PM Revision Instructions:

(1) The shaded “insert” fields throughout this section require one mouse click only. **DO NOT double click**—if you do accidentally double click, click on the Cancel button of the window that opens and try again. The entire field will be highlighted and deleted as soon as you begin to type.

(2) To apply appropriate styles to new material, press Ctrl + Shift + Alt + S to open the styles task pane to the right of the document. A single click on a style in this task pane will apply the style to the paragraph where your cursor is located. It is not necessary to highlight the entire paragraph. Only the styles used in this file are listed in the task pane. FYI: “Emphasis” style is for applying italics to selected characters; “Strong” style is for applying bold to selected characters.

(3) Do not use the term “the Contractor shall.” Begin each applicable instruction with an action verb.

(4) Entering header information below will update headers throughout the file. If any of the coding is lost during revision, header information will have to be entered manually.

MnDOT Design-Build ProgramBook 2—[insert full name of project] Design-Build Project

Federal Project No. [insert #]S.P. [insert #]

# Pavements and Roadway Materials

## General

This Section 10 describes the requirements for pavements and Materials including investigations, Materials requirements, design requirements, and all other Work necessary to meet the requirements of the Project.

## Administrative Requirements

### Standards

In the event of a conflict between the standards set forth in Book 3 relating to roadway pavements and Materials, follow the order of precedence set forth below, unless otherwise specified:

PM: Review status of Special Provisions. See Book 3, Section 5 for how Special Provisions are to be modified. Modify Special Provision requirements in the appropriate location in this Section by adding pertinent requirements OR modify the specific Special Provision text in the Book 3, Section 5 Modifications to Special Provisions document.

* MnDOT Special Provisions
* MnDOT Technical Memoranda
* MnDOT *Standard Specifications for Construction*
* MnDOT *Pavement Design Manual*
* MnDOT *Geotechnical Manual*
* MnDOT *Laboratory Manual*
* MnDOT *Road Design Manual*
* MnDOT *Concrete Manual*
* MnDOT *Grading & Base Manual*
* MnDOT *Concrete Pavement Rehabilitation (CPR) Construction Details*
* MnDOT *Standard Plans Manual*
* MnDOT *Standard Plates Manual*
* AASHTO *Manual on Subsurface Investigations*
* AASHTO Laboratory Specifications
* FHWA Publications
* Subsurface Investigations—Geotechnical Site Characterization Reference Manual
* AASHTO Task Force 27 Report—In Situ Soil Improvement Techniques
* AASHTO Standards
* ASTM Standards
* Other standards set forth in Book 3

### Meeting Requirements

PM: Determine if any specific meetings are required. If none, change subheading to “Not Used.”

### Equipment/Software

PM: Determine any additional equipment/software needs. Examples include Instantel Blastmate III or equivalent for vibration monitoring, vibrating wire piezometer software—provide a performance requirement of the software.

MnDOT Soils Data Dictionary application to collect roadway boring information

Trimble Pathfinder Office to upload roadway boring information

Either Bentley Systems InSitu or GEOPAK Tech to download information

Trimble ProXR (or comparable Trimble GPS) data collector to collect roadway boring information, including Northing and Easting information and strata information

### Permits/Authorizations

PM: Determine if any permits or authorizations are required. Consider approval from local agency for pavement design? Others? If none, change subheading to “Not Used.”

## Design Requirements

### Investigations/Supplemental Work

#### Roadway Boring Requirements

PM: Review closely the approach to roadway boring requirements for the project. Ensure roadway borings are included as an Exhibit, if any have been completed by MnDOT. Other Geotech info is typically RID info. Modify this section as necessary to reflect approach. Previous projects required Contractor to obtain supplemental borings to comply with MnDOT Pavement and Geotech manuals. Language below does not require this, but it may or may not be applicable for all projects, depending on level of boring program conducted by MnDOT.

Consider how much the alignment is allowed to and might change and update the requirements of this section accordingly.

The Contractor is responsible for determining the number and type of soil borings and tests required to assess the soil conditions for pavements and roadway materials. Prepare and submit a Roadway Subsurface Investigation Plan prior to conducting supplemental subsurface investigations. Conduct supplemental subsurface investigations and subsequent geotechnical analysis and design necessary to:

* Supplement information provided in the Exhibits to this Section 10 as necessary for the design and construction of all Project roadways
* Otherwise support the design and construction of the Project

Obtain a sufficient number of tests and borings with sufficient depths to enable the preparation of the Materials Design Recommendation (MDR).

PM: Determine minimum depths of borings and update as needed.

Take borings to a depth of at least 10 feet below the proposed profile grade line in cut areas and at least 5 feet below natural ground in fill sections. Extend at least one boring in each fill section to a depth equal to the height of the proposed fill. If compressible materials are present, extend soil borings a minimum of 5 feet beyond the bottom of the compressible layer, or deeper as required, to adequately design stable embankments.

PM: Consider whether borings plotted on plan, profile and cross section views are required.

Submit electronic copies of all roadway boring final logs. Submit the Trimble Pathfinder output files (\*.SSF) with the Material Design Recommendation.

#### Field Testing and Sampling

Take at least two representative samples of each major soil type (textural class) encountered on the Project for laboratory testing and identification. Retain and make available to MnDOT companion samples of each major soil type until Final Acceptance.

#### Laboratory Testing

Perform laboratory soils tests of sufficient number and type to ascertain the nature, strength, conditions, stability, and consolidation characteristics of soil conditions existing at the Site that influence the proposed design and construction activities. Laboratory tests required are Atterberg limits, particle size (percent sand, silt, and clay), R value, organic content, and Proctor density.

Submit an electronic copy of completed lab test data to MnDOT.

### Reports and Plans

Prepare a Materials Design Recommendation that addresses all grading, base, and pavement features, including subcuts, removals, mainline pavement and shoulders, ramps, loops, local streets and roads, trails, and temporary pavement sections. Prepare recommendations for Project features that include but are not limited to muck excavations, subgrade excavations, embankment construction (including the need for special materials, controlled rate of fill, etc.), need for perforated pipe or dewatering, frost treatments, turf establishment, detention ponds, infiltration zones, and base and surfacing design.

Prepare the Materials Design Recommendation in accordance with and addressing all categories listed in Section 830 of the MnDOT *Pavement Design Manual* and this Section 10. In addition, address temporary and permanent dewatering and the potential impacts of dewatering on nearby structures, wells, springs, etc. Do not address foundation design recommendations in the Materials Design Recommendation, as those are addressed in the Foundation Analysis and Design Reports described in Section 8.

Submit an electronic copy of the Materials Design Recommendation. MnDOT will respond within five Working Days of receipt of the Materials Design Recommendation.

### Materials

#### Borrow Material

Provide MnDOT with documentation that the proposed materials for import to the Project (e.g., any Project borrow material) meet the following criteria:

1. Either of the following:
	1. Native (in-situ) or non-native soil from an import location with a current Phase I Environmental Site Assessment (less than 365 Days old) acceptable to MnDOT, or other such documentation Approved by MnDOT, which indicates no historic or current Recognized Environmental Conditions associated with the borrow source.
	2. Non-native soils from import locations with drilling investigations completed in accordance with investigation work plans in accordance with the MPCA Voluntary Investigation and Cleanup (VIC) program, if applicable, and/or Petroleum Brownfields Program (PBP) unless otherwise Approved by MnDOT. For soils from borrow locations with potential non-petroleum contaminant releases, be sure soil analytical data indicates concentrations less than the MPCA’s Residential Soil Reference Values (SRVs) and Tier 1 Soil Leaching Values (SLVs) for all potential contaminants of concern identified for the import source. Naturally occurring concentrations of some metals, such as arsenic, selenium, and copper, sometimes exceed the SRV or SLV. Such soils are not considered impacted in the absence of a contaminant source or other field or laboratory indications of contamination. Additionally, for soils from borrow locations with potential petroleum releases, ensure soil analytical data contains less than 100 mg/kg diesel range organics (DRO) and gasoline range organics (GRO).
2. Free from solid waste, debris, asbestos-containing material, visible staining, and chemical odor.
3. No organic vapors above background, as measured by a photoionization detector (PID).

In lieu of Items 1 or 2 above, provide analytical testing of the proposed borrow Materials based on the requirements below prior to import of any of the borrow Material into the Work. This requirement also applies to any dredged materials generated from waterways, stormwater ponds, etc., for this Project.

Prepare and submit for MnDOT Acceptance a work plan that details at a minimum where samples will be taken, what samples will be analyzed for, and how samples will be collected. Representative samples should be collected at the borrow area while the potential fill material is still in place, and analyzed prior to removal from the borrow area, or as Approved by MnDOT. When the analysis results and boring/test pit logs are available, MnDOT will review the submittal. MnDOT will not Approve imported soils to this Project that exhibit one or more of the following: evidence of visible staining, chemical odors, solid waste, debris, asbestos-containing material; organic vapors above background concentrations using a PID; DRO or GRO concentrations of greater than 100 mg/kg; or detections of any contaminants above Residential SRVs and Tier 1 SLVs or naturally occurring concentrations.

Gravel, crushed aggregate base, and fill Materials/soil sourced from commercial borrow facilities are exempted from this provision; however, the conditions set forth in 2105.2(B) still apply.

MnDOT will not accept import with any detectable concentrations of contaminants above naturally occurring for use on any properties.

Prepare and submit a subsurface investigation plan at least three Working Days before beginning supplementary roadway subsurface investigations.

#### Detention Ponds and Infiltration Zones

PM: Coordinate design criteria with Sections 4 and 12 as necessary. Also coordinate with Geotech to determine if a slope stability analysis will be required. Provide design criteria, with references to desired design methods/standards as appropriate: slope stability, settlement of fill sections, infiltration rates.

Provide geotechnical recommendations, including infiltration rates, for soils in infiltration zones. Perform analyses necessary to justify geotechnical recommendations for detention ponds and infiltration zones.

#### Retaining Walls

Provide backfill for retaining walls meeting the requirements of Standard Specification 3149.2B2 modified as follows: Not more than 10 percent, by weight, of the portion passing the 1-inch sieve is to pass the #200 sieve. Compact the backfill in accordance with Standard Specification 2105.3F1.

#### Non-Frost-Susceptible Material

Employ non-frost-susceptible Material that meets the requirements of Standard Specification 3138, Classes 3 through 6, and Standard Specification 3149, Select Granular Borrow, or Select Granular Borrow (Modified).

### Pavement Design

#### Pavement Design Requirements

PM: Update heading as required based on facilities where pavement design is provided. Add each roadway title and update pavement design for each. Consider adding a typical section if it is applicable and can be clearly interpreted by the Contractor and MnDOT. Consider whether alternative bid designs will be allowed. Review local agency standards and incorporate as applicable. For roundabouts—coordinate with Section 11 and ensure definition of limits of paving are clear.

Consider what you will and won’t allow – Bit vs. concrete vs. agg surfacing, safety edges, classes, modified materials, etc. Will you specify mix types? Granular equivalency? Minimum widths or exact? Coordinate with Section 8, 12, and 13 Leads for other requirements and considerations (edge drains? Reconstruct areas? Adjacent to structures?).

Provide pavement types and minimum thicknesses as shown in Table 10-1 and as identified on the Preliminary Design Drawings.

Table 10-1: Pavement Sections

| Location | Detailed Description | Pavement Layer Description | Minimum Thickness (inches) |
| --- | --- | --- | --- |
| **Mainline** |  | Non-Reinforced, Doweled ConcreteClass 6 aggregate baseSelect Granular Material (1)Granular Material (1)Type SP 12.5 Wearing Course (3, C) (SPWEB340C)Class 5 aggregate base[PM: Add additional descriptions as required, add additional locations as different pavement sections dictate] |  |
|  |  |
|  |  |
|  |  |
| **[Ramps]** |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| **Sidewalks** |  |  |  |
| **[Trails/shared-use paths]]** |  | Type SP 12.5 Wearing Course (3, C) (SPWEB340C) |  |
| **[Medians/islands]** |  |  |  |
| **[Maintenance crossovers]** |  |  |  |

PM: Provide any notes for pavement sections. Consider providing directions for drainage layer and continuities with existing drainage layers. Consider how proposed pavement will tie into existing pavements. Consider how the approach and departure pavement for roundabouts tie in to existing pavement. How far should concrete pavement extend past approach and departure points? Ask MnDOT materials if design alternates for pavement types can be considered.

Add note for overlay sections where cross slope corrections are required. Provide additional overlay thickness as necessary for required cross slope correction.

Add notes regarding rumble strip requirements, which roads, and what type

NOTES:

1. Extend material layers to the slope and cover with 6 inches of top soil.
2. Provide Select Granular Borrow for the full width of the embankment to the in-slope on the median side to facilitate future expansion.

#### Local Roadways and Standards

PM: Verify construction/repair requirements for all adjacent roadways.

When roadways and driveways adjacent to and crossing the Project are disturbed by construction activities, match the in-place surface type and structure of the existing roadways or driveways, unless otherwise specified. Avoid differential settlement for all pavement tie-ins and account for total surfacing thickness, minimum structural requirements, unbound base/subbase thickness, frost-free characteristics, and other appropriate factors.

#### Concrete Mix Design Options

Produce concrete mix designs following mix design procedures stated in DBS-2301.1, as required for the type of concrete used.

## Construction Requirements

### General

Compact all fill Material in accordance with the Contract Documents when the Material is placed, regardless if it is above grading subgrade, finished grade, or otherwise above the final design location.

Ensure that the depth of all gutter pans adjacent to concrete pavement matches the thickness of the adjacent concrete pavement.

#### Concrete

PM: Provide following: joint spacing and skew, sealant presence and type, dowel bar type and size, tie bar size. Talk to MnDOT concrete office to determine what most current specifications for joints and other materials are.

Suggest relying on standard plans, but discuss with Concrete Office/Materials/etc. Provide discussion of what part of Standard Specification 2301 and DBS 2301.1.1 do not apply or areas that are required to be more stringent– often the incentive and disincentive does not apply as shown by example below.

Follow the requirement(s) below for Portland cement concrete pavement:

Provide concrete meeting the most current Standard Specification 2301 Concrete Pavement requirements.

Construct either the L1TU or L2KTU joint for all longitudinal joints for concrete pavement. If two lanes are paved concurrently, use the L1TU joint between those two lanes. If lanes are paved one at a time, use L2KTU joints for all longitudinal joints.

#### Bituminous

Provide tack coat between all bituminous layers and prior to placing any bituminous mixtures on existing pavement in accordance with Standard Specification 2357.

Use joint adhesive on longitudinal construction joints in accordance with Special Provision 2331 Pavement Joint Adhesive.

PM: Add additional requirements, as needed.

### Supplemental Reinforcement Over Culverts, Storm Sewers, and Water Mains

PM: Provide any information that would differ from Standard Plate 1070M.

In concrete roadways, provide reinforced panels over culverts, storm sewers, and water mains in accordance with MnDOT Standard Plates and the following requirements.

Achieve placement depth of reinforcement of t/2 +/-1 inch, where *t* = concrete thickness.

### Utility Requirements

PM: Provide special utility requirements. Verify requirements with appropriate utility stakeholders. If none, retain subheading and enter “Not Used.”

### Settlement Criteria

PM: Provide exhibit or project-specific criteria for allowable short- and long-term settlement. Determine if Specification 2105 or 2106 applies.

Construct roadway embankment fill placed under this Contract meeting the requirements of Standard Specification 2106 (Excavation and Embankment).

Ensure that differential settlement across approach slabs constructed by the Contractor do not exceed 0.25 inch in 25 feet, observed at any time up to Substantial Completion. Implement ground improvement techniques described later in this Section to the approach embankment subgrade if necessary to meet this requirement.

### Pavement Section Drainage

PM: Coordinate design criteria with Section 12 and Section 8 and update as required. Add requirements for subsurface drainage, including median and shoulder drains. Drainage layer? Subdrains? Consider how subsurface drainage outlets.

Provide pavement section drainage that meets the requirements of Section 12 and the following:

* The bottom of the drainage layer daylights [##] feet above the bottom of the ditch
* Subsurface drains outlet 0.5 foot above the flowline of the ditch
* Subdrains are placed 1 foot above the normal high-water level of the water table
* Existing Topsoil and Slope Dressing

PM: Review project MDR with Materials Office whether Test Rolling (2111) is to be required. Provide project requirements.

Strip all existing topsoil and slope dressing in areas to be disturbed by construction and reuse as slope dressing. Provide Select Grading Material or common borrow for all new embankment and embankment-widening Material.

### Materials for Widened Sections

In any proposed widening construction, match the existing soil in the upper 5 feet of roadways to be widened with soil of a similar class, color, moisture content and performance characteristics. Do not place granular backfill adjacent to existing non-granular soils.

### Tapers and Transitions

PM: Verify taper requirements. Update as needed. Determine if trench boxes will be allowed on this project. If not allowed, indicate below.

In any case where granular embankments or backfill join non-granular soil embankments or backfill, provide a 1:20 (V:H) transition between the change in Material to prevent an abrupt soils differential. Construct the 1:20 (V:H) transition such that the granular backfill Material overlays the adjacent non-granular soil backfill.

Trench boxes are not allowed.

PM: Verify pavement taper requirements. Update as needed.

When connecting new surfacing adjacent to any existing pavements to be widened, cut vertically to the bottom of the existing surfacing or to the bottom of the new surfacing design, whichever is deeper, then at a 2:1 (V:H) slope to the bottom of the recommended subgrade excavation.

PM: Verify pavement taper requirements. Update as needed.

When connecting to existing roadways at the termini of proposed construction, cut vertically to the bottom of the existing surfacing or to the bottom of the new surfacing design, whichever is deeper, then at a 1:20 (V:H) taper to the bottom of the recommended subgrade excavation. Where matching in-place crossroads, cut vertically to the bottom of the in-place surfacing, then at a 1:4 (V:H) slope to the bottom of the recommended subgrade excavation.

Provide for 1:20 (V:H) tapers when changing subcut depths.

Provide for 1:20 (V:H) tapers when changing subgrade Materials.

Provide a saw cut where placing new pavement next to in-place pavement to ensure a uniform joint.

Perform test rolling on the bottom of subcuts and the top of the grading subgrades.

Maximum bituminous lift thickness is 2 inches for wearing courses and 3 inches for non-wearing courses. For trails, maximum bituminous lift thickness is 3 inches.

The embankment must be constructed in accordance with Standard Specification 2106. Use backfill behind abutment walls for bridges and retaining walls that consists of Modified Select Granular Borrow meeting the gradation requirements in Standard Specification 3149.2B4, modified so that 10 percent or less passes the #200 sieve. For placement and compaction of the backfill comply with Standard Specification 2451.3D.

### Ground Improvement Methods

MnDOT will allow a reduced depth of non-frost susceptible material (as defined in Section 10.3.3.4) for designs incorporating lightweight fill for concrete pavement systems on mainline or ramps. Pavement surfacing, aggregate base, and select granular thickness may not be reduced. Where expanded polystyrene (geofoam) or foamed lightweight concrete is used, the following requirements apply:

PM: Update with any project specific requirements. Also check DBSB reference below per previous prompt regarding special provisions.

In lieu of the required depth of granular subbase material required in Table 10‑1 (2 feet of Select Granular and 2 feet of Granular borrow), the pavement system may be designed with 3.5 feet of total pavement structure, including pavement surfacing, and non-frost susceptible material over expanded polystyrene geofoam or foamed lightweight concrete.

Where geofoam is used, cover the expanded polystyrene geofoam on the top and sides with a geomembrane per DBSB 3734. Slope the top of geofoam and install the geomembrane drain. Weld geomembrane seams in the field. See Exhibit 10-B for additional requirements.

### Muck Excavation

PM to determine requirements and update as necessary.

If obtaining soil conditions is difficult due to site restrictions, consider a depth of unsuitable material excavation beyond which the Contractor will be entitled to a Change Order (See TH 371 for example).

Excavate all muck, organic deposits, or other unsuitable material from beneath roadway structures and embankments unless utilizing one of the other ground improvement techniques allowed in Section 8.3.3.3. Excavate to the limits indicated by Section 320.3.A.1 of the Pavement Design Manual. In this section, interpret the word “should” to mean “must” in all instances. Disregard the word “about” and the phrase “as a guide”.

### Materials/Testing Requirements

#### Field Testing and Sampling

Take at least two representative samples of each major soil type (textural class) encountered on the Project for laboratory testing and identification. Retain and make available to MnDOT companion samples of each major soil type until Final Acceptance.

#### Laboratory Testing

Perform laboratory soils tests of sufficient number and type to ascertain the nature, strength, conditions, stability, and consolidation characteristics of soil conditions existing at the Site that influence the proposed design and construction activities. Laboratory tests required are Atterberg limits, particle size (percent sand, silt, and clay), R value, organic content, and Proctor density.

Submit an electronic copy of completed lab test data to MnDOT

## Deliverables

Table 10-2, which lists Deliverables identified in this Section 10, is not intended to be exhaustive. It is Contractor’s responsibility to determine and submit all Deliverables, as required by the Contract.

PM: Review list of deliverables for applicability to each project. MDR may not be needed if MnDOT has already prepared one. If deliverables are deleted here, delete in above text.

Table 10-2: Nonexhaustive List of Deliverables

| Name | Acceptance or Approval | Section Reference |
| --- | --- | --- |
| Roadway Subsurface Investigation Plan | Acceptance | 10.3.1.1 |
| Roadway Borings | Acceptance | 10.3.1.1 |
| Roadway Boring Final Logs | Acceptance | 10.3.1.1 |
| Trimble Pathfinder output files | Acceptance | 10.3.1.1 |
| Laboratory Testing Data | Acceptance | 10.3.1.3& 10.4.10.2 |
| Materials Design Recommendation | Acceptance | 10.3.2 |

EXHIBITS

PM: These exhibits are auto-numbered. To add a new exhibit, copy and paste one of the exhibit titles below and rename accordingly. The rest will renumber and the cross references in the text will also renumber. To update all fields in the document, press Ctrl + A to highlight the entire document and then press the F9 function key.

All exhibits are provided as electronic files.

Exhibit 10-A Roadway Boring Logs

Exhibit 10-B Geofoam Block Lightweight Fill

Exhibit 10-C Roadway Boring Methods (also attached)

EXHIBIT 10-C Roadway Boring Methods

Collect soil boring information using Trimble GPS and the MnDOT Soils Data Dictionary. The Soils Data Dictionary is an application that is used to collect soils strata information using a Trimble ProXR (or comparable Trimble GPS) data collector. Abbreviations for soils terms, as defined in Table 220.3 of the MnDOT Pavement Design Manual, are built into the Soils Data Dictionary. Electronic templates for the boring log program are available on the MnDOT website at: [http://www.mrr.dot.state.mn.us/‌geotechnical/‌foundations/tcontract.asp](http://www.mrr.dot.state.mn.us/geotechnical/foundations/tcontract.asp).

Solid Stem Auger

Take soil borings in accordance with Section 220 of the MnDOT Pavement Design Manual; ensure the borings have a minimum diameter of 3.75 inches.

“Pull dead” soil borings taken in saturated, organic, or thin layered soils instead of being augered to the surface. The augered method is acceptable in most other situations. However, bring no more than 2.5 feet of material to the surface at one time.

For borings deeper than 25 feet, conduct hollow stem auger borings in accordance with the MnDOT Geotechnical Manual.

Rock

If evidence of bedrock or auger refusal is found in any roadway boring, take additional borings or soundings in the immediate area to determine the cause of refusal.

Where evidence suggests that buried bedrock lies above the proposed grade line, take additional borings. For roadway borings in rock extend borings to a depth of 5 feet below the top of the proposed pavement. Base the number of borings on anticipated rock variability and length of cut. On side-hill cuts, take additional borings on the uphill side to reflect maximum rock cut and possible groundwater problems. Show rock outcrops on the profile and cross-section sheets.

Muck

PM: Consider whether a minimum boring requirement should be included or whether the Geotechnical Manual is sufficient for the project needs.

Determine the depth and limits of the required excavation using borings; in areas where muck is known or suspected to exist take a boring a minimum of every 50’ along each alignment. Provide borings along the cross-section in accordance with section 220.2.D.1 “Swamp areas” of the MnDOT Pavement Design Manual.

Plot all muck soundings, borings, and water elevations on a layout and properly identify on the soils profile and cross-sections. Extend all borings through unstable material to a point 10 feet into firm mineral soil. Where the muck section has a sloping bottom or the location alignment encounters the muck area at a point where the roadbed would be partially on unstable foundation materials and partially on higher, more stable ground, take additional soil borings.

Existing Pavements

Take core borings or use another approved method on existing pavements to verify the thicknesses of existing areas of paved surface (i.e., roadway shoulders) to be used to carry traffic during construction. Record thicknesses of bound surfacing and aggregate base. Take cores in all pavement areas where it can be reasonably ascertained that a change in material type or thickness exists