THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

15038.01 DESCRIPTION.

A. This specification identifies a concrete mixture design with an optimum combined aggregate gradation, and the Contractor’s testing and quality control responsibilities. Optimization of the aggregates should produce concrete with low water requirement as well as improved workability and finishing characteristics. While concrete strength is important and is measured, it is not the basis for optimization of the concrete mixture design.

B. Testing and quality control apply to all Contractor produced concrete using the Concrete Design Mixture (CDM). The CDM applies to mainline slip form pavement. At the Contractor’s option, the CDM may apply to any other slip form paving.

15038.02 MATERIALS.

For all materials, meet the quality requirements for the respective items in Division 41 of the Standard Specifications. Compatibility of all material combinations is the Contractor’s responsibility based on acquired field experience with proposed materials.

15038.03 LABORATORY CONCRETE DESIGN MIXTURE.

A. An Iowa DOT PCC Level III Certified Technician is responsible for the development of the CDM. Develop a CDM based on a unit volume of 1.000 according to industry standard practice, and containing proportions of materials, including admixtures. Base the proportions upon saturated surface dry aggregates to produce a workable concrete mixture meeting the constraints of Table DS-15038.03-1:

| Table DS-15038.03-1: Concrete Mixture Constraints |
|-----------------------------------------------|--|
| Nominal Maximum Coarse Aggregate Size | Greater than or equal to 1 inch |
| Gradation | Materials I.M. 532 |
| Cementitious Content | Minimum, 560 pounds per cubic yard* |
| Fly Ash Substitution Rate | See Article 2301.02, B, 6 |
| Water/Cementitious Ratio | Maximum, 0.45 0.42 |
| Air Content | 6% ± 1%, Design Absolute Volume = 0.060 |
| 28 Day Flexural Strength, Third Point | Minimum, 640 pounds per square inch |
* The minimum cement content assumes the use of Type I/II cement with a specific gravity of 3.14 for an absolute volume of 0.106. If cement other than Type I/II is used, use an absolute volume of 0.106 and determine the weight of cement from the specific gravity of the cement. Cement content may need to be increased to maintain the water to cementitious ratio during hot weather conditions.

B. Use normal production gradations to determine the relative percentage of each individual aggregate used in the CDM. Select the relative percentage of each individual aggregate to produce the desired combined aggregate gradation using the following sieves: 1.5 inch, 1 inch, 0.75 inch, 0.5 inch, 0.375 inch, No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, and No. 200.

C. Develop a target combined gradation in Zone II for each CDM based on normal production gradations and the relative percentages of each individual aggregate. Submit Form 955QMC to aggregate producer(s) to ensure individual gradations used are acceptable. Limit the percent passing the No. 200 sieve to no more than 1.5% for the combined aggregate gradation. When the coarse aggregate used meets the increase in percent passing the No. 200 sieve, according to Section 4109, Aggregate Gradation Table, Note 10 of the Standard Specifications, limit the percent passing the No. 200 sieve to no more than 2.0% for the combined aggregate gradation.

D. Comply with AASHTO T 126 for laboratory development of the CDM. Mix designs may be conducted in a ready mix or central mix batch plant provided the following conditions are met:
- All non-mix design materials are emptied,
- Mix design materials are used, and
- Batch size is at least 3 cubic yards.

E. An Iowa DOT PCC Level III Certified Technician is required to oversee the development of the CDM. Allow the Engineer to witness the development of the CDM. Provide notice 7 calendar days prior to this event. Perform the tests in Table DS-15038.03-2 in the development of the CDM:

Table DS-15038.03-2: Tests for CDM

<table>
<thead>
<tr>
<th>Test</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity of Each Individual Aggregate</td>
<td>Materials I.M. 307</td>
</tr>
<tr>
<td>Gradation of Each Individual Aggregate</td>
<td>Materials I.M. 302</td>
</tr>
<tr>
<td>Unit Weight of Plastic Concrete</td>
<td>AASHTO T 121</td>
</tr>
<tr>
<td>Air Content of Plastic Concrete</td>
<td>Materials I.M. 318</td>
</tr>
<tr>
<td>28-Day Flexural Strength</td>
<td>AASHTO T 97</td>
</tr>
<tr>
<td>Temperature of Plastic Concrete</td>
<td>ASTM C 1064</td>
</tr>
</tbody>
</table>

15038.04 MIX DESIGN DOCUMENTATION.

A. At least 7 calendar days prior to the start of paving, submit a CDM report to the District Materials Engineer for approval on Iowa DOT form. Contract extensions will not be allowed due to inadequate or additional CDMs. In the CDM report include the information shown in Table DS-15038.04-1:

Table DS-15038.04-1: Items to Include in CDM Report

<table>
<thead>
<tr>
<th>Category</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Page</td>
<td>Contractor name, Project number, Date and location of CDM laboratory development, Date Submitted, Signature of Contractor representative</td>
</tr>
<tr>
<td>Material Source Information</td>
<td>Brand, Type, Source</td>
</tr>
</tbody>
</table>
The District Materials Engineer may approve the mix design without laboratory mixture testing if
the proposed mix design proportions fall within Zone II-A of Materials I.M. 532. If the mix design is
approved without laboratory testing, cast a set of three beams on the first day of paving from
concrete meeting the mix design criteria. Test the beams for 28 day flexural strength, third point
loading. When the coarse aggregate for the mix design is quartzite, cast an additional set of three
beams, and test at 90 days. Submit the strength results to the Engineer.

15038.05 QUALITY CONTROL.

A. General.

1. The Contractor is responsible for quality control of the concrete. An Iowa DOT PCC Level II
Certified Technician is required to oversee quality control operations. The individual
conducting the testing on grade is required to be an Iowa DOT PCC Level I Certified
Technician. Calibrate and correlate testing equipment prior to and during paving operations.

2. At least 7 calendar days prior to the preconstruction conference, submit to the Engineer a
Quality Control Plan complying with Materials I.M. 530. Include the proposed mix design(s)
with the Quality Control Plan. Do not begin paving until the plan is reviewed for compliance
with the contract documents. Maintain equipment and qualified personnel to direct and
perform all field quality control sampling and testing necessary to:
- Determine the various properties of the concrete governed by the contract documents,
- Maintain the properties described in this specification.

B. Quality Control Testing.

1. Perform all quality control tests necessary to control the production and construction
processes applicable to this specification and as set forth in the Quality Control Plan. Take
samples for quality control testing in a random manner according to the prescribed sampling
rate. Perform the tests listed in Table DS-15038.05-1:

<table>
<thead>
<tr>
<th>Limits</th>
<th>Testing Frequency</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight (Mass) of Plastic Concrete</td>
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</tr>
<tr>
<td>Gradation Combined % Passing</td>
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<td>Air Content Plastic Concrete In Back of Paver</td>
<td>See Article 2301.02, B, 4</td>
<td></td>
</tr>
</tbody>
</table>
2. **Maintain**. The running average of three combined aggregate gradation tests is required to fall within the limits established by the CDM target gradation and the working ranges of Table DS-15038.05-2:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Working Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4 or greater</td>
<td>± 5%</td>
</tr>
<tr>
<td>No. 8 to No. 30</td>
<td>± 4%</td>
</tr>
<tr>
<td>No. 50</td>
<td>± 3%</td>
</tr>
<tr>
<td>No. 100</td>
<td>± 2%</td>
</tr>
<tr>
<td>minus No. 200</td>
<td>See Article DS-15038.03</td>
</tr>
</tbody>
</table>

**C. Corrective Action.**
For QM-C mixes only, plot all process control test results on control charts as described in Materials I.M. 530.

1. **Aggregate Tests.**
   Take corrective action when the running average approaches the working range limits. When a combined gradation test result for a sieve exceeds the working range limits, adjust the target and notify the Engineer. If the verification test result for the minus No. 200 exceeds the limits in Article DS-15038.03 for the combined gradation, the material represented by that test for this sieve will be considered non-complying. Pay factors Price adjustments will be assessed based on Coarseness/Workability Factors as described in Article DS-15038.07, E.

2. **Concrete Tests.**
   Take corrective action when an individual test result approaches the control limits. Notify the Engineer whenever an individual test result exceeds the control limits.

**D. Acceptable Field Adjustments.**

1. All mix changes must be mutually agreed upon between the Contractor and Engineer. Document all mix changes on the QM-C Mix Adjustment form. Determine batch weights using a basic water cement ratio of 0.40. When the water cement ratio varies more than ±0.03 from the basic water cement ratio, adjust the mix design to unit volume of 1.000. A change in the source of materials or an addition of admixtures or additives requires a new CDM. The following are small adjustments that may be made without a new CDM being required:
   - Increase cementitious content.
   - Decrease fly ash substitution rate.
   - Aggregate proportions may be adjusted from CDM proportions by a maximum of ± 4% for each aggregate.
   - Change water reducer to water reducer retarder.
   - Adjustment in water reducer or water reducer retarder admixture dosage.
   - Change in source of fly ash.
   - Change in source of sand, provided target gradation limits are met.
2. When circumstances arise, such as a cement plant breakdown, that create cement supply problems, a change in cement source may be allowed with the Engineer’s approval. Consult the District Materials Engineer for approval of other changes to the mix design. A set of three beams for 28 day flexural strength testing may be required to document the changes.

3. Should conditions beyond the Contractor’s control prevent completion of the work with the CDM, a Class C mix, or a mix based on Class C mix proportions using project materials, will be allowed, at no additional cost to the Contracting Authority. Mutual agreement between the Contractor and Engineer is required. Pay Factor incentives/disincentives in Table DS-15038.07-1, will not be applied to Class C mixtures.

4. Prior to 28 days strength test results, paving with QM-C mix may begin if the Engineer approves when the mix design strength, based on the average of three beams, meets or exceeds 640 psi.

E. Hand Finished Pavement.
Use project materials based on Class C or Class M concrete mix proportions. With approval of the Engineer, the Contractor’s CDM may be used for hand finished pavement. Quality control, as required in this specification, will not apply to hand finished pavement.

15038.06 METHOD OF MEASUREMENT.
Measurement will be as follows:

A. Standard or Slip-Form Portland Cement Concrete Pavement, QM-C.
Square yards shown in the contract documents.

B. Portland Cement Concrete Overlay, QM-C, Furnish Only.
Article 2310.04, A, of the Standard Specifications applies.

C. Portland Cement Concrete Overlay, QM-C, Placement Only.
Article 2310.04, B, of the Standard Specifications applies.

D. Hand Finished Pavement.
Square yards of Standard or Slip-Form Portland Cement Concrete Pavement, QM-C, constructed using Class C or Class M mixtures. For overlays, the Engineer will compute the number of:
- Square yards of Portland Cement Concrete Overlay, QM-C, Placement Only, constructed using Class C or Class M mixtures, and
- Cubic yards of Class C and Class M mixtures used.

15038.07 BASIS OF PAYMENT.
The cost for furnishing labor, equipment, and materials for the work required by the Contractor to design, test, and provide process control for production of QM-C shall be included in the contract unit price for QM-C bid items. Payment will be the contract unit prices as follows:

A. Standard or Slip Form Portland Cement Concrete Pavement, QM-C.

1. Contract unit price for Standard or Slip-Form Portland Cement Concrete Pavement, QM-C, per square yard.

2. The contract unit price per square yard for Standard or Slip-Form Portland Cement Concrete Pavement, QM-C, constructed will be adjusted according to Table DS-15038.07-1 based upon the average coarseness and workability factors for each lot according to Materials I.M. 530.
**Table DS-15038.07-1: Pay Factor Chart**

<table>
<thead>
<tr>
<th>Gradation Zone (Materials I.M. 532)</th>
<th>Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>II-A</td>
<td>1.03</td>
</tr>
<tr>
<td>II-B</td>
<td>1.02</td>
</tr>
<tr>
<td>II-C</td>
<td>1.01</td>
</tr>
<tr>
<td>II-D</td>
<td>1.00</td>
</tr>
<tr>
<td>IV</td>
<td>0.98</td>
</tr>
<tr>
<td>I</td>
<td>0.95</td>
</tr>
</tbody>
</table>

**B. Portland Cement Concrete Overlay, QM-C, Furnish Only.**

Article 2310.05, A, of the Standard Specifications applies. Average coarseness and workability factor for each lot will be determined according to Materials I.M. 530. The contract unit price will be adjusted according to Table DS-15038.07-1.

**C. Portland Cement Concrete Overlay, QM-C, Placement Only.**

Article 2310.05, B, of the Standard Specifications applies. Average coarseness and workability factor for each lot will be determined according to Materials I.M. 530. The contract unit price will be adjusted according to Table DS-15038.07-1.

**D. Hand Finished Pavement.**

1. Standard or Slip-Form Portland Cement Concrete Pavement, QM-C: per square yard.

2. Portland Cement Concrete Overlay, QM-C, Placement Only: per square yard.


4. Pay Factor incentives/disincentives in Table DS-15038.07-1 will not be applied to hand finished pavement.

**E. Price Adjustment**

Failure to provide an optimized gradation within Zone II, when required, will result in the following price adjustments.

**Table DS-15038.07-1: Price Adjustments**

<table>
<thead>
<tr>
<th>Gradation Zone (Materials I.M. 532)</th>
<th>Price Adjustment Per Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>2%</td>
</tr>
<tr>
<td>I</td>
<td>5%</td>
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