

**OKLAHOMA DEPARTMENT OF TRANSPORTATION  
SPECIAL PROVISIONS  
FOR  
PORTLAND CEMENT CONCRETE**

These Special Provisions revise, amend, and where in conflict, supersede applicable sections of the 1999 Standard Specifications for Highway Construction, English and Metric, as applicable. Units of measurement are provided in the subsections in both English and Metric equivalents. The units applicable for this project will be those specified in the project plans.

**701.01. MIX DESIGN AND PROPORTIONING.**

*(delete subsection 701.01(a) and substitute the following:)*

(a) **Classes of Concrete.** The classes of concrete are shown in the following table:

**CLASSES OF CONCRETE**

<b>Class of Concrete</b>	<b>Minimum Cement Content <sup>a</sup>, lb/y<sup>3</sup> (kg/m<sup>3</sup>)</b>	<b>Air Content, Percent</b>	<b>Maximum Water/Cement Ratio <sup>b</sup>, lb/lb (kg/kg)</b>	<b>Slump <sup>c</sup>, inches (mm)</b>	<b>Minimum 28-day Compressive Strength <sup>d</sup>, psi (kPa)</b>
AA	611 (363)	6.5±1.5	0.44	2±1 (50±25)	4000 (27,580)
A	564 (335)	6±1.5	0.48	2±1 (50±25)	3000 (20,685)
AP	470 (279)	6±1.5	0.48	2±1 (50±25)	3000 (20,685)
C	395 (234)	6±1.5	0.62	3±1 (75±25)	2400 (16,550)
P	611 (363)	5±1.5	0.44	3±1 (75±25)	As specified

<sup>a</sup> *Cement Substitution.* Cement substitutions shall be made on a one to one basis by weight (mass) in accordance with the following table.

<b>Cement Substitute</b>	<b>Maximum Percent of Total Cementitious Materials by Weight</b>
Fly Ash, Pozzolan, or Other Approved Substitutes	28 <sup>1</sup>
Slag	50
Silica Fume	10
Total Cement Substitution (may not exceed individual limits)	50

<sup>1</sup> A maximum of 15% fly ash (20% from April through October) may be substituted at the concrete

batch plant. In no case shall the total amount of substitution exceed the 28% referenced above.

Fly ash and slag shall conform to the requirements of Section 702. Pozzolan other than fly ash shall conform to the requirements of AASHTO M 295 including the supplementary optional chemical requirements. Other approved substitutes shall only be used in ASTM C 1157 cement production. Substitutes shall be pozzolanic and/or cementitious in nature and shall be subject to the approval of the Materials Engineer. Silica fume shall conform to the requirements of ASTM C 1240. No cement substitutions other than silica fume are allowed for Class P concrete. The concrete mix design shall reflect all cement substitutions. The contractor should consider the intended use of the concrete and anticipated weather conditions when determining the cement substitutes to be used.

<sup>b</sup> *Water Cement Ratio.* Using the weight in pounds (kilograms) of each material, calculate the water-cement ratio (W/C) by the following equation:

$$W/C = \text{Water} / (\text{Cement} + \text{Cement Substitutes})$$

The water actually used is determined by the water measured into the batch plus the free water on wet aggregate minus the water absorbed by dry aggregate plus water in any admixture solutions and shall not exceed the limit specified.

<sup>c</sup> *Slump.* The slump shall be as shown, or as specified in the contract documents, or as approved by the Engineer, and the consistency required shall be that which will provide satisfactory workability for the type work being done. Slump tests will be made during the progress of the work as a measure of uniformity of the consistency of the concrete. If using a high-range water reducing admixture, limit the slump to a maximum of 9 inches (230 mm).

<sup>d</sup> *Compressive Strength.* Compressive strength is based on the average of three test cylinders. The compressive strength requirements of Class P concrete will be specified in the contract documents.

When the class of concrete is not expressly indicated on the Plans, the following requirements shall govern:

- *Class AA.* Use Class AA concrete in superstructure items, such as bridge floors, approach slabs, reinforced concrete piles, drilled shaft foundations, parapet walls, concrete rail and handrails.
- *Class A.* Use Class A concrete for pavements and in substructures items, such as pier caps, columns, abutments, retaining walls, box culverts, and all reinforced concrete not requiring Class AA concrete.
- *Class AP.* Use Class AP concrete in shoulders, merge areas and gore areas for PCC pavements, unless otherwise directed by plan notes.
- *Class C.* Use Class C concrete for soil erosion control structures.
- *Class P.* Use Class P concrete for precast prestressed concrete members, such as PC beams, double tees, prestressed concrete piling, and stay-in-place precast concrete deck panels, and cast-in-place post-tensioned structures.

*(substitute section 701.02. with the following:)*

**701.02. PORTLAND CEMENT.**

All cement furnished shall meet the specification requirements of one of the following types: Portland Cement; Blended Hydraulic Cement; or Hydraulic Cement - Type GU

(a) Portland Cement shall conform to the requirements of AASHTO M 85 except as modified by these specifications:

1. Limestone Addition: a maximum of 3.0% limestone by mass may be interground with the cement provided that the chemical and physical requirements of AASHTO M 85 are met. Only naturally occurring limestone, containing at least 70% by mass one or more of the mineral forms of calcium carbonate, may be interground. Calculate and report the limestone content in Portland cement on all mill reports as described in ASTM C150, Annex A1.
2. Include the CO<sub>2</sub> content of Portland cement on all mill reports. Determine the CO<sub>2</sub> content in accordance with ASTM C 114. When the CO<sub>2</sub> content exceeds 1.0% or when any quantity of limestone is added, report the C<sub>3</sub>S as calculated in ASTM C150, Annex A1, using the actual CO<sub>2</sub> value.
3. The tricalcium aluminate (C<sub>3</sub>A) content in Type I cement shall not exceed 15%.
4. Report the amount retained on the No. 325 (45- $\mu$ m) sieve in accordance with the procedure specified in AASHTO T 192 on all mill test reports.
5. Total equivalent alkalis shall not exceed 0.95%. This limit may be waived on a project basis if the proposed concrete mix design meets the expansion limits in Option R of ASTM C 1157 when tested according to ASTM C 1260.
6. Type IV and Type V cement shall meet the optional physical requirements.
7. All Types of cement supplied under optimum SO<sub>3</sub> requirements shall supply supporting data as described in footnote <sup>d</sup> of Table 1 quarterly to the Materials Engineer.

(b) Blended Hydraulic Cement shall conform to the requirements of AASHTO M 240 except as modified by these specifications:

1. Total equivalent alkalis shall not exceed 0.95%. This limit may be waived on a project basis if the proposed concrete mix design meets the expansion limits in Option R of ASTM C 1157 when tested according to ASTM C 1260.
2. Tricalcium aluminate content shall not exceed 15%.
3. Report the amount retained on the No. 325 (45- $\mu$ m) sieve in accordance with the procedure specified in AASHTO T 192, and the fineness by the air permeability method in accordance with the procedure specified in AASHTO T 153 on all mill test reports.
4. Silicon Dioxide (SiO<sub>2</sub>), Aluminum Oxide (Al<sub>2</sub>O<sub>3</sub>) and Calcium Oxide (CaO) shall be tested in accordance with the procedures specified in AASHTO T 105 and shall be reported on all mill reports.
5. Cement substitutions shall not exceed the limits in Section 701.01(a) or the limit imposed by the applicable cement specification, whichever is less.
6. All Types of cement supplied under optimum SO<sub>3</sub> requirements shall supply supporting data as described in footnote <sup>a</sup> of Table 1 quarterly to the Materials Engineer.

- (c) Hydraulic Cement shall conform to the requirements of ASTM C 1157 except as modified by these specifications:
1. Total equivalent alkalis shall not exceed 0.95%. This limit may be waived on a project basis if the proposed concrete mix design meets the expansion limits in Option R of ASTM C 1157 when tested according to ASTM C 1260.
  2. Tricalcium aluminate content shall not exceed 15%.
  3. Report the amount retained on the No. 325 (45- $\mu$ m) sieve in accordance with the procedure specified in AASHTO T 192, and the fineness by the air permeability method in accordance with the procedure specified in AASHTO T 153 on all mill test reports.
  4. The loss on ignition for all Hydraulic cements shall not exceed 5.0%.
  5. Cement substitutions shall not exceed the limits in Section 701.01(a) or the limit imposed by the applicable cement specification, whichever is less.

Type I, Type I(SM), Type I(PM), Type IS, Type IP and Type GU shall be used in concrete for general concrete construction. When white Portland cement is required, it shall meet the requirements of Type I. Type V, Type MS, or Type HS shall be used in concrete exposed to moderate sulphate action and Type IV, Type MH, or Type LH shall be used in concrete exposed to moderate heat of hydration, when specified on the Plans or in the Proposal. Type III or Type HE may be used when high early strength concrete is required.

Unless otherwise approved by the Engineer, the product of only one mill of any one brand and type of portland cement shall be used on any structure or adjacent structures. Provide suitable means of storing and protecting the cement against dampness. Cement which for any reason has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used. The cement manufacturer shall state on each shipping ticket the types and amounts of cement substitutions in the cement.

All tests shall be performed by a qualified domestic manufacturer. The Contractor shall reimburse the Department for all inspection expenses incurred outside the United States and for any additional expenses incurred due to the use of foreign cement.

All methods of sampling and testing shall be in accordance with the requirements of AASHTO M 85 or AASHTO M 240, except as modified by the Department's acceptance policy: "Approval Procedure for Hydraulic Cement." The procedure is available on the Department's web page, [www.okladot.state.ok.us/](http://www.okladot.state.ok.us/).