

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Provide concrete formwork for architectural concrete and structural concrete as specified to form concrete to profiles shown.
1. Architectural concrete is defined as concrete for the following exposed reinforced concrete surfaces:
 - a. Interior walls
 - b. Exterior walls to 6 inches below finish grade
 - c. Interior tank walls to 6 inches below normal operating water level
 - d. Beams
 - e. Columns
 - f. Undersides of floor slabs, roof slabs and stairs
 2. Provide concrete with smooth rubbed finish.
 3. Structural concrete is defined as all concrete that is not architectural concrete.
- B. Related Work Specified in Other Sections Includes:
1. Section 03200 - Concrete Reinforcement
 2. Section 03250 - Concrete Accessories
 3. Section 03310 - Cast-In-Place Concrete

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. ACI 318 - Building Code Requirements for Reinforced Concrete
 2. ACI SP-4 - Formwork for Concrete
 3. ACI 303R - Guide to Cast-in-Place Architectural Concrete

1.3 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
 - 1. CONTRACTORS Shop Drawings: Proposed form layout drawings and tie pattern layout drawings for Concrete. Review of these drawings does not relieve the CONTRACTOR of responsibility for adequately designing and constructing forms.
 - 2. Samples: Pieces of each type of sheeting, chamfer strips, form ties, form liners and rustication strips

1.4 QUALITY ASSURANCE

- A. Formwork Compliance: Use formwork complying with ACI SP-4, ACI 347 and ACI 303R.
- B. Mock-Up Erection: Erect, on the site where directed, a full size mock-up of a cast-in-place wall or panel a minimum of 10 feet by 10 feet by 12 inches thick as shown. Conform mock-up to requirements of ACI 303R.
 - 1. Reinforce the panel as shown. Use form ties the same as those approved and with the form tie pattern similar to that approved. Use one face of the panel for smooth architectural concrete including "reveal" rustication with form joints, and the opposite face for form liner concrete.
 - 2. Plug the tie holes as specified to determine the correct mortar mixture to match the panel color. If required, remove and replace tie hole plugging mortar until an acceptable color match is obtained. After the sample panels have been approved, intentionally damage and patch portions of the finish surface of the panels for the purpose of determining the correct mixture for patching mortar and patching technique to match the original panel color and surface.
 - 3. Leave the approved mock-up on the job during construction as the standard of workmanship for the project. Remove mock-up from the premises after completion of the work.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
 - 1. Release Agent
Magic Kote VOC by Symons Corporation

2. Form coating
A.C. Horn Corporation, Brooklyn, NY
3. Form liners
Dura-Tex by Symons Corporation, Des Plaines, IL
4. Rustications
Symons Corporation, Des Plaines, IL

2.2 MATERIALS

A. Structural Concrete: Provide structural concrete form materials as follows:

1. Obtain approval for form material before construction of the forms.
2. Use a barrier type form release agent.
3. Use form ties, hangers, and clamps of such type that, after removal of the forms, no metal will be closer than one inch from concrete surface. Wire ties will not be permitted.
4. Provide ties with swaged washers or other suitable devices to prevent seepage of moisture along the ties. Leave the ties in place.
5. Use lugs, cones, washers, or other devices which do not leave holes or depressions greater than 7/8-inch in diameter.

B. Architectural Concrete: Provide architectural concrete form materials as follows:

1. Construct forms using 3/4-inch thick, High Density Overlay (HDO) Plyform, Class 1 or 2, meeting the requirements of the American Plywood Association. Use surfacing materials having a minimum weight of 60-60.
2. Use form coating, and use thinner as recommended by manufacturer of the form coating, to coat cut or raw edges.
3. Use she-bolts with water seals for form ties.
4. Use form liners having one inch deep relief, elastomeric Dura-Tex in a fractured rib pattern to match existing. Furnish form liners in full height lengths with no horizontal joints, except where shown. Use wood for forms to be used with form liners.
5. Use elastomeric vertical "V-groove" rustications in the concrete bands and the horizontal rustication joints shown in the form liner concrete of the profile shown.
6. Use a barrier type VOC compliant form release agent.

PART 3 EXECUTION

3.1 DESIGN

- A. Design Responsibility: Be responsible for the design, engineering and construction of the architectural concrete formwork and the structural concrete formwork. Conform the work to the recommendations of ACI SP-4 and ACI 303R.
- B. Setting Time and Slag Use: The presence of fly ash or ground granulated blast furnace slag in the concrete mix for architectural concrete and structural concrete will delay the setting time. Take this into consideration in the design and removal of the forms.
- C. Responsibility During Placement: Assume and take sole responsibility for adequate design of all form elements for support of the wet concrete mixtures specified and delivered.
- D. Consistency: Design forms to produce concrete members identical in shape, lines and dimensions to members shown.

3.2 CONSTRUCTION DETAILS FOR FORMWORK

- A. Structural Concrete Details: Follow the following details for all structural concrete:
 - 1. Provide forms which are substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subjected. Make forms sufficiently tight to prevent leakage of concrete.
 - 2. Determine the size and spacing of studs and wales by the nature of the work and the height to which concrete is placed. Make forms adequate to produce true, smooth surfaces with not more than 1/8-inch variation in either direction from a geometrical plane. Provide horizontal joints which are level, and vertical joints which are plumb.
 - 3. Supply forms for repeated use in sufficient number to ensure the required rate of progress.
 - 4. Thoroughly clean all forms before reuse and inspect forms immediately before concrete is placed. Remove deformed, broken, or defective forms from the work.
 - 5. Provide temporary openings in forms at convenient locations to facilitate cleaning and inspection.
 - 6. Coat the entire inside surfaces of forms with a suitable form release agent just prior to placing concrete. Form release agent is not permitted on the reinforcing steel.

7. Assume and take responsibility for the adequacy of all forms and remedying any defects resulting from their use.
- B. Architectural Concrete Details: Follow the following details for all Architectural Concrete:
1. Conform all construction details for formwork to "Construction Details for Formwork," subsections A1, A2, A3, A4, A6 and A7 and the requirements of this section.
 2. Thoroughly clean and lightly recoat HDO plywood panels before each additional use. Do not use forms more than three times.
 3. Install form liners and rustication strips in strict accordance with the manufacturer's written instructions and recommendations. Clog the ends of the form liner pattern and tape all form joints and edges using 1/8-inch thick by 3/4-inch wide foam tape centered on the joints, then caulk in accordance with the manufacturer's recommendations each time forms are set. Have a representative of the manufacturer present at the site to supervise the installation of the form liner for the entire project.
 4. Install forms for smooth concrete in such a manner that there will be no horizontal form joints, and align the forms so that vertical joints occur only at "V-Groove" rustications. Space form ties in a uniform pattern vertically and horizontally. Position form ties in smooth concrete bands and in panels between "reveal" rustications, if any.
 5. Erect beam and girder soffits with a camber of 1/2-inch in 20 feet and sufficiently braced, shored, and wedged to prevent deflection. Clamp column sides in accordance with this specification with metal column clamps, spaced according to the manufacturer's directions.
 6. Provide external angles of walls, beams, pilasters, columns, window openings and girders with 3/4-inch bevel strips.
 7. Give surfaces of concrete panel forms one thinned coat of form film.
 8. Apply the release agent in strict accordance with the manufacturer's instructions.

3.3 FORM REMOVAL

- A. Structural Concrete Form Removal: Do not remove forms for structural concrete until the concrete has hardened sufficiently to support its own load safely, plus any superimposed load that might be placed thereon. Leave the forms in place for the minimum length of time indicated below or until the concrete has reached the minimum strength indicated as determined by testing, whichever time is reached first.

1. The times indicated represent cumulative days or hours, not necessarily consecutive, during which the air surrounding the concrete is above 50 degrees F. These times may be decreased if reshores are installed.

	Minimum Time	Minimum Strength (psi)
a. Columns	12 hrs.	1300
b. Columns	12 hrs.	1300
c. Side forms for girders and beams	12 hrs.	1300
d. Walls	12 hrs.	1300
e. Bottom forms of slabs		
Under 10 feet clear span	4 days	2300
10 to 20 feet clear span	7 days	2700
Over 20 feet clear span	10 days	2900
f. Bottom forms of beams and girders		
Under 10 feet clear span	7 days	2700
10 to 20 feet clear span	14 days	3000
Over 20 feet clear span	21 days	3500

2. Increase form removal times as required if concrete temperature following placement is permitted to drop below 50 degrees F or if fly ash or ground granulated blast furnace slag is used in the concrete mix.
 3. Withdraw the removable portion of form ties from the concrete immediately after the forms are removed. Clean and fill holes left by such ties with grout as specified in Cast-In-Place Concrete, Subsection Structural Concrete Surfaces.
 4. Plug tie holes flush with the surface using portland cement mortar. Prewet tie holes with clean water and apply a neat cement slurry bond coat. Densely tamp mortar of a dry-tamp consistency into the tie holes exercising care so as not to smear mortar onto the finished concrete surface. Include sufficient white cement in the mortar mix to cause the plugged holes to blend in with the adjacent surfaces. Make sample patches with different mixes to assure that this requirement is met.
- B. Architectural Concrete Form Removal: Remove forms for architectural concrete in accordance with the above subsection 3.3 A, except that do not remove forms for vertical surfaces sooner than 12 hours nor longer than 36 hours after placement of concrete.

3.4 RESHORING

- A. Reshoring Method: Develop a system for reshoring and early removal of forms, in the event early stripping of forms becomes necessary. Include details and schedules in this system for each element which is to be reshored.
- B. Construction Load Support: Do not support construction loads upon any unshored portion of the structure exceeding the structural design loads.

3.5 TOLERANCES

- A. Tolerance Limits: Design, construct and maintain concrete form and place the concrete to provide completed concrete work within the tolerance limits set forth in ACI SP-4.

3.6 SURVEY OF FORMWORK

- A. Field Survey: Employ an engineer or surveyor to check by instrument survey the lines and levels of the completed formwork before concrete is placed and make whatever corrections or adjustment to the formwork are necessary to correct deviations from the specified tolerances.
- B. Placement Surveying Requirements: Check formwork during the placement of the concrete to verify that the forms, braces, tie rods, clamps anchor bolts, conduits, piping, and the like, have not been knocked out of the established line, level or cross section by concrete placement or equipment.

END OF SECTION

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