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Evaluation of the Geotechnical Properties of Collapsible Soils by Laboratory Testing.

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Abstract

This paper approaches the geotechnical aspects of unsaturated and collapsible soils that affect foundations structures and earthworks, causing pathologies in various constructions in Brazil. Thus, to analyze the soil properties were used samples collected from the Experimental Site of Soil Mechanics and Foundations of Unicamp. The tests were performed in the laboratory of soils mechanics at Faculty of Civil Engineering, where the tests of characterization, direct shear, collapse potential, and MCT classification were carried out. The results of the research show that the analyzed soil is potentially collapsible and has a laterite clayey soil behavior.

Key words:

Collapsible soil, collapse potencial, unsaturated soil.

Introduction

In Brazil, it is ordinary to observe the formation of cracks and fissures presents in most civil construction works, usually generated by differential settlement. Such settlement is caused by improper construction techniques in soils that are susceptible to flood and overloading.

Due to the tropical climate in many regions of Brazil, the amount of rainfall in certain times of the year is extremely high, therefore, the chances of a settlement by the collapse are higher. As well as the rain, seepage by water pipes disruption or sewer may also be responsible for increasing the soil degree of saturation, go through an abrupt volume variation, caused by a void reduction (ALBUQUERQUE, 2014).

Thus, this research looked for relations between the soil and increase of water content, evidenced in collapse potential and the soil behavior, suggesting the main characteristics of collapsible unsaturated soil.

Results and Discussion

After the collection of the samples, it has started to tests of soil characterization, as Atterberg Limits, Unit Weigh of Solids and Compactation, to establish the soil properties, presents in Table 1.

The Atterberg Limits shows characteristics of clayey soil, with 47% of the liquid limit, 32% of the plastic limit and 16% of the plasticity index. The particle size distribution results in silty sand.

Table 1. Soil properties.

Parameter	Value
Bulk Unit Weight (kN/m³)	13,6
Unit Weight of Solids (kN/m³)	30,8
Optimum Water Content (%)	23
Maximum Dry Unit Weight (kN/m³)	16,80
Void Ratio	1,8
Porosity (%)	64,5
Degree of Saturation (%)	41,7

The direct shear test shows a reduction of up to 40% in the cohesion when flooded and a decrease of 50% in the angle of shearing, reaching 18°.

To determine the Collapse Potential, it was necessary to execute the Double Oedometer test, whereby one sample was consolidated in natural moisture state and another one flooded, allowing comparison of soil void ratio to different verticals stresses and then determine the soil collapsibility by various criteria, presents in Table 2.

Table 2. Identification criteria of collapsible soil.

Method	Collapse Potential
Reginatto & Ferrero	Potentially Collapsible
Jennings & Knight	Serious
Vargas	Collapsible
Lutenegger & Saber	High Severity
Basma & Tuncer	High Collapsibility
Gibbs & Bara	Collapsible

Finally, to the MCT classification, it was held the Mini-MCV test, in order to obtain the compaction and deformability curves, as well as the loss of mass by immersion, being classified as a Laterite Clayey Soil.

Conclusions

Therefore, the analyzed soil presented collapse soil characteristics, evidenced by the high collapse potential in six different methods and by the properties changes according to a rise in water content. Also, the MCT classification shows a laterite soil behavior, whereby there is a frequent occurrence of collapse.

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