DIVISION 03: CONCRETE

END OF TABLE OF CONTENTS

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 01 0000: 'General Requirements':
      a. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control'.
      b. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required'.
   2. Section 03 3111: 'Normal Weight Structural Concrete'.
      a. Tolerances for placing normal weight 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'.
   2. International Code Council (IBC):
      a. IBC Chapter 17, 'Structural Tests and Special Inspections'.

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.

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.

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.

C. Form Removal:
   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) leave forms intact for sufficient period for concrete to reach adequate strength.
   3. Metal bars or prys should not be used. Use wood wedges, tapping gradually when necessary.

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 admixtures.
      c. Sealants and curing compounds used with concrete.
      d. Compact aggregate base for miscellaneous cast-in-place concrete.
      e. Miscellaneous cast-in-place concrete and equipment pads.

B. Products Installed But Not Furnished Under This Section:
   1. Concrete accessories.
   2. Inserts, bolts, boxes, templates, and fastening devices for other work, including those for bases only for Mechanical and Electrical.
   3. Membrane Concrete Curing.

C. Related Requirements:
   1. Section 01 0000: 'General Requirements':
      a. Section 01 1200: 'Multiple Contract Summary' for Owner Furnished Testing and Inspecting Services.
      b. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
      c. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control.
      d. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
      e. Section 01 7800: 'Closeout Submittals'.
   2. Section 03 1113: 'Structural Cast-In-Place Concrete Forming'.
   3. Section 03 3923: 'Membrane Concrete Curing' for quality of curing materials used.
   4. 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.
   5. Furnishing of items to be embedded in concrete specified in Section involved.

1.2 REFERENCES

A. Association Publications:
   1. American Concrete Institute, Farmington Hills, MI www.concrete.org. Abstracts of ACI Periodicals and Publications.
      a. ACI 214.3R-88(97), *'Recommended Practice for Evaluation of Strength Test Results of Concrete*.
      b. ACI 224R-01, '*Control of Cracking in Concrete Structures*'.
      c. ACI 224.1R-07, '*Causes, Evaluation, and Repair of Cracks in Concrete Structures*'.
      d. ACI 224.2R-92(R2004): '*Cracking of Concrete Members in Direct Tension*'.
      e. ACI 224.3R-95(R2013), '*Joints in Concrete Construction*'.
      f. ACI 224.4R-13, *'Guide to Design Detailing to Mitigate Cracking'*.
      g. ACI 302.1R-04: '*Guide for Concrete Floor and Slab Construction'*.
      h. ACI 302.2R-06, '*Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials'*.

i. ACI 304R-00, *'Guide for Measuring, Mixing, Transporting and Placing Concrete*'.
j. ACI 304.6R-09, *'Guide for the Measure of Volumetric-Measuring & Continuous-Mixing Concrete Equipment*'.
k. ACI 305R-10, '*Guide to Hot Weather Concreting'*.
l. ACI 306R-10, *'Guide to Cold Weather Concreting'*.
m. ACI 309.1R-08, '*Report on Behavior of Fresh Concrete During Vibration'.*
n. ACI 311.4R-05, *'Guide for Concrete Inspection'*.
o. ACI 347-04, *'Guide to Formwork for Concrete'*.
p. Certifications:
1) ACI CP-1(13), *'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(13), *'Technical Workbook for ACI Certification of Concrete Strength Testing Technician'*.

2. Council of American Structural Engineers. CASE Form 101: *Statement of Special Inspections*. Washington, DC: CASE, 2001. (c/o American Council of Engineering Companies, 1015 15th St., NW, Washington, DC 20005; 202-347-7474; www.acec.org).

B. Definitions (Following are specifically referenced for testing):
1. Accreditation: Process in which certification of competency, authority, or credibility is presented. Verify that laboratories have an appropriate quality management system and can properly perform certain test methods (e.g., ANSI, ASTM, and ISO test methods) and calibration parameters according to their scopes of accreditation.
2. Approved: To authorize, endorse, validate, confirm, or agree to.
3. Cementitious Materials: Portland cement alone or in combination with one or more of following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
4. Field Quality Control: Testing, Inspections, Special Testing and Special Inspections to assure compliance to Contract Documents.
5. Floor Flatness (FF): Rate of change in elevation of floor over a 12 inches (305 mm) section.
6. Floor Levelness (FL): Measures difference in elevation between two points which are 10 feet (3.05 m) apart.
7. Inspection/Special Inspection: Inspection of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards:
a. Inspection: Not required by code provisions but may be required by Contract Documents.
b. Special Inspection: Required by code provisions and by Contract Documents.
c. Inspection-Continuous: Full-time observation of the Work requiring inspection by approved inspector who is present in area where the Work is being performed.
d. Inspection-Periodic: Part-time or intermittent observation of the Work requiring inspection by approved inspector who is present in area where the Work has been or is being performed and at completion of the Work.
8. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operation, including installation, erection, application, and similar operations.
9. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation. They are not samples. Approved mockups establish standard by which the Work will be judged.
10. Observation: Visual observation of building / site elements or structural system by registered design professional for general conformance to approved construction documents at significant construction stages and at completion. Observation does not include or waive responsibility for performing inspections or special inspections.

11. Owner's Representative: Owner's Designated Representative (Project Manager or Facilities Manager) who will have express authority to bind Owner with respect to all matters requiring Owner's approval or authorization.
12. Preconstruction Testing: Tests and inspections that are performed specifically for Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
13. Product Testing: Tests and inspections that are performed by testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
14. Quality Assurance: Testing, Inspections, Special Testing and Special Inspections provided for by Owner.
15. Quality Control: Testing, Inspections, Special Testing and Special Inspections provided for by Contractor.
16. Service Provider: Agency or firm qualified to perform required tests and inspections.
17. Source Quality Control Testing: Tests and inspections that are performed at source, i.e., plant, mill, factory, or shop.
18. Special Inspection: See Inspection.
19. Special Inspector: Certified individual or firm that implements special inspection program for project.
20. Special Test: See Test.
21. Test/Special Test: Field or laboratory tests to determine characteristics and quality of building materials and workmanship.
    a. Test: Not required by code provisions but may be required by Contract Documents.
    b. Special Test: Required by code provisions and by Contract Documents.
22. Testing Agency: Entity engaged to perform specific tests, inspections, or both.
23. Testing Agency Laboratory: Agency or firm qualified to perform field and laboratory tests to determine characteristics and quality of materials and workmanship.
24. Verification: Act of reviewing, inspecting, testing, etc. to establish and document that product, service, or system meets regulatory, standard, or specification requirements.

C. Reference Standards:
1. American Association of State and Highway Transportation Officials:
    a. AASHTO T 318-02(2011), 'Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying'.
2. American Concrete Institute:
    a. ACI 117-10: 'Specifications for Tolerances for Concrete Construction and Materials and Commentary'.
    b. ACI 117M-10: 'Specifications for Tolerances for Concrete Construction and Materials and Commentary (Metric)'.
    c. ACI 211.1-91(R2009), 'Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete'.
    d. ACI 301-10, 'Specification for Structural Concrete for Buildings'.
    e. ACI 301M-10, 'Specification for Structural Concrete (Metric)'.
    f. ACI 305.1-14, 'Specification for Hot Weather Concreting'.
    g. ACI 306.1-90 (Reapproved R2002), 'Standard Specification for Cold Weather Concreting'.
    h. ACI 308.1-11, 'Standard Specification for Curing Concrete'.
    i. ACI 308.1M-11, 'Standard Specification for Curing Concrete'.
    j. ACI 318-14, 'Building Code Requirements for Structural Concrete and Commentary'.
3. ASTM International:
    a. ASTM A615/A615M-15a, 'Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement'.
    b. ASTM A706/A706M-14, 'Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement'.
    c. ASTM C31/C31M-15, 'Standard Practice for Making and Curing Concrete Test Specimens in the Field'.
    d. ASTM C33/C33M-13, 'Standard Specification for Concrete Aggregates'.

e. ASTM C39/C39M-15a, ‘Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens'.
f. ASTM C42/C42M-13, ‘Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete'.
g. ASTM C94/C94M-15, 'Standard Specification for Ready-Mixed Concrete'.
h. ASTM C138/C138M-14, 'Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete'.
i. ASTM C140/C140M-15, ‘Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units'.
j. ASTM C143/C143M-15, 'Standard Test Method for Slump of Hydraulic-Cement Concrete'.
k. ASTM C150/C150M-15, 'Standard Specification for Portland Cement'.
l. ASTM C171-07, ‘Standard Specification for Sheet Materials for Curing Concrete'.
m. ASTM C172/C172M-14a, ‘Standard Practice for Sampling Freshly Mixed Concrete'.
n. ASTM C173/C173M-14, ‘Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method'.
o. ASTM C192/C192M-15, ’Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory'.
p. ASTM C231/C231M-14, ‘Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method'.
q. ASTM C260/C260M-10a, ‘Standard Specification for Air-Entraining Admixtures for Concrete'.
r. ASTM C330/C330M-14, 'Standard Specification for Lightweight Aggregates for Structural Concrete'.
s. ASTM C494/C494M-15, 'Standard Specification for Chemical Admixtures for Concrete.
t. ASTM C496/C496M-11, ‘Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens’.
u. ASTM C567/C567M-14, ‘Standard Test Method for Determining Density of Structural Lightweight Concrete'.
v. ASTM C595/C595M-15e, ‘Standard Specification for Blended Hydraulic Cements'.
w. ASTM C597-09, ‘Standard Test Method for Pulse Velocity Through Concrete'.
x. ASTM C618-12a, 'Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete'.
y. ASTM C803/C803M-03(2010), ‘Standard Test Method for Penetration Resistance of Hardened Concrete'.
z. ASTM C805/C805M-13a, ‘Standard Test Method for Rebound Number of Hardened Concrete'.
aa. ASTM C989/C989M-14, ‘Standard Specification for Slag Cement for use in Concrete and Mortars'.
bb. ASTM C1077-15, 'Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation'.
cc. ASTM C1157/C1157M-11, ‘Standard Performance Specification for Hydraulic Cement'.
dd. ASTM C1688/C1688M-14a, ‘Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete’.
ee. ASTM D3666-13, ‘Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials'.
ff. ASTM E329-14a: ‘Standard Specification for Agencies Engaged in Construction Inspection and/or Testing'.
gg. ASTM E543-15, ‘Standard Specification for Agencies Performing Nondestructive Testing'.
hh. ASTM E1155-14, 'Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers’.
ii. ASTM E1212-12, ‘Standard Practice for Quality Management Systems for Nondestructive Testing Agencies'.
jj. ASTM F710-11, ‘Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
kk. ASTM F2170-11, ‘Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes'.

4. International Code Council (IBC):

a. IBC Chapter 17, ‘Structural Tests and Special Inspections’.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
1. Participate in 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'.
2. In addition to agenda items specified in Section 01 3100, review following:
a. Review concrete installation scheduling, coordination and placement of exterior concrete.
b. Review 'Verification Of Conditions' requirements.
c. Review requirements for preparation of subgrade.
d. Review aggregate base requirements.
e. Review formwork requirements.
f. Review approved mix design requirements and use of admixtures.
g. Review placement, finishing, and curing of concrete including cold and hot weather requirements.
h. Review safety issues.

1.4 SUBMITTALS

A. Informational Submittals:
1. 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.
2. Source Quality Control Submittals:

a. Concrete mix design: Submit mix designs to meet following requirements:
   1) Proportions:
      a) Mix Type F:
         (1) 4500 psi (31.03 MPa) minimum at twenty eight (28) days.
         (2) Water / Cementitious Material: 0.40 maximum by weight.
         (3) Mix Type F should be used for all exterior concrete exposed to freeze/thaw cycles and deicing salts, unless dictated otherwise by site conditions.
         (4) For concrete paving, use mix design based upon use of 1-1/2 inches (38 mm) coarse aggregate (about 15 percent).
      b) Air Entrainment: Six (6) percent, plus or minus 1-1/2 percent for exterior concrete exposed to freeze/thaw cycles.
      c) 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.
   2) Slump:
      a) 4 inch (100 mm) slump maximum before addition of high range water reducer.
      b) 8 inch (200 mm) slump maximum with use of high range water reducer.
      c) Slump not required for Mix Type F.
   3) Admixtures:
      a) Mix design shall show proposed admixture, amount, usage instructions, and justification for proposed use. Do not use any admixture without Architect's written approval.
      b) Mineral: An amount of specified Class F fly ash not to exceed ten (10) percent of weight of cement may be substituted for cement. If substituted, consider fly ash with cement in determining amount of water necessary to provide specified water / cement ratio.
      c) Chemical: Specified accelerator or retarder may be used if necessary to meet environmental conditions.
      d) Chemical: Special additives to promote rapid drying concrete may be used in interior concrete slabs on grade if necessary to meet construction schedules.

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.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
   1. For Cold Weather and Hot Weather Limitations, see Preparation in Part 3 of this specification.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
1. Manufacturer Contact List:
   a. BASF (Construction Chemicals Division), Cleveland, OH www.master-builders-solutions.basf.us/en-us.
   b. Bonsal American, Charlotte, NC www.bonsal.com.
   c. Dayton Superior Specialty Chemicals, Kansas City, KS www.daytonsuperiorchemical.com.
   d. Euclid Chemical Company, Cleveland, OH www.euclidchemical.com.
   e. Fritz-Pak Concrete Admixtures, Dallas, TX www.fritzpak.com.
   f. Grace Construction Products, Cambridge, MA www.graceconstruction.com and Grace Canada Inc, Ajax, ON (905) 683-8561.
   g. L & M Construction Chemicals, Omaha, NE www.lmcc.com.
   h. Larsen Weldcrete by Larsen Products Corp, Rockville, MD www.larsenproducts.com.
   i. Sika Corporation, Lyndhurst, NJ www.sikaconstruction.com and Sika Canada, Pointe Claire, QC www.sika.ca.
   j. Unitex, Kansas City, MO www.unitex-chemicals.com.
   k. U S Mix Products Co, Denver, CO www.usspec.com.
   l. 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. Table One:

Portland Cement / Blended Hydraulic Cement Equivalencies		
ASTM C150/C150M (Low Alkali)	ASTM C595/C595M	ASTM C1157/C1157M
Type I	IP	GU

2. Aggregates:
   a. 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 as follows:

         a) Table Two: Flat Work, Size No. 67.

Sieve	Percent Passing	Sieve	Percent Passing
One Inch	100	25 mm	100
3/4 Inch	90 - 100	19 mm	90 - 100
3/8 Inch	20 - 55	9 mm	20 - 55
No. 4	0 - 10	4.75 mm	0 - 10
No. 8	0 - 5	2.36 mm	0 - 5

   b. Fine:
      1) Meet requirements of ASTM C33/C33M.
      2) Aggregate shall be uniformly graded by weight as follows:

         a) Table Four:

Sieve	Percent Passing	Sieve	Percent Passing
3/8 Inch	100	9 mm	100
No. 4	95 - 100	4.75 mm	95 - 100
No. 8	80 - 100	2.36 mm	80 - 100
No. 16	50 - 85	1.18 mm	50 - 85
No. 30	25 - 60	0.60 mm	25 - 60
No. 50	10 - 30	0.30 mm	10 - 30
No. 100	2 - 10	0.15 mm	2 - 10

3. Water: Clear, apparently clean, and potable.
4. Admixtures And Miscellaneous:
   a. Mineral:
      1) Fly Ash: 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) MasterAir VR 10 (formally MB-VR), Master AE 90 (formally MB-AE) or MasterAir AE 400 (formally EverAir Plus) by BASF.
            (2) Air Mix 200 Series or AEA-92 Series by Euclid.
            (3) Air Plus or Super Air Plus by Fritz-Pak.
            (4) Sika Air by Sika.
            (5) Daravair or Darex Series AEA by W R Grace.
            (6) 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) MasterPozzolith (formerly Pozzolith) Series by BASF.
            (2) Eucon WR 75 or Eucon 91 by Euclid.
            (3) FR-2 or FR-3 by Fritz-Pak.
            (4) Plastocrete 160 by Sika.
            (5) Daracem, WRDA, or MIRA Series by W R Grace.
            (6) 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) MasterPozzolith (formerly Pozzolith) Series by BASF.
            (2) Eucon Retarder 75 by Euclid.
            (3) FR-1 or Modified FR-1 by Fritz-Pak.
            (4) Plastiment by Sika.
            (5) Daratard Series or Recover by W R Grace.
            (6) 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) MasterRheobuild 1000 (formerly Rheobuild 1000) or MasterGlenium (formerly Glenium) Series by BASF.
            (2) Eucon 37 or Eucon 537 by Euclid.
            (3) Supercizer 1 through 7 by Fritz-Pak.
            (4) Sikament 300 by Sika.
            (5) Daracem or ADVA Series by W R Grace.

(6) 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) MasterSet AC 534 (formerly Pozzolith NC 534) or MasterSet AC 122 (formerly Pozzolith122HE) or MasterSet FP 20 (formerly Pozzutec 20+) by BASF.
      (2) Accelguard 80 by Euclid.
      (3) Daraset, Polarset or Lubricon by W R Grace.
      (4) Equal as approved by Architect before use. See Section 01 6200.
7) 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.
8) 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) Visctrol by Euclid.
      (2) VMAR3 by W R Grace.
      (3) Equal as approved by Architect before use. See Section 01 6200.
9) Shrinkage Reducing Admixture (SRA):
   a) Liquid admixture specifically designed to reduce drying shrinkage and potential for cracking.
   b) Type Two Acceptable Products:
      (1) Eucon SRA by Euclid.
      (2) Eclipse 4500 (exterior concrete) by W R Grace.
      (3) Eclipse Floor 200 (interior concrete) by W R Grace.
      (4) 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. Evaporation Retardant:
   1. Type Two Acceptable Products:
      a. MasterKure ER 50 (Formerly Confilm) by BASF.

b. Sure Film J-74 by Dayton Superior.
c. Eucobar By Euclid Chemical Co.
d. E-Con by L & M Construction Chemicals.
e. Pro Film by Unitex.
f. U S Spec Monofilm ER by U S Mix Products.
g. Equal as approved by Architect before use. 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, building slabs, 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: 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. See ACI 306.1 ‘Standard Specification for Cold Weather Concreting’ for additional requirements.
b. 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.
a) Heating devices used to maintain specified temperatures shall have baffle plate above, of sufficient size, and sand bed below, in order to distribute heat.
b) Heating devices shall be so operated that temperature of air immediately below slab forms shall not exceed 100 deg F (37.8 deg C). Provide sufficient and suitable thermometers to verify compliance.

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) No salt or other chemical may be used for such protection.
6) Only specified non-corrosive non-chloride accelerator shall be used. Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

c. Requirements When Average twenty four (24) Hour Temperature, midnight to midnight, Is Below 40 deg F (4 deg C):
1) Temperature of concrete as placed and maintained shall be 55 deg F (13 deg C) minimum and 75 deg F (27 deg C) maximum.
2) Heat concrete for seventy two (72) hours minimum after placing if regular cement is used; for 48 hours if high early strength cement is used; or longer if determined necessary by Architect.
a) During this period, maintain concrete surface temperature between 55 and 75 deg F (13 and 27 deg C).
3) Vent flue gases from combustion heating units to outside of enclosure to prevent carbonation of concrete surface.
4) Prevent concrete from drying during heating period. Maintain housing, insulation, covering, and other protection twenty four (24) hours after heat is discontinued.
5) After heating period, if temperature falls below 32 deg F (0 deg C), protect concrete from freezing until strength of 2000 psi (13.79 MPa) minimum is achieved.
a) Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi (24.13 MPa) minimum is achieved.

d. Requirements When Average twenty four (24) Hour Temperature, midnight to midnight, Is Above 40 deg F (4 deg C), but when temperature falls below 32 deg F (0 deg C):
1) Protect concrete from freezing for seventy two (72) hours after placing, or until strength of 2000 psi (13.79 MPa) is achieved, whichever is longer.
2) Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi (24.13 MPa) minimum is achieved.

e. Protect soil supporting concrete footings from freezing under any circumstances.

4. Hot Weather Concreting Procedures:
a. See ACI 305.1 ‘Specification for Hot Weather Concreting’ for additional requirements.
b. Maximum concrete temperature allowed is 90 deg F (32 deg C) in hot weather.
c. Cool aggregate and subgrades by sprinkling.
d. Avoid cement over 140 deg F (60 deg C).
e. Use cold mixing water or ice.
f. Use fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.

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.
2. Inserts, bolts, boxes, templates, pipes, conduits, and other accessories required by Divisions 22, 23, and 26 shall be installed and inspected before placing concrete.
3. Install inserts, bolts, boxes, templates, pipes, conduits, and other accessories furnished under other Sections to be installed as part of work of this Section.

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.
2. Exterior Slabs:
   a. Dusting with cement not permitted.
   b. 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).
3. 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. Miscellaneous:
      1) After completion of 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.
         d) 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.
         e) Round edges exposed to public view to 1/2 inch (13 mm) radius, including edges formed by expansion joints.
         f) Remove edger marks.

C. Curing:
1. Membrane Concrete Curing:
   a. As specified in Section 09 3923 'Membrane Concrete Curing'.
   b. Follow Manufacturer's written instructions of preparation, application rates, placement, and cleanup.
      1) Apply as soon as troweling on interior concrete is complete.
      2) Apply as soon as brooming or finishing of exterior concrete is complete.
      3) Spraying application is required.
      4) Do not dilute or thin product.
      5) Do not apply when temperature of concrete is less than 40 deg F (4.4 deg C).
      6) Apply uniformly without puddles or ponding.

7) Do not apply before bleed water has dissipated.
8) Do not apply over standing water.

D. 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.

3.4 CLEANING

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

3.5 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.
2. Do not allow materials resulting from construction activities, which will affect concrete or application of finish floor systems adversely, to come in contact with interior concrete slabs.
3. Protect interior concrete floors from stains, paint, mortar and other construction activities.

B. Curing:
1. Restrict foot or vehicle traffic as curing membrane dries as recommended be Manufacturer.

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.

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, dissipating membrane curing agent that cures freshly placed concrete, forming effective barrier against moisture loss from concrete surface.
   2. Design Criteria:
      a. VOC-compliant compound.
      b. Meet requirements of ASTM C309 and AASHTO M 148, Type 1 or 1-D, Class B.
      c. Interior concrete: containing no mineral spirits, naptha, or other components detrimental to finish flooring installation.
      d. Maintain ninety five (95) percent of mix water present in concrete mass after application.
      e. 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 and Interior Concrete:
            a) Clear Cure J7WB by Dayton Superior Corporation, Miamisburg. OH www.daytonsuperior.com.
            b) L&M Cure R by L&M Construction Chemicals, Inc. Omaha, NE www.lmcc.com.
            c) Clear Water Resin by Right Point, Dekalb, IL www.rightpointe.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

END OF DIVISION