Massachusetts Infrastructure Investment Coalition

Infrastructure Status Report: Massachusetts Roadways

Roadway Maintenance - Pay for maintenance now, or pay a lot more to rehabilitate later!

April 2006 Volume 2, Number 1

Roadway Facts and Terminology:

- ✓ *There are over 35,000 miles of roadway in Massachusetts. MassHighway owns and maintains only **2,800 miles** of roadway (**8%** of the total miles), but these roadways carry almost **30%** of all vehicle miles.*
- ✓ *Local cities and towns own and maintain over **31,800 miles** of roadway (**89%** of the total miles), but these roadways carry only **60%** of all vehicle miles.*
- ✓ ***Interstate Highways**, or **Interstates**, are restricted access highways that primarily serve long-distance trips or through traffic. Interstate Highways are part of the national Interstate Highway System. Examples in Massachusetts include **I-95, I-90, I-495,** and **I-91.***
- ✓ ***Arterial** roadways are major streets or highways, many of multilane or freeway design, serving high-volume traffic corridor movement that connect major generators of travel. Examples in Massachusetts include **Rte 2, Rte 3, Rte 9, and Rte 24,***
- ✓ ***Collector Roads** are roadways that serve intracounty travel rather than statewide travel, in rural areas. In urban areas, major and minor roadways that provide direct access to neighborhoods and arterials. Examples in Massachusetts include **Rte 27**, **Rte 60**, and **Mass. Ave**. in Boston.*
- ✓ ***Local Roads** are minor roadways in neighborhoods used primarily for short trips.*

A critical issue facing Massachusetts is the poor condition of our roadways. The quality of our roads has a tremendous impact on the economy and the quality of life in Massachusetts. According to the Federal Highway Administration, the overall rating of the roadways in Massachusetts is fair to mediocre. Our interstate highways and some of our arterial roadways are in good condition, but many of the arterial roadways, collector roadways, and local roadways are in serious need of rehabilitation. The state needs to appropriate sufficient funds to cities and towns to rehabilitate and maintain our roadways.

There are over **35,000 miles** of roadway in Massachusetts; **8%** are owned and maintained by **MassHighway** and **89%** of roadways are owned and maintained by **local cities and towns**. Figure 1 identifies the amount of roadway miles and vehicle miles for each type of roadway. Interstate highways and arterial roadways comprise a small portion of the total roadway miles, but as shown in Figure 1, they carry the most traffic.

Figure 1 – Massachusetts Centerline Miles and Vehicle Miles by Functional Classification

Classification	Centerline Miles	Percent of Total	Vehicle-Miles Traveled (Millions)	% of Total
Interstates	568	1.6%	15.729	29.3%
Arterials	5,782	16.3%	26.444	49.2%
Collector Roads	5,530	15.5%	3.662	6.8%
Local Roads	23,710	66.6%	7.874	14.6%
Total	35,590	100%	53.709	100%

Source: U.S DOT, FHWA Highway Statistics 2003, Table HM-63, HM-64, and VM-2

MassHighway is responsible for maintaining the Interstate Highways and the State Highway System which includes approximately 2,800 miles of roadway. Of these 2,800 miles, 34% are in excellent condition, 40% are in good condition, 21% are in fair condition, and only 5% are in poor condition. However, the overall ratings of all the roadways in Massachusetts are not as good. Figure 2 identifies the performance rating for each category of roadway.

Figure 2 – Massachusetts Road Condition by Functional Classification

Classification	Very Good	Good	Fair	Mediocre	Poor	Total
Interstate	66.5%	5.1%	24.1%	4.0%	0.2%	100%
Arterials	0.8%	5.0%	50.4%	33.5%	10.3%	100%
Collector Roads	3.2%	10.4%	53.3%	24.4%	8.7%	100%
Local Roads	NI	NI	NI	NI	NI	NI
Total	5.2%	7.3%	50.3%	28.1%	9.1%	100%

Source: U.S DOT, FHWA Highway Statistics 2003, Table HM-63 and HM-64
NI: Not Inspected - States are not required to provided road condition data for local roads

Driving on deteriorated roads increases operating costs for motorists by decreasing fuel efficiency, increasing tire wear, and by increasing repair costs caused by pot holes and poor pavement. A recent study calculated the increase in operating costs due to poor pavement using the Highway Development and Management Model (HDM). The HDM is recognized by the U.S. DOT as an accurate tool for estimating the impact of road conditions on vehicle operating costs. The study found that driving on deteriorated roads costs the average urban driver $400 annually in extra vehicle operating costs. Since there are at least 3 million licensed drivers with registered vehicles in the Boston area, **the increase in operating costs equates to about to $1.2 Billion in annual costs to Massachusetts taxpayers.**

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- ✓ ***Frost Heave**, or the upward localized movement of pavement, is caused by the expansion of water as it freezes under the pavement. Water directly below the pavement is caused by the moisture from rain or snow that seeps through the pavement, or by poor draining soil under the roadway that attracts moisture from the water table below the pavement structure.*
- ✓ ***Pavement Crack Sealer** is typically a mixture of liquid asphalt, fine sand, and other additives, applied to pavement to seal small cracks and prevent moisture intrusion.*
- ✓ ***Rutting** is the permanent deformation of the pavement (indentations) in the wheel paths.*
- ✓ ***Preventive maintenance** is a planned strategy of cost-effective treatments that preserves, maintains, or improves a roadway system and retards deterioration.*
- ✓ ***Reactive maintenance** is typically required to correct a safety issue. Activities include pothole patching, rut filling, or unplugging drainage facilities.*
- ✓ *A **pavement preservation** program utilizes preventive maintenance to preserve investments in the pavement network, extending service life, and enhancing pavement performance, without substantially rehabilitation or replacing the roadway pavement.*

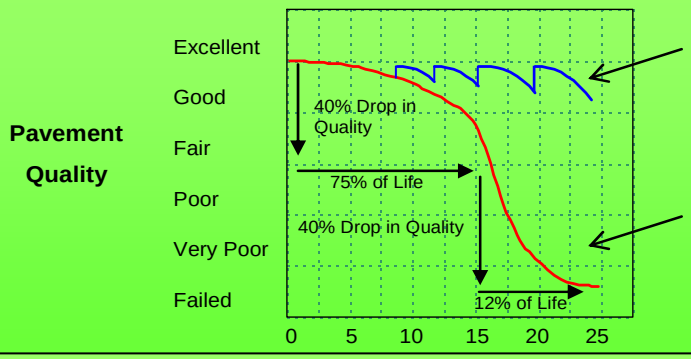
Most motorists first notice that a road is deteriorating when they are jarred by driving over a surface that is rutted or uneven, or the pavement has cracked and a pothole has formed. However, these visible signs of pavement distress are usually the final event in a process of deterioration. Pavement failure is usually caused by a combination of poor pavement structure, traffic loads, and moisture. A properly constructed roadway has adequate pavement thickness to withstand the loads from cars and heavy trucks. It also has a layer of well draining gravel under the roadway that supports the pavement and properly drains away any moisture or water that seeps through the road.

During the late-winter and spring, moisture trapped under pavement repeatedly freezes and thaws causing **frost heaves** and additional cracks in the pavement. The deterioration in the road due to frost heaves from water seeping through cracks in the pavement can be minimized if the initial cracks in the pavement are sealed with **pavement crack sealer.** Frost heaves caused by poor draining soil must be repaired by replacing the poor soil with gravel, and by replacing the pavement.

High volume traffic, particularly from heavier vehicles, puts stress on the road surface, increasing the likelihood that cracks or potholes may form. Pavement cracks and **rutting** on heavily traveled streets is usually caused by poor pavement structure; the pavement thickness is too thin, or the soil under the roadway is not well draining so it is attracting moisture. If the pavement is too thin, an overlay of additional pavement is required. If the problem is caused by poor draining soil, the soil and the pavement must both be replaced.

Pavement failure is a significant source of roadway deterioration, however, a large portion of the cracks in pavement are caused by the natural deterioration of pavement during its service life. The key to effectively maintaining a safe and efficient roadway is to perform **preventive maintenance** to extend the lifespan of roadway surfaces and to avoid more significant pavement rehabilitation. **Preventive maintenance** includes sealing a road surface to prevent moisture from entering cracks in the pavement. It also includes thin pavement overlays, which improve ride quality, correct small surface irregularities, and improve surface drainage and friction. The timing of preventive maintenance is critical. Studies have shown that a program of consistent preventive maintenance can reduce the life-cycle costs of a pavement surface by about one-third. The graph in Figure 3 illustrates this concept. The red line in Figure 4 represents the typical deterioration of a roadway pavement over time. The blue lines in Figure 3 represents the improvement and subsequent deterioration of the roadway after each preventive maintenance**. Preventive maintenance can cost-effectively extend the service life of pavement. The cost to preserve or rehabilitate a roadway is significantly less than the cost to reconstruct the roadway pavement.**

Figure 3 – Typical Pavement Service Life Curve



Source: Galehouse, L., Moulthrop, J. Hicks, G. Principles of Pavement Preservation, TR News, October 2003, P. 8, TRB

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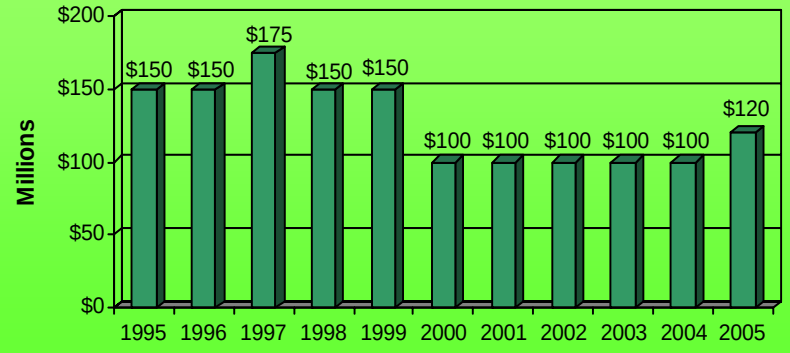
Roadway Facts and Terminology:

- ✓ ***Asset Management*** *is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. Asset management combines engineering principles with sound business practices and economic theory and provides tools to facilitate an organized, logical approach to decision-making. Asset management provides a framework for both short-term and long range planning.*
- ✓ *Studies show every additional dollar spent on preventive maintenance treatments saves up to $10 in future rehabilitation costs.*
- ✓ *Chapter 90 funding cuts have created a backlog of road work in many communities. According to an MMA survey, 87% of responding communities report they have delayed projects such as:*
  - *Reconstruction, reclamation, paving, and/or crack sealing of roadways.*
  - *Line painting for newly paved streets.*
  - *Update of school zone lights that are beyond repair.*
  - *Intersection design work.*
  - *Guard rail replacement.*
  - *Sidewalk and traffic signal improvement projects.*
  - *Erosion control projects, including culvert replacement.*
  - *Scheduled pavement management program projects delayed, resulting in lower pavement condition ratings.*

As previously stated within this report, MassHighway is able to maintain the interstate highways and the arterial roadways in its control in good overall condition. MassHighway is able to accomplish this because they receive federal and state funds to maintain the highways, and because they utilize a Pavement Management System to manage their maintenance program. MassHighway's Pavement Management System is part of an **asset management** system which utilizes roadway roughness and deterioration information to prioritize maintenance, rehabilitation, and resurfacing projects. The Pavement Management System helps MassHighway to maximize the benefit of the available funds to cost-effectively extend the service life of the pavement.

In contrast, local cities and towns each have their own procedure for prioritizing maintenance and rehabilitation work on their roads. More importantly, cities and towns receive limited federal money for the maintenance of their roadways. Some cities and towns utilize real estate tax revenues to fund roadway projects, but most cities and towns rely heavily on funding from the Chapter 90 Program to maintain their roadways. The Massachusetts State government provides funds through the Chapter 90 Program for local road construction, preservation, and improvement projects that create or extend the life of their transportation infrastructure. All Chapter 90 projects are reviewed and approved by MassHighway. During the last six years, Chapter 90 funding levels have been less than the amounts that were approved in the mid 1990's. Figure 5 shows the drop in Chapter 90 funding during the past 6 years.

Figure 4 – Chapter 90 Funding History 1995-2005



According to a recent analysis by the Massachusetts Municipal Association (MMA), cities and towns would need to spend more than $230 million annually to both reconstruct their worst streets and keep the rest of their roads in good overall condition. Since the Chapter 90 funding is not adequate, cities and towns are forced to adopt a program of **reactive maintenance**, which results in more rapid deterioration of the roads and the need for expensive roadway reconstruction. **Adequate annual funding of the Chapter 90 Program reduces the long term need for costly road replacement projects and preserves the taxpayers' investment in our transportation infrastructure. The annual budget for the Massachusetts State Government's Chapter 90 Program needs to be increased in order for cities and towns to bring the local roadways up to an acceptable level. Continued consistent funding will allow cities and towns to properly maintain and preserve the roadway system to extend the service life of roadways and minimize the long term costs to the taxpayer.**

Report References
- Galehouse, L., Moulthrop, J., Hicks, G. Principles of Pavement Preservation, TR News, October 2003, P. 6-7. Transportation Research Board.
- Rough Ride Ahead, Metro Areas with the Roughest Rides and Strategies to Make Our Roads Smoother, May 2005, TRIP
- Results from the 2002 Chapter 90 Survey, Massachusetts Municipal Associations

Massachusetts Infrastructure Investment Coalition – Infrastructure Status Report

Massachusetts Roadways:

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The **Massachusetts Infrastructure Investment Coalition** is identifying the long-term needs for infrastructure investments to support economic development and improve the quality of life for the citizens of Massachusetts. The Infrastructure Status Report for **Massachusetts Roadways** was prepared to provide information about the investment requirements for Massachusetts Roadways. The coalition is currently preparing status reports for other infrastructure elements including: **Aviation, Bridges, Dams, Drinking Water, Energy, Government Facilities, Hazardous Waste, Homeland Security, Housing, Navigable Waterways, Ports and Harbors, Railroads (Freight), Schools, Transit (Rapid/Bus/Commuter Rail), Telecommunications, and Wastewater.**

Massachusetts Infrastructure Investment Coalition

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Aviation – Bridges – Dams – Drinking Water – Energy – Government Buildings - Hazardous Waste – Homeland Security – Housing - Navigable Waterways – Ports and Harbors – Railroads (Freight) – Roads and Highways - Schools – Transit (Rapid/Bus/Commuter Rail) – Telecommunications - Wastewater

The Massachusetts Infrastructure Investment Coalition is supported by:

- A Better City
- American Council of Engineering Companies of Massachusetts
- American Public Works Association-New England Chapter
- Associated Builders and Contractors of Massachusetts
- Associated General Contractors of Massachusetts
- Associated Subcontractors of Massachusetts
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