STATIC COMPACTION OF SOIL UNDER SERIES OF LOADING-UNLOADING CYCLES AT DIFFERENT MOISTURE CONTENTS

Saitama University Student Member ○Syed Kamran Hussain
Saitama University Regular Member Shinya Tachibana
Saitama University Regular Member Jiro Kuwano

1. INTRODUCTION

Soil compaction is one of the most critical components in the construction of roads, airfields, embankments, and foundations. The durability and stability of a structure are related to the achievement of proper soil compaction. Structural failure and the damage caused by foundation settlement can often be traced back to the failure to achieve proper soil compaction. In case of cohesive soils or clays the dynamic compaction methodology doesn't work well. Studies have been made by many researchers to investigate the compaction behavior of soil under static loading of unsaturated soils; i.e. Reddy and Jagadish (1993). The purpose of this research is to estimate the behavior of such geo-materials under static compaction with series of loading and unloading cycles and to study the mechanical behavior and water retention property of the unsaturated soils. To study the response of soil to static compaction, tests were carried out at different target moisture contents.

2. OUTLINE OF THE EXPERIMEMT

DL clay which had the specific gravity G_s of 2.635 was used in the experiment. The schematic of test apparatus is shown in Fig. 1. Clay sample was compacted in the mold which has the diameter of 60mm. Before placing the clay sample, the ceramic disc in the pedestal and path to the power water pressure transducer were beforehand vacuumed for approximately 24 hours to saturate by water and remove air bubble. The top cap has several small holes to the atmosphere and the PTFE filter which allows pass of only air from clay sample is stuck at the surface facing on sample. Therefore, the condition of constant moisture content could be kept during the compaction of clay samples. Three samples with different moisture contents of 10, 15 and 20 % were prepared. The weight of sample was determined so as to get the dry density ρ_d of 1.3 g/cm^3 when the height of sample became 20 mm.

Fig.2 shows the compaction history. Three cycles of loading and unloading processes were provided to compact the clay samples. The vertical stress was increased stepwise every 200 kPa from 0 to 800 kPa in loading process, whereas it was decreased from 800 to 0 kPa in unloading process. In each step, changes in pore water pressure and displacement of sample were measured. It took over approximately 12 hours until the value of pore water pressure and displacement of sample stabilized in each step.

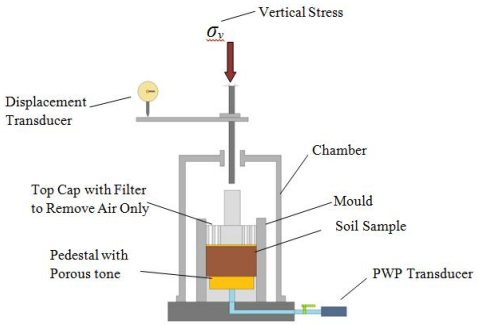

Fig.1: Schematic of Test Apparatus

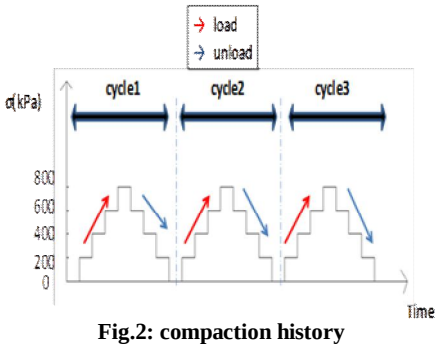

Fig.2: compaction history

3. RESULTS AND DISCUSSIONS

Three experiments have been conducted at 10, 15 and 20 % moisture contents respectively in order to estimate the post compaction behavior of unsaturated soil. Table.1 shows the values of target, initial and final moisture content. It was observed that the moisture content was maintained throughout the test with minor difference.

Moisture Content	Case-A	Case-B	Case-C	Units
Target Moisture Content	10	15	20	%
Initial Moisture Content	10.07	14.75	21.14	%
Final Moisture Content	9.84	14.61	20.06	%

Table-1: Values of Target, Initial and Final Moisture Contents

Fig.3 shows the variation in dry density with respect to loading and unloading cycles for different moisture content samples. Comparing results of three cases at different target moisture contents, it is observed in all cases that due to application of alternate cycles of stress, with the increase of stress, dry density increases with every cycle. At unloading phase there is appreciable decrease in dry density as the void ratio increases. As the number of cycles increase there is

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Contact address: Geosphere Research Institute, Saitama University, 255-Shimo Okubo, Sakura-Ku, Saitama-Shi, Saitama, 338-8570, Japan, Tel: +81- 48-858-3568

less variation in dry density. This may be due to the fact that sample which is in loose state at initial stage gains maximum density at the first applied load cycle and in the later stress phases it shows comparatively less displacement and increase in density.

Fig.4 shows the change in pore water pressure for different moisture contents. As the tests were performed at undrained condition and only air is allowed to drain out through the top cap, the suction of sample is equivalent to negative pore water pressure. At the initial stages the sample shows more suction due to unsaturated condition and as the stress application status changes thus decreasing the pore water pressure in all three cases, with increasing number of loading cycles the suction of the sample decreases.

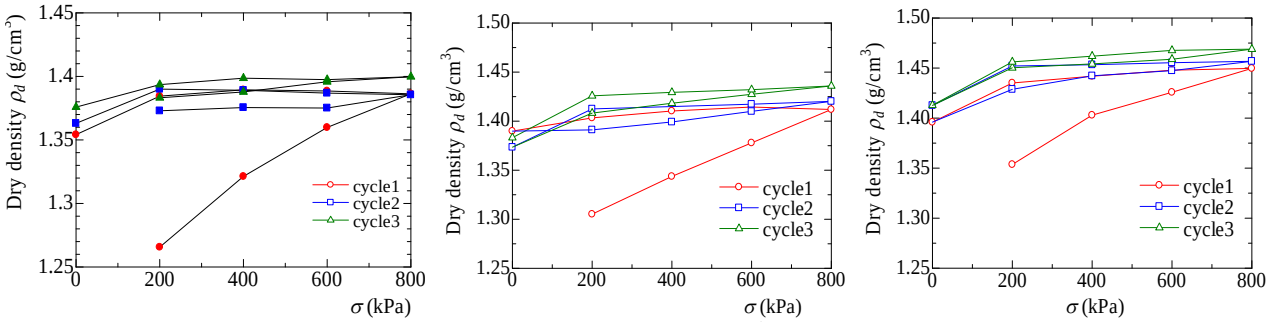

Fig.3: Variation in dry density w.r.t loading-unloading cycles for 10, 15 and 20 % moisture contents

Another important point to be noticed is the amount of suction of soil sample before applying stress is quite less as observed in some previous studies i.e., Tarantino and De Col (2008). It shouldn't be less due the unsaturated condition of soil. In this case that may be due to the porous disc used with small pores, effect of which can be considered in future studies.

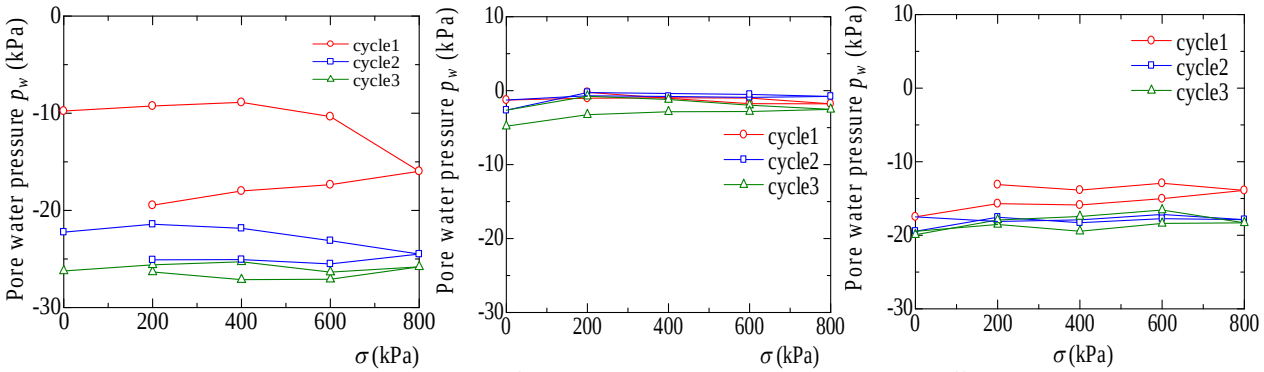

Fig.4: Change in pore water pressure for 10, 15 and 20 % moisture contents with different stress cycles

4. CONCLUSIONS

Observing the dry density versus moisture content relation (Fig.-5) that for given moisture contents the amount of dry density is still increasing towards the wetter side which supports the thought that using static compaction higher density can be obtained at higher moisture contents. The stress applied on the sample in case of static compaction is uniform as it is applied to certain defined area.

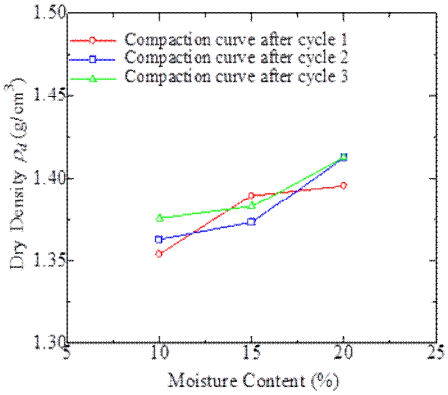

Fig.5: Compaction curve for all three cases 10, 15 and 20 % moisture contents

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