

SECTION 2000 - CONCRETE

2001 SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work.

2002 GENERAL. All cast-in-place concrete shall be accurately formed, and properly placed and finished as shown on the drawings and specified herein.

The Contractor shall inform the Engineer at least twenty four (24) hours in advance of the times and places at which the concrete is to be placed.

2003 MATERIALS.

Concrete Materials: All concrete materials shall conform to the specifications of the Kansas City Metropolitan Materials Board (KCMMB) or alternative mixes as approved by the Engineer. Information is available on the website www.kcmmb.org.

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

Polyethylene Sheeting Curing Material: White, opaque polyethylene sheeting/film with a 4 mil nominal thickness.

Curing Mats: New or used burlap composed of jute, manila hemp or kenaf. Used burlap shall have been previously used for curing concrete. Burlap fabricated from bags shall not be used.

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

Welded Wire Fabric: ASTM A185, and AASHTO Designation M55

Fibermesh: Fibermesh may used in place of wire mesh with the approval of the Engineer. Provide fibers that are one hundred (100%) percent virgin polypropylene, fibrillated, rough textured, interconnected fibers containing no reprocessed olefin materials and specifically manufactured as concrete reinforcement. Provide fibers that are graded with a maximum length of two (2) inches and a minimum tensile strength of thirty two (32) ksi.

2004 CONCRETE MIX DESIGNATIONS.

A. Concrete mixes for pavement, curbs, and curb and gutter shall conform to the specifications of the Kansas City Metropolitan Materials

Board (KCMMB). Approved suppliers, approved aggregates, and approved mixes are available on the website www.kcmmb.org.

Alternative mix designs may be submitted to the Engineer for review. All alternative mixes shall conform to the following minimum requirements.

1. Minimum compressive strengths for alternative mixes shall be 4000 psi at 28 days with a slump of 3" (\pm 1").
 2. Coarse aggregates for all mixes shall be entirely granite, quartzite, or trap rock.
 3. Gradation of the coarse aggregate shall meet the requirements of CPA-3 or CPA-4 as specified in the current edition of the KDOT Standard Specifications. 4. Gradation of the fine aggregate shall meet the requirements of FA-A as specified in the current edition of the KDOT Standard Specifications. All other requirements under KDOT Section 1100 – Aggregates for Concrete, shall apply.
 4. Proportions of the aggregate shall be 50% coarse and 50% fine.
 5. Mix shall contain no less than 20% slag or Class F fly ash based on weight of cement.
 6. Concrete shall be air-entrained with an air content of 6-1/2% (\pm 1-1/2%).
 7. Admixtures, which may include water reducers, set retarders, plasticizers, and accelerators, may be used only with the approval of the Engineer.
 8. Mix design shall include the source and class of aggregates and cement used in the mix.
- B. High-early strength concrete mixes shall be used in full-depth concrete pavement patches, manhole adjustments, commercial and residential entrances, or where designated on the plans or approved by the Engineer. These mixes shall have a minimum strength of 3000 psi at 24 hours with the same slump, air content and aggregate requirements as specified for alternative mixes.
- C. Concrete mixes for sidewalk, recreational paths, driveway approaches, structures and other items designated in the plans or approved by the Engineer may use Class 1 coarse aggregate as specified in the current edition of the KDOT Standard Specifications. Proportions for the mix shall meet the same criteria as specified for alternative mixes.
- D. Exposed aggregate concrete shall conform to the following mix design.

Proportions

Materials

Cement, Type I/II

One Cubic Yard

395 lbs

Slag	169 lbs
Coarse Aggregate (smooth river rock)	1816 lbs
Fine Aggregate	1211 lbs
Water	248 lbs
Air Entraining Agent	3 +/- oz

Properties

Cementations Material, sack/yard	6.00
Water/Cement Material Ratio	.44
Fine Aggregate percent of total (by absolute volume)	40%
Unit weight pcf	32 +/- 1
Air Content	6 +/- 2
Slump	4 +/- 1
Compression Strength (not determined)	-----

2005 PLACEMENT. The limits of each concrete pour shall be predetermined by the Contractor and shall be acceptable to the Engineer. All concrete within such limits shall be placed in one continuous operation.

Before concrete is placed, forms, reinforcements, and embedments shall be rigidly secured in proper position and all dirt, mud, water and debris shall be removed from the space to be occupied by 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.

Placement of concrete shall conform to requirements of ACI 304. Concrete shall be placed within forty-five (45) minutes of mixing operations, with the exception that the Engineer may extend the period to ninety (90) minutes (maximum) dependent upon weather conditions. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. Concrete shall not be placed in horizontal layers exceeding eighteen (18") inches and shall not be deposited in large quantities at any point in the forms and then run or worked along the forms, thus causing segregation of the materials. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedments and into the corners of the forms. The concrete shall be vibrated or spaded to produce a solid mass without honeycomb or surface air bubbles.

Where steep slopes are required for placing concrete with chutes, the chutes shall be equipped with baffle boards or be in short lengths that reverse the direction of movement. Chutes, troughs and pipes shall not be made of aluminum.

Concrete shall not be dropped in the forms a distance of more than five (5') feet, unless confined by chutes or pipes; and care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.

- 2006 COLD WEATHER CONCRETE. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when the descending air temperature in the shade and away from artificial heat reaches forty (40°) degrees F or when forecast to drop below forty (40°) degrees F within twenty four (24) hours of placement, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches thirty five (35°) degrees F.

When concrete work is authorized during cold weather, the aggregates may be heated by methods approved by the Engineer prior to being placed in the mixer. No ingredient that is frozen or contains ice shall be placed in the mixer. The temperature of the concrete shall be not less than sixty (60°) degrees F and not more than eighty (80°) degrees F at the time of placement in the forms. Under no circumstances shall concreting operations continue when the air temperature is less than twenty (20°) degrees F.

No concrete shall be placed on frozen subgrade. Sudden cooling of concrete shall not be permitted. Concrete injured by frost action or freezing weather shall be removed and replaced at the Contractor's expense.

- 2007 HOT WEATHER CONCRETE. The provisions of this section shall apply to all concrete work, which is done when the air temperature is above eighty (80°) degrees 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 ninety (90°) degrees F. Forms, reinforcing and sub-grade surfaces against which the concrete is to be placed shall be wetted down immediately before placement.

When the air temperature exceeds ninety (90°) degrees F and as soon as practicable without causing damage to the surface finish, all exposed concrete shall be kept continuously moist by means of fog sprays, wet burlap, cotton mats, or other means acceptable to the Engineer at no expense to the Owner. This cooling with water shall be in addition to the initial sealing by membrane curing compound.

- 2008 CURING AND PROTECTION. Concrete shall be cured by protecting it against loss of moisture, rapid temperature changes and mechanical injury

for at least four days after placement. Acceptable methods shall be moist curing, white polyethylene sheeting, liquid membrane-forming compounds, or a combination thereof, unless specified otherwise. After concrete finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by the curing medium applicable to local conditions and acceptable to the Engineer. The Contractor shall have the necessary equipment for adequate curing on hand and be ready to install prior to concrete placement.

Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the surface for the duration of the moist-curing period. Burlap or fabric mats shall be long enough to cover the entire surface of the work and lapped at joints to prevent drying between adjacent sheets.

White polyethylene sheets shall be large enough to cover the entire surface of the work and shall be lapped not less than eighteen (18") inches. The sheets shall be adequately weighted to prevent displacement or billowing due to wind. Tear holes appearing in the material during the curing period shall be immediately repaired or replaced with material in acceptable condition.

White membrane curing compound 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 one hundred fifty (150) square feet. The compound shall not be thinned and shall be kept 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 will be required to apply a new coat of compound to the affected area.

During cold weather concreting when the ambient air temperature is expected to drop below forty (40°) degrees F, a sufficient supply of burlap, straw, hay, or other blanketing material shall be provided along the work to protect the concrete and maintain a minimum temperature of forty (40°) degrees F in the concrete as measured on the surface. An approved moisture barrier such as wet burlap or plastic sheeting shall be placed on the concrete prior to placement of the blanketing material. This type of curing shall be maintained for a period of six (6) days as the initial cure.

Sidewalks, curb and gutter, and miscellaneous concrete shall be protected and cured for a period of not less than seventy-two (72) hours after the placing of the concrete by covering with wet burlap or by the application of a membrane curing compound as specified above.

2009 FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings. They 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.

Forms may be of wood or metal and plastic shall be designed to permit easy removal without injury to 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. Forms shall be coated with an approved light oil to prevent concrete from adhering and shall be thoroughly cleaned and re-oiled before re-use.

Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete. The following table gives the approximate minimum time that forms shall be left in place.

AVERAGE AIR TEMPERATURE >	70°	60°	50°	40°
STRUCTURAL MEMBER	TIME IN PLACE (24 HOUR DAYS)			
Slab Shoring	10	12	14	21
Slab Forms	7	7	7	7
Beams Soffits and Shoring	10	12	14	21
Beam Side Forms	1	2	2	3
Wall Side Forms	4	4	4	4

2010 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. A power grinder shall be used, if necessary, to remove projections and provide a flush surface. Surfaces to be damp proofed 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 (3/4") inch sides.

- 2011 REPAIRING DEFECTIVE AND DAMAGED CONCRETE. Any concrete found not to be formed as indicated on the plans, out of alignment or level, having a defective surface, or damaged prior to acceptance of the project by the city, shall be considered as not conforming to the intent of these specifications and may be ordered removed and replaced by the Contractor at his expense unless the Engineer authorizes patching of the defective or damaged area.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured and protected from further damage.

Surface defects such as ridges and bulges shall be removed by grinding.

Honeycombed and other defective concrete that does not affect the structural integrity of the structure shall be chipped out and the vacated area shall be filled. The methods used in this type of repair shall be approved by the Engineer. Material used for patching shall be a nonshrink, non-metallic grout with a minimum twenty eight (28) day compressive strength of five thousand (5000) psi or a similar material approved by the Engineer. Prior to placement of the repair filling, the contact surface of the affected area shall be thoroughly cleaned of all loose and foreign material and shall be coated with an epoxy-bonding agent.

- 2012 REINFORCEMENT. The metal reinforcement shall be protected by the thickness of concrete indicated on the construction drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

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 Engineer and shall be secured in place with wire ties or suitable clips. The minimum clear distance between parallel bars shall not be less than one and half (1-1/2) times the diameter of round bars, except that in no case shall clear spacing between parallel bars be less than two (2) inches or less than one and half (1-1/2) times the nominal size of the coarse aggregate.

Splices in reinforcing steel will not be permitted at points of maximum stress. When it becomes necessary to splice reinforcing steel at points other than those shown on the contract drawings, the character and location of the splice shall be approved by the Engineer. Welding or tack welding of reinforcement will not be permitted. Reinforcements upon which unauthorized welding has been done shall be removed and replaced as directed by the Engineer. Spliced bars shall be placed in contact and securely tied together.

Metal reinforcement at the time concrete is placed shall be free from rust, scale, or other contaminants that will destroy or reduce the bond.

- 2013 CONSTRUCTION JOINTS. Construction joints shall be made at locations indicated on the drawings, as specified, or as approved by the Engineer and shall conform to the requirements of ACI 318.
- 2014 ISOLATION AND CONTRACTION JOINTS. Isolation and contraction joints shall be of the type and at locations as specified, as indicated on the drawings or as required by the Engineer.
- 2015 REINFORCED CONCRETE BOX FORMING SEQUENCE. Wall forms may be placed the day following the placement of the bottom slab, as long as care is taken to protect the slab against rough or abusive handling of forms and or placing equipment. The actual placement of concrete shall not occur prior to the fifth 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 are not to be placed until the third day after placing the walls. The actual placement of concrete for the top shall not occur prior to the fifth 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 four days after the walls are poured. Supports for the top slab shall be left in place according to the schedule shown in this section, paragraph 2009-Forms.

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 after the Contractor obtains the written approval of the Engineer.