For construction of farm production buildings with skeletons of three-hinged frames, use is made predominantly of foundations consisting of prefabricated reinforced-concrete asymmetric footings placed on plain or rubble concrete.

The construction of such foundations calls for consumption of a large quantity of concrete and of erection labor. The backfills around them are, as a rule, of low quality and moisture is concentrated in them, with the result that the bearing capacity of the foundation bed is lowered. Since, depending on the frame span and spacing the thrust may reach 200 kN and more, it is evident that ordinary prismatic piles cannot be used as foundations for such buildings. A support consisting of an ordinary pile with a head cannot withstand large horizontal loads. Supports in the form of pile clusters with cast-in-place heads are not sufficiently effective. For buildings with skeletons of three-hinged frames, a special type of pile was developed which consists of a driven tee beam with a bracket. The pile length is of 3-6 m, and the flange and web width is 0.5 m [1, 2].

This new type of pile has been used in the construction of more than 150 farm production buildings in various regions of the nation (Moscow, Ryazan, Rostov, Novosibirsk, etc.). The economic effect resulting from their use ranges from 5000 to 8000 rubles per building.

The introduction of these piles in the construction field was preceded by tests on them in different types of soils, including collapsible soils. Static tests of these piles were performed in accordance with GOST 5686-78 [3] using a stand designed by the TsNIEPsel' stroi [4].

At an area at which the soil base consisted of homogeneous loams with a consistency index $I_L = 0.4$ and a void ratio $e = 0.85$, tests were carried out using a strain-pile (Fig. 1), provided with Type M-70/11 strain-recording cells, designed by the Central Scientific-Research Institute of Constructional Elements (TsNIISK) of the Government Committee for Construction (Gosstroi) of the USSR, for measuring stresses at the pile-soil interface, and with 2PKM-20-100GB strain gauges for measuring the stresses in the pile cage reinforcement. The displacements of the pile sections were determined by deflectometers. The deflectometer strings were passed through holes drilled from a pit driven at a distance of 3 m from the pile. Each string was fitted with a magnet, by means of which it was secured to a metal part embedded in the pile during its fabrication. The deflectometers were installed in the benchmark system erected in the pit. To calibrate the tee-shaped strain-pile, a stand was fabricated and erected on the power floor. At places determined in the analysis, at distances $l_1 = 1.16$ m, $l_2 = 2.21$ m, and $l_3 = 3.7$ m from the pile head, previously calibrated cylindrical springs were placed. The conditional point of rotation of the pile was fixed on the floor at a distance of 1340 mm from the end. The springs were slipped at their ends over rings 76 mm in diameter and 60 mm long to prevent them from being displaced from their prescribed positions and were set against cantilever tables and supports mounted in the floor by means of anchor bolts. All springs were fitted with 6PAO Aistov System deflectometers, with the aid of which their displacements were measured to an accuracy of up to 0.01 mm. The inclined load was transmitted from the metal support by a hydraulic jack exerting a force of 500 kN in steps.

The experiments were carried out to investigate the dependence of the horizontal displacements, the soil reactions, the stresses, and the bending moments in the pile sections upon the force, the angle of inclination of which with respect to the vertical was $\beta = 40^\circ$. For force inclination angles $\beta = 35$ and $30^\circ$ only the horizontal displacements of the strain-pile sections and the corresponding soil reactions were determined. For each force inclination angle the strain-pile was tested twice. After the test next in turn, the strain-pile was pulled out and driven again for a second test.

Table 1 presents the measured displacements $y$ (mean for two strain-pile tests with $\beta = 40^\circ$) and the soil reaction pressures $q$ at different pile sections, as well as the moduli of subgrade reaction, calculated from the well-known relation $K = q/y$. Table 2 shows the measured strain $\varepsilon$ of the pile reinforcement and the corresponding stresses $\sigma$ and bending moments $M$ in the pile sections. The analysis of the test results showed
that, depending on the load transmitted, the pile deformations take place according to two different schemes. In the initial loading stages, the horizontal displacements of the piles are determined by bending of its upper part; the lower part is not subject to deformation. As the load increases, the length of the bent part of the pile increases also. When the inclined force reaches a certain value, the nature of the pile deformations changes and the horizontal displacements of the sections occur basically as a result of rotation about the point of zero displacements. When the load increases, the bending of the pile decreases, and with sufficient accuracy for all practical purposes the pile may be considered as an absolutely rigid element.

The change in the nature of the deformation of the pile during the process of its driving is due to the fact that the rigidity of the soil base decreases as the inclined force transmitted to the pile increases, this being applied more exactly to the horizontal component of that force (thrust). For small values of the thrust, the base soil deformation takes place as a result of compaction. As the thrust increases, in addition to further compaction there is a partial shear of the soil, attended by decrease in its resistance to horizontal displacement of