AUGUST 20, 2003 - How to Run Soil Suction Tests

Speakers: Dr. Robert L. Lytton, P.E., Dr. Charles P. Aubeny, and Dr. Rifat Bulut, all of TAMU Civil Engineering Department in College Station TX, Tel. 979-845-8211.

PRESENTATION SUMMARY

"How to Perform Suction Tests"

After a PowerPoint presentation, the presenters gave a hands-on demonstration to an audience of about 60 of how to perform suction tests in the laboratory. They brought equipment from their university and showed three different methods of performing suction tests: 1) the filter paper method, 2) the transistor psychrometer method, and 3) the thermocouple psychrometer method.

The first method, the filter paper method follows the ASTM D5298 standard and has been around for decades. However, according to ASTM, this standard has been withdrawn and has not been replaced.

The filter paper method is the more versatile of the presented methods because it allows the computation of matric suction as well as total suction. However, it is more sensitive to technician error and takes muchlonger (about a week) to run.

To run the test, cut two disks of clay from a 3" Shelby Tube sample and place filter paper between them to measure matric suction, sealing the interface between the two disks with electrical tape. Also place filter paper above the two disks with a spacer in between. Place the assembly in a sealed jar for about a week, maintaining ambient temperature to plus or minus 1 degree Celsius. Then remove it from the jar very quickly (in a matter of seconds) and, using tweezers, place the filter papers in small tins and weigh them with a scale that is accurate to 0.0001g. Oven dry for about 10 hours, then loosen the lids and dry another 5 minutes. Then re-tighten the lids, remove the tins and place them on an aluminum block or other type of heat sink to cool quickly. Next, weigh the tin plus filter paper. The difference in the two weight measurements are then compared on a calibration curve to give the suction.

The speakers recommended using Scheicher & Schuell's filter paper no. 589-WH. They said the filter paper calibration curves in the ASTM are erroneous and give a pF that is about 0.5 too high. They recommended using the more accurate calibration curves presented by Dr. Rifat Bulut and included in their slide presentation.

Next the speakers presented the transistor psychrometer method. The equipment they brought was a model that tested twelve samples at a time and cost about $4500 plus another $1000 for a data logger. A less expensive model which tests eight samples and includes a built-in data logger is also available for $4800. The test only gives total suction, which they said was adequate in Houston and other areas that have soils that do not contain high salt content. The equipment is manufactured by Soil Mechanics Instrumentation in Australia.

In this method, the sample probes are dropped in a water bath (used to control the temperature). The device measures a change in millivolts for a change in temperature (dry bulb to wet bulb) in order to determine suction. This test is accurate in the range of 3 - 5.5 pF, whereas the filter paper method can measure down to 2.5 pF. However, because the test can be done in an hour rather than a week, it is attractive compared to the filter paper method.

The third method presented was the thermocouple psychrometer method. The device costs less than the transistor psychrometer and single samples can be tested in an hour. It only measures total suction as does the transistor psychrometer. It is marketed by Wescor Environmental in Utah as a Dew Point Microvoltmeter, model no. HR-33T for around $1000. As with the transistor psychrometer, it is less sensitive to technician error and quick to run.

When questioned about the usual complaint by local geotechnical engineers that they cannot reproduce their suction results using the same soil sample, Dr. Lytton said that all undergraduate students in the introductory soils lab at TAMU are able to accurately reproduce their results before the end of the semester, even with the filter paper method. He cautioned that engineers follow the points listed above for the filter paper method, particularly moving the filter paper to the tins within a few seconds while using tweezers, using a heat sink to quickly cool down the tins, using Scheicher & Schuell's filter paper no. 589-WH, and using Dr. Bulut's calibration curves rather than ASTM's.

For more details on the three methods, download a copy of their slide show in Adobe Acrobat by clicking here.

For previous FPA presentations by the speakers, click on August 2001 and August 2002

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