SECTION 450
PRESTRESSED CONSTRUCTION

450-1 Description.

Fabricate, store, transport, and erect precast prestressed concrete members prestressed by the pretensioning method. The requirements of Section 346, Section 400, Section 415, Section B460, and Division III, together with other applicable Sections of the specifications covering specific construction items, also apply, except as modified herein.

450-2 Pretensioned Precast Prestressed Concrete.

450-2.1 General: Pretensioned precast prestressed concrete members are members prestressed by the pretensioning method. In this method, steel components are stressed and anchored; the concrete for the member is then cast and cured, and finally the stress in the steel components is released from the anchorages to the concrete through bond, after the concrete has attained its specified release strength. When members are prestressed by a combination of pretensioning and posttensioning, meet the applicable requirements of this Section for all the activities related to the fabrication of such members.

450-2.2 Quality Control/Quality Assurance Program:

450-2.2.1 General: The quality control/quality assurance program for precast prestressed concrete members is composed of the quality control activities performed by the Contractor and the quality assurance activities performed by the Department.

Control the quality of fabrication of precast prestressed concrete members in accordance with the requirements described herein, under the monitoring of the Department. Develop a Quality Control Plan (QCP), and obtain the Engineer's approval of it prior to commencement of any work.

450-2.2.2 Definitions: The quality control/quality assurance program is defined by the following:

Quality Control (QC): The activities performed by the Contractor to ensure that materials, methods, techniques, personnel, procedures and processes utilized during fabrication of precast prestressed concrete members are within the required limits.

Quality Assurance (QA): The activities performed by the Engineer to ensure that the quality and acceptability of the precast prestressed concrete members are in accordance with this Section and the Contract Documents.

Independent Assurance (IA): The activities performed by the Engineer, the Federal Highway Administration, or any other local or state agency, who do not normally have direct responsibility for quality assurance. IA sampling and testing and IA procedures are normally used to determine reliability of QC and QA sampling and testing, and to evaluate fulfillment of QC and QA activities.

450-2.2.3 Contractor's Quality Control: Develop and implement a QCP with the objective of verifying that all materials and workmanship incorporated into the precast prestressed concrete members conform with the level of quality required by this Section. The Contractor's QCP shall also verify that the fabrication processes are controlled to ensure that the finished member conforms to the physical characteristics and dimensions called for by the plans and this Section. Provide the QCP with sufficient detail to enable the Department to determine the adequacy of the plan. Include with the plan a management statement of dedication to quality and to the QCP. Include with the plan a schedule of frequencies of the sampling, testing, inspection, and documentation that the Contractor shall perform. As a minimum, the QCP shall address items listed below. Submit the plan in writing to the Engineer for approval prior to beginning fabrication. Submit modifications to the QCP for approval in the same manner.

Obtain the Engineer's approval of a QCP for each project. The Engineer will extend approval of the QCP on a project by project basis upon written request from the Contractor for all

continuing work at a specific prestressed concrete plant, provided the materials, methods, techniques, procedures, processes and personnel qualifications utilized during fabrication of precast prestressed concrete members remain the same.

QCP General Format:

(1) General Information

- Company Name, Address and Location
- Plant Number, Address and Location (if different from above)
- Plant Organizational Chart
- Plant Personnel and Experience
  - General Manager
  - Production Manager
  - Plant Engineer
  - Quality Control Manager
  - Quality Control Inspectors and Technicians
  - Stressing Foreman/Yard Superintendent
- Statement of Management Commitment to Quality Control
- Department Approval of Plant

(2) Materials

- Description of Testing Facilities to be Utilized for Materials Testing
- Site Plan Detailing Material Storage and Handling Facilities
- Sampling and Testing Frequencies of the Following Materials:
  - Concrete (In accordance with 450-2.5.7)
  - Miscellaneous Materials
- Procedure for verifying that steel products received are represented by certified test reports and that the material meets specification requirements.

(3) Inspection

- Responsibility for Inspection Operations
- Inspection of Pre-placement Operations
  - Control of Dimensions and Tolerances
  - Stressing Bed and Formwork
  - Positioning of Embedded Items
  - Size and Position of Reinforcing Steel and Welded Wire Fabric
  - Size, Position, and Condition of Prestressing Steel and/or Posttensioning Ducts
  - Stressing Operations
  - Inspection of Concrete Operations
  - Proportioning and Mixing of Concrete
  - Handling, Placing, and Consolidation of Concrete
  - Concrete Finishing
  - Concrete Curing
- Inspection of Postplacement Operations
  - Detensioning and Stripping of Forms
  - Dimensional and Alignment Tolerances
  - Handling, Storage, Transportation
  - Member Identification
  - Repairs
  - Resolution of Non-Complying Issues
  - Concrete Sealing

(4) Procedures

- Proposed Method of Duct Support

Temperature Changes
Procedure for adjusting stressing force for temperature differential
Procedure for heating, covering, insulating or housing concrete work during cold weather after casting and prior to detensioning
Procedure for protection of exposed strands between stressing headers or anchorages
Proposed location of thermocouples
Detensioning Procedures
Non-complying Members
Procedure for identification, evaluation and disposition of deficiencies
Repair methods and materials
QCP Review/Revision
Procedure to periodically address and correct repetitive noncompliance issues
(5) Acceptance and Certification of Members
Producers Stamp Configuration
Certification Statement
(6) Documentation
Material Acceptance
Pre-placement Inspection
Stressing
Placement Operation
Postplacement Inspection
Deficiencies
Repairs

450-2.2.4 Department's Quality Assurance: The Department will perform inspections, sampling, and testing to ensure the quality and acceptability of the materials, methods, techniques, procedures and processes being utilized by the Contractor in the fabrication of precast prestressed concrete members. For this purpose, the Engineer will perform periodic assurance inspections, sampling and testing during, but not limited to, any of the following stages of fabrication:

(a) Prior to Tensioning
(b) During Tensioning
(c) Prior to Concrete Placement
(d) During Concrete Placement and Curing
(e) Prior to Detensioning
(f) During Detensioning
(g) After Detensioning
(h) Storage
(i) Prior to Shipment

The Department's Quality Assurance Program is reflected in the Department's Manual for Quality Assurance of Precast Prestressed Concrete Members.

450-2.2.5 Independent Assurance: In addition to quality assurance inspection, sampling and testing, the Department may perform independent assurance inspection, sampling and testing to provide independent monitoring of the fabrication process and the QC and QA activities. The Department may perform independent assurance activities during, but not limited to, the stages of fabrication of precast prestressed members identified in 450-2.2.4. Results of the independent assurance inspections, sampling and testing will not constitute a basis for determining the acceptability of precast prestressed concrete members but will assist in the evaluation of the Contractor's quality control.

450-2.3 Prestressed Plant:

450-2.3.1 General: Initial Acceptance of a precast prestressed concrete plant will require approval of a QCP in accordance with 450-2.2.3 and compliance with 450-2.3.2, 450-2.3.3 and 450-2.3.4

below. A plant that fails to comply with these requirements will not be acceptable to produce precast prestressed concrete members for Department projects. A plant is defined as an independent operating facility capable of performing all the operations necessary to fabricate precast prestressed concrete members.

450-2.3.2 Approval: Obtain the Engineer's approval of the precast prestressed concrete plant prior to producing precast prestressed concrete members. Apply, in writing, to the Department for approval of the prestressed concrete plant. Apply with the Department's District Materials Office for the District in which the plant is located. For out-of-state prestressed concrete plants, submit the application to the District Materials Office for the District in which the construction project is located.

The approval status of any prestressed concrete plant may be a provisional approval reflecting only passing an initial inspection by the Department, or a complete approval.

The approval process is intended to evaluate the plant's capability for fabricating quality members in accordance with established standards through a series of inspections, which include an initial in-depth inspection and subsequent unannounced spot inspections of the plant.

Obtain the Department's approval of a plant for each project. The Department will extend approval of the plant on a project-by-project basis upon written request from the Contractor for continuing work provided the plant has produced members for Department projects within one year prior to the request.

450-2.3.3 Plant Staff Organization and Qualifications: The plant's organization shall include, as a minimum, a full-time production manager and a full-time quality control manager at each plant. The plant shall have on staff a Specialty Engineer, or have on retainer a Specialty Engineer. The plant engineer may serve as the quality control manager, unless the plant engineer has direct responsibilities for production. If the plant engineer has duties directly related to production, another Specialty Engineer must be available for consultation by QC personnel relative to QC issues. The quality control manager shall report to the top management of the plant through a path independent of production.

Ensure that the plant has sufficient qualified production personnel with prestressed concrete fabrication experience who are responsible for the complete fabrication process, storage and shipment of the members. Include with the QCP the work experience and qualifications of key plant production personnel and QC personnel such as the production manager, stressing foreman, yard supervisor, and quality control manager.

The quality control manager shall be a registered professional engineer or shall have at least five years of related experience and have a Prestressed Concrete Institute (PCI) Technician/Inspector Level II certification. A quality control inspector shall have, as a minimum, a PCI Technician/Inspector Level II certification. These requirements may be met by alternate experience and certification considered to be equivalent by the Engineer.

450-2.3.4 Measuring and Testing Equipment: Use a laboratory with the equipment necessary to perform required testing. Provide measuring and testing equipment meeting the applicable standards of the specifications. Have the measuring and testing equipment on-site prior to its need and in working condition. Provide a number of units adequate to meet the production and testing schedule included in the QCP. Have available reserve equipment to replace equipment used in daily production in the event of breakdown. Use reserve equipment of the same type as the equipment being used.

450-2.4 Disapproval of Precast Prestressed Concrete Plants:

450-2.4.1 Department's Conditional Status: Take immediate and positive actions as applicable to resolve deficiencies in fabrication that result in failure to meet the Contract Documents. Submit a written proposal to the Engineer explaining how deficiencies noted by the Department will be resolved. Correct any specification compliance deficiency detected by the QCP prior to fabrication. Resolve any deficiency detected after fabrication in accordance with 450-2.6.12. Failure to correct deficiencies in a timely manner or continued production of members with noted deficiencies will be justification for disapproval of the plant.

Periodically address repeating noncomplying issues with plant production personnel and require resolution of the issues through better production control. Include such procedure in the QCP.

Any plant which fails to maintain compliance with this Section and the Contract, as evaluated by the Department, may be placed in a conditional approval status for a period of time which will depend on the nature of the deficiency and the corrective action required. A plant may remain in a conditional approval status for a maximum period of six months. The plant will be removed from conditional approval status by the Department after the deficiencies are satisfactorily resolved. If the deficiencies are not resolved, meet the requirements of 450-2.4.2. Approval of a plant that is in a conditional approval status will not be extended for a new project.

450-2.4.2 Debarment: Failure to maintain the Department's approval status will result in the debarment of the plant. Also, failure to take positive action to resolve deficiencies found by the Department's quality assurance activities will result in the debarment of the plant. Plants that have been debarred will not be allowed to fabricate any members for Department work. Members that have been fabricated prior to debarment of a precast prestressed concrete plant shall be subject to review by the Department for compliance with this Section and the Contract, before shipment to the project site.

The Department will remove debarment status upon satisfactory resolution of deficiencies that caused the debarment.

450-2.4.3 Contract Time Extensions and Claims: Contract Time extension requests and claims for extra compensation will not be considered by the Department for the time and expense for the Contractor to resolve deficiencies or to retain another acceptable precast prestressed concrete producer when a plant is placed on a conditional or debarred status.

450-2.5 Materials:

450-2.5.1 Concrete: Use concrete as specified in Section 346 and the Contract Documents.

Use concrete produced in central mix plants approved in accordance with Section 346, unless otherwise permitted by this Section. Ready mix concrete produced in ready mix plants approved in accordance with Section 346 may be used if the following criteria are met:

Concrete is delivered to the placement site within a maximum of 20 minutes after the initial mixing.

When the concrete is produced in a central mix plant and malfunctions occur, concrete from any other local Department approved plant (either central mix or ready-mixed) is used to complete any ongoing concrete placement of the entire bed line being cast without restrictions on delivery time as stated above. Concrete placement in other bed lines is not resumed until repairs to the central mix plant have been completed or approval to use another approved central mix plant or to continue using a ready mix plant has been obtained from the Department.

450-2.5.2 Prestressing Steel: Use steel strands meeting the requirements of 933-1. Do not use strands from more than one source in any individual prestressed element.

Use steel bars meeting the requirements of 933-2. Use steel wires meeting the requirements of 933-3.

The shipping package for prestressing steel shall be clearly marked stating that the package contains high-strength prestressing steel and indicating the care to be used in handling.

450-2.5.3 Strand Chucks and Splice Chucks: Use strand chucks capable of anchoring stressing loads positively with a minimum of differential slippage and that are designed for the size of strand used. Length of grips and configurations of serrations shall be such as to ensure against strand failure within the grips.

Splice chucks used to transmit the prestressing force from one partial length prestressing tendon to another shall develop at least 90% of the minimum specified ultimate tensile strength of the prestressing steel.

450-2.5.4 Reinforcing Steel: Use steel reinforcement meeting the requirements of 931-1.1, except as otherwise provided in the plans or this Section.

Use welded deformed steel wire fabric for concrete reinforcement meeting the requirements of 931-1.2.

450-2.5.5 Accessories: Use bearing assemblies meeting the requirements of Section 962. Use bearing assemblies coated in accordance with 962-7.

Use inserts that consist of miscellaneous items such as anchor bolts, threaded anchorages, conduits, pipes, wiring, built-in fixtures, and lifting devices. Use inserts meeting the requirements shown on the plans or as approved by the Engineer.

Do not use aluminum inserts.

For duct enclosures embedded in the concrete for prestressing steel, meet the requirements of Section B460.

Use sheathing (debonding material) that is tubular non-slit, high-density polyethylene or polyprophylene with a minimum wall thickness of 0.025 inch [0.6 mm], and that has an inside diameter exceeding the maximum outside diameter of the pretensioning strand by 0.025 inch [0.6 mm] to 0.14 inch [3.5 mm].

To seal sheathing tubes, use a commercial adhesive sealant labeled as 100% silicone.

Use void forms of a type for which service adequacy has been demonstrated. Use void forms that have sufficient strength to provide stability during handling and placing and to withstand hydrostatic pressures and other forces imposed upon them during concrete placement. Use form material that is neutral with respect to the generation of products harmful to the physical and structural properties of the concrete. Assume responsibility for any detrimental effects resulting from the presence of the form material within the member. Positively vent all voids to the outside of the member.

Use lubricated rollers with bronze bushings or roller bearings for hold-up points, and low-friction, free-turning rollers for hold-down points for restraining devices for deflecting draped tendons. Use devices of sufficient rigidity and that have adequate support so that the position of the strand will remain unchanged under the induced load. Do not allow the devices to induce friction to the tendons to the point of preventing attainment of the required jacking force and elongation.

The steel spirals for reinforcing in concrete piling may be manufactured from stock meeting the requirements of any grade of reinforcing steel, as shown in ASTM A 615 [ASTM A 615M], or hard-drawn wire.

450-2.5.6 Miscellaneous Materials: Use membrane curing compound for curing concrete that meets the requirements of 925-2. Use membrane curing compounds that are compatible with coatings or other materials to be applied to the surfaces.

For epoxy resin compounds applied to Portland Cement Concrete, meet the requirements of Section 926.

For curing blankets, use light colored polyethylene-coated blankets; quilted blankets of cotton, burlap, or other suitable water absorbent material weighing not less than 10 oz/yd per 40 inches width [0.3 kg/m^2]; or insulated blankets.

Use burlap meeting the requirements of 925-1.

For penetrant sealers used on concrete, meet the requirements of Section 413. Use a sealer that is compatible with other materials to be applied to the concrete surface.

450-2.5.7 Material Acceptance and Testing:

(a) Concrete:

(1) Contractor Sampling and Testing: Assume the responsibility of QC sampling and testing for concrete, and have the work performed by the quality control inspectors. The quality control inspectors shall perform the sampling and testing of plastic concrete after delivery to the casting site.

Verify the water/cement ratio of concrete deliveries for compliance with requirements. For each design mix, sample and test the concrete for slump, air content, temperature and compressive strength, in accordance with the following, as a minimum for all concrete classes:

For Compressive Strength: Every 50 yd^3 [40 m^3] or part thereof.

For Air Content, Slump and Temperature: Every 50 yd^3 [40 m^3] or part thereof or at intervals not exceeding one hour.

Check the temperature, slump and air content of plastic concrete on the initial load of each placement operation for verification of acceptance criteria.

If the initial concrete temperature is less than the maximum permitted placement temperature by more than 5ºF [3ºC], monitor and record the concrete temperature at one hour time intervals for subsequent loads. During placement when concrete temperature is within 5ºF [3ºC] of the maximum specified placement temperature, check every second load for compliance.

Do not proceed with the concrete placement operation until the concrete complies with specification requirements for plastic concrete. Reject noncomplying loads which cannot be adjusted to meet the specification requirements.

(2) Acceptance Sampling and Testing: The Department will perform acceptance sampling and testing of concrete in accordance with Section 346.

(b) Reinforcing Steel and Welded Wire Fabric: Identify all reinforcing steel and welded wire fabric by LOTs. A LOT of reinforcing steel or welded wire fabric is a shipment of material that is from the same manufacturer and heat. A shipment of material is defined as a single vehicle load of material delivered to the plant. Obtain, and provide to the Department, a certified mill analysis and physical properties report showing compliance with 450-2.5.4 for each LOT of material received. Verify that the report represents the steel received and that the steel meets Contract Documents.

Assign a LOT number to each shipment of reinforcing steel or welded wire fabric received, and tag in a manner such that each LOT can be accurately identified at the plant or job site. Obtain records identifying assigned LOT numbers with the heat of the material represented. Reject all unidentified reinforcing steel or welded wire fabric received at the plant or job site. Reject any material that cannot be positively identified prior to use.

The Department will perform acceptance sampling and testing of reinforcing steel and of welded wire fabric.

If members are cast using material from a LOT that does not meet the above requirements, the Engineer may evaluate such members in accordance with 450-2.6.12.1 and 450-2.6.12.5. Reject the remainder of the material from the same LOT.

(c) Prestressing Steel for Pretensioning: Identify all prestressing steel by LOTs. A LOT of prestressing steel is a shipment of material of the same size and production grade from the same manufacturer. A shipment of material is defined as a single vehicle load of material delivered to the plant. Obtain and provide to the Department for each LOT of material received, certified test values for specified material properties together with a representative load-elongation curve and the modulus of elasticity value based upon strand nominal area. Provide and support by records maintained by the strand manufacturer, production tolerances applied in selection of the reported strand modulus Verify that documents provided represent the shipment and that the steel meets Contract Documents.

Assign each shipment of prestressing steel received by the Contractor a LOT number and tag each in such a manner that each LOT can be accurately identified. Maintain complete records for each LOT identifying the material and its properties. Reject all unidentified prestressing steel received at the plant or job site. Reject any materials that can not be positively identified prior to use.

The Department will perform acceptance sampling and testing of prestressing steel. The Department will select two samples, 7 feet [2 m] long, from each LOT of material

received, for testing. One of the samples shall be tested; the remaining sample, properly identified and tagged, will be stored for future testing in the event of loss or failure of the first sample to meet minimum requirements. If the first sample fails to meet the requirements specified, the second sample will be tested. If both samples fail to meet specified requirements, the heat or LOT of material will be rejected. If one sample fails and one sample meets the material requirements, additional tests may be performed by the Engineer to confirm material acceptability. Tests will be performed to determine compliance with ASTM A 416.

If members are cast using material from a LOT that does not meet the above requirements, the Engineer may evaluate such members in accordance with 450-2.6.12.1 and 450-2.6.12.5. Reject the remainder of the material from the same LOT.

(d) Strand Chucks and Splice Chucks: Acceptance of strand chucks and splice chucks will be based on certified test results obtained by the Contractor showing compliance with 450-2.5.3.

(e) Steel Accessories: Acceptance of steel accessories will be based on certified test results obtained by the Contractor. Use accessory materials for prestressed concrete meeting the requirements of Section 933. Do not use steel accessories which have not been pre-approved by the Department until certified copies of pre-qualification tests which demonstrates satisfactory performance are obtained. Perform additional tests when deemed necessary by the Engineer or when required by the plans.

(f) Ducts: Obtain material certifications for duct material certifying that the material meets the Contract Documents.

(g) Miscellaneous Materials: Acceptance of miscellaneous materials shall be based on certifications by the Contractor that the materials are adequate to function as intended. Do not use miscellaneous materials which have not been pre-approved by the Department until certified copies of pre-qualification tests which demonstrate satisfactory performance are obtained. Perform additional tests when deemed necessary by the Engineer or when required by the plans.

450-2.6 Construction:

450-2.6.1 Shop Drawings: Plans for prestressed members will designate the prestressing to be done by the pretensioning, posttensioning or combined methods. Plans for all precast prestressed concrete members will be detailed for at least one of these methods.

Furnish information necessary to fabricate or erect precast prestressed concrete members that is not included in the plans furnished by the Department or this specification When submission of shop drawings is required, meet the requirements of 5-1 and any additional plan requirements.

When the design plans contain all the information necessary for fabrication of a pretensioned member, a formal shop drawing submittal is not required. Shop drawings will be required for members which are posttentioned or partially posttentioned. In order to fabricate precast pretensioned concrete members under this provision, all detailed and specified materials, dimensions, component types and sizes and methods of stressing and detensioning must be in strict accordance with the plans and this Section.

In lieu of formal shop drawings, furnish one copy of the following to the Engineer for information only:

(a) A copy of the Framing Plan with member designations for all superstructure components.

(b) Strand detensioning schedule.

(c) Tensioning and elongation calculations.

If the Contractor desires to use materials or methods that differ in any respect from those shown in the plans and described in this Section, he shall submit full plan details and specifications. In order for any alternate materials or methods to be considered, they will be required to comply fully with the intent of the following:

(a) The provisions of these Specifications.

(b) The AASHTO Standard Specifications for Highway Bridges, edition with interims as referenced in plans.

(c) The provisions of the Department's "Structures Design Guidelines".

(d) Design criteria and notes on the plans.

(e) The recommendations of the material manufacturer.

(f) Any materials change proposed by the Contractor and approved by the Engineer.

The Engineer will be the sole judge as to the adequacy and propriety of any variation of materials or methods, and the right is specifically reserved to the Engineer to reject any alternate details or designs based upon the use of materials or methods which are not fully equivalent in all respects to those shown in the plans and described in this Section.

450-2.6.2 Inspection:

450-2.6.2.1 General: Perform QC inspections of all phases of work. The inspection frequency and depth shall be sufficient to ensure that all materials and workmanship incorporated into the work meet the Contract Documents and that the fabrication processes are controlled to ensure that the finished product conforms to the physical characteristics and dimensions required by the Contract. The quality control manager shall be responsible for inspection operations. The quality control manager shall have an adequate number of quality control inspectors to ensure review of all materials and fabrication processes. A review of the information obtained through QC inspections shall be discussed on a weekly basis with production personnel to identify fabrication areas that may need strengthening or modifying, or equipment that needs to be repaired or replaced.

Appendix VI in the Department's Manual for Quality Assurance for Precast Prestressed Concrete Members contains guidelines for inspecting precast prestressed concrete member fabrication. These guidelines may be used by the Contractor in developing the QCP inspection requirements.

450-2.6.2.2 Preplacement Operations: The quality control inspector shall routinely review the work operations performed to prepare a casting bed for concrete placement. Prior to concrete placement, the quality control inspector shall review the completed bed to verify all specification requirements have been met. Notify the quality control inspector far enough in advance of concrete placement to give the inspector sufficient time to make a review of the casting bed. Routinely inspect items in 450-2.6.3 through 450-2.6.8 as the work is being performed and again prior to concrete placement.

450-2.6.2.3 Concrete Operations: The quality control inspector shall perform an inspection during concrete placement for precast prestressed concrete members, including the concrete curing. Items in 450-2.6.9 shall be inspected during concrete operations.

450-2.6.2.4 Postplacement Operations: The quality control inspector shall review all work operations and the prestressed member subsequent to concrete placement. Inspect the items in 450-2.6.10 and 450-2.6.11 during the postplacement operations. Also, inspect the member for conformance with 450-2.7.

450-2.6.2.5 Noncomplying Prestressed Members: When a member is damaged or when a determination is made by the quality control manager that a precast prestressed concrete member does not meet the requirements of this Section, he shall notify the Department's inspector for examination and determination of which course of action is appropriate in accordance with 450-2.6.12.

450-2.6.2.6 Member Certification: The quality control inspector shall make a final inspection of completed members within two weeks prior to shipment to verify that all specification requirements have been met. After the QC personnel have verified that all Contract Document requirements have been met and all necessary repairs have been satisfactorily completed, the QC manager shall stamp each member at the plant. The stamp shall be specifically designed for the plant and used only

by the QC manager or inspectors under his direction. The configuration of the stamp shall be shown in the QC plan.

Monthly or with each request for payment, submit a certification that includes the following or similar wording:

"The undersigned being a responsible official of (plant name) certifies that the precast prestressed members listed herein have been produced under strict quality control and meet the Contract requirements for the applicable project."

Include a positive identification on the certification and the members to connect the certification with particular members. The certification shall be signed by an official of the plant that is in a position above the production manager and QC manager.

450-2.6.3 Forms:

450-2.6.3.1 Materials: Use metal side and bottom forms, unless otherwise specified in the Contract Documents. For members with special shapes such as corner sheet piles, wood forms may be used. Slab units and sheet piles may be cast on concrete surfaces finished to meet the requirements of 450-2.6.3.3.

For all beam members, use side forms designed to be removed without damaging the top flange of the beam. Remove the forms horizontally away from the beam by a method that prevents any contact of the form with the top flange after release of the form. Do not subject the top flange to any vertical force at any time. Include the form details and method of removal in the QCP for the project.

For end headers and inside forms, other materials capable of resisting the pressure from the concrete may be used. Use end headers so designed that they can be placed and maintained in correct position between the side forms. Hold the headers in place with devices capable of being removed or loosened after the concrete has attained its initial set allowing free form expansion during curing methods that involve heat. Use end headers with openings conforming to the prestressing steel pattern to permit passage of the prestressing steel. Locate the openings accurately within 1/8 inch [3 mm] of planned location of prestressing steel elements.

Construct circular openings for strands a maximum of 1/4 inch [5 mm] larger than the nominal strand diameter. Construct square or rectangular openings a maximum of 1/4 inch [5 mm] larger, horizontally and vertically, than the nominal strand diameter. Ensure that all headers are mortar tight.

450-2.6.3.2 Supports: Use forms of sufficient thickness, with adequate external bracing and stiffeners, that are anchored to withstand the forces due to placement and vibration of concrete. Ensure that joints in forms are mortar tight. Support bottom forms on concrete pallets with metal stiffeners, wales, shims, etc. Do not use timber elements between the bottom metal form and concrete pallets.

450-2.6.3.3 Alignment: Make and maintain during their use, forms and centering true to the shapes and dimensions for the member being produced. Plumb, align, and secure forms for each member in position before each reuse.

Apply the following tolerances to form alignment and pallets or beds used in prestressed construction:

(1) Horizontal Alignment (horizontal deviation of side forms either side of a vertical plane within the length of a member) ..... 1/8 inch [3 mm]

(2) Vertical Alignment (vertical deviation of the bed or pallet from a horizontal plane within the length of a member) ..... 1/8 inch [3 mm]

(3) Offset Between Adjacent Form Sections ..... 1/8 inch [3 mm]

450-2.6.3.4 End Header Locations: When the ambient temperature is expected to be below 55ºF [13ºC] between the time of stressing and detensioning and the members and exposed strands between the stressing anchorages are not protected, maintain a minimum free length of stressed strand as specified herein between the end header and the stressing anchorage at each end of a bed line. Allow a 20 foot [6 m] minimum free length of stressed strand for stress relieved strand and 25 feet [7.5 m] for low-relaxation strand. When cold weather concrete conditions as specified in 450-2.6.9.1(1) are in effect, protect all exposed strands between stressing anchorages regardless of length. When the members and strands between stressing anchorages are protected, provide protection adequate to maintain the ambient temperature of the air around the members and strand above 55ºF [13ºC] until the members are detensioned. Do not allow the end header to be closer than 5 feet [1.5 m] to the stressing anchorage.

Provide a minimum of 18 inches [450 mm] of exposed strands between adjacent ends of all members except 24 inch [600 mm] square and smaller piles. Provide a minimum of 6 inches [150 mm] of exposed strands between adjacent ends of 24 inch [600 mm] square and smaller piles.

450-2.6.3.5 Surface Conditions: Use clean, rust free form surfaces against which concrete is to be cast. Before each reuse, inspect forms and, if necessary, recondition them.

450-2.6.3.6 Form Ties: For form ties that will remain in the concrete, use either the threaded type or the snap-off type, so that no form wires or metal pieces will be left within 2 inches [50 mm] of the surface of the finished concrete.

450-2.6.3.7 Corners, Angles and Joints: Chamfer, miter, or round corners and angles exposed in the final structure. Use a chamfer, miter, or radius of the rounding of 3/4 inch [20 mm], unless otherwise specified or shown on the plans. Provide mortar tight joints between panel forms, and smooth within the alignment tolerances. Minimize offsets between adjacent form sections.

450-2.6.3.8 Form Release Materials: Treat the facing of all forms with form oil or other bond breaking coating prior to placing concrete, unless previous applications of form release coatings are still effective. Do not apply form surface coatings to the bottom form prior to placing the prestressing steel, unless the form coating materials are of a type, and in such a condition, that they will not contaminate the prestressing steel.

450-2.6.4 Protection and Placement of Prestressing Steel:

450-2.6.4.1 Protection of Prestressing Steel: Maintain and store prestressing steel above the ground surface on platforms, skids, or other supports, to prevent contamination from below, and protect them from mechanical injury. Do not use any packaging or wrapping material that retains moisture at the bottom of the reel. Clean contaminated prestressing steel before use or otherwise reject it.

Handle prestressing steel carefully to prevent nicks or kinks and do not expose it to temperatures greater than 200ºF [90ºC] at any time. Do not use arc welding equipment, including welding electrode lines, within 2 feet [0.5 m] of prestressing steel. Do not perform any welding on forms that have been set in place after the prestressing steel is placed in the bed. Reject prestressing steel that has sustained any physical damage at any time.

Protect prestressing steel for posttensioning operations in accordance with Section B460.

450-2.6.4.2 Placing Prestressing Steel: Use care during placement of prestressing steel to avoid physical damage and contamination. Reject damaged strands. Restore contaminated strands to its original condition prior to concrete placement.

Inspect the prestressing steel for broken wires and other damage after placement into the bed. Do not use prestressing steel containing nicks, kinks, or former chuck grip marks, unless such points will be located outside the members. Do not reuse prestressing steel that has been stressed in a draped position. Do not use steel showing evidence of scale formation or which has become pitted. Remove and replace any damaged prestressing steel in the bed before the stressing operation begins.

450-2.6.4.3 Cleanliness of Prestressing Steel: After stressing operations are complete, inspect the prestressing steel for any evidence of contamination. Use steel that is free of deleterious materials such as grease, oil, wax, dirt, paint (except that used for marking identification) or other similar contaminants. Remove any contaminants detected from the steel before proceeding with fabrication activities.

Rust on prestressing steel which can be removed by light rubbing is acceptable. Streaks or spots which may remain after rust removal are acceptable if no pitting is present.

450-2.6.4.4 Debonded Strands: For debonded prestressing steel, extend the tubular debonding material (sheathing) through the header and tape and tie it at the terminus within the member to prevent intrusion of cement paste during the casting operation.

450-2.6.5 Stressing Equipment: Use stressing equipment meeting the requirements of (a), (b), or (e) below. In addition, calibrate all stressing equipment in accordance with (c) below.

(a) For the stressing equipment, use a hydraulic jacking system that is adjustable to automatically apply and sustain a predetermined load together with a pressure transducer built into the hydraulic system. Connect such transducer to a digital readout and printer which shall provide an instantaneous readout and record of the applied load in pounds [kilonewtons]. Use a jacking system with the capacity to induce the required load. Use jacking equipment with pressure bypass valves that allow pulling to a predetermined load which can be held while elongation checks are made. Base the use of this system on demonstrated accuracy and repeatability verified through comparison with loads indicated by either an independent load cell or proving ring.

Continued use of the equipment will be contingent upon the satisfactory performance of the equipment in service as determined under the requirements of (d) below.

(b) For stressing equipment, use a hydraulic jacking system as described in (a) above with a load cell built directly into the hydraulic jack and connected to the digital readout and printer instead of the pressure transducer. Continued use of the equipment will be contingent upon the satisfactory performance of the equipment in service as determined under the requirements of (d) below.

(c) Prior to their use, calibrate all jacking systems. Repeat calibration at intervals not exceeding 12 months. Recalibration during the intervals may be required by the Engineer as described hereinafter. Calibrate and recalibrate by one of the following methods:

(1) By a qualified calibration agency. A listing of such agencies is available at the Department's Materials Office in Gainesville.

(2) Under the supervision of a Specialty Engineer.

Calibrate gages, jacks and pumps as a system in the same manner they are used in tensioning operations with the cylinder extension in the approximate position that it will be in actual use at final jacking force. Calibrations should cover the load ranges that will be used during production. A certified calibration curve shall accompany each tensioning system. Load readings can be used directly if the calibration determines a reading is within 1.5% tolerance of actual load. Calibration of load cells or proving rings used to calibrate jacking systems shall be on compression testing equipment that has been checked by the National Bureau of Standards within the preceding 24-month period.

If, while work is in progress, any jack or gage appears to be giving erratic results, or if the jack force and elongation do not compare within specified limits and differences cannot be justified, recalibrate the equipment. Also recalibrate the equipment after internal jacking system repairs or when gage and jacking units are switched.

Calibrate or recalibrate in accordance with ASTM E 4 and ASTM E 74. After calibration or recalibration has been completed, prepare a certificate and have it signed by the person in responsible charge of the verifications as outlined in ASTM E 4 and ASTM E 74.

(d) Verify the accuracy of the jacking and recording system a minimum of once each week during stressing operations by either an independently calibrated load cell or a proving ring. The load reading from the recording system shall agree within 1.5% of the load indicated by the load cell or proving ring.

(e) For multiple strand stressing, apply the stressing equipment requirements of Section B460.

450-2.6.6 Stressing Operations:

450-2.6.6.1 General: The stressing operations shall consist of the application of the final load required by the plans and adjusted for abutment rotation, bed shortening, anchorage header movement, anchor set, slippage, live end seating and any other element as applicable for the type of bed and anchorage being used. Also, adjust the final load required by the plans when the temperature differential between the ambient temperature at time of stressing and the expected concrete temperature at time of placement is greater than 25ºF [14ºC]. Increase the load 0.5% for each 5ºF [3ºC] increment between the ambient temperature at time of stressing and the expected concrete temperature at time of placing. When the expected concrete temperature at time of placing is below the ambient temperature at time of stressing, make no adjustment to the final load. Do not allow the stress in the prestressing steel to exceed the stress allowed by the AASHTO Standard Specifications for Highway Bridges.

Compensation for temperature differential and abutment rotation are not required for self-stressing beds. However, adjust the final load for the effects of bed shortening due to the load from all the strands.

If the placement of concrete is delayed for more than seven calendar days after the completion of the stressing operation, check and adjust the final strand load as necessary prior to the placement of concrete.

The stressing methods, in general, consist of stressing to the loads indicated by the jacking system, or stressing to the required load while monitoring the elongation of the prestressing steel.

Accomplish stressing by either single strand stressing or multiple strand stressing, and ensure that it is symmetrical about the vertical axis of the member.

450-2.6.6.2 Single Straight Strand Stressing: When single straight strand stressing is used, tension the prestressing steel until the required final load is attained. The loads indicated by the jacking system shall control the tensioning process. Two stage stressing, consisting of an initial load and final load, may be used. The initial load, if used, shall be between 5% and 25% of the final load.

450-2.6.6.3 Multiple Straight Strand Stressing: Bring each strand to be stressed in a group individually to an initial uniform tension prior to being given its full tensioning. The amount of the initial load will be influenced by the length of the casting bed and the size of strands in the group to be tensioned. The minimum initial tensioning load shall be 5% of the required final load. Increase the magnitude of this load if deemed necessary but do not allow it to exceed 25% of the required final load. Then stress the strands by multiple strand stressing to final load by pulling to elongation and checking against the jack load. Allow the required elongation to control the tensioning. The actual jack load shall agree within 5% of the computed elongation converted to load.

For uniform application of load to strands, the face of anchorage at final load must be in a plane parallel to its position under initial load. Verify this by measurement of movement on opposite sides of the anchorage and check its plumb position before and after application of the final load. During stressing, allow the anchorage to move without restraint.

450-2.6.6.4 Draped Strand Stressing: Tension draped strands by either of the following methods:

(1) Partial Stressing and Subsequent Strains: This method applies when the strands are tensioned through a combination of applied jack loads and strand uplift. To verify the final force, place a load cell between the stressing anchorage and anchor chucks at the dead end on at least two draped strands. Other methods as approved by the Engineer may be used to verify the final force in the dead end. Bring the partially draped strand to an initial tension using a force in the range of 5% to 25% of the required final stressing force. After application of the initial force, establish reference marks for measuring elongation.

Then apply a precalculated jacking force and measure elongations on a minimum of four strands. The average measured elongation shall agree within 5% of the theoretical elongation for strand force measured by jack load, or the factors contributing to the difference shall be identified and corrected prior to proceeding. Allow the load indicated by the jacking system to control the tensioning for the precalculated load.

Obtain the required final force by raising the strand simultaneously at all pickup points or in an approved sequence as shown on the shop drawings. On each different bed setup, after deflecting the strands to their final position, check the final force at the dead end of the bed. If the load is below the required stressing force by more than 5%, adjust it to the final load.

(2) Final Stressing in Draped Position: When the final stressing is performed in the draped position, apply the tensioning load in two increments with the tendons being held in their draped positions. To verify the final force, place a load cell between the stressing anchorage and anchor chucks at the dead end on at least two draped strands. Other methods as approved by the Engineer may be used to verify the final force in the dead end. Bring each strand to an initial tension of 5% to 25% of the final load prior to the application of the required final load.

After application of the initial load, establish reference marks for measuring elongation. Then stress the strands to final load and measure the elongation. Allow the load indicated by the jacking system to control the tensioning for the initial and final loads.

The measured elongation shall agree within 5% of the theoretical elongation for the strand force measured by jack load, or the factors contributing to the difference shall be identified and corrected prior to proceeding.

When the jacking is performed at one end of the bed, check the applied load on two strands at the other end of the bed. If the load on the end opposite the jacking end is below the required value by more than 5%, adjust the load to the required final load.

450-2.6.6.5 Wire Breakage: Limit wire breakage to 2% of the total area of the strands in any member and verify that breakage is not indicative of a more extensive distress condition, otherwise reject all stranding. Replace individual strands with more than one wire failure.

450-2.6.6.6 Strand Chucks and Splice Chucks: Use chucks as complete units and clean, inspect, and lubricate them between each use. Take care to avoid improper fit and seating of wedges on the strands. Use wedges and housing that are compatible and made for the specific type and size of steel being used.

Do not use wedges that become worn, cracked, deformed, or that allow slippage in excess of 3/8 inch [10 mm]. Use components from the same manufacturer to make up chucks and to provide proper wedge fit.

The Engineer will allow one patented splice per strand subject to the following:

(1) Splices are located outside the concrete members (except for precast piling where up to two splices are permitted to be used in each pile, so long as they are not located in the same plane).

(2) Strands which are being spliced have the "lay" or "twist" in the same direction.

450-2.6.6.7 Position of Prestressing Steel: Position prestressing steel as shown in the plans within the tolerances allowed in 450-2.7. Fix the required vertical and horizontal position of each prestressing strand at the ends of each member and at intervals within each member not exceeding 30 feet [9 m]. Use the method of fixing the prestressing steel shown in the QCP. When blocks are to be used for supporting prestressing steel, use those cast from concrete of the same mix design as used in the prestressed member. Stagger the location of blocks with an offset of 12 inches [300 mm] or greater and do not stack them.

450-2.6.7 Reinforcing Steel: Except as provided below, meet the requirements of Section 415 for all reinforcing steel work:

(a) Protection of Reinforcing Steel: Store steel reinforcement above the surface of the ground, upon platforms, skids or other supports, and protect it as far as practical from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcing steel shall be free from loose rust, scale, dirt, paint, oil, grease, and any other foreign material.

(b) Bending: Unless otherwise shown on the plans, Fabricate reinforcing bars as prescribed in the Manual of Standard Practice, published by the CRSI. Bend the reinforcement cold to the shapes indicated in the plans and in accordance with 415-4.

(c) Placing and Tying: Tie and/or support in position all reinforcing steel in each member with other reinforcing steel in a manner that will accurately position the steel throughout the fabrication process. Use types of ties and methods of tying recommended by the CRSI, including lacing. When concrete blocks are used for supporting reinforcing steel, use those that meet the requirements of 450-2.6.6.7. Do not tie reinforcing steel to debonded prestressing steel within the limits of the sheathing material.

Tie or lace beam stirrup bars at a minimum of three points. Tie reinforcing steel, other than stirrup bars in beam ends, as a minimum, at every other intersection. Either tie or lace spiral wire in piling at all four corners in the 1 inch [25 mm] pitch area, at the top corners and bottom center in the 3 inch [75 mm] pitch area, and at the top corners in the center area. Tie the bottom center in the pile center area as necessary to maintain concrete cover. Bend all tie wires away from the form surface to provide maximum concrete cover.

Provide not less than the specified cover for all steel minus 1/4 inch [6 mm].

(d) Welding Reinforcing Steel: When shown on the plans, weld reinforcing steel in accordance with the requirements of AWS Structural Welding Code D 1.4. Do not weld in the prestressing bed.

450-2.6.8 Placing Other Embedded Material:

450-2.6.8.1 Posttensioning Anchorages: Install anchorages for posttensioning tendons in accordance with Section B460.

450-2.6.8.2 Inserts and Lifting Devices: Locate inserts and lifting devices in accordance with the tolerances listed in 450-2.7.2.

450-2.6.8.3 Bearing Assemblies: Set bearing assemblies designed to transmit reaction forces to the concrete in the position shown in the plans.

Place bearing plate assemblies or shoes which are to be cast in a member within appropriate tolerances as provided in 450-2.7.2. Check the assemblies for position after stripping from the forms.

450-2.6.8.4 Void Forms: Securely support and tie in position void forms to avoid displacement throughout concrete placement and consolidation operations.

Vent voids as shown in the plans or shop drawings.

450-2.6.9 Concrete Operations:

450-2.6.9.1 Temperature Restrictions:

(1) Cold Weather Concrete: When the temperature of the surrounding air is expected to be below 40ºF [4ºC] within 24 hours after placing concrete, the temperature of the plastic concrete as placed shall be 55ºF [13ºC] or greater. Maintain the temperature of the concrete after placement above 55ºF [13ºC] until the prestressing steel is detensioned. Make arrangements for heating, covering, insulating or housing the concrete work in advance of placement and maintain the required temperature without injury due to concentration of heat. Do not use direct fired heaters during the first 24 hours after concrete placement, unless actions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide. Continuously monitor the temperature of the concrete or the ambient air around the member until the member is detensioned. Monitor by the use of thermocouples located in the member cross-section or temperature recording devices located under the enclosure. Provide one thermocouple or temperature recording device for each 200 feet [60 m] of bed length or part thereof.

Locate the thermocouples within the member's cross-section as shown in the QCP or as approved by the Engineer. Record the temperature determined by each thermocouple or temperature recording device. If the temperature of the ambient air is monitored, maintain the air temperature above 60ºF [15ºC] to ensure that the concrete temperature is above 55ºF [13ºC].

(2) Hot Weather Concrete: For temperature requirements and special measures for mixing concrete in hot weather comply with Section 346.

Spray the exterior of steel forms with water just prior to placing the concrete when the hot weather concreting special measures are in effect.

450-2.6.9.2 Placing Concrete:

(1) General: Check forms, reinforcing steel, prestressing steel, posttensioning ducts, vent pipes, anchorages, duct supports and other embedded items for compliance with the Contract Documents prior to placing concrete. Place concrete in accordance with 400-7, except as modified by this Section.

For concrete operations conducted at night, provide enough lighting to allow visual inspection of the interior of the forms during the complete concrete placement operation.

Convey concrete by the use of buckets, conveyors, pumps, troughs, or other equipment specifically designed for concrete conveyance, provided the placement method consistently produces quality concrete with no segregation or separation of the mix. Locate the concrete conveyance equipment within 12 inches [300 mm] of the top of the forms or surface of the concrete to minimize the free fall of the concrete.

Multiple placements may be used within a bedline, provided compliance with 450-2.6.11.1 is maintained.

(2) Requirements for Successive Layers: Place concrete in prestressed members in accordance with (aa) through (ee) below, unless concrete with a High Range Water Reducer (HRWR) is used. When HRWR concrete is used, place the concrete in accordance with the following, or as approved in the QCP or as approved in writing by the Engineer.

(aa) Type II and Double Tee Beams, Piling and Precast Slab Units (Except Voided Piling and Slabs): Place concrete in one or more layers or lifts. If more than one layer is used for double tee beams, end the first layer such that the top of the concrete is slightly below the bottom of the flange.

(bb) Type III and Type IV Beams and Voided Units (Slabs and Piling): Place concrete in a minimum of two horizontal layers. The thickness of the first layer shall be such that the top of the concrete is just above the top of the bottom flange. In voided units, end the first layer slightly above the middle height of the void. Fill the form by the last layer.

(cc) Type V and Type VI Beams: Place concrete in a minimum of three horizontal layers. The thickness of the first layer shall be such that the top of the concrete is slightly above the top of the bottom flange. The thickness of the second layer shall be such that the top of the concrete is slightly above the bottom of the top flange. Fill the beam forms by the last layer.

(dd) Bulb Tee Beams: Place concrete in one continuous lift beginning in the end block zone and progressing to the other end. Do not allow the progression of the concrete placement to proceed until previously placed concrete has been properly consolidated, and the rate of advancement equals the ability to fill the forms. In progression of the placement, deposit concrete within the forms on the surface of previously placed concrete; avoid placement directly on posttensioning ducts to the maximum extent possible.

(ee) Time Between Successive Placements of Concrete: In any progressive concrete placement operation, do not allow the time between successive placements onto previously placed concrete to exceed 20 minutes, unless the initial set of previously placed concrete has not yet occurred, as evidenced by the continued effective use of vibration.

(3) Protection of Concrete from Weather: Have protection materials available before the concrete placement begins to cover the members in the event of rain during the placement of concrete. Protection materials may be tarps, curing blankets, or other impervious material that will not puncture when placed over protruding reinforcing steel and/or form elements. Include the method and materials for protection in the QCP.

450-2.6.9.3 Vibration of Concrete: Internal and external vibration will be required as necessary to produce uniformly dense concrete. Use both internal and external vibration for all prestressed beams, except beams with posttensioning ducts. For beams with posttensioning ducts, use internal vibration in the end block sections; use external vibration throughout the beam length. For beams cast using HRWR concrete, only external vibration is required.

Design external form vibrators for the specific use. Design forms used in conjunction with external vibration and build them to effectively transmit vibration to the concrete mass. Mount and operate form vibrators in compliance with the vibrator manufacturer's written recommendations, a copy of which shall be on file at the prestress plant. Secure vibrators to the form mounts by positive locking devices so that maximum vibration is transmitted into the form. Modify or replace external form vibrator systems which are demonstrated to be ineffective. Operate vibrators at each mount location for the time necessary for complete concrete consolidation. Do not allow progressive points of vibration to exceed twice the visually effective radius of vibration. Keep forms equipped with external vibrators clean, and free of any buildup of hardened concrete.

Have internal vibrators available before concrete placement is started. Use an internal vibrator with a head of such size that proper vibration of the concrete will be secured without causing movement of the prestressing steel or reinforcing steel. The vibrating frequency range shall be 8,000 to 15,000 impulses per minute. Have one standby internal vibrator available on-site. Insert the vibrator in the concrete at points spaced to ensure uniform vibration of the entire mass of the concrete. Do not allow points of insertions to be further apart than the radius over which the vibrator is visibly effective. Allow the vibrator to sink into the concrete by its own weight and allow it to penetrate into the underlying layers sufficiently so that the two layers are thoroughly consolidated together. After the concrete is thoroughly consolidated, slowly withdraw the vibrator to avoid formation of holes.

450-2.6.9.4 Inspection of Posttensioning Ducts: After concrete placement and consolidation in a prestressed member are complete, check all posttensioning ducts shall clear them of any obstructions. Check all ducts in accordance with Section B460.

450-2.6.9.5 Finishing:

(1) Beams: Roughfloat the top surface of the beam and then scrub it transversely with a coarse brush or metal tine to produce a roughened surface for bonding.

Unless otherwise specified, Apply a Class 3 surface finish to the external surfaces of prestressed beams in accordance with Section 400.

(2) Piling: Apply a general surface finish to the prestressed pile surface as specified in Section 400. Miter or round the top corners with an edging tool of similar corner radius as in the pile forms. Surfaces exposed during casting shall have a steel trowel finish.

When concrete incorporating microsilica is used, screed and finish with a continuous water fog maintained above the concrete. Do not apply the fog directly toward the concrete. The Contractor may apply a monomolecular finishing aid approved by the Engineer in accordance with the manufacturer's recommendation.

(3) Slabs and Double Tees: When the plans show the top surface of prestress slab or double tee units to be the riding surface, apply a Class 4 floor finish in accordance with Section 400.

When the plans show the surface to be overlaid with asphalt or concrete, roughfloat the top surface and then scrub it transversely with a coarse brush to remove all laitance and to produce a roughened surface for bonding.

Unless otherwise specified, apply a Class 3 surface finish to other exposed surfaces in accordance with Section 400.

When concrete incorporating microsilica is used, maintain a continuous water fog above the concrete during the screeding and the finishing operations. Do not apply the fog directly toward the concrete. A monomolecular finishing aid approved by the Engineer may be applied in accordance with the manufacturer's recommendation.

450-2.6.9.6 Curing:

(1) Methods: After the finishing operations have been completed and as soon as the concrete has hardened sufficiently to permit the application of curing material without marring the exposed surface, cover the exposed surfaces of all prestressed concrete members by one of the following procedures or other alternate curing methods. Alternate curing methods and details proposed by the Contractor shall be included in the QCP or otherwise approved by the Engineer. Base alternate curing methods upon a demonstrated ability to retain surface moisture of the concrete and to control curing temperatures within acceptable limits. Control any curing method that induces heat into the concrete, other than accelerated curing, so that the maximum air temperature within the enclosure is below 130ºF [55ºC] during the curing period. Discontinue use of any alternate curing method other than those included herein upon any indication of noncompliance with this Specification.

(aa) Continuous Moisture: Place burlap on the surface and keep it continuously saturated for the curing period by means of soil soakers, leaking pipes, or automatic sprinklers. Do not apply moisture manually. If side forms are removed during the curing period, extend the burlap to completely shield the sides of the members.

(bb) Membrane Curing Compound: White-pigmented membrane curing compound may be used for the top surface. Apply the compound in a single-coat, continuous operation, at a uniform coverage of at least 1 gal/200 ft^2 [0.2 L/m^2] or as recommended by the manufacturer. Allow surfaces covered by the membrane curing compound to remain undisturbed for the curing period. Recoat any cracks, checks or other defects in the membrane seal which are detected during the curing period within one hour. If side forms are loosened during the curing period, remove them at that time and immediately coat the formed surfaces with a clear membrane curing compound and maintain the surface seal for the remainder of the curing period. Do not apply membrane curing compound to surfaces of concrete members to which other concrete is to be bonded, unless areas to which concrete is to be bonded are sandblasted until all traces of membrane curing compound are removed.

(cc) Curing Blankets: Curing blankets may be used for curing the top surfaces of members so long as the members' side forms remain in place. Do not use curing blankets which have been torn or punctured. Securely fasten edges to provide as tight a seal as practical. Should the system fail to maintain a moist condition on the concrete surface, discontinue it. Allow curing blankets to remain in place for the curing period.

(dd) Accelerated Cure:

(i) General: For accelerated curing of the concrete, use low-pressure steam curing, radiant heat curing or continuous moisture and heat curing. If accelerated curing is completed before the curing period has elapsed, continue curing for the remaining part of the curing period in accordance with one of the curing methods above, unless conditions in 450-2.6.9.6(2) are met.

If accelerated curing is used, furnish temperature recording devices that will provide accurate, continuous, and permanent records of the time and temperature relationship throughout the entire curing period. Provide one such recording thermometer or each 200 feet [60 m] of bed length or part thereof. Initially calibrate recording thermometers and recalibrate them at least annually.

When the ambient air temperature is above 50ºF [10ºC], allow the member to remain undisturbed in the ambient air for a two to four hour preheating period to allow initial set to occur. If the ambient air temperature is below 50ºF [10ºC], apply heat during

the preheating period to hold the air surrounding the member at a temperature of 50 to 90ºF [10 to 32ºC]. When admixtures are used in the concrete mix, the preheating period may be increased up to six hours to the time it takes the concrete to attain its initial set. The time of initial set may be determined by AASHTO T 197.

To prevent moisture loss on exposed surfaces during the preheating period, cover members as soon as possible after casting or keep the exposed surfaces wet by fog spray or wet blankets.

During application of the heat, do not allow the temperature rise within the enclosure to exceed 40ºF/hr [22ºC/hr]. Do not allow the curing temperature throughout the enclosure to exceed 160ºF [71ºC]. Maintain the curing temperature within a temperature range of 130 to 160ºF [54 to 71ºC] until the concrete has reached the required release strength.

Use enclosures for heat curing that allow free circulation of heat about the member and that are constructed to contain the heat with a minimum moisture loss. The use of tarpaulins or similar flexible covers may be used provided they are kept in good repair and secured in such a manner to prevent the loss of heat and moisture. Use enclosures that cover the entire bed from stressing abutment to stressing abutment, including all exposed stranding.

(ii) Low-Pressure Steam: The steam shall be in a saturated condition. Do not allow steam jets to impinge directly on the concrete, test cylinders, or forms. Cover control cylinders to prevent moisture loss and place them in a location where the temperature is representative of the average temperature of the enclosure.

(iii) Curing with Radiant Heat: Apply radiant heat by means of pipe circulating steam, hot oil or hot water, or by electric heating elements. To prevent moisture loss during curing, keep the exposed surfaces wet by fog spray or wet blankets.

(iv) Continuous Moisture and Heat: This method consists of heating the casting beds in combination with the continuous moisture method described above.

Do not allow the heating elements to come in direct contact with the concrete or the forms. Distribute sources of heat in a manner that will prevent localized high temperatures above 160ºF [71ºC]. The initial covering of burlap and the continuous application of moisture shall be as described in 450-2.6.9.6(1). An auxiliary cover in addition to the burlap for retention of the heat will be required over the entire casting bed. Support this cover a sufficient distance above the member being cured to allow circulation of the heat.

(2) Curing Requirements for Microsilica Concrete: When concrete incorporating microsilica is used, begin curing of the concrete immediately after the finishing operation is complete. Keep a film of water on the surface by fogging until curing blankets are in place.

Apply burlap curing blankets as soon as the concrete surface can be covered without marring. Place the curing blankets overlapping sufficiently so that an effective moisture seal is formed.

Saturate curing blankets with potable water immediately upon placement. Apply additional potable water under the curing blankets by using soaker hoses or other approved methods (manual application not allowed). Keep the concrete surface and curing blankets wet throughout the curing period. Provide continuous moist curing of all exposed surfaces for a minimum period of seven days, and do not interrupt the initial seven day moist curing period except as specified in 450-2.8.2. Apply these requirements to all surfaces exposed to air during any portion of the initial seven day curing period. Terminate the moist curing period in the late afternoon or as otherwise approved in the QCP.

Immediately after completion of the seven day moist curing and the removal of the curing blankets, mix and apply a water impervious membrane curing compound meeting the requirements of 925-2 in two independent coats applied in opposing directions (90º to each other) to all surfaces in accordance with the manufacturer's recommendations, subject to the rate of application specified herein. The rate of application of membrane curing compound for each coat shall be

at least 1 gal/300 ft^2 [0.14 L/m^2] for each coat of exposed surface to be cured. Color each coat differently in order to facilitate application at the prescribed coverage. Use white for the top coat. Color the first coat to present a high contrast to the white top coat. Do not allow the concrete to dry prior to curing compound application under any circumstances.

Allow surfaces covered by the membrane curing compound to remain undisturbed for a period of 28 days after casting. Recoat any cracks, checks or other defects in the membrane seal which are detected during the curing period within 30 minutes. If forms are removed during the curing period, immediately coat the surfaces from which the forms are removed with the curing compound and maintain the surface seal for the remainder of the 28-day curing period.

Remove curing compounds applied to surfaces of concrete members to which other concrete is to be bonded by sandblasting after the 28-day curing period is complete and prior to bonding the additional concrete. Water blasting with potable water may be used as an alternate to sandblasting. The minimum nozzle pressure for water blasting is 10,000 psi [70 MPa].

(3) Length of Curing Period: Cure prestressed members not incorporating microsilica in accordance with 450-2.6.9.6(1) for at least 72 hours. Alternatively, except for members used in substructures or superstructures whose environment has been designated on the plans as extremely aggressive, curing may be terminated when the average compressive strength of cylinders kept adjacent to the member and cured by the same methods, has reached 70% of the required 28-day strength or 100% of the release strength, whichever is greater.

450-2.6.10 Form Removal: Do not remove forms sooner than six hours after casting and not until the concrete strength is sufficient to avoid structural damage. For AASHTO Type V, Type VI, and Bulb Tee beams, do not remove the forms supporting the top flange concrete sooner than 12 hours after casting except when the release strength has been reached.

450-2.6.11 Detensioning:

450-2.6.11.1 General: The required concrete strength at which the prestressing force may be transferred to the concrete in a member shall be a minimum of 4,000 psi [28 MPa], unless specified otherwise in the plans. Verify the release strength by compressive strength cylinder breaks or other approved means no later than 24 hours after casting and every 24 hours thereafter until release strength is obtained. For members cured using accelerated curing, release the prestressing force immediately after terminating curing. For members cured using methods other than accelerated curing release the prestressing force within 24 hours of verifying release strength by compressive strength cylinder breaks or other approved strength gain monitoring system, unless the required time for release occurs on a weekend or holiday. Detension members cured using methods other than accelerated curing but which induce heat into the member before a concrete temperature drop of more than 60ºF [33ºC] occurs. When the required time for release occurs on a weekend or holiday, cover the members and exposed strand with curing blankets or other similar materials, or detension the members. Detension the members immediately on the first workday after the weekend or holiday. Cure concrete cylinders used for strength tests in the same manner and location as the prestressed concrete members. Make concrete cylinders in accordance with the Department's test methods.

450-2.6.11.2 Method of Stress Transfer: In all detensioning operations, keep the prestressing forces nearly symmetrical about the vertical axis of the member and apply them in a manner that will minimize sudden shock or loading. Remove or loosen forms, ties, inserts, or other devices that would restrict longitudinal movement of the members along the bed. Remove hold-downs of draped strand profiles at the appropriate time for the specific member.

Release hold-downs for members with draped strands prior to releasing the stresses at the anchorages, unless the hold downs are free to move longitudinally. If the latter is the case, the hold-downs may be released subsequent to release of the anchorage stress.

Cut dormant strands in top of beams prior to releasing any fully tensioned strands. Release fully bonded strands next, followed progressively by strands having the minimum length of tubular sheathing through to those strands having the maximum length of tubular

sheathing. The Contractor may propose alternative detensioning patterns to suit his particular operation. The method of the stress transfer to be used by the Contractor shall be specified either in the QCP, the construction submittal, or the shop drawings to be submitted in accordance with 450-2.2.2 and 450-2.6.1, respectively.

Transfer prestressing forces to the concrete by either single strand release or multiple strand release, as follows:

(1) Single Strand Detensioning: Detension the strand by using a low-oxygen flame, and in accordance with a pattern and schedule provided in the approved shop drawings, or QCP. Heat with a low-oxygen flame played along the strand for a minimum of 5 inches [125 mm]. Heat strands in such a manner that the failure of the first wire in each strand will occur after the torch has been applied for a minimum of five seconds.

Release unsymmetrically stressed members simultaneously and symmetrically about the vertical axis at both ends of the bed and all intermediate points between members to minimize sliding of members. Release symmetrically stressed members simultaneously and symmetrically about the vertical axis at both ends of the bed and at intermediate points between members not greater than 150 feet [45 m] apart. Do not cut the strands quickly, but heat them until the metal gradually loses its strength, in order for release of the strands to occur gradually.

(2) Multiple Strand Detensioning: In this method, detension all the strands simultaneously by hydraulic dejacking. The total force is taken from the header by the jack, then released gradually. Do not allow the overstress required to loosen the anchoring devices at the header to exceed the force in the strand by 5%. After detensioning, strands at all points may be cut progressively from one end of the bed to the other using equipment and methods described in (1) above.

450-2.6.11.3 Trimming Strands: Upon completion of the detensioning operation, cut the exposed strands to required length, using an oxygen flame or mechanical cutting device. On piles, use only mechanical cutting, unless specifications require strand to be burned below the pile surface. Do not use electric arc welders. Unless otherwise specified, allow all strands to protrude 2.5 ± 0.5 inches [65 ± 15 mm] beyond the end of the member, except cut strands for piling back to be flush with or below the concrete surface. Seal openings between strand and sheathing for debonded strands with either an epoxy or silicone sealant within 48 hours of detensioning.

450-2.6.12 Noncomplying Prestressed Members:

450-2.6.12.1 General: When a precast prestressed concrete member does not comply with the requirements of this Section or is damaged, use the following provisions for evaluating and disposing of deficiencies. Apply these provisions in all cases which clearly fall under the circumstances described. Consider situations not covered by these specific circumstances on their individual merits. Consider and apply the following where practical.

The Engineer will examine all deficiencies to determine the applicable provisions and requirements of this Article and which course of action is appropriate. If the Engineer determines that a deficiency is repairable within the terms of this Article, appropriate repairs may be executed immediately. If the Engineer determines that a deficiency requires an engineering evaluation and disposition, the Contractor may submit a repair proposal to the Department in accordance with 450-2.6.12.5. Make all repairs which require a repair proposal under the observation of and to the satisfaction of the Engineer.

The disposition of deficiencies and repair methods provided herein shall at no time, and under no circumstances, be used as an excuse for or applied in such a manner so as to relieve the Contractor of his responsibility for QC in accordance with 450-2.2.3. The number and type of deficiencies evaluated under this specification will, however, be used in evaluating the Contractor's quality control.

In addition, the Department will require a credit on any member with deficiencies attributable to the Contractor which is evaluated in accordance with 450-2.6.12.5 and is accepted for use in the structure.

Bear the costs of repairs and any actions taken to rectify deficiencies at no expense to the Department.

450-2.6.12.2 Surface Deficiencies: Surface deficiencies are defined below. Regardless of the types of deficiencies, when the total surface area of all deficiencies within a single member exceeds 1% of the product of the member's length times its depth, the member shall require engineering evaluation and disposition in accordance with 450-2.6.12.5.

(1) Bughole: A bughole is a form surface air pocket void with an area up to 3.0 in^2 [2000 mm^2] and a depth up to 1.5 inches [40 mm]. Treat any air pocket void with a dimension exceeding either of these dimensions as a honeycomb. The Engineer will not require the Contractor to repair any bughole with a depth less than 0.25 inch [5 mm] and less than 0.75 inch [20 mm] in diameter, unless otherwise indicated in the plans or specifications. Consider all other bugholes cosmetic and repair them in accordance with 450-2.6.12.4(1).

(2) Spall: A spall is a depression resulting when a fragment is detached from a large mass by a blow, action of weather, by pressure or by expansion within the larger mass.

A cosmetic spall is a circular or oval depression not greater than 1.0 inch [25 mm] in depth nor greater than 3.0 in^2 [2,000 mm^2] in area, and shall be repaired in accordance with 450-2.6.12.4(1).

A minor spall is a spall no larger than 1.0 ft^2 [0.1 m^2] and no deeper than 1.5 inches [40 mm]. Repair minor spalls in accordance with 450-2.6.12.4(3).

A major spall is a spall which is deeper than 1.5 inches [40 mm] regardless of the surface area, or a shallower spall with a surface area greater than 1.0 ft^2 [0.1 m^2]. A major spall shall require engineering evaluation and disposition in accordance with 450-2.6.12.5.

(3) Chip: A chip is the local breaking of the corners or edges of the concrete with the resulting void containing angular surfaces.

Cosmetic chips are chips where the sum of the two lateral dimensions perpendicular to the length does not exceed 2.0 inches [50 mm]. Regardless of length, it is not necessary to repair cosmetic chips except for visually exposed surfaces which may require repair in accordance with 450-2.6.12.4(4).

Minor chips are chips where the sum of the two lateral dimensions perpendicular to the length exceeds 2.0 inches [50 mm], but does not exceed 4.0 inches [100 mm], and with a length of no more than 12.0 inches [300 mm]. Repair minor chips in accordance with 450-2.6.12.4(4).

Major chips are any chips larger than minor chips. Major chips shall require engineering evaluation and disposition in accordance with 450-2.6.12.5.

(4) Surface Porosity: Surface porosity is the localized porosity of a formed surface due to medium scaling. Medium scaling is defined as the loss of surface mortar up to ⅜ inch [10 mm] in depth and exposure of concrete aggregate. Repair surface porosity with a surface area greater than 1.0 ft^2 [0.1 m^2] in accordance with 450-2.6.12.4(2) below. Repair surface porosity with an area less than 1.0 ft^2 [0.1 m^2] in accordance with 450-2.6.12.4(1).

(5) Honeycombing: Honeycombing is voids in the concrete, loss of fines or other material from between the aggregate particles, the inclusion of air pockets between aggregate particles, or larger volumes of lost material. Remove honeycombing in its entirety to sound concrete prior to establishing the classification of the defect.

Minor honeycombing is a void no deeper than 1.5 inches [40 mm] to the sound concrete and no larger than 1.0 ft^2 [0.1 m^2] in area that results after the removal of unsound material. Repair minor honeycombing in accordance with 450-2.6.12.4(5).

Major honeycombing is a void deeper than 1.5 inches [40 mm] to the sound concrete regardless of the surface area, or shallower but with a surface area greater than 1.0 ft^2 [0.1 m^2] that results after the removal of unsound material. Major honeycombing shall require engineering evaluation and disposition in accordance with 450-2.6.12.5.

(6) Formed Surface Misshapening: Formed surface misshapening is the visual and measurable deficiency or excess of material from the specified tolerance on any surface of a member.

(a) Pile Ends: Make square pile ends which are outside this Section's tolerances by grinding in accordance with 450-2.6.12.4(6), or any other means of removal as approved by the Engineer. Reshape the chamfer if more than 1/4 inch [5 mm] from the cast pile end is removed and such removal affects the chamfer dimension.

(b) Pile Chamfers: Reshape chamfers outside of this Section's tolerances to within the tolerances in accordance with 450-2.6.12.4(6) below.

(c) Other Surfaces: Any deficiency exceeding the plan dimensions for size, length, squareness, designated skew, plumbness, and the like by up to twice the specified plus (+) tolerance may be corrected by grinding to within the allowable tolerance in accordance with 450-2.6.12.4(6). Any deficiency exceeding the specified minus (-) tolerance or twice the specified plus (+) tolerance shall require an engineering evaluation and disposition in accordance with 450-2.6.12.5.

(7) Bearing Areas: Consider the bearing area to extend from the end of the member to 3 inches [75 mm] beyond the edge of the bearing contact area for the full member width. Treat minor defects in the bearing area in accordance with 400-11.

450-2.6.12.3 Cracks: A crack is the separation of a member or portion thereof which may appear before or after detensioning and may or may not cause separation throughout the member thickness or depth. Identify cracks by the classifications and locations described below and subject them to the disposition required by the identified crack. Regardless of the classifications and locations of cracks within any single member, if the total surface length of all cracks on any and all surfaces exceeds 1/3 of the member's length, the member shall require engineering evaluation and disposition in accordance with 450-2.6.12.5. Establish crack sizes subsequent to release of all pretensioning forces.

The Engineer will reject any pile that is cracked to the point that a transverse or longitudinal crack extends through the pile, shows failure of the concrete as indicated by spalling of concrete on the main body of the pile adjacent to the crack, or which in the opinion of the Engineer will not withstand driving stresses. Occasional hairline surface cracking caused by shrinkage or tensile stress in the concrete from handling will not be cause for rejection.

(1) Classification of Cracks: Regardless of cause and for the purposes of this specification, cracks in prestressed components, excluding piling, will be identified according to their surface appearance in accordance with the following classifications:

Cosmetic Cracks: Cosmetic cracks are any cracks which are less than 0.006 inch [0.15 mm] wide and are in structurally non-critical locations on the member. Treat cosmetic cracks after detensioning in accordance with Section 400 and Section 413.

Minor Cracks: Minor cracks are any cracks which are between 0.006 and 0.012 inch [0.15 and 0.30 mm] wide, inclusive, and are in structurally non-critical locations on members. Repair minor cracks after detensioning in accordance with Section 400, and Section 411 or Section 413.

Major Cracks: Major cracks are any cracks of any width which are located in structurally critical locations on members or cracks in structurally non-critical locations which are greater than 0.012 inch [0.30 mm] wide. Major cracks require an engineering evaluation and disposition in accordance with 450-2.6.12.5.

Cracks in the Riding Surface: Repair cracks in the top surface of components which will become the riding surface (with no overlays) in accordance with Section 400, and Section 411 or Section 413 regardless of the classification of the crack identified in accordance with this Specification.

(2) Locations of Cracks: Regardless of cause and for the purposes of this specification, cracks will be identified as occurring in either structurally critical or structurally non-critical locations in accordance with the following criteria and conditions:

Structurally Critical Locations: Structurally critical locations of cracks are any locations in which a crack would tend to open under stresses occurring at any time during the service life of the structure, or which may reduce the ultimate capacity or fatigue life of the member. Specifically, structurally critical locations of cracks are any locations in a member not defined and included in (3) below as structurally non-critical. Cracks in structurally critical locations shall require engineering evaluation and disposition in accordance with 450-2.6.12.5.

Structurally Non-critical Locations: Structurally non-critical locations of cracks are defined by the position within a member's length, the position within a member's depth, and the orientation of the crack.

(3) Structurally Non-critical Locations of Cracks by Member Type are:

(aa) Piles: Surface cracks in any direction and of a length not exceeding twice the width of the pile.

(bb) Simple Span Prestressed Beams:

End zones (within a distance of twice the depth of the member from the end): One horizontal crack at either or both ends in the top flange and web of the member, not in the plane of nor intersecting any row of prestressing strands, and extending from the end of the member for a length not to exceed 1/2 the member's depth.

Mid-span region (between end zones) before detensioning: Vertical cracks extending through the top flange and web of the member.

Any Location: Horizontal crack at the interface of the web and top flange which is not longer than the member's depth.

(cc) Simple Span Double Tees:

End zones (within a distance of twice the depth of the member from the end): One horizontal crack at either or both ends and in the top flange of the member, not in the plane of nor intersecting any row of prestressing strands, and extending from the end of the member for a length not to exceed half the member's depth.

Mid-span Region (between end zones) before detensioning: Vertical cracks extending through the top flange and not exceeding half the web depth of the member.

Any Location: Horizontal crack at the interface of the web and top flange which is not longer than the member's depth.

(dd) Pretensioned I Beams Containing Longitudinal Posttensioning Ducts:

End zones (within a distance of twice the depth of the beam from the end): Vertical cracks in the bottom half of the beam within an end zone with no posttensioning anchorages and where the posttensioning ducts are located in the top of the beam at the location of a permanent substructure support.

Mid-span Region (between quarter points): Vertical cracks in the web and top flange of the beam provided the beam is to be supported at each end in its final position in the structure.

Horizontal cracks not longer than the beam's depth and only at the interface of the web and top flange provided the beam is to be supported at each end in its final position in the structure.

(ee) Simple Span Prestressed Slab Units:

End Zones (within a distance of twice the depth of the member from the end): One horizontal crack at either or both ends in the top 1/2 of the member, which is

not in the plane of nor intersecting any row of prestressing strands, and extending from the end of the member for a length not to exceed half the member's depth.

Mid-span Region (between end zones) before detensioning: Vertical cracks in the top half of the member.

Any Location (after detensioning): Vertical cracks in the top half of the member.

450-2.6.12.4 Repair Methods and Materials: For minor defects repaired in accordance with the requirements herein, the Engineer will not require a repair proposal and review. Proceed with the defect repair upon completing the "Noncomplying Prestressed Precast Concrete Component Data Sheet" (FDOT Form No. 700-030-010) and receiving signature verification by the Engineer indicating the information on the form is correct. If the Contractor elects to propose an alternate repair method, submit a proposal in conformance with 450-2.6.12.5. Prior to repair, prepare the surface of the repair area by removing all laitance, loose material, form oil, curing compound, and any other deleterious matter. Complete all repairs, other than repairs to cracks and surface grinding, within three working days of discovery. The three working day period for the completion of repairs may be extended if authorized by the Engineer. Cure repaired surfaces for the full curing time required for concrete as specified in 450-2.6.9(f). Repaired surfaces shall have a surface texture, finish and color which matches the appearance of the unaffected surrounding area of the member.

(1) Cosmetic Surface Filling: Repair areas to be filled by filling with a mortar mix consisting by volume of one part cement, 2.5 parts sand that will pass a No.16 [1.18 mm] sieve, and only sufficient water to produce a dry but workable mix consistency compatible with the repair required.

(2) Surface Restoration: Maintain the surface continuously wet for a minimum of three hours prior to application of repair material. Repair areas to be restored with a mortar mix consisting by volume of one part cement, 2.5 parts sand that will pass a No. 16 [1.18 mm] sieve, and sufficient water to produce a viscous slurry mix.

(3) Cutting and Filling: Carefully cut all feathered edges of the area to be repaired back perpendicular to (or slightly undercut from) the surface to the depth of sound concrete or to a minimum depth of 1/2 inch [15 mm], whichever is deeper. Coat the prepared surface with an approved epoxy bonding agent applied in accordance with the manufacturer's recommendations. Fill the cutout area with an approved high-strength, non-metallic, non-shrink grout mixed and applied in accordance with the manufacturer's recommendations. Firmly consolidate the grout mix in the cutout area.

(4) Restoration of Surfaces and Edges: When reinforcing steel, prestressing strand, inserts or weldments are exposed, remove concrete from around the items to provide a 1 inch [25 mm] clearance all around. Form surfaces and edges to the original dimensions and shape of the member. Coat the prepared surface with an approved epoxy bonding agent applied in accordance with the manufacturer's recommendations. Restore surfaces and edges with an approved high-strength, non-metallic, non-shrink grout mixed and applied in accordance with the manufacturer's recommendations. Firmly consolidate the grout mix in the area to be repaired.

(5) Removal and Restoration of Unsound Concrete: Carefully cut the area of unsound concrete to be repaired back perpendicular to (or slightly undercut from) the surface and to the depth of sound concrete or to a minimum depth of 1 inch [25 mm], whichever is deeper. When reinforcing steel, prestressing strand, inserts or weldments are exposed, remove the concrete from around the items to provide a 1 inch [25 mm] clearance all around. Coat the prepared surface with an approved epoxy bonding agent applied in accordance with the manufacturer's recommendations and then filled with an approved high-strength, non-metallic, non-shrink grout mixed and applied in accordance with the manufacturer's recommendations. Firmly consolidate the grout mix in the area to be repaired. Restore surfaces and edges to the original dimensions and shape of the member.

(6) Surface Grinding: Grind off misshaped formed surfaces with an abrasive stone with the following limitations and requirements:

Apply two coats of an approved penetrant sealant to any surfaces which are not subsequently encased in concrete immediately after grinding has been accepted.

Do not apply a penetrant sealer to any surfaces to be subsequently encased in concrete.

(7) Treatment of Cracks: Treat cracks in accordance with Section 400, and Section 411 or Section 413.

450-2.6.12.5 Submittal of Proposal to Accept or Repair Structural Deficiencies: When notified that a member is deficient and, thereby, unacceptable to the Department, the Contractor may propose repairs to the member either in the casting yard, or at the project site when such deficiencies are discovered at the project site. If the Contractor proposes to repair the member, it must be restored to provide its required design capacity and perform its intended function in the structure in order to be considered for acceptance by the Department. Proposals must include an evaluation of the member's relative ability to perform its intended function in the structure and its durability relative to other acceptable, similar members. Submit the proposal in writing to the Engineer as outlined below. Do not ship members which require repairs from the casting yard which require repairs to the project site until such repairs are complete and the Department has determined the member to be acceptable.

If the proposal is accepted by the Department, all Department costs associated with review of the proposal, including the cost of any and all engineering evaluation and/or testing services required, will be borne entirely by the Contractor, but not to exceed 15% of the member value based on unit bid prices.

Prepare the proposal to consist of the following information:

(1) A cover letter prepared on the Contractor's letterhead describing the member and addressed to the Engineer.

(2) Completed "Noncomplying Prestressed Precast Concrete Component Data Sheet" (FDOT Form No. 700-030-010) countersigned by the Department's inspector indicating his agreement with the described defect or noncompliance feature.

(3) A structural and durability evaluation of the member.

(4) A proposed credit to the contract proportionate to the member's deficiency. The credit is in addition to the cost for review and evaluation of the proposal.

(5) Any other supportive information, pictures, sketches, etc. The description of the proposed repair and/or the structural and durability evaluation of the member must be prepared by or under the direct supervision of a Specialty Engineer and must bear his signature and seal.

Include in the proposed credit consideration of the Department's added costs which may include but are not necessarily limited to reinspection, testing, reduced durability, or increased maintenance cost.

The Engineer will review and evaluate the Contractor's proposal and will notify the Contractor of its disposition. The Engineer's review of the Contractor's proposal does not amend or delete code requirements, unless such changes are specifically brought to the Engineer's attention and accepted by the Engineer.

The Engineer's acceptance of a proposal does not relieve the Contractor of his responsibility to provide members that are structurally adequate to resist the loads specified in the contract drawings and that maintain the intended aesthetic, durability and maintenance aspects of the member.

The Engineer will not accept repaired members unless repairs are made as proposed or described, the resulting repairs are sound in all aspects, and the repairs are aesthetically acceptable.

Replace a rejected member with a member meeting the requirements of the Contract Documents at no additional expense to the Department.

450-2.6.12.6 Repairs Prior to Approval: If repairs to precast members are initiated in advance of Department approval of the repair procedures, materials, etc., for deficiencies that

require evaluation in accordance with this Section, the affected member will only be considered for acceptability and use when the following conditions have been satisfied:

(1) Prior to beginning the repairs, prepare and deliver to the Engineer a repair proposal in accordance with the requirements of 450-2.6.12.5.

(2) All repair materials must be selected from the Department's qualified product list or otherwise be subsequently evaluated, tested by the Contractor as required by the Department, and/or approved by the Department for the specific use made of the material.

(3) Perform repairs under the observation of the Engineer.

It shall be clearly understood that such actions taken by the Contractor are entirely at his own risk. It is intended that repairs shall be made only after the proposed methods have been accepted to ensure that the proposal will not be modified or rejected, and the work will be accepted if the repair proves to be adequate.

450-2.7 Dimensional Tolerances:

450-2.7.1 General: Apply all tolerances with respect to the theoretical positions and dimensions shown in the plans.

The tolerances listed in 450-2.7.2 represent the total allowable tolerance that will be accepted in the finished product. Do not accumulate tolerances allowed in other manufacturing sequences to supersede any individual tolerance. Do not apply tolerances shown for the overall dimensions of a member in a manner that will cause the tolerances shown for positions of reinforcing and prestressing steel to be violated whether the position of the steel is considered with respect to the centerlines of the member or to the surfaces of the member as a reference.

450-2.7.2 Tolerances: Apply the following tolerances during and after the fabrication of prestressed members:

Non SI Units	
(a) All Prestressed Members: Allowable reduced concrete cover for reinforcing steel shall be ¼ inch from cover shown, unless shown as "minimum cover" on plans. The tolerance on all miscellaneous shapings including, but not necessarily limited to, chamfers, miters, bevels, keys, tapers, radii, holes, inserts, blockouts, shall be ±1/8 inch of the control dimension of the shape or ±1/8 inch, whichever is greater.	
(b) Piling (voided and solid):	
Length (after detensioning)	-1 inch, +3 inches
Width or Diameter	± 1/4 inch
Sweep-variation from straight line parallel to centerline of member, measured after removal from forms and before shipping	± 1/8 inch per 10 feet, up to 1 inch maximum
Position of Strands	± 1/4 inch
Void Position:	
Longitudinal	± 2 inches
Transverse	± 1/2 inch
Vertical	± 1/2 inch
Holes for cable ties	± 1 inch
Position of Handling Devices	± 6 inches
Variation from Specified End Squareness or Skew	±1/8 in/ft, ±1/4 inch maximum
Local Smoothness of Any Surface	±1/4 inch per 10 feet
Longitudinal Pitch or Spacing of Spiral, for spacing (x) of:	
x<3 inches	±1/4 inch
3≤x≤9 inches	±1/2 inch
x>9 inches	±3/4 inch
Pile Chamfers:	
3 inch dimension	+0 inch, -1/2 inch
3/4 inch dimension	+1/2 inch, -1/4 inch
(c) Sheet Piling:	
Length (after detensioning)	-1 inch, +3 inches
Width	±3/8 inch
Thickness	±1/4 inch
Position of Strands	±1/4 inch
Position of Handling Devices	±6 inches
Variation from Specified End Squareness or Skew (measured along the width of the sheet pile)	±1/8 in/ft, ±1/2 inch maximum
Local Smoothness of Any Surface	±1/4 inch per 10 feet
Longitudinal Spacing of Stirrups	±3/4 inch
(d) Double Tees:	
Length (measured prior to detensioning)	±1 inch
Width (Overall)	±1/4 inch
Depth	±1/2 inch, -1/4 inch
Stem Width	±1/8 inch
Flange Thickness	±1/4 inch
Distance Between Stems	±1/4 inch
Centerline of Stem to Edge of Top Flange	±1/4 inch

Non SI Units	
Variation from Specified Flange Squareness or Skew:	
Horizontal	±1/8 in/ft of width, ±1/2 inch maximum
Variation from Specified End Squareness or Skew:	
Vertical depth (x):	
x>24 inches	±1/8 in/ft of depth of double tee; ±1/2 inch maximum
x≤24 inches	±1/4 inch
Sweep- variation from straight line parallel to centerline of member, measured immediately after storing	1/8 inch per 10 feet, 1 inch maximum
Differential Camber between Adjacent Members of the Same Design	1/2 inch
Position of Strands:	
Individual	±1/4 inch
Bundled	±1/2 inch
Position from Design Location of Deflection Points for Deflected Strands	±6 inches
Position of Blockouts	±1 inch
Size of Blockouts	±1/2 inch
Position of Plates	±1 inch
Position of Bearing Plates	±1/2 inch
Tipping and Flushness of Plates and Bearing Plates, longitudinal and transverse over the width and/or length of the plate	±1/8 inch
Position of Sleeves Cast in Stems, in both horizontal and vertical plane	±1 inch
Position of Inserts for Structural Connections	±1/2 inch
Position of Handling Devices; Parallel to Length	±6 inches
Local Smoothness of any Surface:	
Top of Deck Surface, longitudinal and transverse	3/16 inch in 10 feet
Non Deck Surfaces	1/4 inch in 10 feet
Horizontal Position of Transverse Tendon Duct:	
Inside the member	±1/2 inch
At faces of the member	±1/4 inch
Vertical Position of Transverse Tendon Duct	
Inside the member	±1/4 inch
At faces of the member	±1/8 inch
Position of Stirrup Bars (Longitudinal Spacing)	±1 inch
(e) Slab Units:	
Length, measured prior to detensioning	±1 inch
Width	±1/4 inch
Depth	±1/4 inch
Blockout Location	±1 inch
Variation from Specified End Squareness or Skew, horizontal and vertical	±1/2 inch
Sweep- variation from straight line parallel to centerline of member, measured immediately after storing, for member length (x):	
x<40 feet	1/4 inch

Non SI Units	
40≤x≤ 60 feet	3/8 inch
x>60 feet	1/2 inch
Position of Strands	±1/4 inch
Position of Plates	±1 inch
Local Smoothness:	
Top of Deck Surface, longitudinal and transverse	3/16 inch in 10 feet
Non Deck Surfaces	1/4 inch in 10 feet
Position of Stirrup Bars (longitudinal spacing)	±1 inch
Position of Transverse Posttensioning Ducts:	
Vertical:	
Inside the member	±1/4 inch
At faces of the member	±1/8 inch
Horizontal:	
Inside the member	±1/2 inch
At faces of the member	±1/4 inch
Differential Camber between Adjacent Members of the Same Design	1/2 inch
(f) I-Beams/Bulb Tee Beams:	
Length, to be measured prior to detensioning	±1 inch
Width (Flanges)	±3/8 inch, -1/4 inch
Depth (Overall)	+1/2 inch, -1/4 inch
Depth (Flanges)	±1/4 inch
Width (Web)	+3/8 inch, -1/4 inch
Sweep- variation from straight line connecting similar points of beam ends:	
After release and before removing from bed	1/8 inch per 10 feet beam length, 1.5 inches maximum.
In storage and after placement in the structure	1/8 inch per 10 feet beam length, 1.5 inches maximum.
Variation from Specified End Squareness or Skew:	
Horizontal	±1/4 inch
Vertical	±1/8 in/ft of beam depth
Position of Strands	±1/4 inch
Position from Location of Deflection Points for Deflected Strands Shown in the Shop Drawing	±6 inches
Position of Bearing Plates- horizontal, measured from end of beam	±1/2 inch
Tipping and Flushness of Bearing Plates, longitudinal and transverse over the width and/or length of the plate	1/8 inch
Position of Posttensioning Duct:	
Vertical:	±1/4 inch
Horizontal:	±1/2 inch
Position of Inserts for Structural Connections	±1/2 inch
Position of Handling Devices - Parallel to Length	±6 inches
Position of Stirrups:	
Longitudinal Spacing:	
for spacing ≤ 6 inches	±1 inch

Non SI Units	
for spacing > 6 inches	±2 inches
End Stirrup Bars, from end of beam	not more than 2 inches
Transverse Horizontal Spacing, out to out	±1/4 inch
Projection Above Top	±3/4 inch
Local Smoothness, any surface (does not apply to top surface left rough)	1/4 inch in 10 feet
Position of Strand Sheathing:	±2 inches
Tilt of the Vertical Axis of a Beam End from True Vertical Due to Deviation of Blocking from Horizontal, measured in storage. (Tilt is the right or left incline of the beam end vertical axis as viewed when facing the beam end.)	1/4 in/ft of height (not to exceed 1 inch)

SI Units	
(a) All Prestressed Members: Allowable reduced concrete cover for reinforcing steel shall be 5 mm from cover shown, unless shown as “minimum cover” on plans. The tolerance on all miscellaneous shapings including, but not necessarily limited to, chamfers, miters, bevels, keys, tapers, radii, holes, inserts, blockouts, shall be ±3 mm of the control dimension of the shape or ±3 mm, whichever is greater.	
(b) Piling (voided and solid):	
Length (after detensioning)	-25 mm, +75 mm
Width or Diameter	± 5 mm
Sweep-variation from straight line parallel to centerline of member, measured after removal from forms and before shipping	1 mm/m, up to 25 mm maximum
Position of Strands	± 5 mm
Void Position:	
Longitudinal	±50 mm
Transverse	±15 mm
Vertical	±15 mm
Holes for cable ties	±25 mm
Position of Handling Devices	±150 mm
Variation from Specified End Squareness or Skew	±10 mm/m, ±5 mm maximum
Local Smoothness of Any Surface	±2 mm/m
Longitudinal Pitch or Spacing of Spiral, for spacing (x) of:	
x<75 mm	±5 mm
75≤x≤225 mm	±15 mm
x>225 mm	±20 mm
Pile Chamfers:	
75 mm dimension	+0 mm, -15 mm
20 mm dimension	+15 mm, -5 mm
(c) Sheet Piling:	
Length (after detensioning)	-25 mm, +75 mm
Width	±10 mm
Thickness	±5 mm
Position of Strands	±5 mm
Position of Handling Devices	±150 mm
Variation from Specified End Squareness or Skew (measured along the width of the sheet pile)	±10 mm/m, ±15 mm maximum
Local Smoothness of Any Surface	±2 mm/mm
Longitudinal Spacing of Stirrups	±20 mm
(d) Double Tees:	
Length (measured prior to detensioning)	±25 mm
Width (Overall)	±5 mm
Depth	+15 mm, -5 mm
Stem Width	±3 mm
Flange Thickness	±5 mm
Distance Between Stems	±5 mm
Centerline of Stem to Edge of Top Flange	±5 mm
Variation from Specified Flange Squareness or Skew:	
Horizontal	±10 mm/m of width, ±15 mm

SI Units	
	maximum
Variation from Specified End Squareness or Skew:	
Vertical depth (x):	
x>600 mm	±10 mm/m of depth of double tee; ±15 mm maximum
x≤600 mm	±5 mm
Sweep- variation from straight line parallel to centerline of member, measured immediately after storing	1 mm/m, 25 mm maximum
Differential Camber between Adjacent Members of the Same Design	15 mm
Position of Strands:	
Individual	±5 mm
Bundled	±15 mm
Position from Design Location of Deflection Points for Deflected Strands	±150 mm
Position of Blockouts	±25 mm
Size of Blockouts	± 15 mm
Position of Plates	± 25 mm
Position of Bearing Plates	± 15 mm
Tipping and Flushness of Plates and Bearing Plates, longitudinal and transverse over the width and/or length of the plate	± 3 mm
Position of Sleeves Cast in Stems, in both horizontal and vertical plane	±25 mm
Position of Inserts for Structural Connections	±15 mm
Position of Handling Devices; Parallel to Length	±150 mm
Local Smoothness of any Surface:	
Top of Deck Surface, longitudinal and transverse	1.5 mm/m
Non Deck Surfaces	2 mm/m
Horizontal Position of Transverse Tendon Duct:	
Inside the member	±15 mm
At faces of the member	±5 mm
Vertical Position of Transverse Tendon Duct:	
Inside the member	±5 mm
At faces of the member	±3 mm
Position of Stirrup Bars (Longitudinal Spacing)	±25 mm
(e) Slab Units:	
Length, measured prior to detensioning	±25 mm
Width	±5 mm
Depth	±5 mm
Blockout Location	±25 mm
Variation from Specified End Squareness or Skew, horizontal and vertical	±15 mm
Sweep- variation from straight line parallel to centerline of member, measured immediately after storing, for member length (x):	
x<12 m	5 mm
12≤x≤18 m	10 mm
x>18 m	15 mm
Position of Strands	±5 mm
Position of Plates	±25 mm
Local Smoothness:	

SI Units	
Top of Deck Surface, longitudinal and transverse	1.5 mm/m
Non Deck Surfaces	2 mm/m
Position of Stirrup Bars (longitudinal spacing)	±25 mm
Position of Transverse Posttensioning Ducts:	
Vertical:	
Inside the member	±5 mm
At faces of the member	±3 mm
Horizontal:	
Inside the member	±15 mm
At faces of the member	±5 mm
Differential Camber between Adjacent Members of the Same Design	15 mm
(f) I-Beams/Bulb Tee Beams:	
Length, to be measured prior to detensioning	±25 mm
Width (Flanges)	+10 mm, -5 mm
Depth (Overall)	+15 mm, -5 mm
Depth (Flanges)	±5 mm
Width (Web)	+10 mm, -5 mm
Sweep- variation from straight line connecting similar points of beam ends:	
After release and before removing from bed	1 mm/m beam length, 40 mm maximum.
In storage and after placement in the structure	1 mm/m beam length, 40 mm maximum.
Variation from Specified End Squareness or Skew:	
Horizontal	±5 mm
Vertical	±10 mm/m of beam depth
Position of Strands	±5 mm
Position from Location of Deflection Points for Deflected Strands Shown in the Shop Drawing	±150 mm
Position of Bearing Plates- horizontal, measured from end of beam	±15 mm
Tipping and Flushness of Bearing Plates, longitudinal and transverse over the width and/or length of the plate	3 mm
Position of Posttensioning Duct:	
Vertical:	±5 mm
Horizontal:	±15 mm
Position of Inserts for Structural Connections	±15 mm
Position of Handling Devices - Parallel to Length	±150 mm
Position of Stirrups:	
Longitudinal Spacing:	
for spacing ≤ 150 mm	±25 mm
for spacing > 150 mm	±50 mm
End Stirrup Bars, from end of beam	not more than 50 mm
Transverse Horizontal Spacing, out to out	±5 mm
Projection Above Top	±20 mm
Local Smoothness, any surface (does not apply to top surface left rough)	2 mm/m
Position of Strand Sheathing	±50 mm

SI Units	
Tilt of the Vertical Axis of a Beam End from True Vertical Due to Deviation of Blocking from Horizontal, measured in storage. (Tilt is the right or left incline of the beam end vertical axis as viewed when facing the beam end.)	20 mm/m of height (not to exceed 25 mm)

450-2.8 Handling and Storage:

450-2.8.1 Handling: All members may be handled after transfer of the prestress force except members that are prestressed by a combination of pretensioning and posttensioning. For the latter, do not handle the members before they are sufficiently prestressed to sustain all forces and bending moments due to handling. Exercise care in handling to prevent damage to members. Lift and move the members so as to minimize stresses due to sudden changes in momentum. Pick up members only at points designated as pickup points as shown on the contract plans or shop drawings. Maintain all members in an upright position at all times.

Evaluate the temporary stresses and stability of beams with a length-depth ratio greater than 20 during handling. The temporary stresses induced into the members during handling shall be within the acceptable stresses at release listed in the Department's Structures Design Guidelines. Take appropriate action to increase the stability of members during handling when the factor of safety against lateral buckling instability is below 2.0. Include the expected fabrication tolerance for sweep in the analysis. The analysis procedure provided by the Prestressed Concrete Institute or similar procedures may be used for the stability evaluation.

Verify lifting devices for capacity in lifting and handling members, taking into account various positions during handling. Keep multiple component lifting devices matched to avoid non-compatible use. When a member has multiple lifting devices, use lifting equipment (slings, pulleys, etc.) capable of distributing the load at each device uniformly to maintain the stability of the member. When the lifting devices are grouped in multiples at one location, align them for equal lifting.

Take appropriate steps to prevent the occurrence of cracking. When cracking occurs during handling and transportation, revise handling and transporting equipment and procedures as necessary to prevent cracking for subsequent members.

450-2.8.2 Storage: Store precast prestressed beams, double tees and slab units on only two points of support located within 18 inches [450 mm] of the end of the member. Support skewed beams, double tees or slab units within 18 inches [450 mm] of the end of the full member section. Support other members on an adequate number of supports so as to keep stresses in the members within the allowable stresses at release listed in the Department's Structures Design Guidelines. Locate multiple supports (more than 2) within 1/2 inch [15 mm] of a horizontal plane through the top surface of the supports.

All supports shall be level and on adequate foundation material that will prevent shifting or differential settlement which may cause twisting or rotation of members. Immediately pick up members in storage that have rotated or twisted and adjust the supports to provide level and uniform support for the member.

Support prestressed members that are stacked by dunnage placed across the full width of each bearing point and aligned vertically over lower supports. Do not use stored members as a storage area for either shorter or longer members or heavy equipment.

Where feasible, base the selection of storage sites, storage conditions and orientation upon consideration of minimizing the thermal and time-dependent creep and shrinkage effects on the camber and/or sweep of the precast pretensioned members.

When concrete incorporating microsilica is used, continuous application of water during the initial seven day moist curing period may be interrupted for a maximum of one hour to allow relocation of precast or prestressed elements within the manufacturing facility.

Check the sweep and camber of beams monthly for conformance with 450-2.7.2(f). If the camber exceeds by 1 inch [25 mm] the design camber shown in the plans, take appropriate actions in accordance with 400-7.13.1 to accommodate the member in the structure. If the sweep exceeds the tolerance specified, take immediate measures to bring the sweep of the member back to within tolerance. Special storage conditions for the purpose of removing excessive sweep shall not be restricted by requirements of this Subarticle nor contained in 450-2.7.2(f). If the sweep of the member exceeds the tolerance specified and can not be removed, the disposition of the member shall be in accordance with 450-2.6.12.1 and 450-2.6.12.5.

450-2.9 Shipping: Do not ship precast prestressed members prior to the concrete attaining the required 28-day strength. Do not ship members until accepted and stamped by the Contractor and the Department. The Contractor's stamp shall mean that the member was fabricated in conformance with the Contractor's QCP, the contract, and this Section. The Department's stamp shall mean that the Engineer has reviewed the Contractor's documentation for each member and determined it to be complete, and that a visual inspection of the completed member(s) found only those defects noted on the shipping documents.

When concrete incorporating microsilica is used, allow precast or prestressed concrete elements to remain at the manufacturing location until the initial seven day moist curing is complete. Upon completion of the seven day moist cure, application of the double coating of curing compound, and attaining the required strength, elements may be shipped and stored at the job site until the 28-day curing period has been accomplished.

Evaluate the temporary stresses and stability of all members during shipping and locate supports in such a manner as to maintain stresses within acceptable levels. Include impact loadings in the evaluation. Consider the actual route that will be used for transporting the member and consider any special conditions, such as sharp curvature, high superelevation, uneven roadways, that will cause leaning, rotation, twisting, or impact loadings, in any evaluation of shipping methods. Especially evaluate the lateral stability of beams with a length-depth ratio greater than 20 for transporting. Temporary stresses induced into the members during shipping shall be within the acceptable stresses at release listed in the Department's Structures Design Guidelines.

450-2.10 Erection: Erect precast prestressed members without damage. Meet the handling and storage requirements of 450-2.8 for field operations.

Adequately brace members to resist wind forces and weight of forms and other temporary loads, especially those eccentric to the vertical axis of the members, during all stages of erection. Prior to casting diaphragms and the deck slab, do not allow the horizontal alignment of prestressed concrete beams to deviate from a straight line connecting similar points of beam ends by more than 1/8 inch per 10 feet [1 mm/m] or 1/2 inch [15 mm], whichever is the least.

When concrete containing microsilica is used, precast or prestressed elements must be at least 28 days old before installation is allowed.

450-2.11 Documentation: To establish evidence of proper fabrication and quality of precast prestressed concrete members, maintain a system of records in each plant which will provide full information regarding the testing of materials, tensioning, concrete proportioning, placing and curing, and disposition of members. Include in the recordkeeping for the work specified in this specification deficiencies found from inspection and testing and the disposition of deficiencies. Keep certified test reports for materials incorporated into the production of precast prestressed concrete members, including certified physical properties reports on file. Also keep reports of tests performed on file.

Items for which certifications and/or test reports are required shall include, but are not limited to prestressing steel, reinforcing steel, concrete materials and/or concrete, curing materials and embedded items. Maintain the printout for the stressing operations and ensure they reflect the identification of the bed and members fabricated.

Include in the QCP the method and format proposed to be used for documenting necessary information. Forms as developed by the Department, the Prestressed Concrete Institute or other

source may be used to document inspection and testing. Sample forms are included in Appendix VII of the Department's Manual for Quality Assurance of Precast Prestressed Concrete Members.

Maintain records until all the precast prestressed members for a project have been fabricated. Then submit the records to the Engineer. Records shall be available for inspection at any time by the Engineer and the Federal Highway Administration.

450-2.12 Measurement and Payment:

450-2.12.1 General: The work specified in this Section will be measured and paid for as shown below for the particular item involved.

Precast prestressed concrete members are acceptable to the Department for full payment when all requirements of the contract have been met. No partial payments will be made for precast prestressed concrete members until the 28-day strength requirement, along with other applicable specification requirements, have been met.

The method of payment below will be full compensation for all work and materials specified in this Section, or as otherwise required for the complete item being constructed, transported to and placed into its permanent position in the structure. Such payment will be full compensation for steel reinforcement, pretensioning steel, embedded ducts and posttensioning anchorage hardware, for posttensioning as specified, and other materials as required to fabricate the member.

450-2.12.2 Prestressed Piling (All Piling): Payment will be made at the Contract unit price per foot [meter] for the particular type of piling, measured and paid for as specified in Section 455, including the provisions for cutoffs and splices.

450-2.12.3 Prestressed Beams: Payment will be made at the Contract unit price per foot [meter] for Prestressed Beams, complete in place and accepted. Final pay lengths will be plan quantity based on casting lengths, as detailed on the plans, subject to the provisions of 9-3.2.

450-2.12.4 Prestressed Slab Units: Payment will be made at the Contract unit price per foot [meter] for the units, complete in place and accepted. Final pay lengths will be plan quantity based on casting lengths, as detailed in the plans, subject to the provisions of 9-3.2.

450-2.13 Method of Payment: Payment for the items in 450-2.12 will be made under the following:

Item No. 450- 1-	Prestressed Beams - per foot.
Item No. 2450- 1-	Prestressed Beams - per meter.
Item No. 450- 2-	Prestressed Slab Units - per foot.
Item No. 2450- 2-	Prestressed Slab Units - per meter.