DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Improved Guidance and Specifications for Full-Depth Reclamation

Laboratory and field testing was conducted to evaluate different FDR strategies and develop mechanistic-empirical procedures for rehabilitation designs using FDR.

Pavement

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Project Title:
Improved Guidance and Specifications for Full-Depth Reclamation

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WHAT IS THE NEED?

The California Department of Transportation (Caltrans) is reviewing the use of in-place pavement recycling as an alternative rehabilitation strategy to mill-and-replace, specifically on projects where the distress is bottom-up (i.e., distresses caused by weak base or insufficient layer support). Although the approach has been implemented in California and other states, primarily on lower-volume roads, the design approaches are based on gravel equivalency, with gravel factors for reclaimed layers based on a very limited data set, which often leads to overly conservative pavement designs. The need for a better understanding of the behavior of Full-Depth Reclamation (FDR) pavements under traffic and being able to model this behavior using laboratory test results was identified to allow informed decisions on where to use FDR and how to determine appropriate asphalt concrete thicknesses to ensure that design lives are achieved in the most cost-effective manner.

WHAT WAS OUR GOAL?

The ultimate goal of the Caltrans/UCPRC pavement recycling initiative is the development of a comprehensive guideline document for the rehabilitation and Capital Maintenance (CAPM) design of pavements using full and partial depth reclamation techniques. The objective of this part of the research was to develop a guideline document for pavement rehabilitation design using full-depth reclamation.

WHAT DID WE DO?

- A literature review on research related to the topic
- Monitoring of existing and new field experiments
- Full-depth reclamation of an existing gap-graded rubberized warm mix asphalt test track using pulverization with no stabilization, with portland cement stabilization, with foamed asphalt plus cement stabilization, and with asphalt emulsion stabilization
- Accelerated wheel load testing to compare the four different full-depth reclamation strategies.
- Laboratory testing to refine mix-design procedures and identify suitable criteria for mechanistic-empirical design procedures and performance models.
- Preparation of project selection and mechanistic-empirical design guidelines for full-depth reclamation in California

WHAT WAS THE OUTCOME?

Although long-term evaluation of pavement projects still needs to be completed to collect sufficient data for the finalization of mechanistic-empirical design criteria (and revised gravel factors) for full-depth reclaimed pavements, there is sufficient evidence to show that pavements that are rehabilitated using FDR strategies will satisfactorily withstand design traffic loads common in California. The performance advantages of FDR strategies that either use foamed asphalt with cement or cement only over FDR strategies with no stabilization were clearly evident from the results on completion of the testing. No recommendations can be made at this time on the use of asphalt emulsion as a stabilizer in FDR projects due to the problems experienced during construction of the test section, which were not representative of typical FDR procedures with this stabilizer. Results from testing under wet conditions confirmed that, as with any pavement design, good drainage is critical to ensure that the pavement performs as expected. Laboratory testing procedures have been developed to accurately simulate key mechanistic properties measured on field projects, primarily stiffness change over time.

WHAT IS THE BENEFIT?

Rehabilitation using the FDR approach offers additional advantages of speed of construction, minimal disruption to traffic, reuse of all materials, and there is no need to off haul material from the site. FDR with these stabilization approaches effectively provides a new, stronger base and in the process, replaces extensively cracked existing asphalt layers, thereby preventing the reflective cracking that is common in more traditional overlay projects.

IMAGES

Image 1: Test pit after accelerated wheel load testing on FDR section with foamed asphalt and cement stabilization. An equivalent of 34 million ESALs was applied to this section, resulting in 6mm of rut, but no cracking

Image 2: FWD testing on PLU147 to assess stiffness change over time. This was an FDR project where Portland cement was used as the stabilizer.

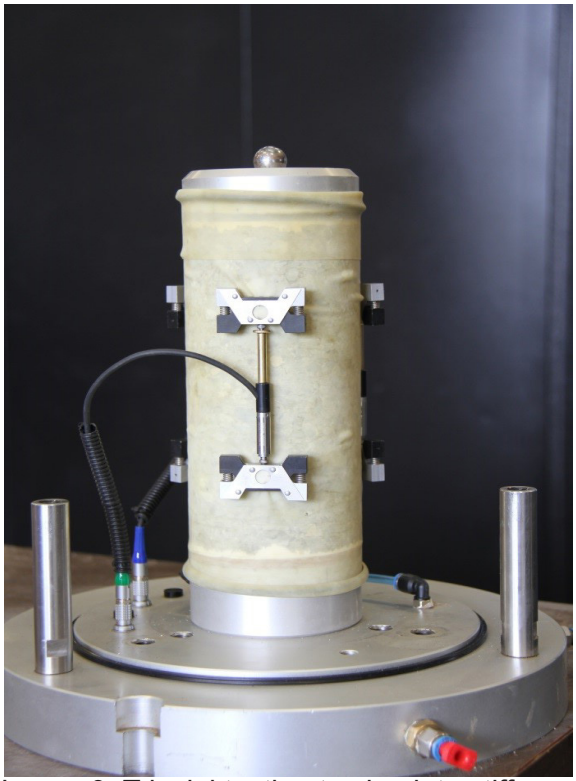

Image 3: Triaxial testing to simulate stiffness changes on FDR projects.