Wisconsin Department of Transportation

2020 Materials Training Concrete Updates

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2020 CONCRETE UPDATES
Optimized Aggregate Gradation and Mixtures

- **Currently a WisDOT STSP**
  - **Should be inserted into all contracts that require slip-form paving.**
- **2019 Construction**
  - **Positive feedback from contractors that used it.**
  - **Good results when reduced cementitious of 520 lbs/c.y. was used. Didn't seem to affect opening strengths.**
  - **A new spreadsheet has been developed for use.**
- **The future of OAG**
  - **<u>Pavements:</u> Remaining as a STSP for 2020 Construction. Moving towards std specification, possibly as early as 2021.**
  - **<u>Structures:</u> BTS is considering applying the shadow specification to structures also. More discussion needed.**

2020 CONCRETE UPDATES
Flexural Strength Beams

- Used on some interstate and large projects in 2019.
- SPV available for use and recommended on projects:
  - With gravel aggregate sources.
  - ≥ 20,000 s.y of slip-formed pavement on an Interstate or USH.
- <u>Contact BTS to discuss prior to including on a project.</u>
- Statewide implementation:
  - No date set for full implementation.
  - All the equipment for the regions has been purchased and received. Shipments pending…

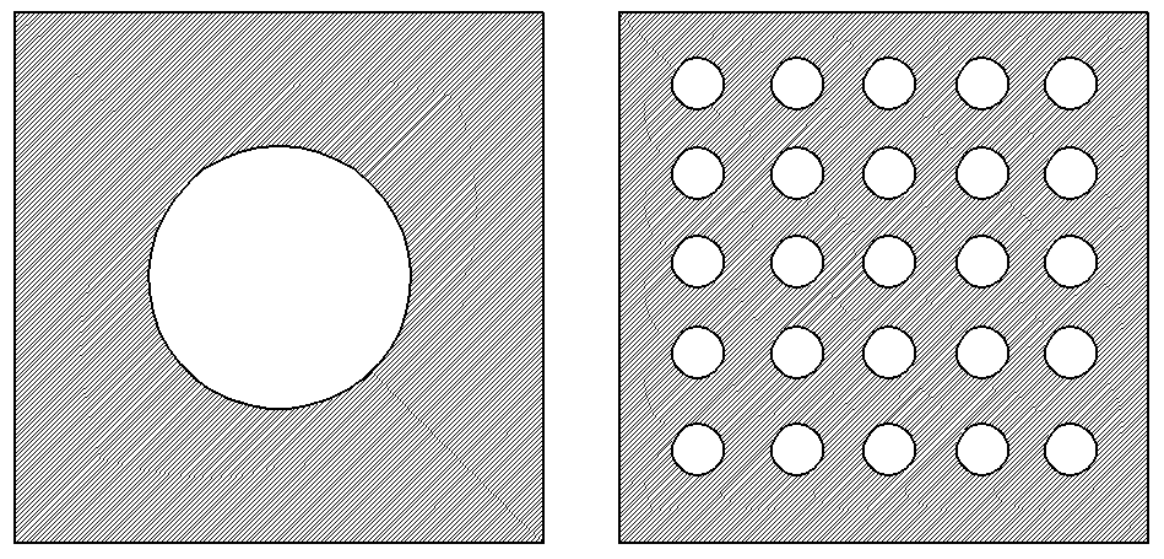
2020 CONCRETE UPDATES
MIT-SCAN-Dowel Scanning

- **Dowel Bar Scanning**
  - **New device purchased in spring of 2019**
  - **5 Projects were scanned this season.**
  - ***Results were shared with the industry.***
  - **1 project had significant nonconformance placement.**
  - ***BTS and Industry are working jointly on new specifications for dowel bar placement and how to handle non-conformance dowel bar placement.***

Super Air Meter (SAM)

Super Air Meter (SAM)

- **Air-entrained bubbles are a key to freeze-thaw resistance in concrete. *DURABILITY***
- **Small air bubbles are more effective than large bubbles.**
- **Has the ability to measure the air volume and distribution of the air.**



2020 CONCRETE UPDATES
SAM – Super Air Meter

- **WHRP Phase 1, project 0092-17-07, is complete.**
  - **https://wisconsindot.gov/Pages/about-wisdot/research/rigid-pave.aspx**
  - **Phase II - Pending**

WHRP
Wisconsin Highway Research Program

Evaluation of Current Wisconsin Mixes Using Performance Engineered Mixture (PEM) Testing Protocols

Project 0092-17-07

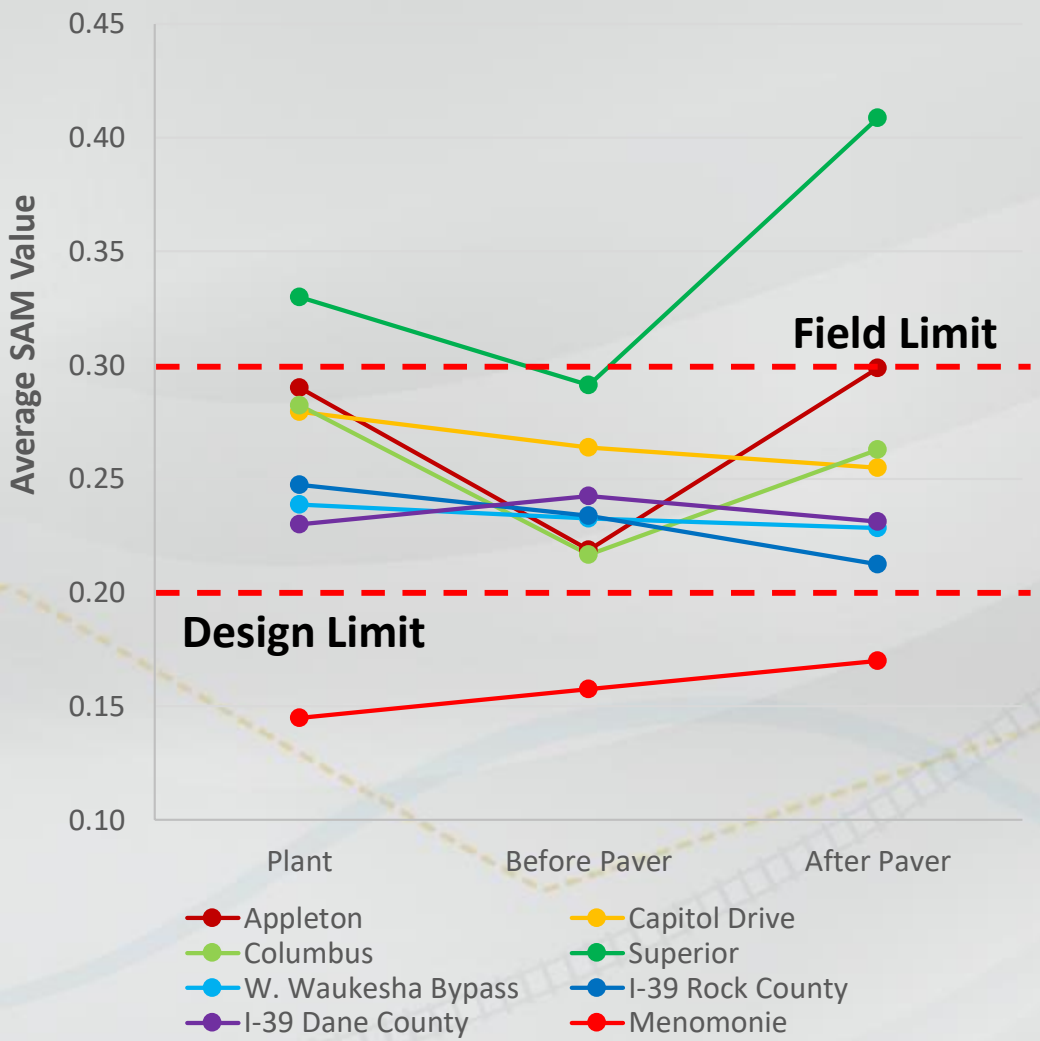
Close Out Presentation
October 28, 2019

Project Location Overview

1. West Waukesha Bypass
2. Appleton- Oneida St.
3. City of Superior USH 2
4. City of Columbus
5. Waukesha- Capitol Drive
6. I-39 Rock County
7. I-39 Dane County
8. I-94 Menomonie

SAM

Durability: SAM



- If SAM < 0.30 at the plant
  - then minimal change of SAM Number after the paver.
- If SAM > 0.30
  - then significant change in SAM Number after the paver.
- Observed air loss did not decrease the quality of the air void system when the SAM Numbers were < 0.30.

2020 CONCRETE UPDATES
SAM – Super Air Meter

- **Acceptance Specifications**
  - **Draft Specs:**
    - **≤0.2 – Accept (72%)**
    - **>0.2 to ≤0.25 – Corrective action. (19.4%)**
    - **>0.25 to ≤0.3 – Remain in place, consider price reduction.**
    - **>0.3 – Remove and Replace.**
    - **A minimum of 4% air would also be required.**

2020 CONCRETE UPDATES
SAM – Super Air Meter

- Shadow specification
  - Pavements:
    - 2019/2020 – Std Spec
  - Structures:
    - 2020 – Added via December 2019 ASP6

2020 CONCRETE UPDATES
SAM – Super Air Meter

715.3 Testing and Acceptance

715.3.1 Class I Concrete Testing

715.3.1.1 General

(1) Provide slump, air content, concrete temperature and compressive strength test results as specified in 710.5. Provide a battery of QC tests, consisting of results for each specified property, using a single sample randomly located within each sublot. If a sublot random test location falls within a mainline pavement gap, relocate the test to a different location within the sublot. Cast three cylinders for strength evaluation.

Revise 715.3.1.1(2) to extend field SAM testing for all class I concrete including structures and concrete barrier.

(2) Test the air void system conforming to AASHTO provisional standard TP118 at least once per lot and enter the SAM number in the MRS for information only. SAM testing is not required for the following:

- For lots with less than 4 sublots.
- High early strength (HES) concrete.
- Special high early strength (SHES) concrete.
- Concrete placed under the following bid items:
  - Concrete Pavement Approach Slab
  - Concrete Masonry Culverts
  - Concrete Masonry Retaining Walls
  - Steel Grid Floor Concrete Filled
  - Crash Cushions Permanent
  - Crash Cushions Permanent Low Maintenance
  - Crash Cushions Temporary

2020 CONCRETE UPDATES
SAM – Super Air Meter

Effective with December 2019 Letting **ASP-6**

715.3.1.1 General

Replace paragraph two with the following effective with the December 2019 letting:

(2) Test the air void system at least once per lot and enter the SAM number in the MRS for information only. SAM testing is not required for the following:

- For lots with less than 4 sublots.
- High early strength (HES) concrete.
- Special high early strength (SHES) concrete.
- Concrete placed under the following bid items:
  - Concrete Pavement Approach Slab
  - Concrete Masonry Culverts
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2020 CONCRETE SPEC UPDATES

- **501.3.8.2.1(2) – Hot Weather Concreting**
  - **Barrier Wall Items added to list.**

501.3.8.2 Hot Weather Concreting

501.3.8.2.1 General

(1) The contractor is responsible for the quality of the concrete placed in hot weather. For concrete placed under the bid items enumerated in 501.3.8.2.1(2), submit a written temperature control plan at or before the pre-pour meeting. In that plan, outline the actions the contractor will take to control concrete temperature if the concrete temperature at the point of placement exceeds 80 F. Do not place concrete under these bid items without the engineer's written acceptance of that temperature control plan. Perform the work as outlined in the temperature control plan.

Revise 501.3.8.2.1(2) to include hot weather placement provisions for permanent concrete barrier bid items. This change was implemented in ASP 6 effective with the April 2019 letting.

(2) If the concrete temperature at the point of placement exceeds 90 F, do not place concrete under the following structure and concrete barrier bid items:

Concrete Masonry Bridges	Concrete Masonry Retaining Walls
Concrete Masonry Bridges HES	Concrete Masonry Retaining Walls HES
Concrete Masonry Culverts	Concrete Masonry Endwalls
Concrete Masonry Culverts HES	Concrete Masonry Overlay Decks
Concrete Barrier Single-Faced 32-Inch	Concrete Barrier (type)
Concrete Barrier Double-Faced 32-Inch	Concrete Barrier Fixed Object Protection (type)
Concrete Barrier Transition Section 32-Inch	Concrete Barrier Transition (type)

2020 CONCRETE SPEC UPDATES

- **603.2 – Cast-in-place Barrier**
  - **Moved to a Class 1 concrete requiring QMP testing.**

Section 603 Concrete Barrier

603.1 Description

(1) This section describes providing permanent and temporary concrete barrier and transitions.

603.2 Materials

(1) Furnish materials conforming to the following:

Joint filler 415.2.3
Steel rail, cap rail, and fittings 614.2
Delineator brackets and delineator reflectors 633.2

Revise 603.2 to specify class I barrier concrete for cast-in-place concrete barrier allow ACI 355.4 adhesive.

(2) Furnish grade A, A2, A-FA, A-S, A-T, A-IL, A-IS, A-IP, or A-IT air-entrained concrete conforming to 501. For cast-in-place barrier, conform to class I barrier concrete requirements and provide QMP as specified in 715.

- **650.1 – Automated Machine Guidance added.**

Section 650 Construction Staking

Revise 650 to implement AMG alternates for all or part of work done under the contractor staking bid items. This change was implemented in ASP 6 effective with the December 2018 letting.

650.1 Description

(1) This section describes the contractor-performed construction staking, or automated machine guidance (AMG) methods, required under individual contract bid items to establish the horizontal and vertical position for the following:

Storm sewer	Subgrade	Base
Curb, gutter, and curb & gutter	Pipe culverts	Structure layout
Concrete pavement	Concrete barrier	Resurfacing reference
Electrical installations	Supplemental Control	Slope Stakes
Curb Ramps		

650.2 (Vacant)

650.3 Construction

650.3.1 General

(1) Department and contractor responsibilities for construction staking are specified in 105.6. Conform to 105.6 and the additional requirements specified here in 650.3 for the individual contractor-staking bid items the contract includes.

(2) Protect and preserve known property and survey marks and land monuments as specified in 107.11.3. The contract may require related work under the 621 bid items.

(3) Obtain or calculate benchmark data, grades, and alignment from plan information. The engineer will furnish data for the horizontal and vertical control points, control point ties, horizontal alignments, profiles, and elevations. Reestablish, set additional, and maintain the horizontal and vertical control points and control point ties, as needed for bid items.

(4) Check horizontal and vertical information including but not limited to alignments, locations, elevations, and dimensions, that either the plans show or the engineer provides, for compatibility with existing field conditions. Conduct similar compatibility checks and accuracy checks of horizontal and vertical positions either the department or the contractor establishes in the field.

(5) Perform survey work using conventional methods or AMG methods capable of achieving the lines and grades the plans show for the work in question. Establish additional benchmarks and control points as necessary to support the method of operation.

650.3.1.1 Staking

(1) Furnish, set, reference, and maintain stakes and markings necessary to establish the alignment, location, benchmarks, elevations, and continuous profile-grades for road and structure work as needed for bid items. Supervise and coordinate construction staking.

(2) Maintain neat, orderly, and complete survey notes, drawings, and computations used in establishing the lines and grades. Make the survey notes and computations available to the engineer within 24 hours, upon request, as the work progresses.

(3) Furnish surveying equipment, stakes, flags, pins, lath, whiskers, and other materials necessary to perform this work, subject to the engineer's approval.

650.3.1.2 Automated Machine Guidance

650.3.1.2.1 General

(1) The contractor may substitute AMG for conventional staking on all or part of the work under the individual staking bid items. Coordinate with the engineer throughout the course of construction to ensure that work performed using AMG conforms to the contract tolerances and that the methods employed conform to the contractor's AMG work plan and accepted industry standards. Revert to conventional staking methods for all or part of the work at any point during construction if AMG is producing unacceptable results.

650.3.1.2.2 AMG Work Plan

(1) Submit a comprehensive written AMG work plan for department review at least 5 business days before the preconstruction conference. In that plan discuss how AMG technology will be integrated into other technologies employed on the project. List the staking bid items that will have work performed using AMG and, for each bid item listed, include the following:

1. Designate which portions of the contract will be done using AMG and which portions will be done using conventional staking.

2. Designate a single staff person as the primary contact for AMG technology issues.
3. List and map the primary and secondary control points required under 105.6.2 enveloping the site.
4. Describe the contractor's quality control procedures. Include the frequency and type of checks performed to ensure that the work conforms to the contract plans.

(2) The engineer will review the plan to determine if it conforms to the contract. Do not perform AMG work until the engineer approves the governing portion of the AMG workplan. Perform the work as the contractor's AMG work plan provides. Update the plan as necessary.

650.3.1.2.3 Geometric and Surface Information

650.3.1.2.3.1 Department Responsibilities

(1) At any time after the contract is awarded the contractor may request the contractor data packet. The department will provide the packet within 5 business days of receiving the contractor's request.

650.3.1.2.3.2 Contractor Responsibilities

(1) Develop and maintain a contractor construction model for areas of the project employing AMG. Confirm that the resulting model agrees with the contract plans.

(2) If the engineer requests, provide the construction model to the department in LandXML or other engineer-approved format.

650.3.1.2.4 Managing and Updating Information

(1) Notify the department of any errors or discrepancies in department-provided information. The department will determine what revisions may be required. The department will revise the contract plans, if necessary, to address errors or discrepancies that the contractor identifies. The department will provide the best available information related to those contract plan revisions.

(2) Revise the construction model as required to support construction operations and to reflect any contract plan revisions the department makes. Perform checks to confirm that the revised construction model agrees with the contract plan revisions. If the engineer requests, provide construction model updates to the engineer. The department will pay for costs incurred to incorporate contract plan revisions as extra work.

650.3.1.2.5 Construction Checks

(1) Check the work against the plan elevation at randomly selected points on cross-sections located at stations evenly divisible by 100 at the frequency the engineer approved as a part of the AMG work plan. Submit the results of these random checks to the engineer daily. Notify the engineer immediately if a check exceeds the tolerances specified in 650.3.1.2.6 below.

(2) Check the work at additional points as the engineer directs. The department may conduct periodic independent checks.

650.3.1.2.6 Construction Tolerances

(1) Ensure that the finished work vertically matches existing or other completed features. Ensure that the work conforms to revised plan elevations as follows:

- Subgrade : +/- 0.10 feet.
- Base : within the tolerance specified in 301.3.4.1(2).

650.3.2 Storm Sewer Staking

(1) Set and maintain construction stakes or marks as necessary to achieve the required accuracy and to support the method of operations. Locate pipe, inlet, catch basin, manhole, and endwall construction stakes to within 0.02 feet horizontally and establish the elevations to within 0.01 feet vertically. Determine that the final elevations of storm sewer pipe outfalls and inlets match the existing field elevations, and provide this information to the engineer at a mutually agreed upon date or least 14 calendar days before ordering inlets, catch basins, manholes, endwalls, and storm sewer pipe.

650.3.3 Subgrade Staking

(1) Set construction stakes or marks at intervals of 100 feet, or more frequently, for rural sections and at intervals of 50 feet, or more frequently, for urban sections. Include additional stakes at each cross-section as necessary to match the plan cross-section, achieve the required accuracy, and to support construction operations. Also set and maintain stakes as necessary to establish the horizontal and vertical positions of intersecting road radii, auxiliary lanes, horizontal and vertical curves, and curve transitions. Locate stakes to within 0.25 feet horizontally and establish the grade elevation to within 0.03 feet vertically.

2020 CONCRETE SPEC UPDATES
Part 7 - QMP

- **Section 715 – Concrete Pavement and Structures**
  - **Cast-in-place concrete barrier added.**
    - **Small qty defined for barrier wall. < 150 c.y.**
    - **Lot size: Max 1,000 c.y., divided into sublots of 100 c.y.**
    - **Testing: Added to Pavement section. (Paving contractor typically suppling the concrete.)**
    - **Acceptance: Added to structure section. Tighter PWL specifications and higher strength because it's a safety item.**
  - **715.2.1(5) – SAM testing added for structures.**

2020 CONCRETE SPEC UPDATES Part 7 - QMP

- **Quality Verification Testing – SAM**
  - **701.3.3.2(3) – The department will conduct a minimum of 1 verification test for each 5 contractor QC tests unless specific QMP provisions specify otherwise.**
  - **2018/2019 – Resource issues.**
  - **2020 – 1 in 5**
  - **Wis.DOT currently owns 14 SAM's, distributed out to regions.**

Questions

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