EXPERIMENTAL INVESTIGATIONS OF SINGLE-PILE FOUNDATIONS

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On the basis of experimental investigations of a test construction of single-pile foundations of ring-section piles, data were obtained on their operation, and the calculation scheme for vertical and horizontal loads was improved. The possibility was proven of determining the limiting resistance of such foundations according to data from static probing. Computer calculation programs were developed.

Among the various types of pile foundations, construction of a single-pile foundation is known, which consists either of one pile with a large cross section, or of a pile with a sleeve. These foundations, thanks to the combination of pile and sleeve of different diameters, most fully meet the requirements imposed on them: the diameter of the upper part of the foundation is chosen with consideration of placement of a column in it; and the length and diameter of the lower part, with consideration of provision of the required bearing capacity in given soil conditions for receiving the load acting on the column. These foundations, depending on soil conditions and the piles' dimensions, are capable of providing for bearing capacity up to 2000 kN. The experience of experimental construction of buildings and structures on single-pile foundations of ring-section piles has shown their effectiveness: estimated cost is reduced by 1.2-1.5 times in comparison with foundations in the form of clusters of prismatic piles [1, 2].

At the Ufa Scientific-Research Institute of Industrial Construction, experimental investigations of such foundations were conducted to improve the calculation scheme for the action of vertical and horizontal loads, and to develop a method for calculating their bearing capacity with the use of data from static probing.

Experiments were carried out at test sites in Ufa. Soil conditions were studied by processing of monoliths taken from boreholes, and by static probing. At the base of the sites lay Quaternary deluvial-alluvial, water-saturated, clay soils up to 15 m thick, with natural moisture content \( w = 0.257-0.331 \), density with natural moisture content \( \rho_f = 1.83-1.94 \text{ g/cm}^3 \), void ratio \( e = 0.779-0.957 \), flow index \( I_f = 0.006-0.343 \), angle of internal friction \( \varphi = 14-23^\circ \), cohesion \( c = 0.01-0.064 \text{ MPa} \), and modulus of total deformation \( E = 13-27 \text{ MPa} \).

We used single-pile foundations consisting of two elements: a sleeve in the form of a pile casing 960 mm in diameter, and a hollow round pile 500 mm in diameter. Before sinking the pile, static probing of the soils was performed with an S-832M unit, with a type-II probe 36 mm in diameter, "with stabilization" every 1 m to a depth of 5 m below the lower end of the foundation.

The elements of the foundation were sunk by the impact method using an S-878M pile driver with an S-330 rod hammer, according to the following technology. First, the upper element of the foundation (the sleeve) was driven, using a ram that does not allow the soil to rise into the sleeve's cavity. Then, it was tested for a vertical load with the ram left in, i.e., with a closed end. In the inner cavity of the sleeve, plate-bearing tests were performed (plate 760 mm in diameter, with an area of 4534 cm²), after which, with the help of a punch, a hollow round pile was sunk and tested. In this case, with the help of a special device, the effect of the sleeve was excluded. The foundation as a whole was tested after concreting the sleeve's cavity. Before concreting, the upper end of the pile was closed with a metal cap plate, so that no concrete got into it.

In the process of sinking the elements, we measured the soil's upward yielding. It was established that, when a reinforced-concrete sleeve 960 mm in diameter is driven to a depth of 2.2 m, the volume of the soil's upward yielding is often equal to or somewhat greater than (due to loosening of the soil) the volume of the sunken part of the construction. With an increase in the relative depth of driving, the volume of upward yielding decreases to from 0.2 to 0.3 of the volume of the pile's body. Subsequently, the pile is sunk on account of interaction of regions of shear and compaction of the soil under its lower end, and the soil does not push up. Visual observation in the process of sinking showed the presence of a cavity along the outside..
surface of the sleeve, which extends to a depth of 1.2-1.7 m. In studying factors affecting the bearing capacity of ring-section piles [3], a reduction was observed in the specific resistances of soil under the lower end of the piles in comparison with the resistance under the tip of a probe. The amount of this reduction depends on the relative depth to which the pile is sunk. Observations of