

CHAPTER 3.05 CONCRETE

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3.05.005 SCOPE. This Chapter of the specifications defines materials to be used in all Concrete work and requirements for mixing, placing, finishing, and curing.

3.05.010 MATERIALS. Materials used in concrete and reinforcing of concrete shall meet the following requirements:

A. Cement. Portland cement shall be Type II or as approved by the City Engineer and shall comply with the Standard Specification for Portland Cement, ASTM C-150.

B. Aggregates. Concrete aggregates shall conform to Tentative Specifications for Concrete Aggregates, ASTM C-33.

C. Water. Water used in mixing concrete shall be clean and free from oil, acid, salt, injurious amounts of alkali, organic matter or other deleterious substances.

D. Entraining Agent. An air-entraining agent shall be used in all concrete exposed to the weather. The agent shall conform to ASTM Designation C-175 and C-260.

E. Admixtures. No admixture (except calcium chloride) will be permitted to be used in concrete unless such use is specifically authorized by the City Engineer. Calcium chloride shall conform to ASTM Standard Specification D-98.

F. Reinforced Steel. All bar material used for reinforcement of concrete shall be intermediate grade steel conforming to the requirements of ASTM Designation A-615 and shall be deformed in accordance with ASTM Designation A-305.

G. Welded Wire Fabric. Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM A-185.

3.05.015 CONCRETE MIX. For the purpose of practical identification, concrete has been divided into three (3) classes: Class A, B, and C, basic requirements and use for each class are as defined below:

<u>Class</u>	<u>Minimum Cement (sacks/c.y.)</u>	<u>Minimum 28-day Comp. Strength (psi)</u>	<u>Primary Use</u>
A	6½	4000	Reinforced structural concrete.
B	6	3500	Sidewalks, curbs & gutters, cross gutters, pavements, and unreinforced footings and foundations.
C	5	2500	Thrust blocks, anchors, mass concrete.

All Concrete shall also comply with the following requirements:

A. Aggregates. The maximum size of the aggregate shall be not larger than one-fifth (1/5) of the narrowest dimension between forms within which the concrete is to be cast, nor larger than three-fourths (¾) of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms. For unreinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth the slab thickness.

B. Water. Sufficient water shall be added to the mix to produce concrete with the minimum practicable slump. The slump of mechanically vibrated concrete shall not exceed four (4) inches. No concrete shall be placed with a slump in excess of five (5) inches.

C. Air-Entraining. Air content for air-entrained concrete shall comply with the following:

<u>Course Aggregate Size (in.)</u>	<u>Air Content (%)</u>
1½ to 2½	5 ∓ 1
¾ or 1	6 ∓ 1
¾ or ½	7 ∓ 1

The air-entraining agent shall be added as liquid to the mixing water by means of mechanical equipment capable of accurate measurement and control.

D. Calcium Chloride. Calcium Chloride may be added as an accelerator with prior approval of the City Engineer during cold weather, with maximum amount being two (2) pounds per sack of cement.

3.05.020 FORMS. Forms shall be substantially built and adequately braced so as to withstand the liquid weight of concrete. All linings, studding, walling and bracing shall be such as to prevent bulging, spreading, or loss of true alignment while pouring and displacement of concrete while setting.

A. Metal forms shall be used for curb and gutter work unless otherwise specified by the City Engineer. All edge forms for sidewalk pavements, curbs, and gutters shall be of sufficient rigidity and adequately braced to accurately maintain line and grade. Prior to concrete placement, all forms shall be lightly coated with oil to prevent concrete adhesion to form materials.

B. Forms for curved sections shall be so constructed and placed that the finish surface of walls and edge of sidewalks, curbs and gutters will not deviate appreciably from the arc of the curve.

C. Exposed vertical and horizontal edges of the concrete in structures shall be chamfered by the placing of moldings in the forms at those locations shown on the Drawings.

3.05.025 JOINTS. Joints shall be provided for sidewalks and curb and gutter as follows:

A. Sidewalks. Shall have scribed joints at intervals of four (4) feet which joints shall be approximately three sixteenths (3/16) inch wide and be approximately one-fourth (1/4) of the total slab thickness. In addition, one-half (½) inch expansion joints shall be provided at thirty two (32) foot intervals and at locations where sidewalks adjoin

curbs or existing sidewalks. Slabs shall be ruled at four (4) foot intervals.

B. Curb and Gutter. Shall be cut into lengths of ten (10) feet by the use of one-eighth (1/8) inch steel division plates of the exact cross section of the curb and gutter or shall be scribed when installed by a lay down machine. Also, one-half (1/2) inch expansion joints shall be provided at curb and gutter radii, where the curb and gutter abuts a solid object and at intervals not to exceed fifty (50) feet, unless otherwise specified by the City Engineer. Material for one-half (1/2) inch expansion joints shall be as defined in AASHTO-33, and shall be installed with its top approximately one-fourth (1/4) inch below the concrete surface.

3.05.030 REINFORCEMENT AND EMBEDDED ITEMS. Reinforcing steel shall be clean and free from rust, scale, paint, grease, or other foreign matter which might impair the bond. It shall be accurately bent and shall be tied to prevent displacement when concrete is poured. Reinforcing steel shall be held in place by only metal or concrete ties, braces and supports. No steel shall extend from or be visible on any finished surface and shall have a minimum of one and one-half (1 1/2) inch concrete cover.

A. The Contractor shall use concrete chairs for holding the steel away from the sub grade, and spreader or other type bars for securing the steel in place. The spreader bars shall be not less than three-eighths (3/8) inch in diameter.

3.05.035 PREPARATIONS. Before batching and placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, forms shall be thoroughly wetted (except in freezing weather) or oiled, and masonry filler units that will be in contact with concrete shall be well drenched (except in freezing weather), and the reinforcements shall be thoroughly cleaned of ice or other coatings. Water shall be removed from spaces to receive concrete.

A. When placing concrete on earth surfaces, the surfaces shall be free from frost, ice, mud, and water. When the sub grade surface is dry soil or pervious material, it shall be sprayed with water immediately before placing of concrete or shall be covered with waterproof sheathing paper or a plastic membrane. No concrete shall be placed until the surfaces have been inspected and approved by the City Engineer or City Inspector.

3.05.040 CONCRETE MIXING. All concrete shall be ready-mixed and delivered in accordance with ASTM C-94. The concrete shall be mixed until there is a uniform distribution of the materials. Sufficient water shall be used in mixing concrete to produce a mixture which will flatten and quake when deposited in place, but not enough to cause it to flow. Sufficient water shall be used in concrete in which reinforcement is to be embedded, to produce a mixture which will flow sluggishly when worked and which, at the same time, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In no case shall the quantity of water used be sufficient to cause the collection of a surplus in the forms or exceed the maximum allowable slump as specified in 3.05.015 (B).

3.05.045 DEPOSITING. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. The concrete placing shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the corners of forms and reinforcing bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work, nor shall retempered concrete be used. No concrete shall be dropped more than three (3) feet. Concrete delivered to the job site having a temperature which exceeds 90EF shall not be placed. Concrete cooling methods during hot weather will be approved by the City Engineer.

A. All concrete in structures shall be vibrator compacted during the operation of placing, and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms.

3.05.050 PLACING CONCRETE IN COLD WEATHER. No concrete shall be poured where the air temperature is lower than 40EF, at a location where the concrete cannot be covered or protected from the surrounding air. When concrete is poured below a temperature of 35EF the ingredients of the concrete shall be heated so that the temperature of the mixture shall not be less than 50EF or more than 100EF. Before mixing, the heated aggregates shall not exceed 125EF and the temperature of the heated water shall not exceed 175EF. Cement shall not be added

until the temperature of the mixed aggregates and water is greater than 100EF. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulating covering and/or heating to prevent freezing of the concrete for a period of not less than seven (7) days after placing. Concrete shall not be placed on frozen soil.

A. Equipment for protecting concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing. In the event heating is employed, care shall be taken to insure that no part of the concrete becomes dried out or is heated to temperatures above 90EF. The housing, covering, or other protection used shall remain in place and intact at least twenty four (24) hours after the artificial heating is discontinued. Combustion heaters shall not be used during the first twenty four (24) hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

3.05.055 FINISHING. All concrete finish work shall be carefully performed and shall produce a top quality visual appearance as is common to the industry. After the concrete for slabs has been brought to the established grade and screened it shall be worked with a magnesium float and then given a light broom finish. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or hasten hardening. Surface edges of all slabs shall be rounded to a radius of one-half (½) inch.

A. After concrete has been poured in curb and gutter forms it shall be puddled and spaded so as to insure a thorough mixture, eliminate air pockets, and create uniform and smooth sides. Before the concrete has thoroughly set, and while the concrete is still green the forms shall be removed and the front and top sides shall be finished with a flat or steel trowel to make a uniform finished surface. Wherever corners are to be rounded, special steel trowels shall be used while the concrete is workable and the corners constructed to the dimensions specified.

B. The top and face of the curb and also the top of the apron on combined curb and gutter must be finished true to line and grade and without any irregularities of surface noticeable to the eye. The gutter shall not hold water to a depth of more than one-fourth (¼) inch, nor shall any portion of the surface or face of the curb or gutter depart more than one-fourth (¼) inch from a straight edge ten (10) feet in length, placed on the curb parallel to the center line of the street nor shall any part of the exposed surface present a wavy appearance.

3.05.060 CURING AND PROTECTION. As soon as the concrete has hardened sufficiently to prevent damage, the finished surface shall be protected for curing in one of the following ways:

A. Ponding of water on the surface or continuous sprinkling.

B. Application of absorptive mats such as three (3) inches of cured hay, clean straw, or fabric kept continuously wet.

C. Application of two (2) inches of moist earth or sand uniformly distributed on the surface and kept saturated by spraying with water.

D. Application of light colored waterproof plastic materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" ASTM C-171, placed and maintained in contact with the surface of the concrete.

E. Application of a curing compound, conforming to "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C-309. The compound shall be light in color and shall be applied in accordance with the manufacturer's recommendations immediately after any water sheen which may develop after finishing has disappeared from the concrete surface.

F. The freshly finished surface shall be protected from hot sun and drying winds until it can be sprinkled or covered as above specified. The concrete surface must not be damaged or pitted by rain. The Contractor shall provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours. The Contractor shall erect and maintain suitable barriers to protect the finished surface. Any section damaged from traffic or other causes occurring prior to its official acceptance shall be repaired or replaced by the Contractor at his own expense in a manner satisfactory to the City Engineer.

G. Defective concrete conditions or surfaces shall be removed, replaced or repaired as directed to meet the approval of the City Engineer.

3.05.065 CONCRETE TESTING. In the event that the concrete placed or delivered to the job site appears to have questionable quality, the City Engineer may order the taking of concrete test cylinders to check required compressive strengths. In-place concrete may be cored for testing. Cost of all required laboratory testing shall be the responsibility of the Subdivider/Developer, Contractor or ready-mix supplier. All concrete delivered to the job site shall be accompanied by a ticket specifying bag mix, air content, etc. Said tickets shall be given to the City Inspector who may field check slump and air entrainment compliance.