

Section 5

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

(SSRBC 414.4.2)

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.

**Table 414.4.2-1
QC/QA Testing Requirements vs Level of Control**

	LEVEL I	LEVEL II	LEVEL III	LEVEL IV
QC TESTING (CONTRACTOR)				
Coarse Aggregate				
Gradation ⁽³⁾	1 test per 2000 T	1 test per 2000 T	1 test per 2000 T	1 test per 2000 T
Moisture Content	1 tests min. per day	1 tests min. per day	1 test min. per day	1 test min. per day
Fractured Faces	1 test min. per 12000 SY	1 test min. per 6000 SY	1 test min.	1 test min.
Fine Aggregate				
Gradation ⁽³⁾ / Fineness Modulus	1 test per 2000 T	1 test per 2000 T	1 test per 2000 T	1 test per 2000 T
Moisture Content	1 test min. per day	1 test min. per day	1 test min. per day	1 test min. per day
Water/Cementitious Ratio	1 test min. per day	1 test min. per day	1 test min. per day	1 test min. per day
Deleterious Substances	1 ea. Gradation test min.	1 ea. Gradation test min.	1 test min.	1 test min.
Dowel Bar Placement	1 test min. per day	1 test min. per day	1 test min. per day	1 test min. per day
Air Content/Slump	At start-up ⁽¹⁾ and 1 min. per 2000 SY	At start-up ⁽¹⁾ and 1 min. per 1000 SY	At start-up ⁽¹⁾ and 1 min. per 1000 SY	At start-up ⁽¹⁾ and 1 min. per 1000 SY
Texture Straightness	1 test min. per day	1 test min. per day	1 test min. per day	1 test min. per day
QA TESTING (CONTRACTOR) ⁽⁴⁾	Gradation Lots: 20000 SY max.	Gradation Lots: 14000 SY max.	Gradation Lots: 14000 SY max.	Gradation Lots: 20000 SY max.
Gradation	1 min. per 4000 SY	1 min. per 2000 SY	1 min. per 2000 SY	1 per 3000 SY
QA TESTING (WYDOT) Paved Lots	Lot Size: 12000 SY max. 3 Sublots (2)	Lot Size: 6000 SY max. 3 Sublots (2)	Lot Size: 6000 SY max. 3 Sublots (2)	n/a
Air Content	1 per subplot	1 per subplot	1 per subplot	1 per 3000 SY
Strength Tests	1 set per subplot	1 set per subplot	1 set per subplot	1 set per 3000 SY
Thickness	1 per subplot	1 per subplot	1 per subplot	1 per 3000 SY

Start-up testing
independent of
frequency testing

⁽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

1st load test is independent
of frequency testing

QA: Number of lots: $24,000/12,000 = 2$ Lots

Number of sublots: $2 \text{ lots} \times 3 \text{ sublots/lot} = 6$ sublots

Test	Daily Testing Frequency	
	Quality Control	Quality Acceptance
Temperature	15 by default	6 by default
Slump	$3 + 24,000/2000 = 15$	6 by default
Unit Weight	15 by default	6 by default
Air Content	$3 + 24,000/2000 = 15$	6 (1 per sublot)
Strength (cyl)	Optional	1 strength test per sublot (3 cyl/test) $3 \text{ cyl/sublot} \times 6 = 18$

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

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 additional 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

$$Cc = \frac{FS}{\sqrt{CS}} \text{ (from lab testing)}$$

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 $1\frac{1}{2}$ inches

(no more than 50% of spaces exceeding 1 inch)

Tine depth: $3/16 \pm 1/16$ 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: $3/16 \pm 1/16$ 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 carper-drag at least once every 5000 yd²

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)
 - $T/3$ when T (thickness) greater than 10 in.
 - $T/4$ when T is less than or equal to 10 in.
- Sawcut depths (early-entry dry-cut saw)
 - $0.15T$ (for $T = 10$ in., depth = 1.5 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

(SSRBC 414.4.3)

- 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