THE COMPRESSIBILITY OF FILL SUBJECTED TO APPLIED STRESS AND INUNDATION

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ABSTRACT

Cut and fill in construction is inevitable in order to achieve the desired formation level for a structure. Structures maybe constructed on compacted fill provided it is compacted according to the requirement specification. However, for poorly compacted soil the settlements of foundation can be caused by consolidation of compressible fill under foundation loading, consolidation of the fill under its own weight, consolidation of the natural ground beneath the fill and the collapse settlement due to inundation. This project is concerned with the settlement of foundation not only due to the increment in the applied stress but also the compressibility due to inundation of water. A series of consolidation tests has been conducted on lateritic clay samples, prepared at various densities representing the poorly, well-compacted density and at maximum dry density. It was observed in this study that the collapse potential for UTM high plasticity Lateritic clay might cause moderate trouble or trouble for the foundation on poorly or non-compacted soil. While the main settlement was occurred due to the increment in the applied stresses. However, the collapse potential increases with the decrement in the moisture content which reflects reduction in the dry density of the soil. The collapse potential also shows an increase trend as applied stress increases.

Keyword: Soil compressibility, foundation settlements, fills, collapse potential

ABSTRAK

Pengorekan dan tambakan adalah proses yang tidak boleh dielakkan dalam mendapatkan aras laras yang dikehendaki bagi sesuatu struktur. Struktur berkemungkinan dibina di atas tanah tambakan yang dipadatkan mengikut spesifikasi. Walaubagaimanapun bagi tanah yang tidak dipadatkan dengan sempurna, enapan asas boleh disebabkan oleh pengukuhan akibat daripada mampatan oleh beban dari asas, pengukuhan akibat beban sendiri, pengukuhan oleh dasar semula jadi yang terletak di bawah tambakan dan enapan runtuh (*collapse settlement)* akibat daripada pembanjiran. Projek ini mengambil kira enapan asas yang bukan sahaja diakibatkan oleh pertambahan di dalam tegasan tetapi juga mengambil kira enapan akibat daripada pembanjiran oleh air. Satu siri ujian *oedometer* telah dijalankan pada sampel tanah liat berlaterit, yang disediakan pada ketumpatan yang berbeza-beza yang mewakili tanah yang tidak dipadatkan dengan sempurna, yang dipadatkan dengan sempurna dan pada ketumpatan kering maksimum. Dalam kajian ini, telah didapati bahawa potensi boleh runtuh *(collapse potential)* bagi tanah liat berlaterit yang mempunyai nilai keplastikan yang tinggi di UTM boleh menyebabkan masalah yang sederhana atau masalah kepada asas yang terletak pada tanah yang tidak dipadatkan dengan sempurna atau yang tidak dipadatkan. Sementara enapan utama berlaku disebabkan oleh pertambahan tegasan. Walaubagaimanapun potensi boleh runtuh *(collapse potential)* meningkat dengan penurunan nilai kandungan lembapan yang mewakili penurunan nilai ketumpatan kering tanah. Selain itu, nilai potensi boleh runtuh *(collapse potential)* juga meningkat apabila tegasan yang dikenakan meningkat.

Katakunci : Kebolehmampatan tanah, enapan asas, tambakan, potensi boleh runtuh

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CP	-	Collapse potential
Cc	-	Compression index
C_v	-	Vertical coefficient of consolidation
G_s	-	Specific gravity
e	-	Void ratio of the soil
e_o	-	Initial void ratio of the soil
γ	-	Unit weight
γ_d	-	Dry unit weight
F	-	Void Ratio change factor
W	-	Water content
u_e	-	Excess pore pressure

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CHAPTER I

INTRODUCTION

1.1 Introduction

Most of developing countries have to build various infrastructures such as highway, building, power supplies, railway and etc. Before building these structures, the soil at the site have to be consolidated using a consolidating machine to prevent the failure or collapsing of the structure. This is due to the soil that will consolidate itself as the load is increase to squeeze out some of the porewater. When the soil settles itself, the structures will fail and thus proven fatal to people involve with the structures.

Knowing the consolidation characteristic, Geotechnical engineer can avoid many problems related to the construction on the soft soil. The most critical soft soil problem is the differential settlement which will cause the building to crack.
Settlements of foundation constructed on fill can cause:

a. Consolidation of compressible fill under foundation loading.
b. Consolidation of the fill under its own weight.
c. Consolidation of the natural ground beneath the fill under the combined weight of the fill and the structure [1].

If the structure is light the movement due to (a) above will be small even in a poorly compacted fill (*it is presumed that founding on very soft clayey fill would not be considered*). The movement due to (b) depends on the depth and compaction of the fill layer and the conditions under which it was placed. Meyerhof has published his curves, which will illustrate the beneficial effect of compacting the fill in layers at the time of placing. Well-compacted sand, gravel, shale, chalk and rock fills show settlements of only one-half percent of their height, whereas poorly compacted chalk fills may settle up to 1 per cent. Well-compacted clay fills show settlements up to one-half percent of their height compared with 1 to 2 per cent for lightly compacted clay placed in deep layers. Sand fills placed by pumping show very small settlements above ground water level due to the consolidating effect of the downward percolating water. On the other hand pumped clay fills show very severe settlement. With controlled tipping in layers the settlement of domestic refuse can be restricted to about 10 per cent of the height, and settlement of a 3m deep fill can be expected to be complete in about five to ten years. When building over poorly compacted fill, it is advisable to use raft foundations [1].

In this project, it is assumed that the soil underneath the fill is incompressible and the foundation is simulated in the Oedometer test.

1.2 Problem Statement

In order to solve the problems that the engineers normally face due to the insufficient compaction at the field area, a study on the compressibility of the shallow foundation on fill is conducted. In most of the construction works, it has noted that the

majority of the compaction works do not follow the engineering standards in term of:

i. The thickness and number of the layers for the compacted fill.
ii. The number of the passes of the compaction machineries [17].

That is definitely affect any structure built on that poorly compacted fill and causes a significant consolidation settlement especially for the buildings with shallow foundations. A sudden settlement due to the effect of inundation has considered as the most dangerous phenomenon for building constructed on fill. Investigation has to be conducted on this soil type to see whether the soil is susceptible to collapse settlement.

1.3 Objectives

The objectives of this study are as follow:

(i.) To study the compressibility of the shallow foundation on compacted fills.

(ii.) To investigate the effect of inundation on the potential collapse settlement.

1.4 Scope of Study

The study focused on the identification, classification and the engineering characteristic of the poorly compacted clayey soil.

i. All soil samples for the study are disturbed sample and were taken from UTM area.

ii. Laboratory works include the physical and geotechnical properties of the soil, Atterberg Limit, Specific Gravity, Particle Size Distribution, Maximum Dry Density and Optimum Moisture Content.

iii. Compaction Test (Standard Proctor Method)

iv. Oedometer Test on poorly compacted clay with different moisture content and clay densities.

This project focuses and considers the natural soil, which does not contain any organic or chemical Content. Additionally, it is assumed that the soil underneath the fill is incompressible.

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