

SECTION 2000 - CONCRETE

2001 SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work. The requirements of this section shall also apply to pre-cast structures intended for use in City of Gardner, unless otherwise approved by the City Engineer.

2002 GENERAL. Concrete shall conform to the standards and specifications established by the Kansas City Metro Materials Board (KCMMB). If KCMMB concrete is not available, Kansas Department of Transportation (KDOT) concrete designated Grade 3.0 AE and/or Grade 4.0 AE shall be used. Prior to opening any concrete construction to light traffic, the concrete shall achieve a minimum of 75% of the mix design strength. Concrete construction shall achieve 80% of the mix design strength prior to opening to full traffic.

2003 MATERIALS. All material used in the manufacture of concrete shall conform to the following:

KCMMB Concrete Mixes: All materials proposed for use in KCMMB approved concrete mixes shall be approved by KCMMB prior to use.

KDOT Grade 3.0 AE and Grade 4.0 AE Concrete: Materials used for KDOT Grade 3.0 and Grade 4.0 concrete shall conform to the requirements of Sections 400, 1100, 1400, 2000, and 2400 of the *Standard Specifications for State Road and Bridge Construction* (latest edition), except as modified herein.

Cement: KDOT Specification 2001.2b. Type I, II, and III Portland cements conforming to AASHTO M 85 with exceptions.

Water: KDOT Specification 2401.

Fine Aggregate: KDOT Specification 1102.2c. Type FA-A, except that artificial or manufactured sand will not be acceptable.

Coarse Aggregate: KDOT Specification 1102.2a. Certification by an independent testing laboratory that the aggregates used were obtained from an approved source and identifying the name and location of the quarry and bed number shall be filed, at the Contractor's expense, with the City Engineer.

Curing Membrane: Type 2-White Pigmented compound, AASHTO Designation M148.

Air-Entrained Agent: AASHTO M 154

Admixtures: ASTM C494, ASTM C1017 for plasticizing admixtures

Reinforcing Steel: ASTM A615: Bars, Grade 60, Beam stirrups & column ties, Grade 40

Welded Wire Fabric: ASTM A185, and AASHTO Designation M 55

2004 MIX DESIGNS.

KCMMB Mixes: The Contractor shall submit a KCMMB approved mix design to the City Engineer for review and approval before any concrete is scheduled for placement. Mix designs shall be submitted for each combination of materials and differing proportions of mixes and water/cement ratios. Admixtures for water reduction, set acceleration or set retardation may be shown as optional provided the mix design shows the allowable application rates or dosages for each optional admixture. Mix designs should include strength, proportions of all materials, gradations of all aggregates, unit weight at the design air content, slump and allowable slump range.

The design water/cement ratio shall not exceed 0.44. The minimum water/cement ratio shall be 0.25.

Air entrainment shall meet the requirements set forth in the current ASTM C260 specifications. The field measured percentage of air content by volume shall be 6.5% plus or minus 1.5%. All concrete mixes shall be designed for 6.5% air entrainment.

KDOT Grade 3.0 AE and Grade 4.0 AE Mixes: The Contractor shall submit a mix design to the City Engineer for approval before any concrete is scheduled for placement. The mix design shall include data on proposed use, design strength, concrete mix proportions, maximum water/cement ratio, slump range, percentage of air entrainment, chemical admixtures and the fine and coarse aggregate gradation. Mix designs shall be submitted for each combination of materials and differing proportions of mixes and water/cement ratios. Adjustments made to an approved mix design shall require approval by the City Engineer. Failure to obtain mix design approval by the City Engineer prior to concrete placement may be cause for removal of the concrete at the Contractor's expense.

2005 CONCRETE MIX DESIGNATIONS. Table 2005-1 illustrates the concrete mix design requirements for each type of construction project. The concrete mix design requirement for project types not listed in the table shall be approved by the City Engineer. KCMMB approved high-early strength concrete mixes may be used when approved by the City Engineer. The Contractor shall be required to submit the high early strength concrete mix design to the City Engineer for approval prior to concrete placement.

Table 2005-1 - Mix Design Requirement per Project Type

Type of Project	KCMMB 4K	KDOT Grade 4.0 AE	KDOT Grade 3.0 AE
Sidewalks	✓		
Curb and Gutter	✓		
Gutter Section of Drive Approaches	✓		
Driveway Approaches	✓		
Concrete Encasement	✓		
Integral Sidewalks and Retaining Walls	✓		
Storm Sewer Structures		✓	
Curb and Area Inlet Tops	✓		
Sanitary Sewer Manholes		✓	
Sanitary Sewer Flowable Fill	✓		
Inverts, Aprons and Collars			✓
Concrete Pavement	✓		
Traffic Signal Pole Bases & Controller Foundations	✓	✓	
Street Light Pole Bases & Controller Foundations	✓	✓	

2006 LIMITING REQUIREMENTS. All concrete shall be within the allowable slump range shown on the approved mix design. In no case shall the water/cement ratio of concrete delivered to the site exceed the water/cement ratio shown on the approved mix design. Concrete with a water/cement ratio exceeding the design water/cement ratio will be rejected.

The Contractor must receive approval from the City Engineer before utilizing optional admixtures in the KCMMB approved mix design. The admixtures must be within the dosage limits specified. A revised slump range will be required if the addition of the admixture causes the slump to fall outside of the range shown on the original approved mix design. Admixtures not shown in the approved mix designs for KDOT Grade 3.0 and Grade 4.0 will not be allowed without approval of the City Engineer. The approval of the City Engineer will be required before admixtures are added to the concrete after the truck has left the batch plant.

The mix design requirement for KDOT Grade 3.0 AE and Grade 4.0 AE concrete mixes shall conform to Table 401-A1 in the KDOT *Standard Specifications for State Road and Bridge Construction*.

Table 2006-1 indicates the acceptable minimum strengths for the various types of concrete.

Table 2006-1 - Mix Design Compressive Strength Requirements

Mix Design	7 Day Strength (psi)	28 Day Strength (psi)
KDOT 3.0 AE	2,250	3,000
KDOT 4.0 AE	3,000	4,000
KCMMB 4K	3,000	4,000

Concrete that does not meet the 28-day minimum compressive strength shall be removed and replaced at the Contractor's expense.

2007 MIXING AND DELIVERY. Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

The consistency of concrete shall be suitable for placement conditions, and the slump shall be uniform.

All concrete delivery tickets shall include the plant name, design water/cement ratio, batch weights per cubic yard, total batched weight of all materials for quantity delivered, time batched, design slump, water withheld (2 gallons per cubic yard maximum), allowable slump range, moisture correction for aggregates and dosages of all approved admixtures. Precast concrete manufacturers shall keep concrete delivery tickets on file for one year. Certifications for the precast concrete shall be provided when the product is delivered to the job site. Concrete tickets for colored concrete shall include the specified federal standard color code.

Ready-mix trucks shall reset the drum revolution counter to zero before batching. Concrete shall be mixed in quantities required for immediate use. Concrete shall be discharged without delay and shall be of the consistency and workability required for the job. The rate of discharge of the plastic concrete from the mixer drum shall be controlled by the rotational speed of the drum with the discharge gate fully open. Concrete shall not be used once it has developed an initial set.

Adding water to the concrete shall not be permitted, except when concrete is delivered in truck mixers. A maximum of two (2) gallons of water per cubic yard may be withheld from the load at the batch site, and if needed, added at the construction site to control the slump as necessary to meet the specified requirements. The need for additional water shall be determined as soon as possible after the load has arrived at the construction site. The adjustment shall be made to the entire load to ensure the water/cement ratio has not been exceeded. After additional water is added, the drum or blades shall be turned an additional twenty (20) to thirty (30) revolutions at mixing speed. The amount of water added at the construction site shall not exceed the amount withheld at the batching plant. Adding water shall be under the City Engineer's supervision and shall be permitted no more than one (1) time per load and only after the initial revolutions at mixing speed have been completed. Calibrated water measuring devices shall be used for dispensing water. In no case shall the water/cement ratio exceed the design water/cement ratio. Concrete that is not within the specified slump limits at the time of placement shall not be used. The concrete shall be delivered to the site and discharged within the maximum time allowed in these Technical Specifications, unless otherwise approved by the City Engineer. The time will

begin with the initial mixing of cement and water at the batch plant. Non-agitating equipment shall not be used for transportation of concrete.

2008 PLACEMENT. The limits of each concrete placement shall be approved by the City Engineer prior to concrete delivery. All concrete within such limits shall be placed in one continuous operation.

All forms, reinforcements and embedment's shall be secured in proper position, and shall be free of all dirt, mud, water, and debris prior to delivery of the concrete. Bonding surfaces shall be cleaned of all foreign material and shall be free from laitance. Concrete shall not be placed on frozen subgrade or in excavations which have not been dewatered.

Concrete shall be placed within forty-five (45) minutes of mixing operations, with the exception that the City Engineer may extend the period to ninety (90) minutes dependent upon weather conditions.

Concrete shall be placed in a manner that prevents segregation of the materials and reinforcing steel shall be properly placed and secured to prevent displacement. During and immediately after placement, concrete shall be thoroughly vibrated to produce a solid mass. Vibrators shall not be used to move the concrete laterally.

Chutes equipped with baffle boards or in short lengths that reverse the direction of flow shall be used for steep slopes. Chutes shall not be made of aluminum.

Concrete shall not be dropped from a height greater than five (5) feet, unless confined by chutes or pipes. Each part of the form shall be filled by depositing the concrete as near to the final position as possible. After initial set of the concrete, the forms shall not be jarred, and no strain shall be placed on the projecting reinforcement.

2009 COLD WEATHER CONCRETING. Unless authorized in writing by the City Engineer, concrete mixing and placement operations shall be discontinued when the descending ambient air temperature reaches 35°F, and shall not be resumed until the ascending ambient air temperature reaches 35°F. Under no circumstances shall concrete placement continue when the air temperature is less than 25°F.

When concrete work is authorized during cold weather, the aggregates may be heated by methods approved by the City Engineer prior to being placed in the mixer. Frozen ingredients or ice shall not be placed in the mixer. The temperature of the concrete shall be not less than 60°F and not more than 80°F at the time of placement. No concrete shall be placed on frozen subgrade. Sudden cooling of concrete shall not be permitted. Concrete damaged by cold weather conditions shall be removed and replaced at the Contractor's expense.

When the ambient air temperature is expected to drop below 35°F, a sufficient supply of insulated blanketing material shall be used to cover the concrete maintaining a minimum temperature of 40°F as measured on the surface. The concrete shall be maintained at the minimum temperature of 40°F for a period of four (4) days. An approved moisture barrier such as wet burlap or plastic sheeting shall be placed on the concrete prior to placement of the blanketing material.

2010 HOT WEATHER CONCRETING. The provisions of this section shall apply to all concrete work which is done when the air temperature is above 80°F at the time of placement.

The temperature of the concrete, when placed, shall not be high enough to cause excessive loss of slump, flash set or cold joints. In no case shall the temperature of the concrete, when placed, exceed 90°F. Forms, reinforcing and subgrade surfaces shall be wetted immediately before placement. In all cases, if the temperature of the concrete at time of placement is 90°F or above, the concrete will be rejected.

When the air temperature exceeds 90°F and as soon as practicable without causing damage to the surface, all exposed concrete shall be kept continuously moist by means of fog sprays, wet burlap, cotton mats or other means acceptable to the City Engineer. This cooling with water shall be in addition to the membrane curing compound. The initial sealing membrane shall be applied within five (5) minutes of completing the finishing operation.

2011 CURING AND PROTECTION. Concrete shall be protected against loss of moisture and rapid temperature changes for at least four (4) days after placement. A white-pigmented liquid curing compound meeting ASTM C-309, type 2, class A shall be applied after finishing operations have been completed and immediately after the free water has left the surface. The surface of the work shall be completely coated and sealed with a uniform layer of the curing compound at a rate of not less than one (1) gallon per 150 square feet. The compound shall not be thinned and shall remain agitated to prevent settlement of pigment. On surfaces where forms are removed prior to the end of the specified curing period, the entire exposed surface shall be coated at the specified rate of coverage. If rain falls on the newly coated surface before the film dries sufficiently to resist damage, or if the film is damaged in any other way, the Contractor shall apply a new coat of curing compound to the affected area. Other methods of curing shall be as approved by the City Engineer.

For stamped concrete median islands, parkways, and roundabouts where colored concrete is specified, a clear, non-yellowing, liquid cure and seal compound meeting ASTM C-1315, Type 1, Class A, shall be applied to the surface. Unless otherwise directed by the Engineer, cure and seal compounds shall be applied the next day after finishing when all surface moisture has disappeared. In all other instances when colored or decorative concrete is specified, cure and seal or seal, as recommended by the manufacture of the decorative concrete system. The surface shall be free of dirt and debris prior to application of the cure and seal. A low-pressure spray, roller or brush shall be used to apply the liquid and shall be applied uniformly without puddles. Multiple thin coats shall be applied, rather than a heavy coat.

2012 FORMS. Forms shall be designed to produce concrete in accordance with the shape, lines, and dimensions shown on the approved plans. They shall be mortar-tight and shall be braced to maintain the desired position, shape, and alignment during and after concrete placement.

Forms may be constructed of wood or metal and shall be designed to permit removal without damaging the concrete. Forms for all exterior exposed surfaces, which will be visible after backfilling, shall be prefabricated plywood panel forms, job-built plywood forms or forms that are lined with plywood or fiberboard. Decorative form liners in accordance with the Standard Details shall be used for retaining walls located along arterial roadways and at all other specified locations. Forms shall be coated with an approved light oil to prevent adhesion and shall be

thoroughly cleaned and re-oiled before re-use.

Form removal shall be in accordance with Section 710 the *KDOT Standard Specifications for State Road and Bridge Construction*.

2013 FINISHING FORMED SURFACES. Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with backfill. Surfaces to be dampproofed shall have fins removed and tie holes filled, but no additional finishing will be required.

Tie holes in all formed surfaces shall be cleaned, wetted, and filled with an expansive cement mortar. Tie hole patches shall be left flush, sound, smooth, even and shall match the texture and color of the adjacent concrete.

Unless provided otherwise in the plans all exposed edges shall be beveled by using dressed, triangular molding, having three-fourths inch (3/4”) sides.

2014 REPAIRING DEFECTIVE AND DAMAGED CONCRETE. Any concrete not in conformance with the approved plans, or damaged prior to acceptance of the project by the City Council, shall be removed and replaced by the Contractor at his expense. Patching shall only be permitted if approved by the City Engineer. Surface defects such as ridges and bulges may be removed by grinding with the approval of the City Engineer.

Honeycombed and other defective concrete that does not affect the structural integrity of the structure shall be chipped out and filled with a non-shrink, non-metallic grout with a minimum 28-day compressive strength of 5,000 psi or a similar material approved by the City Engineer. Prior to placement of the grout, the surface of the affected area shall be thoroughly cleaned of all loose and foreign material and shall be coated with an epoxy bonding agent.

Concrete repair work shall be performed in a manner that will not damage adjacent concrete nor interfere with the thorough curing of surrounding concrete. Repair work shall be adequately cured and protected from further damage.

2015 REINFORCEMENTS. Metal reinforcement shall be protected by the thickness of concrete indicated on the approved plans. The thickness of concrete over the reinforcement, unless otherwise specified, shall be as outlined in Table 2015-1.

Table 2015-1 – Minimum Concrete Cover of Reinforcement

LOCATION OF REINFORCEMENT	COVER
Surfaces where concrete is deposited directly against the ground	3 inches
Formed surfaces exposed to the ground, to water, or to weathering	2 inches
Beams, girder, and columns not exposed to ground, water, or weathering	1-1/2 inches
All surfaces other than those above	1 inch

Reinforcing steel shall be accurately placed and positioned on supports, spacers, hangers or other reinforcing steel as approved by the City Engineer and shall be secured in place with wire ties or suitable clips. The clear distance between bars in parallel locations shall not be less than the minimum dimension of the following:

- one and one-half (1½) times the diameter of the bars
- one and one-half (1½) times the nominal size of the coarse aggregate
- two (2) inches

Splices in reinforcing steel will not be permitted at points of maximum stress. Reinforcing steel splices at points other than those shown on the approved plans, shall be approved by the City Engineer. Welding or tack welding of reinforcement shall not be permitted. Spliced bars shall be placed in continuous contact throughout the length of the splice and shall be securely tied together. Metal reinforcement shall be free from rust, scale or other contaminants that will reduce the bond.

2016 CONSTRUCTION JOINTS. Construction joints shall be made at the locations and to the configuration shown on the approved plans, unless otherwise approved by the City Engineer.

2017 EXPANSION AND CONTRACTION JOINTS. Expansion and contraction joints shall be at locations indicated on the drawings or as specified.

Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the concrete. Formed grooves shall be made by depressing an approved tool or devise into the plastic concrete. Sawed joints shall be constructed by sawing through the surface of the concrete with an approved concrete saw. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to prevent excessive raveling.

Expansion joints shall be formed with pre-formed expansion joint filler of the non-extruding and resilient types, including cork, self-expanding cork, sponge rubber, cork rubber and bituminous fiber. Expansion joint materials shall meet the requirements of ASTM D994, D1751 and D1752.

2018 REINFORCED CONCRETE BOX FORMING SEQUENCE. Wall forms may be placed the day following the placement of the bottom slab as long as the slab is protected during the form setting operation. The placement of concrete for the walls shall not occur prior to the fifth (5th) day after placing the bottom slab. Top forms may be placed with wall forms if the walls and top are to be monolithic construction; otherwise, top forms shall not be placed until the third (3rd) day after pouring the walls. The placement of concrete for the top shall not occur prior to the fifth (5th) day after placing the walls (for base to top shoring) or until the walls have reached their design strength for slab forms shored by the walls. Wall forms shall remain in place a minimum of two (2) days after the walls are poured. Supports for the top slab shall be left in place according to the schedule shown in these Technical Specifications.

The above guidelines for placing forms for reinforced concrete boxes are based on the use of standard forming procedures and with the use of concrete containing no admixtures to achieve high early strength. Variations in forming techniques and/or the use of high early strength concrete shall only be allowed if approved by the City Engineer.