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## **SECTION 430**

### **CONCRETE PAVEMENT**

#### **431 Description**

The work performed under this section shall consist of the construction of a pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established.

#### **432 Materials Specifications**

##### **432.01 General**

The specifications presented in this section are performance oriented. The City's objective in setting forth these specifications is to achieve an acceptable quality of streets. All sources for the mined or manufactured materials listed in Section 432.05 must be annually approved by the City as having met the appropriate materials performance specifications. This approval is a condition of using those material sources for public improvement construction.

##### **432.02 Procedure For Material Source Approval**

On or before April 1st of each year, a material supplier for any City improvement shall supply written documentation and material test results from a qualified, independent materials testing laboratory that describes:

1. Material(s) being tested to meet City specifications.
2. The test procedures employed.
3. The supplier(s) manufacturing, mining or treating process by which the tested materials were created.
4. The material test results.
5. A signed statement by the material supplier that the materials produced and tested for this certification are truly representative of the materials to be provided for public improvements in the City during the coming 365 day period.

### **432.03      Violations of Approval Conditions**

**Random Testing.** The Engineer may order random tests of materials used in City improvements to verify compliance with the material specifications. These tests are in addition to the requirements of Section 434 of this Chapter.

### **432.04      Use of Materials Not Listed in Section 432.05**

Materials listed in this section and provided with a set of specifications are those deemed by the City to be the primary structural materials commonly or typically used in public improvements. Ancillary public improvement materials such as manufactured paints and coatings, bonding agents, sealers, gaskets, insulating materials, etc. should be in compliance with Colorado Department of Highways material specifications for the appropriate material employed. Alternative materials for construction may be proposed for use. Decisions on acceptability of alternative materials will be made by the Engineer.

### **432.05      Portland Cement Concrete**

This material shall consist of a mixture of fine and coarse aggregates, Portland cement, water and other materials or admixtures as required.

- A. Portland cement shall comply with the Colorado Department of Highways requirements and ASTM C-150, C-175 or C-595. The type of cement shall be Type IIA (air entraining) or Type V, unless sulfate conditions allow otherwise. Table 2.2.3 in Chapter 2.2 of ACI 201 presents cements recommendations for sulfate resistances. In addition to the standard chemical requirements for Portland cement in ASTM C-150, the maximum percent of alkalis shall be as specified in Table 2 of ASTM C-150 for low-alkali cement. Other types of cement or admixtures are only to be used upon approval by the Engineer.
- B. Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof. Fine aggregate shall meet Colorado Department of Highways Section 703.01 requirements and gradation, except as shown in the Table below.

<b>FINE AGGREGATES FOR PORTLAND CEMENT CONCRETE</b>	
<b>Sieve Size or Test Procedure</b>	<b>Percent Passing or Test Requirement</b>
3/8"	100
No. 4	95-100
No. 16	45-80
No. 50	10-30
No. 100	2-10
No. 200 (AASHTO T-11)	* 3.0 Max.
Clay Lumps & Friable Particles,% (AASHTO T-112)	3.0 Max.
Coal & Lignite, %, (AASHTO T-113)	1.0 Max.
Deleterious Material, %, (AASHTO T-11)	3.0 Max.
Sand Equivalent, %, (AASHTO T-176)	75 Min.
Fineness Modulus	2.50-3.50
Sodium Sulfate Soundness, %, (AASHTO T-104)	10 Max.

\* 5.0 Max. for crusher fines

- C. Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, air cooled blast furnace slag, or crushed hydraulic-cement concrete, or a combination thereof, conforming to the requirements of this specification. Coarse aggregate shall meet Colorado Department of Highways Section 703.02 requirements and gradation, except as shown in the Table below.
- D. Fly ash only to be used on a case-by-case basis when approved by the Engineer.
- E. Portland cement will be accepted on the basis of certificates of compliance and ASTM-C-150. Reinforcing steel, dowel sand tie bars will be accepted by certificate of compliance and mill reports. Water, if not potable, shall be sampled and tested before use. Water shall meet the requirements of Colorado Department of Highways Section 712.01. Only Colorado Department of Highways approved brands of air entraining agents, chemical admixtures and curing materials may be used and must be documented.

- F. Calcium chloride shall not be used as an admixture in concrete. Admixtures used in prestress or bridge deck concrete shall meet the chloride limitations of ACI 201 for total chloride in concrete.
- G. The curing compound shall be a white pigmented liquid membrane forming curing compound and meet the requirements of AASHTO M-148. The curing compound shall be applied under pressure at the rate of one gallon to not more than 150 square feet by mechanical sprayers.

<b>COARSE AGGREGATES FOR PORTLAND CEMENT CONCRETE</b>	
<b>Sieve Size or Test Procedure</b>	<b>Percent Passing or Test Requirement</b>
2"	100
1-1/2"	95-100
3/4"	35-70
3/8"	10-30
No. 4	0-5
No. 200 (AASHTO T-11)	* 1.0 Max.
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% Wear (AASHTO T-96)	45 Max.
Clay Lumps & Friable Particles, % (AASHTO T-112)	5.0 Max.
Coal & Lignites, %, (AASHTO T-113)	0.5 Max.
Sum of Clay lumps, Friable Particles and Chert, (AASHTO T-11)	7.0 Max.
Sodium Sulfate Soundness, %, (AASHTO T-104)	12 Max.

\* 1.5 Max. for crusher fines

**NOTE:** AASHTO M-43, Size No. 57 may also be used on a case-by-case basis when approved by the Engineer.

- H. Reinforcing steel shall meet the requirements of Colorado Department of Highways Section 709.01, grade 40 minimum.
- I. Proportioning - Minimum laboratory trial mix strength shall be 600 psi (third point flexural) at age 28 days (ASTM C-78). A minimum of 6 test cylinders shall also be taken of the laboratory mix for future correlations (ASTM C-39).

Cement - 564 lbs. minimum per cubic yard of concrete

Air Content - 6% ( $\pm 1-1/2\%$ )

Slump - 3 inch maximum (may be increased to 4 inches for hand work).

Water/Cement Ratio - 0.45 maximum

### **433 CONSTRUCTION REQUIREMENTS**

Materials shall be proportioned, handled, measured, batched, placed, finished and cured in accordance with Section 412 of the Colorado Department of Highways Specifications and ASTM C-94 (whichever is more stringent).

### **434 QUALITY CONTROL**

All samples and tests described herein shall be made in accordance with approved ASTM/AASHTO procedures. The owner/developer shall provide for all testing laboratory services in connection with tests verifying conformance of proposed materials with project requirements. The owner/developer shall also provide for testing laboratory services in connection with tests on materials after incorporation into the project, on a first time basis only. The costs of any retesting, as required, shall be borne by the Contractor.

During placement of Portland cement concrete pavement, observation and testing shall be on a full-time basis. For each day of production, aggregate samples shall be obtained for gradation of both the coarse and fine aggregates.

Slump, air content, unit weight and mix temperature shall be tested for each set of cylinders taken. The first three loads shall be tested for slump and air content. If any one test fails to meet requirements, that load shall be rejected and tests shall continue on each load until three consecutive loads meet requirements. Thereafter, slump, air content, unit weight and mix temperature shall be tested at least every 100 cubic yards. Any load not meeting test specifications shall be rejected.

Five compressive strength cylinders shall be fabricated for each 100 cubic yards or major fraction thereof on each day pavement is placed. Cylinders shall be tested as follows: 2 at 7 days, 2 at 28 days and 1 at a later date, if necessary, as required by the Engineer.

Thickness of fresh concrete must be checked a minimum of every 300 lineal feet each traffic lane according to the Colorado Department of Highways Section 412.24. Any noted deficiency areas shall be corrected at that time. Surface deficiency areas shall also be corrected at that time. Surface smoothness shall be tested and corrected as necessary according to Colorado Department of Highways Section 412.16. The Engineer will decide when the pavement shall be opened to traffic; otherwise the pavement shall not be opened to traffic until 14 days after the concrete was placed, or until the compressive strength of laboratory cured 6 x 12 cylinders (ASTM C-39) averages 3000 psi. Prior to opening to traffic, the pavement shall also be cleaned and all joints sealed.

**435 FINAL ACCEPTANCE**

All test results shall be submitted and reviewed by the City. Provided all tests are acceptable, the pavement will be accepted. Should testing indicate unsatisfactory work, removal, replacement, grinding or reduced payment will be required.

**436 MEASUREMENT AND PAYMENT**

The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard which price and payment shall be full compensation for furnishing and placing all materials, including any dowels, tie bars and joint material, provided, however, that for any pavement found deficient in thickness by more than 0.20 inch, but not more than 1.0 inch, only the reduced price stipulated below shall be paid.

No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans. Reinforcing steel, other than as mentioned above, will be measured and paid for in accordance with the Colorado Department of Highways Section 602.

Where the average thickness of pavement is deficient in thickness by more than 0.20 inch, but not more than 1.0 inch, payment will be made at an adjusted price as specified in the following table.

<b>CONCRETE PAVEMENT DEFICIENCY</b>	
<b>Deficiency in Thickness (Determined by Cores) INCHES</b>	<b>Proportional Part of Contract Price Allowed</b>
0.0 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

When the thickness of pavement is deficient by more than one inch, and judgement of the Engineer is that the area of such deficiency should not be removed and replaced, there will be no payment for the area retained.