

DIVISION 03: CONCRETE

03 1000 CONCRETE FORMING AND ACCESSORIES

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- 03 1511 CONCRETE ANCHORS

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03 3000 CAST-IN-PLACE CONCRETE

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SECTION 03 1113**STRUCTURAL CAST-IN-PLACE CONCRETE FORMING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Design, construction, and safety of formwork.
 - 2. Furnish and install required formwork ready for placing of concrete.
 - 3. Strip and dispose of formwork.
- B. Related Requirements:
 - 1. Section 03 3111: 'Cast-In-Place Structural Concrete' for:
 - a. Tolerances for placing structural concrete.
 - b. Pre-installation conference held jointly with other concrete related sections.

1.2 REFERENCES

- A. Reference Standards:
 - 1. American Concrete Institute:
 - a. ACI 318-14, 'Building Code Requirements for Structural Concrete and Commentary'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in pre-installation conference as specified in Section 03 3111.
 - 2. In addition to agenda items specified in Section 01 3100 and 31 3111, review following:
 - a. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
 - 1) Review requirements and frequency of testing and inspections.
- B. Scheduling:
 - 1. Notify Testing Agency and Architect as directed in Section 03 3111.

1.4 SUBMITTALS

- A. Informational Submittals:
 - 1. Manufacturer Instructions:
 - a. Printed application instructions for form release agents.

PART 2 - PRODUCTS**2.1 COMPONENTS**

- A. Forms: Wood, metal, or plastic as arranged by Contractor:
 - 1. Forming material shall be compatible with specified form release agents and with finish requirements for concrete to be left exposed or to receive a smooth rubbed finish.

2.2 ACCESSORIES

- A. Form Release Agents:
 - 1. Unexposed Surfaces Only: Contractor's option.

- B. Form Release / Finish Agent:
 - 1. Vertical, Exposed Surfaces or Unexposed Surfaces:
 - a. Chemically acting type.
 - b. Type Two Acceptable Products.
 - 1) Crete-Lease 727 or 20-VOC by Cresset Chemical Co, Weston, OH www.cresset.com.
 - 2) Clean Strip (J-1 or J-3 VOC) by Dayton Superior Specialty Chemicals, Kansas City, KS www.daytonsuperiorchemical.com.
 - 3) E-Z Strip or DEBOND Form Coating by L & M Construction Chemicals, Omaha, NE www.lmcc.com.
 - 4) Q-2 by Unitex, Kansas City, MO www.unitex-chemicals.com.
 - 5) U S Spec Slickote by U S Mix Products Co www.usspec.com.
 - 6) Duogard or Duogard II by W R Meadows, Elgin, IL www.wrmeadows.com.
 - 7) Equal as approved by Architect before use. See Section 01 6200.

- C. Expansion / Contraction Joints:
 - 1. 1/2 inch (13 mm) thick.
 - 2. Manufactured commercial fiber type:
 - a. Meet requirements of ASTM D1751.
 - b. Type Two Acceptable Products:
 - 1) Conflex by Knight-Celotex, Northfield, IL www.aknightcompany.com.
 - 2) Sealtight by W R Meadows Inc, Hampshire, IL www.wrmeadows.com.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.
 - 3. Recycled Vinyl:
 - a. Light gray color.
 - b. Type Two Acceptable Products:
 - 1) Proflex by Oscoda Plastics Inc, Oscoda, MI www.oscodaplastics.com.
 - 2) Equal as approved by Architect before Installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Forms:
 - 1. Assemble forms so forms are sufficiently tight to prevent leakage.
 - 2. Properly brace and tie forms.
 - 3. Make proper form adjustments before, during, and after concreting.
 - 4. Use new forms, or used forms that have been cleaned of loose concrete and other debris from previous concreting and repaired to proper condition. Use APA Plyform B-B Class I, or APA HDO Plyform B-B Class I, on exposed to view concrete that do not receive a smooth rubbed finish.
 - 5. Use metal cold joint forms when unable to place concrete for footings, foundations, and slabs in continuous pours.

- B. Accessories:
 - 1. General:
 - a. Provide for installation of inserts, templates, fastening devices, sleeves, and other accessories to be set in concrete before placing.
 - b. Position anchor bolts for hold-down anchors and columns and securely tie in place before placing concrete.
 - 2. Form Release / Finish Agents:
 - a. Film thickness shall be no thicker than as recommended by Manufacturer.
 - b. Allow no release / finish agent on reinforcing steel or footings.
 - 3. Expansion Joints:

- a. Install at joints between floor slab and foundation wall where shown on Drawings.
- C. Form Removal (Slab on Grade):
1. Removal of forms can usually be accomplished in twelve (12) to twenty-four (24) hours.
 2. If temperature is below 50 deg F (10 deg C) or if concrete (stairs, beams, etc) depends on forms for structural support, leave forms intact for sufficient period for concrete to reach adequate strength.
 3. For exposed to view surfaces that receive a smooth rubbed finish, remove forms while concrete is still "green".
 4. Metal bars or prys should not be used. Use wood wedges, tapping gradually when necessary.

3.2 FIELD QUALITY CONTROL

- A. Field Tests And Inspections:
1. Concrete Formwork:
 - a. Inspections are not required and will be performed at discretion of Architect.

END OF SECTION

SECTION 03 1511**CONCRETE ANCHORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Furnished But Not Installed Under This Section:
 - 1. Cast-in place and post-installed concrete anchors including:
 - a. Adhesive anchors for concrete.
 - b. Expansion anchors for concrete.
 - c. Screw anchors for concrete.
 - d. Concrete anchors and inserts not specified elsewhere.
 - 2. Installer responsible when inspection results of concrete anchors require corrective actions.
- B. Related Requirements:
 - 1. Section 01 1200: 'Multiple Contract Summary' for Owner Furnished Testing and Inspecting Services.
 - 2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
 - 3. Section 03 3111: 'Cast-In-Place Structural Concrete' for installation and inspection of cast-in-place anchors.

1.2 REFERENCES

- A. Reference Standards:
 - 1. American Concrete Institute:
 - a. ACI 355.4-11, 'Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary'.
 - b. ACI 548.12-12, 'Specification for Bonding Hardened Concrete and Steel to Hardened Concrete with an Epoxy Adhesive'.
 - 2. American National Standards Institute / American Welding Society (Following are specifically referenced for Structural Steel testing):
 - a. ANSI/AWS D1.1/D1.1M:2015, 'Structural Welding Code - Steel'.
 - 3. ASTM International:
 - a. ASTM A307-14, 'Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength'.
 - b. ASTM A563-15, 'Standard Specification for Carbon and Alloy Steel Nuts'.
 - c. ASTM A706/A706M-16, 'Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement'.
 - d. ASTM F1554-18, 'Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength'.
 - e. ASTM F3125/F3125-15a, 'Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions'.
 - 4. International Code Council (IBC) (2018 or most recent edition adopted by AHJ):
 - a. IBC Chapter 17, 'Structural Tests and Special Inspections'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling:
 - 1. Inspection shall be performed according IBC requirements.

2. Notify Testing Agency and Architect one week before installing anchors so inspection may be scheduled.

1.4 SUBMITTALS

- A. Action Submittals:
 1. Product Data:
 - a. Manufacturer's product literature for each item.
- B. Informational Submittals:
 1. Certificates:
 - a. Adhesive Anchors:
 - 1) Installer to provide current ACI/CRSI certification to Architect prior to installation of anchors.
 2. Test And Evaluation Reports:
 - a. Provide ESR for products used indicating conformance with current applicable ESR Acceptance Criteria.
 3. Manufacturer's Instructions:
 - a. Manufacturer's published installation recommendations for each item.
 4. Qualification Statements:
 - a. All concrete anchors except Adhesive Anchors:
 - 1) Installer to provide record of installer installation training showing dates and those trained for all installed products when required when by Architect.
- C. Closeout Submittals:
 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Testing and Inspection Reports:
 - a) Testing Agency inspection reports of all inspected anchors.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 2. Installer:
 - a. Acceptable to Manufacturer, experienced in performing work of this section and has specialized in installation of work similar to that required for this project.
 - b. Adhesive Anchors:
 - 1) Adhesive Anchors installed in horizontal to vertical overhead orientation to support sustained tension loads shall be installed by Certified Adhesive Anchor Installer (AAI) as certified through ACI/CRSI:
 - a) Refer to most current version of ACI 318 for certification requirements.
 - b) Proof of current certification shall be submitted to the Architect for approval prior to commencement of installation.
 - c. All other Concrete Anchors:
 - 1) Arrange for manufacturer's field representative to provide installation training for all products to be used, prior to commencement of work:
 - a) Provide installation training when required by Architect.
- B. Field Inspection:
 1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
 2. Owner will provide Inspection for post-installed concrete anchors:

- a. Owner will employ testing agency to perform inspection for post-installed concrete anchors as specified in Field Quality Control in Part 3 of this specification:
 - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
 - 2) See Section 01 1200: 'Multiple Contract Summary'.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:

1. Store materials protected from exposure to harmful weather conditions and as directed by Manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Anchors:

1. General:
 - a. Use hot-dipped galvanized or stainless steel with matching nuts and washers in exterior and moist interior applications unless indicated otherwise on Contract Drawings.
 - b. Nut: Conform to requirements of ASTM A563, Grade A, Hex.
 - c. Conform to requirements of ASTM F3125/F3125 for chemical, physical and mechanical requirements for quenched and tempered bolts manufactured from steel and alloy steel.
2. Threaded rod for adhesive anchors and cast-in anchors:
 - a. Conform to requirements of ASTM A307, Grade A or ASTM F1554 Grade 36 unless indicated otherwise on Contract Drawings.
3. Cast-In-Place Anchor Bolts:
 - a. J-Bolts:
 - 1) Non-headed type threaded 2 inches (50 mm) minimum conforming to requirements of ASTM F1554, Grade A.
 - 2) Anchor hook to project 2 inches (50 mm) minimum including bolt diameter.
 - b. Headed Bolts:
 - 1) Headed type threaded 2 inches (50 mm) minimum conforming to requirements of ASTM F1554, Grade A.
4. Reinforcing Bars:
 - a. Composed of deformed carbon steel meeting requirements of ASTM A615/A615M, Grade 60.
5. Adhesive Anchors:
 - a. Products shall have current ESR conforming to current ICC Acceptance Criteria AC308 for concrete.
 - b. Rod diameter and embedment length as indicated on Contract Drawings.
 - c. Type Two Acceptable Products:
 - 1) HIT-RE 500V3 with SafeSet Epoxy Adhesive by Hilti Fastening Systems, Tulsa, OK www.us.hilti.com.
 - 2) Pure 110+ by Powers Fasteners Inc., Brewster NY www.powers.com.
 - 3) SET-XP Epoxy by Simpson Strong-Tie Co., Pleasanton, CA www.simpsonanchors.com.
 - 4) Equal as approved by Architect before installation. See Section 01 6200.
6. Expansion Anchors:
 - a. Products shall have current ESR conforming to current ICC Acceptance Criteria AC193 for concrete.

- b. Type Two Acceptable Products:
 - 1) KWIK Bolt TZ Expansion Anchor by Hilti Fastening Systems, Tulsa, OK
www.us.hilti.com.
 - 2) Power-Stud +SD2 by Powers Fasteners Inc., Brewster NY www.powers.com.
 - 3) Strong-Bolt by Simpson Strong-Tie Co., Pleasanton, CA www.simpsonanchors.com.
 - 4) Equal as approved by Architect before installation. See Section 01 6200.
- 7. Screw Anchors:
 - a. Provide anchors with length identification markings conforming to ICC Acceptance Criteria AC 193 for concrete.
 - b. Type Two Acceptable Products:
 - 1) KWIK HUS-EZ by Hilti Fastening Systems, Tulsa, OK www.us.hilti.com.
 - 2) Wedge-Bolt+ by Powers Fasteners Inc., Brewster NY www.powers.com.
 - 3) Titen HD by Simpson Strong Tie Co, Pleasanton, CA www.simpsonanchors.com.
 - 4) Equals as approved by Architect through shop drawing submittal before installation.
See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification Of Conditions:
 - 1. Embedded Items:
 - a. Identify position of reinforcing steel and other embedded items before drilling holes for anchors:
 - 1) Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items.
 - 2) Take precautions as necessary to avoid damaging pre-stressing tendons, electrical and telecommunications conduit, and gas lines.
 - b. Notify Engineer if reinforcing steel or other embedded items are encountered during drilling.
 - 2. Base Material Strength:
 - a. Unless otherwise specified, do not drill holes in concrete until:
 - 1) Concrete has minimum age of 21 days at time of anchor installation.
 - 2) Concrete has achieved full design strength for load achievement.

3.2 PREPARATION

- A. Surface Preparation:
 - 1. Clean surfaces prior to installation.
 - 2. Prepare surface in accordance with Manufacturer's written recommendations.

3.3 INSTALLATION

- A. Post-Installed Anchors:
 - 1. General:
 - a. Drill holes with rotary impact hammer drills using carbide-tipped bits.
 - b. Unless otherwise shown on Drawings, drill holes perpendicular to concrete surface.
 - c. Perform anchor installation in accordance with Manufacturer's published instructions.
 - 2. Adhesive Anchors:
 - a. Clean holes in accordance with Manufacturer's published instructions before installation of adhesive:
 - 1) Follow Manufacturer's recommendations to ensure proper mixing of adhesive components.
 - b. Adhesive:

- 1) Inject adhesive into holes proceeding from bottom of hole and progressing toward surface so as to avoid introduction of air pockets into adhesive.
- 2) Inject sufficient adhesive into hole to ensure that annular gap is filled to surface.
- 3) Remove excess adhesive from surface and threads of anchor as necessary.
- c. Shim anchors with suitable device to center anchor in hole. Do not disturb or load anchors before Manufacturer's specified cure time has elapsed.
- d. Temperature:
 - 1) Observe Manufacturer's recommendations with respect to installation temperatures for adhesive anchors.
 - 2) Base material temperatures must be maintained above minimum temperatures allowed by Manufacturer for full required epoxy cure time.
3. Expansion Anchors:
 - a. Protect threads from damage during anchor installation and prior to use.
 - b. Set anchors to Manufacturer's recommended torque, using a torque wrench. Following attainment of ten (10) percent of specified torque, one hundred (100) percent of specified torque shall be reached within 7 or fewer complete turns of nut. If specified torque is not achieved within required number of turns, remove and replace anchor, unless otherwise directed by Architect.
4. Screw Anchors:
 - a. Protect threads from damage during anchor installation and prior to use.
 - b. Set anchor flush, collared.
 - c. Do not exceed Manufacturer's maximum allowed torque when seating anchor.

3.4 FIELD QUALITY CONTROL

A. Field And Inspections:

1. Civil and structural field inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
 - a. Quality Control is sole responsibility of Contractor.
 - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
 - a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
 2. Expansion Anchors / Adhesive Anchors / Screw Anchors:
 - a. Certified Inspector from Testing Agency shall verify procedures used for installation of all concrete anchors and monitor their installation for compliance with Manufacturer's requirements.
 - b. Inspections:
 - 1) Inspections shall include required verification and inspection of anchors as referenced in IBC Table 1704.4 and in accordance with most current version of ACI 318 or ACI 318M and applicable ASTM material standards that:
 - a) The correct rod/anchor is used; size and type.
 - b) The correct hole size is used and prepared per Manufacturer's instructions.
 - c) That climactic conditions, and concrete temperature, allow for the anchors' installation and use.
 - d) Proper hole cleaning equipment, per Manufacturer's instructions, is used.
 - e) Torque applied to anchors does not exceed Manufacturer's allowable limits.
 - f) Torque applied to anchors is per Manufacturer's instructions.

B. Non-Conforming Work:

1. Contractor is to immediately notify Architect of incorrectly placed, misplaced or malfunctioning anchors and request instructions for corrective actions.

3.5 CLEANING

A. Waste Management:

1. Disposal of rubbish, debris, and packaging materials.

3.6 PROTECTION

A. General:

1. Protect installed products from damage during construction.

END OF SECTION

SECTION 03 2116**EPOXY - COATED REINFORCEMENT STEEL BARS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install epoxy coated reinforcement steel bars as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 01 1200: 'Multiple Contract Summary' for Owner Furnished Testing and Inspecting Services.
 - 2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
 - 3. Section 03 1113: 'Structural Cast-In-Place Concrete Forming'.
 - 4. Section 03 3111: 'Cast-In-Place Structural Concrete' for:
 - a. Reinforcement installed in concrete.
 - b. Pre-installation conference held jointly with other concrete related sections.

1.2 REFERENCES

- A. Association Publications:
 - 1. American Concrete Institute:
 - a. ACI 'Detailing Manual' (2004 Edition).
 - 2. Concrete Reinforcing Steel Institute (CRSI):
 - a. CRSI, 'Manual of Standard Practice' (2009 28th Edition).
- B. Reference Standards:
 - 1. American Concrete Institute:
 - a. ACI 117-10: 'Specifications for Tolerances for Concrete Construction and Materials and Commentary' (Reapproved 2015).
 - b. ACI 318-14, 'Building Code Requirements for Structural Concrete and Commentary'.
 - 2. ASTM International (Following are specifically referenced for reinforcement bars testing):
 - a. ASTM A615/A615M-18, 'Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement'.
 - b. ASTM A775/A775M-17, 'Standard Specification for Epoxy-Coated Reinforcing Bars'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conferences:
 - 1. Participate in pre-installation conference as specified in Section 03 3111.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Reinforcing placement drawings.
- B. Informational Submittals:
 - 1. Certificates:
 - a. Mill certificates certifying mill tests for reinforcing in accordance with ASTM A775/A775M.
 - 1) Mill test is to be approved before fabrication begins.

1.5 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Comply with provisions of following codes and standards except where more stringent requirements are shown or specified:
 - a. American Concrete Institute:
 - 1) ACI 318, 'Building Code Requirements for Structural Concrete and Commentary'.
 - b. Concrete Reinforcing Steel Institute:
 - 1) CRSI, 'Manual of Standard Practice'.
- B. Qualifications:
 - 1. Throughout progress of the work of this section, provide at least one (1) person who shall be thoroughly familiar with Construction Documents and other applicable specified requirements, completely trained and experienced in necessary skills, and who shall be present at site and shall direct all work performed under this Section:
 - a. In actual installation of the work of this Section, use adequate numbers of skilled workmen to ensure installation in strict accordance with approved design.
 - b. In acceptance or rejection of work performed under this Section, no allowance will be made for lack of skill on part of workmen.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Deliver bars separated by size and tagged with manufacturer's heat or test identification number.
 - 2. Reinforcement steel bars shall be free of abrasions or other penetrations of epoxy-coating at time of delivery and placing.
- B. Storage And Handling Requirements:
 - 1. Properly protect rebar on site after delivery.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Epoxy Coated Reinforcement Steel Bars:
 - 1. Bars shall have grade identification marks and conform to ASTM A615/A615M with coating conforming to ASTM A775/A775M and comply with requirements of ACI 318.21.2.5:
 - a. Bar supports shall be completely coated with epoxy or vinyl, compatible with both concrete and epoxy coating on bars. Coating shall be at least 1/8 inch thick at tips.
 - b. Tie wire shall be nylon coated.
 - 2. Actual yield strength based on mill tests does not exceed specified yield strength by more than 18,000 psi and Ratio of actual ultimate stress (at breaking point) to actual tensile yield stress shall not be less than 1.25.
 - a. Grade 60 minimum, except dowels that are to be field bent, Grade 40 minimum.
 - 3. Bars shall be deformed type.
 - 4. Bars shall be free of heavy rust scales and flakes, or other bond-reducing coatings.

2.2 FABRICATION

- A. Fabricate reinforcement bars according to the Concrete Reinforcing Steel Institute (CRSI) 'Manual of Standard Practice' and details on Contract Documents.

PART 3 - EXECUTION**3.1 INSTALLATION****A. General:**

1. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
2. Blowtorch shall not be used to facilitate field cutting or bending or any other reinforcing work.
3. Reinforcement shall not be bent after partially embedded in hardened concrete.

B. Placing Reinforcement:

1. Comply with Concrete Reinforcing Steel Institute CRSI 'Manual of Standard Practice' recommended practice for 'Placing Reinforcing Bars' for details and methods of reinforcement placement and supports. and as herein specified.
2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations:
 - a. Locate and support reinforcing by chairs, runners, bolsters, bar supports, spacers, or hangers, as required as recommended by 'ACI Detailing Manual, except slab on grade work.
 - b. Support bars in slabs on grade and footings with specified bar supports around perimeter and at 4-1/2 feet on center each way maximum to maintain specified concrete cover.
 - c. Install bar supports at bar intersections.
3. Bend bars cold.
4. Dowel vertical reinforcement for formed concrete columns or walls out of footing or structure below with rebar of same size and spacing required above.
5. Securely anchor and tie reinforcement bars and dowels before placing concrete. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

C. Splices:

1. Non-Concrete Structural System:
 - a. Avoid splices of reinforcement bars at points of maximum stress. Lap bars 60 bar diameters minimum unless dimensioned otherwise on Drawings. Run reinforcement bars continuous through cold joints.
2. Concrete Structural System:
 - a. In beams, slabs, and walls, avoid splices of reinforcement bars at points of maximum stress.
 - b. Lap bars as follows:
 - 1) Compression Splices: 45 bar diameters minimum.
 - 2) Tension Splices: In accordance with ACI 318 Class B requirements.
 - 3) No splice shall be less than 20 inches (508 mm).
 - 4) For epoxy coated rebar, increase lap-splice lengths by 1.5 times those listed above.
 - c. In columns, splices in vertical bars are permitted only at floor levels or points of lateral support and shall consist of 45 bar diameter laps.
 - d. Run reinforcement bars continuous through cold joints.

D. Tolerances:

1. Provide following minimum concrete cover for reinforcement as per ACI 318 or ACI 318M. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations:
 - a. Concrete cast against and permanently exposed to earth:
 - 1) Exterior Slabs on Grade (where shown): 2 inches (50 mm).
 - 2) Sections other than Slabs: 3 inches (75 mm).
 - b. Concrete Exposed to Earth or Weather:
 - 1) No. 6 and Larger Bars: 2 inches (50 mm).
 - 2) No. 5 and Smaller Bars, W31 and D31 Wire: 1-1/2 inches (38 mm).

END OF SECTION

SECTION 03 3111**CAST-IN-PLACE STRUCTURAL CONCRETE****PART 1 - GENERAL****1.1 SUMMARY****A. Includes But Not Limited To:**

1. Furnish and install concrete work as described in Contract Documents including:
 - a. Quality of concrete used on Project but furnished under other Sections.
 - b. Concrete mix information and use of admixtures.
 - c. Field Quality Control Testing and Inspection requirements for concrete.
 - d. Pre-installation conference held jointly with other concrete related sections.
 - e. Sealants and curing compounds used with concrete.
 - f. Compact aggregate base for miscellaneous cast-in-place concrete.
 - g. Miscellaneous cast-in-place concrete and equipment pads.

B. Products Installed But Not Furnished Under This Section:

1. Concrete accessories.
2. Membrane Concrete Curing.

C. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary' for Owner Furnished Testing and Inspecting Services.
2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
3. Section 03 1113: 'Structural Cast-In-Place Concrete Forming'.
4. Section 03 1511: 'Concrete Anchors and Inserts'.
5. Section 03 2116: 'Epoxy-Coated Reinforcement Steel Bars'.
6. Section 03 3517: 'Concrete Sealer Finishing' for application of concrete sealers.
7. Section 03 3923: 'Membrane Concrete Curing' for quality of curing materials used.
8. Section 07 9213: 'Elastomeric Joint Sealant' for quality of sealants.
9. Section 31 0501: 'Common Earthwork Requirements' for:
 - a. General procedures and requirements for earthwork.
 - b. Pre-installation conference held jointly with other common earthwork related sections.
10. Section 31 1123: 'Aggregate Base' for aggregate base under miscellaneous cast-in-place concrete and exterior slabs, and asphalt paving.
11. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
12. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
13. Section 31 2323: 'Fill' for compaction procedures and tolerances.
14. Section 32 8423: 'Underground Sprinklers' for sleeves for underground irrigation system.
15. Section 32 9121: 'Topsoil Grading' for grading of subgrade below topsoil.
16. Divisions 22, 23, And 26: Mechanical and electrical devices including boxes, conduits, pipes, hangers, inserts, and other work to be embedded in concrete work before placing.
17. Furnishing of items to be embedded in concrete specified in Section involved.
18. Owner will provide concrete leveling compounds and patching compounds required for carpet installation.

1.2 REFERENCES**A. Association Publications:**

1. American Concrete Institute, Farmington Hills, MI www.concrete.org. Abstracts of ACI Periodicals and Publications.

- a. ACI 117.1R-14: 'Guide for Tolerance Compatibility in Concrete Construction'.
 - b. Certifications:
 - 1) ACI CP-1(16), 'Technical Workbook for ACI Certification of Concrete Field Testing Technician-Grade 1'.
 - 2) ACI CP-10(10), 'Craftsman Workbook for ACI Certification of Concrete Flatwork Technician/Finisher'.
 - 3) ACI CP-19(16), 'Technical Workbook for ACI Certification of Concrete Strength Testing Technician'.
- B. Definitions:
1. Cold Weather, as referred to in this Section, is four (4) hours with ambient temperature below 40 deg F (4.4 deg C) in twenty-four (24) hour period.
 2. Floor Flatness (F_F): Rate of change in elevation of floor over 12 inches (305 mm) section.
 3. Floor Levelness (F_L): Measures difference in elevation between two points which are 10 feet (3.05 m) apart.
 4. Hot Weather, as referred to in this Section, is ambient air temperature above 100 deg F (38 deg C) or ambient air temperature above 90 deg F (32 deg C) with wind velocity 8 mph (12.9 kph) or greater.
- C. Reference Standards:
1. American Association of State and Highway Transportation Officials:
 - a. AASHTO M 153-06 (2016), 'Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction'.
 2. American Concrete Institute
 - a. ACI 117-10 (R2015): 'Specifications for Tolerances for Concrete Construction and Materials and Commentary'.
 - b. ACI 305.1-14, 'Specification for Hot Weather Concreting'.
 - c. ACI 306.1-90 (R2002), 'Standard Specification for Cold Weather Concreting'.
 - d. ACI 318-14, 'Building Code Requirements for Structural Concrete' (ACI 318) and 'Commentary on Building Code Requirements for Structural Concrete' (ACI 318R).
 3. ASTM International:
 - a. ASTM C31/C31M-19, 'Standard Practice for Making and Curing Concrete Test Specimens in the Field'.
 - b. ASTM C33/C33M-18, 'Standard Specification for Concrete Aggregates'.
 - c. ASTM C39/C39M-18, 'Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens'.
 - d. ASTM C94/C94M-17a, 'Standard Specification for Ready-Mixed Concrete'.
 - e. ASTM C140/C140M-18a, 'Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units'.
 - f. ASTM C143/C143M-15a, 'Standard Test Method for Slump of Hydraulic-Cement Concrete'.
 - g. ASTM C150/C150M-18, 'Standard Specification for Portland Cement'.
 - h. ASTM C172/C172M-17, 'Standard Practice for Sampling Freshly Mixed Concrete'.
 - i. ASTM C173/C173M-16, 'Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method'.
 - j. ASTM C192/C192M-18, 'Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory'.
 - k. ASTM C231/C231M-17a, 'Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method'.
 - l. ASTM C260/C260M-10a(2016), 'Standard Specification for Air-Entraining Admixtures for Concrete'.
 - m. ASTM C330/C330M-17a, 'Standard Specification for Lightweight Aggregates for Structural Concrete'.
 - n. ASTM C494/C494M-17, 'Standard Specification for Chemical Admixtures for Concrete'.
 - o. ASTM C496/C496M-17, 'Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens'.
 - p. ASTM C567/C567M-14, 'Standard Test Method for Determining Density of Structural Lightweight Concrete'.
 - q. ASTM C595/C595M-18, 'Standard Specification for Blended Hydraulic Cements'.
 - r. ASTM C618-19, 'Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete'.

- s. ASTM C1077-17, 'Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation'.
 - t. ASTM C1157/C1157M-17, 'Standard Performance Specification for Hydraulic Cement'.
 - u. ASTM D1751-18, 'Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)'.
 - v. ASTM E329-18: 'Standard Specification for Agencies Engaged in Construction Inspection and/or Testing'.
 - w. ASTM E1155-14, 'Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers'.
4. International Code Council (IBC) (2018 or latest approved edition):
- a. IBC Chapter 17, 'Special Inspections And Tests'.
 - 1) Section 1704, 'Special Inspections And Tests, Contractor Responsibility And Structural Observations'.
 - 2) Section 1705, 'Required Special Inspection And Tests'.
 - a) Section 1705.2, 'Steel Construction'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in MANDATORY pre-installation conference as specified in Section 01 3100 and held jointly with following sections:
 - a. Section 03 1113: 'Structural Cast-In-Place Concrete Forming'.
 - b. Section 03 2116: 'Epoxy-Coated Reinforcement Steel Bars'.
2. Schedule pre-installation conference prior to placing of footings, installation of foundation forms and reinforcing steel, and installation of anchors, dowels, inserts, and block outs in foundation walls and slabs.
3. In addition to agenda items specified in Section 01 3100, review following:
 - a. Set up concrete placement pour card system and verify that all relevant trades have signed off prior to concrete placement.
 - b. Obtaining trade sign-offs on each pour card will be responsibility of General Contactor's foreman or whoever is in charge of ordering concrete.
 - c. Pour cards will be turned in to Quality Assurance representative after the work has been completed so that they can be reviewed and filed.
 - d. Review installation scheduling, coordination, placement of building concrete, and placement of items installed in and under concrete.
 - e. Review installation scheduling, coordination and placement of site concrete and of items installed in concrete.
 - f. Review 'Verification of Conditions' requirements.
 - g. Review requirements for preparation of subgrade and aggregate base requirements.
 - h. Review formwork requirements.
 - i. Review approved mix design requirements, mix designs and use of admixtures.
 - j. Review reinforcing bar submittals.
 - k. Review installation schedule and placement of reinforcing bars.
 - l. Review placement, finishing, and curing of concrete, including cold and hot weather requirements.
 - m. Review joint layout plan for control and expansion joints, fillers for sidewalks, curbs, and gutters:
 - 1) Review jointing requirements.
 - 2) Joint layout for concrete paving is specified in Section 32 1313.
 - n. Review smooth rubbed concrete finish procedures and requirements (applied immediately after removing concrete formwork while concrete is 'green').
 - o. Review concrete slab tolerances and corrective measures if tolerances not met.
 - p. Review safety issues.
 - q. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
 - 1) Review requirements and frequency of testing and inspections.

B. Scheduling:

1. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing concrete.

1.4 SUBMITTALS

- A. Action Submittals:
1. Joint layout plan for control and expansion joints for sidewalks, curbs, and gutters for written approval before starting work on this Section.
 2. Shop Drawings:
 - a. Show dimensioned locations of anchor bolts for hold-down anchors and columns.
 - b. Show reinforcement and all necessary bending diagrams and reinforcing steel list, and construction joint locations.
 - c. Provide bar schedules and bending details.
 - d. Reinforced concrete walls shall be shown in scale elevation (scale at least one quarter inch to one foot). Details shall be in accordance with ACI rules.
 - e. Show all formwork for concrete surfaces which are to remain exposed in the finished work.
- B. Informational Submittals:
1. Certificates:
 - a. Installers:
 - 1) Certification for National Ready Mixed Concrete Association (NRMCA).
 - 2) Certification for ACI-certified Flatwork Finishers and Technicians.
 2. Design Data:
 - a. Mix Design:
 - 1) Furnish proposed mix design to Architect for review prior to commencement of Work.
 - a) Include density (unit weight) and void content determined per ASTM C1688/C1688M for fresh mixed properties and per ASTM C140/C140M for hardened concrete properties.
 - b) Mix design shall show proposed admixture, amount, usage instructions, and justification for proposed use.
 - b. Ready-Mix Supplier:
 - 1) Require mix plant to furnish delivery ticket for each batch of concrete. Keep delivery tickets at job-site for use of Owner or his representatives. Tickets shall show following:
 - a) Name of ready-mix batch plant.
 - b) Serial number of ticket.
 - c) Date and truck number.
 - d) Name of Contractor.
 - e) Name and location of Project.
 - f) Specific class or designation of concrete conforming to that used in Contract Documents.
 - g) Amount of concrete.
 - h) Amount and type of cement.
 - i) Total water content allowed by mix design.
 - j) Amount of water added at plant.
 - k) Sizes and weights of sand and aggregate.
 - l) Time loaded.
 - m) Type, name, manufacturer, and amount of admixtures used.
 - n) Design Data.
 - 2) Provide certificates with supporting testing reports verifying compliance with Contract Document requirements and that materials provided are from single source for following:
 - a) Cement.
 - b) Aggregate.
 - c) Fly Ash.
 3. Source Quality Control Submittals:
 - a. Concrete mix design: Submit mix designs to meet following requirements:
 - 1) Mix Type A:
 - a) General purpose concrete type mix used for footings and for exterior concrete (excluding concrete paving) where not subject to freeze/thaw cycles and deicing or where higher strength is needed due to soil conditions.
 - b) 3000 psi (20.68 MPa) minimum at twenty-eight (28) days.
 - c) Water / Cementitious Material: 0.45 to 0.50 by weight.
 - 2) Mix Type E:

- a) Exterior concrete exposed to freeze/thaw cycles and deicing salts or where soils are 'corrosive'.
 - b) 4500 psi (31.03 MPa) minimum at twenty-eight (28) days.
 - c) Water / Cementitious Material: 0.40 maximum by weight.
 - d) Use twenty-five (25) percent Class F fly ash as part of cementitious material.
 - e) Mix Type E should be used for all exterior concrete exposed to freeze/thaw cycles and deicing salts, unless dictated otherwise by site conditions.
 - f) For concrete paving, use mix design based upon use of 1-1/2 inches (38 mm) coarse aggregate (about 15 percent).
- 3) Air Entrainment: Six (6) percent, plus or minus 1-1/2 percent for exterior concrete and foundation walls exposed to freeze/thaw cycles.
- 4) Do not add water any time during mixing cycle above amount required to meet specified water / cement ratio. No reduction in amount of cementitious material is allowed.
- b. Slump:
- 1) 4 inch (100 mm) slump maximum before addition of high range water reducer.
 - 2) 8 inch (200 mm) slump maximum with use of high range water reducer.
 - 3) Slump not required for Mix Type G.
- c. Admixtures:
- 1) Mix design shall show proposed admixture, amount, usage instructions, and justification for proposed use. Do not use any admixture without Architect's written approval.
 - 2) Fly ash: Amount of specified Class F (or Class C where Class F is not available) fly ash not to exceed twenty-five (25) percent of weight of cementations materials may used.
 - 3) Chemical:
 - a) Specified accelerator or retarder may be used if necessary to meet environmental conditions.
- C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Pour Reports:
 - a) Provide report that records following information:
 - b) Date and time of start of pour, Date and time of end of pour, and Date and time of end of finishing procedures.
 - c) Temperature at start of pour, Temperature at end of Pour, and Maximum temperature during performance of finishing procedures.
 - d) Wind speed at start of pour, Wind speed at end of pour, and Maximum wind speed during performance of finishing procedures.
 - e) Humidity at start of pour, Humidity at end of pour, and High and low humidity during performance of finishing procedures.
 - f) Cloud cover at start of pour, Cloud cover at end of pour, and High and low cloud cover during performance of finishing procedures.
 - g) Screeding method and equipment used.
 - h) Saw cut method and equipment used.
 - 2) Testing and Inspection Reports:
 - a) Testing Agency Testing and Inspecting Reports of concrete.
 - 3) Warranty. Submit rapid concrete drying or MVRA manufacturer warranties for concrete moisture vapor emission induced flooring failure and adhesion; ensure both have been completed in project's name and registered with manufacturer.
 - a) Provide warranty to cover cost of flooring failures due to moisture migration from slabs for life of concrete. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
 - b) Provide stand-alone adhesion warranty matching duration of flooring adhesive or primer manufacturer's material defect warranty.

1.5 QUALITY ASSURANCE

- A. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
1. Installers and Installation Supervisor:

- a. ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
2. Ready-Mix Supplier:
 - a. Comply with ASTM C94/C94M requirements and be certified according to NRMCA's 'Certification of Ready Mixed Concrete Production Facilities'.
3. Testing Agencies:
 - a. Independent agency qualified according to ASTM C1077 and ASTM E329.
 - 1) Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technicians, Grade I according to ACI CP-1 or equivalent certification program.
 - 2) Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be ACI-certified Concrete Laboratory Testing Technician - Grade II.
- B. Testing And Inspection:
 1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
 2. Owner will provide Testing and Inspection on concrete:
 - a. Owner will employ testing agencies to perform testing and inspection on concrete as specified in Field Quality Control in Part 3 of this specification:
 - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
 - 2) See Section 01 1200: 'Multiple Contract Summary'.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 1. Expansion Joint Filler Material:
 - a. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage And Handling Requirements:
 1. Expansion Joint Filler Material:
 - a. Store materials in a clean, dry area in accordance with manufacturer's instructions.
 - b. Protect materials during handling and application to prevent damage.

PART 2 - PRODUCTS

2.1 SYSTEM

- A. Manufacturers:
 1. Manufacturer Contact List:
 - a. Aridus Admixture by US Concrete, Eules, TX www.us-concrete.com/aridus/.
 - b. BASF (Construction Chemicals Division), Cleveland, OH www.master-builders-solutions.basf.us/en-us.
 - c. Bonsal American, Charlotte, NC www.bonsal.com.
 - d. Concure Systems Admixture by Concure Systems, Phoenix, AZ www.ConcureSystems.com.
 - e. Dayton Superior Specialty Chemicals, Kansas City, KS www.daytonsuperiorchemical.com.
 - f. Euclid Chemical Company, Cleveland, OH www.euclidchemical.com.
 - g. Fritz-Pak Concrete Admixtures, Dallas, TX www.fritzpak.com.
 - h. GCP Applied Technologies, Cambridge, MA www.gcpat.com/construction/en-us.
 - i. ISE Logik Industries, Gulfport, MS www.iselogik.com.
 - j. Kryton International Inc., Vancouver, British Columbia, Canada www.kryton.com.
 - k. L & M Construction Chemicals, Omaha, NE www.lmcc.com.

- l. Larsen Weldcrete by Larsen Products Corp, Rockville, MD www.larsenproducts.com.
 - m. Sika Corporation, Lyndhurst, NJ www.sikaconstruction.com and Sika Canada, Pointe Claire, QC www.sika.ca.
 - n. Unitex, Kansas City, MO www.unitex-chemicals.com.
 - o. U S Mix Products Co, Denver, CO www.usspec.com.
 - p. W R Meadows, Hampshire, IL www.wrmeadows.com.
- B. Performance:
- 1. Design Criteria: Conform to requirements of ASTM C94/C94M unless specified otherwise:
 - 2. Capacities:
 - a. For testing purposes, following concrete strengths are required:
 - 1) At 7 days: 70 percent minimum of 28 day strengths.
 - 2) At 28 days: 100 percent minimum of 28 day strengths.
- C. Materials:
- 1. Hydraulic Cement: Meet requirements of ASTM C150/C150M, Type I or IA.
 - 2. Aggregates:
 - a. General:
 - 1) Submit a letter on quarry's letterhead that certifies all aggregate for concrete complies with the requirements of this section. Material certificates which are submitted shall be signed by both the materials producer and the contractor, certifying that materials comply with or exceed requirements specified herein to the Architect, Civil and Structural Engineering Consultant and the Independent Testing Laboratory for review and approval.
 - 2) Aggregates for all concrete shall come from a quarry that is DOT approved and meets or exceeds durability Class I aggregate. The quarry shall submit a letter to Engineer that certifies that all aggregate complies with DOT requirements for durability. Aggregate not meeting DOT durability requirements shall not be used.
 - b. Coarse:
 - 1) Meet requirements of ASTM C33/C33M or nonconforming aggregate that by test or actual service produces concrete of required strength and conforms to local governing codes.
 - 2) Aggregate shall be uniformly graded by weight.
 - c. Fine:
 - 1) Meet requirements of ASTM C33/C33M.
 - 2) Aggregate shall be uniformly graded by weight.
 - 3. Water: Clear, apparently clean, and potable.
 - 4. Admixtures And Miscellaneous:
 - a. Fly Ash:
 - 1) Meet requirements of ASTM C618, Class F (or Class C where Class F is not available) and with loss on ignition (LOI) of three (3) percent maximum.
 - b. Chemical:
 - 1) No admixture shall contain calcium chloride nor shall calcium chloride be used as an admixture. All chemical admixtures used shall be from same manufacturer and compatible with each other.
 - 2) Air Entraining Admixture:
 - a) Meet requirements of ASTM C260/C260M.
 - b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
 - 3) Water Reducing Admixture:
 - a) Meet requirements of ASTM C494/C494M, Type A and containing not more than 0.05 percent chloride ions.
 - b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
 - 4) Water Reducing, Retarding Admixture:
 - a) Meet requirements of ASTM C494/C494M, Type D and contain not more than 0.05 percent chloride ions.
 - b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
 - 5) High Range Water Reducing Admixture (Superplasticizer):

- a) Meet requirements of ASTM C494/C494M, Type F or G and containing not more than 0.05 percent chloride ions.
- b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
- 6) Non-Chloride, Non-Corrosive Accelerating Admixture:
 - a) Meet requirements of ASTM C494/C494M, Type C or E and containing not more than 0.05 percent chloride ions.
 - b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
- 7) Corrosion Inhibiting Admixture:
 - a) Liquid admixture to inhibit corrosion of steel reinforcement in concrete by introducing proper amount of anodic inhibitor. Admixture shall contain thirty (30) percent calcium nitrite solution and shall be used where called for in specifications or on drawings.
 - b) Type Two Acceptable Products:
 - (1) Eucon CIA by Euclid.
 - (2) DCI or DCI-S by GCP Applied Technologies.
 - (3) Equal as approved by Architect before use. See Section 01 6200.
- 8) Alkali-Silica Reactivity Inhibiting Admixture:
 - a) Specially formulated lithium nitrate admixture for prevention of alkali-silica reactivity (ASR) in concrete. Admixture must have test data indicating conformance to ASTM C1293.
 - b) Type Two Acceptable Products:
 - (1) Eucon Integral ARC by Euclid.
 - (2) RASIR by W R Grace.
 - (3) Equal as approved by Architect before use. See Section 01 6200.
- 9) Viscosity Modifying Admixture (VMA):
 - a) Liquid admixture used to optimize viscosity of Self-Consolidating Concrete (SCC). Subject to compliance with requirements, provide following at dosage rates per manufacturer's recommendation.
 - b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
- 10) Shrinkage Reducing Admixture (SRA):
 - a) Liquid admixture specifically designed to reduce drying shrinkage and potential for cracking.
 - b) Type Two Acceptable Products:
 - (1) Equal as approved by Architect before use. See Section 01 6200.
- 11) Moisture Vapor Reduction Admixture (MVRA):
 - a) Liquid, inorganic, ASTM C494/C494M Type S Admixture free of volatile organic compounds (VOCs); specifically formulated to close capillary systems formed during concrete placement and to reduce moisture vapor emission and transmission with no adverse effect on concrete properties or finish flooring.
 - b) Type Two Acceptable Products:
 - (1) MVRA 900 by ISE Logik Industries: www.iselogik.com.
 - (2) Concure Systems Admixture by Concure Systems, Phoenix, AZ www.ConcureSystems.com.
 - (3) Equal as approved by Architect before use. See Section 01 6200.
- 12) Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties:
 - a) Functioning by growth of crystals in capillary pores.
 - b) Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 200 feet of head; provide test reports.
 - c) Type Two Acceptable Products:
 - (1) CWPA 800 by ISE Logik Industries: www.iselogik.com.
 - (2) Krystol Internal Membrane (KIM) by Kryton: www.kryton.com.
 - (3) Equal as approved by Architect before use. See Section 01 6200.

2.2 ACCESSORIES

- A. Formwork:
 - 1. Meet requirements specified in Section 03 1113:

- B. Bonding Agents:
 - 1. Type Two Acceptable Products:
 - a. Acrylic Additive by Bonsal American.
 - b. Day Chem Ad Bond (J-40) by Dayton Superior.
 - c. Flex-Con by Euclid Chemical Co.
 - d. Larsen Weldcrete by Larsen Products Corp.
 - e. Everbond by L & M Construction Chemicals.
 - f. MasterEmaco A 660 (formally Acryl 60) by BASF.
 - g. U S Spec Multicoat by U S Mix Products.
 - h. Intralok by W R Meadows.
 - i. Equal as approved by Architect before use. See Section 01 6200.

- C. Expansion Joint Filler:
 - 1. Expansion Joint Filler Material:
 - a. Design Criteria:
 - 1) Resilient, flexible, non-extruding, expansion-contraction joint filler meeting requirements of ASTM D1751.
 - 2) 1/2 inch (12.7 mm) thick.
 - 3) Resilience:
 - a) When compressed to half of original thickness, recover to minimum of seventy (70) percent of original thickness.
 - b. Type Two Acceptable Products:
 - 1) Fiber Expansion Joint by W R Meadows, Hampshire, IL www.wrmeadows.com.
 - 2) Equal as approved by Architect before installation. See Section 01 6200.

- D. Finishing Material (Exposed Vertical Faces of Foundation and Retaining Walls):
 - 1. Finishing Material available in multiple concrete shades to closely match concrete surface.
 - 2. Type Two Acceptable Products:
 - a. Mixture of 1 part cement (using same cement as used in concrete foundations), 1 part sand with 95 percent passing #50 sieve.
 - b. RapidSet WunderFixx by CTS Cement Manufacturing Corporation, Cypress, CA www.rapidset.com.
 - c. Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification Of Conditions:
 - 1. Concrete Forms:
 - a. Verify dimensions and spot elevations for locations of forms for concrete footings, stem walls, curbs, gutters, walkways, and drainage systems are correct before concrete is placed.
 - 1) Notify Architect of incorrect dimensions or spot elevations in writing.
 - 2) Do not place concrete until corrections are made and verified.

3.2 PREPARATION

- A. Concrete Mixing:
 - 1. General:
 - a. All concrete shall be machine mixed.

- b. Water gauge shall be provided to deliver exact predetermined amount of water for each batch.
 - c. Reliable system must be employed to insure that no less than predetermined amount of cement goes into each batch.
 - d. Re-tempering partly set concrete will not be permitted.
2. Transit Mix:
- a. Transit mix concrete may be used provided it conforms to Specifications and tests herein described and ASTM C94/C94M.
 - b. Central plant producing concrete and equipment transporting it are suitable for production and transportation of controlled concrete and plant is currently approved by local state DOT.
 - c. Maximum elapsed time between time of introduction of water and placing shall be one (1) hour.
 - d. Minimum time of mixing shall be one (1) minute per cubic yard after all material, including water, has been placed in drum, and drum shall be reversed for an additional two (2) minutes.
 - e. Mixing water shall be added only in presence of Inspecting Engineer or inspector employed by Testing Agency.
 - f. Trucks shall not be overloaded in excess of rated capacity as recommended by manufacturer.
3. Cold Weather Concreting Procedures:
- a. General Requirements:
 - 1) Materials and equipment required for heating and protection of concrete shall be approved and available at Project site before beginning cold weather concreting.
 - 2) Forms, reinforcement, metallic embedments, and fillers shall be free from snow, ice, and frost. Surfaces that will be in contact with newly placed concrete, including sub-grade materials, shall be 35 deg F (2 deg C) minimum at time of concrete placement.
 - 3) Thaw sub-grade 6 inches (150 mm) deep minimum before beginning concrete placement. If necessary, re-compact thawed material.
 - 4) Use no frozen materials or materials containing ice.
 - 5) See ACI 306.1 'Standard Specification for Cold Weather Concreting' for additional requirements.
4. Hot Weather Concreting Procedures:
- a. General:
 - 1) Maximum concrete temperature allowed is 90 deg F (32 deg C) in hot weather.
 - 2) Cool aggregate and subgrades by sprinkling.
 - 3) Avoid cement over 140 deg F (60 deg C).
 - 4) Use cold mixing water or ice.
 - 5) Use fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.
 - 6) See ACI 305.1 'Specification for Hot Weather Concreting' for additional requirements.
- B. Surface Preparation:
1. Earthwork Preparation:
 - a. Aggregate base and subgrade:
 - 1) Prepare aggregate base as specified in Section 31 1123.
 - 2) Prepare natural soil subgrade as specified in Section 31 2213.
 - 3) Prepare fill subgrade as specified in Section 31 2323.
- C. Removal:
1. Remove water and debris from space to be placed:

3.3 INSTALLATION

- A. Placing Concrete:
1. General:
 - a. Place as soon after mixing as possible.
 - b. Deposit as nearly as possible in final position.
 - c. No concrete shall be deposited in water.
 - d. Placing of concrete shall be continuous until panel or section is complete.

- e. Compact concrete in forms by vibrating and other means where required.
 - 1) Thoroughly consolidate concrete around reinforcing bars (Consolidation not required in concrete around reinforcing bars with Mix Type G).
 - 2) Use and type of vibrators shall conform to ACI 309.
- f. Form vertical surfaces full depth. Do not allow concrete to flow out from under forms in any degree into landscaped areas.
- g. Consolidate concrete thoroughly.
- h. Do not embed aluminum in concrete.
- i. Do not use contaminated, deteriorated, or re-tempered concrete.
- j. Avoid accumulation of hardened concrete.
- k. Dusting with cement not permitted.
- 2. Footings:
 - a. Bear 12 inches (300 mm) minimum into undisturbed earth or on mechanically compacted engineered fill. Step footings at ratio of 1-1/2 horizontal to One vertical unless detailed otherwise. Exterior footing shall bear 30 inches minimum below finish grades.
 - b. Level top of finish footing and leave rough.
 - c. Where joints are required, bulkhead, key horizontally, and dowel with two No. 5 reinforcing bars, 48 inches (1 200 mm) long.
- 3. Exterior Slabs:
 - a. For continuous placing and where shown on Drawings, saw cut one inch (25 mm) deep control joints before shrinkage occurs (2 inches at 6 inch slabs) (50 mm at 150 mm slabs).
- 4. Miscellaneous Concrete Elements:
 - a. Equipment Bases: Coordinate with appropriate Sections for locations and dimensions.
 - b. Mow Strips, and Aprons:
 - 1) Install bond breaker consisting of three (3) layers of 30 lb (13.6 kg) roofing felt between pole base and adjoining sidewalk, mow strip and building foundations, and aprons and building foundations.
 - c. Mow Strips and Aprons:
 - 1) Aggregate base not necessary under mow strips and aprons.
 - 2) Form and cast mow strips in place.
 - 3) Set top of mow strip above finish grade as follows:
 - a) Sodded Areas: 2 inches (50 mm) below.
 - b) Seeded Areas: One inch (25 mm) below.
 - c) Ground Cover Areas: 2 inches (50 mm) below.
 - d) Trees and Shrub Areas (not individual trees): 4 inches (100 mm) below.
 - 4) Compact topsoil underneath mow strips and aprons to density of undisturbed earth.
 - d. Pipe Bollards:
 - 1) Install plumb and fill with concrete.
 - e. Sidewalks, Exterior Stairs, And Landings:
 - 1) Slope with cross slope of 1/8 to 1/4 inch per ft (3 to 6 mm per 300 mm) (one to two percent) in direction of intended drainage.
 - 2) Slope away from building 1/8 to 1/4 inch per ft (3 to 6 mm per 300 mm) (one to two percent) minimum.
 - 3) Concrete walks shall be screeded to bring surface to grades and lines as indicated. Surface shall be floated with wood float with no coarse aggregate showing and then given broom finish before concrete sets.
- 5. Joints:
 - a. Control Joints (Contraction Joints):
 - 1) Form control joints with early-entry, dry-cut saws as soon as final trowel operations are complete, and joints can be cut without raveling.
 - 2) Depth of control joints shall be approximately one quarter of concrete slab thickness, but not less than one inch (25 mm).
 - 3) Control joints to be hand tooled in sidewalks, curbs and gutters, mow strips, and aprons.
 - 4) Table One:

Concrete Control Joint On-Center Spacing (+/-)		
Sidewalks	4 feet to 6 feet	1.2 meters to 1.8 meters
Curbs and Gutters	10 feet	3.0 meters

Mow Strips	3 feet to 5 feet	0.90 meters to 1.50 meters
Flat Drainage Structures	10 feet	3 meters
Retaining Walls w/guardrails	Align with posts	
Retaining Walls w/chain link fencing	Align with posts	

b. Expansion Joints:

- 1) Expansion joints in Concrete Paving are specified in Section 32 1313.
- 2) Install so top of expansion joint material is 1/4 inch (6 mm) below finished surface of concrete.
- 3) No expansion joint required between curbs and sidewalks parallel to curb.
- 4) Provide expansion joints at ends of exterior site concrete elements that are perpendicular to and terminate at curbs, building foundations or other concrete elements (i.e. sidewalks, mow strips, aprons).
- 5) Provide expansion joints between sidewalks that are parallel, and adjacent, to storage building or main building.
- 6) Provide expansion joints around perimeter of concrete slab on grade at mechanical enclosure, around perimeter of slab on grade at dumpster enclosure and at top and bottom of exterior stairs.
- 7) Table Two:

Concrete Expansion Joint (Isolation) On-Center Spacing (+/-)		
Sidewalks, Curbs and Gutters	40 feet to 100 feet	12 meters to 30 meters
Mow Strips and Aprons	20 feet to 40 feet	6 meters to 12 meters
Flat Drainage Structures	50 feet	15 meters
Retaining Walls w/guardrails	36 feet	11 meters
Retaining Walls w/chain link fencing	50 feet	15 meters

- 8) Seal expansion joints as specified in Section 07 9213 for following areas:
 - a) Between entryway slabs and building foundations.
 - b) Between sidewalks and building foundations.
 - c) Concrete retaining walls.
 - d) Within curbs and gutters.
 - e) Within flat drainage structures and at joints between flat drainage structures and other concrete elements.
- 9) Expansion joints are not required to be sealed for following areas:
 - a) Within aprons and where apron abuts sidewalks.
 - b) Within mow strips and where mow strip abuts building foundation and sidewalks.
 - c) Within sidewalks.
6. Bonding Fresh And Hardened Concrete:
 - a. Re-tighten forms.
 - b. Roughen surfaces.
 - c. Clean off foreign matter and laitance.
 - d. Wet but do not saturate.
 - e. Slush with neat cement grout or apply bonding agent.
 - f. Proceed with placing new concrete.
7. Anchor Bolts:
 - a. Place anchor bolts not tied to reinforcing steel immediately following leveling of concrete. Reconsolidate concrete around bolt immediately after placing bolt.
 - b. Do not disturb bolts during finishing process.

B. Finishing:

1. Exterior Concrete Flatwork:
 - a. Curb, Gutter, Sidewalks, Mow Strips, Flat Drainage Structures, Stairs, And Miscellaneous:
 - 1) After completion of final floating, performed immediately after screeding and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 - a) Provide fine hair finish where grades are less than 6 percent 1-1/4 inch (32 mm).
 - b) Provide rough hair finish where grades exceed 6 percent 1-1/4 inch (32 mm).

- c) Broom finish, by drawing broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide fine line texture acceptable to Architect. At curb and gutter, apply broom finish longitudinal to curb and gutter flowline.
 - d) On inclined slab surfaces, provide coarse, non-slip finish by scoring surface with stiff-bristled broom, perpendicular to line of traffic. At curb and gutter, apply broom finish longitudinal to curb and gutter flowline.
 - e) Do not remove forms for twenty-four (24) hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.
 - f) Round edges exposed to public view to 1/2 inch (13 mm) radius, including edges formed by expansion joints.
 - g) Remove edger marks.
2. Vertical Surfaces (Exposed To View Vertical Surfaces, Exposed Retaining Walls, Exposed Foundation Walls, Concrete Piers, and etc.):
- a. General:
 - 1) Chamfer lines shall be finished.
 - b. Surface Preparation:
 - 1) Formwork shall be stripped from concrete while concrete is still 'green'.
 - 2) Concrete surface to be finished immediately after formwork has been removed.
 - a) Immediately after removing forms, remove joints, marks, bellies, projections, loose materials and other irregularities, and cut back metal ties from surfaces to be exposed.
 - b) Repair defective areas and voids or stone pockets with Finishing Material and smooth to even surface matching surrounding undamaged area.
 - c. Smooth Rubbed Finish:
 - 1) Thoroughly wet with water, apply Finishing Material in thin layer, rub in circular motion to smooth uniform finish.
 - 2) Entire surface shall be protected from rapid drying for not less than three (3) days.
 - 3) Surfaces shall be cleaned of drip marks and discolorations.
 - 4) Concrete surface shall be left with clean, neat, uniform finish, free from form markings and shall be uniform in color and texture.
- C. Curing:
- 1. Membrane Concrete Curing:
 - a. As specified in Section 09 3923 'Membrane Concrete Curing'.
 - b. Follow Manufacturer's written instructions for preparation, application rates, placement, and cleanup:
 - 1) Apply as soon as brooming or finishing of exterior concrete is complete.
 - 2) Spraying application is required.
 - 3) Do not dilute or thin product.
 - 4) Do not apply when temperature of concrete is less than 40 deg F (4.4 deg C).
 - 5) Apply uniformly without puddles or ponding.
 - 6) Do not apply before bleed water has dissipated.
 - 7) Do not apply over standing water.
- D. Exterior Concrete Sealer:
- 1. Exterior Concrete Sealer:
 - a. Exterior concrete placed after about September 1 and located in areas of freeze/thaw cycles and deicing salts are to be sealed per Section 03 3517 'Exterior Concrete Sealer'.
 - b. Apply product as specified in Section 03 3517.
- E. Tolerances:
- 1. General:
 - a. Tolerances shall conform to requirements of ACI 117 or CSA A23.1/A23.2, except where specified differently.
 - b. Maximum Variation Tolerances:
 - 1) Table Three:

Maximum Variation Tolerances		
Thickness, standard	plus 3/8 inch, minus 1/4 inch	plus 9.5 mm, minus 3 mm
Thickness, footings	minus 0 inch	minus 0 mm
Plan, 0 - 20 feet	1/2 inch	12.7 mm
Plan, 40 feet or greater	3/4 inch	19 mm
Plan, footings	plus 1/2 inch	plus 12.7 mm
Eccentricity, footings	2 inch maximum standard, 1/2 inch at masonry	50 mm maximum standard, 12.7 mm at masonry
Openings, size	minus 1/4 inch, plus one inch	minus 6 mm, plus 25.4 mm
Openings, location	plus / minus 1/2 inch at center	plus / minus 12.7 mm at center
Plumb	1/2 inch maximum	12.7 mm maximum
Consecutive Steps, treads	1/4 inch	6 mm
Consecutive Steps, risers	1/8 inch	3 mm
Flight of Stairs, treads	1/4 inch in total run	6 mm in total run
Flight of Stairs, risers	1/8 inch in total height	3 mm in total height

3.4 FIELD QUALITY CONTROL

A. Field Tests And Inspections:

1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
 - a. Quality Control is sole responsibility of Contractor:
 - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
 - a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
2. Concrete:
 - a. Testing Agency shall provide testing and inspection for concrete as per ASTM C1077.
 - b. Testing and inspections, if performed, will include following:
 - 1) Periodic inspection verifying use of required design mix.
 - 2) Inspection of reinforcing bars and anchor bolts before placement of concrete for proper installation.
 - 3) Inspection at time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine temperature of concrete.
 - 4) Inspection of concrete placement for proper application techniques.
 - a) Steel tools are not to be used on exterior concrete.
 - 5) Periodic inspection for maintenance of specified curing temperature and techniques:
 - a) Steel tools are not to be used on exterior concrete. Bull floating and finish floating is to be performed with magnesium or wood floats.
 - 6) Periodic inspect of formwork for shape, location and dimensions of concrete member being formed:
 - a) Certified Inspector shall inspect forms for general location, configuration, camber, shoring, sealing of form joints, correct forming material, concrete accessories, and form tie locations.
 - 7) Periodic inspection of concrete finishing operations for proper finishing techniques.
 - 8) Periodic inspection for placement of specified curing compounds.
 - c. Testing Agency will sample and test during placement of concrete as directed by Architect and may include following:
 - 1) Sampling Fresh Concrete: ASTM C172/C172M, except modified for slump to comply with ASTM C94/C94M:
 - a) Slump: ASTM C143/C143M, test each time set of compressive specimens are made.
 - b) Air Content: ASTM C173/C173M, volumetric method for lightweight or normal weight concrete: ASTM C231/C231M, pressure method for normal weight concrete each time set of compression test specimens are made.

- c) Concrete Temperature: Test each time set of compressive specimens are made.
 - d) Unit Weight: ASTM C567/C567M, test each time set of compressive specimens are made.
 - d. Compression Test Specimen: ASTM C31/C31M, one (1) set of four (4) standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - e. Compressive Strength Tests: ASTM C39/C39M:
 - 1) Obtain one (1) composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd (4 cu m), but less than 50 cu. yd (38 cu m), plus one (1) set for each additional 50 cu. yd (38 cu m) or fraction thereof.
 - 2) One (1) specimen tested at seven (7) days, two (2) specimens tested at twenty-eight (28) days, and one (1) specimen retained in reserve for later testing if required.
 - 3) If strength of field-cured cylinders is less than eighty-five (85) percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.
 - 4) Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi (3.45 MPa).
 - f. Samples:
 - 1) Fresh Concrete: ASTM C172/C172M except modified for slump to comply with ASTM C94/C94M.
 - a) Slump: ASTM C143/C43M, test each time set of compressive specimens are made.
 - b) Air Content: ASTM C173/C173M, volumetric method for lightweight or normal weight concrete: ASTM C231/C231M, pressure method for normal weight.
 - c) Concrete Temperature: Test each time set of compressive specimens are made.
 - d) Unit Weight: ASTM C567/C567M, test each time set of compressive specimens are made.
- B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
1. Correct any work found defective or not complying with contract document requirements at no additional cost to the Owner.

3.5 CLEANING

- A. General:
 1. Curing:
 - a. Clean tools, equipment as directed by Manufacturer's instructions.

3.6 PROTECTION

- A. Concrete:
 1. Protect concrete that has not received its initial set from precipitation to avoid excess water in mix and unsatisfactory surface finish.
- B. Curing:
 1. Restrict foot or vehicle traffic as curing membrane dries as recommended by Manufacturer.

END OF SECTION

SECTION 03 3517**CONCRETE SEALER FINISHING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install Concrete Sealer on concrete surfaces as described in Contract Documents including:
 - a. Concrete sealers are used on new exterior concrete surfaces exposed to freeze/thaw cycles and deicing salts.
- B. Related Requirements:
 - 1. Section 03 3111: 'Cast-In-Place Structural Concrete' for concrete mix information and use admixtures.
 - 2. Section 03 3923: 'Membrane Concrete Curing for curing application.
 - 3. Section 07 9213: 'Elastomeric Joint Sealant' for quality of sealants'.

1.2 REFERENCES

- A. Definitions:
 - 1. Concrete Sealers: As used in this specification, are sealers applied to concrete surfaces to protect from surface damage, corrosion, and staining. Sealers either block pores in concrete to reduce absorption of water and salts or form impermeable layer which prevents such materials from passing. Concrete sealer, when selected and applied properly, will prevent intrusion of water and deicers, minimizing freeze/thaw damage.
- B. Reference Standards:
 - 1. American Association of State and Highway Transportation Officials:
 - a. AASHTO T 259-02(2012), 'Standard Method of Test for Resistance of Concrete to Chloride Ion'.
 - b. AASHTO T 260-97(2011), 'Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials'.
 - 2. ASTM International:
 - a. ASTM C672/C672M-12 'Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals'.
 - 3. German Institute for Standardization (DIN Standards):
 - a. DIN EN 1504-2, 'Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 2: Surface protection systems for concrete (2005).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference: Schedule pre-installation conference for same time as application of mockup application.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Concrete Sealer:
 - 1) Manufacturer's product literature or cut-sheets for specified products.

2) Manufacturer's LEED product literature for specified products.

- B. Informational Submittals:
1. Manufacturer Instructions:
 - a. Concrete Sealer: Written preparation and application instructions.
 2. Source Quality Control Submittals:
 - a. Provide protection plan of surrounding areas and non-work surfaces if requested by Architect/Owner's Representative.
 3. Qualification Statements:
 - a. Applicator: Provide qualification documentation.

1.5 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
1. Comply with applicable VOC standards and other local requirements.
- B. Qualifications:
1. Applicator:
 - a. Applicator shall be acceptable to Manufacturer as applicator of its product.
 - b. Minimum five (5) satisfactorily completed installations of comparable quality, scope, similar size, and complexity in past two (2) years before bidding. Include contact information of person with oversight of each project.
 - c. Provide qualification documentation.
- C. Mockup:
1. Required for all projects. Scheduled as per pre-installation conference.
 2. Mockup shall be representative of work to be expected.
 3. Mockup will be used to judge workmanship, concrete substrate preparation, operation of equipment, material application.
 4. Square footage or size of mock up is between Architect/Owner's Representative and Concrete Sealer Applicator. Consider between 10 sq ft to 20 sq ft (0.93 to 1.86 sq m) for small projects and 100 sq ft to 200 sq ft (9.3 to 18.6 sq m) for larger areas.
 5. Provide as many field mockups required to verify selections made under submittals and to demonstrate effects of concrete sealer. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically approved by Architect/Owner's Representative in writing.
 6. Install mockup in accordance with specification using same materials, staff and equipment.
 7. Use same personnel that will be doing project, including Supervisor.
 8. Approvals should be based on:
 - a. Compliance with approved submittals.
 9. Approval from Architect/Owner's Representative is required BEFORE starting work on Project.
 10. Allow twenty four (24) hours for inspection of mockup before proceeding with work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.
- B. Storage And Handling Requirements:
1. Follow Manufacturer's written instructions for handling and storage of product:
 - a. Store in unopened containers in clean, dry area between 35 deg F (2 deg C) and 110 deg F (43 deg C) or as directed by Manufacturer's instruction.

1.7 FIELD CONDITIONS

- A. Ambient Conditions:

1. Concrete Sealer:
 - a. Follow printed Manufacturer's instruction for environmental hazards:
 - b. Follow printed Manufacturer's instruction for ambient conditions for application of product including:
 - 1) Minimum and maximum application temperatures.
 - 2) Application precautions when rain is expected.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Exterior Concrete Sealer:
 1. Description:
 - a. Concrete sealer that protects new and existing exterior concrete from freeze/thaw cycles and deicing salts.
 2. Design Criteria:
 - a. General:
 - 1) Penetrating water repellent silane or linseed oil/mineral spirit concrete sealers are to be used.
 - 2) Siloxanes are not to be used to replace silane or linseed oil/mineral spirits sealers.
 - b. Linseed Oil/Mineral Spirits Sealers:
 - 1) Protects concrete from freeze/thaw cycles and deicing salts.
 - 2) Resists penetration of water and deicing salts.
 - c. Silane Based Sealers:
 - 1) Protects concrete from freeze/thaw cycles and deicing salts.
 - 2) Resists penetration of water and deicing salts.
 - 3) 100 percent silane active ingredient content.
 - 4) Penetrating sealer.
 - 5) Water repellent.
 - 6) Clear (colorless, non-yellowing). Surface appearance after application: unchanged.
 3. Limitations:
 - a. VOC:
 - 1) If Low VOC product are required or desired, use only those products listed as 'Low VOC' in acceptable products below.
 4. Type One Acceptable Products. See Section 01 6200 for definition of Categories. Applicator Option:
 - a. Linseed Oil/Mineral Spirits Sealers:
 - 1) Anti Spall J33 Concrete Sealer by Dayton Superior Corporation, Miamisburg, OH www.daytonsuperior.com.
 - a) Low VOC.
 - 2) Equal product meeting design criteria requirements as approved by Architect/Owner's Representative before BID. See Section 01 6200.
 - b. Silane Based Sealers:
 - 1) MasterProtect H 1000 by BASF, Cleveland, OH www.master-builders-solutions.basf.us.
 - a) Low VOC.
 - 2) Weather Worker J29A by Dayton Superior Corporation, Miamisburg. OH www.daytonsuperior.com.
 - 3) Baracade Silane 100 by Euclid, Cleveland, OH www.euclidchemical.com.
 - a) Low VOC.
 - 4) Sikagard 705L by Sika Corporation, Lyndhurst, NJ www.usa.sika.com.
 - a) Low VOC.
 - 5) TK-590-100 by TK Products, Minnetonka, MN www.tkproducts.com.
 - 6) Equal product meeting design criteria requirements as approved by Architect/Owner's Representative before BID. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification Of Conditions:
 - 1. Verify concrete has properly cured.

3.2 PREPARATION

- A. Surface Preparation:
 - 1. Concrete Sealer:
 - a. Take necessary precautions to protect adjoining property.
 - b. Do not contaminate any body of water by direct application, cleaning of equipment or disposal of wastes.
 - 2. Cleaning:
 - a. Clean concrete surface of membrane curing and all dirt, mud spots, silt spots, loose material, vegetation, oil spots, and other objectionable and foreign material.
 - b. Remove debris, sand, dirt, and dust from concrete surface.
 - c. Power brooms, power blowers, air compressors, water flushing equipment, and blowers are acceptable equipment for cleaning concrete surface.

3.3 PREPARATION

- A. Surface Preparation:
 - 1. Grease or Oil Patches:
 - a. Remove grease or oil patches, and spillage of any material that has adhered to concrete surface.
 - 2. Cracks, Control Joints and Expansion Joints:
 - a. Remove weed and other live vegetation matter from concrete cracks (if any) and joints:
 - 1) Remove with wire wheel on crack cleaner/edger.
 - b. Repair concrete cracks and joints if required using sealant as specified in Section 07 9213.
 - 3. Cleaning:
 - a. Clean concrete surface of all dirt, mud spots, silt spots, loose material, vegetation, oil spots, and other objectionable and foreign material.
 - b. Remove debris, sand, dirt, and dust from concrete surface.
 - c. Power brooms, power blowers, air compressors, water flushing equipment, and blowers are acceptable equipment for cleaning concrete surface.
 - d. Concrete surface is to be dry, clean and sound.
 - 4. Inspect concrete surface. Repeat any steps if necessary.

3.4 APPLICATION

- A. Concrete Sealer:
 - 1. General:
 - a. Apply concrete sealer after surface preparation has been completed as per Manufacturer's recommendations.
 - b. Follow Manufacturer's ambient conditions for minimum and maximum application temperatures and application precautions when rain is expected.
 - c. Stir material thoroughly before and during application if required by Manufacturer.
 - d. Do not apply sealer if standing water is visible on concrete surface to be treated.
 - e. Apply even distribution of sealer.
 - f. Do NOT over apply. All product should penetrate substrate with no surface build-up. Any excess or puddles of material must be removed.
 - 2. Apply Concrete Sealer:
 - a. Linseed Oil/Mineral Spirits Sealers:

- 1) For maximum protection, apply onto concrete surface before it is exposed to deicing salts.
 - 2) Do not apply in temperatures below 40 deg F (4.4 deg C).
 - 3) Apply first coat at 1 gallon (3.785 liters) per 350 sq ft (32.5 sq m).
 - 4) When first coat is dry to touch, apply second coat at 1 gallon (3.785 liters) per 600 sq ft (55.7 sq m).
 - 5) When second coat is totally dry, surface is ready for traffic.
 - 6) Texture and absorption of surface will influence final coverage rates.
 - 7) This application will turn concrete to dark amber color.
- b. Silane Based Sealers:
- 1) Apply at rate of about 1 gallon (3.785 liters) per 300 sq ft (27.8 sq meters) or as per Manufacturer's recommendations depending upon absorbency of concrete surface.
3. Allow Concrete Sealer to dry as per Manufacturer's recommendations.

3.5 CLEANING

A. General:

1. Clean tools, equipment and spills as directed by Manufacturer's instructions.
2. Clean drips and over spray while still wet.

B. Waste Management:

1. Concrete Sealers:
 - a. Follow Manufacturer's recommendations for approved disposal of product and containers.
 - 1) Do not reuse empty containers.

END OF SECTION

SECTION 03 3923**MEMBRANE CONCRETE CURING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Furnished But Not Installed Under This Section:
 - 1. Quality of membrane concrete curing as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 03 3111: 'Cast-In-Place Structural Concrete' for application of membrane concrete curing.
 - 2. Section 03 3517: 'Concrete Sealer-Finishing' for application of concrete sealer.

1.2 REFERENCES

- A. Definitions:
 - 1. Curing: Process by which hydraulic-cement concrete matures and develops hardened properties, over time, as result of continued hydration of cement in presence of sufficient water and heat. Also used to describe action taken to maintain moisture and temperature conditions in freshly placed concrete.
- B. Reference Standards:
 - 1. American Association of State and Highway Transportation Officials:
 - a. AASHTO M 148-05, 'Standard Specification for Liquid Membrane-Forming Compounds for Curing'.
 - 2. ASTM International:
 - a. ASTM C309-11, 'Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete'.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's product data.
 - b. Material Safety Data Sheets (MSDS).
- B. Informational Submittals:
 - 1. Manufacturer Instructions:
 - a. Printed installation instructions.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Comply with applicable VOC standards and other local requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:

1. Follow Manufacturer's written instructions for handling and storage of product:
 - a. Store in unopened containers in clean, dry area between 35 deg F (2 deg C) and 110 deg F (43 deg C) (Keep from freezing) or as directed by Manufacturer's instruction.
2. Shelf Life: Do not use curing compound that is over one (1) year from manufacturer date.

1.6 FIELD CONDITIONS**A. Ambient Conditions:**

1. Do not apply curing compound when temperature of concrete is less than 40 deg F (4.4 deg C).

PART 2 - PRODUCTS**2.1 MATERIALS****A. Membrane Concrete Curing:**

1. Description:
 - a. Clear water-based, ready-to use membrane curing agent that cures freshly placed concrete, forming effective barrier against moisture loss from concrete surface.
2. Design Criteria:
 - a. Exterior Concrete:
 - 1) Dissipating or non-dissipating membrane curing agent.
 - b. Interior Concrete:
 - 1) Dissipating membrane curing agent only.
 - c. VOC-compliant compound.
 - d. Meet requirements of ASTM C309 and AASHTO M 148, Type 1 or 1-D, Class B.
 - e. Interior concrete: containing no mineral spirits, naphtha, or other components detrimental to finish flooring installation.
 - f. Maintain ninety-five (95) percent of mix water present in concrete mass after application.
 - g. Gradually dissipate after twenty-eight (28) days without leaving stain or discoloring concrete surface.
3. Horizontal and Vertical Cast-In-Place Structural Concrete:
 - a. Type One Acceptable Products:
 - 1) Exterior Concrete:
 - a) Clear Cure J7WB by Dayton Superior Corporation, Miamisburg. OH www.daytonsuperior.com.
 - b) Clear Water Resin by Right Point, Dekalb, IL www.rightpointe.com.
 - c) L&M Cure R by L&M Construction Chemicals, Inc. Omaha, NE www.lmcc.com.
 - d) VOCOMP 20 (do not use when concrete sealer will be applied in areas of freeze/thaw and deicer salts) by W.R. Meadows, Inc. Hampshire, IL www.wrmeadows.com.
 - e) 1100-Clear by W. R. Meadows, Inc. Hampshire, IL www.wrmeadows.com.
 - 2) Interior Concrete:
 - a) Clear Cure J7WB by Dayton Superior Corporation, Miamisburg. OH www.daytonsuperior.com.
 - b) Clear Water Resin by Right Point, Dekalb, IL www.rightpointe.com.
 - c) L&M Cure R by L&M Construction Chemicals, Inc. Omaha, NE www.lmcc.com.
 - d) 1100-Clear by W. R. Meadows, Inc. Hampshire, IL www.wrmeadows.com.
 - b. Equal product meeting design criteria requirements as approved by Architect/Owner's Representative before BID. See Section 01 6200.

PART 3 - EXECUTION: Not Used**END OF SECTION**

SECTION 03 4800**PRECAST CONCRETE SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install decorative precast concrete site fence/wall as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 07 9213: 'Elastomeric Joint Sealants'.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A615/A615M-18, 'Standard Specification for Deformed and Plain Steel Bars for Concrete Reinforcement'.
 - b. ASTM A1064/A1064M-18a, 'Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete'.
 - c. ASTM C33/C33M-18, 'Standard Specification for Concrete Aggregates'.
 - d. ASTM C150/C150M-18, 'Standard Specification for Portland Cement'.
 - e. ASTM C260/C260M-10a(2016), 'Standard Specification for Air-Entraining Admixtures for Concrete'.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer product literature for each type of product indicated.
 - 2. Shop Drawings:
 - a. Precast concrete elements:
 - 1) Detail fabrication and installation of architectural precast concrete units.
 - 2) Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
 - 3) Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
 - a) Indicate separate face and backup mixture locations and thicknesses.
 - 4) Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 5) Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
 - 6) Include plans and elevations showing unit location and sequence of erection for special conditions.
 - 7) Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
 - 8) Indicate relationship of architectural precast concrete units to adjacent materials.
 - 9) Indicate locations and details of stone facings, anchors, and joint widths.
- B. Informational Submittals:
 - 1. Certificates:

- a. Precast concrete elements:
 - 1) Material Certificates: For the following items, signed by manufacturers:
 - a) Admixtures.
 - b) Bearing pads.
 - c) Brick units and accessories.
 - d) Cementitious materials.
 - e) Reinforcing materials.
2. Design Submittals:
 - a. Precast concrete elements:
 - 1) Design Modifications:
 - a) If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings.
 - b) Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
3. Test And Evaluation Reports:
 - a. Material Test Reports:
 - 1) Precast concrete units:
 - a) Aggregates.
4. Source Quality Control Submittals.
 - a. Precast concrete units:
 - 1) Control test reports.
 - 2) Precast Concrete mix design: Submit compressive strength and water-absorption tests for each precast concrete mix design.
5. Field Quality Control Submittals:
 - a. Precast concrete units:
 - 1) Provide special inspection reports.
6. Qualification Statements:
 - a. Precast concrete units:
 - 1) Installer and Fabricator:
 - a) Letter certifying level of training and experience of Installer and Fabricator.
7. Precast Concrete Wall Shop Drawings:
 - 1) Base shop drawings on requirements of contract documents.
 - 2) Shop drawings shall bear stamp and signature of Structural Engineer responsible for design and preparation of shop drawings. Engineer shall be licensed in the State of Utah. Design wall to withstand 3-second gust 120 mph Exposure C wind (Occupancy Category II) and IBC 2018 Seismic requirements. Plain concrete wall panels will not be permitted. Panel reinforcing will be required maximum spacing 3 times the wall thickness or 18" each way. Wall footing to be a minimum of 24 inch diameter and 6 feet deep with reinforcement to meet load capacity requirement.
 - 3) Submit color samples of pre-cast concrete.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 1. Check, carefully unload, and deliver material to site in such manner as to avoid soiling and damaging.
- B. Storage And Handling Requirements:
 1. Store material on planks clear of ground and protect from damage.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Materials:
 1. Design Criteria:

- a. Precast Concrete:
 - 1) Air Entrainment: Wet cast mixture maintains 5 to 7 percent air entrainment where surfaces are exposed to freeze-thaw. Admixture conforms to ASTM C260.
 - 2) Aggregates: ASTM C33/C33M.
 - 3) Cement: ASTM C150/C150M, Type II.
 - 4) Compressive Strength: 4500 psi (31.03 MPa) concrete minimum.
 - 5) Water: Potable water free from impurities.
 - b. Reinforcing:
 - 1) Bars: ASTM A615/A615M, Grade 60.
 - 2) Reinforcing Mesh: ASTM A1064/A1064M.
 - c. Concrete Elements:
 - 1) Color:
 - a) Add Natural Grey color to mix.
 - b) Integral Color: Concentrated dry powder iron oxide pigments designed to meet samples and mock-up.
- B. Precast Concrete fence/wall:
1. Concrete to be integrally colored. Stain to be on both sides of wall.
 2. Wall to have concrete reinforcement per code.
 3. Approved Manufacturers and types:
 - a. Verti-Crete wall by Olympus Precast (Ledgestone design) TJ Ford (385) 232-4135.
tj@olympusprecast.com
 - b. Equal as approved by Architect prior to bid.

2.2 ACCESSORIES

- A. Sealant: As specified in Section 07 9213: 'Elastomeric Joint Sealants'.

2.3 FABRICATION

- A. General:
1. Chamfered edges.
 2. Smooth finish free from pits and rock pockets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Precast concrete fence/wall:
1. Follow Manufacturers installation instructions.

END OF SECTION

SECTION 03 6213**NON-METALLIC NON-SHRINK GROUTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install structural grout as described in Contract Documents.
 - a. For securing anchor bolts and hardware in concrete.
 - b. For securing anchor bolts and hardware in masonry.
- B. Related Requirements:
 - 1. Section 04 0516: 'Masonry Grouting'.

1.2 REFERENCES

- A. Association Publications:
 - 1. American Concrete Institute:
 - a. ACI 305R-10, 'Guide to Hot Weather Concreting'.
 - b. ACI 306R-10, 'Guide to Cold Weather Concreting'.
 - c. ACI 351.1R-12, 'Grouting Between Foundations and Bases for Support of Equipment and Machinery'.
- B. Reference Standards:
 - 1. ASTM International:
 - a. ASTM C1107/C1107M-17, 'Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).'
 - 2. United States Army Corps of Engineers (USACE):
 - a. CRD C-621-93, 'Handbook for Concrete and Cement Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink)'.

1.3 SUBMITTALS

- A. Action Submittals
 - 1. Product Data:
 - a. Manufacturer's data sheets on each product to be used, including:
 - 1) Preparation instructions and recommendations.
 - 2) Storage and handling requirements and recommendations.
 - 3) Manufacturer's printed installation instructions for each product.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Materials shall be delivered in original, unopened packages with labels intact clearly identifying product name and manufacturer until time of use.
- B. Storage And Handling Requirements:
 - 1. Follow Manufacturer's recommendations including but not limited to following:
 - a. Store in clean, dry location.
 - b. Keep containers sealed until ready for use.
 - c. Store materials at room temperature before use.
 - 2. Protect materials during handling and placement to prevent damage or contamination.

- a. Protect materials from freezing or overheating.
3. Shelf Life: One (1) year minimum in original, unopened containers.

1.5 FIELD CONDITIONS

A. Ambient Conditions:

1. General:
 - a. Do not place grout over frozen concrete.
2. Maintain environmental conditions and protect Work during and after installation to comply with referenced standards and Manufacturer's printed recommendations:
 - a. Do not install products under environmental conditions outside Manufacturer's recommendations.
3. Follow ACI requirements for cold and hot weather concreting or Manufacturer's written instructions, whichever is more stringent:
 - a. Cold Weather Limitations:
 - 1) Follow requirements of ACI 306R for cold weather concreting.
 - b. Hot Weather Limitations:
 - 1) Follow requirements of ACI 305R for hot weather concreting.
 - c. ACI 305R-10, 'Guide to Hot Weather Concreting'.
 - d. ACI 306R-10, 'Guide to Cold Weather Concreting'.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Design Criteria:

1. Description:
 - a. Commercial non-shrink, non-metallic grout.
2. Meet following requirements:
 - a. ASTM C1107/C1107M, Type B or Type C.
 - b. Corps and Engineers CRD C-621.
 - c. Compressive strength of 6000 psi (41 MPa) minimum.

B. Type Two Acceptable Products:

1. Masterflow 928 by BASF Systems, Shakopee, MN or BASF Canada, Mississauga, ON www.buildingsystems.basf.com.
2. ProSpec F77 by Bonsal American, Inc., Charlotte, NC www.bonsal.com.
3. Advantage 1107 Grout by Dayton Superior Corporation, Oregon, IL www.daytonsuperiorchemical.com.
4. NS Grout by Euclid Chemical Company, Cleveland, OH www.euclidchemical.com.
5. Five Star Grout by Five Star Products Inc, Fairfield, CT www.fivestarproducts.com.
6. Duragrout by L&M Construction Chemicals Inc., Omaha, NE www.lmcc.com.
7. Planigrout 712 by MAPEI Corporation, Deerfield Beach, FL www.mapei.US or Mapei Inc., Laval, QC www.mapei.com/CA.
8. SikaGrout 212 by Sika Corporation, Lyndhurst, NJ www.usa.sika.com or Sika Canada, Inc. Pointe-Claire, QC www.can.sika.com.
9. MP Grout by US Mix Products Company, Denver, CO www.usspec.com.
10. Sealtight CG-86 Grout by W R Meadows, Hampshire, IL www.meadows.com.
11. Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verification Of Conditions:
1. Examine substrate and verify substrate is suitable for installation.
 2. Notify Architect of unsuitable conditions in writing.
 - a. Do not install board over unsuitable conditions.
 - b. Commencement of Work by installer is considered acceptance of substrate.

3.2 PREPARATION

- A. Surface Preparation:
1. Prepare concrete surfaces in accordance with Manufacturer's written instructions:
 2. Remove all loose materials.
 3. Clean surface of any substance that could interfere with bond on material including dirt, paint, tar, asphalt, wax, oil, grease, latex compounds, form release agents, laitance, loose toppings, foreign substances and any other residues.
 4. Saturate area to be grouted with water in accordance with Manufacturer's written instructions.

3.3 APPLICATION

- A. General:
1. Follow Manufacturer's recommended thickness.
- B. Mixing:
1. Mix grout in accordance with Manufacturer's written instructions.
 2. Add mix water in amount in accordance with Manufacturer's written instructions to provide required placing consistency.
 3. Do not add water in amount that will cause bleeding or segregation of mixed grout.
 4. Do not add any sand, cement, admixtures, or fluidifiers to grout.
- C. Placement:
1. Place grout in accordance with Manufacturer's written instruction including but not limited to the following:
 - a. Proper curing is required.
 - b. Use cold weather or hot weather grouting procedures in accordance with Manufacturer's written instructions, as temperature dictates:
 - 1) Do not use at temperatures that may cause premature freezing.
 - 2) Do not allow to freeze until 4000 psi (27.6 MPa) is attained.
 - c. Employ cold weather or hot weather grouting practices as temperatures dictates.
 2. Completely eliminate air pockets and provide full contact between grout and item being grouted. Do not exceed Manufacturer's recommended thickness.
- D. Curing:
1. Cure grout in accordance with Manufacturer's written instructions or ACI curing practices.
 2. Wet cure grout until forms are removed.
 3. Seal grout surfaces after forms are removed as recommended by Manufacturer.
- E. Keep grout surfaces wet after curing compound has dried for as long as recommended by Manufacture.

3.4 FIELD QUALITY CONTROL

- A. Field Inspections:

1. Verify product has been installed as per Contract Documents and Manufacturer's written instructions.
- B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
 1. Correct any work found defective or not complying with Contract Document requirements at no additional cost to the Owner.

3.5 CLEANING

- A. Use clean water.
- B. Clean tools and equipment with water before material hardens.

3.6 PROTECTION

- A. Follow Manufacturer's recommendation for protection when applying material.
- B. Protect placed grout from freezing until minimum strength of 4000 psi (27.58 MPa) is reached.
- C. Protect placed grout from damage during construction.

END OF SECTION