In construction practice it is not rare that a foundation bed is underlain by bedrock, as in construction areas of L'vov.

Inhomogeneity of a foundation bed affects the function of the construction-foundation-bed system. In the literature, however, there is no information concerning experimental work on measuring stresses in such foundation beds. The only published work on this problem was only carried out for inclined bedrock, and the contact pressures and stresses in the soil mass were not measured [1]. Interesting results were obtained by Lazebnik [2] during field investigations of stresses beneath buildings, but they were very few. In consideration of this, the authors carried out experimental investigations in 1971–1972 for determining the effect of inhomogeneity of a foundation bed and the rigidity of structures on the distribution of contact pressures and on deformation of the structure; they also investigated the distribution of stresses in the foundation bed.

The structure was simulated by a steel beam, for which homogeneity of the material and precision of geometric dimensions are characteristic. To obtain different rigidity values of the structure, beams with three different bending characteristics were used: B-1, channel bar No. 10, 1200-mm long; B-2, a bar with a 100 × 20 mm cross section and a length of 1800 mm. As a standard of comparison a B-3 beam was tested on a homogeneous foundation bed of practically infinite thickness at a depth of \( h = 6b \) of the foundation bed (\( b \) is the width of the beam).

Beams B-1 and B-2 were tested on a sandy foundation bed of restricted thickness \( h = 2b = 200 \text{ mm} \), and also on a stepwise inhomogeneous foundation bed with two or three different values of the total strain modulus of the foundation bed. In addition, the B-3 beam was tested on two additional combinations of a stepwise inhomogeneous foundation bed. Inhomogeneity of the foundation bed was modeled with a clearly defined strain modulus of the soil, which was achieved by a stepwise design of the floor of the pan.

Below we have shown the results of only two series of experiments: No. VIII with the B-1 beam and No. IX with the B-2 beam (Fig. I).

The experiments were carried out in a pan 0.83-m deep, with plan dimensions of 4.23 × 0.7 m. The walls of the pan were covered with a polyvinyl chloride film for reducing the friction between the soil and the wall. The beams were loaded by means of two specially designed mechanical presses, previously calibrated by means of a dynamometer. Strains in the beams were measured by ICh dial indicators with scale divisions of 0.01 mm.

For measurements of pressure in the soil, MK-54 and MK-26 hydraulic dynamometers, designed by Yu. N. Murzenko, and an MTsM-2 dynamometer, designed by G. E. Lazebnik, were used. The readings of the hydraulic dynamometers were recorded by an AI-1 electronic strain meter. In each experiment, from 18 to 24 hydraulic dynamometers participated, and from 13 to 18 strain indicators were mounted.

In the process of conducting the experiments, soil samples were selected for determination of their physical and mechanical properties. For material of the foundation bed, low-moisture sands of medium grain size and density were used. The grain-size distribution is as follows: 8.15% particles larger than 0.5 mm, 48.22% between 0.5 and 0.25 mm, 28.27% between 0.25 and 0.01 mm, and 15.35% below 0.01 mm.

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Fig. 1. Schematic view of experiment VIII (experiment IX was similar). Numbers in the circles are for strain indicators; those beneath the beam are for hydraulic dynamometers. Dimensions and datum marks are in millimeters.

In all the experiments a symmetrical load in the form of two concentrated stresses at a constant distance of 0.8 m between them was applied. At first the beam was compressed by two loads of about 1000 N, which were held till full stabilization of settlement. The strain gauges and the hydraulic dynamometers were read, and these values were taken as the initial values. The beam was then loaded in steps of about 1000 N on each press. Unloading was effected in the same steps. Each step of loading and unloading was maintained to provisional stabilization, i.e., until the dial indicator at the point of greatest settlement did not move a single division for a period of 10 min. Readings of the hydraulic dynamometers were made every 10-20 min after application of the load. After each series of experiments a sample of soil was taken, by means of a cutting ring, from a depth of 20-30 mm, for determination of the principal physical and mechanical properties. The sands were then dug up and packed anew to a depth of 0.2-0.25 m. About 260 samples were collected in every experiment. In addition, about 30 plate tests were made for determining the general strain modulus of the soil, by bending of a steel plate 300 x 100 x 10 mm.

In the initial two or three loading steps, a notable divergence in readings of the hydraulic dynamometers in the contact layer was observed. This was apparently due to the impossibility of producing a dense and uniform contact between the beam and the foundation bed. It was also affected by change in the temperature-moisture regime in the medium surrounding the hydraulic dynamometer after application of the load. Other investigators have also encountered this phenomenon [2-5].

With further loading, and also during unloading, deviations in readings declined. In most cases a small deviation in readings was also observed in hydraulic dynamometers in the lower layers of the foundation bed.

From readings of the dynamometers and the strain indicators, curves of stress $\sigma$ and strain $S$ versus load $P$ were plotted (Figs. 2 and 3).

No linear relation is generally observed between load and stress. An approximate curve was therefore constructed graphically, as recommended in [6, 7].

For criteria of corrections of interpreting readings of the dynamometers and the stress curves, equality of the areas of the contact-pressure curve with applied load was adopted.

In the two series of experiments investigated, the absolute deviation of area of the contact-pressure curve from the load curve ranges from $-36\%$ to $+23\%$ with a standard deviation from the mean value in different experiments of 35 to 38 and with a coefficient of variation of 16-19%. Deviations of this order during stress measurements with the dynamometers have been noted by many scientists [2-5], and they may therefore be taken as fully acceptable.