

**GUIDELINES  
ON  
PAVEMENT MANAGEMENT**



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**EXECUTIVE SUMMARY**

**Pavement management is:**

- The effective and efficient directing of the various activities involved in providing and sustaining pavements in a condition acceptable to the traveling public at the least life cycle cost.
- An ongoing activity that has always existed in transportation agencies and that transcends the traditional boundaries dividing these agencies into their organizational units.

**Pavement management is important because:**

- The emphasis in highway programs has changed from expansion of the system to preservation and rehabilitation of the existing system.
- In many states, pavement decisions are based on the judgment and experience of engineers and administrators in different organizational units, as well as on varying, sometimes inconsistent, sources of information.
- There is a marked absence of factual information on the consequences of previous pavement management decisions.
- Competition for limited legislative funds is intense and will probably remain so in the future.
- There is a need to assess network trends and needs, and demonstrate the impacts of alternative funding programs.

**In an attempt to improve pavement management:**

- It is essential that top management endorse and provide impetus for improvement. Top management support is necessary to promote communication among the many organizational units involved and to coordinate pavement management activities.
- In the short term, an agency should review its existing pavement management practices to promote uniformity and improved decision-making concerning pavements. Improvement can be expedited by reviewing the pavement management practices of other agencies as a potential source for improved procedures.

- In the long term, an agency should work toward developing a program to measure and evaluate the impacts of various strategies in design, construction, and maintenance of pavements. This effort could be expedited by establishing or strengthening the agency's capability to organize, store, and analyze pavement information.

### **Introduction**

The pavement management process in most agencies has typically operated on the basis of historical data. The needs have been established over a period of time, and resources have been allotted accordingly. Changes in the process usually occur over time.

Recently, inflationary costs in the face of declining revenues and a significant increase in the number of heavy wheel loads have prompted a search for better ways of managing pavements so that the maximum benefit is obtained from available funds. Another reason for this search is that many agencies are believed to be falling behind in their attempts to keep their systems in satisfactory condition. There is a growing awareness in government of the need for planned programs of maintenance and rehabilitation of public facilities, including highways. Agencies are being required to provide more thorough accounting of the funds being used and stronger justification for needed additional funds.

Many agencies are unable to document fully the overall condition of their highway networks. Frequently, they are unable to demonstrate specifically to legislative bodies and to the public how funds are allocated and what benefits would be gained with additional funds.

External pressures for the practice of good pavement management will build and not likely decrease in the future. In the past, transportation agencies in city, county, and state governments were concerned primarily with building new highways to accommodate increasing traffic volumes and new development. While this expansion has not ceased entirely, it has been significantly reduced by a shift in emphasis to preservation of existing highways and, in some cases, shifts to other modes of transportation. At the same time, since a large part of the existing highway system is in need of immediate repair, emphasis is now being directed toward preserving the system in place.

In many states, pavement decisions are based on personal judgment and the experience of individuals working in many different organizational units. Often the decisions are based on different and inconsistent sources of information. This potentially uncoordinated approach to pavement management makes it difficult to gain cost-effective solutions to pavement problems and may not present constant, understandable information to legislators, decision makers, and the public.

There is also, in many agencies, a marked absence of factual information on the successes and failures of pavement management decisions. Without proper documentation of past decisions and feedback of subsequent results, pavement decisions will be inconsistent at best and at worst, past mistakes will be repeated.

The financial climate of the 1980s has created funding problems for all governmental agencies. Transportation agencies are no exception. In state legislatures, competition for limited available funds has been intense, and the competition will probably remain so in the future. This problem has highlighted the need to assess highway network trends and to demonstrate the impact of alternative funding programs.

### Definitions

Although pavement management has been a term used frequently by highway engineers, there appears to be no clear consensus as to what it is or what it should be. To provide a common understanding of the various terms connected with pavement management, the following definitions are presented.

*Pavement Management (PM)* is the effective and efficient directing of the various activities involved in providing and sustaining pavements in a condition acceptable to the traveling public at the least life cycle cost. Examples of these activities include, but are not limited to, the following as they relate to pavements:

- planning
- budgeting and programming
- design
- construction
- monitoring
- research
- maintenance
- rehabilitation
- reconstruction

A *Pavement Management System (PMS)* is an established, documented procedure treating many or all of the pavement management activities listed above in a systematic and coordinated manner. It consists of five essential elements structured to serve decision-making responsibilities at various management levels.

1. Pavement surveys related to condition and serviceability.
2. Data base containing all pavement-related information.
3. Analysis scheme.
4. Decision criteria.
5. Implementation procedures.

The difference between the practice of pavement management and a pavement management system is the establishment and documentation of each of these components to formally treat one or more of the pavement activities in a coordinated and objective process. Feedback on these activities is an important part of both PM and a PMS.

A *Pavement Management Information System (PMIS)* is an established and documented procedure for collecting, storing, processing, and retrieving the information required in a pavement management system. It represents a foundation for PMS since all pavement decisions must be based on a common, integrated source of information derived from reliable, good quality data.

*Pavement performance* is the assessment of how well the pavement serves the user over time. The engineer often associates pavement condition with an arbitrary, but quantifiable, value relating to pavement roughness, pavement distress, or pavement strength. Performance is the measured change of condition and/or serviceability over increments of time.

A *pavement management strategy* is a carefully arranged, systematic program of action applied to any area of pavement activity.

*Pavement optimization* is a procedure for obtaining the greatest life cycle benefits for the least cost. Within the practice of pavement management, optimization might best be described as a process of obtaining the highest state of pavement performance over the pavement's life cycle with the least social and economic impact.

The above definitions are intentionally broad in scope. It should be recognized that as each individual transportation agency improves its PM practices or develops a PMS, unique demands and characteristics of the agency will dictate the design of the system.

### Levels

There are two levels of pavement management activities:

1. Network level
2. Project level

Pavement management at the *network level* deals with summary information related to the entire highway network. As such, it involves policy and programming decisions, frequently made by upper management. An example of network-level pavement management is the use of graphic representations to establish rehabilitation programs, set policy, and justify budget requests. These graphic representations might consist of:

- The current condition of the highway network.
- The performance trend of the network with past history and future predictions.
- A projection of future needs.
- The estimated impacts of alternative funding plans on future pavement condition.

Pavement management at the *project level* deals with detailed and technical information related to a specific pavement section. As such, it involves decisions made by middle or lower management. Examples of project-level pavement management include the following as they relate to specific pavement sections:

- Establishing priorities for maintenance, rehabilitation, and reconstruction based on criteria set by top management.
- Obtaining feedback relative to pavement performance to provide input into pavement design, construction, and maintenance activities.
- Applying life cycle cost analysis when considering alternatives.
- Considering major design parameters such as foundation strength, number of projected axle loads, materials specifications, climate, etc., when designing a pavement structure.

In the past, pavement management has generally been emphasized, in some agencies, at the project level. Today's problems involving funding and accountability highlight the need for effective application at both the network and project levels.

### **An Approach for Improving Pavement Management**

Improved pavement management can occur through the following four steps:

1. *Review* existing operations, policies, and organizational structure.
2. *Analyze* existing operations and compare them with those of a preferred Pavement Management program; ensure that they are up-to-date, valid, and efficient.
3. *Identify* needed improvements.
4. *Implement*.

This approach is applicable to any or all of the previous listed organization activities. Implementation of some identified needed improvements can be begun immediately.

Suggested actions for an agency desiring to implement a new or enhance an existing pavement management system are:

1. Make a top management decision to install a PMS.
2. Organize a top level pavement management advisory committee to determine those PM activities to be included in a PM system.
3. Establish an organization charged with the primary responsibility of developing and implementing the PMS, reporting to top management and/or the advisory committee.
4. Devise a preliminary plan. The experiences of other agencies may be useful for this activity.
5. Develop a specific plan to "manage" a portion of the highway network as a test section.
6. Develop or improve pavement rating procedures. Review technical developments in pavement survey equipment and automation.
7. Set up a data base and collect the necessary data for the portion of the network selected. This effort can be expedited by developing computer capability to organize, store, and analyze pavement data.
8. Develop programs, methods of analysis, and reports to determine and report on the condition of the network selected. Develop management reports for decision makers.
9. Expand the system to the entire highway network as experience and needs permit or require.
10. Periodically evaluate the effectiveness of the PMS.

Of all these steps, the first is probably the most important. It is absolutely essential that top management endorse and provide impetus for the development of a PMS.

For most agencies, the introduction of new or different procedures can best be done as an evolutionary process. That is, the changes can be made in a step-by-step fashion rather than one major effort. The task of determining the condition of the statewide highway network, designing and implementing the necessary data processing, developing programs for analysis and reports, and training personnel may be too disrupting or too costly to perform in one step. It may be prudent to begin the implementation process on a small scale. A pilot program could be limited to a specific portion, such as the Interstate System, or perhaps to the highway network in a single district or county. Necessary modifications, additions, and deletions (even a complete new effort, if necessary) could be made without risk of disastrous loss of time and resources. The resulting program could then be expanded to other sections of highway or to other districts or counties. The benefits would be visible and could be used to back the further expansion of the pavement management system.

Improvement of pavement management in transportation agencies should be viewed as both a short-term and long-term activity. In the short term, an agency could review its existing practices in an attempt to promote uniformity and consistency in matters concerning pavements. Improvement may be expedited by reviewing the pavement management practices of other agencies. It should, however, be recognized that pavement management systems need to be tailored to fit the needs of each agency. Some of the significant variables to consider are organization (centralized or decentralized), type of pavements, size and age of system, and the predominant pavement performance deficiencies that are encountered. In the long term, an agency should work toward developing a program to measure and evaluate performance reflecting various techniques of pavement maintenance, rehabilitation, and design.

#### **Development of a Pavement Management Information System**

Since a pavement management information system (PMIS) is essential to a pavement management system, its development deserves special attention.

The development of a PMS data base must be planned carefully and managed with specific authority and responsibility assigned. A technical advisory committee representing all of the involved organizational divisions may be of assistance.

The initial planning for a PMS data base must consider:

- What information should be in the data base?
- How will the information be used and by whom?
- Who will collect it?
- When will it be needed?
- What procedure will be used to update the data?

Where and how the data are to be retained must be determined. The responsibility for the data collection effort and the identification of funds and personnel must be made. Decisions such as boundary limits to be used in the data collection effort (last project, average section length, milepost, etc.) must be agreed upon to ensure the utility of the data base. Rapid advances in computer hardware and technology will continue to reduce the cost and effort required to develop data base systems.

Staged implementation of the pavement information system can provide some immediate results, such as the ability to report present conditions or needs. Long-term benefits accruing as the PMIS development progresses

through predefined stages could include reporting the rate of change in pavement condition. The implementation process may require the collection of one-time data (systems definition, physical dimensions, etc.) as well as monitoring data that may change over time (pavement condition, serviceability, etc.). If possible, the agency may utilize and build on an existing file or files that can be tailored to meet PMS needs.

The effectiveness of the PMIS, its content, and utility must be monitored. Alternatives to 100 percent data collection efforts may be considered, such as using sampling techniques or special studies. Procedures for adding and deleting data elements must be provided. An efficient reporting strategy useful to management must be developed. The operational PMIS should be monitored by an advisory committee representing all involved organizations to ensure a universally accepted system.

The PMIS will provide an effective means of communication within the agency with regard to pavements. Budget requests can be supported with facts. Effectiveness of alternative strategies and performance of the pavement system can be reported. The PMIS does not dictate decisions. Its purpose is to provide management with the best available data upon which to base its decisions and better evaluate its policies.