

# Pavement Management Primer

## What Is Pavement Management?

Pavements represent the largest capital investment in any modern highway system. Maintaining and operating pavements on a large highway system typically involves complex decisions about how and when to resurface or apply other treatments to keep the highway performing and operating costs at a reasonable level. Traditional methods, used since Roman times, left these decisions up to a road supervisor who would select treatments based on his extensive knowledge and experience. This system is still widely practiced and works well in low traffic areas or where repair/restoration funds are not limited. In most cases, however, this is not the situation. First, rarely are there enough funds to complete all identified road repairs, and second, high traffic levels severely restrict when roads can be closed for maintenance.

Pavement management brings more science into this process. A pavement management system consists of three major components:

1. a system to regularly collect highway condition data
2. a computer database to sort and store the collected data
3. an analysis program to evaluate repair or preservation strategies and suggest cost-effective projects to maintain highway conditions

In most agencies, these components are then combined with planning needs and political considerations to develop annual highway repair/preservation programs.

Data collection ranges from simple “windshield surveys” to the use of elaborate testing vehicles that measure smoothness, skid resistance, faulting, and cracking in the road surface. Some agencies own and operate their own vehicles; others contract out the data collection. To make fair comparisons between potential projects, the highways are divided into segments that are more or less equal in length. The data from each segment is stored as one record in the database. The length of a typical segment ranges from 0.1 mile to 1 mile.

The database and analysis are usually set up using commercially available software. The size of the database will vary depending on the number of highways and the length of segment used for analysis. Most pavement management software vendors provide customized input screens, analysis packages, and reports as needed by the agency.

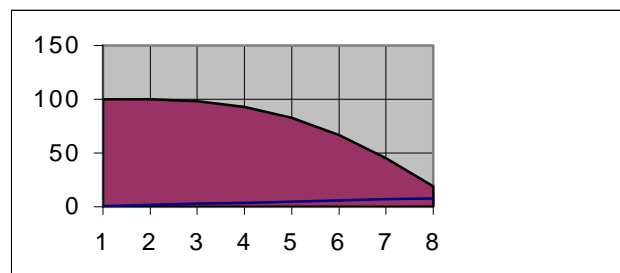
The analysis part of a pavement management system attempts to predict how long a pavement segment will last with a certain kind of repair under the given traffic loads, climate, and other factors. This analysis is based primarily on the collective experience of highway experts (road supervisors) and on the historical costs incurred for repairs or reconstruction. More sophisticated analysis packages also predict annual repair costs, overall system performance, and expected pavement conditions on related routes within planning corridors. Overall, the intent of the analysis is to identify the most cost-effective ways to maintain a highway system in satisfactory condition. Many systems provide a kind of learning process to the analysis program based on the actual performance trends of the highway system. After a few cycles of data collection, these systems can predict the local conditions with remarkable accuracy.

The most common uses of the pavement management information are by planning departments in highway agencies for scheduling repair and reconstruction projects. In addition, pavement management information is used by road supervisors departments for evaluating repair methods and by engineering groups for evaluating pavement designs.

### Does It Work?

Several firms began to experiment with pavement management on computer systems during the 1970's and made some interesting discoveries:

1. **Pavement Deterioration**—Pavements tend to deteriorate very slowly during the first few years after placement and very rapidly when they are aged. Even though pavement designs and materials varied widely, the deterioration of pavements followed a standard curve. This curve, pavement condition vs. age, is shown in the following figure.



2. **Costly Maintenance Practices**—Typically, State and local governments invest more funds for maintaining highways than for any other public purpose. While much of this is due to the high cost of repairs and heavy usage of the highways, there is strong evidence that some of the high operating costs originate from inappropriate or poorly timed maintenance decisions.
3. **Preserve vs. Reconstruct**—Successive years of collecting pavement condition data showed that it was far more economical to preserve roads than to delay repairs and reconstruct roads. The studies further showed that as traffic levels increase the costs of delaying repair work increased greatly. This suggested that the traditional practice of repairing the worst roads first is, in fact, a very expensive way to operate a highway system.
4. **Data Collection Problems**—Data collection by observation was very difficult and was often not objective. Data collection on large highway systems usually required several observers to collect data and led to inconsistencies in the data. This finding led to the development of vehicles that mechanically measure smoothness and other road conditions.
5. **Using Computers**—Early mainframe computers took as much as a week to analyze pavement data and cast some early shadows on the value of the process. With the incredible computing power available on today's desktop computers, these analyses

can be run in a matter of seconds. This allows decision-makers to consider numerous “what-if” alternatives.

Most government agencies have had difficulties introducing pavement management into their decision-making process. Significant misunderstandings still exist about the capabilities of the systems and whether strategically planning highway maintenance is appropriate. Reports are often misinterpreted and not used effectively. Development of pavement management systems can be costly and usually takes several years to produce tangible results.

Today, most of the larger highway systems have incorporated pavement management systems into their operating plans. These agencies report that the systems are worthwhile, but that several cycles of data collection are needed to produce significant cost savings in operations and maintenance.

### Conclusion

More than ever before citizens are demanding accountability from their local governments. In State highway agencies, critical decisions are made every day that affect the overall performance and operating costs of their highways. In this environment, poor decisions can be very costly. Information from a pavement management system provides an effective way to get better performance with less cost by providing valuable information to the appropriate decision-makers.

It is unlikely that traffic levels will decrease in the future or that pavements will get so good that they never need repair. Similarly, it is unlikely that major increases in funding for transportation will occur in the near future. The need for efficient management is greater today than ever before, and for highway pavements, the tool for efficiency is a good pavement management system.