AUGUST 2005 MEETING
Wednesday, August 10, 2005

TECHNICAL PROGRAM

Re-evaluation of Current TxDOT PVR Design Procedure with a New Suction-Based Approach

Speaker: Dr. Rifat Bulut, Ph.D., Post-Doctoral Fellow with Texas A & M University, Tel. 979-458-3434. Dr. Bulut worked for Fugro in Dallas for 1.5 years after graduation from Texas A&M University and currently is working as a postdoctoral researcher at Texas Transportation Institute, Texas A&M University System in College Station, Texas.

PRESENTATION SUMMARY

To an audience of about 40 Mr. Dr. Bulut gave a PowerPoint presentation entitled, "Re-evaluation of Current TxDOT PVR Design Procedure with a New Suction-Based Approach," which included the following:

- TxDOT PVR assumptions
- Analysis program (Flodef)
- Design program (Winpres)
- Laboratory testing for determining Diffusion Coefficient
- TxDOT case studies
- PVR comparison
- Implementation

Dr. Bulut said that several current TxDOT PVR Tex-124-E assumptions are incorrect, including:

- Soil at all depths has access to water in capillary moisture conditions
- Vertical swelling strain is one-third of the volume change at all depths
- Volume change can be predicted by use of the plasticity index alone.

The Flodef and Winpres programs do not use these incorrect assumptions in the analysis. Both programs were developed at Texas A&M for TxDOT.

Flodef is an analysis program that provides a two-dimensional transient analysis for the effects of vertical moisture barriers, subgrade materials (lime stabilized/inert soil), median conditions (paved/non-paved) and shoulder conditions (paved/bare). By analyzing inputs into the Windows based environment regarding the 2D cross section of the surface, soil index properties, geographic location, vegetation, moisture controls, and drainage conditions, the program determines shrink-swell versus time and suction versus time. This program is unique as vegetation can be easily included in the analysis.

Winpres is a design program for determining shrink-swell versus time, present serviceability index (PSI) versus time and international roughness index (IRI) versus time. The following are input into the Windows based program: soil index properties, geographic location, site drainage and vegetation, pavement data, moisture controls, traffic data and reliability level.

Also developed for TxDOT's application is a laboratory test to determine the diffusion coefficient of a soil. It involves embedding thermocouple psychrometers into 20+cm Shelby tube soil samples, sealing all but one end of the sample, and placing the sample into a water bath to maintain a constant temperature.

Data is recorded by a CR 7 Datalogger for approximately 7 days and at the end of the test, suction versus drying time is plotted to determine the diffusion coefficient. In the laboratory they measure the suction with the above-described procedure as well as the filter paper method, and determine the diffusion coefficient, Atterberg limits, #200 sieve and -2 micron (hydrometer test).

Texas A&M has performed case studies using Flodef and Winpres for TxDOT in Fort Worth, Atlanta, and Austin. In each case they found that the field-estimated diffusion coefficients were up to 100 times greater that the laboratory test estimates. They also found that the total movement controls the rate of increase in roughness of the paving and that the shrink prediction can alert the designer to longitudinal cracking. Overall, they determined that the current PVR method over-predicts swell, neglects shrink, and results in overly conservative designs.

Flodef and Winpres will be used in the TxDOT laboratories in Dallas-Fort Worth, Austin and Bryan, and TxDOT owns the rights to the programs.

To download Dr. Bulut's slide presentation, which includes screen shots of the program windows and photos of the diffusion coefficient laboratory testing, click here.

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