No. A-10 APPARATUS FOR TESTING COMPRESSIBILITY AND CAPILLARY PROPERTIES OF SOILS

V. Boulichev, Senior Scientific Worker, All-Union Foundation Research Institute, Moscow, USSR

Apparatus for determination of compression curve, Poisson's ratio, and modulus of elasticity of soils. The following device (see Fig. 1) has been developed for the experimental determination of the compression law and Poisson's ratio for soils.

The apparatus of Boulichev for the determination of the compressive properties and the Pouasson's relation in soils

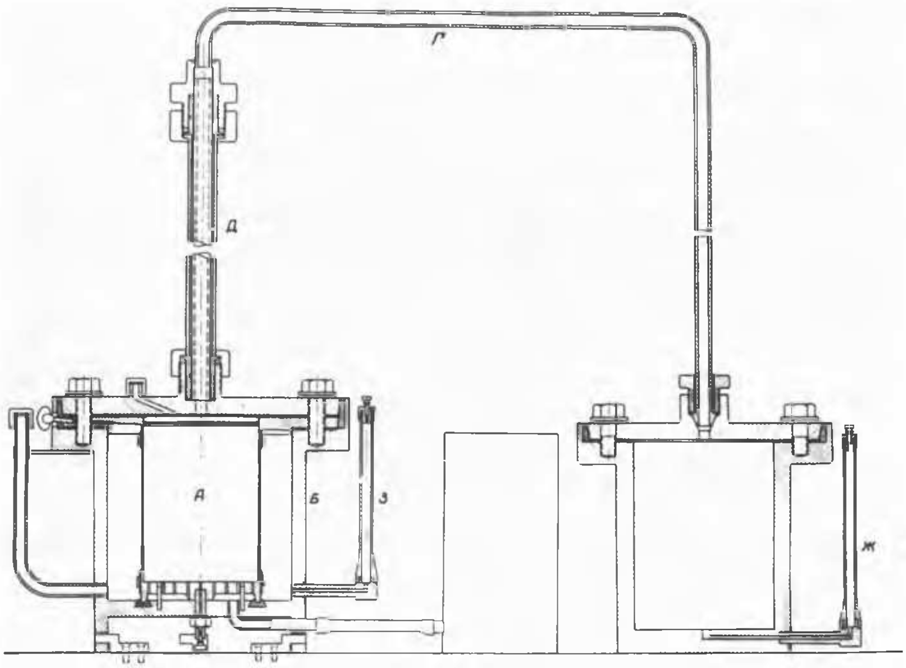

Fig. 1

A cylindrical specimen "A" the sides of which are confined in a rubber envelope is placed in a cylinder Б , the cover of which has a hollow cylindrical space. The vertical pressure is applied by means of compressed air which is supplied from the cylinder "B" through the tube Г .

The compressed air transmits the pressure to the water Д , which in turn transmits the pressure through a rubber membrane to the sample "A".

The exactness with which the deformation of the sample can be measured during the vertical compression depends on the ratio between the cross-section areas of the sample and the tube Г .

The vertical pressure is measured by a manometer Ж .

To eliminate the possibility of lateral expansion of the sample all the space between the cylinder wall and the sample is filled with water, and hermetically sealed. During the compression the lateral pressure is measured by an aerostatical manometer 3 , consisting of a graduated capillary tube made of thick glass.

The apparatus of Boulichev for the determination of the capittary pressure in soils

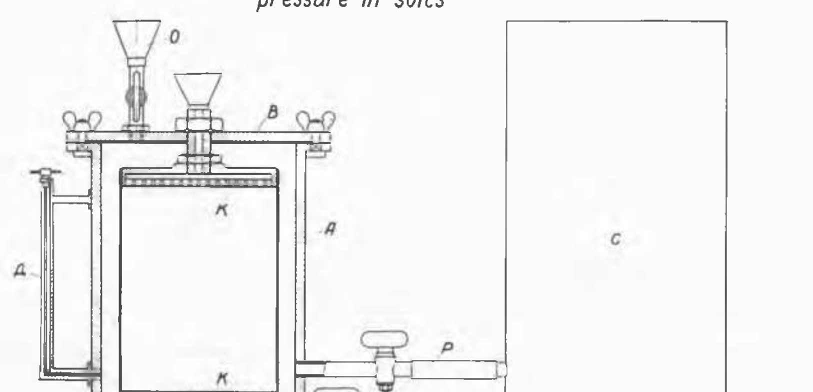

Fig. 2

Apparatus for determination of capillary pressures in soils. The apparatus is shown in Fig. 2 and consists of the following principal parts:

A rigid metal cylinder "A" is hermetically closed with a rigid cover "B". An aerostatical capillary manometer Д is attached to the side of the cylinder. Two openings are made in the bottom of the cylinder. One of them is used for providing communication with the vessel "C" through the tube "M", and the other one for fixing the porous plate "K".

A similar porous plate "K" is fixed in the cover "B". The test is carried out in the following manner:

A cylindrical specimen "T" must be cut from a soil-mass monolith. This specimen is confined laterally by a rubber envelope and placed between the plates "K" which prevent the possibility of the expansion of the sample in a vertical direction.

To eliminate the possibility of the lateral expansion the space between the cylinder wall (A) and the sample is filled with distilled water. The air is forced out through the special cock "O".

After the filling of the cylinder with water the cocks "O" and "P" are closed.

Before the beginning of the test, the following should be noted:

1. The time of the beginning of the test
2. The atmospherical pressure
3. The temperature of the water

After the opening of the cock "M" the water penetrates through the porous plate in the sample and gradually releases the soil from internal stresses. The rising pressure is fixed by the manometer Д . As the diameter of the manometer tube is small, only a negligible lateral expansion of the sample is possible.

The pressure in the water is to be computed from the equation:

$$\sigma = P_o \left(\frac{L_o}{L_1} - 1 \right) \quad \text{where} \qquad (1)$$

P_o is the atmospheric pressure at the moment the manometer is closed. L_0 is the height of the air column in the manometer before the test; L_1 the height of the air column at the moment of the reading.

The corrections for temperature are made according to the generally used formulae.

<u>Apparatus for determination of height of capillary rise in undisturbed soils.</u> The apparatus is based on the following principle:

The weight of the water column, balancing the lifting force of the menisci which divides the capillary water in the soil from the atmosphere, is substituted by the reactive force of compressed air applied to the menisci from their concave sides.

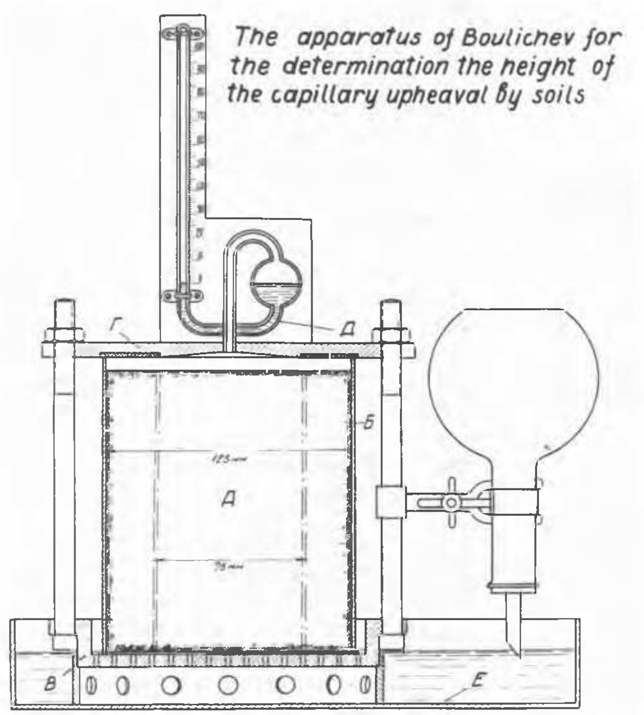

Fig. 3

Hence, by measuring the pressure which it is necessary to apply in order to stop the capillary movement of the water in the soil we obtain the height of the capillary rise.

The apparatus is shown in Fig. 3. An undisturbed soil sample "A" is placed in a metal cylinder Б and confined from two sides by covers "B" and Г , a layer of filter paper being placed between the sample "A" and the cover "B". An aerostatical manometer Д is attached to the upper cover. After the device is assembled, it is immersed in the water filling the vessel "E". The water penetrates the porous bottom "B" and being capillarily raised by the soil compresses the air contained in the voids of the soil.

The pressure in the manometer is computed by Equation (1). The height of the capillary rise is computed as follows:

$$H = 10.03\,\sigma + a$$

Where: "H" is the unknown height of the capillary rise in meters, "a" the height of the capillary rise in the tested sample.

No. A-11 THE SPRING-SCALE CONE, A POCKET-APPARATUS FOR DETERMINING THE FIRMNESS OF CLAY

O. Godskesen, Geo-technical engineer of the Danish State Railways. M.S.D.C.E.

Laboratory investigation of the firmness of clay has been conducted by the Danish State Railways by means of the Fall-Cones, invented by Mr. John Olsson of the geo-technical Commission of the Swedish State Railways (1914-1920).

Two kinds of Fall-Cones have been in use: (1) for soft clay a 60° Steel-cone weighing 60 gr. and (2) for hard clay a 30° Steel-cone weighing 100 gr.

In testing the clay the Steel-cone is fixed in a position, so that the point of the cone just exactly touches the surface of the clay. The cone is then released and drops so far down into the clay as the firmness of this permits, the depth of the imprint of the cone giving a measure of the firmness of the clay.

In the original Fall-cone test the Swedish Firmness Index H (Halfasthedstal) is defined as 10 for a clay in which the 60° and 60 gr. Cone, by falling as above described, made an imprint of 10 mm.

It was, however, difficult to get Danish practical Civil Engineers to use this unit, and therefore in 1926 a new Danish unit was introduced by Mrs. Ellen Louise Mertz (Danmarks geologiske Undersogelse II Raekke, Nr. 44). Mrs. Mertz defines the Danish Firmness Index K (Konsistenstal) as the weight in Kilogram of that 60° Steel-cone, which, by falling as above described, makes an imprint of 10 mm.

The relation of the Danish and Swedish Unit is thus