Project Summary

Texas Department of Transportation

0-6271: FDR (Full-Depth-Reclamation) Performance-Based Design, Construction and Quality Control

Background

Rehabilitating an old pavement by pulverizing and stabilizing the existing pavement is a process referred to as Full Depth Reclamation (FDR). This process shows great potential as an economical rehabilitation alternative that provides deep structural benefit, conserves highway construction raw materials, and quickly returns the section to service. The stabilized layer becomes either the base or sub-base of the new pavement structure.

In the early 1990s, the Bryan and Lubbock Districts constructed their first few projects on low-volume roadways. Their initial experiences were positive, and both districts have now recycled close to 1,000 miles of low-volume roadways. Although the FDR process is widely used in several districts, other districts are just getting started.

What the Researchers Did

Researchers worked with experienced districts to identify the key steps in the design, construction, and monitoring of the FDR process so that a district just getting started can build upon the lessons learned from earlier projects and also identify areas where improvements are needed to design practices and/or construction specifications. In this study the TTI research team:

- Submitted recommended protocols for project evaluation and mixture design.
- Conducted five case studies to test and design FDR projects in the Austin and Dallas Districts.
- Developed and submitted a set of training materials for a comprehensive FDR workshop.
- Conducted a workshop for district personnel in March 2011, in the Dallas and Bryan District offices.
- Delivered a DVD of the key steps in the FDR process for use in future training schools.
- Recommended changes to test protocol and specifications to improve TxDOT's FDR system.

What They Found

The vast majority of the FDR projects in Texas are performing well. TxDOT has all of the required pavement testing tools, lab test protocols, and good specifications available to ensure a successful project. Few problems were identified in the districts when good pavement testing and existing TxDOT design protocols were used. However, lack of guidance in the overall design and construction process, including formulating a mixture design for the reclaimed materials, controlling the construction process, performing quality assurance of the in-place product, and bonding the surface layer to the finished base have led to construction delays and poor performance on several projects.

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Designing and constructing good performing FDR projects in Texas is challenging for several reasons, including:

- The existing hot mix thickness is often very variable, especially if substantial maintenance has been performed. This variability must be measured and accounted for in the pavement design process. TxDOT has little success incorporating more than 50 percent RAP in typical FDR designs so an approach to dealing with very thick localized HMA layers must be developed.
- Problems have been encountered with pavements built on expansive clays (most of east Texas); edge drying and trees down the sides of roadways are a problem when brittle stabilized layers are placed over them. When severe longitudinal cracks exist, the use of the Dynamic Cone Penetrometer should be encouraged to identify the depth of slip planes and to aid in designing the appropriate edge support.
- Old base materials are often contaminated and sometimes weak. TxDOT guidelines based on the plasticity index to select the appropriate stabilizer appear reasonable. Highly plastic bases require the use of lime, and asphalt is only recommended if the plasticity index of the existing base is less than 6.
- Many low-volume roadways are narrow and widening must be part of the FDR process.
- Often the process is conducted on two-lane highways, so handling traffic is a major concern. When performing construction under traffic, it is critical to ensure that the middle portion of the roadway receives the correct amount of stabilizer.

What This Means

Based on the result presented in this study, the following major recommendations were made to improve the existing TxDOT FDR process.

Evaluate the Use of Texas Gyratory Compactor and Indirect Tension Test of Future Designs - TxDOT could initiate an implementation project to further develop the new small sample design procedure. The proposed procedure uses less than 25 percent of the material currently required.

Use the Falling Weight Deflectometer to Verify that the Roadway Is Being Constructed as Designed - During this study the FWD was found to excel at identifying design and construction problems. The simple procedures developed in this project can be used to compare the measured FWD deflections with the target generated during the pavement design process.

Field Evaluation of the Proposed Bond Test - Bonding of the surface to the treated layer continues to be a major concern. A new pull-off test was evaluated in this study. Lab results showed it capable when designing both the best prime material and the optimum amount. However, it is still unknown why the limited number of field projects tested all exhibited very low bond strength. A lab and field study could be initiated to compare laboratory results to field bonding strengths. This could best be achieved by constructing a range of small test strips with the different primes used in the laboratory.

Modifications to Existing Specifications - Six items were suggested by the districts to be incorporated into existing specifications. The most urgent of these was to modify the temperature requirement to avoid the possibility of the stabilized base experiencing freezing conditions in the first or second day after treatment.

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