DIVISION 03 – CONCRETE

SPECIFICATION 031000: FORMS AND FORMWORK

PART 1.0 GENERAL

1.1 DESCRIPTION

The work of this specification includes furnishing of all labor, materials, equipment and incidentals to install, adjust, and remove all formwork required for the forming of cast-in-place concrete, as shown on the Construction Drawings and as specified herein. Forms must be either wood or steel designed to meet the conditions specified herein.

1.2 REFERENCE DOCUMENTS

- American Concrete Institute (ACI)
- American National Standards Institute (ANSI)
- American Plywood Association (APA)
- National Institute of Standards and Technology (NIST)
- NSF International (NSF)
- Codes and regulations of jurisdictional authorities

1.3 SUBMITTALS

1.3.1 Submit product technical data including:

1.3.1.1 Acknowledgement that products submitted meet the requirements of the referenced standards.

1.3.1.2 Manufacturer's installation instructions.

1.3.1.3 Manufacturer's type of proposed form materials.

1.3.1.4 Manufacturer's type of proposed form ties.

1.3.1.5 Manufacturer's type of proposed form coating material.

1.3.2 If forms and formwork are in contact with potable water, any form release agent must be NSF 61 certified.

1.3.3 Submit formwork layout plans, design data, and procedures certified by a Florida Registered Structural Engineer when requested by the Project Manager or Hillsborough County Inspector.

1.3.4 Submit a copy of any design exception prior to installation. Design exceptions are issued by the Utility Design Section Manager. Any deviation from the specifications requires a design exception.

1.4 RELATED WORK

- Specification 032000, Concrete Reinforcement
- Specification 033000, Cast-In-Place Concrete
- Hillsborough County Standard Pump Station Drawings
- Specification 333003, Wastewater Pumping Stations

PART 2.0 PRODUCT

2.1 QUALITY ASSURANCE

2.1.1 The formwork must be designed and erected in accordance with ACI 117 “Specifications for Tolerances for Construction and Materials”; ACI 301”Specification for Concrete Construction”; ACI 318” Building Code requirements for Structural Concrete”; ACI 347 "Guide to Formwork for Concrete" for the loads, lateral pressure, and allowable stresses; and for design considerations, wind loads, allowable stresses and other applicable requirements of the local building code. The design and construction of the formwork must be the responsibility of the Contractor. Form design must be certified by a Professional Structural Engineer currently registered in the State of Florida.

2.1.2 The formwork must be true in every respect to produce hardened concrete to the required shape, size, grade, and alignment as indicated on the Construction Drawings, and of sufficient strength, bracing, and rigidity to maintain their position and shape under the loads and operations incidental to placing and curing the concrete, as well as other forces resulting from the movement of the forms. The forms must be mortar-tight at the time concrete is placed in them and must be so constructed that the surfaces of the finished concrete will be reasonably free from ridges, fins, offsets, or similar defects. The Contractor under the guidance of the EOR must use a form release that does not adversely affect concrete surfaces to be painted, coated, or otherwise finished and does not affect the forming material. Form release agents used in potable water containment structures must be nontoxic and free of taste or odor. Adequate and suitable means for removing the forms without injury to the surfaces or edges of the finished concrete must be provided.

2.1.3 Formwork must be constructed such that the hardened surfaces must conform to the tolerance limits of ACI 347, and the values listed in Specification 033000, whichever is more stringent.

2.2 FORMS AND ACCESSORIES

2.2.1 Use smooth forms on all concrete surfaces exposed to view or water.

2.2.2 Plywood forms must be new 5/8 or 3/4-inch 5-ply structural plywood grade marked Exterior Grade, B-B Concrete Form or High-Density Overlay (HDO) Concrete Form B-B, conforming to the requirements of the NIST Voluntary Product Standard PS-1, Plywood.

2.2.3 Steel Forms will use smooth metal plate free of surface irregularities. Steel forms must be thoroughly cleaned, and mill scale and other ferrous deposits must be sandblasted or otherwise removed from the contact surface for all forms except those utilized for surfaces receiving a rough finish. All forms must have the contact surfaces coated with a form release agent.

2.2.4 Rough forms (not exposed to view or water) must be constructed of dressed or undressed lumber or plywood free of knots, splits, or other defects.

2.2.5 Form ties will be factory fabricated, snap-off metal type of adequate design to minimize form deflection and preclude concrete spalling upon removal.

2.2.6 Form ties will be fabricated so that set back in the concrete is such that the portion of the tie remaining after snap-off and removal of the exterior portions is at least 1-1/2 inches back from the concrete surface.

2.2.7 Form coating must comply with ACI 347 and must be non-grain-raising and non-staining resin or polymer type that will not leave residual matter on the surface of the concrete or adversely affect bonding to concrete of paint, plaster, mortar, protective coatings, waterproofing or other applied materials. For concrete surfaces contacting potable stored water, the coatings and form release agents must be completely non-toxic and approved by the EPA for the intended use.

2.2.8 All forms must be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing and repairs

2.2.9 All joints or gaps in forms must be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging outward or creating surface patterns.

2.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

Store and handle form coating to prevent contamination of coating in accordance with manufacturer's recommendation.

PART 3.0 EXECUTION

3.1 FABRICATION

3.1.1 Use forms that conform to ACI 347. Fabricate with facing materials that produce the specified tolerance requirements of ACI Special Publication No. 4, Formwork for Concrete, produce true surfaces, sharp corners and true lines and are free of offsets, ridges, bulging, waves and concave or convex areas. Forms must be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms such that the concrete and/or exposed rebar (dowels) will not be damaged by their removal. The Contractor must be entirely responsible for the adequacy of the forming system.

3.1.2 Use regular and uniform pattern: long dimensions of panels must be vertical; joints horizontal, vertical, and aligned; form ties uniformly spaced and aligned in horizontal and vertical rows.

3.2 PREPARATION

3.2.1 Forms must not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. All surfaces of forms and embedded materials must be cleaned of any mortar from previous concreting and of all other foreign material or water before coating is placed on them.

3.2.2 Forms must be coated in accordance with manufacturer's recommendations before the form or reinforcement is placed in final position. Surplus coating on form surfaces, or any coating on reinforcing steel and construction joints must be removed before placing concrete.

3.3 INSTALLATION, REMOVAL, AND SHORING

3.3.1 Installation of forms will comply with the following requirements:

3.3.1.1 Forms must be sufficiently tight to prevent loss of mortar from the concrete, set true to the lines and elevations indicated on the Drawings, tied, and braced to remain true during and after concrete placement within tolerances of Part 2.1 of this Specification. The

Project Manager or Hillsborough County Inspector may at any time condemn any section or sections of forms found deficient in any respect, and such form must be promptly removed and replaced.

3.3.1.2 No wooden spreaders must be allowed to remain in the concrete.

3.3.1.3 Place chamfer strips in forms to bevel all corners, edges, joints and other structural elements exposed to views, including use of dummy chamfer and false joints to provide neat and uniform appearance. Exposed corners and edges must have 3/4-inch by 3/4-inch with 45- degree chamfers, unless otherwise indicated on the Construction Drawings.

3.3.1.4 Provide temporary openings at the base of wall forms and at the other points when necessary to facilitate cleaning and inspection immediately before depositing concrete.

3.3.1.5 Secure in position wedges used for final alignment and items to be embedded in concrete.

3.3.1.6 Forms for keyways must be prepared in advance of pouring concrete. Keyway forms in slab edges and vertical wall joints must be rigidly secured in place before the concrete is poured. Forms for keyways for horizontal joints in walls may be placed at the conclusion of the pour, but proper provision must be made for obtaining and holding the full depth and form of the keyway.

3.3.2 Adjustment of forms will comply with the following requirements:

3.3.2.1 Positive means of adjustment must be provided to permit realignment or readjustment of shores if excessive settlement occurs.

3.3.2.2 A pair of wedges may be used at the top or bottom of shores, but not at both ends, to facilitate vertical adjustment, to correct uneven settlements, or to facilitate dismantling of the formwork.

3.3.2.3 Screw jacks for pipe shores or scaffold-type shoring may be used both top and bottom so long as they are secured by the shore or scaffold leg against loosening or falling out, to avoid lateral deflections.

3.3.2.4 During and after concreting, but before initial set of the concrete, the elevations, camber, and plumbness of formwork systems must be checked, using telltale devices. Appropriate adjustments must be promptly made where necessary. If, during construction, any weakness develops and the formwork shows any undue settlement or distortion, the work must be stopped, the affected construction removed if permanently damaged, and the formwork strengthened.

3.4 EMBEDDED ITEMS

3.4.1 Items to be embedded in concrete must be free from oil or foreign matter that would weaken the bonding of the concrete to these items.

3.4.2 Install in the formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these Specifications. Close ends of conduits, piping, and sleeves embedded in concrete with caps or plugs.

3.4.3 Concrete pads, curbs, pedestals, and similar means devised by the Contractor to support the forms will be subject to review by the Project Manager or Hillsborough County Inspector.

3.4.4 Before depositing concrete, check the location and support of items which are to be wholly or partially embedded.

3.4.5 Place reinforcement so that there will be a clear distance of at least two inches between the reinforcement and any anchor bolts or other embedded metal work.

3.5 FIELD QUALITY CONTROL

3.5.1 Construct elements to meet the allowable tolerances of the dimensions, elevations, and positions specified in Specification 033000.

3.5.2 Deposit concrete only when the forms and placement of the reinforcement has been checked and approved by the Project Manager or Hillsborough County Inspector. The Contractor must provide notice to the Project Manager or Hillsborough County Inspector at least 24 hours in advance of any contemplated concrete pour.

3.5.3 Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with the requirements of this Section, in the opinion of the EOR, the Project Manager, or Hillsborough County Inspector, must be grounds for rejection of that portion of the form/concrete work. Rejected work must be repaired or replaced as directed by the EOR or Hillsborough County Inspector at no additional cost to the County. Such repair or replacement must be subject to the requirements of this Section and approval of the EOR

3.6 JOINTS

3.6.1 Unless otherwise directed, make contraction, expansion, and construction joints only where shown.

3.6.2 Continue reinforcing steel and wire fabric across construction joints which are not indicated as being free to move.

3.7 REMOVAL OF FORMS, FALSE WORK, AND CENTERING

3.7.1 Maintain forms, false work, and centering in place until the concrete has attained the minimum percentage of the design strength and met the criteria specified below in both 3.7.2 and 3.7.3. The design strength must include the strength of the concrete structural member(s) to carry their own weight and any loads to which they will be subjected without exceeding the permissible concrete stresses and without deforming.

3.7.2 Maintain forms, false work, and centering in place until the concrete has attained the minimum percentage of specified design strength listed in the following table and 3.7.3

Minimum Percent of Specified Design Strength

Structural Member	Schedule 1
Footings; Inverts, sides of beams, slabs and girders; Slabs and beams on grade	40%
Open cut structure exterior walls; Retaining walls	60%
Soffits and beams; Slabs and girders under 20 feet clear span between supports	80%
Cantilevers and intersecting sections	90%

3.7.3 Maintain forms, false work, and centering for listed and non-listed members until the concrete has attained the minimum specified strength and at least one of the following criteria has been met:

3.7.3.1 The Project Manager has approved calculations showing the anticipated concrete strengths at the time of the proposed early removal based on:

a) Ratio of dead load over live load;
b) Span, height and shape;
c) Ratio of rise over span;
d) Shoring;
e) Loads, resultant stresses, and deformations to which the concrete and reinforcing steel will be subject at the time of removal, subsequent to the removal and until the concrete has attained its design strength;
f) Prevailing site conditions.

3.7.3.2 The concrete strength attained prior to form removal has been determined from tests of cylinders cured adjacent to and under the same conditions as the placed concrete.

3.7.3.3 Three test cylinders taken by the test laboratory have been tested by an independent testing laboratory retained by the Contractor and approved by the Project Manager or Hillsborough County Inspector and the tests performed in accordance with Specification 033000.

3.7.4 Do not alter the loading conditions on the concrete subsequent to the removal of the forms if it results in exceeding the permissible stresses and deformation at the attained concrete strengths.

3.7.5 If formwork is removed from a surface prior to the specified curing period, provide curing and protection per Specification 033000, Part 3.6.