DEPARTMENT OF TRANSPORTATION

Chapter 6: Ramps, Shoulders, Turn Lanes & Miscellaneous Pavements

MnDOT Pavement Design Manual

July 10, 2019

Contents

Introduction

This chapter contains standards and guidance for the pavement design of non-mainline pavements. Often the design of these pavements will require a degree of engineering judgment and may follow district preference/experience.

Section 600: Ramps and Loops

Ramps and loops are short roads which allow vehicles to enter or exit a grade separated highway. Ramp pavements are constructed of HMA or PCC. Use the following to design ramp pavements.

1. HMA

   HMA is a suitable material for ramps for most applications, including for both HMA and PCC mainlines. Existing HMA ramps may be rehabilitated with the same methods as used for mainline pavements (e.g. overlays, full-depth reclamation (FDR), stabilized full-depth reclamation (SFDR), and cold-in-place recycling (CIR)).

   The pavement must meet the pavement design requirements of **Chapter 4: HMA**.

2. PCC

   PCC is a suitable material for ramps and loops. Existing PCC ramps may be rehabilitated with the same methods as used for mainline PCC pavements.

   The pavement must meet the pavement design requirements of **Chapter 5: PCC**. Consider matching the PCC thickness of the ramps to the mainline or cross-road.

Section 610: Shoulders

Shoulders are pavement (HMA/PCC) or aggregate that extends past the marked traffic lanes and is not intended for use as a travel lane. In specially designated areas shoulders may be used by buses to bypass traffic.

Shoulder material is dictated by the mainline pavement material, the amount and type of vehicle use on the shoulder, the condition and type of any existing shoulders, and the results of any required LCCA.

See the **Roadway Design Manual, Chapter 4 – Cross Sections** for more information on shoulder widths and cross-sections.

Materials

A. Aggregate surfacing

(1) Aggregate shoulders

Aggregate is a relatively inexpensive material that may be used to construct shoulders, however, aggregate requires re-grading and may not perform well under high traffic or heavy loads. Because of these limitations, aggregate shoulders are typically used on low-volume, rural roads in which the shoulders are not subject to repetitive loads.

Typically, the top 3.0 inches of aggregate shoulders are constructed of class 1 or class 2 aggregate surfacing and may contain recycled material (depending on district preference/experience) placed on the same aggregate base material as mainline.

(2) Aggregate shouldering with paved shoulder

In addition to any paved shoulder (HMA/PCC), a 1.5-foot wide strip of aggregate (class 1, class 2, or recycled HMA millings) is provided to "round" the intersection of the shoulder and the inslope. This is considered a useable part of the shoulder.

B. HMA

HMA may be used to construct shoulders for either HMA or PCC mainline pavements.

(1) When mainline rehabilitation projects increase the elevation of the mainline pavement, the elevation of the shoulders must be raised to match the mainline. To achieve this, HMA shoulders are typically either overlaid or rehabilitated by reclaiming the existing HMA, placing aggregate base as required, and paving a new HMA shoulder.

(2) HMA shoulders are classified as either "thin" (<4.0 inches) or "thick" (≥4.0 inches). Shoulders classified as "thin," are expected to be rehabilitated by being removed and replaced. "Thick" HMA shoulders are expected to be rehabilitated with an overlay or a mill and overlay. The difference in expected rehabilitation activities will affect any LCCA performed on the road.

(3) New HMA shoulders are typically constructed 3.0 or 4.0 inches thick and placed on the same aggregate base as the mainline. If the HMA shoulder is designated as a bus-only shoulder then the thickness should be structurally designed according to **Chapter 4: HMA.** The subsurface layers should match the mainline pavement to maintain the continuity of drainage and to prevent any differential heaving between mainline and the shoulders.

C. PCC

PCC is suitable shoulder material for PCC mainline pavements. Besides acting as a durable, low-maintenance shoulder material, a tied PCC shoulder provides structural benefits to mainline PCC pavements (that have full lane-width panels) which may result in a thinner required mainline PCC thickness.

Minimum thickness

- PCC shoulders that are placed as whitetopping (PCC overlay of existing HMA) have a minimum required thickness of 4.0 inches (same as whitetopping). See **Section 510: PCC Overlay of Existing HMA/ Whitetopping** for the pavement design of whitetopping.
- For a tied PCC shoulder, the PCC shoulder thickness must meet the following
    - No thinner than 5.0 inches.
    - No thinner than ½ the mainline PCC thickness plus 2.0 inches. This allows the tie-bars to be placed mid-depth in the mainline pavement and provide 2.0 inches of cover for the tie bars.
- If the PCC shoulder is designated as a bus-only shoulder then include dowel bars and design the thickness according to **Chapter 5: PCC**.
- For other circumstances, PCC shoulders have a minimum required thickness of 4.0 inches.

Section 620: Widening Existing Lanes and Adding Lanes

This section discusses permanent additions to an existing pavement such as widening, or adding/extending turn lanes. In general, to minimize differential movement relative to adjacent existing pavements, additions are designed to match the thickness and materials of adjacent pavements as much as practical.

1. Mainline widening and adding through lanes

   Pavements that carry through-traffic must meet the *structural requirements* of **Chapter 4: HMA** or **Chapter 5**: **PCC**. However, the pavement section should be designed to match the adjacent existing section rather than following **Figure 400.1** or **Figure 500.1**. Any of these pavement segments that are more than a ½ mile long must have a signed traffic forecast. Contact the MnDOT Concrete Engineering Unit (Office of Materials and Road Research) to discuss the suitability of tying a new concrete lane to an existing concrete lane.

2. Other additions

   Typically, traffic data is not available to design pavement additions, such as adding (or extending) turn lanes or auxiliary lanes. These sections are recommended to match the adjacent existing pavements and have at a minimum:

   - 4.0 inches of HMA pavement on aggregate base and subbase that matches the mainline structure.
   - 5.0 inches of PCC pavement on aggregate base and subbase that matches the mainline structure.

3. Pavement widening drainage system

   - Permeable aggregate base (PAB) is a recommended option for designs that involve the widening of narrow pavements so as to perpetuate the drainage of any water trapped in the existing pavement by the widening. The drainage system is shown in **MnDOT Standard Plan 5-297.432**. The type of PAB material (drainable stable base (DSB), open-graded aggregate base (OGAB), and permeable asphalt stabilized base (PASB)) used for this widened section is optional.

Section 630: Turn Lanes

If the turn lanes are expected to carry a high amount of heavy commercial truck traffic, then the turn lane should be designed to meet the structural requirements of **Chapter 4: HMA** or **Chapter 5: PCC**. Contact the MnDOT Concrete Engineering Unit (Office of Materials and Road Research) to discuss the suitability of tying a new concrete lane to an existing concrete lane.

At a minimum, turn lanes must meet the following requirements:

- 4.0 inches of HMA pavement on aggregate base and subbase that matches the mainline structure.
- 5.0 inches of PCC pavement on aggregate base and subbase that matches the mainline structure.

Section 640: Temporary Median Crossovers

Temporary median crossovers are HMA pavements that are installed before a project on a divided highway to allow traffic to be diverted from one set of lanes, across the median, to the other set of lanes and are removed at the completion of the project.

At a minimum provide 4.0 inches of HMA with 6.0 inches of aggregate base. It is recommended to construct the entire embankment required for the crossover from granular material.

Note: It is recommended to complete construction of temporary median crossovers 60 days prior to receiving traffic or construct them the previous season if possible.

Section 650: Parking Lots and Driveways

Use this section to design the pavement section of parking lots and driveways. Evaluation and treatments below these sections are at the discretion of the District Materials/Soils Engineer.

1. HMA

- For parking lots or driveways that are ordinarily loaded with passenger cars, the minimum pavement section is 3.0 inches of HMA and 6.0 inches of aggregate base.
- For parking lots or driveways that accommodate heavy trucks, the minimum pavement section is 4.0 inches of HMA and 12.0 inches of aggregate base.
- If a large number of heavy trucks are expected then design the pavement thickness according to **Chapter 4**.
- Mix Designation
    - For parking lots or driveways that are ordinarily loaded with passenger cars, specify a mix designated as SPWEB330A, SPWEB330B or SPWEB330C.
    - For parking lots or driveways that accommodate heavy trucks, specify a mix designated as SPWEB440F.

2. PCC

- For parking lots the minimum pavement section is 5.0 inches of PCC on 12.0 inches of aggregate base.
- If a very large number of heavy trucks are expected, then design the pavement according to **Chapter 5**.
- For driveways the minimum pavement section is 4.0 of PCC on aggregate base.
    - Joints will be sealed, un-doweled and should not be more than 6 feet apart. For doweled joints, follow **Table 530.1**: **PCC Joint Design**.

Section 660: Roundabouts

Roundabouts have the same pavement design requirements as mainline pavements; see **Chapters 4: HMA** or **Chapter 5: PCC.** A separate traffic forecast must be developed for just the roundabout to be used for the pavement design.

Use the recommended mainline HMA mix designation in **Section 450.1** in **Chapter 4: HMA** but because of turning-movements and slow speeds experienced in a roundabout, consider increasing the traffic level and/or MSCR PG Grade. The MnDOT Bituminous Engineer may be consulted to determine the HMA mix designation.

Truck aprons (included with Specification 2521) must be a minimum of 6" thick with a maximum of 15' joint spacing. Contact the MnDOT Concrete Engineering Unit (Office of Materials and Road Research) to discuss details for PCC truck aprons and PCC roundabouts.

Section 670: Shared-Use Paths

A shared-use path is typically located on exclusive right-of-way, with no fixed objects in the pathway and minimal cross flow by motor vehicles. Portions of a shared-use path may be within the road right-of-way but physically separated from the roadway by a barrier or landscaping. Users typically include bicyclists, in-line skaters, wheelchair users (both non-motorized and motorized) and pedestrians.

Subgrade and surfacing recommendations for shared-use paths should be provided by or reviewed by the District Materials/Soils Engineer, and included in the project's Materials Design Recommendation (MDR). Shared-Use Paths may be paved with PCC or HMA. For HMA, it is recommended to specify a SPWEA230B bituminous mixture for the shared-use path surfacing.

Guidelines for the design of the Pavement Structure of shared-use paths are contained in **Section 5-5.0** of **The MnDOT Bikeway Facility Design Manual**.