am very thankful to Allah S.W.T for providing me with the strength and patience to complete with this proposal. I would not be able to complete the job without the endless moral and technical support from the following parties:

I would like to express my most sincere gratitude to my supervisor Ir. Mohd Farid bin Ahmad @ Majid for his useful ideas and advices. His guidance, constructive comments and inspiring enthusiasm were really a great help.

To Mr Anas bin Ibrahim, Madam Chow Shiao Huey, Dr Shanker Kumar Sinnakaudan, Madam Teoh and Dr Iqraz Nabi Khan, my thanks for the useful ideas and opinions given to me. My endless gratitude is also forwarded to laboratory technicians; Miss Farah Hariyani Haris and Mr Malik for their willingness to help me especially in conducting the tests. For Mr Chew, Sales Engineer from ELE, thank you very much for your technical assistance! For others who have contributed directly and indirectly to the completion of this research, your help is very much appreciated.

To my family, whom always be there for me.

## TABLE OF CONTENTS

Acknowledgement	i
Table of Contents	ii
List of Figures	vi
List of Tables	xi
List of Appendices	xii
List of Abbreviation	xiii
Abstract	xiv

CHAPTER	PAGE
<b>1.0 INTRODUCTION</b>	
1.1 Background	1
1.2 Problem Statement	2
1.3 Objective of Study	2
1.4 Significance of Study	3
1.5 Scope of Study	3

## ABSTRACT

The soil at the proposed site for embankment construction in Kerteh has been identified as loose sandy soil based on the in situ test conducted during the planning stage. The soil strata for the study area generally consist of layers of loose sandy silt to loose silty sand begins from depth of 15 meters from the surface. Dynamic Compaction and Vibro Compaction ground improvement work were performed at the area to improve the top 6 m. Quality tests using Cone Penetration Test (CPT) were conducted on site. However, the pre treatment CPT has  $q_c$  values not correlated with laboratory test, therefore, the cohesion,  $c$  and internal resistance,  $\phi$  is unknown. Laboratory direct shear test using electronic-controlled ELE DS7 software has been proposed as part of the overall study on the sandy beach area in Kerteh, in which the loadings for the direct shear test are based on the actual stress experienced by the soil samples at site. Result of the direct shear test in terms of angle of shearing resistance,  $\phi$  has been compared with the  $\phi$  determined from Robertson and Campanella (1983) correlation. The mean angle of shearing resistance from the direct shear test was found out to be  $30^\circ$ , indicating that the Kerteh Beach sand was in loose state and of type silty sand (Budhu, 2002). Soil type obtained from sieve analysis has also verified the type stated by Azazi et. al (2004). Analysis on the effect of fine content on  $\phi$  showed that the fine content had no direct influence on  $\phi$ . However, while presence of less than 10% of fine content cannot be directly related to the value of  $\phi$ , it may cause a significant difference when compared to  $\phi$  obtained from Robertson and Campanella (1983) correlation. For fine content higher than 10%. no conclusions could be made because all the tested samples had less than 10% fine content. It was found out that the correlation may give more accurate value at  $\phi$  values ranging between  $31-35^\circ$ . The direct shear test result also revealed that as the  $c$  value increases, the  $\phi$  value will decrease. For cohesion  $\approx 0$  kPa, the average differences between both correlated and direct shear  $\phi$  was 3.4 %.

Keywords: CPT,  $c$ ,  $\phi$ , fine content.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

The earth crust, having different layers of stratum, has variation in the soil characteristic. Compressible soil strata are undesirable for the purpose of construction works, since this indicates the inability of the stratum to support structure. If construction is to be carried out at site where the soil is not strong enough to cater for heavy load, there are several choices to be made: abandon the site, deep pile foundation, redesign the structure or improve the soil condition using ground improvement techniques.

There are numerous methods in ground improvement techniques, and one of the most widely used is deep compaction. Effect of compaction on the engineering properties of soil could be seen in the increment of maximum dry unit weight of soil, shear strength and soil bearing capacity, and decrement of permeability.

The soil at the proposed site for embankment construction in Kerteh has been identified as soft soil based on the in situ test conducted during the planning stage. The soil strata for the trial area generally consist of various non-homogeneous soil layers. The layer of soft sandy silt to loose silty sand began from depth of 15 meters from the surface. The profile continued with medium