

Office of Infrastructure

Research

R&D
Development

Pavements

Serving the
transportation
community with
innovative pavement
technology solutions



U.S. Department
of Transportation
Federal Highway
Administration

Turner-Fairbank
Highway Research Center

Research
that is essential,
indispensable,
and connected to
our customers



Office of Infrastructure R&D

The Federal Highway Administration's (FHWA) Office of Infrastructure Research and Development (R&D) conducts research that improves the design, construction, operation, and management of pavements and structures. Located at the Turner-Fairbank Highway Research Center (TFHRC), the office has an active outreach program that identifies future targets of opportunity, and researchers who pursue advanced initiatives that drive innovative programs to serve customers' needs.

Sharing research activities and results with partners and other interested parties is very important. The Office of Infrastructure R&D "spreads the word" and engages the transportation community through publications, meetings, and the TFHRC Web site, and collaborates with State highway agencies, industry trade associations, and professional societies.



Pavements

Vision and Goals

The Pavements R&D staff pursues the Agency's vision of long-life pavements that meet our customers' needs, are safe, cost effective, long lasting, environmentally friendly, and can be maintained effectively. Attaining this vision will help FHWA achieve its key goals of improving the productivity and mobility of the national highway system.

The goal of the Pavements R&D program is to address this vision through a series of research efforts within four broad focus areas:

- Optimized Pavement Design, Materials, and Evaluation Systems.
- Advanced Quality Systems.
- Enhanced User Satisfaction with the Driving Experience.
- Environmental Stewardship.

Eight TFHRC laboratories support the Pavements R&D program. The Pavements R&D staff works with stakeholders, partners, and other FHWA offices to develop short- and long-term research, development, and technology transfer plans and projects; demonstrate new technology; conduct field trials; and address customer needs and potential benefits from new technology.

The Pavements R&D staff is composed of three teams that work together to develop and conduct the program:

- Pavement Design and Performance Modeling (PDPM).
- Pavement Materials and Construction (PMC).
- Long-Term Pavement Performance (LTPP).

These teams' products include information, tools, and technology that improve pavement safety, performance, and durability, and decrease construction time and costs. These attributes enhance user satisfaction with the Nation's pavements. The resulting pavements will be easier to maintain and more environmentally friendly.

Because the teams treat pavements as a system, the resulting interaction and synergy among the teams collectively contribute to the successes achieved in each focus area. All three teams also solicit feedback from FHWA's partners and customers, and provide technical assistance that includes forensic analysis, testing, troubleshooting, and guidance.

Learn more about each team...

Working with
the transportation
community to promote
exchange of information
among researchers,
practitioners, and
infrastructure owners
to provide motorists
with safer, more durable,
environmentally friendly,
and cost-effective
pavement systems with
higher driver satisfaction

Pavement Design and Performance Modeling Team

The PDPM team develops models, procedures, and processes that help transportation specialists predict pavement performance and select designs to optimize pavement performance and life cycle costs. To accomplish this objective, researchers consider pavements as a system; integrating materials selection and mixture design, structural design, the construction process, and environmental exposure.

Activities

Pavement Design Analysis. The PDPM team works with the American Association of State Highway and Transportation Officials (AASHTO), the National Cooperative Highway Research Program (NCHRP), other FHWA offices, and State departments of transportation (DOT) to evaluate, validate, and calibrate the new pavement design guide developed under NCHRP Project 1-37A. The success of these activities will require a collaborative team effort.

Concurrently, the PDPM team is developing additional mechanistic and mechanistic-empirical models to



advance the state-of-the-art of pavement structural behavior prediction and design. For example, recent and current accelerated tests conducted at the Pavement Testing Facility (PTF) at TFHRC have enhanced our knowledge

about the behavior of Superpave® asphalt mixes and concrete ultrathin whitetopping. These experiments are conducted with significant input from and cooperation with the paving industry, and provide invaluable data to verify design models. The PDPM team is also working on new pavement design concepts, including composite pavements, to optimize the use of available paving materials.

In addition, the PDPM team is developing guidelines for systematically selecting optimal alternatives for repair and rehabilitation techniques, considering pavement condition, desired performance, and cost, among other factors.

Quality Systems. FHWA has developed the HIPERPAV™ software system to predict the behavior of concrete pavements and avoid problems during construction (for more details, see the PMC team section). As it has evolved, HIPERPAV now includes a series of predictive models that are relevant to the behavior and performance of concrete pavements over both the short and long term. The PDPM team will be working with HIPERPAV as it relates to pavement performance and design.

The PDPM manages the Computational laboratory, which includes finite element programs to analyze pavement performance.

For more information, please contact the PDPM team leader:
Katherine Petros
202-493-3154
katherine.petros@fhwa.dot.gov

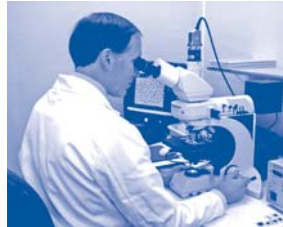
Pavement Materials and Construction Team

The PMC team helps increase pavement life by developing a better understanding of asphalt and portland cement concrete (PCC) paving materials and the pavement construction process.

The PMC team is unique in that it is composed of two groups: the Asphalt group and the Portland Cement Concrete group. These groups work independently on activities unique to their respective materials, but also routinely work together to solve problems and advance knowledge in areas of mutual interest.

Activities

Pavement Design. The PMC team works to enhance the understanding of paving materials characteristics, behaviors, and their role in pavement performance by investigating them at scales ranging from micro to macro. The microscale involves chemical approaches to characterize and assess modified asphalt binder systems, detect asphalt antistripping agents (including lime), investigate alkali-silica reactivity (ASR), and conduct forensic investigations for our State partners.



In the indoor laboratories, the PMC team has a range of activities. Under the Simulation, Imaging, and Mechanics of All Pavements (SIMAP), advanced two- and three-dimensional imaging techniques (including x-ray tomography) map the complex interaction of binders and aggregates. Image analysis identifies and quantifies behavior such as segregation, and advances the state of performance models.

The PMC team has developed several key pieces of equipment used for asphalt and concrete materials testing. The FHWA Dynamic Angle Validator™ is used in the Superpave system to calibrate gyratory compactors. The coefficient of thermal expansion test provides a characteristic of concrete key to its behavior in concrete pavements. Several other pieces of equipment are being assessed and refined.



The Superpave system, developed under the Strategic Highway Research Program (SHRP), is being further refined through the efforts of the PMC team. Superpave is used nationally for asphalt binder specification and mixture design. The PMC team is conducting an indepth indoor laboratory and outdoor full-scale study into the behavior of polymer-modified binders. This effort is being coordinated through the Transportation Research Board's (TRB) Superpave Binder Expert Task Group (ETG) and the Superpave Mixture/Aggregate ETG.

At the outdoor full-scale laboratories, 12 full-scale hot-mix asphalt (HMA) test lanes using modified binders have been constructed at the PTF and are undergoing accelerated load tests. This work is part of national pooled fund project TPF-5 (019) (still open to additional State participants).

Results of this study will help engineers across the country better select the asphalt binders appropriate for increasing the performance and longevity of pavements in their particular climates.

User Satisfaction. To allow traffic on newly constructed pavements within days or hours after the work is completed, pavement contractors began using “fast-track” PCC mixes in the early 1990s. These mixes gain strength rapidly, thus shortening the time delay caused by pavement curing. As a result, fast-track construction improves highway user satisfaction by minimizing the delays caused by construction activities.

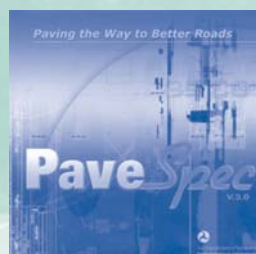
The challenge associated with these rapid strength-gain concretes is to place them successfully to achieve long-term durability and rapid strength. In response to this problem, FHWA began researching construction guidelines for fast-track jointed plain concrete pavements.

Researchers developed the software program HIPERPAV to help control pavement quality during construction. HIPERPAV uses predictive models to consider design, selection of pavement materials, construction, and environmental factors and to recommend select combinations of variables within these factors that will resist early-age distress. Research continues on HIPERPAV to expand its capabilities.

Intelligent construction systems use state-of-the-art technology to streamline and increase the quality of the construction process. The PMC team is currently exploring the use of smart compaction systems that incorporate a global positioning system, density sensors, and a computer graphics interface to help the roller operators optimize the compaction of base and asphalt-bound pavement layers.

Quality Systems. The macroscale deals with activities that have a direct impact on the construction process. The PMC team works with the TRB's Superpave committee to develop quality assurance/quality control guidelines for pavement construction projects. Researchers are developing and validating HMA performance-related specifications (PRS) in cooperation with NCHRP project 9-22. In addition, the team is exploring alternative non-nuclear devices to determine mix compaction and density during HMA construction, and evaluation of one such device is currently underway.

For rigid pavements, PRS research has produced the PaveSpec™ software package that helps pavement specifiers develop their own PRS; the specifications have been tested on several projects in Indiana, with other projects pending.



The PMC team manages the Asphalt Mixtures laboratory, Binder laboratory, Chemistry laboratory, PCC laboratory complex, Petrographic laboratory, PTF, and the SIMAP laboratory.

For more information, please contact the PMC team leader:

Tom Harman

202-493-3072

tom.harman@fhwa.dot.gov

Long-Term Pavement Performance Team



ROAD
TEST
723008

The LTPP team conducts the LTPP program to increase the understanding of why some pavements perform better than others. This information is key to building and maintaining a cost-effective highway system.

Activities

Pavement Design. In 1987, the LTPP program—a comprehensive 20-year study of in-service pavements—began a series of rigorous long-term field experiments monitoring more than 2,400 asphalt and PCC pavement test sections across the United States and Canada. These sections included both existing pavements (General Pavement Studies) and newly constructed sections (Specific Pavement Studies).

NCHRP Project 1-37A has developed a new pavement design guide. Data collected at the LTPP sites since the program's inception have been essential for evaluating and validating the models included in the new guide. LTPP data will continue to be used for further evaluation and validation of the guide.



A new pooled fund study, TPF 5 (039), is being offered to interested States. Objectives of the study, “Falling Weight Deflectometer (FWD) Calibration Center and

Operational Improvements,” include minimizing the variability in pavement-deflection data obtained with FWDs and developing and implementing long-term plans for FWD calibration centers.

User Satisfaction. The LTPP team recently completed a study of pavement smoothness index relationships to improve pavement evaluation and data comparisons. The correlations developed between Profile Indices and International Roughness Indices will allow States to convert from one system of measurement to another and still make use of archived data.

The results of this study and other LTPP efforts will improve monitoring of LTPP sections and other pavements. This will lead to improved quality

control during pavement construction, improved pavement performance, and, ultimately, enhanced satisfaction among highway users.



Quality Systems. In addition to managing the LTPP program to its completion, the LTPP team is collecting, formatting, storing, and analyzing data on the characteristics and performance of paving materials and pavements, in support of the activities of the other two pavement teams. Work will include using new equipment and procedures to collect information, and developing a more user-friendly framework to store and retrieve data, allowing easy access for multiple uses.

LTPP Data Availability

Standard Data Release

LTPP has developed a new “Standard Data Release,” which is a set of CD-ROMs containing the most current pavement performance data in zipped Microsoft® Access® 2000 database files. Also included is an application called Table Navigator, which helps the user understand the contents of the release by combining reference documents into a searchable database. A manual for Table Navigator also is included. To obtain a copy of the current Standard Data Release, please contact the LTPP Customer Support Service Center at ltppinfo@fhwa.dot.gov, by calling 865-481-2967, or by faxing 865-481-8555.

DataPave Online

DataPave Online is the latest effort to expand access to the LTPP pavement performance data while providing a user-friendly graphical interface. DataPave is available at <http://www.datapave.com>. The data provided in DataPave online will be the same as that delivered with the new Standard Data Release, described above; however, data updates on the Web site may lag somewhat behind the Standard Data Release as data is transferred between the two media.


For more information, please contact the LTPP team leader:
Aramis López
202-493-3145
aramis.lopez@fhwa.dot.gov



**For more information, contact:
Office of Infrastructure R&D**

Stephen Forster
Technical Director for Pavements
202-493-3070
steve.forster@fhwa.dot.gov

Paul Teng
Director
202-493-3022
paul.teng@fhwa.dot.gov

A blue-tinted photograph of a rural landscape. In the foreground, a paved road with a white line on the left side curves towards the right. To the left of the road is a field of tall grasses or reeds. In the middle ground, there are more fields and a line of trees. In the background, a bridge or overpass is visible against a sky with scattered white clouds.

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**FHWA-RD-03-090
HRDI-04/08-04(2.5M)E**