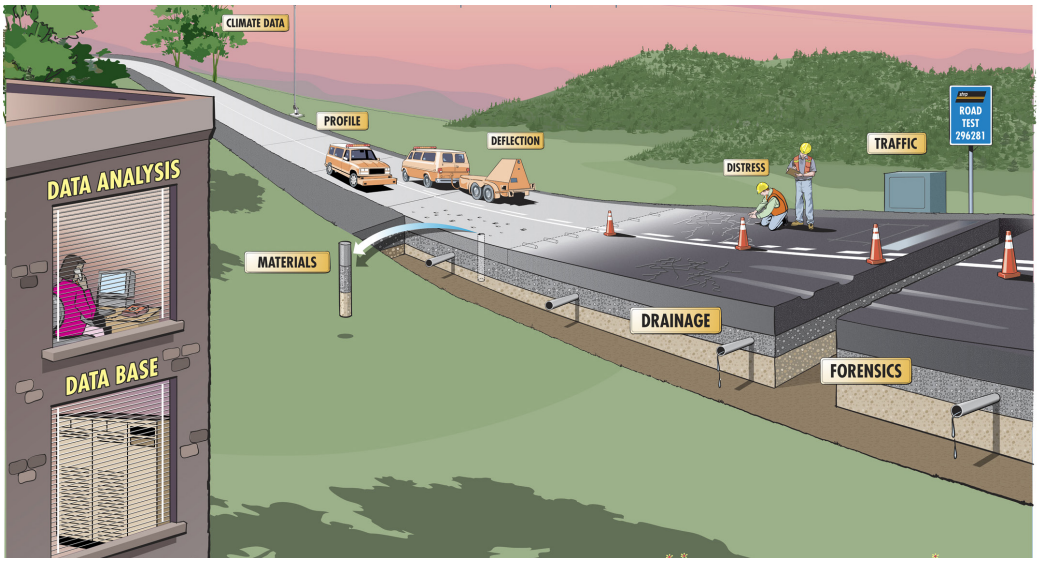

LTPP Newsletter

August 2022
Summer Issue

U.S. Department of Transportation
Federal Highway Administration

Performance of Rigid Pavements After 20 Plus Years

The Long-Term Pavement Performance (LTPP) program provided support to the Transportation Pooled Fund Study TPF-5(291), "Development of a Specific Pavement Study (SPS)-2 Pavement Preservation Experiment," which created a second-tier experiment based on the original SPS-2 experiment. The original experiment designed by the LTPP program examines the structural factors of rigid pavement. The objective of the pooled fund study was to determine the most cost-effective concrete preservation strategies to extend the service life of the aging pavements constructed from the mid-1990s to 2000. Figure 1 shows a U.S. map of the SPS-2 test site locations and the year of construction.

Under the leadership of the Washington State Department of Transportation (WSDOT), this study was conducted from 2014 to 2021, with funding support from six State departments of transportation (DOTs): Arizona, California, Colorado, Georgia, Kansas, and North Carolina. These agencies also served as the Technical Advisory Committee (TAC) for the study.

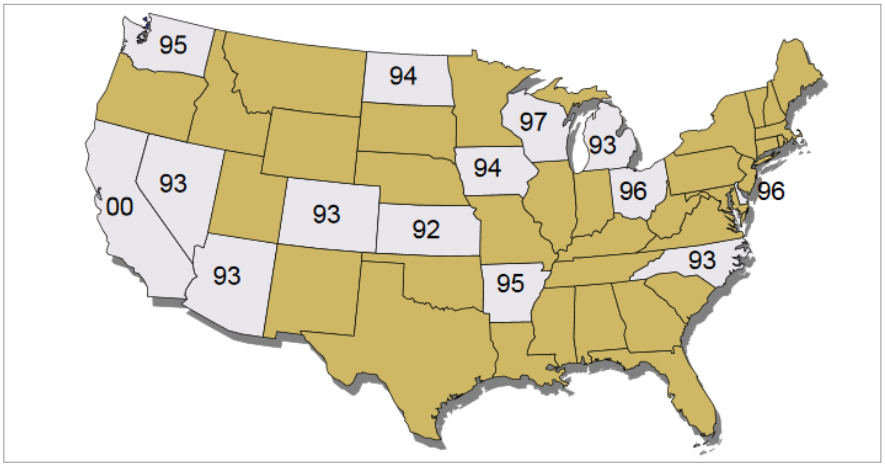

Figure 1. Illustration. States showing location of 14 LTPP SPS-2 sites constructed from 1992 to 2000.

The research team for this study provided an early summary report entitled, *Development of SPS-2 Pavement Preservation Experiment—Final Phase I Report*, of the existing status of the various LTPP experiments to the TAC members, which included options for implementing a new pavement preservation field study within the active SPS-2 test sections still monitored by the LTPP program.[1] TAC members wanted to know if predicted pavement performance is reliable to use as a control for test sections receiving a pavement preservation treatment. Based on the research team's analyses, the American Association of State Highway and Transportation Officials (AASHTO) AASHTOWare Pavement Mechanistic-Empirical (ME) Design predictions are not sufficiently accurate to serve as control

[1] Dufalla, N., Senn, K., Schmalzer, P., and Nichols Consulting Engineers (NCE). 2016. *Development of SPS-2 Pavement Preservation Experiment—Final Phase I Report.* Olympia, WA: Washington State Department of Transportation.

sections. This finding was a key element in the evolution of work conducted under the pooled fund study and is documented in *Final Report—Comparison of Predicted and Actual SPS-2 Performance Using AASHTOWare PaveME*.[2]

The research team also conducted field visits to the sites, called SPS-2 Tech Days. Tech Days exposed a broader audience to the SPS-2 projects and obtained input for potential future activities. Most SPS-2 Tech Days included a classroom discussion of the SPS-2 experiment, key findings, more details about the site, and an onsite field observation (figure 2). A typical Tech Day included approximately 40 attendees, which were a mix of DOTs, industry, academia, and contractor personnel. Several Tech Days included workers who constructed or inspected the test sections during the 1990s. At the field walks, which were particularly well received, the participants were struck by the differences in performance between design features that were revealed over the more than 20 yr since construction. Table 1 shows the nine SPS-2 Tech Days conducted under this study.

SPS-2 Tech Days also provided multiple recommendations for additional analyses that would benefit the pavement community. Based on these recommendations, TAC approved the following studies (and others) to:

- Determine deterioration rates to evaluate the impact of SPS-2 experimental design features.
- Assess impacts of initial smoothness and shoulder type on performance, and the impact of design feature on load transfer efficiency using existing performance data including falling weight deflectometer, distress, and longitudinal profile.
- Assess previous analyses of SPS-2 projects and update the analyses using the additional performance data collected since the original work was done.
- Update the experimental matrix based on measured data as opposed to the assumed properties when the projects were nominated.
- Evaluate the impact of nonexperimental factors on pavement performance.
- Estimate the age of pavement at the time of failure based on projections of measured performance and selected failure criteria.

To see the full list of the studies performed between 2019–2021 along with the documents referenced in this article, see the Documents section on the Transportation Pooled Fund website. For more information, contact Mustafa Mohamedali of WSDOT at mohamem@wsdot.wa.gov, or Deborah Walker of Federal Highway Administration (FHWA) at deborah.walker@dot.gov.

Figure 2. Photo. Washington Tech Day for SPS-2 field visit on May 2, 2018.

SPS-2 Tech Days		
State	**Date**	**Location**
Arizona	2/21/2018	Phoenix
Colorado	3/23/2018	Denver
Washington	5/2/2018	Ritzville
Iowa	5/30/2018	Pleasant Hill
Kansas	10/2/2018	Abilene
North Dakota	10/16/2018 – 10/17/2018	Bismarck/Fargo
California	3/12/2019	Stockton/Delhi
Arkansas	3/19/2019	Little Rock
Ohio	5/22/2019	Delaware

Table 1. Completed SPS-2 Tech Days.

[2] WSDOT. n.d. *Comparison of Predicted and Actual SPS-2 Performance Using AASHTOWare PaveME*. Olympia, WA: Washington State Department of Transportation.

Longitudinal Profile Diurnal Measurements Available in InfoPave™

The LTPP program initiated a special profile-monitoring data collection activity on jointed plain concrete pavements (JPCP) that was designed to capture changes in longitudinal profile roughness over a 1-d timeframe (i.e., diurnal measurement). The intent was to address noted differences in the International Roughness Index on JPCP over short durations limited to a single day.

In 2013, the LTPP program developed guidelines to collect diurnal measurements of longitudinal profile data at the program's rigid pavement project sites (i.e., *Strategic Study of Structural Factors of Rigid Pavements, SPS-2 Projects*). The guidelines were updated in 2019 to include the JPCP from the following experiments: *General Pavement Study (GPS)* and *Environmental Factors in the Absence of Heavy Loads Experiments* (GPS-3 and SPS-8, respectively).[3]

The profile data were collected three times over the course of the day to gather information on how the slab changes as the temperature changes throughout the day. The target times were as follows:

- Early morning: 5–7 a.m., coldest surface relative to temperature of bottom of the slab.
- Midmorning or late evening: 9–11 a.m. or 7–9 p.m., top and bottom of slab at the same temperature.
- Afternoon: 1–3 p.m., hottest surface relative to temperature of the bottom of the slab.

> Diurnal data provided in LTPP InfoPave may be used to investigate the effect of time-of-day measurements, which can affect pay factors for pavement smoothness, pavement condition, and other important questions for State DOTs.

The LTPP InfoPave™ Web portal contains 348 diurnal datasets representing testing at 230 test sections across 23 States, and some sections had multiple diurnal tests over the years. Since January 2013, test sections in the GPS-3 and SPS-2 and SPS-8 experiments have had more than one profile run in a given day. Contact LTPP Customer Service Support Center at ltppinfo@dot.gov for help with locating these data.

The LTPP program directive, Diurnal Collection of Longitudinal Profile Data on SPS-2, GPS-3, and SPS-8 Rigid Pavement Test Sections (P-58) provides more detail on this special profile monitoring data collection activity. For more information, contact Larry Wiser at larry.wiser@dot.gov.

Materials Testing Data Available from Warm-Mix Asphalt Projects

The *Warm-Mix Asphalt Overlay of Asphalt Pavements Experiment (SPS-10)* has been underway since 2014. Test section recruitment, selection, and construction has been completed and the full suite of performance testing from the experimental design is being conducted. Part of the performance evaluation includes detailed materials about the sampling and testing of all pavement layers constructed at the test sections. The experiment called for scheduled materials sampling and testing from 3 to 6 mo, 12 mo, and then again at 18 mo after construction of the warm-mix asphalt layers.

To characterize the materials, bulk samples of subgrade and other unbound layers were obtained, and cores of bound layers were taken. An entire set of characterization tests are being performed, including sieve analysis, classification, Atterberg limits, standard proctor, moisture content, and resilient modulus on subgrade and unbound layers and Hamburg wheel track testing, dynamic modulus, and Fenix testing on the asphalt concrete mixes. The asphalt concrete binders are also being characterized.

While this dataset is developed and laboratory testing is ongoing, a substantial amount of new data are available at LTPP InfoPave. Under the Data tab, select the SPS-10 experiment and the materials data of interest. The information on InfoPave provides new asphalt materials data consisting of mixture, binder, and aggregate testing. This information includes dynamic modulus test results, which are a common input for modern pavement design. There are also new subgrade and unbound test results, including layer characterization and resilient modulus. More data will be available as the laboratory testing progresses.

Materials sampling and testing plans are custom designed for each SPS-10 project and available by contacting LTPP Customer Service Support Center at ltppinfo@dot.gov.

[3] Federal Highway Administration. 2015. *The Long-Term Pavement Performance Program.* Report No. FHWA-HRT-15-049. Washington, DC: Federal Highway Administration. https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/ltpp/15049/15049.pdf, last accessed July 12, 2022.

Winners of the Inaugural 2020-2021 LTIP Student Data Analysis Contest

Four papers were selected for awards in the first Long-Term Infrastructure Performance (LTIP) Student Data Analysis Contest. The student winners are as follows:

Agnimitra Sengupta, Sudeepta Mondal, Ph.D., S. Ilgin Guler, Ph.D., and Parisa Shokouhi, Ph.D.

Pennsylvania State University

1st Place (Bridge): "A State-Based Hidden Markov Model Approach to Impact Echo Signal Classification"

Miaomiao Zhang, Hongren Gong, Yuetan Ma, Xi Jiang, and Baoshan Huang

University of Tennessee

1st Place (Pavement): "Nomogram for Predicting Asphalt Pavement Roughness after Preventive Maintenance Based on LTPP Longitudinal Analysis"

Muhammad Munum Masud

Michigan State University

2nd Place (Pavement): "Guidelines for Effective Weigh-in-Motion (WIM) Equipment Calibration, Application for Modeling WIM Errors, and Comparison of the ASTM and LTPP Protocols"

Greg Seleznev

Howard Community College

3rd Place (Pavement): "Diagnosing Changes in WIM Measurement Accuracy and WIM Calibration Needs Using Data Visualization and Statistical Modeling Tools"

The LTIP Student Data Analysis Contest is designed to encourage students to use either the LTPP or Long-Term Bridge Performance (LTBP) Web portal, LTPP InfoPave or LTBP InfoBridge™, to address specific infrastructure issues or challenges. The LTPP program has a long tradition of student contests, and this was the inaugural year for the LTBP program student contest. This is also the first year a student from a community college submitted a paper using the InfoPave Web portal and placed in the contest.

Congratulations to the winners and thank you to everyone who participated in this year's contest.

In Brief

LTPP First Analysis-Ready Dataset to Be Released This Summer

The LTPP program recognizes that understanding and using the data is not an easy undertaking for users, so over the past 2 yr, we have developed a workplan to create analysis-ready datasets for database users. We are pleased to announce that the LTPP Analysis-Ready Materials Dataset is the first to be created and will be available this summer with the release of the 36th Standard Data Release. Technical and promotional materials will accompany the release of this dataset and describe the process the program used to populate it.

The program has started initial discussions to develop the analysis-ready performance dataset, which is another important dataset for LTPP database users.

LTPP's Impact Abroad

LTPP InfoPave is gaining attention in France. Eshan Dave, a member of the FHWA Expert Task Group for the LTPP program, is on sabbatical at Université Gustave Eiffel, Nantes campus (formerly, Laboratoire Central des Ponts et Chaussées, and the French Institute of Science and Technology for Transport, Development and Networks).

Eshan demonstrated InfoPave to researchers and students at Université Gustave Eiffel during his stay there and introduced InfoPave to the international delegation that participated in the data science workshop in conjunction with the 6th International Conference on Accelerated Pavement Testing (APT) on April 3 (figure 3). Eshan also introduced InfoPave resources to French transportation agency and industry members at the 2022 Journées Techniques Route (which means Road Technical Days) event in May. It is a 2-d event that is held every year in France for all road-related professionals to catch up on the latest technical developments.

Figure 3. Photo. Audience attending the APT Conference on April 3, 2022.

Transportation Pooled-Fund Solicitations

There are two active research solicitations involving the LTPP program. One is to continue the forensic investigations of LTPP test sections (Solicitation 1560), and the other is to look at the performance of pavement preservation treatments (Solicitation 1581). We encourage you to consider being a partner in these new efforts.

New Publications

Reports

Long-Term Pavement Performance Information Management System User Guide

FHWA-HRT-21-038

[PDF]

Exploring the Importance of Traffic Data Input Levels for Mechanistic-Empirical Pavement Design

FHWA-HRT-21-046

[PDF]

LTPP Manual for Collecting and Processing Longitudinal Profile, Macrotexture, and Transverse Profile Data

FHWA-HRT-21-096

[PDF]

TechBriefs

Acceptance Testing of High-Speed Transverse Profile Measuring Systems Purchased for the Long-Term Pavement Performance Program

FHWA-HRT-20-023

[PDF]

Long-Term Pavement Performance Data Analysis Plan

FHWA-HRT-21-088

[PDF]

Brochure

FHWA InfoTechnology

FHWA-HRT-22-009

[PDF]

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