Asphalt Pavement Rehabilitation, Treatments and Preservation

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Prepared by

Flexible Pavements of Ohio

Pavement Rehabilitation, Treatments and Preservation - Agenda

- Selecting appropriate, timely and economical treatments
- Preventive maintenance treatments
- Minor rehabilitation (repair) treatments
- Major rehabilitation and re-construction treatments

Pavement Preservation Concepts

Pavement deterioration is caused by the combined effects of:
•fatigue from loads
•climate: temperature change, sunlight, air, moisture, freeze and thaw

What features contribute to long life and service of asphalt pavements?

1) Good drainage, both surface and subsurface

2) An adequate thickness of asphalt Pavement to carry the anticipated loads for the desired design period for the existing soil conditions and to resist environmental stresses

3) An adequate program of preventative maintenance to retard deterioration due to climate and wear and corrective maintenance to restore lost serviceability

Preventive Maintenance

- Slows the rate of deterioration of pavement due to traffic loads and environmental degradation
- Not primarily related to correcting **serviceability**
- Minimize the life cycle cost of the pavement – probably the most difficult selection
- Crackfilling and surface treatments: chip seals, slurry seals, thin overlays.

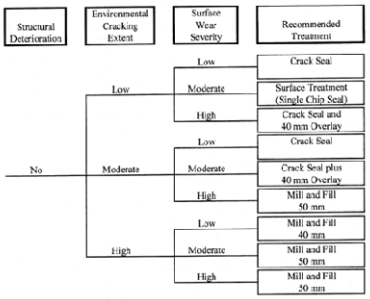
Corrective maintenance

- Correct pavement failures or loss of functional characteristics (serviceability) involving safety
- Reduce liability risk
- Drainage repair or retrofit
- Patching,
- Restoring friction and smoothness with overlays
- Could be part of a rehabilitation

Rehabilitation, Re-construction

- When preventive or corrective maintenance is insufficient or un-economical
- Alternatives may include techniques described for Preventive Maintenance and Corrective Maintenance, drainage, patching and thin overlays
- May require a thick structural overlay or pavement reconstruction

Selecting appropriate, timely and economical PM maintenance treatments



FHWA-IF-00-027

PREVENTIVE MAINTENANCE SUMMARY TABLE

Pavement Applications		Crack Sealing	Chip Seal	Micro-Surfacing	Polymer Modified Asphalt Concrete	Thin Hot Mix Overlay	Concrete Pavement Restoration	Drainage Preservation
Pavement Surface	Concrete	√					√	√
	Asphalt	√	√	√	√	√		√
Reasons For	Friction		√	√	√	√		
	Rideability			√	√	√	√	
	Raveling	√	√	√	√	√		
	Rutting			√	√	√		
	Cracking	√	√		√	√	√	
	Oxidation		√	√	√	√		
	Water	√	√	√	√	√		√
Traffic	Low Volume (<2500 ADT)	X	X	X	X	X	X	X
	High Volume (>2500 ADT)	X		X	X	X	X	X
	Maximum Speed < 45 MPH				TypeA			
Average Cost	Weight / Area	$.60 - $1.00 Per Lb.	$1.00 - $1.75 Per S.Y.	$1.25 - $2.00 Per S.Y.	$2.00 - $4.00 Per S.Y.	$2.50 - $3.50 Per S.Y.	$4.00 - $12.00 Per S.Y.	
	Lane Mile (nominal thickness)	$1,000 - $4,000	$8,000 - $12,000	$8,000 - $10,000	$14,000 - $23,000	$17,000 - $23,000	$25,000 - $75,000	$2,000 - $3,000
Average Life (years)		1 - 4	5 - 8	5 - 8	7 - 12	8 - 12	7 - 12	1 - 5

ODOT, Preventive Maintenance Program Guidelines, 2001

Value Comparison of Alternatives

Economic analysis – valuable if costs and performance can be accurately estimated

- Cost/benefit
- Cost effectiveness
- Life Cycle Cost Analysis

Other value considerations

- What level of serviceability?
- How long? How often?
- Other impacts –indirect economic and environmental
- Life Cycle Assessment of environmental impacts

Preventive Maintenance Treatments

Crack sealing/filling

Surface treatments: seal coats and thin overlays

Goal of any PM treatment

•protect pavement structure from deteriorating effects of climate and wear

•keep the surface impervious to air and water

When is preventive maintenance indicated?

Surface distresses begin to appear:

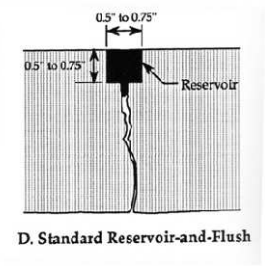
- raveling, progressive disintegration of surface
- shrinkage cracks
- no structural (load related) distress

What to do:

- keep cracks sealed until extent warrants a general surface treatment
- place a general surface treatment such as a thin asphalt overlay

Crack Sealing per Item 423

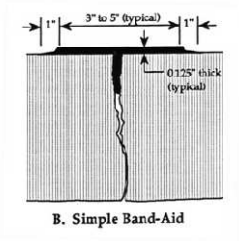
- For structural, full-depth, working cracks and joints - Use type I, rubberized joint sealant per 705.04
- Place the material in a routed or sawed reservoir, flush with the pavement surface.



D. Standard Reservoir-and-Flush

Crack Sealing per Item 423

- For non-structural, surface cracks use type II, III or IV fiber-filled AC crack filler per 702.17
- Fill and overband the crack 2 to 4 inches wide and not more than 3/16ths inch thick.
- ODOT uses with chip seal



B. Simple Band-Aid

Some cracking will not be cured with a surface treatment

- Cracks that penetrate the entire pavement
- Cracks with differential movement
- Even with crack filling, these cracks will reflect through a thin overlay or surface treatment
- Effort is to minimize the damage

Cracking

Asphalt Pavement Preventive Maintenance Surface Treatments

Surface Treatments

- chip seal (Item 422)
- Microsurfacing (Item 421)
- Thin Overlays (424, 442, 441)

Surface treatments fill or bridge over small cracks and seal the pavement surface against the weather while providing a satisfactory wearing surface.

Chip Seal, Item 422, 882

ODOT uses a single chip seal (Item 422) as a PM treatment on highways with less than 2500 ADT (ODOT, PM Guidelines - http://www.dot.state.oh.us/Divisions/Engineering/Pavement/PM%20Guidelines/PM%20Guide.pdf

Item 422 requires one of 2 liquid asphalts for use in chip seal:
RS-2, <500ADT,
Polymer Emulsified Binder (702.16 Type A)> 500ADT
Washed #8 limestone cover aggregate

Other asphalt materials in ODOT specs may be used by others:
CRS-2, 702.07, MWS 60 or 90, MC-3000, HFMS-1

Chip Seal Material

Manual for Emulsion-Based Chip Seals for Pavement Preservation, NCHRP Report 680, TRB, 2011, recommends:

"anionic emulsions should be pared with positively charged aggregates (i.e., calcareous), and
cationic emulsions should be matched with negatively charged aggregates (i.e., siliceous) to avoid possible incompatibility between the materials."

Thin Overlays for Preventive Maintenance

•Single course overlay, or

•Cold milling with single course inlay (mill and fill), or

•perhaps a multiple course overlay or inlay (use in PM overlaps with rehabilitation)

Advantages of an asphalt overlay as a general surface treatment

•protect the pavement structure from damage due to climate and wear
•increase strength
•correct minor surface defects
•improve ride quality and appearance
•can be configured to improve cross slope and drainage
•provide longer more cost effective service life
•ease of maintenance and restoration
•reusable/recyclable

Of course, HMA overlays are also commonly used in rehabilitation treatments ---

•thick overlays to build structural strength
•as a surfacing over base repair or restoration

On varying surfaces use profile milling or a leveling course:

The advantages of using cold milling in conjunction with an inlay include:
- produces a smoother final surface
- permits use of a minimum thickness of HMA
- saves curb exposure
- may permit use of a density acceptance specification
- Removes deteriorated surface material and enables its reuse in new asphalt concrete

A leveling course can serve a similar function where depth is not a constraint or where additional thickness is needed.

As a minimum, provide enough quantity to fill the low spots while maintaining a minimum thickness over the high spots.

Cold Milling and Reuse

Mix Types for Preventive Maintenance

The user must choose materials for the conditions of load, environment and existing surface.

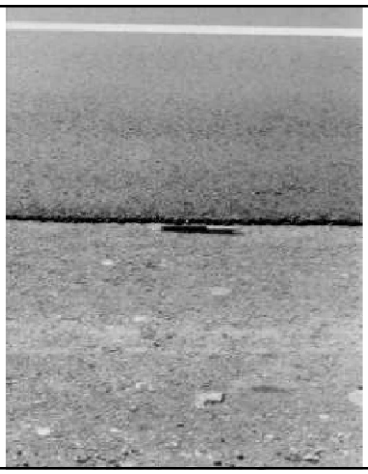
Item 424 , Fine Graded Polymer Asphalt Concrete,

- formulated specifically for thin overlay applications, placed 3/4 to 1 inch thick,
- type B, "smoothseal" designed per 441, for any and all applications including heavy duty and high speed applications.
- These materials have proven very long lasting when used in PM

404LVT – 404 for low volume traffic

Other standard mixes, 441, 442

Smoothseal, Item 424, placed 3/4 inches thick



Minor and Major Pavement Rehabilitation Treatments

Overlays, with and without repairs

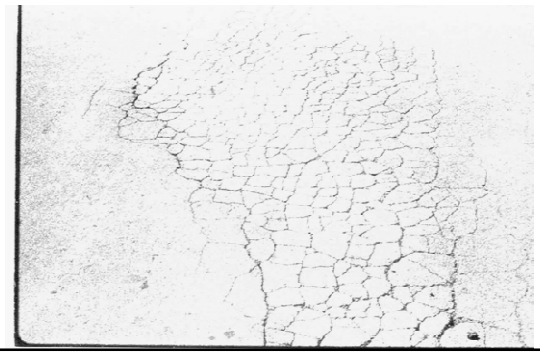
Patching

Milling (pavement planing)

Thin overlays

Correcting deformation

What if your pavement looks like this?



Too late for a PM treatment!

Needs structural repair or rehabilitation

What to do?

Pavement rehabilitation includes all activities short of replacing the existing pavement

- minor rehabilitation--repairs with thin overlays
- Major rehabilitation--thick structural designed overlays, full depth reclamation

Alternatives:

first, correct drainage conditions (ditches, underdrains, inlets?)

if the failures are isolated----remove the distressed area, place a structurally adequate patch and place a thin protective overlay – see the ODOT PM Guide

if the failure is general--- place a thick structural overlay , recycle or reconstruct

Asphalt Structural Overlays

- Ensure structural adequacy
- Evaluate the remaining strength of the existing pavement with visual condition assessment to estimate strength of existing pavement , then design a pavement overlay using the AASHTO or AI methods.
- Non-destructive testing and "black box analysis for soil support and existing base strength
- Design a sufficient thickness of overlay to carry the estimated loads for the desired design period.

Mix Type and Layer Thickness Considerations for Rehabilitaton Overlays:

- The various mix types differ in the minimum thickness that can be practically constructed and many mixes also have maximum course thickness that should not be exceeded for satisfactory performance. Follow the guidance in the ODOT Pavement Manual.
- The minimum course thickness will typically be twice the size of the largest aggregate particles permitted in the mix.
- Additional thickness may be required to accommodate minor rutting or other irregularities in the existing surface.
- Choose a mix that will satisfactorily perform in the required layer thickness and traffic loading.
- specific suggestions for **high stress** loading conditions

Mix type alternatives

- Item 441 Type 1 mixes at 1 to 1 1/2 inches thick for light and medium traffic applications
- Superpave Item 442(Superpave) 9.5mm and 12.5mm mixes placed 1 1/4 and 1 1/2 inches thick, for heavy traffic and high stress applications
- Item 443, (Stone Matrix Asphalt, SMA) placed 1 1/2 inches thick for extreme heavy traffic and high stress applications.

Choice of Asphalt Binders

- Normally PG64-22 for light and medium traffic applications
- Polymer modified binders for heavy traffic (PG70-22M) and high stress (PG76-22M) applications.
- Polymer modified (SBS, SBR) binders have been shown to increase durability and, so, can be expected to extend the life of the pavement
- Other: Asphalt rubber, other modifiers

High Stress alternatives

- Remove (Item 254, Pavement Planing) all deformed material --or at least 3 inches below rut – (determine by cores or a trench)
- Replace with Superpave, Item 442--designed for heavy traffic
- Specify polymer modified binder--PG76-22M

Reconstruction

- Base reclamation
- Thick, designed structural overlay
- New pavement

Full Depth Reclamation and Cold-in-place recycling

References:

- Pavement Design Manual, ODOT, 2012
- Guide for the Design of Pavement Structures, AASHTO, 1993
- Asphalt Overlays for Highway and Street Rehabilitation, MS-17, Asphalt Institute
- Asphalt in Pavement Maintenance, MS-16, Asphalt Institute
- A Basic Asphalt Emulsion Manual, MS-19, Asphalt Institute
- Asphalt Pavement Repair, Manuals of Practice, SHRP-H-348, Strategic Highway Research Program, 1993
- Manual for Emulsion-Based Chip Seals for Pavement Preservation, NCHRP Report 680, TRB, 2011
- Selecting a pavement maintenance treatment for flexible pavement, FHWA-IF-00-027, FHWA
- ODOT, Preventive Maintenance Program Guidelines, 2001
- Other resources: International Slurry Surfacing Assn. , http://slurry.org/, Asphalt Recycling and Reclaiming Association, http://www.arra.org/, FP2, http://www.fp2.org/, AASHTO, http://tsp2pavement.pavementpreservation.org/library/videos-powerpoint-presentations/

Questions?

Flexible Pavements of Ohio

www.flexiblepavements.org