Project Summary

Texas Department of Transportation

0-5873: Develop a New Testing and Evaluation Protocol to Assess Flexbase Performance Using Strength of Soil Binder

Background

TxDOT Specification Item 247 – Flexible Base relies on the Texas Triaxial Test (Tex-117-E) for the evaluation of base materials used for roadway construction projects. It is generally agreed that the Texas Triaxial Test is a reliable strength indicator. Nevertheless, a number of shortcomings inherent in the test method limits the effectiveness of the above material acceptance procedure. First, there are several pre-requisite steps (such as moisture-density testing, and moisture conditioning) that must be completed before the triaxial test can be performed. As a result, the turn around time associated with triaxial testing is approximately 3 weeks. Second, a fairly large quantity of material and significant manpower are needed to run the test. The material quality control process can be greatly enhanced if a faster test that can be performed with a small quantity of material is available. Such a test procedure will be most effective when used in complement with the triaxial test. The base binder flexometer test was developed by Mr. Michael Merrick of the Snyder Area Office of TxDOT's Abilene District for this purpose. The primary objective of this research project was to evaluate the proposed flexometer test procedure.

What the Researchers Did

Samples of flexible base materials from a total of 19 different sources and 12 TxDOT districts were obtained and subjected to a detailed laboratory study. The laboratory study was designed to achieve a number of specific goals:

- review the sample preparation and curing and testing procedures and make necessary refinements,
- examine possible correlation between strength of the binder and strength of the composite material, and
- evaluate the repeatability of the new test method.

The necessary test data for the composite base material including the Texas triaxial strengths were obtained from TxDOT district labs. In addition to the above, the research tasks also included the design and fabrication of a low cost, easy-to-operate prototype test device to determine the flexural strength of the binder material.

Research Performed by:

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What They Found

The data collected and analyzed in this research study showed that small test specimens (5.0in length and 0.75in square cross section) of binder material can be molded, cured, and load tested to obtain consistent and reliable flexural strength data for most flexible base materials.

Furthermore, the data supported the view that the strength of the binder component of roadway base materials has significant influence on the strength of the composite material. In other words, good correlation could be established between the binder strength and 0-psi Texas triaxial strength. The strength of the correlation could be further improved when materials were categorized into sub-groups based on the shape of the flexural strength-moisture content characteristic curve. Among the different sub-groups, the crushed limestone materials provided the best correlation. Limited data of materials modified with cement and flyash also provided reasonably good correlation. Many sand and gravel sources did not produce any consistent trend in data and therefore, could not be included in correlation studies. Therefore, it is reasonable to conclude that estimation of composite strength based on binder strength is not viable for sand and gravel materials.

The data obtained from repeatability studies provided an average coefficient of variation (COV) of 12.6% for the base binder flexometer test. This estimate of the COV is significantly better than the COV of 23.2% calculated for the 0-psi Texas Triaxial Test. Better repeatability of the flexural strength test may be partly attributed to the uniformity in the material used in this test. In other words, there is less variability in the binder portion (i.e., minus sieve No. 40) of the material when compared to the composite that is tested in the Texas Triaxial Test.

To test the new prototype test device, parallel tests were run on the same materials using this device and another, more sophisticated and expensive type of test equipment. The two data sets compared well. However, this comparison also revealed a minor limitation in the new test device. It was found that the new test device over-predicted the flexural strengths when the test specimens had measurable deflection at the point of loading. Steps should be taken to correct this problem before implementation of the test device.

What This Means

Based on the findings from this research study, it is recommended that the base binder flexometer test be implemented in several trial implementation projects to develop an acceptance criteria for this test. In these projects the new test should be used as a supplementary test procedure. In other words, the flexometer test procedure should be run in addition to the test methods that are required by the specifications. The lab technicians who perform the binder flexural test for these projects should have prior experience with the test procedure or should have received adequate training. The objectives of these trial implementation projects would be to further expand the database that was developed in this research project, identify any special concerns that may arise during field implementation of the test protocol, and develop minimum acceptance criteria. These implementation projects would also provide an opportunity to validate the flexural-triaxial strength correlation before statewide implementation occurs.

Further research is needed to investigate the following aspects of the base binder test procedure:

- fine tuning of the test procedure for testing base materials blended with modifiers such as lime, cement and flyash, and
- single-lab and multi-lab variability in the test procedure.

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