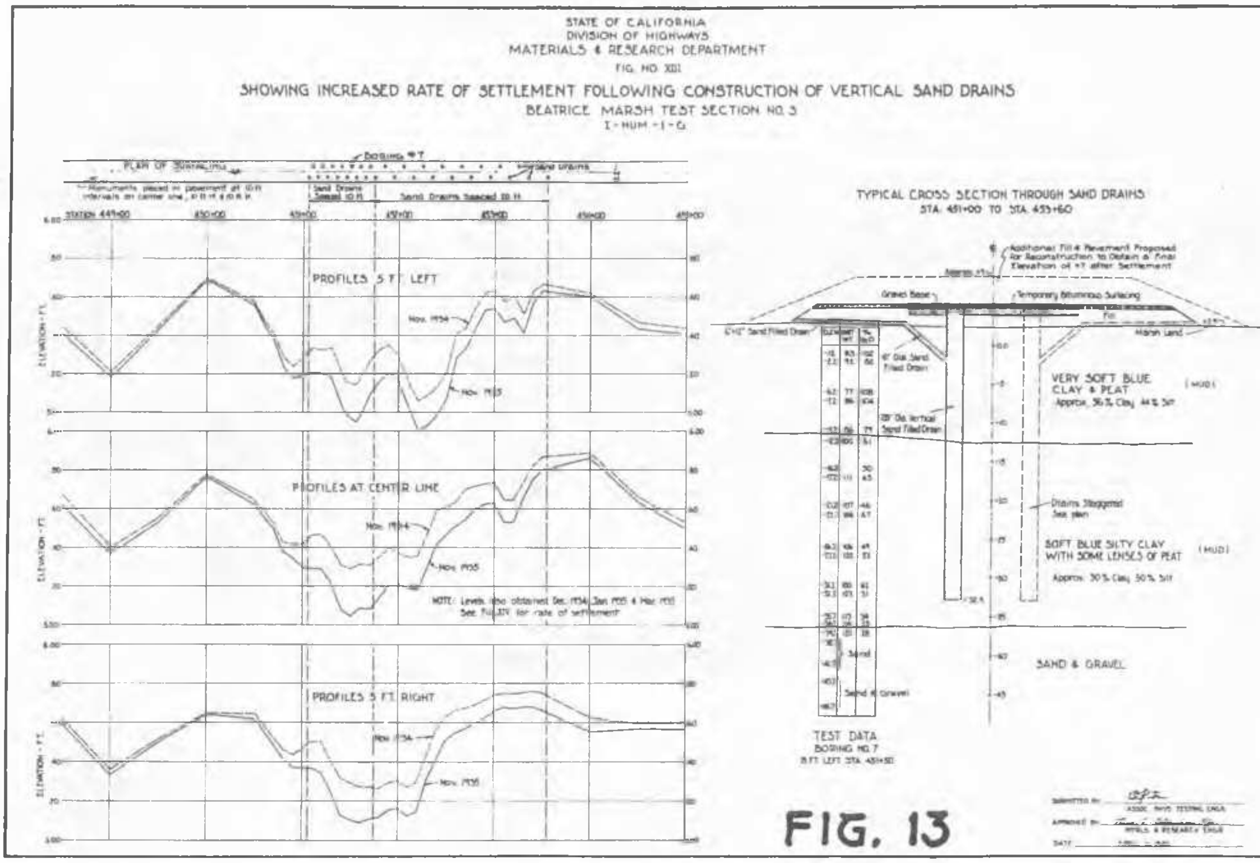

FIG. 13

No. L-2 EXPERIMENTAL ROAD FOR HEAVY TRAFFIC ON A VERY COMPRESSIBLE SOIL (PEAT-BOG-GROUND)

J. A. Royer, Civil-Engineer of the "Provinciale Waterstaat in Zuid-Holland", the Hague.

In a part of the Province Zuid-Holland with a very compressible soil, consisting of peat-bog-ground of a depth of 8 to 10 m and where the firm foundation is situated about 10 to 12 m below the ground-surface (fig. 3b), a number of new roads for heavy traffic must be built.

Till now the usual construction of earth-works in this sort of soil-condition has been the tipping of sand on the peat-bog-ground, which is pressed away by the weight of the sand, until the latter had reached the firm foundation. In this way the railroad on Fig. 1 was constructed.

Apart from the damage caused to the surroundings by the peat-bog pressed aside, this construction has the drawback, that in this case, where the firm foundation is situated very low, a huge quantity of sand has to be used for the laying-down of the road-embankment, which is very expensive.

As the projected roads are to have an embankment of about 18 m (20 yards) wide, so that each m length of the road would require 150 to 200 m^3 (5000 to 7000 cubic feet) sand for the building of the embankment, the construction-costs would be too high. Hence the possibility was faced to get to a less expensive construction, without exposing the stability of the embankment to danger.

Therefore was looked for a construction, which would make it possible, that the peat-bog was only compressed and not pressed away. In this case the sand-body penetrates much slower into the peat-bog and even if the peat would be compressed at the end to a thin layer on the firm foundation, the sandfill will be divided over so many years, that already by that means only is saved considerably on the building-expenses.

As a method to attain this (slow) compression of the peat was chosen a layer of fascine (fascine mattress), built on the top of the peat as foundation for the sand-body, which was gradually tipped on the mattress after it was constructed.

For investigation purposes a road of about 200 m of this system was constructed. It was layed out alongside of a rather narrow many centuries old road and after completion traffic has been directed over it. (Fig. 1)

As at the beginning there were no indications how far within a certain time the mattress would settle in consequence of the weight of the road-embankment and the traffic and as for the preservation of the fascinage it is necessary, that within a few years the top of the mattress is lying beneath the underground water-level, the peat was dug out over a depth of 1 m (Fig. 4a & 5a). On that level the fascine mattress was constructed, so that the top came till 0.10 m above the water-level.

The fascine mattress (Fig. 2, 4 & 5a) is made entirely of fascines or brushwood and consists of 3 main parts, to wit:

GENERALPLAN OF THE EXPERIMENTAL ROAD
SITUATION VON DER PROBESTRASSE

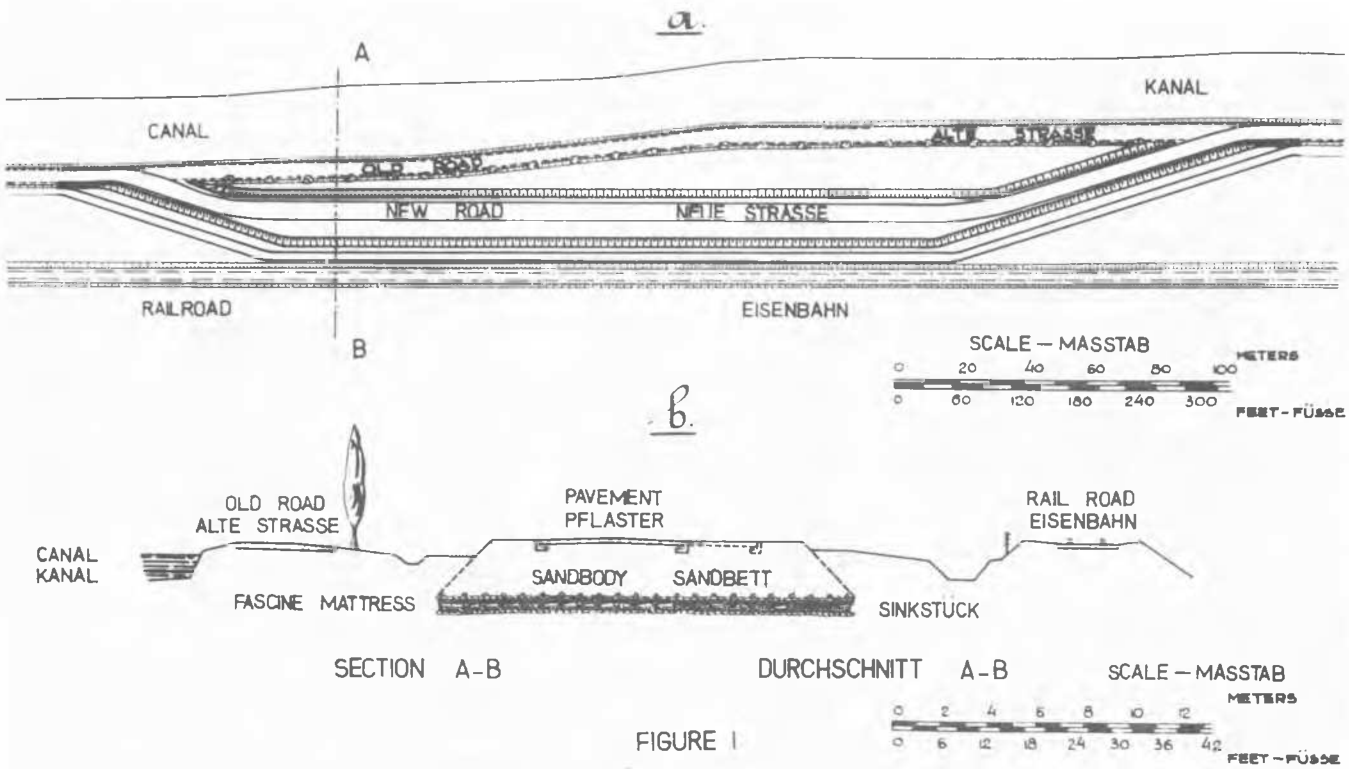

FIGURE I

FASCINE MATTRESS
SINKSTÜCK

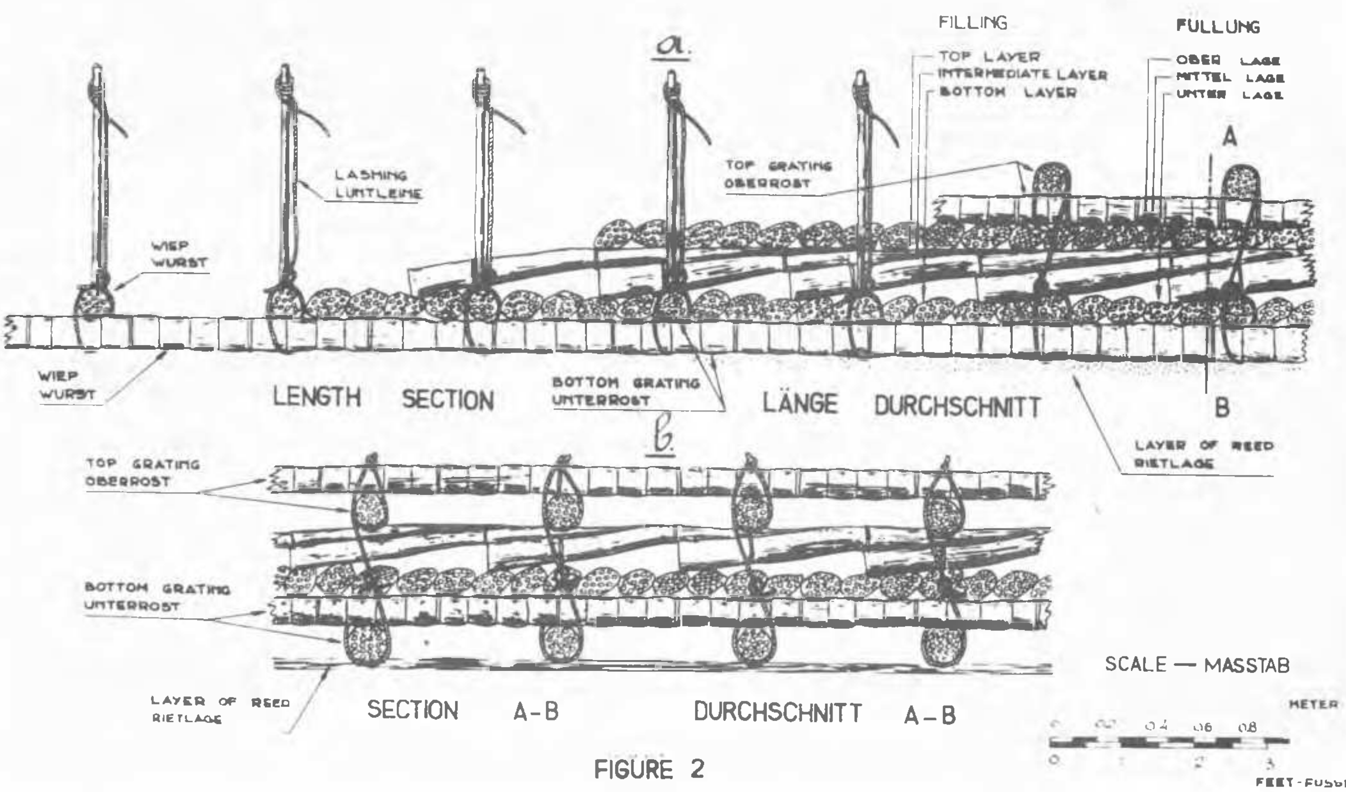

FIGURE 2

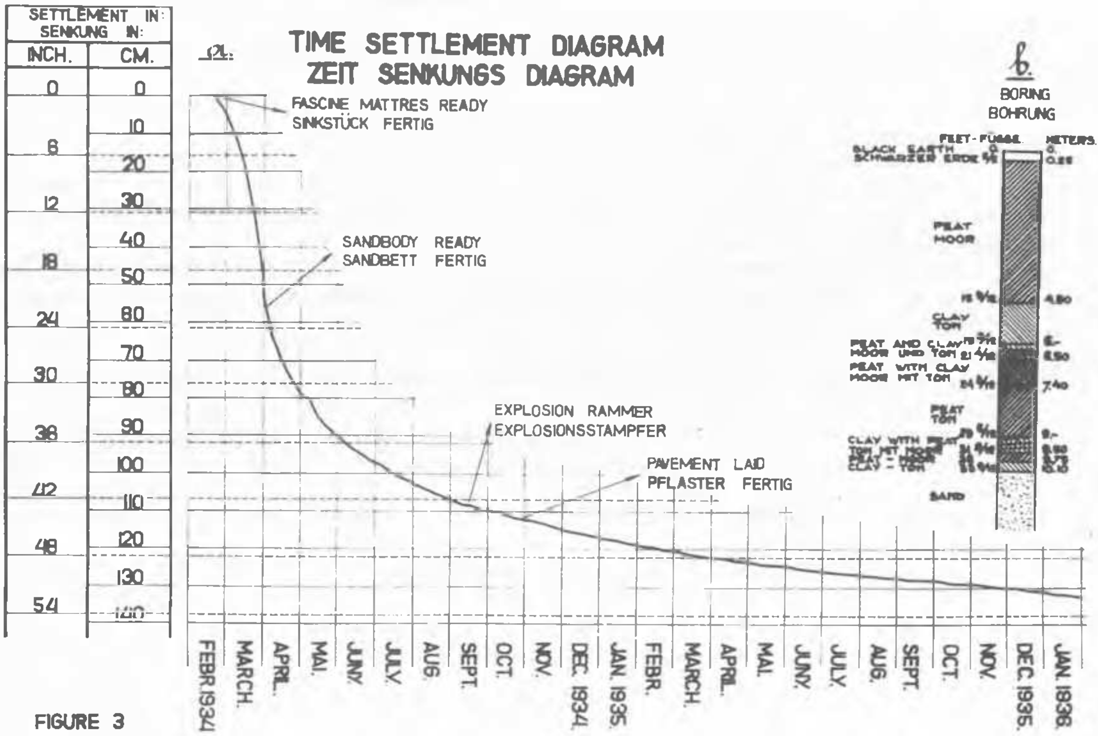

FIGURE 3

a LAYER OF REED RIETLAGE

a SOAKING WITH SAND AND WATER EINSCHLÄMMEN MIT SAND

b FASCINE MATTRESS SINKSTÜCK

FIGURE 4

b EXPLOSION RAMMER EXPLOSIONSSTAMPFER

FIGURE 5

1. one grating constructed by means of "wieps" at a distance of 0.80 m c. to c. (with meshes of about one square yard), which forms the bottom part;

2. a filling of brush-bundles, applied in 3 layers, crossing each other, each layer thick about 0.15 m (5");

3. one grating, similar to the bottom one, which is placed on the top of the filling.

Bottom and top grating are firmly connected by means of ropes (lashings) at each point of intersecting of the "wieps" of the bottom and those of the top grating. For this reason the intersecting points of the "wieps" at bottom and top must correspond, that is to say, they must be placed in the same perpendicular. In this way the entire structure becomes one strong mattress, which has considerable tensile and compressive strength.

"Wieps" are best compared with heavy hawsers. They are made of branches of brushwood, which are placed together in such a way, that they overlop each other. To obtain the necessary strength the branches are pressed together by means of bonds. Bonds are applied at intervals of about 0.15 m (6") and are made of osier twigs.

The "wieps" have a circumference of 0.40 m (16"), except the cross "wieps" of the bottom grating, which have a circumference of 0.55 m (22").

The cross "wieps" are made in one piece with a length of 17 m. The longitudinal "wieps" are made in lengths of 50 m and these lengths are connected by tying the ends together with osier twigs at a distance of about 2.50 m.

The brush-bundles of the intermediate layer of the filling, such in contradistinction to the bottom and top layer, are loosened and spread.

The fascine mattress has a thickness of 0.80 m (32") including the bottom and top grating.

As the peat was so soft, that the workmen were sinking away in it beyond their knees, a thin layer of reed was spread before starting the construction of the mattress (Fig. 4).

Before tipping the sand for the road-embankment on the mattress, the fascinage was penetrated with sand by soaking it with sand and water (Fig. 5a).

The sand for the road-embankment was filled in with layers thick 0.30 m. The first two layers were brought in place by wheel-barrows, the others by trucks. Continually the sand was spread uniformly all over the surface to a total amount of 2.20 m on the top of the mattress. The tipping of the sand took about 2 months.

After completion nothing was done to the sand-body during 4 months. Then the surface was brought to one level, rammed by an explosion-rammer with a dead-weight of 500 kg (Fig. 5b), after which a brick pavement, 6 m wide between concrete curbs, was laid. The top of the pavement was then lying 1.20 m above the underground water-level.

As soon as the laying of the pavement is finished, the traffic is directed over the new road.

Until now the applied construction did not give any disappointment. The fascine-work forms a continuous base without any joints, either in length or width. It has a low dead-weight and distributes the pressure, excercised by the weight of the road-embankment and the traffic. Embankment and fascinage together are able to resist tensile and compressive stresses in case of deflection. This makes it possible, that parts of the soil with less resistance than the surrounding are bridged over and so local settlements are prevented.

It is noted, that the surroundings of the experimental road do not participate in the settlement. The ramming with the explosion-rammer did not influence the settlement of the fascinage. The embankment itself and perhaps the mattress too settled together about 0.10 m (4") in the last $1\frac{1}{2}$ years.

Now during 2 years the settlement of the bottom of the fascine mattress has been observed every week at 14 points. The settlement of those points did not show much difference. The average of those 14 records of the settlement of the mattress, caused by the load, has been given in a time-settlement-diagram (Fig. 3a).

This diagram proves clearly, that the settlement has decreased considerably. But as it is necessary to get surety about the further path of the diagram, also in order to derive the most economical level on which the fascine mattress has to be built, the diagram has been compared with the results of the laboratory-tests of undisturbed soil-samples. These tests were made by the Laboratory for Soil Mechanics at Delft.

For further information can be referred to the Paper of Professor A. S. Keverling Buisman, giving indications which seem favorably for the settlement in the future.

No. L-3

VERTICAL AND LATERAL DISPLACEMENTS OF A REINFORCED CONCRETE CULVERT UNDER A HIGH EARTH EMBANKMENT

M. G. Spangler, Associate Structural Engineer,
Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa

In the development of Marston's Theory of Loads on Underground Conduits, (Bulletins 31, 47, 57, 76, 79, 80, 93, 99, 104, 108, 112, and especially 96 of the Iowa Engineering Experiment Station) it has been shown that the vertical settlement of the top of a culvert in relation to certain elements of the enveloping earth embankment has a very important influence upon the magnitude of the load which the embankment imposes upon the structure. This paper is a report of the measurements of both vertical and lateral displacements of a reinforced concrete horseshoe arch culvert under the action of an earth embankment which is 64 feet high above the top of the culvert.