CONCURRENT WORK SESSION
Thursday, September 5, 1991

PAVEMENT MANAGEMENT AND MAINTENANCE

Moderator

David L. Allen
Section Head, Pavements
Kentucky Transportation Center
University of Kentucky

Panelists

Bruce Matzke
Regional Pavement Engineer
Federal Highway Administration

Steve Kersey
Survey and Mapping Division
Trimble Navigation

Raymond Chavez
Street Maintenance Engineer
City of Albuquerque
Local government road programs represent a significant portion of the Nation's public roads, yet their needs are often overlooked by federal and state highway agencies.

In 1981, Congress directed the Federal Highway Administration (FHWA) to begin a Rural Technical Assistance Program (RTAP) to address this need. The RTAP will provide technical assistance to "...meet the growing demands placed on rural roads resulting from increased urban sprawl and the increased size and weight of trucks carrying goods from farm to market."

As part of the RTAP effort, the FHWA initiated a project entitled "Road Surface Management for Local Governments." This project involved assembling a synopsis of road surface management practices among local governments, developing training materials, and conducting a training course.

Road surface management is defined as the application of pavement management principles to the needs of local governments, including the management of light-type pavements and unpaved surfaces.

Most governmental agencies have road and street responsibilities and, therefore, practice road surface management. Some procedures may be well-thought-out programs based upon current technology and some may be very informal, based upon the judgment and experience of long-term employees.

Bruce Matzke, Regional Pavement Engineer for Region 4 of the Federal Highway Administration, is based in Atlanta, Georgia. Prior to this position, Mr. Matzke served as a staff engineer in the Pavement Division of the Headquarters Office of the FHWA in Washington, DC. He has held several other positions with FHWA during his 22-year career.

Mr. Matzke has a B.S. in Civil Engineering from the University of the Pacific and has done graduate work in public administration at the University of Wisconsin.
In any case, road surface management is not something new, but rather is a current, on-going activity.

The purpose of a road surface management project is to identify areas where current road surface management practices might be improved, with emphasis on building upon the best features of current practices, rather than advocating the implementation of dramatically different and sophisticated systems.

Within the last few years, the concept of pavement management has become increasingly important in the highway community. A comprehensive pavement, or “surface” program consists of a coordinated set of activities. All are directed toward achieving the best value possible for the available public funds, while providing smooth, safe, and economical road surfaces.

Road and street surfaces represent the largest single share of the transportation investment in most communities. It has been estimated that 40 percent of the public funds spent on roads, streets, and highways nationally are spent on pavements.

Agencies must make effective decisions regarding maintenance, repair, rehabilitation, and reconstruction of road surfaces. The concept of road surface management is to improve the efficiency of the way in which these decisions are reached. Without sufficient information, the following types of decision criteria might be:

- Budget whatever was budgeted last year, with an arbitrary increase or decrease.
- Establish a program based upon periodic maintenance, such as crack sealing every other year, seal coats every four years, and overlays every 12 years.
- Respond to emergency demands and citizen complaints as they arise.
- Use political considerations to establish programs and budgets.
- Rely on the knowledge, experience, and “gut feel” of managers and experienced employees.

These criteria, individually or in combination, may be satisfactory if there are adequate funds and the majority of surfaces are in satisfactory condition. However, if the network is in bad shape and getting worse at the same time that funding sources are getting harder to find and pressure exists to lower taxes, then it becomes obvious that a better decision-making process, based upon good information, is needed.
In this environment a more logical, or systematic, procedure is needed that will provide answers to some tough questions.

The process of inventorying the pavement network, assessing condition of the network, weighing alternatives, and establishing long-term programs and budgets can be much more effective if approached from a road surface management point of view.

The analysis of ongoing maintenance needs in a certain region produced some disturbing results. In recent years, it would have cost $268 million to adequately maintain the region's streets and roads. Local jurisdictions actually budgeted only $167 million for maintenance during this period, a figure that fell $101 million short of the required amount. While the effects of this neglect are not readily apparent, over a period of time it can lead to severe and accelerated deterioration. This already serious situation is likely to worsen as time goes by. Many roads were built in the post World War II boom era and are now reaching an age where more expensive treatments are required.

The ramifications of poorly maintained streets and roads go far beyond the inconvenience of rougher rides for the motoring public. Drivers using these roadways experience poorer mileage, and thus pay higher fuel costs; are subject to a greater risk of accidents; and spend more on upkeep because of extra wear-and-tear on their automobiles. The amount of increased user costs attributable to poor roads has been estimated to be in the range of 5 to 10 cents per mile. At the same time, public works officials are noting that liability costs for cities and counties are going up as a result of an increase in accident claims. Less tangible but nonetheless important are the effects that poorly maintained roads can have on the delivery of essential city services, including fire and police protection and transit service. Deteriorating streets also can reduce a city's desirability as a business location.

There are many benefits to approaching the management of road and street surfaces on a systematic basis, such as:

- Reducing the danger in having valuable knowledge and experience locked “in the head” of one individual. Too often, this information is not effectively passed on to others when that key individual retires or otherwise leaves the organization. It is far better to gather, organize, and store essential information so that the whole organization can benefit.

- To make the best decisions, an agency should understand the performance of pavements and relate specific maintenance and rehabilitation actions, costs, and performance to each other. The term “performance” here is defined as condition over time. Although this might be estimated intuitively by very experienced
engineers, it is doubtful that any one individual can do this accurately on a consistent basis. A systematic approach involves collecting and recording condition information on a structure basis, recording treatments and costs, and analyzing information using a consistent procedure.

- Long-range plans and annual budgets for labor, equipment, material, and contract requirements can be arrived at logically, with a minimum of guesswork and “gut feel.”

- Needs can be communicated to the elected board in a very convincing manner. Elected officials, like anyone else, find it more difficult to argue with facts and figures than opinions. More importantly, a systematic approach should yield enough information so that decision-makers will know the consequences of their decisions. If a budget is cut or increased, the impact on the road can be described in some measurable understandable terms.

- Individual citizens are quick to criticize road maintenance decisions, operations, and conditions. However, when the manager can express knowledge of a situation, relay the plan to correct the problem, and explain how an individual road fits into the overall needs of the community, then the hostility of that individual can be quickly dissipated.

- Priorities and needs can be defined so that the greatest benefits can be achieved for the available money. In other words, the “greatest bang for the buck.”

What then, are some of the features of a systematic surface management program?

First is a need to recognize the importance of sound practices. Improvements in basic engineering practices can be as important as a systematic program, so we will begin our discussion here.

There are a number of factors that affect the performance of pavements and should be appreciated by local engineers when designing, building, and maintaining pavements. These factors include: subgrade, temperature, loadings, moisture, quality of construction, and maintenance. The application of proven techniques will result in engineered pavements rather than pavements that evolved through guesswork.

Timing of maintenance and rehabilitation actions can be as important as the action itself. Once a pavement has begun to deteriorate rapidly, the cost to repair can increase dramatically.
The first step in systematic management is to obtain an inventory of the road network. It is impossible to adequately plan for maintenance and rehabilitation needs without knowing the size and characteristics of the network.

The inventory should be as simple as possible, while still collecting the required information. Types of information that may be needed are:

- Section description/identification
- Functional and administration classification
- Pavement structure characteristics
- History, including costs
- Traffic information
- Geometry
- Drainage characteristics

The next step is a condition survey. In the past, maintenance personnel relied on experience and personal knowledge of the network to schedule maintenance and rehabilitation. This may work fine as long as there are no changes in personnel and as long as the elected board does not question opinions.

A systematic condition rating procedure can produce an objective measurement of pavement performance over time, in terms that laymen find easy to understand. A condition rating procedure will not replace good judgement and experience, but rather supplement them.

There are four basic condition rating techniques. Distress surveys are the most common methods used to evaluate pavement condition. Skid resistance is not normally measured by local agencies, but can provide an indication of the safety characteristics of the surface. Roughness measurement and structural testing can be helpful to local agencies.

Of the four condition assessment procedures, however, distress surveys are perhaps the most useful to local governments. In fact, experienced local government engineers already perform distress surveys, although they are usually informal and not recorded.

A more complete approach to distress surveys records the type of distress, the degree of severity, and the extent covered. By recording this information, a performance record can be established and a quantitative measurement made of what was previously an opinion.

Distress surveys should use standard definitions of distress types and severities. There are several references available to assist in establishing
these definitions. Agencies should feel free, however, to modify these definitions to fit local needs.

Aggregate surfaces require some special consideration because their condition changes rapidly with traffic and maintenance activities. Distress surveys of aggregate surfaces should include frequency of maintenance as a measure of condition.

Distress surveys can be as simple as a “windshield survey” or very complex, requiring detailed field measurements. To be most useful, distress surveys should record the distress types, severities, and extent.

Automated condition surveys are becoming more common. As technology advances, new methods will be developed to measure distress, roughness, and structural capacity faster and more accurately. These automated methods will become more and more cost effective as availability and competition increase.

The third step in improved surface management procedures is strategy selection. This process involves evaluating the measured condition of each section and determining the causes of the observed distresses and the most appropriate corrective measures.

A basic concept of surface management is that maintenance resources are better spent on those pavements that are still in relatively good condition. This preventive maintenance concept emphasizes keeping good roads in good shape.

Given the present condition of a pavement, there is one maintenance and repair strategy that is most appropriate. One should avoid confusing how an activity is funded with strategy at this point. We are using the term “strategy” to refer to an overall approach to maintaining and improving roads over their entire life cycle.

Most pavement strategies consist of a series of activities which are grouped into one of five categories: routine maintenance, preventative maintenance, deferred action, rehabilitation, and reconstruction.

Needed current action selection for a given section depends on the overall condition and the distresses present. When using a condition measure such as Pavement Condition Index to determine needed current actions, it should be understood that there may be considerable overlap between what action categories should be selected. The types of distresses present and economic analysis should determine the selection in these cases.

To make the most beneficial and economical maintenance and improvement investments, it is important to examine the long-term
effects of current actions. A life cycle cost analysis allows a complete picture of current and future costs and benefits. This allows more cost effective maintenance and improvement strategies to be selected for each section in the network.

Once the most appropriate current action or life cycle strategy is selected for each section, the overall network needs can be identified.

Using generalized average unit costs for each current action category and the areas determined from the inventory, the total present needs, in terms of dollars, can be determined.

Since it is unlikely that most communities will be able to afford to address their total needs immediately, long-range goals and objectives should be established, in terms of a target network condition, average annual investment requirements, and years to reach the goal. It is usually easier to justify budget requests if the decision makers are presented with such a “road map.”

Because total needs cannot always be addressed immediately priorities must be established.

There are actually two priority choices to be made. The first is among the general action categories. Will emphasis be placed on routine maintenance, preventive maintenance, rehabilitation, or reconstruction? This is essentially a “best-first,”—“worst-first,” or somewhere in-between decision.

Next, priorities should be established within the action categories. There are a number of factors that can go into this, including the measured condition, traffic exposure, route classification, and maintenance history.

These factors can be combined into a simple formula, but care must be taken to avoid placing too much weight on the results. There may not, in fact, be much difference in sections that are ranked close to each other. Any procedure should be flexible enough to allow for non-quantifiable factors in these cases.

Economic analysis using life-cycle costing techniques also can be used effectively for priority selection. There are some relatively simple economic analysis techniques available to assist managers in the pave/not-pave decision, as well.

Once priorities are set, managers can begin to identify specific needs over a long-range period, usually about five years.
A long-range program should include treatment of the currently identified needs, taking into account future deterioration.

Year One of the long-range program becomes the budget for the up-coming year. Of course, at this stage, average unit costs are substituted with more accurate estimates. At this point, specific actions are addressed. A good condition survey will provide sufficient information to identify the necessary work activities.

This overall process will result in the identification of actual needs and a program to address those needs. If the entire process is adopted, it would be called a road surface management system. It may not be necessary, however, to go that far. Local agencies should analyze their present ways of doing things and improve only those elements that will result in significant improvements. This may be simply establishing an inventory or formalizing a distress survey.

Agencies that have made a commitment to an overall systematic approach usually find that a computer is useful to help store and analyze the information collected.

There are several ways to approach the implementation of a road surface management system, including the purchase of a “canned” system, the adaptation of an existing system to local needs, and the development of a tailor-made system.

Regardless of the approach taken, local agencies should critically analyze their management information needs and carefully evaluate the systems under consideration. The degree to which needs are satisfied and the costs of a system usually involve trade-offs.

The operation of any surface management system will depend upon the quality of the condition survey element. Regardless of the cost associated with computers and software systems, the overriding cost of a management system is the year-in, year-out data collection. Data collection requirements of any system should be carefully analyzed to ensure that the information needed will be gathered and that the costs will be reasonable.

There are severe pressures on local governments to control or even reduce levels of expenditures in all areas. There are many creative ways to do this without adversely impacting services.

By working jointly, local governments can take advantage of savings that can be realized by buying materials, contracting, and performing work in large quantities. This is known as “economy of scale.”
Creative management in this area is the key to maintaining services with limited resources. Although independence is highly valued by local boards, the financial facts of life seem to dictate some degree of cooperation and compromise.

There are several ways to realize potential savings through intergovernmental cooperation.

To summarize, we have discussed what surface management is and why it’s important. Then we discussed some of the basic elements of road surface management. Finally, we touched on some implementation issues and ways to realize savings through cooperative efforts with other governmental agencies.

Road Surface Management need not be a complex procedure. It is simply a common sense, step-by-step approach to managing our pavement resources in a consistent, systematic manner.

The tools are available. The challenge is for local governments to recognize potential improvements and to begin to implement them.

(Material taken from NHI Course No. 13426, Road Surface Management for Local Governments.)