SECTION 03 31 00

CONCRETE, FORMS, AND REINFORCEMENT

PART 1 - GENERAL

1.01 Section Includes

A. Formwork for cast-in-place concrete.

B. Steel reinforcing for cast-in-place concrete.

C. Cast-in-place concrete.

D. Curing and Sealing.

1.02 Related Sections

A. Section 07 92 00 - Joint Sealers.

B. Section 01 45 16 – Testing Requirements.

1.03 References

A. ACI 117-90 - Standard Tolerance for Concrete Construction Materials.

B. ACI 301-96 - Structural Concrete for Buildings.

C. ACI 305R-91 - Hot Weather Concreting.

D. ACI 306R-88 - Cold Weather Concreting.

E. ACI 308-92 - Standard Practice for Curing Concrete.

F. ACI 318-08 - Building Code Requirements for Reinforced Concrete.

G. ACI 347-94 - Guide to Formwork for Concrete.

H. ASTM A82 - Steel Wire, Plain, for Concrete Reinforcement.

I. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

J. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

K. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.

L. ASTM C33 - Standard Specification for Concrete Aggregates.

M. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

N. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

O. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

P. ASTM C150 - Standard Specifications for Portland Cement.

Q. ASTM C171 - Sheet Materials for Curing Concrete.

R. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

S. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete.

T. ASTM C260 - Air Entraining Admixtures for Concrete.

U. ASTM C494 - Chemical Admixtures for Concrete.

V. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

W. ASTM C618 - Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete.

X. ASTM D1751 - Performed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

Y. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.04 Quality Assurance

A. Perform formwork in accordance with ACI 347.

B. Perform reinforcement work in accordance with ACI 318.

C. Perform concrete work in accordance with ACI 301.

D. Conform to ACI 305R when concreting in hot weather and ACI 306R when concreting in cold weather.

1.05 Submittals

A. Formwork: Submit manufacturer's data and installation instructions for proprietary materials including form coating, ties and accessories, and manufactured form systems.

B. Reinforcement: Provide shop drawings prepared indicating bar sizes, spacing, locations, and quantities of reinforcing steel, bending and cutting schedules, and supporting and spacing devices.

C. Concrete
   1. Mix Design
      a. Provide dry weight of cement, saturated-surface dry weight of aggregate, brand name, type, and quantity of admixtures, and pounds of water per cubic yard of concrete.
      b. Test data supporting the portions of the design mixes based on laboratory trial batches in accordance with ACI 318. Test data supporting the proportions of the design mixes based on past field experience in accordance with ACI 318 may be provided in lieu of the laboratory data.
      c. Design mixes shall be approved by Engineer a minimum of five working days prior to delivery of concrete to the Site.
   2. Admixtures: Submit manufacturer's literature and certifications.
   3. Delivery Tickets: With each load of concrete delivered, duplicate delivery tickets shall be provided which give the following information:
      a. Name of ready-mix batch plant.
      b. Serial number of ticket
      c. Date.
      d. Truck number.

e. Name of contractor.
f. Name and location of job.
g. Class or designation of concrete.
h. Amount of concrete in cubic yards.
i. Time loaded or of first mixing of cement and aggregate.
j. Water added at jobsite and initials of person authorizing addition.
k. Admixtures, if added.

4. Surface Treatments: Submit manufacturer's literature and application recommendations.

1.06 Delivery

A. Deliver reinforcement in bundles with metal tags indicating bar size and length.

1.07 Coordination

A. Coordinate placement of formwork, formed openings, and placement of accessories and attachments.

PART 2 - PRODUCTS

2.01 Forms

A. Wood Forms
1. Plywood: PS1, BB grade, Class 1.
2. Clean straight lumber, dressed on face and edges, 2-inch nominal thickness.

B. Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Pan Type: Steel of size and profile required.

D. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.

2.02 Formwork Accessories

A. Form Ties: Snap-off type, galvanized metal, adjustable length, cone type, 1-inch breakback dimension. The tie shall not leave holes larger than one inch diameter in concrete surface.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding of coating intended for use on concrete.

C. Chamfered Corners: When Drawings indicate chamfered corners provide wood strip type.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

2.03 Formwork Design

A. Design formwork to safely support vertical and lateral loads that may be applied until such loads can be supported by the concrete structure.

B. Design formwork to carry loads to ground or to concrete that has attained adequate strength.

C. Design formwork to include assumed values of live load, dead load, weight of equipment to be operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient

temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to the safety of the structure during construction.

D. Support form facing materials to prevent deflection.

E. Provide camber as required for anticipated deflections due to weight and pressure of fresh concrete and construction loads.

2.04 Reinforcement

A. Reinforcing Steel: ASTM A615; Grade 60, deformed, unfinished.

B. Welded Steel Wire Fabric: ASTM A185: flat sheets, unfinished.

2.05 Reinforcement Accessories

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

C. Splice Devices: Sized to develop 125 percent yield strength of bar.

2.06 Concrete Materials

A. Portland Cement: ASTM C150, Type 1.

B. Aggregate: ASTM C33.

C. Water: Clean and not detrimental to concrete.

D. Flyash: ASTM C618, Class C.

2.07 Concrete Admixtures

A. Air Entrainment: ASTM C260.

B. Water Reducing: ASTM C494; Type A, Water Reducing.

C. Retarding: ASTM C494. Type D, Water Reducing and Retarding.

D. Accelerating: ASTM C494 Type C Accelerating (non-chloride); Type E, Water Reducing and Accelerating (non-chloride).

E. Superplasticizer: A high-range water reducing admixture meeting requirements of ASTM C494, Type F; Master Builders Rheobuild 1000 or equal.

2.08 Accessories

A. Vapor Retarders: 6 mil thick clear polyethylene film, type recommended for below grade application.

B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.09 Concrete Mix Design

A. Mix and deliver concrete in accordance with ASTM C94.

B. Select proportions in accordance with ACI 301.

C. Provide concrete in accordance with the following requirements:

1. Concrete Mixes

Concrete Mixes		
Class	Compressive Strength at 28 days, psi	Maximum Water-Cement Ratio, by Weight
Plain Concrete		
A	5,000	.48
B	4,000	.57
C	3,500	.62
Air-Entrained Concrete		
D	4,000	.48

2. Air Content: Total air content (entrained and entrapped) for air-entrained concrete shall be in accordance with the following table:

Air Content	
Nominal Max. Size Aggregate	Air Content
¾"	6% ± 1
1"	6% ± 1
1 ½"	5% ± 1

3. In any mix, up to 20 percent of the cement (on a pound per pound basis) may be replaced with flyash.
4. Superplasticizer: Superplasticizer may be used at the Contractor's option. See Drawings for any locations where superplastized concrete is required. Superplasticizer shall generally be added at the plant, but may be added at the jobsite.
5. Concrete Schedule: Unless otherwise indicated in the Contract Documents provide concrete in accordance with the following schedule.

Concrete Schedule	
Concrete Class	Location
Class A	Walls & floors where water tightness is required (i.e. tanks, wet wells)
Class B	Structural slabs Beams and columns Interior precast topping
Class C	Footings Exterior walls Interior walls Interior slabs-on-grade
Class D	Exterior slabs Exterior precast topping Retaining walls Curb & gutter and sidewalk Other similar exterior concrete

D. Slump:

Location	Slump, Inches	
	Slump	Tolerance
Footings	5	± 1
Beams, columns and interior walls	4	± 1
Reinforced foundation walls, exterior walls	3	± 1
Interior slab on grade	3	± 1
Exterior slab on grade	3	± 1
Precast topping	3	± 1
Metal pan stairs	3	± 1
Pavements, sidewalk, curb and gutter	3	± 1
Retaining walls	3	± 1

Superplasticized Concrete Slump: 7 inches, not to exceed 10 inches. Do not use less than the manufacturer's recommended minimum dose. Adjust "water slump" (slump before superplasticizer addition) to be in line with Section D, above, and then utilize an appropriate superplasticizer dose to meet this final slump range.

2.10 Curing Materials

A. Reinforced Paper: Two sheets of kraft paper cemented together with bituminous material reinforced with fiber meeting requirements of ASTM C171.

B. Plastic Film: Polyethylene film with a minimum thickness of 0.004 inches meeting requirements of ASTM C171.

C. Curing Compound: Liquid membrane curing compound meeting requirements of ASTM C309. For concrete floors specified to receive a combination curing, sealing, and dustproofing compound, provide Sonneborn Kure-N-Seal or equal. Compound shall be compatible with resilient flooring and carpet adhesives.

D. Curing/Sealing Material:
1. An acrylic resin curing, sealing, and hardening compound for exterior freshly placed concrete that provides a durable, long-lasting moisture impermeable finish that improves resistance to chemicals, grease, and de-icing salts.
2. Meet requirements of ASTM C1315, Type 1, Class B and ASTM C309, Type 1, Classes A and B.
3. Manufacturer: AS-1 Achro Seal 1315 OTC, TK Products; Seal Cure 309-30, W.R. Meadows; or equal.

2.11 Concrete Sealers

A. Hardener/Sealer: A water soluble sealer densifier that produces a dense surface resistant to abrasion, moisture, and tire marking and provides added gloss to the floor.

B. Manufacturer: Kure-N-Harden, Degussa Building Systems or equal.

PART 3 - EXECUTION

3.01 Form Construction

A. General
1. Construct forms to produce concrete sections of the size, shape lines and dimensions indicated and as required to obtain accurate alignment, location, grade, level and plumbness.

2. Provide for openings, offsets, keyways, moldings, riglets, chamfers, blocking, screeds bulkheads, anchorages, inserts and other required features.

B. Fabrication
1. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage concrete surfaces.
2. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
3. Kerf wood inserts for forming keyways, riglets, recesses, and similar items to prevent swelling and to ensure easy removal.
4. Provide temporary openings where interior area of formwork is inaccessible for cleanout and inspection and concrete placement. Brace temporary openings in as inconspicuous locations as possible.
5. Butt joints tight and provide back-up materials as necessary to prevent leakage of concrete paste.

C. Falsework
1. Support, brace and maintain falsework to safely support vertical. lateral, and asymmetrical loads until loads can be supported by in-place construction. Provide shores and struts with positive means of adjustment capable of taking up settlement during concrete placement using wedges or jacks.
2. Carefully inspect falsework and formwork during and after concrete placement for abnormal deflections or signs of failure. Make any necessary adjustments.

D. Forms for Exposed Concrete.
1. Drill wood forms to suit ties used and to prevent leakage around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Provide sharp, clean corners at intersecting planes without visible edges or offsets. Back joints with extra studs or girts to maintain true intersections.
3. Use extra studs, walers and bracing to prevent bowing of forms between studs. Do not use narrow strips of form material which allows bowing.

E. Corner Treatment: Unless otherwise indicated, form chamfers with 3/4 in. x 3/4 in. strips accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

F. Provisions for Other Trades
1. Provide openings in formwork to accommodate other trades. Verify size and location with trade requiring the opening. Provide openings in accordance with approved shop drawings.
2. Accurately and securely support items to be built into the forms. Other trades shall provide items to be installed and shall provide instructions and supervision as necessary.

G. Installation of Embedded Items
1. Set and build into the work, anchorage devices and other embedded items required for work by others that is attached to or supported by cast-in-place concrete. Use shop drawings, diagrams, templates and/or instructions provided by suppliers or other trades.
2. Thoroughly brace embedded items to prevent movement during concrete placement. Lace items whenever possible.
3. Ducts, conduits, pipes and their fittings shall be installed below slabs whenever possible. When it is necessary to embed them within a slab, they shall not be larger than 1/3 the thickness of the slab. Do not place adjacent ducts, conduits, or pipes closer than three times the O.D. of the smallest element.
4. Do not cut or move reinforcement to accommodate embedded items without approval of Engineer.

H. Edge Forms: Set edge forms or bulkheads and intermediate screwed strips for slabs to obtain

required elevations and contours in the finished slab surface.

I. Cleaning and Tightening:
   1. Thoroughly clean forms and adjacent surfaces immediately prior to pouring concrete.
   2. Apply form release agent at the rate recommended by the manufacturer.
   3. Re-tighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.02 Form Removal

A. Formwork not supporting concrete, such as beams, walls, columns and similar items, may be removed after curing at not less than 50 degrees F for 24 hours after placement, provided concrete is sufficiently hard to not be damaged by form removal. Protection and curing shall be maintained after form removal.

B. Formwork supporting weight of concrete such as soffits, joists, slabs, and other structural elements may not be removed in less than 14 days and not until concrete has attained design minimum 28-day compressive strength.

C. Form-facing material may be removed four days after placement, if shores and other vertical supports have been arranged to permit removal without loosening or disturbing shoring and supports.

3.03 Reuse of Forms

A. Clean and repair surface of forms to be used. Split, frayed, delaminated or otherwise damaged form-facing material shall not be reused.

3.04 Formwork Tolerances

A. Tolerances shall meet requirements of ACI 347.

3.05 Reinforcement Installation

A. Steel Surface Condition
   1. Remove dirt, grease, oil, loose mill scale, excessive rust, or foreign matter that may reduce bonding with concrete.
   2. Steel with rust or mill scale may be used, provided minimum dimensions, including height of deformations and weight of hand wire-brushed test specimen, are not less than applicable ASTM specification.

B. Bends
   1. Inside diameter of bend, other than for stirrups and ties in sizes No. 3 through No. 5, shall not be less than values in ACI 318, Table 7.2.
   2. Inside diameter of bend for stirrups and ties shall not be less than 4 x diameter for No. 5 bars and smaller. For bars larger than No. 5, diameter of bend shall be in accordance with Table 7.2.

ACI 318, Table 7.2	
Bar Size	Min. Diameter
No. 3 - No. 8	6 x diam.
No. 9 - No. 11	8 x diam.
No. 14 and No. 18	10 x diam.

C. Hooks: Bends for hooks shall be in accordance with the following table.

Bends	
Bar Size	Min. Diameter
No. 3 - No. 8	4 x diam.
No. 9 - No. 11	5 x diam.
No. 14 and No. 18	6 x diam.

D. Placement
   1. Accurately place and adequately secure reinforcement in position with concrete or metal chairs and spacers.
   2. Place slab reinforcement in the upper one-third of the slab.
   3. Clear distance between bars or layers of bars shall not be less than one inch or less than 1 1/3 times the maximum size aggregate, whichever is greater.
   4. Move within tolerances to avoid interference with other reinforcing steel or embedded items.
   5. Do not move bars beyond allowable tolerances without approval of Engineer.
   6. Do not heat, bend or cut bars without approval of Engineer.
   7. Place slab reinforcement in the upper one-third of the slab.

E. Splices
   1. Stagger splices in adjacent bars.
   2. Lap bars at least 6 inches or 44 bar diameters, whichever is greater.
   3. Securely wire so that contact is maintained over entire length of splice.
   4. Install splice devices in accordance with manufacturer's instructions.

F. Wire Fabric
   1. Install in longest practical length.
   2. Lap adjoining pieces one full mesh and tie.
   3. Do not make end laps midway between supporting beams or directly over beams of continuous structures.
   4. Offset laps in adjacent sheets.
   5. Extend to within two inches of edge of slab.

G. Fastening: Tie bars at all intersections where spacing is one foot or greater. Where spacing is less than one foot, tie alternate sections.

H. Protection: Keep reinforcing steel in proper position during concrete placement.

I. Approval: All reinforcing shall be approved by the Engineer or his designated representative prior to placing concrete.

3.06 Reinforcement Tolerances

A. Fabrication
   1. Sheared length: ±1 inch.
   2. Depth of truss bars: +0 inch to -1/2 inch.
   3. Stirrups, ties and spirals: ±1/2 inch.
   4. All other bends: ±1 inch.

B. Placement
   1. Concrete cover to formed surface: ±1/4 inch.
   2. Minimum spacing between bars: ±1/4 inch.
   3. Top bars in slabs and beams
      a. Eight inches deep or less: ±1/4 inch.
      b. Eight inches but not over two feet: ±1/4 inch.
      c. More than two feet deep: ±1/2 inch.
      d. Crosswise members: Spaced evenly within ±2 inches.

e. Lengthwise members: ±2 inches.

C. Maximum bar movement to avoid interference with other reinforcing or embedded items: one bar diameter.

D. Minimum Concrete Cover:
1. Concrete cast against and permanently exposed to earth: …… 3 inches
2. Concrete exposed to earth or weather:
   a. No. 6 through No. 18 bars…….. 2 inches
   b. No. 5 bar, W31 or D31 wire, and smaller…….. 1-1/2 inches
3. Concrete not exposed to weather or in contact with ground:
   a. Slabs, walls, joists:
      1) No. 14 and No. 18 bars…….. 1-1/2 inches
      2) No. 11 bar and smaller…….. 3/4 inches
   b. Beams, columns:
      1) Primary reinforcement, ties, stirrups, spirals…….. 1-1/2 inches
   c. Shells, folded plate members:
      1) No. 6 bar and larger…….. 3/4 inches
      2) No. 5 bar, W31 or D31 wire, and smaller…… 1/2 inches

3.07 Preparation for Concrete Placement

A. Check grades and placement of forms.

B. Remove debris, water, excess form oil etc. from forms.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, and anchored securely.

D. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.

E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert dowels and pack solid with non-shrink grout.

3.08 Delivery

A. Deliver and discharge concrete within 90 minutes or before 300 drum revolutions, whichever comes first, after the addition of water to the cement.

B. Do not add water to the mix after the initial introduction of water without the approval of the Engineer. If water is added at the jobsite, the concrete shall be mixed a minimum of 30 drum revolutions. Any water added shall not bring the total water in the mix to an amount above the specified water-cement ratio.

C. The temperature of the concrete as delivered shall not exceed a temperature of 90^0F.

D. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40^0F for more than three successive days, concrete shall be delivered to meet the following temperature immediately after placement:

Minimum Concrete Temperature	
Section Size	Min. Temperature
<12”	55^0F
12”-36”	50^0F
36”-72”	45^0F
>72”	40^0F

3.09 Placing Concrete

A. Place concrete in accordance with ACI 318.

B. Notify Engineer a minimum of 24 hours prior to concrete placement.

C. Ensure reinforcement, inserts, embedded parts, formed expansion joints and contraction joints are not disturbed during concrete placement.

D. Install vapor retarder under interior slabs on grade. Lap joints a minimum of six inches and seal watertight by taping edges and ends.

E. Deposit concrete as close as practical to its final position. Do not drop concrete more than five feet vertically. Superplasticized concrete may be dropped a maximum of five feet vertically with maximum lift depth of five feet.

F. Place concrete continuously between predetermined construction joints.

G. Do not interrupt the placement. Do not permit cold joints.

H. Thoroughly consolidate concrete by suitable means during placement. Thoroughly work concrete around reinforcement and embedded items and into corners of forms.

I. Install joint devices in accordance with manufacturer's instructions.

3.10 Joints

A. Construction Joints: Joints that are placed at the end of a days work. In slabs they may be placed to permit movement and/or to transfer load.
   1. Horizontal constructions joints will not be permitted except as shown on the Drawings.
   2. For building floor slabs on grade, locate joints a maximum distance apart of three times the slab thickness.
   3. Provide keyways at least 1 1/2 inch deep or steel dowels in all construction joints in walls, slabs, and between footings and walls. See drawing details.

B. Expansion Joints: Joints that separate or isolate slabs from other parts of the structure such as walls, footings, columns, and equipment bases and drives and sidewalks from stairs, walls, light poles and other obstructions.
   1. Separate slabs on grade from vertical concrete surface with 3/4 inch preformed joint filler. Extend joint filler to within 1/8 inch of finished slab surface.

C. Control Joints: Joints in slabs to create planes of weakness so that cracks will occur at desired locations.
   1. Provide joints to form panels or patterns as indicated on the Drawings. If joints are not shown, consult Engineer for joint placement.
   2. Inserts: Form 1/4 inch wide joints, one-fourth the depth of the slab thickness (one inch minimum) by inserting pre-molded hardboard or fiberboard strips into the fresh concrete. The top surface of the strip shall be flush with the slab surface. After concrete has cured for a minimum of seven days remove inserts and clean loose debris from the joints.
   3. Sawed Joints (Normal): Saw joints as soon after concrete is set sufficiently to preclude raveling during sawing and before shrinkage cracking takes place. Saw joints no later than 24 hours after concrete placement. Joints shall be 1/8 inch wide and one-fourth the slab thickness (one inch minimum).
   4. Sawed Joints (Early Entry): Saw joints using the "SOFF-CUT System" or equal. Cut as soon as the slab will support the weight of the saw and the operator (normally within two hours).

Joints shall be 1/8 inch wide and ten percent of the slab thickness (depth shall be at least equal to the largest aggregate size).

3.11 Concrete Finishing

A. Provide finishes in accordance with ACI 301, Section 5.

Type	Finish	Comments
1	Screed off	
2	Rough form finish	Patch tie holes and defects. Chip or rub off fins exceeding ¼ in. in height. Leave surfaces with the texture imparted by form.
3	Smooth form finish	Patch tie holes and defects. Remove all fins completely. Comply with rubbed finish.
4	Smooth rubbed finish	Remove forms as early as permitted and perform necessary patching. Produce finish no later than day following form removal. Wet surface and rub with carorundum brick or other abrasive until uniform color and texture are produced. Use no cement grout.
5	Floated finish	Place, consolidate, strike off, and level concrete. Float with hand float, bladed power float with flat shoes, or power disk float when bleed water sheen has disappeared and surface has stiffened sufficiently to allow floating.
Type	Finish	Comments
6	Troweled finish	Float surface, then hand or power trowel. Hand trowel surface smooth and free of trowel marks. Continue until ringing sound is produced as surface is troweled. Floors shall be laser screeded.
7	Broom finish	Immediately after surface has been floated, give the surface a course scored texture using a broom.

1. Finish Schedule: Unless otherwise indicated in the Contract Documents, finish concrete surfaces as follows:

Surface	Finish
Buried foundations, footings and footing walls	1 and 2
Buried walls	2
Exposed exterior walls and retaining walls	3
Interior walls	4
Interior process tanks	3
Tank grout and hopper fillets	6
Tank slabs and bases	5 (1 in grouted area)
Interior structural slabs and floors	6
Interior floors to receive quarry or ceramic tile	5
Interior beams, columns, lintels, etc.	4 or 6
Exterior slabs, steps, ramps, and sidewalks	7
Equipment pads and foundations	4 or 6
Concrete topping for precast decks	6
Flumes and open channels	3 or 5

2. In areas with floor drains, maintain floor elevations at walls; pitch surfaces uniformly to drains at 1/4 inch per foot or as indicated on Drawings.

3.12 Curing and Protection

A. General:
   1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
   2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   3. Cover concrete with polyethylene if rain is eminent.
   4. Cure concrete in accordance with ACI 308.

B. Wet Fabric Method
   1. Place wetted burlap on concrete surface when the concrete is still wet, but firm enough to support the burlap without marring the surface. Lay the burlap flat on the concrete surface, overlapping adjacent strips by a minimum of six inches. After forms are removed, cover edge with burlap.
   2. Keep burlap wet for seven days. Add water as necessary by fine spray.

C. Plastic Film/Reinforced Paper Method
   1. Place plastic film or reinforced paper on exposed concrete surfaces when the concrete is still wet, but firm enough to support the burlap without marring the surface. Place the material flat on the surface, without wrinkles. Weight material so that it remains in contact with the concrete. Place soil or wood strips on material edges.
   2. Keep covered for seven days.

D. Liquid Membrane-Forming Curing Compound
   1. Apply after finishing as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the curing compound will be absorbed into the concrete.
   2. Apply at a uniform rate of 150 to 200 sq. ft. per gallon. When feasible, apply in two applications at right angles to each other with the second coat being applied within 30 minutes of the first.
   3. Coat edges within 30 minutes of form removal.
   4. Use Type 2, white pigmented, for concrete exposed to sunlight and Type 1, clear for other concrete.
   5. Do not use liquid membrane-curing compound on surfaces that are to receive additional concrete, paint, or tile that requires a positive bond, unless it has been demonstrated that the membrane can be satisfactorily removed or that it can serve as a satisfactory base.

E. Curing/Sealing Material
   1. Use for sidewalk and driveways.
   2. Cure and seal concrete with a uniform coating of membrane curing/sealing compound.
   3. Apply with sprayer in accordance with the manufacturer's printed instructions.
   4. Apply two coats at right angles to each other.
   5. Do not apply if the temperature of the concrete is less than 40^0F.

3.13 Floor Sealing

A. Unless indicated elsewhere, seal interior concrete floors.

B. Apply the sealer in accordance with the manufacturer's instructions.

3.14 Field Quality Control

A. Sampling and testing shall be the responsibility of the Contractor. See Section 01 45 16 Testing Requirements.

B. Provide free access to Work and cooperate with testing personnel.

C. Four concrete test cylinders will be taken for every 75 or less cubic yards of each class of concrete placed in one day. Test cylinders will be lab cured. One test cylinder will be broken at 7 days, two at 28 days and one will be held.

D. Engineer may cast additional test cylinders for field curing cold or hot weather may affect curing.

E. One slump test, one air test and the concrete temperature will be taken for each set of test cylinders taken.

F. Sampling and testing will be performed in accordance with the following:
   4. Concrete samples: ASTM C172.
   5. Test cylinders: ASTM C31.
   6. Slump tests: ASTM C143.
   7. Air test: ASTM C231.

G. In addition to providing test results to the Engineer, provide the test results to the concrete supplier.

3.15 Patching

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Honeycomb, embedded debris, and tie holes are not acceptable.

C. Patch imperfections in accordance with ACI 301, Section 5.

3.16 Defective Concrete

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

END OF SECTION

SECTION 03 31 01

SITEWORK CONCRETE

PART 1 - GENERAL

1.01 Section Includes

A. Cast-in-place concrete for curb and gutter, sidewalk, exterior slabs, and other similar exterior concrete. Does not include concrete pavement.

1.02 Related Sections

A. Section 01 45 16 – Testing Requirements.

1.03 References

A. ACI 301 - Specifications for Structural Concrete.

B. ACI 305R - Hot Weather Concreting.

C. ACI 306R - Cold Weather Concreting.

D. ACI 308 - Standard Practice for Curing Concrete.

E. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

F. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

G. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.

H. ASTM C33 - Standard Specification for Concrete Aggregates.

I. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

J. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

K. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

L. ASTM C150 - Standard Specifications for Portland Cement.

M. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

N. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete.

O. ASTM C260 - Air Entraining Admixtures for Concrete.

P. ASTM C494 - Chemical Admixtures for Concrete.

Q. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

R. ASTM C618 - Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement.

S. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds having Special Properties for Curing and Sealing.

T. ASTM D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

U. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.04 Quality Assurance

A. Perform concrete work in accordance with ACI 301.

B. Conform to ACI 305R when concreting in hot weather and ACI 306R when concreting in cold weather.

1.05 Submittals

A. Concrete Mix Design
   1. Provide dry weight of cement, saturated-surface dry weight of aggregate, brand name, type, and quantity of admixtures, and pounds of water per cubic yard of concrete.
   2. Test data supporting the portions of the design mixes based on laboratory trial batches in accordance with ACI 318. Test data supporting the proportions of the design mixes based on past field experience in accordance with ACI 318 may be provided in lieu of the laboratory data.

B. Admixtures: Submit manufacturer's literature and certifications.

C. Delivery Tickets: Provide for each load of concrete delivered; include the following information: Name of ready-mix batch plant, serial number of ticket, date, truck number, name of contractor, name and location of job, class of concrete, amount of concrete in cubic yards, time loaded or of first mixing of cement and aggregate, water added at jobsite and initials of person authorizing addition, admixtures, if added.

D. Test Results.

PART 2 - PRODUCTS

2.01 Reinforcement

A. Reinforcing Steel: ASTM A615; Grade 60, deformed, unfinished.

B. Welded Steel Wire Fabric: ASTM A185: flat sheets, unfinished.

2.02 Concrete Materials

A. Portland Cement: ASTM C150, Type 1.

B. Aggregate: ASTM C33.

C. Water: Clean and not detrimental to concrete.

D. Flyash: ASTM C618, Class C.

2.03 Concrete Admixtures

A. Air Entrainment: ASTM C260.

B. Water Reducing: ASTM C494; Type A, Water Reducing.

C. Retarding: ASTM C494. Type D, Water Reducing and Retarding.

D. Accelerating: ASTM C494 Type C Accelerating (non-chloride); Type E, Water Reducing and Accelerating (non-chloride).

2.04 Accessories

A. Curing Material: Liquid membrane curing compound; ASTM C309, Type 2, white pigmented.

B. Curing/Sealing Material:
1. An acrylic resin curing, sealing, and hardening compound for exterior freshly placed concrete that provides a durable, long-lasting moisture impermeable finish that improves resistance to chemicals, grease, and de-icing salts.
2. Meet requirements of ASTM C1315, Type 1, Class B and ASTM C309, Type 1, Classes A and B.
3. Manufacturer: AS-1 Achro Seal 1315 OTC, TK Products; Seal Cure 309-30, W.R. Meadows; or equal.

C. Preformed Expansion Joint Fillers: ASTM D1751 or ASTM D1752.

2.05 Concrete Mix Design

A. Mix and deliver concrete in accordance with ASTM C94.

B. Select proportions in accordance with ACI 301.

C. Provide concrete in accordance with the following requirements:
a. Concrete Mixes

Concrete Mixes		
Class	Compressive Strength at 28 days, psi	Max. Water-Cement Ratio By Weight
Air-Entrained Concrete		
D	4,000	0.48

2. Air Content: Total air content (entrained and entrapped) for air-entrained concrete shall be in accordance with the following table:

Air Content	
Nominal Max. Size Aggregate	Air Content
¾”	6% ± 1
1”	6% ± 1
1 ½”	5% ± 1

3. In any mix, up to 20 percent of the cement (on a pound per pound basis) may be replaced with flyash.

D. Slump: 3 inches plus or minus 1 inch.

PART 3 - EXECUTION

3.01 Preparation for Concrete Placement

A. Check grades and placement of forms.

B. Remove debris, water, excess form oil etc. from forms.

C. Verify that anchors, seats, plates, reinforcement, inlet castings, and other items to be cast into concrete are accurately placed, and anchored securely.

D. Provide a minimum cover of 1-1/2 inch for reinforcing bars.

E. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.

F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert dowels and pack solid with non-shrink grout.

3.02 Delivery

A. Deliver and discharge concrete within 90 minutes or before 300 drum revolutions, whichever comes first, after the addition of water to the cement.

B. Do not add water to the mix after the initial introduction of water without the approval of the Engineer. If water is added at the jobsite, the concrete shall be mixed a minimum of 30 drum revolutions. Any water added shall not bring the total water in the mix to an amount above the specified water-cement ratio.

C. The temperature of the concrete as delivered shall not exceed a temperature of 90^0F.

D. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40^0F for more than three successive days, concrete shall be delivered to meet the following temperature immediately after placement:

Minimum Concrete Temperature	
Section Size	Min. Temperature
<12”	55^0F
12”-36”	50^0F
36”-72”	45^0F
>72”	40^0F

3.03 Placing Concrete

A. Place concrete in accordance with ACI 318.

B. Notify Engineer a minimum of 24 hours prior to concrete placement.

C. Ensure reinforcement, inserts, embedded parts, formed expansion joints and contraction joints are not disturbed during concrete placement.

D. Deposit concrete as close as practical to its final position. Do not drop concrete more than five feet vertically.

E. Place concrete continuously between predetermined construction joints.

F. Do not interrupt the placement. Do not permit cold joints.

G. Thoroughly consolidate concrete by suitable means during placement. Thoroughly work concrete around reinforcement and embedded items and into corners of forms.

3.04 Joints

A. Construction Joints: Joints that are placed at the end of a days work. In slabs they may be placed to permit movement and/or to transfer load.

B. Expansion Joints: Joints that separate or isolate slabs from other parts of the structure such as walls, footings, columns, and equipment bases and drives and sidewalks from stairs, walls, light poles and other obstructions. Separate slabs on grade from vertical concrete surface with 1/2- inch preformed joint filler. Filler shall extend the full depth of the concrete with the top slightly lower than the concrete surface.

C. Control Joints: Joints in slabs to create planes of weakness so that cracks will occur at desired locations.
   1. Provide joints to form panels or patterns as indicated on the Drawings. If joints are not shown, consult Engineer for joint placement.
   2. Inserts: Form 1/4 inch wide joints, one-fourth the depth of the slab thickness (one inch minimum) by inserting pre-molded hardboard or fiberboard strips into the fresh concrete. The top surface of the strip shall be flush with the slab surface. After concrete has cured for a minimum of seven days remove inserts and clean loose debris from the joints.
   3. Sawed Joints (Normal): Saw joints as soon after concrete is set sufficiently to preclude raveling during sawing and before shrinkage cracking takes place. Saw joints no later than 24 hours after concrete placement. Joints shall be 1/8 inch wide and one-fourth the slab thickness (one inch minimum).
   4. Sawed Joints (Early Entry): Saw joints using the “SOFF-CUT System” or equal. Cut as soon as the slab will support the weight of the saw and the operator (normally within two hours). Joints shall be 1/8 inch wide and ten percent of the slab thickness (depth shall be at least equal to the largest aggregate size).

3.05 Concrete Finishing

A. Provide finish in accordance with ACI 301, Section 5.

B. Unless indicated otherwise, provide a broom finish for concrete for curb and gutter, sidewalk, and exterior slabs. Immediately after the concrete has been floated, give the surface a course scored texture using a broom.

3.06 Curing and Protection

A. General:
   1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
   2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   3. Cover concrete with polyethylene if rain is eminent.
   4. Cure concrete in accordance with ACI 308.

B. Liquid Membrane-Forming Curing Compound (Curb and Gutter):
   1. Apply after finishing as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the curing compound will be absorbed into the concrete.
   2. Apply at a uniform rate of 200 sq. ft. per gallon. When feasible, apply in two applications at right angles to each other with the second coat being applied within 30 minutes of the first.
   3. Coat edges within 30 minutes of form removal.

C. Curing/Sealing Compound (Sidewalk):
   1. Cure and seal concrete with a uniform coating of membrane curing/sealing compound.
   2. Apply with sprayer in accordance with the manufacturer’s printed instructions.

3. Apply two coats at right angles to each other.
4. Do not apply if the temperature of the concrete is less than 40^0F.
5. Protect concrete from all traffic for three days and from vehicular traffic for seven days.

3.07 Field Quality Control

A. Sampling and testing shall be the responsibility of the Contractor. See Section 01 45 16 Testing Requirements.

B. Provide free access to Work and cooperate with testing personnel.

C. Four concrete test cylinders will be taken for every 75 or less cubic yards of each class of concrete placed in one day. Test cylinders will be lab cured. One test cylinder will be broken at 7 days, two at 28 days and one will be held.

D. Engineer may require the casting additional test cylinders for field curing when cold or hot weather may affect curing.

E. One slump test, one air test and concrete temperature will be taken for each set of test cylinders.

F. Sampling and testing will be performed in accordance with the following:
1. Concrete samples: ASTM C172.
2. Test cylinders: ASTM C31.
3. Slump tests: ASTM C143.
4. Air test: ASTM C231.

G. In addition to providing test results to the Engineer, provide the test results to the concrete supplier.

3.08 Patching

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Honeycomb, embedded debris, and tie holes are not acceptable.

C. Patch imperfections in accordance with ACI 301, Section 5.

3.09 Defective Concrete

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

END OF SECTION

SECTION 03 35 16.13

CONCRETE DENSIFIER AND SEALER

PART 1 - GENERAL

1.01 Section Includes

A. Application of liquid hardener/densifier/sealer to protect concrete floors.

1.02 Related Sections

A. Section 00 31 00 - Concrete, Forms and Reinforcement.

B. Section 03 35 16.14 – Concrete Water and Oil Repellant.

1.03 Submittals

A. Submit manufacturer's product data, including surface preparation and application instructions.

1.04 Quality Assurance

A. Applicator: Minimum of three years experience in application of similar systems and products.

B. Manufacturer: Firm regularly engaged in the manufacturer of the products specified.

1.05 Delivery, Storage, and Handling

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials in clean, dry area in accordance with the manufacturer's instructions. Keep containers sealed until ready to use. Keep from freezing.

1.06 Environmental Requirements

A. Do not apply sealer when concrete surface or air temperatures are below 40^0F or above 95^0F during or within 8 hours after application.

B. Provide ventilation during coating evaporation stage in confined or enclosed areas.

PART 2 - PRODUCTS

2.01 Manufacturer

A. Consolideck LS, Prosoco, Inc.; Euco Diamond Hard, Euclid Chemical Company, or equal.

2.02 Concrete Sealer

A. A penetrating silicate liquid that chemically reacts with the concrete to provide an increase in density, durability, and abrasion resistance and reduces dusting.
   1. VOC Content: < 20 g/L.
   2. Coefficient of Friction: ≥ 0.60 wet or dry.

PART 3 - EXECUTION

3.01 Examination

A. Examine concrete surfaces to receive sealer. Notify Engineer if surfaces are not acceptable.

3.02 Surface Preparation

A. Cure concrete in accordance with manufacturer's instructions and Section 00 31 00.

B. Clean all dirt, dust, oil, grease and other contaminants from the surface that interfere with the penetration or performance of the product.

3.03 Application

A. Apply sealer to the concrete surfaces in accordance with the manufacturer's written instructions.

B. Apply to clean, dry, cured and properly prepared surface.

C. Apply product with low pressure sprayer or by poring on surface and distributing evenly with broom or squeegee. Apply at the rate recommended by the manufacturer.

D. Allow product to dwell on the surface for the manufacturer specified time.

E. Remove excess material.

F. Do not dilute or alter products.

3.04 Protection

A. Protect floors from traffic until product has dried.

B. Protect adjacent surfaces from contact with the product. If product gets on adjacent surfaces, immediately wash with clean water.

3.05 Final Cleaning

A. Clean site of all unused product, residues, rinse water, and wastes.

B. Remove and dispose of all materials used to protect surrounding surfaces.

END OF SECTION

SECTION 03 35 16.14

CONCRETE WATER AND OIL REPELLENT

PART 1 - GENERAL

1.01 Section Includes

A. Furnishing and application of water and oil repellent for concrete floors.

1.02 Related Sections

A. Section 00 31 00 - Concrete, Forms and Reinforcement.

B. Section 03 35 16.13 - Concrete Densifier and Sealer.

1.03 References

A. ASTM D3278 - Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus.

B. ASTM D5095 - Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes, and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments.

1.04 Submittals

A. Submit manufacturer's product data, including surface preparation and application instructions.

B. Submit Material Safety Data Sheet.

1.05 Quality Assurance

A. Applicator: Minimum of three years experience in application of similar systems and products.

B. Manufacturer: Firm regularly engaged in the manufacturer of the products specified.

1.06 Delivery, Storage, and Handling

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials in clean, dry area away from potential ignition sources. Keep containers tightly closed when not dispensing.

C. Dispose of unused product in accordance with local, state, and federal regulations.

1.07 Environmental Requirements

A. Do not apply sealer when concrete surface or air temperatures are below 40^0F or above 90^0F during or within 8 hours after application.

B. Provide ventilation during coating evaporation stage in confined or enclosed areas.

C. Do not apply on windy day unless building is enclosed.

PART 2 - PRODUCTS

2.01 Manufacturer

A. Standoff® SLX100® Water and Oil Repellent by Prosoco, Inc or equal.

2.02 Oil and Water Repellent

A. A modified “neat” silane system designed to prevent staining by waterbourne and oily substances and that forms an effective chloride screen that reduces surface erosion and corrosion of reinforcement by water and water-carried salts.
   1. VOC Content: Maximum 400 g/l.
   2. Total Solids: 58%, ASTM D5095.
   3. Active Content: 93%.
   4. Flash Point: ≥ 80^0F, ASTM D3278.

PART 3 - EXECUTION

3.01 Preparation

A. Protect passersby, building occupants, people, vehicles, property, glass, plants, and all non-masonry from product residue, splash, fumes, mist and wind drift.

B. Install all caulking, patching, and joint sealants prior to application of product.

C. Ensure fresh air entry and cross ventilation during application and drying.

D. Extinguish all flames, pilot lights and other potential sources of ignition during use and until all vapors are gone.

3.02 Safety

A. Wear protective clothing and following safety recommendations as indicated in the Material Safety Data Sheet.

3.03 Equipment

A. Apply product with a low-pressure (<50 psi) pump type spray equipment. Adjust tip to prevent atomization during application.

B. Battery powered sprayers shall be rated explosion proof.

C. Sprayers shall be fitted with solvent-resistant hoses and gaskets to avoid discoloration.

D. Any brushes, rollers or other hand application tools shall be solvent-resistant.

3.04 Application

A. Apply in accordance with the manufacturer’s instructions.

B. Apply in a single, saturating application. Use enough product to keep the surface wet for about a minute before penetrating.

C. Broom out all puddles thoroughly until they completely penetrate the surface.

D. Wipe down excess with a clean, absorbent towel.

3.05 Protection

A. Protect floors from traffic until product has dried.

B. Protect adjacent surfaces from contact with the product. If product gets on adjacent surfaces, immediately wash with clean water.

3.06 Cleaning

A. Immediately clean product from adjacent surfaces.

END OF SECTION

SECTION 03 41 13

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 - GENERAL

1.01 Section Includes

A. Furnishing, delivering and erection of precast hollow core concrete planks for floors and roofs.

1.02 References

A. ACI 301 - Specification for Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary

C. ASTM A416 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

D. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

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

F. ASTM C150 - Standard Specification Portland Cement.

G. ASTM C618 - Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete.

H. AWS D1.1 - Structural Welding Code - Steel.

I. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

J. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.

K. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.

L. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

M. PCI MNL-124 - Design for Fire Resistance of Precast Prestredded Concrete.

N. PCI MNL-126 - Manual for the Design of Hollow Core Slabs,

O. PCI MNL-135 - Tolerance manual for Precast and Prestressed Concrete Construction.

1.03 Submittals

A. Submit shop drawings.

B. Indicate on shop drawings, layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials.

C. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

D. Provide product data on standard components.

E. Submit design data report.

F. Shop drawings and design report shall be signed by a Registered Professional Engineer.

1.04 Delivery, Storage, and Handling

A. Handle, precast members in position consistent with their shape and design. Lift and support only from support points. Do not exceed initial allowable transfer stresses.

B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

C. Protect members to prevent staining, chipping, or spalling of concrete.

D. Mark each member with date of production and final position in structure.

1.05 Quality Assurance

A. Designer Qualifications: Engineer experienced in design of the work specified and licensed in the State of Wisconsin.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of three years of experience.

C. Erector Qualifications: Company with experience in performing the work of this section.

PART 2 - PRODUCTS

2.01 Acceptable Fabricators

A. Flexcore Company, Inc., Spancrete Industries, or approved equal.

2.02 Precast Units

A. Precast Hollow Core Planks: Comply with PCI MNL-120, PCI MNL-126 and PCI MNL-124 or ACI 318 and ACI 301.

B. Provide dimensions as indicated on the Drawings.

C. Design components to withstand dead loads and design loads as indicated on the Drawings.

D. Replace as much Portland cement as possible with fly ash while maintaining strength requirements.

E. Design connections in accordance with PCI MNL-123.

F. Design components to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings.

G. Grouted Keys: Capable of transmitting horizontal shear force of 2,000 lb/ft.

H. Fire Resistance: Design planks in accordance with PCI-MNL 124 to achieve a two hour rating.

2.03 Materials

A. Cement: ASTM C150, gray.

B. Aggregate, Sand, Water & Admixtures: Determined by precast fabricator as appropriate to design requirements.

C. Flyash: ASTM C618, Class C.

D. Tensioning Steel: ASTM A416, Grade 250k or 270k, seven-wire stranded steel cable, full length without splices.

E. Reinforcing Steel: ASTM A615, Grade 60, deformed steel bars.

2.04 Accessories

A. Non-shrink Grout: Non-metallic, minimum yield strength of 10,000 psi at 28 days.

B. Cement Grout: Minimum compressive strength of 3,000 at 28 days.

C. Bearing Pads: High density plastic, 1/8 inch thick, smooth both sides, neoprene.

D. Bolts, Nuts, and Washers: High strength steel type recommended for structural steel joints.

E. Connecting and Supporting Devices: Stainless steel; ASTM A666, No. 2D cold-rolled, dull finish.

F. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 lbs dead load, predrilled to receive hanger.

G. Core Hole End Plugs: Fiberglass insulation, minimum 12 inches, sealed with cement grout.

2.05 Fabrication

A. Weld reinforcing in accordance with AWS D1.4.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Provide required openings with dimensions eight inches and larger and imbedded accessories provided by other sections, at indicated locations.

D. Compressive Strength: Minimum 28-day strength of 4,000 PSI.

E. Finish: All members shall be furnished uniformly smooth. Exposed surfaces shall be free of pocks, voids, and honeycombs caused by lack of proper densification of concrete. The presence of these defects may be cause for rejection.

2.06 Fabrication Tolerances

A. Conform to PCI MNL-116 and PCI MNL-135 except as modified below:
   1. Maximum Variation from Nominal Dimensions:
      a. Width: Plus or minus 1/4 inch.
      b. Length: Plus or minus 1/2 inch.
      c. Depth: Plus or minus 1/4 inch.
   2. Maximum Variation from Intended Camber: Plus or minus 1/4 inch in 10 feet.
   3. Maximum Variation from Plain End Squareness: Plus or minus 1/4 inch.
   4. Maximum Sweep: Plus or minus 1/4 inch.
   5. Maximum Misalignment of Anchors, Inserts, and Openings: Plus or minus1/8 inch.

6. Maximum Bowing of Members: Length/360.
7. Maximum Bowing of Members: Plus or minus 1/4 inch in 10 feet to a maximum of 3/8 inch.

PART 3 - EXECUTION

3.01 Examination and Preparation

A. Verify that field conditions are ready to receive the work.

B. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.02 Erection

A. Erect members without damage to structural capacity, shape, or finish.\

B. Install bearing pads at ends of planks.

C. Provide temporary lateral support to prevent bowing, twisting, or warping of members.

D. Align and maintain uniform horizontal and end joints as erection progresses.

E. Adjust differential elevation between precast members to tolerance before final attachment.

F. Install hanger tabs in joints. Secure units in place. Perform welding in accordance with AWS D1.1.

G. Clean joints and wet surfaces prior to placing grout. Tape seal underside of plank joints to prevent grout leakage.

H. Make plank-to-plank joints smooth using grout, troweled smooth. Transition differential elevation of adjoining planks with grout to a maximum slope of 1:12.

I. Hangers for pipes, ceiling, heating, ventilating, electrical, and plumbing shall be furnished and installed by the contractors supplying same prior to grouting and caulking of the precast members.

3.03 Erection Tolerances

A. Erect members level and plumb within erection tolerances.

B. Conform to PCI MNL-135 except as modified below::
1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.
2. Top Elevation from Building Elevation Datum at Plank Ends: Plus or Minus 1/2 inch.
3. Maximum Jog in Alignment of Matching Ends: Plus or Minus 1/2 inch.
4. Exposed Joint Dimension: Plus or minus 3/8 inch.
5. Differential Top Elevation as Erected: Plus or minus 3/8 inch.
6. Bearing Length in Span Direction: Plus or minus 3/8 inch.
7. Differential Bottom Elevation of Exposed Planks: Plus or minus 3/16 inch

3.04 Protection

A. Protect members from damage caused by field welding or erection operations.

3.05 Cleaning

A. Clean weld marks, dirt, and blemishes from surface of exposed members.

END OF SECTION