

SECTION 03010
CONCRETE WORK

PART 1 - GENERAL

1.00 RELATED DOCUMENTS

General and Supplementary Conditions apply to the work specified in this Section.

1.01 THIS WORK INCLUDES

Concrete work as shown on the plans.

1.02 QUALITY ASSURANCE

A. Codes and Standards - Latest Editions

Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified:

- 1) ACI 301 "Specifications for Structural Concrete for Buildings."
- 2) ACI 311 "Recommended Practice for Concrete Inspection."
- 3) ACI 318 "Building Code Requirements for Reinforced Concrete."
- 4) ACI 347 "Recommended Practice for Concrete Formwork."
- 5) ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
- 6) Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
- 7) ACI 302 "Guide for Concrete Floor & Slab Construction".
- 8) ACI 305 "Hot Weather Concreting".
- 9) ACI 211-1 "Selecting Proportions for Normal Weight Concrete".
- 10) ACI 305 "Hot Weather Concreting".
- 11) ACI 308 "Curing Concrete".

ATSM Standards

1. ASTM C31 Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 Concrete Aggregates.
3. ASTM C39 Compressive Strength of Cylindrical Concrete Specimens.

4. ASTM C94 Ready-Mixed Concrete.
5. ASTM C150 Portland Cement.
6. ASTM C172 Sampling Freshly Mixed Concrete.
7. ASTM C260 Air-Entraining Admixtures for Concrete.
8. ASTM C309 Liquid Membrane-Forming Compound for Curing Concrete Type 1 or 1D Class A.
9. ASTM C823 Examination and Sampling of Hardened Concrete in Constructions.
10. ASTM C1046 Measuring Temperature of Freshly Mixed Concrete.
11. ASTM D448 Standard Sizes of Coarse Aggregate for Highway Construction.
12. ASTM E329 Inspection and Testing Agencies for Concrete Steel, and Bituminous Materials As Used in Construction.
13. ASTM C-618 "Chemical Admixtures for Concrete".
14. ASTM C-494 "FLYASH and Raw or Calcined natural Pozzolans for use as a mineral admixture in Portland Cement Concrete".

Florida Department of Transportation Standard Specifications, latest edition, Section 520, 522 and 525.

B. Workmanship

The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes.

C. Laboratory Test Reports; Concrete Work

Submit two (2) copies of laboratory test reports for concrete materials and mix design test as specified.

PART 2 - PRODUCTS

2.00 FORM MATERIALS

A. Forms for Exposed Finish Concrete

Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Forms for Unexposed Finish Concrete

From concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

D. Form Ties

- 1) Provide factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection and to prevent spilling of concrete surfaces upon removal.
- 2) Unless otherwise shown, install ties so portion remaining within concrete after removal is at least 1-1/2" inside concrete.
- 3) Unless otherwise shown, provide form ties which will not leave holes larger than 1" diameter in concrete surface.

E. Inserts

- 1) Provide metal inserts for anchorage of materials to concrete construction, not supplied by other trades and as required for the work.
- 2) Adjustable wedge inserts of malleable cast iron shall be complete with bolts, nuts and washers; 3/4" bolt size unless otherwise indicated.
- 3) Threaded inserts of malleable cast iron shall be furnished complete with full-depth bolts; 3/4" bolt size, unless otherwise indicated.

2.01 REINFORCING MATERIALS

A. Reinforcing Bar

- 1) ASTM A 615, Grade 60 deformed. Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice." In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material. Reinforcement with any of the following defects will not be permitted in the work:
 - a) Bar lengths, depths and bends exceeding CRSI fabricating tolerances.
 - b) Bends or kinks not indicated on drawings or final shop drawings.

- c) Bars with reduced cross section due to excessive rusting or other cause.

B. Supports for Reinforcement

- 1) Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type support complying with CRSI recommendations, unless otherwise indicated. Wood, brick and other devices will not be acceptable.
- 2) For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.02 CONCRETE MATERIALS

A. Portland Cement

- 1) ASTM C 150, Type 1 or Type II, unless otherwise acceptable to Project Engineer.
- 2) Use only one brand of cement throughout the project, unless otherwise acceptable to Project Engineer.

B. Normal Weight Aggregates

- 1) ASTM C 33, and as herein specified. Provide aggregates from a single source for all exposed concrete.

C. Water

- 1) Clean, fresh, potable.

D. Admixtures

- 1) All admixtures shall be reported with proportions of mix per manufacturer's specification.
- 2) HRWR (Superplasticizer): ASTM C-494 Type F/G.
- 3) Air-Entraining Admixture: ASTM C 260.
- 4) Water-Reducing and Retarding Admixture: ASTM C 494, Type A, B or D.
- 5) Calcium chloride will not be permitted in concrete.

E. FLYASH ASTM C-618 Class F (25% Mx. cement replacement).

2.03 RELATED MATERIALS

A. Moisture-Retaining Cover

- 1) One of the following, complying with ASTM C 171.
 - a) Waterproof paper.
 - b) Polyethylene film.
 - c) Polyethylene-coated burlap.

B. Curing Compounds

- 1) After the finishing operations have been completed and as soon as the concrete has hardened sufficiently such that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete are to be cured using a liquid curing compound. Rate of application to be 200 square feet per gallon or as recommended by the manufacturer.
- 2) Do not leave concrete exposed for a period in excess of 30 minutes between stages of curing or during the curing period.

2.04 PROPORTIONING AND DESIGN OF MIXES

A. Normal Weight Concrete

- 1) Prepare design mix for type and strength of concrete in accordance with applicable provisions of ACI 221.1 and ACI 318, Chapter 4.
- 2) Recommended design mixes to provide normal weight with the following properties, as indicated on drawing and schedules:

B. Adjustment to Concrete Mixes

- 1) Mix design adjustments may be requested by the Contractor when characteristics of materials, use of admixtures, job conditions, method of placement, weather, test results, or other circumstances warrant, at no additional cost to the Owner and as approved by the Project Engineer. Laboratory test data for revised mix design and strength results must be submitted to and approved by the Project Engineer before using in the work.

C. Slump Limits

Proportion and design mixes to result in concrete slump at the point of placement as follows:

| | Maximum | Minimum |
|------------------------|----------------|----------------|
| Mass Concrete | 3 | 1 |
| Plain Concrete | 4 | 2 |
| Reinforcement Concrete | 5 | 3 |
| Concrete with HRWR | 8 | 5 |

2.05 CONCRETE MIXING

A. Ready-Mix Concrete

- 1) Comply with the requirements of ASTM C-94, and as specified.
- 2) During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 may be required.
 - a) When the air temperature is between 85° F and 90° F, reduce the mixing and delivery time to 75 minutes, and when the air temperature is above 90° F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.00 FORMS

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Construct forms complying with ACI 347. Provide for openings, offsets, sinkages, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joint to prevent leakage of cement paste.
- C. Form Ties
 - 1) Factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spilling concrete surfaces upon removal.
 - 2) Unless otherwise shown, provide ties so portion remaining within concrete removal is at least 1-1/2" inside concrete.
 - 3) Unless otherwise shown, provide form ties, which will not leave holes larger than 1" diameter in concrete surface.

- D. Provisions for Other Trades
 - 1) Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings from trades providing such items. Accurately place and securely support items built into forms.
- E. Cleaning and Tightening
 - 1) Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate mortar leaks.
- F. Edge Forms and Screed Strips for Slabs
 - 1) Set edge forms for bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screed strips by the use of strike-off templates or accepted compacting type screeds.
- G. Preparation of Form Surfaces
 - 1) Coat the contact surface for forms with a form-coating compound before reinforcement is placed.
 - 2) Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
 - 3) Coat steel forms with non-staining, rust preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.01 PLACING REINFORCEMENT

- A. General - Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacing, and hangers, as required.

- D. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete, not toward exposed concrete surfaces.
- E. Do not place reinforcing bars more than 3" beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- F. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
- G. Splice reinforcement by lapping ends, placing bars in contact, and tightly wire tying. Comply with requirements of ACI 318 for minimum laps of spliced bars.

3.02 JOINTS

- A. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete.
- B. Contraction Joints: Provide contraction joints, sectioning concrete into areas as shown on drawings. Construct contraction joints for a depth equal to at least 1/4 concrete thickness, as follows:

Sawed Joints: Form weakened-plan joints using powered saws equipped with shatterproof abrasive or diamond rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded or otherwise damaged by cutting action.

- C. Construction Joints:
 - 1) Place construction joints at the end of pours and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints.
 - 2) Locate and install construction joints, as indicated on the drawings so as not to impair the strength and appearance of the structure, as acceptable to the Project Engineer.
 - 3) Provide keyways, at least 1 1/2" deep in construction joints in walls, slabs and between walls and footing.

3.03 EMBEDDED ITEMS

General:

Set and build into the work, anchorage devices and other embedded items required for other work that is attached or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto. All hardware used to attach or embed devices into concrete is to be stainless steel or approved equal.

3.04 CONCRETE PLACEMENT

A. General:

- 1) Place concrete in compliance with the practice and recommendations of ACI 304, and as herein specified. No water shall be added to the concrete after initial mixing, unless approved by Project Engineer's jobsite representative.
- 2) Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness with the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.
- 3) Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
- 4) Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete and dispose of at approved off-site location.

B. Placing Concrete Slabs:

- 1) Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
- 2) Bring slab surface to the correct level with a straight-edge and strike-off. Use bull floats or other acceptable methods to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
- 3) Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Maintain reinforcing in the proper position during concrete placement operations.

C. Hot Weather Placing:

- 1) When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- 2) Cool ingredients before mixing to maintain concrete temperature at time of placement below 95° to 100° F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature, provided the water equivalent of the ice is calculated to the total amount of mixing.
- 3) Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- 4) Wet forms thoroughly before placing concrete.

D. Bonding:

- 1) Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of concrete bonding agent, and clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces a manner to expose bonded aggregate uniformly and to not leave laitance, loose particle of aggregate, or damaged concrete at the surface.
- 2) Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:
 - a) At joints between walls or columns and beams or slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.

3.05 FINISH OF FORMED SURFACES

Rough Form Finish:

For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having the texture imparted by the form facing material used with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

3.06 CURING AND PROTECTION

A. General:

Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 72 hours. Continue curing

for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of curing period.

B. Curing Method:

- 1) After the finishing operations have been completed and as soon as the concrete has hardened sufficiently such that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete are to be cured using a liquid curing compound. Rate of application to be 200 square feet per gallon or as recommended by the manufacturer.
- 2) Do not leave concrete exposed for a period in excess of 30 minutes between stages of curing or during the curing period.

3.07 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work may be removed after cumulatively curing at not less than 50°F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

3.08 MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

- 1) Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs:

- 1) Provide monolithic finish to interior curbs by stripping form while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

3.09 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

- 1) Repair and patch defective areas with cement mortar immediately after removal of forms, as specified herein.
- 2) Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar or proprietary patching compound, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout, or proprietary bonding agent.

B. Repair of Formed Surfaces:

- 1) Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Project Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.
- 2) Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
- 3) Repair concealed formed surfaces, where possible, that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete.

C. Repair of Unformed Surfaces:

- 1) Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope.
- 2) Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spilling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
- 3) Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
- 4) Correct low areas in unformed surfaces during or immediately after completion or surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Project Engineer.
- 5) Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cur-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and brush with neat cement grout coating or concrete bonding agent. Mix dry-pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
- 6) Use epoxy-based mortar for structural repairs, where directed by Project Engineer.
- 7) Repair methods not specified above may be used, subject to acceptance by the Project Engineer.

3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General:

- 1) The Project Engineer shall submit the name of the testing laboratory they are using to the Contractor at least ten days before testing on material starts.
- 2) Sampling and testing for quality control during the placement of concrete shall include the following:
 - a) Slump: ASTM C 143; One test each 50 yards or when an apparent change in consistency is observed.
 - b) Air Content: ASTM C 231 pressure for normal weight concrete; one for each set of compressive strength test specimens.
 - c) Concrete Temperature: Test hourly when air temperature is 40°F and below or 80°F and above, and each time a set of compressive test specimens are made.
 - d) Compressive Tests Specimen: ASTM C 31; one set of five (5) standard cylinders for each compressive strength test.
 - e) Compressive Test Specimen: ASTM C 39; one set each 50 cy.yd. or fraction thereof, of each concrete class placed in any one day or for each 1,000 sq.ft. of surface area placed; 1 specimen tested at 3 days; 1 specimen tested at 7 days, 3 specimens tested at 28 days, and one specimen retained in reserve for later testing, if required.
 - f) Test results will be reported in writing to the Project Engineer, Ready-Mix supplier, and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for 3-day test, 7-day tests, and 28-day tests.
 - g) Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strength and other characteristics have not been attained in the structure, as directed by the Project Engineer. The testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.
 - h) Defective Work: Concrete work which does not conform to the specified requirements, including strength, tolerances and finishes, shall be corrected at the Contractor's expense, without extension of

time therefore. The Contractor shall be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SCOPE

Except as otherwise specified, the work shall consist of performing all formwork and related items for all cast-in-place concrete work indicated on the drawings in this section.

1.02 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Definitions and Standards: Section 01068
- B. Concrete Work Section 03010

PART 2 - PRODUCTS

2.01 FORMS

- A. Steel Forms

Material shall meet the requirements of Paragraph 3.01.

- B. Wood Forms

Wood forms shall be constructed of lumber or plywood. For exposed concrete surfaces, use dressed uniform thickness lumber or plywood with surfaces free from defects or irregularities. For non-exposed concrete surfaces and rough work, undressed lumber or plywood may be used.

2.02 FORM TIES

Shall be an approved type or removable bolts or rods. Ties shall have an adequate working strength and be of a type to adjust to the length required. Wire ties will not be permitted.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF FORMS

- A. Construct forms to slopes, lines and dimensions shown, plumb and straight, securely braced and shore forms to prevent displacement and to properly support construction loads. Provide access openings for cleaning and inspecting forms and reinforcement prior to depositing concrete. Do not coat forms with material that will stain or cause injury to exposed concrete surfaces. Keep wood forms wet. Forms shall be constructed for easy removal without damage to concrete. Lumber once used in forms shall have nails removed and the surfaces cleaned before reuse.

- B. Joints shall be tight and leak proof and arranged vertically or horizontally to conform to the pattern of the design.
- C. Forms placed in successive units for continuous surfaces shall be fitted to accurate alignment so that the completed surface shall be smooth and free from irregularities.
- D. For long spans, where intermediate supports are not possible, the anticipated deflection in the forms due to the weight of the fresh concrete shall be accurately considered in the form design so the finished concrete members will have true surfaces conforming accurately to the desired lines, planes and elevations.
- E. Unless otherwise required by building code, or if tremies are not to be used, openings in sides of forms shall be used to limit the free fall of concrete to 4 feet.
- F. All foundation and footing sides shall be formed.
- G. All supporting forms and shoring shall have sufficient strength stiffness, bracing and stability to properly support all construction loads without excessive deflection.
- H. Concrete shall not be placed in any form until inspected and approved by Project Engineer.

3.02 FORM TIES

- A. Form ties shall be of an approved type. Ties used for exposed concrete surfaces shall be of a type approved by Project Engineer. Ties shall be of such type that any metal remaining in place will not be closer than 1-1/2 inches to the concrete surface.
- B. Ties shall not be fitted with any lugs, cones, washers or other device to act as a spreader within the forms of an other purpose which will leave a hole or depression larger than 7/8 inch in diameter or a depression back of the exposed surface of the concrete.
- C. Ties that are to be removed shall be coated with cup grease or other approved material to facilitate removal.
- D. Holes remaining from bolts or tie rods shall be filled solid with cement mortar. Holes passing entirely through the wall or beam shall be filled from inside face with a device that will force the mortar through to the outside face using a stop held at the outside wall surface to assure complete filling. Holes which do not pass entirely through the walls shall be packed thoroughly full. All excess mortar at the face of filled holes shall be struck off flush.

3.03 WETTING AND OILING FORMS

The inside surface of wood board forms shall be soaked with clean water prior to placing concrete. Except as otherwise specified, plywood or metal forms shall be treated with an approved form of oil or lacquer. If oil is used, all excess oil shall be wiped off with rags to leave the surface of the forms just oily to the touch.

3.04 INSERTS AND FASTENING DEVICES IN FORMWORK

- A. Provide for installation of inserts, conduit, pipe or duct sleeves, drains, hangers, metal ties, anchors, bolts, angle guards, dowels, anchor slots, nailing strips, blocking, grounds and other fastening devices required for attachment of other work. Properly locate in cooperation with other trades and secure in position before concrete is placed. See drawings and other sections of specifications for extent, locations and details of items to be embedded or placed in concrete.
- B. All sleeves, chases, inserts, lifting devices, etc. which are provided and placed in the forms shall be maintained in position and protected until the concrete work is completed. Lifting devices shall be anchored to the main reinforcing bars.

3.05 REMOVAL OF FORMS

- A. Forms shall be removed, in accordance with requirements of the ACI Building Code Requirements for Reinforced Concrete, without damage to concrete and in manner to insure complete safety of the structure. Leave shoring in place until concrete member will safely support its own weight plus any live loads that may be placed upon it. Reshore all members as required by conditions to properly and adequately carry all construction loads.
- B. Upon removal of forms the Project Engineer shall be notified by the Contractor in order that an inspection of the newly stripped surfaces can be made.
- C. Upon approval by Project Engineer, freshly stripped surface shall be patched and concrete rubbed out within 24 hours.
- D. All temporary bracing, shoring and re-shoring as required for in place concrete shall be provided.
- E. Face forms or non-supporting forms may be removed within 24 hours after placement of concrete.
- F. Supporting forms shall not be removed until the in-place concrete has reached 70% of the specified design strength except the bridge slabs shall reach 100% design strength, but in no event until seven days after concrete placement, without approved concrete cylinder breaks.

END OF SECTION

SECTION 03400

PRE-CAST CONCRETE

PART 1 - GENERAL

1.01 SCOPE

The Work consists of performing all precast and prestressed concrete work and related items as indicated on drawings and specified in this section.

1.02 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Definitions and Standards: Section 01068
- B. Concrete Formwork: Section 03100

1.03 REFERENCED SPECIFICATIONS

Florida Department of Transportation "Standard Specifications for "Road and Bridge Construction" Sections 346, 400, 413, and 415, Latest Edition.

1.04 WORK INCLUDED

- A. The work shall be to construct precast and prestressed structures and other items as detailed on drawings or as approved by shop drawings.
- B. Records: The Contractor shall record on the drawings in color code, the time, date and location of all precast and prestressed concrete items installed. These drawings shall be kept on file at the project and be subject to inspection by the Project Engineer.

1.05 CODES

American Concrete Institute and Prestressed Concrete Institute Code.

1.06 NOTICE

The Project Engineer shall be given 24 hours advance notice of installation of all precast and prestressed concrete elements and no elements shall be installed without approval of the Project Engineer.

1.07 QUALITY ASSURANCE

Acceptable Manufacturers: Minimum of three years experience in precast and prestressed structure work of quality and scope required on this project.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT

ASTM C-150 - Type 1 Portland Cement shall be used in all precast and prestressed concrete items, unless otherwise specified on plans.

2.02 FINE AGGREGATE SAND

See Section 03010. – 1.02.

2.03 COARSE AGGREGATE

See Section 03010. – 1.02.

2.04 MIXING WATER

See Section 03010. – 1.02.

2.05 MIXING PROPORTIONING

- A. Precast: To be Class IV in accordance with Section 345 of the referenced specifications and produce 28 day compressive strength of moisture cured laboratory samples 3400 p.s.i. minimum.
- B. Minimum cement content: 564 lbs./cubic yard.

2.06 MIXES

- A. Equivalent to ASTM C-94-72.
- B. Mix concrete only in quantities for immediate use.
- C. Do not retemper or use set concrete.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Placing Concrete

1. Convey concrete from mixer to final position by method which will prevent separation or loss of materials.
2. Deposit concrete in continuous operation until section is completed.
3. Regulate rate of placement so concrete remains plastic and flows into position.
4. All other items of handling and placing concrete shall be in accordance with ACI 318-83.

B. Consolidating Concrete

1. Use mechanical vibrating equipment for consolidation. No placement of concrete will be allowed to commence unless the Contractor has a minimum of two operable vibrators on the job.
2. Vertically insert and remove hand-held vibrators at points 18 inches to 30 inches apart.
3. Do not use vibrators to transport concrete in forms.
4. Vibrators shall be 2 1/4" to 2 5/8" in diameter, and shall have a minimum frequency of 10, 000 impulses/minute.
5. Vibrate concrete minimum amount required for consolidation.

C. Construction Joints

Construction joints and/or expansion joints not shown on the plans will be made only with the approval of the Project Engineer.

D. Finishing

1. Tops of forms:
 - a. Strike concrete smooth at tops of forms.
 - b. Float to texture comparable to formed surfaces.
 - c. Steel trowel to seal.
2. Formed surfaces:
 - a. As-cast finish.
 - b. Patch the holes and defects after form removal.
 - c. Remove fins from surfaces.

E. Curing

1. Keep concrete moist by keeping surfaces continually dampened, continuing for minimum of 72 hours, or
2. Apply an approved (white pigmented) membrane curing compound AASHTO M 148 Type 2.

F. Tolerances

1. Overall dimensions of members = 1/4" per 10 feet with ± 1 " maximum after completion of erection.
2. Cross Section Dimensions
 - a. Sections less than 3 inches = +3/8", -1/8".
 - b. Sections over 3 inches and less than 18 inches = +1/2", -1/4"
 - c. Sections over 18 inches = +3/4", -1/2".

3.02 PROTECTION OF COMPLETED WORK

During curing period, protect concrete from damaging mechanical disturbances, water flow, loading, shock and vibration.

3.03 INSPECTION AND TESTING

A. Fabricators Tests: The fabricator shall take a minimum of five concrete compression cylinders for each days concrete placing of each type of product covered by this division and for every 50 cubic yards of concrete placed each day. The five test cylinders shall be cured with the project. Two shall be used to determine if the proper release strength has been achieved. Two cylinders shall then be water cured for twenty-eight days and tested. Three copies of the test reports shall be furnished to the Project Engineer. Regular moisture and grading determinations shall be made on materials and the concrete mix adjusted accordingly.

B. Fabricators Inspections: The fabricator shall inspect initial prestress forces and maintain a check on the manufacturing process in accordance with standards referenced in this section.

Three copies of mix reports on cement, reinforcing steel and strand steel, concrete design, and aggregate gradation shall be furnished to the Project Engineer prior to fabrication of the units.

If so directed by the Owner, the Project Engineer will employ the services of an independent testing laboratory to conduct additional testing. The cost of this testing will be paid by the Owner.

Project Engineer and their authorized representatives shall be allowed access to the casting yard at any time to inspect the fabrication of units for this project.

END OF SECTION