MINNESOTA DEPARTMENT OF TRANSPORTATION
State Aid Division
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To: County Engineers (Distribution 618)
City Engineers (Distribution 650)
MnDOT District State Aid Engineers
MnDOT District Materials Engineers
SALT Consultant list

From: Mitch Rasmussen, P.E.
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MR 3/17/16

Subject: **Specification 2360 - Plant Mixed Asphalt Pavement - Design Guidelines**

Expiration
This Technical Memorandum supersedes Technical Memorandum No. 10-SA-02 and will expire on July 1, 2025 unless superseded prior to this date.

Implementation
The guidelines contained in this Technical Memorandum are effective immediately for all Federal Aid and State Aid projects that contain specification 2360 - Plant Mixed Asphalt Pavement.

Modification(s) to specification 2360 - Plant Mixed Asphalt Pavement shall be requested by the local agency in a letter to the District State Aid Engineer. The request for modification letter shall include justification for the specification deviation(s). The request for modification to the specification shall include at a minimum an explanation of the situation, why the modification is necessary and how this modification will provide a better product. A copy of the request for modification letter shall be retained in the respective local agency project file.

Introduction
Over the past decade, MnDOT and local agencies have been specifying gyratory mix design for their asphalt pavements. Technical Memorandum No. 04-SA-01 "Bituminous Specification Implementation" was a beginning directive toward moving Federal Aid and State Aid projects to gyratory mix design and Technical Memorandum 10-SA-02 "Specification 2360 - Plant Mixed Asphalt Pavement - Design Guidelines" provided guidance and information to designers to follow established best design practices, for selection of appropriate bituminous mixture and asphalt binder grade(s), and reduce bituminous specification ambiguities for contractors bidding State Aid and Federal Aid projects.

Plan reviews for construction projects show that gyratory designed mixes are being specified. However, there has been a recent change in the PG Binder specification with the switch to AASHTO M 332 – *Standard Specification for Performance-Graded Asphalt Binder Using MSCR (Multiple Stress Creep Recovery)*. Therefore, additional guidance is warranted to ensure that the correct PG (performance graded) binder(s) are specified.

Purpose
The main two purposes of this Technical Memorandum are to: First, provide guidance in following established best design practices to ensure that public funds are spent as efficiently as possible. Second, to provide designers with the most current information regarding the appropriate choice of bituminous mixture(s) and asphalt binder grade(s) when specify them on projects.

Guidelines

To further standardize bituminous pavement specifications, all State Aid (including Federal Aid) projects should follow the most current criteria for asphalt pavement mix design and PG binder selection. At the present time, the most current documents are: "Design Criteria 2360" dated April 4, 2014 and "MnDOT PG Binder Guidelines" dated November 12, 2015. Both of these publications can be found at the MnDOT Bituminous Engineering webpage under Design and on the State Aid Pavement webpage under Pavement Design.

Typically each year in January, the MnDOT Bituminous Unit prepares a memo which contains recent specification changes and reminders. Please see the current bituminous specification updates on the State Aid Construction webpage for this information and for the most current 2360 - Plant Mixed Asphalt Pavement specification before starting your bituminous pavement design.

Following is a list of items that designers should watch closely to ensure these items are correct in the plan.

1. Superpave (gyratory design) considers the top four inches (top three inches for local agencies with traffic levels <3 million ESAL's) to be wear. Bituminous mixture placed below the top 4 inches or (top 3 inches for local agencies with traffic levels <3 million ESAL's) is considered nonwear.

2. A PG 58(H, V, E) -34°C should be specified in the top four inches (top three inches for local agencies with traffic levels <3 million ESAL's) for new construction, reclaiming and cold in-place recycling projects. Pavement management data shows thermal cracking may be reduced up to 90% when a PG 58(H, V, E) -34°C is used in the top four inches of the pavement structure. Reduced thermal cracking should lead to longer pavement life.

3. A PG 58S -28°C should be specified in bituminous mix placed as an overlay on existing asphalt pavements. The typical moderate to high degree of thermal cracking associated with older pavements makes the use of more expensive 58x -34°C binders less beneficial.

4. Do not specify a PG 58(H, V, E) -34°C below four inches (top three for local agencies with <3 million ESAL's) in the pavement structure unless, because of small quantities, it makes economic sense to specify the same binder grade for the entire pavement structure. Typically, specify a PG 58S -28°C below four inches (top three inches for local agencies with traffic levels <3 million ESAL's) in the pavement structure. Research at MnROAD has shown that the pavement typically does not reach temperatures below -28° Celsius at these depths. The use of a more expensive asphalt binder below these depths is usually not warranted.

5. Be careful when specifying the aggregate size (A, B, C, D). Aggregate sizes **A** and **B** are specified most often. Aggregate size **A** is ½ inch minus and aggregate size **B** is ¾ inch minus. There has been a shift recently to aggregate size **A** as the aggregate specified most often in the wearing course mixtures. Although aggregate size **B** will accommodate RAP more readily than aggregate size **A**, splitting of RAP into two sizes appears to diminish this. See specification 2360.1 **A3** Mixture Designations for further clarification.

6. Be careful when specifying air voids in the mixture. A nonwear mixture will always have 3.0 percent air voids. Mainline wear mixtures have 4.0 percent air voids and shoulder wear mixes will have 3.0 percent air voids. The Engineer should consider modifying mainline wear traffic level 2 mixtures to 3.0 percent air voids for low-volume local agency pavements having <0.3 million ESAL's. Use 4.0 percent air voids on higher volume facilities.

7. Incentives/Disincentives: The incentive/disincentive specification for density and ride should remain in project specifications as they do have a direct impact on pavement quality. Well compacted smooth pavements are desirable and last longer. However, if incentives are written out, so should the disincentives. If paying increased project costs for incentives is not in accordance with local policy, it is still possible to retain the incentive/disincentive specifications by including a statement informing bidders there will be no net increase in the line item as bid. By stating this, any disincentives incurred can be offset by incentives achieved up to, but not exceeding the line item unit bid price.

Density: Use the maximum density specification for bituminous compaction on the mainline of County State Aid Highways. Achieving the required density is essential to constructing longer lasting pavements. The density specification should be included in its entirety (i.e. density incentive shouldn't be written out and disincentive retained).

Ride: It is highly recommended to include the ride specification in all projects as ride should not be sacrificed for density. Within Specification 2399 select the correct Ride Equation for your project based on number of pavement lifts placed; Ride Equation A is for 3 or more lifts of asphalt pavement, Ride Equation B is for 2 lifts, and Ride Equation C is for 1 lift.

8. Ordinary compaction should be limited to layers identified in the typical sections with a minimum planned thickness of less than 1½ inches, thin lift leveling, wedging layers, patching layers, driveways and areas that cannot be compacted with standard highway construction equipment. See specification 2360.6C Ordinary Compaction Method for further information.

9. Bikeway trail mixture designation should be SPWEB230B. See the Bicycle Path Design State Aid web page for additional guidance.

   http://www.dot.state.mn.us/stateaid/bicycle.html

10. Recycled asphalt pavement (RAP) has been successfully used in MnDOT and local agency bituminous mixtures. The use of RAP is encouraged in both non-wear and wear courses.

11. Warm mix asphalt use is permissible on State Aid projects (including Federal Aid) provided that the requirements of the 2360 specification are met. There may be economical and environmental incentives to use this type of bituminous mix.

Rules of Thumb

- Minimize the number of mixtures and PG grades on any one project. Typically, it is not economical to specify another bituminous mixture for quantities less than 2000 tons.

- New construction, reclaiming, and cold in-place recycling - The top four inches (three inches for local agencies with traffic levels <3 million ESAL's) of bituminous mixture should have the same PG grade. Typically in the top four inches, (three inches for local agencies with traffic levels <3 million ESAL's) specify PG 58(H, V, E) -34 binder. In the occurrence of small quantities, it may make economic sense to specify the same binder grade for the entire pavement structure.

- Overlays - Bituminous mixture placed as an overlay or below four inches from the surface (three inches for local agencies with traffic levels <3 million ESAL's) should be the same PG grade. Typically, specify PG 58S -28 binder. This is because the common high crack frequency associated with older pavements does not make the more expensive binders economical.

Questions

For special or unique design considerations, please contact your District State Aid Engineer for guidance.

For information on the technical contents of this memorandum, please contact John Garrity, MnDOT Bituminous Engineer at (651)366-5577 or Joel Ulring, State Aid Pavement Engineer at (651)366-3831.

Links

A link to all active and historical State Aid for Local Transportation Technical Memoranda can be found at:

State Aid Tech Memos: http://www.dot.state.mn.us/stateaid/tech-memos.html
MnDOT Bituminous Design: http://www.dot.state.mn.us/materials/bituminousdesignpage.html
State Aid Bituminous Design: http://www.dot.state.mn.us/stateaid/pavement.html