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AN IMPROVED TECHNIQUE FOR TAKING HYDRAULIC CONDUCTIVITY CORES FROM FOREST SOILS

Abstract.—Describes a large-diameter, heavy-duty soil sampler that makes it possible to obtain long, relatively undisturbed sample columns from stony, root-filled forest soils. The resultant samples include the roots, root channels, stones, and macro-voids common to forested soils.

Spaces in forested soils caused by animal passageways and old root channels can transmit a tremendous amount of water. So these spaces —macro-voids—must be included in samples whenever hydraulic conductivity in forested soils is to be studied.

However, obtaining undisturbed forest-soil samples that contain macro-voids is difficult. The commonly-used soil samplers either are too small or they do not obtain undisturbed samples.

So we designed a sampler that obtains relatively undisturbed samples that *include* roots, small stones, old root channels, animal passageways, and other macro-voids. The sampler takes cores 6 inches in diameter and up to 18 inches deep. The larger cross-sectional area of the 6-inch cores reduces the relative proportion of the cross-sectional area occupied by an open channel; i.e. the influence of a channel on total conductivity is reduced.

Construction

The body of the sampler is constructed from standard 6¼-inch O.D. seamless steel tubing, ⅛-inch thick. The cutting edge, case-hardened for sharpness and durability, is constructed from 6¾-inch O.D. seamless mild carbon-steel tubing, ½-inch thick. The cutting edge is sweat-fitted and welded to the sampler body (fig. 1). Although we experienced no

difficulty with damage to the cutting edge, there would be some merit in constructing a removable cutting edge that could be attached to the main body of the sampler by screw-on or lug fittings. The driving head is machined from 6¾-inch O.D. seamless steel tubing, ⅜-inch thick, and is sweat-fitted onto the body and spot-welded.

The body of the sampler and the upper part of the cutting edge are machined so they freely accept the removable sample cylinders. The inside of the cutting edge is machined so its diameter coincides with the inside diameter of the sample cylinders. Thus these cylinders rest on a flange slightly wider than the width of the cylinder wall. Coarse threads are cut into the upper portion of the sampler body for the retainer ring that holds the sample cylinders in place.

Sample cylinders and spacer ring are made from standard 6-inch O.D. aluminum tubing 1/16-inch thick. For forested soils, 3- and 6-inch lengths of cylinder are the most useful. The complete sampler weighs about 20 pounds and has a total length of about 21 inches (fig. 2).

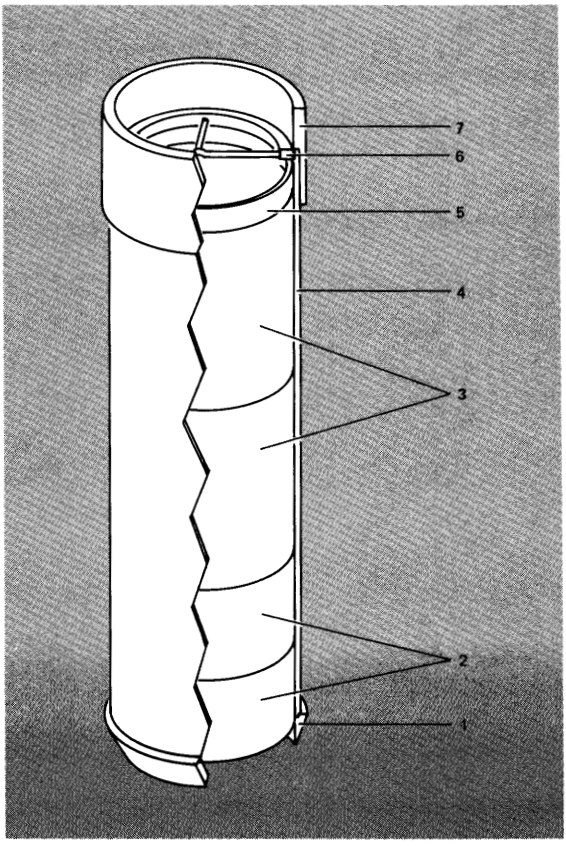

Figure 1. — Plan of the soil sampler. (1) Cutting edge, (2) 3-inch sample cylinders, (3) 6-inch sample cylinders, (4) body of sampler, (5) 1-inch spacer ring, (6) retainer ring, and (7) driving head.

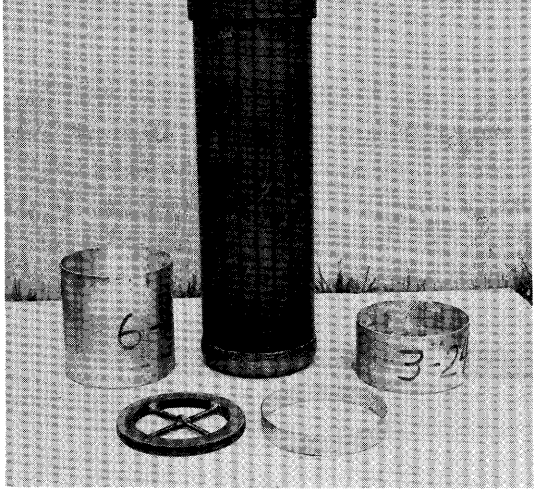

Figure 2. — Sampler, 3-inch and 6-inch sample rings, 1-inch spacer ring, and retainer ring.

Procedure

Combinations of 3- or 6-inch sample cylinders are inserted into the sampler; a 1-inch spacer ring is inserted; and the retaining ring is screwed down snugly but not too tightly. The assembled sampler is then driven into the soil to the desired depth. A heavy hardwood block about 4 x 10 x 24 inches is placed upon the steel driving head to absorb part of the shock of impact. One man holds the block and sampler vertical and steady while a second man drives the sampler into the soil with a sledge or heavy mallet.

After being driven to the desired soil depth, the sampler is dug free and carefully removed. We find it is helpful to place the tip of a shovel under the bottom of the sampler and then pry upward slightly while the sampler is tipped forward. Supporting the bottom of the sample with one hand while handling the sampler prevents portions of the bottom of the sample from falling off. The sample and sample cylinders are best removed from the sampler by gently placing the bottom of the sample on a 4x4x24-inch section of wood and then carefully allowing the sampler to slide downward.

Any multiple of 3-inch deep samples between 3 and 18 inches may be obtained by combinations of sample cylinders. The entire sample is ordinarily rigid enough so that it can easily be removed from the sampler and held upright until the separate cylinders can be taped together with two wraps of 2-inch wide masking tape. However, the sampler or cylinders must not move in any manner that will cause samples to crack or separate where the separate sample cylinders join. After removal, the top and bottom are trimmed flush with the cylinder wall and then covered with a double layer of cheesecloth held in place by rubber bands.

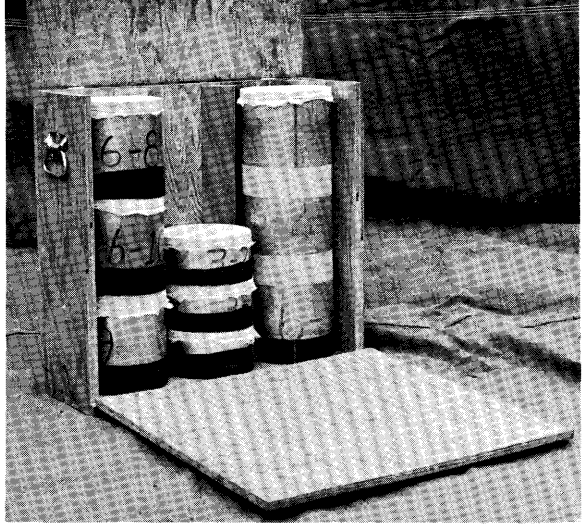

Figure 3. — Transportation-storage box containing 3-, 6-, and 18-inch samples.

A hacksaw blade with one end broken to provide a sharp point is a most useful tool for trimming and separating samples. Samples prepared in the field are shown in figure 3.

Where 3-inch deep samples of the surface soil or other friable layers are desired, two 3-inch cylinders are placed in the sampler first and the remaining space is filled with either 3- or 6-inch cylinders. The sampler is then driven into the soil until the top of the soil sample is flush with the top of the second 3-inch ring. After the soil samples and cylinders are removed from the sampler, the lower cylinder and soil sample are carefully separated from the cylinder and sample above.

The sampler readily cuts through small woody roots up to 1 inch in diameter and even through thin, flat sandstone fragments an inch or more thick with a minimum of soil disturbance. However, each sample should be carefully examined for evidence of disturbance, both in the field and after laboratory hydraulic conductivity determinations. Occasionally roots or stones are encountered that may cause sample disturbance. Some of these disturbances may be observable only after the sample is removed from the cylinder.

To carry and store the samples, we used plywood boxes with hinged top and front (fig. 3). The boxes hold three sets of cylinders up to 18 inches in length and are constructed so that, when closed, the cylinders do not move.

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