CHAPTER 603

Pavement Distress, Repair, and Widening

Design Memorandum	Revision Date	Sections Affected
20-01	Jan. 2020	Previously 304-9.0 through 12.0
22-12	Jul. 2022	603-3.01 and 603-3.04
23-06	Jun. 2023	603-2.04
24-01	Jan. 2024	603-4.0
25-11	Apr. 2025	603-3.01

The applicable design memorandum revision date is noted in brackets next to each affected section heading.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 603

PAVEMENT DISTRESS, REPAIR, AND WIDENING

603-1.0 PAVEMENT DISTRESSES

The strengths and limitations of each pavement system must be understood prior to designing a pavement. The type, extent, and severity of pavement distresses, their causes, and recommended treatments should be well known. See *Distress Identification Guide, LTPP*, FHWA Publication Number: FHWA-RD-03-031, latest version, for additional information.

Types of distresses related to aggregate pavements are as follows:

1. Dusting
2. Potholing
3. Rutting
4. Washboarding

Types of distresses related to asphalt pavements are as follows:

1. Block Cracking
2. Bleeding
3. Blowup – On Composite Pavement with Concrete below HMA
4. Edge Cracking
5. Fatigue Cracking
6. Frost Heave
7. Longitudinal Cracking
8. Longitudinal Joints Open
9. Potholes
10. Polishing
11. Raveling
12. Reflective Cracking
13. Rutting
14. Shoulder Drop-off
15. Shoving
16. Stripping
17. Thermal Cracking
18. Transverse Cracking – Top-Down or Bottom-Up
19. Weathering.

Types of distresses associated with Portland cement concrete pavement (PCCP) are as follows:

1. Alkali-Silica Reactivity (ASR)
2. Blowup
3. Corner Break
4. Durability Cracking ("D" Cracking)
5. Faulting
6. Joint Failure (including Longitudinal Joint related to De-Icing Chemicals)
7. Longitudinal Cracking
8. PCCP Joint-Seal Failure
9. Polishing
10. Poor Rideability
11. Pop-out
12. Pumping
13. Punch-out
14. Transverse Cracking
15. Scaling
16. Spalling
17. Structural Failure

603-2.0 PAVEMENT MILLING

An asphalt or concrete pavement should be milled to remove distressed layers of material, make crown corrections, maintain curb height or vertical clearance, scarify existing surface, correct surface profile, remove asphalt overlays, remove distressed pavement near joints, or provide a pavement transition. It should be noted that pavement milling is an invasive process that can damage the pavement structure. See INDOT *Standard Specifications* 306, including any recurring special provisions, for milling. The types of pavement milling, and their applications are as follows:

1. Asphalt or PCCP Scarification Milling. Scarification milling is used to roughen the existing pavement surface or remove excessive crack sealant prior to placing an HMA overlay.

2. Asphalt or PCCP Profile Milling. Profile milling is used to correct a cross-slope (crown) deficiency.

3. Approach Milling. Approach milling is used to provide a smooth connection between an overlay and driveways, commercial or public-road approaches, and mailbox approaches.

4. Asphalt or PCCP Milling. Asphalt or PCCP milling is used to remove distresses near the surface of the existing pavement prior to placing an HMA inlay.

5. Asphalt Overlay Removal. Asphalt overlay removal is used to remove existing asphalt materials by milling down to a concrete or brick base.

6. Transition Milling. Transition milling is used to provide a transition to an adjoining pavement section.

603-2.01 Asphalt or PCCP Scarification Milling

Asphalt or PCCP scarification milling is used to provide a roughened texture to an existing surface. Asphalt or PCCP scarification milling will remove crack sealant to prevent slippage of the overlay materials or roughen the existing surface that has polished due to traffic. Milling operations to correct pavement conditions that require deeper milling should be in accordance with Section 603-2.04.

Asphalt or PCCP scarification milling is generally used to prepare an existing pavement for a single-course HMA overlay. Asphalt or PCCP scarification milling is used to prepare an existing pavement for a minor structural overlay if the existing pavement has excessive crack sealant or requires minor profile corrections.

603-2.02 Asphalt or PCCP Profile Milling

Asphalt or PCCP profile milling is used to correct minor profile or cross-slope (crown) deficiencies.

603-2.03 Approach Milling

Approach milling is used to provide a connection between an overlay and driveways, commercial or public-road approaches, and mailbox approaches. The transition slope and notch depth in the existing asphalt or concrete pavement will be in accordance with INDOT *Standard Drawings*.

Approach milling is not to be performed at driveways unless it is required to meet a paved surface that continues beyond the construction limit. If the driveway is other than HMA or PCC beyond the construction limits, then approach milling is not required.

603-2.04 Asphalt or PCCP Milling [Rev. Jun. 2023]

Asphalt or PCCP Milling is intended to remove material from an existing pavement to a specified average depth by milling the surface and creating a uniform profile. An average depth of milling should be specified depending on the condition of the pavement or project requirements.
Asphalt and PCCP milling maybe used in the following cases:

1. prior to placing an HMA or PCCP inlay.
2. to correct substandard cross slopes or crown conditions.
3. profile correction; or
4. to maintain vertical clearance or curb height.

In addition to the cases listed above, Asphalt Milling may be used for the removal of stripped or distressed asphalt. The average milling depth specified should be sufficient to accommodate the HMA inlay, or the removal of distressed materials, and to achieve the desired cross slope.

Cross Slope Correction – Variable Depth Profile Milling. Variable depth profile milling is the preferred method to correct pavement cross slope. This approach allows for the placement of uniform thickness intermediate and surface layers. The existing pavement section must be thick enough to accommodate the required milling depth and leave sufficient pavement thickness to support the new HMA material. The limits and associated milling depths should be shown on the typical sections.

Cross Slope Correction – Variable Depth Intermediate QC/QA-HMA. When variable depth profile milling is not feasible, a variable depth intermediate layer may be considered. There are limits to the amount of variability that is acceptable across the pavement section. The limits, as described below, will determine whether QC/QA-HMA or HMA Wedge and Level material is used. QC/QA-HMA is the preferred pavement material. When variable depth QC/QA-HMA or HMA Wedge and Level is used, the maximum and minimum lay rate and Mixture Designation (in mm) should be shown on the plans.

When variable depth QC/QA HMA is specified, the difference between the pavement thickness at the crown and the edge of pavement at any transverse section should not exceed the maximum particle size in the mixture (maximum lift thickness variability). The maximum lift thickness variability by mixture designation is shown in the table below. Too much thickness variability within a single lift of pavement can lead to uneven compaction within the lift. This can be detrimental to pavement life.

Mixture Designation	Maximum Lift Thickness Variability QC/QA-HMA (in.)
9.5 mm	0.5
12.5 mm	0.75
19.0 mm	1.0
25.0 mm	1.5

Cross Slope Correction – Variable Depth HMA Wedge and Level. A combination of variable depth profile milling and variable depth QC/QA HMA should be considered before utilizing a wedge and level course.

When design or field conditions require a variable depth pavement that exceeds the maximum lift thickness variability for QC/QA-HMA, HMA Wedge and Level should be specified. INDOT *Standard Specification* defines the lift thickness of wedge and level as follows: "The finished thickness of wedge and level mixtures shall be at least 1 1/2 times but not more than six times the maximum particle size as shown on the DMF. Feathering may be less than the minimum thickness requirements."

If wedge and level is specified, the smallest feasible mixture designation should be selected. This is typically a 9.5 mm mixture. A consistent depth QC/QA HMA Surface or another type of surface treatment is required to be placed over the HMA Wedge and Level course.

603-2.05 Asphalt Overlay Removal

Asphalt overlay removal consists of milling as a means of removing an entire asphalt overlay from a concrete or brick base. The designer will designate the approximate existing asphalt thickness on the typical cross sections. The designer should be aware that milling can dislodge or loosen bricks and result in construction challenges. To avoid construction issues associated with existing pavements that have brick bases, it is recommended to allow a sufficient amount, at least 2 in. or more, of existing asphalt pavement to remain in-place to keep the existing bricks stable.

603-2.06 Transition Milling

Transition milling is used to provide a connection between an HMA overlay and an adjoining pavement, paving exception, or at the beginning and end of a paving project. The transition slope and notch depth in the existing asphalt or concrete pavement will be in accordance with the INDOT *Standard Drawings*.

603-3.0 PAVEMENT PATCHING

The project manager and the pavement designer should work together to determine and overcome critical project challenges such as maintenance of traffic (MOT), pavement patching, temporary pavements, drainage (underdrains), etc. The pavement designer must be aware of MOT requirements and follow the Interstate Highway Congestion Policy (IHCP), or request an exception with adequate justification. The pavement designer is responsible for specifying the composition, depth, width, length, and location of various patch types.

The pavement designer should produce a Patching Table to assist in the proper design and construction of patches on the project. A Patching Table including start station locations and end station locations of the patches, lane (travel, passing, mainline, shoulder, approach, etc.), direction (NB, SB, etc.), length (ft), width (ft), and area (yd^2) should be included in the plans. Separate tables should be produced for partial depth patches and full depth patches.

603-3.01 PCCP Patching, Full Depth [Rev. Jul. 2022, Apr. 2025]

The following applies to projects that include PCCP patching.

1. Maintenance of Traffic. The pavement designer must coordinate with the roadway designer to determine the necessary MOT, taking into consideration how long a lane can be closed during the patching operation. See Chapter 503 for work zone traffic control considerations.

2. Patching Details. All PCCP patches should be doweled to the existing, remaining concrete pavement. A 6-ft minimum patch length and a 15-ft maximum contraction joint spacing should be between two contraction joints. For example, if a 20-ft panel is replaced, a D-1 joint should be installed at 10 ft in addition to contraction joints at each end of the patch. PCCP patches should be in accordance with *Standard Specification* Section 506 and Standard Drawing series 506-CCPP.

   In certain unique circumstances it may make sense to match transverse joints with the adjacent lane. The pavement designer should specify in the patching table where this should occur and notify INDOT District Pavement Engineers when this unique circumstance occurs. Patches less than one panel in length do not need to be longitudinally tied to the existing concrete pavement. For a 20-ft original concrete joint spacing, the slab movement will be about 1/12 in.

3. Subbase Considerations. Subbase conditions play a significant role in the long-term performance of a pavement patch. Concrete pavements constructed in Indiana are typically placed on subbase

layers consisting of 3 inches of open graded #8 aggregates over 6 inches of dense graded #53 aggregates (Subbase for PCCP). While this subbase provides stable support for the concrete slabs, its efficiency can decrease over time once it becomes saturated with water.

Lean concrete base (LCB) has been utilized successfully as a replacement for the subbase for PCCP in patching operations and RCBA replacements without new terminal joints. LCB is placed and finished the same as PCCP but contains less Portland cement paste than a typical PCC mix. This allows the pavement above to retain the ability to move due to environmental changes. It also provides greater long-term support than aggregates to prevent the formation of any noticeable settlement.

LCB is recommended under all PCCP patching on US Highways and Interstates when maintenance of traffic allows. For all other routes the use of LCB is encouraged when the project budget allows. Construction of a full-depth PCCP patch with LCB can typically be completed during a nighttime closure. The overtopping material may be placed on top of the LCB as soon as placement can be performed without deformation of the LCB, typically within a few hours. When LCB is utilized, a subgrade treatment below the LCB should not be included.

4. Use of HMA. Full depth HMA patches should not be used with full depth PCCP pavement. In special unique circumstances, full depth HMA patches may be used in full depth PCCP, for example when existing PCCP is self-rubblized or MOT is negatively affected by the use of PCCP.

5. Underdrains. The integrity of underdrains should be maintained in the patching process. The designer should incorporate the underdrain details in the design; including sequencing of the patching process in conjunction with underdrain installation. Patching should not disturb or block/clog underdrains.

6. Services Life. A minimum service life of 6 years should be expected for a patching project. For a PCCP structural pavement treatment project, if the patching is over 8%, an LCPCA should be completed to compare patching with a PCCP overlay or slab-reduction technique, e.g., PCCP rubblization with an HMA overlay. Also, if patching is at or above 30%, a slab-reduction technique or reconstruction of the existing pavement structure should be considered and analyzed.

603-3.02 PCCP Patching, Partial Depth

PCCP Patching, Partial Depth is used to patch concrete pavement when full depth patching is not required, but an area of concrete, other than that around a joint, needs to be repaired. When distresses like popouts occur in a concrete pavement, partial depth patching techniques can be used to treat the distress and restore the pavement.

Removal of concrete for PCCP Patching, Partial Depth should be in accordance with *Standard Specifications* Section 506. Placement of new partial depth PCCP should be in accordance with *Standard Specification* Section 506.

603-3.03 PCCP Patching, Joint Repair

Joint repair of PCCP pavement includes the removal or replacement of shallow areas of PCCP at spalled or distressed joints. Joint repair can be a cost-effective measure in repairing concrete pavement joints rather than replacing concrete full depth.

This partial depth treatment should be used when spalling occurs because of joint deterioration, local weak spots, or incompressible material in joints. Joint repair can also be a viable treatment when surface deterioration is caused by reinforcing steel being too close to the surface or poor curing or finishing practices. Joint repair should not be used when spalling is caused by dowel bar misalignment, spalling is present at working cracks due to shrinkage, fatigue, or foundation issues, or when spalling is due to D-cracking or reactive aggregate.

The benefits of PCCP joint repair include the restoration of structural integrity, improved ride quality, extended service life, and the restoration of a well-defined and uniform joint sealant reservoir. PCCP Patching, Joint Repair should be in accordance with the current USP for joint repair.

603-3.04 HMA Patching, Full Depth [Rev. Jul. 2022]

A key element in maintaining asphalt pavements at localized failures and heavily distressed locations is the Full Depth Asphalt Patch. The intent of the Full Depth Asphalt Patch is to remove a failed pavement area and replace the existing asphalt with new HMA.

Full depth HMA patches may be used where the entire pavement section needs to be removed in order to correct the distress and deterioration in a localized area of pavement. The pavement designer will determine locations of existing pavement that require full depth patching based on the severity and type of distress.

The depth and width of the patch is critical to assuring that the new HMA can be installed with proper density. Reference INDOT *Standard Specifications* section 304.

Full depth HMA patches should match existing pavement thickness, or a minimum of 10 in. if the existing pavement is less than 10 in.

Patch width is critical in order to obtain proper compaction. A vibratory roller is typically 8 ft wide. There are smaller non-vibratory rollers as small as 4 ft wide, and even smaller hand-controlled "jumping jack" compactors. Only the vibratory roller can definitively compact the HMA to the desired density. The pavement designer should avoid designing small patches having a width less than 4 ft.

The integrity of the underdrains should be maintained in the patching process. The designer should incorporate the underdrain details in the design; including sequencing of the patching process in conjunction with underdrain installation. Patching should not disturb or block/clog underdrains. The pay item is "HMA Patching, Type____," per INDOT *Standard Specifications* 304.

See Figure 603-3A, Full-Depth HMA Patch for guidance on detailing full-depth asphalt patches.

603-3.05 HMA Patching, Partial Depth

HMA partial-depth patching may be used where the pavement deterioration is only in the upper one or two layers of the existing HMA. A partial depth patch is the process of removing existing HMA, typically to a depth of 3 in. to 6 in. then filling the area with HMA (HMA Patching, Type __).

Longitudinal patching is usually required in a widened area, where the existing asphalt surface has an open longitudinal crack or joint at the mainline/widened interface. A longitudinal patch should be placed by milling or otherwise removing the upper one or two layers of HMA and installing new HMA. The depth and width of the patch is critical to assuring that the new HMA can be installed with proper density. Reference INDOT *Standard Specifications* 304.
Patch width is critical in order to obtain proper compaction. A vibratory roller is typically 8 ft wide. There are smaller non-vibratory rollers as small as 4 ft wide, and even smaller hand-controlled "jumping jack" compactors. Only the vibratory roller can definitively compact the HMA to the desired density. The pavement designer should avoid designing small patches having a width less than 2 ft.

The integrity of the underdrains should be maintained in the patching process. The designer should incorporate the underdrain details in the design; including sequencing of the patching process in

conjunction with underdrain installation. Patching should not disturb or block/clog underdrains. The pay item is "HMA Patching, Type____," per INDOT *Standard Specifications* 304.

See Figure 603-3B, Partial-Depth HMA Patch for guidance on detailing partial depth asphalt patches.

603-3.06 Composite Patching

Composite patches should always match existing pavement composition and depths where practical. The pavement designer will determine the most appropriate patch composition and depth. In many instances, composite pavement will be patched with a full depth PCCP patch. Patch width is very critical for achieving proper compaction. The integrity of the underdrains should be maintained in the patching process. The designer should incorporate the underdrain details in the design; including sequencing of the patching process in conjunction with underdrain installation. Patching should not disturb or block/clog underdrains.

603-4.0 PAVEMENT WIDENING [REV. JAN. 2024]

Where pavements are being widened in an overlay project, the widening is brought up to the elevation of the existing pavement and an overlay is constructed over the widened area and the existing pavement simultaneously for continuity. The depth of the widened area must be at least that of the adjacent pavement so that the subgrade is not stepped. In excessively thick sections compacted aggregate or Subgrade Treatment Type IC, may be substituted for a portion of the HMA. Prior to overlay, existing pavement and new widening should be scarified/profile milled to make a smooth plane for the overlay.

All costs for widening pavements 8 ft or less are included in INDOT *Standard Specifications* 304 Widening with HMA or INDOT *Standard Specifications* 305 Widening with PCCP Base. All costs for widening pavements 8 ft or more are determined based on the individual components of the work.

603-4.01 Widening with HMA

An existing pavement may be widened to 8 ft or less on each side if Widening with HMA mix is used. When widening by more than 8 ft., QC/QA-HMA should be used for use as the widening mix instead of Widening with HMA mix.

The decision to use Widening with HMA or QC/QA-HMA for widening should be determined by the pavement designer and be based on cost-effectiveness and the overall width of widening. The minimum width of widening with HMA specified is 2 ft for constructability purposes. This

minimum width of widening may result in extra lane width or may require removal of existing pavement to satisfy the 2-ft minimum-width requirement.

The longitudinal joint of the widened pavement should not be located in the wheel path of the driving lane. The pay-item designation for this work will be in accordance with Section 304 of INDOT *Standard Specifications*, Widening with HMA, of the type required, regardless of the quantity involved.

If specific project widening requirements exceed 8 ft, the widened pavement area will not be specified as Widening with HMA but will be identified as HMA pavement. The pay items specified will be QC/QA-HMA in accordance with *Standard Specifications* 401 for the entire length of widening, including any widths less than 8 feet. Excavation and subgrade treatment will be as described in the INDOT *Standard Specifications* 207. If the existing pavement has underdrains and a drainage layer, the widening design should perpetuate the underdrain system.

The pay item designation of this work should be Widening with HMA, Type ___ in accordance with the INDOT *Standard Specifications* 305.

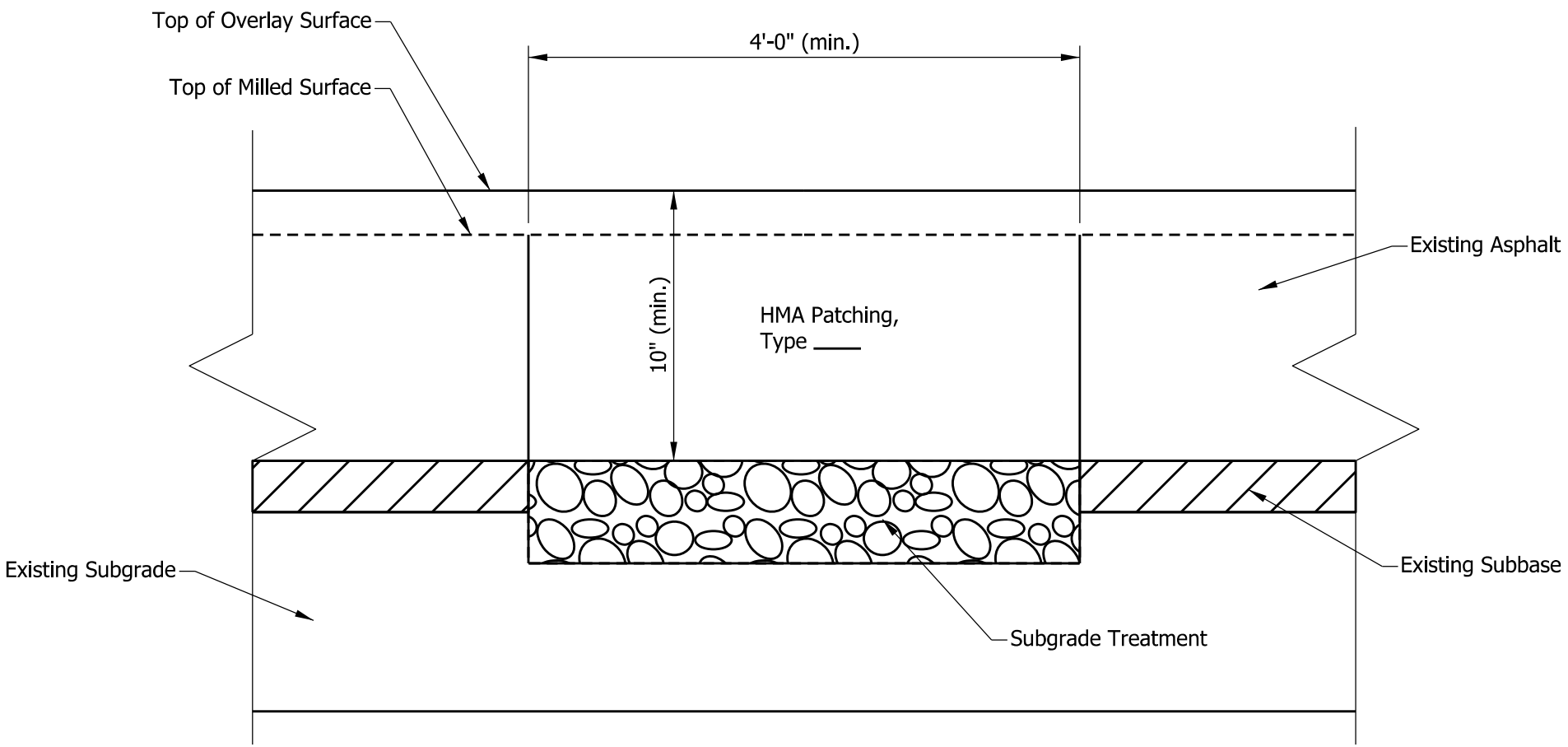
603-4.02 Widening with PCC Base

When widening with PCC the widened section should match the existing adjacent pavement section. If widening of the pavement is needed and the existing pavement section includes a drainage layer, the widened PCC base should include a drainage layer as well. If the existing pavement section does not include a drainage layer, the widened PCC base will likely require a separation layer only, but in some instances a drainage layer may be desirable and should be considered by the pavement designer should drainage issues exist. The width of PCC base widening is limited to pavement widening of less than or equal to 8 ft. An existing pavement may be widened up to 8 ft on both sides with PCC base. The pay item designation of this work will be Widening with PCC Base, ___ in., in accordance with the INDOT *Standard Specifications* 305.

603-4.03 Widening for Composite Pavements

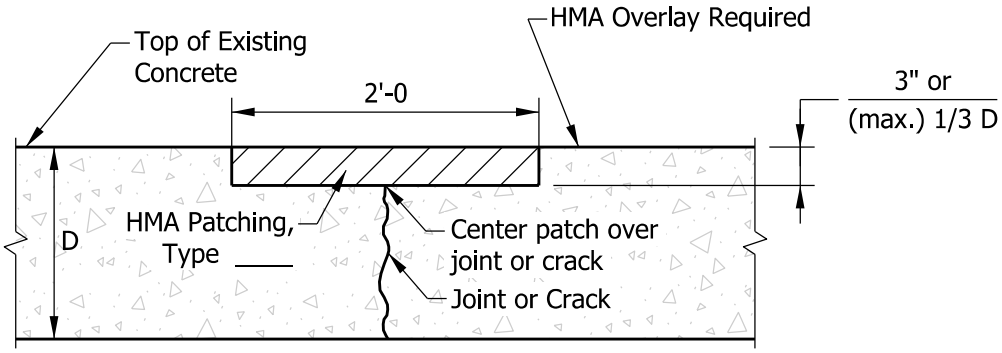
Widening of asphalt over PCC (composite) pavement will be designed to match the existing pavement. If widening of the pavement is needed and the existing pavement section includes a drainage layer, the widened PCC base should include a drainage layer as well. If the existing pavement section does not include a drainage layer, the widened PCC base will likely require a separation layer only, but in some instances a drainage layer may be desirable and should be considered by the pavement designer should drainage issues exist.. See INDOT *Standard Specifications* 302.

It may not be cost effective or practical to widen a composite pavement by 2 ft to 8 ft for one or two miles. Also, the old concrete may not be in suitable condition to install tie bars. There must be good engineering analysis to determine the cost effectiveness or practicality of the widening. In situations such as this, widening with HMA should be considered.

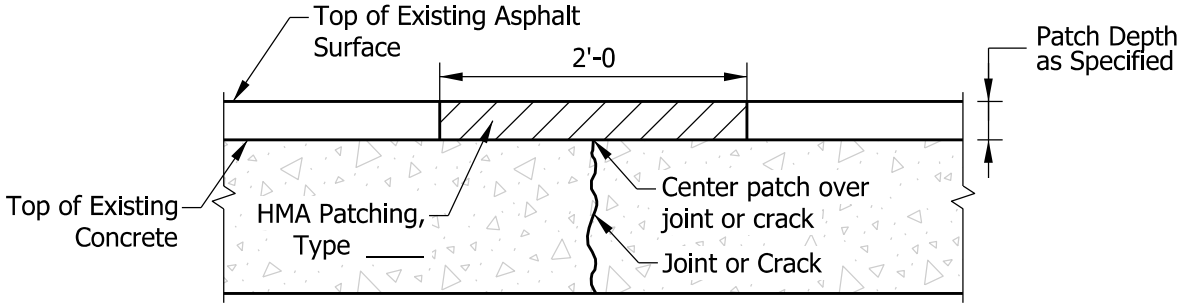


FULL-DEPTH HMA PATCH

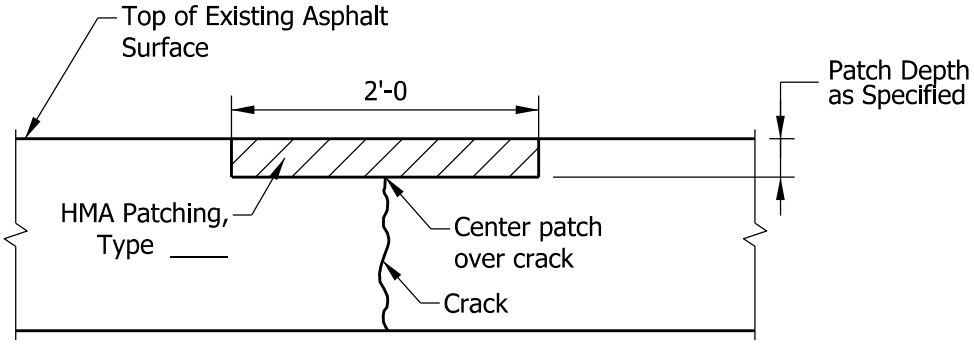
Figure 603-3A



CONCRETE PAVEMENT



COMPOSITE PAVEMENT



ASPHALT PAVEMENT

PARTIAL-DEPTH HMA PATCH

Figure 603-3B