Tests of Small Core Samplers for Permeability Determinations

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Permeability indices of a great number of soil types have been determined by technicians of the Soil Conservation Service and various agricultural experiment stations in the Southeastern states since 1945. In the initial work, several different types of sampling devices were used for procurement of undisturbed cores. As new and modified types were developed, they were used by workers in each of the various states. By 1946 stainless steel cylinders, 4 inches in diameter and 5½ inches long, were accepted as standard in the Southeastern states. These cylinders were either jacked or driven into the soil. Local soil conditions usually determined which method was to be used (Fig. 1).

In 1947, R. E. Uhland developed a new type sampler which incorporated many of the basic ideas used by earlier investigators. This sampler consisted of an outside shell and cutting head into which was inserted a 3- by 3-inch aluminum cylinder sleeve. A cap was placed over this unit and the shell, with its inner sleeve, was driven into the soil through the use of a dropping weight (Figs. 2, 3, and 4).

During the initial tests of this equipment, permeability workers raised the following questions:

1. What is the effect of the smaller core size upon results; would the data from the early work with the larger cores be valid for comparison with the results from cores taken by the new sampler?
2. What is the relative effect of jacking versus driving of the cylinder with regard to permeability of the sample obtained?
3. What are the comparative advantages of the two types of equipment?

In response to these questions, a comparative study of the equipment was undertaken. The results reported herein were obtained at the Blacksburg, Virginia Station.

METHODS

SELECTION OF SAMPLING SITES

A number of sites were selected to provide a population made up of various soil types, i.e., various textural and structural classifications. An effort was made to select a group of soils having a known range in permeability characteristics.

In initial tests, four replicated cores were taken from each soil horizon by each of the following methods:

1. Four-inch stainless steel cylinders (jacked)
2. Three-inch cylinders (jacked)
3. Three-inch cylinders (driven)

Additional equipment later permitted increasing the replicates to five for each horizon.

The cores were trimmed and the 3-inch cores were placed in pint ice cream containers for transportation to the laboratory. The 4-inch stainless steel cores were transported in sectionalized carrying boxes having a sponge rubber bottom.

LABORATORY PROCEDURES

All cores were treated according to standardized methods and procedures. This included evacuation and saturation under a tension of 19 inches of mercury. The saturated cores were percolated under ½ inch head of water to determine free percolation and then drained under 60 cm of tension to determine pore space. Volume weight determinations completed the laboratory studies.

RESULTS

The following comparisons of results from the various types of sampling procedures were made:

FIG. 1.—Jacking bridge in place. Bridge was anchored by two 8-inch diameter augers.