

PART 1 –GENERAL

The General Provisions of the Contract, including Division 1, General Requirements, General and Supplementary Conditions govern the work specified in this Division.

1.1 Work Included

- A. This section specifies formwork for concrete work.

1.2 Related Work Specified Elsewhere:

- A. Concrete Reinforcement, Section 03200.
- B. Cast-in-Place Concrete. Section 03300.

1.3 Quality Assurance

- A. Reference Codes and Specifications:

- 1. “Recommended Practice for Concrete Formwork” ACI Standard 347.
- 2. “Formwork for Concrete” ACI Special Publication No. 4.
- 3. Codes and regulation of jurisdictional authorities.

- B. General Design Criteria

- 1. Design formwork for vertical loads and lateral pressures in accordance with ACI 347, latest edition.
- 2. Design formwork system which is adequately braced and has adequate strength and stability to ensure finished concrete within the specified tolerances.
- 3. When necessary to maintain the specified tolerances, design camber into the formwork to compensate for anticipated deflection and creep due to the weight and pressure of the fresh concrete, pre-stressing forces, and construction.
- 4. Chamfer external corners 3/4 inch.

PART 2 -- PRODUCTS2.1 Materials

- A. Plywood Forms:

- 1. Grade marked.
- 2. B-B Plyform, Exterior Class 1 and 2 and HDO Medium Density Overlaid Plywood Concrete Form, B-Matte Formguard or equal, conforming to the requirements of U.S. Product Standard PS-1.

- B. Steel forms are not required for junctions or elbows.

- C. Hardboard: Tempered, Smooth one side, not less than 3/16 inch thick conforming to the requirements of U.S. Commercial Standard CS 251.
- D. Form Ties:
 - 1. Factory fabricated, snap-off metal type of adequate design to minimize form deflection and preclude concrete spalling upon removal.
 - 2. 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.
- E. Bond Breaker: Non-Staining liquid product which imparts a waterproof film to prevent adhesion of concrete and will not leave a paint impeding coating on the face of the concrete or release agents which will not transfer to the concrete.

PART 3 -- EXECUTION

3.1 Construction and Workmanship

- A. Construct adequately braced formwork so that the resulting concrete surfaces will conform to the tolerances specified.
- B. Brace forms, falsework, and centering adequately to retain forms in position as shown on the approved working drawings.
- C. Provide mortar tight forms of approved materials which conform to the required shapes, lines, and dimensions, and will produce a smooth surface without fins and projections.

3.2 Fields Quality Control

- A. Construct elements to meet the allowable tolerances of the dimensions, elevations, and positions shown and specified in Section 03300, Cast-in-Place Concrete.

3.3 Coating Forms

- A. Coat forms with bond breaker prior to the placement of reinforcing steel.
- B. Do not allow excess coating material to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is to be placed.
- C. Coat bolts and rods that are to be completely removed or that are to be free to move with bond breaker.

3.4 Embedded Items

- A. Clean items to be embedded in concrete free from oil or foreign matter that would weaken the bond of the concrete to these items.
- B. Install in 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.

- C. Concrete pads, curbs, pedestals, and similar means devised by the Contractor to support the forms will be subject to review by the Contracting Officer.
- D. Before depositing concrete, check the location and support of items which are to be wholly or partially embedded.

3.5 Joints

- A. Unless otherwise directed, make contraction, expansion, and construction joints only where shown.
- B. Form keyways as shown.
- C. Continue reinforcing steel and wire fabric across construction joints which are not indicated as being free to move.

3.6 Removal of Forms, Falsework and Centering

- A. Maintain forms, falsework, and centering in place until the concrete has attained the minimum 25 percent of specified design strength for the structural members to carry their own weight and any loads to which they will be subjected without exceeding the permissible stresses and without deforming.
- B. Remove, forms, falseworks, and centering only after:
 - 1. The Contracting Officer 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. Reshoring
 - e. Loads, resultant stresses, and deformations to which the concrete and reinforcing steel will be subject at the time of removal and until the concrete has attained its design strength.
 - f. Prevailing site conditions
 - 2. The concrete strength attained prior to form removal has been determined from tests of cylinders cured as the placed concrete.
 - 3. Three (3) test cylinders taken by the test laboratory have been tested by an independent testing laboratory retained by the Government and approved by the Contracting Officer and the tests performed in accordance with Section 03300, Cast-in-Place Concrete.
- C. 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.

*** END OF SECTION ***

PART1 – GENERAL

The General Provisions of the Contract, including Division 1, General Requirements, General and Supplementary Conditions govern the work specified in this Division.

1.1 Work Included

- A. This section specifies reinforcement for concrete structures on the theoretical unit weights shown in Table 1, ASTM A615. Submittals shall be in accordance, with the provisions of Section 01300 - "Submittals".
- B. Certificates:
 - 1. Submit certificates stating that materials meet the specified requirements.

1.2 Related Work Specified Elsewhere

- A. Cast-In-Place Concrete, Section 03300.
- B. Concrete Formwork, Section 03100.

1.3 Quality Assurance

- A. Allowable Tolerances:
 - 1. Cut and bend reinforcing steel to conform to the dimensions shown and within the following tolerances:

1.4 Submittals

- A. Shop Drawings:
 - 1. Have testing performed in accordance with ASTM A615 as modified by ACI 318 building code requirements for reinforced concrete.
 - 2. Submit certificates stating that materials meet the specified requirements.

1.5 Qualifications

- A. Design reinforcement under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Connecticut.

1.6 Product Delivery, Storage and Handling

- A. Ship reinforcing steel in bundles.
- B. Tag each bundle at the mill with a waterproof tag showing the name of the mill and heat number, the grade and size of the bars, and identifying number.
- C. Protect reinforcing steel and wire fabric from damage and dirt, oil, grease, other foreign matter, and rust causing conditions.

PART 2 -- PRODUCTS**2.1 Materials**

- A. Reinforcing Steel Bars: ASTM A6515, Grade 60, modified in accordance with ACI 318.
- B. Welded Steel Wire Fabric: ASTM A185.
- C. Metal Accessories: As recommended by CRSI Manual of Standard Practice. Where concrete surfaces will be exposed to public view in the finish structure, use supports with plastic protected or stainless steel legs.

PART 3 -- EXECUTION:

3.1 Cutting and Bending

- A. Perform cutting and bending in the shop. Bend steel cold. Do not bend or straighten bars in a manner that will injure the material.
- B. Do not bend bars in the field except to correct minor errors or damage in shipment of certain bars practicable.

3.2 Bar Supports and Spaces

- A. Support bars by means of bolsters or chairs with no less than the minimum required by ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- B. Reinforcing steel in the bottom of slabs resting on earth may be supported by concrete, brick, or mortar blocks.
- C. Do not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.
- D. Do not place bars or fabricated mats on layers of fresh concrete as the work progresses.

3.3 Placing and Fastening

- A. Arrange and place reinforcing steel as shown on the Contract Drawings.
- B. Secure reinforcement positively against displacement during placing of concrete.
- C. Wire or clip bars together as recommended in Concrete Reinforcing Steel Institute Recommended Practice for Placing Reinforcing Bars.
- D. Place steel which is free from dirt, mill and rust scale, oil, grease, and other foreign matter.
- E. Placing Reinforcing Steel:
 - Variation of protective coating 2 inch cover 1/4 inch
 - Variation of protective coating 3 inch cover 1/2 inch
 - Variation from indicated spacing 1 inch

3.4 Splicing

- A. Furnish reinforcing bars in full lengths as shown on the Contract and shop drawings.

- B. Do not splice bars unless approved by the Contracting Officer in writing.

3.5 Inspection

- A. Deposit concrete only when the placement of the reinforcement has been checked and approved by the Contracting Officer.

3.6 Embedment

- A. Place reinforcement so that there will be a clear distance of at least 2 inches between the reinforcement and any anchor bolts or other embedded metal work.
- B. The following reinforcing steel work shall be considered defective and may be ordered by the Contracting Officer to be removed and replaced by the Contractor at no additional cost to the owner.
 - 1. Bars with kinks or bends not shown on drawings.
 - 2. Bars injured due to bending or straightening.
 - 3. Bars heated for bending.
 - 4. Reinforcement not placed in accordance with the drawings and / or specifications.

*** END OF SECTION ***

PART 1 -- GENERAL

The General Provisions of the Contract, including Division 1, General Requirements, General and Supplementary Conditions govern the work specified in this Division.

1.1 Work Included

- A. The work to be done under this section includes everything necessary and incidental to executing and completing all plain and reinforced concrete work, and related reinforcing and form work. This work also includes subbase under floor slabs on grade vapor barrier, expansion and control joints, as shown on the Drawings or hereafter specified.
- B. Inserts and pipe sleeves for structural mechanical and electrical work are included under the structural steel, metal fabrication mechanical and electrical sections of the Specifications.
- C. Installation of embedded structural steel items are also included herein. Supply of materials included under section for match 05120.

1.2 Storage of Materials

- A. Store cement on platform off the ground and protect it from the elements. Handle and store aggregates separately preventing intrusion of foreign material or segregation. Protect all reinforcement until used. Use no frozen materials or materials containing ore or any hardened cement.

1.3 Inserts and Fastening Devices for Other Work

- A. Provide for installation of reglets, inserts, hangers, anchors, cast-in-place plates, bolts, dowels, slots angles, nailing strips, blocking and other fastening devices required for the attachment of other work. Locate these devices in cooperation with other trades and build them in as the work progresses.
- B. Provide for installation of pipe sleeves and inserts for mechanical work as specified in the mechanical sections of the Specification.

1.4 Concrete

- A. Shall be composed of materials proportioned, mixed and deposited in accordance with the requirements of the local building code and ACI - 301 and 318 specifications. Concrete shall conform to class and strength called for on the structural drawings. All poured-in-place concrete (regardless of local building code proportions) shall be a six (6) bag mix per cubic yard, with maximum of 4 inch slump, except as noted. All concrete work, except footings, shall be air entrained concrete.

1.5 TESTS

- A. Compression test cylinders from all footings and slabs shall be made at the Contractors expense by an independent testing laboratory approved by the Contracting Officer and tested in accordance with the ACI Code and "Method of Test for Compressive Strength of Molded Concrete Cylinders (ASTM C39)". Three pair of cylinders will be required for the first cubic yard.
- B. Furnish two (2) copies of this report to the Contracting Officer and one copy to local government building department. Concrete which does not meet the Specifications will be

required to be removed and replaced at the Contractor's expense or may be subjected to a load test, also at Contractor's expense.

PART 2 -- PRODUCTS

2.1 Materials

- A. Portland Cement: Type 1, conforming to the "Standard Specifications for Portland Cement," ASTM C150.
- B. Aggregates: Shall conform to ASTM C33. The maximum size of aggregate shall not be larger than 1/5 of the narrowest dimension between forms, not larger than 3/4 of the minimum clear spacing between reinforcing bars. Sand shall be clean, sharp, natural and free from loam, clay, lumps or other deleterious substances.
- C. Water: Clean and free from oil, acid and injurious amounts of vegetable matter, alkalies and other salts.
- D. Reinforcing Steel: Deformed high strength new billet, clean and free from excessive rust, scale or coatings that will reduce bond and shall conform to ASTM A615, Grades 60. See requirements of structural notes on Drawings and Section 03200, Concrete Reinforcement.
- E. Wire Mesh: Welded wire fabric conforming to ASTM A185, sized as detailed and/or required by structural notes on Drawings.
- F. Metal Accessories: Includes all spacers, chairs, ties and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place, shall be provided as per CRSI requirements.
- G. Expansion Joint Filler: Pre-molded self-expanding cork expansion joint, full depth of slab of joint and 1/2 inch wide unless otherwise indicated at all joints between slab and vertical walls. Material to conform to ASTM D1752.84, Type III and shall be set so that there is a 1/2 inch deep removable strip at top.
- H. Admixtures: Shall conform to ASTM C260 for air entraining agent. Shall conform to ASTM C494, Type A for water reducing admixtures for concrete, expect that the compressive strengths specified in this specification shall be maintained. Air entraining admixture "Darex" or "MD-VR or acceptable equal.
- I. Vapor Barrier: Shall be polyethylene sheet, .006 inch (6 thickness of widest practicable widths. All laps 6 inches, with joints sealed with tape designed for use with the above specified material.
- J. Transit Mix Concrete: Provide certificates for compliance with the provisions of this Specification for materials and mix, in accordance with ASTM C94. No calcium chloride and/or admixtures containing same shall be allowed in any concrete supplied under this Specification or within this project, without the Contracting Officer's approval.

- K. Floor Hardeners: Where required by Drawings for exposed concrete slabs, use one of the following systems:

	<u>Manufacturer</u>	<u>Dust On Integral</u>	<u>Spray on Surface</u>
1.	Sonneborn	Harcol (Natural)	Lapidolith
2.	Chem-Masters	Concolor (Natural)	Sciolith
3.	Grace	Durafax	Hornolith

Coverage: 45 pounds/100 square feet (integral), 150 square feet/gallon.

- L. Water Reducing and Retarding Admixtures: All concrete (when temperatures are above 55 F., a water reducing admixture shall be used. The water reducing and retarding admixture shall be used. The water reducing and retarding admixture shall conform to ASTM C494-82 for Type "D", and the water reducing admixture shall be Type "A". This admixture shall be of a non-air entraining type.

PART 3 -- EXECUTION

3.1 Placing Concrete

- A. Place no concrete until foundations, forms, reinforcing steel, pipes, conduits, sleeves, hangers, anchors, inserts and other work required to be built into concrete has been inspected and approved by the Contracting Officer or his representative. Before pouring footings slabs, the bottoms of excavations shall be on undisturbed earth, free from frost, properly leveled off and tamped. Placing or deposition of all concrete shall be done in accordance with the requirements of the local building code and compliance with practices and recommendations of ACI-304. Concrete shall be mixed and placed only when the temperature is at least 40 degrees F., and rising unless permission is obtained from the Contracting Officer. Before placing concrete adjoining construction joints, roughen, brush clean and wet with neat cement grout the surface of all joints already in place. All forms shall be adequately braced to prevent movement during construction work and all walls, earth and construction shall be shored against movement or collapse due to weather conditions or improper drainage.
- B. CHAMFER EXPOSED CORNERS
1. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints. Chamfer shall be 3/4" wide, 45 degree angle.

3.2 Conveying

- A. General Requirements:
1. Convey concrete from the point of delivery with a continuous flow of concrete to the point of placement without segregation. Deposit in accordance with ACI 304-73.
2. Provide an arrangement at the discharge end of a conveyor to prevent segregation.
- B. Chutes and Troughs:
1. Use only ferrous metal lined chutes and open troughs. Where steep slopes are required, discharge the concrete into a hopper. Keep chutes or open troughs clean of hardened concrete by thoroughly flushing with water after each use.

2. Discharge the water used for cleaning outside the lines of the structure.

C. Adjustable Length Pipes (Elephant Trucks):

1. Use flexible pipes only of ferrous metal, rubber or plastic, 6 inches minimum diameter and use in a manner that will not cause segregation of the concrete.
2. Locate chutes or flexible pipes so that concrete is delivered in a continuous flow to points not more than 5 feet vertically from its final location.
3. Thoroughly clean flexible pipes or elephant trunks after each use.

D. Buggies: When using buggies, construct runways on which buggies will operate, so they will not come in contact with or be supported by the reinforcing steel of the structure.

E. Pumping Equipment:

1. Use pumping equipment designed to handle the types, classes and volumes of concrete to be conveyed without segregation.
2. Operate the pump equipment so that a continuous stream of concrete without air pockets is conveyed. When placing other concrete, position the discharge end of the line as near the final position of the concrete as possible.
3. At the conclusion of the placement, clean the equipment thoroughly, waste debris and flushing water outside of the forms.

3.3 Vibration

- A. Thoroughly tamp, spade and vibrate concrete, as approved, to produce smooth dense concrete free from honeycomb. Vibration shall be performed by personnel skilled in this type of work. Keep reserve vibrators on hand for immediate emergency use. Vibrators shall not be applied to steel reinforcing extending into partially hardened concrete. Vibrators shall be by mechanical vibrators that have a minimum frequency of 8,000 vibrations per minute. Vibrators shall be inserted and withdrawn at many points from 18 inches to 30 inches apart, for 5 to 15 seconds duration.

3.4 Removal of Forms

- A. The Contractor shall be responsible for any damage, failure of injury resulting from the removal of the forms. Form removal shall be required by the local building code and Section 03100, Concrete Formwork.

3.5 Patching Existing Work

- A. Patch defective areas exposed to view in the finished work. Chip defective areas to depth of one inch with edges perpendicular to surfaces. Wet area thoroughly. Use same materials and proportions used by concrete except omit coarse aggregate; use water to form still mortar. Allow mortar to stand for one hour, mixing with trowel to prevent setting and without addition of water. Compact thoroughly in place, screed patch slightly higher than surrounding surface. Leave undisturbed for one to two hours. Finish to match adjoining surfaces.

3.6 Protection, Guarding and Curing

- A. All concrete work shall be protected from the weather to prevent damages by pelting from the storms or dripping and from freezing. Provide temporary coverage and heat when required. Finished slabs shall be protected with kraft paper to prevent chipping and scratching and if necessary with 6 inches of straw, over a covering of non-staining waterproof paper to prevent freezing. Rope off all sections of fresh finish to guard from injury; provide planking or other protection if traffic is necessary before finish is hard. Use only black polyethylene or orange label sisalkraft over slabs and sidewalks. During concrete curing to prevent spotting and light and dark spots on finished surface.
- B. Cure all concrete slab surfaces not otherwise noted, with sealing and dust-proofing. Material that shall become integral part of concrete and leave floor free of residue or film shall not prevent bonding of coating. Material shall be applied as per manufacturer's specifications and meet ASTM C309, Type I-D, Class B, with fugitive dye and is applied in strict accordance with manufacturers recommendations. Do not use membrane curing compound on those portions of the concrete to which concrete topping or mortar are subsequently to be bounded. Sisalkraft paper or other approved covering may be used for curing of the concrete in these areas. Membrane curing compound shall not be used for curing of the concrete where secondary flooring or surface treatment is to be applied unless it is proven that the compound will not prevent bond or unless measures are taken to receive bonded application.
- C. Warm Weather: All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water and mechanical injury. All concrete shall be kept wet for a period of not less than 7 days by covering with water or with an approved water-saturated covering. Any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in the place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and entirely free from any elements which, in the opinion of the Contracting Officer, might cause staining or discoloration of the concrete.
- D. Cold Weather: Concrete when placed during cold weather shall be kept moist and provided with adequate protection for a period of not less than 14 days, in accordance with 9.2 above, and subject to the approval of the Contracting Officer so that the air in contact with the concrete will be maintained at temperatures between 50 and 70 F. for at least the first 5 days of the curing period.

3.7 Cold Weather Specifications

- A. Procedures for protection of concrete against damage by frost during the making and early curing period shall be as noted in "Cold Weather Concreting", ACI 306R-78, but no accelerators will be allowed.
- B. Concrete, when placed in the forms, shall have a temperature of not less than 60 F., no more than 80 F. Freshly placed concrete and the surroundings air shall be maintained at a temperature of 50 F. or greater, for a period of 5 days after placing. The methods of protection and curing shall be such as to prevent evaporation of moisture from the concrete and injury to the surface.
- C. Top covers may be removed between the hours of 8:00 a.m. and 5:00 p.m., on days when the temperature is above 35 F. to permit erection of forms, but they shall be replaced not later than 5:00 p.m.

3.8 Hot Weather Concrete

- A. During hot weather the manufacture, placement curing of the concrete shall conform to the “Hot Weather Concreting”, ACI 305R-77 and as specified herein.
- B. The ingredients may be required to be cooled to keep the temperature of the concrete within the limits shown in ACI-305. Forms and reinforcing steel may be required to be protected from direct rays of the sun and cooled by sprinkling. Concrete in place shall be protected in order to minimize drying and absorption of heat. To prevent too rapid stiffening, the quality of the retarding admixture shall be increased, as required.
- C. Concrete when poured shall have a minimum temperature of 90 F. Ice shall be used in the mixing water to maintain this maximum.

3.9 Cement Finish Wearing Surface

- A. All finished cement floor shall be monolithic and brought to the finished level with Darby. Surface shall be worked with a bull float to thoroughly compact it and provide a finish free from depressions, or irregularities and lightly trowled. In no case shall dry cement, or a mixture of dry cement and sand be sprinkled on the wearing surface and worked into it to absorb moisture or to hasten the hardening. Finish of slabs, floors, etc. shall not begin until all bleed water and water sheen has left the surface. For slabs in which drains occur, special care shall be exercised to slope surface to the drain; the pitch shall be determined by the Engineer/Architect, or as indicated on the or not have a tolerance greater than 1/4 inch in 10 feet in any direction. Any tolerance greater than 1/4 inch shall be ground or flash patched at the Contractor's expense.

3.10 Floor Slabs

- A. Base: Provide gravel or crushed rock base thickness as indicated on Drawings, under all floor slabs on earth using fine gravel for top layer. Wet, tamp with pneumatic tampers and roll bed until thoroughly compacted. Lay polyethylene vapor barrier with 6 inch lap. Allow no traffic after vapor barrier has been installed.
- B. Provide the reinforcing shown on the Drawings and pour concrete to the required thickness. Support reinforced on chairs of proper size to place mesh in center of slab. Strike off at proper levels and double steel trowel to a hard dense true surface.
- C. Set continuous expansion joint strips wherever the edge of the floor slabs abut a vertical surface. Seal the joints at the strips and at the places where pipes penetrate the floors, using rubber neoprene joint sealer.
- D. Apply an epoxy bonding agent on the full contact area of concrete equipment pads before pouring on floor slab.

3.11 Concrete Pads

- A. Mechanical equipment pads, concrete poured-in-place shall be constructed as shown; reinforced as indicated. Concrete for this work shall be 3,000 pounds per square inch stone concrete, air entrained.

3.12 Sidewalks

- A. Provide 4 inch thick concrete sidewalks to sizes shown and located as indicated on the Drawings. Walks shall be scored as shown, but where not shown shall be scored in squares approximately 5 feet x 5 feet. All scoring and joints shall be tooled with an edging tool. Sidewalks up to 8 feet in width shall be poured in lengths not to exceed 20 feet. At each such

joint, and elsewhere where the walks abut vertical building surfaces or curbs, provide 1/2 inch premolded expansion joints of cork, ASTM D1752, Type 2.

- B. Sidewalks shall be placed over compacted fill or earth. All filling required to bring the subgrade to required elevation will be rolled to 95 percent compaction at optimum moisture. Slope sidewalks transversely at 1/4 inch per foot. Provide temperature reinforcing mesh in all sidewalks - 6"x6" - W1.4 x w1.4.
- C. All sidewalks shall receive smooth float with transverse broom surface finish with 1/4 inch radius edging and scoring, unless otherwise noted.
- D. All concrete for sidewalks shall be air entrained, 3,000 pounds per square inch stone concrete. Air entrainment shall be in accordance with ACI-301 standard specification and tested by ASTM standard methods.

*** END OF SECTION ***