Montana Department of Transportation
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Memorandum

To: Distribution

From: Dwane Kailey, P.E.
Chief Engineer

Date: November 16, 2017

Subject: Pavement Design Manual

An updated Pavement Design Manual was developed to provide guidance to MDT's Surfacing Design Unit and MDT's Consultant Design Bureau. The manual can be found at this link: http://www.mdt.mt.gov/publications/manuals.shtml

The purpose of this memo is to update plant mix surfacing guidelines and implement the Pavement Design Manual. This manual should be used as a guideline for all surfacing designs on MDT projects. This memo and the Pavement Design Manual rescinds and replaces the 1991 Pavement Design Manual.

In addition, the following design and construction memos are rescinded:

- Cover Material Revision, Asphalt Cement Quantities by Paul Ferry, PE June 29, 2004
- Revised Surfacing Structural Coefficients and Layer Thicknesses by Loran Frazier, PE May 11, 2006
- Surfacing Design Guidelines by Matt Strizich, PE dated April 7, 2005
- Modified Surfacing Design Requirements by Paul Ferry, PE Dated February 9, 2009
- Project-Specific Asphalt Contents by Matt Strizich, PE dated April 29, 2011
- Commercial Plant Mix Guidance by Dwane Kailey, PE dated September 15, 2015. That memo rescinded and replaced the following memos, which remain rescinded.
    - Plant Mix Special Provisions - June 6, 2008 Construction Memo from Matt Strizich, PE
    - Plant Mix and Aggregate Treatment- June 11, 2008 Design Memo from Paul Ferry, PE

To reduce confusion and promote consistency in surfacing designs, the Materials Bureau offers these additional guidelines for the development of surfacing typical sections. While this memo is primarily directed toward design consultants, it provides guidelines that are also being used internally.

Plant Mix Surfacing

The Department utilizes Commercial Mix and Plant Mix Surfacing bid items to pay for plant mix surfacing. Specify the appropriate Commercial Mix, based on the required binder, for projects with a planned quantity of less than 5,000 tons. On projects with a planned quantity of 5,000 tons or more, use the appropriate Plant Mix Surfacing bid item. For "Non-Commercial" mix, the quantities of asphalt cement, hydrated lime, and plant mix aggregate will be paid separately. For Commercial Mix, the quantities of asphalt cement, hydrated lime, and plant mix aggregate are included in the price bid for Commercial Mix.

PG Binders

Select the grade of Performance Graded (PG) binder using Table 7: PG Binder Selection in chapter 6 of the Pavement Design Manual. Additionally, high and low temperatures should be considered. MDT uses LTPPBind software with the LTPP high- and low-temperature models for selecting the basic binder grade. The high-temperature reliability target should always be 90% or greater. Low-temperature reliability differs based on whether or not the project is an overlay. If the project is an overlay, the new overlay will probably exhibit some reflective cracking and the low-temperature reliability should not be less than 50%. If the project is not an overlay the low-temperature reliability should be 90% or greater.

The basic binder grade, selected using LTPPBind, is adjusted for traffic volume and load rate according to Table 3, taken from the AASHTO Superpave Volumetric Mix Design specification, to determine the adjusted binder grade. These adjustments affect the high-temperature grade only.

Design ESALs,[b]		Adjustment to the High-Temperature Grade of the Binder[a]		
		Traffic Load Rate		
Daily	20-year ESALs (million)	Standing[c]	Slow[d]	Standard[e]
< 41	< 0.3	[f]	—	—
41 to <410	0.3 to <3	2	1	—
410 to <1370	3 to <10	2	1	—
1370 to <4100	10 to <30	2	1	[f]
≥ 4100	≥ 30	2	1	1

Table 3

[a] Increase the high-temperature grade by the number of grade equivalents indicated (one grade is equivalent to 6˚C).

[b] 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.

c Standing Traffic—where the average traffic speed is less than 20 km/h.

d Slow Traffic—where the average traffic speed ranges from 20 to 70 km/h.

e Standard Traffic—where the average traffic speed is greater than 70 km/h.

f Consideration should be given to increasing the high-temperature grade by one grade equivalent.

Often, we will want to insure we are specifying a polymer-modified binder. As a general guide, if the range between the high and low temperature grade is more than 90 degrees, polymer modification will be necessary to meet specification. For example, the range for a PG 64-28 is 64 + 28 = 92. This will be polymer modified.

MDT typically uses the PG binder grades shown in Table 4. The relative cost information is approximate and should be used as a general guide only.

Binder Grade	Approximate Relative Cost
PG 70-28	1.05
PG 64-28	1
PG 58-28	.75

Table 4

Consideration should be given to using a lesser grade of PG binder in lower lifts when 0.4 ft (120 mm) or more new PMS is required. Base this decision on the models within the LTPPBind software and discussion with district design and construction staff regarding the project sequencing and whether or not an actual savings will be realized.

Reclaimed Asphalt Pavement (RAP)

MDT's Standard Specifications allow the use of RAP in all mixes due to the potential cost savings for the Department from the reuse of both the aggregate and asphalt cement. Consideration should be given to making RAP generated during project construction available to the contractor for use on the project whenever possible. In order for this to happen, the contract will need to be structured to allow their use. Some considerations that should be evaluated by the design team are:

- Milling disposal.
  - Agreements with outside agencies should be structured to allow the contractor to use a portion of the RAP generated on the project if they choose to do so. The contractor is allowed to use up to roughly 30% by weight of millings in their new mix, so 30% of the plan quantity of plant mix should be made available to the contractor.
  - Consideration should be given to making the contractor responsible for disposal of the millings when a beneficial use hasn't been identified in accordance with MDT's current policy on disposal of millings. This is particularly true when the project is located within 20 miles of a permanent hot plant facility that is equipped to produce RAP mixes. The contractor may not be able to use them on the current project but once they have them, the Department will be able to realize savings on future projects.
- Project sequencing
  - The contractor will need adequate time to process the millings prior to use. Consider allowing as much time as possible between milling a surface and

repaving. Standard specifications require repaving within 48 hours. Before this requirement can be modified, consideration should be given to the following:

- The adequacy of the surfacing section remaining.
- The traffic levels and the makeup of the traffic.
- The tolerance of the travelling public for a milled surface at the location being considered.

Alternate Typical Sections

To reduce the possibility of Value Engineering proposals by contractors and account for bidding unknowns, MDT encourages the use of alternate typical sections.

Typical Sections Utilizing Geosynthetics

MDT normally specifies geosynthetics for the following reasons:

- Separation and stabilization of known or suspected problem areas on a project. In these situations, geotextiles are used as a separation layer between special borrow and the subgrade for constructability reasons, not to reduce the thickness of the typical section.
- Separation between the subgrade and gravel surfacing section. In these situations, geotextiles are used as a separation layer to prevent the contamination and long term weakening of the surfacing section through the migration of fines from the subgrade.
- Base course reduction through the use of geogrids and/or geosynthetics. MDT is in the early stages of a research project to determine whether or not the thickness of the typical section can be reduced by using geosynthetics. The report may be found at: http://www.mdt.state.mt.us/research/projects/grfp.shtml. If base course reduction through the use of geogrids or geosynthetics is planned for a project, it must be planned and monitored as an experimental project.

Closing

Anyone with surfacing related questions is encouraged to contact the Surfacing Design Unit.

Surfacing Design

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Nondestructive Testing (Falling Weight Deflectometer and Ground Penetrating Radar)

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General information is provided in this memo. It is based on both successes and failures on construction projects throughout the State over a long time. MDT wants engineered solutions to project specific issues and situations that don't fit these guidelines when they are encountered. Early coordination on designs that vary from these guidelines is critical for keeping the project design on schedule.

This information is intended to supplement the Pavement Design Manual. Please distribute this memo to all consultants involved in surfacing design.

Contact the Surfacing Design Unit at 406-444-7650 if you have any questions with respect to the updated guidance.

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