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Innovative Field Experimental Setup for Swelling Pressure Tests

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Abstract

Although the swelling pressure measured in the laboratory is not practical and is influenced by various criteria, it is undoubtedly important to calculate the swelling pressure of the soil on a larger scale, i.e., to determine the field swelling pressure that is very necessary if there is a case of foundation construction in black cotton soils. New innovations are discussed in this paper to solve this issue. The aim of the innovation is to create a field experimental set up to evaluate the field swelling pressure in order to escape the said defects and to reduce the effect of the scale produced in the laboratory determination. An revolutionary method for calculating the swelling pressure of black cotton soils, which is very easy in the region, is also the purpose of the innovation to be proposed. In order to reliably calculate the swelling pressure of black cotton soils, this new setup involves the installation of load cells as well as LVDT with digital display.

Keywords: *Geofoam, Slope, Retaining wall.*

1. Introduction

This invention relates to the development of field experiments set up for swelling pressure tests for black cotton soils and the like and helps to decide the field swelling pressure of the expansive soil, which is a requirement for the building of foundations for swelling and shrinkage problems in black cotton soils [1, 2]. The primary objective of the innovation is to establish a field experimental setup to assess the swelling pressure in order to escape the above-mentioned defects and to reduce the impact of the scale produced in the laboratory determination. An revolutionary method for calculating the swelling pressure of black cotton soils, which is very easy in the region, is also the purpose of the innovation to be proposed.

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2. Prior Art

A primitive process used in the established art is the determination of laboratory swelling pressure of black cotton soils/expansive soils using a very narrow 25 mm high consolidation ring and the swelling pressure effects are deviated due to the scale effect. Another advantage of this invention is to provide in-situ swelling pressure of the black cotton soil, which is actually developed around footing by 1 m x 1 m x 1 m mass of the swelling soil. Since the swelling pressure measured in the laboratory is not practical and is influenced by various parameters, there is a definite need to calculate the swelling pressure of the soil on a larger scale, i.e. to determine the field swelling pressure that is very important if there is a case of foundation construction in black cotton soils.
Limitations of Existing System

Following are the main disadvantages of the existing system:

a. Since the swelling pressure determined in the laboratory is on very small scale i.e with the help of consolidometer which is of only 25mm height and 100mm dia. due to the smaller volume of specimen it becomes highly difficult to get the correct swelling pressure of the expansive soil [3]. Likewise, when the dimensions of the laboratory equipments are very smaller it creates scale effects and it gives unrealistic value of swelling pressure.

b. Compaction is a process in which soil particles are brought closer to each other, so as to exert swelling pressure upon wetting. Some times in case of very small volume the soil sample gets over compacted and does not provide the correct swelling pressure, which ultimately leads to the excessive settlement of foundation i.e. the settlement beyond the permissible limit of design, which is very much dangerous for structures.

c. Swelling pressure is a pressure exerted by the underlying soil, when it comes in contact with water. Ultimately it is the force per unit area exerted by the underlying soil below the foundation. Vertical swelling pressure is exerted in the upward direction i.e. from downward side of foundation towards upward and hence there can be excessive displacement of foundation [4, 5]. In the crude method of swelling pressure determination small volume of soil mass undergoes the process of swelling and it cannot produce the correct pressure which may result into excessive displacement of the foundation. Ultimately leads to the failure of foundation.

3. Proposed Drawing for New Experimental Setup

According to this invention, the construction of two tanks, one inner perforated RCC tank and another brick masonry tank with loading frame and all arrangements as defined and believed, produces a field experimental set up for swelling pressure test. Thus, to address the drawbacks of the old crude method, a revolutionary field experimental setup was developed.

Following invention is described in detail with the help of Fig. 1 which shows the plan for proposed field experimental setup for swelling pressure determination and Fig. 2 showing cross section for proposed field experimental setup. Where,

1 denotes loading frame
2 denotes inner RCC tank 1 m X 1 m
3 denotes outer brick masonry tank

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4 denotes 20 mm diameter holes 100 mm C/C
5 denotes water
6 denotes soil
7 denotes footing 150 mm X 150 mm
8 denotes L.V.D.T.
9 denotes load cell
10 denotes loading jack
11 denotes digital display
12 denotes bed
13 denotes ground level
14 denotes geofoams layer 50 mm thick 150 mm C/C

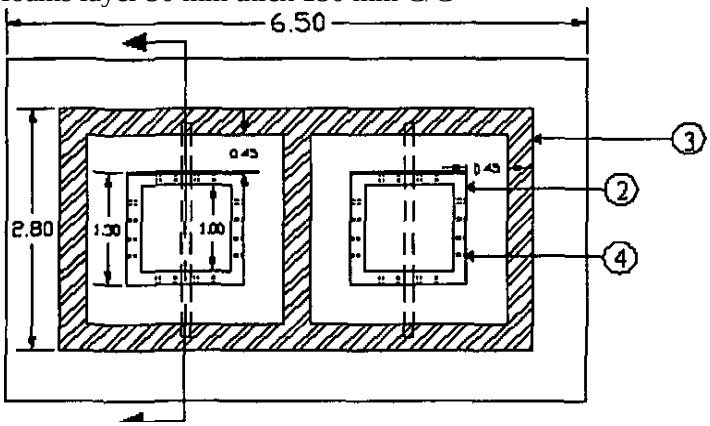

Fig. 1. Plan for proposed field experimental setup for swelling pressure determination

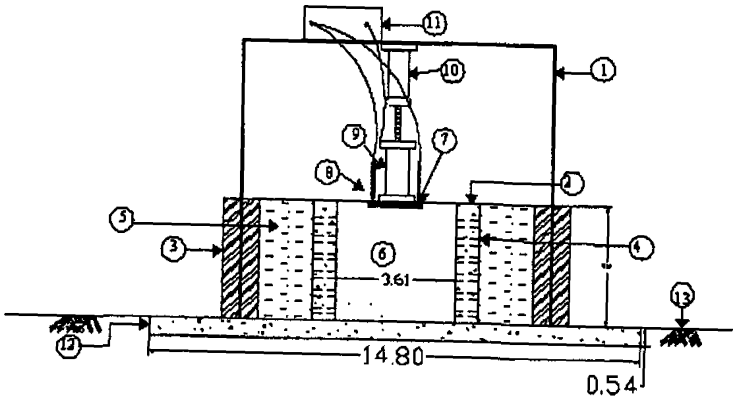

Fig. 2. Cross section for proposed field experimental setup for swelling pressure determination

4. Modifications in New Experiment Setup

As the black cotton soil is very harmful to the foundations, the drawbacks of the rudimentary method for assessing the swelling pressure of the laboratory are discussed above. Both negative effects such as size effect and volume effect are resolved by the suggested procedure for field experimental set up for swelling pressure determination. The benefits of this revolutionary field laboratory set up for swelling pressure testing are that no proving ring and dial gauges need to be used for load and settlement

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measurements. As instrumentation such as load cells and LVDT with digital monitor is being advanced to reliably test the swelling pressure of black cotton soils. As there is advanced instrumentation, i.e. load cells, LVDTs and digital display units, the suggested method is very simple and precise and provides accurate and consistent results in the long run, as it is immortal.

5. Conclusion

The swelling pressure measured in the laboratory is not realistic and is controlled by multiple parameters. In the case of base building in black cotton soils, this issue contributes to the need for adjustment of the experimental setup for field swelling pressure determination. This innovation relates to the development of experimental field set up for swelling pressure testing for black cotton soils and the like, helping to assess the field swelling pressure of the expansive soil, which is the prerequisite for constructing foundations with swelling and shrinkage problems in black cotton soils. There is no need to use test ring and dial gauges for load and settlement measurements as per this modern innovation. To reliably calculate the swelling pressure of black cotton soils, this new set-up involves the installation of load cells as well as LVDT with digital display.

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