MAINTENANCE, PRESERVATION, AND EQUITY OF ASPHALT PAVEMENTS

by Richard O. Wolters, PE, MAPA Executive Director and Jill M. Thomas, PE, MAPA Associate Director

Pavement maintenance is not easily defined. Usually there is agreement as to what it is but there are some differences as to what should specifically be performed and when. Pavement maintenance can be defined as the routine work performed to keep the condition of the pavement, under normal traffic and climate conditions, near the condition at initial construction at an economical cost for the geographical area.

Individuals (the public, tax payers, facility owners, etc.) often wonder why pavement maintenance is necessary. All pavements eventually require maintenance because stresses that produce minor defects are constantly at work. These stresses may be traffic loads, temperature changes, moisture changes, or some combination thereof. Regardless of the cause, the result is the same - without timely, cost-effective maintenance, the pavement ultimately deteriorates. Environmental conditions play an active role in performance characteristics along with facility usage.

One of the most fundamental criteria of pavement thickness design and materials selection for pavement maintenance decisions is the prediction of the anticipated traffic loads for the facility. Understanding the traffic loading should be a high priority and an integral part of feasible maintenance strategies. Predicted traffic volume over the design life of the pavement is translated into equivalent 18,000 pound single axle loads (ESALs). The typical design life is 15 or 20 years after which some maintenance (routine, preventative or rehabilitation) is required.

An asphalt pavement in need of maintenance or repair can exhibit various distresses. Diagnosing pavement distress modes for maintenance strategies is also a very key item. The following links provide two useful resources for distress surveys:

(1) "*A Pavement Rating System for HMA Pavement*" on the MAPA web site: http://www.asphaltisbest.com/PDFs/A%20Pavement%20Rating%20System.pdf
(2) *"Pavement Preservation Solutions: Asphalt Overlays"* on the MAPA web site: http://www.asphaltisbest.com/PDFs/Pavement%20Preservation%20Solutions-Asphalt%20Overlays.pdf

All pavements (interstates, county roads, city streets, township roads, commercial facilities, etc.,) can develop defects or distresses. Some of these distresses may be more of an issue in streets than in any other class of pavement structure. Often, in growing areas where funds are very restrictive, the streets are weathered, have utility connections, or other apparent issues. Maintenance must be done quickly, effectively, economically and at a high level of safety for the public and the worker crew. Since most counties and cities serve more than just passenger cars, they may require increased structural capacity due to heavier loads (i.e. school buses, garbage trucks, construction and development equipment, snow removal equipment size, etc.). A thin hot-mix asphalt (HMA) overlay (less than 2" thickness) is the most economical, smoothest, and effective treatment for the majority of the conditions.[1][2][3] Traffic control, pedestrian usage, tracking and liability problems are greatly reduced. HMA also provides for a longer construction season, especially with the use of warm mix asphalt.

What to do? Successful and economical HMA pavement maintenance also requires a knowledge of which asphalt (binder) is available for the geographical area (see the "*Guide to PG Binder Selection in*

MN" at http://www.asphaltisbest.com/resources_engineering.asp). For the most part, Minnesota is blessed with available aggregate options, less trucking costs, and generally a lower price structure than many states. This is true for HMA since there are numerous Minnesota Department of Transportation (Mn/DOT)[4] certified portable and permanent plants in the area capable of supplying material.

In support of the above, the Strategic Highway Research Program (SHRP) has conducted a pavement study titled "Flexible Pavement Treatments" (SPS-3). In this experiment, pavement treatments were applied throughout the United States and Canada to evaluate the effectiveness of maintenance strategies on pavement service life. A total of 81 test sections were selected to cover various climates, pavement conditions, and traffic volumes. An overview report published in 1992 by the FHWA and the "Best Practices Handbook on Asphalt Pavement Maintenance" manual (#2000-04, sponsored by T^2/LTAP, Mn/DOT, and the Local Road Research Board, February 2000) provide a review of alternatives for the geographic area, initial cost estimates, service life, and more. A recent Mn/DOT Report[5] and a national survey[1] have also validated that thin overlays can have a functional life greater than 15 years depending on the condition of the existing pavement. Current state average values or local prices can be used for specific judgment decisions as shown in the example below.

Surface Treatment	**In Place Initial Cost/yd^2**	**Years Life**	**Cost/Service Life/yd^2**
Thin Seals (Fog)	$ 0.25	2	$ 0.12
Chip Seal	$ 1.30	4	$ 0.32
Slurry Seal	$ 1.40	4	$ 0.35
Microsurfacing	$ 1.95	4	$ 0.49
Thin HMA Overlay (1")	$ 2.70	15*	$ 0.18

*****_National State Average, Pavement Type Selection, Asphalt Pavement Alliance, July 2010, AsphaltRoads.org_

If one assumes that the dimensions of one mile of roadway are 5,280 ft. x 24 ft., this yields an area 14,080 square yards (yd^2). Therefore, the cost per mile can be determined as shown.

Life Cycle Cost of Roadway (Cost per Mile)

Thin Seal (Fog)	14,080 yd^2 x $0.12	=	$1,690
Chip Seal	14,080 yd^2 x $0.32	=	$4,506
Slurry Seal	14,080 yd^2 x $0.35	=	$4,928
Microsurfacing	14,080 yd^2 x $0.49	=	$6,899
Thin HMA Overlay (1")	14,080 yd^2 x $0.18	=	$2,534

If one has to manage pavements that are in fair to medium condition, the options could be a chip seal, slurry seal, microsurfacing, or thin overlay. These pavements can display random cracks, possibly some raveled aggregates, depressions, few local alligator crack areas, some cross-slop correction[6], etc. These pavement conditions may also require some structural improvement. A fog treatment would only apply for a pavement in good condition (structurally sound), possibly exhibiting fine cracking, some raveling of the aggregate matrix, and ordinary effects of wear and tear.

Therefore, because Minnesota has a very competitive price structure for HMA, the highly recommended choice should be thin overlay at approximately $2,534/mile (see previous page), which would also add some structural benefit. **HMA overlays for preventative maintenance and rehabilitation are a viable, cost-effective alternative**. HMA is a 100% sustainable and recyclable product for future generations. HMA pavements continue to grow in equity due to inflation and the positive salvage value of recycling the asphalt cement and aggregate. An asphalt pavement can be used and re-used to provide a smooth, environmentally-friendly surface and as studies have shown, the smoother the pavement, the less fuel consumed by the vehicle.[(3)]

In conclusion, our infrastructure is a significant investment just as a building or any other capital structure. Just as these facilities must be properly maintained to ensure maximum utility, so must our transportation system. Proper detection, and timely maintenance and economical decisions for the facility will preserve and protect the investment for the best interest of all the parties involved, primarily those that pay for the street/roadway/parking lot/facility.

Engineering principles and long term economics cannot be over emphasized in an era of budget constraints. This resource (and accompanying life cycle cost analysis work sheet) can be of assistance. If you have any questions, feel free to call 651.636.4666 or e-mail info@mnapa.org.

[(1)] *Thin Asphalt Overlays for Pavement Preservation*, NAPA IS 135, July 2009.
[(2)] *Effectiveness of Thin Hot Mix Asphalt Overlay on Pavement Ride and Condition Performance*, E. Chou and D. Pulugurta, Univ. of Toledo, April 2008
[(3)] *Smoothness Matters*, Asphalt Pavement Alliance, June 2010, AsphaltRoads.org
[(4)] *Hot Mix Asphalt (HMA) as Surface Treatment*, R. Wolters, May 2003
[(5)] Wood, T., R. Olson, E. Lukanen, M. Wendel, and Watson, *Preventive Maintenance Best Management Practices of Hot Mix Asphalt Pavements*, Minnesota Department of Transportation Report No. MN/RC 2009-18, May 2009
[(6)] *Repair of Potholes with Hot Mix Asphalt (HMA)*, R. Wolters, April 2003

LIFE CYCLE COST ANALYSIS OF MAINTENANCE ALTERNATIVES FOR HMA PAVEMENTS

(Worksheet)

Cost/Service Life Analysis

A. <u>Costs/Treatment</u>

	Surface Treatment	In Place Initial Cost, Yd^2		Years Life		Cost/Service Life, Yd^2
1.	Thin Seal (fog)	$ ___________	÷	______	=	$ ___________
2.	Chip Seal	$ ___________	÷	______	=	$ ___________
3.	Slurry Seal	$ ___________	÷	______	=	$ ___________
4.	Microsurfacing	$ ___________	÷	______	=	$ ___________
5.	Thin HMA Overlay (Per 1")	$ ___________	÷	______	=	$ ___________

If one assumes a mile of roadway has the dimensions of 5,280 ft. x 24 ft. wide, this yields 14,080 sq. yds.

B. <u>Costs/Mile</u>

						$ Per Mile / Year of Roadway
1.	Thin Seal (fog)	14,080 Yd^2	x	$ __________	=	$_________
2.	Chip Seal	14,080 Yd^2	x	$ __________	=	$ _________
3.	Slurry Seal	14,080 Yd^2	x	$ __________	=	$ _________
4.	Microsurfacing	14,080 Yd^2	x	$ __________	=	$ _________
5.	Thin HMA Overlay	14,080 Yd^2	x	$ __________	=	$ _________

Based on the above______________________________is recommended.

____

Signature   Title   Date