ADDENDUM NO. 3
TO THE
BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS
FOR THE
WHITE RIVER INTERCEPTOR SEWER – PHASE IIA PROJECT

OWNER: **City of Anderson**

ISSUED BY/ENGINEER: Beam, Longest and Neff, L.L.C.
8320 Craig Street
Indianapolis, Indiana 46250

ISSUED TO: All Plan and Specifications Holders of Record

ISSUE DATE: December 15, 2020

BID DATE: December 17, 2020

This Addendum No. 3 shall clarify, correct, or change the Bidding Requirements or the proposed Contract Documents. This Addendum is a part of the Bidding Requirements and the proposed Contract Documents and shall govern in the performance of the Work.

PART 1. PROJECT MANUAL

1.1 ITEM NO. 1 – 00011 TABLE OF CONTENTS

A. The Table of Contents has been updated according to the attachment in this addendum.

1.2 ITEM NO. 2 – 00200 INSTRUCTIONS TO BIDDERS

A. Add the following language after 1.18.A.6:

7. Exploratory Site Data – Any exploratory site data information gathered by the Bidder during the bid phase, such as geotechnical information, groundwater information, etc.

1.3 ITEM NO. 3 – 00410 BID FORM

A. Add the following language after 2.01.E:

F. Exploratory Site Data – Any exploratory site data information gathered by the Bidder during the bid phase, such as geotechnical information, groundwater information, etc.

1.4 ITEM NO. 4 – 02530 GRAVITY SANITARY SEWERAGE

A. Add the following after 1.6.A:

B. Reinforced concrete pipe and fitting manufacturer's quality control system shall be ISO 9001 registered, ACPA certified, or equal.

1.5 ITEM NO. 5 – 02530 GRAVITY SANITARY SEWERAGE

A. Add the following after 1.5.B.2.a:

b. Design calculations must be sealed and certified by a Professional Engineer licensed in the State of Indiana.

1.6 ITEM NO. 6 – 03300 CAST-IN-PLACE CONCRETE

A. Add specification 03300 Cast-in-Place Concrete.

PART 2. DRAWINGS

2.1 ITEM NO. 1 – MITIGATION PLAN

A. On sheet C16, the quantity of Common Winterberry should be reduced from 72 to 57 in the Wetland Restoration Planting Table.

PART 3. ADDITIONAL TECHNICAL INFORMATION

The following technical information is not part of the Contract Documents, but Bidder is entitled to rely upon this information as provided in Paragraph 4.02 of the General Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such information.

3.1 PARTIAL GEOTECHNICAL INFORMATION

B. Three (3) hand auger boring were completed on Tuesday, December 8, 2020. This data should be used for planning purposes only and should not be used as a full geotechnical report. This data is attached to this addendum.

3.2 QUESTION AND REPONSE LIST NO. 2

A. The Question and Response List No. 2 is attached with this addendum.

Except as modified by this Addendum and other Addenda, the Bidding Requirements and the proposed Contract Documents shall remain unchanged. You will receive no other notification of this Addendum. **RECEIPT OF THIS ADDENDUM MUST BE ACKNOWLEDGED IN SECTION 00410 - BID FORM, PAGE 00410-1.**

CERTIFIED BY:

Renee Lynn Goff, P.E.
Registered P.E. No. 10403860
State of Indiana

Enclosures: Section 00011 – Table of Contents
Section 00300 – Cast-in-Place Concrete
Hand Auger Data
Question and Response List No. 2

BLN Proj. No. 120046
OWNER City of Anderson
PROJECT NAME White River Interceptor Sewer - Phase IIA

Section 00011 - Table of Contents

03300

Cast-in-Place Concrete

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings

2. Slabs-on-grade.

1.2 ACRONYMS

A. ACI: American Concrete Institute.

B. AISC: American Institute of Steel Construction, Inc.

C. CRSI: Concrete Reinforcing Steel Institute.

D. INDOT SS: Indiana Department of Transportation (INDOT) Standard Specifications, and applicable supplements, current at the time of the bid.

E. NRMCA: National Ready Mix Concrete Association.

1.3 SUBMITTALS

A. Action Submittals

1. Product Data

2. Mix Design: for each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. The mix design shall be submitted a minimum of 7 days prior to the trial batch and shall include the following:

a. A list of all ingredients.
b. The source of all materials.
c. The fine to total aggregate ratio.
d. The aggregate gradation.
e. The absorption of the aggregates.
f. The SSD bulk specific gravity of the aggregates.
g. The specific gravity of Pozzolan.
h. Batch weights.

i. Names of all admixtures.
j. Admixture dosage rates and manufacturer's recommended range.
k. Amounts of mixing water to be withheld for later addition at Project site.

3. Shop Drawings

a. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
b. Field-Required Construction Joints: Details of reinforcing steel, adhesive requirements, and other details at construction joints required due to the planned daily progression of the concrete placement.
c. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
d. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

B. Informational Submittals

1. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

a. Aggregates.

2. Material Certificates: For each of the following, signed by manufacturers:

a. Cementitious materials.
b. Admixtures.
c. Form materials and form-release agents.
d. Steel reinforcement and accessories.
e. Fiber reinforcement.
f. Waterstops.
g. Curing compounds.
h. Floor and slab treatments.
i. Bonding agents.
j. Adhesives.
k. Vapor retarders.
l. Semirigid joint filler.
m. Joint-filler strips.
n. Repair materials.

3. Manufacturers' Instructions

a. Admixtures.
b. Form-releasing agents.
c. Waterstop installation and splicing.
d. Curing compounds.
e. Floor and slab treatments.

f. Bonding agents
g. Adhesives
h. Repair materials.

4. Field quality-control test reports.

5. Batch Tickets, including:

a. Name of concrete supplier.
b. Name of purchase and job location.
c. Date of delivery.
d. Amount of concrete delivered.
e. Time loaded.
f. Design mix designation.
g. Admixture – type and quantity.
h. Quantity of cement on truck.
i. Quantity of water added at plant.
j. For a design mix change, also include:
k. Time concrete arrived at the site.
l. Water added by driver and/or receiver of concrete.
m. Admixtures added on site, including type, quantity, and time.
n. Time concrete was unloaded.

1.4 QUALITY ASSURANCE

A. Flatwork Installer Qualifications: A qualified installer who employs on-Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An INDOT-approved testing laboratory or an independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an 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 an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete,"

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Regulatory Requirements: Use only products meeting all regulatory requirements for water, sewer, or storm sewer structures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Cement: Stored in weathertight buildings, bins, or silos which exclude moisture, contaminants, and minimize warehouse set.

D. Aggregates

1. Arrange and use to avoid excessive segregation and prevent contamination with other materials or other sizes of like aggregate.

E. Admixtures: Store in manner to avoid contamination, evaporation, or damage. Protect liquid admixtures from freezing and from temperature changes which would adversely affect their characteristics.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. 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.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

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

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products that complies with standards applicable to Owner and required by Project funding agencies.

B. Reinforcing Bars: ASTM A615, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A706, deformed.

D. Steel Bar Mats: ASTM A184, fabricated from ASTM A615, Grade 60, deformed bars, assembled with clips.

E. Plain-Steel Wire: ASTM A82, as drawn.

F. Deformed-Steel Wire: ASTM A496.

G. Epoxy-Coated Wire: ASTM A884, Class A, Type 1 coated, as-drawn, with less than 2 percent damaged coating in each 12-inch wire length.

H. Plain-Steel Welded Wire Reinforcement: ASTM A185, plain, fabricated from as-drawn steel wire into flat sheets.

I. Deformed-Steel Welded Wire Reinforcement: ASTM A497, flat sheet.

J. Galvanized-Steel Welded Wire Reinforcement: ASTM A185, plain, fabricated from galvanized steel wire into flat sheets.

K. Epoxy-Coated Welded Wire Reinforcement: ASTM A884, Class A coated, Type 1, plain steel.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, ASTM A775 epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775.

D. Zinc Repair Material: ASTM A780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar

supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 AGGREGATES AND POZZOLAN

A. Coarse Aggregate

1. 100 percent of all aggregates shall pass the 1-inch sieve.

2. 20 percent of coarse aggregates shall be retained on the No. 4 sieve.

3. Aggregates shall be free from lumps or crusts of hardened or frozen materials.

B. Fine Aggregate

1. 100 percent of fine aggregates shall pass the 3/8-inch sieve and a minimum of 80 percent shall pass the No. 4 sieve.

2. Fine aggregates shall comprise at least 35 percent and not more than 50 percent of the total weight of aggregate in each cubic yard. Proportions will be based on saturated surface dry aggregates.

C. Fly Ash

1. Fly ash is the finely divided residue from the combustion of ground or powered coal. Class F fly ash is produced from anthracite or bituminous coal and class C ash is produced from lignite or subbituminous coal.

2. Fly ash or Ground Blast Furnace Slag may only be incorporated in the concrete mix between April 1 and October 15 of the same calendar year.

3. Fly ash will only be accepted from one of the approved sources on the Indiana Department of Transportation supplier sources.

4. Fly ash shall be in accordance with AASHTO M-295 for class C or class F excepting conditions as referenced in INDOT specification 901.02(b)1.

D. Ground Blast Furnace Slag

1. Blast furnace slag shall consist of the non-metallic product, consisting essentially of silicates and aluminosilicates of calcium and other bases, that is developed in a molten condition simultaneously with iron in a blast furnace.

2. Ground granulated blast furnace slag will be accepted based on manufacturer's or distributor's documented ability to consistently furnish these materials in accordance with applicable ASTM and AASHTO requirements.

2.5 PORTLAND CEMENT

A. Portland cement shall conform to the following cited specifications except as noted.

1. Air-entraining Portland blast-furnace slag cement: AASHTO M-240, Type ISA

2. Air-entraining Portland cement: AASHTO M-85, Type IA or IIIA

3. Air-entraining Portland Pozzolan cement: AASHTO M-240, Type IP-A

4. Portland blast-furnace slag cement: AASHTO M-240, Type IS

5. Portland cement: AASHTO M-85, Type I, II, or III

6. Portland Pozzolan cement: AASHTO M-240, Type IP

7. Slag modified Portland cement, Type ISM: AASHTO M-240

B. Exceptions to AASHTO M-240 are as follows:

1. The amount of Pozzolan shall be limited to 20% +/- 5% by weight of Portland-Pozzolan cement for the types IP and IP-A

2. The Pozzolan in the Portland-Pozzolan cements, types IP and IP-A, shall be in accordance with ASTM C-618, class C or class F, with the loss on ignition of the Pozzolan limited to a maximum of 3 percent.

3. The Pozzolan in the Portland-Pozzolan cements, types IP and IP-A, shall be inter-ground with the Portland cement clinker.

2.6 ADMIXTURES

A. Admixtures shall be selected from the INDOT list of approved admixtures. Admixtures containing chloride added as an ingredient of manufacture are unacceptable.

B. Air entraining admixtures are materials added to mixtures at the mixer for the purpose of entraining air.

1. Air-entraining admixtures shall conform to AASHTO M-154.

C. Chemical admixtures are added to the mixture at the mixer for the purpose or purposes indicated below:

1. Type A: admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

2. Type B: admixture that retards the setting of concrete.

3. Type C: admixture that accelerates the setting and early strength development of the concrete.

4. Type D: admixture that reduces the quantity of mixing water required to produce concrete of a given quantity and retards the setting of concrete.

5. Type E: admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of the concrete.

6. Type F: admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or more.

7. Type G: high range water reducing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

2.7 GROUTS AND REPAIR MATERIALS

A. Grout: Grout shall be a mixture of Portland cement and sand with a normal proportioning of 2:1 sand-cement.

1. Grout shall be a mixture of Portland cement and sand with a normal proportioning of 2:1 sand-cement. Grout shall be used to form floor slopes in manholes, valve structures, channel bottoms, clarifier floors and like work where a fine grade of concrete mix is necessary for thin grading with a smooth finished surface.

B. Non-Shrink Grout: Non-shrink, non-metallic grout conforming to ASTM C1107. Non-shrink grout shall:

1. Be sulfate resistant and consist of pre measured, pre packaged materials requiring only the addition of water.

2. Not contain metallic particles such as aluminum powders or iron filings.

3. Have a minimum setting time of 60 minutes when tested in accordance with ASTM C191.

4. When tested at maximum allowable water content, exhibits no shrinkage (0.0%) and a maximum of 4.0% expansion when tested in accordance with ASTM C827 and no shrinkage (0.0%) and a minimum of 0.2% expansion with the hardened state when tested in accordance with CRD C621.

5. Have a minimum compressive strength of 5,000 psi at 28 days.

C. Slab Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109.

D. Slab Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109.

E. Rapid Setting Patching Materials

1. Rapid setting patch materials shall be selected from the INDOT-approved products list.

2. Material shall be capable of being utilized in patches ranging from 1-inch to full depth without bonding agents. No curing material shall be required. Patching material shall be capable of being surface sealed with an epoxy sealer.

3. The product shall be single packaged dry mix requiring only water just prior to mixing. The minimum shelf life shall be 12 months.

F. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

2.8 WATER

A. Potable Water: Potable quality water may be used without testing.

B. Nonpotable Water: Water used in mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substance injurious to the finished product.

1. Water will be tested in accordance with AASHTO T-26 and shall be in accordance with the following:

a. pH: 6 to 8
b. Chloride Ions: less than 300 ppm
c. Sulphate (SO_4) : less than 500 ppm
d. Total Solids: less than 1500 ppm

C. Water containing algae will be unacceptable for use in concrete.

2.9 PREFORMED FILLERS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Joint Fillers in Water, Sewer, or Storm Sewer Structures: Use only products meeting all regulatory requirements for joint filler in water, sewer, or storm sewer structures.

2.10 JOINT SEALER

A. Furnish hot applied joint sealer conforming to ASTM D6690, Type II.

B. Provide preformed elastomeric compression joint seal conforming to ASTM D2628.

C. Joint Sealer in Water, Sewer, or Storm Sewer Structures: Use only products meeting all regulatory requirements for joint sealer in water, sewer, or storm sewer structures

2.11 CURING MATERIALS

A. Burlap cloth according to AASHTO M-182, Class 2.

B. Sheet materials for concrete curing conforming to AASHTO M-171 for moisture loss and reflectance only.

C. Liquid membrane forming compounds for curing concrete conforming to ASTM C309.

D. Low viscosity, non-fuming high molecular weight methacrylate (HMWM) resin conforming to ASTM D2849, ASTM D93, ASTM D323, ASTM D3418, ASTM D2471, and ASTM C882.

2.12 BONDING AGENTS AND ADHESIVES

A. Epoxy Resin Bonding System: Epoxy-resin based bonding system shall conform to ASTM C881. Systems used in tankage in contact with potable water shall be NSF certified for use with potable water or food.

B. Epoxy Injection Resin: Provide epoxy injection resin capable of application, positive adherence, and strength development when applied to moist or wet surfaces at temperatures at 33o F and above. The injection shall meet ASTM C881, Type IV, Grade 1, and Class B or C, for viscosity and ASTM C881, Type 1, Grade 3, Class B or C, for paste materials. Systems used in tankage in contact with potable water shall be NSF certified for use with potable water or food.

2.13 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: Ribbed with center bulb.

2. Dimensions: 6 inches by 3/8 inch thick; nontapered.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed with center bulb.

2. Dimensions: 6 inches by 3/8 inch thick; nontapered.

C. 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: Ribbed with center bulb.

2. Dimensions: 6 inches by 3/8 inch thick; nontapered.

2.14 VAPOR RETARDERS

A. Type C Plastic Vapor Retarder: ASTM E1745, Class C, or polyethylene sheet, ASTM D4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

2.15 FLOOR AND SLAB TREATMENTS

A. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

2.16 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.

3. Ground Granulated Blast-Furnace Slag: 50 percent.

4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use admixture 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 slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.17 CONCRETE MIXTURES FOR STRUCTURAL AND BUILDING ELEMENTS

A. Environmental Structures, General

1. Cement for Sewage Structures

   a. ASTM C595, Type I.
   b. AASHTO M-240, Types IS, IS-A, IP, IPA.

2. Non-Sewage Structures: Type I or Type II cement.

3. Minimum Compressive Strength: 4000 psi at 28 days.

4. Maximum Water-Cementitious Materials Ratio: 0.45.

5. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

6. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

7. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

8. Air Content: No more than three (3) percent for interior troweled finished floors.

B. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.40.

3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

C. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.40.

3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

D. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Minimum Cementitious Materials Content: 520 lb/cu. yd.

3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content, Other than Troweled Finish Floors:
   a. 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
   b. 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

5. Air Content, Troweled Finish Floors: Do not allow air content of troweled finished floors to exceed 3 percent.

6. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd.

7. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

E. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Minimum Cementitious Materials Content:
   a. 470 lb/cu. yd. where maximum aggregate size of 1-1/2 inch is indicated.
   b. 520 lb/cu. yd. . where maximum aggregate size of 1 inch is indicated.
   c. 540 lb/cu. yd. . where maximum aggregate size of 3/4 inch is indicated.

3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content, Other than Troweled Finish Floors:

   a. 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
   b. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

5. Air Content, Troweled Finish Floors: Do not allow air content of trowel-finished floors to exceed 3 percent.

6. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd.

7. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

F. Pump Bases and Equipment Bases: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.40.

3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

2.18 FABRICATING REINFORCEMENT

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

2.19 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94 and, where fiber reinforcement used, ASTM C1116. Furnish batch ticket information.

1. When air temperature is less than 85 deg F, do not exceed 1-1/2 hours mixing and delivery time.

2. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Cement which contains lumps or has partially hardened or set shall be rejected.

4. Frozen or partially frozen aggregates shall not be used. Fine aggregate shall be allowed to drain until it has reached a relatively uniform moisture content before it is used.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

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 structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A , 1/8 inch for smooth-formed finished surfaces.

2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete

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

1. Install keyways, reglets, recesses, and the like, for easy removal.

2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete except where thresholds or other items are to be mounted to the surface.

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

2. Install reglets to receive 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 pipe sleeves and casings for utility wall penetrations.

4. 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 for 48 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained. Removal of forms prior to 48 hours may be authorized by Engineer when the average temperature significantly exceeds 50 deg F; however, no forms shall be removed in less than 24 hours.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. 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.

C. 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 Engineer.

D. Forms for slabs shall not be loosened or removed for at least 24 hours after placement of concrete.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory or multilevel construction, extend shoring or reshoring over a sufficient number of stories or levels to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. 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. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal full length with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with granular fill or fine-graded granular material, and indicated, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

1. Place and compact a 1/2-inch-thick layer of fine-graded granular material over granular fill.

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, paint, concrete, oil, grease, or other deleterious coatings and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

H. All reinforcing steel shall be cold-bent, if bends are required. Welding of reinforcing steel is not permitted.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

1. In order to allow for shrinkage, concrete shall not be placed against the second side of construction joints, including those for columns and walls, for at least 12 hours after that on the first side has been placed.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through expansion joints or sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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. 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-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. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

F. Suspended Slabs: Do not place joints in suspended slabs.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

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

C. Waterstops shall be held firmly in the correct position as the concrete is placed.

3.9 CONCRETE PLACEMENT

A. Preparation

1. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

a. Prior to placement of concrete, forms, reinforcement, and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings.

b. Any oil on the reinforcing steel or other surfaces to be bonded to the concrete shall be removed.

c. Rock surfaces shall be cleaned by wire brush scrubbing, wet sandblasting or air-water cutting, as necessary, and shall be firm and damp prior to concrete placement.
d. Do not place concrete on mud, dried earth, uncompacted fill, or frozen subgrade.
e. Where concrete is placed on grade, the subgrade shall be shaped to the required grade and section, free from ruts, corrugations, or other irregularities, and uniformly compacted.

B. Concrete Placement, General

1. Concrete shall be mixed and delivered by one of the following:
   a. Central mixed concrete shall be completely mixed in a stationary mixer and transported in a truck agitator, truck mixer at agitating speed, or non-agitating equipment.
   b. Shrink mixed concrete shall be partially mixed in a stationary mixer and the mixing completed during transportation in a truck mixer.
   c. Transit mixed concrete shall be completely mixed in a truck mixer.
2. Where admixtures are used, provide agitating equipment to assure thorough distribution of admixtures used in the form of suspensions or nonstable solutions.
3. Discharge from non-agitating equipment shall be completed within 30 minutes of mixing of water, cement, and aggregates.
4. Concrete shall be uniformly mixed when delivered to the job site.
5. Concrete shall be conveyed from the mixer to the placement as rapidly as practicable by methods that will prevent segregation of aggregates or loss of mortar.
6. Place concrete only in the presence of Engineer's representative.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F 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. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces below finished grade or not exposed.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

   a. Apply to exposed concrete surfaces where other rubbed finishes are not indicated.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

   a. Apply to exposed exterior and tops of tanks and concrete environmental structures.
   b. Apply to exposed interior of tanks and concrete environmental structures to twelve inches (12”) below lowest water surface elevation.
   c. Apply at other locations where indicated.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

   a. Apply where indicated.

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 ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.

1. Apply scratch finish to surfaces indicated, to receive concrete floor toppings or, to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to receive trowel finish, and to be covered with fluid-applied or sheet waterproofing, or built-up or membrane roofing.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view, or to be covered with resilient flooring, carpet, or tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

   a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
   b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
   c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
   d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated, or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Apply a trowel and fine-broom finish where indicated.

2. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

F. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

1. Apply a broom finish to exterior concrete platforms, exterior suspended slabs, steps, and ramps, and elsewhere as indicated.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule finish.

1. Apply according to manufacturer's written instructions and as follows:
   a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate or aluminum granules over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
   b. After broadcasting and tamping, apply float finish.
   c. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules.
2. Apply a slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.

2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

4. Apply dry-shake floor hardener finish on all floor surfaces receiving float finish or trowel finish.

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 non-shrink grout, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment. Use non-shrink grout to fill in under equipment bases.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

D. Use grout to form floor slopes in manholes, valve structures, channel bottoms, clarifier floors and like work where a fine grade of concrete mix is necessary for thin grading with a smooth finished surface.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. 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 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment on interior concrete floors that will not receive floor covering according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less the time indicated by treatment manufacturer, minimum seven (7) days.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 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 one month. 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 joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

C. 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 wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

D. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

E. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.17 CONCRETE INTERNAL REPAIRS

A. Concrete that is honeycombed, damaged, or otherwise defective below the surface shall be repaired or removed and replaced.

B. The plan for effecting the repair shall be approved by the Engineer prior to the beginning of the repair work.

3.18 BACKFILLING NEW CONCRETE WALLS

A. Placement and compaction of fill adjacent to new concrete foundations and walls shall not begin less than 14 days after placement of concrete.

B. Walls may be backfilled simultaneously on both sides after 7 days.

C. Heavy equipment shall not be allowed within 3 feet of a new concrete foundation or wall. Compaction shall be with hand tamping or small, manually directed equipment.

3.19 LOADING

A. Do not drive on or load slabs before 14 days have elapsed after concrete placement, unless otherwise specified.

B. Loads shall not be applied to new concrete walls before 14 days have elapsed after concrete placement. Backfill on one side is considered a load.

C. Loads shall not be applied to new concrete columns before 28 days have elapsed after concrete placement, or when concrete has attained its design compressive strength; whichever comes first, unless otherwise specified on the drawings.

3.20 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

6. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Aggregate Tests

1. Aggregate stored on site for use with site-mixed concrete shall be tested from samples secured from the aggregates at the point of batching.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231, pressure method, for normal-weight concrete; and ASTM C173, 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 mixture.

4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

5. Lightweight Structural Concrete Unit Weight: ASTM C567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C31.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. To Verify Strength For Removal Of Shoring And Reshoring In Multistory Construction: Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

8. For field-cured specimens, 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.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

12. Flatness and Levelness Tests: Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of finishing.

E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete, at Contractor's expense, when test results indicate that requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Engineer.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03300

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Hand Auger Borings on Tuesday, December 8, 2020			
Measurements*	Hand Auger Location****		
	MH 2	MH 7	End
Boring Depth (ft)	8	4.5	9
Groundwater Readings (ft)**	5.2	4.4	Dry
At Completion (ft)***	4.9	3.9	8.9

*fluctuations in groundwater level can occur. Data does not constitute a full geotechnical report. Measurements taken from ground level.

**At time of boring

***24 hours after boring

****Locations are approximate

QUESTIONS AND RESPONSES LIST NO. 2
FOR THE
ANDERSON WHITE RIVER INTERCEPTOR PHASE IIA

The following questions that did not warrant revisions to the Contract Documents have been presented by potential bidders for the White River Interceptor Phase IIA Project. Responses to these questions are provided below. These questions and responses serve only to clarify the Bidding Documents and the Contract Documents, as applicable. The responses to these questions do not modify in any respect the conditions and provisions of the Contract Documents. In the event of a conflict between these responses and the Contract Documents, the provisions of the Contract Documents shall supersede these responses.

1. Q: We are being told by A-Lok that the 72" RCP cannot be gasketed in a 10' ID manhole, that it will either need to be 12' ID or a flat wall structure, such as a 10'x10'. Can you clarify what can be used?

   A: It is applicable to use non-shrink grout for connection of 72" RCP pipe to the manholes and conflict structures. A specification has been added via Addendum #3.

2. Q: The allowable tolerances given for manholes referenced in Specification 02530, would ASTM C-478 be acceptable, ASTM C-478 lists tolerances given within specification that our structures meet or exceed.

   A: Section 2.7.A.1 addresses this concern.

3. Q: Specification 02530 Section 2.7.A.2.c says, "Flat Slab Tops shall be designed according to ASTM C-478 outside the right of way and AASHTO if located within the right of way". Would ASTM C-478 take care of both inside and outside right of ways areas for the top slabs?

   A: All manholes for this project are currently outside of any dedicated rights-of-way. However, the AASHTO reference will remain in the chance that the project is amended in the future to include work within a traffic bearing area.

4. Q: Is there a specific reason that the Water Infiltration test per Specification 02530 Section 3.8.E has a maximum allowable infiltration rate of 100 gal/in/mi/day?

   A: Due to the location of the pipe, the shallow depth of cover, and the conveyance of combined sewage, the maximum infiltration has been set to a higher standard.

5. Q: Specification 02530 Section 2.5.B.1 says as per ASTM C-76 but Section 2.5.C.2 says, "both the bell and spigot shall contain circumferential reinforcement". ASTM C-76 does not read this way and we are requesting clarification as to if ASTM C-76 circumferential reinforcement is acceptable the way the specification reads.

A: ASTM C76-20 Section 8.3 covers joint reinforcement. ASTM C76-20 Section 8.3.2.1 requires bell reinforcement for all pipe 12 inches in diameter or larger. Our specification also requires spigot reinforcement which is covered in ASTM C76-20 Section 8.3.2.2 stating that any required spigot reinforcement is required to have a maximum end cover on the last circumferential shall be 2 inches.

6. Q: Do pre-cast manhole shop drawings need to have an engineer's seal before being submitted for review?

   A: Yes, design calculations must be sealed and certified by a Professional Engineer licensed in the State of Indiana.

7. Q: In Specification 02530 Section 2.7.B.1, do all listed requirements need to be met, or are points *b* and *c* required only if applicable?

   A: All requirements must be met under 2.7.B.1.

8. Q: In Specification 02530 Section 1.6.A, is it acceptable for the manufacturer to be certified under other organizations not outlined in the specification?

   A: Reinforced concrete pipe manufacturer can be certified under ACPA or equal in place of being ISO 9001 registered.