

**OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
OPTIMIZED GRADATION FOR PORTLAND CEMENT CONCRETE PAVEMENT**

These special provisions revise, amend, and where in conflict, supersede applicable sections of the 2009 Standard Specifications for Highway Construction, English and Metric.

701.01 MIX DESIGN AND PROPORTIONING

A. Classes of Concrete (*Add the following:*)

If the Contractor provides a Class A concrete utilizing an Optimized Gradation Concrete Mix Design (OGCMD) procedure for use in Portland Cement Concrete Pavements, integral curb, combined curb and gutter, concrete sidewalk, concrete driveways and divider strip, the minimum cement content may be reduced to 470 lbs/yd³ [279 kg/m³]. Ensure Class A concrete used in OGCMD Pavements has a minimum flexural strength of 700 psi [4.83 MPa] at 28 days when tested in accordance with AASHTO T 97. Flexural strength testing will only be required for OGCMD approval and field testing of flexural strength will not be required of the Contractor or Resident Engineer. At the option of the Materials Engineer, The Materials Division may test flexural strength for acceptance or verification purposes.

C. Proportioning (*Add the following:*)

For Class A and AP concrete utilizing an OGCMD procedure, ensure the concrete mix design is based on an absolute volume method for the class of concrete specified. Ensure the consistency of the concrete used for concrete pavement or curb and gutter is suitable for satisfactory placement of the concrete by slipform paving. Ensure OGCMD concrete mixtures are designed and produced in conformance with sections 414, 609, 610, 701, this special provision, and all appropriate special provisions in the contract. Ensure the OGCMD concrete used for high early strength concrete meets the minimum 28 day compressive strength requirement within 72 hours of placement. Submit an optimized gradation mix design at least 30 days before production to the Materials Engineer. Do not place any optimized gradation concrete until the mix design is reviewed and approved by the Materials Engineer.

Include at least the following information with each Optimized Gradation Concrete Mix Design:

- Project identification
- Name and address of the contractor and producer
- A unique mix design name along with the mix designs class designation
- Expected travel time from batch to placement
- Aggregate sources
- Gradations for each aggregate source. Sieve sizes shall include the 1 ½ in. [37.5mm], 1 in. [25.0mm], ¾ in. [19.0mm], ½ in. [12.5mm], ⅜ in. [9.5mm], No. 4 [4.75mm], No. 8 [2.36mm], No. 16 [1.18mm], No. 30 [600µm], No. 50 [300µm], No. 100 [150µm], and the No. 200 [75µm].
- Hydraulic cement type and source
- Types of cement replacement, if used, and sources
- Types of admixtures and sources
- Material proportions

- Combined gradation charts
 - Coarseness / Workability Chart
 - 0.45 Power Curve
 - Percent Retained Chart
- Air content
- Slump
- Unit weight
- Water / cementitious materials ratio
- Compressive and flexural strengths at 7 and 28 days
- Compressive strength at 72 hours for high early strength concrete
- When the combined aggregate gradation contains less than 40% natural sand fine aggregate, provide the results of the acid insoluble residue test described in OHDL-25 for the combined aggregate that passes the No. 4 [4.75mm] sieve.

The optimized gradation concrete mix design and the initial job mix formula are the responsibility of the contractor. Provide one uniquely named mix design for each type of portland cement concrete utilizing an optimized gradation. Ensure the job mix formula provided has a combined aggregate gradation that plots in Area II on a Coarseness/Workability Chart as described in OHDL-52. The initial job mix formula shall establish a single percentage of aggregate passing each required sieve in 701.01.B.(6). for the combined aggregate gradation. Ensure that all necessary quality control steps are taken to maintain control of the combined aggregates job mix formula and ensure that all field samples plot in area II as described in OHDL-52.

Ensure the combined aggregate that passes the No. 4 [4.75mm] sieve has an acid insoluble residue of at least 50% by weight when tested in accordance with OHDL-25.

Determining an optimum combined aggregate blend will require the use of all three combined gradation charts described in OHDL-52. Area II of the coarseness/workability chart will be the primary method used to ensure the aggregate combination will produce a concrete mixture with the appropriate properties for the intended application and placement method. Optimized Gradation Concrete Mix Designs that plot outside of Area II will not be approved. The 0.45 power curve and the percent retained chart will be used as secondary means to verify the coarseness/workability chart results and to identify areas deviating from a well graded aggregate combination. Any optimized gradation that plots more than three sieves outside the box or any one sieve that plots more than 3% outside the box on the percent retained chart of OHDL-52 may be rejected.

Submit new mix designs if:

1. The optimized gradation concrete mix design is rejected by the Materials Engineer,
2. The source of any material changes, or
3. The mix design produces unacceptable workability or production test results.

701.05 FINE AGGREGATE

B. General Requirements *(Add the following:)*

Fine Aggregate used for OGCMD Class A and AP concretes for Portland Cement Concrete Pavement does not have to meet the gradation requirements of section 701.05.C. Ensure OGCMD natural fine aggregates and manufactured fine aggregates when tested by means of laboratory sieves meet the following requirements:

<u>Sieve No.</u>	<u>Percent Passing</u>
½ inch [12.5mm]	100
No. 200 [75µm]	0.0 - 3.0

All natural sand sources of fine aggregate shall be from a fine aggregate source on the Approved Materials List for use in hydraulic cement concrete or limited use. All crushed fine aggregate (manufactured sand) in the mix shall be obtained from a coarse aggregate source on the Approved Materials List for use in hydraulic cement concrete.

701.06 COARSE AGGREGATE *(Add the following:)*

Coarse Aggregate used for OGCMD Class A and AP concretes for Portland Cement Concrete Pavement do not have to meet the gradation requirements of section 701.06. Ensure OGCMD Coarse Aggregate when tested by means of laboratory sieves meets the following requirements:

<u>Sieve No.</u>	<u>Percent Passing</u>
1 ½ inch [37.5mm]	100
1 inch [25mm]	95 - 100
No. 200 [75µm]	0.0 - 3.0

All OGCMD aggregate sources that have material retained on or above the ½ inch [12.5 mm] sieve will be considered coarse aggregate. Ensure all coarse aggregate is obtained from a source on the Approved Materials List for use in hydraulic cement concrete.