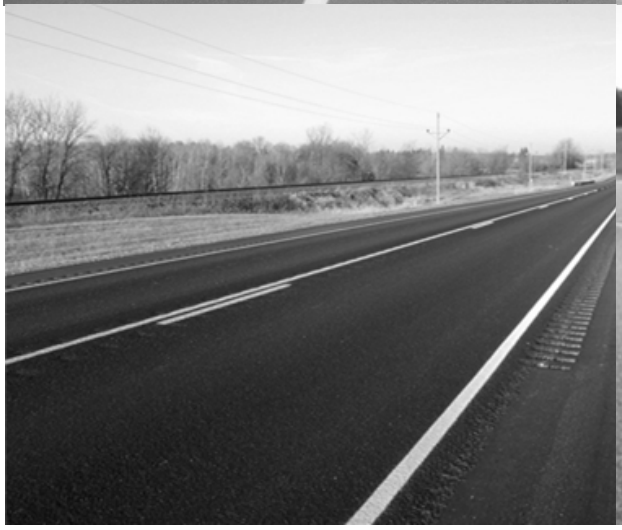
MnDOT Pavement Preservation Manual



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MnDOT Pavement Engineer **Date**

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CHAPTER 1 – INTRODUCTION

Introduction

This document provides information regarding the use of pavement preservation strategies for maintaining pavement condition, and should be used throughout the Department. This manual discusses strategies found in Pavement Management's Highway Performance Management Applications (HPMA) decision trees as well as some that are not yet included in the decision trees. HPMA is a good network level analysis tool; treatment specific decisions are made at the District level.

Portions of this document were adopted from the manuals of the South Dakota and Illinois Department of Transportation and are included with permission.

100 – Definitions

Many transportation agencies use pavement preservation programs to cost-effectively manage their pavement assets. Pavement preservation procedures have been in use for many years, but often agencies use the same pavement preservation terminology in different manners. The Federal Highway Administration (FHWA) provided guidance regarding preservation in a Memorandum dated February 25, 2016. This memo can be found here: https://www.fhwa.dot.gov/preservation/memos/160225.cfm.

The memorandum defined several preservation related terms including:

- Preservation
- Maintenance
    - Routine
    - Preventative

These terms are described in more detail in the following sections.

Preservation

Preservation consists of work that is planned and performed to improve or sustain the condition of the transportation facility in a state of good repair. Preservation activities generally do not add capacity or structural value, but do restore the overall condition of the transportation facility.

Maintenance

Maintenance describes work that is performed to maintain the condition of the transportation system or to respond to specific conditions or events that restore the highway system to a functional state of operation. Maintenance is a critical component of an agencies asset management plan that is comprised of both routine and preventative maintenance.

Routine Maintenance

Routine maintenance encompasses work that is performed in reaction to an event, season, or over all deterioration of the transportation asset. This work requires regular reoccurring attention.

Preventive Maintenance

Preventive maintenance is a cost effective means of extending the useful life of the roadway.

CHAPTER 2 – INTRODUCTION TO PAVEMENT PRESERVATION

Introduction

The intended purpose of a pavement preservation program is to maintain or restore the surface characteristics of a pavement and to extend the service life of the pavement. However, preservation does not generally increase structural value or add capacity to the pavement. As a means of improving the functional condition of the network and reducing the overall rate of deterioration of the pavement asset, preventive maintenance treatments are used in the pavement preservation program. Since they are relatively inexpensive in comparison to resurfacing or reconstruction projects, the preventive maintenance treatments are an effective means to preserve the investment in the pavement asset.

200 – Objectives of Preservation

The implementation of a pavement preservation program is good practice, as it focuses on maximizing the condition and life of a network of pavements while minimizing the network's life-cycle cost. The noted benefits from the use of a pavement preservation program vary from agency to agency, but have been documented as including:

1. Improved pavement performance - preservation activities extend the performance of the pavement and help to improve the overall condition of the transportation system.

2. Higher customer satisfaction - the use of preservation activities can lead to smoother roads and fewer construction delays.

3. Increased cost effectiveness - timely treatments that extend the service life of a pavement reduce the overall life cycle cost.

4. Increased safety - preventive maintenance treatments are designed to provide safer surfaces in terms of improved pavement texture and correction of safety related defects such as ruts, low surface friction, and poor surface drainage.

A successful pavement preservation program relies on proper treatment selection and timing of the treatment to be successful. In order to select the right treatment for the right pavement at the right time, the following should be known (Peshkin et al. 2004):

- What is the structure and condition of the existing pavement?
- What is the expected performance of the pavement?
- How will different treatments affect the pavement's performance?
- What other factors affect how the treatments will perform?

These questions are best answered by information that is available in MnDOT HPMA, field reviews, and discussions with maintenance forces. The pavement management system is a set of tools or methods that assist decision makers in finding optimum strategies for evaluating and maintaining pavements in serviceable condition over a period of time. Pavement management, in the broad sense, includes all the activities involved in the planning, programming, design, construction, maintenance, and rehabilitation of the pavement portion of a public works program (Haas et al. 1994).

Details of MnDOT's pavement management unit can be found at http://www.dot.state.mn.us/materials/pvmtmgmt.html.

CHAPTER 3 – PRESERVATION TREATMENT SELECTION GUIDELINES

Introduction

In this section, MnDOT's preservation treatment selection guidelines and types are defined. It is important to note that this Manual will only discuss treatments on flexible pavements. Rigid preservation treatment inquiries should be addressed directly with the Concrete Office. Future proposed improvements include alternatives for rigid preservation treatments and a selection process.

300 – Treatment Selection Guidelines

Preservation treatments are determined based upon the combination of the current condition of the pavement and the types of distresses present. In some cases, combinations of preservation strategies are needed to correct the combination of distress that is present on the pavement. The process of selecting the combination of treatments for preservation includes the following general steps:

- Gather pavement information.
- Assess pavement condition.
- Evaluate pavement data.
- Identify feasible preservation treatments.
- Select preservation treatment.

Pavement management currently has decision trees that are integrated into the HPMA software to help choose the pavement preservation strategies to maintain the condition of the pavement.

Gather Pavement Information

Selecting preservation techniques includes the collection of historical pavement information, traffic, etc. The type of information needed to select the right treatments include:

- Pavement history, condition, age, and design life
- Traffic Data

Some of this information is included in the HPMA software, the pavement management system, and is a good tool for preliminary information on project sections.

The pavement type dictates the choice of treatment, as different techniques are best for various surface types. In addition to pavement type, the age and design life of the pavement can provide insight into how the pavement has performed over time and how it can be expected to perform in the future. If the pavement is near the end of its design life, it may be an indication that preservation will be less cost effective. Traffic level information, specifically the number of heavy trucks, is a critical detail for determining which treatments to use. Knowing the existing pavement structure and material properties can also be very useful to determine what treatments will work well with the current structure and how the pavement section might perform in the future.

Assess Pavement Condition

In addition to gathering historical pavement information, the current condition of the pavement must be assessed in order to determine feasible preservation treatments. Ideally the condition would be determined in the form of a standard condition rating procedure to include details of the types, severities, and the amounts of all distresses present on the pavement. MnDOT's pavement distress manual is located at:

http://www.dot.state.mn.us/materials/manuals/pvmtmgmt/Distress_Manual.pdf

The distress data is reported in MnDOT's Pavement Management software, HPMA.

Other critical details needed to complete an assessment of the pavement include a field review, non-destructive testing (falling weight deflectometer (FWD), friction, etc.), and interviews with maintenance personnel familiar with the road.

Evaluate Pavement Data

In order to determine whether a pavement section is a good candidate for pavement preservation treatments, the following should be considered:

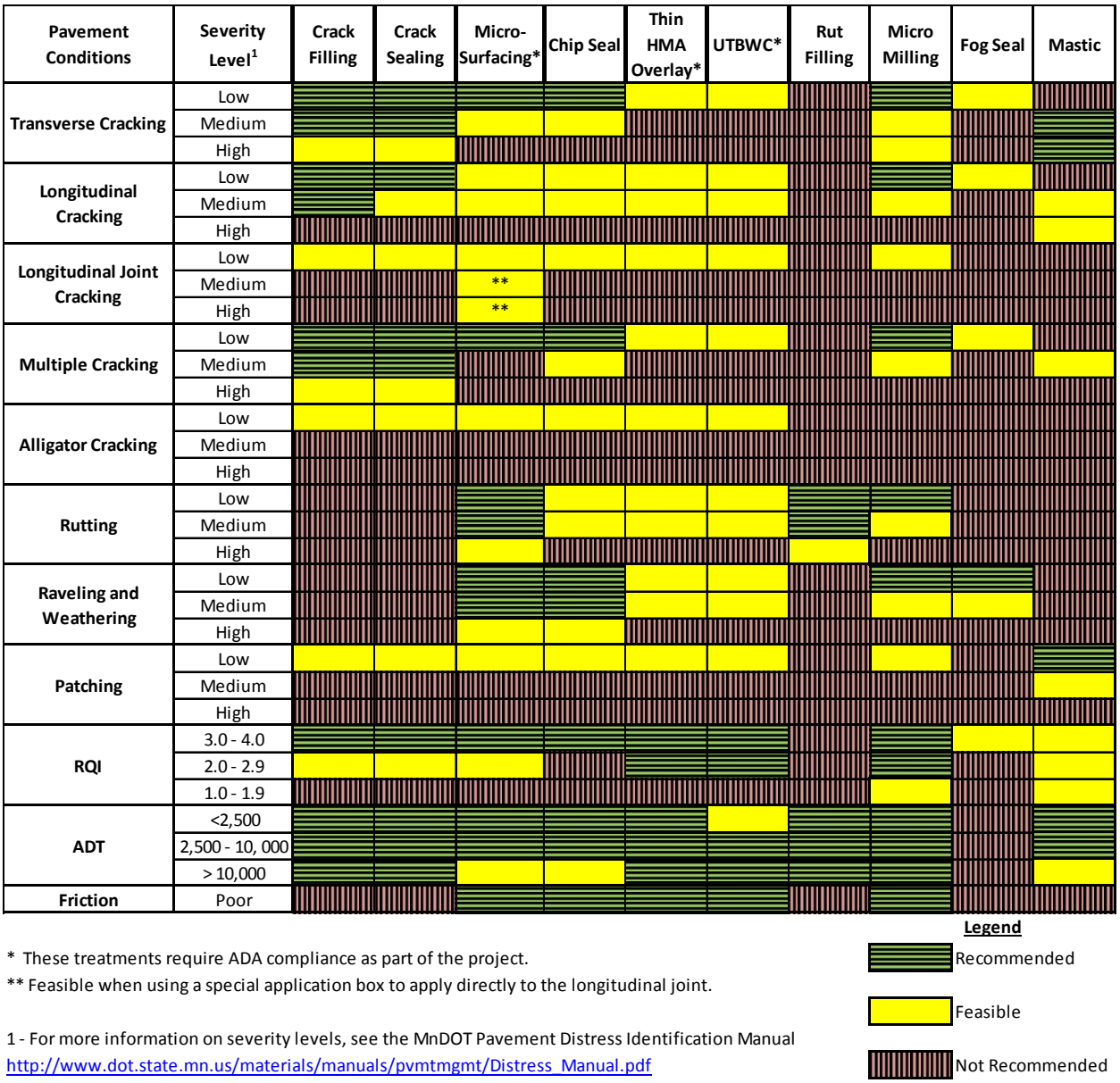
- Are there excessive distresses (large quantities and/or severe levels of distress) on the pavement section or are the distresses a warning sign of an underlying structural problem?
- Has the time for applying a pavement preservation treatment while it is in "good" condition passed?
- Are there other known problems (e.g., material problems, utility issues, drainage issues, or signs of construction problems)?
- Is there a history of pavement problems in this location?

If the answer to the majority of these questions is "no," then the pavement section is likely to be a good candidate for pavement preservation techniques. For pavement sections for which the answer

to most of these questions is "yes," then preservation techniques should not be considered. Instead, more investigation is needed to determine the rehabilitation options.

Identifying Feasible Preservation Treatments

The treatment strategy for those pavement sections identified as candidates for pavement preservation can be determined by looking at the type and severity of pavement distresses present on the pavement. Guidelines for determining recommended and feasible treatments are provided in Figure 3.1. Guidance for treatment selection is based upon attributes such as distress levels, ride quality, surface friction, traffic levels, and relative cost. These characteristics are primarily based on a relationship between a single treatment and a single distress. When multiple distresses exist, the treatment to address each distress type should be examined and the recommended treatments must be used in combination with engineering judgment to make final treatment decisions.



* These treatments require ADA compliance as part of the project.

** Feasible when using a special application box to apply directly to the longitudinal joint.

1 - For more information on severity levels, see the MnDOT Pavement Distress Identification Manual
http://www.dot.state.mn.us/materials/manuals/pvmtmgmt/Distress_Manual.pdf

Treatment Selection Guidelines for Flexible Pavements
Figure 3.1

Select the Best Preservation Treatment

Of the feasible preservation treatments, the best treatment is one that can provide the best cost to benefit ratio while meeting the objectives of the project. There are several methods to identify the treatment with the most benefit for the associated cost. This analysis is done internally within many pavement management systems. Ideally, the selection of the right treatment at the right time is governed by optimization (maximizing benefits for given constraints). However, treatment selection can be accomplished through a manual assessment of the benefits versus the projected treatment cost.

In addition to the benefits and costs of the feasible treatments, the selection of the preservation treatment also includes considering the variety of project constraints that affect treatment selection. Project constraints that should be considered when selecting preservation treatments include:

- Availability of qualified contractors
- Availability of quality materials
- Agency practice or local preference
- Time (of year) of construction
- Initial costs
- User preferences
- Pavement noise
- Facility downtime
- Surface friction

The effect of these constraints will vary from project to project and should be taken into consideration as the final treatments are selected for inclusion in a pavement preservation program.

Identify Existing Pavement Distresses

The MnDOT Pavement Management Unit performs visual surveys on all state highways and interstate routes using pavement management collection vans. Most distresses are recorded for the first 500 ft of every mile. IRI and rutting are measured continuously. This survey identifies and documents the type, extent and severity of a variety of pavement distresses. It is critical to select a treatment type that is capable of correcting or improving the existing pavement distresses. For more information on how Pavement Management Unit collects data, visit: http://www.dot.state.mn.us/materials/pvmtmgmtdocs/Rating_Overview_State_2015V.pdf

The MnDOT Pavement Distress Identification Manual – Visual Distress Manual details the distresses monitored and provides definitions of the various distress types for flexible pavements.

310 – Treatments

Many different pavement preservation techniques and treatments are available. These range from localized applications to treatments that are applied to the entire pavement surface. For all preservation treatments, the purpose is to minimize the effects of pavement distress or prevent them from occurring.

Commonly used preventive maintenance treatments and minor rehabilitation techniques are described in Chapter 4 HPMA Flexible Pavement Treatment Summaries. Each treatment summary is followed by pictures of the treatment. The flexible treatments that are presented are summarized in Figure 3.2. Prior to the presentation of each treatment type is a *Special Considerations* section that provides details that are applicable to a variety of treatments.

Treatments for Flexible Pavements
Crack Filling
Rout and Seal Cracks
Micro surfacing
Seal Coats
Thin Asphalt Overlay – Less than 2.0" (with or without milling prior to overlay)
UTBWC
Micro Milling
Fog Seal
Mastic for Void Filling

Pavement Preservation Treatments for Flexible Pavements
Figure 3.2

There are several special considerations that must be addressed prior to the construction of various pavement preservation techniques.

Pavement Preparation

Complete any crack treatments, spot patching, rut filling, or other required repairs prior to the placement of a preservation treatment. HPMA has smoothness and rutting numbers available for analysis. All flexible pavement sections should be evaluated for the presence of bumps greater than ½" using a 10-foot straightedge. Alternatively, the pavement management unit will provide pavement rutting and longitudinal profile data in mile and tenth of a mile averages when requested. These files will be .erd files that can then be analyzed using ProVAL. ProVAL is a free software provided by FHWA. It can be downloaded from this website: http://www.roadprofile.com/proval-software/ .

Bumps should be evaluated and ground prior to placing of the flexible treatment options that do not include milling or recycling of the pavement surface.

Special attention should be given to properly cleaning all milled materials from the pavement surface prior to applying a treatment. A properly cleaned surface is imperative in order to obtain proper bonding to the underlying pavement for all flexible surface treatments.

When crack sealing is needed prior to a preventive maintenance treatment, the crack seal should be placed at least 1.5 - 3 months in advance to minimize difficulties and conflicts between treatment types and/or contractors.

Pavement Markings

Please review Technical Memorandum No. 14-11-T-02 for guidance on type and placement procedures of striping on preservation treatments. This memo is located here:

http://dotapp7.dot.state.mn.us/edms/download?docId=1520674

Traffic Control

Proper traffic control is needed to ensure acceptable cure times for the majority of treatments. Without proper traffic control after placement, damage to the preservation treatment may occur.

Treatment Sequencing

When epoxy or tape pavement marking exists, coordination of the selected treatment should be considered to maximize the life of the pavement marking.

Rumble Strips/Stripes

Guidance for rumble strips is located here:
http://dotapp7.dot.state.mn.us/edms/download?docId=1463482

CHAPTER 4 – BITUMINOUS PAVEMENT TREATMENT AND FIELD PROCESS GUIDANCE

Introduction

This section summarizes the flexible pavement treatments that are currently found in the HPMA decision tree. The summaries will be followed by brief description of construction with some pictures. The costs in the summaries section were taken from the pavement design units average bid prices found in the initial cost spreadsheets on their web page. This web page is located at http://www.dot.state.mn.us/materials/pvmtdesign/lcca.html .

400 – HPMA Decision Tree Tables

The following Figures will be referenced in the summaries.

RQI ≤ Trigger			
RQI	**Functional Classification**	**RQI**	**Functional Classification**
3.0	Rural Principal Interstate (RIN)	3.1	Urban Interstate (UIN)
3.0	Rural Principal Arterial (RPA)	3.1	Urban Principal Arterial Freeway (UPF)
2.8	Rural Minor Arterial (RMA)	2.8	Urban Principal Arterial (UPA)
2.8	Rural Major Collector (RMJ)	2.7	Urban Minor Arterial (UMA)
2.8	Rural Minor Collector (RMI)	2.6	Urban Collector (UCO)
2.7	Rural Local (RLO)	2.5	Urban Local (ULO)

HPMA RQI Triggers for Functional Classes
Figure 4.00

Good Crack Seal Candidate	
CRITERIA	NOTES
• Age since Last Rehab > 2 but ≤ 5 and	
• Moderate Severity Transverse Cracking ≤ 4% (if BOC pavement Mod. Sev. Trans. ≤ 10%) and	Less than 2 Mod. Sev. Transverse cracks in 500' (If BOC: Less than 5 Mod. Sev. Trans. cracks in 500')
• Low Severity Transverse Cracking ≥ 13% and	More than 6.5 low sev. Trans. Cracks in 500' (crack spacing of less than 75 ft)
• Total Transverse Cracking < 40% and	Less than 20 total transverse cracks, any severity, in 500' (crack spacing of more than 25 ft)
• Last Maintenance Activity not a Crack Seal and	
• Last maintenance Activity not a Crack Fill and	
• Not a Saw & Seal Project	

Not a Good Crack Seal Candidate	
CRITERIA	NOTES
• Age since Last Rehab ≤ 2 or > 5 or	
• Moderate Severity Transverse Cracking > 4% (if BOC pavement Mod. Sev. Trans. > 10%) or	More than 2 mod. Sev. Transverse cracks in 500' (BOC: more than 5 mod. Sev. Trans. cracks in 500')
• Low Severity Transverse Cracking < 13% or	Less than 6.5 low sev. Trans. cracks in 500' (crack spacing of more than 75 ft)
• Total Transverse Cracking ≥ 40% or	More than 20 total trans. cracks, any severity, in 500' (crack spacing of less than 25 ft)
• Last Maintenance Activity a Crack Seal or	
• Last Maintenance Activity a Crack Fill or	
• Saw & Seal Project	

Crack Seal Candidates
Figure 4.01

Good Crack Fill Candidate	
CRITERIA	NOTES
Age since Last Rehab > 5 but ≤ 8 and	
Moderate Transverse Cracking ≤ 50% and	Less than 25 mod. severity transverse cracks in 500' (or crack spacing of more than 20 ft)
No High Severity Longitudinal Cracking and	
No High Severity Transverse Cracking and	
Low Severity Transverse Cracking ≥ 13% and	More than 6.5 low severity transverse cracks in 500' (or a crack spacing of less than 75 ft)
Total Transverse Cracking < 40% and	Less than 20 transverse cracks, any severity, in 500' (or a crack spacing of more than 25 ft)
Last Maintenance Activity not a Crack Seal and	
Last Maintenance Activity not a Crack Fill	

NOT a Good Crack Fill Candidate	
CRITERIA	NOTES
Age since Last Rehab ≤ 5 or >8 or	
Moderate Transverse Cracking > 50% or	More than 25 mod. severity transverse cracks in 500' (or crack spacing less than 20 ft)
Any High Severity Longitudinal Cracking or	
Any High Severity Transverse Cracking or	
Low Severity Transverse Cracking < 13% or	Less than 6.5 low sev. Trans. cracks in 500' (crack spacing of more than 75 ft)
Total Transverse Cracking ≥ 40% or	More than 20 total trans. cracks, any severity, in 500' (crack spacing of less than 25 ft)
Last Maintenance Activity a Crack Seal or a Crack Fill	

Crack Fill Candidates
Figure 4.02

410 – Crack Filling

Crack filling is effective at reducing or delaying moisture damage, further crack deterioration, roughness, and rutting. Crack filling is typically used for non-working cracks.

Specifications: Special Provision 2331 Bituminous Pavement Crack Treatment

Costs: $115-125.00 per road station (RDST).
$3,200 per lane mile
This does not include mobilization, traffic control, and striping.

Treatment Description: Crack filling is the process of placing material into working/non-working cracks to substantially reduce infiltration of water. Crack Filling is characterized by minimal crack preparation and the use of bituminous filler materials.

Crack Filling Crew and Equipment: A broom operator, air compressor operator, driver pulling an air compressor, a heat lance operator, a truck and driver pulling a melter, a wand operator applying filler, crew member placing the toilet paper to prevent tracking, and flaggers / traffic control as deemed necessary.

Pavement Conditions Addressed: Adds no structural benefit, but does reduce moisture infiltration through cracks. Only practical if extent of cracking is minimal and if there is little to no structural cracking.

Construction Considerations: Placement should occur during cool, dry weather conditions. Application during cool weather will allow for expanded crack widths. Proper crack cleaning and a dry crack are essential to achieve good bond and maximum performance. During the placement care should be taken when moisture is present in the pavement layers to insure that proper bonding of the sealant occurs.

FHWA Construction Inspection Checklist:

http://www.fhwa.dot.gov/pavement/preservation/ppcl01.cfm

HPMA Recommends Crack Filling:

- Last rehab an overlay or rehabilitation
- Rutting measured in less than 10% of mile section and is 0.5 inches or less in the left wheel path.
- A good crack seal or crack fill candidate (see Figures 4.01 and 4.02)
- RQI greater than the trigger (varies based on functional classification of the road, see Figure 4.00)

Alternatives to Crack Fill:

- Rout and Seal

Performance Period: 1 to 3 years

Step 1. A typical good candidate for a crack fill application.

Step 2. Cleaning and drying. Cracks must be clean and dry to facilitate sealant bonding. A heat lance is recommended after cleaning to help facilitate adhesion of the sealant material.

Step 3. Material application. This photo shows the application of sealant using a "simple band-aid" configuration. A squeegee should be used to provide a 1" to 3" overband on each side of the crack.

Step 4. Application of blotter. For hot applied materials, typical procedure is to use a single ply of toilet tissue to prevent tracking. Another option for a blotter coat is to use sand to reduce "tracking" of the material by vehicle tires.

Figure 4.10 General Crack Fill Construction Steps

420 – Rout and Seal Cracks

Routing and sealing of cracks is effective at reducing or delaying moisture damage, further crack deterioration, roughness, and rutting.

Specifications: Special Provision 2331 Bituminous Pavement Crack Treatment

Costs: $125.00 per road station
$3,300 per lane mile

Treatment Description: Routing (¾" x ¾") and sealing of cracks is the process of placing flexible material into "working" cracks (i.e., those that open and close with changes in temperature) in order to reduce water infiltration into a pavement. In contrast to crack fill, routing and sealing of cracks requires more substantial crack preparation procedures and uses flexible sealant materials. Thermosetting and thermoplastic materials are both used for crack sealing.

Crack Rout and Seal Crew: Router operators, a broom operator, air compressor operator, driver pulling an air compressor, a heat lance operator, a truck and driver pulling a melter, a wand operator applying filler, crew member placing the toilet paper to prevent tracking, and flaggers / traffic control as deemed necessary.

Pavement Conditions Addressed: Adds no structural benefit, but does reduce moisture infiltration through cracks. Only practical if extent of cracking is minimal and if there is little to no structural cracking.

Construction Considerations: Placement should occur during cool, dry weather conditions. Application during cool weather will allow for expanded crack widths. Proper crack cleaning and a dry crack are essential to achieve good bond and maximum performance.

FHWA Construction Inspection Checklist:

http://www.fhwa.dot.gov/pavement/preservation/ppcl01.cfm

HPMA Recommends Rout and Crack Seal:

- Last rehab an overlay or rehabilitation
- Rutting measured in less than 10% of mile section and is 0.5 inches or less in the left wheel path.
- A good crack seal or crack fill candidate (see Figures 4.01 and 4.02)
- RQI greater than the trigger (varies based on functional classification of the road, see Figure 4.00)

Alternatives to Rout and Crack Seal: Crack Fill

Performance Period: 2 to 4 years

Step 1. Crack Routing. A uniform sealant reservoir increases the probability of a neater, better performing sealant installation.

Step 2. Cleaning and drying. Cracks must be clean and dry to facilitate sealant bonding.

Step 3. Material application. This photo shows the application of sealant using a "single fill flush" configuration.

Step 4. Application of blotter. For hot applied materials, typical procedure is to use a single ply of toilet tissue to prevent tracking. Another option for a blotter coat is to use sand to reduce "tracking" of the material by vehicle tires.

Figure 4.20 General Rout and Seal Construction Steps

430 – Micro Surfacing

Micro surfacing is effective at correcting or inhibiting raveling and oxidation of the pavement surface, improving surface friction, sealing the pavement surface, and filling minor surface irregularities and wheel ruts.

Specifications: 2354 Micro surfacing

ADA Considerations: Compliance with ADA is required when constructing http://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=107

Costs: $2.82 per square yard
$19,900 per lane mile

Production Rate: 7-10 center line miles per day for both scratch and surface course

Treatment Description: Micro surfacing consists of a mixture of modified emulsified asphalt, mineral aggregate, mineral filler, water, and additives. Micro surfacing material is mixed in specialized, compartmented, self-powered trucks or continuous machines and placed on the pavement using an augured screed box. It is typically placed in two courses. The first course, the scratch course, uses a steel box to fill in low areas of the pavements by "scratching" the surface. The surface course is placed with a rubber squeegee to create a smooth surface.

Micro-Surface Crew: A broom and operator, 2 people on front of the continuous machine to hook hose of the emulsion and water trucks to the machine. A micro surfacing continuous machine driver, a pug mill operator, 2 crew members on the back of the box, 1-2 people on the ground with a lute, 1 person adding the mineral filler at the top of the machine, a distributor truck operator for tack placement. Traffic control as necessary for the job.

At the pit you will see a loader operator placing aggregate in as many trucks as needed to keep the operation moving and a crew member filling the emulsion truck.

Pavement Conditions Addressed: Micro surfacing does not add structural capacity but will provide protection of surface distresses like low-severity cracking; raveling/weathering (loose material must be removed); low- to medium-severity bleeding; minor roughness; friction loss; and moisture infiltration. Micro surfacing will also temporarily seal cracks (if severity is low) and can serve as a rut-filler (if the existing ruts are stable). Prior to treatment placement it may be necessary to perform other treatments to address other issues, such as rut filling, patching, crack treating, or spray patching.

Construction Considerations: The micro surfacing material shall be placed only when the air and pavement surface temperature is above 50°F (10°C) and rising. The weather also may not be foggy or rainy. No Micro-surfacing shall be placed when there is a danger that the finishing product will freeze within 48 hours. Micro surfacing material shall not be placed after September 15.

A 1,000 feet nighttime test strip is to be completed prior to placement of the micro surfacing, no matter if the treatment is to be constructed in day time hours. The test strip needs to be able to

carry traffic within one hour of placement. Full production may begin after the test strip is approved by the Engineer.

FHWA Construction Inspection Checklist:

http://www.fhwa.dot.gov/pavement/preservation/ppcl05.cfm

HPMA Recommends Micro surface:

- Traffic greater than 10,000 AADT
- 7 or more years since last rehabilitation and last rehabilitation not a surface treatment
- Rutting measured in less than 10% of mile section and is 0.5 inches or less in the left wheel path.
- Not a good crack seal or crack fill candidate (see Figures 4.01 and 4.02)
- Little or no load related distresses, less than 20' of alligator cracking in 500 feet section, less than 100' high severity longitudinal cracking in 500', less than 10 high severity transverse cracks in 500 feet (crack spacing of 50' or more), less than 100' of multiply cracking in a 500' section.
- RQI greater than the trigger (varies based on functional classification of the road, see Figure 4.00)

Alternatives to Micro surfacing:

- Seal Coat
- Thin lift overlay
- UTBWC

Performance Period: 5 to 7 years.

Step 1. Prepare surface. Surface must be clean. All other in-pavement fixtures (I.E. manholes) need to be protected prior to placement.

Step 2. Tape striping must be removed. All other striping may be pre-treated using CSS-1 or CSS-1h diluted.

Step 3. Micro surfacing placement. This photo shows the placement of material using a micro surfacing spreader box.

Step 4. If the machine needs to stop, a straight edge needs to be made in the micro surfacing. Some handwork may be required to smooth edges. Excessive handwork can segregate the mix as well as leave an unsatisfactory finish.

Figure 4.30 General Micro Surfacing Construction Steps

440 – Seal Coat

Seal coats are effective at improving poor friction, inhibiting raveling, correcting minor roughness and bleeding, and sealing the pavement surface.

Specifications and other Information: 2356 Bituminous Seal Coat

Additional information about seal coats can be found in the Minnesota Seal Coat Handbook
http://www.lrrb.org/media/reports/200634.pdf

Seal coat design software can be downloaded from here:
http://www.dot.state.mn.us/materials/researchsealcoat.html

A short video about applying a seal coat at MnROAD is found here:
https://www.youtube.com/watch?v=Ol5R7n8zGoc

Costs: $1.85 per square yard
$13,000 per lane mile

Production Rate: 10 – 12 centerline mile per day

Treatment Description: CRS-2P asphalt emulsion is applied directly to the pavement surface followed by the application of aggregate chips, which are then immediately rolled to embed chips. Application rates depend upon aggregate gradation and maximum size.

Seal Coat Crew: An emulsion distributor operator, a chip machine operator, 3-4 pneumatic tire roller operators, 3-4 broom operators, trucks as needed to bring chips to project, and traffic control as needed.

At the pit you will need a loader operator to load the trucks with chips.

Pavement Conditions Addressed: Seal coats do not add structural capacity but will provide benefits to pavement distresses like longitudinal, transverse, and block cracking; raveling/weathering (loose material must be removed); friction loss; minor roughness; low-severity bleeding; and moisture infiltration. Prior to treatment placement it may be necessary to perform other treatments to address other issues, such as rut filling, patching, crack treating, crack sealing, or spray patching.

Construction Considerations: Surface must be clean. Treatment should be placed during warm weather with chip spreader immediately behind asphalt distributor and rollers close behind the spreader. Pneumatic-tired rollers should make a minimum of three passes immediately after chip placement. Seal coats are placed from May 15 to August 10 in the northern part of the state and May 15 to August 31 in the southern portion of the state and when the pavement and air temperatures are above 60°F. Construct only in day light hours, roads may be wet but no puddles. Do not construct in rain or foggy weather.

Sweep all pavements the same day as application. Re-sweep the following day to remove all additional loose rock.

A fog seal is recommended on all applications to reduce long term aggregate loss and potential vehicle damage. Fog seal can be placed as soon as one day after the seal coat. Latex permanent stripes can be placed 3 days after the fog seal, all other permanent markings should be placed 14 days after a fog seal.

FHWA Construction Inspection Checklist:

http://www.fhwa.dot.gov/pavement/preservation/ppcl02.cfm

HPMA Recommends Seal Coat:

- Traffic less than 10,000 AADT
- 7 or more years since last rehabilitation and last rehabilitation not a surface treatment
- Rutting measured in less than 10% of mile section and is 0.5 inches or less in the left wheel path
- Not a good crack seal or crack fill candidate (Figures 4.01 and 4.02)
- Little or no load related distresses, less than 20' of alligator cracking in 500 feet section, less than 100' high severity longitudinal cracking in 500', less than 10 high severity transverse cracks in 500 feet (crack spacing of 50' or more), less than 100' of multiply cracking in a 500' section
- RQI greater than the trigger (varies based on functional classification of the road, see Figure 4.00)

Alternatives to Seal Coat:

- Micro-surfacing
- Thin lift overlay
- UTBWC

Performance Period: 5 to 7 years.

Step 1. Prepare surface. Surface must be clean. All other in-pavement structures (I.E. manholes) need to be protected prior to placement. Striping may be pre-treated with emulsion.

Step 2 & 3. Binder and chip application. The asphalt binder is applied to the surface with a distributor truck. A self-propelled, pneumatic-tired, motorized unit that has a hopper on the front where the chips are dumped.

Steps 4 & 5. Rolling and sweeping. After the application of the aggregate, the surface is rolled with pneumatic-tired rollers and swept to remove excess aggregate.

Step 6. After 24 hours, fog seal over the seal coat.

Figure 4.40 General Seal Coat Construction Steps

450 – Thin Overlay or Thin Lift Mill and Overlay

The application of a thin HMA overlay is a viable option for improving ride, surface friction, surface characteristics, and improving the profile, crown, and cross slope.

Specifications: 2360 Plant Mixed Asphalt Pavement

ADA Considerations: Compliance with ADA is required when constructing
http://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=107

Costs: Mill depth of 1.0 – 1.5" is $0.75-$1.00 per square yard.
$6,125 per lane mile
1.5" bituminous overlay $5.00 – $6.00 per square yard.
$35,200-$42,240 per lane mile

Treatment Description: Plant-mixed combinations of asphalt cement and aggregate applied to the pavement in thicknesses between about ¾" and 1 ½". Dense-graded, open-graded, and stone matrix mixes can all be used. Thin HMA overlays consists of placing a 1 ½" single-pass overlay on a previously resurfaced pavement that is not in need of significant repair and is in good condition. If the overlay is applied at the correct time, it can delay serious distresses, extend the life of the pavement, and decrease the lifetime cost of the pavement.

Thin Overlay Crew: A broom operator for sweeping prior to tack, distributor operator to place tack, paver operator, 2 men on the box, 2 crew members walking behind correcting mat with lutes, break down roller operator, pneumatic tire roller operator, and finish roller operator. Traffic control as needed for the project.

Pavement Conditions Addressed: This will provide benefits to pavement distresses like low-severity cracking; raveling/weathering (loose material must be removed); friction loss; roughness; low-severity bleeding; low-severity block cracking (may perform better with additional milling). Thin overlays may also be used to correct rutting but will require the use of a separate rut-fill application.

Construction Considerations: Surface must be clean. A tack coat is required prior to overlay placement and will help improve the bond to the existing surface. Thin HMA overlays dissipate heat rapidly and, therefore, depend upon minimum specified mix placement temperatures and timely compaction. Any additional layer thickness must be taken into consideration to maintain proper clearance under bridges.

FHWA Construction Inspection Checklist:

http://www.fhwa.dot.gov/pavement/preservation/ppcl03.cfm

HPMA Recommends Thin Lift Overlay:

- Rutting measured in 10% of mile section and is 0.5 inches or greater in the left wheel path.
- Less than 30 total transverse cracks, any severity, in 500 feet; or crack spacing of more than 17 feet.
- Little or no load related distresses, less than 20' of alligator cracking in 500 feet section, less than 100' high severity longitudinal cracking in 500', less than 10 high severity transverse cracks in 500 feet (crack spacing of 50' or more), less than 100' of multiple cracking in a 500' section.
- RQI greater than the trigger (varies based on functional classification of the road, see Figure 4.0)
- Mill should be completed prior to the overlay on roads that have curb and gutter

Alternatives to Thin Lift Overlay:

- Micro Surfacing
- UTBWC
- Seal Coat

Performance Period: 8 to 10 years.

Step 1. Prepare surface. Mill if required, adjust manholes as needed. Surface must be clean prior to tack coat.

Step 2. Tack pavement uniformly. Protect tack surface from dirt and debris as much as feasible until placement of the overlay

Steps 3. Place bituminous overlay.

Step 4. Roll the bituminous as needed to achieve density requirements. This will be accomplished with both steel and pneumatic-tired rollers.

Figure 4.50 General Thin Lift Overlay Construction Steps

460 – Ultra Thin Bonded Wear Course (UTBWC)

An ultra-thin bonded wearing course (UTBWC) is a gap-graded thin hot mix asphalt surface course. It effectively addresses minor surface distresses and increases surface friction.

Specifications: 2353 Ultrathin Bonded Wearing Course (UTBWC)

ADA Considerations: Compliance with ADA is required when constructing
http://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=107

Costs: $5.00 per square yard
$35,200 per lane mile

Treatment Description: An UTBWC is formed in one pass with the application of a heavy, polymer-modified asphalt emulsion tack coat and a gap-graded, polymer-modified 0.4 in. to 0.8 in. (10 mm to 20 mm) HMA layer. It is placed using a spray paver.

UTBWC Crew: A broom operator for sweeping prior to paving, spray paver operator, 2 men on the box, 2 crew members walking behind correcting mat with lutes, break down roller operator, pneumatic tire roller operator, and finish roller operator. Traffic control as needed for the project.

Pavement Conditions Addressed: This treatment is applicable for low-severity cracking (high severity can be addressed with cold milling), raveling/weathering (remove loose material), high-severity friction loss, low-severity roughness, and low-severity flushing/bleeding. Provides some increased capacity and retards fatigue cracking, but is not suited for rutted pavements.

Construction Considerations: This treatment requires special paving equipment to place the mix. Repair localized structural problems prior to overlay application. UTBWC courses are not recommended where structural failures exist (e.g., significant fatigue cracking, deep rutting) or if there is high- severity thermal cracking. An UTBWC is not recommended when there is extensive pavement deterioration or little remaining life. UTBWC is capable of withstanding high ADT volumes and truck traffic.

UTBWC is usually placed on top of a new mill and overlay or a micro milled surface. Occasionally it is placed directly on existing asphalt or concrete surface if the overall ride of the existing pavement is in good condition

HPMA UTBWC Recommendations:

- UTBWC is currently is not in decision tree. It is an alternative to seal coat, micro surface, and thin-lift overlay.

Alternatives to UTBWC:

- Micro Surfacing
- Seal Coat
- Thin Lift Overlay

Performance Period: 7 to 12 years.

Step 1. Prepare surface. This can be with a mill and overlay, a micro mill, or just cleaning. Surface must be clean.

Step 2. Place the UTBWC using a spray paver and a shuttle buggy.

Steps 3. Compact using rollers

Figure 4.60 General UTBWC Construction Steps

470 – Micro Milling

Micro Milling uses a milling head with about three times more teeth than a conventional milling head to remove a thin layer of the existing pavement surface and restore pavement smoothness.

Special Provision: 2232 Micro Mill Pavement Surface

ADA Considerations: Compliance with ADA is required when Micro Milling in conjunction with Micro Surface, Cape Seal, Thin Overlay, or UTBWC.
http://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=107

Costs: $0.75 - $1.50 per square yard
$5,280 - $10,560 per lane mile

Treatment Description: The specialized milling head used in Micro Milling produces a surface that has a smoother texture when compared to conventional milling and can improve surface friction of an existing roadway. Much of the smoothness comes from the fact that the ridge to valley depth, or the difference between the lowest and highest points of the micro milled surface, is much less than that of a conventionally milled surface. The milling machine has sonic levelling equipment, usually at the front and rear of the machine that will remove some of the undulations in the pavement profile. Because of the smooth surface texture achieved, a roadway can potentially be opened to traffic after the micro milling operation is complete with no further treatment. Micro Milling is also effective in preparation for treatments such as UTBWC or Thin Lift Overlay. Furthermore, unlike with conventional milling, micro milling can be performed prior to a surface treatment such as a chip seal or micro surface. Mill depth should be limited to one inch.

Crew: A mill operator, mill spotter, haul truck to collect millings, broom operator to sweep surface after milling, and traffic control as needed.

Pavement Conditions Addressed: This treatment is applicable for low to moderate severity roughness (RQI $\geq$ 2.0) and high severity friction loss.

Construction Considerations: A specialized milling head with roughly triple the amount of teeth of a conventional milling head is required for Micro Milling. The milling head should be wide enough to cover an entire lane without the need for multiple passes. The forward speed of the milling machine must be slow enough and RPM of the milling head be such that all teeth across the width of the milling head make proper contact with the existing surface. The pavement must be structurally sound. Micro Milling is not recommended where structural failures exist (e.g., significant fatigue cracking or deep rutting) or if there is high severity thermal cracking. Micro Milling is not recommended when there is extensive pavement deterioration or little remaining service life. Micro Milling is capable of withstanding high ADT volumes and truck traffic if performed on a structurally sound pavement.

HPMA Micro Milling Recommendations:

- Micro Milling is currently is not in the decision tree.
- Micro Milling is a potential alternative to thin mill and overlay when used with a Chip Seal, Micro Surface, Thin Overlay, or UTBWC.

Alternatives to Micro Milling:

- Surface treatment without milling prior to placement.
- Conventional Milling (If combined with a thin overlay or more substantial treatment.)

Performance Period:

- Dependent on the treatment placed on the milled surface.

Step 1. Micro mill is performed across the entire lane width.

Step 2. Millings are collected by a haul truck.

Step 3. Milled surface is swept free of debris.

Figure 4.70 General Micro Mill Construction Steps

480 – Fog Seal

A fog seal is a light application of emulsified asphalt such as CSS-1h or CRS-2Pd. It can be applied to bituminous shoulders, rumble strips, parking lots, recreational trails, or over the top of chip seals.

Specification: 2355 Bituminous Fog Seal

Costs: $2.50 - $3.00 per gallon ($0.13 - $0.60 per square yard)
$915 - $4,225 per lane mile

Treatment Description: CSS-1h or CRS-2Pd asphalt emulsion is applied directly to the bituminous pavement surface at a rate of 0.05 to 0.20 gallons per square yard, depending on the level of raveling and porosity of the existing pavement. The more raveled or porous the pavement surface, the higher the application rate must be. The fog seal must be allowed to fully cure before opening the road to traffic in order to prevent tracking of fog seal and fog seal spraying onto vehicles.

Crew: A broom operator to prepare the surface, distributor operator, and traffic control as needed.

Pavement Conditions Addressed: Fog Seals do not add structural capacity, but will provide benefits to pavement distresses like raveling/weathering (loose material must be removed), moisture infiltration, and low severity cracking. Prior to treatment, it may be necessary to perform other treatments to address other issues, such as rut filling, patching, crack treating, or spray patching.

Construction Considerations: A successful fog seal requires a clean and dry existing surface, therefore the sweeping operation prior to applying the emulsion is very important. A light coating of sand may be applied on top of the fog seal to improve surface friction. Fog seals will only temporarily seal very fine cracks. Crack treatment should be performed prior to fog sealing if medium or high severity cracks are present in the existing roadway. Fog seal must be applied prior to placement of any pavement markings. Existing pavement markings will have to be protected during or replaced after fog seal application. Fog seals are an effective treatment for paved shoulders, rumble strips, parking lots, recreational trails, and can be applied over the top of chip seals.

HPMA Fog Seal Recommendations:

- Fog Seal is not currently in the decision tree.

Performance Period:

- 2 – 4 years

Step 1. Surface is Swept Clean.

Step 2. Fog seal is applied to pavement surface. The example above shows a fog seal applied to a bituminous shoulder.

Step 3. Fog Seal must be allowed to cure.

Figure 4.80 General Fog Seal Construction Steps

490 – Mastic for Crack and Pothole Repair

Mastic is a hot-applied asphalt based product combined with aggregates, polymers, and other modifiers to produce a flowable, load-bearing material that can be used to fill voids in the road surface.

Special Provision: 2331 Mastic for Void Filling

Costs: $2.00 - $3.00 per pound

Treatment Description: Mastic is a hot-applied blend of asphalt material, aggregates, polymers, and other modifiers. It is designed to fill minor voids in the road surface while temporarily sealing the surface from moisture intrusion. Mastic is applied from a thermostatically controlled mixer to a pour box that bridges the void area, leaving a level finish. Mastic is typically used to level cracks that have become cupped due to erosion of the underlying base material, but can also be used to fill other minor voids such as small potholes. Due to the stiff nature of mastic compared to traditional crack sealant, cracks will typically reflect through the mastic between one and three years after its application, but the mastic will remain effective at leveling surface voids.

Crew: Laborers as needed to operate the air compressor, operate the heat lance, apply primer material, fill the mastic pour box, and apply the mastic. Traffic control/flaggers as needed.

Pavement Conditions Addressed: Mastic is effective at improving poor ride quality by leveling cupped cracks and voids in the roadway.

Construction Considerations: Similar to traditional crack treatments, a successful mastic application requires the surface to be cleaned of loose debris and vegetation with an air compressor and dried with a heat lance. If recommended by the manufacturer, a conditioner or primer is then applied to the void before applying the mastic. If necessary, the mastic may need to be applied in two lifts to achieve a level finished surface. Mastic needs a good, solid surface to bond to, therefore the existing surface should be structurally sound and not heavily raveled or deteriorated. Mastic manufacturers have different limitations on lift thickness and depth of repair. Consult the manufacturer's installation instructions for more information. A list of approved mastic products can be found in Special Provision 2331 – Mastic for Void Filling.

HPMA Mastic Recommendations:

- Mastic is not currently in the decision tree.

Performance Period:

- 2 – 8 years

Step 1. Prepare surface. Use air compressor and heat lance to remove moisture, debris, and vegetation.

Step 2. Prime the area to be treated if recommended by manufacturer.

Step 3. Use the pour box to apply a level and uniform band of mastic.

Figure 4.90 General Mastic Construction Steps

INDEX

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