



**SPECIAL PROVISIONS
FOR
ARCHITECTURAL CONCRETE**

**Dallas County
ICAAP-SWAP-8177(626)--SH-25**

**Effective Date
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THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

157153.01 GENERAL.

1.01 SUMMARY

Section includes cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

1.02 REFERENCE STANDARDS

- A. AASHTO M 182 - Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats; 2005.
- B. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- D. ACI 303R - Guide to Cast-in-Place Architectural Concrete Practice; 2012.
- E. ACI 305R - Hot Weather Concreting; 2010.
- F. ACI 306R - Cold Weather Concreting; 2010.
- G. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- H. ACI 347R - Guide to Formwork for Concrete; 2014.
- I. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete; 2013.
- J. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

- K. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
- L. ASTM C150 - Standard Specification for Portland Cement; 2016.
- M. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- N. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- O. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- P. ASTM C33 - Standard Specification for Concrete Aggregates; 2016.
- Q. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete; 2013.
- R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- S. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.
- T. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- U. ASTM C94 - Standard Specification for Ready-Mixed Concrete; 2015.
- V. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- W. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.

1.03 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site – coordinate with Engineer.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place architectural concrete subcontractor.

2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, and concrete repair procedures and protection of cast-in-place architectural concrete.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 1. Indicate amounts of mixing water to be withheld for later addition at project site.
- C. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, form liner inserts, cleanout panels, and other items that visually affect cast-in-place architectural concrete form and finish.
- D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- F. Samples: For each of the following materials:
 1. Form-facing panel.
 2. Form ties.
 3. Form liners.
 4. Coarse- and fine-aggregate gradations.
 5. Chamfers and rustications.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Material Certificates: For each of the following:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Repair materials.
- C. Material Test Reports: For the following, by a qualified testing agency:
 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete

products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
 3. Testing Agency shall be provided by the Contracting Authority.
- C. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

1.08 MOCK-UP

- A. Mock-ups: Two 4 foot minimum length mockups of each wall type (PCC feature wall and PCC seat wall) are required to review wall finish and rustications. Provide mockups as follows:
1. Mock-ups shall be complete in all respects and shall represent the final complete wall assembly, including both side faces, end face, and top of wall, to include the correct concrete mix type and color, graphic form liner pattern layout, sandblast finish, chamfers and rustication joints as shown in the plans. Below grade wall or footing components are not required but may be included at the Contractor's preference.
 2. Construct mock-ups in location and orientation at project site approved by Engineer or off-site and delivered to project site for Engineer's review.
 3. Do not install feature or seat walls until mock-ups are approved.
 4. Where review of mock-up may require revisions of design dimensions or finishes, the Engineer will provide such revisions in writing.
 5. Mock-ups may be utilized in the completed project if approved by Engineer.
 6. Upon approval, the contractor shall remove and dispose of the mock-up.
 7. Contractor shall design and provide structural framework assemblies necessary to support and display mock-ups.

157153.02 MATERIALS.

2.01 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 number of joints.
1. Plywood, metal, or other approved panel materials.
- B. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved non-absorptive panel materials that will provide continuous, true, and smooth

- architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- C. Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, non-absorptive, that will provide continuous, true, and smooth architectural concrete surfaces, medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1.
 - D. Form liners shall be Fitzgerald Formliners Graylastic Western Range Grass Pattern 20003. PCC Feature Walls shall use repeating pattern 20003A for entire length of each side face to meet graphic layout as shown in the plans. PCC seat walls shall use pattern 20003-20 for each side face to meet graphic layout as shown in the Drawings. Utilize flexible bender board backing as needed on curved walls. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
 - E. Rustication Strips: Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining; in longest practicable lengths.
 - F. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.
 - G. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.
 - H. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or Type S, Grade NS that adheres to form joint substrates.
 - I. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
 - J. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - K. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
 - L. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic, internally disconnecting, or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes 3/4 inch in diameter on concrete surface.
 - 2. Furnish internally disconnecting ties that will leave no metal closer than 1 1/2 inch from the architectural concrete surface.
 - 3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch in diameter, of color selected by Engineer from manufacturer's full range.
 - 4. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT AND ACCESSORIES

- A. Reinforcing Bars: ASTM A615, Grade 60 (Grade 420), deformed.

- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
 - 1. Where legs of wire bar supports contact forms, use gray, all-plastic or CRSI Class 1, gray, plastic-protected bar supports.

2.03 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C150, Type I, gray. Supplement with the following:
 - a. Fly Ash: ASTM C618, Class F or Class C.
- B. Normal-Weight Aggregates: ASTM C33, Class 5S coarse aggregate or better, graded. Provide aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch.
 - 2. Gradation: Uniformly graded.
- C. Normal-Weight Fine Aggregate: ASTM C33, manufactured or natural sand, from same source for entire project.
- D. Water: Potable, complying with ASTM C94 except free of wash water from mixer washout operations.
- E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979.
 - 1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
 - 2. Color(s): Limestone buff color or similar to be selected through submittals. Contractor shall submit color options for review.
 - 3. Manufacturers:
 - a. BRICKFORM; BRICKFORM Liquid Integral Color: www.brickform.com/#sle.
 - b. Euclid Chemical Company; COLOR-CRETE: www.euclidchemical.com/#sle.
 - c. L.M. Scofield Company; CHROMIX® Admixtures for Color-Conditioned® Concrete www.scofield.com/#sle.
 - d. Solomon Colors; Solomon ColorFlo Liquid Colors: www.solomoncolors.com/#sle.
 - e. Substitutions: Substitutions shall be approved by and at the discretion of the Engineer.

2.04 ADMIXTURES

- A. Air-Entraining Admixture: 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.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.05 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.
 1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.06 REPAIR MATERIALS

- A. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.07 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
- B. Proportion concrete mixtures as follows:
 1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 3 inch, ± 1 inch.
 4. Air Content: 6%, $\pm 1.5\%$ at point of delivery for 1 inch nominal maximum aggregate size.

- C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30% by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with design references.
- G. Anti-graffiti Coating: Provide a one-component, non-sacrificial, ready-to-use siloxane coating that cures with atmospheric moisture on exposed sections of concrete with proper preparation per manufacturer.
 - 1. Sherwin-Williams or approved equal.

2.08 CONCRETE MIXING

- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94 and furnish batch ticket information.
 - 1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 - 2. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1 1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

157153.03 CONSTRUCTION.

3.01 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. Limit deflection of form-facing panels to not exceed ACI 303R requirements.
- C. In addition to ACI 303R limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch.
- D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
 - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 2. Do not use rust-stained steel form-facing material.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- G. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- L. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.02 REINFORCEMENT AND INSERTS

- A. General: Comply with Standard Specification Section 2404 for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.03 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the work that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Schedule form removal to maintain surface appearance that matches design references.
 - 2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70% of 28 day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.04 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at project site, subject to limitations of ACI 301.
- C. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303R.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inch into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.
- D. Cold-Weather Placement: Comply with ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40°F for 3 successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.
- E. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.05 FINISHES, GENERAL

- A. Architectural Concrete Finish: Match Engineer's design reference sample, identified and described as indicated, to satisfaction of Engineer.
- B. 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.
 1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.06 AS-CAST FORMED FINISHES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.
- B. Sandblasted Finish: Apply the following to smooth-formed finishes to as-cast concrete where indicated:

1. Light to Medium Sandblast Finish: Sandblast concrete to expose aggregate to a depth of approximately 1/8 inch.
- C. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.07 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306R for cold-weather protection and with ACI 305R for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308R, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
 1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for no fewer than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12 inch lap over adjacent absorptive covers.
 2. 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 inch, and sealed by waterproof tape or adhesive. Cure for no fewer than 7 days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
 3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.08 REPAIRS, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Engineer. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved design references. .
 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Engineer's approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before

proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- C. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
 - C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
 - E. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
 - F. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other work from staining or damage due to cleaning operations.
 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

3.09 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contracting Authority will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying, depositing, and vibrating to ensure consolidation around form liners.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100 cubic yards or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31.
 - a. Cast and laboratory cure two sets of two standard 6 inch by 12 inch cylinder specimens for each composite sample or two sets of three standard 4 inch by 8 inch cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39; test one set of laboratory-cured specimens at 7 days and one set of specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens for 6 in by 12 inch cylinders or three specimens for 4 inch by 8 inch cylinders obtained from same composite sample and tested at age indicated.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Engineer.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the work that test reports and inspections indicate do not comply with the contract documents.

157153.04 METHOD OF MEASUREMENT

- A. Feature Walls: Measured based upon the linear foot measured along the centerline of the feature walls installed.
- B. Seat Walls: Measured based upon the linear foot measured along the centerline of the seat walls installed.

157153.05 BASIS OF PAYMENT

- A. Feature Walls: Payment is for full compensation for the feature wall or the seat walls including all labor, materials, and equipment to furnish and install the wall

- B. Seat Walls: Payment is for full compensation for the seat wall including all labor, materials, and equipment to furnish and install the wall