DETERMINATION OF MODULUS OF DEFORMATION OF LOESS SOIL COMPACTED BY HYDROBLASTING METHOD

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One of the most reliable and economical methods of preparing bases on loess soils, especially on soils of Type II collapsibility conditions is compaction of the collapsible masses by previous soaking and deep blasting (hydroblasting method) [1].

This method eliminates the collapsibility properties of the soils. However, over a certain period the soil masses maintain high water content and compressibility. Under modern construction conditions it is not always possible to wait until full stabilization occurs, and it becomes necessary to carry out the work on partially consolidated water-saturated soils. For this reason it is very important to know the modulus of deformation of the compacted base E, in order to correctly take into account its deformation characteristics and to ensure operating reliability of the buildings and structures.

It is extremely difficult to establish with sufficient accuracy the modulus of deformation of a soil mass layer converted after blasting into a highly compressible clayey soil of disturbed structure, since the usual methods of engineering-geologic exploration are little suitable for this purpose. At the NIISK Institute special methods have been worked out for determination of the strength and deformation characteristics of such soils by laboratory testing [2].

In this article a method is proposed for determination of the averaged modulus of deformation based on processing and generalization of data from full-scale observations on ground surface settlements at projects under construction. This approach has been previously applied in many works, for example in [3, 4].

During 1982-1985, in microdistrict No. 15 of the Khortitskii residential unit of Zaporozhe the hydroblasting method was applied for compacting the bases of 13 large-panel nine-story residential buildings (a total of 38 modules). In the microdistrict site, from the surface downward there were collapsible soils consisting of loesses and loesslike loams of a Quaternary deposit. The total collapsible mass thickness \( H_{sl} \) varied from 20 to 28 m. The soils underlying the collapsible mass consisted of reddish-brown loams 4 to 13 m in thickness having a low permeability. The dry density and the coefficient of relative collapsibility of the loess soil under the ordinary (overburden) load varied from 1.32 to 1.46 tons/m\(^3\) and from 0.01 to 0.06, respectively, the natural water content varying from 0.12 to 0.17, while the compressive modulus of deformation varied from 3.5 to 13 MPa in the natural state and from 1.2 to 7.5 MPa in the soaked state. Groundwater was not found within the microdistrict site limits.

In all the compacted areas, the basic technical parameters of the hydroblasting method were unified as follows: Use made of a single spacing of 5 m between the drainage—blasting holes, which were 0.35 m in diameter, the mass of each individual explosive charge (water-resistant “Granulotol”) being 15 kg placed at a depth of 10 m. The soil was soaked to \( S_r = 0.8 \).

All the buildings consisted of separate standard section-blocks in the amount of 2-5 units per building of Series 96—030/1 and 96—034/1, the length of each being 25 m with contraction joints between them. In 1984, in the microdistrict site experimental residential building No. 13 was constructed with an extended paired module 50 m long.

Surveying observations on the settlements of the surface of the compacted masses were carried out using a grid of surface and deep marks, as provided for in Norms [5], over all the compaction stages — during preliminary soaking, immediately after blasting, and over a certain period after blasting. Analysis of the settlement attenuation curves constructed from data from several levelings makes it possible to predict the rate and magnitude of the deformations of compaction under the dead weight of the soil at any instant and to establish the time of start of the construction—erection work. Having the data for the mean settlements of the ground surface and the dimensions of the collapsible mass, it is possible to determine the averaged value of the modulus of deformation of the compacted mass by the time of stabilization of the settlements. When


the soil masses are compacted by hydroblasting, conventional stabilization of the settlements is assumed to be 1 cm per week for structures of Category 2, 3, or 4, and 0.2 cm per week for more important structures [5]. When the above values are reached, the construction—erection work can be started taking into account that for construction on partially consolidated bases it is essential to consider the construction rise, equal to the extrapolated settlement of the soil under its dead weight and the building weight.