

SECTION 4000 - CONCRETE MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE: This Section covers concrete materials and mixtures; flowable fill; materials for reinforcing, formwork, joints, and curing; ready-mix plant and transportation requirements; and special methods for cold and hot weather placement.

1.02 RELATED WORK: Refer to the following sections for related work:

Placing and Finishing Pavements	Section 4100-Concrete Pavement and Flatwork
Placing and Finishing Concrete Structures	Section 4200-Concrete Structures

1.03 REFERENCE STANDARDS: The following documents are referenced in this Section:

- A. Documents by the American Concrete Institute are referenced as “ACI”.
- B. Documents by the Concrete Reinforcing Steel Institute are referenced as “CRSI”.
- C. Mixes specified by the Kansas City Metro Materials Board are referenced as “KCMMB”
- D. Mixes specified by Kansas Department of Transportation are referenced as “KDOT”

1.04 SUBMITTALS: Contractor shall submit the following for review:

- A. Suppliers mix design, strength test results, and aggregate sieve analysis.

PART 2 - PRODUCTS

2.01 FORMWORK: Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings. Construct and maintain forms to the tolerances given in ACI 301, Section 4. Forms shall be sufficiently tight to prevent leakage of mortar and shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement. Provide combined tie-spreaders with snap-off ties leaving a truncated cone hole on formed surfaces exposed to view.

Forms may be of wood or metal and shall be designed to permit easy removal without injury to the concrete. Surface of forms shall provide a smooth, dense, plane surface to the finished concrete where exposed to view. Forms shall be coated with an approved light oil to prevent concrete from adhering and shall be thoroughly cleaned and re-oiled before each use.

2.02 CONCRETE MATERIALS: Material used in the manufacture of concrete shall conform to one of the following:

- A. KCMMB mixes shall use the aggregates, cement and cementitious materials, water, aggregates and admixtures required in the KCMMB specifications.
- B. KDOT mixes shall use the aggregates, cement and cementitious materials, water, aggregates and admixtures required in the KDOT standard specifications as narrowed below:
 - 1. Course aggregate shall be class 1, limestone meeting gradation CA-4,
- C. Air entraining admixture shall conform to the requirements of ASTM C260.
- D. Fly ash shall for flowable fill meet the requirements of ASTM C618, Class C or Class F.

2.03 CONCRETE MIXES: Mix proportions for all concrete shall conform to ACI 211.1 and unless otherwise specified, shall be selected preferably on the basis of field experience. In the case where sufficient or suitable strength test data is not available, concrete shall be proportioned on the basis of laboratory trial mix design. Concrete shall be supplied by ready-mix plants meeting the requirements of this Section. Unless modified by the special conditions, concrete mixes for specific applications shall meet the following limits:

- A. Concrete for cast-in-place structures:
 - 1. Uses:
 - a. Bridge decks, beams, stringers, caps, columns,
 - b. bridge abutments and piers,
 - c. cast-in-place reinforced concrete box culverts, head walls, wing walls, and retaining walls where the wall is within public right of way or supports public right of way,
 - d. retaining walls where the wall is within public right of way or supports public right of way,
 - e. cast in place tops for drainage inlets.
 - 2. Mix: KCMMB, 5K, mix provided by a KCMMB approved supplier.
- B. Concrete for slabs and pavement:
 - 1. Uses:
 - a. curb, and gutter, inlet throats and curb transitions for inlets,
 - b. concrete street pavements,
 - c. driveways and sidewalks for commercial, industrial and institutional land uses,
 - d. driveways and sidewalks installed as part of a Unified Government capital project regardless of land use,
 - e. corner curb ramps,
 - f. concrete base for pavement patch,
 - g. medians and header curbs,
 - h. work not specifically listed under one of the other mixes.
 - 2. Mix: KCMMB, 4K mix, provided by a KCMMB approved supplier.

- C. Concrete for residential flatwork:
1. Uses:
 - a. sidewalks and driveways on residential frontage (except concrete for corner curb ramps shall be the same as concrete for curb and gutter) when installed by or under contract to the resident, lot builder or developer.
 2. Mix: One of the following:
 - a. KDOT Concrete for Pavement, Air Entrained, or
 - b. KDOT Grade 4.0 (AE), coarse and fine aggregate, or
 - c. KCMMB, 4K, provided by a KCMMB approved supplier. Fiber not required for KCMMB mix.
- D. Concrete for precast:
1. Uses:
 - a. precast manholes, junction boxes, and drainage inlets, including precast inlet tops,
 - b. precast reinforced concrete box culverts.
 2. Mix: Either of the following:
 - a. KDOT Grade 4.0 (AE), coarse and fine aggregate, or
 - b. KCMMB, 4K, provided by a KCMMB approved supplier.
- E. Concrete for underground uses:
1. Uses:
 - a. cast in place junction boxes, drainage inlets and manholes, excluding inlet tops
 - b. manhole, junction box and drainage inlet invert/base,
 - c. bases for street light and signal pole, and
 - d. pipe encasement and concrete cradles.
 2. Mix: Either of the following:
 - a. KDOT Grade 3.5 (AE), coarse and fine aggregate, or
 - b. KCMMB, 4K, provided by a KCMMB approved supplier.
- F. Field identifiable parameters: The following field identifiable parameters are for the convenience of the project manager and field personnel. It provides a guide to the preliminary evaluation of concrete quality from typical field tests or job mix information. The table shows typical values for each mix, but it does not constitute a minimum standard nor does it supersede the KCMMB or KDOT mix and material specifications. The KCMMB and to a smaller degree the KDOT specifications are job mix based and absolute minimum values of mix parameters cannot be established. Slump particularly may vary beyond the typical range for machine placed or pumped concrete.

<u>Mix</u>	<u>Cement</u>	<u>Slag/ash</u>	<u>Coarse Aggregate</u>	<u>Slump</u>	<u>W/C Ratio</u>	<u>Break</u>	<u>Air</u>
KCMMB 5K	660	25%	Granite/ Quartz	2 - 4	0.40	6,200	5-8
KCMMB 4K	600	25%	Granite/ Quartz	2 - 4	0.44	5,200	5-8
KDOT Concrete for Pavement, Air Entrained	602	0-20%	Limestone	<2.5	0.49	600 Flexual	>5
KDOT Grade 4.0	602	0-25%	Limestone	2 - 4	0.44	5,200	5-8
KDOT Grade 3.5	564	0-25%	Limestone	2 - 4	0.46	4,600	5-8

2.04 FLOWABLE FILL: Flowable fill shall be self-leveling and shall consist of Portland cement, fly ash, water, and fine aggregate. Fly ash shall for flowable fill meet the requirements of ASTM C618, Class C or Class F. Accelerators may be used. Mix proportions shall be selected by manufacturer. If used as trench fill, the 28-day compressive strength shall be greater than 45 psi but less than 150 psi to permit future excavation. If used for abandonments, there are no minimum strength requirements.

2.05 REINFORCEMENT: Reinforcement shall meet the following specifications:

A. Reinforcing bar: ASTM A615, Grade 60 deformed billet steel bar, uncoated finish.

Epoxy coated bars shall meet the requirements of KDOT Standard Specifications Subsection 1602.

B. Dowels: ASTM A615, Grade 40, plain steel, uncoated finish, greased dowel. Provide matched cap when required by the drawings or Special Conditions. If no size is given, dowels shall be 1-1/8-inch diameter by 18 inches length. Provide dowel basket to hold dowels in parallel alignment.

C. Bolsters, Chairs, and Accessories: Conform to ACI SP-66 and the CRSI Manual of Standard Practice. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support, and fasten reinforcement in place during the concrete placement. Metal accessories shall be galvanized or plastic-coated where legs will be exposed in finished concrete surfaces. Submit representative samples for approval prior to installation.

2.06 FIBER REINFORCEMENT: Where required, fiber reinforcement and application rate shall comply with the material specifications and performance requirements set forth one of the following:

A. Polypropylene fiber: ASTM C1116, for Type III Synthetic-Fiber Reinforced Concrete, and as follows. Synthetic reinforcing fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials. Fibers shall have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and be specifically manufactured to an optimum gradation for use as concrete reinforcement. Provide a minimum of 1.5 pounds fiber reinforcement per cubic yard of concrete. Fibers shall be added at the batch plant.

- B. Cellulose fiber: 100% Alkali-resistant, virgin cellulose fiber with average length of 2.1 mm and fiber count of 1,590,000 fibers/gram. Buckeye UltraFiber 500 or equivalent. Provide a minimum of 1.0 pounds fiber reinforcement per cubic yard of concrete. Fibers shall be added at the batch plant.

2.07 CURING MATERIALS: Curing materials shall meet one of the following requirements:

- A. Waterproof sheeting shall be 4-mil, opaque white polyethylene sheeting conforming to ASTM C171. Sufficient quantity shall be provided to allow laps. Hold down weights to continuously weight all edges and laps shall be provided.
- B. Curing membrane shall be Type 2, white pigmented compound, meeting KDOT Standard Specifications Subsection 1406. Curing membrane shall not be used where concrete shall be subsequently painted.
- C. Where asphalt pavement will overlay a concrete base coarse, use Type SS-1H emulsified asphalt conforming to KDOT Standard Specifications Subsection 1202. The heating and temperature of the bituminous material shall be in accordance with the provisions of KDOT Standard Specifications Section 602.

2.08 PLANT, TRANSPORT, AND MISCELLANEOUS EQUIPMENT: Ready-mix plants shall conform to KDOT Standard Specifications Division 150 and ASTM C94. Ready-mix plants shall have means of controlling the mix temperatures within the limits given in Part 3 of this Section. Transport equipment and methods shall conform to KDOT Standard Specifications Division 150. Vibrators, slip form pavers, saws, and other miscellaneous equipment shall conform to KDOT Standard Specifications Division 150.

PART 3 - EXECUTION

3.01 GENERAL: Transportation, placement, and consolidation of concrete shall conform to KDOT Standard Specifications Division 400 and ACI 304. Curing of concrete shall conform to KDOT Standard Specifications Divisions 500 and 700 and to ACI 301 except only in-form curing, waterproof sheeting, or curing membrane are allowed. Minimum curing times are given in the sections describing installation of specific items.

3.02 COLD WEATHER CONCRETING: This requirement applies when air temperature drops below 40°F or when forecast to drop below 40°F within 24 hours of placing. A specific cold weather protection plan shall be submitted to Engineer for review. Depending on severity of weather, the plan may include heating of concrete mix to between 60°F and 80°F, use of insulating blankets, and use of artificial heat source or other methods recommended by ACI 306. Minimum length of protection shall be 72 hours unless forecast shows daily lows above 40°F. Use of an accelerator or high-early cement will be considered only in the most severe conditions, and then only if delay of placement poses a threat to public welfare. No concrete shall be placed on frozen subgrade.

3.03 HOT WEATHER CONCRETING: This requirement applies when the temperature rises above 90°F. A specific hot weather protection plan shall be submitted to Engineer for review. Depending

on the severity of the weather, the plan may include cooling of concrete mix to below 90°F, scheduling work to place and finish concrete during cool periods of the day, prewetting of forms and subgrade, rapid placement of curing material, use of fiber to extend sawing window, and use of fog spray or other methods recommended by ACI 305. Use of a retarder will be considered only in the most severe conditions, and then only if delay of placement poses a threat to public welfare.

END OF SECTION 4000