No. B-1

# EXPLORATION OF SOIL CONDITIONS AND SAMPLING OPERATIONS

Submitted by the Laboratory of Soil Mechanics, Delft

Methods of exploration. Borings made by means of an auger with valve, give a general idea about the character, the place and the thickness of soil-layers.

Samples obtained from these borings often give, as a matter of fact, a wrong idea about the physical characteristics of the soils encountered. By moulding and mixing the soils, their consistency and water-content is completely altered. When layers of small thickness and variable character vary along the depth of the boring, the mixing of the different soils causes the wrong impression of layers of mixed soils.

Borings made by means of a shell auger, have not the draw-backs ascribed above. The soil comes out of the shell as a curl lying along the blade. The soil-bits from this curl cannot be considered as undisturbed samples. The soil is not so thoroughly remoulded and soils get not mixed up, in so far this method is better than the above mentioned.

In sands and very loose, soft soils this method however fails.

As a rule both methods are used simultaneously to get a general idea regarding the subsoil.

A very different method of exploring the subsoil is the field-testing by means of a sounding-apparatus. A description of this apparatus is contained in paper No. B-3 by Mr. Barentsen.

It gives only a comparison between the consistency of the layers tested by the cone, and its use is generally restricted to the exploration of the softer upper layers, which are of interest when planning road embankments.

A plan of a test-result obtained by sounding the subsoils before the construction of such a road embankment is given in fig. 1.

Methods of sampling. The sampler A (fig.2) is lowered into the boring-pipe, after having shoved the sample-tin inside the container. The length of the sampler-pipe can be increased at will by pipes of 2 m. with threaded ends and sockets.

The force required to press the sampler into the soil is either furnished by its weight or can be exerted on a cross-handle (fixed to the pipe) by hand force or by means of swivels.

During the lowering of the sampler, the rubber-stop is kept fully open, so that the ground-water displaced by the sample can flow out freely through the side-openings.

After filling the sampler, the rubber stop is screwed down by means of the rods, till it fits tightly. The sampler-pipe is then turned round to loosen the soil sample at its bottom end and the sampler is pulled up. The sample-tin is then removed from the container.

The sampler B (fig.2) is constructed according to the same principle. Only the container of the sample-tin is kept very short, and the tin is kept in place by a screw-ring.

The apparatus is generally used for taking samples without the help of a boring-pipe.

Its small weight and simple construction are of great usefullness, when taking samples of the softer upper layers, at small depth of a region of great extension. It can be handled and transported by not more than one man.

The sampler C (fig.2) is a simple instrument. It has been used to obtain undisturbed samples of sand at the bottom of an open pit.

The outting-ring is pressed in; the protuding sand at the upper surface is scratched off with a sharp edge. A thin metal plate is then shoved under the cutting-ring.

The sample can be used to do a consolidation test on the job or the sand can be put in a container to be dryed and weighed afterwards for determination of the water-content and the volume of pores. The dimensions of the sample-tin are given in fig. 2.

The handling of the sample-tin after its removal from the container. After the removal of the sample-tin from the container, the excess-water (and sometimes the muddy rests from the auger-boring) are poured out from the top-end of the tin. Both ends of the tin are then covered with hot paraffin. After the hardening of the paraffin, this acts as a means against the drying-out of the sample and by putting both caps on, the paraffin-covers prevent the change of position of the sample.

During the transportation of the tins to the laboratory vibrations and shocks are avoided as much as possible.

The sample is pushed out of the tin by a plunger. A photograph of the plunger-apparatus is shown in fig. 38 of a paper describing the Delft Soil Mechanics Laboratory (to be published in Vol. II). As the soil-cylinder can be pushed out entirely, it enables the inspection of the whole sample, before it is divided in parts. By means of a strong thin thread parts of the soil-cylinder can be cut off.

The apparatus for practical investigations in the laboratory are made in such a way, that the soil-cylinders can be put in quite easily.

Very soft samples are enveloped in a hose of thin blotting-paper (especially for putting them in the cell-apparatus). This enables the soil-cylinder to retain its original form and the danger of moulding the sample is avoided.

Difficulties in removing the sample are encountered with very sandy soils. The friction between the soil and the tin may then require a considerable force to push the sample out.

The apparatus A (fig.2) can be used to any required depth. At great depths difficulties are chiefly caused by the great hardness of the soils. The use of swivels has shown itself practical, when forcing the sampler down.

It is necessary however to provide the sockets, at regular intervals along the length of the pipe, with circular plates which can put on during the lengthening of the pipe. The outer diameter fits to the

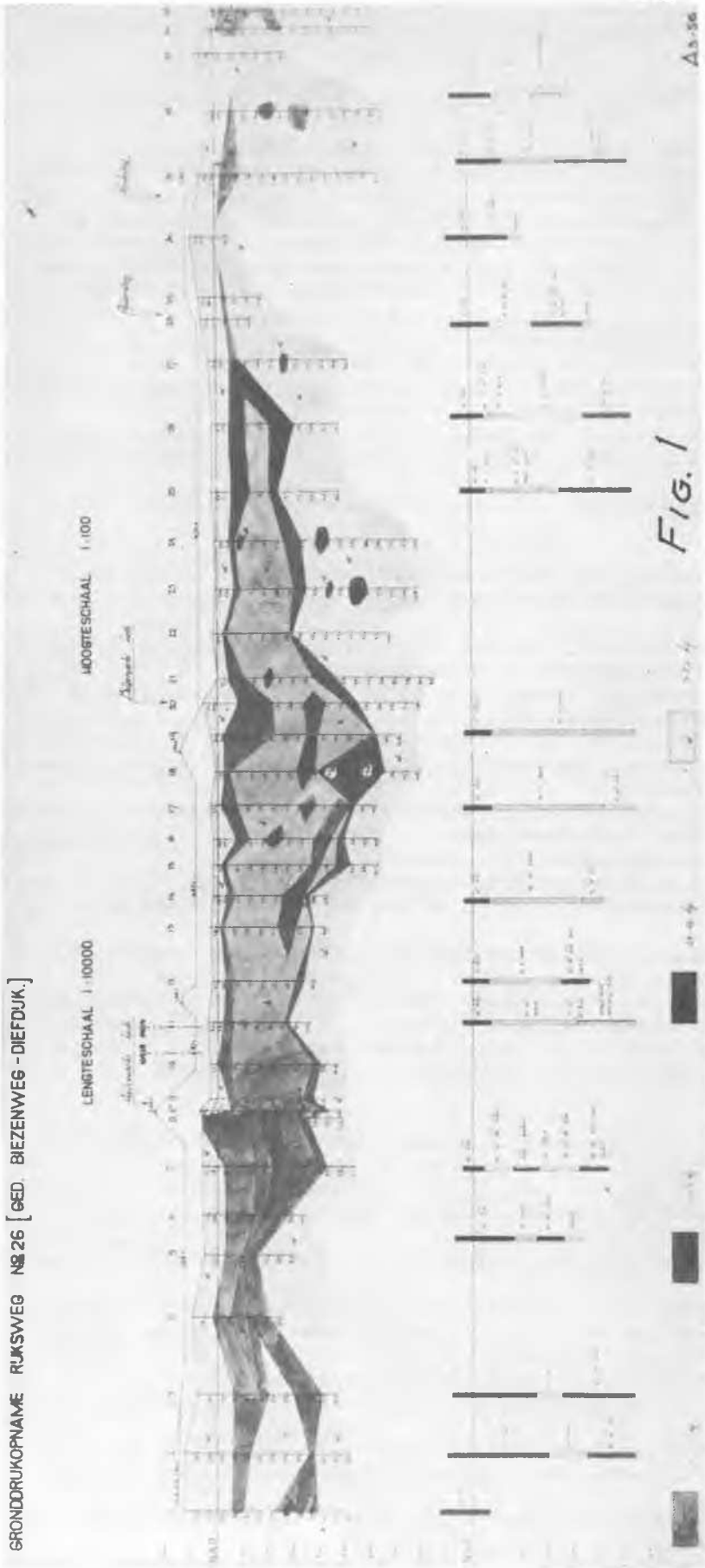


Fig. 1

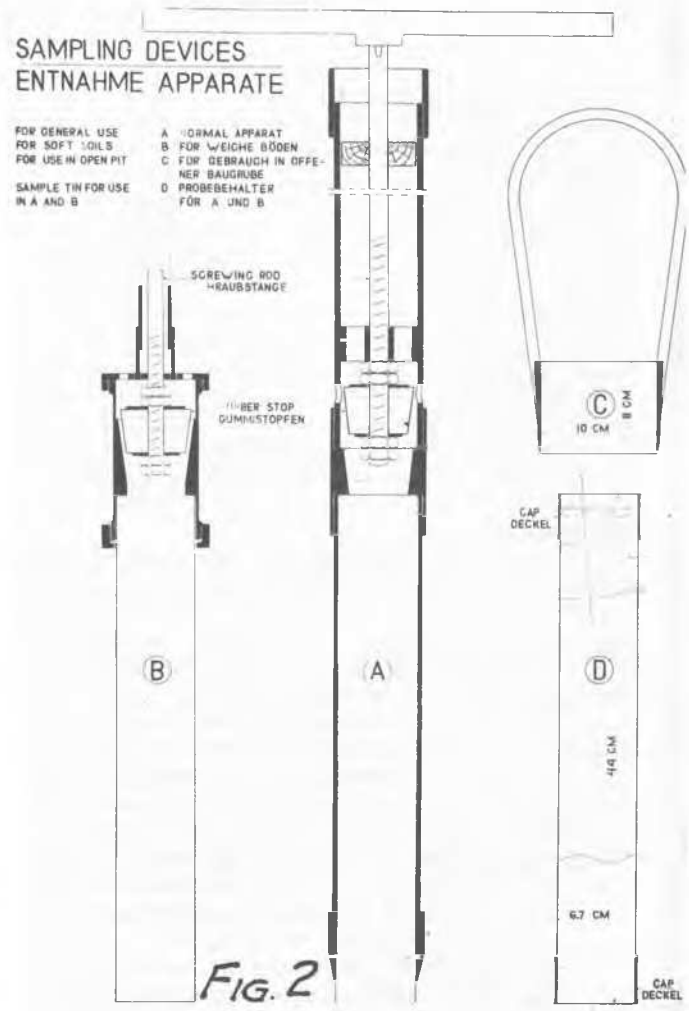


Fig. 2

inner diameter of the boring-pipe and prevents kinking of the sampler-pipe. Samples from a depth of 35 m. were taken with this sampler.

Rate of progress of sampling. For taking samples from softer alluvial upper layers (peat, clay, sandy clay) to a depth of 7m., $\frac{1}{2}$ - $\frac{3}{4}$ man-hours; up to a depth of 12 m. in harder layers 1 - $1\frac{1}{2}$ man-hours are wanted. Hard clay and loam layers at a depth of 20 - 25 m wanted about 3 man-hours. For a sample from a very hard clay and loam-layer from a depth of 35 m. 9 man-hours were necessary. Taking samples from the impregnated sand strata at a depth of 22.50 m. took about $4\frac{1}{2}$ - 6 man-hours. The time is estimated for the entire process of sampling.