SECTION 031000

CONCRETE FORMING & ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Specifications, apply to work of this Section.
B. 033000 - Cast-in-Place Concrete
C. 032000 - Concrete Reinforcements

1.02 SCOPE

A. Furnish labor and materials necessary to install a complete system.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.
B. ACI 301 "Specifications for Structural Concrete for Buildings"
C. ACI 318 "Building Code Requirements for Reinforced Concrete".
D. Regulatory Requirements:
    1. Provide formwork and shoring design by a professional Structural Engineer registered in the same state as the Work and submit to public authority for approval.
    2. Provide inspection of formwork and shoring, and of reshoring, by a professional Structural Engineer registered in the same state as the Work and submit report of inspections as required by public authority.

1.04 SUBMITTALS

A. Submit pursuant to 013000 Shop Drawings, Product Data, Samples.
B. Submit pursuant to 016000 Product Options.
C. Design formwork for structural stability, safety, requirements of public authority, and compliance of the resulting concrete work with the Contract Documents.
D. Formwork joint and shoring design.
E. Trench drains

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workmen familiar with the work and according to manufacturers recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.
B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 FORMWORK MATERIALS

A. Description: In addition to ACI 301 requirements, provide forms that retain their shape and strength after exposure to severe weather conditions.

2.02 PLYWOOD FORMS

A. Description:
   1. For natural concrete finish, smooth or rough form: APA B-B Plyform or better.

2.03 FORM ACCESSORIES

A. Bevel (Chamfer) and Reveal (Rustication) Strips: Clear softwood, planed, not rough sawn. PVC or rubber may be used if held rigid and straight.
   1. Bevel size: 3/4 in. x 3/4 in. unless otherwise shown.
   2. Reveal size: 3/4 in. deep x 1-1/4 in. wide trapezoid at surface of concrete, unless otherwise shown.

B. Stiffeners, Clamps, Frames, Walers, Strongbacks, Braces, Scaffolds, Ties, Bolts and Other Components of Formwork Assemblies: Provide as needed to produce formwork specified in ACI 301.

C. Form Release Agent: Compound that will release forms without discoloring concrete, will not impart roughness of concrete and will not interfere with adhesion, color of coatings or other construction which is to be applied over concrete. Do not use oil.

2.04 EMBEDDED ITEMS

A. Sleeves: Galvanized steel or plastic with wall thickness not less than 1/8 in.

B. Blockouts: Wood or rigid foam plastic; removable without damage to concrete.

2.05 SIDE FORMS

A. Description: Use clean steel or wood forms with stakes or other supports which will withstand fluid, placing and finishing pressures without bowing, inclining or leaking.
   1. Top Edges: Smooth and straight, suitable for use as screeds in guiding strikeoffs without bumps or chatter.

2.06 JOINT FILLER AND SEALANT

A. Nonextruding, Resilient, Preformed Fiber Joint Filler: Asphalt saturated cellulose fibers or cork particles encased between two (2) asphalt saturated glass felt liners.
   1. Cap: Provide plastic cap at top edge of joint filler strip to protect filler from dirt intrusion and as a bond breaker when sealant is applied.
   2. Sealant: Self-leveling urethane.
   3. Referenced standard: ASTM D1751.

B. Bond Breaker: 15 lb./sq. asphalt coated glass fiber base sheet cut in strips equal to full depth of joint.
   1. Referenced standard for base sheet: ASTM D4601, Type I.

C. Self-Leveling Urethane Sealant: Two (2) Part:
   1. Color; Approximately same as concrete.
   2. Hardness when cured; 40 to 60, Shore A Durometer.
   3. Referenced Standard; ASTM C920, Type M, Class 25, Grade P.

2.07 DRAINAGE FILL

A. Description: 3/4 in. washed crushed stone or gravel, or as otherwise specified in 02200 Earthwork.

2.08 INTERIOR FLOOR DRAINAGE SYSTEM FOR APPARATUS BAYS

A. See Section 102815 for Trench Drain Specifications

2.09 CONSTRUCTION JOINT (vertical (wall) applications)

A. Key-Loc Joint System by Form-A-Key Products, Division of Cardinal Mfg. Co., Inc., Louisville, NY 40214, 502-361-1396; fax 502-363-5905 or approved equivalent.
B. Metal keyway shall be 24 gauge galvanized steel with dowel knockouts at 6" centers.
C. Wood forms for construction joints may be used in lieu of prefabricated metal keyways.
D. Accessories include splice pieces, stakes and clips and stay-in-place cap Model #2137.

2.10 CONTROL JOINT FOR SLAB WITH IN-SLAB HEATING (in lieu of saw cutting slab)

A. Two-piece control joint former
B. Greenstreak, 1-800-325-9504, rubber modified polystyrene thermoplastic polymer or approved equivalent.
   1. 6" Slab or thicker: Use Model 856-2"
C. Snap line or use other method for straight line installation.

2.11 VAPOR RETARDER

A. Vapor barrier must have all of the following qualities
   1. Permeance of less than 0.01 Perms [grains/(ft^2 * hr * inHg)] as tested in accordance with ASTM E 1745 Section 7.
   2. Other performance criteria:
      a. Strength: ASTM E 1745 Class A
      b. Thickness: 15 mils minimum.
B. Products: Stego Wrap 15 mil. vapor retarder, Stego Industries, LLC (stegoindustries.com), or approved equivalent.

2.12 WATERSTOPS (at elevator pit)

A. Description: Heat Fusible Polyvinyl Chloride (PVC).
   1. Size: 6 x 3/16 in. or larger.
   2. Profile: Ribbed with center bulb.
   3. Accessories: Provide junction-making materials and factory formed T's, L's and X's.

PART 3 EXECUTION

3.01 MODIFICATIONS TO ACI 301

A. The following provisions modify (change, delete from or add to) ACI 301. Where any part of ACI 301 is modified by these provisions, the unaltered parts of ACI 301 shall remain in effect. Where "acceptable" is used or "subject to acceptance" is required in ACI 301, acceptance shall mean approval by Architect or Structural Engineer of record.
B. Chapter 4, Formwork:

1. ADD to Par. 4.1.3. Form sides of footings except in rock that has been cut to precise footing profile.
2. ADD to Par. 4.2.1. Provide formwork and shoring design by a professional Structural Engineer registered in the same state as the Work and submit to public authority for approval.
3. ADD to Par. 4.2.1. Provide inspection of formwork and shoring, and of reshoring, by a professional Structural Engineer registered in the same state as the Work and submit report of inspections as required by public authority.
4. ADD to Par. 4.2.7. Seal joints at temporary openings and between form pieces with compressible tape that will not leak grout or water; flush with exposed surface.
5. ADD to Table Par. 4.3.1: 7.C. Slope toward nosing in step treads: 1/16 in. +/- 1/32 in. Treads shall not pond water at any point.
6. Par. 4.4.2.1. DELETE "acceptable". No approval of form coating is required if the Specification for form release agent is met.
7. ADD to Par. 4.5.5. Minimum strength of concrete in beams and slabs at time of form removal: 75% of specified f'c as determined by cylinder compression tests. Reshore until f'c equals 100% of design strength.

C. Chapter 6, Joints and Embedded Items.
1. Par. 6.1.4. DELETE "When required or permitted, bond shall be obtained by … REPLACE with "Obtain bond by …".
2. ADD to Par. 6.2.2. When the Work is nearly complete, clean top of joint filler, install bond breaker and seal with self-leveling urethane sealant. Plastic cap at top of joint filler material may be used as bond breaker. If depth of urethane will be equal to approximately half of joint width.
3. ADD to Par. 6.3.2. Set waterstops in place with centerline of waterstop at centerline of joint. Secure waterstops in straight lines without twisting. Wire extreme outer edge of waterstop to reinforcing on each side, or, in the case of split flanges, nail fully spread against joint form. Carry waterstops around corners, without splicing.
4. ADD to Par. 6.3.3. Use prefabricated Ts, Ls, and crosses so that all splices are butt joints.
5. ADD Par. 6.3.4. Clean dust, dirt, and hardened concrete from waterstops, then vibrate fresh concrete around waterstops so that full bond with concrete is ensured, free of voids.

D. Chapter 9, Repair of Surface Defects.
1. ADD Par. 9.1.1. Grind fins and projections as needed to allow smooth application of waterproofing and finishes.
2. ADD Par. 9.1.2. Fill honeycomb, bugholes, and other voids or depressions as needed to allow smooth application of waterproofing and finishes.

E. Chapter 10, Finishing of Formed Surfaces.
1. ADD to Par. 10.2.1. At surfaces to which waterproofing will be applied, provide rough form finish and prepare surface by grinding fins and projections, removing nails, and by filling honeycomb, bugholes, and other voids or depressions with firmly adhered grout.
2. ADD to Par. 10.2.2. Provide smooth form finish at exposed surfaces, whether or not shown to receive architectural finish.
3. ADD to Par. 10.4.2. In addition to walls, columns, ceilings, and soffits generally, surfaces exposed to public view include, but are not limited to, surfaces such as walls of interior and exterior stairways, elevator hoistways, walls and ceilings in spaces or tunnels with 6 ft or greater headroom, and backs of parapet walls. Surfaces which will receive furring, contact plaster, or suspended ceiling are not exposed surfaces.

F. Chapter 11, Slabs.

1. ADD to Par. 11.2.1. Place interior slabs on ground directly on vapor retarder over a layer of approved granular, self-draining compactible fill (NOT concrete-type sand). A clean manufactured sand containing a significant amount of rock dust (No. 10 grading per ASTM D 448) is usually ideal. This granular base course of drainage fill should be wetted and compacted to a minimum thickness of 6 in. or as required by geotechnical report.
2. ADD the following to Par. 11.2:
   a) 11.2.4 Place and seal vapor retarder over base course or other substrate.
   b) 11.2.5 Lap vapor retarder sheet sides and ends 6 in. and sealed so they are vapor-tight. Retarder sheets should be fitted around service openings. There should be no holes in the sheets. Turn sheets up 4 in. above top of subslab fill at walls and columns.
   c) 11.2.6 Protect vapor retarder from puncture before and during concrete placement.
3. ADD the following paragraphs to Par. 11.5:
   a) 11.5.1. Wall Isolation Joints. Isolate edges of interior slabs on ground from concrete wall surfaces with 1 layer of bond breaker felt or joint filler strip except as shown in drawings.
   b) 11.5.2. Column Isolation Joints. Form diamond-shaped area around each column, each side equal to 2'-6". After slabs have been cast, strip forms, install bond breaker at slab edges, then place concrete around columns.
   c) 11.5.3. Contraction joints (control joints, sawed joints). Cut alternate wires or bars in reinforcement passing through joint. Saw joints to a depth of 1/4 slab thickness or 2" max. as soon as concrete will not ravel. Vacuum or blow groove clean immediately after sawing and insert backer rod to keep joint clean during construction. At least 90 days later, or just before time of Substantial Completion, remove rod, clean groove of debris, replace rod and fill with dead level urethane sealant.
4. ADD the following paragraphs to Par. 11.9:
   a) 11.9.1.1. Provide Class A tolerances at floor areas as shown.
   b) 11.9.2.1. Finish all floor areas to Class B tolerance except as otherwise shown.
   c) 11.9.3.1. Class C flatness tolerances may be provided at floor areas which will receive mortar beds for finish materials.
5. ADD paragraph 11.10 Exterior Traffic Surfaces:
   a) 11.10.1. Provide broom finish at exterior walks and ramps.

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END OF SECTION

SECTION 032000

CONCRETE REINFORCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Specifications, apply to work of this Section.
B. 031000 - Concrete Forming and Accessories
C. 033000 - Cast-in-Place Concrete

1.02 SCOPE

A. Furnish labor and materials necessary to install a complete system.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.
B. ACI 301 "Specifications for Structural Concrete for Buildings".
C. ACI 318 "Building Code Requirements for Reinforced Concrete".
D. ASTM A82 "Standard Specification for Steel Wire, Plain, for Concrete Reinforcement".
E. ASTM A185 "Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement".
F. ASTM A615 "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement with Supplementary Requirements".
G. ASTM A617 "Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement".

1.04 SUBMITTALS

A. Submit pursuant to 013000 Administrative Requirements for Shop Drawings, Product Data, Samples.
    1. Design reinforcing for structural adequacy and compliance with Contract Documents. Obtaining approval required by public authorities shall be responsibility of Contractor. Architect's review and approval will be for compliance with Contract Documents only.
B. Submit pursuant to 016000 Product Requirements.
C. Shop Drawings: Submit
    1. Cutting and bending diagrams.
    2. Placing drawings.
D. Certificates of Compliance for all grades and types of: reinforcing steel, welded wire mesh, fiber reinforcement, expansion bolts, ect. used on the project.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workmen familiar with the work and according to manufacturers recommendations and/or industry standards.

B. Standards: The following standards establish the over all level of quality for products and execution: ACI 301 "Specifications for Structural Concrete for Buildings", ACI 318 "Building Code Requirements for Reinforced Concrete", CRSI MSP-1-86 "Manual of Practice", and CRSI RAS-2-84 "Reinforcement Anchorages and Splices".
   1. Articles or paragraphs starting with a chapter (Chapter), table (Table), or a paragraph (Par.) number refer to ACI 301, and incorporate that part of the referenced standard into this Specification. Text following each reference to ACI 301 modifies the referenced standard.
   2. The words "approved" and "accepted" in this Section and in ACI 301 shall mean approved and accepted by the Architect or the Structural Engineer of record.

C. Regulatory Requirements:
   1. Provide reinforcing shop drawings and submit to the Architect and Structural Engineer of record for approval.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.
B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 MODIFICATIONS TO ACI 301

A. The following provisions replace or repeat parts of ACI 301. Unaltered provisions of Chapter 5 in ACI 301 remain in effect.

2.02 REINFORCING BARS

A. Description: Billet steel deformed bars. Provide plain bars only where shown.
   1. Yield strength: 60,000 lb./sq. in. minimum; Test 8.
   2. Elongation in #4 to #6 bars, 8 in. long: At least 9%; Test 8. Ability to withstand 180 degree bend around pin without cracking;

BAR SIZE	BENDING PIN SIZE
#3 - #5	3.5 bar diameters or less.
#6 - #8	5 bar diameters or less.
#9 - #11	7 bar diameters or less.
#14 - #18	9 bar diameters or less.

   3. Phosphorus content: 0.06% maximum; Test 5.

B. Referenced Standards:
   1. Par. 5.2.1, 5.2.2. of ACI
   2. ASTM A615, Grade 60.

2.03 WELDED WIRE FABRIC

A. Description: Plain welded steel wire grid with a galvanized coating, and if specified on the drawings - deformed welded steel wire grid, uncoated. Provide in flat sheets. Welded intersections shall not be spaced farther apart than 6" in each direction

B. Referenced Standards:
   1. Par. 5.2.4, 5.2.5. of ACI
   2. Plain wire: ASTM A82.
   3. Plain welded wire fabric: ASTM A185.
   4. Deformed welded wire fabric: ASTM A497.
   5. Welded wire fabric galvanized coating:ASTM A123

2.04 TIE WIRE

A. Description: Annealed steel wire of sufficient gage to hold reinforcing steel in place under construction loads. Coating of wire shall be the same as the coating, if any, on reinforcing steel.

2.05 SUPPORTS FROM GROUND OR MUD MAT

A. Description: Steel, galvanized steel, or molded plastic bolsters, chairs, and spacers, or precast concrete blocks, sufficient to withstand construction loads.
B. Referenced Standards: Par. 5.7.3, 5.7.3.1. of ACI.

2.06 FIBER REINFORCEMENT

A. Description: Fiber mesh reinforcing for slabs.
   1. Qualities: Polypropylene fibers engineered and designed for secondary reinforcement of concrete slabs, batch plant mixed at a minimum rate of 1.5 lbs. per cubic yard and fibers not less than 1/2" long.
   2. Standard: ASTM C 1116, Type III.
   3. Sources (or approved equal):
      a) Durafiber, Durafiber Corp.
      b) Fibermesh, Fibermesh Co., Div. Synthetic Industries, Inc.
      c) Grace Fibers, W.R. Grace & Co.

2.07 EXPANSION BOLTS (attaching steel members to concrete or masonry elements)

A. Description: Stud type with a single piece three section wedge and zinc plated in accordance with ASTM B633. Anchors shall be installed in drilled holes and per manufacturer's recommendations.
B. Product: Hilti Kwik Bolt TZ or Kwik Bolt 3, diameter as specified, by Hilti Corp. or approved equal.

2.08 ADHESIVE ANCHOR BOLTS (attaching steel members to concrete elements)

A. Description: Threaded anchor rods, nut and washer and an injectable adhesive (components A and B) material. Anchors shall be installed in drilled holes and per manufacturer's recommendations. Anchor rods supplied in accordance with ASTM A 36, or if required: ASTM F 593 (AISI 304 stainless steel). Nuts shall be furnished to meet the requirements of the above anchor rod specifications. Anchors rods (non-stainless steel), nuts and washers to be zinc plated in accordance with ASTM A 153.

B. Product: Hilti HIT-HY 10 PLUS or HIT-RE 100 (see details), diameter as specified, by Hilti Corp. or approved equal.

PART 3 EXECUTION

3.01 REINFORCING LAP SPLICES & CORNER BARS

A. Reinforcing shall be spliced with laps equal to 40 bar diameters (i.e. #6 = 30" lap).
B. Provide corner bars in walls of the same size and frequency as the horizontal bars in the wall adjacent walls. When size or frequency varies between walls, use the size of the larger bar and its frequency for the corner bars.

3.02 MODIFICATIONS TO ACI 301

A. The following provisions modify (change, delete from or add to) ACI 301. Where any part of Chapter 5 in ACI 301 is repeated or modified by these provisions, unaltered parts of ACI 301 remain in effect.

3.03 CHAPTER 5, REINFORCING

A. ADD: 5.2.7 Ties and Stirrups: Provide deformed bars of same grade as main reinforcing of beam or column. Where deformed bars or matching grade of steel are not available in specified tie or stirrup size, provide ties or stirrups that will develop equal withdrawal resistance and tensile load resistance.

B. ADD to table in Par. 5.7.1: Unformed surfaces in parking structures, vehicular ramps, and bridge decks. Minimum cover 2-1/2 in. unless dimensioned otherwise.

C. ADD to 5.7.3: Turn back tie wires at formed surfaces.

D. ADD to 5.7.4: Do not extend welded wire fabric through expansion joints and isolation joints. Cut alternate wires where fabric crosses control joints. Unless otherwise dimensioned, place welded wire fabric:
   2" down from top of slab for slabs on grade.
   2" down from top of slab in elevated (framed) & mezzanine slabs 6" or thicker.

E. In 5.7.5 (templates for column dowels), DELETE "unless otherwise permitted".

F. In 5.7.6 (mechanical connections), REPLACE "when accepted" with "as specified".

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 1 of the Specifications, apply to work of this Section.
B. Section 014533 - Code Required Special Inspections.
C. Section 032000 - Concrete Reinforcement.
D. Section 033500 - Concrete Finishing.

1.02 SCOPE

A. Furnish labor and materials necessary to install a complete system.

1.03 STANDARDS

A. All work of this section shall conform to industry standards manufacturer's recommendations and the ACI manual of concrete practice.
B. ACI 301 "Specifications for Structural Concrete for Buildings".
C. ACI 302 "Guide for Concrete Floor Construction".
D. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete".
E. ACI 305 "Hot Weather Concreting".
F. ACI 306 "Cold Weather Concreting".
G. ACI 308 "Standard Practice for Curing Concrete".
H. ACI 309 "Recommended Practice for Consolidation of Concrete".
I. ACI 311 "Guide for Concrete Inspection".
J. ACI 318 "Building Code Requirements for Reinforced Concrete".
K. ACI 347 "Recommended Practice for Concrete Formwork".
L. ASTM C33 "Standard Specification for Concrete Aggregates".
M. ASTM C94 "Standard Specification for Ready-Mixed Concrete".
N. ASTM C150 "Standard Specification for Portland Cement".
O. ASTM C309 "Standard Specification for Liquid Membrane-Forming Compound for Curing Concrete".
P. ASTM D994 "Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)".
Q. ASTM D1751 "Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)".
R. ASTM C31 "Standard Practice for Making and Curing Concrete Test Specimens in the Field".
S. ASTM C39 "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens".
T. ASTM C88 "Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate".
U. ASTM C138 "Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete".
V. ASTM C143 "Standard Test Method for Slump of Portland Cement Concrete".
W. ASTM C172 "Standard Method of Sampling Freshly Mixed Concrete".

X. ASTM C173 "Standard Method for Air Content of Freshly Mixed Concrete by the Volumetric Method".
Y. ASTM C231 "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method".
Z. ASTM C666 "Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing".
AA. ASTM C567 "Standard Test Method for Unit Weight of Structural Lightweight Concrete".
BB. ASTM C618 "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete".
CC. ASTM C109 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)".
DD. ASTM D638 "Standard Test Method for Tensile Properties of Plastics".
EE. ASTM D2240 "Test Method for Rubber Property - Durometer Hardness".
FF. ASTM C 157: Standard Test Method for Length Change For Hardened Hydraulic-Cement Mortar and Concrete.
GG. ASTM D 5084: Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
HH. ASTM E 96: Standard Test Method for Water Vapor Transmission of Materials.
II. ASTM E 1643 Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
JJ. ASTM E 1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
KK. ASTM F 710-11 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
LL. ASTM C 494/C 494M-08a Chemical Admixtures For Concrete Type S

1.04 SUBMITTALS

A. Submit pursuant to 013000 Administrative Requirements for Shop Drawings, Product Data and Samples Submittal.
B. Submit pursuant to 016000 Product Requirements.
C. Certificates of Compliance for all components of concrete including but not limited to: cement, fly ash, sand, coarse aggregate, admixtures, etc. used on the project.
D. Review proposed design of each concrete mix for approval prior to start of work.
E. Submit product data, including manufacturer's published instructions, for admixes, bonding agents, joint fillers, water stops, curing covers and compounds.
F. Prior to mix design review by Architect, submit certificate of compliance from admixture manufacturer that admixture meets specified requirements, including chloride ion content of admixture.
G. Submit reports of cylinder tests.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workmen familiar with the work and according to manufacturers recommendations and/or industry standards.
B. Perform testing and analysis of concrete and related work as specified in Part 3 Field Quality Control and 014533 - Special Inspections for Concrete Construction.
C. Perform concrete work pursuant to ACI 301.
D. Obtain materials from same source throughout the Work.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.
B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, normal - Type I; standard color; Portland type.
   1. Use cement from a single plant of a single manufacturer for all exposed work.
   2. Standard color: Color commonly offered by ready-mix plants in locality of the Work.
B. Normal Weight Aggregate: ASTM C33, with maximum chloride ion content of 0.1%. Provide aggregates from a single source for all exposed concrete.
   1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
   2. Coarse Aggregate for Normal Weight Concrete: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter. Provide a minimum of 1,800 pounds per cubic yard of coarse aggregate in concrete used for interior slabs on grade.
   3. Do not use tailings from mining of minerals such as taconite, pitchblende, coal and phosphate rock in producing aggregates. Use non-ore, non-processed rock, gravel, and sand only.
   4. Max. Aggregate Size: Not larger than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, or three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.
C. Water: Clean and drinkable. Maximum chloride ion content: 0.1 percent.
D. Calcium Chloride: Do not use.
F. Fly Ash: use an amount that does not exceed 15 percent of the total cement plus fly ash weight. Use only for interior and below grade concrete work.

2.02 BONDING AGENTS

A. Structural Bonding Agent
   1. Qualities: Structural bonding adhesive, suitable for adhering freshly-mixed concrete to hardened concrete, non-filled, non-flexible epoxy type.
   2. Standard: ASTM C881 or AASHTO M235, Type II, viscosity grade and temperature-range class as selected for use.
   3. Source (or Architect approved substitution):
      a) Poly Epoxy Bonding 100, by Anti-Hydro.
      b) Sikadur 32 or 35, by Sika.
      c) Sonobond, by Sonneborn/Rexnord.
      d) or Architect approved substitution.
B. Patch Bonding Agent
   1. Qualities: Moisture-resistant polymer resin bonding adhesive, suitable for adhering concrete patches up to 1-1/2 in. deep, with feathered edges, to hardened concrete. Do not use PVA latex emulsion bonding agent.
   2. Source (or Architect approved substitution):
      a) Anchor-It, by Anti-Hydro.
      b) Sonocrete, by Sonneborn/Rexnord.
      c) or Architect approved substitution.

2.03 JOINT FILLERS

A. Fiber/Asphalt: vacuum processed cellular fibers securely bonded together and uniformly saturated with asphalt.
   1. Standard: ASTM D1751.

2.04 CURING COVERS AND CURING COMPOUNDS

A. Clear Curing compound.
   1. Qualities: 100% resin base, with fugitive dye, free of any oils or waxes.
   2. Standard: ASTM C309 Type 1, Class B.
   3. Super Kurseal 309 by A.H. Harris or Architect approved Equivalent
   4. Do not use curing compounds on apparatus bay slab or any other areas designated to received an epoxy resin coating or salt guard sealer. These slabs must be wet cured.

2.05 CONCRETE MIXES

A. Qualities: Ready-mix all concrete at one plant. At least 15 days before any concrete is placed on project, at Contractor's expense, employ a commercial testing laboratory approved by Architect to design concrete mixes, if trial mixes are selected as method of proportioning. Design mixes using samples of materials approved for use. Verify each mix design by strength tests. Design proposed mix to achieve an average strength 1,200 lb./sq. in. higher than specified compressive strength, f'c. Over-design factor for f'c = 5,000 and stronger concrete: 1,400 lb./sq. in.

B. Standards:
   1. ASTM C94 for ready-mixed concrete.
   2. ACI 318, Sections 4.1, 4.2, 4.3, and 4.5 for proportioning.
   3. ASTM C39, C192 for strength tests.

C. Mix Classes:

Use Min. As Applicable	f'c, psi	Max.aggregate size, inches	Min-Max slump, inches	Min.-Max. Air Entrainment (%)
Footings	3,000	2	2-4	3-6
Foundation Walls/Piers	3,000	1 1/2	3-5	3-6
Retaining Walls & Elevator Pit w/ **MVRA**	3,000 w/c=0.45 (max.)	1 1/2	3-5	3-6
Apparatus Bay Slab on Grade, All slabs with radiant tubing w/ **MVRA**	6,000 w/c=0.45 (max.)	1	2-4	2-3 (interior)
Exterior aprons	6,000	1	2-4	4-6 (exterior)
Framed Slab	3,500	3/4	2-4	0-2
Common Areas Slab on Grade w/ **MVRA**	3,500 w/c=0.45 (max.)	1	2-4	0-2
Stair Pans	4,000	1/2	2-4	0-2

D. Color and Workability: Balance factors such as cement color, water-cement ratio, entrained air, use of fly ash, admixtures, and aggregate grading to provide concrete which:
   1. Is of uniform color in exposed locations.

2. Consolidates with a minimum of honeycomb and bugholes when placed pursuant to ACI 301, Chapter 8.

2.06 CONCRETE MOISTURE VAPOR REDUCTION ADMIXTURE – "MVRA"

A. Concrete Moisture Vapor Reduction Admixture (MVRA): Use at all perimeter building envelope retaining walls (exterior 'site' retaining walls and foundation walls that top out at elev. 100'-0" can be excluded), elevator pit, and interior slabs on grade (administration spaces, apparatus bay spaces and firematic support spaces) shall be non-toxic, liquid admixture that is specifically designed to have a natural chemical reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through the slab by restricting the integral capillary system. The chemical reaction forms a permanent barrier (capillary break) that is integral to the concrete, insoluble and irremovable.

1. Source (or Architect approved substitution): Barrier One High Performance Concrete Admixture, by Barrier One, Inc. Apopka, Florida 32703. www.barrierone.com
2. Provide the above named product or approved equivalent that meets or exceeds the following project specific performance requirements at the expense of the concrete moisture vapor reduction admixture (MVRA) manufacturer:
   a. Project specific quality control process to include, but not be limited to:
      1) Independent procurement of one cylinder per day of placement of concrete containing MVRA.
      2) Independent testing of all cylinders for hydraulic conductivity per ASTM D 5084.
      3) Assessing each cylinder for maximum flow of 6.0 E-08 cm/sec.
      4) Should any cylinder exceed the maximum flow, procure a core from that day's placement.
      5) Independently test core for hydraulic conductivity per ASTM D 5084.
      6) Should any core exceed the max. flow, provide a topical moisture mitigation system for all areas not meeting the stated limit; moisture mitigation system to include all labor, material and warranty that meets or exceeds the terms of the concrete moisture vapor reduction admixture manufacturer's warranty.
   b. Warranty requirements: Said product must be installed according to and in compliance with the manufacturer's published data sheet to include but not limited to dosing instructions, onsite representation requirements, and the use of an ASTM E 1745 vapor retarder, installed following ASTM E 1643 and ASTM F 710 guidelines; suspended concrete slabs do not require a vapor retarder.
      1) MVRA manufacturer's warranty shall include:
         a) Term: Ten years.
         b) Repair and or removal of failed flooring
         c) Placement of a topical moisture remediation system.
         d) Replacement of flooring materials like original installed to include material and labor.
      2) MVRA Manufacturer shall provide an adhesion warranty to match the term of the adhesive manufacturer's warranty in accordance with the MVRA manufacturer's requirements for conveyance of such.

B. Material - Concrete Water Vapor Transmission Inhibiting Admixture: Non-toxic, liquid admixture for concrete that reacts with water and portlandite filling the capillary system with calcium silicate hydrate (CSH) to eliminate the route for moisture migration. Once

the admixture is added to the mix design, the admixture shall react with the water to allow the concrete to be flexible, even at low slump.

C. Product Description: Concrete water vapor transmission inhibiting admixture shall be a complex formula that is free of all volatile organic compounds (VOC). It shall be specifically designed to have a natural chemical reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through concrete by closing down the integral capillary system. The chemical reaction shall form a permanent barrier (capillary break) which is integral to the concrete and irremovable.
   1. Water Vapor Transmission: 0.20 US perms per ASTM D 5084
   2. Appearance: Colorless
   3. Odor: None
   4. Toxicity: None
   5. Flammability: None
   6. Ph: 11E
   7. Shelf Life: Indefinite
   8. Weight: 11.2 lbs per gallon
   9. Freeze Temp: 32°F
   10. Storage Temp: Above 36°F
   11. Solvent: Water
   12. Acid Resistance: Excellent
   13. Hazardous Vapors: None
   14. Capillary Break: Calcium Silicate Hydrate Gel
   15. Installation: All concrete
   16. VOC Levels: Zero

D. Related Materials - Sheet Vapor Retarder: As specified in Division 03 Section “Cast-in-Place Concrete.” Comply with the following:
   1. Sheet Vapor Retarder: ASTM E 1745-09 Class A vapor barrier maintaining a permeance of 0.01 US perms (grains/ft2*hr*inHg) or less after the required product conditioning specified in ASTM E 1745-09 Include manufacturer's recommended adhesive or pressure-sensitive tape.
      a. Products: Any sheet vapor barrier that can show compliance with required perm rating after product conditioning specified in ASTM E 1745-09. Final approval is with Barrier One.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause difficulty in placing concrete. Remove all debris from formwork.

3.02 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent pursuant to manufacturer's published instructions.

B. At locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout specified under 036000 Grout.

C. Where new concrete is to be bonded to old concrete, use structural epoxy bonding agent.

D. Where concrete is to be patched and featheredged to a depth less than 1-1/2 in., use patch bonding agent.

3.03 JOINTS

A. Construction Joints: Locate and install construction joints, which are not shown on Drawings, so as not to impair strength and appearance of structure, as acceptable to Architect. Construction joints should be located not less than 5 feet from any other joint to which they are parallel.
   1. Provide keyways, formed with removable forms, at least 1-1/2 inches thick in all construction joints in walls, slabs, and between walls and footings. Bulkheads designed for this purpose may be used for slabs if approved by Architect. Do not use metal keyways unless shown on the drawings.
   2. Place construction joints perpendicular to main reinforcement. Continue all reinforcement across construction joints.

B. In elevated slabs, minimize the number of construction joints. Locate construction joints in elevated slabs parallel to and away from beams (joists) or at points of minimum moment, dowel and bond as approved by Architect. Install joint key 1-1/2 in. wide by 1/3 the depth of slab, with top not less than 1-1/4 in. below slab surface. For slabs-on-grades, see details for construction joints. Continue all reinforcement through joints or use dowels as detailed.

C. Column Isolation Joints (Bollard Isolation joint similar): Provide diamond pattern isolation joints around columns extending through floor slabs on grade. Place concrete in diamond shaped area around columns after floor slabs have been placed. Coat edge of floor slab with curing/sealing/compound before concrete is placed around columns. Tool edge of diamond shaped area, straight and true, to a depth of 1-1/4 in. After concrete has cured, clean tooled joints, and leave ready to receive sealant specified in Section 079005 Joint Sealers.

D. Wall Isolation Joints: Isolate edges of interior slabs on grade from vertical concrete wall surfaces with insulation as detailed. Where not detailed use one 1/2 in. layer of fibrous joint filler to within 1/2 inch of top of slab. There shall also be a plastic cap at top edge of joint filler strip to protect filler from dirt intrusion and as a bond breaker when a continuous bead of sealant is applied.

E. Contraction Joints (control or sawed joints for slabs on grade and elevated framed slabs and elevated mezzanines if applicable): Form Contraction joints by sawing joints to a depth equal to 1/4 of slab thickness. Cut alternate wires in welded wire fabric reinforcement and interrupt alternate rods in bar reinforcement at Contraction joints. Clean groove of loose material immediately after sawing and insert backer rod material to keep joint clean during construction. After concrete has cured and undergone its initial Contraction, and just before time of Substantial Completion, clean groove of loose debris and leave ready for sealant specified in 079005 Joint Sealers.
   1. Saw joints as soon as possible without raveling concrete.
   2. Seal joints as late as possible in Contract Time
   3. Joints in elevated framed slabs and elevated mezzanines, are not required. Allow random cracks to form and patch cracks 1/16 inch or wider.

F. Provide joint fillers. Use sealants that are compatible with fillers, as recommended by joint filler manufacturer.

3.04 PLACING CONCRETE

A. Notify Architect and Testing Agency when reinforcing is in place and at least 24 hr prior to start of each concreting operation.

B. Ensure that reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

C. Do not place interior concrete slabs on grade or framed slabs until building is made weather tight.

D. Excessive bug holes, honeycomb, and embedded debris in concrete are defects. Improve placement procedures and correct defects.

3.05 CONCRETE CURING AND PROTECTION

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperature using specified curing method. Maintain in moist condition at a relatively constant temperature for a period of time necessary for hydration of cement and attainment of design strength.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

C. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by use of curing compounds, or by combinations thereof.

1. Cure by use of curing and sealing compounds as follows:
   a) Apply specified curing and sealing compound by power spray, squeegee or roller to all slabs which will receive carpet, resilient flooring, or which will be left exposed, immediately after final finishing operation. Do not use hand sprayers.
   b) Apply specified dissipating resin-type curing compound to other interior slabs.
   c) Apply curing compounds immediately after final finishing.
   d) Recoat areas which are subjected to heavy rainfall within 3 hr after initial application.
2. **Do not use curing and sealing compound on surfaces to receive any finishes other than carpet or resilient flooring. Slabs to receive epoxy resin finish or salt guard sealer must be wet cured.**
3. Moist curing - either method (a) or (b) for a period of seven (7) days or (3) days for concrete mixes that contain a moisture reduction admixture (MVRA).
   a) Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 12” and weighted down to prevent displacement by wind. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   b) Cover concrete with burlap. Completely wet burlap and maintain uniformly wet during curing period.

D. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, sides of slabs on grade, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

E. Curing unformed surfaces (slabs).

1. The Apparatus Bay or any other areas designated to received an epoxy resin coating or salt guard sealer shall be moist cured. (see 03 35 00 Concrete Finishing).
2. Exterior concrete aprons, slabs, stoops, sidewalks, etc. shall be moist cured and shall receive salt guard sealer (see 033500 Concrete Finishing)..
3. Absolutely no chemicals, compound, curing agents, etc. may be used on concrete mentioned in “E” 1 & 2 above.

3.06 FINISHING: Provide pursuant to Section 033500 Concrete Finishing.

3.07 PATCHING: Provide pursuant to Section 033500 Concrete Finishing.

3.08 DEFECTIVE CONCRETE

A. Cut out and patch or replace concrete not conforming to required levels and lines, details, and elevations.
B. Repair or replace concrete not properly placed or not of specified type. Repair or replace concrete containing excessive bug holes, honeycomb, embedded debris, cracks, and other defects. Use specified bonding agents.

3.09 FIELD QUALITY CONTROL

A. The Owner will employ an approved, independent, objective and competent inspection & testing agency to perform tests and to submit test reports.
B. Review proposed design of each concrete mix for approval prior to start of work.
C. Cast cylinders and perform slump tests.
    1. Standards: ACI 318 5.6 and 5.8; ASTM C31, C39, C143, C172, C173, and either C231 or C138.
D. Cast 5 concrete test cylinders for every 50 cu. yd., or fraction thereof, of each mix design of concrete placed each day. Test one set of two laboratory-cured specimens at 7 days and one set of two laboratory-cured specimens at 28 days. A compressive strength test shall be the average compressive strength from a set of two specimens obtained from the same composite sample and tested at age indicated.
E. Cast one additional test cylinder during cold weather and cure on site under same conditions as concrete it represents.
F. Test cylinders for compressive strength. Maintain records of placed concrete items. Record date, location of pour, curing temperature and techniques, quantity, air temperature, test samples taken, and compressive strengths attained.

3.10 PROTECTION

A. Protect finished work.
B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and attainment of design strength.

3.11 SPECIAL CONDITIONS

A. The Apparatus Bay slab is heated with an in-slab hydraulic tubing.
B. The tubing is tied to, and in contact with the mesh and/or reinforcing.
C. **Under no circumstances whatsoever shall the Contractor use any mechanical device to lift the reinforcing.**
    1. **Any damage to the tubing during placement of the concrete shall be fixed by the General Contractor at no cost to the Owner.**
    2. **Do not saw cut concrete with radiant heat systems unless approved by Architect.**
D. The Apparatus Bay slab requires 7 days wet curing. From time of placement, it should be free of lifts (of any kind) for 14 days. It should be free of heavy loads (staging) of construction material for 14 days.

3.12 APPLICATION - MVRA

A. Install vapor barrier following ASTM E 1643-98(2005) guidelines and in accordance with Division 03 Section “Cast-in-Place Concrete”.

B. Moisture Vapor Reduction Admixture: Add Barrier One Admixture in accordance with manufacturer's recommendations to all ready-mix concrete, to be placed in perimeter building envelope retaining walls (exterior 'site' retaining walls and foundation walls that top out at elev. 100'-0" can be excluded), elevator pit, and interior slabs on grade construction, at the batch plant or at the job site.
   1. A representative or agent of Barrier One Admixture must be present at the jobsite during the placement of all treated concrete. Do not proceed without the Barrier One representative being present for the certification of the mix and placement process. Provide minimum 10 days notice of the placement of the treated concrete.
   2. The Quality Control Protocol for Barrier One Admixture shall consist of the Barrier One representative procuring two random cylinders from every placement of concrete containing Barrier One Admixture. These cylinders will be sent to an independent laboratory for hydraulic conductivity (coefficient of permeability) per ASTM D5084. The results of this "project specific" quality control protocol forms the basis for the issuance of the project specific warranty.

C. Dispense Barrier One admixture at a rate of 14 oz. per 100 lbs. of cementitious materials at the tail end of the load, dose to be within plus or minus 3 percent. Additional dosage may be required based on the mix design.
   1. Add Barrier One Admixture to ready mix concrete truck, in the require dosage, and mix for 7 (seven) minutes before discharge. Barrier One Admixture is to be used in lieu of designed mix water, not in addition to mix water.
   2. Do not alter 0.45 water/cementitious materials ratio without prior approval.
   3. The addition of non-chlorinated admixtures is permitted.
   4. The addition of Shrink Reducing Admixtures is NOT permitted.

D. Other admixtures may be used in the same concrete batch with Barrier One provided that such admixtures are added separately.
   1. The water-to-cementitious material ratio (w/c) is critical and it is imperative to comply with the mix design. Barrier One is used in lieu of that portion of the mix water, not in addition to the mix water.
   2. Use of plasticizers or water reducers is recommended to achieve slumps greater than 4 inches.

3.13 CURING - MVRA

A. Comply with curing requirements in Division 03 Section "Cast-in-Place Concrete."

3.14 FIELD QUALITY CONTROL - MVRA

A. Concrete Water Vapor Transmission Inhibiting Tests: Testing of slabs containing concrete water vapor transmission inhibiting admixture shall be carried out by the concrete water vapor transmission inhibiting admixture manufacturer's technical representative to include: two random, 4-inch drilled sample cores and/or cylinders on all project slabs. The sample cores and/or cylinders shall be sent to an independent laboratory and tested for permeability in accordance with ASTM D 5084, and shall achieve a minimum 6.0 E-08 cm/sec. The results shall be provided to the Contractor and Architect prior to the installation of floor coverings and as part of the warranty closeout documents. Additional testing may be required in accordance with the water vapor transmission inhibiting admixture manufacturer's requirements. No other testing shall be required for installation of floor coverings.

3.15 REPAIRS - MVRA

A. Make repairs to slab in accordance with Division 03 Section “Cast-in-Place Concrete” and as shown in manufacturer’s published details and remediation program.

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SECTION 033500

CONCRETE FINISHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Specifications, apply to work of this Section.
B. 031000 - Concrete Forming and Accessories.
C. 033000 - Cast-In-Place Concrete.

1.02 SCOPE

A. Furnish labor and materials necessary to install a complete system.

1.03 STANDARDS

A. All work of this section shall conform to industry standards manufacturer's recommendations and the ACI manual of concrete practice.
B. ACI 301 "Specifications for Structural Concrete for Buildings".
C. ACI 303 "Guide to Cast-In-Place Architectural Concrete Practice".

1.04 SUBMITTALS

A. Submit pursuant to 013000 Administrative Requirementgs for Shop Drawings, Product Data, Samples Cover Sheet.
B. Submit pursuant to 016000 Product Requirements.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workmen familiar with the work and according to manufacturers recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.
B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 SALT GUARD SLAB SEALER

A. Salt Guard WB (water based) by Prosoco, Inc. or Architect approved equivalent.
    1. Apply to Apparatus Bay and all adjacent rooms with a concrete floor shown in the Room Finish Schedule.
    2. Apply to all exterior concrete slabs, stoops, aprons, sidewalks and patios.
    3. Apply to mezzanine slabs.
B. Handle and apply according to manufacturers Specifications

C. Apply salt guard sealer to slabs that are a minimum of 28 days old, have been thoroughly moist cured and have been allowed to air dry.

PART 3 EXECUTION

3.01 FINISHING UNFORMED SURFACES (SLABS)

A. Floated & Soft Broom Finish: (Apparatus bays, mezzanines and adjacent rooms)
   1. After placing, consolidating, and striking-off - level slabs per the following tolerances. Slope surfaces uniformly to drains. Do not work surface until ready for floating.
   2. Deviations in level and sloped surfaces:
      a. Do not exceeding 1/8 in. in 2 ft when tested with a 2 ft straight edge.
      b. Do not exceeding 1/4 in. in 10 ft when tested with a 10 ft straight edge.
   3. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
   4. These slabs should be finished with a mild, soft broom finish in the direction of drainage.
   5. **The Contractor will prepare a 24" x 24" test panel or similar sample of the finish for approval by the Owner and Architect.**
   6. **Said sample will remain on the job site during finishing operations and will be used as a guide for the slab finish.**

B. Troweled Finish: (Non-Apparatus Bay Areas, for rooms to receive tile or carpet)
   1. After floating, steel-trowel slab surface to a smooth, even, impervious finish free from trowel marks. For exposed to view concrete slabs, give slab surface a second steel trowelling to a burnished finish, uniform in texture and appearance. Grind smooth surface defect which would telegraph through applied floor covering system.
   2. Deviations in level and sloped surfaces:
      a. Do not exceeding 1/8 in. in 2 ft when tested with a 2 ft straight edge.
      b. Do not exceeding 1/4 in. in 10 ft when tested with a 10 ft straight edge.

C. Slip Broom Finish: (Exterior Concrete)
   1. After placing, consolidating, and striking-off slabs. Slope surfaces uniformly to drains. Do not work surface until ready for floating.
   2. Deviations in level and sloped surfaces:
      a. Do not exceeding 1/8 in. in 2 ft when tested with a 2 ft straight edge.
      b. Do not exceeding 1/4 in. in 10 ft when tested with a 10 ft straight edge.
   3. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances above. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
   4. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom in straight, parallel lines perpendicular to main traffic route. Coordinate required final finish with the Architect before application.

D. Caution: Do not use jitterbugs at any time.

3.02 FINISHING FORMED SURFACES (retaining walls, sides of steps and elevated landings)

A. Repair of Formed Surfaces (walls): Where exposed to view only, remove form ties so that they are no closer than 3/4" to the formed surface of the concrete. Fill holes leaving them flush with the formed surface.

B. Make structural repairs with prior approval of Architect as to method and procedures, using structural patching mortar.

3.03 REPAIR OF DEFECTIVE WORK

A. Repair of Unformed Surfaces (Slabs): Test unformed surfaces, such as monolithic slabs, for smoothness and to verify that surface planes conform to tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
   1. Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects include crazing, cracks in excess of 0.01 in. wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
   2. Repair defective areas, except random cracks and single holes not exceeding 1 inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 in. clearance all around.
      a) Dampen concrete surfaces in contact with patching concrete and apply specified bonding compound. Place patching concrete after bonding compound has dried. Mix patching of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   3. Repair isolated random cracks and single holes not over 1 in. in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles.
   4. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
   5. Correct low areas in unformed surfaces during, or immediately after completion of, surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Use specified bonding or patching compound.

B. Make structural repairs with prior approval of Architect as to method and procedures, using structural patching mortar.

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SECTION 034900
GLASS-FIBER REINFORCED CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural Ornimentation.

B. Supports, anchors, and attachments.

1.02 RELATED REQUIREMENTS

A. Section 042000 - Unit Masonry: Placement of anchors specified in this section.

B. Section 042723 - Cavity Wall Unit Masonry: Placement of anchors specified in this section.

C. Section 061000 - Rough Carpentry: Placement of anchors specified in this section.

D. Section 079200 - Joint Sealants: Sealing perimeter and intermediate joints.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

B. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.

C. ASTM C150/C150M - Standard Specification for Portland Cement 2020.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate locations, layout, fabrication details, reinforcement, metal framing details, connection details, dimensions, and relationship to adjacent materials. Provide erection drawings.

C. Samples: Submit two samples 3 inch by 3 inch in size illustrating surface color, finish and texture.

D. Manufacturer's Installation Instructions: Indicate surface cleaning instructions.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 5 years ofdocumented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle units to position, consistent with their shape and design. Lift and support only from support points.

B. Lifting Device: Capable of maintaining unit shape during manufacture, storage, transportation, erection, and in position for fastening.

C. Blocking and Lateral Support During Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping. Place spacers in same location during transport and site storage.

D. Protect edges of units to prevent staining, chipping, or spalling of concrete.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M Portland Type I - Normal; white color.

B. Concrete Aggregates: ASTM C33/C33M.

C. Reinforcement: Alkali resistant chopped glass fiber rovings specifically formulated for use in concrete, with lengths varying from 1-1/2 to 2 inches.

2.03 SURFACE FINISH MATERIALS

A. Surface Finish Aggregate: Comply with sample available for inspection at office of Architect.

2.04 SUPPORT DEVICES

A. Connecting and Support Devices: ASTM A666 Type 304 stainless steel.

2.05 ACCESSORIES

A. LED strip light placed in recess.

2.06 FABRICATION

A. Spray-up concrete mix in multiple passes; maintain consistent quality during manufacture.

B. Embed anchors, inserts, plates, angles, and other cast-in items as indicated on shop drawings.

C. Fabricate connecting devices, fasteners and accessories necessary for proper installation.

D. Cure units to minimize appearance blemishes such as non-uniformity, staining or surface cracking.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.02 INSTALLATION

A. Coordinate installation with structural supports, backup, and opening framing, if any.

B. Install units without damage to shape or finish. Replace or repair damaged panels.

C. Install units level and plumb within allowable tolerances.

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END OF SECTION

SECTION 036000

GROUTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Specifications, apply to work of this Section.

1.02 SCOPE

A. Furnish labor and materials necessary to install a complete system.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.
B. ASTM C109 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens)".
C. ASTM C827 "Early Volume Change of Cementitious Mixtures".
D. Corps of Engineers "CRD-C621 Specification for Non-Shrink Grout".
E. ASTM C 476-16 Standard Specification for Grout for Masonry

1.04 SUBMITTALS

A. Submit pursuant to 013000 Administrative Requirements for Shop Drawings, Product Data, Samples.
B. Submit pursuant to 016000 Product Requirements.
C. Certificates of Compliance for all grout products used on the project.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workmen familiar with the work and according to manufacturers recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.
B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 NON-METALLIC, NON-SHRINK GROUT (for below base plates, bearing and leveling plates)

A. Description: Premixed, non-staining, non-gassing grout, requiring only the adding of water, suitable for use as plastic, flowable, or fluid mix with no shrinkage in either the plastic or the hardened state.
   1. Compressive strength at 28 days, from flowable mix: pass ASTM C1090; 5000 lb./sq. in. minimum.

2. Volume change from plastic to hardened state: pass ASTM C827; -0%, to +2% maximum.

B. Producers:
   1. Five Star Grout, by Five Star Products, Inc. or approved equivalent.

2.02 GROUT FOR CONCRETE UNIT MASONRY

A. Use fine grout for spaces up to 1 1/2" wide or to fill cells up to 4" in size.
   1. Compressive strength at 28 days: 3,000 psi.

B. Use course grout only to fill cells having larger dimensions.
   1. Compressive strength at 28 days: 3,000 psi.

C. Mix Ratio:
   1. 1 part Portland cement
   2. 0.1 part hydrated lime or lime putty
   3. Aggregate as follows:
      a) For fine grout, use fine aggregate in a volume of 2.2 to 3.0 times the sum of the volumes of the cementitious materials.
      b) For a course grout with fine aggregate, use aggregate in a volume of 2.25 to 3.0 times the sum of the volumes of the cementitious materials
      c) For a course grout with course aggregate, use aggregate in a volume of 1 to 2 times the sum of the volumes of the cementitious materials.
      d) Maintain a slump of 8 to 10 inches.
      e) Maintain a compressive strength of 3,000 psi.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prepare surfaces, install non-shrink grout, and cure pursuant to manufacturer’s recommendations.

B. Install grout in driest, stiffest possible mix, pursuant to manufacturer's published mixing instructions, that will assure filling of voids. Fill space between structural support member and bearing structure and work the grout so as to assure full contact and no voids. Trim and seal exposed edges

END OF SECTION