MONITORING THE DEFORMABILITY OF LAMINAR FOUNDATION BEDS DURING THEIR ENGINEERING PREPARATION

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This paper outlines practical experience gained with the development and use of monitoring of the consolidation compaction of nonuniform peaty foundation beds by vertical drainage with a surcharge at the experimental testing ground "Ol’gino" in a suburb of Saint Petersburg, which makes it possible to establish the effectiveness of the engineering preparation of laminar foundation beds.

The effectiveness of the engineering preparation of an land areas depends on both the properly selected (for specific soil conditions) method, and also the required monitoring of the process itself. To ascertain the effectiveness of different types of drains, experiments have usually been conducted in a uniform stratum of weak saturated soils to remove the influence exerted by any kind of inhomogenieties on the test results. Both domestic and foreign researchers have proceeded in this manner [1, 2]. Moreover, there is the opinion that if a stratum of weak soils is separated by horizontal interlayers of sand or good filtering soils, it is senseless to drain it by vertical drains, since their role in the overall drainage of the stratum is insignificant as compared with the performance of horizontally filtering layers or interlayers. One can agree with this in the general case; however, one should not forget that these layers may be closed, and hence, their significance as moisture receivers becomes minor. In our case, the selection of a site for experimentation was dictated by other conditions. A geologic-engineering section typical for the region was selected primarily, and the most effective type of drainage was determined for the site. Since all drains used in the experiment functioned under similar conditions, determination of their efficiency from results of the investigations did not present difficulties.

A site in the settlement of Ol’gino in a suburb of Saint Petersburg with nonuniform stratification of the stratum, which is characteristic of the northwestern European portion of our country, and with layers of weak soil – peat – distributed not only at the surface, but also throughout the depth, was selected for the investigations. Here, the physicomechanical properties of the soils varied significantly with depth.

It should be pointed out that characteristic features of the consolidation of the nonuniform stratum of soil, which is composed of three layers of peat occurring at different depths and separated by layers of weak saturated clayey loams, are still not well understood. There is the assumption that horizontal stratifications of peat will promote the discharge of water from the stratum being compressed. It is also impossible, however, to exclude the fact that layers of peat, which have been consolidated under the pressure of a surcharge fill, lose the ability to act as horizontal drains. If the influence exerted by the degree of peat decomposition on permeability is considered, these interlayers, may, with time, act as a certain obstacle to the vertical movement of water toward the filtering sandy surcharge. Under these conditions, vertical drains may play an inestimable role in the discharge of pore water.
Fig. 1. Diagram showing location of experimental sites (Nos. 1-6) and points where soils were investigated. 1 and 2) points where monolithic specimens were removed, respectively, prior to and after consolidation; 3) same, by Finnish specialists; 4) cone penetration of soils; 5) probing; 6) testing of soils for rotational-shear strength.

The basic goal of large full-scale field investigations has been to develop a rational method of stabilization and to ascertain the effectiveness of different types of vertical drains for acceleration of the stabilization process of strata formed from weak saturated soils with a core of expressed lamination. Work has been conducted on a complex cooperative program with Finland, an important part of which involved provision for consolidation monitoring of the investigations. Some results are presented in [3].

A program of consolidation monitoring was developed for the engineering preparation of experimental sections with drainage, which includes the following:

1) geologic-engineering monitoring related to monitoring of the physicomechanical indices of the soils by field and laboratory testing, penetration studies, and vane-wheel tests to determine the rotational-shear strength;

2) deformation monitoring, which calls for the installation of deep marks at each site for measurement of the layer-by-layer settlement of the nonuniform foundation bed and observation of the settlement of the contact surface of the sections being consolidated using surface marks and a system of horizontal inclinometric monitoring; and,

3) filtration monitoring, which is performed by observing the variation in excess pore pressure at characteristic points of the saturated layers of the foundation beds using pore-pressure piezometers, and in the ground-water table (GWT).

In turn, each consolidation-monitoring unit called for the following stages:

- a monitoring stage, which consists of a certain number of observation, measurement, or test cycles, which are supported by the program;

- an estimating stage, which consists in analysis of the observational results obtained and the derivation of preliminary conclusions; and,

- a prediction stage, which is executed by appropriate calculations and their comparison with the experimental data obtained.

Comprehensive investigations of the soils at all experimental sites were conducted within the framework of geologic-engineering monitoring. Figure 1 shows a site-location diagram for the experimental testing ground "Ol'gino" with an indication of the points subjected to the soil investigations. The properties of the