SECTION 03 30 00

CAST-IN-PLACE CONCRETE

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR
0	01 May 2025	LL-03 IFB	Initial issue	S. Horton

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete.
2. Concrete Forming and Accessories.
3. Concrete Reinforcing steel and welded wire for cast in place concrete and architectural and structural precast concrete.
4. Bar supports, spacers and accessories for supporting reinforcing and welded wire.
5. Concrete Finishing.
6. Concrete Curing.
7. Control, expansion and contraction joint devices.
8. Bearing pads

B. Related Sections:
1. Section 01 33 00 - Submittal Procedures.
2. Section 01 35 73 – Delegate Engineer Design Responsibilities.
3. Section 01 45 33 – Code-required Special Inspections and Procedures.
4. Section 01 80 13 - Project Site Design Criteria.
5. Section 01 81 13 – Sustainable Design Requirements
6. Section 07 13 00 – Sheet Waterproofing.
7. Section 07 26 00 – Vapor Retarders
8. Section 07 90 00 – Joint Protection
9. Section 26 05 26 – Grounding and Bonding for Electrical Systems
10. Section 31 00 00 – Earthwork

1.2 REFERENCES

A. Abbreviations and Acronyms:
1. American Concrete Institute (ACI).
2. Engineered Wood Association, formerly American Plywood Association (APA).
3. American Society of Mechanical Engineers (ASME).
4. ASTM International (ASTM).
5. American Welding Society (AWS).
6. Building Code of New York State (BCNYS)

7. Concrete Reinforcing Steel Institute (CRSI).
8. Expanded Polystyrene (EPS).
9. Environmental Product Declarations (EPD)
10. Federal Specifications and Standards (FS).
11. High Density Overlay (HDO).
12. International Code Council (ICC).
13. International Organization for Standards (ISO)
14. National Ready Mixed Concrete Association (NRMCA).
15. Polyvinyl chloride (PVC).
16. Product Category Rule (PCR).

B. Definitions:
1. Cold Weather (as defined in ACI 306.1): A period when for more than three successive days the average daily outdoor temperature drops below 40 degrees Fahrenheit. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50 degrees Fahrenheit occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.
2. Hot Weather (as defined in ACI 305.1): One or a combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results: high ambient temperature, high concrete temperature, low relative humidity, and high wind speed.
3. Mass Concrete: Concrete with sections with a minimum specified dimension that is equal to or greater than 36 inches.

C. Reference Standards:
1. ACI 117, Specification for Tolerances for Concrete Construction and Materials and Commentary.
2. ACI 207.1R, Mass Concrete – Guide.
3. ACI 211.1, Selecting Proportions for Normal-Density and High-Density Concrete—Guide.
4. ACI 301, Specifications for Concrete Construction.
5. ACI 305.1, Specification for Hot Weather Concreting.
6. ACI 306.1, Standard Specification for Cold Weather Concreting.
7. ACI 308.1, Specification for Curing Concrete.
8. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
9. ACI 347R, Guide to Formwork for Concrete
10. ACI 350.1, Tightness Testing of Environmental Engineering Concrete Structures - Specification.
11. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.
12. ACI CP-1, Technician Workbook for Concrete Field Testing Technician – Grade 1.
13. ACI MNL-066, ACI Detailing Manual.
14. AISC 360 – Specification for Structural Steel Buildings.

15. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) ASCE/SEI 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
16. APA PS 1, Structural Plywood.
17. American Society of Mechanical Engineers (ASME) A17.1, Safety Code for Elevators and Escalators.
18. ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
19. ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-finished.
20. ASTM A576, Standard Specification for Steel Bars, Carbon, Hot Wrought, Special Quality.
21. ASTM A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
22. ASTM A641/A641M – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
23. ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
24. ASTM A706/A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
25. ASTM A767/A767M, Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
26. ASTM A1064/A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
27. ASTM C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
28. ASTM C33, Standard Specification for Concrete Aggregates.
29. ASTM C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
30. ASTM C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
31. ASTM C94/C94M, Standard Specification for Ready-Mixed Concrete.
32. ASTM C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
33. ASTM C150/C150M, Standard Specification for Portland Cement.
34. ASTM C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
35. ASTM C171, Standard Specification for Sheet Materials for Curing Concrete.
36. ASTM C172/C172M, Standard Practice for Sampling Freshly Mixed Concrete.
37. ASTM C173/C173M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
38. ASTM C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
39. ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
40. ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
41. ASTM C321, Standard Test Method for Bond Strength of Chemical-Resistant Mortars.

42. ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
43. ASTM C595/C595M Standard Specification for Blended Hydraulic Cements
44. ASTM C618, Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
45. ASTM C803/C803M, Standard Test Method for Penetration Resistance of Hardened Concrete.
46. ASTM C845, Standard Specification for Expansive Hydraulic Cement.
47. ASTM C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
48. ASTM C920, Standard Specification for Elastomeric Joint Sealants.
49. ASTM C979/C979M, Standard Specification for pigments for Integrally Colored Concrete.
50. ASTM C989/C989M, Standard Specification for Slag Cement for Use in Concrete and Mortars.
51. ASTM C1012/C1012M, Standard test method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
52. ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
53. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
54. ASTM C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.
55. ASTM C1116/C1116M, Standard Specification for Fiber-Reinforced Concrete. ASTM C1157/C1157M, Standard Performance Specification for Hydraulic Cement.
56. ASTM C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
57. ASTM C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
58. ASTM C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
59. ASTM C1610/C1610M, Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique.
60. ASTM C1611/C1611M Standard Test Method for Slump Flow of Self-Consolidating Concrete.
61. ASTM C1621/C1621M, Standard test Method for Passing Ability of Self-Consolidating Concrete by J-Ring.
62. ASTM C1778, Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
63. ASTM D226/D226M, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
64. ASTM D227/D227M, Standard Specification for Coal-Tar Saturated Organic felt Used in Roofing and Waterproofing. ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
65. ASTM D638, Standard Test Method for Tensile Properties of Plastics.
66. ASTM D903, Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

67. ASTM D994/D994M, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
68. ASTM D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
69. ASTM D1171 Standard Guide for Evaluating Nonwoven Fabrics.
70. ASTM D1259, Standard Test Methods for Nonvolatile Content of Resin Solutions.
71. ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types).
72. ASTM D1752, Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
73. ASTM D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
74. ASTM D2240, Standard Test Method for Rubber Property – Durometer Hardness
75. ASTM D4397, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
76. ASTM D5249, Standard Specification for Backer Material for Use with Cold- and Hot- Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
77. ASTM D6817, Standard Specification for Rigid Cellular Polystyrene Geofoam.
78. ASTM D7357, Standard Specification for Cellulose Fibers for Fiber Reinforced Concrete.
79. ASTM E96/E96M, Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
80. ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
81. ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
82. ASTM E1155, Standard Test Method for Determining FF-Floor Flatness and FL Floor Levelness Numbers.
83. ASTM E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
84. ASTM E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
85. American Welding Society (AWS) D1.1/D1.1M Structural Welding Code – Steel.
86. American Welding Society (AWS) D1.4/D1.4M, Structural Welding Code – Steel Reinforcing Bars.
87. COE CRD-C_572 Corps of Engineers Specifications for Polyvinylchloride Waterstop.
88. Concrete Reinforcing Steel Institute (CRSI) MSP, Manual of Standard Practice.
89. ICC – BCNYS.
90. WRI WWR-500 Manual of Standard Practice, Structural Welded Wire Reinforcement.

D. CAUTION: Use of this Section without including the above-listed items results in omission of basic requirements.

E. In the event of conflict regarding requirements between this Section and another section, the provisions of this Section govern.

F. Reference the Contract and Contract Documents in addition to the requirements of this Section.

1.3 SUSTAINABLE DESIGN REQUIREMENTS

A. Comply with Section 01 81 13 – Sustainable Design Requirements.

1.4 DESIGN REQUIREMENTS

A. Formwork and Accessories:
   1. Contractor is responsible for design, construction, and safety of all formwork.
      a. Design, engineer, and construct formwork, shoring, and bracing in accordance with sound engineering principles achieve concrete shape, line and dimension as indicated on Drawings. Design should consider principles presented in ACI 347R.
      b. Design forms and shoring to support, properly and safely, vertical and lateral loads for applicable construction, material, pre-stressing, environmental, impact, and other anticipated loads until the structure can carry such loads.
   2. Refer to Section 01 80 13 Project Site Design Criteria for project conditions and minimum requirements.

B. Internal Cooling System for Mass Concrete:
   1. Design, furnish, and install an Internal Cooling System for Mass Concrete when determined necessary by the Thermal Control Plan. Cooling system shall be approved by the A/E and Owner. Exposed portions of cooling system to remain after construction shall be type 316 stainless steel. Cooling system pipes shall be filled in a manner approved by the A/E and Owner after cooling operations are concluded.

1.5 SUBMITTALS

A. Refer to the Submittal Schedule at the end of Part 3 for a list of submittal requirements for this Section.

B. Refer to Section 01 33 00 Submittal Procedures for submittal procedures including deferred submittal requirements.

C. Refer to Section 01 45 33 Code-required Special Inspections and Procedures for special inspection submittal requirements.

D. Refer to Section 01 35 73 – Delegate Engineer Design Responsibilities for delegate design engineer submittal requirements.

E. Thermal Control Plan: For concrete sections with a minimum specified dimension meeting the definition of Mass Concrete.

1.6 QUALITY ASSURANCE

A. Refer to Section 01 45 33 – Code-required Special Inspections and Procedures for inspection requirements.

B. Qualifications:
1. Concrete Supplier: Minimum of five years of experience in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment. The supplier must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
2. Concrete Contractor: Minimum of five years of experience with installation of concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful service performance.
3. Adhesive Anchor Installers: Only individuals certified in accordance with ACI/CRSI Adhesive Anchor Installer Certification program may perform installation of adhesive anchors that are horizontally or upwardly inclined.
4. Licensed Professionals: The Contractor's formwork design is to be performed by a professional engineer registered in the state where the project is located. with demonstrated experience in the design of concrete formwork.
5. Welder Qualifications Qualify procedures and personnel according to ANSI/AWS D1.4.

C. Survey for Anchor Rods and Reinforcing Steel Dowels: Retain qualified licensed professional engineer or licensed land surveyor to lay out the proper location of all embedded anchor rods and reinforcing steel dowels for columns above before they are encased in concrete. Submit surveyed locations of such elements to the A/E for record, if requested.

D. Manufacturer Representative Presence:
1. Post-installed anchors: Responsibilities of manufacturer's representatives for each post-installed anchor product (adhesive, expansion, undercut, screw, or insert anchor):
a. Be present during the first day's installation of the product to provide instruction for the correct installation of each type of any to be installed in accordance with the manufacturer's recommendation and the current ICC-ES Evaluation Report.

E. Formwork and Accessories:
1. Perform Work in accordance with ACI 301 and ACI 117.
2. Use plywood form panels marked with an APA grade mark.
3. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

F. Reinforcing:

1. Perform work in accordance with CRSI MSP.
2. Prepare shop drawings in accordance with ACI MNL-66.
3. Utilize testing/inspection agencies in conformance with ASTM E329 and Code requirements and with experience in special inspection and testing.

G. Concrete:
1. Perform work in accordance with CRSI MSP.
2. Utilize testing/inspection agencies in conformance with ASTM E329 and with experience in special inspection and testing, with tests performed in accordance with ACI 301 and Special Inspection requirements.
3. Submit proposed mix design for each class of concrete to appointed testing firm and Owner for review prior to commencement of work.
4. Provide concrete shrinkage testing meeting the requirements of ASTM C157 for each mix design requiring low-shrinkage concrete.
   a. Submit results of concrete shrinkage testing to Owner and A/E for review prior to commencement of work.
5. Acquire cement and aggregate from one source for work.
6. Fire Rated Construction: Rating as indicated on Drawings.
7. Tested Rating: Determined in accordance with ASTM E119.
8. Provide a Thermal Control Plan meeting the requirements of ACI 301 for all Mass Concrete.
9. Obtain all environmental permits as required by the AHJ for site batch plants.

H. Curing: Perform Work in accordance with ACI 308.1.

I. Mockup for Mass Concrete:
1. Prepare mockup(s) meeting the minimum dimensions of 7-feet by 7-feet by 7-feet which implements the thermal control plan prior to placement of concrete to ensure the Thermal Control Plan effectively controls measured temperatures to be within the specified temperature limits.
   a. Prepare Mockups for each concrete mix design used for Mass Concrete elements. Mockup shall have internal and external temperature gages to measure both the maximum temperature and temperature differential. Mockup shall be cured in conditions similar to concrete placements in the final condition.
   b. Update the Thermal Control Plan based on the performance of the mockup.

J. Maintain one copy of each reference standard affecting Work of this Section on site.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Concrete:
1. Conform to ACI 305.1 when concreting during hot weather.
2. Conform to ACI 306.1 when concreting during cold weather.

B. Concrete Mix Design
1. Environmental Product Declarations (EPD): Provide a Product Specific Type III EPD for each concrete mix design conforming to ISO 14025 and ISO 21930,

including Life Cycle Assessment Modules A1 – A3 and including Global Warming Potential (GWP). Comply with NSF International Product Category Rule (PCR) for concrete.

2. Bill of materials description: Submit the amount of each product type and specification, prior to start of construction and at completion of construction. Report any assumptions and allowances included in amounts.

1.8 COORDINATION

A. Reinforcing: Coordinate with placement of formwork, formed openings and other work. Do not place reinforcing steel in the forms until form release and bond breaker application is complete.

B. Concrete: Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

C. Finishing: Coordinate the work with concrete floor placement and concrete floor curing.

D. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the A/E prior to submitting proposal for resolving conflict. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the A/E.

E. Testing of Materials and Installed Work; Test/retest as directed by the governing building code or the A/E, at any time during progress of Work.

1. Provide 48-hour notification to the Owner's Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that will be back charged to the Contractor by the Owner.
2. Coordinate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
3. Make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
4. Provide laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
5. Furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
6. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. See Structural Testing and Inspections Section of the Specifications.

F. Concrete Admixtures and Chemical Treatments Compatibility: Select admixtures and surface treatments that are compatible with the intended use of the concrete including all

final surface treatments called for within this or other specifications or on the structural or architectural drawings.

1. Follow manufacturer’s instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.

G. Sequencing: Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds, and other fastening devices required for attachment of work.

1. Properly locate in cooperation with other trades and secure in position before concrete is poured.
2. Do not install sleeves in any concrete slabs, beams, or columns except where shown on the drawings or upon written approval of the A/E.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Void Forms:

1. Deliver void forms and installation instructions in manufacturer's packaging.
2. Store off ground in ventilated and protected manner to prevent contamination, soiling, and/or damage.

B. Reinforcing:

1. Deliver reinforcing to the site in bundles marked with tags calling out bar size, length, grade, piece number, and bend diagram.
2. Unload, store, and handle bars in accordance with CRSI publication “Placing Reinforcing Bars”.
3. Mark reinforcing and accessories for proper identification and placement location.
4. Store reinforcing in separate piles or racks to avoid confusion or loss of identification after bundles are broken.
5. Store materials off ground and protect from moisture and contamination.

C. Concrete:

1. Transport ready-mix concrete in accordance with ASTM C94.
2. Utilize ready-mix trucks in accordance with ASTM C94, NRMCA and the Department of Transportation in the state where the project is located.
3. Place admixtures into the mix at the batch plant.
4. Dispose of excess concrete offsite or as approved by Owner.
5. Mark reinforcing, accessories, and embedded items for proper identification and placement location.

D. Site Mixed Concrete:

1. Deliver packaged items in manufacturer's container with seals intact.
2. Store materials, except aggregate, off ground and protect from moisture and contamination.
3. Stockpile aggregate in manner to prevent contamination with other materials or with other sizes of aggregates. Conduct tests for determining conformance to requirements at point of batching. Do not use bottom 6 inches of aggregate piles in contact with ground. Allow sand to drain until it has reached uniform moisture content before it is used.

4. Store admixtures in manner to prevent contamination. Protect admixtures from extreme temperatures which would adversely affect their characteristics.

E. Curing:
1. Deliver curing materials in manufacturer's packaging, including application instructions.
2. Store curing materials off ground and protect from moisture and contamination; protect materials from extreme temperature which would adversely affect their characteristics.

F. Joint Fillers:
1. Verify delivered materials are in accordance with Specifications and suppliers' product data sheets prior to unloading and storing on site.
2. Store materials under tarps to protect from oil, dirt and sunlight.

PART 2 PRODUCTS

2.1 GENERAL

A. Products/Manufacturers named below are acceptable subject to compliance with project requirements. Submit proposed substitutions for more locally available products to the A/E for review prior to use.

2.2 FORMWORK

A. Plywood for Concrete Surfaces Not Exposed After Construction is Complete:
1. APA B-B Plyform exterior grade or better, Class I, with straight, sealed edges and 5/8-inch minimum thickness.
2. HDO Plyform is acceptable.

B. Plywood for Concrete Surfaces Exposed after Construction is Complete: APA HDO Plyform, exterior grade or better, Class I, with straight, sealed edges and 5/8-inch minimum thickness.
1. Produce a smooth uniform texture on the concrete with form facing material.
2. Do not use form facing material with raised grain, torn surfaces, worn edges, patches, dents, or other defects that may impair the texture of the concrete.

C. Lumber: Dressed, tongue and grooved, free from loose knots.

D. Metal: Reusable, segmental, matched, and tight fitting and stiffened as required. Smooth, clean, corrosion-free, without dents or holes, with closely matching edges.

E. Fiberglass: Reusable, segmental, matched to within 1/8 inch tolerance and tight fitting. Smooth, clean, without dents or holes, with closely matching edges.

F. Laminated Round Fiber Tubes: Spirally laminated paper fiber, wax impregnated on exterior surfaces, interior ply allowing uniform moisture penetration.

G. Corrugated Paper Void Forms: Biodegradable, with corrugated paper interior cellular configuration and moisture-resistant treated paper faces. Design forms to support weight of wet concrete mix and construction loading until initial set, with minimum 600psf compressive strength. Design shall account for environmental exposure as applicable. The forms shall be designed in such a way that the bottom of the form will collapse when acted upon by upward movement of soil and shall collapse to provide the required clearance shown on the Contract Documents. Design shall be compatible with sub-base preparation and comply with manufacturer requirements. Provide cover board per manufacturer's requirements.

1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
    a. "Box Voids", by Deslauriers, Inc.
    b. "SlabVoid System" or "Form Void System", by VoidForm Products, Inc.

H. Collapsible Carton Void Form: Fluted polypropylene plastic interior and end caps with moisture-resistant treated paper faces. Design forms to support weight of wet concrete mix and construction loading until initial set, with minimum 600psf compressive strength. Design shall account for environmental exposure as applicable. The forms shall be designed in such a way that the bottom of the form will collapse when acted upon by upward movement of soil and shall collapse to provide the required clearance shown on the Contract Documents. Design shall be compatible with sub-base preparation and comply with manufacturer requirements. Provide cover board per manufacturer's requirements.

1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
    a. "StormVoid", by VoidForm Products, Inc.

I. Soil Retainers: Soil retainers shall be provided where specified and shown on the drawings to prevent migration of backfill under suspended foundation elements. Retainers shall be composed of high-density polyethylene materials that are not adversely affected by moisture. They must be flexible, impact resistant and shall be designed to resist lateral loads applied by soil.

1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
    a. "Motzblock" by M&M Construction Specialties.
    b. "Backfill Retainer" or "SureRetainer" by VoidForm Products, Inc.

2.3 FORM RELEASE AGENTS

A. Type acceptable to cement manufacturer, will not cause surface imperfections, non-staining, and compatible with field applied paints, toppings, linings, curing compounds, and other coatings.

B. For concrete surfaces in water storage or treatment structures use agent that will be nontoxic within 30 days after use.

C. Use same brand form release agent throughout project.

2.4 FORMWORK ACCESSORIES

A. Provide form ties, anchors, and hangers of sufficient strength to resist displacement of forms due to construction loads and depositing of concrete. Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces. Wire ties are not permitted.

B. Provide ties and spreader form ties designed so no metal will be within 1 inch of surface when forms are removed.

C. Where concrete surfaces are exposed to view, use form ties that will leave a depression not more than 1 inch in diameter when removed.

D. Use water seal ties in concrete work containing waterstops.

E. Provide form sealants and gaskets as necessary to provide tight forms.

F. Corners: rigid plastic chamfers installed in maximum practical lengths with end-butted splices. Material to be fastened securely to minimize movement during concrete pour.

G. Bituminous Joint Filler: ASTM D1751.

H. Anchor Bolt Sleeves:
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. “Wilson Anchor Sleeves”, by Wilson Anchor Bolt Sleeve Company.
      b. “Contec Anchor Bolt Sleeves”, by Portland Bolt & Manufacturing Company.

I. Wall and Slab Sleeves: ASTM D1785, Schedule 40 PVC pipe.

2.5 WATERSTOPS

A. Coordinate with Section 07 13 00 Sheet Waterproofing.

B. Provide waterstops at all construction joints, joints in foundation walls below grade, and where shown on the Drawings. Size to suit joints and factory fabricate corners, intersections, and directional changes. The selected waterstop products shall be appropriate for the specific joint condition as specified by the manufacturer, including number of layers of reinforcement, minimum concrete thickness and minimum concrete cover.

C. Flexible PVC Waterstops: 3/8-inch x 6-inch polyvinyl chloride, serrated with center bulb incorporating looped galvanized steel wire along both edges, unless noted otherwise on Drawings.
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. “Wirestop” by Paul Murphy Plastics.
      b. "Greenstreak® PVC Waterstop", by Sika Corporation.

D. 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 (19 by 25 mm).
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. “Waterstop-RX”, by Colloid Environmental Technologies Company.
      b. “Sika Swellstop”, by Sika Corporation.

E. Chemical Resistant Waterstops: Chemical resistant profiles of various materials based on chemistries to be resisted. Fully weld joints in waterstops.
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. Thermoplastic elastomeric rubber, resistant to oils, fuels, acids, bases, and solvents,
         1) “WESTEC TPER”, by Sika Corporation.
         2) “Earth Shield Thermoplastic Vulcanizate (TPV/TPER)” by J. P. Specialties, Inc.
         3) “Chemical Resistant (TPER)” by BoMetals, Inc.
      b. VLDPE (Very Low Density, Polyethylene), resistant to hydrocarbons like Benzene, Toluene, Xylene.
         1) “Westec PE”, by Sika Corporation.
      c. Stainless steel, resistant to severe chemical application like isopropyl alcohols, hydrogen peroxide, anhydrous ammonia, deionized (DI) water, and high temperatures.
         1) "SS Waterstop", by Sika Corporation.
      d. Hydrophilic waterstops are not compatible with chemical containment and are not acceptable for this application.

2.6 REINFORCEMENT

A. Recycled content in steel reinforcement: Provide at least 75 percent post-consumer recycled content.

B. Deformed Reinforcement: ASTM A615; steel bars, unfinished, Grade 60 or 80.

C. Weldable Deformed Reinforcement: ASTM A706; steel bars, Grade 60 or 80.

D. Galvanized Reinforcing Steel at Water Tanks: Provide galvanized reinforcing bars at the locations indicated on the drawings. Galvanized reinforcing bars shall conform to ASTM A767 Class II (2.0 ounces zinc per square foot), hot dipped galvanized after fabrication and bending. Bars that are to be galvanized shall conform to the type of steel required for the given situation as noted on the drawings.

E. Plain Welded Wire Reinforcement: ASTM A1064; 75ksi yield strength, W1.2 minimum size; furnished in flat sheets; uncoated unless noted otherwise.
   1. Galvanized finish per ASTM A641 where noted on the Drawings.

F. Deformed Welded Wire Reinforcement: ASTM A1064; 75ksi yield strength, W1.2 minimum size; furnished in flat sheets; uncoated unless noted otherwise.

1. Galvanized finish per ASTM A641 where noted on the Drawings.

G. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete and meeting the requirements of the manufacturer's design.
   1. Provide design calculations by the manufacturer or their Engineer, sealed by a Professional Engineer registered in the State where the project is located.

H. Synthetic Micro Fiber Reinforcement: Collated, fibrillated, or monofilament polypropylene, cellulose, or multi-filament nylon fibers conforming to ASTM C1116, Type III or Type IV. Type IV products shall also conform to ASTM D7357. Reinforcement shall be approved by ICC-Evaluation Service, Inc and Contractor shall submit the Evaluation Service Report for A/E review.
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. "PSI Fiberstrand" series by The Euclid Chemical Company.
      b. "Econo-Mono" or "Econo-Net", by Forta Corporation (ESR-2720).
      c. "SINTA M2219", by GCP Applied Technologies, Inc. (ESR-1506).
      d. "UltraFiber 500", by Solomon Colors, Inc. (ESR-1032).

I. Synthetic Macro Fiber Reinforcement: Monofilament polypropylene/polyethylene fibers conforming to ASTM C1116, Type III having an aspect ratio between 50 and 90 and a minimum tensile strength of 90 KSI. The fiber lengths shall be between 1.5 and 2 inches long. Reinforcement shall be approved by ICC-Evaluation Service, Inc. and Contractor shall submit the Evaluation Service Report for A/E review.
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. "Tuf-Strand SF", by The Euclid Chemical Company (ESR-4072).
      b. "Forta-Ferro", by Forta Corporation (ESR-2522).
      c. "Strux 90/40", by GCP Applied Technologies, Inc (ESR-2942).
      d. "MasterFiber MAC Matrix", by Master Builders, Inc. (ESR-4066).

J. Steel Fibers: Provide deformed cold-drawn wire or modified cold-drawn steel fibers meeting the requirements of ASTM A820, Types I or V; and are listed as an acceptable product for use in the D900 series of UL Fire Rating Assemblies. The fibers shall have a minimum tensile strength of 145,000 PSI when tested in accordance with ASTM A370. The fibers shall have a minimum aspect ratio of 50 and maximum aspect ratio of 100.
   1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      a. "Dramix 3D 65/60 BG" or "Dramix 3D 80/60 BG", by Bekaert Corp.
      b. "SikaFiber Novocon HE-4550", by SIKA Corp.
      c. "Helix 5-25 Micro Rebar", by Helix Steel (ESR-3949).

2.7 REINFORCEMENT ACCESSORIES

A. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

B. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Class 1, Class 2, or Plastic type; size, thermal properties, and shape to meet Project conditions. Provide supports appropriate for concrete exposure and surface grinding/sandblasting requirements.

C. Tie Wire: Tie wire shall be annealed steel tie wire, minimum 16 gauge.
1. Tie wire in architecturally exposed concrete shall be plastic coated or stainless steel.
2. Tie wire for epoxy-coated reinforcement shall be epoxy-coated.
3. Tie wire for galvanized reinforcement shall be galvanized.

D. Reinforcing Splicing Devices: Exothermic welding type; full tension; sized to fit joined reinforcing and designed to develop 125 percent of the yield strength of the reinforcing steel.
1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
a. "nVent Lenton Cadweld", by nVent Electric plc.

E. Reinforcing Splicing Devices: Type 2 Mechanical Splice: set screw threaded, or grout-injected type; full tension; sized to fit joined reinforcing and designed to develop 125 percent of the yield strength of the reinforcing steel.
1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
a. Grade 60 Reinforcing Steel
1) "nVent Lenton Connect S2 Series Shear Bolt Coupler" by nVent Electric plc.
2) "nVent Lenton Interlock (LK with HY15LM)", by nVent Electric-plc.
3) Williams Grade 60 All Thread Rebar and R52 Stop Type All Thread rebar coupler, by Williams Form Engineering Corp.
4) HRC 500/510 Xtender Mechanical Coupler, by Headed Reinforcement Corp
5) NMB Splice Sleeve, by splice sleeve North America, Inc. .
6) NMB Splice sleeve xUX, by splice Sleeve, Japan, LTD.

b. Grade 80 Reinforcing Steel

1) "nVent Lenton Interlock (LK with HY15LM)", by nVent Electric plc.

2) Dayton Superior Bar Lock XL, by Dayton Superior Corporation.

F. Deformed Bar Anchors:
1. 3/8" to 5/8" diameter AWS Type C studs manufactured in conformance with ASTM A1064 with a minimum yield strength of 70,000 psi and a tensile strength of 80,000 PSI.
2. 3/4" or larger diameter, ASTM A706 bars of equal size with welds to steel substrate that develop the full strength of the anchor. ASTM A615 reinforcing bars may not be substituted for deformed bar anchors.

3. Acceptable Products and Manufacturers, subject to compliance with project requirements:
    a. “Nelson D2L Deformed Bar Anchor Studs”, by Nelson Stud Welding, Inc. (ESR-2907).
    b. “Deformed Bar Anchors”, by Tru-Weld Division, TFP Corporation (ESR-2823).

G. Dowel Bar Replacement: All grade 60 reinforcing steel dowel bars shown on the Drawings crossing concrete construction joint surfaces with inserts cast flush against the form and having reinforcing bars connected to the insert in a subsequent concrete pour shall conform to the following:
1. Splice connection to the insert shall develop the 125 percent of the specified yield strength and the full tensile strength of the spliced bar.
2. Acceptable Products and Manufacturers, subject to compliance with project requirements:
    a. “Bartec Form Fixer Coupler”, by Dextra Manufacturing Co., Ltd. (IAPMO-UES 0702).
    b. “nVent Lenton Form Saver SA”, by nVent Electric, plc. (IAPMO-UES 0129).

H. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A576, ASTM A615, or A706 material and shall develop the full tensile strength of the bar when installed at the manufacturer’s recommended depth.
1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
    a. “Bartec Mechanical Anchorage System”, by Dextra Manufacturing Co., Ltd (IAPMO-UES 0789).
    b. “HRC 555 Headed Reinforcing Bars”, by Headed Reinforcement Corporation (ESR-2935).
    c. “HRC 670 HeadLock”, by Headed Reinforcement Corporation (IAPMO-UES 0177).
    d. “nVent Lenton Terminator”, by nVent Electric plc. (IAPMO-UES 0188).
    e. “nVent Lenton Ultimate”, by nVent Electric plc. (IAPMO-UES 0188).

2.8 REINFORCEMENT FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI MSP and ACI MNL-66, except ensure splice lengths are in accordance with ACI 318.

B. Bend bars cold.

C. Tie reinforcing bars in bundles and tag with non-rusting tags showing shop drawing numbers.

D. Form standard hooks as indicated on Drawings with minimum bend diameters in accordance with ACI 318.

E. Fabricate column reinforcement with offset bends at reinforcement splices.

F. Spiral column reinforcement:
1. Form from minimum 3/8-inch-diameter continuous deformed bar or wire, except as indicated on the Drawings.
2. Spirals to have 1-1/2 extra finishing turns at top and bottom.

G. Weld reinforcement in accordance with AWS D1.4.
1. No tack welding of reinforcing bars is allowed without prior review of procedure by Structural Engineer of Record.

2.9 CONCRETE MATERIALS

A. Expansive Hydraulic Cement: ASTM C845.

B. Cement:
1. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M
2. Blended Hydraulic Cement
a. Unless otherwise specified, excluding Type IS (greater than 70) conforming to ASTM C595.
b. Performance Based Cement: Conform to requirements of ASTM C1157/C1157M
1) For sections of the structure that are assigned Exposure Class F3, submit certification on cement composition verifying that concrete admixture conforms to Table 4.2.1.1(b)
3. Low-Alkali Cement:
a. Where low-alkali cement is required per the Contract Documents, provide cement with equivalent Alkalis (Na2O + 0.658 K20) not exceeding 0.60 percent in accordance with ASTM C150.
4. Furnish from one source.

C. Aggregates:
1. Unless otherwise permitted, furnish from one quarry location for each aggregate type used in a mix design.
2. Furnish in accordance with ACI 301, except as modified herein.
3. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
4. Do not use aggregates that are susceptible to alkali-carbonate reactions.
5. Normal Weight Aggregates: ASTM C33.
a. Do not exceed 1 ½ in maximum nominal aggregate size unless otherwise noted.
b. Largest aggregate size for elevated slabs and slabs supported by drilled pier foundations shall be between 1 inch minimum and 1 ½ inch maximum.
6. Nominal maximum size of coarse aggregate shall not exceed:
a. 1/5 the narrowest dimension between sides of forms.
b. 1/3 the depth of slabs.
c. ¾ the minimum clear spacing between individual reinforcing bars, wires, or bundles of bars.
7. Do not use manufactured sand for fine aggregate without approval from Owner.

a. Manufactured sand used to replace natural sand shall be limited to 35 percent of the total fine aggregate content by weight for use in low-shrinkage concrete mixes and is subject to concrete shrinkage test results that are approved by Owner.
b. Manufactured sand, if approved by Owner, shall meet the requirements of ASTM C33.

D. Fly Ash: ASTM C618 Class F, in accordance with ASTM 618 except as modified herein.
1. Loss on ignition is not to exceed 3 percent.
2. When air entrainment is specified, comply with uniformity requirements of Table 3 of ASTM C618.

E. Silica Fume: ASTM C1240.

F. Slag: ASTM C989; Grade 100 or 120; ground granulated blast furnace slag. Except as modified herein.
1. Do not use slag in low-shrinkage concrete mix designs unless approved by Owner.

G. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water unless alternative sources of water are permitted.
1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
a. Chloride Content: 1,000ppm.
b. Sulfate Content as SO_4: 3,000 ppm.
c. Alkalis as (Na_2O + 0.658 K_20): 600 ppm.
d. Total Solids by Mass: Less than 50,000 ppm.

2.10 ADMIXTURES

A. General:
1. Avoid using admixtures containing calcium chloride or chloride ions except where the content complies with chloride and calcium chloride limits for the proposed mix designs. Do not use admixtures with calcium chloride for Exposure Class S2 or S3. Submit certificate of compliance to this requirement.
2. If tank linings, slab toppings are bonded to concrete, manufacturer of lining, topping to approve the type and brand of admixture used.
3. Submit information needed for manufacturer to verify compatibility with other constituents in mix.

B. Types:
1. Air-Entraining: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
1) “Conair” by Cormix.
2) “Eucon Air-Mix” by Euclid Chemical Company.

3) “Darex AEA” or “Daravair 1000” by GCP Applied Technologies, Inc.
4) “MasterAir VR 10” by Master Builders, Inc.
5) “Sika AER-C” by Sika Corp..

2. Water-Reducing: ASTM C494, Type A and containing no chlorides.
   a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) “Eucon WR-75” by Euclid Chemical Company.
      2) “WRDA” series by GCP Applied Technologies, Inc.
      3) “MasterPozzolith” series by Master Builders, Inc.
      4) “Metco WR” by Metalcrete Industries.
      5) “Plastocrete 161” by Sika Corp.
3. Medium-Range Water-Reducing: ASTM C494, Type A or F and containing no chlorides.
   a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) “Eucon MR” by Euclid Chemical Company.
      2) “MasterPolyheed” series by Master Builders, Inc.
      3) “Sikament” series by Sika Corp.
4. High-Range Water-Reducing: ASTM C494, Type F or G and containing no chlorides.
   a. Type F Acceptable Products and Manufacturers:
      1) ”Eucon 37” by Euclid Chemical Company.
      2) “Eucon 1037”, or “Plastol 5000” by Euclid Chemical Company.
      3) “Daracem 100” or "ADVA 190" by GCP Applied Technologies, Inc.
      4) “Master Rheobuild 1000” by Master Builders, Inc.
      5) “Viscocrete 2100” by Sika Corp.
   b. Type G Acceptable Products and Manufacturers:
      1) “Eucon 537” by Euclid Chemical Company.
      2) “Daracem 100” by GCP Applied Technologies, Inc.
5. Water-Reducing, Retarding: ASTM C494, Type D and containing no chlorides.
   a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) “Eucon Retarder 75” by Euclid Chemical Company.
      2) “Daratard” series by GCP Applied Technologies, Inc.
      3) “MasterSet R 100” by Master Builders, Inc.
      4) “Plastiment” by Sika Corp.
      5) “SikaTard 440” by Sika Corp.
6. Accelerating:
   a. ASTM C494, Type C or E. Non-chloride and non-thiocyanate type.
   b. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) “Accelguard 80” by Euclid Chemical Company.
      2) “Daraset” series by GCP Applied Technologies, Inc.
      3) “Polar Set: by GCP Applied Technologies, Inc.
      4) “MasterSet FP 20” by Master Builders, Inc.
7. Shrinkage Reducing: ASTM C494, Type S and containing no chlorides.

a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
   1) "MasterLife SRA 20" or "MasterLife SRA 035" by Master Builders, Inc.
   2) "Eucon SRA" series by Euclid Chemical Company.
   3) "Eclipse" series by GCP Applied Technologies, Inc.
   4) "SikaControl" series by Sika Corp.

8. Crystalline-Forming Waterproofing Admixture: Where shown on the Drawings, provide a powder admixture capable of producing concrete that is watertight under hydrostatic pressure up to seven atmospheres when tested in accordance with Corps of Engineers test CRD-C48 and capable of sealing cracks up to 0.4 mm.
   a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) "Penetron Admix." By ICS/Penetron International/Ltd.
      2) "Krystol Internal Membrane" by Kryton International, Inc. (ESR-1515).
      3) "Xypex Admix C1000" or "Xypex Admix C500" by Xypex Chemical Corporation.
      4) "Sika WT-215P" by Sika Corporation.
      5) "MasterLife 300C" by Master Builders Solutions.
      6) "Eucon Vandex AM-10" by The Euclid Chemical Company.
9. Concrete Surface Enhancing Admixture: Where shown on the drawings, provide an admixture which is capable of reducing the number of pinholes, open pores, and other surface defects in concrete. ASTM C494 Type S and containing no chlorides.
   a. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) "Sika Perfin-305" by Sika Corporation.
10. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing chloride ions are not permitted.
11. Certification: Written conformance to all the above-mentioned requirements and the chloride ion content of the admixture as tested by an accredited laboratory will be required from the admixture manufacturer at the time of design mixture review by the Engineer.

2.11 ACCESSORIES

A. Vapor Retarders – as shown on the Drawings.
   1. Coordinate with Section 07 13 00 Sheet Waterproofing and 07 26 00 Vapor Retarders.
   2. High demand areas:
      a. ASTM E1745, Class A or B. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
      b. Acceptable Products and Manufacturers, subject to compliance with project requirements:
         1) "Stego Wrap 15-Mil" by Stego Industries LLC.
         2) "Griffolyn 15 Mil Green" by Reef Industries, Inc.

3) "Moistop Ultra 15" by Fortifiber Building Systems Group, Inc..
4) "Husky Yellow Guard, 15 mil" by Poly-America, L.P.

3. Medium demand areas:
   a. ASTM E1745, Class C, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
   b. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) "Stego Wrap 10-Mil" by Stego Industries, LLC.
      2) "Husky Yellow Guard, 10 mil" by Poly-America, L.P.
4. Low demand areas:
   a. ASTM E1745, Class C, not less than 6 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
   b. Acceptable Products and Manufacturers, subject to compliance with project requirements:
      1) "Moistop Ultra 6" by Fortifiber Building Systems Group, Inc.
      2) "Griffolyn Type-65" by Reef Industries, Inc.

B. Vapor Retarder: Polyethylene sheet, ASTM D4397, not less than 6 mils thick.

C. Bearing Pads – As shown on the Drawings.
1. Elastomeric Pads: AASHTO M251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D2240; minimum tensile strength 2250 psi (15.5 MPa), ASTM D412.
2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," or with MIL-C-882E.
4. Frictionless Pads: PTFE glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

D. Rigid Cellular Polystyrene Geofoam (EPS): ASTM D6817 rigid, closed cell, expanded polystyrene designed to support construction loading. Design and selection shall account for environmental exposure as applicable. Minimum 14.0 psi compressive resistance at 1% strain.
1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
   a. "Insulfoam GF", by Carlisle Companies, Inc.
   b. "Atlas Geofoam", by Atlas Molded Products.

E. Bonding Agent
1. Unless otherwise specified, in accordance with the following.

a. ASTM C881/C881M Type V
b. Two component, moisture insensitive, 100 percent solids epoxy.
c. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions,

2. Acceptable Products and Manufacturers
a. Master Inject 1500 Master Builders Solutions.
b. Euco #452 Epoxy System, Euclid Chemical Co.
c. Prime Bond 3000 and 39000 Series, Prime Resins
d. Sikadur 32 HiMod, Sika Chemical Company.

3. Bonding agent for Fiber Reinforced Topping: Provide creamy cement water slurry mixture, thick enough to be broomed into place and sustain approximate ¼ inch thickness until topping is cast.

F. Bond Breaker
1. Non staining type, providing positive bonding prevention.
2. Acceptable Products and Manufacturers:
a. SureLift J6WB, Dayton Superior Corporation
b. Silcoseal Select, Nox-Crete Products Group.

2.12 JOINT DEVICES AND FILLER MATERIALS

A. Expansion Joint Cap:
1. Two-part plastic cap for use over preformed joint filler.
2. Acceptable Product and Manufacturer:
a. “Snap-Cap” by W. R. Meadows, Inc.

B. Preformed Joint Filler:
1. ASTM D5249, Type 2, nonextruding, 3/8-inch wide by full depth of concrete with top of cap strip at finished surface.
2. Acceptable Product and Manufacturer:
a. “Ceramar” by W. R. Meadows, Inc.

C. Firm Preformed Joint Filler: ASTM D1751, nonextruding, full depth of concrete.

D. Elastomeric Joint Materials:
1. Sealant:
a. FS TT-S-00230, Type I, Class A, single component cold applied, pourable or gun grade, as applicable, polyurethane base.
b. Closely match color of adjacent exposed surface of concrete slab and closely match color of epoxy joint sealant.
c. Keep same color throughout project.
d. Utilize sealant compatible with construction material placed against it.
2. Joint Back-Up Material:
a. Polyethylene foam, 60 percent closed cell.

E. Epoxy Joint Filler:
1. 100 percent solids per ASTM D1259, two-part semi-rigid epoxy with instantaneous Shore A hardness minimum of 80 per ASTM D2240, adhesion to concrete of 150 to 250 psi per ASTM C321, minimum elongation of 6 percent

per ASTM D638, and a tensile strength of 350 to 600 psi per ASTM D638 at 7 days. Provide filler compatible with construction material placed against it, such as tile adhesive.

2. Closely match color of adjacent exposed surface of concrete slab. Keep same color throughout project.
3. Acceptable Products and Manufacturers:
   a. "Euco 700" by Euclid Chemical Company.
   b. "MM-80P" by Metzger-McGuire Co.

F. Joint Dowel Bars: Smooth bars used to dowel across slab-on-grade construction joints shall conform to ASTM A615, Grade 40 or ASTM A36, plain-steel bars. Cut bars true to length with ends square and free of burrs.

G. Epoxy-Coated Joint Dowel Bars: Smooth epoxy-coated bars used to dowel across slab-on-grade construction joints shall conform to ASTM A775 with ASTM A615, Grade 40 or ASTM A36 plain-steel bars. Cut bars true to length with ends square and free of burrs.

H. Dowel Bar Sleeves: Plastic or gage metal (26 gauge minimum) sleeves with an inside diameter of 1/16 inch greater than the dowel bar that it encases, that have the strength, durability, and design to provide free movement of the dowel relative to the concrete slab and that are specifically manufactured for this purpose.

I. Alternate Slab-on-Grade Joint Load Transfer Systems at Construction Joints: A system that consists of flat, ASTM A36 plate that is saw cut into a square or rectangular shape and is embedded into or encased by a plastic sleeve that allows movement in both lateral directions but not in the vertical direction.

1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
   a. "Diamond Dowel System", by PNA Construction Technologies.
   b. "Speed Plate", by Greenstreak Group Inc.

J. Alternate Slab-on-Grade Joint Load Transfer Systems at Saw-Cut Contraction Joints: A system that consists of a load plate basket. Load plate saw cut from hot rolled plate per ASTM A36. Load plate clip to contain compressible foam on each vertical side to allow limited horizontal movement parallel and perpendicular to joint. Side frame supports to be ¼-inch diameter cold drawn wire, ASTM A108 grade 1010-1020.

1. Acceptable Products and Manufacturers, subject to compliance with project requirements:
   a. "PD3 Basket", by PNA Construction Technologies.
   b. "Double-Tapered Basket", by Greenstreak Group Inc.

2.13 CONCRETE MIX

A. General:

1. Use only materials and their proportions included on concrete supplier's standard mix design forms for this Project for which Owner has given final review.
2. Unless otherwise specified, prepare design mixtures for each type and strength of concrete used on the Project.

3. Measure and mix ingredients in accordance with most stringent requirements of ACI 211.1, ACI 301, and ASTM C94.
4. Use cementitious materials of same brand and type and from same manufacturing plant for each class of concrete throughout the project, unless approved otherwise by the A/E and Owner. Submit mill certificates certifying conformance to this specification for each brand and type of cement.
5. Use water reducing admixture or water reducing admixture and high range water reducing admixture for the following:
    a. Concrete mixtures that will be pumped
    b. Concrete mixtures with a water cementitious materials ratio below 0.5.
    c. Concrete mixtures used in columns, piers, pilasters and walls.
    d. When needed to achieve fresh properties that facilitates handling, placing, and consolidating of concrete mixtures, and to achieve specified hardened properties.
    e. When anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
6. Unless otherwise specified, desired fresh properties of concrete must be determined by Contractor and coordinated with concrete producer. Fresh properties of concrete must remain stable to the satisfaction of Contractor for the duration of placement and consolidation and must remain in conformance with requirements of the Contract Documents.
7. Concrete producer is encouraged to employ environmentally sustainable concrete mix design technologies such as supplementary cementitious materials and aggregate packing.
8. Color Pigment: Where required in Supplement, add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

B. Workability: Provide concrete with proper consistency so that the material flows readily into forms and around reinforcement without segregation, voids or excessive bleeding.

C. Concrete shrinkage limits shall be as follows:
1. Concrete designated as "Low Shrinkage" on construction drawings shall utilize concrete with shrinkage of less than 0.02 percent at 28 days. Provide 7 days of wet curing, beginning immediately after concrete placement.
2. All other concrete (including concrete used for suspended slabs that are not on metal deck) shall utilize concrete with shrinkage of less than 0.035 percent at 28 days tested in accordance with ASTM C157 unless other methods to reduce deleterious effects of shrinkage are utilized.

D. Self-Consolidating Concrete (SCC)
1. Unless otherwise specified, select a target slump flow at point of delivery for self-consolidating concrete mixtures.
2. Do not exceed 30 inches for selected target slump flow.
3. Do not show visible signs of segregation in SCC mix.
4. Use target slump flow value indicated on the submittal as a basis for acceptance during the project.
5. Determine slump flow in accordance with ASTM C1611/C1161M
6. Slump flow tolerances in accordance with ASTM C94/C94M.

E. Provide concrete based on the Exposure Categories and Classes as noted on the Drawings.

F. Slump:

1. Proportion concrete so slump without adding mid-range or high-range water-reducing admixture or fibers, if used, would be as follows:

Types of Construction	Slump (in.)
Mass concrete	2 (±1)
Sloping Surfaces up to 45 Degrees	3 max
Floor Slabs and Pavement	4 (+1/2, -2)
Pipe bedding and encasement, electrical conduit encasement (duct banks) and concrete fill	4-8
Other Concrete	4 (±1)

2. For concrete containing medium-range or high-range water-reducing admixture:
   a. Admixture shall be added on site after initial slump tests are performed.
   b. Maximum slump for concrete mixes designated as “Low-Shrinkage”, after adding admixture, shall not be less than 6 inches and not more than 9 ½ inches at point of delivery.
   c. Maximum slump for all other mixes, after adding admixture, shall not be less than 6 inches and not more than 8 inches at point of delivery.
   d. Concrete shall not show visible signs of segregation.
   e. Target slump indicated on submittal shall be used as basis for acceptance during the Project.
   f. Determine slump by ASTM C143/C143M
   g. Slump tolerances shall be in accordance with ACI 117.

G. Admixtures:

1. Add water-reducing admixture as needed to improve workability and reduce water content.
2. Add mid-range or high-range water-reducing admixture as needed to improve workability or pumpability, to lower water/cement ratio, to increase ultimate and early strengths, and to increase slump.
3. Provide an air-entraining admixture where air-entrainment is specified. Do not air-entrain interior floor slabs with troweled finish.
4. Include admixture chemical composition in mix material limit compliance.
5. Other admixtures may be used only with written approval of the Owner.
6. Use admixtures in accordance with manufacturer's recommendations.

H. Supplementary Cementitious Materials (SCM):

1. When multiple SCM are used in a concrete mix design, the maximum percentage of the combined SCM combined is 25 percent of the total cementitious material by weight.

2. Fly ash (Pozzolan)

a. Use as partial replacement for Portland cement if approved and other requirements of this Section are met.
b. Unless noted otherwise, do not use fly ash in concrete that will be exposed to final view. Do not use fly ash in floor slabs.
1) Fly ash may be used in low-shrinkage concrete mixes with written approval of the Owner.
c. If fly ash is used, ensure weight of fly ash divided by sum of cement and fly ash weight is at least 15 percent and does not exceed following percentages by mass:
1) Fly Ash or Other Pozzolans: 25 percent maximum by mass.
2) Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
3) Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
d. When air-entrainment is specified, comply with uniformity requirements of Table 3 of ASTM C618.

3. Slag cement:
a. Use as a partial replacement for Portland cement if approved and other requirements of this section are met.
1) Where slag cement is specified in a concrete mix design, maximum content is 25 percent.

4. Silica Fume:
a. Use as a partial replacement for Portland cement if approved and other requirements of this section are met.
1) Where silica fume is included in concrete mix, minimum silica fume content is 5 percent of weight of total cementitious material.

5. Take special care concerning following:
a. Maintain air-entrainment at specified levels.
b. In cold weather ensure that concrete strength gain is above specified levels.

I. Required average compressive strength: Calculated in accordance with ACI 318 Section 26.4.4.1(c) and method outlined in ACI 301 Section 4.2.3.3.

J. Site Mixed Concrete: Mix concrete in accordance with ACI 301 and 318. Use a central-mix type batch plant.

K. For electrical conduit encasement, provide 3 pounds of red oxide per sack of cement.

2.14 TEMPERATURE LIMITS

A. Provide concrete, as delivered to site, with temperature between 50 degrees to 95 degrees Fahrenheit. or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified.

1. Provide Mass Concrete, with concrete temperature per the accepted Thermal Control Plan

B. For Mass Concrete sections:
   1. Provide documentation that maximum concrete temperature in structure will not exceed 160 degrees Fahrenheit.
   2. Provide documentation that maximum temperature differential between center of section and external surfaces of concrete will not exceed 35 degrees Fahrenheit.
   3. Accelerating admixtures may not be used in mass concrete sections unless the thermal control plan specifically addresses the concrete mixture with the same accelerating admixture, at a dosage equal to or greater than being proposed for the mass concrete.

2.15 SLIP RESISTANT TREATMENT

A. Slip Resistant Finish: Silica sand type and color as selected from manufacturer's standard range.

B. Abrasive Aggregate: 95 percent minimum fused homogeneous aluminum oxide, Crushed emery, minimum 45 percent aluminum oxide or Silicone carbide.

2.16 CURING AND SEALING MATERIALS

A. Sheet Materials for Curing Concrete: ASTM C171.
   1. Synthetic Fiber/Plastic:
      a. White synthetic fiber matting securely attached to white plastic sheet backing.
      b. Acceptable Products and Manufacturer, subject to compliance with project requirements:
         1) “Transguard 4000” by Reef Industries, Inc.
         2) “HydraCure” by PNA Construction Technologies, Inc.
   2. Coated Burlap:
      a. ASTM C171, 10-ounce burlap with 4-mil minimum white opaque polyethylene extruded onto burlap.
      b. Acceptable Product and Manufacturer, subject to compliance with project requirements:
         1) “Curelap” by Midwest Canvas Corp.

B. Liquid Membrane Curing and Sealing Compound for areas requiring low VOC compliance:
   1. Conform to ASTM C1315, Type I (VOC compliant, 350 g/l).
   2. Styrene-acrylate or methyl-methacrylate type, 25 percent minimum solids content, clear, non- yellowing, with no styrene-butadiene.
   3. Acceptable Product and Manufacturer, subject to compliance with project requirements:
      a. “Super Aqua-Clear VOX or Super Diamond Clear VOX” by Euclid Chemical Company.
      b. "L&M Dress & Seal WB 25" by L&M Construction Chemicals.
      c. “Vocomp-25” by W.R. Meadows, Inc.

C. Sealer/Densifier:
1. High performance, deeply penetrating concrete densifier; odorless, colorless, VOC-compliant, non-yellowing siliconate based solution designed to harden, to dustproof and to protect concrete floors subjected to heavy vehicular traffic, and pto resist black rubber tire marks on concrete surfaces.
2. The compound must contain a minimum solids content of 20 percent, of which 50 percent is siliconate.
3. Acceptable Products and Manufacturers, subject to compliance with project requirements:
a. "Ashford Formula" by Curecrete Distribution, Inc.
b. "Euco Diamond Hard" by Euclid Chemical Company.
c. "L&M Seal Hard" by Laticrete International, Inc.

D. Chemical Hardener:
1. Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 pounds of fluosilicates per gallon.
2. Acceptable Products and Manufacturers, subject to compliance with project requirements:
a. "Surfhard" by Euclid Chemical Company.
b. "MasterKure HD 300WB" by Master Builders, Inc.

E. Coatings (applied within the building interior): Comply with California Department of Public Health (CDPH) Standard Method for VOC emissions requirements.

F. Coatings (applied within the building interior): VOC content limits in grams per liter (g/L) as follows.
1. Sealers: 100 g/L.
2. Concrete Curing Compound: 350 g/L.

PART 3 EXECUTION

3.1 EXAMINATION

A. Formwork and Accessories:
1. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
2. Verify that subgrade surfaces and excavations are ready to receive formwork.

B. Concrete:
1. Verify requirements per ACI 301 for concrete cover over reinforcement are met.
2. Verify that anchors, seats, plates, reinforcement and other embedded items are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Formwork and Accessories:

1. Provide form surfaces free of dirt, mud, mortar, loose or nonadherent rust, and other foreign material.
2. Apply a form release agent to form and form liner surfaces prior to positioning of the forms and placement of the reinforcing steel and concrete.
3. For concrete exposed to view, utilize form surfaces free of surface irregularities and patches and capable of producing the desired finish.
4. For vertical surfaces of footings not exposed to view, earth cuts as forms are acceptable where the soil is firm and stable.
5. Cut earth form surfaces compact, neat, and accurate in size and shape in accordance with Project Specific geotechnical report and Section 31 00 00 Earthwork
6. Clean top edges of earth forms of loose material to prevent sloughing.
7. Increase concrete section dimensions to provide reinforcing steel with minimum specified cover at earth forms.

B. Reinforcement:
1. Place reinforcing steel free from dirt, mud, grease, oil, ice or snow, kinks, loose or non-adherent rust, loose mill scale, form-release coating/sealer or bond breaker, and any foreign matter or nonmetallic coating that adversely affects the bonding capacity of the reinforcing steel with the concrete.
2. Clean bars extending through construction joints of concrete and other contaminants prior to placement of subsequent concrete.
3. Provide surface preparation for welding in accordance with AWS D1.4. Removal of loose or non-adherent rust and loose mill scale is acceptable.
4. Turn tie wire ends away from concrete exterior.

C. Concrete:
1. Prior to placement of concrete, complete the formwork, position and secure in place reinforcing steel and embedded items, ensure the space in which the concrete is to be poured is free of debris and rubbish, spilled concrete, sloughed soil, standing water, etc., and complete inspection and acceptance of the work.
2. Provide steel floor deck surfaces for contact with concrete that are free from dirt, mud, dust, grease, oil, wax, ice or snow, frost laitance, and/or unsound material, and any foreign matter or coating that adversely affects the bonding capacity of the concrete.
3. Prior to placing of subsequent concrete at construction joints, clean the contact surface by sandblasting or other approved means to remove laitance, expose the aggregate, and roughen the surface to a minimum of 1/4-inch amplitude. Clean contact surfaces to remove loose and/or foreign material. Inspect construction joints prior to closing forms and the placement of concrete.
4. Treat wall joints, elevated slab joints, and any other joints as shown on the Drawings with non-reemulsifiable bonding agent in accordance with the manufacturer’s written instructions and specification prior to subsequent concrete placement.
5. Prevent damaging waterstops during construction joint preparation.
6. Prevent splattering concrete on exposed/finish surfaces.
7. Provide an operable backup vibrator on site prior to and during concrete placement.

3.3 FORMWORK INSTALLATION

A. Formwork – General:
   1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
   2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
   3. Camber shored forms to compensate for form deflection due to placement and hardening of concrete.
   4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete. Complete wedging and bracing before placing concrete.
   5. Stagger joints in form panels and provide a tight fit. Solidly butt and align joints. Provide backup at joints as required to prevent leakage.
   6. Apply form release agent in accordance with manufacturer's recommendations prior to placement of reinforcing steel, anchoring devices, and embedded items.
   7. Install fillet and chamfer strips on external corners of specified members.

B. Forms for Smooth Finish Concrete:
   1. Use steel, plywood or lined board forms.
   2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
   3. Install form lining with close-fitting square joints between separate sheets without springing into place.
   4. Use full size sheets of form lines and plywood wherever possible.
   5. Tape joints to prevent protrusions in concrete.
   6. Use care in forming and stripping wood forms to protect corners and edges.
   7. Level and continue horizontal joints.
   8. Keep wood forms wet until stripped.

C. Architectural Form Liners:
   1. Erect architectural side of formwork first.
   2. Attach form liner to forms before installing form ties.
   3. Install form-liners square, with joints and pattern aligned.
   4. Seal form liner joints, seals and form tie holes to prevent grout leaks.
   5. Dress joints and edges to match form liner pattern and texture.
   6. Locate panel seams and joints at the same elevation and tight fitting.
   7. Locate abutting panels in straight alignment for the entire length of the element.
   8. Chamfer panels abutting rustification strips to match rustification strips.
   9. Install in and attach to formwork in accordance with the manufacturer's written instructions and specifications.

D. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

3.4 INSTALLATION – INSERTS, EMBEDDED PARTS, AND OPENINGS FOR FORMWORK

A. Install formed openings for items embedded in or passing through concrete work.

B. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

C. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Securely anchor embedded items in correct location and alignment prior to placing concrete.
4. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

D. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. For pipes and conduit passing through slabs, grade beams, and walls, provide sleeved holes sized 1 inch in diameter larger than the outside diameter of the pipe/conduit. Sleeves to extend the full thickness of the section.

E. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. If necessary to grease tie threads, do not allow grease to contact remainder of tie when wall will be exposed to hydrostatic pressure.
5. Use column clamps in lieu of form ties at square and rectangular columns.

F. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces, in order to provide straight line at joints.
2. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
3. Arrange joints in continuous line straight, true and sharp.

G. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
4. Do not stake through or otherwise penetrate the membrane.

3.5 FORM CLEANING

A. Clean forms and formed cavities of debris and rubbish, spilled concrete, sloughed soil, mud, standing water, ice or snow, tie wire trimmings, etc. prior to placing concrete.

B. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

C. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

A. Prior to removal of non-weight supporting forms:
   1. Allow concrete to harden sufficiently to resist damage from removal operations, but in no case sooner than 24 hours.

B. Prior to removal of weight supporting forms:
   1. Removal of forms or shores is acceptable per provisions of ACI 318.

C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finished concrete surfaces scheduled for exposure to view.

D. Remove formwork progressively so no unbalanced loads are imposed on structure. Do not damage concrete surfaces during form removal.

3.7 PLACING REINFORCING

A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance as defined in ACI 301 and CRSI 10-MSP. Do not weld crossing reinforcement bars for assembly except as approved by the Owner.

B. Do not displace or damage vapor retarder.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcement in accordance with ACI 318, except as noted on the Drawings.

E. Provide lap type reinforcing steel splices unless detailed otherwise on the Drawings. Submit splices not specified in these Specifications or shown on the Drawings for prior review by the A/E.

F. Install continuous horizontal bars in the longest possible lengths with ACI Class B lap splices in accordance with ACI 318, unless detailed otherwise on the Drawings.

G. Provide spiral lap splices 48 bar diameters minimum unless detailed otherwise on the Drawings. Provide spacers in accordance with CRSI-MSP for spiral reinforcing.

H. Support reinforcing steel at 4 feet on center maximum in any direction.

I. Submit field bending of reinforcing steel not shown on the Drawings for approval. Do not heat reinforcing bars for bending purposes.

J. Welded Wire Fabric: Position fabric by supports spaced such that construction loads, including workers, do not cause permanent deflection of more than 1/2 inch.

K. Bond and ground reinforcement in accordance with requirements of Section 26 05 26.

3.8 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify testing laboratory and Owner minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.

D. Install vapor retarder over prepared base material where indicated under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends. Ensure tape and adhesives are compatible with vapor retarder.

E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

F. Apply sealants in joint devices in accordance with Section 07 90 00 – Joint Protection.

G. Water may not be added to the mix at the site unless approved by the Owner. In no case is the maximum water/cement ratio to be exceeded.

H. Raking or flowing of concrete to move it or re-tempering of concrete is not permitted.

I. Convey and place concrete at a regular rate, as close as possible to final position. Prevent segregation of mix, and sequence in a manner which minimizes shrinkage. Do not support concrete conveying equipment on the reinforcing steel or supporting accessories.

J. Wall, beam, and slab concrete shall be placed in 125-foot maximum lengths unless specific measures to reduce the deleterious effects of shrinkage as approved by the EOR are utilized.

K. Do not use aluminum equipment for conveying or finishing concrete.

L. Use tremies or other approved method when drops over 5 feet are required and concrete will have to pass through obstructions, such as reinforcing.

M. Unless otherwise specified, consolidate concrete by vibration. Consolidate concrete around reinforcement, embedded items and into corners of forms to eliminate honeycombing or planes of weakness due to air voids and stone pockets. Unless otherwise specified, use the largest and most powerful internal vibrators to consolidate the concrete. Utilize workers experienced in the use of vibrators. Do not use vibrators to move concrete within the forms.
   1. Provide additional vibrators on-site to be on stand-by in case primary vibrators malfunction.

N. Place concrete in continuous operation for each panel or section determined by joints shown on the Drawings or as specified in these Specifications. Submit construction joints not shown on the Drawings or specified in these Specifications for prior review by the Owner.

O. Do not interrupt successive placement and do not permit cold joints to occur.

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

Q. Place floor slabs in checkerboard or saw-cut pattern indicated on drawings.

R. Concrete sections with a minimum specified dimension meeting the definition of Mass Concrete:
   1. Cure and protect concrete in accordance with accepted thermal control plan and as follows:
      a. Minimum curing period shall be 14 days.
      b. Unless otherwise permitted, preserve moisture by maintaining forms in place.
   2. Strength measurement shall be representative of in-place concrete within 2 inches of concrete surface.
   3. Concrete strength shall be verified through correlation of concrete temperature and compressive strengths established by cylinder compressive tests and in accordance with ASTM C1074.
   4. Unless otherwise specified, control concrete temperatures to within specified limits from time concrete is placed until time internal temperature has cooled from its maximum, such that difference between average daily ambient and maximum internal concrete temperature at time of protection removal, is less than specified temperature difference limit.
   5. Unless otherwise specified, place one temperature sensor at center of mass of placement and one temperature sensor at a depth 2 inches from center of nearest exterior surface. Place additional sensor at each location to serve as a backup in event that other temperature sensor fails. In addition, provide temperature sensor in shaded location for monitoring ambient onsite temperature.
      a. Unless otherwise specified, monitor temperatures hourly using electronic sensors capable of measuring temperature from 32 degrees F to 212 degrees F to an accuracy of 2 degrees F.
      b. Ensure temperature sensors are operational before placing concrete.
      c. Unless otherwise specified, provide data from sensors to Engineer on a daily basis, until requirements are met.

d. Compare temperatures and temperature differences with maximum limits specified in the project specific thermal control plan every 12 hours, unless otherwise permitted. If either exceeds specified limits, take immediate action as described in accepted thermal control plan to remedy situation. Do not place additional mass concrete until cause of excessive temperature or temperature difference has been identified and corrections are accepted.

3.9 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface to 1/4-inch amplitude and remove deleterious material. Broom and vacuum clean.

B. Completely remove all curing or sealing compounds on substrate per manufacturer recommendations prior to placing topping slabs.

C. Slabs that are sloping shall not be less than 2 inches thick at their thinnest dimension. To slope from 2 inches to 0 inches, an epoxy grout shall be used.

D. Place required dividers, edge strips, reinforcing, and other embedded items.

E. Apply bonding agent to substrate.

3.10 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301.

B. Float finish surfaces scheduled to receive roofing, waterproofing membranes, and sand bed terrazzo.
1. Power float and/or hand float surface.
2. Wood float surfaces receiving quarry tile, ceramic tile, and cementitious terrazzo with full bed setting system.

C. Trowel finish exposed interior walking surfaces and surfaces to be covered with carpet, resilient floor, paint and other thin-film finish coating systems.
1. After floating as specified, power trowel or hand trowel surface.
2. Ensure kneeboard impressions, trowel marks or chattered areas are not evident after floor is finished.
3. Steel trowel exposed surfaces and surfaces receiving carpeting, 0resilient flooring, and seamless flooring.

D. Scratch finish surfaces that are to receive mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring materials, except bonded concrete floor toppings.

E. Broom finish exposed exterior walking surfaces, ramps and outside paving, unless noted otherwise on the Drawings.

F. Screed floors and slabs on grade level, maintaining required surface flatness. Wet screeding and jitterbugging is not permitted.

G. Saw-cut joints within 12 hours after placing. Use 3/16-inch-thick blade, cut into 1/4 depth of slab thickness.

H. Formed concrete surfaces not exposed to view may have a rough form finish and formed concrete surfaces exposed to view to have a smooth form finish in accordance with ACI 301.

I. Metallic and Hard Aggregate Finish:
   1. Apply metallic or hard aggregate floor surface material, where noted on the Drawings, in accordance with manufacturer's recommendations.
   2. Distribute material with a mechanical spreader.
   3. Apply material at following minimum rates:
      a. Mineral Aggregate: 1.0 pounds per square foot of floor area.
      b. Metallic Aggregate: 1.5 pounds per square foot of floor area.

J. Abrasive Aggregate Finish: Apply in accordance with manufacturer's recommendations.

K. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains as indicated on Drawings.

3.11 FLOOR FINISHING TOLERANCES

A. Provide final surfaces within tolerances per ACI 117 and as specified below.

B. Floor Finished Surface Flatness and Levelness:
   1. Random Traffic Areas:
      a. F-Number Requirements: Conform to F-number requirements specified and as described in ASTM E1155, except as specified or as shown on Drawings:
         1) Interior Slabs on Grade: FF35/FL25 minimum overall for composite of measured values for entire day's concrete placement; FF25/FL20 minimum for any individual floor section.
         2) Elevated Slabs Shored Until After Testing: FF25/ FL20 minimum overall for composite of measured values for entire day's concrete placement; FF20/FL15 minimum for individual floor section.
         3) Unshored Elevated Slabs: FF23 minimum overall for composite of measured values for entire day's concrete placement; FF17 minimum for individual floor section.
   2. Boundary Requirements: Bound individual floor sections for testing purposes by the following that provide the smallest sections: construction joints, control joints, or column and half-column lines.
   3. Additional Requirements:

a. Conform to F-numbers specified for floor areas within 2 feet of construction and isolation joints, in lieu of ASTM E1155 requirements excluding these areas.
b. Limit to 1/4-inch maximum elevation change that may occur within 2 feet of vertical elements (such as columns or walls) that pass through slab surface.

4. Defined Traffic Areas, as Noted on Drawings:
a. F_{min} Requirements: Fmin 60, at locations in way of future lift truck wheel tracks and over truck wheel space dimensions.

5. Remedies for Out-of-Tolerance Work:
a. Grind into tolerance or remove and replace slabs measuring below specified F_{min} number.
b. Filling of low spots is not permitted.

6. Elevation Envelope: Ensure top of entire floor falls within plus or minus 5/16 of an inch of finished floor elevation indicated on Drawings.

C. Exterior Exposed Mat Foundation Finished Slope 0 per construction drawings.
1. Vertical deviation tolerance of sloped surface from specified slope plane: +/-0.2 percent.

3.12 FORMED CONCRETE FINISHING

A. Provide formed concrete finishes in accordance with ACI 347.3R – Guide to Formed Concrete Surfaces as follows, unless noted otherwise on construction drawings:
1. Basement walls: CSC1;
2. Interior exposed walls, columns, beams, joists: CSC2;
3. Exterior exposed walls, columns, beams, joists: CSC2;
4. Underside of supported floors and structure exposed to view: CSC2;
5. Stairwells: CSC2;

3.13 CURING

A. General:
1. Cure concrete in accordance with ACI 308.1, except as noted.
2. Start curing as soon as concrete surface will not be damaged by curing operations.
3. Continuously cure concrete, except high early strength concrete, for at least 7 consecutive days.
4. Cure high early strength concrete for at least 5 consecutive days.
5. During curing period, do not allow any part of concrete to become dry.
6. Keep forms in contact with concrete wet during curing period unless type of form is impervious to water, such as metal or fiberglass.
7. If forms are removed before curing period is complete, continue curing immediately with one of following methods.

B. Spraying: Spray water over floor slab areas and maintain wet.

C. Liquid Curing Compound: Curing compounds may only be used with written approval from the A/E.

1. Apply curing compound in one coat.
2. Apply curing compound at coverage rate of 300 square feet maximum per gallon for broomed finish and abrasive aggregate finish.
3. For troweled finish, metallic or hard aggregate finish, and other finishes where curing compound can be used, apply curing and sealing compound at coverage rate of 400 square feet per gallon, or the strippable curing compound at 300 square feet per gallon.
4. Do not use liquid curing compound on surface against which additional concrete, other finishing materials, coatings, tank linings or slab toppings are bonded if their bond will be affected by curing compound.
5. High solids content of curing compound may clog hand sprayers; plan for this by using power sprayer or other approved means of application if necessary.
6. During the curing period, immediately recoat within 3 hours surfaces subjected to rainfall or surfaces damaged by subsequent construction operations.

3.14 SEALING

A. Apply a uniform coat of liquid sealing compound in accordance with manufacturer's recommendations at locations directed by the contract documents. This application is not intended for the purposes of a curing compound. If surfaces were cured with a liquid curing compound, use the same product for sealing as was used for curing. Commence application immediately after removing curing fabrics or papers or after liquid curing compound has thoroughly dried.

B. Floor Sealing
1. Just prior to completion of construction, apply uniform coat of liquid sealer to trowel finished interior floor surfaces in accordance with manufacturer's recommendations at locations directed by contract documents. Do not apply sealer if incompatible with planned coating or surface treatment.
2. Apply compound after slab repairs and sealing of joints is complete.
3. Remove stains and thoroughly clean and dry surfaces immediately prior to application.
4. Apply sealer/densifier and shake on hardener on exposed interior floors subjected to vehicular abrasion at locations directed by the contract documents. Apply in accordance with the directions of the manufacturer and just prior to completion of construction.

3.15 FIELD QUALITY CONTROL

A. Refer to Section 01 45 33 – Code-required Special Inspections and Procedures for inspection requirements.

B. Sampling and Testing:
1. Sampling Procedures: ASTM C172.
   a. Cylinder Molding and Curing Procedures: ASTM C31 cylinder specimens, field cured.
   b. Sample concrete and make one set of four standard 6-inch diameter by 12-inch cylinders per 75 cubic yards or less of each class of concrete

placed each day and per 5,000 square feet of surface area for slabs and walls.

1) 4-inch diameter by 8-inch cylinders conforming to the requirements of ASTM C31 are acceptable for testing strength and modulus of elasticity of concrete with compressive strength of 6000 psi or greater. Sample concrete and make one set of five cylinders per 75 cubic yards or less of each class of concrete placed each day and per 5,000 square feet of surface area for slabs and walls.

c. Field cure samples using the same procedures as the concrete they represent.

d. When volume of concrete for any class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch when less than five batches are used.

e. Make one additional cylinder during cold weather concreting, and field cure.

f. Use standard-cured cylinders for acceptance testing for specified strength.

g. Provide additional cylinders for substantiation of concrete strength for other construction purposes.

2. Field Testing:
   a. Slump Test Method: ASTM C143.
   b. Air Content Test Method: ASTM C231.
   c. Temperature Test Method: ASTM C1064.
   d. Measure slump and temperature for each compressive strength concrete sample.
   e. Measure air content in air entrained concrete for each compressive strength concrete sample.
3. Cylinder Compressive Strength Testing:
   a. Test Method: ASTM C39.
   b. Test Acceptance: In accordance with ACI 318.
   c. Test one cylinder at 7 days.
   d. Test two cylinders at 28 days.
   e. Test one cylinder at 56 days only if 28-day tests are below the specified strength.
   f. Retain one cylinder for 28 days for testing when requested by Owner.
   g. Dispose remaining cylinders when testing is not required.
4. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
5. Supplemental testing options for non-compliant strength concrete. Reference section on investigation of low concrete strength test results for additional information.
   a. Core Compressive Strength Testing:
      1) Sampling and Testing Procedures: ASTM C42.
      2) Test Acceptance: In accordance with ACI 318.
      3) Drill two cores for each failed strength test from concrete represented by 56-day compressive strength tests that are below the specified strength, except as authorized by the Owner.

4) Locate reinforcing steel prior to coring. Do not cut reinforcing steel during coring.

b. Execute penetration resistance tests of concrete for indication of compressive strength in accordance with ASTM C803.
   1) Test concrete where the 56-day compressive strength tests are below the specified strength.
   2) Execute test within 72 hours of the noncomplying cylinder tests.

c. Provide core compressive strength and penetration resistance tests without additional cost to the Owner.

d. Provide the following within 48 hours after completion of tests and inspections:
   1) Test reports concerning slump, air content, temperature and compressive strengths of concrete and ambient temperature at the time of placement.
   2) Inspection reports concerning concrete placement and slab surface flatness.

6. Perform shrinkage testing in accordance with ASTM C157 except as modified herein. At Contractor's option, the ASTM C157 standard curing period of 28 days may be modified to a 7-day curing period. Testing protocol shall be submitted to Owner for review and approval prior to commencing with shrinkage testing.
   a. Prior to construction:
      1) Provide shrinkage testing for each proposed concrete mix. Shrinkage testing shall include at least 6 specimens without the use of ASTM C494, Type S shrinkage reducing admixture (control specimens) and at least 6 specimens that utilize ASTM C494, Type S shrinkage reducing admixture (prototype specimens). Test results shall indicate the relative performance with and without the ASTM C494, Type S shrinkage reducing admixture. Test results shall be submitted to A/E and Owner for review and approval prior to commencing work.
   b. During construction:
      1) Provide shrinkage testing for each 500 cubic yards of concrete for each mix design placed.
      2) If (3) consecutive test results meet specified limits, shrinkage testing may be decreased to each 3,000 cubic yards of concrete for each mix design placed.
         a) If more than 1-in-4 consecutive test results do not meet specified limits, increase shrinkage testing to each 500 cubic yards of concrete placed until test results are within specified limits. Shrinkage testing may then resume to each 3,000 cubic yards of concrete for each mix design placed.
7. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.16 PATCHING AND CLEANING

A. Clean honeycomb voids, rock pockets, lifting insert holes, and form tie holes to sound concrete and fill with grout or patching mortar mixed with diluted non-reemulsifiable bonding agent. Remove fins and projections.

B. Patch imperfections in accordance with ACI 301.

C. Provide surface repairs to match the finish of the adjacent concrete surface. Provide curing agent and sealer, as needed, to match adjacent unrepaired surface finish where exposed to view.

D. Clean concrete splatter from exposed/finish surfaces. Provide cleaned surfaces equal to the original surface with no visible splatter.

3.17 DEFECTIVE CONCRETE AND COSMETIC SURFACE REPAIRS

A. Defective Concrete: Concrete not conforming to required dimensional tolerances, finishes, strength of structure, or durability as required by the Contract Documents. Concrete shall be considered defective per the following standards:
   1. Defective Dimensional Tolerances: Per ACI 301 Section 1.8.2.
   2. Defective Finishes: Per ACI 301 Section 1.8.3.
   3. Defective Strength of Structure: Per ACI 301 Section 1.8.4.
   4. Defective Durability: Per ACI 301 Section 1.8.5.

B. Repair or replace defective concrete at no additional cost to A/E or Owner. Submit to A/E and Owner proposed repair methods, materials, and modifications needed to repair concrete work to meet requirements in Contract Documents. Additional inspections required for correction of non-complying surfaces shall be at the Contractor’s expense.

C. Cosmetic Surface Repairs: Concrete surfaces which do not qualify as defective concrete but have cracks in excess of 1/32 inch in width, voids, honeycombing, rock pockets, tie holes, crazing, popouts, spalling, or discolorations that cannot be removed by cleaning shall require cosmetic concrete repair.

D. Provide cosmetic surface repairs at no additional cost to A/E or Owner. Submit to A/E and Owner proposed repair methods, materials, and modifications needed to repair concrete work to meet finish requirements in Contract Documents.
   1. Cosmetic surface repair of formed concrete surfaces shall consider the provisions in ACI 347.3R – Guide to Formed Concrete Surfaces.

3.18 PROTECTION

A. Barricade concrete surfaces immediately after finishing.

B. Do not permit light traffic, except for curing purposes, over unprotected floor surface until concrete has obtained 60 percent of its specified compressive strength (7 days minimum) determined by field-cured test cylinders.

C. Do not permit heavy traffic over unprotected floor surface until concrete has obtained its specified design strength determined by field-cured test cylinders. Ensure construction traffic does not exceed floor design loads.

D. If concrete has been cured by water or sheet material, permit concrete to dry minimum of 2 additional days after curing is completed before removing barricades.

E. Protect finished slabs from traffic, mud, dirt, concrete splatter, joint compound, sealants, paint, oil, grease, etc., during construction by use of a durable waterproof craft paper.

F. Do not place earth backfill behind walls until the concrete has attained 100 percent of its specified 28-day compressive strength as substantiated by field-cured test cylinders.

G. Brace walls tied to slabs or members as required to resist lateral loads until the slab or members are complete and have attained 100 percent of its specified 28-day compressive strength as substantiated by field-cured test cylinders.

3.19 TESTING OF LIQUID-HOLDING CONCRETE STRUCTURES

A. General:
   1. Test concrete tanks, clarifiers and other liquid-holding structures for liquid tightness prior to backfilling, application of waterproofing, or application of any lining, coating or other finishing material to concrete, unless otherwise allowed by Owner.
   2. Notify Owner one week minimum in advance of beginning testing.
   3. Conform to requirements of Watertightness Test Requirements.

3.20 REMOVAL OF TEMPORARY ELEMENTS REQUIRED FOR CONSTRUCTION

A. Contractor is responsible for the means, methods and safety of the erection, installation and placement of the materials included in this section and shall design, furnish, install and de-install all temporary elements required for construction purposes and not required for the structural adequacy of the completed project. Structural construction documents contain the permanent elements required for structural adequacy of the completed project.

B. Repair damaged surfaces resulting from the removal of these temporary elements (including paint, finishes, sealants, protective coatings, etc.).

C. Account for cost and schedule impact of the removal the temporary elements and associated repairs.

D. Temporary elements may only be allowed to become permanent upon written approval by the A/E and owner.

3.21 INVESTIGATION OF LOW CONCRETE STRENGTH TEST RESULTS

A. Contractor Responsibility for Low Strength Concrete:
   1. If the average of any three consecutive strength tests falls below the required f’c for a class of concrete but no individual strength test is more than 500 PSI below

the required f’c, the Contractor shall immediately notify the Engineer by telephone or email and take immediate steps to increase the average of subsequent strength tests.

2. If any individual strength test falls more than 500 PSI below the required f'c, the Contractor shall immediately notify the Engineer by telephone or e-mail and take immediate steps to assure that the load-carrying capacity of the structure is not jeopardized.

B. Additional Field Tests to Confirm Low Concrete Strengths:

1. The cost of all investigations of low-strength concrete, as defined by any individual strength test being more than 500 PSI below the required f’c, shall be borne by the Contractor.
2. Code-Prescribed Acceptance: The only accepted field-test methods of determining actual in-situ concrete strength are core tests as prescribed by ACI 318.
3. Non-Destructive Tests: If any individual strength test falls more than 500 PSI below the required f'c, the Engineer may request that non-destructive field tests be performed on the concrete in question using Swiss Hammer, Windsor Probe, or other appropriate methods as approved by the Engineer. Report the comparative test results of the suspect concrete under consideration with identical tests done on concrete of known strength and of the same class. The Engineer considers these test results as only approximate indicators of strength and may not necessarily, by themselves, resolve the low concrete strength issue. These test results will be considered as additional information by which to make an informed judgment. The Engineer reserves the right to accept the concrete based on the results of these approximate tests or order that core tests be taken as prescribed below. At the Contractor’s option, the approximate non-destructive field-tests may be waived and core tests immediately initiated.
4. Core Tests: If, in the opinion of the Engineer, the likelihood of low-strength concrete is confirmed and it has been determined that the load-carrying capacity of the structure is significantly reduced as a result, the Engineer may request that core tests be taken from the area in question as directed by the Engineer. There shall be a minimum of three cores taken for each strength test more than 500 PSI below the required f'c in accordance with ASTM C 42. If concrete in the structure will be dry under service conditions, cores shall be air dried (temperature 60° to 80°F, relative humidity less than 60 percent) for seven days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and tested wet. The Contractor shall fill all holes made by drilling cores with an approved drypack concrete.
5. Acceptance Criteria for Core Test: Concrete in an area represented by core tests shall be considered adequate if the average of three cores is equal to at least 85% of the required f'c and no single core is less than 75% of the required f'c. If approved by the Engineer, locations of erratic core strengths may be retested to check testing accuracy.
6. Load Test: If the concrete strength is not considered adequate based on core tests and the structural adequacy remains in doubt, the Engineer may order a load test

as specified in ACI 318 be conducted for the questionable portion of the structure.

7. Strengthening or Demolition of the Structure: If the structural adequacy of the affected portion of the structure remains in doubt following the load test, the Engineer may order the structure to be strengthened by an appropriate means or demolished and rebuilt at the Contractor's expense.

3.22 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 30 00-01	Reinforcing: Shop Drawings: Indicate bar sizes, spacings, locations, splice lengths and locations, bending diagrams, supporting devices (including spacing) for reinforcing and welded wire. Certificates: Submit AWS qualification certificate for welders employed on the Work. Submit certified copies of mill test report of reinforcement materials analysis. Submit the following: • EPD certification for fabricated reinforcing • EPD certification for unfabricated reinforcing		Two weeks prior to fabrication or purchase

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 30 00-02	Concrete: • Product Data: Submit data on joint devices, attachment accessories, admixtures and all accessories to be embedded in concrete. Design Data: • Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following: • Hot or cold weather concrete work. • Air entrained concrete work. • Identify mix ingredients and proportions, including admixtures. • Identify chloride content of admixtures and whether chloride was added during manufacture. • Provide documentation showing aggregates have been evaluated for Alkali-Aggregate Reaction (AAR) and are classified as non-reactive.		Two weeks prior to fabrication or purchase
03 30 00-05	Finishing: Submit data on concrete hardeners, sealers, curing compounds, curing papers, slip resistant treatments, compatibilities, and limitations. Submit locations where products will be installed.		Two weeks prior to construction
03 30 00-06	Curing: Submit data on curing compounds, mats, paper, film compatibilities, and limitations. Submit locations where products will be installed.		Two weeks prior to construction

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 30 00-07	Cold weather: Detailed plan for curing and protection of concrete placed and cured in cold weather. Plan shall include but not be limited to: • Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to concrete placement. • Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement. • Methods of temperature control during placement. • Types of covering, insulation, housing, or heating to be provided. • Curing methods to be used during and following protection period. • Use of strength accelerating admixtures. • Methods of verification of in-place strength. • Procedures for measuring and recording concrete temperatures.		Two weeks prior to construction.
03 30 00-08	Hot Weather: Detailed plan for hot weather placements including curing and protection for concrete. Plan shall include but not be limited to: • Procedures for measuring and recording temperatures of reinforcement and other embedded items and concrete materials prior to placement of concrete. • Use of retarding admixture. • Methods for controlling temperature of reinforcement and other embedded items prior to placement of concrete. • Types of shading and wind protection to be provided. • Curing methods, including use of evaporation retardant. • Procedures for measuring and recording concrete temperatures.		Two weeks prior to construction.

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 30 00-09	For each Mass Concrete placement: • Submit a Thermal Control Plan meeting the requirements of ACI 301. • Submit documentation of Internal Cooling System if determined necessary by Thermal Control Plan. Submittal shall include layout, pipe sizes, material, connections, method of support, and system for monitoring the temperature of the water in the cooling pipes. Submittals shall be prepared by a Professional Engineer who specializes in temperature control of mass concrete. Update and resubmit thermal control plan if changes in concrete materials or mixture proportions affect compliance with temperature limits.		Two weeks prior to construction.
03 30 00-10	Concrete shrinkage testing protocol and test results.		As required by construction schedule for approval of proposed concrete mix.
03 30 00-14	Construction Joints: Submit drawings of proposed construction joint locations in concrete for slabs, structural floors, roofs, and walls. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.		Two weeks prior to construction.
03 30 00-15	Openings, Sleeves, and Cores: Submit drawings of all openings to be formed, sleeved, cored, or sawcut in cast-in-place elements. Drawings shall indicate size and location of openings, sleeves, or cores.		Two weeks prior to construction.
03 30 00-16	Penetrations in Beams and Girders: Submit drawings locating all horizontal and vertical penetrations in beams and joists. Drawings shall indicate location, size, orientation, and type of penetrations.		Two weeks prior to construction.

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
03 30 00-17	Embedded Items: Submit drawings showing all items to be embedded in concrete elements, including plates, angles, bolts, and any non-structural items, such as conduit. Drawings shall indicate location, size, orientation, and type of embedded item.		Two weeks prior to construction.
03 30 00-18	Anchor Rods: Submit drawings showing layout and details for steel templates used for placing anchor rods.		Two weeks prior to construction.
03 30 00-20	Field Quality Control: Sampling, testing, and inspection reports.		Per construction schedule.
03 30 00 21	Coordinate submittal requirements with Section 01 81 13 – Sustainable Design Requirements. LEED cover sheets for each material.		Per construction schedule.
03 30 00 22	Certificate of compliance for CDPH Standard Method: Sealers (interior only) andcoatings (interior only). Include quantity applied in liters for each product		Two weeks prior to fabrication or purchase.
03 30 00 23	Product data for VOC content (g/L): Sealers(interior only) and coatings (interior only). Include quantity applied in liters for each product.		Two weeks prior to fabrication or purchase.

END OF SECTION