SECTION 31 0000

CAST-IN-PLACE HIGH PERFORMANCE STRUCTURAL CONCRETE

This section includes editing notes to assist the user in editing the section to suit project requirements. These notes are included as hidden text, and can be revealed or hidden by one of the following methods:

Microsoft Word 2007: Click the OFFICE button, select WORD OPTIONS, select DISPLAY, then select or deselect the HIDDEN TEXT option.

Microsoft Word (earlier versions): From the pull-down menus select TOOLS, then OPTIONS. Under the tab labeled VIEW, select or deselect the HIDDEN TEXT option.

Corel WordPerfect: From the pull-down menus select VIEW, then select or deselect the HIDDEN TEXT option.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cast-in-place concrete for [roads] [bridges] [aviation runways] [boat ramps] [industrial infrastructure] [building frame members] [shear walls] [elevator shaft walls] [foundation walls] [supported slabs] [slabs on grade] [control, expansion, and contraction joint devices] [equipment pads] [light pole bases] [flagpole bases] [and] [____].

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 03 1000 - Concrete Forming.
3. Section 03 2000 - Concrete Reinforcing.
4. Section 03 3500 - Concrete Finishing.
5. Section 07 9200 - Joint Sealers.
6. Section 07 9513 - Expansion Joint Cover Assemblies.
7. Section [__ ____- _____]: Mechanical items cast into concrete.
8. Section [__ ____- _____]: Electrical items cast into concrete.

C. Unit Prices:
1. Concrete - slab-on-fill or grade:
   a. Basis of Measurement: By the [square [foot] [meter] [____].] [cubic [yard] [meter] [____].]
   b. Basis of Payment: Includes concrete, placement accessories, consolidating and leveling, troweling, and curing.
2. Concrete - vertical in forms:
   a. Basis of Measurement: By the [square [foot] [meter] [____].] [cubic [yard] [meter] [____].]
   b. Basis of Payment: Includes concrete, placement accessories, consolidating, and curing.
3. Concrete - miscellaneous locations:
   a. Basis of Measurement: By the [square [foot] [meter] [____].] [cubic [yard] [meter] [____].]
   b. Basis of Payment: Includes concrete, placement accessories, consolidating and leveling, troweling, and curing.
4. Concrete - grouting:
   a. Basis of Measurement: By the cubic [yard] [meter].
   b. Basis of Payment: Includes preparation of substrate, grout, placement, consolidating, troweling, and curing.
5. Devices - [control] [expansion] [and] [contraction]:
   a. Basis of Measurement: By the linear [foot] [meter] [____].
   b. Basis of Payment: Includes component and placement with accessories.

1.2 REFERENCES

A. American Concrete Institute (ACI):

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

B. ASTM International (ASTM):
1. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
3. C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
4. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. C78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
7. C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. C150 - Standard Specification for Portland Cement.
9. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. C469 - Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
14. C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. C496/C496M - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
16. C512 - Standard Test Method for Creep of Concrete in Compression.
17. C595 - Standard Specification for Blended Hydraulic Cements.
18. C666/C666M - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
19. C672/C672M - Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
20. C845 - Standard Specification for Expansive Hydraulic Cement.
21. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear.
22. C928 - Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
23. C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
24. C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
25. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
26. C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
27. C1600/C1600M - Standard Specification for Rapid Hardening Hydraulic Cement.
28. D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
29. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
30. D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
31. D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
32. E96 - Standard Test Methods for Water Vapor Transmission of Materials.
33. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
34. E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth

or Granular Fill Under Concrete Slabs.

35. E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

C. American Association of State Highway and Transportation Officials (AASHTO) TP-60-00 - Standard Method of Test for Coefficient of Thermal Expansion of Hydraulic Cement Concrete.

D. South Coast Air Quality Management District (SCAQMD) Rule 1 168 - Adhesive and Sealant Applications.

1.3 PERFORMANCE REQUIREMENTS

A. Vapor Retarder Permeance: Maximum [I perm] [0.3 perms], when to ASTME96, Procedure A.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Product Data:
      a. Submit product standards, physical and chemical characteristics, technical specifications, limitations, and general recommendations regarding each material.
      b. Submit data on joint devices, attachment accessories [, and admixtures].
   2. Samples: [6] [__] inch long [expansion] [and] [control] joint samples.

B. Quality Control Submittals:
   1. Design data:
      a. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for:
         1) Hot and cold weather concrete work.
         2) Air entrained concrete work.
      b. Identify mix ingredients and proportions, including admixtures.
      c. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
   2. Certificate of Compliance: Certify that Products furnished meet or exceed specified requirements.

C. Sustainable Design Submittals:
   1. Recycled Content: Certify recycled material content for recycled content products.
   2. Regional Materials: Certify source for local and regional materials and distance from Project site.
   3. Rapidly Renewable Materials: Certify materials made from plants harvested within a ten year or shorter cycle.

D. Closeout Submittals:
   1. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum 3 years [documented] experience.

B. Applicator Qualifications: Company specializing in placing cast-in-place high performance structural rapid setting concrete with minimum 2 years [documented] experience.

C. Mockup:
   1. Construct mockup for architectural concrete surfaces receiving special treatment or finish as result of formwork.
   2. Size: Sufficient to show special treatment or finish required.
   3. Locate [where directed.] [where indicated.]

4. Approved mockup may [not] as part of Work.

D. Perform Work in accordance with [ACI 301] [and] [ACI 318].

E. Acquire cement and aggregate from one source throughout Work.

F. Fire Rated [Wall] [Floor] [Roof] Construction:
1. [Rating as indicated on Drawings] [[__] hour rating].
2. Tested rating: Determined in accordance with ASTME119.

G. Prescriptive Rating: [Item Number [__],] determined in accordance with [applicable] [____] code.

H. Perform Work in accordance with [State] [Municipality] of [____] [Highways] [Public Works] standard.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Maintain high early strength concrete temperature after installation at minimum 50 degrees F for minimum 24 hours unless otherwise directed.

1.7 COORDINATION

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on EkkoMAX by CERATECH Inc. (www.ceratechinc.com)

**** OR ****

B. Contract Documents are based on KemRok by CERATECH Inc. (www.ceratechinc.com)

C. Substitutions: [Under provisions of Division 01.] [Not permitted.]

2.2 MATERIALS

A. Structural Concrete:
1. Effectively placed in ambient temperatures ranging from 30 to 120 degrees Fahrenheit following traditional post hydration curing practices.
2. Mixed and placed similar to traditional Portland concrete,.
3. 1 to 5 hours working time.
4. Finished via standard concrete finishing practices.
5. Achieve compressive strengths of 350 to 4500 psi (2.4 to 31.0 MPa) at 72 degrees F (22 degrees C) within twenty four hours following the addition of water.
6. [Moderate] [High] sulphate resistance.

B. Aggregate: Type recommended by cementitious concrete manufacturer; 3/8 inch (10 mm), 1/2 inch (13 mm), 3/4 inch (19 mm), or 1 inch (25 mm) clean washed fractured stone.

2.3 STRUCTURAL CONCRETE MATERIALS

A. Cement: ASTM C1157, manufactured by CERATECH Inc.; [ASTM C595], [____].

**** OR ****

B. Hydraulic Cement: ASTM C1600 Type VRH or URH.

**** OR ****

C. Expansive Hydraulic Cement: ASTM C845.

D. Recycled Content: Minimum 90 percent, classified as pre-consumer.

E. Rapidly Renewable Content: Minimum 5 percent.

F. Water: ACI 318; potable, [without deleterious amounts of chloride ions] [with maximum 2 percent of water soluble chloride ions by weight of cement].

2.4 ADMIXTURES

A. Air Entrainment: ASTM C260.
   1. MicroAir from BASF per manufacturer's instructions.
   2. Substitutions require approval by cement manufacturer.

B. 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].

C. Plasticizing:
   1. ASTM C1017/C1017M Type I, plasticizing.
   2. Use only with prior approval from cement manufacturer.

2.5 ACCESSORIES

A. Vapor Retarder:
   1. 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.
   2. Furnish joint tape recommended by manufacturer.
   3. Acceptable Manufacturers:
      a. [_____].
      b. [_____].
      c. [_____].
      d. Substitutions: [Under provisions of Division 01.] [Not permitted.]

B. Non-Shrink Grout:
   1. ASTM C1107, Grade [A] [B] [C] [____]; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   2. Capable of developing minimum compressive strength of [2,400] [____] psi ([17] [____] MPa) in 48 hours and [7,000] [____] psi ([48] [____] MPa) in 28 days.
   3. Manufacturers:
      a. [_____].
      b. [_____].
      c. [_____].
      d. Substitutions: [Under provisions of Division 01.] [Not permitted.]

C. Concrete Reinforcing Fibers:
   1. ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete.
   2. 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.
   3. Manufacturers:
      a. [_____].
      b. [_____].
      c. [_____].
      d. Substitutions: [Under provisions of Division 01.] [Not permitted.]

2.6 JOINT DEVICES AND FILLER MATERIALS

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 [_____].

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 [_____].

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 [_____].

F. Sealant and Primer: [____] type, as specified in Section [07 9200.] [__ ____.]

**** OR ****

G. Sealant:
   1. ASTM D6690, [Type I;] [____] manufactured by [_____].
   2. [Interior] sealants and sealant primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

**** OR ****

H. Sealant:
   1. [Cold applied] [two part liquid neoprene] [____]; [____] manufactured by [_____].
   2. [Interior] Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2.7 CAST-IN PLACE STRUCTURAL CONCRETE MIX

A. Provide concrete to the following criteria:

CHARACTERISTIC		RESULTS-NET / RESULTS EXTENDED
Compressive Strength	ASTM C39	
24 hours		[350 - 4500] psi ([2.4 – 31.0] MPa)
7 days		[2000 - 8500] psi ([13.8 – 58.6] MPa)

CHARACTERISTIC		RESULTS-NET / RESULTS EXTENDED
28 days		[3000 - 10000] psi ([20.7 – 68.9] MPa)
Flexural Strength	ASTM C78	
7 days		[385 - 795] psi ([2.6 – 5.5] MPa)
28 days		[450 - 850] psi ([3.1 – 5.9] MPa)
Splitting Tensile Strength	ASTM C496	
28 days		[245 - 800] psi ([1.7 – 5.5] MPa)
Bond Strength	ASTM C882	
24 hours		NA
7 days		NA
Rapid Freeze Thaw Resistance (Durability Factor - retained percentage of Dynamic Modulus) 300 cycles	ASTM C666 Method A	Greater than 90 percent
Scaling Resistance, Greater than 90 percent 50 cycles	ASTM C672	0 to 2
Modulus of Elasticity 28 days	ASTM C469	[5.00] psi ([3.4] GPa)
Coefficient of Thermal Expansion 28 days	AASHTO TP 60	4.7 in/in/F

CHARACTERISTIC		RESULTS-NET / RESULTS EXTENDED
Length Change, Percent of total length	ASTM C1600	-0.04 to -0.06 percent
28 days dry cure (Air Storage)		
Creep (365 days)	ASTM C512	1.91
Strain / psi)		
Creep Coefficient		
Set Times at 72 degrees F/ 22 degrees C		
Initial (Work Time)		120 to 180 minutes
Final		200 minutes
Load Bearing Strengths dependent upon mix design		
Foot Traffic		4 to 5 hours
Wheeled Traffic		48 hours
Block Construction		24 to 36 hours
Steel Construction		24 to 48 hours
Stripping Formwork		24 to 48 hours
Curing		White pigmented Curing Compound or Evaporative Retarder
Thickness		
Minimum		3 inches or 3x MSA
Maximum		No restrictions to depth of placement profile except for mass concrete placement

B. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer and in accordance with the cast-in-place high performance structural

rapid setting concrete manufacturer's installation/mixing instructions.

1. MicroAir from BASF.
2. Substitutions: Not permitted.

C. Transit Mixed Concrete: Mix and deliver concrete in accordance with manufacturer's instructions.

D. Site Mixed Concrete: Mix concrete in accordance with manufacturer's instructions [and ACI 318].

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. 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. Site Preparation: Construction site should be prepared in accordance with ACI Guidelines for placement of structural concrete.

B. Prepare previously placed concrete by cleaning with steel brush and moistening to a saturated surface dry condition. Remove laitance, coatings, and unsound materials.

C. 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.

D. Remove debris and ice from formwork, reinforcement, and concrete substrates.

E. Remove water from areas receiving concrete before concrete is placed.

3.3 MIXING INSTRUCTIONS

A. Standard Mixing Procedures (Rotating Drum Transit Truck Concrete Mixer), mix design to be determined and verified prior to project start.

3.4 PLACING STRUCTURAL CONCRETE

A. General: Working times based on ambient temperature, types of aggregate and total amount of water.

1. Working times are influenced by substrate, surface temperature, humidity and repair profile.
2. Upon initial set, a broom finish can be applied. Upon final set, the material can be saw-cut, drilled, sanded and/or polished.
3. Do not re-temper. The addition of water to the surface of concrete will negatively affect the materials final properties.
4. Clean all tools and equipment with water prior to the material reaching final set.

B. Place concrete in accordance with [ACI 301] [ACI 318].

C. Notify Testing Laboratory [and Architect/Engineer] minimum 24 hours prior to commencement of

operations.

D. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and [____] are not disturbed during concrete placement.

E. Sand fill may be installed over vapor retarder. Coordinate installation with Section [__ ____].

F. 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] [____].

G. 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.

H. Separate slabs on grade from vertical surfaces with [3/8] [1/2] inch ([10] [13] mm) thick joint filler.

I. Place joint filler in [floor slab] [____] pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

J. Extend joint filler from bottom of slab to within 1/8 inch (3 mm) of finished slab surface. Conform to Section [07 9200] [__ ____] for finish joint sealer requirements.

K. Install construction joint devices in coordination with [floor slab] [____] pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

L. Install joint device anchors. Maintain correct position to allow joint cover to be flush with [floor] [and] [wall] finish.

M. Install joint covers in [one piece] [longest practical] length, when adjacent construction activity is complete.

N. [Apply sealants in joint devices in accordance with Section [07 9200] [__ ____].

O. Deposit concrete at final position. Prevent segregation of mix.

P. Place concrete in continuous operation for each panel or section determined by predetermined joints.

Q. Consolidate concrete. By vibration.

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

S. Place concrete continuously between predetermined expansion, control, and construction joints.

T. Place floor slabs in [checkerboard] [or] [saw cut] pattern indicated.

U. [Saw cut joints within 2 to 4 hours after placing. Use 3/16 inch thick blade, cut into 1/2 depth of slab thickness.]

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

3.5 SEPARATE FLOOR TOPPING

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. Place concrete floor toppings to required lines and levels. [Place topping in checkerboard panels, dimension not to exceed [20] [____] ft ([6] [____] m).]

D. Screed toppings level, maintaining surface flatness of [F_f of [30] [____]] [maximum [1/8] [____] inch in 10 ft ([3] [____] mm /3 m)].

3.6 CONCRETE FINISHING

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].

B. Finish concrete floor surfaces in accordance with [ACI 301] [ACI 318] [____].

C. Wood float surfaces receiving [quarry tile] [ceramic tile] [terrazzo] [____] with full bed setting system.

D. Steel trowel surfaces receiving [carpeting] [resilient flooring] [seamless flooring] [thin set quarry tile] [thin set ceramic tile] [____].

E. Steel trowel surfaces which are indicated to be exposed.

F. 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].

3.7 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Protect concrete footings from freezing for minimum one day.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

D. Cure floor surfaces in accordance with manufacturer's installation instructions and [ACI 308.1] [ACI 301] [ACI 318] [____].

3.8 FIELD QUALITY CONTROL

A. Field [inspection and] testing will be performed by Owner’s testing laboratory in accordance with [ACI 318] [[applicable] [____] code].

**** OR ****

B. Perform field [inspection and] testing in accordance with [ACI 318] [[applicable] [____] code].

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed mix design to [inspection and] testing firm for review prior to commencement of Work.

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

F. Strength Test Samples:
   1. Sampling Procedures: ASTM C172.
   2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, field cured.
   3. Sample concrete and make one set of [three] [____] cylinders for every 75 cu yds (57 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.

G. 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.

H. Cylinder Compressive Strength Testing:
   1. Test Method: ASTM C39.
   2. Test Acceptance: In accordance with [ACI 318] [[applicable] [____] code].
   3. Test [one] [____] cylinder at 6 hours.
   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.

I. 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.

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

3.9 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 [manufacturer's instructions] and [ACI 301] [ACI 318]] [_____].

3.10 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.

3.11 SCHEDULE - CONCRETE TYPES AND FINISHES

A. Foundation Walls: [____] psi [(____ MPa)] 28 day concrete, form finish with honeycomb filled surface.

B. Underside of Supported Floors and Structure Exposed to View: [____] psi [(____ MPa)] 28 day concrete, sack rubbed finish.

C. Slab on Grade: [____] psi [(____ MPa)] 28 day concrete, [_____].

D. Columns: [____] psi [(____ MPa)] 28 day concrete, [_____].

E. Roadways: [____] psi [(____ MPa)] 28 day concrete, [_____].

F. Aviation Runways: [____] psi [(____ MPa)] 28 day concrete, [_____].

G. Boat Ramps: [____] psi [(____ MPa)] 28 day concrete, [_____].

H. Building Frame Members: [____] psi [(____ MPa)] 28 day concrete, [_____].

I. Shear Walls: [____] psi [(____ MPa)] 28 day concrete, [_____].

J. [_____]: [____] psi [(____ MPa)] 28 day concrete, [_____].

END OF SECTION