Section 6
WYDOT Specifications for Portland Cement Concrete Pavement
(PCCP) SSRBC 414

WMTC Concrete Training & Certification Seminar
Watering (SSRBC 209.3)
For both pavement & structural concrete

Water Meter
- Calibrated preceding 12 months
- Accurate with plus or minus 3%
Proportioning PCCP (SSRBC 414.4.7)

Mix Design Requirements (Levels I, II, III)

- Cement plus fly ash (FA) \( 564 - 705 \) lbs/cy
- Min. cement for FA mixes \( 470 \) lbs/cy
- Level I \( 20\% \) to \( 25\% \) FA required
- Max. w/cm ratio \( 0.45 \)
- Slump \( 0.5 - 2'' \) slip-form paver
- 4'' max unless using water reducer, then 6'' for formed concrete
- Air content \( 4.5\% \) to \( 7.5\% \)
- 28-day flexural strength as shown, otherwise \( 650 \) psi
- Flexural strength determined from cylinders and cylinder/beam laboratory correlation
- WYDOT may run test batch to verify performance
• For Level IV, WYDOT will furnish mix design

• For all Levels of Control, new mix design required if any changes in material source, admixtures, cement type or fly ash source

• Fine aggregate may be adjusted up to 2% by mass (based on total weight) without requiring new mix design

• Fine aggregate fraction shall not exceed 44% of total aggregate mass
For Level I, printed ticket shall show…

1. Project Number
2. Truck Number
3. Time batched
4. Total yards batched per load
5. Total yards batched per day
6. Aggregate weights
7. Aggregate moisture
8. Cement & fly ash weights
9. Admixtures and amount added
10. Water add at plant
11. Other ???
Quality Control (QC)

- Contractor’s responsibility
- Provide Quality Control system to ensure materials & product conform to contract requirements
- Perform inspections & tests
- Maintain inspection & test records
- Maintain equipment & qualified personnel
- Quality control plan
Quality Acceptance (QA)

• WYDOT determines acceptability of materials & products
• WYDOT responsible for acceptance sampling & testing (Quality Acceptance Testing)
• Perform quality analysis & pay factor

What is the real difference between QC/QA and non-QC/QA projects?
Level of Control

Defines ...

• Mix design requirements
• Extent of contractor’s quality control program
• Extent of WYDOT’s quality acceptance program

• Level of Control is defined in plans and dependent on level of service of concrete pavement installation and project size.

(SSRBC 414.4.2)
## Start-up testing independent of frequency testing

<table>
<thead>
<tr>
<th>QC/TESTING (CONTRACTOR)</th>
<th>LEVEL I</th>
<th>LEVEL II</th>
<th>LEVEL III</th>
<th>LEVEL IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>1 test per 2000 T</td>
<td>1 test per 2000 T</td>
<td>1 test per 2000 T</td>
<td>1 test per 2000 T</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>1 tests min. per day</td>
<td>1 tests min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
</tr>
<tr>
<td>Fractured Faces</td>
<td>1 test min. per 12000 SY</td>
<td>1 test min. per 6000 SY</td>
<td>1 test min.</td>
<td>1 test min.</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gradation (3) / Fineness Modulus</td>
<td>1 test per 2000 T</td>
<td>1 test per 2000 T</td>
<td>1 test per 2000 T</td>
<td>1 test per 2000 T</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
</tr>
<tr>
<td>Water/Cementitious Ratio</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
</tr>
<tr>
<td>Deleterious Substances</td>
<td>1 ea. Gradation test min.</td>
<td>1 ea. Gradation test min.</td>
<td>1 test min.</td>
<td>1 test min.</td>
</tr>
<tr>
<td>Dowel Bar Placement</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
</tr>
<tr>
<td>Air Content/Slump</td>
<td>At start-up (1) and 1 min. per 2000 SY</td>
<td>At start-up (1) and 1 min. per 1000 SY</td>
<td>At start-up (1) and 1 min. per 1000 SY</td>
<td>At start-up (1) and 1 min. per 1000 SY</td>
</tr>
<tr>
<td>Texture Straightness</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
<td>1 test min. per day</td>
</tr>
<tr>
<td>Graded Lot</td>
<td>1 min. per 4000 SY</td>
<td>1 min. per 2000 SY</td>
<td>1 min. per 2000 SY</td>
<td>1 per 3000 SY</td>
</tr>
<tr>
<td>QA TESTING (WYDOT) Paved Lots</td>
<td>Lot Size: 12000 SY max. 3 Sublots (2)</td>
<td>Lot Size: 6000 SY max. 3 Sublots (2)</td>
<td>Lot Size: 6000 SY max. 3 Sublots (2)</td>
<td>n/a</td>
</tr>
<tr>
<td>Air Content</td>
<td>1 per subplot</td>
<td>1 per subplot</td>
<td>1 per subplot</td>
<td>1 per 3000 SY</td>
</tr>
<tr>
<td>Strength Tests</td>
<td>1 set per subplot</td>
<td>1 set per subplot</td>
<td>1 set per subplot</td>
<td>1 set per 3000 SY</td>
</tr>
<tr>
<td>Thickness</td>
<td>1 per subplot</td>
<td>1 per subplot</td>
<td>1 per subplot</td>
<td>1 per 3000 SY</td>
</tr>
</tbody>
</table>

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(1) Conduct air and slump tests on the first load, then 2 times within one hour of start-up, and after any shutdown exceeding 30 minutes.

(2) 1 lot minimum in all cases. 3 sublots per lot, each comprising 1/3 the lot surface area.

(3) Conduct gradation quality control testing during aggregate production.

(4) Contractor is responsible for gradation QA testing during concrete production. Gradation lots are independent of other paved lots. 1 lot minimum in all cases, with between 5 and 7 sublots.
QA: Lots & Sublots (Paved Lots)

• For **air content**, **strength** and **thickness**
• Lot size controlled by surface area of concrete placed
• Lot can span several days

**Maximum Lot Sizes**

- Level I   12,000 SY max
- Level II  6,000 SY max
- Level III 6,000 SY max

• **Lots must have at least ...**
  – 3 sublots per lot
  – 1 set of 3 cylinders for strength (3 per subplot or 9 per lot)
  – Test for air content (1 per subplot or 3 per lot)
  – Pavement thickness (1 per subplot or 3 per lot)
  – Each subplot represents 1/3 of the lot surface area
Example

For a Level I paving project with 24,000 SY/Day

**QC**: at start up (3 test) plus 1 test per 2000 SY

**QA**: Number of lots: \( \frac{24,000}{12,000} = 2 \text{ Lots} \)

Number of sublots: 2 lots x 3 sublots/lot = 6 sublots

<table>
<thead>
<tr>
<th>Test</th>
<th>Daily Testing Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality Control</strong></td>
<td><strong>Quality Acceptance</strong></td>
</tr>
<tr>
<td>Temperature</td>
<td>15 by default</td>
</tr>
<tr>
<td>Slump</td>
<td>( 3 + \frac{24,000}{2000} = 15 )</td>
</tr>
<tr>
<td>Unit Weight</td>
<td>15 by default</td>
</tr>
<tr>
<td>Air Content</td>
<td>( 3 + \frac{24,000}{2000} = 15 )</td>
</tr>
<tr>
<td>Strength (cyl)</td>
<td>Optional</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1st load test is independent of frequency testing
Correlation of Field Testing Equip. & Personnel

• Compares contractor & WYDOT’s testing
• Insures no equipment or procedural bias exist
• Correlation testing required for ...
  
  Slump
  Air Content
  Unit Weight
• Minimum batch size = 1 cubic yard

(SSRBC 414.4.5)
Correlation of Slump, Air Content & Unit Weight  
(SSRBC 414.4.5.1)

- Perform two sets of tests
  1. Quality Control Technician (Contractor)
  2. Quality Acceptance Technician (WYDOT)

- Compare two sets of test results

- Difference cannot exceed the following values
  - Slump (when < 4 inch) 0.5 inch
  - Slump (when ≥ 4 inch) 1.0 inch
  - Air Content 0.4%
  - Unit Weight 1 pcf
Three Conditions Can Exist

1. Differences less than limit, then proceed

2. Differences exceed limits, then begin dispute resolution procedure

3. Differences exceed limits and both results meet specifications, production can proceed provided that ...
   a) dispute resolution procedure started
   b) next load tested & both results meet specifications
Dispute Resolution (SSRBC 414.4.6)

1. QC & QA technicians meet & review testing procedures, equipment condition & calibrations & sampling techniques

2. If cause for bias determined & corrected, perform correlation again

3. If second slump, air content & unit weight differences exceed limits again, contact Independent Assurance (IA) or third party agreed to by Contractor & WYDOT

- Repeat testing with IA or third party
  (3 sets of test results)
- Compare differences between three sets of tests
- Confirm either contractors or WYDOT’s test results
- Party with faulty testing pays third party
Additional Correlation

Perform addition correlations if ...

- Reason to believe either equipment or testing bias is present
- New testing personnel or different equipment used to perform tests

Quality Control

• Responsibility of contractor

• Contractor must have & maintain a quality control system - ensure conformance with contract specifications

• Contractor responsible for ...
  • All concrete materials
  • Constructed concrete structures
Quality Control Plan  (SSRBC 414.4.8.2)

- For Levels I and II, contractor must submit QC Plan to WYDOT 14 days prior to preconstruction conference
- QC Plan must be approved by WYDOT before placing concrete
- Adherence to QC Plan required
- QC Plan must contain ...

1. Organizational chart indicating lines of authority
2. General mix design and trial batch information
3. Organization performing the mix design and trial batch
4. Plan for collecting quality control samples
5. Anticipated on-site admixtures
6. Personnel who have the authority to re-dose trucks on-site
7. Dowel bar and/or tie bar installation
   method of dowel placement
   type of supporting units
   method of anchorage
   verification method for location and alignment

8. Curing equipment and curing compounds to be use

9. Curing compound rates and procedures for application.

10. Plan for control joint sawing and sealing,
    with specific timing of the sawing and sealing.

11. Timing of smoothness testing, equipment to be used, equipment
    settings, and equipment calibration data

**Quality Control Chart** displayed & showing . . .

- Coarse & fine aggregate gradations
- Slump, air content & w/cm ratios
- Specified limits for above

(SSRBC 414.4.8.3)
Quality Acceptance

- WYDOT performs Quality Acceptance, except for gradation

- With the exception of gradation, contractor’s test results **cannot** be used for QA

- **Quality Acceptance tests**
  a) air content  
  b) strength tests  
  c) pavement thickness  
  d) gradation

- For each strength test, test slump, air content, unit weight & temperature

- If slump outside limits - reject concrete

- Quality analysis & pay factors for Levels I, II, III

- Level IV not based on lots & no pay factors apply, except for gradation lots and gradation & joint sealant pay adjustments
Air Content
• One test per sublot

Thickness
• One test per sublot
• Pavement cored at locations as directed by Engineer.
Concrete Strength

• One “set” of cylinders (3) per subplot
• One test = Test Avg of 3 cylinders
• Convert Compressive Test Avg (CS) to Equivalent Flexural Strength (FS) using Lab. Correlation Constant (Cc)

\[ FS = Cc \sqrt{CS} \]

• Only lab beams made during mix design

\[ Cc = \frac{FS}{\sqrt{CS}} \quad \text{(from lab testing)} \]
Pay Factors

- Computed by WYDOT
- Rewards good control
- Penalizes poor control
- Only used for Control Levels I, II & III
- Based on …
  - Air content
  - **Strength** (computed flexural)
  - Pavement Thickness
  - Aggregate Gradations
  - Smoothness
  - Overfilling of joints with sealants
Base Preparation (SSRBC 414.4.10.4)

• Don’t operate hauling units that cause rutting & displacement on base or subgrade

• Subgrade or base should be uniformly moist unless other is specified

• If needed, sprinkle base without forming mud or pools of water
Handling & Measurement  (SSRBC 414.3)

• Central mixing plant - know capacity & mixing speeds
• Separate scales for aggregate and cement
• If cement & fly ash weighed together - weight cement first
• Scales
  • Beam or springless dial type
  • Accurate within 0.5% throughout range
  • Contractor furnish at least ten 50 lb weights for testing or approved calibration device
Mixing & Delivery  (Section 414.4.10.2)

• Mixer
  • Good condition, meeting blade tolerances
  • All water should be added to batch within first 15 seconds of mixing time
  • Not less than 50 sec. mixing time (central mixer)
  • Don’t exceed mixer capacity
  • Note batching sequence

• Place non-agitated concrete within 35 min. from the time mixed & within 60 min. of the start of mixing
Placing and Finishing
(SSRBC 414.4.10.6 & 414.4.10.7)

Slip-form Method
• Repair subbase displaced & damaged by hauling vehicles
• Vibrators
  • Max. spacing 24 inches
  • Impulses per min. = 7,000 to 12,000
• Adjacent paving
  • Wait 72 hrs or until concrete achieves 80% of design strength

Form Method
• Don’t let vibrators come into contact with joints, rebar or forms
Texturing (SSRBC 414.3.2, 414.4.10.8)

- Start as soon as finishing operations complete
- Use burlap drag first, then texture
- Texture options

a. **Transverse Tining**
   - Tine width: 3/32 to 1/8 inch
   - Tine spacing: random between 1/2 and 1½ inches
     - (no more than 50% of spaces exceeding 1 inch)
   - Tine depth: 3/16 ± 1/16 inch
   - Rake width: 3 ft min.
b. **Longitudinal Tining**

Tine width: 3/32 to 1/8 inch  
Tine spacing: 3/4 inch maximum  
Tine depth: 3/16 ± 1/16 inch  
Straightness: no deviations exceeding 1 in. parallel to centerline in 50 ft length

c. **Carpet Drag**

Straightness: no deviations exceeding 1 in. parallel to centerline in 50 ft length  
Clean carpet-drag at least once every 5000 yd$^2$

d. **Broomed**

Striations that are 1/16 in. to 1/8 in. deep, parallel to transverse joint
Curing (SSRBC 414.4.10.9)

- Use “premium white” curing compound
- Apply within 15 minutes after surface texturing
- Apply at 1 gal/150 sqft
- Cover entire surface, sides and edges
- Don’t spray curing compound on free standing water
- Don’t spray rebar & dowel bars
- If delayed, use foggers or approved evaporation retarder
- If curing compound cannot be applied, immediately place wet burlap and plastic sheeting & halt paving until conditions approve
**Joints**  (SSRBC 414.4.10.10)

- Saw joints in timely manner (before cracking)
- Sawcut depths (wet saw)
  
  \[ \frac{T}{3} \text{ when } T \text{ (thickness) greater than 10 in.} \]
  
  \[ \frac{T}{4} \text{ when } T \text{ is less than or equal to 10 in.} \]
- Sawcut depths (early-entry dry-cut saw)
  
  \[ 0.15T \text{ (for } T = 10 \text{ in., depth } = 1.5 \text{ inches)} \]
- Tie bars
  
  - Inserted during paving operation
  - Located with 1 inch of midpoint of pavement
  - If not inserted, must be held by chairs or supports to prevent displacement
- Install construction joint if paving operation is interrupted for more than 30 minutes
WYDOT Weather Limitations

- Pave during daylight unless light provided
- Don’t pave during raining weather
- Fresh concrete temperature 50F & 90F during placement
- No paving when air temperature drops below 40F
- If air temperature drops below 35F, cover or provide heat so pavement surface temperature maintained at 50F for 72 hrs & above 40F for additional 96 hrs
- When field cured cylinders achieve compressive strength of 3,500 psi, protection can be removed
- Don’t place concrete on frozen subgrade
- Don’t pave when wind speed exceeds sustained 20 mph unless approved by Engineer