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A public works crew does preventive maintenance on a road rated in "good" condition, which will extend its lifespan.

Investing in Pavement Management CAN IMPROVE ROADS, SAVE MONEY

By William Scarpati and Jerry Guerra

The largest portion of your community's infrastructure is literally under your feet—or your tires. A community's pavement network allows residents and commerce to move from place to place, provides for efficient response time during emergencies, and offers safe bus routes to get children to school. Paved roads are, by far, the nation's primary mode of transportation. For this reason, rebuilding, maintaining and preserving the condition of our pavement should be a top priority.

The aftereffects of serious winter storms can serve to remind us of the generally poor state of local roadway networks throughout Massachusetts. The reoccurring potholes, crumbling roadway edges, and new and deeper cracks that emerge in late winter and early spring are a fact of life, due largely to New England's freeze/thaw cycles. The American Society of Civil Engineers reports that 41 percent of the major roads in Massachusetts are in poor or mediocre condition. Funding to repair and rebuild municipal roads is woefully inadequate, however. (See related stories, this issue.) A solution to this quandary for cities and towns may be an effective pavement management system.

A pavement management system—most likely the oldest type of asset management known to highway and transportation officials—is a long-term, formalized approach to gathering information about a community's roadway network. Municipal officials then use the data to make informed roadway repair and maintenance decisions, prioritizing work to ensure the best return on investment. A pavement management system is a cost-effective tool for improving pavement conditions and maximizing the limited roadway repair and reinvestment dollars available to municipalities. A pavement management system can also help to build a case for additional funding for roadway infrastructure.

Some municipalities do an excellent job of pavement management, says John Livsey, the town engineer in Lexington, but most don't have a strong enough grasp of the concept to benefit from its use. "I find that there is not a good understanding of pavement management among many of my peers," he says. "For the majority of the towns I'm familiar with, the people who manage the roads don't follow a pavement management process."

WHAT IS PAVEMENT MANAGEMENT?

A pavement management system is a geographic information system-based technology used to measure a community's entire road system, evaluate its road conditions, and log this data in a comprehensive database. The data are then analyzed and used to develop several important tracking metrics, including the average Pavement Condition Index (PCI). The backlog of needs is expressed in both miles and dollars. Public works staff and other municipal officials respon-

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sible for the pavement management program monitor the metrics, setting and measuring goals and results relative to pavement condition and sustainability.

The idea is to take a comprehensive, long-range view of a community's roadway assets. After completion of an initial pavement management study, communities usually make an upfront commitment to an annual investment in maintenance, including a strategic and balanced program of resurfacing and base rehabilitation improvement projects. Major reconstruction projects are typically scheduled in later years of the plan.

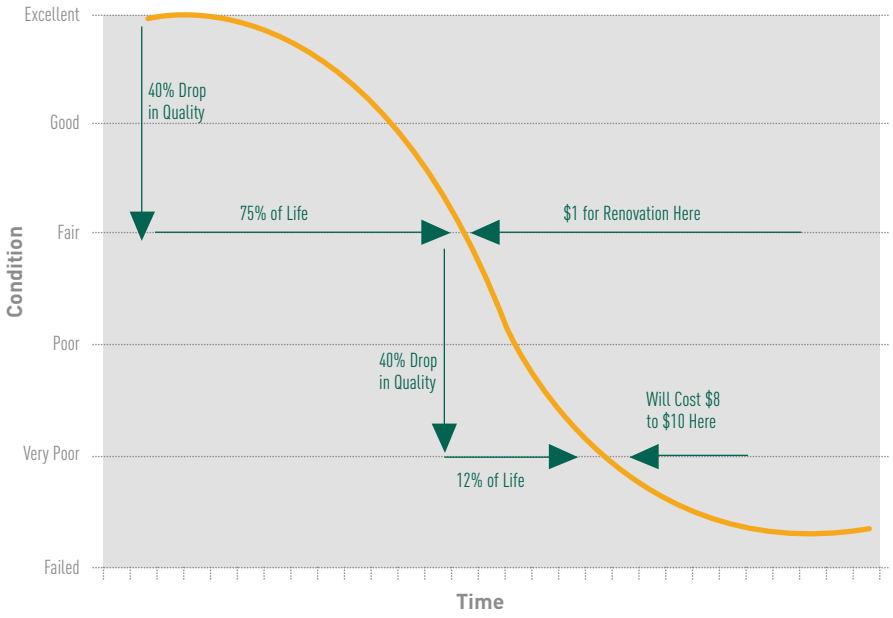
After conducting the study, communities will sometimes, though not always, increase their roadway budget. Rarely is the additional investment enough to cover all the work that's needed, but with a strategic program of maintenance and repair in place (i.e., a pavement management system), the dollars spent go a lot farther.

Livsey has overseen pavement management programs in two towns, first in Billerica and now in Lexington. "One thing I hear from a lot of my peers is that they can't have a pavement management program because they don't have enough funding," he says. "I'd argue that it's even *more* important to follow a pavement management program if funding is tight. Once you begin following the early steps and seeing how it works, you can make a stronger case to the community to fund roadway improvements. It builds on itself."

A pavement management system can alter the way municipal leaders think about roadway maintenance. Typically, it will turn the "worst-first" mentality completely around. Fixing streets in the worst condition first may seem like common sense, but it is actually not the most efficient or cost-effective way to proceed. With a pavement management system, municipalities can clearly see the flaw in this thinking. Rather than exhausting their budget to reconstruct a one-mile stretch of roadway in poor condition, with the same dollars a community may be able to preserve or treat eight miles of roadway in somewhat less dire condition.

"The most important thing to understand is that you need to do basic repairs and general road maintenance early in the process or pavement lifecycle," says Steven Tyler, superintendent of utilities and facilities for the town of Spencer. "Those are the least expensive repairs and, because of it, they're the most valued repairs. That's

Pavement Deterioration Curve



(PCI) Treatment Band Ranges

DO NOTHING PCI Band #1 (100–88 PCI)	**Excellent Condition** — in need of no immediate maintenance.
ROUTINE MAINTENANCE PCI Band #2 (87–68 PCI)	**Good Condition** — may be in need of crack sealing or minor localized repair
PREVENTIVE MAINTENANCE PCI Band #3 (37–47 PCI)	**Fair Condition** — pavement surface in need of surface sealing or thin overlay
STRUCTURAL IMPROVEMENT PCI Band #4 (46–21 PCI)	**Poor Condition** — pavement structure in need of additional thickness to resist traffic loading
BASE REHABILITATION PCI Band #5 (20–0 PCI)	**Failed Condition** — in need of full depth reconstruction/reclamation.

The PCI ranges given in this table are general averages. The actual treatment band threshold numbers depend on pavement surface type and functional classification

where the gap is. A lot of people in my position don't understand how critical it is to spend money on roads in good condition before you spend it on roads in bad condition."

It's a lot less expensive to maintain pavement in decent condition—thereby extending its useful lifecycle before it needs replacement—than it is to completely reconstruct a road that's in poor condition. At the same time, good maintenance of a large portion of a community's roadway system helps to build public support and a greater willingness to finance additional repairs. "When people see the town doing maintenance, and see that we're taking care of fifteen miles of road instead of three, and it's not just raw improvements, that helps to get buy-in from the community," says Livsey.

THE PAVEMENT MANAGEMENT PROCESS

There are many ways to do pavement management. Many cities and towns hire an outside engineering firm or pavement management consultant that incorporates advanced software products, while others choose to perform the duties in-house. In the latter case, communities may use technology as simple as spreadsheet software.

One approach to pavement management includes the following steps:

1. **Project Initiation Meeting:** Consultants meet with key community officials (e.g., DPW director, town/city manager, town/city engineer) to establish goals, collect existing data and prioritize the work areas.
2. **Database Construction:** The project team collects and enters existing data into the software, configuring the program to prepare it for additional data entry.

3. **Pavement Data Collection:** An inventory and evaluation of pavement conditions is conducted for the agreed-upon roadway miles. Factors considered include material type, age, geometry, drainage, substructure conditions and construction history, as well as basic geophysical segmentation, average daily traffic (if available), functional class, curb reveal, and thickness (if available). The comparative measure of this information is the Pavement Condition Index, which is rated on a scale of 0 (worst) to 100 (best). PCI surveying practices and calculation methods have been standardized by ASTM International and accepted by the American Association of State Highway Transportation Officials. Typically, communities strive for a PCI in the low 80s on their major arterial/collector streets and high 70s on their local roadway network.
4. **Quality Assurance, Strategy Meeting and Data Analysis:** After ensuring the integrity of the data, the consultant and municipal officials meet to review the findings, discuss the community's repair policies and prioritize objectives to develop a long-term pavement management strategy. The consultant then determines what the repair "backlog" is and establishes priorities, costs and alternatives for stemming the pavement network's deterioration and moving toward improvement.
5. **Report of Findings:** Data, costs and alternatives are condensed into a report, expressed in layman's terms and incorporating graphs, charts, tables and other illustrations to better explain the findings and proposed solutions.
6. **GIS Integration:** If a community has a geographic information system available, analysts develop a linear route system to aid in the development of a new pavement data layer in the system.
7. **Training and Guidance:** Consultants will train community officials to understand and use the software, while remaining available to assist with the implementation of the program. In many cases, when the consultation is ongoing, an annual status report is also part of the process.

Even if a community is not willing or able to engage an outside expert to implement a pavement management system, this should not prevent officials from benefitting from the concept.

"It can be done at many different levels," says Lexington's Livsey. "We had the money to hire a consultant, so that's what we did. But a town can still go out there and do an evaluation of their roads using a more rudimentary scaling system. You need some knowledge of the process, but you can put together a system in a spreadsheet. With in-house staff, you wouldn't have the power of [a commercial software] model, and you don't have someone whose sole focus is the pavement management system like you do with a consultant, but you would at least get a decent understanding of the funding you need."

Realistically, communities with more than 100 miles of roadway may have a difficult time conducting a comprehensive pavement management review in-house. But the bottom line is that any pavement management system is better than nothing at all.

KEYS TO SUCCESS

Even communities that invest the time and money in a pavement management system can falter in the process. Turnover in key positions or a shift in funding priorities can spell trouble.

There are, however, some prescribed steps that can improve a community's chances of benefitting from an investment in pavement management.

- Ensure buy-in at the top. If a municipality's governing bodies and officials don't support the pavement management system—or worse, don't understand why they're doing it—it will more than likely run off the rails. Communities with the best pavement management results tend to have political leadership with a strong commitment to changing for the better their approach to pavement repair and maintenance.
- Identify project champions. Change is often met with fear and resistance. The person in the organization charged with ensuring implementation of the pavement management system must also be its greatest advocate, stopping at nothing until it is accepted and considered the

COURTESY PHOTO

An engineer checks the grade of a sidewalk curb cut.

guiding force behind the pavement repair and maintenance process. The higher in the organization this person is, the better. It is also critical to identify additional champions to carry on this leadership should the primary person move on to another job.

- Select a software package that is best suited for your organization. Employing technology to solve problems can sometimes complicate a process, especially in the short term. As noted earlier, small and rural communities with a relatively low number of roadway miles can use a simple spreadsheet program. Larger and more urbanized municipalities should consider investing in a comprehensive asset/work order management software program that can address not only pavement, but also water, sewer, sidewalks, ramps, signs, signals and other systems. Whichever approach a community takes, officials should ensure that the program is robust enough to address issues such as short- and long-term prioritization, spending optimization, reporting and querying capabilities, and so on. And don't skimp on training; the best system in the world is useless if the people who matter don't know what it can do or how to use it.
- Conduct a quality assurance review of pavement management data. Proper analysis and planning require accurate data. Identify what you're going to collect, why you need the information, how you will use it and so on. Identify the appropriate data and models required to produce the desired output. Conduct a pilot—select a snow route, district or ward to test data collection and modeling. Perform tests to ensure that the collected data is uniform and consistent, especially when multiple personnel are gathering and entering data.
- Deliver a readable and useful report. The people reading the data are likely to have a range of technical knowledge, so it is imperative to use language that is understandable to a wide audience. Express data and recommendations with terms such as dollars, miles, and months or years. Recommendations should be clear and candid. Tell it like it is.
- Continually update the pavement management database. Pavement/asset management is a living process. It should not be done once and then followed—or worse, forgotten. If pavement management is to be beneficial, the community needs to maintain accurate and up-to-date records of repairs, costs, schedules and so on. One rule of thumb is to inspect between one-quarter and one-third of the roadway network every year.

LONG-TERM BENEFITS

It's tempting to look at pavement management as a quick fix or a silver bullet for all of a community's roadway woes. While pavement management does offer some immediate benefits, this is not the primary motivation. A pavement management system is a long-range plan that will stretch a roadway repair budget and will eventually result in a vastly improved system. The plan typically covers a period of three to five years, with a focus on the work that is necessary to bring the roadway system up to more acceptable standards.

Identifying a community's backlog of work, and the costs associated with addressing these needs, helps the community effectively manage the finances of its roadway infrastructure program. The pavement management system becomes the blueprint for a proactive, cost-effective preservation and maintenance program, as well as the foundation for a strategic capital infrastructure improvement plan.

The benefits don't end with roads, however. Pavement management systems can be shared and coordinated with utility companies, for example. Before a city or town invests in a resurfacing project, it can ensure that any conflicts with utility infrastructure are addressed.

A pavement management plan overlaid with other condition assessments can help communities make better decisions about all of their assets. One example is sidewalk condition data, which allows a community to address issues related to compliance with the Americans with Disabilities Act by identifying problem areas. This includes costs and a timetable for corrective measures.

So what should a community do first? "I suggest talking to some neighboring communities to see what they're doing and what's working for them," says Tyler. "When taking on a challenge of this nature, I feel more comfortable talking with my peers. If they have a pavement management plan, what do they like and what don't they like, what works, how do they manage the data?

"Despite the challenges, pavement management has definitely benefitted Spencer. We've used it to make the public more aware of these concepts, and it has helped us get additional funding to improve the condition of our roads. When you document the issues and show the level of dollars needed, it makes you feel better about the decisions being made on where to spend money."