Chapter Fifty-three

PAVEMENT PRESERVATION AND REHABILITATION STRATEGIES

BUREAU OF DESIGN AND ENVIRONMENT MANUAL

Chapter Fifty-three
PAVEMENT PRESERVATION AND REHABILITATION STRATEGIES

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Chapter Fifty-three

PAVEMENT PRESERVATION AND REHABILITATION STRATEGIES

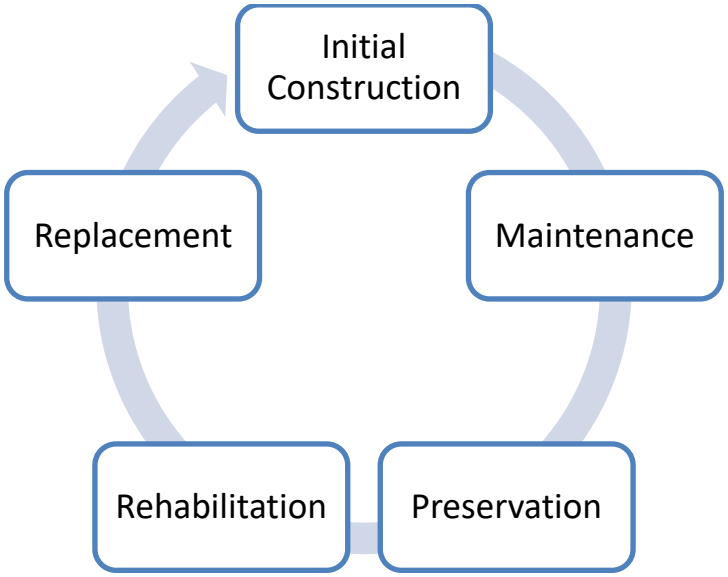
53-1 GENERAL

53-1.01 Scope of Chapter

The Illinois Transportation Asset Management Plan (TAMP) was developed and implemented consistent with the requirements established by 23 U.S.C. 119 and 23 CFR 515. The pavement management aspects of the TAMP are documented in this chapter as well as in the Pavement Management and Evaluation Manual.

This chapter focuses on the preservation and rehabilitation aspects of the pavement life cycle shown in Figure 53-1.A and should be used in conjunction with the Pavement Management and Evaluation Manual. Guidance is given to allow the user to:

- select the proper pavement management methodology,
- gather pavement information,
- identify feasible treatment alternatives,
- select the appropriate treatment, and
- develop the design of the selected treatment.



Pavement Life Cycle

Figure 53-1.A

Pavement design/replacement information is found in Chapter 54. Information previously contained in Chapter 52 has been integrated into this chapter. Contract maintenance program requirements are available in Chapter 12 of the Bureau of Operations Maintenance Policy Manual.

The pavement treatments outlined in this chapter are for pavements on the state system and local pavements on the National Highway System (NHS). Preservation and rehabilitation treatments for local agency pavements off the NHS should be developed using Chapters 45 and 46 of the Bureau of Local Roads and Streets Manual.

53-1.02 Definitions

1. Binder Course. One or more layers of a hot-mix asphalt (HMA) overlay or full-depth pavement structure. A surface course or wearing course must be placed over this course to protect it from environmental effects and provide appropriate friction characteristics.

2. Composite Pavement. A pavement structure consisting of a portland cement concrete (PCC) slab overlaid with HMA. The PCC slab may be either a newly constructed base course or an existing jointed PCC or continuously reinforced concrete pavement.

3. Condition Rating Survey (CRS). The primary pavement performance metric used by the Illinois Department of Transportation (IDOT) to quantify the condition of its pavement assets. CRS values range from 9.0 to 1.0, with 9.0 representing a newly constructed, rehabilitated, or preserved pavement and a 1.0 representing a pavement at the end of its service life.

4. Continuously Reinforced Concrete Pavement (CRCP). A rigid pavement structure having continuous longitudinal reinforcement. The continuous reinforcement is achieved by overlapping the longitudinal steel reinforcing bars.

5. Designed HMA Overlay. A hot-mix asphalt overlay consisting of two or more lifts intended to mitigate the effects of underlying structural distresses and provide a stable wearing surface over an existing pavement.

6. Flexible Pavement. A pavement structure whose surface and principle load distributing component is a combination of HMA binder and surface layers, and potentially coarse aggregate layer(s). These pavements may include both conventional flexible and full-depth HMA pavements.

7. Full-Depth Hot-Mix Asphalt Pavement. A flexible pavement structure that uses HMA throughout the entire thickness (binder course and surface course layers).

8. Jointed Plain Concrete Pavement (JPCP). A rigid pavement structure without reinforcing steel that uses doweled joints for effective load transfer at the transverse joints which are typically spaced at 15 ft (4.6 m). This pavement type is the Department's default rigid pavement and is shown on Highway Standard 420101.

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9. Jointed Reinforced Concrete Pavement (JRCP). A rigid pavement that uses distributed steel reinforcement and transverse contraction joints. This pavement type was discontinued in the late 1980s.

10. Major Rehabilitation. A strategy of placing an overlay with substantial thickness on a pavement in poor condition. These treatments restore serviceability and slow the propagation of underlying structural distresses with an anticipated service life of 10 to 15 years.

11. Minor Rehabilitation. A strategy of either placing an overlay with nominal thickness or recycling the existing HMA on a pavement in fair condition. These treatments reduce or eliminate functional distresses and restore serviceability with an anticipated service life of 10 to 15 years.

12. National Highway System (NHS). The NHS consists of the highway routes and connections to transportation facilities that serve major population centers, international border crossings, ports, airports, public transportation facilities, and other intermodal transportation facilities and other major travel destinations; meets national defense requirements; and serves interstate and interregional travel and commerce.

13. Pavement Field Investigation (PFI). A method of analyzing the existing pavement to determine the appropriate pavement management methodology and/or treatment selection.

14. Pavement Performance. The trend of pavement condition indices over time with respect to traffic and environmental effects.

15. Pavement Preservation. A cost-effective strategy of placing either a non-structural surface or proactive maintenance treatment on a pavement to extend service life at fair or good condition.

16. Pavement Structure. The combination of granular or stabilized subbase and pavement layers (flexible or rigid) which support the traffic load and distribute it to the subgrade.

17. Predicted CRS. The projected CRS value corresponding to the program year in which the treatment will be placed. This value is calculated annually by the Bureau of Programming.

18. Pre-Treatment Activity. An activity (e.g., milling, patching, etc.) that is used to correct a specific distress to improve the pavement condition, enabling the use of a treatment from another category (e.g., improve from standard overlay to pavement preservation).

19. Proactive (Preventive) Maintenance. A strategy of placing a minimal treatment at an early stage of service life in order to prevent deterioration or associated distresses and maintain the condition of the pavement. Preventive maintenance is a cost-effective means of extending the useful life of a pavement.

20. Ramp. A roadway that connects two or more legs at an interchange and includes at least one ramp terminal section. Roadways that connect two legs of freeway and are

continuations of mainline lanes or arise from tapers designed for high-speed operation are not considered ramps but are considered part of the mainline for structural design.

21. Reactive (Routine) Maintenance. Work that is performed in reaction to an event, season, or overall deterioration to restore serviceability of a pavement until a rehabilitation treatment can be constructed. This work includes that which is performed by State Operations forces and as part of the Contract Maintenance program.

22. Rehabilitation. A strategy of either recycling the HMA or placing a layer of HMA or PCC over a pavement in poor to fair condition.

23. Rigid Pavement. A pavement structure whose surface and principle load distributing component is a PCC slab (e.g., JPCP, CRCP, JRCP).

24. Rubblized PCC Pavement. Rubblization is a replacement alternative in which the existing PCC pavement is broken (in-place) into small pieces and compacted to create a uniform base for the new pavement.

25. Standard HMA Overlay. A hot-mix asphalt overlay consisting of two lifts to mitigate the effects of functional distresses and provide a stable wearing surface over an existing pavement.

26. Surface Course (Wearing Course). The top layer of an HMA pavement or overlay which resists skidding, traffic abrasion, and the disintegrating effects of the environment.

27. Surface Treatment. A non-structural, full-width wearing course. Examples include: cape seal, chip seal, micro-surfacing, and slurry seal.

28. Traffic Factor (TF). The total number of 18-kip equivalent single-axle load applications (ESALs) to the design lane anticipated during the design period, expressed in millions. It is used as an equivalency factor for mixed traffic loads.

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53-2 PAVEMENT MANAGEMENT METHODOLOGIES

53-2.01 Selection of Pavement Management Methodology

The life cycle of pavements as defined in the TAMP includes initial construction, maintenance, preservation, rehabilitation, and replacement. Initial construction is not covered in this chapter. Figures 53-2.A and 53-2.B illustrate the relationship between the four major categories of treatments discussed here (maintenance, preservation, rehabilitation, and replacement), typical treatments representative of actions taken in those categories, and the CRS range in which those typical treatments are most applicable. These categories are only the initial step and further evaluation may warrant a change in either the category or specific treatment.

Pavement maintenance and preservation are the first levels of treatment. Pavement maintenance is briefly discussed in Section 53-2.02. The pavement preservation methodology is described in detail in Section 53-3. Once the pavement has deteriorated beyond the point where preservation is cost-effective, pavement rehabilitation should be utilized. The complete description of pavement rehabilitation methodology is provided in Section 53-4. As presented above, pavement replacement becomes necessary when pavement rehabilitation is no longer cost-effective. This methodology is discussed in detail in Chapter 54. However, Interstates with ADT < 15,000 and non-Interstates with ADT < 3,000 may receive a major rehabilitation treatment in lieu of Replacement.

Once the appropriate treatment category is determined, the process of matching pavements and treatments includes the following general steps:

- Gather pavement information,
- Identify feasible preservation treatments, and
- Select the most appropriate preservation treatment.

Additional information on activities necessary for final selection of a treatment strategy is contained in the Pavement Management and Evaluation Manual.

53-2.02 Maintenance Methodologies

Maintenance can take the form of preventive (proactive) or routine (reactive). Proactive maintenance activities are included in the pavement preservation category. Reactive maintenance activities are included in the Contract Maintenance program which is administered by the Central Bureau of Operations.

Proactive maintenance is a subcategory of pavement preservation and includes those activities used to prevent water and incompressible material infiltration, surface oxidation, and other environmental factors. These treatments are applied soon after initial construction or rehabilitation and can be reapplied as needed throughout the pavement's life cycle.

When a pavement segment is in need of treatment but cannot be brought into the annual or multi-year program, reactive maintenance can be used as a stop-gap measure to maintain the roadway

in a serviceable condition until the program can accommodate the proper treatment for the project. Reactive maintenance is addressed through the contract maintenance program which may be used to supplement the maintenance work effort of state forces and is limited to repair and restoration of immediate needs. The contract maintenance program operates under guidelines issued by the Central Bureau of Operations.

53-2.03 Pavement Preservation Methodologies

Pavement preservation treatments are lower cost, non-structural treatments used to extend the surface life of a pavement before the roadway reaches a condition that requires rehabilitation. These treatments are a cost-effective means of increasing the overall service life of a pavement by addressing functional surface distresses before they progress to a structural issue. Matching the right preservation treatment with the right pavement calls for an awareness of the current condition of the pavement in terms of the types of distresses present as well as their severities. It also helps to understand the typical performance of the pavement in its location and considering how it's used.

In some cases, the best strategy will consist of a combination of pre-treatment activities and preservation strategies in order to address a pavement's current and expected performance.

Details on pavement preservation strategies are provided in Section 53-3.

53-2.04 Rehabilitation Methodologies

Rehabilitation consists of improvements made to an existing pavement section that has progressed beyond the limitations of pavement preservation treatments. These strategies remove surface distresses that develop in flexible pavements due to aging and exposure to environmental effects, such as block cracking, raveling, and weathering, as well as reduces the impacts of structural distresses caused by repeated loadings or loss of support. In concrete pavements, pavement rehabilitation consists of the addition of one or more layers of either hot-mix asphalt (HMA) or portland cement concrete (PCC) to address functional or structural distresses and restore ride quality and/or safety. Details on rehabilitation strategies are provided in Section 53-4.

53-2.05 Pavement Replacement Methodology

Once a pavement has insufficient load carrying capacity and can no longer be cost-effectively rehabilitated, the entire pavement structure should be replaced. When selecting this treatment methodology, a complete design and life-cycle cost analysis (LCCA) shall be performed according to Chapter 54 to determine the most cost-effective pavement type.

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Category	Subcategory	Treatments	Service Life	Predicted CRS
Do Nothing			N/A	7.6-9.0
Preservation (Section 53-3)	Proactive Maintenance	Crack and Joint Filling, Crack and Joint Sealing, Diamond Grinding, Diamond Grooving, Longitudinal Joint Sealing (Concrete)	2 - 5	> 6.0
	Low	Micro-Surfacing	3 - 7	6.6-7.5
	High	Longitudinal Joint Partial-Depth Repair, SMART Overlay, Ultra-Thin Bonded Wearing Course, Load Transfer Restoration (Transverse Cracking - Concrete) (1)	7 - 12	5.5 - 6.5
Rehabilitation (Section 53-4)	Minor	Bonded Concrete Overlay on Asphalt (2), Standard HMA Overlay	10 - 15	4.6-5.4
	Major	Designed HMA Overlay, Structural Concrete Overlay (Requires an exception) (1)	10 - 15	4.0-4.5
Replacement (3) (Chapter 54)		Replacement of complete pavement structure, New Pavement (HMA or PCC) over Rubblized PCC, Unbonded Concrete Overlay	30-40	< 4.0
Contract Maintenance	Reactive Measures	See Contract Maintenance Program Guidelines (4)	Varies	< 5.5 (5)

Notes:

(1) Treatment will require an experimental feature according to Construction Memo 02-2.

(2) Bonded Concrete Overlay on Asphalt is limited to pavements with a rigid traffic factor less than or equal to 7.5.

(3) Interstates with ADT < 15,000 may receive a major rehabilitation treatment in lieu of replacement.

(4) Low Preservation treatments may be used as a stop-gap measure. High Preservation activities of Full-depth Repairs and Longitudinal Joint Partial-Depth Repair are allowed as Reactive Measures. HMA Surface Mill and Replacement will be approved on a case-by-case basis.

(5) For localized failures, any CRS value may be considered (patching, centerline failures, intermittent locations of surface repairs).

Interstate TAMP Category Selection Criteria - Pavements

Figure 53-2.A

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Category	Subcategory	Treatments	Service Life	Predicted CRS
Do Nothing			N/A	7.6-9.0
Preservation (Section 53-3)	Proactive Maintenance	Crack and Joint Filling, Crack and Joint Sealing, Diamond Grinding, Diamond Grooving, Longitudinal Joint Sealing (Concrete)	2 - 5	> 6.0
	Low	Cape Seal, Chip Seal (A-1, A-2, A-3), Half-SMART, Micro-Surfacing	3 - 7	6.6 - 7.5
	High	Longitudinal Joint Partial-Depth Repair, Hot In-Place Recycling (1), SMART Overlay, Ultra-Thin Bonded Wearing Course, Load Transfer Restoration (Transverse Cracking - Concrete) (1)	7 - 12	5.0 - 6.5
Rehabilitation (Section 53-4)	Minor	Bonded Concrete Overlay on Asphalt (2), Cold In-Place Recycling (Requires a Design Exception) (1), Standard HMA Overlay	10 - 15	4.1 - 4.9
	Major	Designed HMA Overlay, Structural Concrete Overlay (Requires an exception) (1)	10 – 15	3.5 - 4.0
Replacement (3) (Chapter 54)		Replacement of complete pavement structure, New Pavement (HMA or PCC) over Rubblized PCC, Unbonded Concrete Overlay	30-40	< 3.5
Contract Maintenance	Reactive Measures	See Contract Maintenance Program Guidelines (4)	Varies	< 5.0 (5)

Notes:

(1) Treatment will require an experimental feature according to Construction Memo 02-2.

(2) Bonded Concrete Overlay on Asphalt is limited to pavements with a rigid traffic factor less than or equal to 7.5.

(3) Projects with ADT < 3,000 may receive a Major Rehabilitation treatment in lieu of Replacement.

(4) Low Preservation treatments may be used as a stop-gap measure. High Preservation activities of Full-depth Repairs and Longitudinal Joint Partial-Depth Repair are allowed as Reactive Measures. HMA Surface Mill and Replacement will be approved on a case-by-case basis.

(5) For localized failures, any CRS value may be considered (patching, centerline failures, intermittent locations of surface repairs).

Non-Interstate TAMP Category Selection Criteria - Pavements

Figure 53-2.B

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53-2.06 Pavement Information Needed for Treatment Selection

Good treatment selection is guided by understanding as much as possible about the overall pavement structure, such as pavement type, overall pavement age and age of surface, traffic volumes, and pavement typical sections and materials. Much of this information is currently found in several databases within IDOT. The databases are identified in detail in the Pavement Management and Evaluation Manual. Once IDOT's Enterprise Asset Management System (EAMS) is implemented, it will allow data from multiple databases to be viewed in one central location and evaluated comprehensively.

Knowing the existing pavement structure and materials properties can be very useful to determine which treatment(s) will work best with the current structure and how the pavement section might perform in the future. Depending on the methodology being considered, a pavement field investigation (PFI) may be required. Details on the requirements for PFIs can be found in the Pavement Management and Evaluation Manual.

53-2.07 Pre-Treatment Activities and Other Factors

When determining final treatment selection, all aspects of the project must be considered to ensure a comprehensive approach, which will maximize performance. These include pre-treatment activities, secondary considerations, and additional design features.

53-2.07(a) Pre-Treatment Activities

When pavement preservation and rehabilitation treatments are being determined, pre-treatment activities can be used to eliminate or reduce distresses that are prohibiting the use of specific treatments and/or to improve the performance of the chosen treatment. The following pre-treatment activities, summarized in Section 53-5.05, may be considered based on the existing pavement type and results of the PFI.

- Cold Milling / Fine Milling
- Full-Depth CRCP Patches (Class A)
- Full-Depth Dowelled Patches (Class B)
- Full-Depth Undowelled Patches (Class C and Class D)
- Partial-Depth Patches
- Longitudinal Crack Repair

53-2.07(b) Secondary Considerations

Other factors that should be considered when making the final selection include ADA ramps, ADT, traffic control operations, constraints (e.g., bridge clearances, ramps, side slopes), condition of adjacent pavements, and costs.

53-2.07(c) Additional Design Features

While developing the scope of a project, the pavement section needs to be reviewed to determine if any additional design features will require attention, while the preservation or rehabilitation treatment is being constructed. The following additional design features, summarized in Section 53-5.05, should be evaluated to determine if they are still functioning properly.

1. Pipe Underdrains. Pavement distress can be accompanied by pumping of the subbase and subgrade material. For this reason, it is important to evaluate the need for underdrain installation. As part of a rehabilitation or replacement project, pipe underdrains should be installed on the Interstate System and other freeway facilities that are designed to Interstate criteria, if they have not been previously installed. Although pipe underdrains are not mandatory on non-Interstate primary facilities, they can be very useful where existing drainage problems exist. Pipe underdrains should be installed prior to patching unless there are valid reasons to do otherwise.

   See the *Highway Standards* for underdrain installation details for Interstate highways. Depending on the type of underdrain material specified, it may be necessary to adjust the depth of the underdrain to accommodate outfall drainage into existing shallow roadside ditches. Ensure the depth is sufficient to prevent overstressing the underdrain material. Generally, pipe will not be overstressed if the trench depth is 24 in. or greater. Consult the Engineer of Pavement Technology in the Bureau of Research for guidance if it is necessary to place pipe in shallower trenches. If deep roadside ditches or high fills are encountered, consider shifting the locations of pipe drain laterals to avoid outfall onto the long steep slopes. Replace any aggregate outlets of existing outfall pipe drains with concrete headwall outlets. If pipe underdrains have been installed on a previous contract, investigate to determine the need for cleaning or repairing the underdrain system.

2. Expansion and Terminal Joints. Expansion joints on PCC pavements and overlays of PCC pavements should be visually inspected to determine if they are in working order. If patching is an integral part of the rehabilitation strategy, closed expansion joints should be re-established regardless of the type of patching that is specified.

   Existing lug systems and/or wide flange beam terminal joints on CRCPs and overlays of CRCPs and should be closely inspected to determine if the joint is working properly both at the beam and at the expansion joint between the beam and the bridge approach or jointed pavement. In addition, the flange of the beam should be inspected for signs of fatigue cracking. When a terminal joint is determined to be non-functioning, contact the Pavement Design Engineer in the Bureau of Research for assistance in selecting a treatment strategy.

53-2.08 Exception Requests

If the district would like to deviate from the TAMP category selection criteria or the overlay policies contained in Chapter 53, an exception request will be required.

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53-2.08(a) TAMP Category Selection Exception Requests

If the pavement investigation report indicates that a deviation from the category recommended by Figures 53-2.A or 53-2.B or a rehabilitation treatment recommended by Figure 53-4.A is the best alternative, a TAMP category selection exception request will be required when the project is entering the first three years of the multi-year program. Examples of TAMP category selection exception requests include:

- When Figure 53-2.A or Figure 53-2.B recommends replacement, however, the pavement evaluation indicates that rehabilitation is a better alternative.
- When Figure 53-4.A recommends minor rehabilitation, however the pavement evaluation indicates major rehabilitation is a better alternative.

53-2.08(b) Overlay Policy Exception Requests

An overlay policy exception request is required when either a lift thickness(es) would deviate from Figure 53-4.J in either the standard or designed overlays, or when there is preference to use a single lift instead of two lifts for an HMA overlay. This exception request must be submitted prior to the project entering the annual program.

53-2.08(c) Exception Request Submittals

All exception requests shall be submitted to the Asset Management Engineer in the Bureau of Programming, and the documentation shall include the following information:

1. Length and Limits of Project/Limits of Request. If the condition of the section is variable, clearly define the limits of the distressed areas that require additional thickness by station or log mile rather than requesting additional thickness over the entire project. Include the key route inventory number and the key route mileposts.

2. Traffic. Document traffic volumes including breakdown of passenger vehicles, single-unit trucks, and multiple-unit trucks.

3. Pavement History. Include the date of construction, pavement cross-section data, date and description of previous rehabilitations, current and historical CRS ratings, and distress history.

4. Pavement Investigation Report.

    a. Existing Condition. Include the type, severity, and frequency of distress (including photos); directional differences, faulting measurements; rutting measurements; and estimated patching quantities.

    b. Core Data. When core data is required, photos and descriptions of the cores and information on the quantity and location should be included. When available, additional information on the material characteristics of those cores should also be

provided, such as: densities (%), conditioned split tensile strength (psi), and strip rating (numeric rating).

5. Calculations and Estimates. Include all relevant supporting calculations and cost estimates.

6. Other. Include any other supporting evidence and test data and photographs.

Based on the type of exception request, content of the submittal, and the total length of the project, a joint review with the district, the Asset Management Engineer in the Bureau of Programming, and the Engineer of Pavement Technology in the Bureau of Research may be warranted.

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53-3 PAVEMENT PRESERVATION TREATMENT SELECTION GUIDELINES

53-3.01 Identify Feasible Preservation Treatments

When identifying the appropriate pavement preservation treatment for candidate projects, analyze the type and severity of pavement distresses present on the pavement, as well as other relevant collected information, to match pavement and project characteristics with treatment capabilities. Figures 53-3.A, 53-3.B, and 53-3.C can then be used to help identify feasible preservation treatments for flexible, composite, and rigid pavements. These figures provide guidance for treatment selection based upon attributes such as distresses and their level of severity, ride, friction, traffic levels, and relative costs. They relate a single distress or other characteristic to a single treatment; where there are multiple distresses, examine the appropriate treatment(s) to address each distress type. Then, use the recommended treatment(s) in combination with engineering judgment to make a final treatment selection.

Note that this process is not expected to result in the identification of a single treatment that is appropriate for a given set of site conditions; rather it is much more likely that there will be a number of feasible treatments that address those conditions. Therefore, there is at least one more step in the treatment selection process.

53-3.02 Select Appropriate Preservation Treatment

The selection of the most appropriate preservation treatment includes considering the various constraints on a project that affect treatment selection. The following list identifies some of the project constraints that should be considered when selecting the most appropriate preservation treatment.

- Availability of qualified contractors,
- Availability of quality materials,
- Time (of year) of construction,
- Initial costs,
- Ride quality (i.e., International Roughness Index),
- Pavement noise,
- Facility downtime, and
- Surface friction.

The effects of these constraints vary from project to project and should be reviewed for each project when finalizing treatment selection. Contact the Bureau of Research if assistance is needed in evaluating various treatment options to address constraints.

		Proactive Maintenance		Low Preservation Treatments [1]					High Preservation Treatments [1]			
Pavement Conditions	Severity Levels	Crack & Joint Filling/ Sealing	Diamond Grinding	Long. Jt. Micro-surfacing	Cape Seal [2]	Chip Seal [2]	Half-SMART [2]	Micro-surfacing [3]	Long. Jt. PD Repair	HIR [2]	SMART Overlay	UTBWC
Alligator/ Fatigue Cracking	L1	R	R	N/A	R**	R**	R**	R**	N/A	R	R	R
	L2, L3, L4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Block Cracking	M1, M2	R	R	N/A	R	R	R	R	N/A	R	R	R
	M3	R	R	N/A	NR	NR	NR	NR	N/A	R	R	R
	M4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
"Stable" Rutting	≤ 0.13	R	R	N/A	R	R	R	R	N/A	R	R	R
	≤ 0.25	NR	NR	N/A	NR	NR	NR	R	N/A	R	R	R
Joint Reflection and Transverse Cracking	O1, O2, O3	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	O4	R	R	N/A	NR	NR	NR	NR	N/A	R	R	NR
	O5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Overlayed Patch Reflective Cracking	P1, P2, P3	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	P4	R	R	N/A	NR	NR	NR	NR	N/A	R	R	R
	P5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Longitudinal / Center of Lane Cracking	Q1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	Q2, Q3	R	R	N/A	NR	NR	NR	NR	N/A	R	R	NR
	Q4, Q5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Reflective Widening Crack	R1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	R2, R3	R	R	N/A	NR	NR	NR	NR	N/A	R	R	F*
	R4, R5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Longitudinal Joint Deterioration [4]	S1, S2	R	R	R	R**	R**	R**	R**	R	R	R**	R*
	S3, S4	NR	NR	R	NR	NR	NR	NR	R	F	R	F
Edge Cracking	T1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	T2	R	R	N/A	F*	F*	F*	F*	N/A	F*	F*	F*
	T3, T4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Permanent Patch Deterioration	U1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	U2	F*	F*	N/A	F*	F*	F*	F*	N/A	R	R	F*
	U3, U4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Weathering/ Raveling	W1, W2	NR	NR	N/A	R	R	R	R	N/A	R	R	R
	W3	NR	NR	N/A	R*	R*	R*	NR	N/A	R	R	R
	W4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Reflective D-Cracking	X1	N/A	N/A	N/A	R	R	R	R	N/A	R	R	R
	X2, X3	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Friction	Poor	NR	NR	N/A	R	R	R	R	N/A	R	R	R
ADT	< 5,000	R	R	R	R	R	R	R	R	R	R	R
	5,000 – 10,000	R	R	R	NR	NR	NR	R	R	R	R	R
	> 10,000	R	R	R	NR	NR	NR	R	R	NR	R	R
Relative Cost	($ to $$$)	$	$	$$	$$	$$	$$	$$	$$	$$$	$$$	$$$

R - Recommended treatment. Care must be taken to ensure all critical distress types are addressed by selected treatment.

R* - Recommended treatment when used with milling prior to treatment.

R** - If milling is not included as a mitigating activity, crack sealing is recommended one year prior to treatment.

F - Feasible treatment but depends upon other project constraints including other existing distresses.

F* - This is a localized distress and should be treated locally while other distress types present should dictate choice of global treatment.

NR - Treatment is not recommended to correct the specified pavement condition.

N/A - Distress does not impact treatment selection.

1 - Full-Depth and Partial-Depth patching only allowed as a mitigating activity. A maximum of 0.50 percent will be allowed with any preservation treatment.

2 - Treatment not allowed on Interstate pavements.

3 - ADT ≤ 25,000 use 1-pass; ADT > 25,000 use 2-pass

4 - If only distress present, use indicated treatments. If other distreses are present, use the treatment that addresses the distresses across the full lane.

TREATMENT SELECTION GUIDELINES FOR FLEXIBLE PAVEMENTS

Figure 53-3.A

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		Proactive Maintenance		Low Preservation Treatments [1]					High Preservation Treatments [1]			
Pavement Conditions	Severity Levels	Crack & Joint Filling/ Sealing	Diamond Grinding	Long. Jt. Micro-surfacing	Cape Seal [2]	Chip Seal [2]	Half-SMART [2]	Micro-surfacing [3]	Long. Jt. PD Repair	HIR [2]	SMART Overlay	UTBWC
Alligator/ Fatigue Cracking	L1	R	R	N/A	R**	R**	R**	R**	N/A	R	R	R
	L2, L3, L4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Block Cracking	M1, M2	R	R	N/A	R	R	R	R	N/A	R	R	R
	M3	R	R	N/A	NR	NR	NR	NR	N/A	R	R	R
	M4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
"Stable" Rutting	≤ 0.13	R	R	N/A	R	R	R	R	N/A	R	R	R
	≤ 0.25	NR	NR	N/A	NR	NR	NR	NR	N/A	R	R	R
Joint Reflection and Transverse Cracking	O1, O2, O3	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	O4	R	R	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
	O5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Overlayed Patch Reflective Cracking	P1, P2, P3	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	P4	R	R	N/A	NR	NR	NR	NR	N/A	R	R	R
	P5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Longitudinal / Center of Lane Cracking	Q1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	Q2, Q3	R	R	N/A	R**	NR	R*	NR	N/A	R	R	R*
	Q4, Q5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Reflective Widening Crack	R1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	R2, R3	R	R	N/A	NR	NR	NR	NR	N/A	R	R	F*
	R4, R5	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Longitudinal Joint Deterioration [4]	S1, S2	R	R	R	R**	R**	R**	R**	R	R	R**	R*
	S3, S4	NR	NR	R	NR	NR	NR	NR	R	F	R	F
Edge Cracking	T1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	T2	R	R	N/A	F*	F*	F*	F*	N/A	F*	F*	F*
	T3, T4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Permanent Patch Deterioration	U1	R	R	N/A	R**	R**	R**	R**	N/A	R	R**	R
	U2	F*	F*	N/A	F*	F*	F*	F*	N/A	R	R	F*
	U3, U4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Weathering/ Raveling	W1, W2	NR	NR	N/A	R	R	R	R	N/A	R	R	R
	W3	NR	NR	N/A	R*	R*	R*	NR	N/A	R	R	R
	W4	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Reflective D-Cracking	X1	N/A	N/A	N/A	R	R	R	R	N/A	R	R	R
	X2, X3	NR	NR	N/A	NR	NR	NR	NR	N/A	NR	NR	NR
Friction	Poor	NR	NR	N/A	R	R	R	R	N/A	R	R	R
ADT	< 5,000	R	R	R	R	R	R	R	R	R	R	R
	5,000 – 10,000	R	R	R	NR	NR	NR	R	R	R	R	R
	> 10,000	R	R	R	NR	NR	NR	R	R	NR	R	R
Relative Cost	($ to $$$)	$	$	$$	$$	$$	$$	$$	$$	$$$	$$$	$$$

R - Recommended treatment. Care must be taken to ensure all critical distress types are addressed by selected treatment.

R* - Recommended treatment when used with milling prior to treatment.

R** - If milling is not included as a mitigating activity, crack sealing is recommended one year prior to treatment.

F - Feasible treatment but depends upon other project constraints including other existing distresses.

F* - This is a localized distress and should be treated locally while other distress types present should dictate choice of global treatment.

NR - Treatment is not recommended to correct the specified pavement condition.

N/A - Distress does not impact treatment selection.

1 - Full-Depth and Partial-Depth patching only allowed as a mitigating activity. A maximum of 0.50 percent will be allowed with any preservation treatment.

2 - Treatment not allowed on Interstate pavements.

3 - ADT ≤ 25,000 use 1-pass; ADT > 25,000 use 2-pass

4 - If only distress present, use indicated treatments. If other distreses are present, use the treatment that addresses the distresses across the full lane.

TREATMENT SELECTION GUIDELINES FOR COMPOSITE PAVEMENTS

Figure 53-3.B

		Proactive Maintenance Treatments				High Preservation Treatments [1]	
Pavement Conditions	Distress Levels	Crack Sealing	Joint Resealing	Diamond Grinding [2]	Diamond Grooving	LTR [3]	UTBWC
D-cracking	A1, A2	R	N/A	NR	NR	NR	R
	A3	NR	N/A	NR	NR	NR	R
	A4, A5	NR	N/A	NR	NR	NR	NR
Transverse Cracking	B1, B2	R	R	NR	NR	NR	R
	B3	R	R	NR	NR	NR	NR
	B4, B5	NR	NR	NR	NR	NR	NR
Transverse Joint Deterioration	C1, C2	R	R	R	NR	R	R
	C3, C4	NR	NR	NR	NR	NR	NR
Centerline Deterioration	D1	R	R	NR	NR	NR	R
	D2, D3	NR	NR	NR	NR	NR	NR
Longitudinal Cracking	E1, E2	R	R	NR	NR	NR	R
	E3, E4	NR	NR	NR	NR	NR	NR
Edge Punchouts (CRCP)	F1	R	N/A	F	NR	NR	R
	F2, F3	NR	NR	NR	NR	NR	NR
Faulting	≤ 0.15	NR	NR	NR	NR	NR	NR
	> 0.15	NR	NR	R*	NR	R	NR
Corner Breaks (JPCP)	H1	N/A	N/A	N/A	NR	N/A	R
	H2, H3	NR	NR	NR	NR	NR	NR
Map Cracking and Scaling	I1	NR	NR	R	NR	NR	R
	I2	NR	NR	R	NR	NR	R
	I3	NR	NR	R	NR	NR	R
Popouts/High Steel	J1, J2, J3	NR	NR	NR	NR	NR	F**
Permanent Patch Deterioration	K1	R	R	F**	F**	NR	R
	K2, K3, K4	NR	NR	NR	NR	NR	NR
Roughness (High IRI)	IRI > 140 in/mi	NR	NR	R	NR	F*	F
Friction	Poor	NR	NR	R	R	N/A	R
Relative Cost	($ to $$$$)	$	$	$$	$$	$$$	$$

R - Recommended treatment. Care must be taken to ensure all critical distress types are addressed by selected treatment.
R* - Recommended when used in conjunction with LTR.
F - Feasible treatment but depends upon other project constraints including other existing distresses.
F* - Feasible treatment if poor ride is a result of undoweled joints or faulted transverse (mid-slab) cracking.
F** - Other distress types should dictate choice of treatment.
NR - Treatment is not recommended to correct the specified pavement condition.
N/A - Distress does not impact treatment selection.
1- Full-Depth and Partial-Depth patching will only be allowed as a mitigating activity. A maximum of 0.50 percent will be allowed.
2 - If intermittent bump grinding, no additional activity necessary. Large areas of > 100 ft in length require diamond grooving.
3 - LTR (Load Transfer Restoration) is normally used in combination with diamond grinding.

TREATMENT SELECTION GUIDELINES FOR RIGID PAVEMENTS

Figure 53-3.C

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53-3.03 Pavement Preservation Treatments

Available and commonly used pavement preservation treatments are summarized in this section by TAMP subcategory (proactive maintenance, low preservation, high preservation). Further details regarding the treatments are available in the *IDOT Standard Specifications*, supplemental specifications, and special provisions. One-page treatment summaries may be found in Section 53-5 and include additional detail on each treatment. Utilize the guidance contained there to select the final treatment.

53-3.04 Other Factors

There are several other factors that must be addressed during the selection and/or design of various pavement preservation techniques.

53-3.04(a) Shoulders Versus Mainline

Pavement preservation treatments may be different between mainline and shoulders. Some spray applications that are not allowed for high-speed mainline sections may be used on shoulders since that is not the travel lane.

53-3.04(b) Pavement Markings and Raised Reflective Pavement Markers

All pavement markings, except latex paint, shall be removed prior to placement of a preservation treatment. Review all pavement sections for the presence of raised reflective pavement markers (RRPMs) prior to treatment placement for edge-to-edge treatments. RRPMs cannot be masked to protect and leave in place. All treatments will require removal and replacement of RRPMs.

53-3.04(c) Rumble Strips

Care shall be taken to avoid reducing the effectiveness of existing rumble strips when applying pavement preservation treatments.

53-3.04(d) Surface Preparation

Pavement preservation treatments are thin compared to a traditional two-lift HMA overlay and certain existing conditions will negatively impact their performance if not addressed. These conditions include, but are not limited, to the following.

1. Existing Pavement Markings. Some pavement preservation treatments require complete removal of all pavement markings before placement (e.g., thermoplastic, paint). When designing a project, review construction requirements of the selected treatment to determine if this work is required.

2. Roughness. Most thin preservation treatments will not improve a rough ride, unless multiple applications are used. Even then, there are limitations to how much roughness can be corrected. Bumps greater than 0.5 in. (12.5 mm) (measured using a 16-ft [4.9 m] straightedge) should be ground off prior to construction, unless the project includes surface milling or recycling. If excessive bump grinding would be required, consider treating the entire surface with fine milling.

3. Insufficient Cross Slope. Preservation treatments are not thick enough to adjust pavement cross slope when it is needed. If a pavement needs cross slope improvements, this should be accomplished by milling.

4. Cracking. Medium and high severity cracks will reflect through a preservation treatment. Proactive crack sealing should be completed at least 3 months prior to the placement of the treatment to minimize difficulties in constructing the treatment. If considering as a pre-treatment activity before pavement preservation, investigate the possibility of performing a sealing contract in the previous construction season. The sealant should be flush with or slightly below the surface of the pavement to minimize bleed-through.

53-3.04(e) Pavement Markings

A period of several days of good drying weather is necessary prior to the placement of permanent markings on various flexible pavement preservation treatments. Review each treatment specification to determine how much time is needed. Temporary markings of water-based paint or foil-backed tape will be necessary until permanent markings can be applied.

53-3.04(f) Timing Treatment Application

The weather limitations for the selected treatment must be considered when determining the letting date. Some treatments have small ranges of dates and/or temperatures in which they can be constructed. Schedule the letting at a time to avoid late season paving to promote proper cure of the treatment prior to the onset of winter.

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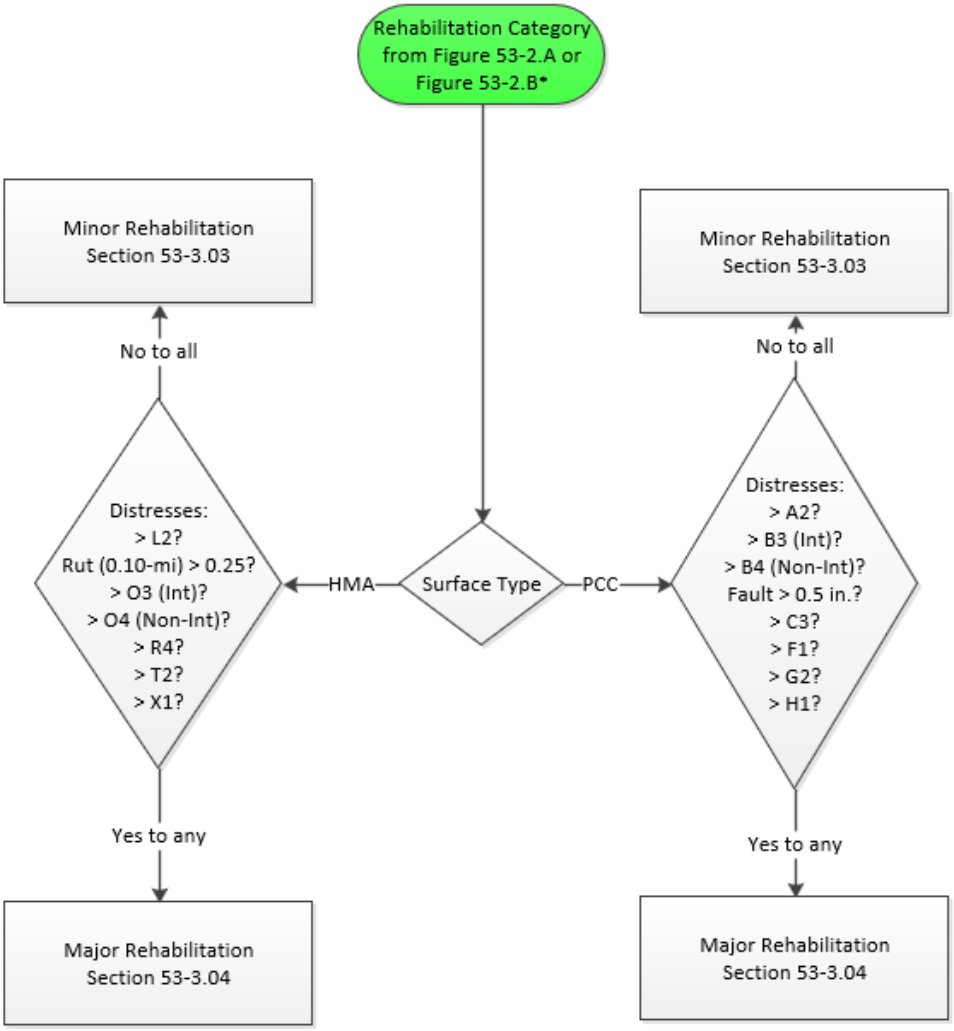
53-4 PAVEMENT REHABILITATION TREATMENT SELECTION GUIDELINES

53-4.01 Select Appropriate Pavement Rehabilitation Treatment

Figure 53-4.A provides the decision tree for initial selection of the rehabilitation treatment based on the surface type of pavement and the presence of high severity structural distresses. Use this figure in conjunction with the PFI data as described in the Pavement Management and Evaluation Manual to make a final determination of rehabilitation subcategory (minor or major rehabilitation). Once the final subcategory has been established, utilize the guidance in the one-page treatment summaries to select the final treatment.



* **Note:** Thickness for Pavement Rehabilitation Treatments does not apply to the Contract Maintenance Program. Contract Maintenance thicknesses will typically be 1.5-2.0 inches.

REHABILITATION TREATMENT SELECTION

Figure 53-4.A

53-4.02 Minor Pavement Rehabilitation Treatments

A rehabilitation strategy normally is developed and targeted to address specific deficiencies with a particular pavement type. The strategy usually will be a combination of a rehabilitation treatment and one or more mitigating activities that, when completed, will correct deficiencies (i.e., functional failure, structural failure, or both) in the most cost-effective manner. The following pages provide brief descriptions of the pavement rehabilitation treatments typically used by the Department. Use these descriptions to better understand each rehabilitation treatment's purpose and application when developing alternative rehabilitation strategies.

Minor rehabilitation options include standard HMA overlays and bonded concrete overlays on asphalt (BCOA).

1. For a Standard HMA Overlay, use the appropriate thickness guidelines presented in Section 53-4.02(a). HMA mixture design criteria must be met as outlined in Section 53-4.04.

2. When a BCOA is selected, the overlay should follow the guidelines in Section 53-4.02(b).

53-4.02(a) Standard HMA Overlay

If the projected CRS value for the pavement section is within the range for minor rehabilitation according to Figure 53-4.A and the PFI concurs, a standard HMA overlay may be selected.

1. Milling. For HMA-surfaced pavements, the milling depth should remove the entire existing surface lift. When determining milling depth, avoid milling within 0.50 in. of an HMA lift line or within 1.0 in. above underlying PCC whenever possible to eliminate scabbing.

   If there are constraints such as curb and gutter or other profile limits, take pavement cores to better define milling depth and required HMA lift thickness.

2. Number of Lifts. Full-depth HMA pavements may use a single lift of 2.00 in. (50 mm). All other pavement types will require the use of two lifts; however, a single 2-in. (50-mm) lift may be requested as an overlay policy exception according to Section 53-2.08.

3. Thickness. The resurfacing thickness for standard HMA overlays shall be according to the following.

   a. Interstates. Two lifts with a total thickness of 3.00 to 4.25 in.

   b. Other State Maintained Highways. Two lifts with a total thickness of 2.00 to 2.75 in. Bare PCC will require a minimum total thickness of 2.50 in.

53-4.02(b) Bonded Concrete Overlay on Asphalt (BCOA)

A bonded concrete overlay on asphalt is a rehabilitation strategy that involves a 3.0 in. to 6.0 in. portland cement concrete overlay over an existing HMA surface. The BCOA procedure does not apply to concrete thickness greater than 6.0 in. For thicker concrete slab designs, an unbonded

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concrete overlay, which is a pavement replacement option, should be considered. This alternative rehabilitation strategy shall apply to Class I, II, III, and IV pavements, but shall not be used when the traffic factor (based on the rigid pavement equations) exceeds 7.5.

The BCOA treatment requires bonding between the new PCC surface and the underlying HMA as well as selecting slab sizes to balance the number of joints with debonding potential and increased slab stresses.

The successful application of BCOA requires a thorough field evaluation of the existing pavement, as well as close attention to profile, elevation, pavement cross section, and utility adjustments. See the bonded concrete overlay on asphalt pavement evaluation information contained in the Pavement Management and Evaluation Manual for more details.

The existing pavement surface shall be milled to correct the longitudinal and transverse profile, remove surface irregularities, and to maintain an acceptable cross-slope. Milling will also promote better bonding between the HMA and new PCC layer. The existing HMA layer, or remaining HMA after milling, shall be a minimum of 2.5 in. thick. If the remaining HMA does not meet this requirement, mill the entire HMA layer and replace with 2.5 in. new HMA to provide a good surface for the new concrete.

If a portion of the BCOA in excess of 5% will be bonded directly to bare concrete, brick, or other old slabs of concrete, this rehabilitation method shall not be used. This 5% limitation allows for existing concrete patches or other existing pavement features. Construction may be hindered by complicated geometrics, utility obstructions, traffic demand, and condition of the existing pavement.

To ensure good performance, synthetic macrofibers are specified for all BCOA projects. Synthetic macrofibers increase the structural capacity of concrete overlays by increasing the concrete material toughness. Additionally, synthetic microfibers are used to minimize the effects of plastic shrinkage cracks.

1. Procedures. All proposed BCOA projects must be submitted to the Bureau of Research for approval. The request should be documented in a “BCOA Project Request Report” and should include the following:

    - Preliminary and detailed pavement investigations, including performance testing of the existing HMA surface to remain in place,
    - existing and proposed cross sections,
    - existing and projected traffic information,
    - construction sequencing and proposed traffic control,
    - a document summarizing why the BCOA option is preferred over other rehabilitation alternatives.

Guidelines regarding the items to be included in the report and other BCOA design details are provided in the following sections. The designer should review all requirements and conduct preliminary calculations to check for feasibility before proceeding with detailed assessments.

2. Identify Design Considerations. There are several design issues that must be considered before submitting a BCOA rehabilitation proposal for review and approval. Issues that the designers should accommodate for prior to design submission for review are as follows:

   a. Design Period. The design period to be used for this rehabilitation strategy is 15 years.

   b. Drainage Considerations. Maintaining proper drainage through design and during construction is important. During construction, maintaining drainage is especially critical for projects that include an inlay. Repairing inadequate surface, subsurface, and/or lateral drainage may be required in certain locations prior to placement of a BCOA.

   c. Thickness Design and Joint Spacing. Using macrofibers in the mix, the bonded concrete overlay thickness design is based on the traffic factor, the underlying HMA thickness, and the panel size. The concrete thickness shall be 3.0 in. to 6.0 in. with 0.50 in. increments allowed.

      The traffic factor shall be determined according to the applicable equation for each pavement class using the equations in Section 54-4.01(g). Based on the traffic factor, the thickness of the underlying HMA material, and panel size, the bonded concrete overlay thickness may be determined either from Figures 53-4.B through 53-4.I or by using a computer program which is available from BDE: www.dot.il.gov/desenv/pdp.html.

      This program allows the designer to input the traffic factor, the thickness of the underlying HMA material, panel size, and macrofibers residual strength to calculate the bonded concrete overlay thickness. The result from the program is rounded up to the nearest 0.50 in.

      The thicknesses shown in Figures 53-4.B through 53-4.I were calculated using the computer program with the following default values as design inputs:

      Elastic Modulus of HMA Layer (E_{AC}) = 350,000 psi
      Elastic Modulus of PCC Overlay or Inlay (E_C) = 3,600,000 psi
      Modulus of Rupture (*MOR*) = 750 psi
      Residual strength (F_{150}) = 150 psi
      Modulus of Subgrade (k)= 100 pci
      Coefficient of Thermal Expansion (*CTE*) = 5.5 x 10^{-6} in./in./°F
      Percent of Panels with Cracking (P_{cr}) = 20%
      Reliability Factor (R) = 85%
      Temperature Gradient (ΔT) = -1.4 °F/in.
      Occurrence of Temperature Gradient (*% Time*) = 58%

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A key to the successful application of BCOA is longitudinal and transverse jointing. These joints are saw cut into hardened concrete to relieve stresses due to drying and thermal shrinkage as well as curling. The joints should be laid out on a regular pattern for both longitudinal and transverse directions (to form panels) based on the spacing used to determine the thickness. No skewed joints will be allowed.

Transverse and longitudinal joints should be laid out to match existing joints, utility obstructions, and geometrics of the existing pavement when PCC pavement is exposed during milling. When feasible, longitudinal joints should be laid out to avoid the wheelpath areas of the traveling lanes. Typically, this means 6 ft slab sizes should be selected to avoid longitudinal contraction joints in the wheelpath that occur with 4 ft panel sizes. The layout of all transverse and longitudinal joints should be detailed on the plan sheets.

The cost of sawing may significantly influence the cost of the BCOA. A thicker overlay may be more economical than a thinner one because the greater thickness may increase the joint spacing, resulting in less sawing.

The following list defines the variables shown in Figures 53-4.B through 53-4.I.

F_{150} = Residual Strength (psi) calculated at a net deflection of L/150 (L = span length) or 3 mm in accordance with ASTM C1609-12.

h_{ac} = Thickness of existing remaining HMA after milling.

h_c = Thickness of new bonded concrete overlay.

L = Maximum joint spacing in the longitudinal and transverse directions.

d. Final Finish. Locations with a posted speed limit greater than 40 mph shall use a Type A final finish. All other locations shall use a rough broom final finish struck perpendicular to the direction of traffic flow in lieu of a Type B final finish. The rough broom finish shall be used across the entire surface area of the PCC surface.

e. Traffic Control. The control of traffic through the project must be considered and well established prior to time of construction. The best alternative for traffic control is to completely close the project to traffic. This alternative may be difficult for urban projects; however, somewhat easier for rural projects. If closure to traffic is not possible, traffic control must be established that will effectively move traffic through the project with minimal disruption to construction operations and traffic flow. Traffic control that can be left unattended overnight must be anticipated for each stage of construction.

f. Construction Staging. Construction staging for a bonded concrete overlay on asphalt project must be considered with respect to the construction timeframe and traffic flow through the project. The project must be staged in such a way that continuous traffic flow will be maintained. Construction staging must also consider

the geometrics of the project and any lane to lane drop off restrictions that may be present with the overlay thickness.

A PCC traffic opening strength of 550 psi flexural or 3,000 psi compressive is required. The current PCC mix design specified may obtain the opening strength in as little as three days if properly proportioned. If the BCOA must be opened to traffic in a shorter time frame, consult the District Materials Office for an acceptable high-early-strength PCC mixture. The risk of excessive shrinkage and debonding increases at higher cement contents and with thinner slabs.

3. Request for Review and Approval. Upon completion of the BCOA analysis, a completed "BCOA Project Request Report" should be submitted to the Bureau of Research for review and approval. Contact the Engineer of Pavement Technology in the Bureau of Research for an example of a "BCOA Project Request Report."

If the program is used in lieu of Figures 53-4.B through 53-4.I to determine the thickness, the BCOA Project Request Report must include screenshots of the program indicating the inputs used for the design.

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With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
---	---	3
≤ 0.065	---	3.5
≤ 0.7	---	4
≤ 5	≤ 0.05	4.5
≤ 5	≤ 0.27	5
≤ 5	≤ 1.2	5.5
≤ 5	≤ 4.5	6

BCOA THICKNESSES WHERE h_{ac} = 2.5 in.

Figure 53-4.B

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 0.025	---	3
≤ 0.25	---	3.5
≤ 2.5	≤ 0.02	4
≤ 5	≤ 0.12	4.5
≤ 5	≤ 0.6	5
≤ 5	≤ 2.5	5.5
≤ 5	≤ 5	6

BCOA THICKNESSES WHERE h_{ac} = 3.0 in.

Figure 53-4.C

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 0.14	---	3
≤ 1.3	≤ 0.011	3.5
≤ 5	≤ 0.06	4
≤ 5	≤ 0.35	4.5
≤ 5	≤ 1.5	5
≤ 5	≤ 5	5.5

BCOA THICKNESSES WHERE H_{ac} = 3.5 IN.

Figure 53-4.D

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 1	---	3
≤ 5	≤ 0.042	3.5
≤ 5	≤ 0.21	4
≤ 5	≤ 1.1	4.5
≤ 5	≤ 4.5	5
≤ 5	≤ 5	5.5

BCOA THICKNESSES WHERE H_{ac} = 4.0 IN.

Figure 53-4.E

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 5	≤ 0.037	3
≤ 5	≤ 0.19	3.5
≤ 5	≤ 0.86	4
≤ 5	≤ 4	4.5
≤ 5	≤ 5	5

BCOA THICKNESSES WHERE h_{ac} = 4.5 in.

Figure 53-4.F

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 5	≤ 0.22	3
≤ 5	≤ 0.95	3.5
≤ 5	≤ 4.2	4
≤ 5	≤ 5	4.5

BCOA THICKNESSES WHERE h_{ac} = 5.0 in.

Figure 53-4.G

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 5	≤ 1.5	3
≤ 5	≤ 5	3.5

BCOA THICKNESSES WHERE h_{ac} = 5.5 in.

Figure 53-4.H

With Synthetic Fibers (F_{150} = 20%)		
Design Parameters		**BCOA Thickness, h_c (in.)**
Traffic Factor *L* = 48 in.	**Traffic Factor *L* = 72 in.**	
≤ 5	≤ 5	3

BCOA THICKNESSES WHERE H_{ac} = 6.0 IN.

Figure 53-4.I

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53-4.03 Major Rehabilitation Treatments

Major Rehabilitation treatment options include Designed HMA Overlays and Structural Concrete Overlays (SCO).

1. For a Designed HMA Overlay, use the appropriate thickness guidelines presented in Section 53-4.03(a). HMA mixture design criteria must be met as outlined in Section 53- 4.04.

2. SCO is still considered experimental by the Department. Selection of this treatment as the rehabilitation method must be approved by the Bureau of Research. Design thickness and specification development for the overlay shall also be coordinated through the Bureau of Research.

53-4.03(a) HMA Designed Overlay

If the projected CRS value for the pavement section is within the range for major rehabilitation according to Figure 53-4.A and the PFI results concur, an HMA Designed Overlay may be selected as the rehabilitation treatment.

1. Milling. For HMA-surfaced pavements, consult the Pavement Investigation Report to determine the appropriate milling depth. When determining milling depth, avoid milling either within 0.50 in. of a HMA lift line or within 1.0 in. above underlying PCC whenever possible to eliminate scabbing. If proposed milling thickness exceeds the new overlay thickness, contact the Bureau of Research to confirm residual pavement structure and final milling thickness.

2. Number of Lifts. All pavement types will use a minimum of two lifts.

3. Thickness. A thickness design procedure is still under development. Until the procedure is completed, HMA Designed Overlays will use the following default thicknesses.

   a. Interstates. 5.00 in.

   b. Other State Maintained Highways. 3.75 in.

   The mixture gradations and lift thicknesses shall be selected from Figure 53-4.J.

53-4.03(b) Structural Concrete Overlay (SCO)

When a pavement section has experienced structural deterioration with a high frequency of working cracks, an HMA overlay may not be the best option due to the propensity for reflective cracking. At this point, the best option is a SCO. The SCO consists of placing a non-reinforced layer of PCC pavement that is sawed both longitudinally and transversely to create panels.

This treatment utilizes an interlayer that serves as a bond breaker over an existing distressed pavement which insulates the overlay from the underlying distresses. If the pavement has been

previously resurfaced with HMA, the surface may be milled to correct profile irregularities and use the remaining existing HMA overlay as the interlayer. If the pavement is bare PCC, an interlayer shall be placed as a bond breaker.

Pavements that have high severity structural distresses (e.g., frequent, high severity transverse cracking) are suited for this treatment to reduce the potential for reflective cracking in the overlay.

This treatment has had limited use and is still considered experimental. The district must work with the Bureau of Research to design the PCC thickness, interlayer type and thickness, and joint spacing for the SCO.

Use of the SCO requires an experimental feature according to Construction Memo 02-2 and approval by the Bureau of Research. Contact the Engineer of Pavement Technology in the Bureau of Research for additional information on use and design of this treatment.

53-4.04 HMA Design Guidelines

These guidelines apply to all HMA construction.

53-4.04(a) Minimum HMA Lift Thickness

The mixture gradations and lift thicknesses shall be selected from Figure 53-4.J.

Mixture Gradation	Type of Lift	Minimum Lift Thickness (in.)
IL-19.0	Binder only	2.25
IL-9.5	Surface or Binder	1.50
IL-9.5FG	Surface or Binder	1.25
IL-4.75	Binder only	0.75 – Over HMA Surface 1.00 – Over PCC Surface
SMA 12.5	Surface or Binder	2.00
SMA 9.5	Surface or Binder	1.50

LIFT THICKNESS REQUIREMENTS FOR HMA OVERLAYS

Figure 53-4.J

53-4.04(b) HMA Mixture Requirements Table

Figure 53-4.K was designed to accommodate HMA mixtures and is required to be completed and inserted into the General Notes of the project plans for each HMA mixture application specified.

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Use the following guidelines to complete the table in Figure 53-4.K:Location(s). Specify, by route number or stationing, the location(s) where the mix will be placed.

The following HMA mixture requirements are applicable for this project:

Location(s):	
Mixture Use(s):	
PG:	
Design Air Voids:	
Mixture Composition: (Mixture Gradation)	
Friction Aggregate:	
Mixture Weight:	
Quality Management Program:	
Sublot Size:	
Number of Roller Passes 1/	

1/ When a number of roller passes is specified, the Contractor may opt to use intelligent compaction in lieu of density testing under the Quality Control for Performance (QCP) program.

HMA MIXTURE REQUIREMENTS TABLE

Figure 53-4.K

1. Mixture Use(s). Corresponds to the generic description of the mixture(s) (i.e., surface course, binder, base course, shoulders, etc.). On full-depth projects, specify the lift (e.g., “full-depth, lower binder,” “full-depth, top binder,” or “full-depth, surface”).

2. PG. Specify the Performance-Graded (PG) binder for the mixture, including polymer modified asphalt binder (e.g., PG64-28, SBS-PG64-28, PG70-22, SBS-PG70-22). The PG binder grade shall be specified without consideration of RAP and/or RAS addition. Obtain the required PG binder designation from the District Materials Engineer.

3. Design Air Voids. Specify the target air void content for the mixture. For example, “4.0% @ N_{design} = 50”, “4.0% @ N_{design} = 70”, etc. All HMA mixtures will typically require 4.0% air voids; however, the N_{design} number will change. Obtain the N_{design} number from the District Materials Engineer.

4. Mixture Composition. Specify the aggregate gradation for the mixture design:

   - IL-19.0 – binder.
   - IL-19.0L – low volume binder.
   - IL-9.5 – surface or binder.
   - IL-9.5L – low volume surface.

- IL-9.5FG – fine-graded surface or binder.
- IL-4.75 – binder.
- SMA-12.5 – surface or binder.
- SMA-9.5 – surface or binder.

5. Friction Aggregate. Specify the aggregate to be used to meet surface course friction requirements (i.e., Mixture C, Mixture D, Mixture E, Mixture F). Because there are no friction requirements for binder courses, leave this entry blank when specifying binder courses. Refer to Section 53-4.04(f) for additional information.

6. Mixture Weight. Specify the unit weight used to determine the plan quantities for HMA surface course. Use 112.0 lb/sq yd/in. thickness as the unit weight for typical standard mixes using natural aggregate. For a specialty mix design, such as those using synthetic aggregates with differing unit weights (e.g., air-cooled blast furnace slag (light) or steel slag (heavy)), the designer should consult the District Materials Engineer to determine the anticipated unit weight.

7. Quality Management Program. Specify which quality management program will be used for each mixture use listed in Item 2 above. If the same mixture has two QMPs, each QMP should be in separate columns in the mixture requirements table. Options include: Pay-For-Performance (PFP), Quality Control for Performance (QCP), and Quality Control/Quality Assurance (QC/QA).

   a. PFP. PFP utilizes pay adjustments based upon percent within limits statistical calculations. PFP should be specified for interstate, freeway and expressway resurfacing; and full-depth pavement projects having a minimum quantity of 8,000 tons per mix. PFP may also be considered for smaller projects where a more accurate measure of quality is desired. PFP should not be used on:

      - incidental surfacing (e.g., driveways, entrances, minor sideroads, and side road returns);
      - temporary pavements;
      - shoulders, unless they are used as auxiliary lanes;
      - patching;
      - turn lanes less than 500 ft in length; or
      - shared-use paths or bike lanes unless paved with the mainline pavement.

   b. QCP. QCP utilizes step-based pay adjustments and should be specified for:

      - mainline mixture quantities between 1,200 and 8,000 tons; or
      - shoulder applications that are greater than 8 feet wide and having quantities of 1,200 tons and greater.

      QCP should not be used on:

      - incidental surfacing (e.g., driveways, entrances, minor sideroads, and side road returns);

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- temporary pavements;
- patching;
- turn lanes less than 500 ft in length; or
- shared-use paths or bike lanes unless paved with the mainline pavement.

c. QC/QA. The use of QC/QA is limited to:

- mixtures with quantities less than 1,200 tons,
- shoulders placed with a road widener, and
- patching or incidental surfacing (e.g., entrances, minor sideroads).

8. Sublot Size. The sublot size for QCP and PFP will typically be 1,000 tons. On rare occasions, the sublot size may be reduced to lower the payment risk for smaller tonnage projects. Sublot size is not applicable when the QC/QA quality management program is used.

9. Number of Roller Passes. To give the Contractor the option of using intelligent compaction in lieu of density testing for variable depth HMA binder (i.e., used to correct cross-slope or rutting) placed under the QCP quality management program, specify the number of passes (typically 5 passes or 7 passes) the rollers must make over the HMA binder to ensure enough compactive effort is being applied.

53-4.04(c) ESAL Calculation

Use Section 54-2.01(c) and Section 54-5.01(g) to calculate ESALs for the design lane. To select the PG binder and design compactive effort (N_{design}), the ESAL value, equivalent to the Traffic Factor (TF), is calculated according to the equations in Figure 54-5.B. Use a Design Period (DP) of 20 years. In this application, the calculation is purely to determine the mixture design parameters; actual pavement/thickness design may require a different design period and/or TF calculation. Minimum structural design traffic levels should be ignored for mixture design purposes.

It is recommended that each district designate a single individual to coordinate ESAL calculations. In instances where major routes cross district borders, it is recommended that the ESAL counts be confirmed between districts.

53-4.04(d) Design Compactive Effort

The design compactive effort is expressed as an N_{design} number, which is selected based on the estimated 20-year ESAL loading of the traffic lane.

Figure 53-4.L lists the design compactive effort (N_{design}) required for the different levels of traffic loading and describes the typical roadway application. Consult the District Materials Engineer for the appropriate N_{design} value.

Design ESALs (millions) (20-yr. Design)	N_{ini}[1]	N_{des}	N_{max}[1]	Typical Roadway Application
< 0.3	5	30	42	Roadways with very light traffic volume such as local roads, county roads, and city streets where truck traffic is prohibited or at a very minimal level. (Considered local in nature; not regional, intrastate, or interstate.) Special purpose roadways serving recreational sites or areas may also be applicable.
0.3 to 3	6	50	74	Includes many collector roads or access streets. Medium-trafficked city streets and the majority of county roadways.
3 to 10	7	70	107	Includes many two-lane, multi-lane, divided, and partially or completely controlled access roadways. Among these are medium-to-highly trafficked streets, many state routes, US highways, and some rural Interstates.
> 10	8	90	141	Includes Interstates, both urban and rural in nature. Special applications such as truck-weighing stations or truck-climbing lanes on two-lane roadways may also be applicable to this level. May also include the class of roadways in the row above which have a high amount of truck traffic.

[1] N_{ini} and N_{max} are for informational purposes only. It is recommended the air voids at N_{ini} be greater than 11% to avoid mix tenderness. Also, air voids at N_{max} should be greater than 2% to prevent premature rutting.

DESIGN COMPACTIVE EFFORT FOR VARIOUS TRAFFIC CONDITIONS

Figure 53-4.L

53-4.04(e) Asphalt Binder Selection

Selection of Performance-Graded (PG) binders is based on temperature and traffic conditions. Figure 53-4.M lists the appropriate PG binders for use with all HMA mixtures. Consider the following when selecting the asphalt binder:

1. Polymer Modified PG Binders. Where polymer modifiers are required, designate “SBS” in front of the PG binder requirements in the General Notes table. The following grades of asphalt binder must be polymer modified: PG 64-28, PG 70-22, PG70-28, PG76-22, and PG76-28.

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2. Overlays of PCC or Composite Pavements. Overlays of PCC or composite pavements should use the grades shown in Figure 53-4.M for a standard traffic level. Adjustments to this grade are dependent upon conditions such as slow moving traffic, high ESALs, or standing traffic. These modifications should be made for the corresponding N_{design} number and/or ESAL number. The appropriate asphalt binder grade should then be reported on the General Notes table of the plans.

3. Full-Depth HMA Pavements or Overlays of Full-Depth HMA Pavements. Full-depth HMA pavements or overlays of full-depth HMA pavements should be designed using the PG binders shown in Figure 53-4.M. The appropriate binder grade should be reported on the General Notes table of the project plans.

53-4.04(f) Friction Aggregate

An HMA surface course must be specified for each rehabilitation/resurfacing project. Section 11-2.02(f) gives safety analysis procedures to determine risks contributing to substantive safety problems.

Before the appropriate mix is selected, determine whether or not pavement surface friction is contributing to a substantive safety problem at the site. Presence of “wet pavement” crashes alone is not sufficient, as other risks related to wet weather may be present. For example, inadequate warning signage or visibility of stop or maneuver areas, unexpected geometric conditions, rutting, lack of surface drainage, inadequate pavement cross slope, or excess spray from vehicle tires may be more important than surface friction for locations of wet pavement crashes. Review of crash reports including narratives and sketches, site reviews during wet conditions, and surface friction testing should be included in an analysis of wet pavement crashes. Pavement friction testing may be requested according to the Bureau of Research Pavement Technology Advisory-“Testing Pavement Friction” (PTA-T3), http://idot.illinois.gov/Assets/uploads/files/Transportation-System/Research/Pavement-Technology-Advisories/Testing-and-Data-Collection-Series/PTAT3.pdf.

If the segment demonstrates a pattern of wet pavement crashes, identification of the risks contributing to the crash pattern will help to indicate the appropriate countermeasures, possibly including improved positive guidance, geometric changes, surface to full-depth repairs of rutting, improved drainage or cross slope, or improved surface texture (pavement grooving) or resurfacing with appropriate friction aggregate.

PG BINDER GRADE SELECTION - ALL APPLICATIONS

Type of HMA Pavement	Layer	Illinois N_{design} Number	Design ESALs[1] (million)	PG Binder Grade[2][3] Traffic Loading Rate		
				Standard[4]	Slow[5] or High ESALs[6]	Standing[7]
IL-4.75	Surface[8] and Binder	50	≤ 10	SBS PG 70-22	SBS PG 70-22	SBS PG 70-22
			> 10	SBS PG 76-22	SBS PG 76-22	SBS PG 76-22
SMA Overlay of PCC or Composite Pavement	Surface and Binder	50	≤ 10	SBS PG 76-22	SBS PG 76-22	SBS PG 76-22
		80	> 10	SBS PG 76-22	SBS PG 76-22	SBS PG 76-22
SMA for Full-Depth Pavement and Overlays of Full-Depth Pavement	Surface and Binder	50	≤ 10	SBS PG 76-28	SBS PG 76-28	SBS PG 76-28
		80	> 10	SBS PG 76-28	SBS PG 76-28	SBS PG 76-28
Overlay of PCC or Composite Pavement	Surface or Binder	30	≤ 0.3	PG 58-22	PG 64-22	PG 64-22
		50	> 0.3 to 3	PG 64-22	SBS PG 70-22	SBS PG 76-22
		70	> 3 to 10	PG 64-22	SBS PG 70-22	SBS PG 76-22
		90	> 10	SBS PG 70-22	SBS PG 70-22	SBS PG 76-22
Districts 1-6 Full-Depth Pavement and Overlays of Full-Depth Pavement	Surface and Top Binder	All	All Levels	SBS PG 64-28[9]	SBS PG 70-28	SBS PG 76-28
	Lower Binder	All	All Levels	PG 64-22	PG 64-22	PG 64-22
Districts 7-9 Full-Depth Pavement and Overlays of Full-Depth Pavement	Surface and Top Binder	All	All Levels	PG 64-22[9]	SBS PG 70-22	SBS PG 76-22
	Lower Binder	All	All Levels	PG 64-22	PG 64-22	PG 64-22

Figure 53-4.M (1 of 2)

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1. *Design ESALs are the anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years and choose the appropriate N_{design} level.*
2. *The binder grade provided in the table is based on the recommendations given in Illinois-Modified AASHTO M 323, Table 1, "Binder Selection on the Basis of Traffic Speed and Traffic Level."*
3. *Consider increasing the high temperature grade by one grade and/or use polymer modified binder within 2,500 ft upstream of the exit terminal stub to 2,500 ft downstream of the entrance stub at weigh stations.*
4. *Standard Traffic - where the average traffic speed is greater than 43 mph.*
5. *Slow Traffic - where the average traffic speed ranges from 12 mph to 43 mph.*
6. *High ESALs – where ESALs are > 30 million.*
7. *Standing Traffic - where the average traffic speed is less than 12 mph.*
8. *For pavements with a posted speed limit ≤ 30 mph.*
9. *Consider increasing the high temperature grade by one grade for ESALs 10 to 30 million.*

PG BINDER GRADE SELECTION - ALL APPLICATIONS

Figure 53-4.M (2 of 2)

It is not desirable to specify short, closely spaced segments of special high-quality friction mixes (i.e., patchwork surfacing). If a higher-quality friction mix treatment is required at more than one location on a project and the distance between locations is less than 1,000 ft, the gaps should also be treated with the higher-quality mix. Also, if the special treatment is required on more than 50 percent of the project, it should be used throughout the entire project.

Four surface course mixtures have been developed that will provide adequate skid resistance for various Average Daily Traffic (ADT) levels: Mixtures C, D, E, and F. Figure 53-4.N designates the ADT levels allowable for each of the surface course mixtures.

It is expected that the application of friction aggregate according to Figure 53-4.N will address most pavement friction needs. However, some conditions create friction demands exceeding typical conditions anticipated by this tabulation. Examples include locations where problem identification shows a pattern of wet pavement related crashes and one of the following conditions:

- on grades exceeding 3.5%;
- locations with a heavy commercial vehicle (HCV) volume (Single Units plus Multiple Units) exceeding 400 per day and equal to 25% or more of the total ADT (Note – 25% HCV represents about 15% of State System mileage);
- locations that are shadowed or otherwise tend to remain wet for an extended time compared to typical locations; or
- other sites where similar friction demands or pavement conditions exist. At such locations, the Mixture designation may be increased by one step (e.g., from Mixture D to Mixture E).

Number of Lanes in Both Directions	**Frictional Requirements (ADT)**			
	Mixture C	**Mixture D**	**Mixture E**	**Mixture F**
≤ 2	≤ 5,000	> 5,000	N/A	N/A
4	≤ 5,000	5,001 to 25,000	25,001 to 100,000	> 100,000
≥ 6	N/A	5,001 to 60,000	60,001 to 100,000	> 100,000

Note: ADT levels are for the expected year of construction.

FRICTIONAL REQUIREMENTS FOR SURFACE MIXTURES

Figure 53-4.N

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53-5 TREATMENT SUMMARIES

The following section contains one-page summaries of all pavement preservation treatments (proactive, low, and high), rehabilitation treatments (minor and major), pre-treatment activities, and other design considerations.

53-5.01 Flexible and Composite Pavement Preservation Treatment Summaries

FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (PROACTIVE MAINTENANCE)

Name: Crack/Joint Filling

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to both Functional and Structural Failures

Purpose. Crack filling is effective at reducing or delaying moisture damage, further deterioration, roughness, and rutting. However, crack/joint filling can also have a negative impact on roughness and friction.

Treatment Description. Crack filling is the process of placing material into non-working cracks to substantially reduce the infiltration of water and to reinforce the adjacent pavement. Crack filling is characterized by minimal crack preparation and the use of lower quality bituminous filler materials.

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.

Application Limitations. These treatments are not recommended when structural failures exist (e.g., extensive fatigue cracking, high-severity rutting) or if there is extensive pavement deterioration or little remaining life. Crack filling is appropriate for non-working (e.g., longitudinal, block) cracks 0.25 in. (6 mm) to 1.0 in. (25 mm) wide.

Non-working cracks narrower than 0.25 in. (6 mm) that do not exhibit spalling should not be filled. These cracks generally do not penetrate through the surface course nor do they pose a source of pavement deterioration. The practice of filling this type of crack by the method of pouring filler on the pavement surface is seldom of value. Perform a crack analysis to determine whether crack filling would be effective.

Letting/Construction Considerations. The project letting date should be selected to target construction during cool, dry weather conditions. Application during cool weather will allow for expanded crack widths.

Traffic Considerations. Performance is not significantly affected by varying ADT or truck levels. However, improper installation can permit the filler to fail.

Special Considerations/Comments: Crack filling may have negative effects. Undesirable visual impacts may occur, which include tracking of filling material by tire action, obscuring lane markings, and adversely affecting friction/skid resistance. Crack filling may result in a rougher pavement surface when the filler material is forced out of the cracks during warm months.

Performance Period. 2 to 4 years.

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FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (PROACTIVE MAINTENANCE)

Name: Crack/Joint Sealing

Application:

System: Interstates and Non-Interstates
Pavement Type(s): All Pavements
Distress Type(s): Relates to both Functional and Structural Failures

Purpose. Crack/joint sealing is effective at reducing or delaying moisture damage, further crack deterioration, roughness, and rutting. However, crack/joint sealing can also have a negative impact on roughness and friction.

Treatment Description. Crack/joint sealing is the process of placing higher-quality material into "working" cracks (i.e., those that open and close with changes in temperature) and construction joints in order to reduce water infiltration into a pavement. In contrast to crack "filling," crack sealing requires crack routing and uses higher quality sealant materials. Thermosetting and thermoplastic materials are both used for crack/joint sealing.

Pavement Conditions Addressed. Adds no structural benefit, but does reduce future intrusion of incompressible materials, water, and soluble chemicals (e.g., salts, brines) into the cracks/joints. It is only practical if extent of cracking is minimal and if there is little to no structural cracking.

Application Limitations. These treatments are not recommended where structural failures exist (e.g., extensive fatigue cracking, high-severity rutting) or if there is extensive pavement deterioration or little remaining life. Crack/joint sealing is appropriate for cracks and joints 0.25 in. to 0.75 in. (6 mm to 19 mm) wide.

Non-working cracks narrower than 0.25 in. (6 mm) that do not exhibit spalling should not be routed and sealed. These cracks generally do not penetrate through the surface course nor do they pose a source of pavement deterioration. The practice of routing and sealing this type of crack can increase pavement roughness without gaining any benefit.

Letting/Construction Considerations. The project letting date should be selected to target construction during cool, dry weather conditions. Application during cool weather will allow for expanded crack widths.

Traffic Considerations. Performance is not significantly affected by varying ADT or truck levels. However, improper installation can cause the sealant to fail.

Special Considerations/Comments: Crack/joint sealing may result in a rougher pavement surface when the sealant material is forced out of the cracks during warm months. Sealing is best accomplished several months in advance of any other maintenance surface applications. If sealing quantities become excessive, the district may want to consider a higher level treatment.

Performance Period. 2 to 8 years.

FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (LOW PRESERVATION)

Name: Cape Seal

Application:

System:	Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to Functional Failures

Purpose. A cape seal combines a chip seal with micro-surfacing to provide a smooth, quiet wearing surface at a lower cost than an HMA overlay.

Treatment Description. The treatment consists of a chip seal, followed within a few days by a micro-surfacing treatment to cover the chips and seal them in.

Pavement Conditions Addressed. Cape seal can be used to address longitudinal, transverse, and block cracking; friction loss; raveling/weathering (remove loose material); minor roughness; low- to medium-severity bleeding; and moisture infiltration. Adds no structural capacity. It is somewhat effective at sealing medium-severity fatigue cracks in comparison with other treatments.

Application Limitations. Not recommended for pavements with the following conditions: structural deficiency, unsealed cracks > 0.25 in. (6 mm) wide, medium- to high-severity alligator cracking, many potholes, rutting > 1 in. (25 mm) deep, and very rough surface.

Letting/Construction Considerations. The project letting date should be selected to target construction between May 1 and August 31.

Traffic Considerations. This treatment is not recommended for ADT greater than 10,000. Temporary pavement markings are required until permanent markings are applied. Because the application of the micro-surfacing removes the hazard of loose chips, the final surface of the cape seal leaves no concerns. However, keep traffic to slower speeds on high-volume or high-speed roadways until the chip seal portion has cured properly and/or it is covered by the micro-surfacing.

Special Considerations/Comments: Give special consideration to raised reflective pavement markers and bump grinding prior to treatment placement.

Performance Period. 4 to 7 years.

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FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (LOW PRESERVATION)

Name: Chip Seal (Bituminous Surface Treatment)

Application:

System:	Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to Functional Failures

Purpose. Chip Seals, also known as Bituminous Surface Treatments (BSTs), are effective at improving poor friction, inhibiting raveling, correcting minor roughness and bleeding, and sealing the pavement surface.

Treatment Description. Asphalt emulsion is applied directly to the pavement surface followed by the application of aggregate chips, which are then immediately rolled to imbed chips. Application rates depend upon aggregate gradation and maximum size. This treatment can be applied in multiple layers (e.g., double chip seals) and in combination with other surface treatments. For sections with ADT > 1,000, a fog seal shall be included with the treatment.

Pavement Conditions Addressed. Chip seals can be used to address longitudinal, transverse, and block cracking; raveling/weathering (remove loose material); friction loss; minor roughness; low-severity bleeding; and moisture infiltration. Adds no structural capacity. The flexible, impermeable HMA surface helps reduce cracking and is somewhat effective at sealing medium-severity fatigue cracks in comparison with other treatments.

Application Limitations. Chip seals are not recommended for pavements with structural deficiency, cracks greater than 0.25 in. (6 mm) wide, medium- to high-severity alligator cracking, many potholes, rutting greater than 1 in. (25 mm) deep, and very rough surface.

Letting/Construction Considerations. The project letting date should be selected to target construction between May 1 and August 31.

Traffic Considerations. With special design and proper placement, chip seals can perform well on high-volume roads. However, its use is sometimes limited to lower-speed, lower-volume roads because of the propensity for loose chips to crack windshields. This treatment is not recommended for ADT greater than 10,000. Use lightweight aggregate to help minimize claims. Flaggers may be needed at crossing intersections to control traffic.

Special Considerations/Comments: Temporary pavement markings are required until permanent markings are applied. Give special consideration to raised reflective pavement markers and bump grinding prior to treatment placement. Additional information is available from the BLRS Report, *Seal Coats (Oil & Chipping)*.

Performance Period. Single seals (A-1): 4 to 6 years; double seals (A-2): 5 to 7 years; triple seals (A-3): 6 to 8 years.

FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (LOW PRESERVATION)

Name: Half-SMART Overlay

Application:

System:	Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to Functional Failures

Purpose. Placing a combination of HMA binder and a chip seal is a viable option for improving surface friction, profile, crown, and cross slope.

Treatment Description. Half-SMART overlays consist of placing a nominal 0.75 in. (19 mm) layer of HMA binder followed by a chip seal. Only place this treatment on a previously resurfaced pavement that is not in need of significant repair and is in good condition.

Pavement Conditions Addressed. Half-SMART overlays are applicable for low-severity cracking; raveling/weathering (remove loose material), friction loss, low-severity flushing/bleeding, and low-severity block cracking (may perform better with additional milling). Half-SMART overlays may also be used to correct minor rutting (depths less than 0.25 in. (6 mm)).

Application Limitations. Half-SMART overlays are not recommended where there are structural failures (e.g., fatigue cracking), extensive pavement deterioration, or if there is high-severity thermal cracking. If this treatment is being placed to correct rutting, evaluate the pavement to determine if the rutting is stable. Do not use half-SMART overlays on pavements that have unstable rutting due to stripping in the existing asphalt layers.

Letting/Construction Considerations. The project letting date should be selected to target construction of the chip seal portion between May 1 and August 31.

Traffic Considerations. Use of the Half-SMART overlay is sometimes limited to lower-speed, lower-volume roads because of the chip seal layer, which has the propensity for loose chips to crack windshields. This treatment is not recommended for ADT greater than 10,000. Lightweight aggregate can be used to help minimize claims. Flaggers may be needed at crossing intersections to control traffic.

Special Considerations/Comments. Repair localized distressed areas prior to the placement of the overlay. If milling is not used in conjunction with the Half-SMART overlay, give special consideration to bump grinding prior to treatment placement.

Consider using IL-9.5FG or IL-4.75 gradations for the binder lift to promote better performance.

Performance Period. 5 to 7 years.

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FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (LOW PRESERVATION)

Name: Micro-Surfacing

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to Functional Failures

Purpose. 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 average wheel ruts up to 0.25 in. (6 mm) deep over the entire project. Projects with isolated rut depths up to 1.25 in. (30 mm) deep may be addressed with a rut filling mix prior to full-width placement of the micro-surfacing.

Treatment Description. Applied in a process similar to slurry seals, micro-surfacing consists of a mixture of latex-modified emulsified asphalt, mineral aggregate, mineral filler, water, and additives. Micro-surfacing material is mixed in specialized, compartmented, self-powered trucks and placed on the pavement using an augured screed box.

Pavement Conditions Addressed. Micro-surfacing may be used to address block, transverse, and longitudinal cracking; raveling/weathering (remove loose material), bleeding, minor roughness, friction loss, and moisture infiltration.

Application Limitations. Micro-surfacing is not recommended when the pavement contains structural failures (e.g., significant fatigue cracking), high-severity thermal cracking, or extensive pavement deterioration.

Letting/Construction Considerations. The project letting date should be selected to target construction between May 1 and October 15.

Traffic Considerations. Micro-surfacing is very successful on both low-and high-volume roadways. However, avoid areas of heavy truck turning or downgrade locations as there is a high potential for early damage.

Special Considerations/Comments: Give special consideration to raised reflective pavement markers and bump grinding prior to treatment placement. All RRPMs shall be removed prior to placing micro-surfacing. Covering or masking RRPMs is not permitted.

Centerline/Longitudinal Joint micro-surfacing is permitted on full-depth HMA pavements and composite pavements. This treatment should only be considered if the distress is at low severity and limited to close proximity of the joint. If a pavement has three or more lanes and all longitudinal joints are in need of a longitudinal joint micro-surfacing, caution shall be used due to the potential for water to be trapped in the center lane(s) during heavy rain events. If the pavement has multiple distresses that would benefit from a full-lane micro-surfacing treatment, it is best to use that in lieu of treating only the longitudinal joints.

Performance Period. 4 to 7 years.

FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (HIGH PRESERVATION)

Name: Longitudinal Joint Partial-Depth Repair

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to Functional and Structural Failures

Purpose. The partial-depth removal and replacement of the longitudinal joint is a viable option for addressing raveling and spalling of the joint due to high permeability and reduces the potential for moisture infiltration into the pavement structure.

Treatment Description. This treatment consists of milling a 2- to 3-ft (600- to 900-mm) strip of the surface lift, centered over the longitudinal joint, and replacing with new HMA mix.

Pavement Conditions Addressed. Longitudinal Joint Partial-Depth Repair can be used to address low to medium severity longitudinal joint deterioration.

Application Limitations. This treatment is allowed if longitudinal joint deterioration is the only distress. If other distresses are present, a full-width treatment should be considered.

Letting/Construction Considerations. None.

Traffic Considerations. Performance is not affected by different ADT or percent trucks.

Special Considerations/Comments: When determining milling depth, it is recommended to mill 0.5 in. (13 mm) greater than the existing lift thickness to ensure all material is removed, which will minimize the potential for scabbing.

Performance Period. 7 to 10 years.

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FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (HIGH PRESERVATION)

Name: Hot In-Place Recycling

Application:

System: Non-Interstates
Pavement Type(s): Full-Depth HMA and Composite Pavements
Distress Type(s): Relates to Functional Failures

Purpose. Hot In-Place Recycling (HIR) is effective at correcting surface distresses that are limited to the top 1 in. to 2 in. (25 mm to 50 mm). Examples include rutting, corrugations, raveling, flushing/bleeding, loss of surface friction, minor thermal cracking, and minor load-associated cracking.

Treatment Description. HIR is a process of correcting HMA pavement surface distress by softening the existing surface with heat, mechanically loosening the pavement surface, mixing the loosened surface material with recycling agent, aggregate, rejuvenators, or HMA, and relaying the recycled material without removing it from the site. Different HIR processes include surface recycling (e.g., heater scarification), repaving, and remixing.

Pavement Conditions Addressed. HIR is effective at correcting surface distresses that are limited to the top 1 in. to 2 in. (25 mm to 50 mm). Examples include rutting, corrugations, raveling, flushing, loss of surface friction, and minor thermal and load-associated cracking.

Application Limitations. As the HIR equipment is relatively wide and long, short road sections, particularly in urban settings, are not suitable for HIR treatment.

This treatment must be approved by BDE and will require an experimental feature study according to Construction Memorandum 02-2. Good HIR candidates have no structural failures, limited variation in the existing HMA mix, no paving fabrics or interlayers in the anticipated treatment depth plus 25%, no deep ruts greater than one-half of the anticipated HIR treatment depth, and no large stone mixes. The presence of rubber in the surface lift, rubberized seal coats, and some crack fillers require special attention in the mix design process.

Letting/Construction Considerations. The project letting date should be selected to target construction when the air temperature is moderate (i.e., 50°F (10°C) or above). HIR pavement can remain tender for a number of days. Do not allow this treatment to remain exposed over the winter season without a surface treatment or HMA overlay as the final wearing surface.

Traffic Considerations. HIR is appropriate for very low to high traffic conditions. Only use the heater-scarification process for low volume traffic. The remixing and repaving processes can be used on high traffic volume roads.

Special Considerations/Comments: Remove crack sealant prior to the HIR operation to reduce flash fires or excessive blue smoke from the treatment placement.

Performance Period. 6 to 15 years, depending on method of HIR.

FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (HIGH PRESERVATION)

Name: Surface Maintenance at the Right Time (SMART) Overlay

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	Full-Depth HMA and Composite Pavements
Distress Type(s):	Relates to Functional and Structural Failures

Purpose. The combination of cold milling and the application of a Surface Maintenance at the Right Time (SMART) overlay is a viable option for improving rideability, surface friction, profile, crown, and cross slope.

Treatment Description. SMART overlays may be continuous or intermittent and consist of placing a 1.50 in. (38 mm) (1.75 in. (44 mm) for F-mix) single-pass overlay on a previously resurfaced pavement that is not in need of significant repair and is in good condition. For Full-Depth HMA pavements, the single lift is 2.00 in. (50 mm) thick. If the SMART overlay is applied at the correct time, it can delay serious distresses, extend the life of the pavement, and decrease the overall cost.

Pavement Conditions Addressed. SMART Overlay can be used to address low-severity alligator cracking, stable rutting ≤ 0.25 in. (6 mm), medium-severity longitudinal and transverse cracking, medium-severity raveling/weathering, and medium-severity block cracking.

Cold milling is recommended to reduce pavement irregularities and to produce a uniform surface or to correct cross slope. Milling is required where: (1) rutting is continuous and, in isolated areas, exceeds 0.25 in (6 mm), (2) the CRS block cracking distress level is M3, and/or (3) CRS distress level W3 is present. Milling need not be continuous throughout the section.

Application Limitations. SMART overlays are not allowed on bare PCC pavements.

Letting/Construction Considerations. None.

Traffic Considerations. Performance is not affected by different ADT or percent trucks.

Special Considerations/Comments. During Phase I, the district shall review the project according to the requirements in Chapter 12 of this manual.

Repair localized distressed areas prior to the placement of the overlay. If milling is not used in conjunction with the SMART overlay, give special consideration to bump grinding prior to treatment placement.

Raised Reflective Pavement Markers shall be removed and replaced.

Performance Period. 7 to 10 years.

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FLEXIBLE AND COMPOSITE PAVEMENT PRESERVATION TREATMENT (HIGH PRESERVATION)

Name: Ultra-Thin Bonded Wearing Course

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Pavements
Distress Type(s):	Relates to Functional and Structural Failures

Purpose. An ultra-thin bonded wearing course (UTBWC) is an alternative to chip seals, micro-surfacing, or thin HMA overlays as it effectively addresses minor surface distresses and increases surface friction.

Treatment Description. A UTBWC is formed in one pass with the application of a heavy, polymer-modified asphalt emulsion tack coat and a gap-graded, polymer-modified, 0.75 in. to 0.9 in. thick HMA layer.

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. Retards fatigue cracking, but is not suited for rutted pavements.

Application Limitations. Ultra-thin bonded wearing courses are not recommended where structural failures exist (e.g., significant fatigue cracking, deep rutting) or if there is high-severity thermal cracking. They also are not appropriate where there is extensive pavement deterioration or little remaining life.

Letting/Construction Considerations. The project letting date should be selected to target construction when the air temperature is moderate (i.e., 50°F or above).

Traffic Considerations. It is capable of withstanding high ADT volumes and truck traffic better than other thin treatments.

Special Considerations/Comments: Give special consideration to bump grinding prior to treatment placement. Patching quantities should be included to repair localized structural problems prior to overlay application.

Avoid using on pavements with heavy turning movements or bus stops.

Performance Period. 7 to 12 years.

53-5.02 Rigid Pavement Preservation Treatment Summaries

RIGID PAVEMENT PRESERVATION TREATMENT
(PROACTIVE MAINTENANCE)

Name: Crack Sealing

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Rigid Pavements
Distress Type(s):	Relates to both Functional and Structural Failures

Purpose. Crack sealing is effective at reducing or delaying moisture damage, further crack deterioration, roughness, and rutting. However, crack sealing can also have a negative impact on roughness and friction.

Treatment Description. Crack sealing is an operation involving thorough crack preparation and placement of high-quality materials into or over candidate cracks to significantly reduce moisture infiltration and to retard the rate of crack deterioration. Sealed cracks in PCC pavements deteriorate less and contribute less to the overall deterioration of the pavement. PCC cracks are typically sealed with thermosetting bituminous materials.

Pavement Conditions Addressed. Crack sealing is effective at sealing low- or medium-severity transverse or longitudinal cracks where the crack width is ≤ 0.5 in. (13 mm). Full-depth working transverse cracks typically experience substantial movement; therefore, it is recommended that these cracks be sealed to reduce water and incompressibles.

Application Limitations. Crack sealing is most effective when performed on PCC pavements that exhibit minimal structural deterioration and in which the cracks are not showing other significant distress (e.g., faulting, spalling). Do not use crack sealing where there are unpatched pavement blowups, rocking slabs, pumping of water or fines through the crack, or full-depth punchouts. In these instances, use full-depth patching as a mitigating activity.

Letting/Construction Considerations. The project letting date should be selected to target construction during cool, dry weather conditions. Application during cool weather will allow for expanded crack widths.

Traffic Considerations. Performance is not significantly affected by varying ADT or truck levels, but sealant should be allowed to cure before opening to traffic.

Special Considerations/Comments: Crack sealing may result in a rougher pavement surface when the sealant material is forced out of the cracks during warm months. If sealing quantities become excessive, the district may want to consider a higher level treatment.

Performance Period. 4 to 8 years.

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RIGID PAVEMENT PRESERVATION TREATMENT
(PROACTIVE MAINTENANCE)

Name: Diamond Grinding

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Rigid Pavements
Distress Type(s):	Relates to Functional Failures

Purpose. Diamond grinding is effective at removing joint faulting and other surface irregularities to restore a smooth-riding surface and increase pavement surface friction.

Treatment Description. Diamond grinding is the removal of a thin layer of concrete (generally up to about 0.25 in. (6 mm)) from the surface of the pavement, using special equipment outfitted with a series of closely spaced, diamond saw blades.

Pavement Conditions Addressed. Diamond grinding is used to remove joint faulting and other surface irregularities to restore a smooth-riding surface, increase pavement surface friction, and reduce noise.

Application Limitations. If the average faulting over the section is > 0.15 in. (4 mm) or other signs of structural failure (e.g., mid-panel cracks, corner breaks) exist, diamond grinding is not appropriate. The presence of materials-related distresses (e.g., D-cracking, ASR) may also preclude the use of diamond grinding. Soft aggregate will wear much quicker and require more frequent grinding.

Letting/Construction Considerations. None.

Traffic Considerations. Grinding may be used to remove faulting, which, if the mechanism is not addressed, can reoccur due to the continued application of truck traffic. If used to restore friction to a polished pavement (due to vehicle traffic), heavy volumes of traffic may cause the problem to recur.

Special Considerations/Comments: Note that diamond grinding is a surface repair method because it corrects the existing faulting and wear of PCC pavements. It does nothing to correct pavement distress mechanisms. Therefore, grinding usually is performed in combination with other rehabilitation methods to both repair certain pavement distresses and prevent their recurrence.

Performance Period. 8 to 15 years.

RIGID PAVEMENT PRESERVATION TREATMENT
(PROACTIVE MAINTENANCE)

Name: Diamond Grooving

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Rigid Pavements
Distress Type(s):	Relates to Functional Failures

Purpose. Diamond grooving is effective at increasing wet-pavement friction and reducing splash and spray in identified problem areas.

Treatment Description. Diamond grooving is the process of cutting narrow, discrete grooves in the PCC surface to reduce hydroplaning and wet-pavement crashes in localized areas. Grooving can be performed in both the longitudinal and transverse directions, but is more commonly performed longitudinally.

Pavement Conditions Addressed. Grooving is conducted to increase wet-pavement friction and reduce splash and spray. Diamond grooving is conducted in localized areas of a project where wet-pavement crashes have historically been a problem (e.g., curves, intersections).

Application Limitations. In general, candidate pavements for grooving should be structurally and functionally sound.

Letting/Construction Considerations. None.

Traffic Considerations. Performance is not affected by varying ADT or truck levels.

Special Considerations/Comments: Clearly indicate the areas to be grooved on the project plans. The entire lane area should be grooved; however, allowance should be made for small areas that were not grooved because of pavement surface irregularities. Grooving is most commonly performed longitudinally due to ease of construction; however, if the district would like to place the grooving transversely, the Bureau of Research should be contacted for assistance. This treatment can be used in conjunction with diamond grinding.

Performance Period. Remaining service life of the pavement structure.

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RIGID PAVEMENT PRESERVATION TREATMENT
(PROACTIVE MAINTENANCE)

Name: Longitudinal Joint Sealing

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Rigid Pavements
Distress Type(s):	Relates to both Functional and Structural Failures

Purpose. Joint sealing helps keep moisture out of the pavement layers and incompressibles out of joints, which reduces spalling.

Treatment Description. Sealing longitudinal joints in PCC pavements is intended to minimize the infiltration of surface water into the underlying pavement structure and to prevent the intrusion of incompressibles into the joint.

Pavement Conditions Addressed. Joint sealing is effective in addressing low or medium severity joint spalling.

Application Limitations. Longitudinal joint sealing is most effective when performed on PCC pavements that exhibit minimal structural deterioration. Base material selection on the expected time until next treatment.

Letting/Construction Considerations. The project letting date should be selected to target construction during cool, dry weather conditions. Application during cool weather will allow for expanded crack widths.

Traffic Considerations. Performance is not affected by different ADT or percent trucks.

Special Considerations/Comments: Joint sealing is necessary when the existing sealant has deteriorated to the point that it readily allows water and incompressibles to enter the joint. The primary cause of sealant failure is improper installation (e.g., not preparing joint sidewalls, getting bonding).

Performance Period. 4 to 8 years for hot-poured asphalt sealant; approximately 8 years for silicone sealant.

RIGID PAVEMENT PRESERVATION TREATMENT
(HIGH PRESERVATION)

Name: Load Transfer Restoration

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	Jointed Plain Concrete Pavements
Distress Type(s):	Relates to Functional and Structural Failures

Purpose. Load transfer restoration, also known as dowel bar retrofit, is effective at mitigating medium severity transverse joint deterioration and faulting by re-establishing load transfer across the joint. This treatment should only be used on transverse joints.

Treatment Description. Load transfer restoration is the addition or replacement of dowel bars across a transverse joint. A gang saw is used to grind slots across the joints, a bar is placed in each slot, and then the slot is filled with a non-shrink grout. Once cured, the transverse joint is re-established and diamond grinding is performed to remove faulting, if present.

Pavement Conditions Addressed. This treatment should be used when the concrete pavement is in good condition and the only distresses are faulting and transverse joint deterioration.

Application Limitations. If significant faulting, other signs of structural failure (e.g., mid-panel cracks, corner breaks), or materials-related distresses (e.g., D-cracking, ASR) are present, load transfer restoration is not appropriate.

Letting/Construction Considerations. None.

Traffic Considerations. None.

Special Considerations/Comments: Contact the Bureau of Research for the latest special provision.

Performance Period. 8 to 15 years.

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RIGID PAVEMENT PRESERVATION TREATMENT
(HIGH PRESERVATION)

Name: Ultra-Thin Bonded Wearing Course

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Rigid Pavements
Distress Type(s):	Relates to Functional and Structural Failures

Purpose. An ultra-thin bonded wearing course (UTBWC) effectively addresses minor surface distresses and increases surface friction.

Treatment Description. A UTBWC is formed in one pass with the application of a heavy, polymer-modified asphalt emulsion tack coat and a gap-graded, polymer-modified, 0.75 in. to 0.9 in. thick HMA layer.

Pavement Conditions Addressed. This treatment is applicable for low-severity D-Cracking, ASR, transverse cracking, and/or longitudinal joint deterioration; medium-severity transverse joint deterioration and/or longitudinal cracking; and surficial cracking such as map cracking and popouts/high steel.

Application Limitations. Ultra-thin bonded wearing course is not recommended where structural failures exist (e.g., significant D-cracking, ASR, excessive permanent patch deterioration) or where there is extensive pavement deterioration or little remaining life.

Letting/Construction Considerations. The project letting date should be selected to target construction when the air temperature is moderate (i.e., 50°F or above).

Traffic Considerations. It is capable of withstanding high ADT volumes and truck traffic better than other thin treatments.

Special Considerations/Comments: Give special consideration to bump grinding prior to treatment placement. Patching quantities should be included to repair localized structural problems prior to overlay application.

Avoid using on pavements with heavy turning movements or bus stops.

Performance Period. 7 to 12 years.

53-5.03 Minor Rehabilitation Treatment Summaries

PAVEMENT REHABILITATION TREATMENT (MINOR)

Name: Bonded Concrete Overlay on Asphalt (BCOA)

Application:
System: Interstates and Non-Interstates
Pavement Type(s): HMA-Surfaced Pavements
Distress Type(s): Relates to Functional and Structural Failures

Purpose. BCOA is suitable for HMA pavements that have a history of rutting and/or shoving. Intersections, with stopping, starting, standing, and turning actions of vehicles, are an example. Other roadways with volumes and types of vehicles that rapidly rut HMA pavements are also good candidates for BCOA.

Treatment Description. A BCOA consists of placing 3.0 in. to 6.0 in. (75 mm to 150 mm) of PCC pavement over an existing distressed HMA pavement surface. The existing HMA is first milled to correct profile irregularities and provide a surface for bonding the overlay.

Pavement Conditions Addressed. BCOA is effective in treating low- to medium-severity alligator cracking, rut depth < 0.25 in. (6 mm), low- to medium-severity transverse cracking, and low- to medium-severity reflective widening cracking.

Traffic Considerations. The best alternative for traffic control is to completely close the project to traffic. This alternative may be difficult for urban projects; however, somewhat easier for rural projects.

Special Considerations/Comments. Currently, this rehabilitation strategy is only allowed when the traffic factor does not exceed 7.5. If the district is interested in using this treatment on a project with a higher traffic factor, they must work with the Bureau of Research to design the thickness and joint spacing for the BCOA. Contact the Engineer of Pavement Technology in the Bureau of Research for additional information on design.

Bare concrete or brick areas included in the rehabilitation area should not exceed 5% of the total area. The HMA layer shall be at least 2.50 in. (63 mm) thick. Consider complicated geometrics, utility obstructions, traffic demand, frequency of at-grade and overhead structures, and condition of the existing pavement when selecting this rehabilitation type.

Performance Period. 10 to 15 years.

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PAVEMENT REHABILITATION TREATMENT (MINOR)

Name: Cold In-Place Recycling

Application:

System: Non-Interstates
Pavement Type(s): Full-Depth HMA and Composite Pavements
Distress Type(s): Relates to Functional and Structural Failures

Purpose. Cold In-Place Recycling (CIR) is very effective at correcting distresses contained in the top 3 in to 6 in. (75 mm to 150 mm) of the pavement surface. Examples include poor friction and roughness, bleeding, raveling, rutting, and poor cross slope.

Treatment Description. Cold in-place recycling (CIR) is an in-situ process used to recycle the top 3 in to 6 in. (75 mm to 150 mm) of an existing HMA pavement to restore integrity of a flexible pavement layer. As the name suggests, the recycling process is conducted without the addition of heat. During the CIR process, the reclaimed asphalt pavement (RAP) is sized, mixed with additives (e.g., asphalt binder, emulsion, rejuvenator, virgin aggregate), and re-laid. The recycled pavement is then typically resurfaced with a surface treatment or HMA overlay. Note that the compacted thickness will be 5 to 10 percent thicker than the depth milled.

Pavement Conditions Addressed. CIR is effective where cracking is limited to the surface layers; profile, crown, and cross slope problems; poor ride quality and surface friction; rutting, corrugations, and bumps; raveling; and flushing/bleeding. This treatment may be used when transverse cracking level is O4 and the age of surface is greater than 12 years.

Application Limitations. This treatment must be approved by BDE and will require an experimental feature study according to Construction Memorandum 02-2. CIR is not an appropriate treatment for pavements with major or extensive structural deficiencies (e.g., severe alligator cracking, severe structural rutting) or distresses deeper than the CIR depth. CIR may also be difficult to conduct on steep grades, tightly curved roads, or on roads with many utility appurtenances.

Letting/Construction Considerations. The project letting date should be selected to target construction when the air temperature is moderate (i.e., 50°F (10°C) or above). CIR pavement can remain tender for a number of days. Do not allow this treatment to remain exposed over the winter season without a surface treatment or HMA overlay as the final wearing surface.

Traffic Considerations. CIR is most often used on secondary and low volume roads. This treatment is not recommended for ADT greater than 10,000.

Special Considerations/Comments: Remove and replace areas of weak material with suitable patching material prior to recycling to reduce the risk of the cold-planing machine or other CIR equipment breaking through the pavement. If excessive concrete patches are present at the pavement surface, this treatment should not be used.

Performance Period. 5 to 13 years.

PAVEMENT REHABILITATION TREATMENT (MINOR)

Name: Standard Hot-Mix Asphalt (HMA) Overlay
(Formerly known as the Policy Resurfacing Program)

Application:

System:	Interstates and Non-Interstates
Pavement Type(s):	All Pavements
Distress Type(s):	Relates to All Functional and Limited Structural Failures

Purpose. Standard HMA Overlays are used to reduce or eliminate distresses and restore serviceability on a pavement in fair to poor condition.

Treatment Description. Standard HMA Overlays consist of placing two lifts of HMA, unless otherwise noted. The mixture gradation and thickness shall be specified according to Section 53-4.03(a). HMA mixture design criteria must be met as outlined in Section 53-4.04.

Pavement Conditions Addressed. Standard HMA Overlays are effective in treating low- to medium-severity alligator cracking, rut depth < 0.25 in. (6 mm), low- to medium-severity transverse cracking, and low- to medium-severity reflective widening cracking.

Traffic Considerations. Roadway segments with extremely high multiple unit counts may want to consider a Stone-Matrix Asphalt mixture.

Special Considerations/Comments. If the district wants to use an alternative thickness range (increased or decreased) or a single lift, an exception request must be submitted to the Asset Management Engineer to coordinate with the Engineer of Pavement Technology for approval.

For existing HMA-surface pavements, cold milling and inlay may be used in conjunction with a Standard HMA Overlay to maintain existing grade elevation or gain clearance under overhead structures. More information on cold milling is available in the pre-treatment activity summaries (Section 53-5.05).

Performance Period. 10 to 15 years.

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53-5.04 Major Rehabilitation Treatment Summaries

PAVEMENT REHABILITATION TREATMENT (MAJOR)

Name: Designed HMA Overlay
(Formerly known as Structural Overlay)

Application:

System:	Interstates and non-Interstates
Pavement Type(s):	All Pavements
Distress Type(s):	Relates to All Functional and Structural Failures

Purpose. Designed HMA overlays are used to restore serviceability and slow the propagation of underlying structural distresses on a pavement in poor condition.

Treatment Description. Designed HMA overlays consist of placing two or more lifts of HMA. The mixture gradation and thickness shall be specified according to Section 53-4.04(a). HMA mixture design criteria must be met as outlined in Section 53-4.04(b).

Pavement Conditions Addressed. For Interstate CRS values ≥ 4.0 and non-Interstate CRS values ≥ 3.5, designed HMA overlays may be effective in treating infrequent high-severity alligator cracking, high-severity transverse cracking, and high-severity reflective widening cracking.

Traffic Considerations. Roadway segments with extremely high multiple unit counts may want to consider a Stone-Matrix Asphalt mixture.

Special Considerations/Comments. For existing HMA-surface pavements, cold milling and inlay may be used in conjunction with a designed HMA overlay to maintain existing grade elevation. More information on cold milling is available in the pre-treatment activity summaries (Section 53-5.05).

If milling depth is greater than designed overlay thickness, an exception request must be submitted according to Section 53-2.08.

Performance Period. 10 to 15 years.

PAVEMENT REHABILITATION TREATMENT (MAJOR)

Name: Structural Concrete Overlay (SCO)

Application:

System: Interstates and Non-Interstates
Pavement Type(s): All Pavements
Distress Type(s): All Functional and Structural Failures

Purpose. The Structural Concrete Overlay (SCO) is designed to span underlying structural distresses while minimizing the potential for random cracking of the PCC slab.

Treatment Description. SCOs consist of placing a non-reinforced layer of PCC pavement over an existing distressed pavement. This treatment is sawed both longitudinally and transversely to create panels.

If the pavement has been previously resurfaced with HMA, the surface may be milled to correct profile irregularities. If the pavement is bare PCC, an interlayer shall be placed as a bond breaker between the existing PCC pavement and the SCO.

Pavement Conditions Addressed. Pavements that have high severity structural distresses (e.g., frequent, high severity transverse cracking) are suited for this treatment to reduce the potential for reflective cracking in the overlay.

Traffic Considerations. The best alternative for traffic control is to completely close the project to traffic. This alternative may be difficult for urban projects; however, somewhat easier for rural projects.

Special Considerations/Comments. This treatment has had limited use and is still considered experimental. The district must work with the Bureau of Research to design the PCC thickness, interlayer type and thickness, and joint spacing for the SCO.

Use of the SCO requires an experimental feature according to Construction Memo 02-2 and approval by the Bureau of Research. Contact the Engineer of Pavement Technology in the Bureau of Research for additional information on use and design of this treatment.

Performance Period. 12 to 15 years.

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53-5.05 Pre-Treatment Activity Summaries

PRE-TREATMENT ACTIVITY SUMMARY

Name: Cold Milling / Fine Milling

Application:
Pavement Type(s): HMA Pavements, Composite Pavements
Distress Type(s): Relates to both Functional Failures and Structural Failures

Description and Purpose: Cold milling and fine milling are effective at mitigating functional distresses and providing a smoother surface by removing vertical deformations. It can also be used to restore proper grades and cross-slopes on existing pavement.

Cold milling involves the removal of part or all of an existing HMA surface to prepare an HMA surface for an HMA overlay or SMART overlays. Milling depth should match what is required to remove the entire HMA surface lift. Deeper milling may be required based on the findings of a pavement investigation report or project constraints.

Fine milling, which uses modified milling equipment, is used in preparation for a preservation treatment. Contact the Bureau of Research for the current version of the fine milling special provision.

Special Considerations/Comments:

Some rehabilitation treatments require a minimum thickness of HMA for construction purposes. See Section 53-4 for requirements.

PRE-TREATMENT ACTIVITY SUMMARY

Name: Full-Depth CRCP Patches (Class A)

Application:
Pavement Type(s): CRCP, HMA Overlaid CRCP
Distress Type(s): Structural Failures

Description and Purpose:

Class A patching consists of removing the failed pavement area and patching it with a full-depth, continuously reinforced PCC patch. Where CRCP facilities are to be patched, it is important to make every attempt to maintain the integrity of the continuous reinforcement. A decision that the pavement distress is so severe that continuity cannot be maintained must be justified by district field testing and subsequent review by the Central Office. In some cases, previous contracts or maintenance activities may have resulted in the use of non-tied PCC or HMA patches being placed on a CRCP facility. Such patches should be replaced with Class A patches when rehabilitation is justified. Obtain BDE approval prior to specifying other than Class A patching for CRCP facilities. Refer to the *Highway Standards* for Class A patching details. The minimum Class A patch dimensions will be a length of 4.50 ft and a width that includes half the width of the travel lane.

Special Considerations/Comments:

It is not desirable to create the large number of closely spaced joints in a pavement that would result from placing a large number of closely spaced patches. The minimum distance between patches is 15 ft. If less than 15 ft of existing pavement will remain, the entire area between the two patches should be removed and replaced.

For all Class A patching projects, review previous plans to determine the locations of any lug systems or wide-flange beam terminal joints.

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PRE-TREATMENT ACTIVITY SUMMARY

Name: Full-Depth Dowelled Patches (Class B)

Application:
Pavement Type(s): JPCP, JRCP, HMA Overlaid JPCP, and HMA Overlaid JRCP
Distress Type(s): Structural Failures

Description and Purpose:

Class B patching consists of removing the failed pavement area and patching it with a full-depth dowelled PCC patch. For highways on the State system, including Interstate facilities, that have sound JPCP/JRCP and less than 2% of previously placed undowelled patching, specify Class B patching regardless of whether or not the pavement will be overlaid. Class B patching also should be specified on other low-ADT routes that have existing load transfer and sound plain concrete pavements with no previously placed undowelled patches. In general, use dowelled patches on sound JPCP/JRCP. Specify undowelled patching if field testing indicates that the concrete is so unsound as to preclude the use of Class B patching. Refer to the *Highway Standards* for Class B patching details. The minimum Class B patch dimensions will be a length of 6 ft and a width that includes the full width of the travel lane.

Special Considerations/Comments:

It is not desirable to create the large number of closely spaced joints in a pavement that would result from placing a large number of closely spaced patches. The minimum distance between patches is 6 ft. If less than 6 ft of existing pavement will remain, the entire area between the two patches or between a patch and the existing joint should be removed and replaced.

PRE-TREATMENT ACTIVITY SUMMARY

Name: Full-Depth Undowelled Patches (Class C and Class D)

Application:
Pavement Type(s): HMA Pavements, JPCP, JRCP, and HMA Overlaid JPCP/JRCP
Distress Type(s): Structural Failures

Description and Purpose:

Undowelled patching may consist of either Class C or Class D patches. Class C patching consists of removing the distressed pavement area and patching it with an undowelled PCC patch. Class D patching consists of removing the distressed pavement area and replacing it with an HMA patch. Specify "Pavement Patching" to permit the contractor the option of using either PCC or HMA unless there exists a justifiable reason to specify one or the other. If a particular patch material is specified, document the basis for the material selection in the district project files.

Special Considerations/Comments:

Use the following guidelines when specifying either Class C or Class D patching:

1. PCC Pavements. Undowelled patching for PCC pavements should only be specified when field testing indicates that the concrete is so unsound as to preclude the use of Class A or B patching.

2. Full-Depth HMA Pavements. Class D patching shall be specified for all full-depth HMA pavements.

3. Level of Existing Patching. Undowelled patches also may be specified if there exists 2% or more of previously placed undowelled patching and the undowelled patches are in good condition and performing well.

4. Emergency Patching. Except in an emergency, Class D patching should not be specified on the Interstate System or on any supplemental freeway constructed to Interstate criteria. On such facilities, replace emergency Class D patches with permanent Class A, B, or C patches as soon as practical.

5. Full-Depth Patching. Where the multiple unit (MU) traffic is greater than 200 ADT, the minimum dimensions for full-depth patches will be a length of 4 ft and a width of half the travel lane. Where the MU traffic is 200 ADT or less, the minimum patch dimensions for full-depth patches will be as shown in the *Highway Standards* for Class C and Class D patches.

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PRE-TREATMENT ACTIVITY SUMMARY

Name: Partial-Depth Patches

Application:
Pavement Type(s): All Pavement Types
Distress Type(s): Structural and Functional Failures

Description and Purpose:

Partial-Depth patching is effective at removing distresses that are primarily in the top portion of the pavement (e.g., isolated unstable rutting, spalling of joints in a PCC pavement, distresses limited to the HMA portion of a composite pavement, etc.). This activity typically uses HMA patching material, but some applications may warrant using PCC patching material.

Special Considerations/Comments:

Areas for partial-depth patching shall be clearly identified on the plans using a detail or note near typical sections or clear typical sections to note milling depth in relation to the cross-sectional layers. For example, the removal depth can include only HMA, or the removal depth can include a combination of HMA and deteriorated concrete.

When patching an HMA or composite pavement, the minimum partial-depth patch size will be 4 ft by 4 ft at the necessary depth. If using HMA patching material, lift thickness requirements shall be followed to ensure good performance of the patch. Mixture requirements, lift thickness, and placement methods are determined by whether or not the patch will be resurfaced.

When patching a bare PCC pavement, the minimum partial-depth patch size will be 2 ft by 2 ft at a depth of 2 to 4 inches. If PCC patching material is used, all joints within patches shall be reestablished to prevent random cracking.

PRE-TREATMENT ACTIVITY SUMMARY

Name: Longitudinal Crack Repair

Application:
Pavement Type(s): All PCC and HMA Overlaid PCC Pavements
Distress Type(s): Structural Failures

Description and Purpose:

Longitudinal crack repair is a cost-effective method of prolonging the service life of a pavement which has distress along a longitudinal crack while the rest of the pavement is sound. The recurring special provision for Portland Cement Concrete Partial Depth Hot-Mix Asphalt Patching shall be used for this work.

Many CRC pavements exhibit longitudinal cracking with severe spalling and D-cracking adjacent to the cracks. The cost of placing a full-depth patch at these locations would be prohibitive. Instead, the crack can be milled to a depth of 2 in. to 3 in. with a width of 12 in. to 24 in. The milled area can then be filled with a HMA mixture without a need to overlay the pavement. This method can also be used to repair high severity longitudinal cracks in JPCP/JRCP and reflective cracks in HMA overlays.

In lieu of milling, the longitudinal crack may be sealed with an asphalt mastic product. If interested in this option, contact the Bureau of Research for the special provision.

Special Considerations/Comments:

When using this method on bare PCC pavements, it is important to limit the depth of the milling to just above the depth of the reinforcing steel so as not to damage the steel.

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53-5.06 Additional Design Feature Summaries

ADDITIONAL DESIGN FEATURE SUMMARY

Name: Expansion Joints

Application:
Pavement Type(s): PCC Pavements, Composite Pavements
Distress Type(s): Relates to both Functional Failures and Structural Failures

Description and Purpose:

Expansion joints should be visually inspected to determine if they are in working order. If patching is an integral part of the rehabilitation strategy, closed expansion joints should be re-established regardless of the type of patching that is specified.

Special Considerations/Comments:

Consider the following guidelines when re-establishing expansion joints:

1. Jointed Pavements. Consider the following for JPCP and JRCP:

   a. Dowelled Patches. Where the pavement requires patching at or near a closed expansion joint, a new joint should be established using a dowelled expansion patch as shown in the *Highway Standards* for Class B patches. If the joint is closed, but does not require patching, an expansion joint may be formed by sawing the pavement and filling the saw cut with a preformed expansion joint filler material that meets the *Standard Specifications* for expansion joints.

   b. Non-Dowelled Joints. If other than dowelled patches are required and if the pavement is not being resurfaced, a new expansion joint may be formed by sawing the pavement and filling the saw cut with a preformed expansion joint filler material that meets the *Standard Specifications*.

2. CRC Pavements. If a CRC pavement is being patched with a Class A patch, whether or not the pavement is being resurfaced, existing expansion joints should be re-established using a saw cut filled with preformed expansion joint filler material that meets the *Standard Specifications* for expansion joints.

ADDITIONAL DESIGN FEATURE SUMMARY

Name: Lug Areas/Pressure Relief Joints

Application:
Pavement Type(s): CRC Pavements, HMA Overlaid CRC Pavements
Distress Type(s): Relates to both Functional Failures and Structural Failures

Description and Purpose:

Lug systems are typically located just prior to the approach pavement of a structure. When developing patching contracts, consult previous plans to determine actual locations.

Lug areas that do not show signs of tilting or other similar distresses should not be cut free. If they have previously been cut free and there is no sign of tilting, the continuity of the pavement should be restored through the use of a Class A patch.

Special Considerations/Comments:

If signs of tilting exist and the pavement surface over the lug area is excessively rough, a 4 in. wide pressure relief joint that is filled with a preformed expansion joint filler material should be provided 150 ft from the lug area. The entire lug system should be subsealed to fill voids, and the area over the lug should be resurfaced to complete the leveling process.

In extreme cases, the lug system should be removed and replaced with a lug system or wide flange beam expansion joint as shown in the *Highway Standards*.

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ADDITIONAL DESIGN FEATURE SUMMARY

Name: Pipe Underdrains

Application:
Pavement Type(s): All Pavements
Distress Type(s): Relates to both Functional Failures and Structural Failures

Description and Purpose:

Drainage is an important pavement rehabilitation consideration. Water is a fundamental variable in most problems associated with pavement performance and is directly or indirectly responsible for many pavement distresses. A drainage survey may indicate that pipe underdrains are required to control one or more sources of water in the pavement, thus increasing pavement serviceability and life. Subsurface drainage systems should be designed and constructed with long-term performance and maintenance goals in mind, including periodic inspections to check performance.

Special Considerations/Comments:

The moisture that infiltrates the pavement/shoulder joint usually is the only moisture that can be readily drained. A benefit to installing retrofit pipe underdrains is that it will minimize the potential to trap moisture in the slab/base interface. A properly designed and constructed longitudinal edge drain system can, in some cases, improve the long-term load-carrying and distribution properties of the base and subgrade materials. Note that underdrains by themselves cannot restore a pavement that is structurally inadequate.

ADDITIONAL DESIGN FEATURE SUMMARY

Name: Wide-Flange Beam Terminal Joints

Application:

Pavement Type(s): CRC Pavements, HMA Overlaid CRC Pavements

Distress Type(s): Relates to both Functional Failures and Structural Failures

Description and Purpose:

Wide-Flange Beam Terminal Joints are typically located just prior to the approach pavement of a structure. When developing patching contracts, consult previous plans to determine actual locations.

Existing wide flange beam terminal joints should be closely inspected to determine if the joint is working properly both at the beam and at the expansion joint between the beam and the bridge approach or jointed pavement. In addition, the flange of the beam should be inspected for signs of fatigue cracking.

Special Considerations/Comments:

If the pavement in the area of these joints or the beam itself show signs of distress, special patching details may be required. Contact the BDE for assistance in preparing plans for the proper remedial treatment.

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53-6 REFERENCES

1. *Guide for the Design of Pavement Structures,* American Association of State Highway and Transportation Officials, Washington, DC., 1993.

2. *Modern Pavement Management*, Haas, R., W. R. Hudson, and J. Zaniewski, Krieger Publishing Company, Malabar, FL., 1994.

3. FHWA-RD-03-031 *Distress Identification Manual for the Long-Term Pavement Performance Program,* Miller, J. S. and W. Y. Bellinger, Federal Highway Administration, Washington, DC., 2003.

4. FHWA-NHI-04-171 *Pavement Preservation: Design and Construction of Quality Preventive Maintenance Treatments*, Peshkin, D. G., T. E. Hoerner, K. D. Smith, J. E. Bruinsma, and S. B. Seeds, NHI Course 131103, Reference Manual, National Highway Institute, Federal Highway Administration, Washington, DC., 2004.

5. *Seal Coats (Oil & Chipping*), BLRS Technology Transfer Center (T^2), IDOT, 2006.