

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install cast-in-place concrete, reinforcement and related materials.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete.

1.2 QUALITY ASSURANCE

A. Source Quality Control:

1. Concrete Testing Service:

- a. OWNER shall employ acceptable testing laboratory to perform materials evaluation, testing and design of concrete mixes.

B. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ACI 301, Specifications for Structural Concrete for Buildings (includes ASTM Standards referred to herein except ASTM A 36).
2. ACI 304, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3. ACI 305, Hot Weather Concreting.
4. ACI 306, Cold Weather Concreting.
5. ACI 315, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
6. ACI 318, Building Code Requirements for Reinforced Concrete.
7. ACI 347, Guide to Formwork for Concrete.
8. ACI 350, Environmental Engineering Concrete Structures.
9. ASTM A 36, Specification for Structural Steel.
10. Concrete Reinforcing Steel Institute, Manual of Standard Practice, includes ASTM Standards referred to herein.

1.3 SUBMITTALS

- ###### A. Samples: Submit samples of materials as specified and may be requested by ENGINEER, including names, sources and descriptions.

- B. Shop Drawings: Submit for approval the following:
1. Copies of manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures, bonding agents, and concrete related materials.
 2. Drawings for fabrication, bending, and placement of concrete reinforcement, and reinforcement accessories. Comply with ACI 315, Chapters 1 through 7.
 3. Concrete Mix Design Report:
 - a. All concrete mix design report shall be submitted to ENGINEER at least 15 days prior to start of Work. Do not begin concrete production until mixes have been reviewed and are acceptable to ENGINEER. Mix designs may be adjusted when material characteristics, job conditions, weather, test results or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by ENGINEER.
 - b. Concrete mix design proportions.
 - c. Mill test reports covering chemical and physical properties of cement included in concrete design mix.
 - d. Sieve analysis report of fine and coarse aggregates to show compliance with specified requirements.
 - e. Manufacturer's literature on all admixtures used in the mix design.
 - 1) All admixtures must be included and tested in the concrete design mix to predetermine satisfactory results.
- C. Laboratory Batch Trial Test Reports: ENGINEER'S review will be for general information only. Production of concrete to comply with specified requirements is the responsibility of CONTRACTOR.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. All materials used for concrete must be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer. Bins or platforms having hard clean surfaces shall be provided for storage. Suitable means shall be taken during hauling, piling and handling to insure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II.

- B. Aggregates: ASTM C 33.
 - 1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank run sand and manufactured sand are not acceptable.
 - 2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.
- C. Coarse Aggregate Size: Size to be ASTM C 33, Nos. 57 or 67, unless permitted otherwise by ENGINEER.
- D. Water: Clean, drinkable.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Water-Reducing Admixture: ASTM C 494, Type A. Only use admixtures which have been tested and accepted in mix designs. Only to be added onsite by a certified admixture representative of the concrete supplier.
- G. Water-Reducing High Range Admixture: ASTM C 494, Type F/G. Only use admixtures which have been tested and accepted in mix designs. Only to be added onsite by a certified admixture representative of the concrete supplier.

2.2 CONCRETE

- A. Proportioning and Design Mix
 - 1. Minimum compressive strength at 28 days: 4000 psi.
 - 2. Maximum water cement ratio by weight: 0.44.
 - 3. Minimum cement content: 564 pounds per cubic yard.
 - 4. Normal weight: 145 pounds per cubic foot.
 - 5. Use air-entraining admixture in all concrete: provide not less than 4 percent nor more than 8 percent entrained air for all concrete.
 - 6. Slump Limits:
 - a. Proportion and design mixes to result in concrete slump at the point of placement of not less than 1 inch and not more than 4 inches. If Water-Reducing Admixtures or Superplasticizers are used slump after addition of the admixture shall not exceed 8 inches.
 - 7. Calcium Chloride: Do not use calcium chloride in concrete, unless otherwise authorized in writing by ENGINEER. Do not use admixtures containing calcium chloride.

2.3 FORM MATERIALS

- A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.
- B. Exposed Concrete Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces. Use largest practical sizes to minimize form joints.
- C. Unexposed Concrete Surfaces: Suitable material to suit project conditions.
- D. Provide 3/4-inch chamfer at all exposed corners.
- E. Form Ties:
 - 1. Provide factory-fabricated, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal. Materials used for tying forms will be subject to approval of ENGINEER.
 - 2. Unless otherwise, shown, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1-inch from the outer concrete surface. Unless otherwise shown, provide form ties that will leave a hole no larger than 1-inch diameter in the concrete surface.
 - 3. Ties for exterior walls and walls subject to hydrostatic pressure shall have waterstops.
 - 4. Provide wood or plastic cones for ties, where concrete is exposed in the finish structure and in the interior of tanks.
 - 5. Wire ties are not acceptable.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60.
- B. Welded Wire Fabric: ASTM A 185.
- C. Steel Wire: ASTM A 82.
- D. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
 - 1. Use wire bar type supports complying with CRSI recommendations, except as specified below. Do not use wood, brick, or other unacceptable materials.
 - 2. For slabs on grade, use supports with sand plates or horizontal runners where base materials will not support chair legs.
 - 3. For all concrete surfaces, where legs of supports are in contact with forms, provide supports complying with CRSI, Manual of Standard Practice as follows:
 - a. Either hot-dip galvanized, plastic protected or stainless steel legs.

- E. Adhesive Dowels:
1. Where adhesive dowels are shown or required to be installed into concrete, adhesive material shall be used for the installation of all reinforcing bars.
 2. Adhesive Material:
 - a. Capsule or injectable adhesive material shall be a two-component system which includes a hardener and a resin.
 - b. Product and Manufacturer: Provide adhesive material by one of the following:
 - 1) HY 150 or HVA capsule by Hilti Fastening Systems, Inc.
 - 2) Power-Fast or Needle-Capsule by Powers Fastening, Inc.
 - 3) Or equal.
 3. Dowel:
 - a. Dowel reinforcing bars shall meet the ASTM standards for Grade 60, A615 steel.
- F. Form Savers: Form savers may be used as a mechanical connection in applications where drilling holes in form material is not desired. This connection shall be a full mechanical connection that shall develop in tension or compression, as required, at least 125 percent of specified yield strength (f_y) of the bar in accordance with ACI 318 Section 12.14.3.
1. Product and Manufacturer: Provide on of the following:
 - a. Form Saver by Lenton Rebar Splicing Division of Erico Products, Inc.
 - b. Or equal.

2.5 RELATED MATERIALS

- A. Construction Joint Waterstops
1. Polyvinylchloride (PVC) Waterstops:
 - a. Provide PVC waterstops complying with Corps of Engineers CRD-C572.
 - b. Provide serrated type with a minimum thickness of 3/8 inch by a minimum width of 6 inches may be provided in specific applications as approved by the ENGINEER.
 - c. Product and Manufacturer: Provide PVC waterstops as manufactured by one of the following:
 - 1) Style No. 783 or No. 724, Greenstreak Plastic Products Company.
 - 2) Style No. R6-38T or No. RSB6-38, Vinylex Corporation.
 - 3) Or equal.
 2. Adhesive Waterstop:
 - a. Provide preformed adhesive waterstop in construction joint locations where shown, or as alternative to PVC waterstop where appropriate.
 - b. The preformed waterstop shall meet or exceed all requirements of Federal Specifications SS-S-210A, "Sealing Compounds for Expansion Joints".
 - c. Product and Manufacturer: Provide waterstops as manufactured by one of the following:
 - 1) Synko-Flex Waterstop by Synko-Flex Products, Division of Henry Products, Inc.
 - 2) Or equal.

3. Hydrophilic Waterstops:
 - a. Hydrophilic waterstop may be used as an alternate to the adhesive waterstop.
 - b. Product and Manufacturer: Provide waterstops as manufactured by one of the following:
 - 1) Hydrotite CJ-0725-3K and Leakmaster LV-1, Greenstreak Plastic Products Company.
 - 2) Adeka MC201OM and P201 by Adeka, Inc.
 - 3) Or equal.

- B. Membrane-Forming Curing compound: ASTM C 309, Type I-D.
 1. Provide without fugitive dye when requested by ENGINEER.

- C. Epoxy Bonding Agent:
 1. Two-component epoxy resin bonding agent.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Sikadur 32, Hi-Mod LPL, as manufactured by Sika Chemical Corporation.
 - 2) Epoxite Binder (Code No. 2390), as manufactured by A.C. Horn, Incorporated.
 - 3) Or equal.

- D. Latex Bonding Adhesive:
 1. Provide a latex bonding adhesive formulated for use in both interior and exterior locations. The bonding adhesive shall be stable in submerged locations and shall not be affected by chlorine. Adhesive shall be capable of being applied to damp or dry surfaces. The latex bonding adhesive shall comply with ASTM C1059, Type II, where specified.
 2. Product and Manufacturer: Provide one of the following:
 - a. Weld-Crete by Larsen Products Corp.
 - b. Or equal.

2.6 GROUT

- A. Nonshrink Grout:
 1. Prepackaged nonstaining cementitious grout requiring only the addition of water at the job site.
 2. Product and Manufacturer: Provide one of the following:
 - a. Euco N-S, as manufactured by the Euclid Chemical Company.
 - b. Masterflo 713, as manufactured by Master Builders Company.
 - c. Or equal.

- B. Grout Fill:
 1. Except where otherwise specified use 1 part cement to 3 parts sand complying with the following:
 - a. Cement: ASTM C 150, Type II.
 - b. Fine and Coarse Aggregate (No. 7) meeting ASTM C 33.

- c. Specified 28-day Compressive Strength: 3,000 psi.
- d. Maximum Water-Cement Ratio by Weight: 0.50.
- e. Air Content Percentage $7\pm 1\%$.
- f. Minimum Cement Content in Pounds per Cubic Yard: 611.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer shall examine the substrate and the conditions under which Work is to be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 FORMWORK

- A. Construct the concrete members and structures to correct size, shape, alignment, elevation and position, complying with ACI 347.
- B. Provide openings in formwork to accommodate Work of other trades. Accurately place and securely support items built into forms.
- C. Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required. Retighten forms during and after concrete placement if required to eliminate mortar leaks.

3.3 REINFORCEMENT MATERIALS

- A. Comply with the applicable recommendations of specified codes and standards, and CRSI, Manual of Engineering and Placing Drawings, for details and methods of reinforcement placement and supports.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Position, support, and secure reinforcement against displacement during formwork construction or concrete placement, including sidewalks. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
 - 1. Place reinforcement to obtain the minimum concrete coverages as shown and as specified in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set with ties so that twisted ends are directed away from exposed concrete surfaces.

2. Reinforcing steel shall not be secured to forms with wire, nails or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.
- D. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- E. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars in accordance with ACI 318.
- F. Install welded wire fabric in as long lengths as practical, lapping at least one mesh. Locate and support fabric by metal chairs, runners, bolsters, spacers and hangers, as required for proper placement of the concrete.
- G. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates and instructions provided under other Sections and other contracts for locating and setting. Refer also to Paragraph 1.1.B., Coordination.
- H. Adhesive Dowels:
1. Drilling equipment used and installation of adhesive dowel shall be in accordance with manufacturer's instructions.
 2. Assure that embedded items are protected from damage and are not filled in with concrete.
 3. Unless otherwise shown or approved by ENGINEER conform to following for adhesive dowels:

<u>Bar Size</u>	<u>Embedment Depth</u>
#3	3 ¾"
#4	5 ½"
#5	7"
#6	8 ½"
#7	10"
#8	11 ¾"
#9	12 ¾"

(If an alternate adhesive material is submitted, CONTRACTOR must submit embedment depths per manufacture's recommendation. Embedment depths shall be based on a compressive strength of 2000 psi when embedded into existing concrete.)

4. The CONTRACTOR shall comply with the adhesive material manufacturer's installation instructions on the hole diameter. The CONTRACTOR shall properly clean out the hole utilizing a synthetic brush and compressed air to remove all loose material from the hole, prior to installing adhesive capsules or material. Proper mixing of the two-component system shall be done to the manufacturer's recommendations.
5. Adhesive material manufacturer's representative shall observe and demonstrate the proper installation procedures for the adhesive dowels and adhesive material at no additional expense to the OWNER. Each installer shall be certified in writing by the manufacturer to be qualified to install the adhesive dowels.

3.4 CONSTRUCTION JOINTS

- A. Comply with ACI 301, Chapter 6, and as specified below.
- B. Locate and install construction joints as shown. Additional construction joints shall be located as follows:
 1. In walls locate joints at a spacing of 50 feet maximum.
 2. Provide other additional construction joints as required to satisfactorily complete all work.
- C. Horizontal Joints:
 1. Roughen the surface in an acceptable manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, or damaged concrete at the surface.
 2. Remove laitance, waste mortar or other substance which may prevent complete adhesion.
 3. For concrete over 45 days old, apply concrete epoxy bonding adhesive prior to placing new concrete.
- D. Vertical Joints:
 1. Roughen the surface in an acceptable manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, or damaged concrete at the surface.
 2. Remove laitance, waste mortar or other substance which may prevent complete adhesion.
 3. For concrete over 45 days old, apply concrete epoxy bonding adhesive prior to placing new concrete.

3.5 BONDING TO HARDENED CONCRETE

- A. The surface of hardened concrete upon which fresh concrete is to be placed shall be rough, clean, sound, and damp. Before placement of new plastic concrete, the hardened surface shall be cleaned of all laitance and foreign substances (including curing compound), washed with clean water and wetted thoroughly.

- B. For bonding to hardened concrete less than 30 days old, coarse aggregate shall be omitted from the first batch or batches of concrete placed against hardened concrete. The mortar puddle shall cover the hardened concrete with at least 2 inches at every point.
- C. Use epoxy bonding agent for the following:
 - 1. Bonding of fresh concrete to concrete cured greater than 30 days or to existing concrete.
 - 2. Handle and store epoxy adhesive in compliance with the manufacturer's printed instructions, including safety precautions.
 - 3. Mix the epoxy adhesive in complete accordance with the instructions of the manufacturer.
 - 4. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy grout not less than 1/16-inch thick. Place fresh concrete while the epoxy material is still tacky, without removing the in-place grout coat, and as directed by the epoxy manufacturer.

3.6 LATEX BONDING ADHESIVE

- A. Use latex bonding adhesive as an alternative to epoxy bonding agent in specific applications as approved by the ENGINEER.
- B. Handle and store latex bonding adhesive in compliance with the manufacturer's printed instructions, including safety precautions.
- C. Mix the latex bonding adhesive in complete accordance with the instructions of the manufacturer.
- D. Before applying latex bonding adhesive, thoroughly roughen and clean hardened concrete surfaces.
- E. Latex bonding adhesive shall not be exposed to water from the time it is placed up to a period of at least 7 days after the concrete has been placed.

3.7 CONCRETE PLACEMENT

- A. CONTRACTOR is solely responsible for the means and methods used to properly transport concrete onsite from the unloading point to the point of placement. The mechanism and equipment used to properly transport concrete shall be closely considered when the CONTRACTOR is planning his Work. Pumping of concrete is not required, however, if the CONTRACTOR fails to place the concrete to the satisfaction of the OWNER and ENGINEER by means other than pumping, the concrete shall be pumped by the CONTRACTOR at no additional cost to the OWNER.

- B. Concrete shall not be placed until all reinforcement materials are inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.
- C. Inspection: Notify OWNER and ENGINEER at least 1 full working day in advance before starting to place concrete.
- D. Manufacturing and delivery shall be in accordance with ASTM C 94.
- E. Discharge Time:
 - 1. As determined by set time, do not exceed 1-1/2 hours after adding cement to water unless special approved time delay admixtures are used. Coordinate time delay admixture information with manufacturer and ENGINEER prior to placing concrete.
 - 2. Maintain required slump throughout time of concrete placement and consolidation. Discontinue use of high range water reducing admixture (superplasticizers) and provide new mix design if it fails to maintain slump between 4 to 6 inches and produce good consolidation for the length of time required. Redesign mix adjusting set control admixtures to maintain setting time in range required.
- F. Job-Site Mixing: Not permitted for this project.
- G. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
- H. Concrete Placement: Comply with ACI 304, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.
- I. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
- J. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.
- K. Pumping of Concrete:
 - 1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to assure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
 - 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
 - 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- L. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping, so that concrete is worked around reinforcement and other embedded items and into all parts of forms.

1. Consolidate concrete with internal vibrators with minimum frequency of 8,000 cycles per minute and amplitude as required to consolidate concrete in section being placed.
 2. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.
 3. Consolidation Equipment and Methods: ACI 309R.
 4. During concrete placement, vibration consolidation shall not exceed distance of 3 feet from point of top of concrete being placed.
 5. Vibrate concrete in vicinity of joints to obtain impervious concrete.
- M. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement, and curing.
1. In hot weather comply with ACI 305.
 2. In cold weather comply with ACI 306.

3.8 CURING

- A. Curing: Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours or apply curing compound immediately after final floating and finish. Continue curing through use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protection as required to prevent damage to exposed concrete surfaces.

3.9 FINISHES

- A. Slab Finish:
1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Use a wood float only. Check and level the surface plane to a tolerance not exceeding 1/4-inch in 10 feet when tested with a 10 foot straightedge placed on the surface at not less than 2 different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.
 2. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
 3. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straight edge. Grind smooth surface defects which would telegraph through applied floor covering system.
 4. Use trowel finish for the following:
 - a. Interior exposed slabs unless otherwise shown or specified.
 5. Apply non-slip broom finish to exterior concrete slab and elsewhere as shown on the Drawings.

B. Formed Surfaces:

1. Rough Form Finish:

- a. Standard rough form finish shall be the concrete surface having the texture imparted by the form material used, with tie holes and defective areas repaired and patched with mortar of 1 part cement to 1 1/2 parts sand and all fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.
- b. Use rough form finish for the following:
 - 1) Exterior vertical surfaces up to 1 foot below grade.
 - 2) Interior exposed vertical surfaces of liquid containers up to 1 foot below liquid level.
 - 3) Interior and exterior exposed beams and undersides of slabs.
 - 4) Other areas shown.

2. Smooth Form Finish:

- a. Produce smooth form finish by selecting form materials which will impart a smooth, hard, uniform texture. Arrange panels in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas as above with all fins or other projections completely removed and smoothed.
- b. Use smooth form finish for surfaces that are to be covered with a coating material. The material may be applied directly to the concrete or may be a covering bonded to the concrete such as waterproofing, dampproofing, painting or other similar system.

3. Smooth Rubbed Finish:

- a. Provide smooth rubbed finish to concrete surfaces which have received smooth form finish as follows:
 - 1) Rubbing of concrete surfaces not later than the day after form removal.
 - 2) Moistening of concrete surfaces and rubbing with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
- b. Except where surfaces have been previously covered as specified above, use smooth rubbed finish for the following:
 - 1) Interior exposed walls and other vertical surfaces.
 - 2) Exterior exposed walls and other vertical surfaces down to 1 foot below grade.
 - 3) Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
 - 4) Interior exposed vertical surfaces of liquid containers down to 1 foot below liquid level.
 - 5) Other areas shown.

4. Grout Cleaned Finish:

- a. Provide grout cleaned finish to concrete surfaces which have received smooth form finish as follows:
 - 1) Combine 1 part portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches,

so that the final color of dry grout will closely match adjacent concrete surfaces.

- 2) Thoroughly wet the concrete surface and apply grout uniformly by brushing or spraying immediately to the wetted surfaces. Scrub surface with cork float or stone to coat surface and fill surface holes. Remove excess grout by scraping, followed by rubbing with clean burlap to remove any visible grout film. Keep grout damp during the setting period by means of fog spray at least 36 hours after final rubbing. Complete any area in the same day it is started, with the limits of any area being natural breaks in the finished surface.
- b. Except where surfaces have been previously covered as specified above, use grout cleaned finish for the following:
 - 1) Interior exposed walls and other vertical surfaces.
 - 2) Exterior exposed walls and other vertical surfaces down to 1 foot below grade.
 - 3) Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
 - 4) Interior exposed vertical surfaces of liquid containers down to 1 foot below liquid level.
 - 5) Other areas shown.
5. Related Unformed Surfaces:
 - a. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.10 GROUT PLACEMENT

A. Nonshrink:

1. Place nonshrink grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until ENGINEER provides clarification.
2. Drypacking of nonshrink grout will not be permitted.
3. Placing grout shall conform to the temperature and weather limitations described in Article 3.4 above.

B. Grout Fill:

1. Grout Fill shall be placed, cured, and finished as described in Article 3.7, 3.8 and 3.9.

3.11 FIELD QUALITY CONTROL

A. Reinforcement Materials

1. The CONTRACTOR shall correct improper workmanship, remove and replace, or correct as instructed, found unacceptable or deficient.

2. Adhesive Dowels:
 - a. OWNER will retain an independent testing laboratory to perform field quality testing of installed adhesive dowels. A minimum of ten percent of the adhesive dowels shall be tested to fifty percent of the yield capacity of the reinforcing bar.
 - b. CONTRACTOR shall provide access for the testing agency to places where work is being produced so that required inspection and testing can be accomplished.
 - c. If failure of any of the adhesive dowels occur, the CONTRACTOR will be required to pay for the costs involved in testing the remaining ninety percent of the adhesive dowels.
 - d. The CONTRACTOR shall pay for all corrections and subsequent tests required to confirm the integrity of the dowels.
 - e. The independent testing and inspection agency shall complete a report on each area. The report should summarize the observations made by the inspector and be submitted to the ENGINEER.

B. Concrete Work

1. Quality Control: OWNER'S testing laboratory will perform sampling and testing during concrete placement, as follows:
 - a. Sampling: ASTM C 172.
 - b. Slump: ASTM C 143, one test for each load at point of discharge.
 - c. Air Content: ASTM C 31, one for each set of compressive strength specimens.
 - d. Compressive Strength: ASTM C 39, one set of 4 cylinders for each 50 cubic yards or fraction thereof of each class of concrete as directed by OWNER or ENGINEER; 1 specimen tested at 7 days, 2 specimens tested at 28 days, 1 specimen tested at 56 days.
 - e. Report test results in writing to ENGINEER on same day tests are made.
2. Cut out and properly replace to the extent ordered by ENGINEER, or repair to the satisfaction of ENGINEER, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Patches or plastering will not be acceptable.
3. Repair, removal, and replacement of defective concrete as ordered by ENGINEER shall be at no additional cost to OWNER.

+ + END OF SECTION + +