

Insights into Pavement Preservation

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FOREWORD

For more than 40 years, the focus of the U.S. highway community was the construction of what has been called “the greatest public works program in the history of the world,” the Dwight D. Eisenhower National System of Interstate and Defense Highways. Now, however, the highway network that transformed American life is largely completed. The task of the highway community has changed. The challenge facing highway agencies today is to preserve a system on which so much of importance—from the national economy to individual lifestyles—routinely depends.

This shift of emphasis from building and improvement to maintenance and preservation requires both a national scope and a local sense of purpose. State and local, as well as Federal, highway agencies are faced with rethinking and retooling. This booklet’s focus, pavement preservation, is just one aspect of a complex endeavor in which the broad range of organizations composing the highway community is cooperating.

One of the aims of this publication is to make clear what pavement preservation is—and what it is not. *Pavement preservation* may be defined as activities undertaken to provide and maintain serviceable roadways, including preserving investment in the national highway system; extending pavement life; enhancing pavement performance; ensuring cost-effectiveness; and reducing user delays. Pavement preservation includes preventive maintenance, as well as minor rehabilitation activities. It *does not* include new or reconstructed pavements or pavements requiring reconstruction or major rehabilitation. *Preventive maintenance* is a tool for pavement preservation and a planned strategy of cost-effective treatments to an existing roadway and its components that preserves the system, retards future deterioration, and maintains or improves functional condition of the system without increasing structural capacity. Preventive maintenance for pavement narrows the focus to the application of treatment generally to the surface of a structurally sound pavement. Activities such as pavement reconstruction or major rehabilitation, which significantly affect structural capacity, are considered capital improvements and *not* maintenance.

This compendium is meant to provide a short, nontechnical survey of recent articles on pavement preservation for use by members of the highway community—as well as the general public—who have an interest in this important topic, but not necessarily a technician’s background. The Federal Highway Administration is publishing this as a part of its mission to provide tools and concepts useful to the skilled hands and informed judgments that maintain and preserve our National Highway System.

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Pavement Preservation: Preserving Our Investment in Highways

By Robert M. Davies and Jim Sorenson

As we enter the new millennium, the demands on our highway network and available transportation funding are greater than ever. These demands, combined with growing, public expectations for safety, quality, and performance, require highway agencies to maintain the highest level of service practical. To meet these demands, highway agencies are redefining their objectives, requiring them to focus on preserving and maintaining rather than expanding our existing highway system. We are working to make the system work better, run more smoothly, and last longer.

The nearly 70,000 kilometers of the Dwight D. Eisenhower National System of Interstate and Defense Highways, also known as the Interstate Highway System, cost more than \$129 billion to construct. The cost of the interstate highways and the cost to construct and maintain the more than 6 million kilometers of State and local roadways represent one of the nation's largest infrastructure investments in our country's history. Roads and streets are just that—an investment.

The 1997 report to Congress titled *Status of the Nation's Surface Transportation System: Condition and Performance* declared that the pavement for approximately 48.7 percent of our rural interstate mileage and almost 60 percent of our urban interstate mileage is rated in fair to poor condition. From these percentages, it is evident that the pavement condition of our nation's highway infrastructure is deteriorating.

The financial demands on highway agencies to repair the damage is greater than ever and will continue to grow unless we can better control the rate of deterioration. To maintain high-quality pavements and to remain within budgetary limits, a change in philosophy from the traditional reactive maintenance approach to a preventive approach must be made. The preventive approach is represented by the concept of pavement preservation, which seeks to make sure that reconstructed, rehabilitated, and existing good pavements last longer, stretching available funding further. If accomplishing this seems like a challenge, that's because it is, but it can be done.

If we delay maintenance and repair of pavement until it has gone beyond its effective service life, the work required to renew it will be more extensive and costly than regular maintenance. Also, the repair work will make a portion of the highway unusable, and the flow of traffic will be disrupted for an extended period of time.

However, if we take a proactive approach in maintaining our existing highways, we can reduce costly, time-consuming rehabilitation and reconstruction and the associated traffic disruptions. With timely preservation, we can provide the traveling public with improved mobility; reduced congestion; and safer, smoother, longer lasting pavements. This is the true goal of pavement preservation—a goal that the Federal Highway Administration (FHWA), working in partnership with States, industry organizations, and other interested stakeholders, is committed to achieving.

Reprinted from *Public Roads*, January 2000



The end result of proper pavement preservation is a highway with an extended service life—thus saving funds—and a highway that provides a more consistent, better overall ride quality.

What Is Pavement Preservation?

As a component of system preservation, pavement preservation is aimed at preserving the investment in our highway system, extending pavement life, and meeting our customers' needs. It is the timely application of carefully selected surface treatments to maintain or extend a pavement's effective service life. Pavement preservation does not include new or reconstructed pavements or any activity that significantly increases the structural capacity of the existing pavement. Figure 1 shows the general concept behind pavement preservation.

An effective pavement preservation program encompasses a full range of preventive maintenance techniques and strategies, such as fog seals, slurry seals, chip seals, microsurfacing, thin lift overlays, crack sealing, portland cement concrete (PCC) joint sealing, dowel-bar retrofit, full- and partial-depth concrete pavement repair, and milling and grinding.

A traditional rehabilitative approach allows the original pavement section to deteriorate to a fair to poor condition in terms

of both ride quality and structural condition. At this point, structural damage has occurred, and the objective of the rehabilitative treatment is to repair that damage and restore the pavement. Thus, the traditional approach is reactive and can be a costly and time-consuming process.

A preservative or proactive approach entails the application of a series of low-cost, preventive maintenance treatments that individually last for a few years. The key is to apply the treatment when the pavement is still in relatively good condition with no structural damage. (Once structural damage occurs, a preventive maintenance treatment is no longer a viable option.) Timely preventive maintenance treatments will significantly reduce traffic delays.

The end result is an extension of the service life of the original pavement, and extending the service life instead of having to rehabilitate the pavement translates into a savings in funds and a better overall ride quality. It is important to realize that no pavement lasts forever, and pavement preservation activities do not prevent a pavement from eventually deteriorating. They

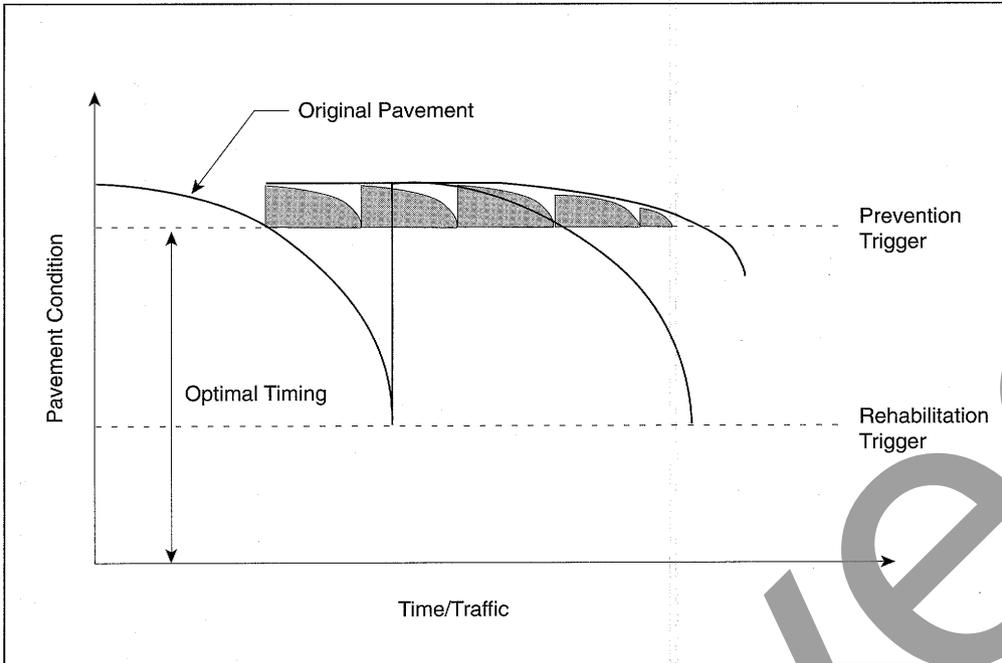
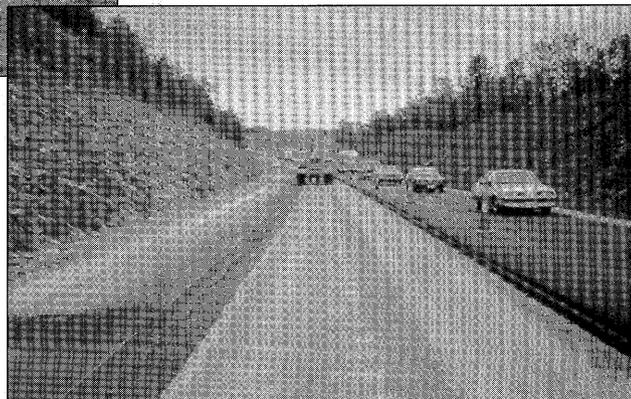


Figure 1. Applying pavement treatments at the optimal time provides the most efficient use of funds to extend the life of the pavement.



When a highway is this badly deteriorated, preventive maintenance is no longer a viable option.



When a highway must be reconstructed, congestion and travel delays are often the consequences.

are intended to reduce the rate of deterioration and to make highway maintenance more cost-effective.

For a successful pavement preservation program, a long-term commitment and financial support from management is required. Pavement preservation is more than just a collective set of specific pavement maintenance techniques. It is a way of thinking and the guiding force behind an agency's financial planning.

Implementing the Pavement Preservation Philosophy

A major hurdle in establishing a pavement preservation program is dedicated funding. In many highway agency budgets, maintenance activities have traditionally received "bottom of the barrel" funding. In addition, because most maintenance budgets cover the cost of activities such as snow and ice removal, a harsh winter can severely impair an agency from funding its reactive maintenance needs—let alone having money for preservation.

So, from where will these dedicated funds come? That funding is the responsibility of lawmakers, budgetary planners, and upper level management. However, these individuals, along with the public, need to be convinced that every dollar spent now on pavement preservation can save up to six dollars in the future. Therein lies the importance of a comprehensive training program in conjunction with champions who are committed to fostering the success of pavement preservation programs and techniques.

The good news is that these efforts are underway, and they are making a difference. In 1997, an expert task group (ETG) with members from the American Association of State Highway and Transportation Officials (AASHTO), industry, and FHWA was established to provide guidance and technical assistance in the area of pavement preservation. This ETG provides technical advice and review on such things as training

materials, courses, and research activities.

In July 1997, FHWA, AASHTO, and several industrial organizations signed a formal letter of understanding that committed industry and FHWA to jointly fund the development of short courses on pavement preservation and other mutual research interests. This is the first time industry has put up equal funding to develop this type of training program.

The National Highway Institute (NHI) is developing a comprehensive pavement preservation training program of at least four courses.

The initial course is "Pavement Preservation: The Preventive Maintenance Concept" (NHI course #13154). This 16-hour course addresses policy issues, funding strategies, and pavement maintenance technologies. It emphasizes the need for and the benefits of an effective pavement preservation program.

The second course, "Pavement Preservation: Selecting Pavements for Preventive Maintenance" (NHI course #13158), is currently being developed and will illustrate in detail the project selection and evaluation, materials consideration, and construction operations necessary for quality pavement preservation treatments.

The AASHTO Lead States Team on Pavement Preservation has been promoting the philosophy of pavement preservation among State departments of transportation (DOTs) and other related agencies for the past three years. The AASHTO Lead States Team, in association with the Pavement Preservation ETG and the Foundation for Pavement Preservation (FP²), developed a "Protecting Our Pavements" video featuring DOT officials from Georgia, Kansas, Michigan, and Pennsylvania and a former director of FHWA's Office of Engineering.

The video discusses the importance of pavement preservation and is the first in a series of videos aimed at educating both upper management and field personnel. A

second video, which is scheduled to be released in early 2000, focuses on selecting the proper pavement for pavement preservation activities. Future video topics include construction and design techniques for various pavement preservation treatments and the incorporation of pavement preservation into a pavement management system.

The Lead States Team also recently developed research protocols for pavement preservation. The importance of accurate and reliable information cannot be overlooked. This information, when combined with life-cycle cost analysis (LCCA), is needed to make informed decisions and to demonstrate the effectiveness and economics of pavement preservation. The research protocols were established to serve as guidelines in performing research related to pavement preservation to ensure the generation of clear, concise, and comprehensive research data necessary to demonstrate the proper implementation of pavement preservation activities.

To identify roadblocks, barriers, and obstacles for future improvements in pavement preservation, AASHTO, FHWA, and FP² conducted a "Forum for the Future" in Kansas City, Missouri, in October 1998. Approximately 120 stakeholders from 32 States and Canada attended the forum. They brainstormed for ways to meet challenges in the areas of management, marketing, local government, research, training, and data management. The result of this forum was the development of a "road map" that outlines action items required to address the challenges identified by the forum participants. The information contained in the road map will serve as the Lead States Team's recommendations to the AASHTO Subcommittee on Maintenance and as part of the Lead States Team's transition plan.

The results of all of these efforts have been an increased awareness of and dedication to pavement preservation within highway agencies and industry. Several States are considering or establishing a formalized

pavement preservation program and are using dedicated funding to support such initiatives.

While the concept of and techniques for pavement preservation are universal, the actions required to successfully implement a pavement preservation program are regionally dependent. Each highway agency needs to establish its own protocols, strategies, and methodologies to produce the desired return on investment.

Experiences With Pavement Preservation

The potential benefits of a successful pavement preservation program can be numerous. A 1997 AASHTO Lead State survey of State highway agencies showed that most highway agencies are convinced of the advantages associated with a properly designed and implemented pavement preservation program. The anticipated benefits from such a program can include higher customer satisfaction, increased safety, cost savings/cost-effectiveness, improved pavement condition, improved strategies and techniques, and better informed decisions.

The States with the most experience in successfully implementing a pavement preservation program include California, Georgia, Michigan, New York, and Texas. Georgia and Texas, which have been performing preventive maintenance on their roadways for several years, report that their pavement preservation programs have played a substantial role in improving the condition of their highway infrastructure.

In its 1997 summary of pavement conditions, the city of Bedford, Texas, documented that the cost of preventive maintenance treatments is much less than the cost of rehabilitation or reconstruction. Therefore, the city recommended the timely use of these treatments rather than waiting until rehabilitation or reconstruction was needed.

Georgia reported that the effects of reallocating funds from rehabilitation and re-

Defining the Concept

Promoting the concept of pavement preservation requires that everyone, including the promoters, have a clear understanding about what pavement preservation is and about how it relates to existing maintenance activities. A major problem is that a consensus has not been met on the definitions of pavement preservation, preventive maintenance, and pavement maintenance. Through the recent efforts of the American Association of State Highway and Transportation Officials (AASHTO) Lead States Team on Pavement Preservation, industry representatives, and FHWA, an attempt has been made to clarify the relationship between preservation and maintenance.

Pavement preservation is the sum of all activities undertaken to provide and maintain serviceable roadways, including preserving investment in the national highway system, extending pavement life, enhancing pavement performance, ensuring cost-effectiveness, and reducing user delays. Pavement preservation includes preventive maintenance and minor rehabilitative activities. Pavement preservation is a component of system preservation.

Pavement preservation does not include new pavement, reconstructed pavement, or pavement requiring major

rehabilitation or reconstruction.

Preventive maintenance for pavement is a tool for pavement preservation. It is a strategy to apply cost-effective treatments to the surface of a structurally sound pavement to preserve the system, retard future deterioration, and maintain or improve the functional condition of the system without increasing its structural capacity.

Pavement maintenance includes three forms of maintenance activities: preventive, routine, and reactive (corrective) maintenance. Preventive maintenance is defined above. Routine maintenance is day-to-day activities, such as crack sealing, line stripping, mowing, and cleaning roadsides. These activities are scheduled, and the scheduling is within the control of maintenance personnel. Reactive maintenance is activities that must be done in response to events beyond the control of highway agencies. These activities include pothole patching, repairing pavement blowups, snow and ice removal, and unplugging drainage facilities. Activities, such as major pavement rehabilitation and pavement reconstruction, that significantly affect the structural capacity of the pavement are considered capital improvements and not maintenance.

construction to pavement preservation have been minor. Georgia found that very few major projects were delayed while the State addressed the larger number of lower cost pavement preservation projects.

California, Michigan, and New York more recently implemented a pavement preservation (preventive maintenance) program. In these three States, the decision to

implement a pavement preservation program followed an analysis that determined that pavement preservation was the most cost-effective means to achieve long-term, pavement goals. As part of their implementation process, these States identified pavement-related, preventive maintenance treatments that worked successfully in their States. For these treatments, they identified

the pavement conditions, expected service life of the treatment, and its estimated cost.

Michigan notes that rehabilitation and reconstruction projects cost about 14 times as much as preventive maintenance projects per lane-mile. By implementing a preventive maintenance program, Michigan has enjoyed a cost savings of more than \$700 million since 1992 (based on what would have been needed for more major programs if the network had been allowed to deteriorate).

Caltrans (California Department of Transportation) in a workshop presented to the California Transportation Commission, notes that preventive maintenance treatments can restore a pavement surface and "extend its service life by 5 to 7 years.... This added service life will delay the need for the more costly pavement rehabilitation, allowing additional rehabilitation projects to be funded and constructed."

New York's experiences have shown that a dedicated fund with money set aside for pavement preservation activities is highly beneficial and that support from upper level management is crucial in obtaining those funds. New York also notes that selling the preservation program is a continuing effort because legislators and executives change.

A common observance among all of these States is the relatively long length of time for the benefits of pavement preservation to be realized in terms of improved pavement condition. Georgia and Texas, who have had a preservation program in place for many years now, have anecdotal evidence of the benefits. New York, whose preservation program was established in 1993, is beginning to observe the results in their annual pavement condition survey.

The Road Ahead

In addition to establishing a pavement preservation philosophy, other issues must be addressed to ensure the proper implementation of a pavement preservation program.

The success of a pavement preservation program is based on selecting the right treatment for the right pavement at the right time. The real challenge lies in selecting the optimal time to apply a treatment to the road.

Time is the element by which cost-effectiveness is defined. Placing a treatment on the road too late, meaning structural damage has already started to appear, will result in poor performance because pavement preservation treatments are not designed to increase structural capacity. On the other hand, placing the treatment too early will result in the unnecessary expenditure of much-needed funds and can cause other pavement problems, such as flushing or rutting. Neither scenario is cost-effective. The optimal time will maximize the return on investment of a given treatment by allowing for the most efficient use of funding to extend the life of the pavement.

To determine the optimal timing, performance standards and indices for various treatment types need to be established through research and the collection of performance data. To be reliable, these indices must be descriptive of the environment in which the pavement treatments are to be used. This not only includes existing pavement conditions, climatic weather, material properties, and traffic loading, but also agency resources and funding limitations.

Another issue is the emergence of performance-related specifications (PRS) and associated performance level warranties. In the future, pavement contractors may be required to guarantee the performance of a pavement for a specified service life. To ensure this level of performance, the contractor will be responsible for performing maintenance or preservation activities on an elective basis. It is critical that the concepts and techniques of pavement preservation are passed on to the contractor to ensure that maintenance is preventive rather than reactive. Therefore, pavement contractors must be part of the target audience.

And finally, we must integrate pavement preservation into the overall pavement management system (PMS) to allow highway officials to manage pavement conditions as part of managing their resource allocations. PMS provides critical information needed to make decisions about pavement preservation. By using an integrated PMS, a manager can select the proper proportion of preventive maintenance, corrective maintenance, rehabilitation, and reconstruction that optimizes available dollars and extends the service life of the pavements within the system.

FHWA and its partners will continue to make strides to identify the important factors in a successful pavement preservation program and to provide the necessary tools to make cost-effective decisions. Pavement preservation is the key to our highway's future, and together, we can ensure its success and benefit from its rewards as we preserve one of our nation's largest investments.

Desired Outcomes Necessary for Pavement Preservation Implementation*

1. Better understanding of pavement preservation activities, which, in turn, will lead to more broad-based support for preventive maintenance/pavement preservation.
2. Integrated pavement performance data, including costs, benefits, and effectiveness of preventive maintenance strategies.
3. Greater understanding of the need for dedicated funds for pavement preservation and top management support for pavement preservation.
4. Performance specifications; improved quality control/quality assurance procedures; and readily available, state-of-the-practice training materials.

*Defined by the 1998 Forum for the Future in Kansas City, Mo.

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Mapping the Road to Pavement Preservation

With the Nation's highway system essentially complete, highway agencies must take up the challenge of keeping existing pavements in top condition. "We need to shift our focus and communicate the need for changing our traditional philosophy to one that focuses on maintaining and preserving—rather than expanding and upgrading—our existing highway system," says Jim Sorenson of the Federal Highway Administration (FHWA).

State and local highway agencies will need new tools to make this shift to pavement preservation, including a battery of pavement maintenance strategies and dedicated funding commitments. For example, they will need procedures for collecting and managing data on the condition of their pavements before they exhibit conventional distresses. To determine what tools are needed and the best ways to get these tools to users, more than 100 preventive maintenance experts from highway agencies, industry, academia, and FHWA gathered in Kansas City, Missouri, in October for the "Forum for the Future."

Participants represented a range of organizations involved in preventive maintenance, including the American Association of State Highway and Transportation Officials (AASHTO) and its Lead States teams, the National Association of County Engineers, the American Public Works Association, FHWA, universities, and staff from a number of highway agencies, including Arizona, Georgia, Kansas, Missouri, and Pennsylvania. Industry was represented by contractors and suppliers and by the Foun-

ation for Pavement Preservation (formerly the Foundation for Pavement Rehabilitation and Maintenance Research), the American Concrete Pavement Association, and other organizations.

Forum participants focused on six areas: local government, management, training, data management, research, and marketing. For each area, participants developed specific recommendations for research, field test and evaluation projects, training, and policy improvements. This was the first time stakeholders had met to map out the priorities and strategies for enhanced system preservation.

Speaking at the forum, Wouter Gulden, of the Georgia Department of Transportation and a member of the AASHTO Lead States Team for Pavement Preservation, summarized why pavement preservation is important: "The public wants us to focus on keeping roads smooth, reducing user delays from maintenance activities, and reducing accident rates related to work zones and pavement conditions."

The results of the forum will be published as *Pavement Preservation: A Road Map for the Future*. This publication, which will be available next month from FHWA, will identify what steps highway agencies, industry, and others should consider in addressing the needs facing preventive maintenance practitioners.

To request a copy of *Pavement Preservation: A Road Map for the Future* (Publication No. FHWA-SA-99-015), contact FHWA's Research and Technology Report Center (phone: 301-577-0818; fax: 301-577-1421).

Road Map for Pavement Preservation

By Jim Sorenson, Federal Highway Administration

One of the key challenges facing highway agencies today is maintaining the quality of existing pavements. A new FHWA publication due out in February, *Pavement Preservation: A Road Map for the Future*, addresses this challenge by identifying important steps for highway agencies, industry, and others to consider when planning pavement preservation strategies.

The publication is the result of "Forum for the Future," a gathering that took place last October in Kansas City, MO, and involved more than 100 preventive maintenance experts from highway agencies, industry, academia, and FHWA. The forum was the first opportunity for stakeholders to meet and to devise priorities and strategies for enhancing system preservation.

The participants focused on six areas:

- Local government
- Management
- Training

- Data management
- Research
- Marketing

For each area, they developed specific recommendations for research, testing, training, and policy improvements. Participants in the forum emphasized the need to shift from believing in the traditional philosophy of continually expanding and upgrading our highway system, to believing in a philosophy of maintaining and preserving it. The forum provided an opportunity to determine what new tools State and local highway agencies will need to make the shift to pavement preservation, as well as the best ways to get those tools to users.

To request a copy of *Pavement Preservation: A Road Map for the Future* (Publication No. FHWA-SA-99-015), contact FHWA's Research and Technology Report Center by phone, (301) 577-0818; or by fax, (301) 577-1421.

Reprinted from *R&T Transporter*, February 1999

Preventive Maintenance Means Smooth Driving in Georgia

In a 1995 survey of motorists nationwide, pavement conditions topped the list of priority areas for improvement in the Nation's highway system. That was no surprise to the Georgia Department of Transportation (DOT), one of the members of the Lead States team for pavement preservation and a strong proponent of pavement preservation through a systematic approach to preventive maintenance. For more than 20 years, Georgia DOT has strived to satisfy its customers by making smoother pavements a goal of its pavement preservation strategy.

The State's pavement preservation strategy centers on preventive maintenance treatments that help keep pavements in good condition. Preventing pavements from deteriorating not only benefits Georgia DOT by delaying the need for pavement rehabilitation and repairs, but it also benefits motorists by significantly improving the ride quality of Georgia's roads.

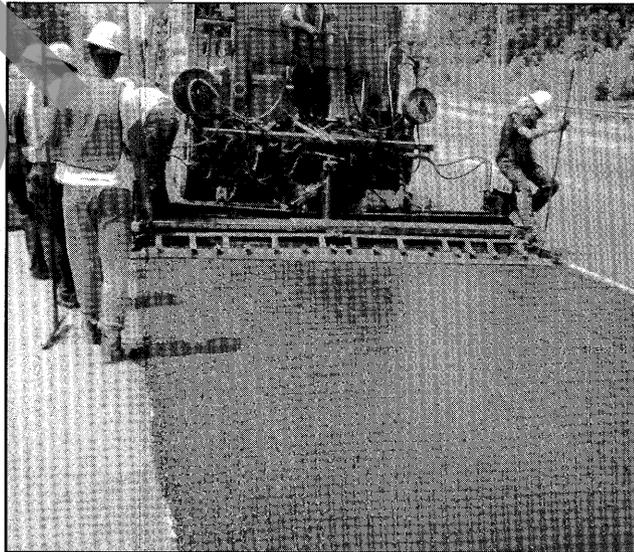
Between 1972 and 1997, the smoothness of asphalt pavements in Georgia improved by more than 300 percent, according to smoothness measurements routinely taken just before and right after asphalt pavements are resurfaced. This means that asphalt pavements that are about to be resurfaced today are more than four times smoother on average than similar pavements scheduled for resurfacing more than 2 decades ago.

The figures for concrete pavements are nearly as impressive. Between 1979 and 1996, the smoothness of concrete pavements on Interstate highways in the State

improved by more than 200 percent. This improvement is measured by surveying the same stretches of Interstate highway every year.

Georgia's pavements have reached a high enough level of ride quality that smoothness data collected for the State's pavement management system are no longer a key factor in scheduling preventive maintenance treatments. Pavement management systems are used to keep track of the condition of the pavements in a State and to target maintenance and repairs. "Our pavement management system doesn't really consider smoothness because most of our roads already meet our standards," says Wouter Gulden of Georgia DOT.

Georgia DOT treats about 10 percent of its pavements each year using a variety



Georgia DOT has recently added microsurfacing to its arsenal of preventive maintenance treatments.

of preventive maintenance treatments, including thin asphalt overlays.

Gulden stresses, however, that it's the concept, not the details of Georgia's—or any State's—pavement preservation program that is important to other States considering establishing a preventive maintenance program. "What works for me may not work for you. Every State has to develop its own strategy. The level of maintenance may vary and the techniques may vary."

What is also important is dedicated support for pavement preservation. "Long-term support and financial commitment are the keys to success," said Wayne Shackleford, commissioner of Georgia DOT. "We spend approximately \$70 to \$80 million a year on preventive maintenance. Our citizens are reaping the financial benefits of this commitment."

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Preventive Maintenance Yields Huge Savings, Says Michigan Study

Maintenance engineers have been making the case for preventive maintenance for years—but their message has often gone unheeded. Now, a study from the Michigan Department of Transportation (DOT) provides hard evidence that preventive maintenance is a wise investment. According to the study, the DOT's preventive maintenance strategy is more than six times as cost-effective as rehabilitation and reconstruction projects.

Michigan DOT adopted its preventive maintenance strategy in 1992 as a way to keep its 15,420 km (9,580 mi) of highways in the best shape possible despite declining financial resources. Since then, preventive maintenance treatments have been applied to about 4,260 km (2,650 mi) of asphalt and portland cement concrete pavements, at a cost of \$80 million.

Had the DOT not implemented its preventive maintenance strategy, the study found, the DOT would have to spend \$700 million today on rehabilitation and reconstruction projects to bring pavements up to their current condition. That's more than eight times as much money as has been spent on preventive maintenance treatments.

The study was conducted by Michigan DOT's Bureau of Transportation Planning and is based on very conservative assumptions about the performance of preventive maintenance treatments. To further validate the value of preventive maintenance, Michigan DOT hired an independent consultant to verify that the pavements had actu-

ally benefited from the preventive maintenance treatments. "We wanted to see whether the treatments had worked and whether they were in fact a good value," says Larry Galehouse, pavement maintenance engineer at Michigan DOT. The consultant concluded that most preventive maintenance treatments were successful in extending the life of the pavement.

Michigan DOT makes the most of its resources by carefully timing the application of preventive maintenance treatments. Galehouse says the DOT has found that applying maintenance treatments to pavements with light to moderate distress provides a substantial improvement in pavement life; in contrast, treating a severely distressed pavement accomplishes very little.

Michigan DOT relies on a wide variety of maintenance treatments, which allows the highway agency to select the least expensive treatment that will address the problems found on a specific pavement. "We don't need an expensive fix for every road," Galehouse says.

The highway agency's preventive maintenance strategy is also designed to make yearly funding needs more predictable. The DOT classifies pavements in one of six categories, ranging from roads in need of almost immediate rehabilitation to roads expected to last for another 2 or 3 decades. Today, the amount of roads in each category varies widely. By carefully matching pavements with appropriate preventive maintenance treatments, the DOT is evening out the disparity; this will prevent huge surges in the number of pavements in need of costly rehabilitation or reconstruction in any given year.



Michigan DOT relies on a wide variety of preventive maintenance treatments to extend the life of its pavements. Here, a chip seal is applied.

Update on the Lead States Team for Pavement Preservation

In its role as a member of the Lead States team for pavement preservation, Michigan is publicizing the results of its study. A recent survey by the team, which also includes Georgia, Minnesota, Texas, and Wisconsin, had found that several States are seeking information they can use to help increase management support for preventive maintenance.

Wouter Gulden of Georgia DOT, leader of the Lead States team for pavement preservation, reports that the team's members are documenting the details, costs, and benefits of their own

preventive maintenance strategies.

"We're also asking other States to write up their experiences with preventive maintenance strategies," Gulden says.

The team is producing a videotape that features top officials from several State highway agencies speaking out on the importance of preventive maintenance. The videotape is designed to help chief engineers persuade legislators, top-level managers, and others of the value of funding preventive maintenance.

Videotape Portrays Preventive Maintenance as Key to Long-Lasting Pavements

The success of preventive maintenance treatments such as chip seals prompted Michigan DOT to produce a video promoting the adoption of preventive maintenance strategies.

Spending a little money today on a well-planned preventive maintenance strategy can keep pavements in good shape at a much lower cost than repairing or rehabilitating pavements after they begin to fall apart. It can be hard, however, to get that message to the people who hold the purse strings. A new videotape from the Michigan Department of Transportation (DOT) and the Federal Highway Administration (FHWA) helps deliver the message.

The 14-minute videotape, "Protecting our Pavements: PREVENTIVE Maintenance," takes a nontechnical approach to its subject. The videotape defines preventive maintenance and explains how using the right treatment on the right road at the right time can significantly extend the service life of a pavement—and can save money in the long run. Repairing or rehabilitating a pavement costs six to eight times more than using preventive maintenance treatments to keep the pavement in good shape. The videotape also points out that preventive maintenance should be part of a highway agency's broad pavement preservation strategy and should receive dedicated funding to ensure that maintenance needs are not neglected.

To reinforce its message, the videotape features comments from five prominent highway agency officials: Gary Hoffman, chief engineer-highway administration at

Pennsylvania DOT; Mike Lackey, assistant secretary and State transportation engineer at Kansas DOT; Wayne Shackleford, commissioner of Georgia DOT; Bob Welke, former deputy director of Michigan DOT's highways bureau; and Gerry Eller, the former director of FHWA's Office of Engineering.

"The video is intended to introduce the concept that directing some funds to protect good pavements and correct minor deficiencies is a much better approach than directing all funds to reconstruct pavements that are in terrible condition," says Michigan DOT's Larry Galehouse, who helped put the videotape together. "We hope this message will stimulate highway agencies to develop a strong preventive maintenance program."

A letter from American Association of State Highway and Transportation Officials (AASHTO) Executive Director Frank Francois and FHWA Executive Director Tony Kane accompanies the videotape. In the letter, they say that "The use of the right preservation strategy, at the right time will allow us to meet the traveling public's demands for improved safety and serviceability, given limited resources and increasing needs." Francois and Kane recommend using the videotape in presentations to senior management, legislators, county commissioners, and others who set budget priorities for State and local highway agencies.

Galehouse says the idea for the videotape came from Michigan DOT's success with preventive maintenance (see September 1997 Focus). "Michigan DOT appreciates the value of a comprehensive preventive maintenance program, so it seemed

logical that Michigan should step forward to produce a video.”

In producing the videotape, Michigan DOT received support from AASHTO, the Foundation for Pavement Preservation (formerly the Foundation for Pavement Rehabilitation and Maintenance Research), the Lead States team for pavement preservation, and FHWA. The State highway agencies of Georgia, Kansas, and Pennsylvania also assisted with the videotape.

Nearly 1,000 copies of the videotape have been distributed to the highway agencies of all 50 States, the District of Columbia, and Puerto Rico and to the 57 Local Technical Assistance Program (LTAP) centers. Copies have also been provided to industry groups and FHWA offices and should be available from any LTAP center or FHWA division office.

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FHWA Teams Up To Promote Preventive Maintenance

By Jim Sorenson, Federal Highway Administration

Recognizing that the big challenge facing State highway departments is no longer building new pavements, but preserving the pavements that we have, Congress passed legislation earlier this decade allowing States to use Federal-aid highway funding for preventive maintenance activities. FHWA is working with its State and industry counterparts that are demonstrating leadership in preventive maintenance to help other States learn more about cost-effective maintenance strategies and when to use them.

Several States are participating in projects aimed at refining pavement maintenance techniques that were developed under the Strategic Highway Research Program (SHRP). FHWA is also supporting the American Association of State Highway and Transportation Officials (AASHTO) Lead States teams who are helping other States to shorten the learning curve for key SHRP maintenance technologies.

FHWA, AASHTO, the National Highway Institute (NHI), and industry have established a national work group that will identify new technologies and applications, advise on research needs, and help imple-

ment policies in support of pavement maintenance. The members of the work group are also assisting in the development of a training course on preventive maintenance that is scheduled to be ready this fall.

In addition, FHWA has teamed up with the Foundation for Pavement Preservation (formerly the Foundation for Pavement Rehabilitation and Maintenance Research). Working with the Lead States team for pavement preservation, this partnership has produced a videotape on preventive maintenance that will be distributed nationally.

Additional resources include:

- FHWA's preventive maintenance test and evaluation projects
- FHWA's partnership with the Foundation for Pavement Preservation and other industry groups
- The Lead States team for innovative maintenance materials
- The RoadSavers Web site, which includes an economic analysis of the costs-versus-benefits of research on preventive maintenance conducted under the Strategic Highway Research Program (SHRP)
- The National Highway Institute

Reprinted from *R&T Transporter*, March 1998

FHWA and Industry To Cosponsor Pavement Preventive Maintenance Workshops

A new series of training workshops in pavement preventive maintenance is being developed by the Federal Highway Administration (FHWA) with financial support from industry.

"This is the first time that an industry group has come to the table and put up equal funding to develop this kind of training program," said Tony Kane, executive director of FHWA. "The traveling public will benefit directly and at an accelerated pace because of this partnership between FHWA and industry."

A Letter of Understanding in support of this innovative partnership "to meet the challenges of preserving the nation's pavements while providing improved service to the traveling public" was signed July 2 [1997] in Washington, DC.

The training workshops will address policy issues, funding strategies, and pavement maintenance techniques and will emphasize the "when and why" of pavement preservation. The workshops will give top-level managers an increased awareness of the effectiveness of pavement preventive maintenance and the need for dedicated funding for pavement preventive maintenance. Mid-level managers will also learn more about pavement preservation strategies so they can make better-informed decisions on the timing and type of maintenance treatments to be applied.

Reprinted from *Focus*, September 1997

"Industry recognizes that times have changed—that government agencies can't be expected to fund all the costs," said Bill Ballou, president of the Foundation for Pavement Preservation (formerly the Foundation for Pavement Rehabilitation and Maintenance Research). Ballou credits Michigan's historical data on pavement preventive maintenance as the "driving force" behind the agreement.

"This initiative will display that enormous benefits will be realized from the adoption of a pavement preventive maintenance program," says Larry Galehouse of the Michigan Department of Transportation.

The courses will be presented as part of FHWA's National Highway Institute short-course program and will be offered to State and local agencies, as well as industry groups.

Galehouse, a member of the Lead States team for pavement preservation, signed the Letter of Understanding. The agreement was also signed by representatives from the Asphalt Institute, Asphalt Emulsion Manufacturers Association, Asphalt Recycling and Reclaiming Association, FHWA, Foundation for Pavement Preservation, International Slurry Surfacing Association, and National Highway Institute.

"This training program is all about minimizing the cost to users and delivering the best product," said Kane. "It will help us satisfy highway users, who have told us that their number-one concern is pavement condition."

LTPP Findings Help Kansas DOT Improve Pavement Maintenance Practices

As a result of its participation in the long-term pavement performance (LTPP) program, the Kansas Department of Transportation (DOT) has confirmed the importance of preventive maintenance, improved its preventive maintenance techniques, and expanded its range of preventive maintenance treatments. The result—a highly effective and economical strategy for keeping asphalt concrete pavements in top condition.

In 1990, Kansas decided to expand its knowledge of preventive maintenance treatments by participating in the LTPP program's Specific Pavement Study (SPS) 3, which examines the effectiveness of preventive maintenance treatments for asphalt concrete pavements. Each SPS-3 project has five test sections: a control section that has received no preventive maintenance, and four sections that have each received a different preventive maintenance treatment (an overlay, a chip seal, a slurry seal, or crack seals). This arrangement allows engineers to make side-by-side comparisons of the effectiveness of the different treatments. Kansas constructed two SPS-3 projects—one on Route 68 near Ottawa, and a second on U.S. 400 near Ford, about 27 km (17 mi) from Dodge City.

In 1995, Ronald Shuberg from the Kansas DOT joined colleagues from Iowa, Kentucky, Michigan, South Dakota, and Manitoba in a project to evaluate the 19 SPS-3 projects in the north-central LTPP region. The team's mission was to compare the treatments' effectiveness and their potential for use in a preventive maintenance strategy.

The team found that thin hot-mix asphalt overlays and chip seals were extremely effective. Of the test sections with overlays, almost 80 percent were in better condition than the control sections. Overlays also improved ride quality.

Two-thirds of the pavements treated with chip seals were in better condition than the control sections. Chip seals are made up of a thin coating of asphalt binder that is then covered with uniformly sized aggregate to waterproof the pavement and improve surface friction.

Slurry seals were a disappointment—less than half of the sections with slurry seals were in better condition than the control sections.

The real surprise was the value of crack seals, which proved much more effective than the team had predicted when they had evaluated the SPS-3 projects in 1993. Almost two-thirds of pavements where cracks had been sealed were in better condition than the control sections—even though many States hadn't kept new and existing cracks sealed over the course of the experiment. Sealing cracks helps preserve pavement by preventing water and incompressible material from getting into the cracks and causing more damage.

As a result of the 1995 evaluation of SPS-3 projects, Kansas DOT has changed its preventive maintenance practices to incorporate lessons learned from the experiment. The DOT has increased the amount of crack sealing it performs and has adopted the heat lance for cleaning, heating, and drying routed cracks, a technique other States in the north-central region have found effective. Although other States in the

north-central LTPP region used wide, shallow reservoirs for crack sealant at their SPS-3 projects, Kansas DOT is staying with easily cut narrow reservoirs (approximately 12.5 mm [0.5 in] wide).

“We’re getting lifespans of 4 to 5 years with the current shape, so we haven’t tried to change our practice,” says Dean Steward, assistant director of the bureau of maintenance and construction at Kansas DOT. “It’s more important to get the cracks sealed and for maintenance personnel to understand the concept.” The DOT does encourage experimentation on crack seal shape, so this policy may change over time.

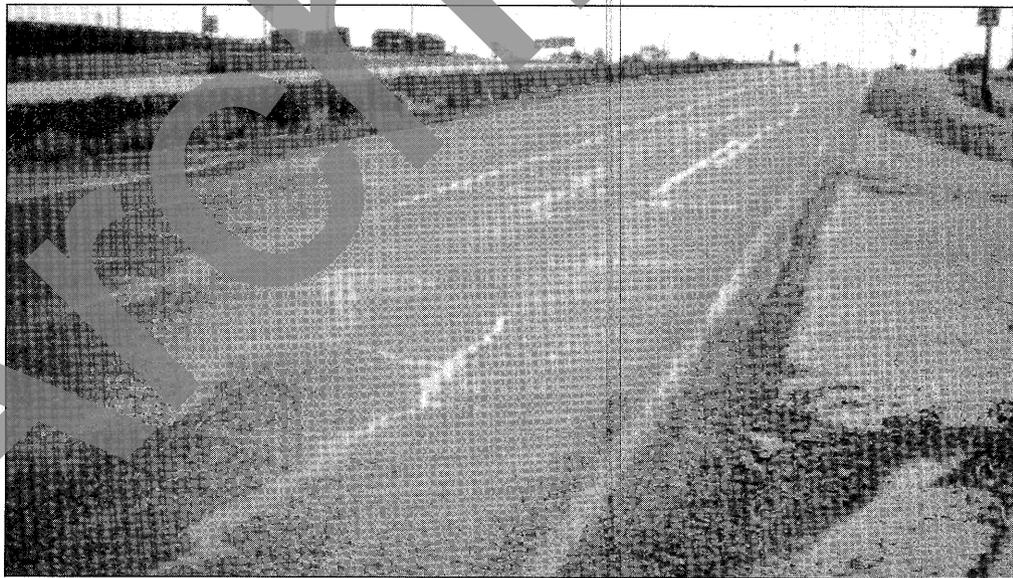
The evaluation team’s findings—particularly on crack seals—reaffirms the value of what Kansas DOT had long practiced. Prior to the SPS-3 experiments, the highway agency had set up a committee to review research and other States’ experiences with crack seals and to update the agency’s policy on crack seals accordingly. The committee included representatives of sealant and equipment suppliers, which Steward notes

are an important part of the training process. Although the DOT was confident that crack seals were valuable, there was little hard data on the subject.

“The crack seal committee had annual meetings with district maintenance engineers to talk about the proper ways to seal cracks and to encourage crews to seal cracks soon after they’ve appeared,” says Steward. “That’s been confirmed by SHRP findings.”

Steward has little doubt that chip seals and crack seals are effective and economical. “In my estimation, early crack sealing extends pavement life, and preventive maintenance definitely saves money,” he says. “Take our site on Route 68 in Ottawa. The portion we chip sealed and crack sealed is still one of our best-performing pavements. It’s evident that it’s performing extremely well, and the treatments were very inexpensive. And now we know that it’s a statistically valid strategy.”

Crack and chip seals are particularly important for the open-graded and semi-open-graded asphalt concrete mixes some



Kansas DOT applied chip seals and crack seals to Route 68 in Ottawa, producing one of the State’s best-performing pavements. The treatments were not only effective, but also very inexpensive.

highway agencies are using for pavements and overlays, Steward says. These mixes are durable, but some in Kansas are also susceptible to stripping as a result of their greater permeability. This increases the importance of sealing cracks soon after they appear.

The timing of preventive maintenance treatments is critical to good performance and cost-effectiveness. Based on Kansas DOT's experience, "If you crack seal one year and chip seal the next, it's an ideal situation," Steward says.

"My primary objective is to promote

early and effective crack sealing and chip seals where applicable," says Steward. He tours all 25 construction and maintenance areas in the State every year and discusses preventive maintenance with everyone from district engineers to front-line supervisors. As a result of the SPS-3 experiment and the work of suppliers, top management, and the committee on crack seals, Steward says, "I've seen an increase in crack sealing, and maintenance personnel now know what works and why. We are meeting with FHWA and suppliers to explore training seminars for field employees."

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RESOURCES

Articles for this compendium were collected from three publications of the Federal Highway Administration (FHWA):

Focus, a monthly FHWA newsletter promoting Strategic Highway Research Program (SHRP) products and other highway technologies that FHWA and the States are using to build better, safer roads. To subscribe to *Focus*, please send your name, address, and phone and fax numbers to Harrington-Hughes & Associates, Inc., 733 15th Street, NW, Suite 500, Washington, DC, 20005, or fax to 202-347-6938; or you may email to gburge@harrington-hughes.com. There is no charge for subscription. *Focus* can also be found at www.tfhrc.gov/focus/focus.htm.

Public Roads, a bimonthly magazine of the FHWA Office of Research, Development, and Technology, covering advances and innovations in highway/traffic research and technology, critical national transportation issues, important activities and achievements of FHWA and others in the highway community, specific FHWA program areas, and subjects of interest to highway industry professionals. To subscribe to *Public Roads*, please send check or money order payable to New Orders, Superintendent of Docu-

ments, PO Box 37195, Pittsburgh, PA, 15250-7954, for \$18 per year (\$22.50 for foreign mailings). *Public Roads* can also be found at www.tfhrc.gov.

Research and Technology Transporter, a monthly newsletter of the FHWA research and technology programs, transmitting the latest research- and technology-based developments from FHWA program offices to engineers in the field and professionals in the industry. To subscribe to *Research and Technology Transporter*, please send your subscription request to Judy Dakin at US Department of Transportation, FHWA, Turner-Fairbank Highway Research Center, 6300 Georgetown Pike, HRTF, McLean, VA 22101-2296. You can also reach her by telephone at 202-493-3192 or email at judy.dakin@fhwa.dot.gov. There is no charge for subscription. *Transporter* can also be found at www.tfhrc.gov/trnsprtr/rtt.htm.

In addition, the Lead States Teams of the American Association of State Highway and Transportation Officials (AASHTO) sponsor the AASHTO Innovative Highway Technologies Pavement Preservation Web site, which can be found at leadstates.tamu.edu/pp/.

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