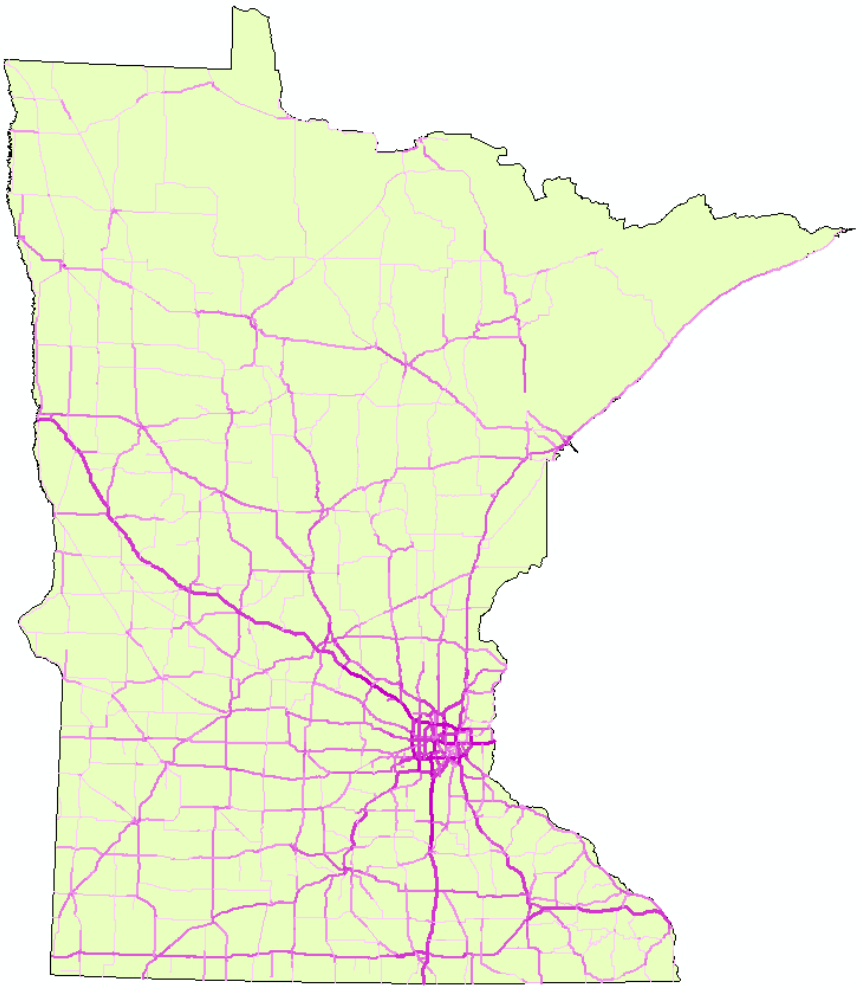
DEPARTMENT OF TRANSPORTATION

Chapter 9: Construction and Rehabilitation Alternates

MnDOT Pavement Design Manual



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Chapter 9 - MnDOT Pavement Design Manual, Dec 16, 2019

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Introduction

This chapter contains alternates to consider for new construction/reconstruction or rehabilitation of existing pavements. It is intended to be used to develop the pavement alternates required by Pavement-Type Selection (see **Chapter 7: Pavement-Type Selection**) and may be used as an aid to the scoping process.

The process for using this chapter is as follows:

STEP 1. Find the existing pavement-type and the possible rehabilitation alternates in **Table 900.1.**

STEP 2. Use the tables in **Sections 910-950** to determine which alternates are applicable. Additionally, consult **Table 960.1** for noneconomic factors.

Section 900: Existing Pavement-Types

Table 900.1 – Existing Pavement-Types and Possible Rehabilitation Alternates

Existing Pavement-type	Description	Possible Rehabilitation*
HMA on Aggregate Base	HMA pavement, including any HMA overlays, placed on several inches of aggregate base.	• HMA overlay (>2 inches) • PCC overlay • FDR/SFDR/CIR • New/Reconstruction
Full-Depth HMA on Subgrade	HMA pavement, including any HMA overlays, placed on sub-grade.	• HMA overlay (>2 inches) • PCC overlay • FDR/SFDR/CIR • New/Reconstruction
HMA on PCC	HMA pavement placed on previously constructed PCC Pavement.	• HMA overlay(>2 inches) • PCC overlay • CIR • Rubblization • Crack and Seat • New/Reconstruction
PCC on Aggregate Base or Subgrade	PCC pavement placed on either aggregate base or subgrade.	• HMA overlay (>2 inches) • PCC overlay • Rubblization • Crack and Seat • New/Reconstruction
PCC on HMA	PCC pavement placed on previously constructed HMA Pavement.	• HMA overlay (>2 inches) • PCC overlay • FDR/SFDR • New/Reconstruction
PCC on PCC	PCC pavement placed on previously constructed PCC Pavement.	• HMA overlay (>2 inches) • PCC overlay • Rubblization • Crack and Seat • New/Reconstruction

* This list includes typical, available rehabilitation alternates. It is not intended to exclude any alternates that may be available for a project

Section 910: Rehabilitation with HMA Overlay (>2 inches)

Table 910.1 - HMA Overlay on Existing HMA

Title	Text
Manual Location	**Section 460.**
Description	Paving >2" of HMA on an existing HMA pavement's surface. It is intended to improve ride, reduce surface distress, may improve pavement structure, and preserve the existing pavement. Existing HMA may be milled prior to the HMA overlay to remove surface distresses and to reduce the road's profile.
Design Life	Typically, MnDOT projects use a design life of 13-19 years depending on existing pavement condition, traffic, and HMA overlay thickness.
Good Candidate	• Structurally sound pavement that needs only minor improvements. • Projects in which a limited design life is acceptable.
Poor Candidate	• Pavements that exhibit structural problems such as: o Deforming or rutting subsurface layers. o Large amounts of bottom-up fatigue cracking. o Subgrade failures and/or seasonal heaving issues. • Pavements with a large amount of surface distress (rutting, cracking, and poor ride) that will not be sufficiently improved by an HMA overlay. • Projects in which a long design life is desired.
Pros	• May add structure. • Improves ride and reduces surface distresses. • Relatively inexpensive. • Short construction period. • Reduces short-term maintenance.
Cons	• Limited ability to improve structure and function. • May raise road profile. • Limited design life.

Table 910.2 - HMA Overlay on Existing PCC

Title	Text
Manual Location	**Section 460.**
Description	Paving >2" of HMA on an existing PCC pavement's surface. It is intended to improve ride, reduce surface distress, may improve pavement structure, and preserve the existing pavement. Any existing HMA may be milled prior to the HMA overlay to remove surface distresses and to reduce the road's profile.
Design Life	Typically, MnDOT projects use a design life of 13-17 years depending on existing pavement condition, traffic, and HMA overlay thickness.
Good Candidate	• Structurally sound pavement that needs only minor improvements. • Projects in which a limited design life is acceptable.
Poor Candidate	• Pavements with rocking or moving panels. • Pavements on subgrades with seasonal heaving issues. • Pavements with large amounts of cracked or shattered panels. • Projects in which a limited design life is unacceptable.
Pros	• May add structure. • Improves ride and reduces surface distresses. • Relatively inexpensive. • Short construction period. • Reduce short-term maintenance.
Cons	• Limited ability to improve structure and function. • Limited design life. • Joints and cracks in the existing PCC will reflect through the HMA overlay. • May induce PCC blow-ups. • The HMA overlay may spall at severe existing PCC joints or cracks. • Probable reflective cracking over joints and cracks in the concrete. • Raises in the pavement profile.

Section 920: Rehabilitation with PCC Overlay

PCC overlays may be used to rehabilitate existing HMA and existing PCC pavements. PCC overlays of HMA pavements, or whitetopping, may be designed using two different procedures. One procedure, using the BCOA-ME, requires a durable bond between the PCC overlay and the existing HMA. The other whitetopping design procedure, using MnPAVE-Rigid, doesn't consider a bond and may be used on more deteriorated HMA pavement than the bonded design. PCC overlays of existing PCC pavement, or UBOL, use an interlayer to prevent the bonding of the PCC overlay to the existing PCC pavement.

Table 920.1 – Bonded PCC Overlay of Existing HMA – Designed using BCOA-ME

Title	Text
Manual Location	**Section 510.**
Description	This type of design counts on the bond between the PCC overlay and the existing HMA to ensure that they behave as a single monolithic pavement layer. BCOA thicknesses typically range from 4.0" to 6.0". The surface of the existing HMA may be milled to remove surface distresses and to reduce or eliminate increases in the profile of the overlaid pavement. Any existing PCC overlay may be removed, the existing HMA prepared, and replaced with a new PCC overlay.
Design Life	20 years
Good Candidate	• The existing HMA pavement has stable support conditions with only localized weak areas that may be repaired prior to placing the PCC overlay. • The primary distresses in the existing HMA pavement are surface distresses. • Thermal cracks in the HMA pavement are predominately non-deteriorated thermal cracks. Deteriorated thermal cracks will require repair prior to placing the PCC overlay. • There is sufficient existing HMA thickness so that after any proposed milling: o 85% of the cores are 4.0" or thicker. o Any individual core must be a minimum of 3.0" thick. Any areas of less than 3.0" of HMA may be treated by removing the existing HMA pavement and constructing a 6.0" (minimum) PCC section.

Title	Text
Poor Candidate	• The existing HMA pavement has significant structural deterioration and areas of uneven support conditions. • Existing HMA overlay of PCC Pavement. • The existing pavement exhibits differential frost movements. • The existing HMA has been widened, or will require widening, within the area of the driving lane. • The HMA pavement that will remain after any milling exhibits stripping and/or debonded layers. • HMA pavements with predominately deteriorated thermal cracks that will require repair prior to placing the PCC overlay. • There is an insufficient existing HMA thickness so that after any proposed milling: o More than 15% of the cores are less than 4.0” thick. o There are individual cores less than 3.0” thick. However, any areas of less than 3.0” of HMA may be treated by removing the existing HMA pavement and constructing a 6.0” (minimum) PCC section.
Pros	• Adds structure. • Improves ride and reduces surface distresses. • Relatively inexpensive.
Cons	• Requires a sufficient thickness of sound HMA pavement. • Requires stable support. • May require a rise in road profile. • Existing active cracks in the HMA may reflect through to the PCC overlay

Table 920.2 – Non-Bonded PCC Overlay of Existing HMA – Designed using MnPAVE-Rigid

Title	Text
Manual Location	**Section 510.**
Description	This design-method does not require a bond between the PCC Overlay and the existing HMA. The minimum thickness is 6.0”. Any existing HMA may be milled prior to the HMA overlay to remove surface distresses and to reduce the road’s profile. Any existing PCC overlay may be removed, the existing HMA prepared, and replaced with a new PCC overlay.
Design Life	20 or 35 years
Good Candidate	• The existing pavement has stable support conditions or will require only localized repairs.
Poor Candidate	• Poorly draining roads that will not provide stable support for the PCC overlay. • The existing pavement exhibits differential frost movements.
Pros	• Adds structure. • Improves ride and reduces surface distresses. • May be used on most existing HMA pavements.
Cons	• More expensive than a bonded PCC overlay. • May require a raise in road profile. • Existing active cracks in the HMA may reflect through to the PCC overlay.

Table 920.3 – Unbonded PCC Overlay of Existing PCC - "UBOL"

Title	Text
Manual Location	**Section 520.**
Description	A PCC overlay that uses a "bond-breaker" to separate it from existing PCC pavement. The minimum pavement thickness is 6.0 inches.
Design Life	20 or 35 years
Good Candidate	• The existing pavement has stable support conditions or will require only localized repairs. • The roadway has room to permit a significant raise in road profile.
Poor Candidate	• Existing pavement has rocking or moving panels. • The existing pavement exhibits differential frost movements. • Roadways with a significant number of bridges requiring profile adjustments.
Pros	• Improves ride and pavement distress. • May be used on most existing PCC pavements. • May be used on faulted pavements or pavements with material related distresses. • Significantly streamlined construction as compared to reconstruction.
Cons	• Requires stable support conditions. • Will require a significant raise in road profile.

Section 930: Rehabilitation with FDR/SFDR/CIR

Note: MnPAVE-Flexible must be used to design these options.

Table 930.1 – Full-Depth Reclamation (FDR)

Title	Text
Manual Location	**Section 420.**
Description	FDR involves using a reclaiming machine to crush and blend-together existing HMA pavement and aggregate. The blended material is moved as necessary to allow it to be compacted in 6-inch lifts. After compaction and shaping, it will then act as base for new HMA pavement.
Design Life	20 years
Good Candidate	• A roadway with few or no subgrade problems. • The pavement has sufficient existing aggregate base to cool the reclaimer teeth and to reclaim with existing HMA. HMA may be milled or aggregate added to the pavement surface prior to reclaiming to help meet this proportion. • A roadway that has room to permit a significant raise in road profile.
Poor Candidate	• A roadway that requires a large amount of subgrade repair. • The roadway does not have room to permit a significant raise in road profile. • The pavement exhibits differential frost movements.
Pros	• Typically, less expensive than reconstruction. • Rehabilitates pavements that are structurally and functionally unsound. • Removes all pavement distresses and pavement material problems.
Cons	• Not intended to repair subgrade problems (however, localized areas can be addressed during design and construction). • Requires sufficient thickness existing aggregate. • Will require a significant raise in road profile.

Table 930.2 – Stabilized Full-Depth Reclamation (SFDR)

Title	Text
Manual Location	**Section 420.**
Description	SFDR is FDR that has had a stabilizing agent added. After the roadway has been reclaimed, a second pass of the reclaiming machine is made to apply and blend-in a stabilizer. The stabilizer is typically emulsified asphalt with additives or foamed asphalt cement. This layer will then be compacted, shaped, and allowed to cure before being paved with new HMA pavement.
Design Life	20 years
Good Candidate	• A roadway with few or no subgrade problems. • An HMA pavement with at least 3 inches of existing aggregate base.
Poor Candidate	• A roadway that requires a large amount of subgrade repair. • A pavement without aggregate base. • The pavement exhibits differential frost movements.
Pros	• Rehabilitates pavements that are structurally and functionally unsound. • Uses thinner HMA as compared to FDR. • Will require less of a raise in road profile than FDR. • Requires less in-place aggregate than FDR. • Typically, less expensive than reconstruction. • Removes all pavement distresses and pavement material problems.
Cons	• Not intended to repair subgrade problems (however, localized areas can be addressed during design and construction). • Requires some existing aggregate. • Stabilization adds to the cost as compared to FDR.

Table 930.3 – Cold In-place Recycling (CIR)

Title	Text
Manual Location	**Section 420.**
Description	CIR involves milling a portion of the existing HMA, mixing the milled material with emulsified asphalt and additives, and paving the roadway with the milled/emulsified mix. These activities are all performed in one pass of a CIR 'train'. The paved CIR material is then compacted and, after a suitable curing time, it is paved with HMA pavement.
Design Life	20 years
Good Candidate	• A roadway with few or no subgrade problems. • Will support the CIR train.
Poor Candidate	• A roadway that requires a large amount of subgrade repair. • Support for the heavy CIR train cannot be provided during construction. • The pavement exhibits differential frost movements.
Pros	• CIR layer may retard reflective cracking. • Removes surface distresses.
Cons	• Will not repair subgrade problems. • Retains the distresses and any materials problems of material that is left remaining.

Section 940: Rehabilitation with Rubblization/Crack & Seat

Table 940.1 – Rubblization

Title	Text
Manual Location	**Section 430.**
Description	Rubblization is intended to reduce the existing PCC modulus in order to prevent reflective cracking of the new HMA pavement and allow it to act as new base. Rubblization involves breaking the existing PCC slab into pieces (3.0 inches maximum at surface and 9.0 inches maximum at the bottom of pavement), compacting the rubblized material, and paving an HMA pavement.
Design Life	20 years
Good Candidate	• Subgrade with an average R-Value of at least 17 or at least 12 inches of granular material. • Room to permit a raise in road profile.
Poor Candidate	• The pavement exhibits differential frost movements. • Subgrade with an R-Value of less than 17 and less than 12 inches of granular material. • Rise in road profile not permissible.
Pros	• Less expensive than reconstruction. • Removes surface distresses and allows the existing PCC pavement to act as base for a new HMA pavement. • Rubblized PCC is stronger than aggregate base.
Cons	• Requires a solid subgrade that doesn't require subgrade repairs. • Significant rise in road profile. • Edge-drains must be installed prior to rubblization.

Table 940.2 – Crack and Seat

Title	Text
Manual Location	**Section 430.**
Description	The Crack & Seat process involves cracking the existing PCC pavement into 3 to 4-foot pieces, firmly seating the pieces, and paving HMA pavement. The intention is to reduce the size of the PCC pieces to minimize movements at existing cracks and joints. This will minimize the frequency and severity of reflective cracking. It is an especially useful technique when moving or rocking panels have been identified.
Design Life	Typically, MnDOT projects use a design life of 13-17 years depending on existing pavement condition, traffic, and HMA overlay thickness.
Good Candidate	• Roadway with a good subgrade that does not require extensive repairs. • Room to permit a raise in road profile.
Poor Candidate	• Saturated subgrade which cannot be addressed through edge drain installation. • The pavement exhibits differential frost movements. • Rise in road profile not permissible.
Pros	• Less expensive than reconstruction. • Removes surface distresses and allows the existing PCC pavement to act as base for a new HMA pavement. • Cracked PCC is stronger than aggregate base
Cons	• Requires a solid subgrade that doesn't require subgrade repairs. • Significant rise in road profile. • Edge-drains need to be installed prior to Crack and Seat.

Section 950: New/Reconstruction

Table 950.1 – New/Reconstruction

Title	Text
Manual Location	**Section 400 (HMA)** or **Section 500 (PCC).**
Description	Removal of any existing pavement and construction of new pavement placed on new or existing base and subbase.
Design Life	20 or 35 (PCC only) years.
Good Candidate	• New alignment. • Structurally and functionally unsound pavement. • Requires changes in geometry. • Requires widespread subgrade repairs. • Doesn't have room to permit a rise in the road profile.
Poor Candidate	• Projects in which less expensive options are available.
Pros	• Subgrade repairs may be performed and subsurface drainage installed. • Geometric problems may be addressed. • Pavement subsurface may be constructed with frost resistant materials. • Removes previous distresses and poor materials. • Controls final road profile. • Long design life. • Provide a sound platform for future rehabilitations.
Cons	• Typically, the most expensive alternate. • Generally, a longer construction period than other alternates. • Construction operations are susceptible to elements.

Section 960: Noneconomic Factors

Table 960.1 – Noneconomic Factors to Consider When Evaluating Pavement Alternates

Technical	Other
• Roadway geometrics (e.g., varying lane widths, presence of vertical curves, longitudinal grades). • Continuity of adjacent pavements and lanes. • Characteristics of subgrade soils. • Traffic during construction. • Future needs on geometric or capacity changes. • Safety considerations, such as delineating the contrast between pavement and shoulder.	• Availability of local materials and experience. • Conservation of materials and energy. • Local government preferences or local politics. • Stimulation of competition among paving materials suppliers. • Noise issues due to work-zone construction or tire-pavement friction. • Experimental materials or design concepts. • Maintenance experience and equipment. • Industry capability to perform the required work. • Sustainability, such as through energy efficiency, emissions reduction, and resource conservation.