

SECTION 03300

CAST-IN-PLACE CONCRETE

This section includes cast-in-place or in situ concrete for structural building frame, slabs on fill or grade and other concrete components associated with building. This section references ACI 301 and ACI 318. ICC codes require use of ACI 318. Edit references to suit Project conditions.

This section includes basic finishing and curing methods. Detailed concrete floor finishing and curing methods are specified in other SPECTEXT sections.

This section includes integral accessory control, expansion and contraction joint devices to encourage concrete cracking and movement to occur at predetermined locations. Water stops and other form accessories are included in Section 03100. Joint sealants can be included in this section or referenced to Section 07900.

This section includes provision for work performed using unit price payment method, when applicable.

Manufacturers listed in this section were identified as representative and not as an endorsement for meeting this specification. For additional product information, visit 4Specs at www.4specs.com, ARCAT at www.arcata.com, Reed Construction Data FirstSource at www.firstsourceonl.com, SpecSource at www.specsource.com, and Sweets at www.sweets.construction.com.

This section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

Contact the CSRF Support Center at supportcenter@csrf.org to submit comments or suggestions for improvements to this specification. Visit the SPECTEXT web site at www.spectext.com for current product announcements.

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
 - 1. Building frame members.
 - 2. Shear walls.
 - 3. Elevator shaft walls.
 - 4. Foundation walls.
 - 5. Supported slabs.
 - 6. Slabs on grade.
 - 7. Control, expansion and contraction joint devices.
 - 8. Equipment pads.
 - 9. Light pole base.
 - 10. Flagpole base.
 - 11. Thrust blocks.

12. Manholes.
13. [_____].

B. Related Sections:

1. Section [_____-_____]: Sidewalks, curbs and gutters.
2. Section 02320 - Backfill: Sand layer over vapor retarder.
3. Section 03100 - Concrete Forms and Accessories: [Formwork and accessories.] [Placement of [joint device] [joint device anchors] in formwork.]
4. Section 03200 - Concrete Reinforcement.
5. Section 03350 - Concrete Finishing.
6. Section 03390 - Concrete Curing.
7. Section [_____-_____]: Preparing concrete surfaces to receive [dampproofing] [waterproofing].
8. Section 05810 - Expansion Joint Cover Assemblies.
9. [Section 07900 - Joint Sealers.]
10. Section [_____-_____]: Mechanical items for casting into concrete.
11. Section [_____-_____]: Electrical items for casting into concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

Use this article ONLY when work of this section is performed under unit price payment method. Delete this article when payment is by Stipulated Sum/Price.

A. Concrete - Slab-on-fill or grade:

1. Basis of Measurement: By the [square [foot] [_____]] (square [meter] [_____]) [cubic [yard] [_____]] (cubic [meter] [_____]).
2. Basis of Payment: Includes concrete, placement accessories, consolidating and leveling, troweling, curing.

B. Concrete - Vertical in Forms:

1. Basis of Measurement: By the [square [foot] [_____]] (square [meter] [_____]) [cubic [yard] [_____]] (cubic [meter] [_____]).
2. Basis of Payment: Includes concrete, placement accessories, consolidating, curing.

C. Concrete - Miscellaneous Locations:

1. Basis of Measurement: By the [square [foot] [_____]] (square [meter] [_____]) [cubic [yard] [_____]] (cubic [meter] [_____]).
2. Basis of Payment: Includes concrete, placement accessories, consolidating and leveling, troweling, curing.

D. Concrete - Grouting:

1. Basis of Measurement: By the cubic [yard] [_____]] (cubic [meter] [_____]).
2. Basis of Payment: Includes preparation of substrate, grout, placement, consolidating, troweling, curing.

- E. Devices: [Control] [Expansion] [and] [Contraction].
 - 1. Basis of Measurement: By the linear [foot] [_____] (linear [meter] [_____]).
 - 2. Basis of Payment: Includes component, placement with accessories.

1.3 REFERENCES

List reference standards included within text of this section. Edit the following for Project conditions.

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 305 - Hot Weather Concreting.
 - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 4. ACI 308.1 - Standard Specification for Curing Concrete.
 - 5. ACI 318 - Building Code Requirements for Structural Concrete.

- B. ASTM International:
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
 - 3. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 4. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 5. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 6. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 7. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 - 8. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 9. ASTM C150 - Standard Specification for Portland Cement.
 - 10. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 - 11. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - 12. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 13. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 14. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
 - 15. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
 - 16. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
 - 17. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

18. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
19. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
20. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
21. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
22. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
23. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
24. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
25. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
26. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
27. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
28. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
29. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
30. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
31. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
32. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
33. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
34. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
35. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.4 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum [1 perm] [[0.3] [_____] perms] ([57] [17] [_____] ng/Pa/s/sq m) when tested in accordance with ASTM E96, Procedure A.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

- A. Section 01330 - Submittal Procedures: Submittal procedures.

- B. Product Data: Submit data on joint devices, attachment accessories [, admixtures] and [_____].
- C. Design Data:
 - 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
 - 2. Identify mix ingredients and proportions, including admixtures.

Chloride can contribute to corrosion of metals embedded in concrete. Admixture manufacturers are not required to identify chloride content, unless requested.

- 3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

Include the following paragraph for submission of physical samples for selection of finish, color, texture, and other properties.

- D. Samples: Submit two [____x____] inch ([____x____] mm) long samples of [expansion/contraction joint] [and] [control joint].
- E. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with [ACI 301] [ACI 318].
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

1.8 QUALITY ASSURANCE

- A. Fire Rated [Wall] [Floor] [Roof] Construction: [Rating as indicated on Drawings] [[_____] hour rating].

1. Tested Rating: Determined in accordance with ASTM E119.

Refer to IBC for tables of fire resistance ratings for various material and assemblies. Tables use item numbers to identify each assembly.

2. Prescriptive Rating: [Item Number [_____]]; determined in accordance with [applicable] [_____] code.
 - B. Perform Work in accordance with [[State] [Municipality] of [_____] [Highways] [Public Work's] standard.]

Include the following paragraph only when cost of acquiring specified standards is justified.

- C. Maintain [one copy] [[_____] copies] of [each] document on site.

1.9 MOCKUP

Use this article for full sized erected assemblies required for review of construction, coordination of work of several sections, testing, or observation of operation.

- A. Section 01400 - Quality Requirements: Requirements for mockup.
- B. Construct mockup for architectural concrete surfaces receiving special treatment or finish as result of formwork.

Select first paragraph below to approve form panel. Use second paragraph to require several panels from which Architect/Engineer can select acceptable form finish.

- C. Mockup Panel: Sufficient size to indicate special treatment or finish required.

***** [OR] *****

- D. Mockup Panel: Construct [two] [_____] panels, [_____] feet ([_____] m) long by [_____] feet ([_____] m) wide, to indicate special treatment or finish required.
- E. When requested by Architect/Engineer, cast concrete against sample panel. Obtain acceptance of resultant surface finish prior to erecting formwork.
- F. Locate [where directed by Architect/Engineer] [where indicated on Drawings].
- G. Incorporate accepted mockup as part of Work.

***** [OR] *****

H. Remove mockup [when directed by Architect/Engineer] [_____].

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain concrete temperature after installation at minimum 50 degrees F (10 degrees C) for minimum 7 days.

***** [OR] *****

C. Maintain high early strength concrete temperature after installation at minimum 50 degrees F (10 degrees C) for minimum 3 days.

1.11 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

Verify cement type or types. Type 1 Normal and Type V Sulfate Resistant are most commonly used.

A. Cement: ASTM C150, [Type I - Normal] [Type IA - Air Entraining] [Type II - Moderate] [Type IIA - Air Entraining] [Type III - High Early Strength] [Type IIIA - Air Entraining] [Type IV - Low Heat of Hydration] [Type V - Sulfate Resistant] Portland type; [_____] manufactured by [_____]; [ASTM C595], [list appropriate blend and cement type].

***** [OR] *****

Blended cements are available in the following types and each type is available as an air entraining cement by adding suffix A to type designation. ACI 318 excluded the use of Type S and Type SA in structural concrete.

Type IP - portland pozzolan cement.

Type P - portland pozzolan cement when high early strengths are not required.

Type I(PM) - pozzolan modified portland cement.

Type I(SM) - slag modified portland cement.

Type S - slag cement.

B. Blended Cement: ASTM C595; Type [_____], [gray] [white] [_____] color.

***** [OR] *****

The following standard is a performance specification without regard for cement composition. The available types include the following. Low reactivity with alkali reactive aggregates is available as an option with all types.

Type GU - General Use when none of the following special types are required.

Type HE - High Early Strength.

Type MS - Moderate Sulfate Resistance.

Type HS - High Sulfate Resistance.

Type MH - Moderate Heat of Hydration.

Type LH - Low Heat of Hydration.

C. Hydraulic Cement: ASTM C1157; Type [_____].

***** [OR] *****

Expansive hydraulic cement is used for shrinkage compensating concrete, relying on expansion during early hardening period after setting.

D. Expansive Hydraulic Cement: ASTM C845.

When necessary, edit following paragraph to suit local conditions and aggregate supply. Itemize gradation when special aggregates are required. ASTM C33 is for normal weight aggregate and C330 is for lightweight aggregate.

Coarse aggregate size is limited by thickness of concrete element and by distance between reinforcement.

E. Normal Weight Aggregates: [ASTM C33] [_____].

1. Coarse Aggregate Maximum Size: [[_____] inches ([_____] mm)] [In accordance with ACI 318].

***** [OR] *****

F. Lightweight Aggregate: [ASTM C330] [_____].

1. Coarse Aggregate Maximum Size: [[_____] inches ([_____] mm)] [In accordance with ACI 318].

Limit chloride ions for prestressed concrete and concrete with aluminum embedded items. ACI 318 defines limits of chloride ions based on type of concrete and concrete exposure. Include specific chloride limit when required for Project.

- G. Water: ACI 318; potable, [without deleterious amounts of chloride ions] [with maximum [_____]] percent of water soluble chloride ions by weight of cement].

2.2 ADMIXTURES

In this article, list manufacturers acceptable for this project.

- A. Manufacturers:
 - 1. [_____] Model [_____].
 - 2. [_____] Model [_____].
 - 3. [_____] Model [_____].
 - 4. Substitutions: [Section 01600 - Product Requirements] [Not Permitted].

***** [OR] *****

- B. Furnish materials in accordance with [[State] [Municipality] of [_____]] [Highways] [Public Work's] standards.]

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with manufacturers' products specified above.

Admixtures are used for air entrainment and specific changes desired in properties of workability of concrete mix, setting time and corrosion resistance.

- C. Air Entrainment: ASTM C260.
- D. Chemical: ASTM C494/C494M [Type A - Water Reducing] [Type B - Retarding] [Type C - Accelerating] [Type D - Water Reducing and Retarding] [Type E - Water Reducing and Accelerating] [Type F - Water Reducing, High Range] [Type G - Water Reducing, High Range and Retarding].

Fly ash and pozzolans are classified as follows:

Class N - Raw or calcined natural pozzolans.

Class F - Fly ash with pozzolanic properties produced from burning anthracite or bituminous coal.

Class C - Fly ash with pozzolanic and cementitious properties from lignite or subbituminous coal.

- E. [Fly Ash] [Calcined Pozzolan]: ASTM C618 Class [_____].

F. Silica Fume: ASTM C1240.

Ground granulated blast furnace slag is normally used only with portland cement and not with blended cement. Grades correspond to performance based on slag activity and resulting concrete strength compared to portland cement concrete. Higher grade numbers produce higher concrete strengths.

G. Slag: ASTM C989; Grade [80] [100] [120]; ground granulated blast furnace slag.

Plasticizing admixtures produce flowing concrete without further addition of water. Both types are rated to increase slump by 3.5 inches (90 mm) minimum.

H. Plasticizing: ASTM C1017/C1017M [Type I, plasticizing] [Type II, plasticizing and retarding].

2.3 ACCESSORIES

A. Bonding Agent: [Polymer resin emulsion] [Polyvinyl Acetate] [Latex emulsion] [Two component modified epoxy resin] [Non-solvent two component polysulfide epoxy] [Mineral filled polysulfide polymer epoxy] [Mineral filled polysulfide polymer epoxy resin] [Polyamid cured epoxy].

1. Manufacturers:

- a. [_____] Model [_____].
- b. [_____] Model [_____].
- c. [_____] Model [_____].
- d. Substitutions: [Section 01600 - Product Requirements] [Not Permitted].

Specify vapor retarders with consideration for finish floor materials applied to concrete slabs. Many floor finishes are critically sensitive to moisture vapor transmission that may cause degradation of adhesives used to install flooring materials.

Performance is specified by water vapor transmission rate or permeance. ASTM E1745 permits 0.3 perms maximum. Products are available with zero perm ratings. Coordinate perm rating with performance requirements.

Class A provides greatest tensile strength and puncture resistance; Class C the least.

B. Vapor Retarder: ASTM E1745 Class [A] [B] [C]; [6] [_____] mil ([0.5] [_____] mm) thick [clear polyethylene film] [fabric reinforced plastic film] [_____]; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

1. Manufacturers:

- a. [_____] Model [_____].
- b. [_____] Model [_____].

- c. [_____] Model [_____].
- d. Substitutions: [Section 01600 - Product Requirements] [Not Permitted].

The use of non-shrink grout in this section is primarily for doweling to existing Work; including setting anchor bolts and base plate grouting.

- C. Non-Shrink Grout: ASTM C1107, Grade [A] [B] [C] [_____]; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of [2,400] [_____] psi ([17] [_____] MPa) in 48 hours and [7,000] [_____] psi ([48] [_____] MPa) in 28 days.
 - 1. Manufacturers:
 - a. [_____] Model [_____].
 - b. [_____] Model [_____].
 - c. [_____] Model [_____].
 - d. Substitutions: [Section 01600 - Product Requirements] [Not Permitted].

Verify usage of concrete reinforcing fibers for project. Delete following paragraph if product is not used. Fiber reinforcing is not an allowable material for structural concrete under ACI 318.

- D. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength -[130] [_____] ksi ([896] [_____] MPa); toughness [15] [_____] ksi ([103] [_____] MPa); [3/4] [_____] inch ([19] [_____] mm) long fibers, [34] [_____] million/lb ([34] [_____] million per 0.6 kg/cu m) fiber count.
 - 1. Manufacturers:
 - a. [_____] Model [_____].
 - b. [_____] Model [_____].
 - c. [_____] Model [_____].
 - d. Substitutions: [Section 01600 - Product Requirements] [Not Permitted].

2.4 JOINT DEVICES AND FILLER MATERIALS

Select one or several of the following joint filler types as required. When more than one type is utilized, designate each with Type and schedule Types at end of this section or on Drawings.

- A. Joint Filler [Type [A] [_____]]: [ASTM D1751] [ASTM D994]; Asphalt impregnated fiberboard or felt, [1/4] [_____] inch ([6] [_____] mm) thick; tongue and groove profile; [_____] manufactured by [_____].

***** [OR] *****

- B. Joint Filler [Type [B] [_____]]: [ASTM D1752;] Closed cell [polyvinyl chloride] [molded vinyl] foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness; [_____] manufactured by [_____].

***** [OR] *****

- C. Joint Filler [Type [C] [_____]]: [ASTM D1752;] Premolded sponge rubber fully compressible with recovery rate of minimum 95 percent; [_____] manufactured by [_____].

Construction joint devices are used with slabs on grade and can be used to form concrete slab into checkerboard panels. Top edges of devices form screed for concrete finishing.

- D. Construction Joint Devices: Integral [galvanized steel] [extruded plastic]; [_____] inch ([_____] mm) thick, formed to tongue and groove profile, [with removable top strip exposing sealant trough,] knockout holes spaced at [6] [_____] inches ([150] [_____] mm), ribbed steel spikes with tongue to fit top screed edge; [_____] manufactured by [_____].

Expansion and contraction joint devices are used with interior slabs on grade, supported slabs above grade and in vertical concrete components to permit concrete to expand and contract without damage to concrete.

- E. Expansion [and Contraction] Joint Devices: [ASTM B221 (ASTM B221M)] [_____] alloy, extruded aluminum; resilient [elastomeric] [vinyl] [neoprene] filler strip with Shore A hardness of [35] [_____] to permit plus or minus [25] [_____] percent joint movement with full recovery; [[extruded aluminum] [vinyl] cover plate,] of longest manufactured length at each location, [flush] [recessed] mounted; [_____] color [as selected]; [_____] manufactured by [_____].

When cross referencing sealants to Section 07900 in the following paragraph, coordinate sealant types required with this section. Verify sealant type and priming materials are compatible with joint filling materials included in this section.

- F. Sealant and Primer: [_____] type, as specified in Section 07900.

***** [OR] *****

ASTM D6690 available as:
- Type I, for moderate climates with performance tested at 0 degrees F (-18 degrees C) using 50% extension.

- Type II, for most climates with performance tested at -20 degrees F (-29 degrees C) using 50% extension.
- Type III, for most climates with performance tested at -20 degrees F (-29 degrees C) using 50% extension and other special tests.
- Type IV, for very cold climates with performance tested at -20 degrees F (-29 degrees C) using 200% extension.

G. Sealant: ASTM D6690, [Type I;] [_____] manufactured by [_____].

***** [OR] *****

H. Sealant: [Cold applied] [two part liquid neoprene] [_____] [_____] manufactured by [_____].

The concrete mix can be specified by performance or prescriptive criteria. Select the following article for performance specifications or subsequent article for specifying by prescriptive criteria.

Be very cautious when performance specifying due to many variables and options allowed.

2.5 CONCRETE MIX

For performance specifying by referencing ACI 301 in the following paragraph, select Method 1, 2, or 3 as follows:

- Method No. 1 requires concrete supplier to furnish mix design and strength by trial batch.
- Method No. 2 requires concrete supplier to furnish field test criteria to achieve specified performance criteria.
- Method No. 3 requires concrete supplier to furnish concrete to specific minimum water/cement ratio.

A. Select proportions for normal weight concrete in accordance with ACI 301 [Method 1] [Method 2] [Method 3].

***** [OR] *****

For performance specifying by referencing ACI 318 in the following paragraph, select trial mixtures or field test data as follows:

- Trial mixtures method requires concrete supplier to provide mix design and strength by trial batch.
- Field test data method requires concrete supplier to provide field test data to achieve specified performance criteria.

- B. Select proportions for concrete in accordance with ACI 318 [trial mixtures] [or] [field experience] [or both].

***** [OR] *****

- C. Select proportions for concrete in accordance with ACI 318 without trial mixtures or field experience when approved by Architect/Engineer.

Modify the following table as applicable to Project requirements.

When more than one strength of concrete is required, repeat the following table, listing locations for various strengths or include schedule listing at end of this section.

Minimum compressive strength and maximum water-cement ratio are governed by ACI 318 and ICC codes for concrete intended to have low permeability, exposed to freezing and thawing, and for corrosion protection of reinforcement when concrete is exposed to chlorides.

Cement type, minimum compressive strength, and maximum water-cement ratio are governed by ACI 318 and ICC codes for concrete exposed to sulfate containing solutions or soils.

Select air content to suit maximum aggregate size and expected exposure. Refer to ACI 318 and ICC codes for allowable air content.

- D. Provide concrete to the following criteria:

Material and Property	Measurement
Compressive Strength (7 day)	[] psi ([] MPa)
Compressive Strength (28 day)	[] psi ([] MPa)
Cement Type	[ASTM C150] [ASTM C595] [ASTM C845] [ASTM C1157]
Cement Content (minimum)	[] pounds/cu yd ([] kg/cu m)
Aggregate Type	[Normal weight] [Lightweight]
Coarse Aggregate	[] percent by volume
Fine Aggregate	[] percent by volume
Fiber Reinforcement	[] percent by volume
Water-Cement Ratio (maximum)	[] by weight
Aggregate Size (maximum)	[] inch ([] mm)
Aggregate Size (minimum)	[] inch ([] mm)
Air Content	[] percent plus or minus 1.5 percent
Admixture	[] type
Admixture	[] type

[Fly Ash] [Pozzolan] Content:	[_____] percent of cementitious materials by weight, maximum
Silica Fume Content:	[_____] percent of cementitious materials by weight, maximum
Slag	[_____] percent of cementitious materials by weight, maximum
Slump	[_____] inches ([_____] mm) plus or minus 1 inch (25 mm)

E. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.

1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
2. Use calcium chloride only when [_____].

***** [OR] *****

3. Do not use calcium chloride nor admixtures containing calcium chloride.
4. Use set retarding admixtures during hot weather.
5. Add air entrainment admixture to concrete mix for work exposed to [freezing and thawing] [or] [deicing chemicals].
6. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fume, and slag content as required by [applicable] [_____] code.

As Project test data become available, ACI 318 and ICC codes permit reducing the amount of by which design mix compressive strength must exceed specified compressive strength when standard deviation is within limits of ACI 318.

F. Average Compressive Strength Reduction: [Permitted in accordance with ACI 318] [Not permitted].

G. Ready Mixed Concrete: Mix and deliver concrete in accordance with [ASTM C94/C94M] [ASTM C685/C685M].

H. Site Mixed Concrete: Mix concrete in accordance with ACI 318.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.

- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.

Concrete can be placed under water using tremie.

- D. Remove water from areas receiving concrete before concrete is placed.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with [ACI 301] [ACI 318].
- B. Notify testing laboratory [and Architect/Engineer] minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and [_____] are not disturbed during concrete placement.

Sand fill may be installed over vapor retarder. Coordinate installation with Section 02320.

- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum [6] [_____] inches ([150] [_____] mm) and seal watertight by [adhesive applied between overlapping edges and ends] [taping edges and ends] [_____].
- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum [6] [_____] inches ([150] [_____] mm) and seal watertight.

Edit Paragraphs F, G and H for joint fillers and sealants used at slab on grade conditions.

- F. Separate slabs on grade from vertical surfaces with [_____] inch ([_____] mm) thick joint filler.

- G. Place joint filler in [floor slab] [_____] pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- H. Extend joint filler from bottom of slab to within [1/2] [1/4] [1/8] [_____] inch ([13] [6] [3] [_____] mm) of finished slab surface. Conform to Section [07900] [_____] for finish joint sealer requirements.

Next paragraph addresses joint devices used specifically at slab on grade conditions; when slab saw cutting technique is to be used, delete following paragraph.

- I. Install construction joint devices in coordination with [floor slab] [_____] pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- J. Install joint device anchors. Maintain correct position to allow joint cover to be flush with [floor] [and] [wall] finish.
- K. Install joint covers in [one piece] [longest practical] length, when adjacent construction activity is complete.
- L. [Apply sealants in joint devices in accordance with Section 07900.]
- M. Deposit concrete at final position. Prevent segregation of mix.
- N. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- O. Consolidate concrete.
- P. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- Q. Place concrete continuously between predetermined expansion, control, and construction joints.
- R. [Do not interrupt successive placement; do not permit cold joints to occur.]

Ensure drawings indicate jointing patterns when following paragraph is utilized.

- S. Place floor slabs in [checkerboard] [or] [saw cut] pattern indicated.
- T. [Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into [1/4] [_____] depth of slab thickness.]

- U. Screed [floors] [and] [slabs on grade] level, maintaining surface flatness of [F_r of [20] [_____]] [maximum [1/4] [_____] inch in 10 ft ([6] [_____] mm in 3 m)].

3.4 SEPARATE FLOOR TOPPINGS

- A. Prior to placing floor topping, [roughen substrate concrete surface and] remove deleterious material. Broom and vacuum clean.
- B. Place required [dividers] [edge strips] [reinforcing] [_____] and other items to be cast in.
- C. [Apply bonding agent to substrate.]

***** [OR] *****

- D. [Apply sand and cement slurry coat on base course, immediately prior to placing toppings.]
- E. Place concrete floor toppings to required lines and levels. [Place topping in checkerboard panels, dimension not to exceed [20] [_____] ft ([6] [_____] m).]
- F. Screed toppings level, maintaining surface flatness of [F_r of [30] [_____]] [maximum [1/8] [_____] inch in 10 ft ([3] [_____] mm /3 m)].

3.5 CONCRETE FINISHING

The following paragraph requires all surfaces to be finished. When only certain surfaces are to be finished, indicate which surfaces by listing in schedule at end of this section.

- A. Provide formed [concrete surfaces to be left exposed] [concrete [walls] [columns] [beams] [joists] [_____]] with [smooth rubbed] [_____] [sand float] [sack rubbed] finish [as Scheduled in this section].

Use following paragraph to specify finishing of surfaces to requirements stated in Section 03350, including hardeners, coatings or sealers.

Use subsequent paragraphs to specify troweling and finishing of surfaces within this section, without hardeners, coatings or sealers.

- B. Finish concrete floor surfaces to requirements of Section [03350] [_____].

***** [OR] *****

- C. Finish concrete floor surfaces in accordance with [ACI 301] [ACI 318] [_____].

- D. Wood float surfaces receiving [quarry tile] [ceramic tile] [terrazzo] [_____] with full bed setting system.
- E. Steel trowel surfaces receiving [carpeting] [resilient flooring] [seamless flooring] [thin set quarry tile] [thin set ceramic tile] [_____].
- F. Steel trowel surfaces which are indicated to be exposed.
- G. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains [at [1/8] [1/4] [_____] inch per foot ([10] [20] [_____] mm per m) nominal] [as indicated on drawings].

3.6 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

ACI 308.1 includes curing requirements for various methods. ACI 301 and ACI 318 include limited curing requirements. Section 03390 includes a variety of curing materials and methods.

- C. Cure concrete in accordance with ACI 308.1 using [_____] method.
***** [OR] *****
- D. Cure concrete floor surfaces as specified in Section [03390] [_____].
***** [OR] *****
- E. Cure floor surfaces in accordance with [ACI 301] [ACI 318] [_____].
- F. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for [7] [_____] days.
- G. Spraying: Spray water over floor slab areas and maintain wet for [7] [_____] days.

3.7 FIELD QUALITY CONTROL

- A. Section [01400 - Quality Requirements: Testing and Inspection Services] [01700 - Execution Requirements: Testing, adjusting, and balancing].

ICC codes require special inspections and verification, except for some concrete footings, slabs-on-grade, and walls depending on building height, installation conditions, and design methods. Refer to code for specific exemptions.

Except for selected applications, ICC codes require structural tests and special inspections to be performed by testing laboratory employed by Owner or Architect/Engineer.

- B. Field [inspection and] testing will be performed by Owner's testing laboratory in accordance with [ACI 318] [[applicable] [_____] code].

***** [OR] *****

- C. Perform field [inspection and] testing in accordance with [ACI 318] [[applicable] [_____] code].

- D. Provide free access to Work and cooperate with appointed firm.

- E. Submit proposed mix design [of each class of concrete] to [inspection and] testing firm for review prior to commencement of Work.

- F. Concrete Inspections:

1. Continuous Placement Inspection: Inspect for proper installation procedures.
2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

- G. Strength Test Samples:

1. Sampling Procedures: ASTM C172.

Standard (laboratory) curing for test cylinders is normal practice. By ICC codes building officials may require field cured test cylinders.

2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, [standard cured] [field cured].

ACI 318 and ICC codes require the average of two tests at 28 days to determine concrete strength. Adjust number of samples when testing at other times is required.

When less than 50 cu yd (38 cu m) of a class of concrete is used, testing is not required.

3. Sample concrete and make one set of [three] [_____] cylinders for every [75] [150] [_____] cu yds ([57] [115] [_____] cu m) or less of each class of concrete placed each day and for every 5,000 sf (465 sq m) of surface area for slabs and walls.
4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
5. Make one additional cylinder during cold weather concreting, and field cure.

- H. Field Testing:

1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: [ASTM C173/C173M] [ASTM C231].
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

I. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39.
2. Test Acceptance: In accordance with [ACI 318] [[applicable] [_____] code].
3. Test [one] [_____] cylinder at [7] [_____] days.

ACI 318 and ICC codes require the average of two tests at 28 days to determine concrete strength.

4. Test two cylinders at 28 days.
5. Test [_____] cylinder at [_____] days.
6. Retain [one] [_____] cylinder for [_____] days [for testing when requested by Architect/Engineer].
7. Dispose remaining cylinders when testing is not required.

J. Core Compressive Strength Testing:

1. Sampling and Testing Procedures: ASTM C42/C42M.
2. Test Acceptance: In accordance with [ACI 318] [[applicable] [_____] code].
3. Drill [three] [_____] cores for each failed strength test from concrete represented by failed strength test.

Include the following test when corrosion protection of reinforcement is required for concrete exposed to chlorides.

K. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218; tested at [28] [_____] days.

1. Maximum Concentration: As permitted by [applicable] [_____] code.

L. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.8 PATCHING

A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.

C. Patch imperfections [as directed by Architect/Engineer] [in accordance with [ACI 301] [ACI 318]] [_____].

3.9 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

3.10 SCHEDULE - CONCRETE TYPES AND FINISHES

Include schedule to identify differing concrete types, locations, or exposed surfaces.

Consider the following examples when developing Project schedule.

- A. Foundation Walls: 3,000 psi (21 MPa) 28 day concrete, form finish with honeycomb filled surface.
- B. Underside of Supported Floors and Structure Exposed to View: 4,000 psi (28 MPa) 28 day concrete, sack rubbed finish.
- C. Exposed Portico Structure: 4,000 psi (28 MPa) 28 day concrete, air entrained, smooth stone rubbed finish.

3.11 SCHEDULE - JOINT FILLERS

Include schedule when differing joint fillers and joint devices are utilized in differing locations on the Project.

- A. Basement Floor Slab Perimeter: Joint filler Type A set 1/8 inch below floor slab elevation.
- B. Exterior Retaining Wall at Loading Dock: Joint filler Type F recessed 3/8 inch with sealant cover.

END OF SECTION