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 Class A or AP concrete utilizing an Optimized Gradation Concrete Mix Design (OGCMD) procedure is provided for use in Portland cement concrete pavements, integral curb, combined curb and gutter, concrete sidewalk, concrete driveways and divider strip, then the minimum cement content for Class A concrete may be reduced to 470 lbs/yd3 [279 kg/m3], and Class AP concrete may be reduced to 450 lbs/yd3 [267 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 optimized gradation concrete mix design approval and field testing of flexural strength will not be required. At the option of the Department's Materials Engineer, the Department 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 Subsections 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 Department's 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
- Aggregate sources
- Gradations for each aggregate source. Sieve sizes to include: 1 ½ in. [37.5mm], 1 in. [25mm], ¾ in.[19mm], 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 No. 200 [75µm].
- Hydraulic cement type and source
- Types of cement replacement (if used) and sources
- Types of admixtures, sources, and dosage rates

- Material proportions
- Combined gradation charts
  - Tarantula Curve
  - Individual and Combined Gradation Charts
- 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
- 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 optimized gradation are the responsibility of the Contractor. Ensure the mix design provided has a combined aggregate gradation that plots within the limits of the Tarantula Curve as described in OHDL-60. Ensure that all necessary quality control steps are taken to maintain control of the combined aggregates used in the mix design.

Ensure the combined aggregate that is retained on each individual sieve, when tested in accordance with T-11 and T-27, meets the requirements specified in Table 701:3A, and Equations 701:1 and 701:2 below.

Table 701:3A
Combined Aggregate Gradation

Sieve Size	Percent Retained
1 ½ inch [37.5 mm]	0.0
1 inch [25 mm]	0.0 - 16
¾ inch [19 mm]	4.0 - 20
½ inch [12.5 mm]	4.0 - 20
⅜ inch [9.5 mm]	4.0 - 20
No. 4 [4.75 mm]	0.0 - 20
No. 8 [2.36 mm]	0.0 - 12
No. 16 [1.18 mm]	0.0 - 12
No. 30 [600 µm]	4.0 - 20
No. 50 [300 µm]	4.0 - 20
No. 100 [150 µm]	0.0 - 10
No. 200 [75 µm]	0.0 - 3.0

$N8 + N16 + N30 \geq 15\%$ Equation 701:1

$N30 + N50 + N100 + N200 = 29\% \pm 5\%$ Equation 701:2

Where:

$N8$ = percent (%) retained on the No. 8 sieve

$N16$ = percent (%) retained on the No. 16 sieve

$N30$ = percent (%) retained on the No. 30 sieve

$N50$ = percent (%) retained on the No. 50 sieve

$N100$ = percent (%) retained on the No. 100 sieve

$N200$ = percent (%) retained on the No. 200 sieve

Ensure the combined aggregate that passes the No. 4 [4.75mm] sieve has an acid insoluble residue of at least 60% by weight when tested in accordance with OHDL-25.

Minor changes to the aggregate source proportioning percentages may be made to the mix design during production, in order to maintain compliance with the specification, if requested in writing and approved by the Resident Engineer. If the OGMCD has a manufactured fine aggregate source, ensure that any proportion increase greater than 5% to the percent of material from that source has the approval of the Materials Engineer.

A new mix design must be submitted if any of the following occur:

- The optimized gradation concrete mix design is rejected by the Materials Engineer,
- The source of any material changes,
- Greater than a 5% increase in the proportion of the manufactured fine aggregate (if used), or
- The mix design produces unacceptable workability or production test results.

701.05 FINE AGGREGATE

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

Fine Aggregates used for an OGCMD Class A or AP concrete for Portland Cement Concrete Pavement do not have to meet the gradation requirements of Subsection 701.05.C. All OGCMD aggregate sources that have no material retained on or above the ½ inch [12.5 mm] sieve will be considered fine aggregate. 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 Aggregates used for an OGCMD Class A or AP concrete for Portland cement concrete pavement do not have to meet the gradation requirements of section 701.06. 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.