Florida Department of Transportation Research

Field Testing and Calibration of the Vertical and Horizontal In situ Permeameter

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Current Situation

Hydraulic conductivity, or permeability, is a measure of the resistance of a medium, such as soil or sand, to water flow. This effect can be observed anywhere rainwater has pooled and gradually soaks into the ground. The rate at which this happens depends on the permeability of the soil. Because soil is often structured in layers with different permeabilities, the flow of water down through the layers (vertical permeability) and the flow of water across the layers (horizontal permeability) can be different. It is important to know both of these numbers for a particular site when designing retention ponds that collect stormwater runoff and hold it for a period of time, during which exposure to the air and sunlight helps to reduce potential pollutants before they enter the groundwater. The best way to measure permeability is at the potential retention pond site, using a probe that can measure both vertical and horizontal permeability directly.

Retention ponds protect Florida groundwater by holding stormwater runoff for a periof of time while air and sunlight reduce pollutants.

Research Objectives

University of Florida researchers designed and tested a permeability probe that can be used in situ to measure both vertical and horizontal permeabilities.

Project Activities

A number of projects have been conducted to directly measure both vertical and horizontal permeability in the field. Typically, various problems were encountered, including clogged injection screen slots, mechanically complicated probe designs, difficulty driving the probe to greater depths, and issues establishing a physically sound method for interpreting test results in terms of horizontal and vertical conductivities.

Lessons learned in previous projects led to the development of the device used in this project, which focused on construction and testing of a new probe configuration with a smaller diameter and without lateral wings, which allows the probe to be pushed to greater depths. The new probe can measure horizontal and vertical conductivities from a single operation and, by using two pressure observations along the probe casing, it reduces or eliminates effects of screen smearing or partial clogging. The complicated mechanism inside the probe formerly used to open and close the tip and protect the screens has been eliminated.

A PVC version of the probe was tested in the laboratory in barrels with designed layering of different soil densities and in a field test setting. These tests confirmed the proper performance of the probe by comparison with other direct measurements of vertical and horizontal permeabilities. With these confirmations, a steel version of the probe was manufactured and tested in the field. The probe performed well and was compatible with existing test equipment. Repeated testing suggested small improvements to the device.

Project Benefits

An improved method of testing soil permeability with lead to improved drainage designs and better protection of Florida groundwater.

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