SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

A. This specification section governs the labor, materials, and equipment required to form all cast-in-place concrete shown on the Contract Drawings including, but not limited to, all slabs, joists, beams, columns, walls, stairs, and equipment pads. Work includes shoring and form supports, and installation of embedded items.

1.2 RELATED SECTIONS

A. Section 03 20 00 – Concrete Reinforcing

B. Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCED CODES AND STANDARDS

A. Standards and References listed below apply where designation is cited in this Section. Where applicable year of adoption or revision is not listed below, the latest edition applies.

B. San Francisco Building Code (SFBC) 2019

C. American Concrete Institute (ACI)

1. 117 – Specification for Tolerances for Concrete Construction and Materials
2. 301 – Specifications for Structural Concrete
3. 318 – Building Code Requirements for Structural Concrete
4. 347R – Guide to Formwork for Concrete
5. MNL – Field Reference Manual (formerly SP-15)

D. ASTM International Standards, latest edition

1. D994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
2. D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

E. The Engineered Wood Association PS-1 – Construction and Industrial Plywood.

1.4 RESPONSIBILITY

A. The design, construction, and safety of all formwork shall be the responsibility of the Contractor. All forms, shores, backshores, falsework, bracing, and other temporary supports shall be engineered to support all loads imposed including the wet weight of concrete, construction equipment, live loads, laterals loads due to wind and wet concrete imbalance. The Contractor shall also be responsible for determining when temporary supports, shores, backshores, and other bracing may be safely removed.

1.5 SUBMITTALS

A. General: Refer to Section 01 33 00 – Submittal Procedures for submittal requirements and procedures.

B. Product Data:

1. Form-Facing Materials: Submit data on form-facing materials proposed if different from that specified in Section 2.1 of this specification.

2. Submit manufacturer's data sheet for the following:

a. Form release agent

b. Form liner

c. Form ties

d. Expansion joint materials

e. Waterstop materials

f. Joint sealants

C. Formwork Drawings: Formwork Drawings, prepared under the supervision and sealed by a registered professional engineer in the State of California, shall be submitted for Owners record and shall be reviewed by the City Representative for conformance to structural layout only. Such shop drawings shall indicate types of materials, sizes, lengths, connection details, design allowance for construction loads, anchors, form ties, shores, braces, construction joints, reveals, camber, openings, formwork coatings and all other pertinent information.

D. Shoring Plan: Submit drawings to indicate the number of levels of shoring, proposed time and sequence of formwork and shore removal, minimum concrete strength for stripping of forms and shore removal, assumed construction loads, amount and layout of shores (including reshores and backshores), and length of time shores are to be left in place. This plan shall be strictly followed by the Contractor. Shoring plans are to be submitted for Owner's record and reviewed for impact to structure.

E. Design Calculations; Calculations of all formwork and shoring plan, sealed by a registered professional engineer in the State of California, shall be submitted for Owners record.

1.6 QUALITY CONTROL

A. The Contractor is responsible for the quality control of the Work.

B. Perform work in accordance with ACI 301, ACI 347, and ACI 318.

C. Allowable tolerances shall be in accordance with the requirements of ACI 347 unless otherwise noted on Contract Drawings or specified.

1.7 QUALITY ASSURANCE

A. Maintain copies of all applicable Codes and Standards at the project site at all times.

B. Design formwork and/or falsework under direct supervision of a registered professional civil or structural engineer in the State of California experienced in design of this work.

C. Conform to the requirements of the State of California, Division of Occupational Safety and Health (Cal/OSHA), and all other codes and regulations.

1.8 SPECIAL INSPECTION

A. An independent special inspection and testing agency will perform special inspections and field quality control tests as required in the Statement of Special Inspections noted in the Contract Drawings. This does not preclude the Contractor's responsibility for inspections by the Contractor's Testing Agency.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in accordance with manufacturer's instruction.

B. Store materials in a manner that will preclude any damage or deterioration and provide easy access for inspection and identification of each item.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Form-Facing Materials

1. General: Form face material in contact with concrete shall be lumber, plywood, tempered concrete-form-grade hardboard, metal, plastic, or paper that creates specified appearance and texture of concrete surface.

2. Exposed Surfaces:

a. B-B Plyform: APA grade-stamped, Class I, B grade veneer, Class I, exterior grade Douglas Fir plywood; minimum ¾ inch thick; mill oiled and edged sealed. Each piece shall be grade marked; clean, smooth, uniform in size and free of raised grain, torn surfaces, worn edges, patches or other defects. Form oil shall leave surface slightly greasy to the touch with no free oil on panel.

b. Medium Density Overlay (MDO) Plyform: APA grade-stamped, Class I, exterior grade Douglas Fir plywood; minimum ¾ inch thick; mill-release agent treated and edge sealed. Each piece shall be grade marked; clean, smooth, uniform in size and free of raised grain, torn surfaces, worn edges, patches or other defects.

c. Metal forms shall be of smooth metal plate free of surface irregularities, of an acceptable type for the class of work involved, and of the thickness and design required for rigid construction.

3. Unexposed Surfaces:

a. Wood forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots; plywood shall be sanded smooth and fitted with tight joints between panels. The minimum grade shall be B-C, exterior grade.

b. Metal forms shall be of an acceptable type for the class of work involved and of the thickness and design required for rigid construction.

4. Curved Surfaces: Form with metal, plywood, or adequately supported, surfaced and matched Douglas Fir boards not more than 4-inches wide.

B. Formwork Accessories

1. Form Ties: Metal, removable to a depth of at least 1-1/2 inches below the surface of the concrete. Ties shall be of sufficient strength to prevent the spreading of the forms during

concrete placement. The use of wire ties will not be permitted.

2. Form Release Agents: Use an approved non-staining coating which will permit the ready release of forms and which will not affect application of applied finishes. Form release agents containing mineral oils or petroleum solvents such as paraffin will not be permitted. Use specially formulated coatings for metal forms to prevent rust stains on concrete.

3. Chamfer Strips: Except as noted on Contract Drawings and at flush joints between concrete and other construction, provide ¾ inch triangular wood or plastic strips, place and secure in forms at external corners.

4. Expansion and Isolation Joint Material: Preformed, ½ inch thick, unless otherwise noted, composed of blend of asphalts, vegetable fibers, and minimal fibers, conforming to ASTM D994. Size for installation ¼-inch below concrete surface.

5. Polyvinylchloride (PVC) Waterstops: PVC Waterstops shall be centerbulb type (ribbed or dumbbell) extruded from an elastomeric polyvinylchloride (PVC) compound meeting the requirements in the U.S. Army Corps of Engineers Specification CRD-C 572-74; and shall be 3/8-inch thick minimum. PVC Waterstops shall be Sealtight PVC Waterstop manufactured by W.R. Meadows, Hampshire, IL; Greenstreak PVC Waterstop manufactured by Sika Corporation, Lyndhurst, NJ; or approved equal.

6. Hydrophilic Waterstops: Hydrophilic Waterstops shall be swellable strips including Hydrotite manufactured by Sika Corporation, Lyndhurst, NJ; Hydro-Flex manufactured by The Henry Company, El Segundo, CA; Waterstop-XP as manufactured by Cetco, a Mineral Technologies Company,Hoffman Estates, IL; or approved equal. For irregular shaped joints, rough surfaces, odd penetrations, etc., use Leakmaster LV-Z, manufactured by Sika Corporation, Lyndhurst, NJ; or approved equal.

7. Joint Sealants: Joint Sealants shall be non-sag, polyurethane polymer designed to bond to concrete which is continuously submerged in water. Joint Sealants shall be two-part polyurethane conforming to the requirements of ASTM C920. Joint Sealants shall be Sikaflex-2C NS EZ manufactured by Sika Corporation, Lyndhurst, or approved equal.

C. All other materials, not specifically described, but required for proper completion of concrete formwork, shall be as selected by Contractor and subject to the approval of the City Representative.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contractor shall conform to the recommendations in ACI 318, Section 20.7 and Chapter 26.

B. Vertical and Horizontal Controls: Establish and maintain necessary benchmarks, lines, or controls throughout construction.

C. Obtain necessary information and provide for openings, sleeves, chases, pipes, recesses, nailers, anchors, ties, inserts, and similar embedded items. Coordinate with concrete and other related work for requirements governing embedment and sleeving of pipes and conduit.

D. Obtain written approval from the City Representative before framing any openings not shown on Contract Drawings.

3.2 CONSTRUCTION OF FORMS

A. General:

1. Construct formwork to produce concrete surfaces conforming to tolerances in ACI 301. Construct formwork to the exact shapes, lines and dimensions of concrete members, arranged to allow erection in proper sequence and to permit removal without damage to concrete finish.

2. Unless otherwise indicated on Contract Drawings, construct formwork panels in sections as large as practicable. Construct forms of boards or plywood of same widths, shapes, and design for accurate location of form joints as indicated on the shop drawings. Fasten together with cleats; joists and studs may be used, at Contractor's option, in lieu of cleats if required for structural integrity of formwork. Verify clear space between forms to insure allowable coverage for reinforcing steel and allowable tolerances for construction.

B. Framing and Bracing: Framing, bracing and supporting members shall be of ample size and strength to safely carry, without excessive deflection (exceeding allowable tolerances), all dead and live loads to which formwork may be subjected, and shall be placed sufficiently close to prevent any apparent bulging or sagging of forms.

C. Exposed Concrete Surfaces:

1. Make plywood panel patterns regular and symmetrical, joints plumb and level, horizontal joints continuous. Control reuse of forms for exposed surfaces to provide surface of uniform color and texture without sharp demarcation between adjacent surfaces.

2. Form ties for exposed concrete surfaces shall be arranged symmetrically and shall be aligned both vertically and horizontally (do not stagger).

3. In general, provide ¾-inch chamfer at corners for exposed concrete unless otherwise noted. At chamfers, the concrete cover for reinforcement is critical and the minimum specified thickness shall strictly apply.

4. Edges of all form panels in contact with concrete shall be flush within 1/32-inch and form for plane surfaces shall be such that the concrete will be plane within 1/16-inch in 4 ft. Form joints shall be tight to prevent the passage of mortar, water and grout.

D. Embedded Items: Contractor shall secure all inserts, bolts, plates, and other embedded items. Use templates for equipment anchor bolts and other embedded items where final alignment is critical. Fill voids with readily removable material to prevent entry of concrete.

E. Waterproofing Conditions: Concrete surfaces to receive waterproofing and damp-proofing materials shall be formed to provide a relatively smooth surface free of sharp corners, projections, and offsets at form joints. Form ties shall not penetrate or damage applied waterproofing and damp-proofing.

F. Camber forms for slabs and beams as required for compensating deflection of form members. Positive means of adjustment (wedges or jacks) of shores and struts shall be provided to permit realignment or readjustment.

G. Forms for walls of considerable height shall be arranged with tremies and hoppers for placing concrete in a manner that will prevent segregation and accumulation of hardened concrete on the forms or reinforcements above the fresh concrete.

H. Provide temporary openings at bottom of forms where necessary to facilitate cleaning and inspection before concrete placement. Provide blockouts for mechanical and electrical work wherever necessary.

I. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.

J. Construction joints and expansion joints shall be provided where indicated on the Contract Drawings. Otherwise, Contractor shall provide the layout for review and approval.

3.3 APPLICATION OF FORM COATINGS

A. Thoroughly clean forms and coat with approved form–coating material prior to initial use and before each reuse. Excess form coating material shall not stand in puddles in the forms nor shall such coating come in contact with hardened concrete against which fresh concrete is to be placed.

B. Apply form–coating material before reinforcing steel, anchoring devices and embedded items are placed and in strict accordance with manufacturer's directions.

3.4 FALSEWORK

A. Contractor shall be fully responsible for the proper strength, safety of the falsework, supports and bearing surfaces which are used in connection with the work. Falsework shall be designed to support imposed loads without deformation, deflection or settlement.

B. Wedges in pairs or jacks shall be used where required to maintain and/or adjust forms and formwork for beams, slabs and other parts of the structure at exact elevations. To ensure uniform bearing, single wedges are not permitted. Comply with requirements of ACI 347.

C. Vertical and lateral loads shall be carried to ground by falsework framing, or by the completed structure after it has attained the requisite strength. Falsework supports, when placed on ground, shall be protected against undermining or settlement.

3.5 FIELD QUALITY CONTROL

A. Contractor shall provide quality control of construction of forms and falsework, and the installation of accessories as required to ensure conformance with construction documents.

B. Contractor's Inspection and Testing Agency shall inspect erected forms and falsework to ensure that work is in accordance with design, and to verify that supports, fastenings, wedges, ties, and other items are secure.

C. Do not reuse wood forms more than 3 times for concrete surfaces exposed to view. Do not patch forms.

3.6 QUALITY ASSURANCE

A. Special Inspection:

1. Periodic special inspection by an approved independent Special Inspection and Testing Agency is required during construction and removal of forms and falsework, and installation of cast-in anchors and other embeds.

2. The Special Inspection and Testing Agency shall be notified for forms, falsework, and cast-in anchors special inspection not less than 48 hours prior to concrete placement.

3. Inspection records by the Contractor's Inspection and Testing Agency may be accepted by the City Representative for quality assurance.

3.7 REMOVAL OF FORMS AND FALSEWORK

A. Responsibility: The sole responsibility for removal of forms/falsework and for any resulting damage(s) rests with the Contractor. If forms/falsework are to remain, The Contractor shall adhere to all governing requirements and/or recommendations.

B. The removal of forms and falsework shall be carried out in such manner as to ensure the complete safety of the structure. Supports shall not be removed until members have sufficient strength to safely support their own weight and all superimposed loadings with proper factor of safety.

C. Unless otherwise specified in the Drawings, the minimum time for forms to remain in place shall be:

1. Side forms for footings, foundations, slabs on grade, or other components that do not resist bending shall not be removed in less than 48 hours after concrete placement. At times of low temperature or other adverse weather conditions, the Engineer may increase the required time to five days.

2. The falsework and forms supporting concrete girders, beams, joists, slabs, walls, or other members subject to bending stress, shall not be removed or released in less than 14 days after the concrete has been placed. In any case, the falsework and forms supporting the members shall not be removed until the concrete has attained a compressive strength of at least 80% of the design strength based on test results of field cured cylinders. Furthermore, such members shall not be loaded until the concrete has attained its 28-day compressive strength.

D. All forms, supports, and falsework shall be arranged so that they may be readily removed without hammering or prying against the concrete.

E. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled, and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

3.8 REUSE OF FORMS

A. Reuse of forms will be accepted, providing they are in good condition and have been cleaned, repaired, and resealed as required to achieve concrete of the specified quality and texture. Do not reuse form facing more than three (3) times. Do not patch formwork.

END OF SECTION