SECTION 03 11 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):

a. 117, Standard Specifications for Tolerances for Concrete Construction and Materials.
b. 318/318R, Building Code Requirements for Reinforced Concrete.
c. 347, Formwork for Concrete.

1.2 DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 301, ACI 347 and ACI 318 to provide concrete finishes specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. When high range water reducer (superplasticizer) is used in concrete mix, forms shall be designed for full hydrostatic pressure per ACI 347.

C. Make joints in forms watertight.

D. Limit panel deflection to 1/360th of each component span to achieve tolerances specified.

1.3 SUBMITTALS

A. Shop Drawings:

1. Form Ties-Tapered Through-Bolts: Proposed method of sealing form tie hole; coordinate with details shown.
2. Manufacturer’s Data for the Following Product: Form release agent.

B. Samples: One each as follows:

1. Form ties.

C. Information Submittals: Statement of qualification for formwork designer.

1.4 QUALIFICATIONS

A. Formwork Designer: Formwork, falsework, and shoring design shall be by an Engineer licensed in the State of the project site.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Wall Forms and Underside of Slabs:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in “new and undamaged” condition, of sufficient strength and surface smoothness to produce specified finish.
2. Circular Structures:

    a. Conform forms to circular shape of structure.
    b. Straight panels may be substituted for circular forms provided panels do not exceed 2’ in horizontal width and angular deflection is no greater than 3-1/2° per joint.

B. Painted Surface Forms: High density overlay plywood for flat concrete surfaces to be painted.

C. All Other Forms: Materials as specified for wall forms.

D. Form Release Agent:

1. Material: Release agent shall not bond with, stain, or adversely affect concrete surfaces, and shall not impair subsequent treatments of concrete surfaces when applied to forms. A “ready to use” water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations and can be used in potable water facilities.
2. Manufacturers and Products:

    a. Master Builders, Inc.; Rheofinish 211.
    b. Cresset Chemical Company; Crete-Lease 20-VOC.
    c. US Mix Products Company; US SPEC Slickote.

E. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

F. Form Ties:

1. Material: Steel
2. Spreader Inserts:

    a. Conical or spherical type.
    b. Design to maintain positive contact with forming material.
    c. Furnish units that will leave no metal closer than 1” to concrete surface when forms, inserts, and tie ends are removed.

3. Wire ties not permitted.
4. Flat bar ties for panel forms furnish plastic or rubber inserts with minimum 1” depth and sufficient dimensions to permit patching of tie hole.
5. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

    a. Integral steel water stop 0.103” thick and 0.625” in diameter tightly and continuously welded to tie.
    b. Neoprene water stop 3/16” thick and 15/16” diameter whose center hole is 1/2-diameter of tie, or molded plastic water stop of comparable size.

c. Orient water stop perpendicular to tie and symmetrical about center of tie.
d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

6. Through-Bolts: Tapered minimum 1” diameter at smallest end.
7. Elastic Vinyl Plug:

a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming watertight seal.
b. Manufacturer and Product: Dayton/Richmond Co., Miamisburg, OH; A58 Sure Plug.

Recess plug 1” minimum and grout over hole. See Section 03 60 00 GROUT.

PART 3 - EXECUTION

3.1 FORM SURFACE PREPARATION

A. Thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants prior to coating surface.

B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by the manufacturer.

C. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

3.2 ERECTION

A. General: Unless specified otherwise, follow applicable recommendations of ACI347.

B. Beveled Edges (Chamfer):

1. Form 3/4” bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4”, obtain Engineer’s approval of size prior to placement of beveled edge.

C. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in an uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to assure conformance with specified tolerances.

D. Forms for Curbs and Sidewalks:

1. Provide standard steel or wood forms.
2. Set forms to true lines and grades, and securely stake in position.

E. Form Tolerances: Provide forms in accordance with ACI 117, 347 and 318 and the following tolerances for finishes specified:

1. Wall Tolerances:

a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.

b. Wall Type W-A:

1) Plumb within 1/4” in 10’ or within 1” from top to bottom for walls over 40 feet high.
2) Depressions in Wall Surface: Maximum 5/16” when 10’ straightedge is placed on high points in all directions.

c. Wall Type W-B:

1) Plumb within 1/8” in 10’ or within 1/2” from top to bottom for walls over 40’ high.
2) Depressions in Wall Surface: Maximum 1/8” when 10’ straightedge is placed on high points in all directions.

2. Thickness: Maximum -1/4” or +1/2” from dimension shown.

F. Form Offset: Between adjacent pieces of form work, facing material shall not exceed 1/8” where exposed to public view and 1/4” maximum for all other conditions.

3.3 ADDITIONAL REQUIREMENTS

A. Construct forms tight enough to prevent loss of concrete mortar.

B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses and the like for easy removal.
2. Do not use rust-stained steel form-facing material.
3. Use only form or form-tying methods which do not cause spalling of the concrete upon form stripping or tie removal.

C. Set edge forms, bulkheads and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

D. Provide temporary 12 inch wide x 18 inch high openings for cleanouts and inspection ports every 7 feet at the bottom of each lift form and where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations, where possible.

E. Chamfer exterior corners and edges of permanently exposed concrete.

F. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and waterstops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and other debris just before placing concrete.

H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

I. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions before placing reinforcement.

J. Embedded Items.

1. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.

    a. Install anchor bolts/rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
    b. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles and other conditions.
    c. Check special castings, channels or other metal parts that are to be embedded in the concrete prior to and again after placing the concrete.
    d. Check nailing blocks, plugs and strips necessary for the attachment of trim, finish and similar work prior to placing the concrete.

K. Pipes and wall spools cast in concrete.

1. Install wall spools, wall flanges, and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools or anchors to the reinforcing steel.
2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will occur during construction.
3. Pipes or spools located below operating water level shall have waterstop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast. Pipes fitted with thrust rings shall be cast in place.

L. Removing and reusing forms.

1. General: Do not remove forms from concrete which has been placed with outside temperature below 50°F without first determining and verifying with Engineer if the concrete has properly set without regard for time. Do not apply loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

    a. Leave formwork for beam soffits, joists, structural slabs, beams, girders and other structural elements that support weight of concrete in place until concrete has achieved 100 percent its 28-day design compressive strength.
    b. Formwork for sides of beams, walls, columns and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F (10 deg C) for 48 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
    c. Leave bracing for walls until the top or roof slab concrete reaches 100% of its 28-day design compressive strength.

d. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

2. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
3. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.

M. Aluminum surfaces in contact with concrete.

1. Aluminum surfaces in contact with concrete or grout or dissimilar metals shall be protected with a Mylar isolator, bituminous paint or other material approved by Engineer.

N. Shores and reshores.

1. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation and removal of shoring and reshoring.

a. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

2. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
3. For multi-storied structures, the shoring and reshoring diagrams and procedures shall be signed and sealed by a Registered Professional Engineer in the state where the construction is being undertaken. These diagrams and procedures shall take into account the effect of the loads on the uncured concrete and the construction load on each floor.
4. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

END OF SECTION