

**SECTION 03310****PORTLAND CEMENT CONCRETE****03310.01 GENERAL****A. Description**

Portland cement concrete shall include, but not necessarily be limited to, furnishing various strengths of Portland cement concrete as specified in the Contract Documents.

**B. Related Work Included Elsewhere**

Not applicable.

**C. Quality Assurance**

## 1. Inspection

The Engineer will inspect all materials before and/or after installation to ensure compliance with the Contract Documents. When specific materials tests are called for in the referenced standards and specifications, the Engineer will have the option of requiring that any or all of these tests be performed for materials furnished for a specific Project. When testing is required, it will be specified herein or in the "Special Provisions".

## 2. Mixes

All mixes furnished shall have been approved by the Maryland State Highway Administration for use on State highway work and produced in plants approved by the State Highway Administration.

## 3. Control Testing

The Contractor shall furnish the necessary molds meeting the requirements of AASHTO M 205. Control testing shall be in accordance with the following requirements:

<u>Test</u>	<u>Method</u>	<u>Min Test Frequency</u>	<u>Responsibility</u>
Slump	AASHTO T 119	1 per 50 cu. yds. or fraction thereof - min 2 per day	Engineer
Air Content	AASHTO T 52 (NOTE 3) or T 196	1 per 50 cu. yds. or fraction thereof - min 2 per day	Engineer
Compression	AASHTO T 22 and T 23 except that MSMT 504 may be used in lieu of AASHTO T 231	1 per 100 cu. yds or fraction thereof: as randomized and directed by the Engineer – min 2 tests per day	Molding, curing, and delivery to an approved laboratory by the Contractor after a 1 to 3 day storage period
Split Tensile Mix No. 7 only	AASHTO T 198	3 per day- 4 specimens per test plus optional early strength tests	Same as for Compression

NOTE 1: A second test will be made if the first slump or air content test fails. The concrete will be accepted or rejected on the basis of second test results.

NOTE 2: Mix No. 7 concrete is required to gain 300 psi strength before opening to traffic.

NOTE 3: Air meter will be calibrated in accordance with MSMT 505.

4. Quality Control During Construction

- a. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days for determination of the compressive strength of the concrete.
- b. Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
  - 1) Average of all sets of those constructive strength tests equal or exceed the required 28 day compressive strength indicated in paragraph 03310.03 A.
  - 2) No individual strength test (average of two cylinders) falls below the required 28 day compressive strength by more than 500 psi.
- c. If either of the above requirements are not met, steps shall be taken to increase the average of subsequent strength test results. If the strength test of laboratory-cured cylinders falls below the specified strength value by

more than 500 psi steps shall be taken, if required by the Engineer, to assure that load-carrying capacity of the structure is not jeopardized. The Engineer may require cores drilled from the area in question in accordance with ASTM C 42. In such cases, three cores will be taken by the County for each strength tests more than 500 psi below the required 28 day compressive test. Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is equal to at least 85% of the required 28 day compressive strength and if no single core test is less than 75% of the required 28 day compressive strength.

- d. If the above criteria are not met, the Contractor shall remove and replace the concrete in question at no additional cost to the County. If the concrete is acceptable, the additional testing will be at the expense of the County, but if the concrete is not acceptable, the additional testing will be at the Contractor's expense.

#### **D. Submittals**

1. Mill Test

The Contractor shall furnish a certified copy of mill tests on each load of cement delivered to the batching plant. The tests shall show the cement's physical and chemical analysis.

2. Control Curves

The Contractor shall furnish manufacturer's curves for all high range water reducer admixture. The curves shall show the fluid ounces of high range water reducer per 100 pounds of cement as related to water reduction and strength gain for 12 hours when used with a cement factor of a minimum of 700 pounds.

3. Mix

The Contractor shall submit to the Engineer the proportions of materials to be used for each concrete mix. The mixture shall meet the requirements of Section 03310.03 and consist of Portland cement, fine aggregate, coarse aggregate, water, and such admixtures as may be specified.

4. Load Tickets

The producer shall provide and issue, in duplicate, tickets for each load. Each ticket shall show the following:

- a. Contract number;
- b. date;
- c. mix number;
- d. number of cubic yards;

- e. truck number;
- f. time loaded for dry batched material or time water was added for central mixed material;
- g. ounces of air entraining agent and other types of admixtures, if applicable, per cubic yard.
- h. the moisture content of the coarse and fine aggregates in excess of the saturated surface dry condition;
- i. the maximum mixing water that can be added at the job site based on the maximum w/c ratio; (Actual water required for mixing will normally be less than the maximum. In central mix plants, the actual water used shall be shown. Maximum allowed slump shall not be exceeded). Additional mixing of 50% of the total mixing time will be required.

In addition, each load ticket shall contain a certification stating that all materials comply with pertinent specifications and the approved design.

Regardless of the quantities involved, the Engineer will conduct the normal job control tests, i.e. slump and air content on the plastic concrete and making test cylinders.

## **03310.02 MATERIALS**

### **A. Materials Furnished by the County**

1. The County will not furnish any materials for Portland cement concrete.
2. The Contractor may purchase water from the County's potable water system in accordance with the current County policies and procedures.

### **B. Contractor's Options**

1. The Contractor may furnish higher strength concrete than specified.
2. Fly ash may be used as a replacement for cement as specified.

### **C. Detailed Material Requirements**

1. Portland Cement

Portland cement shall be in accordance with AASHTO M 85 with the fineness determined in accordance with AASHTO T 153 and the time of setting determined in accordance with AASHTO T 131.

2. Fine Aggregate

Fine aggregate shall meet the gradation requirements contained in Table 03310-1 and shall be in accordance with the quality requirements of AASHTO M 6 except:

- a. The maximum permissible limits for deleterious substances apply.
- b. The uniformity of grading requirements is deleted.
- c. In areas exposed to traffic, only natural sand shall be used.

3. Coarse Aggregate

Coarse aggregate shall be in accordance with the Class A quality requirements of AASHTO M 80 using sodium sulfate to determine the soundness. Grading of aggregate shall be in accordance with AASHTO M 43, size numbers 57, 67, or 7, Table 03310-1.

4. Aggregate Gradations

**TABLE 03310-1**

Mass Percent Passing

Sieves Sizes <u>U.S. Standard</u>	<u>AASHTO M 43</u>			<u>AASHTO M 6*</u>
	<u>No. 57</u>	<u>No. 67</u>	<u>No. 7</u>	<u>FA, PCC</u>
1-1/2 inch	100	-	-	-
1 inch	95-100	100	-	-
3/4 inch	-	90-100	100	-
1/2 inch	25-60	-	90-100	-
3/8 inch	-	20-25	85-100	100
No. 4	0-10	0-10	0-15	95-100
No. 8	0-5	0-5	0-5	-
No. 16	-	-	-	45-85
No. 50	-	-	-	10-30
No. 100	-	-	-	0-10

\*Modified

5. Water from Other Than Potable Sources

Water shall meet the pH requirements of AASHTO T 26, Method B. Water shall not smell or be discolored. Water suspected of questionable quality shall meet limits of the comparison tests with distilled water in accordance with AASHTO T 26. The chloride concentration of water used in mixing and curing of Portland Cement will be determined in accordance with ASTM D 512 and shall not have a chloride concentration exceeding 1000 ppm. The maximum water soluble chloride ion content in the concrete shall not exceed 15% by weight of cement.

6. Chemical Additives for Concrete

Chemical additives for concrete shall not contribute more than 200 ppm of chlorides based on the cement content when tested in accordance with MSMT 610. The relative durability factor of concrete with chemical additives shall be determined in accordance with ASTM C 666, Procedure B.

a. Air Entraining

Air entraining admixtures shall be in accordance with AASHTO M 154.

b. Chemical

Chemical admixtures shall be in accordance with AASHTO M 194.

c. High Range Water Reducing Admixtures

When specified, high range water reducing admixtures shall be liquid and meet the requirements of AASHTO M 194, Type F or G. When this material is used in patching, the admixture shall be liquid and meet the requirements of AASHTO M 194, Type F, for air entrained concrete with the following exceptions.

- 1) The water content shall be a maximum of 85% of that of the control.
- 2) The relative durability factor shall be a minimum of 90 when tested in accordance with ASTM C 666, Procedure B.
- 3) The 12 hour compressive strength for Type F admixture shall be 180% of that of control.

Additionally, the admixture shall be nonfoaming when tested in accordance with ASTM D 1173. It shall not contribute more than 200 ppm of chlorides based on the cement content when tested in accordance with MSMT 610.

The Engineer will determine the minimum dosage rate of admixture to be used in the field.

7. Fly Ash

Fly ash shall be in accordance with AASHTO M 295, pozzolan Class C or F, except:

Loss on ignition, for Mix Nos. 3 and 6	% max	3.0
Moisture content,	% max	1.0

**03310.03 EXECUTION**

**A. Concrete Mixes**

The concrete shall be proportioned by weight. Water and chemical additives may be proportioned by volume or weight. The mix shall be homogeneous, placeable, and uniformly workable.

Coarse aggregate shall be maintained at a uniform moisture content at least equaling its absorbed moisture. Water, if used for wetting, shall meet the requirements of Section 03310.02.

Portland cement concrete shall meet the following requirements:

Mix No.	28 Day Specified Design Compressive Strength (psi)	Min Cement Factor pounds per cubic yard	Coarse Aggregate AASHTO M 43 Size Number	Max Water/Cement Ratio	Slump (Inches)
1	2500	470	57 or 67	0.55	2-5
2	3000	560	57 or 67	0.50	2-5
3	3500	610	57 or 67	0.50	2-5
4	3500	650	57 or 67	0.45	4-8
5	3500	610	7	0.50	2-5
6	4500	650	57 or 67	0.45	2-5
7	350 Split Tensile	610	57	0.50	1 1/2-3

NOTE 1: Mixes using size number 57 aggregate shall contain 5% ± 1 1/2% air. Mixes using number 67 aggregate shall contain 6 ± 2% air except Mix No. 4. Mix No. 4 shall only be used for placing concrete under water by a tremie method.

NOTE 2: When concrete is exposed to water exceeding 15,000 ppm sodium chloride content or to sewage, Type II cement shall be used. Type I or Type II cement shall be used for all other concrete.

NOTE 3: Type D-Retarding Admixture or Type A-Water Reducing Admixture shall be added to concrete. If a High Range Water Reducing Admixture, Type F or Type G, is specified, the slump requirement shall be 4 to 8 inches.

NOTE 4: The Contractor may request to substitute a minimum of 15% of the weight of cement with fly ash. When fly ash is used, the minimum cement factor and water cement ratio would be determined on the basis of combined weight of the cement and fly ash.

**B. Mixers and Agitators**

1. All mixers shall display a current Maryland State Highway Administration approval stamp. Mixers and agitators and mixing and delivery of ready-mixed concrete shall meet the requirements of AASHTO M 157 with the following exceptions:

- a. Transit mixed concrete will not be permitted. The following requirements shall apply when additional water is added on the job site:
    - 1) No water shall be added after partial discharge of the batch.
    - 2) The water-cement ratio shall not be exceeded.
    - 3) The material shall be mixed a minimum of 20 additional revolutions even though the maximum of 100 revolutions may be exceeded.
    - 4) Acceptance will be based upon a retest of the slump and air content.
  - b. All concrete shall be discharged within 1 hour after the mixing water is added or 1 1/2 hours after the addition of the cement to the aggregates, whichever is the lesser time.
  - c. No mixer or agitator containing free water in the drum shall be loaded.
  - d. Should the timing device on a stationary mixer become broken or out of order, the Contractor will be permitted to operate while it is being repaired if he furnishes an approved time piece with minute and second hand. If the timing device is not placed in good working order within 72 hours, further use of the mixer will not be permitted until satisfactory repairs are made.
  - e. When the concrete is specified or permitted to be made by volumetric batching and continuous mixing, the batching and mixing unit shall meet the applicable requirements of ASTM C 685.
2. Where no mixer performance tests are made for stationary mixers, the minimum time shall be 75 seconds, unless a greater mixing time is recommended by the mixer manufacturer. The mixing time may be reduced to a point at which satisfactory mixing is accomplished as determined by mixer performance tests in accordance with ASTM C 94, but in no case shall this time be less than 45 seconds. The mixer performance test shall be repeated whenever the concrete indicates that adequate mixing has not been accomplished. Mixing time shall begin when all ingredients are in the mixer drum.

#### 03310.04 METHOD OF MEASUREMENT

Measurement for furnishing Portland cement concrete will be made as specified in the Sections where Portland cement concrete is utilized.



**03310.05 BASIS OF PAYMENT**

Payment for Portland cement concrete will be made at price bid for the various classes as specified in the Sections where Portland cement concrete is utilized.