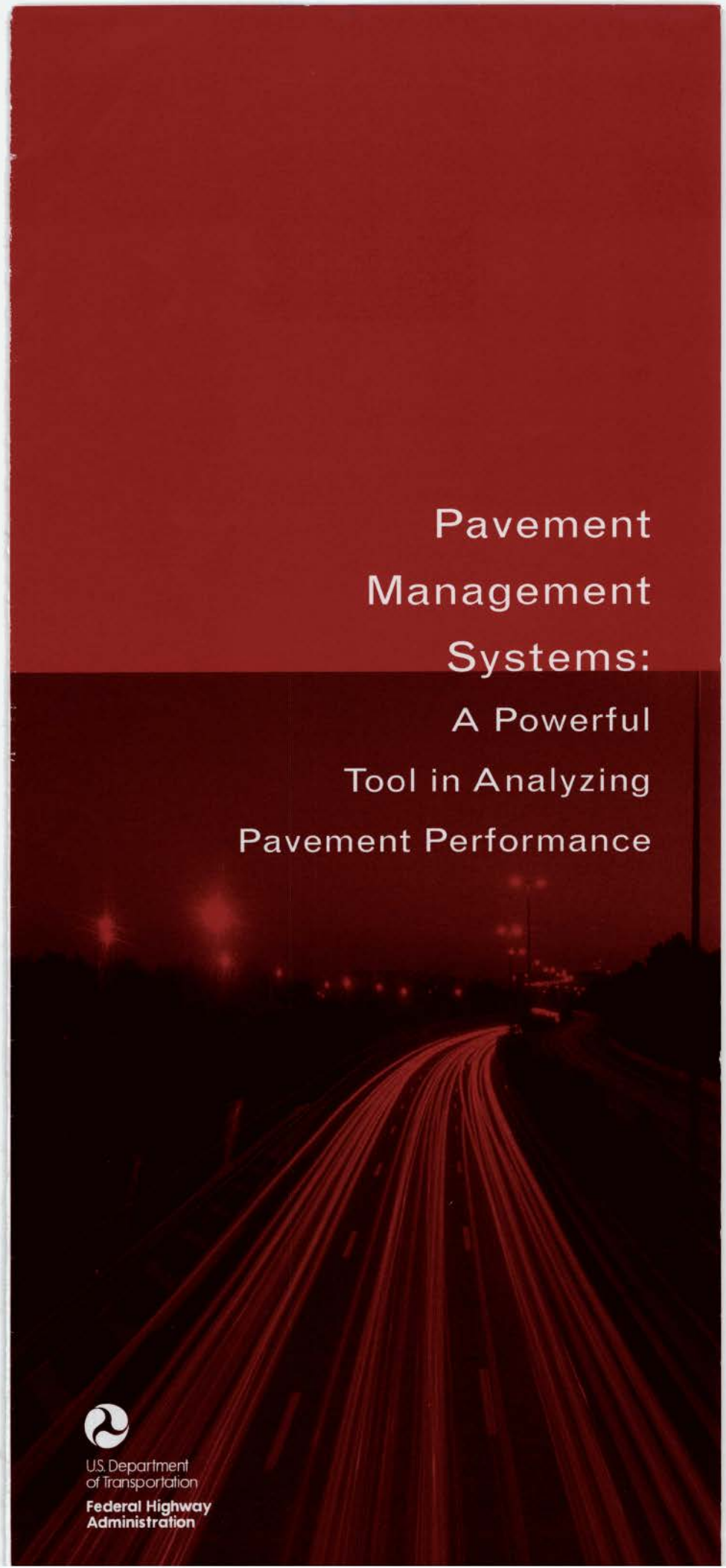
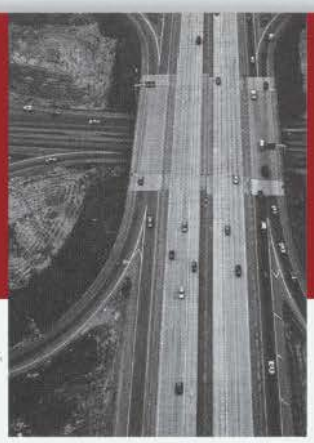
Pavement Management Systems: A Powerful Tool in Analyzing Pavement Performance



U.S. Department of Transportation
Federal Highway Administration



Why Pavement Performance is So Important

Reported cost estimates show that building, rehabilitating, and maintaining pavements consumes two-thirds of a highway agency's total budget. The most vital information used in the engineering and decisionmaking process to manage pavements is the performance of the pavement. There is a huge difference, however, in using anecdotal data, casual observations, and subjective opinions to evaluate pavements versus applying a sound, objective engineering process to measure and evaluate the real life performance of pavements.

The Past, Present, and Future

Until now, most highway agencies have only used their pavement management systems (PMS) at the network level to plan, program, and budget pavement preservation strategies. With the advancement of PMS technology over the past 3 decades, many State DOTs now have mature and reliable PMS condition databases containing valuable performance data, covering in most cases a time frame of 5 to 20 years. These historically rich databases are a primary source of invaluable data that can be used to objectively document, measure, and evaluate the real life performance of numerous pavement parameters that affect performance, i.e., structural design, mix design, materials, construction specifications, climate, load, and aging.

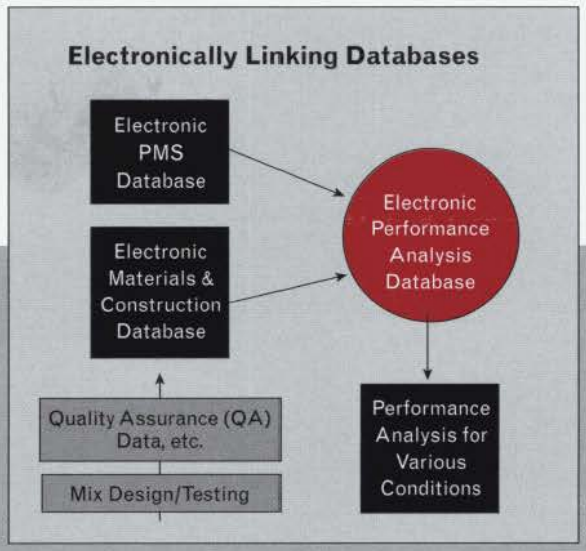
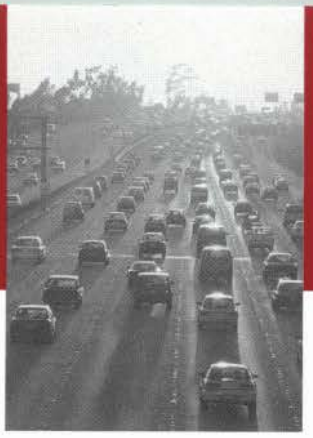


Fig. 1



A Generic Process for Performance Monitoring

Objective pavement performance monitoring can only be done using a sound and comprehensive process. Fortunately, processes exist, generic in nature, that cover most pavement parameters. Engineers now have fully automated systems available to monitor performance and to link related pavement construction, traffic, and materials databases electronically. Figure 1 illustrates a generic performance monitoring process and the flow of information, and demonstrates the necessity for electronic data entry and the linking of databases.

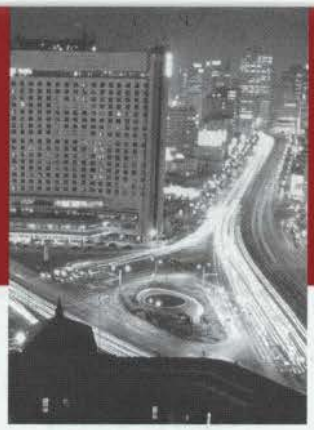
Washington State's Experience

The Washington State Department of Transportation (WSDOT) has made a major effort to put nearly all of its essential data on pavement materials and construction in electronic format. Partnering with the University of Washington, WSDOT has developed a Web-based system to link and integrate needed performance data for Superpave and stone matrix asphalt (SMA) pavements. This Web site has been dubbed HMA View. Started in early 2001, the site allows WSDOT to track the performance of pavements by assessing such characteristics as rutting or cracking. "It's a wonderful tool that allows you to look at the field data during production via automated control charts, which are all on one page for easy viewing and analysis," says Kim Willoughby of WSDOT. "Also, the pavements' performance over time can be monitored and linked to actual field test results."

Testing the Performance Monitoring Process on Superpave

The Maryland DOT partnered with FHWA; a PMS research team assembled by FHWA that included Charles Dougan, Ronald Hudson, Carl Monismith, and Pim Visser; and the University of Washington to conduct a "Pathfinder" study to apply the WSDOT performance monitoring process to Superpave pavements. Seven Superpave projects constructed since 1999 were selected and data collected

Fully automated performance monitoring is only possible if the pavement data is recorded electronically and the individual pavement construction and materials databases are linked electronically.

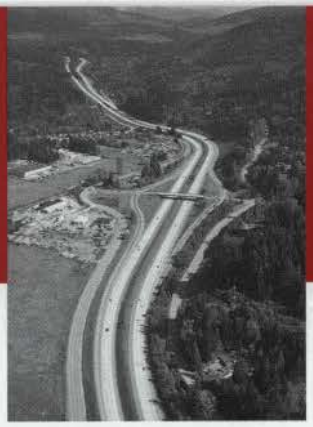


from the Maryland State Highway Administration's (SHA) quality assurance, pavement design, mix design, and PMS files. The data entry process took 2 months of effort, as most of the data was not in electronic format. The data not in electronic format was transformed from flat files and other sources by SHA staff and was then loaded into the WSDOT Web-based system. Some data gaps existed but despite the limitations encountered, the project successfully demonstrated how a State highway agency can assemble a detailed database that can be used to evaluate the performance of Superpave and other design and new material concepts. "It has become clear that there is much more data present in PMS, pavement design, materials, and construction files than is currently used or accessible for performance monitoring and that some of the missing data could easily be collated in the future," says Peter Stephanos of Maryland SHA. The project also clearly demonstrated the advantages of collecting data in electronic format, making it easily accessible for other applications. Putting things in electronic format requires a change in attitude and the realization that this data can be useful in many applications and for many different offices and divisions within any given State DOT.

Since the Pathfinder study, Maryland SHA has continued working with the University of Washington on a performance monitoring pilot project. "Using HMA View, we have merged seven databases that monitor materials, construction, and performance into one program," says Gloria Burke of Maryland SHA. The seven databases that have been merged track pavement design, project performance, ride quality, binder data, construction details, mix design, and QA. The combined database was uploaded into a version of HMA View customized for Maryland, which included maps, control charts, and thermal and digital images. The new comprehensive database was pilot tested on an 8-km (5-mi) section of roadway resurfacing located on I-68 in western Maryland. "The I-68 pilot project using HMA View was quite successful. After completion of the project, the steering team met to review the pros and cons and future needs. We came up with a short list of improvements to make for the future, including better mapping capabilities, adding a GPS search option, and increasing document storage," says Burke. Maryland's next step with HMA View is to use it in concert with a construction project being sponsored by the agency's Highway Design department. Project engineers will be provided with handheld military grade computers to use in the field. This will give them the ability to connect to HMA View wirelessly while in the field, providing immediate access to all test results, control charts, and more. "We're looking forward to doing this new project. It's definitely the way we're going to go in the future," says Larry Michael of Maryland SHA.

Information Technology—The Work Ahead

Many State DOTs do not have complete PMS databases. They lack data or connections with data sources on materials, construction, and traffic, etc., which are necessary for performance monitoring. The reality is many States have the miss-



ing data; however, these data are in flat files or other storage media and must be converted to electronic files. In addition, most individual databases are not yet electronically linked to one another. While the task of establishing complete electronic databases sounds like a daunting one, it is ultimately doable.

Mechanistic Design

The AASHTO *2002 Pavement Design Guide* that is currently under development will present a unique opportunity for using PMS data, as the Guide will contain new mechanistic design concepts that have not been tested by many States. Linking PMS and materials, construction, and related databases will be essential to successfully implementing the Guide. For example, clear records will be needed of design concepts and details, as well as data on as-built pavement thicknesses and their material properties. To verify the models in the Guide, it will also be important to ensure that good traffic and load data are recorded annually. Linking all of this data will be crucial when comparing the estimated and measured performance of pavements constructed using the Guide's models. "Work should begin immediately to set up plans for a database with nationwide potential to initialize data for sections designed according to the 2002 Guide," says Carl Monismith of the University of California at Berkeley and a member of the PMS Research Team. With FHWA, AASHTO, and other groups taking a lead role, "a national plan should be prepared for using PMS data to evaluate the 2002 Guide, the Superpave system, and other new materials and design concepts," says Monismith.

Need for Standards

Many pavement management engineers in the States and particularly the private sector agree that a standard or protocol for measuring pavement condition data (i.e., roughness, cracking, rutting, etc.) is highly desirable because it enables communication among States, consultants, and equipment vendors. It is likely that a consensus among States to use a standard would have the dual benefit of lowering the cost of data collection and significantly improving the quality of the data. History shows that the 30-year evolution of PMS that started on a positive note of innovation has led to numerous ways to measure the same type of distress. This current situation does not allow State to State communication on pavement types such as Superpave or SMA. To solve this problem, new Provisional Standards are being developed and sponsored by AASHTO. "These standards are essential, as they will facilitate the exchange of information among States," says Charles Dougan of the Connecticut Transportation Institute and a member of the PMS Research Team. If State DOTs want to communicate in the future on the subject of pavement performance at the State network level using their PMS databases, it is vital that they support the new AASHTO standards.

How are **Superpave®** pavements performing in your State?

Are you able to verify **mechanistic design procedures** for local conditions?

Do you know the expected performance life of pavement systems such as **Stone Matrix Asphalt?**

The process for deriving answers to these questions is summarized in this brochure. The findings are based on more than 4 years of research and in-depth case studies provided by the following organizations:

Maryland Department of Transportation (DOT)
Florida Department of Transportation
Indiana Department of Transportation
Arizona Department of Transportation
Washington State Department of Transportation
University of Washington

Training

FHWA's National Highway Institute (NHI) has a new training course (Course No. 131105) designed to show how PMS can be used to do engineering analysis. The course also covers systems performance monitoring. To request this course, contact Ewa Rodzik at NHI, 703-235-0524 (email: ewa.rodzik@fhwa.dot.gov). For more information on the course content, contact Sonya Hill at FHWA, 202-366-1337 (fax: 202-366-9981; email: sonya.hill@fhwa.dot.gov).

References

For more information on the PMS Performance Monitoring Study, contact Sonya Hill at FHWA, 202-366-1337 (fax: 202-366-9981; email: sonya.hill@fhwa.dot.gov). The study report can be found on the Web at www.fhwa.dot.gov/infrastructure/asstmgmt/pms.htm.

For more information on HMA View, contact George White at the University of Washington, 206-685-7198 (email: gcw@u.washington.edu) or Kim Willoughby at WSDOT, 360-709-5474 (email: willouk@wsdot.wa.gov). You can also visit the HMA View Web site at hotmix.ce.washington.edu/hma.

For more information on Maryland's performance monitoring pilot project, contact Gloria Burke at Maryland SHA, 800-477-7453 (email: gburke@sha.state.md.us).

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The Time is Now

When it comes to tracking our pavements using PMS databases, we don't have time to waste. Having an accurate account of pavement performance is an essential element in an effective asset management program. To analyze Superpave and other pavements over time, precise, unambiguous location identification information for the pavement sections is essential. While locations can be provided by GPS measurements, this information must be tied to traditional location identification information, such as project number, mile point, lane, direction, and date. The information must be entered now into PMS databases or as time passes and personnel changes occur, it may be lost forever. If no one knows where your Superpave or mechanistically designed pavements are 5 or 10 years from now, no one will be able to analyze them.

Superpave pavements and those designed using mechanistic principles are not the only types of pavements that PMS databases can be used to track, however. PMS data can be useful in analyzing the performance of recycled materials, defining the service life of high-performance materials, tracking and documenting pavements constructed using performance-related specifications, and performing life-cycle cost analysis (LCCA), among other applications. "To accurately evaluate the various pavement design and rehabilitation alternatives through LCCA, it is imperative that engineers be able to accurately predict the pavement performance of those alternatives," says Peter Grass, President of the Asphalt Institute. "The routine use of a PMS program that includes data that is both easily accessible and reliable will allow users to better predict performance, allowing a better understanding of the economic impacts of past decisions and shaping those decisions for the future." In addition, "as we move into the future with warranty construction, the use of PMS data will become critical to evaluating the performance indicators for that work," says John D'Angelo of FHWA. As States such as Maryland and Washington have demonstrated, the time is now to put your PMS data to work for you.