

**SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES****PART 1 - GENERAL**

## 1.1 SUMMARY

- A. Section Includes:
1. Formwork for cast-in-place concrete.
  2. Shoring, bracing, and anchorage.
  3. Architectural form liners.
  4. Form accessories.
  5. Form stripping.
- B. Related Requirements:
1. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel and required supports for cast-in-place concrete.
  2. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frame, slabs-on-grade, and other concrete components associated with building.
  3. Section 05 50 00 - Metal Fabrications: Product requirements for metal fabrications for placement by this Section.

## 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
  2. ACI 301 - Specifications for Structural Concrete.
  3. ACI 318 - Building Code Requirements for Structural Concrete.
  4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest & Paper Association:
1. AF&PA - National Design Specification (NDS) for Wood Construction.
- C. American Society of Mechanical Engineers:
1. ASME A17.1 - Safety Code for Elevators and Escalators.
- D. APA - The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard - Structural Plywood.
- E. ASTM International:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard No. 17 Grading Rules for West Coast Lumber.

### 1.3 COORDINATION

- A. Section 01 31 13 – Project Coordination: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on void form materials and installation requirements.
- C. Shop Drawings:
  - 1. Indicate:
    - a. Formwork, shoring, and reshoring.
    - b. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
    - c. Means of leakage prevention for concrete exposed to view in finished construction.
    - d. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift, and height of drop during placement.
    - e. Vertical, horizontal, and special loads according to ACI 347, and camber diagrams when applicable.
    - f. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
    - g. Procedure and schedule for removal of shores and installation and removal of re-shores.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Delegated Design Submittals:
  - 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for formwork and shoring.
  - 2. Indicate loads transferred to structure during process of concreting, shoring, and reshoring.
  - 3. Include structural calculations to support design.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:
  - 1. Submit qualifications for licensed professional.

**1.5 QUALITY ASSURANCE**

- A. Perform Work according to ACI 347, 301, and 318.
- B. For wood products furnished for Work of this Section, comply with AF&PA.

**1.6 QUALIFICATIONS**

- A. Licensed Professional: Professional Engineer experienced in design of specified Work and licensed at Project location.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Section 01 61 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept void forms on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

**PART 2 - PRODUCTS****2.1 PERFORMANCE AND DESIGN CRITERIA**

- A. Design, engineer, and construct formwork, shoring, and bracing according to ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line, and dimension as indicated on Drawings.
- B. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, desiccant method.

**2.2 WOOD FORM MATERIALS**

- A. Form Materials: At discretion of Contractor.
- B. Plywood Forms:
  - 1. Application: Exposed finish concrete.
  - 2. Description:
    - a. Comply with APA/EWA PS 1.
    - b. Panels: Full size, 4 by 8 feet.
    - c. Label each panel with grade trademark of APA/EWA.
  - 3. Plywood for Surfaces to Receive Membrane Waterproofing:
    - a. Minimum Thickness: 5/8 inch.
    - b. Grade: APA/EWA "B-B Plyform Structural I Exterior."
  - 4. Plywood with "Smooth Finish" Indicated on Drawings:
    - a. Minimum Thickness: 3/4 inch.
    - b. Grade: APA/EWA "HD Overlay Plyform Structural I Exterior."

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## 2.3 PREFABRICATED FORMS

- A. Manufacturers:
  - 1. EFCO - Economy Forms Corp.
  - 2. Symons by Dayton Superior
  - 3. Substitutions: As specified in Section 01 61 00 - Product Requirements.
  
- B. Preformed Steel Forms:
  - 1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
  - 2. Minimum Thickness: 16 gage.
  
- C. FRP Forms: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
  
- D. Pan:
  - 1. Material: Steel.
  - 2. Configuration: Size and profile as required.
  
- E. Tubular Column:
  - 1. Description: Round spirally wound laminated fiber.
  - 2. Surface Treatment: Release agent, non-reusable.
  - 3. Sizes: As indicated on Drawings.
  - 4. Manufacturers:
    - a. Sunoco Products Co.
    - b. Substitutions: As specified in Section 01 60 00 - Product Requirements.
  
- F. Steel Forms:
  - 1. Description: Sheet steel, suitably reinforced.
  - 2. Design: For particular use as indicated on Drawings.

## 2.4 FORMWORK ACCESSORIES

- A. Form Ties:
  - 1. Type: Removable; Snap off; or cone.
  - 2. Length: Fixed.
  - 3. Furnish waterproofing washer.
  - 4. Free of defects capable of leaving holes larger than 1 inch in concrete surface.
  
- B. Spreaders:
  - 1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.
  - 2. Wire ties, wood spreaders, or through bolts are not permitted.
  
- C. Form Release Agent:
  - 1. Description: Colorless mineral oil that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

- D. Corners:
  - 1. Type: Chamfer.
  - 2. Size: 1 by 1 inches.
  - 3. Lengths: Maximum possible.
  
- E. Vapor Retarder:
  - 1. Description: Polyethylene sheet.
  - 2. Thickness: 8 mils.
  
- F. Bituminous Joint Filler: Comply with ASTM D1751.
  
- G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.
  
- H. Waterstop:
  - 1. Material: PVC.
  - 2. Tensile Strength: Minimum 1,750 psi.
  - 3. Working Temperature Range: Minus 50 to plus 175 degrees F.
  - 4. Width: min 6 inches.
  - 5. Lengths: Maximum possible.
  - 6. Profile: Ribbed.
  - 7. Corner Sections: Preformed.
  - 8. Jointing: Heat welded.
  - 9. Manufacturers:
    - a. Sika Greenstreak
    - b. BoMetals, Inc.
    - c. Or Equal

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Section 01 73 00 - Execution Requirements: Requirements for installation examination.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Verify that dimensions agree with Drawings and Shop Drawings.
- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

#### **3.2 INSTALLATION**

- A. Earth Forms: Not permitted.
- B. Formwork:
  - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.

2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
  3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
  4. Positioning:
    - a. Carefully verify horizontal and vertical positions of forms.
    - b. Correct misaligned or misplaced forms before placing concrete.
  5. Complete wedging and bracing before placing concrete.
  6. Erect formwork, shoring, and bracing to achieve design requirements according to ACI 301.
  7. Stripping:
    - a. Arrange and assemble formwork to permit dismantling and stripping.
    - b. Do not damage concrete during stripping.
    - c. Permit removal of remaining principal shores.
  8. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
  9. Install chamfer strips on external corners of, columns and walls.
  10. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view.
  11. Do not patch formwork.
  12. Leave forms in place for minimum number of days according to ACI 347.
- C. Form Removal:
1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and removal has been approved by Engineer.
  2. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
  3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
  4. Discard damaged forms.
  5. Form Release Agent:
    - a. Apply according to manufacturer instructions.
    - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
    - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
    - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
  6. Form Cleaning:
    - a. Clean forms as erection proceeds to remove foreign matter within forms.
    - b. Clean formed cavities of debris prior to placing concrete.
    - c. Flush with water or use compressed air to remove remaining foreign matter.
    - d. Ensure that water and debris drain to exterior through cleanout ports.
    - e. Cold Weather:

- 1) During cold weather, remove ice and snow from within forms.
  - 2) Do not use de-icing salts.
  - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
7. Reuse and Coating of Forms:
- a. Thoroughly clean forms and reapply form coating before each reuse.
  - b. For exposed Work, do not reuse forms with damaged faces or edges.
  - c. Apply form coating to forms according to manufacturer instructions.
  - d. Do not coat forms for concrete indicated to receive "scored finish."
  - e. Apply form coatings before placing reinforcing steel.
- D. Forms for Smooth Finish Concrete:
1. Use steel, plywood, or lined-board forms.
  2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
  3. Install form lining with close-fitting square joints between separate sheets without springing into place.
  4. Use full-sized sheets of form liners and plywood wherever possible.
  5. Tape joints to prevent protrusions in concrete.
  6. Apply forming and strip wood forms in a manner to protect corners and edges.
  7. Level and continue horizontal joints.
  8. Keep wood forms wet until stripped.
- E. Framing, Studding, and Bracing:
1. Maximum Spacing of Studs:
    - a. Boards: Maximum 16 inches o.c.
    - b. Plywood: 12 inches o.c.
  2. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
  3. Construct beam soffits of material minimum 2 inches thick.
  4. Distribute bracing loads over base area on which bracing is erected.
  5. When placed on ground, protect against undermining, settlement, and accidental impact.
- F. Form Anchors and Hangers:
1. Do not use anchors and hangers leaving exposed metal at concrete surface.
  2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
  3. Penetration of structural-steel members is not permitted.
- G. Inserts, Embedded Parts, and Openings:
1. Install formed openings for items to be embedded in or passing through concrete Work.
  2. Locate and set in place items required to be cast directly into concrete.
  3. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.

4. Joints:
    - a. Install waterstops continuous without displacing reinforcement.
  5. Openings:
    - a. Provide temporary ports or openings in formwork as required to facilitate cleaning and inspection.
    - b. Locate openings at bottom of forms to allow flushing water to drain.
  6. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.
- H. Form Ties:
1. Provide sufficient strength and quantity to prevent spreading of forms.
  2. Place ties at least 1 inch away from finished surface of concrete.
  3. Leave inner rods in concrete when forms are stripped.
  4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.
- I. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- J. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
  2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
  3. Appearance:
    - a. Show no overlapping of construction joints.
    - b. Construct joints to present same appearance as butted plywood joints.
  4. Arrange joints in continuous line straight, true, and sharp.
- K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, anchor slots, nailers, waterstops, and other features.
  2. Do not embed wood or uncoated aluminum in concrete.
  3. Obtain installation and setting information for embedded items furnished under other Sections.
  4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
  5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
- L. Openings for Items Passing through Concrete:
1. Frame openings in concrete where indicated on Drawings.
  2. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
  3. Coordinate Work to avoid cutting and patching of concrete after placement.
  4. Perform cutting and repairing of concrete required as result of failure to provide required openings.



- M. Screeds:
1. Set screeds and establish levels for tops of and finish on concrete slabs.
  2. Slope slabs to drain where required or as indicated on Drawings.
  3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms; remove freestanding water.
- N. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
  2. Staking through membrane is not permitted.
- O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
  2. Clean forms and surfaces against which concrete is to be placed.
  3. Remove chips, sawdust, and other debris.
  4. Thoroughly blow out forms with compressed air just before concrete is placed.

### 3.3 TOLERANCES

- A. Construct formwork to maintain tolerances according to ACI 301.
- B. Camber:
1. Slabs and Beams: 1/4 inch per 10 feet.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection:
1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
  2. Notify Engineer after placement of reinforcing steel in forms but prior to placing concrete.
  3. Schedule concrete placement to permit formwork inspection before placing concrete.

**END OF SECTION 03 10 00**