ADVICE TO DESIGNERS AND INVESTIGATORS

USE OF STOCK PILES OF SMALL SECTION FOR DETERMINING BEARING CAPACITY OF PILED FOUNDATIONS

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In recent years, when conducting tests associated with the determination of the bearing capacity of piled foundations, an ever wider application is being found for investigations of stock piles of small section (pile models), sunk by driving them to levels corresponding to the anticipated depths of the tips of industrial piles [1]. They substantially reduce the cost and testing periods owing to the reduction in the number, and even the complete elimination of investigation, of test piles of full size.

The effectiveness of application of stock piles of small section instead of test piles is governed by the following factors:

a. the possibility of multiple use of these piles in tests;

b. use of a considerably lighter, more mobile and cheaper pile-driving equipment,

c. employment of a lighter equipment involving less metalwork, for testing piles with static loading;

d. shorter duration for testing.

At Fundamentproekt designs were developed for stock piles of small section, also a self-propelled unit for their sinking and withdrawal, equipment for static-load pile testing, and a methodology for conducting these tests and determining the bearing capacity of pile foundations from their results.

A stock pile of small section consists of a steel pipe of 114-mm outside diameter, with a conical tip, made up of several sections 2 m long, with threaded joints (Fig. 1).

The sinking and withdrawal of stock piles, also assembly of the supporting components for their static-load testing, is carried out with a special self-propelled unit erected on the bed of an automobile chassis GAZ-53 (Fig. 2), which includes a pile driver equipped with a mechanical hammer of 400-kg mass freely falling from a height of 1-1.5 m, a double-plunger (paired) jack of 400-kN capacity for withdrawing piles after the tests, and an erection crane of 5-kN capacity.

Static-load tests on stock piles of small section are carried out with the aid of a demountable unit which consists of a hydraulic jack of 500-kN capacity, and is mounted onto the pile to be tested; a supporting arrangement (with or without a beam) which takes up the reactive forces from the jack and transfers them to anchorages; stock anchors (steel tubes, Cock dental, 12 mm in diameter and 3 m long, with a U-shaped head, Fig. 1).

Fig. 1. Stock pile of small section.
screwed piles, or anchors with expanding blades), and a datum mark with devices for measuring displacements of the pile during testing.

Presented in Fig. 3 is a general view of a unit employing a beamless supporting system whose principal elements are: a steel cap installed onto a hydraulic jack, inclined tie rods with swivel joints connecting the cap sill to the anchors, and horizontal tie rods connecting the anchors to a circular frame which takes up the horizontal components of the anchor loads.

Sinking of the stock piles of small section, and preparation for and carrying out of static-load testing is effected having regard to the requirements of All-Union State Standard (GOST) 5686-69. However, based on an analysis of test data, the adopted criterion of "conditional stabilization" of settlement at each step of static-test loading differs from that given in GOST: The conditional stabilization is considered to be achieved if the increment of displacements not exceeding 0.1 mm is observed within 30 min, and not 2 h as specified in GOST. Adoption of such a criterion enables the duration of tests of small-section piles to be reduced substantially.

It should be noted that tests on stock piles of small section must be carried out in conjunction with static probing of the soils, the results of which are used to mark the locations and number of tests and to determine the necessity or otherwise of conducting investigations on full-sized test piles.

The results of observations of driving stock piles of small section, like those of dynamic tests of test piles, are used to verify the possibility of driving production piles to designated depths and for supplementary evaluations of the homogeneity of soils at the site.

The results of static-load tests on stock piles of small section are used to determine the bearing capacity of full-scale piles under press-in loading. Also, the standard resistance of piles is determined by an empirical formula which is similar to Eq. (4a) in [1]:

\[ \frac{p_{st}^f}{u_{fp}} = \frac{u_{sp}}{u_{sp}} \frac{p_{st}^s}{u_{sp}} \]

where \( p_{st}^f \) is the standard pile resistance corresponding to settlement \( \Delta \), which is determined in accordance with Paragraph 6.3 of Chap. II-B.5-67 of Construction Standards and Regulations (SNiP); \( u_{fp} \), perimeter of the full-scale pile; \( u_{sp} \), perimeter of the stock pile of small section; \( p_{st}^s \), standard resistance of the stock pile, taken to be equal to that load on the settlement vs. loading graph at which settlement of the stock pile is equal to the above-mentioned settlement \( \Delta \).

The correctness of applying Eq. (1) is confirmed by the results of the generalization, analysis, and statistical processing of data from 70 static-load tests carried out in parallel on stock and full-scale piles, in different ground conditions. For the full-scale piles the sectional dimensions were 30\( \times \)30 cm and 25\( \times \)25 cm, and the driven depth for full-scale and stock piles ranged from 5 to 10.5 m.