CAPITAL PREVENTIVE MAINTENANCE

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MDOT
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CONSTRUCTION AND TECHNOLOGY DIVISION

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CAPITAL PREVENTIVE MAINTENANCE PROGRAM

DEFINITION OF PREVENTIVE MAINTENANCE

Preventive maintenance is a planned strategy of cost effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system without substantially increasing structural capacity.

DESCRIPTION OF PROGRAM

The Capital Preventive Maintenance (CPM) Program was established to preserve the structural integrity and extend the service life of the state trunkline network through a series of construction contracts. The program was initiated by the Michigan Department of Transportation's Maintenance Division (currently the program resides in the Construction and Technology Division) in 1992, in cooperation with the Federal Highway Administration. Funding for the program is a combination of federal and state transportation dollars.

The CPM program has two subgroups, Pavement Sealing and Functional Enhancements, to encourage a balanced CPM strategy that will complement the Regions Road Rehabilitation/Reconstruction strategy. A discretionary budget and an emerging technologies budget also exist to supplement either group to achieve the most cost effective preventive maintenance strategy. The discretionary budget can be used for pavement sealing, functional enhancements, or emerging technologies. Emerging technologies are new treatments that are promising, but whose performance and cost effectiveness are unknown.

The following table lists all Standard CPM treatments and indicates whether the treatment is a pavement seal or a functional enhancement.

Standard Capital Preventive Maintenance Treatments	
Pavement Seal	Functional Enhancement
●HMA Crack Treatment ●Concrete Crack Treatment ●Concrete Joint Resealing With Minor Spall Repair ●Overband Crack Fill- Pretreatment ●Chip Seals ●Micro-surfacing ●Ultra-Thin HMA Overlay-Low & Medium Volume (<1″ thick) ●Shoulder Fog Seal ●Paver Placed Surface Seal	●Non-Structural HMA Overlay(1.5″)* ●Surface Milling with Non-Structural HMA Overlay (1.5″)* ●HMA Shoulder Ribbons ●Full Depth Concrete Pavement Repairs ●Diamond Grinding ●Dowel Bar Retrofit ●Concrete Pavement Restoration** ●Underdrain Outlet Clean Out and Repair

* Please see Program Guidelines for direction on when 2″ of HMA is allowed in the CPM program

** Includes Joint Spall Repair, Surface Spall Repair, Joint/Crack Sealing, Full Depth Repairs and Diamond Grinding.

EMERGING TECHNOLOGY TREATMENTS

A statewide fund is available for projects utilizing emerging technology treatments. Emerging technologies are treatments that are promising, but their performance and cost effectiveness is unproven. Emerging technology treatments are listed in the Table below. Emerging Technologies not listed in the table will be considered on a case by case basis with input from the pavement committee.

Emerging Technology Treatments
●Polymer Injection Slab Stabilization ●Ultra-Thin Bituminous Overlay-High Volume (<1″ thick) ●Fibermat (Stress Absorbing Membrane Interlayer ●TruPave Engineered Paving Mat (Interlayer) ●Longitudinal Joint Stabilizer (Possible use for rumble strips)

ORGANIZATIONAL STRUCTURE

CONTACTS

The Capital Preventive Maintenance Program is administered by the Construction and Technology Division. The contacts for the CPM program are:

Kevin Kennedy
Capital Preventive Maintenance Engineer
Phone # (517) 322-6043
Email Kennedyk@michigan.gov

Andy Bennett
Scoping Technician
Phone #517-322-5043
Email Bennetta@michigan.gov

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CAPITAL PREVENTIVE MAINTENANCE PROGRAM

GUIDELINES

PROJECT IDENTIFICATION AND SELECTION

The performance of a highway depends upon the type, time of application, and quality of the maintenance it receives. Pavement maintenance can be classified into three activity groups which are preventive, reactive, and routine maintenance. ***Preventive Maintenance*** is the planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration and maintains or improves the functional condition of the system without (significantly) increasing structural capacity. In essence, preventive maintenance activities protect the pavement and decrease the rate of deterioration. ***Reactive maintenance*** are activities that must be done in response to events beyond the control of the Department. Some events require response as soon as possible to avoid serious consequences because a present or imminent danger exists. Reactive maintenance cannot be scheduled because they occur without warning and often must be immediately addressed. Examples of reactive maintenance activities include pothole patching, removing and patching pavement blowups, or unplugging drainage facilities. ***Routine maintenance*** is the day-to-day maintenance activities that are scheduled or whose timing is within the control of maintenance personnel. Examples of routine maintenance include filling cracks in pavement, painting pavement markings or cleaning ditches. Delays in preventive maintenance increase the quantity of pavement defects and their severity so that, when corrected, the cost is much greater. Consequently, the life cycle costs of the pavement will be considerably increased.

The purpose of the Capital Preventive Maintenance Program is to protect the pavement structure, slow the rate of pavement deterioration and/or correct pavement surface deficiencies. Emphasis should be placed on life cycle work for both rigid and flexible pavement. A high priority should be given to newly constructed pavement structures. Appropriate preventive maintenance activities should employ life cycle scheduling until repair costs exceed the benefits derived from such activities or until the pavement structure needs to be reconstructed or rehabilitated. This may require that preventive maintenance activities be performed on pavements at more frequent intervals. The basis of preventive maintenance activities should be consistent with the Region's overall preservation strategy. Each Region should develop a preventive maintenance action plan for their newly constructed pavement structures.

Project selection for preventive maintenance is now assisted by using data from the Pavement Management System (PMS). Recommended pavement condition levels are listed for each preventive maintenance treatment. These condition levels have been identified to aid the Engineer in determining for what existing pavement condition a specific preventive maintenance treatment is cost effective. Pavement condition data includes Remaining Service Life (RSL), Distress Index (DI), International Roughness Index (IRI), Ride Quality Index (RQI), and Rut Depth. These condition measures are consistent statewide and will insure that preventive maintenance treatment selection for specific projects is consistent with long term network pavement strategies identified by the Department. The application of preventive maintenance treatments should be on pavements with a Remaining Service Life (RSL) of greater than two years. Pavements having less than two years RSL will be a candidate for either a Rehabilitation or Reconstruction Project. Pavement conditions that require immediate attention are ideal candidates for routine maintenance until the R/R is implemented.

Preventive maintenance projects can be performed on any highway under the jurisdiction of the Michigan Department of Transportation. These projects should be relatively simple and should focus on pavement structures with more than 2 years of remaining service life. Severely distressed pavement structures or pavements with a severely distorted cross section are generally not candidate projects for the Capital Preventive Maintenance Program. Project work should be kept

between the outside edges of the shoulders or curbs because such a project qualifies for a blanket 3C environmental approval. Minor safety work can be included in Preventive Maintenance Projects, but such work should not be extensive. Examples of minor safety work include; pavement cross section corrections by either milling or by placing a bituminous wedge course, the replacement of blunt and turned down guardrail ending with the new guardrail ending standard, the connection of the guardrail to the bridge rail and/or bridge pier, and the replacement of the existing pavement markings to current standards.

The Capital Preventive Maintenance Program uses mostly surface treatments as categories of work. These surface treatments are targeted at pavement surface defects primarily caused by the environment and by pavement material deficiencies. Occasional structural deficiencies of the pavement structure caused by traffic loading can be corrected by this program. Other preventive maintenance treatments used to protect the pavement structure and/or to slow the rate of pavement deterioration include limited shoulder work and drainage work. The Capital Preventive Maintenance Program includes the following treatments:

Flexible and Composite Pavement Treatments

-Non-Structural HMA Overlay
-Surface Milling with Non Structural HMA Overlay
-Chip Seals
-Paver Placed Surface Seal
-Micro-Surfacing
-Crack Treatment
-Overband Crack Filling
-HMA Shoulder Ribbons
-Ultra Thin Overlay

Rigid Pavement Treatments

-Full Depth Concrete Pavement Repair
-Concrete Joint Resealing
-Concrete Spall Repair
-Concrete Crack Sealing
-Diamond Grinding
-Dowel Bar Retrofit
-Concrete Pavement Restoration
-HMA Shoulder Ribbons
-Open-Graded Underdrain Outlet Cleaning & Repair

All candidate selections consistent with these guidelines will be the responsibility of the Regions. Joint reviews with Lansing Construction and Technology representation is not necessary, unless requested by the Region. The form, Proposed Project Field Review Report (See Appendix A), shall be used to document the field review for each candidate project. Personnel from the TSC and/or Region office will complete the description of the proposed project and the historical data portion of the form before the field review. After the field review, the Preventive Maintenance Coordinator from the Region office will complete the form. The completed form will contain the description of the proposed project, the historical data on the highway section, and field review comments. A copy of the completed form will be sent to the Capital Preventive Maintenance Engineer per the annual Call for Projects letter.

FLEXIBLE and COMPOSITE PAVEMENT SURFACE TREATMENT

NON-STRUCTURAL HMA OVERLAY

Description: A dense graded HMA mixture limited to a 165 lbs/sq. yd. (1.5″) application rate. In certain cases the use of an application rate of 220 lbs/sq. yd. (2″) is approved. Pre-approved cases include: the use of 2″ HMA overlays for crown correction, the use of superpave mixes that require 2″ lifts, and the use of a scratch course prior to a 1.5″ HMA overlay in areas where there is a concern with crack sealing materials. The use of 2″ overlays is still the exception to the rule and the use of 2″ overlays of HMA in the CPM program for any reason other than the pre-approved reasons listed above will require approval from the region system manager, FHWA, and the MDOT CPM Engineer on a case by case basis.

Purpose: A non-structural HMA overlay is the highest type of surface treatment fix available in the Capital Preventive Maintenance Program. It will provide some protection to the pavement structure, slow the rate of pavement deterioration, correct many pavement surface deficiencies, improve the ride quality and add some strength to the existing pavement structure.

Existing pavement condition: The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include moderate raveling, longitudinal and transverse cracks and small amounts of block cracking. Low associated distress may be present. The pavement should only have some minor base failures and depressions.

Rumble strips: If there are existing rumble strips, they should be filled in with the HMA overlay and re-established after the HMA overlay. If the desire is to establish new rumble strips they should be ground in after the HMA overlay.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I	Rut
Flexible	**3**	**<40**	**<70**	**<163**	**<1/2″**
Composite	**3**	**<25**	**<70**	**<163**	**<1/2″**

Existing pavement surface preparation: This preparation work should be limited to the repair of the minor base failures and depressions, the filling of voids in the pavement surface, the removal of any patched area with poor adhesion or a very high asphalt content that may bleed up through the new bituminous surface, the correction of severely tented joints and the correction of deficient superelevations, if required.

Performance: This treatment performs best on flexible pavement structures, but is also applicable to composite pavements depending on the extent of the reflective cracking.

Life Extension

Pavement	Years
Flexible	5 to 10
Composite	4 to 9

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: A non-structural HMA overlay should not be placed on the following existing pavement conditions: severely distressed composite pavement, severely raveling or rutted bituminous pavement, pavement with a weak base, or a bituminous surface that is debonding. In addition, a pavement with excessive amounts of crack sealing may not be a good candidate for a non-structural HMA overlay (please see Appendix B).

FLEXIBLE and COMPOSITE PAVEMENT SURFACE TREATMENT

SURFACE MILLING WITH NON-STRUCTURAL HMA OVERLAY

Description: The removal of an existing bituminous surface by the cold milling method and placement of a dense graded HMA mixture limited to a 165 lbs/sq. yd. (1.5″) application rate. In certain cases the use of an application rate of 220 lbs/sq. yd. (2″) is approved. Pre-approved cases include: the use of 2″ for crown correction, the use of superpave mixes that require 2″ lifts, the use of a scratch course prior to a 1.5″ overlay in areas where there is a concern with crack sealing materials, and where it is necessary to mill 2″ to address distress (such as rutting). The use of 2″ overlays is still the exception to the rule and the use of 2″ of HMA in the CPM program for any reason other than the pre-approved reasons listed above will require approval from the region system manager, FHWA, and the MDOT CPM Engineer on a case by case basis.

Purpose: In the Capital Preventive Maintenance Program, the cold milling operation has been used to: (1) correct specific existing surface deficiencies, (2) correct the shape of the existing cross section and (3) produce a more economical project as compared to a non-structural HMA overlay project. The non structural HMA overlay replaces the bituminous material that is removed.

Existing pavement condition: The existing pavement should exhibit a good base condition. The visible surface distress may include: severe surface raveling, multiple longitudinal and transverse cracking with slight raveling, a small amount of block cracking, patching in fair condition, debonding surface and slight to moderate rutting.

The cold milling operation is used to correct rutting in the existing bituminous surface layer where the rutting is not caused by a weak base and when the condition of the existing pavement has deteriorated to a point where it is not practical to correct the rutting problem by a more economical treatment. The cold milling operation is also used to remove an existing bituminous course that is debonding.

Existing pavement crown and superelevation sections that have been identified as having a relationship to accidents can be modified by cold milling. Often, only a single lane of the existing cross section needs a preventive maintenance treatment. In these cases, it is more economical to remove the existing bituminous surface in that lane by cold milling and do nothing or do a less expensive fix on the less deteriorated portions of the cross section. In a curb and gutter section, cold milling can be used to remove a portion of the existing bituminous surface to retain the existing curb face. Cold milling can also be used in those areas where the existing pavement grade cannot be raised.

Rumble Strips: If there are existing rumble strips they should be re-established after the milling and on course HMA overlay. If the desire is to establish new rumble strips they should be ground in after the milling and one course HMA overlay.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.*	I.R.I*	Rut
Flexible	**3**	**<40**	**<80**	**<212**	**<1″**
Composite	**3**	**<30**	**<80**	**<212**	**<1″**

** Higher R.Q.I. and or I.R.I values may be accepted in urban locations if the cause for the poor ride can be corrected.*

Existing pavement surface preparation: None.

Performance: This type of treatment will protect the remaining pavement structure, slow the rate of deterioration and improve the ride quality.

Life Extension

Pavement	Years
Flexible	5 to 10
Composite	4 to 9

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: This treatment should not be used on an existing pavement that shows evidence of a weak base.

FLEXIBLE and COMPOSITE PAVEMENT SURFACE TREATMENT

CHIP SEAL

Description: A chip seal is the application of a polymer modified asphalt emulsion with a cover aggregate. A single or a double chip seal can be used in the Capital Preventive Maintenance Program.

Purpose: A chip seal will seal and/or retard the oxidation of an existing pavement surface, improve skid resistance of the pavement surface, seal fine surface cracks in the pavement thus reducing the intrusion of water into the pavement structure, and will retard the raveling of aggregate from a weathered pavement surface.

Existing pavement condition: The existing pavement should exhibit a good cross section and a good base. The visible surface distress may include slight raveling and surface wear, longitudinal and transverse cracks with a minor amount of secondary cracking and slight raveling along the crack face, first signs of block cracking, slight to moderate flushing or polishing and/or an occasional patch in good condition.

Rumble strips: If there are existing rumble strips the chip seal should be placed over the existing rumble strips. If the desire is to establish new rumble strips, they should be ground into the pavement prior to the chip seal.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I	Rut
Flexible	**5 (double) 6 (single)**	**<30 (double) <25 (single)**	**<54**	**<107**	**<1/8″**
Composite	**5 (double)**	**<15**	**<54**	**<107**	**<1/8″**

Existing pavement surface preparation: For single chip seals, all visible cracks and construction joints should be sealed by the overband crack fill method. On double chip seals all cracks and construction joints greater than twelve inches in length and greater than one fourth of an inch in width should be sealed by the overband crack fill method. When the number of cracks and construction joints to be sealed reaches the difference of the cost between a single and double seal, it may be more economical and practical to place a double chip seal in lieu of a single chip seal with overband crack fill.

Performance: Since chip seals are used to seal the cracks and construction joints in the pavement in lieu of extensive stand alone overband crack fill, the life expectancy may vary based on reflective cracking.

Life Extension

Pavement	Years
Flexible:	
Single Seal	3 to 6
Double Seal	4 to 7
Composite:	
Double Seal	3 to 6

The time range is the expected life extending benefit given to the pavement, not the anticipated

longevity of the treatment.

Performance Limitations: Chip seals are used only on low volume rural roads and on HMA surfaced shoulders. Chip seals may perform poorly under moderate to heavy commercial traffic because of aggregate loss and flushing. The construction season for this work is relatively short. Chip seals should not be placed in cool weather. It usually requires about one month of warm weather following construction for the aggregate particles to become reoriented and properly embedded in the asphalt membrane. Application during periods of high temperatures and humidity may cause slow cure and excessive flushing. Loose aggregate not embedded in the asphalt membrane will become airborne and possibly damage windshields of vehicles of the traveling public. Traffic noise will also increase after a chip seal is placed.

Micro surface/ Chip Seal Combinations:
A combination of a chip seal followed by a micro-surface, commonly called a cape seal, can be used to effectively treat pavements that have a higher level of distress, including higher levels of cracking and raveling. Micro surface can also be used for filling ruts prior to chip sealing.

FLEXIBLE and COMPOSITE PAVEMENT SURFACE TREATMENT

MICRO-SURFACING

Description: Micro-Surfacing is a mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed, and placed on a paved surface.

Purpose: A single course micro-surfacing will retard oxidation and improve skid resistance in the pavement surface. A multiple course (or heavy single course) micro-surfacing is used to correct certain pavement surface deficiencies including severe rutting, minor surface profile irregularities, polished aggregate or low skid resistance and light to moderate raveling. Micro-surfacing is typically used on flexible or composite pavements and can perform under all traffic volumes.

Existing pavement condition: The existing pavement should exhibit a uniform cross section and a good base. The visible surface distress may include slight cracking, rutting, minor surface irregularities, flushed or polished surface and/or moderate raveling.

Rumble strips: If there are existing rumble strips they should be filled in and re-ground after the micro surface. If the desire is to establish new rumble strips, they should be ground into the pavement after the micro surface.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.*	I.R.I*	Rut
Flexible	**5 (multiple or heavy single) 10 (regular single)**	**<30 (multiple or heavy single) <15 (regular single)**	**<54**	**<107**	**<1″**
Composite	**5 (double)**	**<15**	**<54**	**<107**	**<1″**

Existing pavement surface preparation: Surface preparation typically includes overband crack fill, bump removal (if necessary), removal or protection of raised pavement markers, removal of pavement markings, and seal patching for large voids and potholes.

Performance: This treatment corrects rutting, flushing and low friction. A Micro-Surface performs well on high volume roadways to correct the pavement surface conditions described above.

Life Extension

Pavement	Years
Flexible: Single Course Multiple Course	 3 to 5 4 to 6
Composite: We acknowledge that micro surfacing will provide a life extension to a composite pavement. However, data is not available to quantify the life extension.	

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: A standard micro-surfacing formulation should not be used on a

pavement with moderate to heavy surface cracks. Due to its brittle nature, it is a poor crack sealer. Micro-Surfacing mixes are very aggregate specific because of the chemically triggered, quick reaction characteristics of the mixture. Because micro-surfacing mixes require warm to moderate temperatures for curing, caution is recommended for late season night time work.

Micro surface/ Chip Seal Combinations: A combination of a chip seal followed by a micro-surface, commonly called a cape seal, can be used to effectively treat pavements that have a higher level of distress, including higher levels of cracking and raveling. Micro surface can also be used for filling ruts prior to chip sealing.

FLEXIBLE and COMPOSITE PAVEMENT TREATMENT

CRACK TREATMENT

Description: Crack treatment consists of both crack sealing and crack filling. Crack sealing is attained by the Saw/Rout and Seal Method. Crack filling is attained by the Overband Crack Fill Method. The Saw/Rout and Seal Method consists of sawing/routing the desired reservoir shape at the working crack in the existing HMA surface, cleaning the cut surfaces and placing the specified materials into the cavity to reduce the intrusion of water and incompressibles into the crack. The Overband Crack Fill Method consists of cleaning the non-working crack in the HMA pavement surface and placing the specified materials into and above the crack to substantially reduce infiltration of water and to reinforce the adjacent pavement.

Purpose: The purpose of sealing and filling cracks and construction joints in the flexible pavement surface is to reduce the amount of water and incompressibles entering the pavement structure.

Existing pavement condition: The existing HMA surface should be a relatively newly placed surface on a good base and with a good cross section. On a flexible base, the HMA surface should be two to four years old and on a composite pavement, one to two years old. If the pavement does not meet the description above of if the crack treatment is a second application in the pavement's life cycle, crack treatment may be an appropriate fix but consideration should be given to not placing a warranty on the project. The visible surface distress may include: fairly straight open longitudinal and transverse cracks with slight secondary cracking and slight raveling at the crack face, and no patching or very few patches in excellent condition.

If the existing pavement surface is a surface seal (micro, chip seal, etc.) consideration should be given to the desired outcome of the crack treatment. If the desire is to protect the underlying pavement, the treatment may be excessive since there was likely an overbanding operation prior to the application of the surface seal. If a crack treatment is performed on a surface seal consideration should be given to not placing a warranty on the project.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.*	I.R.I*	Rut
Flexible	**10**	**<15**	**<54**	**<107**	**<1/8″**
Composite	**10**	**<5**	**<54**	**<107**	**<1/8″**

Existing pavement surface preparation: None.

Performance: The effectiveness of the seal will greatly depend upon the width of crack being sealed and the movement of the pavement structure at the crack.

Life Extension

Pavement	Years
Flexible	Up to 3
Composite	Up to 3

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Generally, all transverse cracks in the traveled lanes should be sealed by the Cut and Seal Method. All other cracks in the traveled lanes and the shoulder areas can be filled by the Overband Crack Fill Method. Transverse cracks that have excessive secondary cracking around the main crack should not be individually sealed. The presence of this type transverse crack is an indication that the pavement surface may warrant a more extensive pavement surface treatment.

This treatment is not a one shot operation. In order to maintain the sealed pavement surface, this treatment should be followed up by a routine maintenance crack sealing or crack filling operations when additional cracks develop.

FLEXIBLE and COMPOSITE PAVEMENT TREATMENT

OVERBAND CRACK FILLING

Description: The Overband Crack Filling consists of cleaning the crack in the HMA pavement surface and placing the specified materials into and above the crack to substantially reduce infiltration of water and to reinforce the adjacent pavement.

Purpose: The purpose of overband filling the cracks in the surface of the bituminous pavement is to reduce the amount of water and incompressibles entering the pavement structure. This treatment is commonly used as a surface preparation for surface seal treatments. Use as a stand alone Preventive Maintenance treatment, due to excess wear or failure shall be limited to older pavement where the saw/rout and seal method is not suitable.

Existing pavement condition: The condition of the existing HMA surface depends upon the other Preventive Maintenance treatment that Overband Crack filling treatment will be used as a surface preparation for. Overband Crack filling should be used to fill all non-working cracks.

FOR STAND ALONE APPLICATION

Pavement	Minimum RSL (years)	D.I.	R.Q.I.*	I.R.I*	Rut
Flexible	**7**	**<20**	**<54**	**<107**	**<1/8″**
Composite	**7**	**<10**	**<54**	**<107**	**<1/8″**

Performance: This treatment will help extend the service life of the surface treatment it is being used with as a pretreatment. A stand alone overband crack filling will also extend the life of the pavement structure.

Life Extension

Pavement	Years
Flexible	Up to 2
Composite	Up to 2

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: If this treatment is to be used as a stand alone, caution should be taken in the selection of a pavement where there are too many cracks. This treatment may be a good alternative where the cracks in the pavement have deteriorated just beyond the requirements for a Crack Treatment (cracks are too wide, too many secondary cracks, and/or minor spalling.)

FLEXIBLE, COMPOSITE OR RIGID PAVEMENT TREATMENT

HMA SHOULDER RIBBONS

Description: This work includes the construction of a new HMA shoulder ribbon where gravel shoulders exist or the removal and replacement of a deteriorated bituminous shoulder ribbon.

Purpose: The purpose of a HMA shoulder ribbon is: (1) to accommodate an increasing encroachment of traffic, (2) to expedite runoff water from the traveled lane pavement, (3) to provide other usage such as bicycle paths, (4) to reduce edge stresses and edge and corner deflections by increased lateral support and (5) to reduce the development of pavement edge drop-offs.

Existing pavement condition: In order for this treatment to be used in the Capital Preventive Maintenance Program, the condition of the adjacent pavement structure must meet the Capital Preventive Maintenance Program's pavement condition criteria.

REQUIREMENT

The design life of the shoulder ribbons should be equal to or less than the Remaining Service Life (RSL) of the main line pavement.

Performance: Most shoulder deterioration is attributable to truck encroachment, water intrusion in the longitudinal joint, use of lower quality materials, and inadequate structural thickness. Field observations have shown that shoulder distress is primarily concentrated within 2 feet from the traveled lane. The extension of pavement life will be up to 3 years.

Performance Limitations: The total thickness of the HMA shoulder is limited to 340 lbs/sq. yd. The width of the HMA shoulder ribbon is usually 3 feet. This width of the bituminous shoulder ribbon can be increased where it is justified.

FLEXIBLE and COMPOSITE PAVEMENT TREATMENT

ULTRA-THIN HMA OVERLAY

Description: A dense graded HMA mixture applied with a target application rate of 83 lbs/sq. yd.

Existing pavement condition: The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include slight raveling, minor surface irregularities, and a slightly polished surface. The cross sections should be free of ruts or distortions.

Rumble strips: If there are existing rumble strips, they should be filled in with the HMA ultra-thin overlay and re-established after the HMA ultra-thin overlay. If the desire is to establish new rumble strips they should be ground in after the HMA ultra-thin overlay.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I	Rut
Flexible	**7**	**<30**	**<54**	**<107**	**<1/8″**
Composite	**7**	**<20**	**<54**	**<107**	**<1/8″**

Existing pavement surface preparation: Surface preparation typically includes overband crackfill pre-treatment, bump removal if necessary, removal of raised pavement markers and patching large voids and potholes. Placement of an ample bond coat and warm temperatures are keys to successful application of an ultra-thin hma overlay.

Performance: This treatment performs best on surfaces that are distortion free.

Life Extension

Pavement	Years
Flexible	3 to 6**
Composite	3 to 6**
*** We acknowledge that an ultra-thin HMA overlay will provide a life extension to a pavement, however data are not available to quantify the life extension.*	

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: An ultra-thin HMA overlay should be used only on roads that exhibit light distress. The ultra-thin should not be placed on a milled surface. The ultra-thin should not be used on rutted pavements or pavement exhibiting distortion.

FLEXIBLE and COMPOSITE PAVEMENT SURFACE TREATMENT

PAVER PLACED SURFACE SEAL

Description: A special paver places a polymer modified asphalt emulsion followed immediately by a gap-graded ultra-thin HMA surface course.

Purpose: A paver placed surface seal is a non-structural HMA overlay in combination with a bonding/sealing polymer modified asphalt emulsion. It will help seal the existing pavement surface to reduce the intrusion of water into the pavement structure, improve friction, slow the rate of pavement deterioration, correct minor pavement surface deficiencies and improve the ride, noise and skid qualities of the pavement.

Existing pavement condition: The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include severe raveling, moderate severity longitudinal and transverse cracks, moderate block cracking, moderate patching, or moderate bleeding. Reflection cracking at joints should not exceed moderate severity level.

Rumble strips: If there are existing rumble strips, they should be filled in with the paver placed surface seal and re-established after the paver placed surface seal. If the desire is to establish new rumble strips they should be ground in after the paver placed surface seal.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I	Rut
Flexible	**5**	**<30**	**<62**	**<132**	**<1/4″**
Composite	**5**	**<15**	**<62**	**<132**	**<1/4″**

Existing pavement surface preparation: This preparation work should be limited to minor repairs. Ruts or other depressions greater than ¼ inch depth should be filled with suitable material prior to placement of the paver placed surface seal. Cracks greater than ¼ inch wide should be sealed using an approved crack sealing method. The maximum sealant "film" thickness allowed will be ¼ inch.

Performance: This treatment corrects minor rutting and low friction. The process may be used in lieu of extensive stand alone overband crack fill when the cracking meets the criteria described above. Paver placed surface seal performs well on high volume roadways to correct the pavement surface conditions described above.

Life Extension

Pavement	Years
Flexible	**4 to 6****
Composite	**3 to 5****
*** We acknowledge that a paver placed surface seal will provide a life extension to a pavement, however, data are not available to quantify the life extension.*	

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Paver placed surface seal should not be placed on the following existing pavement conditions: severely distressed composite pavement, severe rutted flexible pavement, pavement with a weak base, a flexible surface that is debonding or severe bleeding flexible surface. Paver placed surface seal will not stop reflective cracking. The construction season may start in early May, but should be discontinued by no later than mid October.

RIGID PAVEMENT TREATMENT

FULL DEPTH CONCRETE PAVEMENT REPAIR

Description: The work consists of complete removal and replacement of the concrete pavement at the deteriorated joint or open crack. The new concrete repair should include load transfer (dowel bars) and contraction and /or expansion joints with joint seals.

Purpose: A full depth concrete repair will restore the pavement's structural integrity and should at least maintain its existing ride quality. Secondary benefits include a reduced amount of water entering the pavement structure and a slower rate of future distress formation.

Existing pavement condition: Overall, the concrete pavement should be in good condition and deteriorating at a slow rate. Transverse joints and cracks to be repaired should show at least 3 feet of moderate to severe spalling over its length within the lane. Other transverse cracks exhibiting a crack width greater than 1/4 inch or faulting more than 1/8 inch are appropriate for full depth repairs.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I
Rigid	**7**	**<20**	**<54**	**<107**

*The full depth concrete pavement repair is limited to 30 patches per lane mile.
**Higher R.Q.I./I.R.I. numbers should consider Concrete Pavement Restoration.

Performance: The time period from casting to intended opening to traffic should be a minimum of 3 days.

Life Extension

Pavement	Years
Rigid	3 to 10

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Concrete repairs will usually induce a variation in tire noise from a difference in surface texture between the repair and the existing pavement. If a calcium chloride accelerator is used for faster strength gain, then the anticipated longevity of the repair will be reduced by approximately 50%. In general, the longevity of the repair will be reduced when strength gain is accelerated from normal rates using Grade P1 concrete.

RIGID PAVEMENT TREATMENT

CONCRETE JOINT RESEALING

Description: This work includes the removal of the existing joint seals, and resealing the transverse and longitudinal joint with low-modulus hot-poured rubber.

Purpose: The purpose of resealing the concrete pavement joints is to prevent water and incompressible from entering the pavement structure, thus slowing the rate of deterioration of the concrete pavement.

Existing pavement condition: Rigid Pavements where the existing sealant has failed.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I
Rigid	**10**	**<15**	**<54**	**<107**

Existing Surface Preparation: Remove all existing joint sealant material prior to resealing with low- modulus hot poured rubber. Repair spalls greater than 1 ½ inches prior to resawing and sealing the pavement joints. Review existing pavement drainage for signs of pumping or sub-surface water that may inhibit adhesion of the low-modulus hot poured rubber.

Performance: A properly placed concrete pavement seal should benefit the service life by slowing the deterioration rate of the concrete pavement.

Life Extension

Pavement	Years
Rigid	3 to 5

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the

RIGID PAVEMENT TREATMENT

CONCRETE CRACK SEALING

Description: Crack sealing involves the sawing or routing, cleaning and sealing of cracks in the concrete pavement that are greater than 12 inches in length and greater than 1/8 inch in width. If the crack is greater than 3/8 inch in width a backer rod must be used.

Purpose: The purpose of sealing the cracks in the concrete pavement is to reduce the water and incompressibles from entering the pavement structure and thus slowing the deterioration rate of the pavement.

Existing pavement condition: Concrete pavement that exhibits a slow rate of deterioration should have a high priority for crack sealing. Subsequent Preventive Maintenance crack sealing projects should follow every five years or until the condition of the pavement requires extensive work that is beyond the scope of the Capital Preventive Maintenance Program.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I
Rigid	**10**	**<15**	**<54**	**<107**

Performance: Crack sealing should help slow the deterioration rate of the concrete pavement. This treatment is best used in conjunction with other treatments of rigid pavements such as joint resealing and minor spall repair and /or full depth concrete joint repair. The benefit from sealing concrete pavements with open graded drainage course and underdrains has not been determined.

Life Extension

Pavement	Years
Rigid	Up to 3

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

RIGID PAVEMENT TREATMENT

DIAMOND GRINDING

Description: This work consists of diamond grinding the entire lane width as specified on the plans.

Purpose: Diamond grinding is used to restore the surface longitudinal profile and crown of a concrete pavement that provides an improved ride quality. Benefits from diamond grinding include: the removal of joint and crack faults, the removal of wheel ruts caused by studded tires, the restoration of transverse drainage, and the improvement of skid resistance. If appropriate, only one lane of a multi-lane roadway can be improved by diamond grinding.

Existing pavement condition: The existing pavement should exhibit a uniform cross section and a good base. The visible surface distress may include joint and crack faults not exceeding 1/4 inch, rut depths less than 1/4 inch, moderate to severe polishing, or not over twenty five percent scaling of the surface area.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I
Rigid	**12**	**<10**	**<54**	**<107**

Existing pavement surface preparation: Diamond grinding should not be viewed as a one step solution to treating the concrete pavement surface. Often other repairs should be performed prior to diamond grinding. Diamond grinding should be considered when the average ride quality index (RQI) is greater than 54, average friction number is 30 or less, or there are more than 50 full depth repairs per mile.

Performance: The reduced impact loading caused by diamond grinding should significantly extend the pavement service life. Faulting at the joints and cracks may return after several years of service to the condition prior to diamond grinding. This will depend on several factors, including the joint efficiency of the pavement and the amount and quality of concurrent concrete pavement treatment work. The improved skid resistance due to diamond grinding depends on the final micro texture and macrotexture and the hardness and polishing characteristics of the aggregates. The improved skid values will decline until they reach the skid levels of the original surface at which point the values will generally remain steady.

Life Extension

Pavement	Years
Rigid	3 to 5

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Diamond grinding should generally not be used on concrete pavements where the faulting is greater than 1/4 inch. Greater fault depths will greatly increase the unit cost of diamond grinding. As mentioned above, diamond grinding should not be used as a one step solution to treating the deficiencies of the concrete pavement.

RIGID PAVEMENT TREATMENT

DOWEL BAR RETROFIT

Description: Dowel bar retrofit is an operation in which slots are cut into the concrete pavement across faulted joints and cracks, and dowel bars are placed in the slots to restore the load transfer. The work consists of five operations: cutting the slots, preparing the slots, placing the dowel bars, backfilling the slots and opening the pavement to traffic.

Purpose: A dowel bar retrofit treatment restores the effective load transfer at faulted joints and cracks, significantly reduces the recurrence of faulting and increases the structural capacity of the pavement.

Existing pavement condition: This treatment should be used to rehabilitate existing jointed concrete pavements in good to fair condition before serious deterioration is present. There should be very little to no spalling along the joint or crack. Crack widths should be less than 1/4 inch and faulting less than 1/8 inch.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I
Rigid	**10**	**<15**	**<54**	**<107**

Performance: This treatment should generally be used with other rigid pavement treatments such as diamond grinding, to extend the service life of existing jointed concrete pavements. Joint resealing or concrete crack sealing may also be necessary on pavements with poorly draining bases.

Life Extension

Pavement	Years
Rigid	2 to 3

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: If serious faulting at the existing cracks and joints in the concrete pavement is present, this should not be used as a stand alone treatment. Base problems must be addressed.

RIGID PAVEMENT TREATMENT

CONCRETE PAVEMENT RESTORATION

Description: This work shall include full depth concrete pavement repairs and diamond grinding. A combination of additional treatments, including spall repair, dowel bar retrofit, crack sealing and joint resealing, can provide substantial benefit to the pavement.

Purpose: Most projects will require several treatments used in combination to correct existing distresses. The treatments not only repair distress, but also prevent or slow the recurrence of distress.

Existing Pavement Conditions: The concrete pavement will likely display deterioration that requires a combination of various treatments. The key is to select a repair strategy that considers costs, longevity and future maintenance and reconstruction options. Generally, roadways considered for concrete pavement restoration have 3 to 7 years of Remaining Service Life (RSL).

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	I.R.I
Rigid	**3**	**<40**	**<80**	**<212**

Performance: A proper application of treatments to correct deficiencies will result in longer lasting concrete pavements. Additionally, the work will result in greater public consciousness of the improvements. If the pavement condition requires more than 70 full depth concrete repairs per lane mile, a rehabilitation or reconstruction alternative approach may be more cost effective.

Life Extension

Pavement	Years
Rigid	7 to 15

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: If a calcium chloride accelerator is used for faster strength gain, then the anticipated longevity of the repair will be reduced by approximately 50%. In general, the longevity of the repair will be reduced when strength gain is accelerated from normal rates using Grade P1 concrete.

RIGID PAVEMENT TREATMENT

OPEN-GRADED UNDERDRAIN OUTLET CLEANING AND REPAIR

Description: This work includes the clean out and repair of the rigid PVC, corrugated plastic or steel open-graded underdrain outlets from outlet ending to the connection with the mainline open-graded underdrain.

Purpose: The installation of an open-graded drainage system improves the long term load carrying and load distribution properties of the base, subbase and subgrade materials by removing the free water which can decrease the stiffness of these load carrying layers. The clean out and repair of the open-graded underdrain outlets will help re-establish the effectiveness of the open-graded underdrain drainage system.

Existing pavement condition: The clean out and repair of open-graded underdrain outlets should begin on a rigid pavement that is approximately ten years old. Subsequent Preventive Maintenance clean out and repair projects should follow every ten years or until the condition of the pavement requires extensive work that is beyond the scope of the Capital Preventive Maintenance Program.

Performance: The clean out and repair of the open-graded underdrain outlets will help re-establish the effectiveness of the open-graded underdrain drainage system thus maintaining the load carrying capacities of the base, subbase and subgrade.

Performance Limitations: Since this work will be done by contract, it is necessary to define the work to be done in the contract and provide a relatively accurate plan quantity. Requiring the contractor to explore for the open-graded underdrain outlets shall not be included in the Preventive Maintenance Projects because such work can not be accurately identified and quantified. The underdrain outlet repair work will be limited to work perpendicular to the roadway.

CAPITAL PREVENTIVE MAINTENANCE PROGRAM

SAFETY CRITERIA

Projects that have been selected will no longer require a crash history analysis by the Safety Programs Unit except for HMA surfacing projects. On those projects, the regions will be required to accurately report superelevation measurements for curves that have a history of crashes. The elevation shots will be provided to the Geometric Design Unit early in the design stage of the project. A correlation of crashes to deficient geometry will require an upgrade of superelevation.

The following criteria shall apply to <u>all projects:</u>

- Gravel shoulder shall require a minimum 3 feet wide paved shoulder ribbons.

- The regions are to conduct roadside hardware inspections to determine the amount of guardrail that has severe post and guardrail deterioration. The region will determine whether the guardrail should be upgraded on the capital preventive maintenance project or delayed until a future project. Replacement of deficient guardrail on freeways should be coordinated through the Region Development Engineer and the Lansing Traffic and Safety Division.

- Cable-Type guardrail shall be upgraded to current standards or appropriate slope modifications should be made.

- Blunt and turned down guardrail endings shall be replaced with an appropriate ending from the Road and Bridge Standard Plans.

- Guardrails shall be connected to bridge rails and piers.

- The pavement markings, advance warning signs, and crossbucks for all railroad crossings shall be upgraded to meet current standards. However, railroad crossbucks with active signals or gates do not require upgrading by the capital preventive maintenance program. The railroad company will have responsibility for replacing signals and gates with prioritization independent of the roadway projects.

Approved 03-03-95 (EOC)
04-10-95 (FHWA)
Terminology Update 5-16-00,11-5-2009

CAPITAL PREVENTIVE MAINTENANCE PROGRAM

ADA RAMPS

The details MDOT policy regarding ADA ramp requirements are still being finalized. At this time, as a general guide:

- Projects with less than ¾″ overlays do not require ADA ramp upgrades.

- Projects with ¾″ or greater overlays require ADA ramp upgrades if technically feasible and if they can be upgraded without the need to acquire right of way on a project that otherwise does not include right of way acquisition. This category includes HMA mill and resurface projects.

- Projects with ¾″ or greater overlays that need to acquire ROW in order to upgrade the ADA ramps are required to upgrade the ramps if ROW acquisition is within the scope of the project. If ROW acquisition is not within the scope of the project, ADA ramps are not required to be upgraded.

As with all safety related items, if history reveals there is a safety related issue with regards to ADA ramps, an effort should be made to include improvements in the project. In addition, the most recent FHWA requirements and most recent MDOT policy should be consulted before making any decisions on ADA ramps.

REGION DEVELOPMENT GUIDELINES
for
WORKPLANS for EMERGING TECHNOLOGY TREATMENTS
for PAVEMENT PRESERVATION PROJECTS

At their January 2000 meeting the Engineering Operations Committee approved a general process to track and document the effectiveness of new "emerging technologies" for pavement preservation. The basis for the process was the *Research Protocols for Pavement Preservation,* dated September 1999, which was developed by AASHTO. The following guidelines further explain how a workplan should be developed for department preservation projects, whenever a new technology is utilized.

A workplan is required for any project that uses a new technology that is not considered standard department practice. The purpose of the workplan is to fully describe the technology and its particular use on a project(s). It answers questions such as; How will the technology be used? What are its benefits? In addition to a general description of the project and how the work will be performed.

Department Oversight
The Regions/TSCs have primary responsibility for the initiation, construction, monitoring, and reporting of projects utilizing new technologies. The Pavement Committee maintains statewide oversight of the process and review/approval responsibility for project acceptance. The Region/TSC will draft a workplan, which is then submitted to the Pavement Committee for review and acceptance.

WORKPLAN COMPONENTS

Summary Page
Provides a brief (snapshot) summary of the project. Includes the project location and description, identification (CS & JN), technology name, proposed construction date, and whether the project is R&R or CPM.

Background Statement
Describes the project details and the purpose of the technology. Includes some background on the technology, as to its' primary benefits and development/usage to date. Why was this project selected to demonstrate the technology's effectiveness?

Description of the Treatment (Fix)
Provide a detailed description of the project. Include any additional information not included in the background statement, as to how the technology is expected to extend the pavement's service life, if R&R, or extend service life, if CPM.

Objective
Provide a concise statement regarding the intend accomplishments from this project with emphasis on the technical merits involved. What about the technology needs to be understood and demonstrated?

Study Tasks
Provide a listing of the work tasks involved to accomplish the project objective. These could involve pre-testing of materials, specific construction oversight, collection of samples, field documentation, data analysis, and documentation/reporting. Does the vendor or material supplier have a role in

the project outcome and/or is their presence required on site? The AASHTO research protocol provides additional insight for this item.

Anticipated Results
Describe what benefits are likely to occur and how they are applicable to current department practices.

Documentation and Reporting
Describe what project documentation is required. How long will project monitoring need to take place? As a minimum, after construction is completed a series of reports are required. They are:

Construction Report - Documents how the work was performed with emphasis on any deviation from the intended course of action. Includes all pertinent information about the technology itself; including actual usage, limits, material reports, IDRs, and deviations from plan details. Initial conclusions about the technology and recommendations on additional trial projects are desired.

Progress Reports - Depending on the duration of the monitoring cycle, one or more progress reports may be required. Their primary purpose is to report on current field performance, including trends over time, and recommendations on further use. An annual update is usually required, unless unusual circumstances justify a more lengthy reporting schedule.

Final Report - A detailed accounting of the project's findings. Summarizes previous information from past reports. Includes all data analysis and outcomes from study tasks with conclusions/recommendations regarding the technology's use and implementation into department practice. Was the objective accomplished? Documents project costs and benefits derived.

Project Oversight
Identifies a regional contact person(s) who will take the lead on the project. If more than one Region is involved, than identify a "lead" Region. If multiple persons are involved, identify individual roles and responsibilities. Include a description of assistance required from others, including the central office or contracted (non-department) personnel.

Budget
Account for any special needs that require extra project funds or personnel. Are special materials, testing equipment, or facilities required? If so, how will they be acquired?

Appendix A

Project Field Review Report

Proposed Project Field Review Report

Field Review By:			
Route:	**Control Section (s) & Mile Point (s):**	**Project Length: (Route Miles)**	**Lane Miles:**
Location Description:			
Pavement Type:	**Pavement Width:**	**Shoulder Type:**	**Shoulder Width:**
Previous Fix & Year Last Improved:	**ADT Range:**	**Comm. ADT Range:**	
Recommended Treatment:			
Pavement Condition Requirements for Recommended Treatment			
Min. RSL (Yrs):	**Max. DI:**	**Max. RQI: Or Max IRI:**	**Max. Avg. Rut:**
Pavement Management Data			
RSL (Yr.)	**DI (Yr.)**	**RQI (Yr.): Or IRI (Yr.):**	**Avg. Rut (Yr.):**
Field Review Comments:			
Construction Cost:	**PE Cost (3%):**	**CE Cost (3% Warr) (5% Non-Warr):**	**Total Project Cost:**
Treatment Approved By:			

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_____

Signature **Date**

Appendix B

MEMO: ONE COURSE HMA OVERLAYS ON ROADS WITH CRACK TREATMENT

MDOT Michigan Department of Transportation

OFFICE MEMORANDUM

DATE: July 28, 2004

TO: TSC Managers
Resident/Project Engineers
Region/TSC Delivery Engineers
Region/TSC Development Engineers

FROM: Kevin Kennedy
Capital Preventive Maintenance Engineer
Construction and Technology Support Area

SUBJECT: One Course HMA Overlays on Roads with Crack Treatment

One course HMA overlays have been an effective tool in the Capital Preventive Maintenance program. However, there are two potential issues that can arise during construction.

The first issue deals with bumps forming in the asphalt overlay above areas where crack sealant is present. During the compaction process, rollers tend to push the HMA forward. If the underlying surface has uniform restraining characteristics, a smooth finished surface can be constructed. However, if the underlying surface varies significantly, a wave formation can form in the HMA which results in unwanted bumps during construction. Low melt temperature sealants may soften when heated by the overlay, which may prevent restraint of the HMA if it displaces during construction. Potential solutions for this problem include:

1. Use of rollers with power driven front drums.
2. Use of two course paving with the first course being a thin leveling coat (1/2″ scratch course)
3. Modifying rolling patterns and temperatures based on operator experience to reduce mix shoving.
4. Slowing roller speed during compaction, especially on intermediate and final rolling
5. Rolling to achieve compaction with the minimum number of passes. Do not “over roll”.
6. Milling the existing surface prior to the overlay.

For any of the above potential solutions, HMA density requirements should not be waived.

The second issue deals with the tires on construction equipment pulling out sealing material during construction. This occurs when tack coat sticks to the tires of construction equipment and then the tires pull out the sealing material as they pass over the material. Potential solutions for this problem include:

1. Diluting the tack coat. Care should be taken to not over dilute the tack coat to the point that bonding is prevented.
2. Apply a non-stick material (lime, sand, etc.) over the sealant to prevent adherence. Care should be taken to limit the non-stick material to the area over the sealant.
3. Remove excess sealant and/or avoid excessive sealant applications.
4. If overband crack treatment is applied prior to the HMA overlay, remove all dirt, debris, and moisture from cracks prior to applying overband material (as per specification).

Due to the potential complications listed above, projects with excessive amounts of previous crack treatments may not be ideal for one course overlays. On projects that are selected, the above listed actions should assist in overlay construction.

If you have any questions or comments, please contact me at 517-322-6043.

_____

cc: B. O'Brien
C. Bleech

Appendix C

HISTORICAL COSTS

Capital Preventive Maintenance
Average Costs

Note: All unit costs are based on the 2008 CPM project bid tabs. When using these costs to prepare preliminary estimates consideration must be given to the condition of the roadway being treated.

Cold Milling Bituminous/HMA Surface: The cost of cold mill or surface mill ranged from $0.01/yd^2 to $4.50/yd^2 with the average being $0.72/yd^2. If the cost needs to be estimated in tons the cost ranged from $3.00/ton to $18.5/ton with the average cost of $6.10.

Non Structural Bituminous/HMA Overlay: The unit cost for a *Non Structural HMA Overlay* ranged from $33.82/ton to $95.39/ton. The Average unit cost was $52.97/ton.

Overband Crack Fill: The unit cost for a *Overband Crack Fill* ranged from $1,210.00/rbmi to $16,100.00/rbmi, with an average cost of $3662/rbmi. The price of Pre-Treatment Overband Crack Fill varies based on crack severity and the location of the project.

Bituminous Crack Treatment: The unit cost for *Bituminous Crack Treatment* ranged from $2000.00/rbmi to $11,500.00/rbmi, with an average cost of $3699/rbmi.

Chip Seal: The unit cost for *Single Chip Seal* ranged from $0.91 to $1.67d^2, with an average cost of $1.21/yd^2. The unit cost for *Double Chip Seal* ranged from $2.22/yd^2 to $2.52/yd^2, with an average cost of $2.35/yd^2

Single Course Micro-Surfacing: The unit cost of *Single Course Micro-Surfacing* ranged from $1.65/yd^2 to $2.45/yd^2, with an average cost of $1.72/yd^2.

Micro-Surface with Warranty: The unit cost of *Micro-Surface Warranty* ranged from $2.03/yd^2 to $6.8/yd^2, with an average cost of $2.57/yd^2.

HMA Ultra-Thin with Low Volume Warranty: The unit cost of *HMA Ultra-Thin with Low Volume Warranty* ranged from $2.27/yd^2 to $2.27/yd^2, with an average cost of $2.27/ yd^2. (This is based on one job)

HMA Ultra-Thin with Medium Volume Warranty: The unit cost of *HMA Ultra-Thin with Medium Volume Warranty* ranged from $2.15/yd^2 to $3.41/yd^2, with an average cost of $2.53/yd^2.

HMA Ultra-Thin with High Volume Warranty: The unit cost of *HMA Ultra-Thin with High Volume Warranty* ranged from $2.79/yd^2 to $3.20/yd^2, with an average cost of $2.90/ yd^2. This is based on two jobs.

Paver Placed Surface Seal: The unit cost of *Paver Placed Surface Seal* ranged from $4.33/yd^2 to $4.45/yd^2, with an average cost of $4.40/yd^2.

The following costs for Concrete Pavements are based on 2007 and 2008 projects.

Diamond Grinding Concrete Pavement: The unit cost of *Diamond Grinding Concrete Pavement* ranged from $2.81/yd^2 to $8.80/yd^2, with an average cost of $4.88/yd^2.

Resawing and Sealing Longitudinal Joints: The unit cost for *Resawing and Sealing Longitudinal Joints* ranged from $0.78/ft to $2.00/ft, with an average unit cost of $1.15/ft.

Resawing and Sealing Transverse Joints: The unit cost for *Resawing and Sealing Transverse Joints* ranged from $0.81/ft to $2.25/ft, with an average unit cost of $0.92/ft.

Resealing Transverse Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.75/ft to $2.50/ft, with an average unit cost of $0.88/ft.

Resealing Longitudinal Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.75/ft to $1.50/ft, with an average unit cost of $0.82/ft.

Crack Sealing Concrete Pavement: The average unit cost for *Crack Sealing Concrete Pavement* ranged from $0.99/ft to $2.25/ft with an average unit cost of $1.20/ft. The cost for *Concrete Crack Sealing* varies based on the crack severity and the location of a project.

Capital Preventive Maintenance
Average Costs

Note: All unit costs are based on the 2007 CPM project bid tabs. All bid proposals were written using the English system. When using these costs to prepare preliminary estimates consideration must be given to the condition of the roadway being treated.

Cold Milling Bituminous/HMA Surface: The cost of cold mill or surface mill ranged from $0.31/yd^2 to $11.82/yd^2 with the average being $0.84/yd^2. If the cost needs to be estimated in tons the cost ranged from $.01/ton to $20/ton with the average cost of $2.65.

Non Structural Bituminous/HMA Overlay: The unit cost for a *Non Structural Bituminous/HMA Overlay* ranged from $24.82/ton to $100.00/ton. The Average unit cost was $43.33/ton.

Overband Crack Fill: The unit cost for a *Overband Crack Fill* ranged from $2,020.00/rbmi to $17,050.00/rbmi, with an average cost of $4,605/rbmi. The price of Pre-Treatment Overband Crack Fill varies based on crack severity and the location of the project.

Bituminous Crack Treatment: The unit cost for *Bituminous Crack Treatment* ranged from $2000.00/rbmi to $10,750.00/rbmi, with an average cost of $3477/rbmi.

Chip Seal: The unit cost for *Single Chip Seal* ranged from $1.15/yd^2 to $1.50/yd^2, with an average cost of $1.37/yd^2. The unit cost for *Double Chip Seal* ranged from $2.30/yd^2 to $2.30/yd^2, with an average cost of $2.30/yd^2 (This is based on one job).

Single Course Micro-Surfacing: The unit cost of *Single Course Micro-Surfacing* ranged from $1.48/yd^2 to $2.01/yd^2, with an average cost of $1.56/yd^2.

Micro-Surface with Warranty: The unit cost of *Micro-Surface Warranty* ranged from $1.87/yd^2 to $2.98/yd^2, with an average cost of $2.33/yd^2.

HMA Ultra-Thin with Low Volume Warranty: The unit cost of *HMA Ultra-Thin with Low Volume Warranty* ranged from $2.27/yd^2 to $2.27/yd^2, with an average cost of $2.27/ yd^2. (This is based on one job).

HMA Ultra-Thin with Medium Volume Warranty: The unit cost of *HMA Ultra-Thin with Medium Volume Warranty* ranged from $2.28/yd^2 to $2.65/yd^2, with an average cost of $2.37/yd^2. This is based on 3 jobs.

HMA Ultra-Thin with High Volume Warranty: The unit cost of *HMA Ultra-Thin with High Volume Warranty* ranged from $2.82/yd^2 to $2.82/yd^2, with an average cost of $2.82/ yd^2. This is based on one job.

Paver Placed Surface Seal: The unit cost of *Paver Placed Surface Seal* ranged from $4.38/yd^2 to $4.92/yd^2, with an average cost of $4.72/yd^2.

Diamond Grinding Concrete Pavement: The unit cost of *Diamond Grinding Concrete Pavement* ranged from $2.81/yd^2 to $8.80/yd^2, with an average cost of $3.37/yd^2.

Resawing and Sealing Longitudinal Joints: The unit cost for *Resawing and Sealing Longitudinal*

Joints ranged from $0.81/ft to $2.00/ft, with an average unit cost of $1.15/ft.

Resawing and Sealing Transverse Joints: The unit cost for *Resawing and Sealing Transverse Joints* ranged from $0.81/ft to $2.25/ft, with an average unit cost of $1.57/ft.

Resealing Transverse Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.75/ft to $2.50/ft, with an average unit cost of $0.87/ft.

Resealing Longitudinal Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.75/ft to $1.01/ft, with an average unit cost of $0.79/ft.

Crack Sealing Concrete Pavement: The average unit cost for *Crack Sealing Concrete Pavement* was $1.09/ft. The cost for *Concrete Crack Sealing* varies based on the crack severity and the location of a project.

Capital Preventive Maintenance
Average Costs

Note: All unit costs are based on the 2006 CPM project bid tabs. All bid proposals were written using the English system. When using these costs to prepare preliminary estimates consideration must be given to the condition of the roadway being treated.

Cold Milling Bituminous/HMA Surface: The cost of cold mill or surface mill ranged from $0.01/yd^2 to $13/yd^2 with the average being $0.69/yd^2. If the cost needs to be estimated in tons the cost ranged from $.01/ton to $20.93/ton with the average cost of $5.40.

Non Structural Bituminous/HMA Overlay: The unit cost for a *Non Structural Bituminous/HMA Overlay* ranged from $32.40/ton to $113.00/ton. The Average unit cost was $42.78/ton.

Overband Crack Fill: The unit cost for a *Overband Crack Fill* ranged from $2,100.00/rbmi to $10,000.00/rbmi, with an average cost of $4,086.29/rbmi. The price of Pre-Treatment Overband Crack Fill varies based on crack severity and the location of the project.

Bituminous Crack Treatment: The unit cost for *Bituminous Crack Treatment* ranged from $2450.00/rbmi to $7250.00/rbmi, with an average cost of $3846.03/rbmi.

Chip Seal: The unit cost for *Single Chip Seal* ranged from $1.03/yd^2 to $1.13/yd^2, with an average cost of $1.05/yd^2. The unit cost for *Double Chip Seal* ranged from $1.85/yd^2 to $2.50/yd^2, with an average cost of $2.15/yd^2.

Single Course Micro-Surfacing: The unit cost of *Single Course Micro-Surfacing* ranged from $1.20/yd^2 to $1.50/yd^2, with an average cost of $1.32/yd^2.

Micro-Surface with Warranty: The unit cost of *Micro-Surface Warranty* ranged from $1.88/yd^2 to $3.10/yd^2, with an average cost of $2.24/yd^2.

Micro-Surface Rut fill: The unit cost of *Micro-Surface Rut fill* had an average of $200/ton.

HMA Ultra-Thin with Low Volume Warranty: The unit cost of *HMA Ultra-Thin with Low Volume Warranty* ranged from $1.35/yd^2 to $2.39/yd^2, with an average cost of $2.07/ yd^2.

HMA Ultra-Thin with Medium Volume Warranty: The unit cost of *HMA Ultra-Thin with Medium Volume Warranty* ranged from $2.10/yd^2 to $2.44/yd^2, with an average cost of $2.19/yd^2. This is based on 2 jobs.

HMA Ultra-Thin with High Volume Warranty: The unit cost of *HMA Ultra-Thin with High Volume Warranty* ranged from $2.50/yd^2 to $2.50/yd^2, with an average cost of $2.50/ yd^2. This is based on one job.

Paver Placed Surface Seal: The unit cost of *Paver Placed Surface Seal* ranged from $5.50/yd^2 to $5.50/yd^2, with an average cost of $5.50/yd^2. This is based on one job.

Diamond Grinding Concrete Pavement: The unit cost of *Diamond Grinding Concrete Pavement* ranged from $3.21/yd^2 to $3.93/yd^2, with an average cost of $3.49/yd^2.

Resawing and Sealing Longitudinal Joints: The unit cost for *Resawing and Sealing Longitudinal Joints* ranged from $0.86/ft to $1.35/ft, with an average unit cost of $.92/ft.

Resawing and Sealing Transverse Joints: The unit cost for *Resawing and Sealing Transverse Joints* ranged from $0.83/ft to $3.00/ft, with an average unit cost of $.96/ft.

Resealing Transverse Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.71/ft to $15.00/ft, with an average unit cost of $0.76/ft.

Resealing Longitudinal Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.70/ft to $2.70/ft, with an average unit cost of $0.75/ft.

Crack Sealing Concrete Pavement: The average unit cost for *Crack Sealing Concrete Pavement* was $1.37/ft. The cost for *Concrete Crack Sealing* varies based on the crack severity and the location of a project.

Capital Preventive Maintenance
Average Costs

Note: All unit costs are based on the 2005 CPM project bid tabs. All bid proposals were written using the English system. When using these costs to prepare preliminary estimates consideration must be given to the condition of the roadway being treated.

Cold Milling Bituminous/HMA Surface: The cost of cold mill or surface mill ranged from $0.01/yd^2 to $5.60/yd^2 with the average being $0.74/yd^2. If the cost needs to be estimated in tons the cost ranged from $4.00/ton to $13.06/ton with the average cost of $7.35.

Non Structural Bituminous/HMA Overlay: The unit cost for a *Non Structural Bituminous/HMA Overlay* ranged from $25.71/ton to $67.00/ton. The Average unit cost was $37.21/ton.

Overband Crack Fill: The unit cost for a *Overband Crack Fill* ranged from $1,800.00/rbmi to $9,777.00/rbmi, with an average cost of $4,378/rbmi. The price of Pre-Treatment Overband Crack Fill varies based on crack severity and the location of the project.

Bituminous Crack Treatment: The unit cost for *Bituminous Crack Treatment* ranged from $1952.00/rbmi to $9680.00/rbmi, with an average cost of $3829/rbmi.

Chip Seal: The unit cost for *Single Chip Seal* ranged from $0.78/yd^2 to $1.03/yd^2, with an average cost of $0.93/yd^2.

Single Course Micro-Surfacing: The unit cost of *Single Course Micro-Surfacing* ranged from $1.32/yd^2 to $1.78/yd^2, with an average cost of $1.62/yd^2.

Micro-Surface with Warranty: The unit cost of *Micro-Surfac Warranty* ranged from $2.01/yd^2 to $3.25/yd^2, with an average cost of $2.27/yd^2.

Micro-Surface Rut fill: The unit cost of *Micro-Surface Rut fill* had an average of $137/ton.

HMA Ultra-Thin with Low Volume Warranty: The unit cost of *HMA Ultra-Thin with Low Volume Warranty* ranged from $1.00/yd^2 to $1.00/yd^2, with an average cost of $1.00/ yd^2. This is based on one job. The average for jobs in 2004 was $1.76/yd^2.

HMA Ultra-Thin with Medium Volume Warranty: The unit cost of *HMA Ultra-Thin with Medium Volume Warranty* ranged from $1.58/yd^2 to $1.58/yd^2, with an average cost of $1.57/yd^2. This is based on 2 jobs.

HMA Ultra-Thin with High Volume Warranty: The unit cost of *HMA Ultra-Thin with High Volume Warranty* ranged from $2.10/yd^2 to $2.10/yd^2, with an average cost of $2.10/ yd^2. This is based on one job. The average for jobs in 2004 was $2.37/yd^2.

Paver Placed Surface Seal: The unit cost of *Paver Placed Surface Seal* ranged from $3.56/yd^2 to $4.60/yd^2, with an average cost of $4.19/yd^2.

Diamond Grinding Concrete Pavement: The unit cost of *Diamond Grinding Concrete Pavement* ranged from $3.71/yd^2 to $8.41/yd^2, with an average cost of $4.84/yd^2.

Resawing and Sealing Longitudinal Joints: The unit cost for *Resawing and Sealing Longitudinal Joints* ranged from $0.80/ft to $2.00/ft, with an average unit cost of $.88/ft.

Resawing and Sealing Transverse Joints: The unit cost for *Resawing and Sealing Transverse Joints* ranged from $0.83/ft to $2.00/ft, with an average unit cost of $1.00/ft.

Resealing Transverse Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.82/ft to $2.00/ft, with an average unit cost of $0.97/ft.

Resealing Longitudinal Pavement Joints with Hot-Poured Rubber: The unit cost for *Resealing Transverse Pavement Joints with Hot-Poured Rubber* ranged from $0.73/ft to $1.00/ft, with an average unit cost of $0.84/ft.

Crack Sealing Concrete Pavement: The average unit cost for *Crack Sealing Concrete Pavement* was $1.28/ft. The cost for *Concrete Crack Sealing* varies based on the crack severity and the location of a project.