

**Part II**  
**Division 3**  
**Concrete**



SECTION 03 01 00  
CONCRETE REHABILITATION

1 PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Concrete restoration and maintenance; structural crack-injection systems.

1.2 REFERENCES

A. ASTM International:

1. ASTM C881/C881 M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

B. American Concrete Institute (ACI):

1. ACI 503.1 Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive.
  2. ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.
  3. ACI 503.3 Standard Specification for Producing a Skid-Resistant Surface on Concrete by the Use of a MultiComponent Epoxy System.
  4. ACI 503.4 Standard Specification for Repairing Concrete with Epoxy Mortars.
- International Organization for Standardization (ISO).

C. International organization for Repairing Concrete with Epoxy Mortars.

1. ISO 9001 Quality Systems - Model for Quality Assurance.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide products and systems that have been manufactured, fabricated and installed to the following criteria:

1. Comply with ASTM C881.
2. Comply with ACI 503.1-4.

1.4 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division1 Submittal Procedures.

- B. Product Data: Submit product data for specified products.

C. Quality Assurance:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

3. Manufacturer's Instructions: Manufacturer's installation instructions.
- D. Manufacturer's Field Reports: Manufacturer's field reports specified herein.
- E. Closeout Submittals: Submit the following:
  1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

#### 1.5 QUALITY ASSURANCE

- A. Qualifications:
  1. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
  2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction and approving application method.
- B. Provide concrete restoration and maintenance system and/or structural crack-injection system that comply with the following requirements:
  1. ASTM C881.
  2. ACI 503.1-4.
- C. Pre installation Meetings: Conduct preinstallation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.

#### 1.6 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirements.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and Protection: Store materials protected from exposure to harmful weather conditions.

#### 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Safety Material Data Sheets: Comply with requirements.

#### 1.8 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions:

## 2 PART 2 PRODUCTS

### 2.1 CONCRETE RESTORATION AND MAINTENANCE EPOXY COMPOUND

#### A. Manufacturer: Abatron, Inc.

1. Contact: 5501 95th Ave., Kenosha, WI 53144; Telephone: (800) 445-1754, (262) 653-2000; Fax: (262) 653-2019; E-mail: [info@abatron.com](mailto:info@abatron.com); website: [www.abatron.com](http://www.abatron.com), or equal.

#### B. Products Systems:

1. Epoxy Adhesive Paste: AboWeld 55-1, for building up on vertical surfaces without forms or molds, or equal.
  - a. Compliance: ASTM C881, Type 1 and 3, Grade 3, Class C.
  - b. Features: No slump, thixotropic.
  - c. Composition: 100% solids,
  - d. Ratio by Volume: 1/1.
  - e. Pot Life: 1 hour.
  - f. Hardening Time: 1 - 6 hours at room temperature.
  - g. Color: Gray
  - h. Cold Weather Hardener: AboCure 55-1 CLD.
2. Adhesive Patching Paste: AboWeld 8708-2, for fast hardening filling or sealing of nonmoving cracks and holes prior to injection, or equal.
  - a. Compliance: ASTM C881, Type 1, Grade 3, Class Band C.
  - b. Features: Fast hardening, no slump.
  - c. Composition: 100% solids.
  - d. Ratio by Volume: 1/1
  - e. Pot Life: 10 - 15 minutes.
  - f. Hardening Time: 10 - 20 minutes,
  - g. Finished Blended Color: Gray.

### 2.2 STRUCTURAL CRACK REPAIR

#### A. Structural Crack Injection System: AboJet, or equal:

1. Compliance: ASTM C881.
2. Tensile Strength: 5000 - 11,000 psi (35 - 76 MPa).
3. Flexural Strength: 5000 - 13,000 psi (35 - 90 MPa).
4. Compressive Strength: 8000 - 16,000 psi (55 - 110 MPa).

#### B. Crack Injection Resins:

1. AboJet-1, or equal, for general purpose, dry and wet surfaces:
  - a. Compliance: ASTM C881, Type 1, Grade 2, Class C.
  - b. Viscosity: Medium, 20 poises.
  - c. Resin/Hardener Ratio: 2/1.
2. AboJet-2, or equal, for freezing weather and underwater or wet surfaces:
  - a. Compliance: ACI 503; ASTM C881.
  - b. Viscosity: Low, < 5 poises.

- e. Resin/Hardener Ratio: 2/1.
- d. Limitations: Toxic, exterior use only.
- 3. AboJet 8610-1, or equal, for very thin cracks:
  - a. Viscosity: Very low, < 2 poises.
  - b. Resin/Hardener Ratio: 5/1.
- 4. AboJet 8610-2, or equal, for thin cracks < 1/4 inch:
  - a. Viscosity: Low, < 5 poises.
  - b. Resin/Hardener Ratio: 5/1.

### 2.3 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions permitted, subject to compliance with requirements as judged solely by Architect/Engineer.

## 3 PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, and product carton installation instructions.

### 3.2 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have either been previously installed under other sections, or that existing site conditions, are acceptable for product installation in accordance with manufacturer's instructions.

### 3.3 PROTECTION

- A. Other Trades: Protect installed work of other trades from staining or contamination.

### 3.4 PREPARATION

- A. Surface Preparation: Concrete Restoration:
  - 1. AboWeld 55-1, AboWeld 8708-2:
    - a. Remove oil, grease, wax, old paint, areas exhibiting laitance with products recommended by manufacturer for application intended.
    - b. Rinse, dry and vacuum affected area.
    - c. Deepen and widen thin cracks to allow filling with grout.
    - d. Rinse well; neutralize with soda-ash solution and rinse well.
- B. Surface Preparation: Structural Crack Repair:
  - 1. AboJet-1, AboJet-2, AboJet 8610-1, AboJet 8610-2:
    - a. Clean crack with water jet to render crack free and accessible.
    - b. Remove oil, grease, wax, old paint products recommended by manufacturer for application intended.

### 3.5 MIXING

#### A. Mixture: Concrete Restoration:

1. AboWeld 55-1, AboWeld 8708-2:
  - a. Pour resin and hardener in pail in accordance with manufacturer's recommended ratio.
  - b. Mix thoroughly.
  - c. Add sand to quantities as recommended by manufacturer after 2 - 3 minutes of mixing.
  - d. Add fillers in quantities as recommended by manufacturer, mix thoroughly.
  - e. Add dry concrete powder while stirring.
  - f. Blend in Manufacturer recommended additive to ratios as recommended by manufacturer.
  - g. Induction Period: 5 - 10 minutes.

#### B. Mixture: Structural Crack Control:

1. AboJet-1, AboJet-2, AboJet 8610-1, AboJet 8610-2:
  - a. Measure and mix by hand resin and hardener in accordance with manufacturer's recommended ratio.
  - b. Mix and dispense prepackaged and pre-proportioned resin and hardener with specialized pump.
  - c. Mix manufacturer pre-measured containers of resin and hardener
  - d. Mix resin and hardener in pre-measured compartmented cartridge with mixing plunger

### 3.6 APPLICATION

Specifier Note: AboSolv can be added in any concentration to the ABOCRETE blend for use as a thin primer coating. The unfilled resin/hardener blend can be diluted 2/1, 1/1 or 1/2 with AboSolv and so rolled, brushed or sprayed as a primer for solventless (filled or unfilled) resin/hardener blend. For thick coating or patches, no more than 5 - 6% solvent is recommended. Consult manufacturer's technical literature or contact manufacturer for comprehensive application instructions.

#### A. Primer Coating:

1. AboWeld 55-1, AboWeld 8708-2:
  - a. Prime with PrimKote 8006-1.
2. Apply primer in accordance with manufacturer's recommendations.

#### B. Application: Concrete Restoration:

1. AboWeld 55-1, AboWeld 8708-2:
  - a. Ensure temperature of application is > 60 degrees F (15 degrees C) and < 85 degrees F (29 degrees C).
  - b. Spread blend in accordance with manufacturer's recommendations.
  - d. Allow application to harden.

C. Application: Structural Crack Repair:

1. AboJet-1, AboJet-2, AboJet 8610-1, AboJet 8610-2:
  - a. Predrill holes for insertion of injection ports.
  - b. Insert 2 inch - 3 inch (51 - 76 mm) long x 1/4 inch (6.4 mm) diameter copper tubing sections or plastic ports (injection ports) into crack on front side of wall starting from bottom of crack every 8 inches - 12 inches (203 - 305 mm).
  - d. Seal crack around ports and between them with AboWeld 55-1, AboWeld 8708-2.
  - e. Mix in fillers to resin/hardener blend.
  - f. Inject blend through lowest port, until resin starts oozing from port above that.
  - g. Crimp lowest port shut to prevent resin backflow, and inject resin through next port above, until resin starts oozing from port above that.
  - h. Crimp second port, inject resin through port above it, repeat process until no resin can be injected.
  - i. Finish crack surface when surface hardens.

3.7 FIELD QUALITY CONTROL

- A. Written Reports: Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- B. Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- C. Schedule site visits to review Work at stages listed:
  1. After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
  2. During progress of Work.
  3. Upon completion of Work, after cleaning is carried out.
- D. Obtain reports within Three days of review and submit.

3.8 TESTING & VERIFICATION

- A. Perform tests recommended and required by manufacturer to verify required performance of products.

3.9 COMPLETION & CLEANUP

- A. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

...END OF SECTION



SECTION 03 30 00

CAST-IN-PLACE CONCRETE AND REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
- B. Related Sections include the following:
  - 1. Division 2 Section "Earthwork"

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mix water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
  - 1. Cementitious materials and aggregates.
  - 2. Form materials and form-release agents.
  - 3. Steel reinforcement and reinforcement accessories.

4. Fiber reinforcement.
5. Admixtures.
6. Waterstops.
7. Curing materials.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Epoxy joint filler.
13. Joint-filler strips.
14. Repair materials.

E. Minutes of preinstallation conference.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
1. ACI 301, "Specification for Structural Concrete."
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials including notification procedure of on-site testing agency. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

- a. Contractor's superintendent.
- b. Independent testing agency responsible for concrete design mixes.
- c. Ready-mix concrete producer.
- d. Concrete subcontractor.
- e. Owner's representative.
- f. Testing agency.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete (at areas exposed to view): Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Plywood, metal, or other approved panel materials.
  2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1, or better.
    - b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
    - c. Structural 1, B-B, or better, mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.
  2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, assembled with clips.
  1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars.
- C. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
  2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II.
  1. Fly Ash: ASTM C 618, Class C or F.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
  1. Class: Severe weathering region, but not less than 3S.
  2. Nominal Maximum Aggregate Size: 3/4 inch (19 mm).
- C. Water: Potable and complying with ASTM C 94.

## 2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.

## 2.6 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Fibrillated Fibers:
    - a. Fibrasol F; Axim Concrete Technologies.
    - b. Fibermesh; Fibermesh, Div. of Synthetic Industries.
    - c. Forta; Forta Corporation.
    - d. Grace Fibers; W. R. Grace & Co., Construction Products Div.

## 2.7 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
  - 1. Profile: Flat, dumbbell with center bulb.
  - 2. Profile: As indicated.
- B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
  - 1. Profile: Flat, dumbbell with center bulb.
  - 2. Profile: As indicated.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Rubber Waterstops:
    - a. Greenstreak.
    - b. Progress Unlimited Inc.
    - c. Westec Barrier Technologies; Div. of Western Textile Products, Inc.
    - d. Williams Products, Inc.

2. PVC Waterstops:

- a. Greenstreak.
- b. Meadows: W. R. Meadows, Inc.
- c. Murphy: Paul Murphy Plastics Co.
- d. Progress Unlimited Inc.
- e. Sternson Group.
- f. Tamms Industries Co.; Div. of LaPorte Construction Chemicals North America, Inc.
- g. Vinylex Corporation.
- h. Westec Barrier Technologies; Div. of Western Textile Products, Inc.

D. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
- b. Conseal CS-231; Concrete Sealants Inc.
- c. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
- d. Hydrotite; Greenstreak.
- e. Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.
- f. Adeka Ultra Seal; Mitsubishi International Corporation.
- g. Superstop; Progress Unlimited Inc.

2.8 VAPOR RETARDERS

- A. Vapor Retarder: As specified on foundation drawings.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Curing compound still required at areas receiving evaporation retarder.
- B. Water: Potable.
- C. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 22 percent solids.
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

H. Products: Subject to compliance with requirements, provide one of the following:

1. Evaporation Retarder:

- a. Cimfilm; Axim Concrete Technologies.
- b. Finishing Aid Concentrate; Burke Group, LLC (The).
- c. Spray-Film; ChemMasters.
- d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
- e. Sure Film; Dayton Superior Corporation.
- f. Eucobar; Euclid Chemical Co.
- g. Vapor Aid; Kaufman Products, Inc.
- h. Lambco Skin; Lambert Corporation.
- i. E-Con; L&M Construction Chemicals, Inc.
- j. Confilm; Master Builders, Inc.
- k. Waterhold; Metalcrete Industries.
- l. Rich Film; Richmond Screw Anchor Co.
- m. SikaFilm; Sika Corporation.
- n. Finishing Aid; Symons Corporation.
- o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.

2. Clear, Solvent-Borne, Membrane-Forming Curing Compound:

- a. AH Clear Cure; Anti-Hydro International, Inc.
- b. Spartan-Cote; Burke Group, LLC (The).
- c. Spray-Cure & Seal 15; ChemMasters.
- d. Conspec #1-15 percent solids; Conspec Marketing & Manufacturing Co., Inc.
- e. Day-Chem Cure and Seal; Dayton Superior Corporation.
- f. Diamond Clear; Euclid Chemical Co.
- g. Nitocure S; Fosroc.
- h. Cure & Seal 309; Kaufman Products Inc.
- i. Lambco 120; Lambert Corporation.
- j. L&M Dress & Seal 18; L&M Construction Chemicals, Inc.
- k. CS-309; W. R. Meadows, Inc.
- l. Seal N Kure; Metalcrete Industries.
- m. Rich Seal 14 percent UV; Richmond Screw Anchor Co.
- n. Kure-N-Seal; Sonneborn, Div. of ChemRex, Inc.
- o. Flortec 14; Sternson Group.
- p. Cure & Seal 14 percent; Symons Corporation.
- q. Clear Seal 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
- r. Acrylic Cure; Unitex.
- s. Certi-Vex AC 309; Vexcon Chemicals, Inc.

3. Clear, Waterborne, Membrane-Forming Curing Compound:

- a. AH Clear Cure WB; Anti-Hydro International, Inc.
- b. Klear Kote WB II Regular; Burke Chemicals.
- c. Safe-Cure & Seal 20; ChemMasters.
- d. High Seal; Conspec Marketing & Manufacturing Co., Inc.
- e. Safe Cure and Seal; Dayton Superior Corporation.
- f. Aqua Cure VOX; Euclid Chemical Co.

- g. Cure & Seal 309 Emulsion; Kaufman Products Inc.
  - h. Glazecote Sealer-20; Lambert Corporation.
  - i. Dress & Seal WB; L&M Construction Chemicals, Inc.
  - j. Vocomp-20; W. R. Meadows, Inc.
  - k. Metcure; Metalcrete Industries.
  - l. Cure & Seal 150E; Nox-Crete Products Group, Kinsman Corporation.
  - m. Rich Seal 14 percent E; Richmond Screw Anchor Co.
  - n. Kure-N-Seal WB; Sonneborn, Div. of ChemRex, Inc.
  - o. Florseal W.B.; Sternson Group.
  - p. Cure & Seal 14 percent E; Symons Corporation.
  - q. Seal Cure WB 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
  - r. Hydro Seal; Unitex.
  - s. Starseal 309; Vexcon Chemicals, Inc.
4. Clear, Waterborne, Membrane-Forming Curing Compound, 18 to 22 Percent Solids:
- a. Klear Kote WB II 20 percent; Burke Chemicals.
  - b. Safe-Cure & Seal 20; ChemMasters.
  - c. Conspec 21; Conspec Marketing & Manufacturing Co., Inc.
  - d. Diamond Clear VOX; Euclid Chemical Co.
  - e. SureCure Emulsion; Kaufman Products Inc.
  - f. Glazecote Sealer-20; Lambert Corporation.
  - g. Dress & Seal WB; L&M Construction Chemicals, Inc.
  - h. Vocomp-20; W. R. Meadows, Inc.
  - i. Metcure 0800; Metalcrete Industries.
  - j. Cure & Seal 200E; Nox-Crete Products Group, Kinsman Corporation.
  - k. Rich Seal 18 percent E; Richmond Screw Anchor Co.
  - l. Kure-N-Seal W; Sonneborn, Div. of ChemRex, Inc.
  - m. Florseal W.B.; Sternson Group.
  - n. Cure & Seal 18 percent E; Symons Corporation.
  - o. Seal Cure WB STD; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
  - p. Hydro Seal 800; Unitex.
  - q. Starseal 0800; Vexcon Chemicals, Inc.
5. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound:
- a. Spray-Cure & Seal Plus; ChemMasters.
  - b. UV Super Seal; Lambert Corporation.
  - c. Lumiseal Plus; L&M Construction Chemicals, Inc.
  - d. CS-309/30; W. R. Meadows, Inc.
  - e. Seal N Kure 30; Metalcrete Industries.
  - f. Rich Seal 31 percent UV; Richmond Screw Anchor Co.
  - g. Cure & Seal 31 percent UV; Symons Corporation.
  - h. Certi-Vex AC 1315; Vexcon Chemicals, Inc.
6. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:
- a. Klear-Kote Cure-Sealer-Hardener, 30 percent solids; Burke Group, LLC (The).
  - b. Polyseal WB; ChemMasters.



- c. UV Safe Seal; Lambert Corporation.
- d. Lumiseal WB Plus; L&M Construction Chemicals, Inc.
- e. Vocomp-30; W. R. Meadows, Inc.
- f. Metcure 30; Metalcrete Industries.
- g. Vexcon Starseal 1315; Vexcon Chemicals, Inc.

## 2.10 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi (39 MPa) at 28 days when tested according to ASTM C 109/C 109M.

## 2.12 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
  1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Footings, Elevated Interior Slabs, And Miscellaneous Concrete: Proportion normal-weight concrete mix as follows:
  1. Compressive Strength (28 Days): 3000 psi (27.6 MPa).
  2. Maximum Slump: 4.5 inches (100 mm).
  3. Maximum water / cement ratio = 0.51.
  4. Maximum Slump for Concrete Containing Mid-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 3- to 4.5-inch (50- to 100-mm) slump.
  5. Air Entrainment: 4.5% - 7.5% (at concrete exposed to weather)
- D. Foundation Walls and Piers: Proportion normal-weight concrete mix as follows:
  1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
  2. Maximum Slump: 4.5 inches (100 mm).
  3. Maximum water / cement ratio = 0.42.
  4. Air Entrainment: 4.5% - 7.5%
  5. Maximum Slump for Concrete Containing Mid-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 3- to 4.5-inch (50- to 100-mm) slump.
- E. Interior Slabs on Grade: Proportion normal-weight concrete mix as follows:
  1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
  2. Maximum Slump: 4.5 inches (100 mm).
  3. Maximum water / cement ratio = 0.42.
  4. Fiber Reinforcement
  5. Maximum Slump for Concrete Containing Mid-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 3- to 4.5-inch (50- to 100-mm) slump.
- F. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.

- G. Maximum Water-Cementitious Materials Ratio: 0.42 for concrete exposed to deicers or subject to freezing and thawing while moist.
- H. Maximum Water-Cementitious Materials Ratio: 0.42 for concrete subject to severe or very severe sulfate exposure.
- I. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
  - 1. Air Content: 6 percent for 1-inch- (25-mm-) nominal maximum aggregate size.
- J. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
- K. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- L. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.90 kg/cu. m).
- M. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  - 4. Accelerator: W.R. Grace

## 2.13 FABRICATING REINFORCEMENT

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

## 2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch (3 mm) (exposed areas).
  - 2. Class B, 1/4 inch (6 mm) (unexposed areas).
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
  - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor bolts, accurately located, to elevations required.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 7 days after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
  1. At least 70 percent of 28-day design compressive strength.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR RETARDERS

- A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
  2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Concrete slabs shall encase steel columns on all sides except where prevented by designated floor openings.
- C. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.
- D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- E. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
  2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to

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

- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
  4. Prior to placing concrete, contractor shall take necessary precautions to maintain concrete temperature continuously above 50 deg F and in a moist condition for the first seven days after concrete placement. Precautions shall include, but not be limited to concrete blankets and tenting with external heat source if necessary. Contractor shall measure and record daily concrete temperatures with High / Low concrete thermometers during seven day period. The seven day requirement may be reduced to three days if High Early Strength concrete is used.
- H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.10 FINISHING FORMED SURFACES

- A. General: Coordinate with Architect's requirements.



- B. Rough-Formed Finish (permitted at non-exposed concrete only): As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- C. Smooth-Formed Finish (required at exposed concrete): As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.
  - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
  - 2. Do not apply rubbed finish to smooth-formed finish.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. General: Comply with Architect's requirements.
- C. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
  - 1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.
- D. Float Finish: Required at areas to be covered by wood floor and elsewhere as specified by the owner. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- E. Trowel Finish: Required at areas specified by owner. After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
  2. Finish and measure surface so gap at any point between concrete surface and an unlevelled freestanding 10-foot- (3.05-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:
    - a. 1/8 inch (3.2 mm).
- F. Trowel and Fine-Broom Finish: Required at sloped areas adjacent to drains. Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- G. Broom Finish: Required where specified by owner. Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- H. Slip-Resistive Aggregate Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
  2. After broadcasting and tamping, apply float finish.
  3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.
- I. Mineral Dry-Shake Floor Hardener Finish: After initial floating, apply mineral dry-shake materials to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply mineral dry-shake materials at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m), unless greater amount is recommended by manufacturer.
  2. Uniformly distribute approximately two-thirds of mineral dry-shake materials over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second mineral dry-shake application, uniformly distributing remainder of material, and embed by power floating.
  3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake material manufacturer and apply immediately after final finishing.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with

in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

### 3.13 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
  - 1. Concrete shall be maintained above 50 degrees F, and in a moist condition for at least the first seven days after placement. This may be reduced to three days if high early strength concrete is used in approved mix design.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
  - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - 2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's

- written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

- a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
    - a. Test two field-cured specimens at 7 days and two at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
  - C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  - D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
  - E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
  - F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  - G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect. Costs associated with reinspecting or retesting deficient areas will be paid for by the Contractor.

END OF SECTION 03300

SECTION 03 45 00

PRECAST CONCRETE PRODUCTS

1 PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This specification covers the materials for and manufacture of precast reinforced concrete units produced in accordance with the plans and these specifications.

1.2 REFERENCES - Where applicable, the latest editions of the following standards shall be considered a part of these specifications. In case of conflict, these specifications shall take precedence over the listed standard. (See also Article 2.4, Concrete Materials)

- A. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. "Standard Specification for Highway Bridges"
  - 2. "Guide Specifications for Structural Design of Sound Barriers"
- B. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete
- C. ACI 318 - Building Code Requirements for Reinforced Concrete
- D. ASTM C478 - Specification for Precast Reinforced Concrete Manholes Sections
- E. ASTM C825 - Standard Specification for Precast Concrete Barriers
- F. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- G. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures"
- H. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- I. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures
- J. ASTM C915 - Standard Specification for Precast Reinforced Concrete Crib Wall Members
- K. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- L. ASTM C936 - Standard Specification for Solid Concrete Interlocking Paving Units
- M. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
- N. ASTM C1227 - Standard Specification for Precast Concrete Septic Tanks

- O. ASTM 1433 - Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
- P. ASTM C1478 - Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
- Q. AWS D1.1 - Structural Welding Code - Structural Steel
- R. AWS D1.4 - Structural Welding Code - Reinforcing Steel
- S. CRSI Manual of Standard Practice

### 1.3 SUBMITTALS

#### A. Product Data

1. For standard precast concrete units, the precast concrete producer will supply cut sheets showing conformance to project drawings and requirements and to applicable ASTM specifications listed in this specification. The Precast concrete producer shall certify that such products will meet the ASTM specifications.
2. For proprietary precast concrete units, the precast concrete producer may supply standard plans or informative literature. Supporting calculations and design details shall be available upon request. The Precast concrete producer shall warrant that such products will perform the intended task.

#### B. Shop Drawings

1. The plans for custom-made precast concrete units shall be shop drawings furnished by the precast concrete producer for approval by the Owner or his agent (specifier). These drawings shall show complete design, installation, and construction information in such detail as to enable the Owner to determine the adequacy of the proposed units for the intended purpose. Details of steel reinforcement size and placement as well as supporting design calculations, if appropriate, shall be included. The drawings shall include a schedule, which will list the size and type of precast concrete units at each location where they are to be used. The precast concrete units shall be produced in accordance with the approved drawings.

### 1.4. QUALITY ASSURANCE

- A. Precast concrete producer shall demonstrate adherence to the standards set forth in the National Precast Concrete Association Quality Control Manual. Precast concrete producer shall meet requirements written in subparagraph 1 or 2.
  1. NPCA Certification - The precast concrete producer shall be certified by the National Precast Concrete Association's Plant Certification Program prior to and during production of the products for this project.
  2. Qualifications, Testing and Inspection
    - a. The Precast concrete producer shall have been in the business of producing precast concrete products similar to those specified



for a minimum of 5 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the precast concrete producer to produce quality products consistent with industry standards.

- b. The Precast concrete producer shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed for each 150 cu. yd. of concrete placed, but not less frequently than once per week.

- 1) Slump: C143
- 2) Compressive Strength: C31, C192, C39
- 3) Air Content (when air-entrained concrete is being used): C231 or C173
- 4) Unit Weight: C138

- c. The Precast concrete producer shall provide documentation demonstrating compliance with this subparagraph.

- d. The Owner may place an inspector in the plant when the products covered by this specification are being manufactured.

## 1.5 DELIVERY, STORAGE AND HANDLING

### A. Handling

1. Products shall be stored, handled shipped and unloaded in a manner to minimize damage. Lifting holes or inserts shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose.

### B. Acceptance at Site

1. The Owner's representative shall make final inspection and acceptance of the precast concrete products upon arrival at the jobsite.

## 2 PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. The precast concrete manufacturer must meet the guidelines written in article 1.5 paragraph A.

### 2.2 MANUFACTURED PRECAST UNITS

- A. Precast Concrete: Provide all units shown in Contract Documents and as needed for a complete and proper installation

B. Design Criteria - Design units in accordance with:

1. 1999 BOCA building code.
2. ACI 304 and 318.
3. CRSI Manual of Standard Practice.
4. Applicable ASTM Standard(s).

C. Finishes

1. Formed non-architectural surfaces: Surfaces cast against approved forms using industry practice in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be tolerated but no major imperfections, honeycombs or other defects will be permitted.
2. Unformed surfaces: Surfaces finished with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be tolerated but no major imperfections, honeycombs, or other defects shall be permitted.
3. Special finishes:
  - a. Troweled, broom or other finishes shall be according to the requirements of project documents and performed per industry standards or supplier specifications.
  - b. Precast concrete producers shall submit finishes for approval when required by the project documents. The sample finishes shall be approved prior to the start of production.
  - c. Colors shall be as selected by the architect from the manufacturer's complete color line.

D. Patching and Repairs

1. Any and all damaged products shall be reviewed by the architect and owner. A determination of the proper repair or complete replacement will be evaluated at that point in time. Any damage occurring in exposed surfaces of the products will not be acceptable and shall be replaced.

2.3 MATERIALS

- A. Concrete - Concrete shall be a uniform mix of quality materials listed in Article 2.4. Mix proportions shall be determined by following the standards in ACI 318 Chapter 5. Recommendations for selecting proportions for concrete are given in detail in Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete (ACI 211.1). Recommendations for lightweight concrete are given in Standard Practice for Selecting proportions for Structural Lightweight Concrete (ACI 211.2).
1. Water-Cement Ratio
    - a. Concrete that will be exposed to freezing and thawing shall contain entrained air and shall have water-cement ratios of 0.45 or less. Concrete which will not be exposed to freezing, but which is required to be watertight, shall have a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. For corrosion protection, reinforced concrete exposed to deicer salts, brackish water or seawater shall have a water-cement ratio of 0.40 or less.
  2. Air Content

- a. The air content of concrete that will be exposed to freezing conditions shall be within the limits given in Table 1.

Table 1 Total Air Content For Frost-Resistant Concrete

Nominal Maximum Aggregate Size (Inches)	Air Content, %	
	Severe Exposure	Moderate Exposure
3/8	6.0 to 9.0	4.5 to 7.5
1/2	5.5 to 8.5	4.0 to 7.0
3/4	4.5 to 7.5	3.5 to 6.5
1	4.5 to 7.5	3.0 to 6.0
1-1/2	4.5 to 7.0	3.0 to 6.0

\* For specified compressive strengths greater than 5000 psi, air content may be reduced 1%.

3. Compressive Strength

- a. All concrete shall develop a minimum compressive strength of 4,000 psi in 28 days unless other strengths are designated on the drawings.

B. Portland Cement: ASTM C150, Type I, II, III or V.

C. Aggregates: ASTM C33 or C330.

D. Water: Potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

E. Admixtures:

- 1. Air-entraining: ASTM C260
- 2. Water reducing, retarding, accelerating, high range water reducing: ASTM C494
- 3. Pozzolans, fly ash and other mineral admixtures: ASTM C618
- 4. Ground granulated blast furnace slag: ASTM C989
- 5. Pigments: Non-fading and lime-resistant

2.4 REINFORCEMENT AND CONNECTION MATERIALS

A. Provide all reinforcement, accessory and connection materials required. Concrete reinforcement shall be steel bars or welded wire fabric, or a combination thereof.

B. Reinforcing Bars:

- 1. Deformed Billet-steel: ASTM A615
- 2. Deformed Rail-steel: ASTM A616
- 3. Deformed Axle-steel: ASTM A617
- 4. Deformed Low-alloy steel: ASTM A706

C. Reinforcing Wire:

1. Plain Wire: ASTM A82
  2. Deformed Wire: ASTM A496
- D. Welded Wire Fabric:
1. Plain Wire: ASTM A185
  2. Deformed Wire: ASTM A497
- E. Epoxy Coated Reinforcement:
1. Reinforcing Bars: ASTM A775
  2. Wires and Fabric: ASTM A884
- F. Galvanized Reinforcement:
1. Reinforcing Bars: ASTM A767
- G. Inserts and Embedded Metal - All items embedded in concrete shall be of the type required for the intended task, and meet the following standards:
1. Structural steel plates, angles, etc: ASTM A36
  2. Proprietary items: In accordance with manufacturers published literature
  3. Welded studs: AWS D1.1
  4. Finishes (as required):
    - a. Shop primer: Manufacturers' standards
    - b. Hot-dipped galvanized: ASTM A152
    - c. Zinc-rich coating: MIL-P-2135 self-curing, one component, sacrificial
    - d. Cadmium coating: Manufacturers' recommendations
- H. Joint Sealant and Joint Gaskets:
1. Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets: ASTM C443.
  2. External Sealing Bands for Noncircular Sewer, Storm Drain, and Culvert Pipe: ASTM C877.
  3. Joints for Concrete Pipe, Manholes, and Manufactured Box Sections Using Preformed Flexible Joint Sealants: ASTM C990
  4. Specification for Elastomeric Joint Sealants: ASTM C920
- I. Pipe Entry Connectors:
1. Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals: ASTM C923.
- J. Grout:
1. Cement grout: Portland cement with enough water for the required strength and sand for proper consistency. May contain mineral or chemical admixtures, if approved by Owner's representative.
  2. Non-shrink grout: Premixed, packaged expansive and non-expansive shrink-resistant grout.

## 2.5 FABRICATION

- A. Forms for manufacturing precast concrete products shall be of the type and design consistent with industry standards. They should be capable of consistently providing uniform products and dimensions. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected can cause no product damage.
  - 1. Forms shall be cleaned of concrete build-up after each use.
  - 2. Form release agents shall not be allowed to build up on the form casting surfaces.
  
- B. Reinforcement
  - 1. Cages of reinforcement shall be fabricated either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding where permissible in accordance with AWS D1.4. Reinforcing shall be positioned as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 in. Concrete cover shall not be less than 1/2 in. Positive means shall be taken to assure that the reinforcement does not move significantly during the casting operations.
  
- C. Embedded Items
  - 1. Embedded items shall be positioned at locations specified in the design documents. Inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products shall be held rigidly in place so that they do not move significantly during casting operations.
  
- D. Placing Concrete
  - 1. Concrete shall be deposited into forms as near to its final location as practical. The free fall of the concrete shall be kept to a minimum. Concrete shall be consolidated in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Vibrators used to consolidate concrete shall have frequencies and amplitudes sufficient to produce well consolidated concrete.
  - 2. Cold Weather Requirements - Recommendations for cold weather concreting are given in detail in Cold Weather Concreting reported by ACI Committee 306.
    - a. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather.
    - b. All concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact shall be free from frost.
    - c. Frozen materials or materials containing ice shall not be used.
    - d. In cold weather the temperature of concrete at the time of placing shall not be below 45° F. Concrete that freezes before its compressive strength reaches 500 psi shall be discarded.

3. Hot Weather Requirements - Recommendations for hot weather concreting are given in detail in Hot Weather Concreting reported by ACI Committee 305.
  - a. During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90° F.

E. Curing

1. Curing by Moisture Retention - Moisture shall be prevented from evaporating from exposed surfaces until adequate strength for stripping (Article 2.6, paragraph F) is reached by one of the following methods:
  - a. Cover with polyethylene sheets a minimum of 6 mils thick.
  - b. Cover with burlap or other absorptive material and keep continually moist.
  - c. Use of a membrane-curing compound applied at a rate not to exceed 200 sq. ft. per gallon, or per manufacturers' recommendations.
2. Surfaces that will be exposed to weather during service shall be cured as above a minimum of 3 days. Forms shall be considered effective in preventing evaporation from the contact surfaces. If air temperature is below 50°F the curing period shall be extended.
3. Curing with Heat and Moisture
  - a. Concrete shall not be subjected to steam or hot air until after the concrete has attained its initial set. Steam, if used, shall be applied within a suitable enclosure, which permits free circulation of the steam. If hot air is used for curing, precautions shall be taken to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 160° F. These requirements do not apply to products cured with steam under pressure in an autoclave.

F. Stripping Products from Forms

1. Products shall not be removed from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

G. Shipping Products

1. Products shall not be shipped until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75% of the specified 28-day strength, or that damage will not be caused which will impair the performance of the product.

2.4 SOURCE QUALITY CONTROL

- A. Fabricate units in accordance with ACI 318 and the National Precast Concrete Association's Quality Control Manual for Precast Plants.

3 PART 3 EXECUTION

3.1 INSTALLATION

A. Site Access

- 1. General contractor shall be responsible for providing adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

B. Installation

- 1. Precast concrete products shall be installed to the lines and grades shown in the contract documents or otherwise specified.
- 2. Products shall be lifted by suitable lifting devices at points provided by the precast concrete producer.
- 3. Products shall be installed per the precast concrete producer's recommendation.

C. Water tightness

- 1. Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.2 FIELD QUALITY CONTROL

- A. Site tests - when testing is required for an underground product, one of the following methods need to be followed:

- 1. Vacuum testing prior to backfill according to ASTM C1244.
- 2. Water testing according to contract documents and precast concrete producer's recommendations.

...END OF SECTION

