Project Summary

Texas Department of Transportation

0-6587: Flexible Base Acceptance Testing

Background

TxDOT accepts flexible base construction in the field by testing for density and water content. However, concerns over the lack of moisture control during compaction, testing thick lifts, and the lack of a field stiffness or modulus parameter, led to investigating alternative methods for compaction acceptance. This project aimed to refine specification parameters for flexible base construction while determining if a mechanistic-based acceptance framework was feasible. Accomplishing these objectives would enable TxDOT to better optimize

What the Researchers Did

The research group reviewed the state of the practice in other agencies in light of TxDOT's concerns with their flexible base construction specification. Next, the team performed controlled field testing, evaluating non-density based devices for compaction acceptance. Finally, they conducted parallel testing with alternative acceptance devices on TxDOT construction projects. While the nuclear density gauge was used as the default test, alternative devices evaluated included the portable falling weight deflectometer (PFWD), dynamic cone penetrometer (DCP), and, in some cases, the portable seismic pavement analyzer (PSPA). Researchers evaluated these data to determine:

- How did the water content at the time of compaction impact the mechanical properties of the base after curing?
- Which alternative device best distinguished among different levels of compaction?
- How could the alternative devices be used in the field for compaction acceptance?

After answering these questions through analyses of the data collected, the research team recommended revisions to TxDOT's flexible base specification and proposed a compaction acceptance procedure using a non-density based test device.

What They Found

Many state departments of transportation restrict lift thickness to values between 3 and 6 inches. Additionally, some DOTs have standard procedures in place to employ the DCP or PFWD for compaction acceptance. Through controlled field tests, the research team discovered that:

- Simply attaining density does not always maximize mechanical properties. Some Texas flexible bases increase in mechanical properties with additional compaction effort even though no significant density increase occurs.

Research Performed by:

Texas Transportation Institute (TTI),
The Texas A&M University System

Research Supervisor:
Tom Scullion, TTI

Researchers:
James Frazier, TTI
Stephen Sebesta, TTI
Chang Seon Shon, TTI
Ross Taylor, TTI

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- Compacting the base at water contents substantially different from optimum diminishes the mechanical properties after curing, even if density is achieved.
- The water content of the flexible base under test strongly influences the mechanical properties measured with the non-density based devices.

Of the alternative devices evaluated, the DCP was better able to distinguish among different levels of compaction. The DCP also most closely matched the pass/fail results from the nuclear density gauge during parallel testing on TxDOT construction projects. While DCP criteria for compaction acceptance from another state department of transportation seemed too lenient for Texas bases, the research team believes revised criteria could be employed for Texas bases.

What This Means

TxDOT should implement tighter controls on flexible base compaction and allow for non-density based compaction acceptance. Key areas of recommended specification revisions include:

- Lift thickness should be restricted to not exceed 6 inches, unless otherwise shown on the plans or approved by the engineer.
- Moisture content during compaction should be no more than 1 percentage point below and not more than 1.5 percentage point above the optimum water content determined by Tex-113-E.
- Acceptance testing should be performed within 16 hours of completion of compaction.
- Methods of compaction acceptance should be expanded to include Penetration Index from the DCP. Figure 1 illustrates testing for penetration index on a construction project with the DCP.

This project developed a draft revised flexible base construction specification incorporating these recommendations. The draft specification should be shadow tested on upcoming construction projects.

Figure 1. Testing for Penetration Index with Dynamic Cone Penetrometer.

For More Information:
Research Engineer - German Claros, TxDOT, 512-416-4730
Project Director - Miguel Arellano, TxDOT, 512-832-7093
Research Supervisor - Tom Scullion, TTI, 979-845-9910

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Texas Department of Transportation
Research and Technology Implementation Office
P.O. Box 5080
Austin, Texas 78763-5080
512-416-4730