

**PART 1 GENERAL**

## 1.1 SCOPE:

- A. This section covers the work necessary for construction of PCC pavements, with or without reinforcement, composed of portland cement, water, fine aggregate, coarse aggregate, and special purpose additives when required or permitted. The pavement shall be constructed on an approved base, complete.

**PART 2 PRODUCTS**

## 2.1 FINE AGGREGATES:

## A. GENERAL

1. Fine aggregate shall consist of natural sand or other materials with similar characteristics having hard, strong, durable particles.
2. Stone screening, if used, shall consist of particles resulting from the crushing of clean, tough durable rock or gravel. Screening shall conform to the specifications for fine aggregate.
3. Fine aggregates varying more than 0.20 from the fineness modulus of the fine aggregate used in the Contractor's mix design shall not be used. The finest modulus of the fine aggregate is determined by adding the percentages by weight retained on the following sieves having square openings, and dividing by 100: 3/8, No.4, No.8, No. 16, No.30, No.50, and No. 100.

## B. DELETERIOUS SUBSTANCES:

1. The amount of deleterious substances shall not exceed the following limits.

<b>TABLE B-1</b>	
Substance	Percent by weight
Oil, Salt, Acid, and Alkali	0
Friable Particles	1
Lightweight	1
Material Passing No.200 Sieve	4*

\* If this material consists of fractured dust, essentially free of clay or shale and is non-plastic, the percentage may be increased to 6-percent.

## C. SOUNDNESS.

1. When fine aggregate is subjected to five repetitions of the sodium sulfate soundness test, AASHTO T 104 or ODOT TM 206, the weighted percentage of loss shall not be more than 10-percent by weight.

## D. ORGANIC IMPURITIES.

1. All fine aggregate shall meet the requirements of AASHTO M 6 for organic impurities.

## E. GRADING.

1. Fine aggregate shall be graded within the following limits.

<b>TABLE B-2</b>	
<b>GRADING REQUIREMENTS FINE AGGREGATE - PORTLAND CEMENT CONCRETE</b>	
<b><u>SIEVE SIZE PASSING</u></b>	<b><u>PERCENTAGE BY WEIGHT</u></b>
3/8"	100
No.4	90-100
No.8	65-90
No.16	45-75
No.30	25-55
No.50	5-30
No.100	0-8

## F. SAMPLING AND TESTING.

1. Sampling and testing of fine aggregate shall be in accordance with the following ODOT Test Methods or the equivalent ASTM or AASHTO specification.

Sampling	ODOT TM 214
Material Passing the No.200 Sieve	ODOT TM 205
Organic Impurities	ODOT TM 212
Sieve Analysis	ODOT TM 204
Soundness	ODOT TM 206
Friable Particles	ODOT TM 221
Lightweight Pieces	ODOT TM 222
Sand Equivalent	ODOT TM 101
Fineness Modulus	ODOT TM 771

Testing for deleterious substances, grading, and sand equivalent will be on the produced aggregates.

Testing for soundness and organic impurities will be on the source material from which the aggregates are produced and on the produced aggregates.

## 2.2 COURSE AGGREGATES:

## A. GENERAL.

1. Course aggregates shall consist of rock, gravel, or other approved inert material of similar characteristics having hard, strong, durable pieces free from adherent coatings.
2. The size of coarse aggregate in PCC pavement shall be 12 A - No.4.

## B. DELETERIOUS SUBSTANCES.

1. The amount of deleterious substances shall not exceed the following:

PERCENTAGES BY WEIGHT	
Lightweight Pieces	0.25
Friable Particles	2.0
Material Passing No.200 Sieve	1.00-1.50
Wood Waste	0.05

## C. DURABILITY.

1. The material from which coarse aggregates are produced or manufactured shall meet the following qualifying test requirements.

TABLE B-3		
TEST	TEST METHOD	REQUIREMENTS
Soundness (5 cycles)	ODOT TM206	12% Max.
Degradation: Passing No.200 Sieve Sediment Height	ODOT TM208	30% Max 3% Max.
Abrasion	ODOT TM211	30% Max

## D. GRADING.

1. The grading of each of the specified sizes of coarse aggregate shall be in conformance with the following:

<b>TABLE B-4</b>				
<b>GRADING REQUIREMENTS</b>				
<b>COARSE AGGREGATE - PORTLAND CEMENT CONCRETE</b>				
<u>Separated Sizes</u>	<u>2" - 1"</u>	<u>1" - 3/4"</u>	<u>1"-No.4</u>	<u>3/4" - No.4</u>
Sieve Size	Percentage Passing (by weight)			
2-1/2"	100			
2"	90-100	100		
1-1/2"	35-70	90-100	100	
1"	0-15	30-65	90-100	100
3/4"	--	0-15	50-80	90-100
3/8"	--	--	15-40	20-50
No.4	--	--	0-10	0-10

2. Elongated pieces in the coarse aggregate will be determined as described in ODOT Test Method 229 N, with the proportional caliper device set at a ratio of 5:1, and shall not exceed 10-percent by weight of the material retained on the No.4 sieve.
3. All determinations of sizes and grades will be made by the use of laboratory sieves having square openings.

**E. FRACTURE OF GRAVEL.**

1. If gravel is used in the manufacture of aggregates for PCC, the coarse aggregate shall contain not less than 60-percent, by weight, of fragments which have at least one fractured face produced by mechanical crushing.

**F. SAMPLING AND TESTING.**

1. Sampling and testing of coarse aggregate shall be in accordance with section 2.1(F).
2. Testing for abrasion, degradation, and soundness will be on the source material from which the aggregates are produced and on the produced aggregates. Testing for deleterious substances and grading will be on the produced aggregates.

**2.3 PORTLAND CEMENT:**

- A. The portland cement shall be ASTM C 150 Type I-II, II, or III.
- B. Differing brands or types of cement, or the same brand or type of cement from different mills shall not be mixed during use nor shall they be used alternately.

**2.4 BLENDED HYDRAULIC CEMENT:**

- A. Blended hydraulic cement shall be either portland-pozzolan cement or pozzolan-modified cement conforming to AASHTO M 240.
- B. The pozzolan constituent shall be between 10 and 20-percent by weight of the blended cement.
- C. Certifications for blended hydraulic cements shall be supplied in conformance with AASHTO M 240.

**2.5 POZZOLAN:**

- A. Pozzolan shall be Class C or Class F and shall conform to ASTM C618 with the following exceptions.
  - 1. Loss on ignition shall be 1.5-percent max.
  - 2. Moisture content shall be 1.0-percent max.
  - 3. Available Alkalis shall be expressed as  $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$  and shall not exceed 1.5-percent.

**2.6 WATER:**

- A. Water used in mixing PCC shall be clean and free of oil, salt, acid, alkali, sugar, vegetable matter, or other deleterious substances, and shall conform to AASHTO T 26. Water of approved potable quality may be used without testing.

**2.7 ADMIXTURES:****A. AIR-ENTRAINING ADMIXTURES.**

- 1. Air-entraining admixtures shall conform to AASHTO M 154.
- 2. Chloride content of admixtures used in concrete in contact with embedded metals shall not exceed 0.5-percent, by weight, of the weight of the mixture.
- 3. The admixture shall be able to produce 16-percent air in a portland cement mortar when tested in accordance with AASHTO T 137.

**B. WATER-REDUCING, RETARDING, AND ACCELERATING ADMIXTURES.**

- 1. Water-reducing, retarding and accelerating admixtures shall conform to AASHTO M 194.
- 2. Chloride content of admixtures used in concrete in contact with embedded metals shall not exceed 0.5-percent, by weight, of the weight of the admixture.

**2.8 BAR REINFORCEMENT:**

- A. Bar reinforcement, if required, shall conform to the requirements of Section 3100.

**2.9 DOWELS:**

- A. Dowels shall conform to AASHTO M 227, Grade 70, unless otherwise specified.

**2.10 TIE BARS:**

- A. Tie bars shall be deformed bars. Clean and free of scale and or rust.

**2.11 WELDED WIRE FABRIC:**

- A. Welded wire fabric shall conform to AASHTO M 55. Deformed welded wire fabric shall comply with AASHTO M 221.

**2.12 JOINT MATERIALS:****A. PREFORMED JOINT FILLERS.**

1. Preformed joint fillers for concrete shall conform to AASHTO M 153 or AASHTO M 213 except that those furnished under AASHTO M 213 shall be tested in accordance with ASTM D 1751.

**B. PREFORMED ELASTOMERIC JOINT SEALS.**

1. Preformed elastomeric joint seals shall conform to AASHTO M 220.

**C. POURED FILLER.**

1. Poured filler for concrete joints shall conform to AASHTO M 173.

**2.13 CURING MATERIALS:**

- A. Curing materials shall conform to the following requirements:

White polyethylene film	AASHTO M 171
Liquid membrane-forming compounds	AASHTO M 148

**2.14 MIX DESIGN:**

- A. The contractor shall furnish a mix design for approval by the Engineer or may propose the use of a current mix design on file with the Owner or ODOT.

**B. CLASSES OF CONCRETE.**

1. The classes of concrete shall designate the compressive strength of the concrete in 28-

days (psi) followed by the maximum size of aggregate to be used in the concrete, i.e.: Class 3300-1<sup>1</sup>/<sub>2</sub> shall indicate concrete, or as shown.

2. The following must be submitted with the mix design:
  - a) Mix design calculations.
  - b) Documentation of compressive strength according to ACI 301-84, subsection 3.9.
  - c) Test reports on aggregate, plastic concrete, compressive strength, and water.
  - d) Certification of compliance for portland cement, fly ash, and admixtures,

#### C. PROPORTIONING OF CONCRETE MIX.

1. The PCC mixture shall be designed in accordance with the requirements of ACI 211.1 or a modification employing the "absolute volume" method. This shall include the proportions by weight of cement, water, fine aggregate, coarse aggregate, air-entraining admixture, and any other materials or admixtures needed to produce a workable concrete that conforms to the specifications.
2. When using 3/4-inch maximum size aggregate, the fine aggregate shall be between 40-percent and 48-percent of the total aggregate. When using 1-1/2-inch maximum size aggregate, the fine aggregate shall be between 35-percent and 45-percent of the total aggregate.

#### PORTLAND CEMENT CONTENT

<u>Compressive Strength f`c</u>	<u>Minimum Cement Content</u>
<3,000	518 pounds (5.5 sacks)
≥3,000	564 pounds (6.0 sacks)

#### D. ADMIXTURES.

1. The quantity of each admixture to be used in the PCC mix shall be determined by trial batches prior to its use in PCC incorporated in the work. The admixture shall be used according to the manufacturer's recommendations and at a rate sufficient to achieve the properties indicated in subsection 2.15.

#### 2.15 PCC MIXTURE TOLERANCES AND LIMITS:

- A. The PCC shall be a workable mixture, uniform in composition and consistency, having the following properties or limits.

<b>TABLE B-5</b>			
<b>Material or Property</b>	<b>Percent of</b>	<b>Quantity</b>	<b>Specification or Test Method</b>
Entrained Air	Plastic Mix	4.0 – 7.0%	AASHTO T152
Fly Ash	Cement	20% Max	ASTM C311
Concrete Temperature		50o Min. 80o Max.	ASTM C1064
Slump		3” – 5” Max.	AASHTO T119

Cement Content and Water/Cement Ratio\*

<u>Cement</u> (lbs/cy)	<u>Max Water-Cement</u> (lb/lb)
<592	0.50
≥658	0.48

\* For concrete containing fly ash, the water-cement ratio shall be based on the total weight of portland cement plus the weight of fly ash.

2.16 PLASTIC PCC:

- A. Compliance of the plastic PCC will be based on test performed by the Contractor and on any check tests performed by the Engineer.

<b>TABLE B-6</b>			
<b>TEST</b>	<b>TEST METHOD</b>		
	<b>AASHTO</b>	<b>ODOT</b>	<b>ASTM</b>
Molding Concrete Specimens in field	T23		
Sampling Fresh Concrete	T141		
Slump	T119		
Cement Content	T121	TM713	
Air Content	T152	TM714	
Water Cement Ration		TM729	
Yield	T121		
Concrete Temperature			C1064

**PART 3 EXECUTION**

3.1 PROCESS CONTROL:

- A. The Contractor is responsible for process control and shall conduct sampling, testing, measurement, and inspection required to insure the finished pavement meets specifications.

3.2 EQUIPMENT:

- A. The plant, equipment, and tools used in the work must be approved as to design, capacity, and condition.



### 3.3 WEATHER LIMITATIONS:

- A. The Contractor shall coordinate all operations involved in constructing the pavement so the work will result in a finished pavement conforming to specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the work is permitted to proceed.
- B. PCC shall not be placed during periods of rain. PCC shall not be placed on frozen bases. Placement shall not occur when descending air temperature falls below 40° F, nor shall it resume until ascending air temperature reaches 35° F. Air temperature shall be measured in the shade and away from artificial heat.
- C. The contractor shall protect the pavement from weather damage. The contractor shall protect unhardened PCC from precipitation with protective material. When PCC is being placed during cold weather, and the air temperature is forecast to drop below 35°F, the contractor shall prevent the PCC from freezing for a minimum of seven days after placing.
- D. Weather-damaged pavement shall be removed and replaced at no expense to the Owner.

### 3.4 PREPARATION OF BASE:

- A. Before paving operations begin, the base shall be brought to the finished condition required by the specifications. If the equipment used by the contractor requires additional width for support, the contractor shall provide the support necessary to assure the equipment maintains proper grade and cross section.
- B. Manholes, inlets, and other such structures shall be completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact with them. Manhole frames and other independent metal structures in the pavement area shall be prepared with an approved bond-preventing agent.

### 3.5 MIXING PCC:

- A. PCC shall be mixed at a central plant or in truck mixers. Material containing frost or lumps of hardened material shall not be used. The mixing time in a central mix plant shall be at least 60-seconds but not more than 90-seconds. PCC mixed in truck mixers shall be mixed a minimum of 100-revolutions at the rated mixing speed of the mixer. PCC shall be mixed only in the quantity required for immediate use.
- B. PCC shall not be retempered by adding water or by other means.

### 3.6 PLACING PCC:

- A. Damage to the subgrade, base or reinforcement shall be corrected prior to placement of PCC.
- B. The PCC shall be placed in final position, in one layer, so that a minimum of finishing will be necessary to provide a dense, homogenous pavement conforming to specified grade and cross section.

- C. The pavement shall be consolidated and finished with a slip-form paving machine. The machine shall be operated with as nearly continuous forward movement as possible. The machine shall vibrate the concrete with vibrating tubes or arms working in the concrete for the full width and depth of the pavement being placed. If, for any reason, it is necessary to stop the forward motion of the paver, the vibratory and tamping elements shall be stopped at the same time.
- D. PCC shall not be used if it is not in place within 1-2 hours after being mixed, or has begun to take an initial set prior to placement.
- E. Hand spreading and distributing shall be with shovels, not rakes. Hand vibrators shall be used to consolidate the pavement in the area within 6-feet each side of construction and isolation joints.

### 3.7 PLACING REINFORCEMENT:

- A. Provisions shall be made for placing dowels, tie bars, and other devices called for by the plans, during placement of the PCC. Reinforcement shall be placed on supporting devices and maintained in position while the PCC is being placed.

### 3.8 DOWELS:

- A. Dowel bars shall be smooth, round, coated with plastic, grease, heavy oil, or other approved material that will neither bond with nor be harmful to PCC. Dowels shall be placed in a supporting framework that holds the dowels parallel with each other, parallel with the surface of the pavement and perpendicular to the joint. Maximum alignment tolerances shall be 5-degrees or 1/4-inch in length of the dowel.

### 3.9 LONGITUDINAL JOINTS:

- A. Longitudinal joints shall be of the weakened-plane type.

### 3.10 CONSTRUCTION JOINTS:

- A. Construction joints shall be constructed when there is an interruption of 45-minutes in placing operations. Care shall be taken when forming construction joints to assure that reinforcement and its supports are not displaced, distorted, or otherwise disturbed.

### 3.11 TERMINAL ISOLATION JOINTS:

- A. Terminal isolation joints at the ends of runs of continuously reinforced pavement shall conform to the dimensions and details shown on the plans.

### 3.12 SURFACE FINISHING:

- A. After the PCC has been given a preliminary finish, the surface of the pavement shall be checked by the contractor with a straightedge device not less than 12-feet in length. Each successive check with the straightedge device shall lap the previous check path by at least half the length of the straightedge. Surface deviations exceeding 0.02-foot shall be corrected.

- B. Upon completion of the surface floating but before any required edge tooling or joint tooling, and before initial set of the surface PCC, the pavement shall be given a textured finish.
- C. The textured finish shall be accomplished by a steel tine tool that will mark the finished PCC to a depth of 1/8-inch plus or minus 1/16-inch. The markings shall be about 1/8-inch in width, randomly spaced, averaging about 3/4-inch on center.

### 3.13 EDGE TOOLING:

- A. The free edges of new pavement and joints with previously placed PCC shall be tooled to remove laitance and mortar resulting from finishing operations and to provide a clean rounded edge to the new pavement. Tooling shall not form ridges on the surface of concrete.

### 3.14 CURING OF PCC:

- A. Immediately after the surface finishing and edging has been completed, the entire exposed surface of the PCC shall be covered and cured for at least 72-hours in accordance with one of the following provisions.
  - 1. LIQUID MEMBRANE-FORMING COMPOUNDS - Liquid membrane-forming compound shall be applied uniformly to the damp concrete by pressure-spray methods at the manufacturer=s recommended rate. The compound shall form an impervious membrane when tested in accordance with ODOT TM 721.
  - 2. POLYETHYLENE FILM - White or clear polyethylene film, a minimum of 4 mils in thickness, shall be applied to damp concrete as soon as the film can be placed without marring or discoloring the surface. The membrane shall be placed in contact with the surface, shall extend beyond the sides or edges of the slabs or forms, and shall be held in position to maintain a moisture proof covering. Laps shall be sufficient to maintain waterproofing equivalent to the sheeting.

### 3.15 PROTECTION OF CONCRETE:

- A. The Contractor shall erect and maintain suitable barriers to protect the concrete from traffic or other detrimental trespass until the pavement is opened to traffic. If necessary, in the opinion of the Engineer, the Contractor shall provide watchmen. Concrete damaged as a result of detrimental trespass shall be replaced at the direction of the Engineer at no expense to the Owner.
- B. The contractor shall not operate construction equipment or allow traffic on newly placed PCC until the concrete attains the specified 28-day compressive strength.

**3.16 COMPRESSIVE STRENGTH:**

- A. Acceptance sampling and testing for strength will be based on 28-day strength tests. The contractor shall provide the Engineer's testing lab access to the mix for sampling a minimum of four cylinders for every 1,000-feet of paved lane or one days work, which every is less.
- B. Cylinders will be sampled, prepared, and cured according to AASHTO T 141 and T 23 for compressive strength testing. One of the four cylinders will be tested for information at 7-days. The other three will be tested at 28-days, according to AASHTO T-22. Sampling and testing shall comply with Section 2000 of these specifications.
- C. The average of the 28-day compressive strength tests of the tree cylinders will constitute the strength test value. If any one of the three cylinders tested indicates a compressive strength more than ten percent below the average strength of the other two cylinders, the results from that cylinder will be discarded and the test strength value will be based on the average strength of the two remaining cylinders.
- D. The Engineer may require removal and replacement of any work incorporating concrete that fails to comply with compressive strength requirements. If deficient PCC is allowed by the Engineer to remain in place, payment will be adjusted in conformance with subsection 7.3.

**3.17 SURFACE TOLERANCE AND TESTING:**

- A. The surface of finished pavement shall not deviate from longitudinal and transverse smoothness more than the prescribed limits. Testing shall be done under the supervision of the Engineer with equipment furnished and operated by the Contractor at the Contractor's expense as soon as the hardness of the concrete permits. The pavement surface shall not deviate from the straightedge at any point by more than 0.02-foot of the specified line, grade, and cross section.

**3.18 SMOOTHNESS:**

- A. For travel lanes, including ramps, testing for longitudinal and transverse smoothness shall be done with a 12-foot straightedge. Extent of the testing shall be determined by the Engineer. The pavement surface shall not deviate from the straightedge at any point by more than 0.02-foot.

**3.19 CORRECTION OF DEFICIENCIES:**

- A. If the pavement does not conform to the prescribed limits of deviation, the following corrections shall apply.
- B. **PLASTIC PCC FAILURE TO MEET STRAIGHTEDGE** - The paving operations shall be stopped until revised methods, changes in equipment, or correction of procedures are made or proposed for trial, and are approved by the Engineer.
- C. **HARDENED PCC FAILURE TO MEET SMOOTHNESS REQUIREMENTS** - For any segment or partial segment failing to meet the straightedge test requirements, the contractor shall take corrective action as follows:

1. Profiling by use of an abrasive grinder equipped with a cutting head comprised of multiple diamond blades. All areas corrected by grinding shall have the required surface texture restored by sawing with diamond-blade saws.
2. Removal of the pavement and replacement with pavement conforming to the plans and specifications.

### 3.20 PAVEMENT THICKNESS:

- A. The Engineer will select locations for non-destructive measurement or core samples to determine pavement thickness. If non-destructive measurements indicate the pavement is less than the thickness shown on the plans, or is otherwise out of specification, the contractor may take cores at the same locations to verify the engineer's measurements. The Contractor shall restore the cored areas using materials and methods complying with the specifications.
- B. Pavement found to be out of specification shall be subject to replacement or to payment at adjusted prices. If the pavement is found to comply with specifications, coring and restoration work performed by the Contractor will be paid for as extra work.

### 3.21 MEASUREMENT AND PAYMENT:

- A. Measurement of Portland Cement Concrete pavement will be made on a square yard basis for the pavement complete in place as specified and accepted. Measurement will be made of width and length of each separately constructed strip of pavement, wherein the width is the design width for edge-to-edge width of pavement, whichever is the lesser, and the length is from end to end of pavement to the nearest 0.1-foot and the square yardage shall be to the nearest 0.1-square yard.
- B. Payment will be made to the nearest 0.1-SY of field-measured product constructed.

## **PART 4 TESTING**

### 4.1 GENERAL:

- A. All testing of PCC shall be done at the direction of the Engineer and shall conform to the requirements, conditions, and specifications as outlined herein.
- B. Test conducted the first time shall be paid by the Owner. If test meet the requirements of these specifications there will be no repeat test of the same material for the same lot, but if test indicate that material is inadequate repeat test for corrected materials shall be paid for by the Contractor.

END OF SECTION