

SECTION 03110

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SCOPE

This Specification section prescribes materials and methods to be used in fabricating, erecting, and removing forms for cast-in-place concrete. The CONTRACTOR shall furnish all form design, forms, shoring, ties, form coating, and materials and all labor, equipment, and other items necessary or convenient to the CONTRACTOR for the fabrication, erection, and removal of formwork.

1.02 GENERAL

- A. Forms shall be fabricated, erected, and removed as specified herein and shall be of a type, size, shape, quality and strength to produce hardened concrete having the shape, lines and dimensions indicated on the drawings. The forms shall be true to line and grade in accordance with the tolerances as specified in "Cast-In-Place Concrete" and shall be mortar tight and sufficiently rigid to resist deflection during concrete placement. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces.
- B. The responsibility for correctly assessing and analyzing the erection stresses induced upon the structure, its elements and supporting foundations during construction will be the total obligation of the CONTRACTOR. Since the ENGINEER does not dictate or determine the CONTRACTOR'S sequence of operations of construction, the ENGINEER cannot determine erection stresses and therefore assumes no responsibility or obligation to do so. The CONTRACTOR must employ or otherwise provide for adequate professional structural engineering supervision to determine erection stresses and notify the ENGINEER of the results of the study.
- C. The responsibility for adequate formwork design for construction of cast-in-place, reinforced concrete will be the total obligation of the CONTRACTOR. The CONTRACTOR shall employ competent professional engineering services to design formwork and supervise the erection of all formwork needed for the job.
- D. Except as modified herein, form design, fabrication, and erection shall conform to the requirements of ACI 347 and ACI 318 and shall be acceptable to the ENGINEER. Design criteria for plywood shall conform to APA Form V345.
- E. Formwork shall comply with the requirements of ANSI A10.9 and OSHA Construction Standards, Part 1926, "Subpart Q, Concrete, Concrete Forms, and Shoring."

1.03 SUBMITTALS

- A. When requested by the ENGINEER, the CONTRACTOR shall submit to the ENGINEER for review shop drawings and design calculations for formwork the CONTRACTOR intends to use in constructing the work. The CONTRACTOR shall furnish said shop drawings and design calculations at no additional cost to the OWNER.
- B. Prior to beginning concreting operations, the CONTRACTOR shall submit to the ENGINEER for approval engineering data and manufacturer's literature on all form ties, spreaders, bar supports, form coatings, and prefabricated steel forms intended for use in the work.

1.04 STORAGE

All form materials and accessories shall be stored above ground on framework or blocking and shall be covered with a suitable waterproof covering providing adequate air circulation and ventilation.

PART 2 - PRODUCTS

2.01 FORMS

- A. Forms for surfaces which will be exposed to view when construction is completed shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard.
- B. Plywood or lined forms will not be required for surfaces which are normally submerged or not ordinarily exposed to view, such as the insides of manholes or wetwells. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms, and may be used as backing for form linings. Forms are required above all extended footings.
- C. Forms for cast-in-place concrete shall conform with the following requirement:

- | | |
|------------------------------|--|
| 1. Prefabricated Steel Forms | Simplex "Industrial Steel Frame Forms", Symons "Steel Ply", Universal "Uniform", or equal. |
| 2. Plywood | Product Standard PSI, waterproof resin-bonded, exterior type Douglas Fir. |
| a. Normal | Face adjacent to concrete Grade B or better |
| b. Architectural | Face adjacent to concrete Grade B or better with plastic overlay. |

PART 3 - EXECUTION

3.01 FABRICATION AND ERECTION

- A. Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement. Walers, studs, internal ties, and other form supports shall be sized and spaced so that proper working stresses are not exceeded. Joints in forms shall be bolted tightly and shall bear on solid construction. Forms shall be constructed so they can be removed without hammering, wedging, or prying against the concrete. Form ties in exposed surfaces shall be uniformly spaced and aligned in horizontal and vertical rows. The forms shall produce finished surfaces that are free from off-sets, ridges, waves, and concave or convex areas.
- B. Forms to be reused shall be thoroughly cleaned and repaired. Split, frayed, delaminated, or otherwise damaged forms shall not be used.
- C. All form panels shall be placed in a neat, symmetrical pattern with horizontal joints level and continuous. The CONTRACTOR shall place special attention on mating forms to previously placed walls so as to minimize steps or rough transitions. Form panels shall be of the largest practical size to minimize joints and to improve rigidity.
- D. Beams and slabs supported by concrete columns shall be formed so the column forms may be removed without disturbing the supports for the beams or slabs.
- E. Wherever the top of a wall will be exposed to weathering, the forms on at least one side shall not extend above the top of the wall and shall be brought to true line and grade. At other locations forms for concrete which is to be finished to a specified elevation, slope, or contour, shall be brought to a true line and grade, or a wooden guide strip shall be provided at the proper location on the forms so that the top surface can be finished with a screed or template. At horizontal construction joints in walls the forms on one side shall not extend more than 2 feet above the joints.
- F. Temporary openings shall be provided at the bottom of column and wall forms and at other points where necessary to facilitate cleaning and inspection prior to concrete placement.
- G. Unless shown otherwise on the Drawings, all salient corners and edges of beams, columns, walls, slabs, and curbs shall be provided with a 3/4 inch by 3/4 inch chamfer formed by a wood or metal chamfer strip.
- H. Forms for exposed surfaces and all steel forms shall be coated with nonstaining form release agent which shall be applied just prior to placement of steel reinforcement. After coating, any surplus form release coating on the form surface shall be removed. Wood forms for unexposed surfaces may be thoroughly wetted with water in lieu of coating immediately before concrete placement, except in freezing weather form release coating shall be used.

- I. Should misalignment of forms or screeds, excessive deflection of forms, or displacement of reinforcement occur during concrete placement, immediate corrective measure shall be taken to insure acceptable lines and surface to required dimensions and cross sections.
- J. If any forms bulge or show excessive deflection, in the opinion of the ENGINEER, the concrete shall be removed and the forms rebuilt and strengthened.

3.02 FORM REMOVAL

- A. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Shoring beneath beams or slabs shall be left in place and reinforced as necessary to carry any construction equipment or materials placed thereon.
- B. No forms shall be removed without the approval of the ENGINEER. In general and under normal conditions, the ENGINEER will approve removal of forms after the following time has elapsed:

ITEM	TIME AFTER PLACEMENT
Elevated Slabs and Beams	14 days
Columns	7 days
Walls	3 days
Other Concrete	2 days

- C. When ambient air temperatures during the curing period fall below 45 degrees F., form removal will take place based on job-cured test cylinder strength only.
- D. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, or other damage to the concrete. Immediately after form removal, any damaged or imperfect work shall be repaired as specified in "Cast-In-Place Concrete" of these Specifications.