State Aid for Local Transportation
395 John Ireland Blvd., MS 500
St. Paul, MN 55155

MEMO

Date: January 23, 2018

To: Minnesota City and County Engineers

From: Joel Ulring, Pavement Engineer

RE: Guidelines for Managing Low-binder, Coarse-gradation Asphalt Pavements

Introduction

In the late 1990's, Minnesota adopted the Superpave asphalt pavement technology and a few years later switched their asphalt mix design methodology to gradation-based referred to as Asphalt Film Thickness (AFT). As a result, regions of the state began seeing binder (oil) contents in asphalt mixes drop as mix gradations became coarser. It was noted that pavements constructed with these mixes appeared to lose their dark color quicker than those designed previously using the volumetric mix design methodology. Although these mixes meet MnDOT 2360 bituminous mix specifications, local agency and MnDOT engineers alike were concerned about the performance and durability of asphalt pavements constructed with these mixes. This prompted a lot of discussion and a resulting MnDOT research project.

Research

In 2014, a research project was funded to look at performance and durability of pavements constructed with low binder coarse asphalt mixes. The final report, *Impact of Low Asphalt Binder for Coarse HMA Mixes – Report 2017-27* was recently published in August 2017. The project identified 10 pavement in Minnesota that were constructed using 13 low-binder, coarse-graded asphalt mix designs.

The report concluded the pavements constructed with low-binder, coarse-gradation mixes were more permeable making them more prone to premature moisture and freeze-thaw damage. The coarse gradation of the asphalt mixes make the pavements less resistive to thermal and transverse cracking. These conclusions support the durability and performance concerns expressed by both MnDOT and local agency engineers.

Pavement Management Guidance

Many low-binder, coarse-gradation pavements exist in central, western and northwestern Minnesota. What can a local agency do to best preserve these pavements? An agency can be proactive or reactive when it comes to management of these pavements. The method of approach depends on several factors of which are up to the individual agencies to determine. This guidance looks at both approaches.

Proactive Guidance:

Taking a proactive approach, low-binder, coarse-gradation asphalt pavements can be preserved by placing surface type treatments on them. These can be light, inexpensive treatments which only last a few years before needing reapplication or more robust treatments which can last much longer. Lighter preservation treatment options consist of fog, rejuvenating and sand seals. More robust treatments consist of chip and scrub seals, to slightly more robust slurry seal, cape seal and microsurfacing. The more robust treatments have a higher initial cost, but also have longer service lives so the actual life cycle or annualized cost may be

less. Following is a table of treatments, relative typical cost and estimated treatment service life to assist in better selection of treatments.

Pavement Preservation: Surface Treatments for Asphalt Roadways

Treatment Type	Typical Distresses Treated					Improves Ride	Typical Cost ($/yd²)	Life Expectancy (years)
	Raveling, Wear and Oxidation	Rutting	Cracking	Flushing	Polished Aggregate			
Fog Seal	X				X	No	$$$$$	2 to 3
Rejuvenator Seal	X		X (small)			No	$$$$$	3 to 5
Sand Seal	X		X		X	No	$$$$$	3 to 4
Scrub Seal	X		X		X	No	$$$$$	3 to 6
Chip Seal	X		X	X	X	No	$$$$$	3 to 6
Multiple Chip Seals[1]	X		X	X	X	No	$$$$$	4 to 8
Slurry Seal	X	X	X		X	Yes	$$$$$	6 to 8
Cape Seal	X	X			X	Yes	$$$$$	6 to 8
Microsurfacing	X	X			X	Yes	$$$$$	6 to 8
Thin Overlay[2]	X	X			X	Yes	$$$$$	8 to 12
Overlay	X	X			X	Yes	$$$$$	10 to 15

Notes: 1. The number of chip seal layers placed will determine the cost and life expectancy. The more layers placed will increase the cost and life expectancy.
2. The binder type and aggregate gradation will influence the cost.

Reactive Guidance:

It is very plausible to take a reactive approach to preserving these pavements. However, the agency would need to be watchful and may need to take swift action to preserve a pavement if surface distresses appear. Expected distresses would be cracking, potholes and raveling. Because pavements are allowed to deteriorate further taking this approach, treatments required to preserve the pavement are anticipated to be more costly, toward the bottom of the above table and consist of slurry seal and microsurfacing to thin overlays and overlays. If significant raveling or other distress of the pavement is occurring, it would be advisable to mill or micro mill the surface to expose sound underlying pavement before placing any treatment.

Resources

More detailed information on these various treatments can be found in the following documents:

- MnDOT's roadway Maintenance Manual Chapter 3 Smooth Roads, Section 3-4.0 *"Maintenance of Roadway Surfaces"*
- Minnesota Seal Coat Handbook 2006-34
- Asphalt Seal-Coat Treatments, USDA Forest Service - 1999
- National Center for Pavement Preservation

Questions concerning this memo may be directed to:

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