SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies Cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

A. Refer to the Special Provisions and section 013300 for additional submittal guidelines. Before any equipment and/or material is fabricated or shipped, furnish to the Engineer full details, shop drawings, dimensions, catalog cuts, schematic (elementary) diagrams, and other descriptive matter as required to fully describe the equipment and/or material specified under the Section.

B. Product Data: for each type of product indicated.

C. Design Mixtures: for each concrete mixture.

D. Shop Drawings: For steel reinforcement.

E. Material test reports.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain major materials, products, equipment, and system components, from one source from a single manufacturer.

B. Manufacturer Qualifications: a firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

   a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities".

C. ACI Publications: comply with the following unless modified by requirements in the Contract Documents:

   a. ACI 301: "Specification for Structural Concrete," Sections 1 through 5.
   b. ACI 117: "Specifications for Tolerances for Concrete Construction and materials".

D. Pre-installation conference: conduct a conference at the project site.

1.5 CODES, ORDINANCES, AND REGULATIONS

A. Do all work and install materials and/or equipment in accordance with the requirements of the applicable Federal, State, County, City, and applicable laws and ordinances having jurisdiction.

1.4 MEASUREMENT

A. Measurement and payment are per bid schedule Section 004100.

1.5 RELATED SECTIONS

A. Divisions 31, 32, and 33.

1.6 REFERENCES

A. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

B. ASTM C94: Ready-Mixed Concrete.

PART 2 PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials approved by UL wherever standards have been established by that organization.

B. Furnish and install all incidental items not specifically shown or specified which are required by good practice to provide the complete systems specified herein.

C. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

2.2 FORM-FACING MATERIALS

A. Smooth-formed finished concrete: form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize the number of joints.

B. Rough-formed finished concrete: plywood, lumber, metal, or other approved materials. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M. Grade 60 (grade 420), deformed.

B. Galvanized-steel welded wire reinforcement: ASTM A 185, plain, fabricated from galvanized steel wire into flat sheets.

C. Bar supports: bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or pre-cast concrete according to CRSI's "Manual of Standard Practice".

2.4 CONCRETE MATERIALS

A. Cementitious Material: use the following cementitious materials, of the same type, brand, and source, throughout the project:

   a. Portland Cement: ASTM C150, Type III

B. Normal-weight aggregates: ASTM C33, graded, ¾ inch (19 mm) nominal maximum coarse-aggregate size.

   a. Fine and Coarse Aggregates: free of materials with deleterious reactivity to alkali in cement.

C. Water: Clean (not detrimental to concrete). ASTM C94/C94M and potable.

2.5 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical Admixtures: provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

   a. Water reducing admixture: ASTM C494C494M, Type A.
   b. Retarding admixture: ASTM C494/C494M, Type B.
   c. Water reducing and retarding admixture: ASTM C494/C494M, Type D.
   d. High range, water reducing admixture: ASTM C494/C494M, Type F.
   e. High range, water reducing and retarding admixture: ASTM C494/C494M, Type G.
   f. Plasticizing and retarding admixture: ASTM C1017/C1017M, Type II.

2.6 VAPOR RETARDERS

A. Plastic vapor retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397 not

less than 6 mil thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

B. Joint seams to overlap a minimum of twelve inches and be secured in place with manufacturer recommended and Owner approved joint tape.

2.7 CURING MATERIALS

A. Evaporation retarder: waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz/sq. yd. (305 g/sq. m) when dry.

C. Moisture-retaining cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: potable.

E. Clear, waterborne, membrane-forming curing compound: ASTM C 309, Type 1, Class B, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

F. Clear, waterborne, membrane-forming curing compound: ASTM C 309, Type 1, Class B, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, solvent-borne, membrane-forming curing and sealing compound: ASTM C 1315, Type 1, Class A.

H. Clear, waterborne, membrane-forming curing and sealing compound: ASTM C 1315, Type 1, Class A.

2.8 RELATED MATERIALS

A. Expansion and isolation joint filler strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Provide concrete to the following criteria:

a. Minimum compressive strength: 2500 psi at 28 days.

b. Maximum water-cementitious materials ratio: 0.45.
c. Slump limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
d. Air content: 6 percent, plus or minus 1.5 percent at point of delivery for ¾ inch (19 mm) nominal maximum aggregate size.

2.10 CONCRETE MIXING

A. Ready mix concrete: measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.

a. When air temperature is between 85- and 90-degrees F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "manual of Standard Practice".

PART 3 EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Plastic vapor retarders: place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

a. Lab joints twelve inches minimum and seal with manufacturer's recommended tape.
b. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4 STEEL REINFORCEMENT

A. General: comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

3.5 JOINTS

A. General: construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction joints: install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Engineer.

C. Contraction joints in slabs-on-grade: form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

   a. Grooved joints: form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   b. Sawed joints: form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch (3.2 mm) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation joints in slabs-on-grade: after removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 EXAMINATION

A. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed and positioned securely and will not cause hardship in placing concrete.

3.7 PREPARATION

A. Thoroughly compact concrete bearing area to a minimum depth of 6 inches. Compaction shall be a minimum of ninety-five percent (95%) relative compaction beneath all foundations.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no

new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

a. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-weather placement: comply with ACI 306.1.

D. Hot-weather placement: comply with ACI 301.

3.8 FINISHING FORMED SURFACES

A. Rough-formed finish: as cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

a. Apply to concrete surfaces.

B. Smooth-formed finish: as cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

a. Apply to concrete surfaces exposed to public view.

C. Related unformed surfaces: at tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General: comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float finish: consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Rte-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

a. Apply a trowel finish to surfaces indicated.
b. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10 foot (3.05 m) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed ¼ inch (6 mm).

C. Trowel finish: after applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

D. Trowel and fine-broom finish: apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.

   a. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

E. Broom finish: apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.10 CONCRETE PROTECTING AND CURING

A. General: protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation retarder: apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

   a. Moisture curing: keep surfaces continuously moist for not less than seven days.
   b. Moisture-retaining-cover curing: cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   c. Curing compound: apply uniformly in continuous operation by power spray or heavy rainfall within three hours after initial application maintain continuity of coating and repair damage during curing period.
      i. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
   d. Curing and sealing compound: apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 FIELD QUALITY CONTROL

A. Testing and inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

   a. Testing services: tests shall be performed according to ACI 301.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT AND PAYMENT

A. Measurement and payment for all work shall be in accordance with the contract BID SCHEDULE, refer to Section 004100 and actual work as field measured and verified. No payments will be made for materials on hand. All payments to be made following field verification of work.

END OF SECTION 033000