

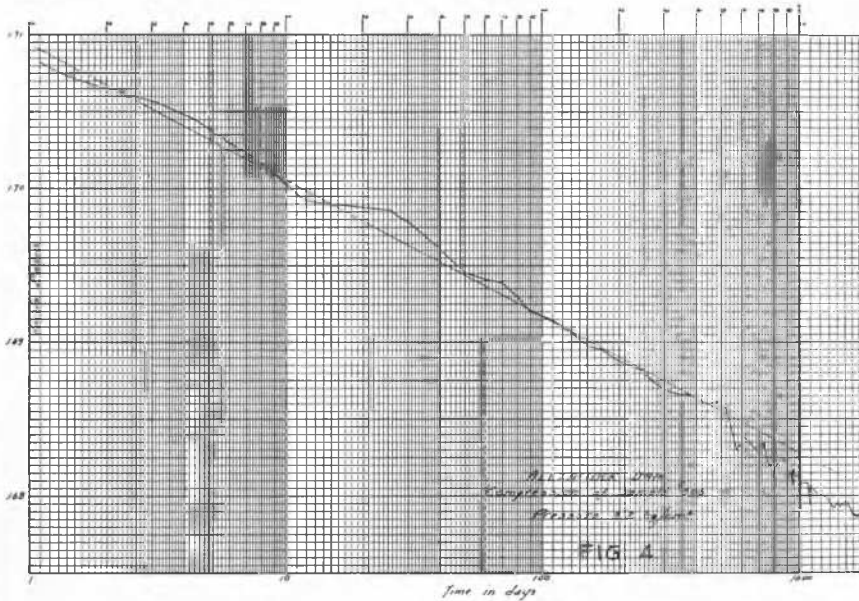
INTERNATIONAL SOCIETY FOR SOIL MECHANICS AND GEOTECHNICAL ENGINEERING



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their open structure under compression and a failure to drain properly when consolidated by compression. The final completion of the dam was therefore accomplished by the provision of an extensive tile drainage system throughout the downstream beach or shoulder section of the dam, Fig. 1 and 2. With this provision no difficulty was experienced in completing the dam to its full height of 128 feet above the ground surface under the centerline. Its performance since completion has been entirely satisfactory with a settlement somewhat less than computed by the consolidation curve of the core, Fig. 3.

In connection with the core consolidation studies we are continuing a long-time consolidation test on a representative sample, as shown in Fig. 4.

During construction of the dam more than one hundred soil samples were subjected to a complete analysis, including determination of consolidation characteristics, Atterberg Limits, grain size distribution, etc.

No. Z-13

EXPERIMENTS WITH MODELS FOR DETERMINING THE DEFORMATION
AND TENSIONS IN FOUNDATIONS ON PLASTIC GROUND
Ing. Ad. Pogany, Krakaw, Poland

When designing foundations we often make arbitrary assumptions on stress distribution which simplify the calculation of stresses, but may have nothing in common with reality. It is true that some American, German and Swedish investigators have carried on practical and theoretical studies of the mechanics of soils. Nevertheless in my opinion there have as yet been no suitable and systematic investigations of the joint action of the building ground and foundation, or of the stress distribution caused by the phenomena of settling of the building and the relation of the settling to the deformation of the foundations.

The correct determination of stress distribution requires a method which (1) is not excessively costly, i.e. which does not demand any particular outlay for equipment; (2) can be easily adopted everywhere, not only in a specially equipped laboratory, but also on the building site; (3) can give sufficiently useful results for a practical design.

In my investigations I have studied the deformations of plastic soils by means of models, in which the soil is replaced by another plastic mass with different physical properties. The actual magnitude of the deformations in the soil under a foundation cannot be determined by experimenting with models. However, the experiment with a model serves principally to determine the pressure distribution, or the assumptions of the deformation for a system of foundations, and for this purpose it is not indispensable to know the exact physical soil constants.

The plastic masses used in the tests, freshly made mortar with gypsum, mortar with cement and concrete with sand, harden after subsequently setting and the pictures of the deformation can easily be examined in these hardened

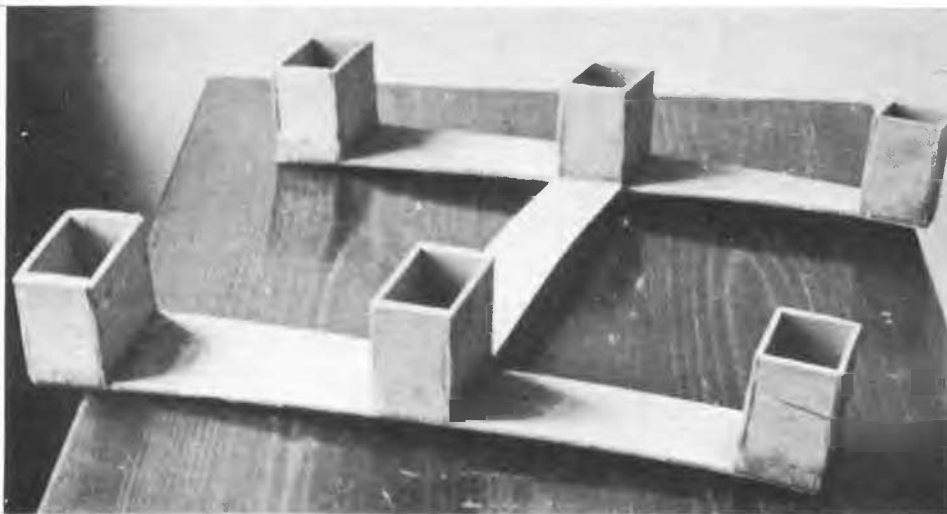


Fig. 1

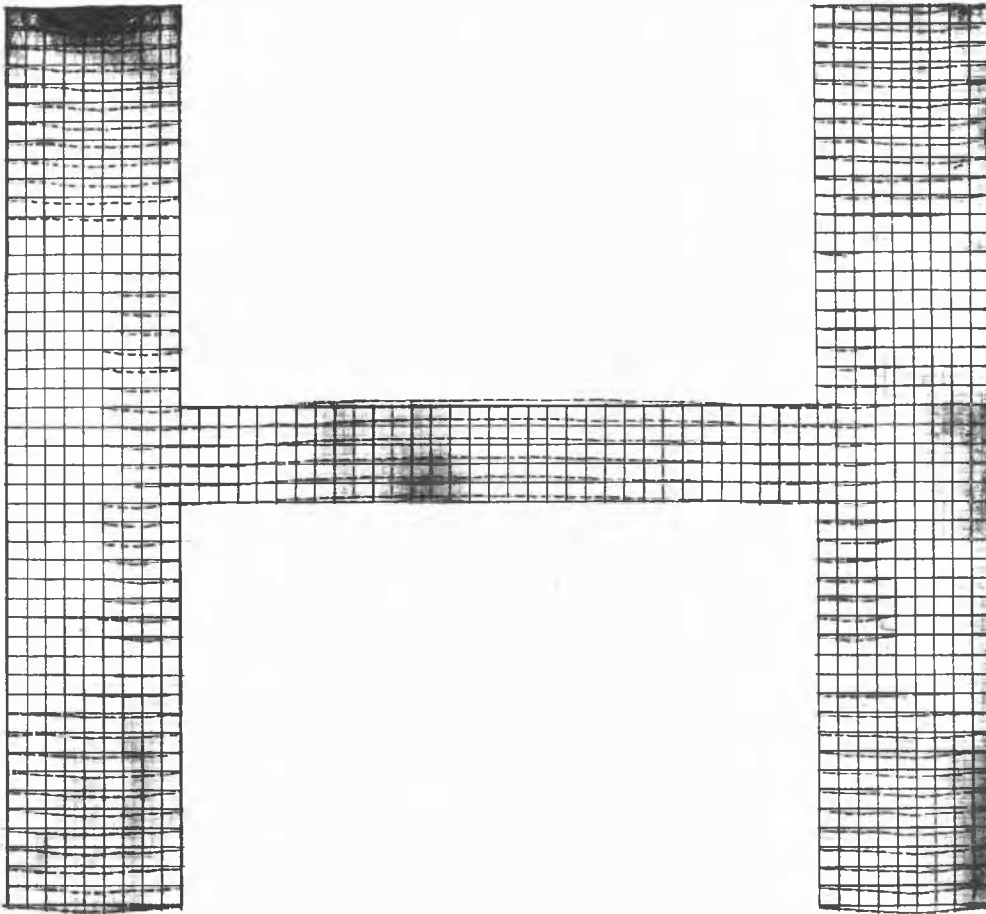


Fig. 2

masses. The deformations were measured by means of a wire stretched above the deformed mass in the original surface, using a Zeiss extensometer which reads with an accuracy of $1/100$ mm. The measured deformations can be shown graphically.

How far the small models can be compared with the actual buildings and to what extent these mechanical similarities can be applied is a question still to be specially examined. Geometrically similar bodies may give mechanically similar results. Kögler finds that the behaviour of foundations of various dimensions varies during the process of settling though the units of pressure are the same. With a constant pressure per cm^2 the settling in relation to the dimensions of the surface is neither constant nor proportional. In spite of their geometrical similarity the foundations are not mechanically similar. As we observe from Föppl's experiments (Vorlesungen über techn. Mech. 13 d IV, S. 305, Routh: Dynamik der Systeme starrer Körper

p. 330) when the models are executed to the scale of $1:\lambda$, the forces in the model should be calculated as $1:\lambda^2$ for the true conclusions to be drawn.

When investigating soil the question is not so simple. Young's modulus in the soil itself is not constant and it differs with the depth. From simple investigations with models one could make great blunders in defining the actual figures of the deformation. However, my experiments show that the results are reliable as far as the relative distribution of the deformations in a system of foundations is concerned.

Various forms of foundations were made with elastic wooden plates of various lengths, loaded with uniform pressure. See Fig. 1. The positive and negative deformations as well as the inflection points are situated in similar points. For static calculations it is usual to assume a uniform distribution of the reaction, or else a complicated parabolic distribution of the reaction, difficult to solve mathematically. On the basis of these arbitrary assumptions we obtain the bending moments and design the foundations.

Fig. 2 shows the actual deformations after a test. We see at places the negative distortion in the foundations and we conclude that the assumption of a uniform distribution of the reaction would show completely false results. Fig. 1 shows the wooden models. Their dimensions are not in a previously calculated relation to the actual foundations, the conditions of elasticity for the wooden models are also other than in reality. It has already been stated that it is not here a case of defining actual changes and stress values but only of a test of the truth of the general assumption as to the deformation and distribution of the reaction. It is therefore not necessary that the dimensions of the foundations should be in strict mathematical conformity with those of the model.