PAVEMENT PRESERVATION COMPENDIUM

SEPTEMBER 2003

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Foreword

by David R. Geiger

More than 1.75 trillion dollars has been invested in our Nation's highway system. Managing and preserving that investment is increasingly the goal of highway agencies around the country, with more and more agencies realizing the benefits of a sound pavement preservation program. Benefits range from improved pavement performance and increased safety to higher user satisfaction and reduced overall life-cycle costs. And because applying pavement preservation treatments is faster than rehabilitating or reconstructing existing pavements, pavement preservation efforts can contribute to increased mobility, improved work zone safety, and overall improved customer satisfaction.

As highway agencies establish pavement preservation programs, they face the challenge of determining the best pavement treatments to apply to roads. Treatments must be carefully selected and must be applied when the pavement is still in good condition, that is with no structural damage. Assisting agencies in applying the *right* treatment to the *right* road at the *right* time will mean taking research into innovative and effective system preservation technologies to a higher level, as research to date has lagged behind the demand for knowledge. To meet this challenge and increase the knowledge available to State and local agencies, FHWA is working to build partnerships among States, industry, academia, and the Transportation Research Board. FHWA is also exploring options for launching a 5-year coordinated pavement preservation research program. This coordinated effort is vital to addressing the research, technology, and development needs of our Nation's highway agencies and to ultimately better meeting the safety, efficiency, and mobility requirements of our customers.

The articles and other reference material in this Compendium describe the many facets of pavement preservation activities underway in the United States today, from California to Michigan to North Carolina. As we look forward to advancing pavement preservation research, skills, and knowledge, they provide an introduction to what our State and local partners are already accomplishing, and a roadmap to our future.

David R. Geiger is the Director of FHWA's Office of Assset Management.

Strategic Planning for Pavement Preventive Maintenance

Michigan Department of Transportation's "Mix of Fixes" Program

by Larry Galehouse

The amount of travel on the Michigan state highway system has increased more than 30 percent since 1986, yet the number of lane-miles to support the traffic has increased by only 3 percent. In the early 1990s, demands on Michigan's highway network increased, but the available resources decreased. Operating revenues failed to keep pace with needs, and Michigan Department of Transportation (DOT) staffing was reduced substantially.

In 1992, the Michigan DOT developed a program to preserve the highway network's pavement and bridge structures. Department leaders committed themselves to implementing the program and pledged revenues and staffing for the initiative.

The exclusive purpose of the Michigan Capital Preventive Maintenance Program is to preserve pavement and bridge structures, delay future deterioration, and improve overall conditions cost-effectively and efficiently. This article focuses on the state's preventive maintenance program.

Lane-Miles to Upkeep

Michigan DOT is responsible for a highway network of 27,345 lane-miles (44,008 lane kilometers). The roadway pavements are asphalt, concrete, and composites of asphalt on concrete. The state highway system represents about 8 percent of the state's lane-miles of roads but carries approximately 55 percent of all travel and 72 percent of commercial travel in Michigan—more than 50 billion annual vehicle-miles of travel (AVMT) and more than 4 billion AVMT of commercial travel.

In 1991, the Intermodal Surface Transportation Efficiency Act made highway preventive maintenance eligible for federal-aid funds. The National Highway System bill, which became law in November 1995, strengthened the provision: "A preventive maintenance activity shall be eligible for federal assistance…if the state demonstrates to the satisfaction of the Secretary that the activity is a cost-effective means of extending the useful life of a Federal-Aid Highway."

"Mix of Fixes" Approach

Michigan DOT satisfies public expectations by implementing a comprehensive strategy for pavement preservation. The Department initiated a pavement preventive maintenance program in conjunction with a pavement management system. In the last decade, both programs have become integral in the Department's investment decision making.

The preventive maintenance program meets public expectations for safe, smooth, and well-maintained roads by applying cost-effective treatments to correct minor pavement deficiencies before the problems become major. The pavement management system departs from traditional approaches that had focused on reactive maintenance and reconstruction.

The strategy combined long-term fixes (reconstruction), medium-term fixes (rehabilitation), and short-term fixes (preventive maintenance). In this "mix of fixes" approach, each fix category has a critical role in improving the future condition of the state highway network.

Reconstruction

Reconstruction involves the complete replacement of the pavement structure with a new equivalent—a long-term action that is designed to last at least 20 years. Most favorable to the traveling public, reconstruction is also the most costly fix. Like most transportation agencies, Michigan DOT does not have sufficient funds to sustain the level of investment for continual reconstruction of the highway network.

In addition, directing available funds to highway reconstruction neglects the majority of the network.

Rehabilitation

Rehabilitation applies structural enhancements to improve a pavement's load-carrying capability and extend the service life. Most rehabilitation projects are designed to last 10 to 20 years.

Although less costly than reconstruction, rehabilitation to improve the overall network condition still requires a prohibitive level of investment. Combined with a reconstruction program, rehabilitation can provide a marginal increase in pavement performance, but the results are not optimal.

Preventive Maintenance

Preventive maintenance applies lower-cost treatments to retard a highway's deterioration, maintain or improve the functional condition, and extend the pavement's service life. With various short-term treatments, preventive maintenance can extend pavement life an average of 5 to 10 years. Applied to the right road at the right time—when the pavements are mostly in good condition—preventive maintenance can improve the network condition significantly at a lower unit cost.

Combining Components

Combining all three programs into a single comprehensive strategy achieves the most manageable highway network.

Preventive maintenance is perhaps the single most influential component of the network strategy, allowing the Department to manage pavement condition. Preventive maintenance postpones costly reconstruction or rehabilitation activities by extending the service life of the original pavement. The challenge is to ascertain the right time to apply a treatment to achieve maximum benefit or return on investment.

Routine maintenance is important for a highway; but routine maintenance is a holding action, maintaining the service level without extending the pavement life. Routine maintenance will not improve the overall condition of a highway network.

Partnerships for Training

Many of the surface treatments and repair techniques adopted for the new program were not familiar at first to Michigan DOT personnel. For example, microsurfacing had been applied only to a limited number of locations in Michigan before 1992, and the benefits were not well known. Similarly, the Department did not have working knowledge and experience with chip seals and certain kinds of concrete repairs.

Established contractors and suppliers were asked to develop training workshops to educate Department personnel about the new treatments. The workshops have proved popular and successful. The training partnership with contractors and suppliers has continued and has contributed to improvements in products and materials.

Surface Treatments

From the beginning, the program's emphasis has been on targeting pavement surface defects caused by the environment and deficiencies in materials, not on deficiencies in the pavement structure caused by traffic loading.

Surface treatments for flexible pavement surfaces include microsurfacing, chip seals, slurry seals, crack sealing, 3/4-inch (20-mm) overlays of ultrathin hot-mix asphalt, and 1.5-inch (40-mm) hot-mix asphalt overlays. In some situations, it was cost-effective to treat curb and gutter pavement sections by cold milling and resurfacing with a 1.5-inch hot-mix asphalt overlay.

Treatments for rigid pavements include full-depth concrete pavement repairs, joint resealing, dowel-bar retrofits, minor small repair, crack sealing, and diamond grinding. Later, the removal and replacement of narrow bituminous shoulders (less than 1 meter) were added as acceptable treatments.

Building Up the Budget

Since its inception in 1992, the Capital Preventive Maintenance Program has had a dedicated budget, assuring that funds are protected and used for their designated purpose. The first year, the program was funded at $12 million, with $6 million for bridge preventive maintenance. With federal-aid eligibility, Michigan's funding obligation was approximately 20 percent of the program's total cost.

The pavement preventive maintenance budget has increased steadily, reaching $25 million in 1997. In 1998, the Transportation Equity Act for the 21st Century revised the federal funding formulas, and Michigan received a much needed revenue increase.

In addition, Governor John Engler obtained a gasoline tax increase to improve the state's transportation system. Michigan DOT leaders have demonstrated commitment to the program by designating a greater portion of funds for pavement preventive maintenance. Today, the pavement preventive maintenance program has an annual budget of $60 million, and the budget will increase to $73.5 million in 2003.

Rating Conditions

The rating of pavement conditions on the state-managed highway system is based on standard criteria such as distress, ride quality, friction, and rutting. Detailed data are collected for the pavement management system and used by pavement engineers, but usually the data are translated into ratings of "good" or "poor" for easier understanding by other agencies and the public.

In explaining the Michigan Road Strategy to the public, officials made a distinction between freeways and nonfreeways. Freeways referred to all Interstate highways, as well as other limited-access state highways. Nonfreeways represented all of the remaining highways that are not limited-access, including all two-lane roads.

Pavement condition data for 1996 indicated that 79 percent of Michigan's freeways and 56 percent of the nonfreeways were in good condition. In 1997, the State Transportation Commission established a specific 10-year condition goal—to have 95 percent of freeways and 85 percent of nonfreeways in good condition by 2007.

The only viable strategy was to implement a three-tiered program of reconstruction, rehabilitation, and preventive maintenance. The approach addresses the worst highways through reconstruction, the poor highways by rehabilitation, and the good highways with aggressive preventive maintenance.

Optimizing Funds

The mix-of-fixes approach helps optimize available funds to meet network condition needs. In estimating the outcome of a mix-of-fixes strategy, Michigan DOT relies on the Road Quality Forecasting System, which uses current condition data from the pavement management system to predict future network conditions at different levels of investment. The forecasting model has proved an invaluable tool.

Integrating pavement preventive maintenance with reconstruction and rehabilitation produces dramatic results in the network's condition. Even the most skeptical traditionalist soon realizes that preventive maintenance is the only cost-effective means to improve overall pavement condition. More than a program of short-term treatments, preventive maintenance is a management tool that optimizes funding allocations.

Balancing Service Life

The bar chart in Figure 1 shows the remaining service life of a typical pavement network that failed to implement a mix-of-fixes strategy. The unequal distribution of remaining service life represents a significant future problem when the largest group approaches no remaining life. With no service life remaining, the pavements are candidates only for rehabilitation and reconstruction.

Large surges in construction can be devastating to overall maintenance. First, large fluctuations in funding are required—an unpopular alternative for the public. Second, the variation in construction activities from year to year creates staffing and logistical problems for the highway agency and the contractor. The practice of hiring and laying off personnel as workloads change hurts employees and disrupts the organization. Finally, contractors and suppliers need a stable source of work to survive in the marketplace. Years of heavy workloads followed by years of light workloads can force many contractors out of business.

Preventive maintenance can alter the distribution of a pavement's remaining service life. By targeting large concentrations of pavements with similar remaining service lives, preventive maintenance treatments can balance projected workloads before a management problem develops. Balancing the remaining life of the network pavements will ensure manageable workloads at available funding.

Managing the Process

Data Collection

Every year pavement condition data are collected for half of the Michigan highway network, so that the entire network is surveyed every two years, and the cycle repeats. The survey collects information by videotaping one lane, providing a record of all distress in the pavement surface. The videotape is tagged by location and analyzed in 10-foot segments, with each segment assigned a distress index number that increases with the level of severity.

In addition, the survey collects ride quality and rut measurements for the pavement management system. The new data are compared with historical data to forecast future pavement conditions in terms of remaining service life.

Michigan DOT's seven regional offices are using the pavement condition data to create long-term strategies and projects to achieve the State Transportation Commission's 10-year condition goal. Each region's strategy relies on the Road Quality Forecasting System to recognize needs and variability within assigned budget targets.

Call for Projects

The Department annually issues a call for projects, allowing the regions to introduce candidate projects for roads and bridges. Projects involving reconstruction and rehabilitation are planned for five years away. At the end of each construction season, new projects for reconstruction and rehabilitation supply the next fifth year. Preventive maintenance projects are identified only for one year away, because the projects must address pavement deficiencies early on, before the problems become serious.

The annual call for projects assures that the programs are consistent with the state's long-range plan and its Transportation Improvement Program. The Department gains an opportunity to make midcourse corrections if the program adjustments become necessary. But the call for projects also emphasizes the principle that preventive maintenance will improve the overall highway network's pavement condition cost-effectively.

Evaluating Performance

The value of pavement preventive maintenance is anchored to the performance of the treatments—the key is not how long the treatments last but the life-extending value imparted to the pavement. Michigan DOT annually assesses the life-extending value of the different treatments. A team of independent engineers, experienced and knowledgeable about pavements, performs the evaluations.

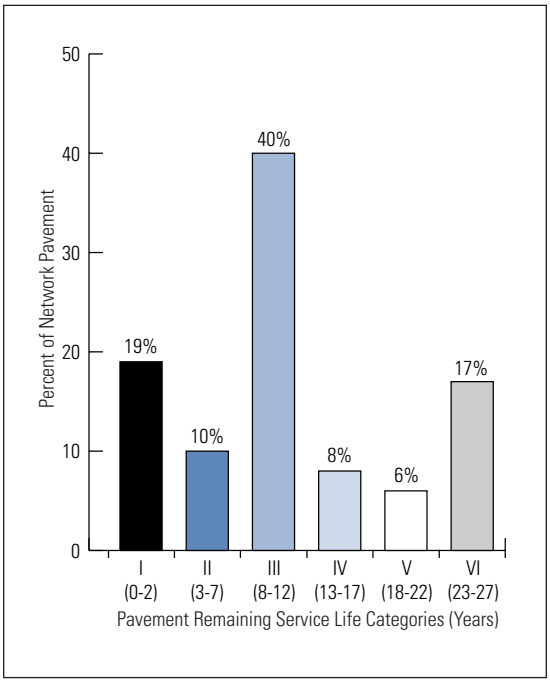
Data Analysis and Field Tests

The evaluations concentrate on treatments that are several years old. Before a field investigation of the treatment, information is gathered, including details about the original pavement section, construction history, historical and current traffic counts, and pavement management system condition data. The condition data on distress, ride quality, and rutting are of primary interest and include the years preceding and following the treatment application.

After the data analysis, the field phase begins. A representative number of segments are chosen to provide an accurate assessment of pavement surface condition. Each segment measures 0.1 mile (160 meters) in length. All of the selected segments are surveyed carefully and the extent and severity of each type of distress are recorded. Performance curves are developed, and the life-extending value of the treatment is extracted for each project.

Figure 2 provides a simplified depiction of the life-extending benefit of a treatment. The graph shows a typical deterioration curve interrupted when a preventive maintenance treatment is applied to a pavement in good condition. The preventive maintenance improves the condition for a period, until the pavement returns to the condition before the treatment. The time the pavement condition was improved by the treatment is the life extension given to the original pavement, or the extended service life.

Figure 1. Remaining service-life distribution of typical pavement network maintained without mix-of-fixes strategy, based on current condition of roadways.



The pavement management system's measurements of pavement condition over a period of time before and after the application of preventive maintenance makes it possible to determine the extended service life of a treatment.

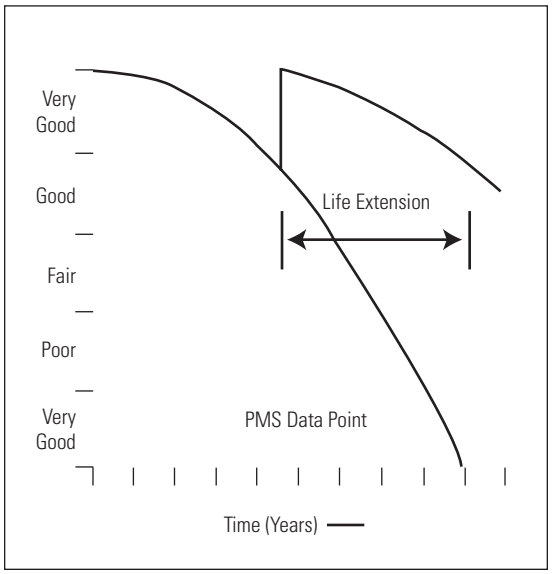
Prescribing Treatments

Although evaluations continue, the extended service life of a preventive maintenance treatment depends on the pavement's rate of deterioration. Pavement condition is possibly the most important factor in achieving the maximum benefit from a preventive maintenance treatment.

An engineer should evaluate a highway like a doctor diagnoses a patient—each patient has different physical traits, and the doctor prescribes a medication to fit the particular individual. Similarly, the engineer must select a preventive maintenance treatment that fits the unique condition of the pavement.

Michigan DOT prescribes treatments according to pavement condition measures, not by schedules for timely applications. The likely gains in extended service life from various treatments applied to different types of pavement are indicated in Table 1.

Figure 2. Life-extending benefit of preventive maintenance treatment.



Consolidating Gains

The mix-of-fixes approach provides the greatest flexibility to the highway agency in enhancing pavement performance, with a three-tier program of reconstruction, rehabilitation, and preventive maintenance. An agency can address the worst highways through reconstruction, improve poor highways by rehabilitation, and preserve good highways with timely preventive maintenance. Preventive maintenance can improve pavement performance cost-effectively and efficiently, as measured by such attributes as ride quality, safety, and remaining service life.

In Michigan, pavement preventive maintenance is now integrated into a strategy designed to meet long-term pavement condition goals. Funding for the pavement preventive maintenance program has grown steadily from $6 million to $73.5 million annually. The performance of the preventive maintenance treatments and the extension of service life imparted to the original pavements are evaluated regularly.

Michigan DOT has a strong partnering relationship with preventive maintenance contractors and suppliers for improving products and materials. As a result, even better-performing treatments are expected in the future. ✳

Resources

Asset Management Primer. Federal Highway Administration, December 1999.

Five-Year Road and Bridge Program, Volume III: 2001 to 2005. Michigan Department of Transportation, January 2001.

Good News from MDOT: A Progress Report from the Michigan Department of Transportation. Michigan Department of Transportation, December 2000.

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TABLE 1: Extended Service Life Gains for Preventative Maintenance Treatments

Treatment	Pavement Type	Extended Service Life (years)[a]
Overband crack filling	Flexible Composite	Up to 2 Up to 2
Crack sealing	Flexible Composite Rigid	Up to 3 Up to 3 Up to 3
Single chip seal	Flexible Composite	3 to 6 N/A[b]
Double chip seal	Flexible Composite	4 to 7 3 to 6
Slurry seal	Flexible Composite	N/A[b] N/A[b]
Microsurfacing (single course)	Flexible Composite	3 to 5[c] N/A[b]
Microsurfacing (multiple course)	Flexible Composite	4 to 6[c] N/A[b]
Ultrathin hot-mix asphalt, .75-in. (20-mm) overlay	Flexible Composite	3 to 5[c] 3 to 5[c]
Hot-mix asphalt, 1.5-in. (40-mm) overlay	Flexible Composite	5 to 10 4 to 9
Hot-mix asphalt, 1.5-in (40-mm) Mill and overlay	Flexible Composite	5 to 10 4 to 9
Joint resealing	Rigid	3 to 5
Spall repair	Rigid	Up to 5
Full-depth concrete repairs	Rigid	3 to 10
Diamond grinding	Rigid	3 to 5[c]
Dowel-bar retrofit	Rigid	2 to 3[c]
Concrete pavement restoration	Rigid	7 to 15[c]

Notes

[a] The time range is the expected life-extending benefit given to the pavement, not the anticipated longevity of the treatment.

[b] Sufficient data are not available to determine life-extending value.

[c] Additional information is necessary to quantify the extended life more accurately.

Pavement Preservation: A Call to Action

Ensuring that roads that are in good condition stay that way is the goal behind pavement preservation efforts nationwide. These efforts are paying off, but highway agency resources are often limited, slowing progress, and there is still much to be done. Recent surveys of road conditions show that 32 percent of major U.S. roads are in poor or mediocre condition. Driving on roads in need of repair, meanwhile, costs U.S. motorists $49 billion a year in vehicle repair and operating expenses. Improving these numbers and establishing a coordinated national pavement preservation research effort brought representatives from across the country together at a Pavement Preservation "Think Tank" meeting held in McLean, Virginia, in February. Attendees represented State highway agencies, industry, the American Association of State Highway and Transportation Officials (AASHTO), Transportation Research Board (TRB), and the Federal Highway Administration (FHWA), among others.

The new initiative will build upon the work accomplished over the last 7 years by the AASHTO Lead State Team on Pavement Preservation, Foundation for Pavement Preservation (FP2), AASHTO Subcommittee on Maintenance, and FHWA Pavement Preservation Expert Task Group. This work has resulted in greater acceptance nationwide of the need for pavement preservation treatments. Some State highway agencies, such as North Carolina, for example, have created pavement preservation engineer positions. Highway agencies, trade associations, and members of academia have united to form the Midwestern Pavement Preservation Partnership to share knowledge and best practices in pavement preservation. And local agencies and municipalities are applying more and more preservation treatments to their roads to make their investment last longer.

New Pavement Preservation CD Available

More than 50 technical documents are now available on a new CD to assist highway agencies with establishing or improving pavement preservation programs. Pavement Preservation 2: State of the Practice contains guidelines for State and local preventive maintenance programs. New and updated technical manuals on pavement evaluation and a variety of preventive maintenance treatments are included, as well as resources to assist with staff and public education. Eight State departments of transportation contributed documents from their pavement preservation programs to the CD, an update of the 2001 edition.

The CD was developed by the Foundation for Pavement Preservation (FP^2), in cooperation with the Federal Highway Administration (FHWA), several State highway agencies, and industry associations. To obtain a copy, contact Bill Ballou of Koch Pavement Solutions and President of FP^2 (email: balloub@kochind.com). To learn more about pavement preservation, contact your local FHWA division office or Steve Mueller in FHWA's Office of Asset Management, 202-366-1557 (fax: 202-366-9981; email: steve.mueller@fhwa.dot.gov). You can also visit the FHWA and FP^2 Web sites at www.fhwa.dot.gov/preservation and www.FP2.org.

Pavement preservation treatments may include various types of surface seals, thin lift overlays, and crack sealing for asphalt pavements. Treatments for concrete pavements might include crack and joint sealing, diamond grinding, and retrofit dowel bars. The key is to apply the treatments when the pavement is still in good condition, with no structural damage. Placing a treatment too late will result in poor performance, while applying treatments too early can cause other pavement problems and use up funds before they are needed. "Applying the right treatment to the right road at the right time allows highway agencies to get the most out of their maintenance dollars," says Jim Sorenson of FHWA.

Meeting participants noted that building on advances made to date and increasing awareness of the need for pavement preservation will mean addressing some critical issues. These include the need to:

- Standardize mix designs and test procedures for pavement preservation treatments.
- Provide clear definitions of what preservation is and how it differs from corrective and reactive maintenance.
- Increase the amount of data and knowledge available on the performance of pavement preservation treatments. Guidelines are needed on what treatment to use, where to use it, and what the performance expectations are.

TRB's proposed Future Strategic Highway Research Program (F-SHRP) includes one project related to pavement preservation: "Integrating the 'Mix of Fixes' Strategy into Corridor Development." This project will identify current and next generation rehabilitation options and provide assessment tools on how to choose the optimal combination of solutions along a given corridor.

To augment the planned F-SHRP research and other current efforts, meeting attendees recommended that a national workshop be held to develop a comprehensive pavement preservation research program for the next 5 years. A proposal to hold such a workshop under the auspices of the National Cooperative Highway Research Program (NCHRP) 20-07 program is being developed for submission to the AASHTO Subcommittee on Maintenance.

State and local highway agencies are applying more and more preservation treatments to their roads, such as the chip seal shown here.

"This meeting brought together the many organizations that have a stake in meeting current pavement preservation research, development, and technology needs," said Sorenson. "The meeting underscored the need and commitment required to implement an asset management philosophy through pavement preservation," noted Bill Ballou of Koch Pavement Solutions and President of FP2.

For more information on the NCHRP 20-07 proposal or pavement preservation activities, contact Jim Sorenson at FHWA, 202-366-1333 (fax: 202-366-9981; email: james.sorenson@fhwa.dot.gov) or Chris Newman at FHWA, 202-366-2023 (fax: 202-366-9981; email: christopher.newman@fhwa.dot.gov). ❋

Reprinted from *Focus,* May 2003.

Pavement Preservation Training: How to Make the Most of Your Highway Investment

As transportation agencies across the country make decisions about spending limited highway dollars, they are looking for a high payoff in terms of maximizing resources and optimizing the return on their investment. With the Interstate system completed and much of the National Highway System exceeding its design service life, these decisions are increasingly focused on maintaining and preserving the Nation's $1 trillion dollar investment in existing highway infrastructure assets. To accomplish this goal, many agencies are now considering a wider range of actions to take to maintain and preserve their transportation infrastructure. In response to State and industry needs, the Federal Highway Administration (FHWA) has developed a series of pavement preservation training courses to provide guidance in this area of asset management.

Two courses are currently being offered to highway agencies through FHWA's National Highway Institute (NHI), while two more are expected to be available by this fall. The development and presentation of the courses has been supported by industry and the Foundation for Pavement Preservation. *Pavement Preservation: The Preventive Maintenance Concept* introduces the overall concepts of pavement preventive maintenance. Its target audience is highway agency decisionmakers, management, senior maintenance staff, and others who have the ability to create and fund department programs and initiatives. The course highlights components of a preventive maintenance program, provides an overview of treatments and techniques, and explores the use of life-cycle cost analyses to promote preventive maintenance. The course also makes extensive use of case study information collected from visits and interviews with five pavement preservation Lead States. Since November 2000, the course has been presented 32 times in 17 States. "The popularity of the course underscores a widespread interest in learning more about implementing or improving preventive maintenance practices at both the State and local level," says Jim Sorenson of FHWA.

"We have sent all engineering managers in the field at the division, district, and county levels to both courses," says Steve Varnedoe, State Maintenance and Equipment Engineer for the North Carolina Department of Transportation. "These courses have been very effective in helping to bring about a cultural change in the organization regarding the value of pavement preservation. We believe getting buy in and an understanding of the concepts of pavement preservation at all levels of management is essential for an agency to sustain a pavement preservation program."

Selecting Pavements for Preventive Maintenance targets engineers and field supervisors who make decisions about which roads receive treatment and when. The course provides guidance on identifying when pavements are candidates for preventive maintenance, learning how to identify appropriate preventive maintenance treatments, and understanding all of the factors that need to be considered to select the most appropriate treatment. Also featured are hands-on exercises that test participants' abilities to identify appropriate candidate pavements for preventive maintenance, select feasible treatments, and analyze cost and performance data to identify the best treatments to use. Since November 2001, the course has been presented 24 times in 11 States.

The third course, *Design and Construction of Quality Preventive Maintenance Treatments,* is under development. "This course is probably the most eagerly anticipated among both agencies and contractors," says Sorenson. It targets those field personnel involved in constructing preventive maintenance treatments, such as agency inspectors and contractor foremen. The course includes modules on all of the different types of preventive maintenance treatments now in use, focusing on best practices for designing and constructing those treatments. It also addresses poor practices and their

resulting impacts. As with the other courses, it is being developed by Applied Pavement Technology, Inc., in close collaboration with industry organizations and contractors. "They are providing their own training materials and storehouse of technical knowledge and experience to help ensure that the resultant training course is accurate and useful," says Sorenson.

The final course in the Pavement Preservation series, *Pavement Preservation: Integrating Pavement Preservation Practices and Pavement Management,* focuses on finding the common ground that needs to exist between preventive maintenance and pavement preservation practices and pavement management programs. Much of the responsibility for pavement preservation activities rests with an agency's maintenance division at the local or district level. Such activities mirror pavement management ones in many ways, but they often take place outside of the agency's pavement management framework. Not only may there be costly duplication of effort, but all of the benefits of preventive maintenance are not realized if it is not done in concert with pavement management.

The course addresses technical issues of integration, such as performance indicators, data collection, treatment selection, and software needs and capabilities, as well as the need to enhance interagency communication and agency organization. The course objectives also include:

- Describing the characteristics and goals of a pavement management system (PMS), including the difference between network-and project-level decisions.
- Demonstrating how preventive maintenance and other pavement preservation practices affect pavement performance and how these treatments should be incorporated into pavement management models.
- Describing how an enhanced or integrated PMS can be used to support asset management decisions by demonstrating the long-term cost effectiveness of preventive maintenance programs and how these programs can be used to achieve agency pavement condition goals.

To schedule the two courses currently available, contact Danielle Mathis-Lee at NHI, 703-235-0528 (email: danielle.mathis-lee@fhwa.dot.gov). For more information about the Pavement Preservation course series, contact Ewa Rodzik at NHI, 703-235-0524 (email: ewa.rodzik@fhwa.dot.gov) or your local FHWA Division Office. ✻

Reprinted from *Focus,* March 2003.

The North Carolina Department of Transportation places a chip seal, which is one of the pavement preservation practices covered in FHWA's new training courses.

Performance-Based Contract Brings Innovation and Revitalization to DC Streets

by James B. Sorenson and Edward A. Sheldahl

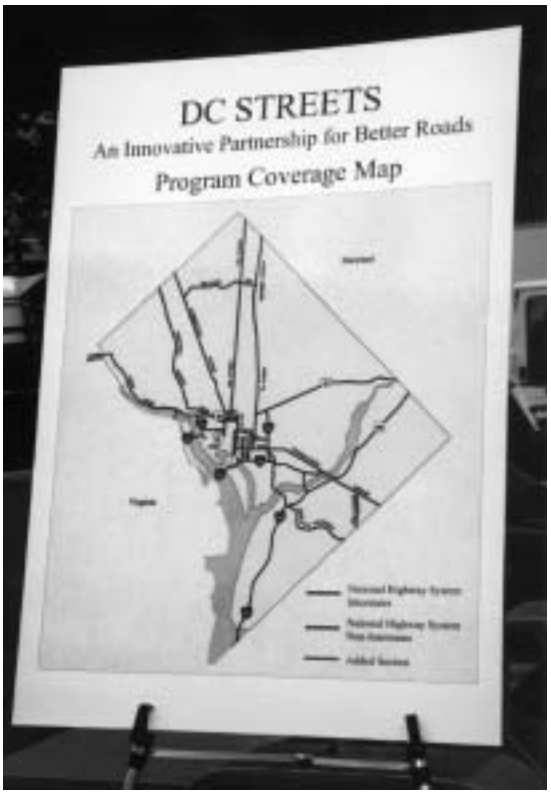
National Highway System (NHS) roads that serve as the primary gateway to the Nation's Capital have gotten a new lease on life, thanks to the first urban, performance-based asset management contract in the United States. Known as "DC Streets," the project was developed by the District of Columbia Division of Transportation (DDOT), Federal Highway Administration (FHWA), and FHWA's engineering services consultant team, led by Science Applications International Corporation (SAIC). In June 2000, DDOT kicked off the project by awarding a contract to VMS, Inc., to preserve and maintain approximately 121 km (75 mi) of the major streets and highways in the District. These roads are heavily used by residents, commuters, and tourists alike. A recent study of the project's first year shows that considerable progress has been made toward accomplishing the contract's performance goals. For drivers in DC, this means that the roads are getting better every day.

NHS roads in the District include heavily traveled segments of I-295 and I-395, as well as such gateways into the Nation's Capital as Pennsylvania Avenue, Constitution Avenue, and Independence Avenue. Assets being maintained under the 5-year, $70 million experimental contract include tunnels; pavements; bridges; roadside features (including curbs, gutters, sidewalks, and retaining walls); pedestrian bridges; roadside vegetation; and such traffic safety equipment as guardrails, barriers, impact attenuators, and signs. Also covered is snow and ice control. The performance-based nature of the contract means that instead of specifying the materials or methods to be used, as is done for traditional maintenance contracts, the desired outcome is identified and it is then up to the contractor to achieve it. By focusing on outcomes, the approach provides flexibility and encourages innovation. It also means that the contractor must accept

Washington, DC, mayor Anthony Williams spoke at the June 2000 launch of the DC Streets project.

more responsibility for customer input. The DC Streets contract represents the largest transportation investment in DDOT's history. It is also the first time that FHWA has teamed directly with a city government on a program to preserve its city roadway infrastructure.

The study done at the end of the contract's first year compared the condition of the roadway assets against the performance measures, providing an overall score and a score for each maintenance category. Performance measures and the benchmarks were established by evaluating the baseline condition of roadway assets or their elements and then determining a reasonable goal. A score of 100 would mean that, on average, the condition of the assets met the performance goal. The overall score for the first year of the contract was 92. Although the complete goals of the initiative have not been realized yet, much improvement can already be seen on the streets. These improvements have been noticed by city residents. The evaluation report noted that "the first year…showed a marked decrease in negative feedback from the public and press. Probably the most noted change was the lack of pothole complaints, which have plagued DDOT in years past."



The contract puts a strong emphasis on revitalizing the communities where the maintenance work is being performed. During the first year of the project, VMS worked with local community development organizations; donated employee time, equipment, and materials to community projects; and focused on hiring local residents and businesses. The contract also emphasizes the use of innovative methods and procedures for infrastructure maintenance. Innovative practices and technologies employed by VMS in the first year of the contract included using a mobile spray pothole patcher and instituting performance-based contracts with a number of subcontractors.

The experimental nature of the contract means that other cities, states, and countries are learning from the project experiences as they consider instituting asset management initiatives. Presentations on the DC Streets initiative have been made at meetings ranging from the Mid Atlantic Quality Assurance Workshop to the Transportation Research Board Annual Meeting. Project staff have also met with visiting delegations from Ireland, Northern Ireland, Finland, and the Southern Africa Development Community.

For more information on the DC Streets initiative, contact Luke DiPompo at DDOT, 202-645-6134 (fax: 202-645-6129; email: luke.dipompo@dc.gov), Michael Kirk at VMS, 804-553-4001 (fax: 804-264-1808; email: mkirk@vmsom.com), or Edward A. Sheldahl at FHWA, 202-219-3514 (fax: 202-219-3545; email: edward.sheldahl@fhwa.dot.gov). ✳

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"DC Streets" is a Capital Success

For Washington, DC, drivers, the ride is looking and feeling smoother. Launched with fanfare in June 2000, the "DC Streets" initiative constituted the first urban, performance-based asset management project in the United States. The District of Columbia Division of Transportation (DDOT) and the Federal Highway Administration (FHWA) and its engineering services consultant, Science Applications International Corporation (SAIC), worked together to develop the project. DDOT then awarded a contract to a private firm, VMS, Inc., to preserve and maintain approximately 121 km (75 mi) of the major streets and highways in the District. These roads make up the District's portion of the National Highway System (NHS) and are heavily used by residents, commuters, and tourists. A recent assessment of the first year of the project showed that substantial progress has been made toward meeting the contract's performance measures.

Assets that are being maintained under the 5-year, $70 million experimental contract include tunnels, pavements, bridges, roadside features (including curbs, gutters, sidewalks, and retaining walls), pedestrian bridges, roadside vegetation, and such traffic safety equipment as guardrails, barriers, impact attenuators, and signs. Also covered is snow and ice control. Roads throughout the city have been worked on, including Pennsylvania Aveneue, I-295, and New York Avenue. The performance-based nature of the contract means that instead of specifying the materials or methods to be used, the desired outcome is outlined and it is then up to the contractor to achieve it. The contract is the largest transportation investment in DDOT's history and also represents the first time that FHWA has teamed directly with a city government on a program to preserve its highway infrastructure.

Roads in the LeDroit Park neighborhood of Washington, DC, are being spruced up under the new "DC Streets" initiative.

The evaluation compared the condition of the assets against the performance measures, providing an overall score and a score for each maintenance category. A score of 100 would mean that, on average, the condition of the assets meets the performance goal. The overall score for the first year of the contract was 92. "We're very pleased with the progress that's been made so far. The trends are going up in all categories," says Shannon Moody of VMS. "DC Streets has brought a lot of improvement to the NHS, although we still have a ways to go in realizing the goals of the initiative," says Edward A. Sheldahl of FHWA.

Reaction from the city has been positive also. "We've received a lot of feedback from residents and community members telling us that they think we're doing a good job," says Moody. The evaluation report noted that "the first year…showed a marked decrease in negative feedback from the public and press. Probably the most noted change was the lack of pothole complaints, which have plagued DDOT in years past."

"Contracting this work to VMS has brought wonderful results to our residential neighborhood and to the city as a whole," said Maria Taylor, Commissioner of the Foggy Bottom and West End Advi-

sory Neighborhood Commission. Washington, DC, resident Jim Wheeler noted the "prompt and good work VMS and its subcontractors have performed in repairing street signs, removing abandoned meter posts, installing temporary sidewalk patches, and repairing tree boxes along Wisconsin Avenue and on sections of M Street in Georgetown."

One of the contract's goals is to use innovative methods and procedures for infrastructure maintenance. Innovative technologies used by VMS in the first year included a mobile spray pothole patcher. The contract also has the goal of revitalizing the communities where the maintenance is being performed. During the first year, VMS worked with local community development organizations, participated in community projects, and focused on hiring local residents and businesses.

Word of the success of DC Streets is spreading. Presentations on the project were made last year at the Transportation Research Board Annual Meeting, Mid Atlantic Quality Assurance Workshop, and the FHWA Eastern Area Engineering Conference. Project staff also met with delegations from Ireland, Northern Ireland, Finland, and the Southern Africa Development Community.

For more information on the DC Streets initiative, contact Luke DiPompo at DDOT, 202-654-6134 (fax: 202-645-6129), Michael Kirk at VMS, 804-553-4001 (email: mkirk@vmsom.com), or Edward A. Sheldahl at FHWA, 202-219-3514 (fax: 202-219-3545; email: edward.sheldahl@fhwa.dot.gov). ✻

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DC Streets: An Innovative Partnership for Better Roads

Asset management is coming to city streets, thanks to a new partnership among the District of Columbia Department of Public Works (DCDPW), the Federal Highway Administration (FHWA), and the highway industry. In an initiative known as "DC Streets," DCDPW and FHWA are contracting with VMS, Inc., to preserve and maintain approximately 75 miles of the major streets and highways in the District. These roads make up the District's portion of the National Highway System and are heavily used by residents, commuters, and tourists.

The innovative contract calls for performance-based work, in which a desired outcome is specified rather than a material or method. This differs from traditional maintenance contracts, which typically mandate what materials and techniques are to be used. "Instead of the District looking to see how many people we have on the job or how many tons of asphalt we use, they'll look at the results of what we do, such as the rideability of the pavement. They'll see if we meet the standards," says Preston Kelley of VMS.

The new contract reflects the increasingly popular concept known as asset management, which emphasizes the preservation, upgrading, and timely replacement of highway assets through cost-effective planning and resource allocation decisions.

The project will cover not only pavement maintenance, but also upkeep of such assets as tunnels, bridges, roadside features (including curbs, gutters, sidewalks, and retaining walls), and pedestrian bridges. Starting in the winter of 2001/2002, snow and ice control will also be part of the contract.

"Under this new partnership, major roads and neighborhood streets will be better maintained, which will benefit residents as well as visitors," said FHWA Administrator Kenneth Wykle at the June 19 ceremonial signing of the contract. "We're using an innovative method of contracting that will save time and money and is based on outcome, not bureaucratic process."

In addition to saving time and money, the new contract brings the added benefit of freeing up DCDPW employees to spend more time improving and maintaining the more than 1,400 miles of additional roads and neighborhood streets in the District. "This will be a real plus for the city," says Luke DiPompo, project manager for the new contract at DCDPW. "Because we have a shortage of personnel, being able to redeploy our staff to other streets will be a main benefit."

VMS has worked on performance-based contracts in States such as Virginia, Texas, and Oklahoma, with its 1996 contract with the Virginia Department of Transportation being the first time a private firm assumed full responsibility for comprehensive maintenance of significant portions of a State's Interstate highway system. The DC project, however, "is the first time a city has done this on such a large scale," says Kelley.

The $70-million, 5-year contract is the largest transportation investment in DCDPW's history. It also represents the first time that FHWA has teamed directly with a city government on a program to preserve its highway infrastructure. FHWA's role will include providing management advice and assisting in evaluating the work of VMS annually, using objective measures evaluated against the baseline and targets set in the contract.

For more information, contact Jim Sorenson at FHWA, 202-366-1333 (fax: 202-366-9981; email: james.sorenson@fhwa.dot.gov). ✻

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Midwestern States Partner to Preserve Pavements

Pavement Preventive Maintenance (PPM) is getting a Midwestern twist, as highway agencies, trade associations, and members of academia in the region unite to find new ways to apply PPM techniques to roads subject to the freezing weather conditions common in their States.

While transverse cracking, moisture-induced damage, and other cold climate pavement distresses occur to some degree in other parts of the United States, Midwestern States are particularly hard hit because of their climatic conditions. To address these common problems, highway agencies in the region formed a partnership last year to improve the technical aspects of PPM application in their States. PPM is defined as a planned strategy of applying cost-effective treatments to a structurally sound roadway to preserve the system and retard future deterioration.

The founding meeting of the Midwestern Pavement Preservation Partnership was hosted in Grand Rapids in April 2001 by the Michigan Department of Transportation (DOT). Participants came from Illinois, Indiana, Kansas, Michigan, Minnesota, Montana, Nebraska, Ohio, and Wisconsin to summarize the status of PPM in their respective States and share the techniques that work for them. The 60 attendees formed work groups and identified and ranked issues of importance to them in the areas of preservation policy, construction specifications, research, materials, and training. These high-priority issues include developing performance standards for preservation treatments, determining the proper timing of treatments, improving pavement performance predictions using mechanistic parameters, and implementing ongoing training for workers.

Enthusiasm for what the partnership will bring to States was voiced by participants. "I feel the pavement preservation partnership can become as beneficial to States in the future as the asphalt user-producer groups were during the implementation of Superpave," said Nebraska highway engineer Wayne Teten, whose own Department of Roads began formally implementing a preventive maintenance program in 2001.

Preventive maintenance treatments, such as the chip seal shown here, can preserve the roadway and retard future deterioration.

Some of the specific goals suggested for the partnership relate to the PPM techniques of microsurfacing and crack sealing. Although the process is becoming more popular among State highway agencies, microsurfacing specs vary from State to State. If the partnership, along with suppliers and contractors, is able to agree on a uniform standard, a more economical and consistent process could be developed. Similarly, with crack sealants, there are small variations among States in the application criteria, field performance criteria, and in the product itself. Having a uniform standard would yield a more cost-effective use of resources and lower bid prices for work, according to Federal Highway Administration (FHWA) pavement engineer Keith Herbold.

Another potential benefit resulting from the partnership's work, says Herbold, is that by broadening the exposure of members of academia to the practicalities of implementing a PPM program, universities will be able to better prepare the highway engineers of tomorrow.

Initial funding for the partnership's organizational work and first meeting came from FHWA's Midwestern Resource Center and the Foundation for Pavement Preservation. The partnership has proposed that subsequent funding come from State highway agencies, with in-kind support provided by vendors, consultants, and universities.

The partnership will hold its second meeting in Minneapolis from August 19–21. For more information on the partnership or to participate in its next meeting, contact Keith Herbold at FHWA, 708-283-3548 (email: keith.herbold@fhwa.dot.gov). ✻

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The Right Treatment for the Right Road

Type of treatment, road, and timing affect pavement maintenance management

by Bill O'Leary

Pavement maintenance is much more complex than most people think. It is not as simple as sealing a pavement surface or joints and cracks every several years. In this column every other month, I will try to explain "The Right Treatment on The Right Road at The Right Time." There has been a lot of thought put into that phrase, and it has been adopted as a battle cry by the Foundation for Pavement Preservation (FP2).

Therefore, in this first article I want to discuss the workhorse of preventive maintenance treatments: chipseals. There are many variations of this technique and the materials available for this purpose. It is good to have an understanding of the reasons for selecting a particular alternative.

First, the most commonly used chipseal consists of a uniform film of asphalt placed on an existing pavement, followed by an evenly distributed, clean aggregate. The asphalt seals the road surface and binds the aggregate in place; and the aggregate provides a skid-resistant wearing surface.

The size and type of aggregate vary from 0.25 inches (6.35 mm) to more than 0.75 inches (19.1 mm) and can be gravel, sandstone, limestone, rock asphalt, expanded shale, trap rock and the list goes on. In any case, it should be durable and skid resistant. The aggregate can be precoated or uncoated. It may be preheated in some cases, but it should always be clean. Single-sized aggregate in most applications is preferred. This is because in a chipseal design, the size and surface area of the aggregate are used to calculate the asphalt rate to achieve a desired level of embedment. If the design calls for 50 percent embedment of a 0.5-inch (12.7-mm) aggregate, then a 0.25-inch (6.35-mm) aggregate would be 100-percent embedded. That's not to say acceptable results cannot be achieved with a varied aggregate, but, ideally, single-sized is best. Another issue with regard to embedment is there are two stages: Initial embedment occurs on the day of placement; and final occurs within the first year. Predicting the final embedment of the aggregate is very tricky because it is almost completely dependent on the surface you are sealing. If the surface is very hard, you may have no further embedment. If the surface is soft or flush with asphalt, subsequent embedment from traffic is a certainty. This is one of the reasons the same aggregate and binder may yield different results on different pavements.

The asphalt in a chipseal performs two major functions. First, it seals the road surface. Second, it bonds the cover stone to the road. The asphalt bond is created chemically and mechanically, and the aggregate, once properly seated, contributes to the bonding by frictionally interlocking. All these things are needed in producing a good chipseal. The other considerations are binder types, equipment, weather, traffic, season of placement, etc. It's not possible to cover all of those aspects in this article. Therefore, I am going to explain chipseal variations and touch on why one may be best for a particular road section.

Single course chipseal

This is the most commonly used treatment and is best suited for a sound asphalt pavement that has very limited defects. This treatment is a single shot of asphalt binder followed by aggregate evenly spread so it is only one stone thick. There is a wide range of asphalt rates and aggregate sizes that will work very well. The larger the stones in a chipseal, the longer they will last. The larger stones are also more skid-resistant and produce more road noise. Keep in mind the amount of asphalt depends on the size of aggregate used. Larger stone requires more asphalt. Smaller stone chipseals are generally used on residential or other lower traffic volume streets.

Racked in

Racked in is a variation to the single course chipseal. In this type, there is one application of asphalt binder followed by two applications of stone. The first stone is two to three times larger than the second. This allows the larger stone to be well placed in the binder, and the second layer of the smaller stone fills the voids and displaces the binder further upward on the larger stone. The larger stone is mechanically locked in place by the smaller stone and binder.

Double chipseal

This type, also called two-course surface treatment, is two applications of asphalt binder and cover stone. The first application is the larger stone. The voids in the newly placed mat allow interlocking of the second application of asphalt binder and smaller stone. The placing of the second course should follow the first within a relatively short period of time, because the two courses interlock and work together as a system. A two-course treatment is often used in new construction over a compacted base.

Sandwich seal

Sandwich seal is very much like a two-course treatment except the first application of binder is omitted. This treatment works well to combat a flushed surface or to kill bleeding. The coarse stone is placed on the road first with no binder underneath it. The single application of binder is sprayed on the uniformly spread stone, followed by the second application of smaller stone and then rolled. The technique addresses the problems associated with further embedment. The excess asphalt on the existing surface squeezes up through the voids created by this treatment.

Chipsealing has much more potential than most people think. Not only are there variations in techniques that are underutilized, but, with different binders and aggregates, many problems can be solved. One last thought — chipsealing is more an art than a technique, and, in practicing this art, you must know "The Right Treatment on The Right Road at The Right Time." ✳

Bill O'Leary is the president of Prime Materials and Supply Corp., Houston.

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Pavement Preservation Forum II: Investing in the Future

For the nearly 200 participants of the National Pavement Preservation Forum II, held in San Diego, California, in November 2001, the numbers told the story. The Michigan Department of Transportation (DOT) estimates that it has saved more than $700 million since implementing a pavement preventive maintenance program in 1992. In California, the number of lane miles in need of repair on the Nation's most heavily traveled highway system is at its lowest level in 10 years, thanks to an infusion of pavement preservation funds. And in a recent survey, 34 of the 40 highway agencies that responded reported that they have established preventive maintenance programs.

These examples and many more were highlighted in the 3-day conference, which gave participants an opportunity to share success stories, detail challenges, and discuss what comes next. "Many of the issues and challenges we face are the same," said conference cochair Larry Orcutt of the California DOT. He urged conference attendees to ask themselves, "What can I take back to my area of the country? What can I do to make a difference?"

The event, which was a follow-up to the 1998 Forum for the Future, was sponsored by the Foundation for Pavement Preservation (FPP), Federal Highway Administration (FHWA), and the California DOT.

From California to Georgia, pavement preservation is ultimately about "keeping good roads good." It involves the timely application of carefully selected treatments to maintain or extend a pavement's service life. These treatments may include various types of surface seals, thin lift overlays, and crack sealing for asphalt pavements. Treatments for concrete pavements might include crack and joint sealing, diamond grinding, and retrofit dowel bars. The key is to apply the treatments when the pavement is still in good condition, with no structural damage. Placing a treatment too late will result in poor performance, while applying treatments too early can cause other pavement problems and use up funds before they are needed. As keynote speaker Tommy Beatty of FHWA noted, "We must apply the right treatment to the right road at the right time to get the most out of our maintenance dollars."

A primary theme of the conference was the importance of education and awareness as vehicles for promoting pavement preservation. Other keys to success cited by forum participants were:

- Adequate dedicated funds
- Effective marketing of preventative maintenance
- Support from management
- Legislative support
- Training and buy-in of workers
- Public awareness of the financial benefits of preventive maintenance.

California is directing more than $50 million to preventive maintenance. "The competition for transportation funds is fierce. We had to demonstrate the benefit of making the investment in preventive maintenance in terms of safety, improved ride ability, and longer lasting pavements requiring fewer and less frequent repairs," said Susan Massey, California DOT's Pavement Program Manager. "We had to tell them it's good business, that it's a good investment." The DOT began its pavement preservation efforts in 1992 and now issues an annual Pavement Condition Report, which it uses to determine high-priority needs. The DOT also developed 10-year pavement goals, which were implemented in 1998. These goals include reducing the backlog of distressed lane kilometers from 22,000 (14,000 mi) to 8,000 (5,000 mi) by 2008.

Preventive maintenance work to date has included applying a 30-mm (1.2-in) asphalt rubber overlay to 241 lane km (150 lane mi) of Interstate 5 in Fresno. The work, which was done by Granite Con-

struction Company, had to be completed in 65 days and come with a 1-year warranty. "We knew it was going to take some additional quality controls to do the project," said Jim Queener of Granite. These measures included performing multiple trial mixes in the lab before work started. Granite also conducted frequent quality control tests while the job was underway. Ultimately, "this was a really successful job," said Queener. The DOT, said Orcutt, found that the overlay "improved the ride dramatically and extended the pavement life by 10 additional years."

Colorado DOT is looking at both improving its pavements and working faster and more efficiently by taking an innovative approach and performing full depth restoration with precast concrete panels. An initial test and evaluation project was conducted on US 287 near Fort Collins, Colorado, in December 2000. Using new technology developed by URETEK USA, three panels, approximately 3.6-m (12-ft) x 4.6-m (15-ft) each, were removed and replaced with custom sized and shaped precast concrete slabs. The site was reopened to traffic the same day. A project was then conducted on I-25 in June 2001 that involved replacing eight 3.6-m (12-ft) x 4.9-m (16-ft) panels in an overnight operation. The site was reopened to traffic by 5:30 a.m. the next day. Colorado is now looking at replacing 44 panels on both I-25 and US 287 this spring using the precast method.

Full depth restoration is performed on US 287 near Fort Collins, Colorado, using precast concrete panels.

The conference also provided the contractor's view. "Being a preventive maintenance contractor has changed dramatically in the past 25 years," said Michael Buckingham of Strauser, Inc. "Training is an important aspect of preventive maintenance for both the agency and the contractors. As contractors we need to know what the most effective time is to apply preventive maintenance treatments."

Training is also important for the next generation of engineers. A session on education and outreach highlighted the work the University of Illinois is doing, in conjunction with the FPP, to develop a Pavement Preservation curriculum that can be adapted and used by other universities. The material will include lecture outlines, an instructor's guide, and visual aids.

As conference organizers and participants looked at the future of pavement preservation, they noted that challenges exist, particularly as top management priorities change. "As long as you can demonstrate on a daily basis the importance of performing preventive maintenance, you will continue to enjoy public support and the resources to get the job done," Orcutt said. Documenting the benefits of preventive maintenance can help maintain that support, he noted. Data must be accurate and it should also be accessible. Surmounting the challenges and carrying forward with the progress made to date, added conference cochair Jim Sorenson of FHWA, will also require partnerships that share a common vision, increased worker training, additional research into new and improved techniques, and better communication with stakeholders and the public.

For more information on pavement preservation treatments and techniques, contact Julie Trunk of the FHWA Office of Asset Management's Construction and System Preservation Team, 202-366-1557 (fax: 202-366-9981; email: julie.trunk@fhwa.dot.gov; Web: www.fhwa.dot.gov/infrastructure/asstmgmt/preserv.htm), or Steve Hersey at FPP, 703-610-9036 (fax: 703-610-9005; email: info@fp2.org; Web: fp2.org). ✳

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FHWA Announces New Source of Bridge Preservation Funding

Maintenance and preservation of highway bridges received a boost in January 2002, when the Federal Highway Administration (FHWA) announced that Highway Bridge Replacement and Rehabilitation Program (HBRRP) funds can now be used to perform preventive maintenance on highway bridges. This new flexibility in State highway agencies' use of the Federal funds will help extend the useful life of bridges in a cost-effective manner. The added flexibility will also assist States in using their limited highway budgets to best manage their aging highway assets.

Preventive maintenance activities eligible for funding include sealing or replacing leaking joints; applying deck overlays that will significantly increase the service life of the deck by sealing the deck surface and reducing the impact of aging and weathering; painting the structural steel; and applying electrochemical chloride extraction treatments to decks and substructure elements. States are encouraged to contact their local FHWA division offices for more specific details on eligible work.

King Gee, Program Manager for FHWA's Office of Infrastructure, noted in his announcement of the new policy that, "It is important that system preservation activities for the purpose of preventive maintenance on bridges be carried out using a systematic process, such as a Bridge Management System (BMS)." A BMS can help a State make the most efficient use of preventive maintenance funding by creating cost/benefit scenarios and investment strategies.

For more information on using HBRRP funds for bridge preservation activities, contact your local FHWA division office or Ray McCormick at FHWA, 202-366-4675 (email: raymond.mccormick@fhwa.dot.gov). For more information on implementing a BMS, contact George Romack at FHWA, 202-366-4606 (email: george.romack@fhwa.dot.gov). ✻

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North Carolina Takes a New Approach to Financing Road Maintenance

Faced with a problem confronting many States—where to find money to maintain highways—North Carolina turned to a process known as cash flow financing, or cash management, to obtain the needed funds. As part of the process, North Carolina's General Assembly passed a special provision in September 2001 authorizing the State Department of Transportation (DOT) to use $470 million in State Highway Trust Fund cash balances to restore primary routes that range from fair or poor condition to good condition.

Although North Carolina is only 11th in the Nation in population, it has the second largest State-maintained road system at 126,000 km (78,000 mi). More than 23,000 km (14,000 mi) of the system are primary highways carrying 60 percent of vehicle miles traveled in the State. Forty-one percent of the State's road system is currently rated at "fair" or "poor." Because it was crucial to improve safety and mobility for North Carolina's drivers, the State budget bill (SB1005) directed a portion of the Highway Trust Fund's cash balance to be spent on pavement preservation efforts, which include the strengthening, shoulder widening, and resurfacing of the State's primary (non-Interstate) highway system. In all, $150 to $170 million has been allocated each year for 3 years to North Carolina's 14 highway divisions for needed road work.

Essentially, cash flow financing allows State DOTs to tap into funds to which they previously did not have access; in North Carolina's case, it took a legislative act to free up money for pavement preservation. At the end of the 1999-2000 fiscal year, the Highway Trust Fund had reserves of $858 million and the Highway Fund had a cash balance of $270 million. The State's Joint Legislative Oversight Committee, seeking to divert some of that money into projects that could immediately help fulfill the State's highway maintenance needs, contracted with Dye Management Group, Inc., of Bellevue, Washington, to study the matter. Dye recommended that North Carolina use the cash balance for road repair projects if the General Assembly passed legislation making the funds available. According to Dye's David Rose, "This idea is not unique in that several other States have done it in recent years. However, the approach isn't foolproof—States must implement sound financial management and planning or else run the risk of depleting highway funds."

The North Carolina legislation directs the DOT to use "cash flow financing to the maximum extent possible to fund highway construction projects" and addresses the inherent risks by mandating a number of controls, including the establishment of a financial planning committee, monthly financial reports, fund cash level targets, revenue forecasting procedures, reorganization of preconstruction functions to expedite project delivery and maximize use of cash flow financing of projects, and the designation of a person to be responsible for project delivery. The law also empowers the State Treasurer to combine the balances of the Highway Trust Fund and the Highway Fund and to make short-term loans between the Funds to facilitate cash flow financing.

In addition to the $470 million to be used for primary route pavement preservation, the legislation specifies two other smaller provisions: $15 million per year for 3 years is to be used for the planning and design of projects so that money can be saved over the long run in maintenance costs. And another $15 million per year for 3 years is designated for installing electronic signal and traffic management systems that will improve the operational efficiency of the State's road system by reducing delays and facilitating traffic flow. The new provisions also stipulate that the DOT must ensure that improvements made using cash balance funds will not interfere with the delivery of Highway Trust

Fund projects on the 2002–2008 Transportation Improvement Program schedule.

In an announcement of the special provision, North Carolina Transportation Secretary Lyndo Tippett called the law a "landmark" move that is "undoubtedly the most significant transportation legislation since the Highway Trust fund in 1989." In illustrating the importance of the provision, Tippett added, "Under [the previous] funding system, it might be 10 to 20 years before some of these roads would ever be resurfaced. In fact, some of these projects would not have been completed for many generations."

Quick to allocate the new funds, the DOT reports that $115 million was let to contractors by the end of December 2001. These funds are allowing needed repairs to be made immediately to the State's primary roads, thus increasing safety and mobility for customers. Dye Management Group, Inc., is currently assisting the DOT in implementing new cash management procedures, developing forecasting tools, and making the transition to a cash-flow based program.

For more information, contact Len Sanderson, State Highway Administrator for North Carolina DOT, 919-733-7384 (email: lsanderson@dot.state.nc.us). *

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Scanning the Globe for Pavement Preservation Innovations

In recent years, an increasing number of highway agencies have discovered the benefits of low-cost pavement preservation treatments that can extend the service life of pavements. To learn more about pavement preservation innovations worldwide, the Federal Highway Administration (FHWA), American Association of State Highway and Transportation Officials (AASHTO), and industry sponsored a Pavement Preservation International Scanning Tour in July 2001.

The scanning tour team, which included representatives from FHWA, State departments of transportation, and other public and private organizations, identified France, South Africa, and Australia as countries using innovative techniques, materials, procedures, and equipment in their pavement preservation programs. Team member Duane Blanck, a Highway Engineer with the Crow Wing County Highway Department in Minnesota, says, "It was an excellent opportunity to observe and learn from the rest of the world." Blanck represented the National Association of County Engineers on the tour.

A surface treatment has been applied to this highway near Johannesburg, South Africa.

The host countries shared with the team their experiences and expertise with pavement preservation. The team's findings were divided into four categories:

- Management Perspective and Policies;
- Resource Commitment and Cost-Effectiveness;
- Treatments, Techniques, and Performance; and
- Innovative Methods, Practices, and Procedures.

The countries visited are committed to designing and building long lasting structural pavements for their roadway networks. Such policies mean that these countries have focused their maintenance activities on preserving surface courses with low-cost seals and thin overlays to protect the large investment in the roadway. These design techniques postpone more costly methods of rehabilitation.

France and South Africa share similar management philosophies that help them effectively appropriate resources. France develops a comprehensive road investment plan every 5 years, and South Africa uses a rolling 5-year improvement plan, which is developed annually using Pavement Management System (PMS) data and funding optimization strategies. Australia takes a different approach to management by implementing long-term maintenance contracts (10 years) that give control and responsibility for roadway system maintenance, rehabilitation, and capital improvements to private contractors.

The team discovered in the three countries a general acceptance of and commitment to using effective pavement management systems and techniques to protect structural investments. In South Africa, 80 to 90 percent of the needed maintenance projects identified using PMS data are scheduled for implementation. Nearly 90 percent of the annual maintenance budget in various regions of Australia is com-

A preventive maintenance approach has helped to ensure the excellent condition of this primary highway in Perth, Australia.

mitted to maintenance, with the other 10 percent going towards rehabilitation. And France conscientiously implements protective measures by using low-cost seals on a 7- to 10-year cycle.

Each of the countries uses only high quality materials for bitumen and aggregates, which is ensured through the implementation of rigorous specifications. Using high quality materials results in longer lasting products that respond well to their environment. "We were amazed that they would haul high quality aggregate 250 to 700 km," says Blanck, "We use what's available locally."

Such high quality materials are more costly, which makes preservation all the more important. South Africa and Australia make extensive use of chip seals, with Australia improving performance by pre-coating the aggregates. Australia also widely uses polymerized asphalts to ensure a quality seal. The polymers were generally being applied at twice the rate used in the United States. Because hot-mix asphalt is not always available, France has found success in using cold asphalt concrete as a riding surface for low-volume roads.

Innovative methods, practices, and procedures were observed in all three countries. France has developed the "Charter of Innovation" system, for example, through which the government and industry share the risks and rewards of developing new products and applications. A crack activity meter was designed in South Africa to measure surface cracking and the need to repair a road surface before applying a traditional overlay. And in Australia, the use of sandwich seals with a two-coat geotextile reinforced treatment has resulted in surfaces with 11-year acceptable performance ratings.

Following the tour, the team reviewed their observations from the countries visited and came up with a number of pavement preservation recommendations, such as applying thin seals earlier in the distress cycle and developing mechanisms to evaluate and implement new and innovative pavement preservation processes. The team's ultimate conclusion: Apply the right treatment to the right pavement at the right time.

A report detailing the findings and recommendation from the scanning tour is due out in early 2002. A technical working group comprised of representatives from the team, the AASHTO Subcommittee on Maintenance, FHWA, and a consulting firm are developing a Scan Technology Implementation Plan (STIP) that will demonstrate to transportation agencies and industry the observed innovative pavement preservation techniques and facilitate the implementation of the team's recommendations. Overall, the team found that the direction that the United States is taking in pavement preservation is in alignment with some of the best practices in the world.

For more information on the scanning tour or STIP, contact Luis Rodriguez at the FHWA Southern Resource Center, 404-562-3681 (email: luis.rodriguez@fhwa.dot.gov). For more information on pavement preservation treatments and techniques, contact Julie Trunk of the FHWA Office of Asset Management's Construction and System Preservation Team, 202-366-1557 (fax: 202-366-9981; email: julie.trunk@fhwa.dot.gov; Web: www.fhwa.dot.gov/infrastructure/asstmgmt/preserv.htm). *

Reprinted from *Focus,* December 2001.

Protecting Our National Investment in Pavements

by Larry Orcutt and Jim Sorenson

"Keeping good roads good" is the driving goal of pavement preservation efforts being carried out by highway agencies across the country. These efforts, as well as what the future holds for preservation programs, will be highlighted at the upcoming National Pavement Preservation Forum II. Scheduled for November 6–8, 2001, in San Diego, CA, the Forum's theme is "Protecting Our Investment." This theme will be explored in general sessions covering such topics as pavement preservation goals, best practices, and achieving customer satisfaction. Participants can also choose from nine breakout sessions on subjects ranging from how to evaluate the cost-effectiveness of pavement treatments to introducing new products and techniques to highway agencies.

Breakout sessions will also highlight innovative contracts, asset management, and tips for stretching funding dollars. A special session on "Toolboxes for Treatments" will provide an overview of pavement management treatments that are successfully being used in State pavement preservation programs.

The conference, which is being sponsored by the Foundation for Pavement Preservation, California Department of Transportation (DOT), and the Federal Highway Administration, will continue the work begun at the 1998 Forum for the Future. Held in Kansas City, MO, that event drew 120 participants from 32 States and Canada.

Pavement preservation involves the timely application of carefully selected surface treatments to maintain or extend a pavement's service life. An effective pavement preservation program includes the use of a range of preventive maintenance techniques and strategies, such as fog seals, slurry seals, thin lift overlays, crack sealing, and surface recycling for flexible pavements. Similar treatments for concrete roadways include crack and joint sealing, retrofit dowel bars, partial depth repairs, and diamond grinding. These treatments reduce the amount of water infiltrating the pavement structure, slow the rate of deterioration, or correct surface deficiencies such as roughness. Unlike routine maintenance, which is usually performed when the pavement is failing, preventive maintenance treatments must be applied when the pavement is still in good condition, with no structural damage. It is estimated that the use of preservation treatments can extend the life of a structurally sound pavement by 5 to 10 years.

One highway agency that has made a Statewide commitment to pavement preservation is the Ohio DOT. The agency issued new Pavement Preventive Maintenance Guidelines this year and provided training on the guidelines to each of its Districts and Counties. Showcased in the guidelines are the available pavement preventive maintenance treatments that have been approved for use by current State specifications. The treatments include crack sealing, chip seals, microsurfacing, concrete pavement restoration, and drainage preservation. For each treatment available, the guidelines discuss:

- Description and Purpose
- Pavement Condition Considerations
- Traffic Constraints
- Design Considerations
- Seasonal Construction Limitations
- Unit Cost for Estimating
- Anticipated Performance and Service

Ohio has found that the major benefits of preventive maintenance include increased customer satisfaction, improved pavement condition and ride quality, safer roads, and lower life-cycle costs. The benefits also include reduced congestion and more cost-effective use of funds. You can find Ohio's Pavement Preventive Maintenance Guidelines on the Web at www.dot.state.oh.us/pavement/publications.htm. For more information, contact Aric Morse at Ohio DOT, 614-995-5994 (email: aric.morse@dot.state.oh.us).

Michigan, meanwhile, has set specific goals aimed at "keeping good roads good" through the use of preventive maintenance. The DOT has set a target of having 95 percent of its expressways and 85 percent of its non-expressways in fair to good condition by 2007. Michigan has found that rehabilitation and reconstruction projects cost about 10–14 times as much as preventive maintenance projects per lane mile. The DOT estimates that it has saved more than $700 million since 1992 by implementing a preventive maintenance program.

Preventive maintenance also continues to be a top priority in California, where the Golden State is spending nearly $1 billion this year alone to keep the Nation's most heavily traveled highway system in working order. That effort is paying big dividends for California, where the number of lane miles in need of repair is at its lowest level in nearly 10 years.

The California Department of Transportation has dedicated $250 million to fund a series of preventive maintenance strategies, nonconventional asphalt concrete (AC) treatments, and pavement warranties. The strategies and treatments include using rubberized asphalt, microsurfacing, rubberized chip seals, polymer modified asphalt and emulsion, and recycled AC. Pilot projects have been selected for 1-year warranty programs, and warranty evaluation and design guides have been developed. The intent of the warranty is to guarantee the pavement's service life and prevent typical failures that may occur in the first year after construction. The result is a smoother riding, more durable pavement that requires less maintenance, resulting in less disruption to the traveling public.

For more information on the National Pavement Preservation Forum II or to register, contact the Foundation for Pavement Preservation at 703-533-0251. You can also download a registration form and preliminary program from the Web at www.fp2.org/. ✳

Larry Orcutt is chief, division of maintenance at the California Department of Transportation. He can be reached at 916-654-5849 (email: larry_orcutt@dot.ca.gov). Jim Sorenson is the Team Leader for the Construction and System Preservation Team in the Federal Highway Administration's Office of Asset Management. He can be reached at 202-366-1333 (fax: 202-366-9981; email: james.sorenson@fhwa.dot.gov).

Reprinted from *Roads & Bridges,* October 2001.

Keeping Good Roads Good

From using innovative contracting procedures for maintenance work to developing partnerships for pavement preservation programs, the National Pavement Preservation Forum II will look at both the state-of-the-practice for pavement preservation and what the future holds. Scheduled for November 6–8, 2001, in San Diego, California, the event is a follow-up to the 1998 Forum for the Future, which drew 120 participants from 32 States and Canada. The event is being sponsored by the Foundation for Pavement Preservation, Federal Highway Administration, and the California Department of Transportation.

Pavement preservation involves the timely application of carefully selected surface treatments to maintain or extend a pavement's service life. An effective pavement preservation program includes the use of a range of preventive maintenance techniques and strategies, such as fog seals, slurry seals, thin lift overlays, and crack sealing. The key is to apply the treatments when the pavement is still in good condition, with no structural damage.

The Forum's general session will cover such topics as pavement preservation goals, best practices, and achieving customer satisfaction. Participants can then choose from nine breakout sessions on subjects ranging from how to evaluate the cost-effectiveness of pavement treatments to introducing new products and techniques to your agency. A session on Innovative Contracts will cover incentives, fast-track construction, and end result specifications, among other topics, while "Toolboxes for Treatments" will provide an overview of pavement management treatments that are successfully being used in pavement preservation programs across the country.

For more information or to register, contact the Foundation for Pavement Preservation at 703-533-0251. You can also download a registration form and preliminary program from the Web at www.fp2.org/. *

Reprinted from *Focus,* September 2001.

In and Out in 72 Hours

Seventy-two hours and time to spare. Faced with three intersections on U.S. 395 in Kennewick, Washington, that needed to be completely reconstructed last fall, the Washington State Department of Transportation (DOT) took the unconventional route and shut each intersection down completely for one weekend to perform the necessary repair work with full depth concrete. The roads were closed at 7:00 p.m. on a Thursday and were required to be reopened by 6:00 a.m. on Monday. In each case, the contractor, Inland Asphalt, completed the work ahead of schedule and the roads were back in service by Sunday evening.

"Many people think concrete streets require 14 or 28 days of curing before allowing traffic on them," says Tom Nelson of the American Concrete Pavement Association (ACPA). However, these intersections were reconstructed with a high early-strength Portland cement concrete mix that allowed the roads to be opened to traffic within about 12 hours. To ensure that the project stayed on schedule, the contractor used a critical path timeline based on hours, not days. Inland Asphalt also employed such techniques as keeping an extra milling machine onsite as a backup, in case the machine being used broke down.

Equally critical was keeping area residents and businesses informed about the reconstruction plans and letting motorists know about alternate routes. Numerous meetings were held during the design phase of the project to allow for public input. The DOT also contacted local business owners prior to the construction work to explain the reconstruction process and held weekly meetings to update the media. Media coverage started a week before the actual road closures, which allowed the public time to prepare for using detour routes. "Going into this, the community was skeptical. But when all was said and done, they were very happy that they were only affected one weekend," says Nelson.

Following the weekend closures, the DOT interviewed about 40 businesses surrounding the intersections. While all of the businesses reported being affected by the closures and most had experienced a loss in sales, every respondent indicated that he or she would support weekend closures in the future for reconstruction work, rather than construction occurring over a longer period of time. Typical responses included: "Less impact overall," "Get it over with—It is more clogged doing it during the week," and "Businesses will not be affected as long with closures."

"The DOT's South Central Region was very pleased with the way things went. The project ran smoothly. We got the people in, got the job done, and impacted the public for just a short time," says Jeff Uhlmeyer of Washington State DOT.

To highlight the project and how it was accomplished, the Washington State DOT, Federal Highway Administration, and ACPA held an open house on June 19, 2001. The event was intended for design

Three intersections in Kennewick, Washington, were completely closed to traffic for 3 days, allowing for uninterrupted reconstruction work.

The three intersections were reconstructed with full depth concrete.

and construction personnel, material suppliers, contractors, and representatives from government agencies. It drew 75 people from Canada, Oregon, Idaho, Montana, and Washington State, with city and county agencies, public works offices, contractors, consultants, and State DOT officials all represented. Attendees heard from the project engineer and the contractor, as well as the city manager and local merchants. They also had the opportunity to tour the project sites and see the finished product. "Everyone was very impressed," says Nelson.

The intersection reconstruction work was documented as part of the Innovative Pavement Research Foundation's research program. A video and report on the reconstructions are currently being prepared.

For more information on the Kennewick intersection reconstructions, contact Jeff Uhlmeyer at Washington State DOT, 360-709-5485 (email: uhlmeyj@wsdot.wa.gov), or Tom Nelson at ACPA, 360-956-7080 (email: nelsontl@uswest.net). ✳

Reprinted from *Focus,* August 2001.

FHWA Course Offers New Look at Pavement Preservation

A 2-day course entitled, *Pavement Preservation: The Preventive Maintenance Concept* (Course No. 131054), is now available by request from the Federal Highway Administration (FHWA), through the National Highway Institute (NHI). The course serves as an introduction to preventative maintenance programs and highlights the importance of these programs to successful pavement preservation.

The Preventive Maintenance Concept centers on the information required to develop or improve a preventative maintenance program, and examines the steps that California, Georgia, Michigan, New York, and Texas have used in developing their own preventative maintenance programs. Included in the course is a description of the currently available tools and technologies, such as fog seals, undersealing, and hot in-place recycling, which make preventative maintenance programs possible. An extensive list of references for each tool and technology covered is also provided. Upon completion of the course, participants will be able to:

- Identify the components of a preventative maintenance program.
- Identify various pavement preservation techniques and materials and discuss the need for performance evaluation and pavement condition analysis.
- Discuss the effects of various treatments on pavement performance and pavement condition indices.
- Describe the importance of integrating pavement preservation into pavement management systems.
- Explain cost/benefit concepts.

The course's intended audience is upper and mid-level highway agency professionals who are responsible for pavement preservation and maintenance. The cost is $230 per participant. This is the first of four planned courses on the subject of pavement preservation. The second course in the series, *Pavement Preservation: Selecting Pavement for Pavement Maintenance,* will be available this fall.

For information on scheduling the course, contact Lynn Cadarr at NHI, 703-235-0528 (email: lynn.cadarr@fhwa.dot.gov). For technical information on the course, contact Julie Trunk at FHWA, 202-366-1557 (email: julie.trunk@fhwa.dot.gov). More information is also available at the NHI Website (www.nhi.fhwa.dot.gov/131054.html).*

Reprinted from *Focus,* August 2001.

Preventive Maintenance Videos Win Public Relations Award

Two preventive maintenance videos coproduced by the Michigan Department of Transportation (DOT) and the Federal Highway Administration (FHWA) were recently recognized with the Crystal PACE Award, one of the highest honors in the public relations field. Presented by the Public Relations Society of America, the award is conferred upon programs that have successfully addressed a contemporary issue with exemplary skill, creativity, and resourcefulness.

Protecting Our Pavements: Preventive Maintenance, released in April 1998, targeted upper-level highway managers with a message about the critical need for and benefits of adopting new policies and funding strategies in support of preventive maintenance programs. This video was followed by the June 2000 release of *Preventive Maintenance: Project Selection,* which was aimed at the maintenance supervisors and program managers who make the daily decisions to implement various preventive maintenance treatments. These treatments, which include such things as crack and joint sealing, surface seals, and thin overlays, help retard pavement deterioration and can extend the life of a structurally sound pavement by 5 to 10 years.

Since the videos' release, which was also made possible through support from the Foundation for Pavement Preservation and the American Association of State Highway and Transportation Officials Lead State Team on Pavement Preservation, thousands of copies have been distributed across the country and worldwide to highway agencies and contractors. The videos have also been the subject of numerous presentations at conferences, workshops, and national and regional meetings. "Along with highway agency personnel and contractors, the videos have been viewed by legislators, community groups, and local government officials, which has served to dramatically increase public awareness of the importance of preventive maintenance," says Jim Sorenson of FHWA.

To obtain copies of the videos, contact FHWA's Office of Asset Management at 202-366-0392, or the Foundation for Pavement Preservation at 703-538-3542 (email: info@fp2.org). For more information on preventive maintenance techniques, contact Jim Sorenson at FHWA, 202-366-1333 (fax: 202-366-9981; email: james.sorenson@fhwa.dot.gov), or Larry Galehouse at Michigan DOT, 517-322-3315 (fax: 517-322-3385; email: galehousel@mdot.state.mi.us). ✻

Reprinted from *Focus,* June 2001.

States Make Major Strides in Adopting Pavement Preservation Strategies

For the past 3.5 years, the American Association of State Highway and Transportation Officials (AASHTO) Lead States Team for Pavement Preservation has been working with FHWA, industry, and highway agencies across the country to improve the practice of pavement preservation. "The goal of the Lead States team was to have all agencies recognize that pavement preservation strategy plays an important role in managing an agency's investment in pavements," says Wouter Gulden of the Georgia Department of Transportation (DOT) and leader of AASHTO's Lead States Team for Pavement Preservation.

To assess the current status of pavement preventive maintenance strategies in North America, the Lead States team recently conducted a survey of transportation agencies in the 50 States, the District of Columbia, and Puerto Rico, as well as 6 Canadian Provinces.

Thirty-four of the 40 agencies that have responded to date report that they have established pavement preventive maintenance programs. Half of those programs have existed for more than 10 years, and only seven are less than 3 years old. Here are some of the key findings from the survey:

- Half of the reporting agencies characterize their pavement preventive maintenance program administration as being a mixture of centralization and decentralization.
- Thirty of the agencies have pavement preservation programs that are integrated with pavement management systems.
- Dedicated funding is available for pavement preventive maintenance activities in 28 of the reporting agencies.
- Agencies in 25 States have established guidelines for pavement preventive maintenance activities, and another 4 agencies are in the process of developing guidelines.
- Most agencies try to apply pavement treatments while the pavement is in good or fair condition. Half of the agencies, however, report that they are applying treatments to pavements in poor condition. Treatment decisions are generally made on a case-by-case basis using objective criteria.
- Overlays are the most frequently cited pavement treatment, followed by single-course chip seals, crack treatments, and single-course microsurfacing.
- The number of pavement preservation strategies used in each State varies widely, from none to 16.

Gulden says, "The survey tells us that agencies are taking major strides in recognizing the value of adopting pavement preservation strategies in improving the conditions of their pavements. Money spent on pavement preservation is well spent."

For more information, contact Wouter Gulden at Georgia DOT, 404-363-7512 (fax: 404-362-4925; email: wouter.gulden@dot.state.ga.us), or Bob Davies at FHWA, phone: 202-366-2023 (fax: 202-366-9981; email: robert.davies@fhwa.dot.gov). ✳

Funds Spent Annually on Pavement Preventive Maintenance Programs, as Reported by 35 Agencies

Dollars (Millions)	Agencies
Less than 10	6
10-25	12
25-50	5
50-75	4
Over 75	8

Reprinted from *Focus,* April 2000.

Partnering Pavement Preservation and Research

by David R. Geiger, P.E., Director of Asset Management, Federal Highway Administration

On February 11, the FHWA convened a meeting of Federal, State, industry, and academic pavement engineers in order to develop a strategy to advance pavement preservation research and development to maximize the benefit of this program to State and local government and the motoring public. The FHWA seeks to better coordinate the efforts of its Offices of Pavement Technology, Asset Management, and Research and Technology, along with the TRB/ NCHRP activities and the SPR programs of State Departments of Transportation. Better coordination among these parties will help to ensure that research needs of pavement preservation programs do not go unmet.

Agencies are now becoming increasingly proactive in preservation initiatives. Many agencies are realizing the cost benefits of a sound pavement preservation program. With over one trillion dollars invested in our Nation's highway system, State, City and County DOT's are evaluating their roadway assets and are recognizing the need to manage that investment. The potential benefits of pavement preservation are numerous, including improved pavement performance, safer roads, higher user satisfaction and reduced overall life-cycle costs. Also, pavement preservation programs facilitate decreasing traffic congestion, increasing mobility and improving work zone safety because preventive maintenance treatments are quicker and more cost-effective than the rehabilitation or reconstruction of existing pavements.

The ISTEA and TEA-21 facilitated the flexible use of Federal-aid highway funds for preventive maintenance activities. Many departments of transportation now have some type of pavement preservation program area. The challenge faced by many jurisdictions is one of determining the best design and preservation treatment applications for required extended performance of the highway pavement. In contrast with new construction or the reconstruction and rehabilitation of roads (for which materials, methods and specifications have been highly developed over the years), the research and experience on pavement preservation materials, performance and equipment lags behind the demand for such knowledge.

Developing national or regional protocols and publishing them as AASHTO standards would improve overall quality and long-term performance of both the treatment and the highway pavement. The availability of such standards would also help disseminate information enabling all agencies to use the most cost-effective treatments for their highways, roads and streets. Additional research is needed to better provide information in the areas of design, materials, specifications, and performance criteria. To best accomplish our goals, we envision both short-term and long-term research and development programs to address the need: defining the scope and preparing work plans, then embarking on a 5-year effort to research topic areas and write the protocols necessary for implementation.

Several industry groups are already working with Federal, State, and academic practitioners to further pavement preservation programs. These groups are enthusiastic about the potential benefits of this project in improving road quality while lowering costs, and will support and provide assistance in the implementation of the proposed research activities.

For your consideration and use we are attaching the minutes of the meeting, as well as several of the presentations and other supporting information. You are encouraged to share this information with your State DOT and interests from maintenance, pavements, materials, and research program managers. If you have any questions, or require further information on this subject, please contact Steve Mueller at (202) 366-1557 or steve.mueller@fhwa.dot.gov or Christopher Newman at (202) 366-2023 or christopher.newman@fhwa.dot.gov. ✳

Pavement Preservation Research & Development Initiative

Monday, February 11, 2003, McLean, Virginia

Introductions and Welcome:

Bill Ballou, National Pavement Preservation Leader, Koch Pavement Solutions, recognized the participants and extended his appreciation to everyone who was in attendance. For ten years the Foundation for Pavement Preservation has endeavored to advance the concept of preserving our highway investments through education and outreach. This process would not be possible without the ability to partner with AASHTO, FHWA, TRB, Asphalt Institute, NAPA, ACPA and many industry trade groups. The partnership has gained credibility and trust because of collective efforts from groups represented in this meeting.

Asset management requires us to endorse preserving our current highway system. But preserving the system also comes with an expectation of higher performance. A major drawback for agencies to routinely use many preservation treatments, has been the lack of data and knowledge in materials, selection, construction methods which results in inconsistent performance.

A group of industry partners developed research problem statements relative to pavement preservation in a June 2000 workshop. They also identified needs and estimated associated costs in a January 9, 2002, white paper (copy attached) entitled, "A Call for Action: A National Initiative for Pavement Preservation." Accordingly, the Foundation has been working with the FHWA to initiate a dedicated, funded research program in the areas identified in the white paper. In meetings with AASHTO, FHWA and industry officials on March 15, 2002 in Washington, D.C., and again on July 18, 2002, in Orange Beach, Alabama, these groups committed to move preservation forward. To accomplish this initiative, a strategic plan must be developed which will establish the goals and objectives of a coordinated research effort.

Jim Sorenson, Senior Engineer & Team Leader, FHWA, acknowledged a number of people interested in advancing the pavement preservation movement were unable to attend this meeting. He reaffirmed the complete support from Dave Sprynczynatyk, North Dakota DOT, Gary Hoffman, Pennsylvania DOT, Randy Iwasaki, California DOT, and others.

This meeting sets the stage to establish a coordinated pavement preservation research effort. Both AASHTO and FHWA are encouraged to assist the industry in addressing the needs identified during the March 15, 2002 meeting. Industry has met the challenge and now is requesting support. The framework of the meeting was briefly discussed.

A Call for Action—The Industry Challenge:

Gerry Eller, GLE Services, proposed that pavement preservation should have the same priority as other major program areas, such as design and construction. State Highway Agencies no longer have the revenues necessary to sustain a major construction effort as in the past. The interstate construction era is over and its time to preserve.

Based on feedback from the state DOT's, the following statements are consistent with a needed pavement preservation effort.

1. Every pavement will need some sort of preservation treatment to advance its effective service life and get the most out of the public investment.
2. As partners and stewards of public funds, the highway industry needs to work collectively to provide the lowest life cycle costs.

Both statements highlight a need for change for the following reasons.

- Past tradition assumed that maintenance activities didn't need tight specifications. Only design and construction required strong specifications and when specifications weren't available, research was considered. Today, durable preservation treatments will use materials and methods requiring greater knowledge and research than ever before.
- The slogan, "The *right* treatment on the *right* road at the *right* time" is critical to success. Agencies lack the resources or institutional knowledge of pavement preservation to effectively optimize costs by increasing pavement life.
- Pavement preservation activities must be planned by State Highway Agencies. Agencies no longer can afford to implement the ways of the past. Today the public expects highway agencies to be more accountable for funding decisions and practices.

The first time in history federal transportation funds could be used for pavement preservation occurred with the passage of ISTEA in 1991. This change was prompted by public groups that demanded funds should be directed to preserve what we have. Model programs emerged in pavement preservation as a result of ISTEA funding. Training was pushed by industry through a formal agreement with FHWA. Most recently, action began to establish a National Center for Pavement Preservation. This concept has been fully endorsed by AASHTO and industry. While all of these initiatives inspire a direction for pavement preservation, a coordinated public sector investment has never been made to advance the process.

The industry challenge is:

1. How does preservation become part of the major program area?
2. How are pavement preservation programs applied for effective asset management?
3. How does FHWA and AASHTO become part of the process to show leadership in pavement preservation?

The times are changing as now exhibited by the fact that several state DOT's are creating "pavement preservation engineer" positions. Local agencies and municipalities are applying more and more preservation treatments to their roads and streets to make their road investments last longer.

Dennis Jacobson, Director of DOT LTAP Support Center, North Dakota State University, stated that in North Dakota most managers believe that preservation activities are maintenance and not eligible for federal funding. The FHWA - Division Office has too many restrictions for the state to fully consider benefits from timely pavement preservation. As a result the overall highway system pavement condition is not improving in North Dakota. Although the interstate/NHS are getting better, the remaining roads are not. States need flexibility to best manage their resources and meet their needs.

Bill O'Leary, President, Prime Materials & Supply, has experienced problems with local and state agencies being able to partner with the Foundation of Pavement Preservation to advance preservation activities. A funding mechanism isn't available to advance the process. There seems to be a gap in support for moving preservation ahead.

Larry Galehouse, Director, "future" National Center for Pavement Preservation, recognized the Midwestern Pavement Preservation Partnership which was formed by the state DOT's to share knowledge and best practices in pavement preservation. Industry is recognized as a partner in this effort. Research knowledge isn't available for states to draw conclusive information.

Bob Peda, Bureau of Maintenance & Operations, Pennsylvania DOT, provided an example of a product not placed on the *right* road at the *right* time. The improper application of the product caused major problems for PennDOT.

Jim Mack, Executive Director/CEO, American Concrete Paving Association - Northeast, observed that many projects are stopped because of funding restrictions or program requirements. These projects can extend the life of the pavement at low cost but the information and policy is not being uniformly applied.

Jim Sorenson, Senior Engineer & Team Leader, FHWA, suggested a remedy to address the funding concern may necessitate FHWA to develop and issue an advisory for funding. The PPETG is working on such a document at this time. When completed this advisory would be forwarded to the FHWA Division Administrators.

Louay Mohammad, Associate Professor, Louisiana Transportation Research Center, commented that the Louisiana DOTD has determined that a pavement preservation engineer is critical in order to champion the preservation effort. Louisiana has such a position on staff. Working with LSU LaDOT is working on full implementation of a national center for pavement preservation similar to that mentioned at Michigan State University.

Steve Varnedoe, State Maintenance & Equipment Engineer, North Carolina DOT, acknowledged that North Carolina DOT made the decision to advance pavement preservation by creating a dedicated pavement preservation position. The position is staffed by an engineer with a PMS background that oversees the North Carolina preservation program. Steve is also the SCoM Pavements Task Force Leader. As such he has championed the development of several successful Subcommittee resolutions and unsuccessful requests for national level research and program support.

Jim Sorenson, FHWA, offered to assist any agency requesting a workshop on pavement preservation, or wishing to schedule several hours of technical discussion with their program counterparts. These have been highly successful in assisting states and local governments interested in pursuing a pavement preservation program. NHI courses are also available at this time and can be used to support such a local forum.

Advancing Pavement Preservation Research and Development:

Dave Geiger, Director, Office of Asset Management, FHWA, cited a partnership comprised of industries, agencies, academia and consulting professionals as the ideal means to provide the best product for the customer. FHWA has a long-term role in promoting better technologies for highways and pavement preservation certainly meets that purpose. System preservation is a recognized link into Asset Management. Although the link is widely recognized, FHWA Division Administrators sometimes interpret direction differently. FHWA must do a better job of getting the program out.

Currently there are five areas or emerging areas that can advance research and development needs. These areas are FHWA, AASHTO, NCHRP/TRB, F-SHRP, and state highway agencies through individual or pool-funded efforts.

FHWA Infrastructure Research and Technology Program:

Steve Forster, Technical Director for Pavements Research & Development, FHWA, outlined new processes that will allow FHWA to deliver a more comprehensive R&T program. The program will be delivered through three technology areas, defined as asset management, bridges and pavements. The pavement program vision is, "pavements that meet our customers needs and are safe, cost effective, long lasting and can be effectively maintained." Interestingly the pavement program area is labeled long life pavements because most of the approximately 160,000 miles of NHS is more than 35 years old. Presently, there is a $59 billion shortfall to maintain the existing condition.

There are four focus areas in the pavement R&T program.

- Advanced Pavement Design Systems
- Advanced Quality Systems
- Enhanced User Satisfaction
- Enhanced Technical Workforce Capability

It was noted there is no defined platform for pavement preservation in the FHWA Infrastructure Research and Technology Program.

AASHTO Technology Implementation Group (TIG):

Byron Lord, Deputy Director of Pavement Technology, FHWA, explained that many new and emerging technologies offering improved performance and effectiveness are often developed through research and proven through real world applications. Many technologies have been found during international technology scanning tours. The program's purpose is "accelerating the implementation of high payoff technology."

Innovative technologies may be submitted to the AASHTO TIG at any time. Information regarding a new technology must follow a 2-stage evaluation process. This process is available at www.aashtotig.org. Examples of technologies selected by the TIG include prefabricated bridge elements and systems, ITS technologies in work zones, accelerated construction, ground penetrating radar, GPS for surveying, and air void analyzer.

National Cooperative Highway Research Program /TRB Initiatives:

Crawford Jencks, Manager NCHRP, Transportation Research Board, discussed research opportunities available through Division D of the Transportation Research Board, known as the Cooperative Research Program. The research is split into two cooperatively sponsored programs. The major program area focusing on highway research is the National Cooperative Highway Research Program (NCHRP), which is sponsored by participating members of AASHTO in cooperation with FHWA. This program was created in 1962 as a means to accelerate research in acute problem areas that affect highway planning, design, construction, operation, and maintenance. Financial support is provided by state DOT's, SPR funds, and through FHWA.

Opportunities exist for research in three areas; regular research projects, continuing projects, and the proposed F-SHRP. Regular research projects have specific objectives, deliverables and costs. These projects are submitted by either state DOT's, AASHTO committees and subcommittees, or the FHWA.

The continuing projects include:

- Synthesis Series (Project 20-5), which synthesizes information related to highway practice. This year 165 synthesis statements were recommended with only 12 topics selected.
- AASHTO SCOH (Project 20-7), addresses research for the Standing Committee on Highways. Tasks are selected semiannually by SCOH at the AASHTO spring and annual meetings.
- NCHRP IDEA (Project 20-30), known as the Innovations Deserving Exploratory Analysis Program. The program is designed to assist entrepreneurs by initiating product ideas through the development stage.
- Legal Studies (Project 20-6), is a synthesis of case law for legal problems arising out of highway programs. An NCHRP panel makes selections periodically and there is no formal submission process.
- International Exchange (Project 20-36), supports foreign scanning tours and sponsors participation in PIARC. The costs are split between NCHRP and FHWA.

F-SHRP and the Pavement Preservation Program:

Neil Hawks, Director of Special Programs, Transportation Research Board, outlined the proposed F-SHRP (Future Strategic Highway Research Program) structure. F-SHRP is divided into four research areas.

- Accelerating the Renewal of America's Highways —Renewal
- Making a Significant Improvement in Highway Safety—Safety
- Providing a Highway System with Reliable Travel Times—Reliability
- Providing Highway Capacity in support of the Nation's Economic, Environmental, and Social Goals—Capacity

In each research area there are specific topics and projects. Topics are broad avenues of research while projects are discrete pieces of work. There appears to be one project in the renewal research area that is related to pavement preservation. The primary focus of renewal is rebuilding on the interstate system by incorporating three concepts: rapid, long life facility, and minimum disruption.

Project 1-1.2, is entitled "Integrating the 'Mix of Fixes' Strategy into Corridor Development." By using the corridor concept, a DOT will need to determine optimal rehabilitation strategies for specific bridges and pavements within a given corridor. Such strategies must consider: the nature and extent of renewal required, what service life to reconstruct for, and associated life cycle and user costs. This project will identify current and next generation "mix of fix" options and provide assessment tools on how to choose the optimal combination of solutions along a corridor.

The F-SHRP research team will develop project statements for preservation strategies in three areas.

- Project 1. Asphalt-based Solutions for Flexible and Rigid Pavement Surfaces.
- Project 2. Hydraulic Cement-based Solutions for Rigid Pavement Surfaces.
- Project 3. Bridge Preservation Strategies.

The research team requests feedback on how to affect better strategies. Feedback contributions must conform to criteria of F-SHRP, which is strategic in nature. Research criteria should be:

- System wide in its impact;
- Major change rather than incremental change (replacement technology);
- High risk (attack the problem);
- A concentrated effort that is accomplished in six years; and,
- Unlikely to be carried out as part of any other research program.

Funding for F-SHRP is anticipated for the 2004 Transportation Re-authorization Program.

Preparing States for Pavement Preservation:

Steve Varnedoe, State Maintenance & Equipment Engineer, North Carolina DOT, compared the concept of pavement preservation to a dog chasing a car and not knowing what to do if it's caught. The AASHTO Lead State Team on Pavement Preservation began to move the concept about seven years ago. Critical research and training needs were identified to increase the awareness level of states on the benefits of implementing a pavement preservation program. Later, the AASHTO Lead State Team, FHWA, and the Foundation for Pavement Preservation, held a national conference and produced an initial plan for the future direction of this effort. Since the sunset of the lead state concept, the AASHTO Subcommittee on Maintenance is taking the lead. But the driving force behind today's pavement preservation effort is the FHWA Pavement Preservation ETG. Some critical issues include:

- Standardized mix designs and test procedures. Many pavement preservation treatments in use today, do not have national or regional mix designs or testing procedures.
- Major advancements, such as Superpave®, have improved some pavement preservation treatments, but neglected many others such as chip seals, slurry seals and micro-surfacing.
- Industry and academia have brought forward new preservation initiatives and techniques. It's now time for government to step up to institutionalize this move towards preservation.
- Many "IT" systems (ie, PMS and MMS) require solid guidance and must be correctly modeled to accurately influence decision making.
- Maintenance people aren't skilled in writing problem statements and need help from the outside arena. The AASHTO Subcommittee on Maintenance has repeatedly brought forward research problem statements, however, with success.

Bryon Lord, Deputy Director of Pavement Technology, FHWA, commented that perhaps the best avenue to advance research is through state sponsored pooled fund studies with SPR funds. Through group discussion, a problem was revealed that states often lack sufficient resources (people and money) to institute pooled fund studies. Through agency downsizing, people are frequently so weighed down with their current responsibilities that no appetite exists to take on additional work of a national pooled-fund project. This is increasingly true for both SHA's and FHWA.

Challenges Facing State and Federal Governments:

Frank Moretti, Director of Policy and Research, TRIP, provided insight on transportation issues from The Road Information Program (TRIP). Recent research reports reveal some interesting facts about trends affecting traffic flow, safety and the pavement.

Current surveys of roads have determined that 32% of the U.S. major roads are in poor and mediocre condition. Driving on roads in need of repair costs U.S. motorists $49 billion a year in extra vehicle repairs and operating costs. This equates to $259 per motorist per year in repair cost.

Vehicle travel on U.S. highways increased by 148 percent from 1970 to 2000, yet the population increased 38 percent over the same period and new road mileage increased by only 6 percent. During the past decade, vehicle travel increased by 28 percent from 1990 to 2000, while the population grew 13 percent during the same period.

Continued population increases and growth in vehicle travel, particularly of large commercial trucks, will lead to worsening traffic congestion on the Interstate system, unless there is expansion of Interstate and other highway routes as well as further improvements made in the ability of key highways to carry more vehicles efficiently. The nation's population is expected to grow by 40 million people by the year 2020, a 16 percent increase, and all vehicle travel is expected to increase another 42 percent

and large commercial truck travel by another 54 percent by 2020.

Traffic congestion costs American motorists $67.5 billion a year in wasted time and fuel costs. Americans spend an additional 4.5 billion hours a year stuck in traffic. Two out of five urban Interstate miles are considered congested because they carry traffic at volumes that result in significant delays.

According to public polls, highway improvements that should receive the most attention for resources are:

- Traffic Flow 25%
- Safety 24%
- Pavement 20%

Because of security concerns about travel by air in the aftermath of September 11, our nation's already overburdened roads and bridges face increased travel demands in the short-term from an increase in the number of trips that normally would have been made by air that are now being made by car.

The public expects improved accountability by government agencies. Provided the highway agencies respond to the public needs, there is a willingness to pay the bill for the following improvements.

- Better traffic flow
- Fewer work zone delays
- Improved safety
- Smoother ride
- More durable repairs

The study concludes that every $1.00 invested in the nation's highway system yields $5.70 in economic benefits because of reduced delays, improved safety and reduced vehicle operating costs.

Will the money be there? That's the state and federal challenge. Options are available for a significant boost in surface transportation funding to help tackle the congestion and maintain the benefits provided by the highway system. These options include:

- Increasing the federal 18.4 cent-per-gallon motor fuel tax.
- Indexing the federal motor fuel tax to inflation, so that it increases at the rate of inflation.
- Reimbursing the Federal Highway Trust Fund for revenue lost because of exemptions for gasohol.
- Drawing down the reserve balance in the federal highway trust fund.
- Capturing the interest on the federal highway trust fund that currently goes to the general fund.

An approach to advance pavement preservation could include a media campaign that targets public opinion. An example may highlight the decrease in pothole patching materials after a pavement preservation program was implemented. Show that funds spent for a preservation program improved pavement conditions and provided the smooth ride demanded by the motorist.

Reauthorization and the Pavement Preservation Program:

Tony Kane, Director of Engineering & Technical Services, AASHTO, detailed major issues affecting transportation in America and AASHTO's priority objectives and recommendations for the new TEA-21 Reauthorization. In 1998, Congress enacted the six-year Transportation Equity Act for the 21st Century (TEA-21), which increased the federal investment in highways by $168 billion. AASHTO published a report in September 2002, which assessed the nation's highway needs from 2004 to 2009.

The key highway findings include:

- An annual capital investment of $92 billion is needed for highways and bridges to maintain the condition and performance of the system.
- An annual capital investment of $125.6 billion is necessary to improve the condition and performance of highways and bridges.
- Between 1990 and 2000, highway expenditures for all purposes, from all levels of government, increased 71 percent from $75 billion to $128 billion, with $64.6 billion going to capital expenditures.
- If capital expenditures increased 71 percent over the next decade, they would reach $110 billion by 2010.

AASHTO has more than two thousand DOT personnel serving various committees and subcommittees. The Standing Committee on Highways (SCOH) meets twice each year, at the AASHTO Annual (September) Meeting and the AASHTO Spring (June) Meeting. Its subcommittees, task forces, and other special groups largely do the committee's extensive work and report activities to the standing committee officers and voting members.

The members of SCOH, the chief engineers, oversee the business and work of subcommittees. Due to the rapid turnover of DOT personnel, AASHTO has needs and vacancies on many committees and subcommittees.

Priority objectives were developed by AASHTO that include:

- Stimulate economic recovery by reauthorizing TEA-21.
- Grow the TEA-21 program over the next six years: highways to at least $45 billion and transit to at least $11 billion. This means the highway program increases from $34 billion in FY 2004 to at least $45 billion in FY 2009.
- Maintain funding guarantees and fire-walls and fix the Revenue Aligned Budget Authority (RABA). RABA should be refined to avoid radical swings in funding.
- Retain the basic program structure, which includes Interstate Maintenance (IM), National Highway System (NHS), Surface Transportation (ST), and Congestion Mitigation/Air Quality (CMAQ).
- Increase flexibility to meet priority needs: security, safety, congestion relief, freight, preservation, and capacity.
- Improve environmental stewardship and expedite project review.

Recommendations were developed by AASHTO for growth in research efforts. Overall federal financial support for highways and transit has grown considerably in recent years, but federal support for research has barely grown at all. AASHTO recommends that the current formula-based approach for State Planning and Research (SP&R) Program continue, but the FHWA's Research and Technology Program should be increased by 50 percent to $300 million annually. This effort will increase the University Transportation Centers Program from $32.5 million to $50 million annually. Additionally, an increased FHWA R&T Program will expand technology transfer programs such as LTAP and NHI.

Tony suggested that a "great" pool-fund project with a waive of federal matching funds could be to address Pavement Preservation needs. However as a basis for the new legislation, AASHTO's approach to system preservation for the means and includes everything but new capacity. This is different from the recommendations and definitions presented by the AASHTO Lead State Team for Pavement Preservation.

Brainstorming Solutions for Advancing Pavement Preservation R&D:

Gary Hicks, Principal, Mactec, organized the participants into three breakout groups to identify issues and develop solutions to advance pavement preservation in three critical areas: Policy and Outreach, Research, and Funding. The results of group brainstorming sessions are as follows:

1. The **Policy and Outreach** session was facilitated by Gerry Eller and Jim Moulthrop. The policy and outreach issues and solutions are:
   - ***Definitions of preservation verses maintenance . . .***
     What preservation is and how it differs from corrective and reactive maintenance is not clear to many practitioners. There is a need for clear definitions.
   - ***Explain "worst first" to legislatures . . .***
     The need to move from reactive to proactive must be communicated to the people that provide the funds. They must fully understand the need to change from reactive to proactive maintenance. Use analogies such as painting a house or changing the oil in a car.
   - ***Commitment from agencies . . .***
     This commitment must begin with FHWA, from both headquarters and the divisions, before it can be embraced by other agencies.
   - ***Define and document the benefits of a pavement preservation program . . .***
     Commitment to adopt a preservation program is lukewarm in a lot of places and there is concern that FHWA upper management doesn't support it. In order to be adopted, the commitment of leadership is essential. This is a call for FHWA.
   - ***Clarify eligibility of federal aid funds for pavement preservation use . . .***
     The FHWA must ensure that division offices are familiar with policy and that they communicate the same message to the States. Lots of agencies are still not aware that federal funds can be used in the preservation area.

- ***Outreach to Stakeholders, Industry, Legislature, Public, DOT's . . .***
  There needs to be a collective effort to develop an outreach program that reaches all constituents.
- ***Streamlining business plans . . .***
  Environmental and safety approval processes simply take too long on preservation projects to obtain approvals. One year lost in doing a job can mean falling behind the curve and impacting the cost effectiveness.
- ***Pavement management systems are based on failure oriented measures . . .***
  Many PMS are outdated and need to develop maintenance condition measures that detect preservation needs before failure occurs. Integrating preventive preservation into a pavement management system is an important task to complete so we can adequately manage our pavement system. Current distress measures and trigger points in pavement management systems are not responsive to pavement preservation needs.
- ***Economic analysis . . .***
  Life cycle costs analysis is an important process to understand in order to sell the pavement preservation concept. Anecdotal information is available, but not sufficient to sell the concept. Both LLC and user costs fully support proactive preservation concepts.
- ***Document what works and what does not . . .***
  Guidelines are needed on what action to use, where to use it, and performance expectations to sell a pavement preservation program. Pavement preservation needs to be a planned strategy, not just selecting one treatment over another.
- ***Pavement engineering has changed . . .***
  Include the philosophy of pavement preservation as part of an engineer's education. From the initial pavement design the types of preservation activities need to be factored in the pavement life. The pavement engineer is no longer only a designer.
- ***Best practices policy ...***
  A best practice's synthesis or guidebook would be an excellent outreach tool. No research project is needed to get this accomplished.
- ***Create a guideline to develop a pavement preservation strategy . . .***
  Agencies need guidance in order to formulate and initiate a successful program.
- ***Pavement preservation is a department program . . .***
  It is time to end the myth that pavement preservation is a maintenance program, it should be adopted as a department wide program in every agency.
- ***Convey that pavement preservation strategies are the best solution in lean economic times . . .***
  When budgets are running short, low cost, effective treatments can be very effective and extend the life of the pavement system.
- ***Qualified contractors are important to DOT's . . .***
  To have continuous funding it's a chicken and egg approach. Without qualified contractors, it is nearly impossible to develop and maintain an effective pavement preservation program. They need to see a long-term commitment to a preservation program before they willingly invest resources that are necessary to do quality work.

2. The **Research** session was facilitated by David Peshkin.

   Before the results of the research group's efforts were presented, a review was made of recent efforts in this area. A large number of preventive maintenance research topics have been put forward by various segments of the pavement community over the past four years. For example, in 1999, the AASHTO Lead State Team for Pavement Preservation issued "Research Protocols for Pavement Preservation"(copies are available at the AASHTO Innovative Highway Technologies Web site, http://leadstates.tamu.edu/pp/research_protocols.stm). That report describes one of the goals of the Lead State Team "to establish the need for pavement preservation research and to have various states/agencies construct test sections (with control test sections) by the year 2000."

   The Maintenance Research Master Planning Workshop held at the January 2000 meeting of the Transportation Research Board (TRB 2000), had the goal of developing a 3-, 5-, and 10-year master plan of maintenance research needs. The

report from that meeting describes four topics under the heading of pavement maintenance, but all is applied research for specific treatments.

In June 2001, a workshop on pavement preservation research was held in Sacramento, California, which produced a joint report by FHWA and the Foundation for Pavement Preservation entitled, "Pavement Preservation Research Problem Statements," June 21-22, 2001, Publication No. FHWA-IF-02-017, U.S. Department of Transportation. That workshop resulted in the development of 50 research problem statements in the following areas:

- Construction practices
- Material selection and design
- Treatment strategies and selection
- Performance evaluation
- Training
- Policy

Despite these various efforts, the only topic on which there is a widespread consensus is the need for further research. Pavement preservation competes with a host of other worthy research needs for the limited funding that is available. In addition to these initiatives, the TRB Pavement Maintenance Committee and the AASHTO Subcommittee on Maintenance routinely propose research topics for consideration and funding by NCHRP. These efforts have not generally resulted in funded R&D projects.

Research Topics. The group began by looking at a research statement included in Neil Hawks' F-SHRP presentation handout. In Appendix A of the handout, four objectives were listed under Project 1-1.2, "Integrating the -Mix of Fixes-Strategy into Corridor Development." The objectives, paraphrased below, were suggested by the group as a good summary of research topics on pavement preservation.

- How can preventive maintenance treatments be integrated into an overall process of pavement management?
- What types of treatments are appropriate for preventive maintenance under different conditions, and what is the effect of those treatments under those conditions?
- What is the best time to apply preventive maintenance?
- What methods are appropriate for selecting preventive maintenance treatments?
- How to establish an effective Pavement Preservation Program?

The group identified performance-related specifications and warranties for preventive maintenance as an additional important research topic. However, there was also considerable discussion about whether the treatments or the users were ready for performance-related specifications.

A final key topic discussed at length was whether or not preventive maintenance is even effective. It was proposed that considering the need for any research begs the fundamental question for fully documenting the benefits and cost-effectiveness of preventive maintenance. This work was not completed in the SHRP Program from 1987-92.

Advancing Research. A new approach must be tried if efforts to advance the pavement preservation research agenda are to be successful. The agenda is not moving because of a lack of ideas or lack of interest, but rather the absence of a unified front from the pavement preservation community and the failure to present that unified front to the funding agencies that has hampered any previous efforts.

As a result, the following steps are proposed to develop a unified, realistic, and coherent set of research problem statements and an overall research program that could be funded and carried out in an expeditious manner:

- Conduct a national level workshop to develop pavement preservation research program for the next five years under the auspices of NCHRP 20-07 funding.
- Identify and secure the attendance of participants who can make a meaningful contribution and help to see the identified research needs to fruition.
- Select a facilitator to organize the meeting and deliver a final report.
- Extract, develop, and flush-out the ideas generated at this workshop.
- Publish the findings and present them to appropriate funding groups (discussed at a concurrent session of a think tank meeting).

The success of this approach requires that the following steps be followed:

a. The Pavements Task Force of the AASHTO Subcommittee on Maintenance recommends the need for a 20-07 project to the Subcommittee.

b. The AASHTO Subcommittee on Maintenance approves, and forwards the recommendation to NCHRP and the Standing Committee on Highways (copy attached.)

c. The AASHTO Standing Committee on Highways approves and requests NCHRP assistance.

If approved, this initiative can be undertaken as a "sole source" contract and the contracting effort can be started fairly rapidly so it's completed by late Fall 2003.

3. The **Funding** session was facilitated by Gary Hicks. The issues and solutions are:

   - The need to ensure language is in the TEA-21 re-authorization bill to fund pavement preservation and the corresponding education and research efforts. At present, the university research capabilities in the pavement preservation arena are very limited.
   - F-SHRP funding will require a compelling argument in order to fund research in pavement preservation. We need to sell pavement preservation to F-SHRP and to state CEO's. The LTAP Centers can help sell the concept to local agencies.
   - The FHWA does not have any available discretionary funding because of all the earmarks in the pavement research program area. NCHRP funding is generated through the Standing Committee on Research and projects need to be submitted by the states. Most current funding for research through the FHWA from the highway trust fund and a preservation platform does not exist. The research can be any or all of the following:
     a. Authorized - SP&R, NCHRP, F-SHRP
     b. Authorized earmarks - WRI, UNH, ACPA, GSB-88, NCAT, etc.
     c. Appropriated - State design/construction dollars
   - SP&R funds are the probably best source for pavement preservation. Since 1980, the funding in each bill has increased. The first year of each bill (2004) is a good time to pursue work, especially pooled fund studies like the micro-surface design study. If the study is of national significance, it may be possible to waive the state match (20%). The state must be willing to provide a management team for pooled fund studies.
   - The university transportation centers (copy attached) are a possible funding source. We must look at the existing centers to determine who is doing what research and match needs with resources available.
   - There is a need to connect state maintenance people with researchers in the various states. Most research efforts are currently located in the materials groups. The Snow and Ice Pooled Fund Cooperative Program (SICOP) is a good example to follow and always seems to get research funded. The AASHTO SCoM is pursuing this with AASHTO management.
   - AASHTO is supportive of the asset management program, of which pavement preservation is a key component. The Task Force on Asset Management should be encouraged to more fully support the preservation program and its research needs. The 20-7 activity can be used to leverage activities within the AASHTO subcommittees on maintenance and materials, the joint task force on pavements, and others. Gary Hoffman, a strong supporter of pavement preservation, leads the 20-7 group.

In summary, there are numerous possible state and federal funding sources including TEA-21, F-SHRP, NCHRP, FHWA, SP&R and pooled fund studies. However, none of them is currently a perfect fit for pavement preservation and this program's R&D needs.

Creating a Partnership to Meet Preservation Research, Development, and Technology:

Bill Ballou, National Pavement Preservation Leader, Koch Pavement Solutions, proposed a partnership agreement to underscore the need and commitment required to implement an asset management philosophy through pavement preservation. This agreement will recognize the partners that attended the meeting today. The document will be further refined by Tommy Beatty before distribution to the participants.

On behalf of the FHWA, Tommy Beatty expressed appreciation for the meeting.

The meeting was adjourned at 3:50 p.m.

A Call for Action: A National Initiative for Pavement Preservation

Proactive Asset Management, Lower Life Cycle Costs and Higher Quality Pavements

The investment in our nation's highway system is over one trillion dollars. As state, city and county departments of transportation are evaluating their road assets to comply with GASB 34 guidelines[1], they are recognizing the need to manage that investment.[2,3,4] Many agencies are realizing the cost benefits of a sound pavement preservation program which includes preventive and corrective maintenance practices. For example, Michigan DOT reports they are saving $10 in future rehabilitation and reconstruction costs for every $1 spent on preventive maintenance while improving the overall quality of their roads.[5]

ISTEA and TEA-21 facilitated the use of federal-aid highway funds for preventive maintenance activities, and many departments of transportation now have some type of pavement preservation program area. While in the past, most agencies had previously been reactive in their maintenance approach, they are now becoming increasingly proactive in preservation initiatives. The potential benefits are numerous, including improved pavement performance, safer roads, higher user satisfaction and reduced overall life-cycle costs. For example, Rhode Island calculates that if they had spent six to seven million dollars for preventive maintenance, they would not now be faced with a 30 million dollars rehabilitation need for Interstate 295.[6]

Further, sound pavement preservation programs facilitate decreasing congestion, increasing mobility and improving work zone safety because preventive maintenance treatments are quick and cost-effective.

Protocols for Performance

Materials, methods and specifications for new construction, reconstruction and rehabilitation of roads have been highly developed by years of peer-reviewed research and discussion by TRB, ASTM and AASHTO, including the Superpave specifications and test protocols developed by the Strategic Highway Research Program (SHRP). The primary goals of the SHRP asphalt research projects were to improve overall quality and prevent premature failures. Nationwide AASHTO standards recommended by the work done by SHRP are now in place. The AASHTO standards, guidelines and mix design methods generally have a proven record of performance and are readily available to all agencies.

The same is not true, however, of pavement preservation techniques, which include but are not limited to, crack and joint sealing; hot and cold preventive maintenance surface treatments such as chip seals, slurry seals, micro-surfacing and HMA overlays; hot and cold partial depth recycling; and minor rehabilitation of both flexible and rigid pavements by such methods as milling and filling, diamond grinding, and dowel bar retrofit. Here the research and experience on materials, performance and equipment seriously lags behind the demand for such knowledge.

There was some limited work during SHRP recognizing the importance of pavement preservation, and some preliminary research was done which documented the positive impact of thin surface treatments and their long-term performance. There is also much in the literature on various pavement preservation techniques and some agencies have developed their own local application standards. For example, Montana, Minnesota, California and other transportation departments have detailed

design and testing procedures for chip seals, and New Mexico has detailed information on cold in-place recycling. However, there are no nationally recognized protocols for design, materials, selection, specifications and quality assurance or performance criteria for most preservation techniques.

The use of pavement preservation techniques varies throughout the U.S. In many cases some of the techniques were applied for years but are no longer used because of a history of poor performance caused by inadequate design, materials, specifications, construction, performance criteria or quality assurance / quality control. For example, while chip seals are used on Interstate highways in some states, they are not used on any type of road in other States. The recent International Scanning Tour on Pavement Preservation found that chip seals are routinely used on all types of pavements in Australia and South Africa, where there are highly developed protocols for design, materials, construction and acceptance. A survey of all states found that while 21 states routinely use cold in-place recycling, quality varies significantly, and one of the primary complaints is the lack of a national design procedure.

Addressing the Need

Developing national protocols and publishing them as AASHTO standards would improve overall quality and long-term performance. The availability of such standards would also help disseminate information enabling all agencies to use the most cost-effective treatments for their highways, roads and streets. Four areas of need are:

- Design,
- Materials,
- Specifications, and
- Performance criteria.

Short- and long-term programs are required to address these areas of need; the short-term program would consist of a 6-month project to define the scope and to prepare work plans. The long-term program would be a 5-year effort to research topic areas and write the protocols. A budget of $10 million per year for the 5 years is suggested.

The industry associations are enthusiastic about the potential benefits of this project in improving road quality while lowering costs, and the members of the Asphalt Emulsion Manufacturers Association, the Asphalt Recycling and Reclaiming Association and the International Slurry Surfacing Association, as well as the Foundation for Pavement Preservation, pledge our support and assistance in its successful implementation.

Current Activities

A literature search and analysis of current best practices should be an important part of the process. The Basic Asphalt Emulsion Manual (updated in 1996), the recently published Basic Asphalt Recycling Manual, other publications by industry associations, and the newly developed National Highway Institute training courses on pavement preservation are just a few of the available materials to facilitate the work.

The Foundation for Pavement Preservation, working closely with FHWA and Industry Associations has assembled toolboxes of information, which are distributed at workshops to improve overall pavement preservation practice. These toolboxes consist of materials on preservation practices, two award-winning videos on the benefits of preservation and project selection, and periodic newsletters. In addition, the Foundation supports a website (www.fp2.org) and booths at association annual conferences (including the National Association of County Engineers, American Public Works Association and AASHTO Subcommittee on Maintenance).

The Foundation has also developed a standard glossary of pavement preservation terms, National Highway Institute training classes, and a CD on pavement preservation state of practice. Support for research on topics from slurry seals and micro-surfacing to noise measurements are also an important part of the Foundation's vision. To provide incentives for preservation, the Foundation will be giving Excellence in Highway Preservation Awards. And to improve communication and knowledge sharing, the Foundation sponsors such opportunities as the Forum for Pavement Preservation II "Protecting Our Investment" conference and workshop in San Diego in November 2001, several state workshops, Spray Applied Binder Workshop scheduled for March 2002, and a demonstration of various preservation techniques at the next AASHTO maintenance meeting.

Similarly, AEMA has produced a CD of basic emulsion practices, AEMA, ISSA and ARRA have all expanded their newsletters, and all have recently sponsored international conferences bringing

together experts from all over the world to share best practices as well as innovations in preservation techniques.

The Next Steps

Leadership and immediate action is needed to develop and implement a contract for the short-term program, which would scope the longer term R & D project, to write a work plan, develop a budget, obtain funding and execute the 5 year program. Immediate action appears necessary to input R & D needs into the reauthorization legislative process. ✻

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