TECH**BRIEF**

LTPP™

The Long-Term Pavement Performance (LTPP) Program is a large research project for the study of in-service pavements across North America. Its goal is to extend the life of highway pavements through various designs of new and rehabilitated pavement structures, using different materials and under dfferent loads, environments, subgrade soil, and maintenance practices. LTPP was established under the Strategic Highway Research Program and is now managed by the Federal Highway Administration.

U.S. Department of Transportation
Federal Highway Administration

LONG-TERM PAVEMENT PERFORMANCE DATA ANALYSIS PLAN

This document corresponds to the Federal Highway Administration's LTPP Data Analysis Plan. [1]

OBJECTIVE

This TechBrief summarizes the planning, conduct, and outcomes of the Federal Highway Administration's (FHWA's) Long-Term Pavement Performance (LTPP) program Data Analysis Workshop. FHWA conducted a multiday virtual workshop in November 2020 to gather input from subject matter experts to update the LTPP Data Analysis Plan. Formerly known as the Strategic Plan for LTPP Data Analysis, the newly formed LTPP Data Analysis Plan has five objectives, where the previous plan had nine.

BACKGROUND

The basic framework for the Strategic Plan for LTPP Data Analysis was developed by the Transportation Research Board (TRB) LTPP Data Analysis expert task group (ETG)[1],[2] in 1997 to guide the National Cooperative Highway Research Program's investment in LTPP data analysis with the following objectives:

1. Improve traffic characterization and prediction.

2. Improve materials characterization.

3. Improve consideration of environmental effects in pavement design and performance prediction.

4. Improve evaluation and use of pavement condition data in pavement management.

5. Evaluate existing and develop new pavement response and performance models applicable to pavement design and performance prediction.

6. Provide guidance for maintenance and rehabilitation strategy selection and performance prediction.

7. Quantify the performance impact of specific design features (e.g., presence or absence of positive drainage, differing levels of pre-rehabilitation surface preparation).[3]

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[1] From 1992 through 2016, FHWA sponsored the TRB Long Term Pavement Performance Committee and several supporting ETGs, including the LTPP Data Analysis ETG, as a forum to receive consensus stakeholder input on the conduct of the LTPP program. These groups were sunset and replaced by the TRB Long Term Infrastructure Performance Committee and supporting ETG on Pavements in 2017.

The plan was adopted by FHWA and expanded upon and further developed through a series of workshops over the next several years. In 2010, a 3-day LTPP Pavement Analysis Forum was held with pavement specialists to review and refine targeted analytical outcomes under the Strategic Plan.[4] This resulted in the addition of two new objectives:

8. Conduct analyses supporting and enhancing the use of the Mechanistic-Empirical Pavement Design Guide (MEPDG).[5]

9. Maintain comprehensive use of LTPP to improve the management of pavement assets.[6]

The LTPP Data Analysis Plan is a living document and has been revised and updated regularly since its adoption to show the status of analysis projects.[7]

Given recent accomplishments in pavement research resulting from LTPP and other programs' efforts, and to respond to evolving highway agency needs, FHWA recognized the need to update the plan to include projects that would provide answers to questions that reflect current pavement practices. The LTPP program staff collaborated with members from the TRB ETG on Pavements to refine the nine objectives and their intended outcomes to help address current and future needs of State departments of transportation (DOTs).

PREPARATION FOR THE WORKSHOP

Preparations for a data analysis workshop were initiated through a discussion at the TRB Long-Term Infrastructure Performance (LTIP) ETG on Pavements meeting in April 2020.[8] This was followed by a series of meetings to obtain ETG input toward revised objectives and anticipated outcomes that address current needs relevant to management of highway pavements assets. The following objectives and associated outcomes were developed:

Table 1. LTPP Data Analysis Objectives and Outcomes	
Objectives	**Outcomes**
Objective 1 Characterize loading, environment, and materials and impact on pavement performance	A. Characterization and impact of traffic loading on pavement performance B. Characterization and impact of environmental effects on pavement layer characteristics and pavement performance C. Impact of material characteristics and properties on pavement performance D. Relationship among individual performance indicators (e.g., roughness, deflection) and pavement performance
Objective 2 Determine the effects of design features on pavement performance	A. Quantified impact of specific design features (e.g., subsurface drainage, base types, shoulder types, edge support) on performance B. Impact of design features on measured pavement responses (deflections, load-transfer, strains, etc.) C. Guidelines to select design features for improved pavement performance
Objective 3 Improve selection and design methodologies for new and rehabilitated pavements	A. Enhanced pavement response and performance prediction models B. Distress prediction based on commonly collected pavement data C. LTPP data to support/improve mechanistic-empirical procedures
Objective 4 Improved strategies for planning maintenance and preservation treatments	A. Performance analysis ready maintenance and preservation datasets B. Procedures for identifying maintenance and preservation needs C. Performance prediction of maintenance and preservation treatments
Objective 5 Improve pavement asset management practices	A. Evaluation and use of pavement performance data in pavement management and performance reporting B. Data collection efficiency and quality management

CONDUCTING THE WORKSHOP

The purpose of the LTPP Pavement Data Analysis Workshop was to receive input from pavement experts concerning current and future needs of the pavement community that can be addressed utilizing LTPP data and information. The specific objective was to inform development of an updated LTPP Data Analysis Plan reflecting a strategic approach and a focused set of

short- and long-term (5 and 10 yr, respectively) data analysis project descriptions that will apply the LTPP data to address high priority pavement engineering needs of national importance.

The 42 workshop participants included members of the TRB LTIP ETG on Pavements; other pavement experts from State DOTs; academia and industry; and FHWA staff. Based on their experience, participants were assigned to a workgroup tasked with considering one of the five objectives. Members of the TRB LTIP ETG on Pavements served as chairs of the workgroups.

Workshop participants were provided with premeeting reading material and asked to provide input concerning further revision of the objectives and outcomes, if needed. Each of the five workgroups was instructed to review the existing problem statements against the revised objectives and associated analytical outcomes to determine if they were still relevant to the pavement community and to identify potential new projects to add to the plan.

The virtual workshop was conducted in early November 2020 and was spread over 6 workdays. Three plenary sessions were held; however, most of the time was spent in concurrent working group sessions that covered each of the five LTPP Data Analysis Objectives. The first plenary session consisted of an FHWA welcome message, participants' introductions, goals of the workshop, the data analysis plan, logistics, and questions and answers.

During the second plenary session, workgroups reported back on progress. The objective of the second plenary session was for all participants to review the list of ideas from each workgroup and eliminate duplication. New projects suggested by the participants were vetted within that workgroup and across different workgroups as to their relevancy.

The third plenary session consisted of all workgroups reporting back on final outcomes from their deliberations. A revised list of project descriptions was reviewed to ensure the list of assembled final drafts of project descriptions was comprehensive. The session concluded with closing remarks.

OUTCOMES

The input from the workgroups supported well-founded and informed revisions to the objectives and outcomes and assembled a candidate set of updated LTPP data analysis project descriptions that outline the required work by using a provided template. The workgroups drafted complete problem statements for those projects that were considered to have immediate benefits to the highway community. At the close of the workshop,

FHWA received the following 22 proposed problem statements from the participants, with many of them offering their support to further develop other statements, if requested:

Objective 1: Characterize loading, environment, and materials and impact on pavement performance.

- Develop traffic loading estimates for pavement analysis using truck volumes from non-traditional data sources.

- Determine loading trends for use in pavement load forecasting.

- Conduct examinations of construction variability in the LTPP database.

- Determine effects of reclaimed asphalt pavement and polymer-modified asphalt on pavement performance.

- Identify and deliver best practices by leveraging LTPP data.

- Verify long-term pavement performance design recommendations using accelerated pavement testing data.

Objective 2: Determine the effects of design features on pavement performance.

- Influence specific pavement studies (SPS)-1 and SPS-8 design features on performance of flexible pavements.

- Influence SPS-2 and SPS-8 design features on performance of rigid pavements.

- Develop a plan for an LTPP satellite research program for pavement preservation.

- Develop a plan for an LTPP satellite research program for new construction.

Objective 3: Improve selection and design methodologies for new and rehabilitated pavements.

- Develop longitudinal cracking models for portland cement concrete pavements.

- Model for predicting degradation of unbound granular base and subbase quality of in service pavements.

- Assessment of and guidance on future enhancements to models for predicting variability in pavement layer modulus over time.

- Develop MEPDG performance models for other pavement distresses affecting functional performance.

- Understand the curling and warping effects on jointed concrete pavements by using seasonal and diurnal profile data.

Objective 4: Improved strategies for planning maintenance and preservation treatments.

- Develop distress threshold triggers for maintenance and rehabilitation treatments.

- Select appropriate pavement rehabilitation techniques for existing conditions and features.

- Incorporate structural condition into maintenance decision-making.

Objective 5: Improve pavement asset management practices.

- Develop predictive pavement performance models for asset management.

- Create climate models for transportation asset management.

- Establish pavement data collection requirements for network-level and project-level pavement management.

- Develop localized international roughness index roughness triggers for pavement maintenance actions.

The proposed data analysis projects resulting from this workshop are being considered and prioritized by FHWA for implementation. The LTPP program staff used the feedback obtained throughout the workshop to update the LTPP Data Analysis Plan to show revised objectives, outcomes, and analysis projects. The revised plan is available on the LTPP InfoPave™ [1] website, under the Analysis hub.

ACKNOWLEDGEMENTS

If you have any questions, please contact Larry Wiser at larry.wiser@dot.gov.

REFERENCES

1. Federal Highway Administration. n.d. "LTPP InfoPave™: Analysis: LTPP Data Analysis Plan" Web page. https://infopave.fhwa.dot.gov/Analysis/InteractiveDataAnalysis, last accessed May 19, 2021.

2. Federal Highway Administration. 2017. "Expert Task Group Defines LTPP Data Analysis Program" (web page). (FHWA-RD-00-065) https://www.fhwa.dot.gov/publications/focus/00dec/lttp.cfm, last accessed May 19, 2021.

3. Federal Highway Administration. 1999. "Strategic Plan for Long-Term Pavement Performance Data Analysis" (web page). https://highways.dot.gov/sites/fhwa.dot.gov/files/docs/research/long-term-pavement-performance/analysis/2056/tablecloth.pdf, last accessed May 19, 2021.

4. Federal Highway Administration. 2011. "Thank You for Saying 'Yes' When We Called." LTPP Newsletter 7, no. 1, Winter 2011: 2. http://www.fhwa.dot.gov/publications/ltppnews/11028.pdf, last accessed May 19, 2021.

5. NCHRP 01-37A [Completed], Development of the 2002 Guide for the Design of New and Rehabilitated Pavement Structures: Phase II, https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=218, last accessed May 19, 2021.

6. Federal Highway Administration. 2017. "Long-Term Pavement Performance Data Analysis Program: Strategic Plan Objectives, Analysis Outcomes, and Supporting Projects" (web document). https://highways.dot.gov/sites/fhwa.dot.gov/files/images/RDT-HRDI-Programs-LTPP-expanded-performance_data_analysis_final20181101.pdf, last accessed May 19, 2021.

7. 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 May 19, 2021.

8. Ajegba, P. 2020. "Long-Term Infrastructure Program Letter Report," National Academies of Sciences, Engineering, Medicine Letter No. 27, Jan. 20, 2011: 4. http://onlinepubs.trb.org/onlinepubs/reports/LTIP_letter_03.pdf, last accessed May 19, 2021.