LTRC RESEARCH PROJECT CAPSULE

MARCH 2008

08–2P

TECHNOLOGY TRANSFER PROGRAM

JUST THE FACTS

Start Date:
January 1, 2008

Duration:
12 Months

End Date:
December 31, 2008

Funding:
State

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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential

Analysis of Seasonal Strain Measurements and Asphalt Materials Under Accelerated Load

PROBLEM

Since 1996, The Louisiana Department of Transportation and Development (LADOTD) has utilized the Accelerated Loading Facility (ALF) at LTRC to determine the effectiveness of innovative pavement technologies in an environment that closely resembles actual in-service field conditions. In Experiment I, conventional and alternative base materials were evaluated. In Experiment II, benefits of using powdered rubber in hot-mix asphalt (HMA) surface and base course mixes were quantified and validated. In Experiment III, the use of reclaimed asphalt pavement (RAP) base layers was investigated instead of conventional base course asphalt mixes. In Experiment IV, the use of blended calcium sulfate base and foamed asphalt recycled base was evaluated as compared to a conventional stone base course.

In these past experiments, quantitative performance of the test lanes was established in terms of evolution of rutting and cracking with the number of repetitions. In addition, instruments responses were used to provide an indication of the performance of the different test sections and to validate developed theoretical models. In these experiments, a wide array of sensors was used, including H-type strain gage and earth pressure cells (Figure 1). However, the seasonal variation of measured pavement responses with temperature and its relationship to the predicted performance has not been thoroughly evaluated for ALF experiments. Such information may be used to improve instrumentation strategies in future ALF experiments.

Results of past ALF experiments may also be used to link laboratory measured properties of recovered asphalt binders to the measured performance at the ALF facility. Such a link may be used to update current binder standards by specifying measurement of properties that are indicative of pavement performance. Such properties may be obtained by complementing or modifying current specifications with the direct tensile test (DTT) or a newly developed dynamic shear rheometer (DSR) test (e.g., multiple stress recovery creep test) instead of the current ductility, elastic recovery, and force ductility tests. The conventional tests have long been used in Louisiana as a specification for asphalt binder, but a number of asphalt suppliers from out of state have indicated that their products only comply with the Super Pave Binder Specification System, as it is required by many states that do not consider conventional tests such as the ductility test.

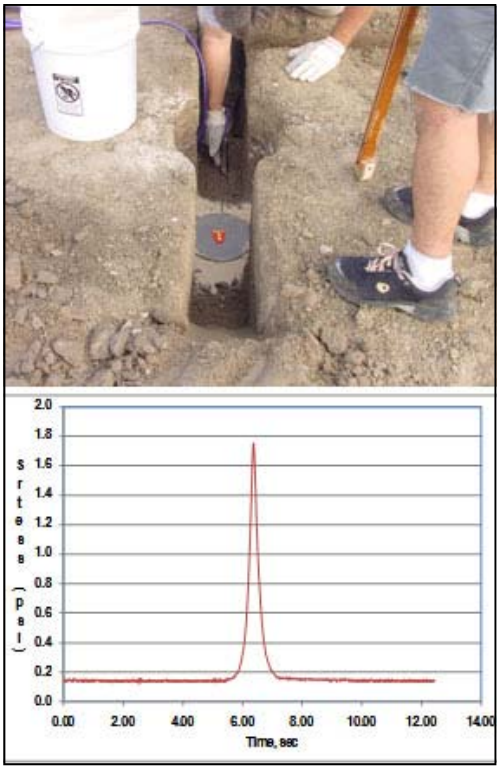

Figure 1. Installation of a Pressure Cell at ALF and Typical Response to Loading

OBJECTIVES

The objectives of this study are twofold. First, instrument responses in past ALF experiments (II, III, and IV) will be analyzed in an effort to quantify the impacts of seasonal variation of pavement responses with temperature and its relationship to pavement performance. This analysis will be used to suggest possible modifications to the instrumentation strategy in the upcoming ALF Experiment V and to develop a successful instrumentation plan. This strategy will also attempt to ensure repeatable and accurate measurements of pavement responses.

Second, binder performance will be ranked based on ALF fatigue resistance while the strains measured during ALF loading are taken into consideration. The fatigue performance will be compared to the binder fatigue properties measured originally and those measured after extraction. This characterization will be used to determine the feasibility of using the DTT or the DSR as part of the current binder specification system in Louisiana and will take the place of the current ductility test. To achieve the objective, the performance of binder, as predicted by these tests, will be compared to field performance and to the measured performance from the DTT or a newly developed DSR test (e.g., multiple stress recover creep test).

METHODOLOGY

In an effort to achieve the aforementioned objectives, the following research tasks will be conducted:

1. Review and analyze collected instrument responses from Experiments II, III, and IV, and quantify the impacts of temperature variations on instrument responses and on the predicted pavement performance;
2. Develop an instrumentation plan for the upcoming Experiment V;
3. Acquire HMA samples from lane test sections in Experiments II, III, and IV, and extract asphalt binders from the collected samples;
4. Conduct the ductility, elastic recovery, and force ductility tests on the extracted and sampled asphalt binders and determine their ability to predict field performance and failure as predicted from the ALF experiments;
5. Conduct the direct tensile test on the sampled and extracted binders, and compare the ranking obtained from this test to the prediction obtained from conventional tests (i.e., ductility, elastic recovery, and force ductility tests) and to the observed performance in the ALF test sections;
6. Conduct a newly developed dynamic shear rheometer test on the extracted and sampled binders, and compare the ranking from this test to the prediction obtained from conventional tests; and
7. Prepare a final report that documents the research effort in this study, provides an instrumentation plan for Experiment V, and establishes a laboratory test procedure to determine the ductility and relaxation properties of asphalt binders based on SuperPave equipments.

IMPLENTATION POTENTIAL

The research results from this project can be used by the LTRC and LADOTD to update instrumentation plans in the upcoming ALF experiments and to modify current binder specifications that currently require performing the ductility test and elastic recovery test. Nowadays, these tests are rarely used by state DOTs, and the adoption of Super Pave equipment to characterize the ductile behavior of asphalt binder will ensure that current specifications are consistent with national trends.

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