

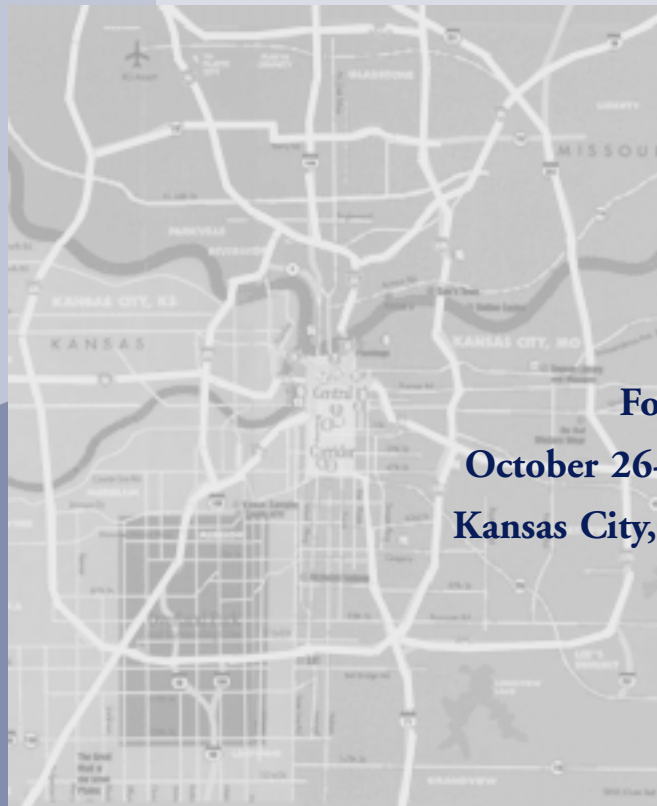
PAVEMENT PRESERVATION:

A Road Map for the Future

**Ideas, strategies,
and techniques for
Pavement Preservation**



U.S. Department
of Transportation
**Federal Highway
Administration**



**Forum held
October 26-28, 1998
Kansas City, Missouri**

Developed in Conjunction with:



American Association
of State Highway and
Transportation Officials



Asphalt Institute



Foundation for Pavement
Rehabilitation and
Maintenance Research

Foundation for Pavement
Rehabilitation and
Maintenance Research

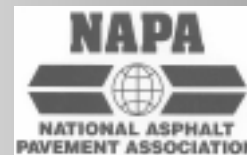


International Slurry
Surfacing Association

International Grooving and
Grinding Association



National Asphalt
Pavement Association



National Highway Institute

Federal Highway
Administration



U.S. Department
of Transportation
**Federal Highway
Administration**

Asphalt Emulsion
Manufacturers Association



Asphalt Recycling and
Reclaiming Association



Pavement Preservation:

A Road Map for the Future

Table of Contents

Acknowledgments	Page iii
Introduction	Page 1
The Growing Need for Pavement Preservation	Page 2
Key Areas for Action	Page 4
<i>Appendix I</i> Research: A Key to the Future	Page 11
<i>Appendix II</i> Participants	Page 13

Acknowledgments

Forum for the Future Steering Committee

BILL BALLOU, FPRMR
Salina, KS

ROBERT DAVIES, FHWA–R&D
McLean, VA

TOM DEDDENS, Asphalt Institute
Shawnee Mission, KS

SAL DEOCAMPO, FHWA
Kansas City, MO

KURT DUNN, FHWA
Kansas City, MO

JOHN FIEGEL, FPRMR
Washington, D.C.

JOSE GARCIA, FHWA
Washington, D.C.

WOUTER GULDEN, Georgia DOT
Forest Park, GA

JACK HARDIN, AEMA
Tampa, FL

DENNIS JACKSON, Washington State DOT
Olympia, WA

TOM KEITH, Missouri DOT
Jefferson City, MO

RAY McCORMICK, FHWA
Washington, D.C.

MAUREEN MCGINTY, FPRMR
Washington, D.C.

JIM MOULTHROP, Koch Materials Co.
Austin, TX

ALI ROOHANIRAD, Department of Public Works
Jackson County, MO

LARRY SCOFIELD, Arizona DOT
Phoenix, AZ

JOHN SELMER, Iowa DOT
Ames, IA

JIM SORENSON, FHWA
Washington, D.C.

DEAN STEWARD, Kansas DOT
Topeka, KS

STEVE TRITSCH, ACPA
Lenexa, KS

MIKE VOTH, FHWA (Chairman)
Topeka, KS



Introduction

As the Nation's transportation infrastructure carries us into the 21st century, highway officials are faced with the challenges of an ever-expanding, still-evolving, yet aging highway network. The Nation's largest public works project—the Interstate System of National and Defense Highways—is now complete. The Federal-aid highway program is undergoing a significant transition from its original focus on building the Nation's highway network to one of preserving our investment in, and improving the quality of, the infrastructure.

The demands on our highway network are greater than ever, and they will continue to grow into the next millennium. With this increasing demand comes the expectation of a higher standard of performance. A 1995 National Quality Initiative survey found that pavement condition was the number-one concern of highway users, and the seemingly ever-present work zones were a close second. This dissatisfaction translates into a general perception that highway agencies are not doing a very good job of maintaining the public's roadways. The levels and volumes of traffic on highways today far exceed design expectancy, but preventive maintenance strategies can allow us to satisfy the general public.

The Federal Highway Administration (FHWA), in partnership with the other members of the transportation community, must champion continued improvements to the quality, performance, and safety of the 4 million miles of streets and highways in the United States. Until now, the primary goal of FHWA has been to oversee the development and construction of the Interstate highway system. With that system now completed, FHWA is redefining its goals to support continual improvement in quality—in terms of comfort, convenience, and safety—on our Nation's highway system and its intermodal connections.

Pavement preservation is at the core of all future highway programs. It calls for a concerted effort by industry and Federal, State, and local highway agencies to generate support for a program of activities that will provide highway users—our customers—with a higher level of quality and cost-effectiveness. To accomplish this, highway agencies will first have to clearly identify needed preservation activities, and then implement those activities. State and local governments will have to increase the amount of funding available for pavement preservation. A key step in creating support for pavement preservation will be to increase the awareness of both elected officials and the highway community as to its value and benefits. Highway agencies must be able to communicate a new philosophy—one that focuses on preserving our investment in, rather than expanding, our existing highway system.

Pavement preservation is a program of activities aimed at preserving our investment in the Nation's highway system, enhancing pavement performance, extending pavement life, and meeting our customers' needs.

The Growing Need for Pavement Preservation

The vastness of our transportation system sets our Nation apart from others. Early in our history, commercial activities flourished as trails, roads, canals, and then railroads enabled goods and people to readily move about the country. In fact, the history of American transportation has been one continuous push for new or improved modes and technologies of movement. The condition of those modes—particularly our roads—has in large part determined the vitality of the U.S. economy. In that regard, today is no different from any other period of our history. The replacement of outdated modes with newer ones—trails to mud roads to gravel roads to paved roads to airplanes—has allowed us the freedom of being able to build new rather than rebuild. But now we have nothing to replace the Interstate system. By improving ride quality, extending pavement life, and ensuring safety (without increasing user delays), pavement preservation programs allow people and goods to continue to move safely and efficiently throughout the Nation.

Pavement preservation is a program of activities aimed at preserving our investment in the Nation's highway system, enhancing pavement performance, extending pavement life, and meeting our customers' needs. It is the sum of all activities undertaken to provide and maintain serviceable roadways; this includes corrective maintenance and preventive maintenance, as well as minor and major rehabilitation. It excludes capacity improvements and new or reconstructed pavements.

An effective pavement preservation program encompasses a full range of maintenance strategies, as well as rehabilitation treatments, with the goal of enhancing pavement performance (ride quality, safety, service life, etc.) in a cost-effective and efficient manner. This concept, as simple as it seems, has not been fully accepted by the transportation community; the traditional intent of maintenance has been to react to problems after they occur, rather than to prevent them from occurring. This reactive approach to maintenance not only may be more costly and time consuming than a preventive one, but could also jeopardize the structural capacity of the pavement.

Prior to the 1970s, few States devoted much attention to preventive maintenance, focusing on reactive maintenance and meeting Federal regulations. Federal-aid funding was only available for new construction. Since

then, numerous legislative acts have recognized the need for Federal involvement in the post-construction phases. With the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, the National Highway System Act of 1995, and the new Transportation Equity Act for the 21st Century (TEA-21), pavement preservation activities are now eligible for Federal funding. ISTEA allowed Federal funds to be used for pavement preservation activities on Interstate highways. The National Highway System Act expanded that eligibility to all Federal-aid highways. TEA-21 emphasizes the need for transportation system preservation and for properly funded pavement preservation programs. The stage has been set, and it is now up to us to get the most out of our premier highway system.

Workshop Purpose

Pavement preservation is often linked to the philosophy of “applying the right treatment to the right road at the right time.” Selecting the road, determining the cause of the problem and the appropriate treatment, and identifying the right time to apply the treatment requires more than just having the right information. It also requires overcoming several roadblocks that currently impede the effective implementation of pavement preservation activities and policies. Ways must be found to address and overcome these challenging roadblocks. That is exactly what more than 200 champions, practitioners, and stakeholders in pavement preservation did at the “Forum for the Future” held October 26–28, 1998, in Kansas City: namely, develop a road map for the future of pavement preservation activities and needs.

FHWA served as the catalyst and leader to develop and conduct this joint industry/agency workshop. The workshop provided an opportunity for academia, research, industry, and highway agencies at the Federal, State, and local levels to

- ◆ Identify existing roadblocks to implementing pavement preservation;
- ◆ Identify and evaluate research needs and other solutions to these roadblocks;
- ◆ Develop consensus for a course of action; and
- ◆ Suggest other issues that must be addressed in the near future.

The workshop provided an opportunity to examine and discuss where the Nation stands on pavement preservation and where we want to be by the year 2005 with regard to roadway safety, higher customer satisfaction, and effective agency pavement strategies. The recommendations, desired outcomes, and actions presented in this report have been guided by goals aimed at improving pavement condition, reducing work zone accident rates, and implementing effective life-cycle cost analysis (LCCA) for pavement decision processes.

Workshop Approach

The workshop was designed by a steering committee representing State and local highway agencies, the American Association of State Highway and Transportation Officials (AASHTO), the Preventive Maintenance Expert Task Group, the AASHTO Lead States Teams for Pavement Preservation and Innovative Pavement Maintenance Materials, and FHWA. Participants in the workshop came from 32 States and represented industry, research, academia, and Federal, State, and local governments. They exchanged ideas on how to meet challenges in the areas of

- ◆ local government,
- ◆ management,
- ◆ training,
- ◆ data management,
- ◆ research, and
- ◆ marketing/public relations.

In each breakout session, participants discussed a straw list of background issues and challenges developed by the steering committee. Participants were asked to identify roadblocks and develop consensus on a strategy for achieving the desired outcome. Breakout groups were also encouraged to explore different topics and to come up with their own lists of challenges. Participants represented a broad cross section of technical disciplines within the highway community. Each was given the opportunity to

attend two of the six breakout sessions noted above. Facilitators conducted the brainstorming sessions, and a note taker documented the essence of the discussions.

The breakout sessions often yielded similar recommendations and desired outcomes, indicating consensus on key issues and actions. This report presents a summary of the key challenges, recommendations, and action items identified during the workshop. The report is intended to bring about a positive change in the way we pursue pavement preservation.

Pennsylvania DOT is convinced that there is a direct relationship between pavement roughness and deterioration of the pavement: as the pavement gets rougher, heavy trucks impart more of a dynamic load, and the increasing dynamic load hastens the deterioration of the pavement. Thus, says Pennsylvania DOT Chief Engineer Gary Hoffman, "We determined that our primary focus in pavement preservation was going to be on addressing roughness."

But determining the right road, the right treatment, and the right timing for preventive maintenance activities requires that you have the right information to make the decision. "And that means you need a pavement management system," says Hoffman.

Pennsylvania's pavement management system became operational in 1986. It covers Pennsylvania's 40,000 center lane miles of roadway, and divides them into about 111,000 management sections, each a half-mile long. Each section has the capability of storing about 700 individual data elements, such as international roughness index, overall pavement index, friction measurements, and traffic.

"The value of our pavement management system is not only in having the information to make wise decisions on maintaining our assets, but also in generating support for user-fee increases," says Hoffman.

Hoffman explains that Pennsylvania has more than 400 legislators. "We met with every one of those legislators and showed them the data from the pavement management system, and said, 'Here are the needs in your district, and if you want to address those needs to a certain level or bring the condition of the roadways up to an expected level of service, we are going to have to do something,'" says Hoffman. "With their input, we determined the right road and the right treatment. We were fortunate last April to have a 400-million dollar a year user-fee increase. Coupled with the TEA-21 increases, Pennsylvania now has the money to do the right thing on the right roads."

Hoffman says that Pennsylvania used to be rated as having the worst Interstate pavements in the Nation. A recent survey rated his State's Interstate as "most improved," and that, says Hoffman, is "because we are doing the right thing. Our governor now has a maintenance-first philosophy, and he is putting his money where his mouth is."

Key Areas for Action

The recommendations from the workshop participants can be categorized into four key areas of need:

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

“You can’t talk about pavement maintenance

without talking about pavement management

systems.”

Mike Lackey

Better Understanding of Pavement Preservation

In many localities, preventive maintenance has been given short shrift. Potholes and other problems that demand immediate attention place a strain on limited maintenance budgets. The public’s expectations to “fix the worst first” often cause preventive maintenance work to be neglected, which hastens the deterioration of the roadway network.

Some of the public’s lack of support for preventive maintenance is based on a misunderstanding of *what pavement preservation is* and *why it is important*. Within the highway community itself, there is some confusion about the purpose of and need for pavement preservation activities, compounded by the inconsistent use of the terms *preventive maintenance* and *pavement preservation*. Although the terms are often used interchangeably, they may have two distinct meanings.

Pavement preservation is the sum of all activities undertaken to provide and maintain serviceable roadways; this includes corrective maintenance and preventive maintenance, as well as minor rehabilitation projects. It excludes new or reconstructed pavements and pavements requiring major rehabilitation or

reconstruction. Pavement preservation is a program of activities aimed at preserving our investment in the Nation’s highway system, extending pavement life, enhancing pavement performance, ensuring cost-effectiveness, and reducing user delays—in short, meeting our customers’ needs. This is all part of the bigger picture of transportation system preservation.

Preventive maintenance, as defined by AASHTO, is a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without substantially increasing structural capacity). It is a tool for pavement preservation.

Pavement preventive maintenance narrows that focus to the application of one or more treatments, generally to the surface of a structurally sound roadway.

This report focuses on pavement preservation and pavement preventive maintenance strategies (doing the right thing at the right time).

The general tendency to resist change, coupled with a reluctance to consider alternatives “not invented here,” can also impede acceptance of various pavement preservation alternatives. The fact that there is more “glory” in building new roads than in improving the performance of existing ones poses another challenge to meeting pavement preventive maintenance needs.

An uninformed public can also contribute to the reluctance to adopt pavement preservation strategies. For example, motorists often misunderstand the purpose of preventive maintenance and thus complain when they see a work crew “fixing something that isn’t broken.” In order to effectively implement a pavement preservation program, elected officials, top management, and the general public must possess a basic understanding of what pavement preservation is, why it is needed, and why pavement preventive maintenance must be a priority.

If we are to engender support for pavement preservation, we must clearly explain the purpose and benefits of preventive maintenance treatments. After all, as one workshop participant said, “If you don’t get the support, you don’t get the bucks.” And you won’t get the support without an understanding of the benefits.

Strategies/Recommendations

The highway community needs to do a better job of differentiating between *pavement preservation* and *preventive maintenance*. More consistent use of these terms will promote nationwide acceptance and implementation of pavement preservation programs and preventive maintenance techniques and could make it easier to obtain dedicated funding for preventive maintenance projects.

By showcasing various success stories from agencies nationwide, executive-level seminars or workshops could make elected officials and upper management more aware of pavement preservation and pavement preventive maintenance treatments. Presentations and handouts at industry association meetings attended by elected officials could be effective channels of communication. Industry associations and resources such as the Local Technical Assistance Program (LTAP), AASHTO, National Association of County Engineers (NACE), and American Public Works Association (APWA) can be effective in reaching both professional staff and elected officials. One-on-one discussions between professional staff and elected officials are strongly encouraged.

“The quality of preservation work performed on roads directly determines surface life, future maintenance costs, ride quality, and user costs.... Our primary responsibility is to ensure that the taxpayer gets his money worth.”

Duane Blank

Many agencies and their constituents do not have a clear vision of how pavement preservation is at the heart of improving the roadway’s level of service. A public awareness campaign highlighting the value of the road system, as well as the costs and benefits (for both the agency and the taxpayers) of keeping it in safe condition, should be aimed at elected officials, top management, and technical staff. Public hearings, seminars, forums, and user surveys can then be used to set level-of-service targets; pavement preservation strategies and techniques could then be implemented to meet those targets.

The pavement preservation concept needs to be **marketed to the public**. A flexible marketing package for local and State agency use could be facilitated nationally through FHWA. This would reduce duplicative efforts and cut costs. AASHTO and FHWA, including LTAP, should develop and distribute public service announcements for radio and television, brochures to be distributed at neighborhood meetings, press releases, and communication strategies for local and State agencies. A better-informed public would help agencies obtain support for referendums on pavement preservation programs. Universities should be encouraged to incorporate the basics of pavement preservation into undergraduate courses.

With the current emphasis within AASHTO on system preservation and asset management, top managers are beginning to focus on available pavement preservation information. Similar emphasis at the local level should be encouraged and pursued through national associations like NACE and APWA. By providing technical information and recommendations, agencies can help generate support for pavement preservation at this level.


Without public awareness and management support, budgetary decisions will be based on political pressures and misperceptions, rather than factual data. Information supporting asset management concepts should also be conveyed to technical staff by LTAP and the National Highway Institute (NHI).



Desired Outcome

A clear, broad-based understanding of the rationale for pavement preservation and the benefits of timely pavement preventive maintenance applications.

Actions

- 
- ◆ AASHTO and FHWA should take the lead in promoting the proper understanding and use of the terms *pavement preservation*, *preventive maintenance*, and *pavement preventive maintenance*, particularly regarding procedures, techniques, field operations, and funding eligibility.
 - ◆ Develop a series of seminars to expand management's awareness of, and support for, pavement preventive maintenance techniques and strategies.
 - ◆ FHWA and its partners should sponsor a national seminar on pavement preservation, with a focus on developing effective strategies and programs. The outcome of the seminar could be used to develop technology transfer materials.
 - ◆ The AASHTO Subcommittee on Maintenance should team with FHWA to develop a public outreach campaign extolling the safety, ride quality, and cost benefits of pavement preservation.
 - ◆ AASHTO and industry should establish a public awareness campaign to increase support for pavement preservation and timely pavement preventive maintenance treatments.

The goal of the Lead States Team for Pavement Preservation is to have all States recognize by the year 2000 that pavement preservation is an important philosophy and essential program in managing the Nation's highway investments.

"One thing we always get asked," says team leader Wouter Gulden, from Georgia DOT, "is where is the payoff, what is the cost? Thus it is important to obtain life-cycle cost data. The literature says the payback is anywhere from 4 to 1 to 10 to 1, but you need to determine that ratio for your own State.

"At Georgia DOT, we found it requires a long-term commitment to get the payback, but it is well worth it," says Gulden.

Integrating Pavement Performance Data

A lack of comprehensive field data on the timing, performance, and cost-effectiveness of pavement preventive maintenance treatments makes it difficult to develop guidelines for best practices. It is not enough to collect "success stories" about preventive maintenance techniques. Documented performance histories must be collected and disseminated to help agencies reach consensus on best practices and to evaluate the effectiveness of various treatments for their pavements.



Data on timing, performance, and cost-effectiveness will also add credibility to maintenance programs, as well as encourage agencies to select the most effective treatment or strategy. The data can serve to eliminate any unintentional bias toward a particular process or product line, which could hamper selection of the best treatment or process.

Much of the data that is available today is not being properly collected, reported, or analyzed because highway agencies see little value in doing so. Agencies that do see the value tend to differ in the type of information and manner of collection; thus, there is little consistency nationally in the information used to develop, implement, and manage pavement preservation programs.

Agencies should be encouraged to document their pavement preservation experiences in their pavement management systems. Without such documentation, agencies cannot effectively develop maintenance schedules or pavement life-cycle costs. Documentation of pavement preservation activities will not only buttress future budget requests, but will also ensure that funds are distributed to areas where they will do the most good overall. The documentation can also be used as a basis for determining the remaining life of a pavement and the health of the road network.

Asset management concepts should be used to determine the true cost of our highway system and to assess the value of that system and the need to protect our investment through pavement preservation.


Strategies/Recommendations

An AASHTO/FHWA task force should be created to collect, analyze, and report performance and effectiveness data on a variety of pavement preventive maintenance applications, techniques, and treatments. This information should then be broadly disseminated within the highway community to encourage adoption of pavement preservation. The information should be presented at regional conferences so that agencies everywhere can learn about the variety of pavement preservation practices being implemented across the country; those presentations would also serve to encourage agencies to document and share information about their own experiences. The data should be in a format consistent with the long-term pavement performance (LTPP) database so that State and local agencies, as well as industry, can use this information to provide a higher level of safety at a lower cost.

Desired Outcome

Better understanding and use of pavement preservation data, which in turn will improve the quality and effectiveness of pavement preventive maintenance treatments.

Actions

- 
- ◆ Establish a pooled-fund, National Cooperative Highway Research Program (NCHRP), or FHWA test and evaluation project to collect, analyze, and report the construction and performance data necessary to support an effective pavement preservation program.
 - ◆ Highway agencies need to allocate resources for documentation of pavement preservation activities.
 - ◆ Combine pavement management systems data with pavement preservation data.
 - ◆ Expand the use of asset management tools.
 - ◆ AASHTO/FHWA should form a national task force to formulate and define data management and analysis and to identify the type of data that needs to be collected and the pavement measuring standards, including surface friction, that need to be used.

- ◆ Establish a Web page that could allow highway agencies to access information on current data collection activities and analysis procedures.
- ◆ NHI/industry should develop a pavement preservation short course to address the need for information on pavement preservation and data management activities. This course should build on existing short courses.
- ◆ Create public/private working groups to identify and define research methodology for performance studies.

Need for Dedicated Funding

In many agencies, pavement preservation needs are considered only after all other programs are planned and funded; pavement preservation gets whatever funds are left. An effective pavement preservation program can be effective only if agencies commit funds for it up front, during the planning process. Inadequate funding hinders the success of pavement preservation programs by not providing funds that will allow the right treatment to be applied at the right time. This challenge is not unique to State governments; it is also an issue for local governments. Nationwide, there is a 8- to 10-year backlog of maintenance and repair work; without adequate, dedicated funding, agencies will never catch up, and the backlog will continue to grow.

Top management support for pavement preservation and preventive maintenance strategies is often low because of a lack of understanding of the effectiveness of these programs and their impact on system performance. This lack of understanding is at the root of the funding problem. There is a limited amount of money in each agency, whether State or local, and there is a large number of needs. The funds go where the support is. Thus it is very important that upper management be aware of the growing need to preserve the Nation's highway infrastructure and direct funds to this area. As agencies become more decentralized, upper management support becomes even more important, in order to provide uniformity and direction in the implementation of pavement preservation programs.

The lack of legislative support is often the result of a lack of understanding of the value and impacts of pavement preservation programs.

Strategies/Recommendations

Pavement preservation programs have to be marketed to legislators and other decision makers who have the authority to establish funding priorities for highway agencies. They need to be presented with information on long-term strategies that outline the program or sequence of activities that compose an effective pavement preservation program. A well-designed, long-term plan, together with a life-cycle cost analysis, will strengthen support for dedicated funding and effective pavement preservation programs.

Proposals for pavement preservation programs should address problems and obstacles, as well as realistic solutions. Proposals should also identify potential “champions.” For example, a champion might be an agency that has successfully responded to the need for a sound pavement preservation program.

Identifying and teaming up with a champion is a good way of gathering success stories and data. It not only fosters relationships with partners inside and outside the industry, but also provides opportunities to find solutions to many of the common challenges that currently impede preventive maintenance efforts. A champion’s involvement in pavement preservation activities should be more than a collateral duty and should be strongly linked with technical support from FHWA and industry.

To cost-effectively and efficiently extend the service life of the total system, agencies need access to the entire range of databases and information on system condition, performance, and safety. Agencies should partner with Federal, State, and local agencies, as well as industry, to share resources and to take advantage of economies of scale when exploring new technologies, treatments, or materials. Agencies should also be encouraged to take advantage of new opportunities afforded by the funding flexibility in TEA-21 when seeking grants and establishing dedicated funding at Federal and State levels.

An active demonstration package program could be an effective means of exchanging information on program improvements and successful technologies among State and local agencies. Compiling actual case studies will certainly help agencies improve their credibility, as field data are more effective than anecdotal



reports of past practices when garnering support among decision makers. Project data from actual case studies could be compared with and tailored to conditions in other States. Demonstration program information should be shared with the AASHTO Subcommittees on Maintenance and Materials to solicit more support for pavement preservation at a national level.

AASHTO and FHWA technology sharing programs, including LTPP, should be used to facilitate dissemination of project outcomes and success stories from the various entities.

Desired Outcome

Managers and legislators will become more aware and supportive of pavement preservation and thus will be more likely to dedicate funds for preservation activities.

Actions

- ◆ AASHTO’s Subcommittee on Maintenance (through the Standing Committee on Highways), NCHRP, and FHWA should sponsor a 2-day seminar to increase awareness of the effectiveness of pavement preservation programs among top-level State and local managers.
- ◆ NHI and AASHTO should develop a short course to introduce the concept of asset management to the academic community and others. The concepts can be further disseminated through university curricula.



Performance Specifications, Improved Quality Control/Quality Assurance, and Training Materials

As agencies downsize, senior staff members retire, and the pool of potential employees becomes smaller, agencies are frequently faced with insufficient in-house technical knowledge and experience. As the number of senior employees drops, there are fewer opportunities for new employees to “learn from the masters.”

Although an outside expert can be brought in to lead a project or program, once the contract is up, the project often dies from lack of technical continuity and management support.

The highway community needs to develop an improved methodology for training delivery. Training is the basis for successful implementation of any new practice. Training allows us to exploit new opportunities presented by technological advancements. But training programs are not always properly designed, nor are they equally accessible across State boundaries. There is a wide range of pavement preservation techniques, strategies, and practices for which training courses need to be developed. Many of these need to be tailored to meet the specific needs of the target audience, be it work crews, project planners/designers, or management.

Strategies/Recommendations

First, we must identify the various groups for whom training courses should be developed and the different channels through which they can be delivered. Given the diversity of the training programs needed, funding should be sought from a variety of sources. Potential funding sources need to be presented with packaged training programs that best suit their needs. The more funding sources, the more people a training program can reach.

The various training programs already in existence need to be evaluated for effectiveness. Effective programs can then be used as models for new programs, and ineffective programs can be phased out. The evaluations must take into account the likelihood of variations in the trainers’ technical knowledge and suitability of the course to the audience. Because of limitations on travel funds, those courses rated highly effective should be made available across State lines. Alternatives to classroom instruction, such as videoconferencing, interactive CD-ROM, and project site visits, should be explored.

There is a need to increase field awareness of pavement preventive maintenance expertise and training resources available in industry and agencies. Industry should be encouraged to sponsor and support the development of training courses, especially those designed to “train the trainer.” Industry-sponsored programs should be held where they are most needed and can be most effective.



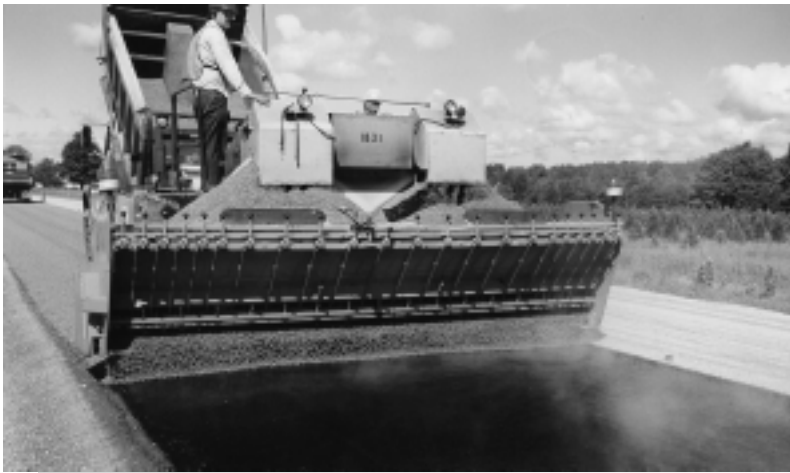
Desired Outcome

Improved knowledge among State and local government staff about pavement selection and timing and application of pavement preventive maintenance treatments.

Actions

- ◆ FHWA, through LTAP, should improve the technical assistance program in the area of pavement preservation.
- ◆ FHWA and its State and industry partners should develop and market short courses and training workshops through NHI, LTAP, and industry.
- ◆ FHWA, in concert with State and local highway agencies, should help publicize the availability of knowledgeable people willing to share their expertise with others.





“Our Interstate was in horrible condition, and we decided we needed something to get out of this crisis mode,” says Mike Lackey of Kansas DOT. “We came up with the idea for a pavement preservation program. But management said, ‘We don’t have money.’ So the operations people said, here’s an idea: ‘We’ll cut maintenance materials cost by one-third, reduce salaries [through attrition] by one-third, and management will come up with one-third out of State funds. Then we’ll then do a maintenance surface program by contract.’”

Lackey says it was tough cutting materials and staff, but it was the only way to accomplish what they needed. “We started with a small program, but we demonstrated how effective it could be. We then started on a pavement management system in the late 1970s/early 1980s. We brought all our engineers together, hired a consultant, and held a series of meetings to decide what it is we were about.”

In particular, Lackey credits the freedom to “put a lot of different techniques out there. We did a lot of trade-offs, based on the experience of the engineers that were in the room, until we reached consensus.”

Kansas DOT now inventories its highway system once a year in the spring, evaluating all of its roughly 10,000 miles for ride quality and sampling every third mile for cracks. The data are then entered into a computer, which then rates each section as being in one of three levels:

Level 1—No work required

Level 2—Routine maintenance required (which can be done with small subarea crews)

Level 3—Major maintenance required (which is beyond the DOT’s ability to do and thus is done by a contractor).

“We honed in on trying to educate the legislature about the importance of preservation. If you don’t get the money, you can’t do the work, and the way to get the money is to make it simple, so that they understand it. We showed them pictures of the distresses, pictures of roads going bad, cracked roads, potholed roads, roads with bad shoulders, roads with cracks, roads with wheel ruts, and so forth, until we persuaded them that we had some problems. Then we said, ‘Here are some ways we can fix this.’ We have this system that tells us.

“We set up a series of choices for the legislature, showing them various options that could be done for X amount of dollars. One choice we called ‘appropriate maintenance,’ which was if we could have everything we wanted, that is what we would like to have.”

The legislature then debated the choices.

“Because they had been educated on what the system looked like, the debate came down to how much money do you want to devote and how good a system do you want to have? The very thing you want them talking about—results and policy. They selected the ‘adequate’ level (72 percent in Level 1 and 5 percent in Level 3),” says Lackey.

Lackey says Kansas has been “extremely lucky” to have the pavement management system supported by top management. “It is easy to understand, easy to sell, and we have the numbers to show them it works, and that is extremely important.”

Lackey points out that the pavement management system has another benefit: As the agency right sizes and down sizes and a lot of the most experienced people retire, the pavement management system is a steadying influence— “It helps people who might not have quite the experience in pavement maintenance that some other people do, and the system can then help them ramp up the learning curve.”

Appendix I

Research: A Key to the Future

With the evolution of the pavement preservation philosophy, the need for accurate and reliable information escalates rapidly. This information, combined with life-cycle cost analysis, is needed to make informed decisions, demonstrate the effectiveness and economics of preventive maintenance programs, and educate the travelling public. Pavement preservation has not been fully researched or defined. The Strategic Highway Research Program (SHRP) commenced a coordinated effort to do so and thus accelerated the move from a reactive approach to maintenance to one that is proactive and preventive in nature. The SHRP projects focused primarily on the effective use of surface treatments to extend the life of a pavement. Although the SHRP preventive maintenance initiatives were a step in the right direction, additional research needs to be pursued if we are to complete our journey to successful pavement preservation.

The role of the research breakout session was to identify challenges or weaknesses associated with research activities in pavement preservation and to recommend strategies and action items for overcoming any deficiencies. Figure 1 depicts the suggested pavement preservation research process, a consensus of the two individual breakout groups.

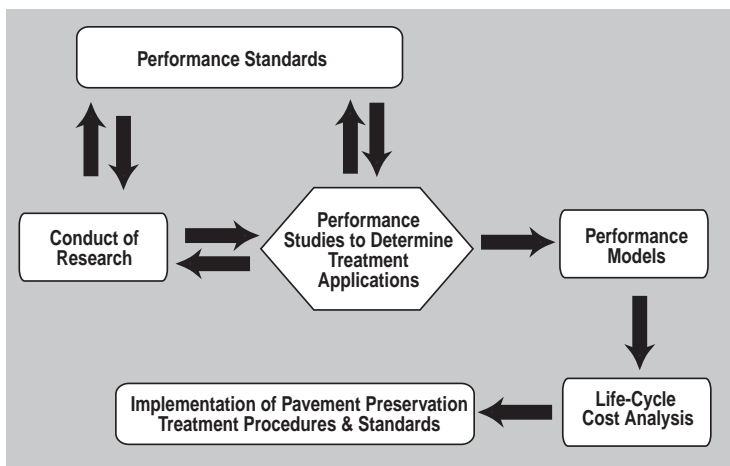


Figure 1: Suggested Research Process for Pavement Preservation

The breakout groups agreed that the most important element of Figure 1 was “Performance Studies to Determine Treatment Applications.” There is a lack of data and information dealing with pavement preservation treatments that can be used to produce specifications. Compelling arguments can only be made to upper management and decision makers if we can show examples of successful pavement preservation/preventive maintenance (PP/PM) techniques and their effectiveness in reducing the life-cycle cost of a pavement. Performance studies involve conducting experiments and studies in the laboratory using performance tests, accelerated testing, and field studies. The key element is developing the performance studies and documenting the results.

The group believed the best way to accomplish this was to create public/private working groups to identify and define research methodology. Defined research can be conducted through the use of pooled fund studies, which will look at the performance of various types of treatments and material variability and monitor the performance of experimental field sections. These studies can be conducted in several regions, which will emphasize different environmental conditions. The data generated by the LTPP Specific Pavement Studies (SPS) and General Pavement Studies (GPS) can be extended to focus on PP/PM treatments. The information gathered from performance studies can be used to generate accurate cost data, material/treatment performance data and design procedures, and implementation documentation.

Branching out from the central element, the individual groups emphasized different aspects of the diagram. One group focused on the importance of performance models and life-cycle cost analysis (LCCA) while the other emphasized the conduct of research.

The proper conduct of research when developing research studies entails using the right concepts and philosophies, establishing test and control sections, and keeping a focus on the issues: “How does it affect pavement performance?” and “How does it affect the customer?” These questions should be answered in terms of safety, ride quality, longevity, and cost-effectiveness. The importance of using control sections cannot be overstated.

An experiment or study must answer the following questions to ensure that research is conducted properly:

1. Does the treatment enhance performance in any way?
2. Is the treatment cost effective?
3. What is the correct timing of the treatment?
4. What is the best treatment/material to use?

The general consensus is that most research that has been done in the area of PP/PM began and ended with question 4. This is a major weakness that has hindered the highway community from collecting necessary data and information. Research studies need to address the remaining questions as well if they are to provide us with the information we need to sell PP/PM. There has traditionally been a lack of funding and associated lack of long-term commitment in relation to PP/PM-related research. Champions and stakeholders need to sell the cost effectiveness of PP/PM research and market the need for commitment in both the policy and funding of the research. Success stories from other agencies need to be promoted. Issues need to be defined and conduct of research protocols need to be established through the partnership between industry and public agencies.

Once the conduct of research has been established the process can then move on to performance standards. A weakness is that there is no uniformity or standardization in terms of a defined level of performance for different types of treatments. The development of performance standards and measurements are key to ensuring that the customer's needs and expectations are met. Performance levels need to be defined along with measuring and equipment standards used to determine the level of performance of various treatments. These standards need to be developed based on state-of-the-art measuring techniques, equipment, and criteria. Public and private working groups need to be formed to define, promote and implement performance standards. Most importantly, the key for success is to listen to the customer and monitor customer feedback. Performance standards, performance studies, and conduct of research form a cyclic process by which potential treatments and methodologies are developed.

After performance data has been collected it can be imported into performance models that need to be developed for each of the various treatments. These models must predict treatment performance based on various types of distress and pavement conditions. Currently experienced-based models do not exist and underlying assumptions of model characteristics are unproven. Expert decision models need to be generated. The model development must have the long-term support of management so models can be updated and upgraded as more performance data become available. Model development should use data provided by accelerated pavement techniques and test section performance, and must be multidimensional. The group recommends that an expert panel be created to define the models and foster their development.

State and local agencies can use the results generated by the models as inputs for LCCA. The LCCA will then determine which PP/PM treatment is the most cost-effective over the entire life of the pavement. The problem with current LCCA is the lack of uniform cost data and the exclusion of user costs as inputs. When user costs are employed there tends to be confusion over actual versus perceived costs and the overall user benefit associated with PP/PM. To overcome this confusion, a specified methodology based on the use of probabilistic LCCA needs to be promoted.

Accurate material and cost data need to be generated through industry involvement. User costs need to be defined through the input of others in the traffic and planning areas. The uniform cost data and findings need to be simplified and documented so

that they can be implemented nationwide through training programs and seminars.

Supplied with the data and information from the LCCA, pavement preservation champions can then develop support, a philosophy, and a program for implementation of PP/PM within the State and local agencies' maintenance allocations. These champions then need to promote their success stories to others and to publish their findings and experiences. In summary, Figure 1 serves as a roadmap for the proper implementation of PP/PM research and relating the outcomes to LCCA and program development.

The research breakout groups also developed an example performance study work plan that includes the following six steps:

1. Create public/private working groups to define research methodology (or conduct of research) and baselines.
2. Use existing and install experimental sections in field and develop accompanying quality control/quality assurance techniques.
3. Evaluate section performance.
4. Obtain cost information.
5. Develop material design procedures.
6. Create implementation documents.

The groups strongly recommend looking at the ability of some laboratory test or a quality control/quality assurance test to predict performance of a treatment in the field.

Figure 2 is a suggested research timetable for completing the work necessary to use the roadmap outlined in Figure 1. Regarding the conduct of research, efforts have already been made in that the Pavement Preservation Lead State Team has already developed the initial protocols for the conduct of research.

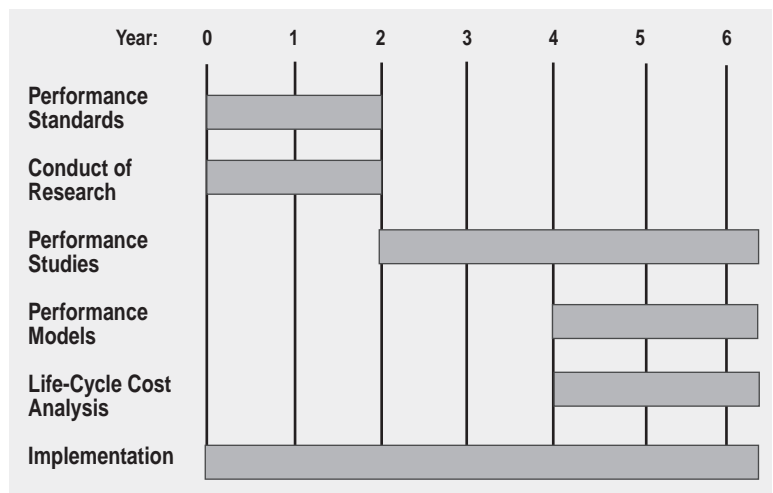


Figure 2: Suggested Research Timetable

Appendix II

Participants

- Osama Abdulshafi, Director, Ohio LTAP Center, Columbus, OH
Clay Adams, KDOT, Kansas City, KS
Daniel Ahart, Shelby County Engineer, Shelby County Road Department, Harlan, IA
Chris Anspaugh, Strawser Inc., Columbus, OH, 43223
Robert E. Arnold, Vice President - Technical, Ergon Inc., Memphis, TN
Lucy T. Avera, Consulting Editor, *Asphalt Contractor Magazine*, Independence, MO
John Babcock, KDOT, Kansas City, KS
Mike Backman, Labor Supervisor, City of Sioux City, Sioux City, IA
Bill Ballou, Koch Materials Company, Salina, KS
Susan Barker, Staff Engineer, KDOT, Topeka, KS
Tony Barter, State of Alaska DOT, Anchorage, AK
Wendell Bates, Street Superintendent, City of Hutchinson, Hutchinson, KS
Ronald W. Berglund, Area Engineer, KDOT, Syracuse, KS
Don Bethards, Assistant County Engineer, Wayne County, Corydon, IA
Duane Blanck, Crow Wing County Engineer, Brainerd, MN
J.F. Bledsoe, Senior Pavement Management Engineer, MODOT, Jefferson City, MO
Kevin S. Bloss, Assistant State Maintenance Engineer, Oklahoma Department of Transportation, Oklahoma City, OK
Doyt Bolling, Utah State University, Department of Civil Engineering, Logan, UT
Thomas S. Borgmeyer, Maintenance Field Liaison Engineer, MODOT, Jefferson City, MO
Bob Bowden, KDOT, Kansas City, KS
Steven C. Bower, Supervising Engineer, MDOT, Lansing, MI
Chuck Boyd, Deputy Reg. Administrator, FHWA, Kansas City, MO
Rick Boyle, Ohio DOT, Columbus, OH
Donald M. Brooks, Vice President and General Manager, CrafcO, Inc., Chandler, AZ
Joseph Broschart, Special Projects Coordinator, Ohio DOT, Columbus, OH
Randy P. Brown, Rural Metro Maintenance Supervisor, MODOT, Kirksville, MO
William D. Brown, City Engineer, Overland Park, KS
Kevin C., Bruemmer, Project Coordinator, Public Works, Prairie Village, KS
Tony Bryant, Maintenance Supervisor, MODOT, Kansas City, MO
James Burgess, Bridge Maintenance Engineer, MODOT, Kansas City, MO
J. Baxter Burns, II, Vice President, Ergon Inc., Jackson, MS
Martin R. Burrow, Vice President, Ergon Inc., Jackson, MS
Brad Butterfield, General Manager, Ergon Inc., Jackson, MS
Ken Campbell, District Engineer, Meade, KS
Randy Canfield, Koch Materials Company, Kansas City, MO
Dean Carlson, Secretary of Transportation, KDOT, Topeka, KS
Peter Carttar, Staff Engineer, KDOT, Topeka, KS
D. Wayne Childers, Operations Manager, East Region, Ergon Inc., Jackson, MS
Norman Clark, Geotechnical Engineer, KDOT, Topeka, KS
Richard B. Clark, Pavement Management Supervisor, Montana DOT, Helena, MT
Dennis M. Clennan, Director of Public Works, City of Hutchinson, Hutchinson, KS
Claudia Cornish, Public Information Officer, Washington State DOT, Seattle, WA
Tommy Cox, Manager, Black Oils, Lion Oil Company, El Dorado, AR
Jerome F. Daleiden, Project Engineer, Fugro-BRE, Austin, TX
Bryan Danielson, New Mexico State Highway & Transportation Department, Santa Fe, NM
Don Davidson, RDT Director, MODOT, Jefferson City, MO
Robert M. Davies, Research Highway Engineer, FHWA, McLean, VA
Danny Dawood, Chief Pavement Engineer, Penn DOT, Harrisburg, PA
Larry J. Day, President, Ballou Construction Co., Salina, KS
Tom Deddens, Asphalt Institute, Shawnee Mission, KS
Bruce T. Dietrich, State Pavement Management Engineer, Florida DOT, Tallahassee, FL
John Donahue, Transportation Engineer, FHWA, Jefferson City, MO
David J. Dorsett, Area Maintenance Engineer, Iowa DOT, Ottumwa, IA
William L. Dotzler, Senior Civil Engineer, City of Sioux City, Sioux City, IA
Barry Dunn, Viking Construction, Austin, TX
Kurt Dunn, Pavement Engineer, FHWA, Kansas City, MO
Dennis Dvorak, Construction/Materials Engineer, FHWA, Topeka, KS
Kelly Eaton, Maintenance Supervisor, MODOT, Kansas City, MO
Greg Edington, Maintenance Operations Manager, Boone County Public Works, Columbia, MO
Timothy Ehrich, County Engineer, Wayne County, Corydon, IA
Mohamed Elfino, Assistant State Materials Engineer, VDOT, Richmond, VA
Gerry Eller, Koch Performance Asphalt Company, Englewood, CO

Participants *(continued)*

- Bill Ellis, District Materials Engineer, KDOT, Chanute, KS
John Epps, Technology Transfer Center, University of Nevada-Reno, Reno, NV
Jim Evans, Supervisor, City of Overland Park, Overland Park, KS
William H. Fair, Customer Service Engineer, Flexible Pavements Inc., Columbus, OH
Brian Feldkamp, Area Superintendent, KDOT, Kansas City, KS
John Fiegel, Foundation for Pavement Rehabilitation & Maintenance Research, Washington, DC
Ken Foster, District Bridge Engineer, MODOT, Macon, MO
Andrew C. Fox, Industry Manager, Construction, Westvaco Corporation, Charleston Heights, SC
Kirk Fredrichs, Transportation Engineer, FHWA, Kansas Division, Topeka, KS
Tom Freeman, Engineering Research Associate, Texas Transportation Institute, Texas A&M University, College Station, TX
Kenneth W. Fuels, Director of Pavements, Texas DOT, Austin, TX
Larry Galehouse, Pavement Maintenance Engineer, Michigan DOT, Lansing, MI
Victor Gallivan, Pavement/Material Engineer, Federal Highway Engineering, Indianapolis, IN
Jose Garcia, Highway Engineer, FHWA, Washington, DC
Ted Garcia, Project Development Engineer, New Mexico State Highway & Transportation Department, Santa Fe, NM
Mark P. Gardner, Project Engineer, Fugro-BRE, Austin, TX
Ollie Gates, Missouri DOT Commissioner, Kansas City, MO
Jerry Geib, Pavement & Materials Engineer, FHWA, St. Paul, MN
David Geiger, Division Administrator, FHWA, Topeka, KS
Andrew Gisi, Assistant Geotechnical Engineer, KDOT, Topeka, KS
Ron Glenn, Vice President, Industrial Coatings, Ergon Inc., Jackson, MS
Arthur Francis Gourley, Staff Maintenance Engineer, IDOT, Dyersville, IA
Joe Graff, Director, Maintenance Section, Texas DOT, Austin, TX
James R. Gremaud, Area Engineer, MODOT, St. Charles, MO
Wouter Gulden, State Materials & Research Engineer, Georgia DOT, Forest Park, GA
Ronald F. Hall, District Maintenance Engineer, KDOT, Garden City, KS
Oscar L. Hamilton, Area Maintenance Superintendent, KDOT, Kansas City, KS
Brian Hansen, Vice President, Operations, Dustrol Inc., Towanda, KS
Jack Hardin, Vice President, Operations, Mariani Asphalt Co., Tampa, FL
James Harris, County Coordinator, Bourbon County, Fort Scott, KS
Myron Hartman, Maintenance Supervisor, MODOT, Kansas City, MO
Rick Harvey, North District, Boone County Public Works, Columbia, MO
Lonnie Hendrix, Assistant State Maintenance Engineer, Arizona DOT, Phoenix, AZ
Keith D. Herbold, Pavement Engineer, FHWA, Olympia Fields, IL
Jennifer Hinson, Special Assignments Engineer, MODOT, Willow Springs, MO
Gary L. Hoffman, Chief Engineer, PennDOT, Harrisburg, PA
Frank Howell, Pavement/Construction Engineer, FHWA, Ames, IA
John Hrenak, District Staff Engineer, KDOT, Chanute, KS
John E. Huffman, Vice President-Engineer, Brown & Brown, Inc., Salina, KS
Randell H. Iwasaki, Program Manager, California DOT, Sacramento, CA
Dennis Jackson, State Construction Engineer, Washington State DOT, Olympia, WA
Leroy Jackson, KDOT, Kansas City, KS
Rosie James, Special Projects Manager, Boone County Public Works, Columbia, MO
Niall Jansson, Senior Materials Inspector, MODOT, Chesterfield, MO
Joe Johnson, Director of Public Works, City of Leawood, Leawood, KS
Tisha Jones, Koch Materials Company, Wichita, KS
Donald D. Jordison, Executive Vice President, Asphalt Paving Association of Iowa, West Des Moines, IA
Ken Kamradt, Labor Supervisor, City of Sioux City, Sioux City, IA
Thomas E. Keith, MODOT, Jefferson City, MO
K. Chris Kepler, Maintenance Chief, State of Alaska DOT/PE, Anchorage, AK
Clyde Killion, Public Works Supervisor, Bourbon County, Fort Scott, KS
Joe Kindler, Pavement Maintenance Engineer, KMS & Associates, Dublin, OH
Bill Kobs, Public Works Administrator, Meade County, Meade, KS
Mike Lackey, Assistant Secretary & State Transportation Engineer, KDOT, Topeka, KS
William Lampton, President, Asphalt Division, Ergon Inc., Jackson, MS
David LaRoche, Transportation Engineer, FHWA, Kansas Division, Topeka, KS
Glenn Larson, Administrator of Public Works, Washington County Public Works Department, Washington, KS

Participants (continued)

- David Leach, Koch Materials Company, Wichita, KS
Daniel J. Leslie, Street Superintendent, City of Iola, Iola, KS
David Ley, Project Engineer, City of Leawood, Leawood, KS
James A. Lilly, Assistant Maintenance Engineer, Minnesota DOT, St. Paul, MN
Toby Linzmeier, Assistant Editor, *Pavement Maintenance Magazine*, Fort Atkinson, WI
Donald C. Little, Transportation Tech 3, ODOT, Columbus, OH
John H. Livering, KDOT, Kansas City, KS
Roy Maestas, New Mexico State Highway & Transportation Department, Santa Fe, NM
Erik Maninga, Field Materials Engineer, MODOT, Jefferson City, MO
Ken Massingill, KDOT, Kansas City, KS
Ronald Matteson, Koch Materials Co., Salina, KS
Pat McDaniel, Design Standards Engineer, MODOT, Jefferson City, MO
Maureen McGinty, Senior Convention Assistant, Foundation for Pavement Rehabilitation & Maintenance Research, Washington, DC
Mitzi McIntyre, Engineering Director, MO/KS Chapter, ACPA, Lenexa, KS
Myles McKemie, Vice President, Marketing, Ergon Asphalt & Emulsions, Austin, TX
Kenneth McKenzie, KDOT, Kansas City, KS
Bob McQuiston, Pavement Engineer, FHWA, Columbus, OH
Joe Mickes, Chief Engineer, MODOT, Jefferson City, MO
Jerome Miller, Assistant Planning Engineer, Nebraska Department of Roads, Lincoln, NE
J.C. Miller, Assistant Planning Engineer, Nebraska Department of Roads, Lincoln, NE
Rick Miller, Assistant Geotechnical Engineer, KDOT, Topeka, KS
Dan Montag, Highway Engineer, FHWA, Lincoln, NE
James S. Moretz, Chief, PennDOT, Harrisburg, PA
Jim Moulthrop, Koch Materials Co., Austin, TX
Matthew W. Mueller, Pavement Tech. Engineer, Illinois DOT, Springfield, IL
Wess Murray, Maintenance Supervisor, MODOT, Kansas City, MO
Jim Murray, RDT Division Engineer, MODOT, Jefferson City, MO
Hugh Musselman, Street Superintendent, Chillicothe, MO
Haruyo Nakashima, Technical Writer, FHWA, McLean, VA
Salim F. Nassif, Program Manager, FHWA, Washington, DC
Richard E. Nelson, Project Coordinator, Valentine Surfacing Co., Bend, OR
Charlie Nemmers, Director, FHWA Office of Engineering, Turner-Fairbank Highway Research Center, McLean, VA
Danny Nichols, Special Projects Engineer, Nebraska Department of Roads, Lincoln, NE
Ed Nichols, Maintenance Supervisor, MODOT, Kansas City, MO
Chuck Oldaker, Area Engineer, KDOT, Ulysses, KS
Bill Onacki, Vice President, Copperstate Emulsions Inc., Chandler, AZ
Lee W. Onstott, State Construction Engineer, New Mexico State Highway & Transportation Department, Santa Fe, NM
Larry Orcutt, California DOT, Maintenance Division, Sacramento, CA
David G. Peshkin, Vice President, AP Tech, Oakbrook Terrace, IL
Mike Pittman, Area Engineer, KDOT, Dodge City, KS
Gary Plumb, District Construction Engineer, KDOT, Chanute, KS
Roger Port, Technology Transfer Engineer, FHWA, Kansas City, MO
Shahram Pourazari, Special Projects Engineer, City of Leawood, Leawood, KS
Charles Protasio, IMMS Engineer, KDOT, Topeka, KS
Robert C. Rea, Pavement Design Engineer, Nebraska Department of Roads, Lincoln, NE
Matt Redington, Transportation Engineer, FHWA, Lincoln, NE
Abe Rezayazdi, KDOT, Kansas City, KS
Roy Rissky, KDOT, Kansas City, KS
Steve Rodriguez, State Maintenance Engineer, New Mexico State Highway & Transportation Department, Santa Fe, NM
Gerald J. Rohrbach, State Materials Engineer, Minnesota DOT, Maplewood, MN
Ali Roohanirad, Design Chief/Liaison Engineer, Department of Public Works, Jackson County, Independence, MO
Patrick Russell, Project Manager, Russell Standard Corporation, Mercer, PA
Larry Scofield, State Research Engineer, Arizona DOT
Ali Selim, South Dakota State University, Brookings, SD
Mike Selm, Urban Engineer, KDOT, Topeka, KS
John R. Selmer, Director, Maintenance Operations, Iowa DOT, Ames, IA
Wesley A. Shemwell, Pavement Engineer, FHWA, Wisconsin Division, Madison, WI
Steve Shober, Chief Research & Pavement Engineer, Wisconsin DOT, Madison, WI
Jon Singelstad, Staff Maintenance Engineer, Iowa DOT, Creston, IA
Omar Smadi, Pavement Management Specialist, Center for Transportation, Research & Education, Ames, IA
John Smith, Engineer/Manager, Boone County Public Works, Columbia, MO
Jim Sorenson, Senior Engineer, Highway Operations, FHWA, Washington, DC

Participants *(continued)*

Dominick Stasi, Public Works Superintendent, City of Leawood, Leawood, KS

James R. Stevenson, Quality Control Rev Supervisor, Montana DOT, Helena, MT

Dean Steward, Field Construction/Maintenance Engineer, KDOT, Topeka, KS

Scott H. Stone, Area Engineer, MODOT, Willow Springs, MO

Haleem Tahir, SHRP Coordinator, AASHTO, Gaithersburg, MD

Benny Tarverdi, Metro Engineer, KDOT, Wichita, KS

John Tenison, Geotechnical Engineer, New Mexico State Highway & Transportation Department, Santa Fe, NM

Dean Testa, Chief of Construction and Maintenance, KDOT, Topeka, KS

August J. Timpe, Environmental Compliance Coordinator, MODOT, Jefferson City, MO

Carl Titsworth, Field Engineer, KDOT, Topeka, KS

Francis Todey, Preservation Program Engineer, Iowa DOT, Ames, IA

Sandra Tommer, KDOT, Kansas City, KS

Dave Van Deusen, Research Project Engineer, Minnesota DOT, Maplewood, MN

Jaci Vogel, Assistant Bureau Chief, KDOT, Topeka, KS

Michael Voth, Pavement/Transportation Engineer, FHWA, Topeka, KS

Dennis Webb, Logistics Coordinator, City of Knoxville, Knoxville, IA

Laird E. Weishahn, Flexible Pavement Engineer, Nebraska Department of Roads, Lincoln, NE

R. David Welborn, Technical Manager, Asphalt, Westvaco Corporation, Charleston Heights, SC

Mark R. Wikelius, State Maintenance Engineer, Minnesota DOT, St. Paul, MN

James Williams, KDOT, Osage City, KS

Donald F. Wise, Quality Assurance Engineer, PennDOT, Harrisburg, PA

Alvin Wolf, Operator, Bourbon County, Fort Scott, KS

George Woolstrun, Engineer of PCC & Tests, Nebraska Department of Roads, Lincoln, NE

Beth Wright, Operations Engineer, MODOT, Kansas City, MO

John Wulf, Assistant City Engineer, City of Clayton, Clayton, MO

John Young, Supervisor, City of Knoxville, Knoxville, IA

Jerry Younger, FEA, KDOT, Wichita, KS

Sameh Zaghloul, Roadway Management Specialist, ITX Stanley, Cambridge, Ontario, Canada

