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Research paper

Design and construction of foundations on wetlands

Aleksandr V. Kulikov *

Industrial University of Tyumen, Tyumen, Russia
**Corresponding author E-mail: zeeebr@mail.ru*

Abstract

The paper reports the excess pore pressures effect (that arises in shrinkable peat foundation) on its own physical mechanical characteristics. The authors suggested the upgraded assembly scheme of the soil pressure sensors (load cells). The laboratory research of the water-saturated macro peat sample was made in compression conditions with "ground lock" and modeling of the experiment with Plaxis 2D software system. The unit deformation-pressure graph and excessive pore pressure against time in different steps of load graph were built and based on this findings.

Keywords: *Pore Pressure; Peat; Plaxis 2D; Russian Federation.*

1. Introduction

The West-Siberia is the world leader in marshes concentration and marshes formation. Waterlogged soils cover more than 50% of a whole territory e.g. [1]:

- Russian Federation area is 17098.2 thousand square kilometers.
- West Siberian area is 2454.1 thousand square kilometers.
- Tyumen region area (without areas of districts) is 1464.2 thousand square kilometers.

Soviet scientists made the important contribution in question of organo-mineral soils. Especially, the research of compression tests of peat made by Amaryan LS and written in his monographs [2], [3]. Also Kazarnovskij VD and Evgenev IE [4], [5] presented the full classification of boggy grounds and the methods of engineering of line structures on a peaty moors.
Morareskul NN due to extended compression tests determinated K coefficient that show the conversion from 1-day unit deformation to 2 years tests [6].
One of the basic methods of building of engineering structures on peat soils is a surcharging with a well filtrate artificial basis made of medium, coarse or gravel type of sand. If the region is poor for such sand, then low filtering ability materials will be also applicable. Konovalov PA and Kushnir SY were made the large-scale set of experiments for studying of influence of filtration properties of filled-up grounds on a consolidation process of peat mass [7].

2. Subjects and method

The experiment includes studying of stress-strain state of a water-saturated macro peat sample with "ground lock" that consists of coarse sand.
The experimental investigation was made for studying of influence of excessive pore pressures on physical mechanical characteristics of muck foundation. The experiment was conducted in an interdepartmental experimental science lab of TSUACE (Tyumen State University of Architecture and Civil Engineering).

The experiment includes studying of stress-strain state of a water-saturated macro peat sample with "ground lock" that consists of coarse sand.
Experimental device (Fig. 1)is described in detail in the articles: "Investigation of physical and mechanical properties of peat", "Determination of physical and mechanical characteristics of macro sample of water saturated peat" and "Erection of transportation construction bankets from frozen and thawed swamp cohesive soils in permafrost" [8 - 10].

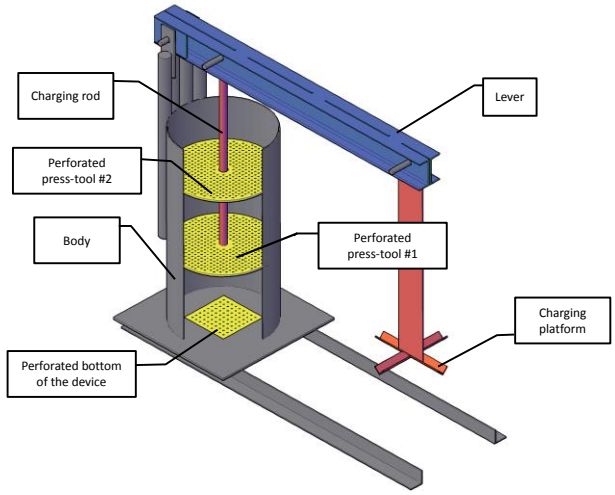


Fig. 1: An Experimental Device: 3d-Model.

The computing simulation of compression was made with Plaxis 2D v.8.2 software system (hereinafter referred to as PLAXIS) for identification in patterns of change in stress-strain state of peat soil (Fig. 2). The axisymmetric problem was set as initial conditions. The full water saturation was set for peat sample and for the "ground lock" (Fig. 3). Characteristics of soil based on physical mechanical characteristics of soils in lab tests.
Author used the elastoplastic model with Mohr-Coulomb yield criterion (hereinafter referred to as Mohr-Coulomb model) for modeling of the process.

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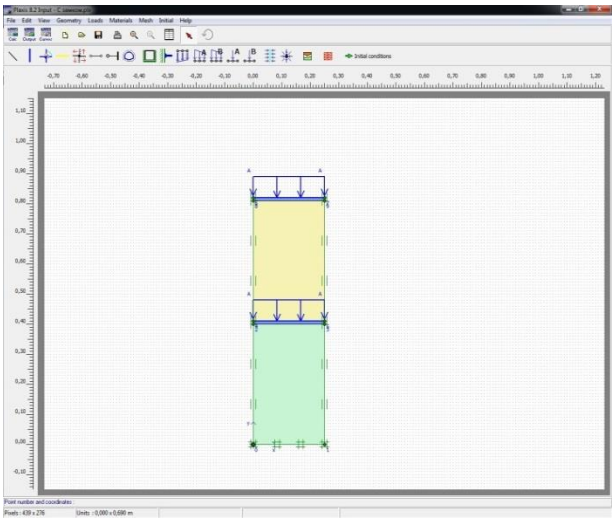


Fig. 2: Plaxis: Initial Conditions.

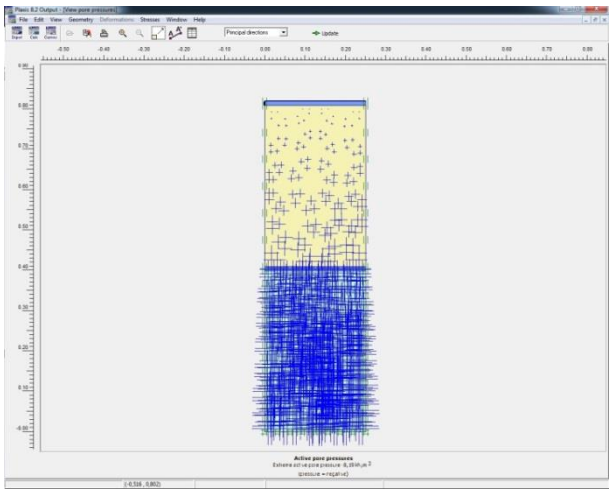


Fig. 3: Plaxis: Pore Pressures.

3. Results

The graph of unit deformations-pressure (Fig. 4) was built and based on the results of computing simulation and lab tests. According this model, the unit deformations were 0.247. It is 5% more than in lab tests.

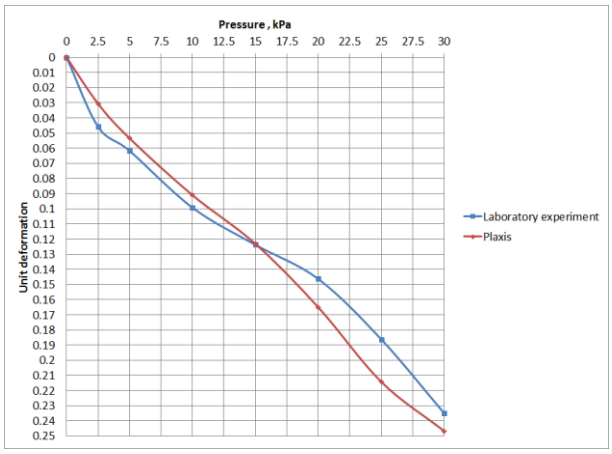


Fig. 4: Unit Deformation-Pressure Diagram.

In addition, the graph of the stresses in soil against the sample pressure at depths of 200 mm (Fig. 5) and graph of the excessive pore pressure against sample pressure at depths of 380 mm (Fig. 6) graph were also built.

New experimental device for research of mechanical properties of peat with excess pore pressure based and built on the results of lab research and analysis of literature sources.

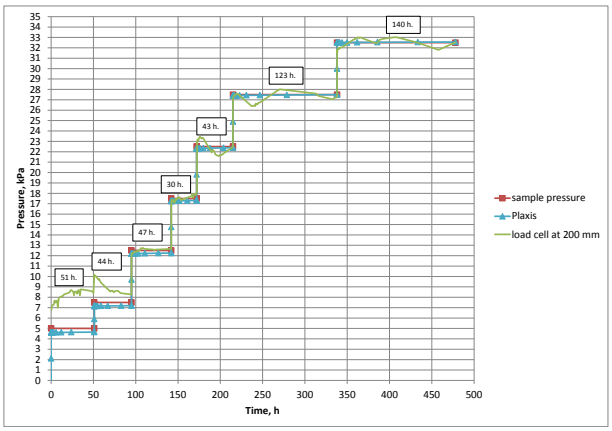


Fig. 5: Graph of the Stresses in Soil against the Sample Pressure at Depths of 200 Mm.

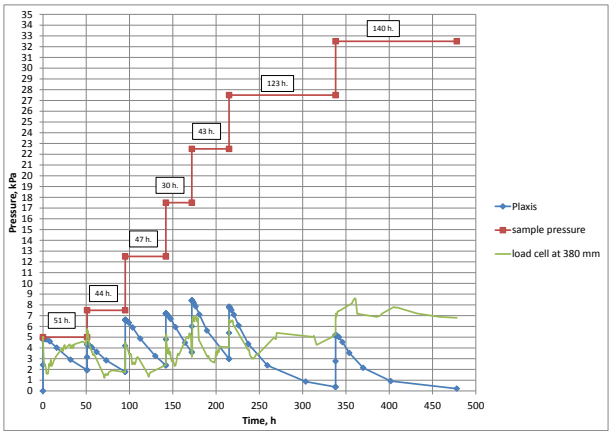


Fig. 6: Graph of the Excessive Pore Pressure against Sample Pressure at Depths of 380 Mm.

4. Conclusion

1) Russian Federation is the first in quantity of peat soils. Moreover, in Tyumen region it is more than 15% of a whole territory of region. The experience in design and construction of linear engineering constructions suggests that it is necessary to spot the mechanical characteristics of water saturated peat to reduce the errors in designing.
2) Existing methods for determination of physical mechanical characteristics of peat soils does not provide for the possibility of taking into account the influence of the excessive pore pressure on the mechanical characteristics (e.g. peat humidity can be more than 2000%).
3) Matching the values of general pressures that measured with load cell under press tool with the strain shows the 4% error (in 10-30 kPa range).It means that created assembling and connecting of load cells technology is efficient. Moreover, load cells have not been crashing during all the experiment.
4) Plaxis 2D v.8.2 software system is a good tool for displaying and modeling of the total pressing in soil. Nevertheless, differences in pore pressures indicate that chosen elasto-plastic model with Mohr-Coulomb yield criterion does not show the real picture. Further, it is necessary to spot the soil characteristics that make possible to use other models of Plaxis software system.

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