## SECTION 03011

## CONCRETE, GENERAL

### PART 1-GENERAL

1.01 DESCRIPTION

All concrete work shown is governed by this section. Concrete strength not otherwise designated shall be 3,000 psi, as determined by the use of ASTM C31 and C39.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified. Where provisions of these codes and standards are in conflict with the building code in force for this project, the building code shall govern.

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 318 "Building Code Requirements for Reinforced Concrete".
3. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
4. ACI 311 "Recommended Practice for Concrete Inspection".
5. ACI 347 "Recommended Practice for Concrete Formwork".
6. ACI Manual 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures".

B. Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Should cylinders and cores indicate unacceptable concrete, load testing or removal and replacement of the concrete may be required at no cost to the Owner.

C. Concrete Testing Service:

1. The Contractor shall employ, at his own expense, a testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests, to design concrete mixes, and to perform strength tests associated with form removal and testing of the concrete during the process of the work.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI Manual 315 in detailing reinforcing. Show location of construction joints planned.

B. Test reports specified hereinafter.

C. Product Data: Submit manufacturer product data, specifications with application and installation instruction for proprietary materials and items, including admixes, bonding agents, joint systems and others, as requested by the Architect/Engineer.

### PART 2-PRODUCTS

2.01 FORM MATERIALS

A. Exposed Finish Concrete: Use plywood metal or metal-framed plywood, to provide continuous, straight, smooth exposed surfaces. Use plywood conforming to U.S. product standard PS-1 "B-B (concrete form) plywood", Class I, exterior grade or better, mill-oiled and edge sealed.

B. Unexposed Finish Concrete: Use plywood, lumber or metal. Lumber dressed on four sides.

2.02 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, as follows:

1. Provide Type I cement or Type III High Early Strength Concrete. Use one brand of cement throughout project unless otherwise acceptable to the Architect/Engineer.

B. Aggregates: Conform to ASTM C33 for pea gravel aggregate, conform to ASTM C404, size No.8.

C. Water: Clean, fresh, drinkable.

D. Admixtures:

1. Air-Entraining Admixture: ASTM C260.
2. Water-Reducing Admixture: ASTM C494, Type A.
3. Set-Control Admixture: ASTM C494, as follows:
   a. Type D, Water-reducing and Retarding.
   b. Type E, Water-reducing and Accelerating.
4. Fly Ash: ASTM C618, Type F.
5. Calcium Chloride: Do not use calcium chloride in concrete.

E. Non-Shrink Grout: CRD-C588, factory pre-mixed grout; use non-metallic, "Masterflow 713" by Master Builders, "Sonogrout", by Sonnoborn-Contect, or equal.

F. Epoxy Adhesive: Use Sikadur 35, Hi-Mod Lv (as recommended by the manufacturer SIKA Corp.) or equal.

2.03 RELATED MATERIALS

A. Performed Expansion Joint Fillers: Fiber type conforming to ASTM D1751 or cork type conforming to ASTM D1752, Type II.

B. Vapor Barrier: ASTM D4397 polyethylene sheeting, minimum 6 mil. thickness.

C. Joint Sealant Compound:

1. Horizontal surfaces (less than 3% slope)
   Outside buildings - ASTM D1190
   Inside buildings - ASTM D1190 or ASTM D1850

2. Vertical surfaces (greater than 3% slope)
   ASTM C920

D. Water Stops: Flat, dumbbell type or center bulb per Corps of Engineers CRD-C513, or CRD-C572.

E. Curing Material:

1. Membrane-forming curing compound: ASTM C309, Type I.
2. Moisture retaining cover: ASTM C171.

2.04 REINFORCING MATERIALS

A. Reinforcing: ASTM A615, Grade 60.

B. Welded Wire Fabric: ASTM A185.

C. Supports for Reinforcing: Conform to CRSI recommendations and other applicable codes and standards. Brick, wood and other devices will not be acceptable.

2.05 PROPORTIONING AND DESIGN OF MIXES

A. All concrete shall contain a minimum of five sacks of cement per cubic yard. Contractor may use fly ash as part of cement content of coverage. Fly ash shall be a maximum of 25% of the cement content, by weight (cement plus fly ash).

B. Slump Limits: All concrete, unless otherwise noted, 2" to 4"; grout for reinforced masonry, 5" to 10".

C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete as required, complying with ACI 211.1 for normal weight concrete.

1. Field Experience Method: When field experience method is used to select concrete proportions, establish procedures as specified in ACI 301 and ACI 318. Conform to applicable codes and standards.

2. Laboratory Trial Method: When laboratory trial batches are used to select concrete proportions, prepare test specimens in accordance with ASTM C192 and conduct strength test in accordance with ASTM C39, as specified in ACI 301. Conform to applicable codes and standards.

D. Submit testing facility report to the Architect/Engineer for each produced mix at least 14-days prior to start of work.

E. Admixtures:

1. Use air-entraining admixture in all concrete, 3-6 percent entrained air.
2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing.

**PART 3-EXECUTION**

3.01 CONCRETE MIXING

A. Use Only Ready-Mix Concrete: Comply with the requirements of ASTM C94.

1. A delivery ticket showing truck number, date, and time that mixing was started shall be given to the Contractor's superintendent at the job site before placing the concrete from the truck mixer. At the job site the Contractor's superintendent shall note on the delivery ticket the time of completion of the concrete placement from the truck and the general area of the structure in which the concrete was placed. A complete file of all delivery tickets shall be maintained and kept available at the job site until completion of the project.

2. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is between 85 degrees F and 90 degrees F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F, reduce the mixing and delivery time to 60 minutes.

3. No additional water shall be added to concrete without the approval of the Architect/Engineer. Should additional water be required to obtain a slump as specified in this section of the type of concrete, the Contractor shall perform slump tests in accordance with ASTM C143 to determine the actual slump of the concrete in the mixer. The contractor may then add water, but in no case shall the additional water exceed 3 percent of the mix-design water content, nor shall the slump of the mix exceed the maximum slump specified for the type concrete. Slump tests and the addition of water to the mixer shall be completed within 15 minutes of the arrival of the mixer at the site. Additional water shall not be added to the mix after the mixer has been on the site longer than 15 minutes.

3.02 FORMWORK: Design of all formwork is the Contractor's responsibility. Conform to applicable standards and ACI 347. Coat forms with form coating compound before reinforcing is placed. Comply with ACI 347 for shoring and reshoring.

3.03 PLACING REINFORCING: Conform to CRSI "Manual of Standard Practice" and other noted applicable codes and standards. Clean reinforcing of loose rust, mill scale and other items that reduce or destroy the bond.

3.04 CONCRETE PLACEMENT: Conform to ACI 304. All concrete shall be consolidated by internal vibration with mechanical vibrators per ACI 304. Cold weather placing shall conform to ACI 306. Use water-reducing retarding admixture (type "D") when required by high temperatures, low humidity or other adverse placing conditions.

3.05 CONCRETE CURING: Start curing as soon as free water has disappeared from concrete surface. Cure for at least 7-days in accordance with ACI 301.

3.06 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls and columns, may be removed after curing for 24 hours after placing concrete.

B. Formwork supporting weight of concrete such as beam soffits, slabs and other structural elements shall not be removed in less than 14-days or until concrete has reached its 28-day design strength, as determined by concrete compressive strength tests on field cured specimens.

3.07 FINISH ON FORMED SURFACES

A. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This is as cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

B. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
1. Moisten concrete surface and rub with Carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

3.08 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to monolithic slab and topping surfaces to receive trowel finish and other finishes as hereinafter specified.

1. After screening, consolidating, and leveling concrete slabs, consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4" in 10' when tested with a 10' straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

B. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, paint or other thin film finish coating system and all surfaces not otherwise noted.

1. After floating, begin first trowel finish operation using a power-driven trowel. Finish with tolerance not exceeding 1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system. Finish uniform in texture and appearance, free of trowel marks.

C. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

1. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

D. Chemical-Hardener Finish: Apply chemical-hardener finish to exposed interior concrete floors. Apply liquid chemical hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water, and apply in 3 coats; first coat, 1/3-strength; second coat, 1/2-strength; third coat, 2/3-strength. Evenly apply each coat, and allow 24 hours for drying between coats.

1. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.
2. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.09 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Sampling and testing for field quality control during the placement of concrete may include the following, as directed by the Architect/Engineer.

1. Slump: ASTM C143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.

2. Compression Test Specimens: ASTM C31; one set of 3 standard cylinders for each compressive strength. Cast and store cylinders for laboratory cured test specimen and field-cured test specimens as specified in ASTM C31.

3. Compressive Strength Tests: ASTM C39; one set for each 50 cubic yards or fraction thereof, of each mix design placed in any one day or for each 2,500 square feet of surface area placed; 1 specimen tested at 7 days; 2 specimens tested at 28 days.

B. Test results will be reported in writing to the Architect/Engineer and Contractor on the same day that tests are made.

C. Additional Tests: The testing service shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect/Engineer. Testing services may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests, and any additional tests required, when unacceptable concrete is verified.

**END OF SECTION**