

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Refer to other Divisions of these Specifications to determine the type and extent of work therein affecting the work of this trade, whether or not such work is specifically mentioned in this Section.

1.2 SUMMARY

- A. Except for that specifically excluded below, furnish and combine materials for all the work indicated on the Drawings or herein specified to be of plain or reinforced concrete, its installation with forms and reinforcement, its curing and finishing. Shop drawings, tools, ways, apparatus, and equipment necessary for concrete production, installation, and finish are included. The work under this Section includes but is not limited to the following:
 - 1. Strip Footings.
 - 2. Foundation walls
 - 3. Slabs-on-grade.
 - 4. Slabs on metal deck.
 - 5. Furnishing and installing joint fillers, dams, and similar items required in conjunction with the concrete work.
 - 6. Installing items furnished by other trades and required to be built into the concrete work.
 - 7. Grouting column base plates.
 - 8. Furnishing and installing dowels for masonry walls.
 - 9. Installing embedded steel anchorages provided by others for the attachment of structural steel or architectural precast.
 - 10. Metal pan stair fill, housekeeping pads, and curbs for equipment.
 - 11. Dustproofing interior concrete slabs.
 - 12. All other items of concrete and related work shown on the Drawings, specified herein, or needed to make the work of this Section complete.
- B. The following are excluded from the work specified in this Section:
 - 1. Furnishing of certain metal inserts and other embedded items, installed under this Section, but supplied by other trades, including but not limited to stone masonry anchors, steel embed plates, etc.
 - 2. Inserts and pipe sleeves for mechanical trades to be furnished and installed by mechanical contractors.

- C. Specification Sections that directly relate to the work of this Section include, but are not limited to, the following:
 - 1. Section 04 18 00 – Concrete Unit Masonry.
 - 2. Section 05 12 00 - Structural Steel.
 - 3. Section 05 50 00 – Miscellaneous Metals

- D. Notify all other trades responsible for installing inserts, sleeves, etc., when ready for such installation and for final checking immediately before concrete is placed. Cooperate with such trades to obtain proper installation. Leave openings in walls for pipe, ducts, etc., for mechanical and electrical work as shown on Drawings or required by layout of systems.

1.3 REFERENCED STANDARDS

- A. Follow the guidelines contained in the latest editions of the following codes, specifications, and standards, including references contained in each document, except where more stringent requirements are shown or specified.

- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T260 – Methods of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials.

- C. American Concrete Institute (ACI):
 - 1. ACI 211.1 – Recommended Practice for Selecting Proportions for Normal Weight Concrete.
 - 2. ACI 214 – Recommendation for Evaluation of Compression Test Results of Field Concrete.
 - 3. ACI 301 – Standard Specification for Structural Concrete.
 - 4. ACI 304 – Recommended Practice for Measuring, Mixing and Placing Concrete.
 - 5. ACI 305 – Recommended Practice for Hot Weather Concreting.
 - 6. ACI 306 – Recommended Practice for Cold Weather Concreting.
 - 7. ACI 306.1 Standard Specification for Cold Weather Concreting
 - 8. ACI 308 – Recommended Practice for Curing Concrete.
 - 9. ACI 309 – Recommended Practice for Consolidation of Concrete.
 - 10. ACI 311 – Recommended Practice for Concrete Inspection.
 - 11. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 12. ACI 318 – Building Code Requirements for Reinforced Concrete.
 - 13. ACI 613 – Recommended Practice for Selecting Proportions for Concrete.

- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM C31 – Standard Method of Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33 – Standard Specification for Concrete Aggregates.
 - 3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
 - 5. ASTM C143 – Standard Method of Test for Slump of Portland Cement Concrete.
 - 6. ASTM C150 – Standard Specification for Portland Cement.

7. ASTM C173 – Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 8. ASTM C192 – Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory.
 9. ASTM C231 – Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
 10. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
 11. ASTM C309 – Standard Specification for Liquid Membrane – Forming Compounds for Curing Concrete.
 12. ASTM C494 – Standard Specifications for Chemical Admixtures of Concrete.
 13. ASTM C595 – Standard Specification for Blended Hydraulic Cement.
 14. ASTM E329 – Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction.
- E. National Ready Mixed Concrete Association (NRMCA):
1. NRMCA Check List for Certification of Ready Mixed Concrete Production Facilities.

1.4 SUBMITTALS

- A. General
1. All submissions shall be in accordance with the submission schedule, which shall be developed and agreed between the Architect and Construction Manager at the commencement of the project.
 2. Submittals shall be made in compliance with the Conditions of the Contract and Division 1 Specification Section 01 33 00 – Submittal Procedures.
 3. Review of submittals is of a general nature only, and the responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that the fabricator has correctly interpreted the construction documents.
- B. Submit the following action submittals for review and approval:
1. Concrete mix design for each type of concrete. The Contractor shall warrant by the submission of the design mixes that such mixes are totally representative of the concrete that he intends to supply to meet the requirements of the Contract Documents. Submit new design mixes for review and approval when any change in materials is required or needed. Include the following information for each concrete mix design:
 - a. Method used to determine the proposed mix design (per ACI 301, Article 3.9).
 - b. Compressive strength at seven, twenty-eight, and, where required, fifty-six days: Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength.
 - c. Gradation of fine and coarse aggregates: Testing data confirming proposed coarse aggregate meets ASTM C33 class designation. Include

- ASTM test results for aggregates subjected to aggressive soil conditions (low pH).
- d. Proportions of all ingredients including all admixtures to be added either at the time of batching or at the job site.
 - e. Water-cementitious materials ratio.
 - f. Slump tested in accordance with ASTM C143.
 - g. Air content of freshly mixed concrete by the pressure method, ASTM C231, or the volumetric method, ASTM C173.
 - h. Unit weight of concrete ASTM C138.
 - i. Mill test reports of fly ash including chemical and physical analysis and certification of compliance with ASTM C618, Class C or F, if used.
 - j. Manufacturer's Spec Data Sheets of each concrete admixture, including brand name, manufacturer, and dosage rate range.
2. Shop drawings for reinforcement detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.
 3. Product Data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, curing compounds, and others if requested by the Architect.
 4. Proposed methods for curing Cast-in-Place concrete.
- C. Submit the following informational submittals for record:
1. Health and Safety Data Sheets for each concrete admixture.
 2. Proposed Schedule of Concrete Placement. Contractor shall keep a permanent log of the dates and times of concrete placement and where on the project the concrete was cast. This log shall be made available to the Architect for inspection, upon request.
 3. Qualifications of Concrete Foreman showing five years experience with this type of concrete installation.
 4. Tickets for each batch of concrete delivered to the jobsite containing the following information:
 - a. The compressive strength of the concrete being delivered.
 - b. The volume of concrete in the delivery truck.
 - c. The time the concrete was batched (i.e. the time that water was discharged into the delivery truck to mix with the cement and aggregates).
 - d. List of admixtures.
 - e. Slump of concrete as placed.
 - f. Volume of water added to the delivery truck after initial batching.
 - g. Location where the concrete is being placed (i.e., foundation walls along grid Line A, between Grids 1 and 4).

1.5 QUALITY ASSURANCE

- A. Foreman's Qualifications: Concrete work shall be done under the supervision of an experienced concrete foreman having at least five years of foreman experience with "Cast-in-Place" concrete, similar to that used on this project.

- B. The Contractor shall perform all work in strict accordance with all applicable laws and regulations of the building code and with all other authorities having jurisdiction. All such requirements shall take precedence over the requirements of the Specifications except in cases where the requirements of the Specifications are more exacting or stringent.
- C. Concrete Mix Design: The Contractor shall employ an independent testing laboratory, acceptable to the Owner, to perform material evaluation tests and to design concrete mixes or, when acceptable to the Engineer, provide copies of recently made material tests and mix designs.
 - 1. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements, the Contractor shall have his laboratory modify the design, subject to approval, until the specified concrete is obtained.
- D. Testing of materials and inspections of installed work shall be completed throughout the duration of the project, as directed by the Engineer. Contractor shall provide free and safe access to material stockpiles and facilities for inspectors.
 - 1. Retesting of rejected materials or reinspection of deficient work, shall be done at the Contractor's expense.
- E. The Contractor is responsible for correction of concrete work that does not conform to the specified requirements, including strength, mix proportions, air void system, tolerances, and finishes. Correct deficient concrete as directed by the Engineer.
- F. All finishing crewmembers shall be ACI Certified Concrete Flatwork Technicians and Finishers. The supervisor shall be an ACI Certified Flatwork Technician and shall have input to the crew's placement and finishing procedures regarding the application of ACI Standards for quality flatwork. The ACI Standards that shall be observed are contained in the ACI - Concrete Craftsman Series.
- G. The Architect will reject Cast-in-Place Concrete that exhibits the following defects:
 - 1. Bulging: Concrete surfaces that bulge due to insufficiently secured formwork, undersized ties, or flat bar clamps.
 - 2. Wavy Concrete: Concrete surfaces that exhibit waves along plywood joints due to moisture migration into unsealed cuts of plywood sheets causing swellings.
 - 3. Spalling: Concrete spalling due to shale, alkali reactivity, rusting steel too close to the surface, carbonation, improper removal of formwork, expansion of cast-in steel during the welding process, or other reasons.
 - 4. Cracking and Cracking: Concrete cracking and crazing due to lack of control joints or high water/cement ratio above 0.50.
 - 5. Air holes: Air holes resulting from improper vibration and excessive heights of individual layers of pours between vibration. Air holes due to spreading of concrete with vibrators rather than moving buckets or hoses.
 - 6. Honeycombing: Concrete honeycombing including loss of fines from leaking formwork or other causes.
 - 7. Discoloration: Concrete discoloration, outside of typical concrete industry standards, caused by any reason, including inconsistent concrete mix, different sources of cement and aggregates, temperature variation between individual pour and curing phases, improper and inconsistent use of

- vibrators, variation of time span of concrete in formwork, form oils, and migration of plasticizer into concrete from exposed sealant beads on formwork and around cast-in items such as electrical outlet boxes.
8. Visible Pour Joints: Visible pour joints in concrete resulting from leaking formwork due to lack of gaskets and insufficient overlap with old concrete preventing proper tightening of formwork. Placement of concrete layers in excessive heights and spreading concrete with vibrator.
 9. Debris in Concrete: Concrete that includes debris, whether caused by insufficient cleaning of formwork or lack of cleanout and access doors at base of formwork.
- H. The Contractor shall schedule a Concrete Preconstruction Meeting at least thirty days prior to placement of any concrete. Attendance at the meeting shall include the Construction Manager, Ready Mix Supplier, Concrete Pumping Subcontractor, Field Testing Laboratory, and the Engineer of Record (EOR). The agenda of the meeting shall be prepared by the Contractor and shall include, but not be limited, to the following:
1. Review of concrete mix designs.
 2. Field testing and quality control.
 3. Concrete placing sequence and schedule.
 4. Formwork, shoring, reshoring, and stripping.
 5. Placing, jointing, and finishing procedures.
 6. Curing and protection procedures.
- I. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- J. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- K. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests.
- L. Conduct a pre-installation conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
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 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. Concrete subcontractor.

- M. The Owner shall employ a Special Inspector to oversee and administer, and an independent Testing Agency(s) to perform, a Program of Structural Tests and Inspections for compliance with Chapter 17 of the 2009 International Building Code. The Structural Engineer of Record (SER) shall prepare a statement of structural tests and inspections specifying the program tests and inspections to be performed throughout the construction of this project. Submission and approval of this statement must be complete prior to beginning construction. The statement and program are contained in Section 01 46 00 Quality Control and Testing Services.
1. The Special Inspector will organize and direct the test and inspection program. All inspection and test reports shall be submitted to the Contractor, Construction Manager (CM), the Owner's Representative, and the SER. The Contractor shall be responsible for understanding the test and inspection program and notifying the Testing Agency and the Special Inspector when work is ready for tests and/or inspections. The Contractor will provide access to the Testing Agency, Special Inspector, and the SER. Inspections and tests of the Structural Tests and Inspection Program will not relieve the Contractor of responsibility for supervision, testing, and inspection for quality control of the work.
 2. The Owner's Representative will provide testing and inspection reports to the local building official when requested by the local building official. Upon completion of the construction, the independent Special Inspector will make a final report on the satisfactory completion of the Program for Structural Tests and Inspection to the building official and to the Owner's Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 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.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.

- b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, or rubber strips, 3/4 by 3/4 inch, minimum or as indicated on contract documents.
- E. Rustication Strips: Wood, metal, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent with a maximum of 100 g/L volatile organic compounds (VOC) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
- 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
- 2.2 STEEL REINFORCEMENT
- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 50 percent.
- B. Regional Production: Provide steel reinforcement produced and fabricated within a 500-mile radius of the project site. Steel scrap used in the production of the reinforcement must also be sourced from within a 500-mile radius of the project site.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- D. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed, as required.

- E. Plain-Steel Wire: ASTM A 82, as drawn.
- F. Deformed-Steel Wire: ASTM A 496.
- G. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- H. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. 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 precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II.
 - a. Source cement from a kiln located within 500 miles of project site.
 - 2. Fly Ash: ASTM C 618, Class F. Maximum mercury content 2 ppb (0.002 mg/L). Fly ash may not be sourced from a coal plant co-fired with hazardous waste, medical waste, or tire-derived fuel, nor from a municipal solid waste incinerator.
 - a. Source fly ash from a coal-fired power plant located within 500 miles of the project site.
 - 3. Ground Granulated Blast-Furnace Slag ("slag"): ASTM C 989, Grade 100 or 120. Slag may not be sourced from a plant co-fired with hazardous waste, medical waste, or tire-derived fuel.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregate: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 5 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Use siliceous

aggregate for all footings (spread and strip) subjected to aggressive soil conditions (low pH).

1. Maximum Coarse-Aggregate Size: See Table below.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 3. Source aggregate from a quarry located within 500 miles of the project site.
- D. Lightweight Aggregate: ASTM C 330. Provide aggregates from a single source with documented service record data of at least 5 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: See Table below.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 3. Source aggregate from a quarry located within 500 miles of the project site.
- E. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. General Admixture Requirements
1. Concrete supplier and Contractor shall use manufacturer's product identified in this Section or submit alternate manufacturer product for approval by Architect.
 2. All admixtures used in the concrete shall be produced by a single manufacturer.
 3. Concrete supplier and Contractor shall certify compatibility of all ingredients in each mix design. Use admixtures in strict accordance with manufacturer's recommendations.
 4. Concrete supplier and Contractor shall account for admixture volume in the concrete mix proportions in accordance with admixture manufacturer's recommendations.
 5. Do not use calcium chloride or admixtures containing more than 0.1% chloride ions.
- B. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
- C. Water-Reducing Admixture: ASTM C494, Type A.
- D. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
- E. Water-Reducing, Accelerating Admixture: ASTM C494, Type F.
- F. High Range Water-Reducing Admixture: ASTM C494, Type F or Type G.

2.6 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch. Subject to compliance with requirements, provide one of following, or approved equivalent:
1. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
 2. Concrete Sealants Inc.; Conseal CS-231.
 3. Greenstreak; Swellstop.
 4. Henry Company, Sealants Division; Hydro-Flex.
 5. JP Specialties, Inc.; Earthshield Type 20.
 6. Progress Unlimited, Inc.; Superstop.
 7. TCMiraDRI; Mirastop.

2.7 VAPOR RETARDERS & WATER-PROOFING MEMBRANES

Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape. Refer to Architectural drawings Division 7 specifications for additional information.

Water-Proofing Membranes: refer to Architectural drawings and Division 7 specifications.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Maximum VOC content 50 g/L.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, opaque.
1. Curing Blanket: Inorganic, non-woven blended fabric with a white UV resistant polyethylene coating, non-perforated. Fabric backing shall trap and retain water to provide high humidity below cover.
 - a. Hydracure by PNA Construction Technologies: Single or multi-use.
 - b. HydrAdsorb by Fortifiber
 2. Curing Paper: Asphalt laminated, reinforced wet strength kraft paper
 - a. Orange Label Sisalkraft by Fortifiber
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified in writing by curing compound manufacturer to not interfere with bonding of floor covering. Maximum VOC content 100 g/L.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified in writing by curing compound manufacturer to not interfere with bonding of floor covering. Maximum VOC content 100 g/L.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- 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.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement unless the Engineer approves a higher limit and corrosion inhibitors are added to the mixture to offset the additional chloride. Water-soluble chloride ion content by weight of cement and of concrete shall be tested in accordance with FHWA RD-77 or AASHTO T260-84.
- C. Design mixes to use maximum replacement of cement with fly ash, slag, or other SCMs while meeting performance criteria. For limits, see Table 1. The quantities in Table 1 assume either fly ash OR slag. If a mix of SCMs is used (e.g. fly ash plus slag), weight the quantity limits in proportion to the SCM proportions, e.g. in a given mix type, if the maximum allowable percentage of slag is 50% and the maximum allowable percentage of fly ash is 25%, and if a 75/25 mix of slag/fly ash is used, then the maximum allowable percentage of the mix is $0.75 \times 50\% + 0.25 \times 25\% = 44\%$.

Maine Medical Center
 Bean 2 Roof Addition
 For Construction
Issued for Permit

PERKINS+WILL
 C140135461 (MMC) /152168.00 (P+W)
 June 14, 2013
February 07, 2014

Table 1 – Concrete Properties

Property:	Mix Description:			
	1	2	3	4
	Interior Slabs-on-grade	Foundations and Grade Beams	Slabs-on-metal-deck	All Other
Design Weight	Normal	Normal	Lightweight	Normal
Design Compressive Strength, f'c, (psi)	4,000	4,000	4000	4,000
No. of Days to Reach f'c	28	56	28	28
Max w/c Ratio	0.45	0.40	0.45	0.45
Cement Type ASTM C150	Type I/II	Type II	Type I/II	Type I/II
Type F Fly Ash as Percentage of All Cementitious Materials	15% min. 25% max.	25% min. 35% max.	5% max.	15% min. 25% max.
Type C Fly Ash as Percentage of All Cementitious Materials	15% min. 30% max.	30% min. 40% max.	10% max.	15% min. 30% max.
GGBFS (Slag) as Percentage of All Cementitious Materials	25% min. 35% max.	35% min. 50% max.	10% max.	25% min. 35% max.
Silica Fume as Percentage of All Cementitious Materials	0-5%	5-10%	0-5%	0-5%
Maximum Nominal Aggregate Size	3/4 in.	1 in.	3/4 in.	3/4 in.
Maximum Entrained Air Content (%)	< 3%	3 +/- 1%	< 3%	< 3%
Maximum Slump (inches) prior to the addition of super-plasticizer	4	3	4	4
Max/Min Density of Concrete (pcf)	145 ± 3%	145 ± 3%	110 ± 3%	145 ± 3%

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials, floor drains, and other related materials with placement of forms and reinforcing steel.
- B. Cast in Place Contractor shall coordinate with Structural Steel Fabricator's reviewed and approved shop drawings for placement of Anchor Bolts and embed plates connecting cast-in-place concrete elements to structural steel elements. Contractor shall use templates, provided by Steel Fabricator, as required, for placing anchor bolts and embeds within specified tolerances.

3.2 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.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast

concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. 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.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Formwork and form-tie material and layout must be approved by architect for architecturally exposed concrete surfaces.

3.3 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.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.4 VAPOR RETARDERS & WATER-PROOFING MEMBRANES

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

1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Water-Proofing Membranes: Place, protect, and repair water-proofing membranes according to manufacturer's written instructions.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder or water-proofing membrane. Repair damage and reseal vapor retarder and/or water-proofing membrane before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 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 Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Grade: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-third of concrete thickness as follows:
 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- 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.
 1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.7 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.8 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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. 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.
 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 301.
 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 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate

concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 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 deg F for three 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 or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Typical Concrete: Maintain concrete temperature below 90 deg F at time of placement.
 2. 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. Cool the mix in a manner acceptable to the Engineer if the concrete temperature is higher.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 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.
1. Apply to concrete surfaces not exposed to public view.

- 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.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
 - a. Vertical exposed western face of curved site wall to receive green screen treatment.
- 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.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 - 1. Apply scratch finish to surfaces indicated and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated and areas to be covered with sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten 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.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, or carpet.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

- b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
- E. 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.
 - 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
 - F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
 - G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
 - H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
 - 1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
 - 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 - 3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.
- 3.11 MISCELLANEOUS CONCRETE ITEMS
- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 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 305 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 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less 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 inches, 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.

- a. Moisture cure or use moisture-retaining covers to cure top surface of all flatwork concrete surfaces including all slabs, slabs on grade, slabs on metal deck.
3. Curing Compound: Apply uniformly in 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. Maintain continuity of coating and repair damage during curing period.
 - a. Do not use curing compound on the top surface of any cast-in-place concrete flatwork, or for concrete surfaces to receive floor coverings.
 - b. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. 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 in solid concrete, but not less than 1 inch in depth. 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 Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Tests shall be conducted no sooner than 6 months after the slabs were cast to allow for long-term creep deflection to occur. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.14 QUALITY ASSURANCE
- A. Testing and Inspecting: Owner 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 and depositing.
 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 C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 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 C 143/C 143M; 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 C 231, 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 C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure three sets of two standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days, a second set of two specimens at 28 days, and a third set of two specimens at 56 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. 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.
 9. Test results shall be reported in writing to Architect, 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.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 11. 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 Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION