8-34.1 Sampling and Testing
Aggregate sampling techniques and minimum sample sizes must be in accordance with the appropriate sample method. Use of larger samples should be considered by the QC staff to increase the probability of obtaining a respective sample. When split samples are required by the provision, the field sample size shown in CMM 8-50 needs to be doubled.

8-34.1.1 Sampling During Production or Post-Production
For the production or post-production sampling required by the provision, the contractor can obtain samples from the finished product conveyor belt or stockpile. Obtaining samples from the belt discharge is acceptable if the full production stream can be obtained with sufficient rapidity and safety.

Selection of random sample locations must be in accordance with the QMP provision.

8-34.1.2 Sampling During Placement
Sampling from the roadbed must be performed according to the provision. Sampling must take place after blading and shaping but before beginning compaction. The intent is to obtain samples as near to the final placement location of the material as possible so as to truly represent the aggregate placed. Sampling from roadbed windrows should only be used when the subgrade is granular, and it would not be possible to differentiate the change in material between the crushed aggregate base course and the granular subgrade.

The quantity of materials for roadbed field sampling should be doubled since samples are needed for both quality control and department testing according to special provision requirements of the contract.

8-34.1.3 Sieve Analysis
Sieve analysis testing must follow AASHTO T11 and T27 as modified by WisDOT. This procedure is outlined in CMM 8-60. The sample weights derived from this procedure are minimums. As has been pointed out for field sample sizes, the use of larger samples should be given careful consideration by the QC staff to increase the probability of obtaining a representative sample.

Test data and calculation results should be recorded on a copy of department form DT1348, Sieve Analysis for Mixture of Fine and Coarse Aggregates. For consistency throughout the testing operations it is preferred the test mass be made in units of grams. Figure 1 is an example of a completed test data sheet for a typical sample of aggregate base course material.
Form WS3015, Running Average Calculations, is a generic sheet that may be used to calculate running average values for the aggregate gradation sieve fractions. WS3017, Aggregate Gradation Control Charts, may be reproduced for plotting aggregate sieve fractions.

Gradation of aggregate should be expressed in percent passing sieve sizes. Separate charts must be kept for 2", 1-1/2", 1", 3/4", 1/2", 3/8", #4, #8, #10, #16, #30, #40, #50, #100 and #200 (50mm, 37.5mm, 25mm, 19mm, 12.5mm, 9.5mm, 4.75mm, 2.36mm, 2.00mm, 1.18mm, 600µm, 425µm, 300µm, 150µm and 75µm). Control charts for only the sieve sizes specified by the applicable specification need to be produced.

### 8-34.1.4 Atterberg Limits

Record Atterberg Limits test results on WS3050 Atterberg Limits Worksheet.

### 8-34.1.5 Fractured Particle Count

Fractured particle testing must be according to CMM 8-60. The QC tester should complete the test form by making the required calculation. Fractured particle test results must be plotted on a control chart. The tester may use WS3019 Base Aggregate Fractured Particle Control Chart, for reproduction as needed.
8-34.2 Department Testing
Verification and independent assurance sampling and testing will be performed by the department or a department representative as described in the provision.

8-34.2.1 Verification Testing
Verification testing will be performed by an HTCP certified department representative on random samples collected independently of the contractor's samples. Testing of the material will be conducted in a separate laboratory and with separate equipment from the contractor's tests.

8-34.2.2 Independent Assurance Review
Independent assurance reviews will be conducted by a department representative in accordance with the provision and the department's Independent Assurance Program. These reviews will be made of the contractor's quality control and the department's verification sampling and testing equipment and personnel.

8-34.3 Dispute Resolution
Dispute resolution will be conducted according to the provision. The split samples of the material collected for QC testing can be used to help resolve conflicts. The use of these samples will be as agreed to by the contractor and the department.

8-34.4 Aggregate for Concrete Pavement
8-34.4.1 Sampling
Obtain aggregates using field sample sizes according to CMM 8-50. The use of larger samples should be considered by the QC staff to increase the probability of obtaining a respective sample.

For the aggregate sampling required by the provision, the contractor can obtain samples from the finished product conveyor belt, holding bins, or stockpile. Obtaining samples from the belt discharge is excellent if the full production stream can be obtained with sufficient rapidity and safety.

Selection of random sample locations must be in accordance with the QMP provision.

8-34.4.2 Testing
8-34.4.2.1 Aggregate Sieve Analysis
The methods and frequencies for aggregate gradation sampling and testing must be according to the QMP provision.

The QMP provision allows for a portion of the gradation testing of coarse aggregates to be performed with an unwashed method. The procedures for unwashed (dry) sieve analysis are identical to those for washed (wet) sieve analysis except for references to washing operations. The processes for washed or unwashed sieve analysis testing must follow AASHTO T11 and AASHTO T27 as modified by WisDOT. Be aware that it is necessary to grade (sieve) all individual samples of both fine and coarse aggregates through the coarse and fine sieve series. Test data must be recorded on a copy of WS5015 Sieve Analysis for Concrete Aggregate, as shown in Figure 2.

The sieve analysis test data sheet, and all subsequent use of the data should clearly indicate whether washed or unwashed testing was used. The tester must refer to CMM 8-60 for instructions to determine whether dry sieving is acceptable or if wet sieving is required. While the QMP special provisions specify only every 10th sample of coarse aggregate is to be subjected to a washed analysis, the intention is that a dry analysis should be used only if it will provide reliable data. If, when comparing test results, sieve analysis comparisons are marginal or P/200 is above the warning limit, a washed sieve analysis must be performed on each sample until results by washed sieving meet the criteria.

8-34.4.2.2 Fineness Modulus
The fineness modulus of fine aggregate is required to be calculated by the special provision and is intended to be for information only. Fineness modulus must be calculated for the fine aggregate as outlined below. Data and calculations should be recorded on a copy of WS5015 Sieve Analysis for Concrete Aggregate, as shown in Figure 2. Fineness modulus is determined by adding the total percentages of material by weight retained on sieve Nos. 4, 8, 16, 30, 50 and 100 then dividing by 100, as shown in the following example.
Figure 2 Sieve Analysis for Concrete Aggregate

<table>
<thead>
<tr>
<th>WS5015 SIEVE ANALYSIS FOR CONCRETE AGGREGATE</th>
<th>PROJECT DESCRIPTION</th>
<th>SAMPLE INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project ID:</td>
<td></td>
<td>Material Source:</td>
</tr>
<tr>
<td>Highway</td>
<td></td>
<td>Material (Type, Grade, etc.):</td>
</tr>
<tr>
<td>Description</td>
<td></td>
<td>Same as above</td>
</tr>
<tr>
<td>Contractor</td>
<td></td>
<td>Date Sampled:</td>
</tr>
<tr>
<td>Foreman of Testing</td>
<td></td>
<td>Time Sampled:</td>
</tr>
</tbody>
</table>

**MOISTURE CONTENT:**

\[
\text{Percent Moisture} = \frac{W_d - W_w}{W_d - T} \times 100
\]

\[
T = \text{Weight of Container}
\]

\[
W_w = \text{Weight of Container + Wet Sample Weight}
\]

\[
D_w = \text{Weight of Container + Dry Sample Weight}
\]

**SIEVE ANALYSIS:**

<table>
<thead>
<tr>
<th>Washed</th>
<th>Unwashed</th>
<th>Weight, gms.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td>515</td>
</tr>
</tbody>
</table>

**Fine:**

<table>
<thead>
<tr>
<th>Wt. Ret'd,</th>
<th>% Ref'd</th>
<th>% Pass</th>
<th>Fine</th>
<th>C.A. #1</th>
<th>C.A. #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2 (50 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2&quot; (37.5 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot; (25 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot; (19 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot; (9.5 mm)</td>
<td>0</td>
<td>0.0</td>
<td>100.0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>#4 (4.75 mm)</td>
<td>15</td>
<td>2.9</td>
<td>97.1</td>
<td>90-100</td>
<td></td>
</tr>
<tr>
<td>#8 (2.36 mm)</td>
<td>97</td>
<td>18.8</td>
<td>81.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#16 (1.16 mm)</td>
<td>218</td>
<td>48.3</td>
<td>51.7</td>
<td>45-80</td>
<td></td>
</tr>
<tr>
<td>#30 (0.6 mm)</td>
<td>306</td>
<td>59.8</td>
<td>40.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#50 (0.3 mm)</td>
<td>434</td>
<td>82.1</td>
<td>17.9</td>
<td>10-30</td>
<td></td>
</tr>
<tr>
<td>#100 (0.16 mm)</td>
<td>498</td>
<td>96.4</td>
<td>3.6</td>
<td>3-10</td>
<td></td>
</tr>
<tr>
<td>#200 (0.075 mm)</td>
<td>510</td>
<td>99.0</td>
<td>1.0</td>
<td>0-1.5</td>
<td></td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

| Wt in Pan = 5 |

**FINENESS MODULUS (Fine Aggregate):**

\[
\text{Fineness Modulus} = \frac{\sum \text{total } \% \text{ Ret'd} \times \#4, \#8, \#16, \#30, \#50, \#100}{100}
\]

\[
= \frac{3 + 19 + 48 + 60 + 82 + 97}{100} = 3.03
\]

**Remarks:**

---

*November 2010*
<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Spec. Percent Passing</th>
<th>Sample Percent Passing</th>
<th>Sample Percent Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (4.75mm)</td>
<td>90-100</td>
<td>98</td>
<td>2</td>
</tr>
<tr>
<td>8 (2.36mm)</td>
<td>80</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>16 (1.18mm)</td>
<td>45-80</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>30 (600µm)</td>
<td>10-30</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>50 (300µm)</td>
<td>2-10</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>100 (150µm)</td>
<td>2-10</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Total =</td>
<td></td>
<td>302</td>
</tr>
</tbody>
</table>

Fineness Modulus = 302/100 = 3.02

8-34.4.3 Corrective Action
Corrective action must be implemented according to the provision.

8-34.4.4 Department Testing
Quality verification and independent assurance sampling and testing will be performed by the department or a department representative as described in the provision. Sampling and testing will be performed by a certified technician.

8-34.4.4.1 Verification Testing
Verification testing will be performed by an HTCP certified department representative on samples collected independently of the contractor’s samples. Testing of the material will be conducted in a separate laboratory and with separate equipment from the contractor’s tests.

With this provision, the contractor has two options for when the department’s quality verification testing will be performed on the aggregate for concrete pavement.

1. For option 1:
   Quality Verification testing is performed at the time of production.

2. For option 2:
   Quality Verification testing is performed at the time the aggregate is being used or relocated.

Regardless of which option is used, the contractor is responsible for the product after it has been sampled, tested and accepted. Minimal segregation, contamination, and degradation must occur with relocation of the material. The engineer may require additional sampling and testing at the concrete plant site and use a statistically based Pooled T-Test to evaluate whether the quality of the material has been maintained. Follow procedure for the Pooled T-Test (Attachment 1).

8-34.4.4.2 Independent Assurance Review
Independent assurance reviews will be conducted by a department representative in accordance with the provision and the department’s Independent Assurance Program. These reviews will be made of the contractor’s Quality Control and the department’s verification sampling and testing equipment and personnel.

8-34.4.4.3 Dispute Resolution
Dispute resolution must be conducted according to the provision.

List of Attachments
Attachment 1 Pooled t-Test Procedure