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Portions of the Manual contain material that has been reproduced and/or revised from the Prestressed Concrete Institute. The material was used in an effort to standardize definitions and inspection procedures for prestressed concrete elements. We thank the Prestressed Concrete Institute for permitting the State to reproduce portions of their Manual for Quality Control for Plants and Production of PRECAST AND PRESTRESSED CONCRETE PRODUCTS MNL 116, Third Edition, 1985.
SECTION 100
INTRODUCTION

The New York State Prestressed Concrete Construction Manual (PCCM) is a mandatory part of the Contract Documents for Department of Transportation projects which include items requiring the Contractor to furnish Structural Precast, and/or Prestressed Concrete Units.

The PCCM supplements the Prestressed Concrete Section of the Standard Specifications as provided therein.

The Manual is double spaced to allow for personal notes by Users of the Manual and to allow for supplemental updates that will replace pages but may be single spaced.

The Contract Documents provide that the Contractor/Fabricator/Erector is responsible for the quality of his own work. When the terms Fabricator and/or Erector are used, contractually, it shall mean the Contractor.

Quality Control (QC) during fabrication and erection is the responsibility of the Contractor. Verification of the effectiveness of the Contractor's fabrication/erection QC program, Quality Assurance (QA) is the responsibility of the State. Quality Assurance inspection shall not relieve the Contractor of his responsibility to furnish the quality of materials and workmanship required by the Contract Documents. See Section 3, Inspection, for a more-detailed description of the duties of Inspectors and responsibility for Quality Control and Quality Assurance.
Precast (Non-Prestressed) Concrete Units. Whenever the Manual indicates procedures applicable to prestressing applications only, they shall be disregarded.

Whenever the term Prestressed is used, it shall be interpreted to mean Precast, where applicable.

When transfer strength is mentioned, it shall be interpreted as lifting strength.
SECTION 200
DRAWINGS

210. CONTRACT DRAWINGS.

210.2 Definition. The drawings which are part of the Contract
documents, hereinafter designated as the "Contract Drawings",
"Contract Plans", or "Plans", are all Contract Drawings under the
provisions of the Contract Documents and are not intended to be
"Working Drawings" or "Erection Drawings" required by these
Specifications. The word Plans will generally be used throughout
this Manual to describe Contract Drawings.

210.3 Details and Specifications. Any details not sufficiently
shown on the Plans will be furnished to the Contractor by the Deputy
Chief Engineer (Structures), DCES, upon request. Any question about
notes on the Plans or requests for clarification of the Specification
requirements should be directed to the DCES.

210.3 Dimensions. In case of a difference on the Plans between scale
dimensions and figures, the figures shall be followed.

210.4 Errors. The Contractor shall verify and be responsible for the
correctness of all dimensions other than the principal-controlling
dimensions shown on the Plans, and shall call the attention of the
DCES to any errors or discrepancies that he may discover therein.
The Contractor shall have no claim for damages that may result from
following an error except for an error in the principal-controlling
dimensions and material properties shown on the Plans or listed in
the Specifications.
210.5 Principal-Controlling Dimensions and Material Properties. The
following shall be considered principal-controlling dimensions and
material properties:
a. Length of span, i.e., the horizontal distance
   between bearings, pin centerlines, or other points of support.
b. Length of member, out-to-out.
c. Thickness, webs, flanges, etc.
d. Depth.
e. Prestressing Force.
f. Concrete Strengths.

The Contractor shall be responsible for modifying the dimensions of
units to compensate for elastic shortening, shrinkage, grade
correction, and other phenomena that make in-process fabricating
dimensions different from those shown on the Contract Drawings.

220. WORKING DRAWINGS.

220.1 Preparation. Complete and accurate drawings shall be made by
the Contractor, indicating how each prestressed concrete unit is to
be fabricated. Approval of the Working Drawings by the DCES shall
not relieve the Contractor from the responsibility for the
correctness of all dimensions shown on these drawings. These
drawings shall be made as soon as possible after the award of the
Contract and they shall be designated as Working Drawings.

220.2 Size and Type. Working Drawings shall be neatly drawn and
clearly legible to produce microfilm negatives. The drawings shall
be made in ink, or reproduced from the pencil drawings by a process
subject to the approval of the DCES, on tracing cloth or mylar of
acceptable quality. Working Drawings shall be cut to a standard size of 22 x 36 inches and arranged to conform to the Contract Drawings.

Failure to submit Working Drawings of the required size will be cause for their return without examination. The margin line shall be drawn one-half inch from the top, bottom, and right-hand edges and two inches from the left-hand edge to permit binding. The working space on these drawings will, therefore, be 21 inches by 33-1/2 inches. A space 3 inches by 11 inches, and parallel to the length of the sheet, shall be reserved in the lower right-hand corner for title and approval signature. Each Working Drawing shall have an identical (top right) corner box to the one shown on the Contract Drawings. The sheets shall be arranged so that, as far as possible, the notes will appear above each other near the right edge of the sheet.

220.3 Information Required on Working Drawings. The Working Drawings shall include the following information:

1. Plan layout of superstructure indicating the piece mark assigned to each prestressed unit.

2. Fabricating plant production schedule.

3. Description of the fabricating plant, including any backup concrete mixing facilities, original design mix, and proposed method of placement. Modifications or deviations from the original mix at any time after the Working Drawings have been approved, shall be submitted, in writing, to the DCES.

4. Proposed admixture to be added to the concrete mix.
5. Quality control tests and procedures.
6. Method and outline of unit and cylinder curing procedure, as required by "Curing", 560.
7. The name of the Manufacturer of the prestressing steel, including any alternate source.
8. Calculations of strand elongation for each unique casting length (grip-to-grip).
9. Material and manner of sealing the exposed portions of the prestressing steel.
10. Transfer of prestress procedure for all unit types to be fabricated.
11. Complete details, including anticipated camber, tensioning force (initial and final), concrete strength (transfer and 28-day), and type and location of lifting device for all prestressed concrete units to be fabricated.
12. Proposed method of handling and transporting prestressed concrete units to the project site.
13. Working Drawings shall clearly indicate any proposed deviations from the prestressed concrete unit details shown on the Contract Drawings.
14. Winter concreting procedures, if need is anticipated.

220.4 Required Format For Drawings:
220.41- Production Note Sheet - See Information Required on Working Drawings, except 1., and attached Sample Format Sheet.
220.42 - Layout Sheet:
1. Plan Layout of structure.
3. Piece Mark and its location on each beam.
4. Bridge Begin, End Stations, and Pier Stations as needed.
5. Center-To-Center of bearings, all spans.
6. Necessary Section Details.

220.43 - Beam Detail Sheets, Indicating:
2. Beam Elevation.
4. Strand Locations and Cutting Sequence.
5. Reinforcing Layout, Plan, Elevation, and Cross Section.
6. Railing Anchorage Layout and Details.

220.44 - Bar List Sheet:
1. Bar Sizes and Bend Dimensions.
2. Bar Cages, if used.
3. Misc. Hardware, Plates, etc.

230. SUBMISSION OF WORKING DRAWINGS. When the Working Drawings, prepared by the Contractor, as specified, are completed, Check Prints shall be submitted to the DCES, who will indicate thereon such correction as may be necessary to secure the completion of the Contract in accordance with the requirements of the Contract Documents. The Contractor shall submit Three Sets of Check Prints for the DCES and Two Additional Sets of Check Prints for each Railroad or other Agency involved with the Contract. All sets of Check Prints shall be submitted to the DCES, who will make the distribution to the Railroad and other Agencies involved.
One Set of Check Prints or Sepias with desired corrections indicated thereon in colored crayon or pencil, will be returned to the Contractor. When the revisions have been completed to the satisfaction of the DCES, the Original Drawings shall be forwarded to him for written approval, after which a Set of Approved Drawings will be returned. The Original Drawings shall remain the property of the State.

240. DETENTION OF WORKING DRAWINGS. The DCES shall be allowed two work days for the examination of each drawing in a set of Working Drawings, or ten work days minimum per set. A set of Working Drawings shall be considered to be all drawings received by the DCES from any given Contractor for a particular Contract on any calendar day. If the Working Drawings are detained for examination for a period longer than that previously stated, such detention will be taken into account when considering application by the Contractor for an extension of time for the completion of the Contract.

All Working Drawings are time and date stamped as they are received and recorded in a log at the Office of the DCES. This log shall be the basis for determining when drawings must be returned without consideration for an adjustment of the completion date, as described herein.

Approval of Working Drawings shall not constitute approval for the following information required on the Working Drawings 220.3(3) and 220.3 (7).
250. DISTRIBUTION OF APPROVED WORKING DRAWINGS. The DCES will distribute Approved Working Drawings as soon as possible in accordance with the distribution listed below:

1. One (1) Set of Approved Reproducibles to the Fabricator of the precast and/or prestressed concrete units, unless the General Contractor desires all drawings to flow through him.

2. Two (2) Sets of Approved Reproducibles to the Regional Director of Transportation with instructions for him to forward One (1) Set to the General Contractor.

3. Three (3) Sets of Approved Paper Prints to the Fabrication Inspection Agency.

4. Three (3) Sets of Approved Paper Prints for every Railroad or Company or Public Agency involved in the Contract and One (1) Set of Approved Reproducibles.

260. ERECTION DRAWINGS.

260.1 General. The Contractor shall submit two copies of the Erection Drawings to the DCES and to the Regional Director for each structure in the Contract. These shall meet all the requirements of Subsection 220.2, Working Drawings. Copies shall also be sent for comments to any Railroad Company or other Agency affected by the proposed erection procedure.

These drawings must be received at least 30 days prior to the proposed beginning of erection. The DCES will review the erection procedure for the general requirements listed below and for its structural adequacy based on the information presented. The DCES will forward one copy of the erection procedure with comments to the
Regional Director for his use in approving the procedure. The Regional Director's Office will review any portion of the erection procedure that affects the maintenance of traffic, modifies the existing pavement, or the flow of water. The Regional Director's Office will forward all of the comments to the Contractor for incorporation into the procedure.

260.2 Required Information. The following minimum information shall be placed on the erection drawings for each individual structure. Erection procedures for similar structures or twin bridge may be shown on the same sheet:

1. Title block with contract number, project identification number (PIN), project and structure name and county.

2. Plan of the work area showing support structures, roads, railroad tracks, canals or streams, utilities or any other information relative to erection.

3. Erection sequence for beam units, noting use of holding cranes or temporary supports, falsework, and bents.

4. Delivery location of each beam unit.

5. Location of each range for each pick.

6. Capacity chart for each crane and boom length used in the work. Cranes lifting over active railroad facilities shall have a minimum lifting capacity of 150 percent of the lift weight.

7. Pick point location(s) on each member.

8. Lifting weight of each member (including clamps, spreader beams, etc.).

9. Lift and setting radius for each pick (or maximum lift radius).
10. Description of lifting devices or other connecting equipment.

11. Beam tie down details or other method of stabilizing erected beam units, if required.

12. Blocking details, if required, for stabilizing members supported on expansion bearings and on bearings that do not limit movement in the transverse direction.

260.3 Notes to be placed on the Erection Drawings:

1. No crane will be operated in a manner that will exceed its rated capacity at any radius as specified by the Crane Manufacturer.

2. The table or chart prepared by the Crane Manufacturer to describe the maximum lift at all conditions of loading shall be posted in each crane cab in clear view of the Operator.

3. The Contractor shall be responsible for verifying the weight of each lift and for insuring the stability of each member during all phases of erection.

4. The final alignment and profile of the erected beams shall conform to the requirements of the Contract Documents.
SECTION 300

INSPECTION

310. GENERAL. Fabrication/Erection Inspection and Testing (Quality Control) and Verification Inspection and Testing (Quality Assurance) are separate functions. For the purpose of this Manual, the terms Quality Control (QC) and Quality Assurance (QA) shall be used. Quality Control (Fabrication/Erection Inspection and Testing) shall be performed as necessary prior to strand tensioning, casting, during casting and after casting to insure that materials and workmanship meet the requirements of the Contract Documents.

Quality Control (Fabrication/Erection Inspection and Testing) is the responsibility of the Contractor, unless otherwise provided in the Contract Documents.

Quality Assurance (QA) is the responsibility of the State. The Quality Assurance (QA) Inspector is the duly designated person who acts for and on behalf of the State on all inspection and quality matters within the scope of the Contract Documents. The Quality Control (Fabrication/Erection) Inspector is the duly designated person who acts for and on behalf of the Contractor on all inspection and quality matters within the scope of the Contract Documents.

When the term Inspector(s) is used without further qualification, it applies equally to QC and QA within the limits of responsibility designated in this Manual.
320. QUALIFICATION OF INSPECTORS. Quality Assurance Inspectors shall possess a current ACI Certification for Concrete Field Testing Technician - Grade I, or approved equal, as determined by the DCES.

Quality Control Inspectors are encouraged to possess an ACI Certification, for Concrete Field Testing Technician, Grade I. The Contractor (Fabricator) is required to perform all tests in accordance with specified procedures in the presence of the QA Inspector.

330. RESPONSIBILITIES OF INSPECTORS.

330.1 General. The Inspector shall ascertain that all fabrication, handling, transportation, and erection is performed in accordance with the provisions of the Contract Documents. QC Inspectors shall be furnished by the Contractor (Fabricator) complete Working Drawings and those portions of the Contract Documents that describe material and quality requirements for the products to be fabricated.

The QA Inspector will be furnished required materials by the DCES. Fabrication of units shall be inspected by an Inspector designated by the State.

330.2 Inspection of Materials. The Inspector shall make certain that only materials conforming to the requirements of the Contract Documents are used. All materials used shall be approved by the Department. The prestressing strand shall be in accordance with Standard Specifications Section S709-06 and approved by the DCES. All other material shall be approved by the Materials Bureau of the Department in accordance with
their procedures and directives. Copies of all certifications shall be
given to the Department's QA Inspector.

330.3 Inspection of Fabrication. The Inspector shall make certain that the
fabrication of the unit meets all of the requirements of the Contract
Documents and the Approved Working Drawings.

340. INSPECTOR'S MARK OF ACCEPTANCE FOR SHIPMENT. When the concrete unit
is ready for shipment from the plant and is properly loaded on the
rail cars, trucks, or barges, the Inspector representing the State
shall affix the Acceptance Stamp of his Company. This acceptance
mark shall be made by paint or ink stamp, placed near the erection
mark on the piece.

Application of the Inspector's Acceptance Stamp implies that, at the
time of shipment from the plant, it was the opinion of the Inspector
that the concrete unit was fabricated from accepted materials, meets
the Contract requirements, and was properly loaded for shipment in
accordance with the requirements of the Contract Documents.
Application of the Inspector's Stamp of Approval for shipment does
not imply that the concrete unit will not be rejected by the State if
subsequently found to be defective.

350. REPORT OF SHIPMENT OF STRUCTURAL CONCRETE (FORM CEU NO. 5.) The
acceptance document for all structural concrete material subject to
plant inspection is the Report of Shipment of Structural Concrete
(Form CEU No. 5). When the material is shipped from the plant to the
project or a temporary storage area, the Inspector shall complete and
sign Form CEU No. 5 to cover all materials subject to his inspection.
This document shall indicate to the Engineer that the structural
concrete material, if not damaged by shipment, storage, erection, or subsequently found to be defective in workmanship or materials, may be paid for under the rules for payment established by the Department.

360. FACILITIES FOR INSPECTION. The Contractor shall provide all facilities for inspection of material and workmanship at the fabrication plant. The QA Inspector shall have sole access to a work station which includes the following minimum requirements:

1. Desk.
2. Chair.
3. File Cabinet With Lock.
4. Telephone Access In Plant.

370. INSPECTOR'S AUTHORITY. The QA Inspector shall have the authority to inspect all materials and fabrication procedures to determine if they conform to the Contract Documents.

380. OBLIGATIONS OF THE CONTRACTOR. The Contractor shall be responsible for the acceptability of his fabricated units. His QC Inspector shall take all necessary steps to assure that all materials, fabrication procedures, and final product meet all the requirements of the Contract Documents. The Contractor shall comply with all requests of the Inspector (his own employee or the QA Inspector, as appropriate) to correct deficiencies in material and fabrication procedures, as provided in the Contract Documents.

All testing required to assure compliance with the Contract Documents shall be performed by the Contractor in the presence of the QA
Inspector. The Contractor shall inform the DCES or his representative 72 hours prior to:

1. Commencement of work.
2. Commencement of work after a work suspension of 48 hours or more.
3. Unit shipping.
SECTION 400

MATERIAL REQUIREMENTS

410. MATERIALS FOR FABRICATION.

410.1 Concrete. The concrete shall meet the requirement of §501-2, under 501, Portland Cement Concrete, General, with the following modifications:

1. Cement shall be either Type I, Type II, or Type III except that only Type II cement shall be used in concretes exposed to seawater and its spray. For the purpose of this specification, the term seawater shall mean all tidal waters of New York State except those of the Hudson River and its tributaries north of the Newburgh-Beacon Bridge. Only one type of cement shall be used to fabricate units for any one structure.

2. Coarse aggregate gradation shall be No. 1 Size or ASTM D448, No. 67.

3. Concrete requirements for Classes A, B, and C concrete shall not apply.

4. Air content shall be 7 percent ± 2 percent.

5. The use of calcium chloride, or an admixture containing calcium chloride will not be permitted.
Steel.

1. Bar reinforcement shall meet the requirements of §709-01 or §709-03.

2. Wire fabric shall meet the requirements of Standard Specifications §709-02.

3. Chairs or other devices necessary to ensure the proper placement of steel items shall meet the requirements of §556-2.02.

4. Prestressing steel shall meet the requirements of §709-06.

5. Chairs, or other metal devices, shall be equipped with snug fitting, high density, polyethylene tips which provide one-quarter (1/4) inch minimum clearance between the metal of the chair and any exposed surface. Chairs may be made of a dielectric material or be stainless steel without polyethylene tips and shall meet the requirements of ASTM A493. AISI Type 430.

The Contractor shall keep the QA Inspector informed of the day-to-day scheduling of operations. The Inspector shall have free access throughout the fabrication plant to see that the work being done is in conformance with the Contract Documents. Work done while the Inspector has been refused access shall be automatically rejected.

-10.3 Epoxy. Epoxy shall meet the requirements of §721-01, Epoxy Resin System; §721-03, Epoxy Polysulfide Grout, or §721-05, Epoxy Report Paste.

410.4 Concrete Repair Materials. These materials shall meet the requirements of §701-06, except the water demand shall be as the Manufacturer suggests for the needed application.
410.5 **Fine Aggregate.** Fine aggregate shall meet the requirements of §703-03, Mortar Sand; or §703-04, Grout Sand. Fine aggregate shall be absolutely dry.

420. **MATERIALS FOR FIELD CONSTRUCTION.**

420.1 **Transverse Tie Rod or Strands.** Transverse tie rods or strands shall meet the material requirements shown on the Plans.

420.2 **Shear Key Material.** Shear key material for box beam units, hollow slab units, and solid slab units shall meet the following requirements of §701-06, Cement Based Grout Materials For Shear Keys.

420.3 **Anchorage Block-Out Grout.** The mortar shall consist of §701-05, Concrete Grouting Material; §701-06, Cement Based Grout Materials For Shear Keys, or a Two-Component Epoxy System and Fine Aggregate. The Epoxy System used shall conform to the requirements of §721-01, Epoxy Resin System; §721-02, Epoxy Polysulfide Binder; §721-03, Epoxy Polysulfide Grout; or §721-05, Epoxy Repair Paste. The Fine Aggregate shall be completely dry and shall conform to the requirements of §703-03, Mortar Sand; §703-04, Grout Sand; or §703-07, Concrete Sand.

420.4 **Anchor Dowel Fill Material.**

1. Expansion End Material Option:

   N.Y.S. Mat. Spec. §702-05 – Asphalt Filler.

   Fed. Mat. Spec. TT-S-00227E-Elastomeric Type, Multi Component.


2. Fixed End Material Option:

N.Y.S. Mat. Spec. §721-03—Epoxy Polysulfide Grout With Sand.*
N.Y.S. Mat. Spec. §701-05—Concrete Grouting Material or 701-06.

* Bone-Dry, Sandblast Sand Shall be added in the ratio of:

(1) part epoxy to (2) parts sand by volume.

§ Indicates Section in Standard Specifications Construction And Materials.
SECTION 500

FABRICATION REQUIREMENTS

510. PLANT FACILITY. Fabrication plants shall have, as a prerequisite for casting approval, the following minimum requirements:

1. Business Office With Telephone Facilities.
2. Inspector Facility.
3. Sufficient Area For Concrete Batch Plant And Raw Material Storage
   If Plant Produced Concrete, Prestressing Beds And Storage Of
   Finished Units.
5. Necessary Concrete Forms.
6. Required Quality Control Equipment.
7. Required Equipment For Proper Curing Of Concrete Units.

515. ORDERING OF MATERIALS. The Contractor shall bear all costs for damages or unacceptable material which may result from the ordering of materials prior to the approval of the Working Drawings.

520. COMMENCEMENT OF FABRICATION. No fabrication shall be started until the Working Drawings have been approved and the Inspector has received prints made from the Original Drawings.

525. DATA FOR Q.A. INSPECTOR.

525.1 Data required to be submitted to the Inspector for approval prior to start of fabrication:

1. A calibration certificate indicating the load calibration of each gauge and hydraulic jack combination used for tensioning. The gauge shall be calibrated from zero, throughout its entire load range. The gauge shall have clearly marked divisions that are easily readable at the initial and final tensioning force. The
calibration date of each combination gauge and hydraulic jack shall be within the 12-month period immediately prior to the start of the work.

2. A calibration certificate attesting to the fact that the concrete cylinder testing machine to be used has been calibrated within the 12-month period immediately prior to the first date of actual use of the machine.

525.2 Data required to be submitted to the Inspector for approval, prior to the inclusion of the respective material in the unit:

1. A certificate from the Prestressing Steel Manufacturer stating that the prestressed steel has been manufactured in accordance with §709-06.

2. Typical load-strain curves made during the processing of steel from which the elongation appropriate to the required prestressing force can be determined, including the following information:
   a. The breaking strength.
   b. The elongation at rupture.
   c. The load at one percent elongation.
   d. The test dates.

The aforesaid information shall be submitted to the Inspector, in duplicate, for each reel of prestressing steel.

3. Certificates indicating acceptance of bar reinforcement, concrete materials, and any other material used in the prestressed concrete unit.

530. CONCRETE FORMS.

530.1 General. Forms shall be well-constructed, carefully aligned, clean,
substantial and firm, securely braced and fastened together and sufficiently tight to prevent leakage of mortar. They shall be strong enough to withstand the action of mechanical vibrators. All forms for each unit shall be approved by the Inspector prior to placing concrete.

All form surfaces that come in contact with the concrete shall be thoroughly treated with an approved form coating in the manner and at the rate specified by the Manufacturer. Forms so treated shall be protected against damage and dirt prior to placing the concrete. Any form coating material that will stick to or discolor concrete shall not be used.

530.2 Void-Producing Forms. Void forms shall be waterproof or be coated with a waterproofing material on the outside and shall have a 3/4 inch diameter drain placed at each end of each void.

When units are steam-cured, all voids shall be vented during curing unless waived by the DCES and plugged with approved material after curing.

535. REINFORCEMENT AND PRESTRESSING STEEL. Prior to installation in the units, reinforcement and prestressing steel shall be free of frost, dirt, oil, paint, mill scale, corrosion, or any foreign material that may prevent bond between the steel and the concrete.

Tack welding of design bar reinforcement shall not be delivered under any circumstances.
Welded wire fabric, smooth or deformed, may be substituted for the required bar reinforcement provided that:

1. The required cover is maintained.
2. The design steel area of the fabric equals that of the bar reinforcement.
3. Splices to the fabric are made in accordance with the requirements of the N.Y.S.D.O.T. Standard Specifications For Highway Bridges, §8.32.5 and §8.32.6, as applicable.

If wire fabric is used, the details shall be indicated on the Working Drawings. Design computations shall also be included.

540. TENSIONING OF PRESTRESSING STRANDS. A calibrated force of between 3,000 pounds and 5,000 pounds shall be applied initially to each strand. Consideration will be given by the DCES to a different initial force for special cases. This load shall be the starting point for additional tensioning by elongation.

For drape strands, the additional tensioning or prestressing force induced in the prestressing steel shall be measured by jacking gauges and by elongation of the steel. The jacking gauges shall read within 5 percent of the force theoretically calculated to be induced by elongation. For straight strands, elongation only shall determine the prestressing force. However, the jacking gauges shall read within 3 percent of the force theoretically calculated to be induced by elongation.
During tensioning of any one strand, the process shall be so conducted that the applied load and the elongation of the strand may be measured at all times.

Two copies of recorded gauge pressures and measured elongations, as required for the tensioning of prestressing strands in each unit, shall be submitted to the Inspector.

The use of load cells or other tension measuring devices may be required. They shall be furnished by the Inspector and used in accordance with his instruction.

545. CONCRETE MIX DESIGN AND PROPORTIONING. The Contractor shall be responsible for designing a concrete mix to produce the strength and other requirements specified on the Contract Plans. If no strength is indicated, the required minimum strength shall be 4,000 psi at transfer and 5,000 psi at 28 days. Maximum cement content for any proposed mix, however, shall be eight bags per cubic yard. Proposed mixes shall be indicated on the Working Drawing and in accordance with Subsection 410.1. Automatic proportioning equipment will not be required.

The Contractor may request permission from the DCES to incorporate a High Range Water Reducing (HRWR) admixture into the concrete mix. The DCES will grant such permission only if he deems it to be in the best interests of the State and then only under such conditions as the DCES requires.

550. PLACING CONCRETE. No concrete shall be placed without the Inspector's approval. Compliance with the precasting tolerances listed under
Subsections 610 through 660 is a prerequisite for approval by the Inspector. When the atmospheric temperature is below 40°F, the fabrication of the units shall be in accordance with the winter concreting procedures, as approved on the Working Drawings.

Suitable means shall be used for placing concrete without segregation. The concrete mixture shall not be dropped from a height greater than one foot above the top of the forms. Special care shall be taken to deposit the concrete in its final position in each part of the form. The plastic concrete shall be consolidated in-place by either external or internal vibration methods, or both, if necessary. The vibrators shall be of a type and design approved by the Inspector and the size of the vibrating head will be governed by the spacing of the prestressing steel and reinforcement. Vibrators shall be used only to consolidate the concrete after it has been properly placed.

The internal vibrator shall be slowly inserted and removed from the concrete.

555. FINISHING. To assure production of well-formed matching beams with overall pleasing appearance, all surfaces of concrete shall be true and even, free from rough, open or honeycombed areas, depressions or projections. After all the concrete shall has been placed and thoroughly compacted as required under "Placing Concrete", the tops of units shall receive a stiff broom finish, or finished as shown on the Working Drawings. If required, all exposed surface shall be finished by bagging.
All exposed reinforcement shall be protected with neat cement paste or approved equal prior to placement in the storage area.

560. CURING.

560.1 General. The Contractor shall indicate on the Working Drawings, for approval, the method of cure and complete outline of the proposed procedure under each of the phases of the curing cycle. The Contractor may choose any one of the following acceptable curing methods. However, only one curing method will be allowed for the units of a single structure. Acceptable methods are:

1. Accelerated Cures:
   A. Low Pressure Steam.
   B. Radiant Heat and Moisture.

2. Non-Accelerated Cure:
   A. Saturated Cover.

To ensure complete hydration of cement, and to prevent the formation of cracks, moisture must be retained within the concrete. Therefore, immediately upon the completion of concrete placement for each unit, an enclosure shall be placed over the casting bed. The Contractor shall submit all covers to the Inspector for approval prior to the commencement of work.

560.2 Method. The full curing cycle shall consist of an Initial Curing Phase and Final Curing Phase described as follows:

1. Accelerated Cure.
   A. Initial Curing Phase. The initial curing phase for each unit shall be that period beginning from the time each unit is completely covered and continuing until the final curing phase commences. The Contractor shall indicate the duration
of the initial curing phase for each unit. However, the initial curing phase shall not exceed eight hours. During this phase, the enclosure temperature shall be maintained at approximately the concrete placing temperature; artificial heat shall be applied if necessary.

B. Final Curing Phase. The final curing phase for each unit shall be that period required to raise the initial curing phase temperature to the selected temperature range at a rate not exceeding 60°F per hour and continuing until the concrete has attained the minimum transfer strength as noted on the Contract Plans or as noted in this Manual, under Subsection 545, Concrete Mix design and Proportioning, whichever is applicable. The temperature shall not be raised to the selected curing temperature range until the concrete has reached its initial set as determined by ASTM C403.

The selected curing temperature range shall be as approved on the Working Drawings, but not exceed a maximum range of 30°F or a maximum temperature of 180°F.

2. Non-Accelerated Cure.

A. Initial Curing Phase. The requirements of 560.2(1.A.) above shall apply.

B. Final Curing Phase. The final curing phase may begin at any time after commencement of the initial curing phase. Each unit shall be covered with heavy, water-saturated burlap, or other material acceptable to the Inspector. The burlap shall be kept saturated, and the concrete
surface temperature shall not drop below 70°F. These conditions shall be maintained until the minimum transfer strength has been reached.

560.3 Record of Curing Time - Temperature. The Contractor shall provide one (1) automatic temperature recorder for every 100 feet of casting bed. The recorder shall continuously record curing temperatures for the initial and final curing phases. Temperature sensors shall be carefully placed within the curing enclosure to ensure that ambient temperatures are measured at the designated locations. Recorder accuracy shall be certified once every 12 months and the certificate displayed with each recorder. In addition, random temperature checks of each recorder shall be made by the Inspector.

Each temperature chart shall indicate the casting bed, date of casting, time of commencing graphic plot and units represented by chart. The start of artificial heat and the transfer of prestress shall be indicated on each graphic record.

After completion of the final curing phase, the charts shall be properly marked and given to the Q.A. Inspector. Temperatures recorded on the charts shall be considered as verification of whether the units have been cured in accordance with the approved Working Drawings.

560.4 Transfer of Prestress. Transfer of prestress shall be accomplished as soon as the final curing phase is complete and in the manner approved on the Working Drawings.
570. CONCRETE STRENGTH REQUIREMENTS.

570.1 Test Cylinders.

1. The concrete strength shall be determined from 6" diameter x 12"
(6" Ø x 12") high concrete test cylinders made in conformance with
ASTM C31. The actual procedure for making the test cylinders shall
be indicated on the Working Drawings. All cylinders shall be tested
in conformance with ASTM C39, on an approved testing machine. All
cylinders shall be made and tested by the Contractor in the
presence of the Q.A. Inspector.

The cylinders shall be made from concrete actually placed in the
precast units. The Q.A. Inspector shall be the sole judge of which
cylinders are defective or damaged and are not to be included in
the determination of the strength class. Test cylinders used to
determine required strengths for detensioning shall be cured as
specified on the Working Drawings.

All cylinders used to test for concrete strength shall be cured in
the same manner as the units they represent unless otherwise
indicated on the Working Drawings.

2. The Contractor shall cast a sufficient number of concrete test
cylinders to fulfill the concrete strength test requirements as
stated in Subsection 570.2. The testing procedure may be altered
by the DCES. If an alternate procedure is to be followed, it
shall be indicated on the Working Drawings. The expected number of
test cylinders to be cast for each unit shall be shown on the
Working Drawings.

570.2 Testing For Concrete Strength. The strength requirements for each
unit shall be verified by the Contractor as follows, before the unit
is accepted for strength:

1. Transfer Strength. Two cylinders from each unit shall be tested in
   immediate succession to verify prestress transfer strength. One
   of the two cylinders tested to determine the strength of the last
   unit cast in any bed shall be taken from the last batch of
   concrete placed in that unit. The strength of each cylinder shall
   be at least 95 percent of the required prestress transfer
   strength. The average strength of the two cylinders shall be
   equal to or greater than the required prestress transfer strength.

2. 28-Day Strength.

   A. Two cylinders from each unit shall be tested in immediate
      succession at 28 days of age to verify the required 28-day
      strength of the concrete. The average strength of the two
      cylinders shall be equal to or greater than the required
      28-day strength. If this requirement is not met, any
      remaining cylinders representing the unit shall be tested at
      28 days of age. The average strength of all cylinders
      representing the 28-day strength of any one unit shall be
      equal to or greater than the required 28-day strength.

   B. The Contractor may, at his option, test two cylinders from
      each unit in immediate succession, prior to the 28-day age
      limit. If this option is exercised, sufficient cylinders
      shall be made to ensure that at least two cylinders are
available for 28-day test. Each cylinder shall have a strength of at least 95 percent of the required 28-day strength. The average strength of the two cylinders must be equal to or greater than the required 28-day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived.

580. ADDITIONAL CONCRETE TESTS. Quality Control test listed below shall be performed by the Contractor in the presence of the Inspector, from the same concrete sample as that used for the Concrete Strength Requirement Section 570. Sample test procedures are indicated in Appendix G.

1. Slump, ASTM C143.
2. Air Content by Pressure Method, ASTM C231.
3. Temperature.

585. REJECTION OF UNITS. Any unit not fabricated in accordance with the Contract Documents or displaying any of the following defects shall be subject to rejection.

585.1 Strength Requirement. Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, Subsection 570.

585.2 Exposed Prestressing Steel. Any unit that has one (1) prestress strand exposed in excess of 24 diameters, or two (2) or more exposed strands.

585.3 Honeycombing. Honeycombing of the unit to such an extend that chipping away from the honeycombed concrete results in the conditions described under Exposed Prestressing Steel, above.
585.4 Stress Cracks. Any unit that has a stress crack in the area beginning four (4") inches from the unit end to the centerline of the unit that is greater than one-half inch (1/2") in depth and twenty-five ten thousandths (.0025) of an inch in width.

585.5 Injurious Materials. Materials used for the manufacturer of concrete shall not contain, nor cause concentration of, chemicals or other material injurious to concrete.

Concentrations of total chloride ions in excess of 0.06% by weight of cement are considered injurious.

Other material and concentration injury potential will be determined by the DCETS according to Department-written instructions.

595. SHIPPING. Units shall not be shipped until accepted by the QA Inspector and the minimum 28-day strength has been attained, but, in no case, before 72 hours' storage time has elapsed following transfer of prestress.
SECTION 600
TOLERANCES

610. GENERAL. - The provisions of this Section shall apply to the applicable unit types listed in Sections 620., 630., 640., 650., 660., and 670. If a different unit type is used, its tolerances will be indicated in the Specification for that particular unit type.

620. PRESTRESSED CONCRETE I-BEAM UNITS.

620.1 Precasting. In accordance with the provisions under Placing
Concrete subsection 550., all forms, reinforcing and prestressing steel, etc, shall be inspected for compliance with the applicable tolerances listed below:
Depth (overall): - 1/2 In., - 1/4 In.
Depth (flanges and fillets): ± 1/2 In.
Tendon Position: ± 1/4 In.
Position of Deflection Points for Deflected Strands: ± 1 Ft.
Side Inserts: ± 1/2 In.
Stirrup Bars (longitudinal spacing): ± 2 In.
Bulkhead (deviation from square or designated skew):
   Horizontal: 1/4 In.
   Vertical: 1/8 In. Per Ft. of Depth

Any movement of the forms during casting beyond the tolerances listed above is cause for rejection of the unit. The Q.A. Inspector shall document any form movement to the DCES. A determination will be made
by the DCES as to the unit's acceptability in the structure because of form movement.

620.2 Transfer of Prestress. All units shall be checked for compliance with the tolerances listed below within 24 hours after transfer of prestress. The Q.A. Inspector shall document to the DCES any unit with dimensions out-of-tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES:

Horizontal Alignment (Deviation from Straight Line Parallel to Centerline of Unit):

1/2 In. up to 40 Ft. Lengths.
3/4 In. 40 to 60 Ft. Lengths.
1 In. Greater than 60 Ft. Lengths.

Camber Deviation from Design Camber: ± 1/8 In. Per 10 Ft. of unit length

620.3 Shipping. All Units shall be checked for compliance with tolerances listed below, after the units have completed the Final Curing Phase and within three days prior to shipping. The Q.A. Inspector shall document to the DCES any unit with dimensions out-of-tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES:

Length: ± 1 In.
Bearing Area Deviation from Plane: ± 1/8 Inc.

630. PRESTRESSED CONCRETE BOX BEAM UNITS.

630.1 Precasting. In accordance with the provisions under Placing Concrete Subsection 550., all forms, reinforcing and prestressing steel, etc. shall be inspected for compliance with the applicable tolerances listed below.
Width (overall): ± 1/4 In.
Depth (overall): + 1/2 In., - 1/4 In.
Width (web): ± 3/8 In.
Depth (top slab): ± 1/2 In.
Depth (bottom slab): + 1/2 In., - 1/8 In.
Position of Tendons: ± 1/4 In.
Stirrup Bar Projection: ± 3/4 In.
Void Position: ± 1 In. from end of void to center tie hole—
+ 2 In., - 1 In. adjacent to end block.
Tie Rod Tubes (spacing between the centers of tubes and from
the centers of tubes to the ends of the unit): ± 3/4 In.
Tie Rod Tubes (spacing between the centers of tubes to the
bottom of the unit): ± 3/8 In.
Position of Stirrup Bars: ± 2 In.
Bulkhead (deviation from square or designated skew):
  Horizontal: 3/8 In.
  Vertical: 3/8 In.
Dowel Tubes (spacing between the centers of tubes and from
centers of tubes to the ends of the unit): 1/2 In.
Position of Side Inserts: ± 1/2 In.
Any movement of the forms during casting beyond the
tolerances listed above is cause for rejection of the unit.
The Q.A. Inspector shall document any form movement to the
DCES. A determination will be made by the DCES as to the
unit's acceptability in the structure because of form
movement.
630.2 Transfer of Prestress. All units shall be checked for compliance with the tolerance listed below within 24 hours after transfer of prestress. The Q.A. Inspector shall document to the DCES any unit with dimensions out-of-tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES:

Horizontal Alignment (deviation from straight line parallel to centerline of unit):

- 1/4 In. to 40 Ft. Lengths.
- 3/8 In. from 40 to 60 Ft. Lengths.
- 1/2 In. Greater than 60 Ft. Lengths.

Camber Deviation from Design Camber: ± 1/8 In. Per 10 Ft. but not greater than ± 1/2 In.

630.3 Shipping. All units shall be checked for compliance with the tolerances listed below, after the units have completed the Final Curing Phase and within three days prior to shipping. The Inspector shall document to the DCES any unit with dimensions out-of-tolerance. Any Unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES.

- Length: ± 1 In.
- Bearing Area (Deviation from Plane Surface when tested with a straight edge through middle half of unit): ± 1/8 In.

640. PRESTRESSED CONCRETE HOLLOW SLAB UNITS. - The requirements of Section 630., Prestressed Concrete Box Beam Units, shall apply.

650. PRESTRESSED CONCRETE SOLID SLAB UNITS. - The requirements of Section 630., Prestressed Concrete Box Beam Units, shall apply.

660. PRESTRESSED CONCRETE PILE UNITS
660.1 Precasting. In accordance with the provisions under Placing Concrete, Section 550, all forms, reinforcing and prestressing steel, etc. shall be inspected for compliance with the applicable tolerances listed below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width or Diameter</td>
<td>$-\frac{1}{4}$ inch, $+\frac{3}{8}$ Inch</td>
</tr>
<tr>
<td>Position of Spiral Reinforcement</td>
<td>$\pm \frac{3}{4}$ Inch</td>
</tr>
<tr>
<td>Position of Tendons</td>
<td>$\pm \frac{1}{4}$ Inch</td>
</tr>
<tr>
<td>Anchor Dowel Holes</td>
<td>$\pm \frac{1}{2}$ Inch</td>
</tr>
<tr>
<td>Wall Thickness</td>
<td>$-\frac{1}{4}$ Inch, $+\frac{1}{2}$ Inch</td>
</tr>
</tbody>
</table>

Any movement of the forms during casting beyond the tolerances listed above is cause for rejection of the unit. The Q.A. Inspector shall document any form movement to the DCES. A determination will be made by the DCES as to the unit's acceptability in the structure because of form movement.

660.2 Transfer of Prestress. All units shall be checked for compliance with the tolerances listed below within 24 hours after transfer of prestress. The Q.A. Inspector shall document to the DCES any unit with dimensions out-of-tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES:

- **Horizontal Alignment** (Deviation from straight line parallel to the centerline of the unit): $\frac{1}{8}$ Inch Per 10 Ft.
- **Variation from specified end squareness** or Skew: $\frac{1}{8}$ Inch Per 12-Inch of Width
- **Position of Steel Driving Tip**: $\pm \frac{1}{2}$ Inch
560.3 Shipping. All units shall be checked for compliance with the tolerances listed below, after the units have completed the Final Curing Phase and within three days prior to shipping. The Q.A. Inspector shall document to the DCES any unit with dimensions out-of-tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES:

Length: ± 2 Inches
SECTION 700
CONSTRUCTION DETAILS

710. INSPECTION, STORAGE, AND HANDLING. Units shall be inspected upon arrival at the construction site to determine any damage during shipment and for conformance to dimensional tolerances. An additional inspection shall be made prior to erection to determine any damage during storage.

The Contractor shall handle and store the concrete units with extreme care to prevent damage to the units.

720. REPAIR OF DAMAGED UNITS. Damaged units shall be repaired in a manner approved by the Engineer. Units which, as determined by the Engineer, cannot be repaired or which do not meet dimensional and camber tolerances shall be rejected and replaced with acceptable units furnished by the Contractor.

Rejection of a unit shall be done only with the concurrence of the DCES.

730. ERECTION.

730.1 Field Inspection. The Contractor shall provide the Engineer with all facilities necessary to conduct a thorough inspection of all the erection work.

730.2 Procedure and Equipment. Prior to erection of the units, the Contractor shall furnish to the DCES and the Regional Director the erection procedure, Subsection 260., with detailed information concerning the proposed method of construction and the construction
equipment he plans to use. NO WORK SHALL BE DONE WITHOUT THE ENGINEER'S APPROVAL.

730.3 Bearing Surfaces. Bearing surfaces shall be properly finished and formed to provide full and even supporting surfaces for bearings, bearing plates, and concrete units.

730.4 Transverse Tie Rods, Strands, and Anchor Rod. The installation of the tie rods, strands, and anchor bolts shall comply with the requirements shown on the plans. However, the anchor rods shall be placed and grouted prior to the placement of the shear keys.

730.5 Shear Key Joints for Box Beam and Hollow Slab Units.

730.51 Keyway Surface Cleaning. The keyway surface shall be sandblast cleaned of any material which may prevent bonding (i.e. - oil, grease, water, dirt, etc.). This work may be done at the fabrication plant, or in the field. However, it shall be done prior to erection. If the sandblasting is to be done at the fabrication plant, the working drawings shall so indicate.

730.52 Preparation for Placement. Prior to placing shear key material, there shall be no force in the transverse tie rods or strands, the beam anchorage system shall be completely installed and the anchorage grout material hardened. Immediately prior to filling the keyway, it shall be cleaned of all debris. After cleaning, the keyway shall be tightly sealed below the bottom of the shear key to prevent material loss. The work shall be done in such a manner that the sealing material shall be at least 1/4 inch below the shear key bottom. After sealing operations are completed, the Engineer shall inspect the work to ensure that the sealing material level is at least 1/4 inch below the shear key bottom. All sealed locations in violation of this requirement shall be corrected.
at no additional expense. No further work will be done to the shear key prior to the Engineer’s inspection and approval, of the sealing operations.

The ends of the keyway shall also be sealed to prevent material loss.

730.53 Mixing-General. The following mixing requirements shall be adhered to:

1. Mixing shall be done as close as possible to the keyway to be filled.

2. All necessary equipment for mixing and placing shall be present at the work site prior to the start of mixing. All equipment shall be in good working order as determined by the Engineer.

3. Material which, in the Engineer’s opinion is not pourable, exhibits signs of setting, or hardening, prior to placement, shall not be incorporated in the work. It shall be removed from the work site.

730.54 Placement. Placement of Cement Based Grout Material for Shear Keys.

1. The Grout manufacturer’s instructions regarding mixing and placing shall be followed, except that:

A. No aggregate shall be added to the grout.

B. The actual water to cement (w/C) ratio used shall comply exactly with the value given for the specific product as published in the Department’s approved list titled: Cement Based Grout Materials for Shear Keys, §701-06.

C. Grout shall not be placed during rainfalls.

D. Grout shall not be placed if the ambient temperature is outside the range of 40°F to 100°F.
2. Immediately prior to placing the grout, keyway surfaces shall be thoroughly wetted with clean water. However, no puddling of water will be allowed.

3. Only one shear key shall be filled at a time. Filling shall begin at one end of the key and proceed continuously to the opposite end. No placement interruptions will be permitted. Grout shall be thoroughly rodded as it is placed in the keyway. Grout shall be finished flush with the top of keyway.

4. Curing shall be in accordance with the Grout Manufacturer's instructions unless otherwise required by the Engineer. If directed by the Engineer, the Contractor shall supply and place suitable curing blankets over the grout after placement. Such blankets shall be kept saturated damp, with clean water, for at least six (6) hours. Blankets shall be placed as soon as practicable after placement has been completed, but, under no circumstances, later than one (1) hour subsequent to placement.

730.55 Loading. No loading of any span will be permitted until the following events have occurred:

1. All of the longitudinal shear keys of the span have been filled with shear key material.

2. At least 24 hours have elapsed from the time the last keyway was filled.

730.56 Tightening of Transverse Ties. These shall be tightened to the force shown on the plans. Tightening shall not be done until the requirements of Subsection 730.55 have been accomplished.
Tightening shall be completed prior to performing any further work on the superstructure.

Grouting of ties is not required, except that anchorage block-outs of fascia units shall be filled with anchorage block-out mortar. Mortar consisting of (§701-05) or (§701-06) shall be prepared and applied in accordance with the Manufacturer's instructions. Epoxy mortar systems shall be prepared and applied in accordance with the Manufacturer's instructions. Epoxy mortar systems shall be mixed and placed in accordance with the requirements of Subsection 502-3.15 of the Standard Specifications.

The temperature of the surface against which the mortar is to be placed shall be at least 50°F. No placement of mortar shall be permitted if the ambient temperature is less than 50°F, or if the ambient temperature is expected, or predicted, to become lower than 50°F for a period of 12 to 15 hours after placement. After the mortar has been placed, it shall be dusted with cement dust to match the surrounding concrete.
APPENDIX A
DEFINITIONS
APPENDIX A

DEFINITIONS

Admixture - A material other than water, aggregates, and cement used as an ingredient of concrete or grout to impart special characteristics.

Ambient Temperature - The temperature of the surrounding air and of the forms into which concrete is to be cast.

Camber - The upward deflection which occurs in prestressed concrete members due to the net bending resulting from stressing forces and dead load. Is specifically does not include dimensional inaccuracies due to errors in manufacturer, improper bearings, or other deficiencies in construction.

Concrete Engineering Unit (CEU) - A Unit in the Department's Structures Division responsible for Structural Precast, Prestressed, and Post-Tensioned Concrete Units.

Contract Documents - The Contract Documents shall include the advertisement for proposals, the Contractor’s proposal; the agreement; Standard Specifications; the plans; any addenda and/or amendments to specifications and all provisions required by law to be inserted in the Contract, whether actually inserted or not.

Whenever separate publications and the NYSDOT Standard Specifications are referenced, in the Contract Documents, it is understood to mean the publication and specifications, as amended, which are current on the date of advertisement for bids.

Contractor - The individual, firm, or corporation undertaking the execution of the work under the terms of the Contract and acting directly or through his, their, or its agents or employees.

DCES - Deputy Chief Engineer (Structures), New York State Department of Transportation.
DCETS - Deputy Chief Engineer (Technical Services), New York State Department of Transportation.

Department - The New York State Department of Transportation, a word commonly used to mean the Commissioner of Transportation or his authorized representative.

Detensioning of Strand - Transfer of Prestress - The release of tension from the strand, usually occurring at the time the prestressing force is transferred from the bed anchorage to the individual pieces cast in the bed.

Detensioning Strength - Transfer Strength - The strength of the individual concrete pieces at the time the prestressing force is transferred to them.

Dynamometer - A device which will measure the tension applied to it when it is connected between two tensile forces.

Engineer or Engineer-In-Charge (EIC) - The Engineer representing the Department of Transportation having direct supervision of the execution of the Contract under the direction of the Regional Director.

Fabricator - Any firm or corporation whom the Contractor retains to fabricate the precast and/or prestressed concrete units.

Final Prestress - The prestressing force in the concrete after substantially all losses have occurred.

Form Release Agent - A substance applied to the forms for the purpose of preventing bond between the form and the concrete cast in it.

Grips - The parts of a strand vise which actually contact or grip the wires or strands.

Initial Prestress - The prestressing force applied to the concrete at the time of detensioning or when post-tensioned concrete tendons are stressed and anchored.
Inspector - Person designated by the Fabricator or the State to determine the compliance of the fabricated item with the Contract requirements.

Load Cell - A sensitive electrically operated strain gauge attached to a calibrated cell to provide direct readings of loads applied to the cell.

Loss of Prestress - The reduction of the prestressing force resulting from the combined effects of relaxation in the tendons, creep, and shrinkage in the concrete, and elastic deformation.

Materials Bureau - The Department's Materials Bureau has a responsibility in the quality assurance program for materials to be used on the Contract and maintains a testing facility in Albany, New York.

Plans - The official Contract Drawings and applicable Standard Sheets, which show the location, character, dimensions, and details of the work to be performed.

Post-Tensioning - A method of prestressing concrete whereby the tendon is kept from bonding to the concrete, then elongated and anchored directly against the hardened concrete, imparting stresses through end bearing.

Pretensioning - A method of prestressing concrete whereby the tendons are elongated, anchored while the concrete in the member is cast, and released when the concrete is strong enough to receive the stresses from the tendon through bond.

Proposal - The offer of the bidder for the work, when executed and submitted on the prescribed form.

Proving Ring - An elastic alloy steel ring used to calibrate or measure loads. A dial indicator inside the ring measures deflection under load and calibration curves enable direct determination of load. Standard high capacity rings, certified by the National Bureau of Standards, and accurate to 0.1 of 1%, are used to calibrate mechanical force measuring systems.
Regional Director - The Director, acting through the Commissioner, who is delegated the authority and responsibility to execute the local Department prescribed work plans for his respective Region.

Retempering - The addition of water and remixing of concrete which has started to stiffen in order to make it more workable.

§ - Symbol indicating particular sections referred to in the Standard Specifications, Construction and Materials.

Strand - A tendon composed of seven-wire assemblies.

Strand Vise - A device for holding a strand under tension.

Tendon - A tensioned element, generally high-strength steel wires, strands or bars, used to impart prestress to the concrete. In post-tensioned concrete, the complete assembly of prestressing steel, anchorages and sheathing, when required, is also called a tendon.

Wet-Mix Concrete - Concrete mixtures designed for typical water-cement ratios, slumps, and handling and consolidation methods.
REPORTS

APPENDIX B

B100. **GENERAL.** The State Inspector shall complete the necessary reports, contained in this Appendix, to maintain proper control of the fabrication of precast and/or prestressed concrete products the Department uses. The reports shall be accurately prepared.

B200. **FREQUENCY AND DISTRIBUTION OF REPORTS.**

B200.1 **Daily Reports (FORM CEU NO. 1 AND NO. 2)**

1. General. Copies of Daily Reports shall be submitted by the Q.A. Inspector to the DCES, **Attention: Supervisor of the CEU**, at least twice a week or sooner if the need exists. A copy of all Reports shall be retained by the Q.A. Inspector.

2. State Employee. If the Q.A. Inspector is a State Regional Office Employee, copies of the Daily Reports shall also be sent to the Regional Director at least once a week.

3. Consultant Agency Employee. If the Q.A. Inspector is employed by a Consultant Inspection Agency, copies of all reports shall also be sent to the proper person in the Consultant Agency at a frequency required by the Agency. These reports shall be reviewed for accuracy, co-signed, and submitted as record copies to the DCES, **Attention: Supervisor of the CEU**, and to the Regional Director.

B200.2 **Post Pour Inspection (FORM CEU NO. 3)**

The Q.A. Inspector shall submit copies, as completed, to the Fabricator and also attach to the Daily Report and submit as indicated in B200.1.
B200.3 Concrete Strength Data (FORM CEU NO. 4)
The C.A. Inspector shall submit copies to the DCES, Attention:
Supervisor of the CEU when the project is completed and also attach
copied copies to the appropriate Daily Report.

B200.4 Report of Shipment of Structural Concrete (FORM CEU NO. 5)
The C.A. Inspector shall issue this report to the person directly
responsible (normally the truck driver) for delivering the structural
material to the project site. The delivery person shall be
instructed to hand-deliver the shipping report to the State's
Engineer-In-Charge for the project. A copy of this report shall be
attached to the Daily Report.

B200.5 Letter of Discrepancy (FORM CEU NO. 6)
The C.A. Inspector shall hand-deliver this letter to the fabricator
the day the discrepancy is discovered. Copies of this letter shall
be issued to the Contractor, Regional Director, DCES, Attention:
Supervisor of the CEU, and the Inspection Agency, if involved. A
copy of this letter shall be attached to the Daily Report.

B200.6 Letter of Rejection (FORM CEU NO. 7)
A Letter of Rejection shall be issued if the DCES, after reviewing
the contents of the Letter of Discrepancy and discussions with the
Inspector and his Agency, deems the situation to warrant it. The
letter will be issued by the Consultant Inspection Agency with the
concurrence of the DCES or by the DCES, if inspection is by Regional
Personnel. Distribution shall be as indicated in B200.5.
FORM NO. CEU NO. 1 (11/26)
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION STRUCTURES DIVISION
DAILY INSPECTION REPORT OF STRUCTURAL CONCRETE MATERIAL

Check Appropriate Box: Prestressed □  Precast □

Report No. □□□□□□□□
Date □□□□□□□□

Contract No. □□□□□□□□
Project No. □□□□□□□□
Country □□□□□□□□

INSPECTION AGENCY OR REGION

Fabricator □□□□□□□□
Name & Address □□□□□□□□
Contractor □□□□□□□□
Item No. □□□□□□□□

Description of Items (Box, I, Slab, Panel □□□□□□□□
Size and Length of Element □□□□□□□□

No. of Beams or Units □□□□□□□□
Required Strength of Concrete □□□□□□□□
Transfer or Lifting □□□□□□□□
Jacking Force (Lbs.) □□□□□□□□

If Prestressed □□□□□□□□
(No., Type & Diameter of Strands) □□□□□□□□

Source of Concrete □□□□□□□□
Cement Type & Source □□□□□□□□
Sand Source □□□□□□□□
Stone Source □□□□□□□□

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<th>No. Today</th>
<th>Piecemarks</th>
<th>No. To Date</th>
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<tbody>
<tr>
<td>No. Units Tensioned (If Prestress)</td>
<td></td>
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<tr>
<td>No. Units Cast</td>
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<tr>
<td>No. Units Detensioned or Stripped</td>
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<tr>
<td>No. Units Accepted</td>
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<td>No. Units Shipped</td>
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Calculated Elongation □□□□□□□□
For Prestressing □□□□□□□□
Actual Elongation □□□□□□□□
Time Stressing Complete □□□□□□□□
Time Pour Started □□□□□□□□

Type of Curing □□□□□□□□
(Steam, Radiant Heat & Moisture) □□□□□□□□
(Natural, Etc.) □□□□□□□□

Total Hours □□□□□□□□

CYLINDERS

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<tr>
<th>Cylinder Marks</th>
<th>Unit Piecemarks</th>
<th>Slump</th>
<th>Air</th>
<th>Unit Wt.</th>
<th>Date Made</th>
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BREAKING STRENGTH OF CYLINDERS

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<tr>
<th>Cylinder Marks</th>
<th>Unit No.</th>
<th>Age</th>
<th>Total Load</th>
<th>Strength (PSI)</th>
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</tbody>
</table>

Inspector
REMARKS (List Work Inspected and Highlight Only Unusual Occurrences); i.e. - Strand Breakage, Strand Sampled, and Cement Received.

Inspector Hours: Start __________ Finish __________ Total __________

Indicate Here, Or On Form CEU NO. 2
Tollie __________ Per Diem __________ Miscellaneous Expense __________

Inspector's Signature __________ Asst. Inspector's Signature __________

Supervisor Of Inspection Agency
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION STRUCTURES DIVISION
DAILY INSPECTION REPORT OF STRUCTURAL CONCRETE

Report No.__________________________
Page_________ of___________
Date__________________________

REMARKS


Inspector Hours: Start_________ Finish_________ Total_________
Tolls_________ Per Diem_________ Miscellaneous Expense_________

Inspector's Signature__________________________ Asst. Inspector's Signature__________________________

Supervisor Of Inspection Agency

55
FORM CEU NO. 3 (11/86)  
NEW YORK STATE  
DEPARTMENT OF TRANSPORTATION STRUCTURES DIVISION  
POST POUR INSPECTION SHEET  

Piecemark No.: ___________________________  
Contract No.: ___________________________  
County: ___________________________  
Fabricator: ___________________________  
Date Cast: ___________________________  

Date: ___________________________  
Daily Report No.: ___________________________  
Item No.: ___________________________  
Unit Type: ___________________________  
Date Released: ___________________________  

INSPECTION AGENCY OR REGION  
Concrete Strength: ___________________________  

Unit Dimensions:  
Length ___________________________  
Width ___________________________  
Depth ___________________________  
Camber Release ___________________________  

Appearance  
Top Finish ___________________________  
Anchor Dowel Hole Location ___________________________  
Exposed Steel ___________________________  
Transverse Tie Rod Hole ___________________________  
Sweep of Beam ___________________________  
Batter at Ends of Unit ___________________________  
Void Drains Opened ___________________________  
Vents Plugged ___________________________  

REQUIRED FINISHING (List All Work Required To Be Done); i.e. - Coating of Reinforcing, Beam End Finishing, Spall Repairs. Use Sketches As Required.  

_________________________________________________________________________  
_________________________________________________________________________  
_________________________________________________________________________  
_________________________________________________________________________  
_________________________________________________________________________  
_________________________________________________________________________  

Inspector: ___________________________  

NOTE: Place an asterisk next to any Form entry that is out-of-tolerance and explain under Required Finishing.
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<th>Dial Reading (LBS.)</th>
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**TRANSFER STRENGTH**

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<th>Unit Type:</th>
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**Specified 28-Day Design Strength** PSI
**Specified Transfer Strength** PSI
**Design Mix Cement Factor** #/CY
**Design Mix Water Content** #/CY
**Super Plasticizer** #/CY
**NEW YORK STATE**

**DEPARTMENT OF TRANSPORTATION STRUCTURES DIVISION**

**PIN:**

**BRIDGE:**

**COUNTY:**

**REPORT OF SHIPMENT OF STRUCTURAL CONCRETE**

<table>
<thead>
<tr>
<th>Fabricator:</th>
<th>Item No.:</th>
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<tr>
<td>Name &amp; Address:</td>
<td>Description of Item:</td>
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<tr>
<th>Contractor:</th>
<th>Truck No.:</th>
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<tr>
<td>Erector:</td>
<td>Date of Shipment:</td>
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<tr>
<th>Piecemark</th>
<th>Member Description</th>
<th>Date Cast</th>
<th>Report Number</th>
<th>Member Length</th>
<th>Concrete Strength</th>
<th>Camber, If Applicable</th>
<th>Truck Number</th>
<th>Remarks</th>
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I hereby certify: (a) that the material described herein has been inspected, sampled, and tested in accordance with the terms of the current Agreement between the State and my Company; (b) that this material has been found to conform to the requirements of the Contract Documents, or approved Working Drawings; and (c) that the accepted material bears the identifying mark of my Company.

Date Examined: _____________  Date Approved: _____________

58  Inspector's Signature
LETTER OF DISCREPANCY
FORM CEU NO. 6 (11/86)

DATE____________________

PRODUCER____________________________________
________________________________________________

Gentlemen:

Re: Project No. __________________________: Contract ______
________________________________________________
________________________________________________
Country________________________________________
Item No.(s)________________________________________

Prestressed/Prefed Unit No. __________ exhibits the following discrepancies:

________________________________________________
________________________________________________
________________________________________________
________________________________________________

These discrepancies, listed above, have been reported to the New York State Department of Transportation - Structures Division.

Reported, verbally, to NYSDOT - Mr. __________________________

Date __________________________

Very truly yours,

JERSEY TECHNOLOGY LABORATORIES, INC.

________________________________________, INSPECTOR

Cc: Contractor____________________________________
Cc: NYSDOT Structures Division - Attention:____________________
Cc: NYSDOT Regional Director of Transportation, Region ________
Cc: Inspection Agency________________________________________
LETTER OF REJECTION
FORM CEU NO. 7 (11/86)

DATE: __________________________

PRODUCER __________________________

_______________________________

Gentlemen:

Re: Project No. ________________________ Contract __________

_______________________________

County __________________________

Item No.(s) ________________________

Prestressed/Prefabricated Unit No.(s) __________ does not conform to the Specifications and, with the concurrence of the Deputy Chief Engineer (Structures), is rejected. As recorded in our Inspector's discrepancy letter dated ________________________, the prestressed/prefabricated unit is rejected for the following reasons:

_______________________________

_______________________________

This unit will not be accepted for shipment by us unless otherwise notified by our Client, New York State Department of Transportation.

Very truly yours,

JERSEY TECHNOLOGY LABORATORIES, INC.

Cc: Contractor ______________________

Cc: NYSDOT Structures Division - Attention: ______________________

Cc: NYSDOT Regional Director of Transportation, Region ______________________

Cc: Inspection Agency ______________________
APPENDIX C

COMMENTARY
COMMENTARY
APPENDIX C

C100. Intent of Commentary on Plant Inspection.

This portion of the Manual is intended to be used as a guideline for the Fabricators engaged in the production of precast and/or prestressed concrete units. The procedures set forth in this portion of the Manual shall be followed by the Quality Assurance (Q.A.) Inspector, unless conflicts exist between this Commentary and the Main Body of the Manual. If conflicts exist, the Main Body of the Manual shall be followed and the discrepancy brought to the attention of the Deputy Chief Engineer (Structures) (DCES).


C210. The Q.A. Inspector shall view the steps in the fabrication of prestressed concrete units as indicated in this Manual. He shall complete, and properly distribute, the required reports outlined in this Manual under Reports (Appendix B), and, in general, oversee that the production of the prestressed units are done according to the Contracts Documents. The Q.A. Inspector shall make at least weekly telephone contact with the Concrete Engineering Unit (CEU), or sooner if the need exists. The Q.A. Inspector shall keep a bound diary of the project and submit it to the CEU after the completion of the project.

C220. Prior to start of fabrication, the Quality Control (Q.C.) and Q.A. Inspectors shall determine that all materials are State approved. He shall have, and be properly familiar with, the Contract Documents; Contract Plans, Project Proposal, Standard Specifications, Approved Working Drawings, and this Manual.

C300. Materials.
C310. Sampling Procedures.

1. Portland Cement.
   a. The Q.A. Inspector is to take cement samples once a week during fabrication production. The samples shall be placed in a one gallon metal container that is lined with a plastic bag. The samples shall be taken as the delivery truck discharges the cement into the storage silo, approximately from the middle of the truck.
   b. The Q.A. Inspector must report cement brand name and address of Cement Company, along with other pertinent data on N.Y.S.D.O.T. BR 240 Form.
   c. The Q.A. Inspector is to enclose BR240 in BR 241 envelope and send with samples to the:
      Materials Bureau, State Campus,
      Building No. 7, Room No. 210
      1220 Washington Avenue
      Albany, New York 12232

2. Fine And Coarse Aggregate.
   a. The Q.A. Inspector is to sample fine and coarse aggregates at the beginning of the fabrication operations, and thereafter once each month during fabrication. The sample size for both fine and all sizes of coarse aggregate shall be 50 lbs.
   b. The Q.A. Inspector shall furnish the name of Supplier, address and N.Y.S.D.O.T. Test Number with other pertinent data on the N.Y.S.D.O.T. Form
BR3A and ship with BR241 envelope placed outside the sample bags to the Materials Bureau.

3. Water.

The Q.A. Inspector is to sample mixing water at the beginning of each job; thereafter, once a month when taken from a Municipal supply. The sample size shall be two gallons.

When water is from a pond or stream, sampling must be done one each week. Sample, accompanied by a BR240 Form in a BR241 envelope, is to be sent to the Materials Bureau's address noted above.

4. Prestressing Strand.

Three (3), five foot (5'-0'') samples shall be taken from each reel of prestressing steel by the Q.A. Inspector and submitted for testing. The steel shall be tested for compliance with the requirements of ASTM A416.

Testing shall be conducted by the Department at a place designated by the Department. Use a BR240 Form if samples are submitted to the Materials Bureau.


Sieve analysis tests of the coarse and fine aggregate are to be conducted by the Q.A. Inspector at the beginning of each job and thereafter, once a week during fabrication of members. All sampling and sieve analysis data, as well as all other pertinent data, is to be recorded on your Daily Report Sheets (mailed twice a week to the Structures Division).
C400. Stressing Requirements.

C410. General.

The provisions set forth in this Manual shall be followed in the application and measurement of stresses induced into prestressed concrete members.

C420. Tensioning of Tendons.

In all methods of tensioning, stress induced in the tendons shall be measured by elongation after the initial prestress force is applied. This requirement shall hold true, unless a change is approved, by the DCES. The initial tensioning force for all strands shall be 3000 to 5000 lbs. The exact force will be shown on the Front Sheet of the Working Drawings.

After the initial force has been applied to the tendon, reference points for measuring elongation due to additional tensioning forces shall be established.

Calculations for elongations shall include allowances for friction, strand slippage, and movement of abutments. This force shall be verified by gauges that are properly calibrated.

C430. Methods of Stress Measurement.

1. Initial Tensioning.

Initial force shall be determined by one of the following:

a. Pressure gauges to measure force from the pressure applied to hydraulic jacks.

b. Dynamometers connected in tension into the stressing system.
c. Load Cells.

2. Final Tensioning.

In the computation of tendon elongation, the modulus of elasticity of the tendon shall be determined from stress-strain curves furnished by the Manufacturer. An average modulus may be used, provided it falls within the tolerances specified by the ASTM.

Gauges shall also be used to determine the Final Force.


Pressure gauges for gauging systems should preferably have a full pressure capacity of approximately twice their normal working load. Loads to be gauged should not be less than one-fourth and not more than three-quarters of the total graduated capacity, unless calibration information clearly establishes consistent accuracy over a wider range. Gauges should have indicating dials at least 6 inches in diameter. Gauges should also be mounted at or near working eye level and within 6 feet of the Operator, positioned so that readings may be obtained without parallax.

Gauging systems can be calibrated under the supervision of a registered Professional Engineer on the staff of a production plant or as a Consultant, as long as the calibration equipment is appropriate and accurate.

Gauges for single strand jacks may be calibrated by means of an approved and calibrated load cell. Gauges for large multiple strand jacks acting singly or in multiple must be calibrated by proving
rings or by load cells placed on either side of the movable end

carriage.

In multiple strand tensioning, use of a master gauge system to

monitor accuracy of hydraulic gauges is acceptable as an ongoing

calibration method, since the cycles of tensioning are only a

fraction of the cycles in a single strand system.

C450. Stress-Relieved vs Low-Relaxation Strands.

Only stress-relieved strand is to be used in prestress concrete,

unless written permission by the DCES is granted. The strand shall

conform to the requirements of ASTM A416.

Low-Relaxation strand is manufactured in the same manner as

stress-relieved, except that an additional process causing a

permanent elongation is performed. This final process results in a

reduction in the loss of prestress, thus it must be accounted for in

the tensioning of strands.

C460. Control of Jacking Force.

Manual of automatic pressure cutoff valves may be used for stopping

the jack at the required load. When manual cutoffs are used, the

rate of loading shall be such that the jack can be stopped within the

specified load tolerances of the strand. If automatic pressure

cutoff valves are used, it shall be capable of adjustment to assure

that the proper force is induced into the tendon.

C470. Wire Failure in Tendons.

Failure of wires in pretensioned strand is allowed, providing the

total area of wire failure is not more than 2 percent of the total

area of tendons in any member.
If a gauge is connected to a prestressing strand that fails during stressing, the gauge shall be recalibrated before it will be allowed to be reused on the project.

C500. Pretensioning.

C510. General.

Pretensioning consists of stressing wire strands before the concrete is placed and releasing the strands from their anchorages after the concrete has reached its specified transfer strength.

There are two stages to be followed in tensioning all prestress strands:

1. Initial Tension - Application of a force of 3,000 to 5,000 lbs. per strand to straighten the strand, eliminate slack, and provide a constant reference point for measuring elongation.

2. Final Tension - This is the total force required for each strand as shown on the Contract Plans. This force shall always be measured by elongation and verified by gauge, unless an alternate procedure is allowed by the DCES. For straight strands, the agreement between the two methods shall be 3 percent and for draped strands 5 percent.

C520. Forms, Release Agents, Strand Surfaces.

Before the stringing of strands, the forms shall be inspected as to proper alignment and cleanliness. All forms coming into contact with concrete shall be properly aligned, sealed to prevent mortar leakage, cleaned and ground smooth and coated with an effective release agent.
After the strands have been placed and tensioned, they shall be inspected for possible contamination due to form release oil, mud, grease, etc. If any contamination is found, the strand shall be cleaned with an effective solvent.

C530. Stringing of Strands.

Strands shall be placed in such a manner that entanglement of strand is avoided.

Strands shall be threaded through bulkheads, etc. so they pass freely and binding does not occur during the stressing operation.

C540. Strand Grips.

Strand grips shall be inspected between each use for cleanliness and lubricated when necessary. Grips that are visibly worn, distorted, etc. shall not be allowed.

C550. Stress Corrections.

1. Friction in Jacking System.
   a. Because of a large jacking ram and heavy sliding or rolling anchorage, multiple strand tensioning is subjected to a considerable amount of friction which must be accounted for. To minimize friction, the sliding surfaces shall be cleaned and lubricated.
   
   b. Because the frictional losses are small in single strand tensioning, they can usually be ignored.

2. Thermal Effects.

Prior to casting, if the stressed bed will be subjected to a temperature variation of $25^\circ F$ or more, corrections shall be made for thermal effects.
Final Stressing of Draped Strands.

Draped pretensioning strands shall be done by one of the following methods:

1. Partial Stressing and Subsequent Strains.
   In this method, the strands are tensioned to an intermediate stress value between initial and final stress. The strands are tensioned in a straight or partially draped position. The strands will be tensioned to an intermediate value, either in a low position or a high position. If the strands are stressed in a low position, they shall be held down at low points and raised between beam units, or, if they are stressed in a high position, they shall be held up between beam units and pulled down at points within the member. To reduce friction in this method, the ideal procedure is to either lift or depress the strands simultaneously at all points on the bed. If this cannot be done practically, the lifting or depressing shall be done starting in the middle of the bed and progressing symmetrically to the ends.

2. Final Stressing in Draped Position.
   In this method, the strands are tensioned to their final value in the draped position. The strands shall pass over pin and roller fixtures which effectively reduce friction at all deflection points. Hold-down devices shall be of sufficient quality to assure that there is no detrimental effect to the strand, (necking-down), etc.

These methods may be used for either single or multiple strand tensioning.
C570. Unbonded Strand.

Pretensioned beam units may require unbonding of strand at critical portions of a member in order to reduce the concrete stresses. If unbonding is required or allowed, it will be indicated on the Working Drawings. Unbonding shall be by split plastic tubing 1-1/3 wrap and taped at the ends to prevent movement.

C580. Strand Splices.

Splicing is permitted for single strand tensioning provided the splice does not occur in a beam.

For multiple strand tensioning, all strands must be spliced or not more than 10 percent may be spliced. If all strands are spliced, provisions for strand slippage shall be considered. If 10 percent or less are spliced, no provisions are necessary for strand slippage. In both of the above-mentioned cases, no splice will be allowed in the beam unit.

C590. Strand Position.

Strands shall be placed as shown on the Working Drawings.

C600. Transfer of Prestress.

C610. General.

Stress transfer to the concrete shall not be performed until the concrete has attained its specified transfer strength. The transfer strength shall be shown on the Working Drawings. The Concrete strength shall be determined by cylinders made, cured, and tested in conformance with the requirements of Section 570.
Transfer shall take place after the concrete has attained its necessary strength and immediately following the curing period.

During transfer the prestressing force shall be kept as symmetrical about the vertical axis as possible, and applied in such a manner as to minimize sudden or shock loading. The maximum eccentricity about the vertical axis shall be limited to one strand. The exact procedure shall be shown on the Working Drawings.

Forms, ties, hold-downs, etc. that will restrict longitudinal movement of the units along the bed shall either be removed or loosened prior to transfer.

C620. Detensioning of Draped Strands.

Since longitudinal movement of members having draped strands may result in cracking of concrete or destruction of the hold-down devices, or both, special care shall be given to these members to prevent longitudinal movement. It is normally advisable to release hold-downs prior to release of anchorage stress, providing the vertical force, thus formed, does not cause cracking in the top flange.

C630. Multiple Strand Detensioning.

In this method, strands are released simultaneously by hydraulic jacks. With this procedure, some sliding of members on the bed is inevitable.

C640. Single Strand Detensioning.

In this method, the strand force is released by heat cutting using a low-oxygen flame. Cutting of the strand shall be done in such a
manner as to minimize sliding. Heating of the strand shall be done in a manner such that the stress in the strand is gradually released.

C700. Non-Prestress Steel Reinforcement And Appurtenances.

C710. Steel.

The reinforcing steel used shall conform to ASTM A615, Grade 40 or Grade 60, as required by the Contract, and be free from rust and any other material that might be harmful. It shall be adequately secured by chairs or blocking to forms or by ties to tendons so it will maintain its position during the casting of the concrete.

C720. Steel Cages and Mild Steel Reinforcement.

Steel cages shall be tied. Tack welding may be allowed to provide extra rigidity to the steel cage. The bars that may be allowed to be tack welded shall be additional bars added by the Fabricator, and located in a position approved by the DCES and shown on the Working Drawings.

C730. Inserts.

All inserts shall be placed according to the plans and held firmly in position during the placing of the concrete.

Aluminum inserts will not be allowed.

Inserts that are for the convenience of the Contractor shall be shown on the Working Drawings for approval location by the DCES. All inserts shall be recessed one inch. The adequacy and location of the inserts is the responsibility of the Contractor.
C740. Bearings.

Bearing plates shall be placed as shown on the Plans and to the tolerances as given in the Specifications. Special care shall be taken to assure that there is no movement of bearing plates during concrete placement. A space shall be provided on the front side of the plate to reduce a cracking tendency of the concrete in this area during prestress transfer.

Daps required in the bearing area shall preferably be made from steel plate, checked carefully for proper position, and held firmly in position. The holding device shall be designed to move with the beam during the detensioning process. If spalls or cracks in the concrete develop because of restriction in dap plate movement, the form attaching procedure shall be altered.

C750. Internal Voids.

Forms used for internal voids shall have sufficient strength to provide stability during concrete placing and to resist hydrostatic pressures during fabrication. Void forms shall be adequately held in their proper position to prevent movement during the concrete operations.

Void forms shall be sealed at their ends and spliced to make them mortar tight. For beam units to be steam cured, voids shall be vented. Void drains shall be provided in accordance with the requirements stated in Section 530.2 and shall be properly protected during the concrete placement operation.
C800. Concrete.

C810. General.

All properties of concrete are, for the most part, related to compressive strength. Engineers consider many properties of concrete in design, but usually specify compressive strength as a means of controlling all properties. It is, therefore, essential that concrete of high quality be achieved in the manufacture of prestressed concrete units.

It is the Fabricator's responsibility to produce high quality concrete in accordance with the Contract Documents. To produce concrete of high quality, the following factors must be controlled:

1. Quality of materials: sand, gravel, cement, water, and mixture.
2. Handling of materials.
3. Water-cement ratio.
4. Proportioning and mixing of materials.
5. Placing of concrete.
7. Methods of testing and handling test specimens.

Although quality control is the Fabricator's responsibility, it is the Q.A. Inspector's responsibility to verify that the concrete produced is the quality concrete required.

C820. Materials.

The Inspector shall verify, prior to commencement of work, that all materials used in the production of Portland Cement Concrete are State-approved materials in accordance with the directives of the
Department's Materials Bureau, stated elsewhere in this Commentary. The initial acceptance of a material shall in no way preclude further examination and testing of a material at any time the Q.A. Inspector suspects that the material is no longer properly represented by the accepted sample. The Q.A. Inspector shall keep the DCES properly informed of all material acceptances and rejections.

1. Portland Cement.

Each Manufacturer of Portland Cement uses a trade or brand name under which the product is sold. The actual trade or brand names and the types of cement to be used will be indicated on the Working Drawings. In the production of prestressed concrete units, normally only cement Types I, II and III are allowed. The brand name and type of cement to be used will be shown on the Working Drawings. If another type of cement is to be allowed for a particular project or a particular type required, it will be indicated in the Contract Documents and shown on the Working Drawings.

Cement shall be stored in an enclosed silo so that water or moisture contact does not occur since hardened lumps and unusable material might occur.

A sample of the cement used in the fabrication of prestressed units shall be taken by the Q.A. Inspector and submitted to the Materials Bureau of the Department at least once a week during production.
2. Ordinary Aggregate.

In general, it is required that the aggregate shall be clean and free of foreign materials such as wood, glass, and mud balls; and shall be hard (sound and durable), and properly graded with consistent gradation. Clean aggregate is necessary to assure a good bond will develop between paste and aggregate. Proper and consistent gradation permits the aggregate to occupy more space in the concrete (aggregate acts as a filler) and permits the judicious use of paste without sacrificing strength or workability. Therefore, it is essential that the Inspector examine the aggregate at regular intervals to verify that the fine aggregate and coarse aggregate continues to conform to the requirements of §703-01 and §703-02, respectively.

Aggregate segregation occurs in each handling. Ideally, aggregates should be delivered directly from the Supplier's finish screening operation to the storage bins but in all cases handling shall be kept to a minimum.

When aggregates are to be stockpiled, the site must be hard, compacted, and in a well-drained area. If contamination cannot otherwise be avoided, the area should be planked or paved. Stockpiles should be built up in horizontal or gently sloping layers. Overlap of different materials should be prevented by suitable walls or ample distance between piles.
Procedures for handling and storage of aggregates are prescribed in further detail in the following publication of the American Concrete Institute which are made a part of this Section by reference:

ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

ACT 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

3. Lightweight Aggregate.
Lightweight aggregates shall not be used, without specific approval of the DCES.

Potable water is usually satisfactory for batching concrete. Ordinarily the fact that any harmful impurities—alkaline, sulfates, salt, decayed vegetable matter, oil, sewage, excessive amounts of silt or high iron content are present will be known. Water samples shall be submitted for laboratory analysis in accordance with procedures stated elsewhere in this Commentary.

5. Admixtures.
Admixtures for prestressed concrete shall be limited to the following purposes:
Water-Reducing Admixture - An admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.
Retarding Admixture - An admixture that retards the setting of concrete.
Water-Reducing and Retarding Admixture - An admixture that combines the individual effects.

Air-Entraining Admixture - An admixture that improves workability and mix cohesion of plastic concrete, and is the single-most important factor for durability of hardened concrete.

All Admixtures shall conform to the requirements of NYSDOT §711-08, Admixtures.

Set-accelerating admixtures shall not be used in prestressed concrete.

Admixtures containing calcium chloride shall not be used in prestressed concrete.

C830. Concrete Mixtures.

1. Design Mix.

The Working Drawings shall indicate the concrete mix (for information only) that will be used to produce the concrete. The mix will be reviewed by the DCES to assure that the materials and quantities comply with the specified requirements and that it appears to be adequate to achieve the desired results. The mix shall not be modified without the approval of the DCES. In general, the cement, water, air-entraining agent, fine aggregate, coarse aggregate, and possibly an admixture shall be proportioned to produce concrete having the following properties: Workability suitable for uniform placement without excessive fluidity, when hardened, strength and durability. The Inspector shall verify that the mix is being batched and the above concrete properties are being attained.
2. Admixtures.

a. Air-Entraining Admixture.

Air-entrained concrete is required for all prestressed concrete units.

Air-entraining affects the following properties of plastic and hardened concrete: increases workability or reduces the water-cement ratio for the same degree of workability, decreases bleeding and segregation, increases resistance to freezing and thawing and to the destructive action of salt and sulphates.

The volume of entrained air shall be maintained at 7±2 percent of the total volume of concrete and continuously monitored by the Inspector to assure that: (1) enough air is entrained to accomplish the desired results and, (2) to assure that excessive air is not entrained that would reduce the strength of the concrete.

b. Water-Reducing and Set-Retarding Admixtures.

If one or both of these admixtures are to be included in the concrete mix, it shall be indicated on the Approved Working Drawings. The Inspector shall verify that the Manufacturer’s recommendations are being followed in their use. Also, whenever more than one admixture is used, he shall determine that each material is performing as required without affecting the performance of the other.

3. Water-Cement Ratio.

Concrete strength and shrinkage is dependent upon the quality of the cement paste. The quality of the paste is dependent upon the
ratio of water to cement. In general, the lower the water-cement ratio, the higher the strength and less shrinkage.

Therefore, it follows that the water-cement ratio should be held to a minimum consistent with workability for satisfactory placement. Although the Specification does not place any restriction on the water-cement ratio, the Inspector shall continuously monitor the ratio to determine the quality of the cement paste with respect to the workability of the plastic concrete.

4. Consistency of Mix.

It is essential for quality concrete that the consistency and the workability be uniform throughout production. Under conditions of uniform operation, changes in consistency, as indicated by the slump, are useful in indicating changes in the character of the material, the proportions, or the water content. The slump test, as herein described, shall be used as a measure of consistency.

Prior to batching, the Producer shall make known to the Inspector the mix slump. The Inspector shall continuously monitor the slump as required under Section 580.

Uniform consistency shall be defined as measured slumps within one inch (plus or minus) of the adopted mix slump.

C840. Tests of Concrete.

1. Introduction.

The reasons for testing fresh and hardened concrete are:

Determine properties of the plastic mix;

Determine properties of the hardened concrete;

Control the uniformity of the concrete; and
Check on quality of materials.

A test is only reliable if it is performed properly. Poor tests penalize good concrete unfairly. Quality control of concrete is as much dependent upon sound testing procedures as any other factor. ASTM standards should be carefully followed. Some actual test procedures are indicated in Appendix G of the Manual.

2. Consistency Test.

The slump of portland cement concrete shall be used exclusively to determine the consistency of plastic concrete. The slump shall be determined by the ASTM Method C-143, as described in Appendix G. The ball penetration method shall not be allowed unless specifically approved by the DCES.

The slump test for both Control Series and Cylinder Series shall be as required under Frequency Testing, C340.6. The Inspector shall reject the representative concrete batch, if the slump of the test specimen is not within the stated limits. However, if the Producer requests the batch be placed, the Inspector shall allow the placement but require a contingent Control Series be made during the placement of the concrete.

For mixes using HRWR admixtures, placement will not be allowed if the slump is not within the prescribed limits.

3. Air Content Test.

The Control Series Air Content Test shall be performed in accordance with either ASTM Methods C173 or C231, only. The Inspector shall witness the above ASTM tests. The Chace Indicator method shall be performed solely by the Q.A. Inspector.
The Air Content Test shall be performed as required under Frequency of Testing, C840.6. The Inspector shall reject the represented concrete batch, if the volume of entrained air is not within the limits stated under Section 410.1, Air-Entraining Admixture. The Chace Indicator shall not be considered accurate enough to reject the concrete batch.

NOTE: Since the Chace Indicator is an approximate method and consistent readings are dependent on the individual’s experience, it is recommended that the Inspector "calibrate" himself against a pressure test a number of times to establish a correction factor.

4. Unit Weight and Yield Tests.

The unit weight (ASTM C-138) of the concrete batch shall be performed in accordance with Appendix G.

The Inspector shall record the unit weight of the concrete batch as required under Frequency of Testing, C840.6.

The yield and relative yield of the concrete batch shall be checked by the Q.A. Inspector at intervals of his discretion. A fluctuation of 2 percent (plus or minus) in relative yield is considered acceptable. If greater fluctuations occur, retests should be conducted and the reasons for the fluctuation determined.

5. Strength Test.

a. Concrete test cylinders shall be used exclusively to determine the compressive strength of the concrete in the represented prestressed concrete unit.

The Inspector shall witness all procedures associated with the casting and testing of the concrete test cylinders.
The Specifications requires that a minimum of 4 cylinders for each unit be cast. More cylinders than the minimum are required if early breaks are to be allowed and additional cylinders are recommended to assure an adequate number for transfer break requirements. The actual number of cylinders to be taken shall be understood by the Q.A. Inspector and the Fabricator prior to casting.

b. Sampling Prior to Casting.
The concrete shall be sampled in accordance with ASTM Method C172. **NOTE: Samples should be carefully selected and be representative of the mix. Therefore, samples shall be taken from the middle of the bucket or from a chute which is under full flow of concrete.**

Molds for making test cylinders shall be in accordance with the requirements of ASTM C31 or C470, except that paper molds shall not be allowed for steam-cured concrete. The Inspector shall prohibit the use of any mold that is dirty, deformed, or does not comply with the dimensional requirements of the ASTM Specification. The test cylinders shall be made in strict compliance with ASTM Method C31, except as herein modified and as described in Appendix G. Concrete in cylinders shall be consolidated by vibration or rodding. Cylinders should be made as close as possible to the location where they will be cured and not disturbed, picked-up, or in any way handled from approximately 1/2 hour after casting.
until they are ready to be tested for transfer strength requirements.

d. Cylinder Curing.
Test cylinders shall be cured with and by the same methods as the unit they represent until the unit is approved for transfer. The Inspector shall verify that the cylinders are placed in a region of the bed representing the worst curing conditions.

After removal from the casting bed, the 28-day and early break cylinders shall be protected against damage, but subjected to the same environment as the units they represent.

e. Cylinder Capping.
The practice of capping fresh cylinders with a thin layer of neat cement paste shall not be allowed.

Hardened cylinders, unless cast or ground to within 0.002 in. of a plane surface, shall be capped prior to testing in accordance with ASTM Method C617, except that, with fast-setting sulphur compounds, compression testing can be performed 1/2 hour after the caps have been in-place.

For prestress transfer, two cylinders from each unit shall be chosen at random and shall be tested. However, the cylinders from the last unit cast shall be taken from the last batch of concrete placed in that unit. If the Q.A. Inspector ordered any contingent cylinders cast, two cylinders from each contingent set shall be tested.
The requirements for 28-day strength shall be in accordance with the Contract Documents. If contingent cylinders were cast, they shall also meet the requirements of the Specification before strength approval by the Q.A. Inspector. Testing of cylinders shall be performed in accordance with ASTM Method C39.

The Inspector shall strictly enforce the rate of loading, as a faster rate may indicate an erroneously higher strength. Cylinders that are obviously defective or damaged shall, at the Q.A. Inspector's discretion, be discarded.


a. Control Series.

The control series shall be defined as a Slump Test and Air Content Test.

b. Cylinder Series.

The cylinder series shall be defined as a Slump Test, Air Content Test, Unit Weight Measured, and Cylinder Set Cast.

c. Contingent Cylinder Series.

The contingent cylinder series shall be the same as the cylinder series, except that the Unit Weight shall not be required.

<table>
<thead>
<tr>
<th>TEST SERIES</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL</td>
<td>Every truck or bucket: prior to depositing in bed.</td>
</tr>
<tr>
<td>(SLUMP, AIR)</td>
<td></td>
</tr>
</tbody>
</table>
C950. Batching and Mixing.

The Inspector shall verify the adequacy of plant equipment, both mechanically and for required accuracy.

1. Batching.

The Inspector's primary batching tell-tale is the concrete slump. However, the two important factors in batch control are:

- Water-Cement (w/c) which controls strength;
- Water-Total Weights (w/t), which controls workability.

Therefore, it is recommended that plants include in their batching procedure an adjustment in water content for the free-moisture content of the aggregate.

2. Mixing.

The Inspector shall verify that the mixing is through with minimum segregation of aggregate.

Optimum mixing time is dependent upon the type of mixer. However, once a time has been established, over-or-under mixing shall be avoided.

C960. Placing of Concrete.

1. General.

The Specification requires that the Inspector shall approve the method of placing concrete.

In general, the basic requirement for placing concrete is that, during all stages from mixer to final placement, only methods and
equipment shall be used which result in placing concrete in a uniform, compacted condition without separation of coarse aggregate and paste. Placing equipment shall be capable of handling concrete of specified proportions so it can be readily consolidated by vibration.

2. Casting Bed Approval.

Prior to placing concrete, the Inspector shall inspect the casting bed for conformance with the unit's respective Working Drawing and tolerance requirements and, in general, that the bed is representative of quality workmanship. No concrete shall be placed until the Inspector approves the casting bed.

3. Handling of Concrete.

Since separation of coarse aggregate from the mix is the single-most important consideration in handling and depositing concrete, the Inspector shall verify that the procedure achieves this end. Separation occurring during handling will not be eliminated in the course of other operations. Therefore, it must be prevented, not corrected.

Another consideration in handling of concrete is the loss of slump, i.e., the consistency at the time of placing. Slump loss is usually caused by mixing, excessive evaporation of mixing water, high absorption of aggregates, or excessive agitation while conveying. Also, if the time between mixing and placing is too long, the mix will stiffen. In general, the concrete shall be transported in the shortest possible time and deposited into the forms while in its original mixed or plastic state. The Inspector
shall reject any batch that has started to stiffen and/or been retempered, i.e., water added and concrete remixed.

The plastic concrete shall be placed as nearly as possible, in final position, adjacent to the preceding and following batch and the whole mass consolidated by vibration. In order to produce a monolithic mass the concrete shall be deposited efficiently (speedily) and in even layers shallow enough so it may be placed while the previous layer is still plastic. The Inspector shall reject any unit exhibiting a cold joint.

4. Consolidation of Concrete.
All concrete for precast or prestressed units shall be consolidated by vibration. Generally, internal vibration shall be used on all sections that are sufficiently large to admit them. External vibrators are generally used for smaller sections and sections produced by some extrusion or slip-form processes. External vibrators may also be used to supplement internal vibrators on larger sections and on sections with areas inaccessible by internal vibrators.

Techniques to be followed in consolidation of concrete shall include the following:

a. Vibration shall be distributed so that the concrete becomes a uniformly dense and plastic mass, as evidenced by the leveled and glassy appearance of the concrete at the exposed surface and the embedment of surface aggregate.

b. Vibrators shall be used for compaction only and not for
flowing concrete along the forms, as such a practice usually causes segregation.

c. For both horizontal and vertical operation of vibrators, the spacing of points of vibration shall be so that zones of influence overlap. It should be noted that the radius through which the vibration is effective is visible at the exposed surface.

d. The vibrator shall be inserted vertically and allowed to sink due to its own weight to the bottom of the layer and be slowly withdrawn. For succeeding layers, the vibrator shall penetrate into the preceding layer.

e. Vibrators shall not be allowed to unduly hit bar reinforcement, unit inserts nor form sides.

In general, concrete must be consolidated without appreciable segregation. Over-vibration will cause aggregate to settle to the bottom, forcing paste to the surface. Also, over-vibration will cause water pockets to form under the reinforcement which will prevent necessary bond between steel and concrete. It should be noted that it is difficult to over-vibrate low-slump concrete or HRWR mixes and that under-vibration is a more probable source of poor products than over-vibration.

The effectiveness of consolidation can usually be judged by the surface condition of the concrete.

C870. Curing Concrete.

1. Introduction.

The speed with which a prestressed unit can be cast, cured, and moved from the bed is one of major economic importance.
Therefore, included in the Specification are two acceptable methods of accelerating the cure of fresh concrete.

Proper curing of fresh concrete by any method requires moisture be retained in order for complete hydration of cement to take place and to prevent formation of surface cracks due to rapid loss of water while the concrete is plastic. For all prestressed concrete operations, the curing procedure shall be well established and carefully controlled, the Inspector's attention is directed to the requirements stated elsewhere in Section 560 and to the procedure as outlined on the Working Drawings.


Enclosure. Curing shall be under a suitable moisture-retaining cover (enclosure). The Inspector shall approve the plant's enclosure as required by Section 560. The enclosure shall be fabricated of a substantial material with no holes or tears, of sufficient width to cover casting bed ground-to-ground and composite length to form a continuous cover for the casting bed, impervious to moisture and ideally have an insulating quality to minimize heat loss.

As soon as possible upon completing the casting of the first unit and each successive unit, the enclosure shall be positioned over the cast unit. The enclosure shall allow free circulation of the steam or air around the sides and tops of members.

Recording Thermometer. Because the time-temperature charts shall be considered as verification of whether the units have been cured in accordance with the approved Working Drawings, it is essential that the Inspector verify that all the requirements of the
Specification regarding "Record of Curing Temperature" (Section 560.3) are carried out.

The temperature sensors shall be carefully placed within the curing enclosures to ensure that ambient temperatures are recorded. They shall also be located approximately as follows:

For "I" Units - at the junction of the web and top flange;
For "Box" Units - at the junction of the web and top slab.

The Inspector shall periodically, during the curing cycle, correlate the time-temperature chart with a hand thermometer. The Q.A. Inspector shall record this information on his Daily Report.

3. Curing With Low-Pressure Steam.

a. Initial Curing Phase.

The plastic concrete of each unit cast shall be allowed to attain its initial set before steam is applied to elevate the concrete temperature; otherwise the elevated temperature may have a detrimental effect on the concrete strength. The delay period of initial set shall be as indicated on the Working Drawings. Initial set can be determined by ASTM C403. If the enclosure temperature is below 50°F., enough heat shall be applied to maintain the concrete at its placing temperature.

b. Final Curing Phase.

Application of live steam shall not be directed on the concrete or forms as to cause localized high temperature. During the initial application of live steam, the enclosure temperature should increase uniformly at an average rate not exceeding 60°F per hour until the curing temperature range
indicated on the Working Drawings is reached. In no case shall the enclosure temperature exceed 180°F.

As per the Working Drawings, the selected curing temperature shall be maintained until the concrete has attained the minimum transfer strength required. However, if the curing temperature range is not achieved or is erratic (in and out) for the entire or any portion of the casting bed, the Inspector may require an extension of the cure. The cure shall be extended 1 hour for every 10°F. or fraction thereof not achieved.

The Inspector shall terminate the final curing phase and approve the bed for transfer when he is satisfied that: (1) the curing procedure on the Working Drawings has been successfully completed and (2) the cylinder breaks indicate sufficient concrete strength for the units to be detensioned.


Acceleration of Cure. Radiant heat may be applied to beds by means of pipes circulating steam, hot oil, or hot water, or by electric blankets or heating elements on forms.

In general, the criteria established (temperature limits, etc.) for low-pressure steam curing shall be similar for radiant heat curing. However, due to the numerous variables associated with this method of curing, the Inspector is directed to follow the detailed procedure as adopted on the Working Drawings.

5. Non-Accelerated Cure, (Saturated Cover). This approach is based on successfully preventing moisture loss from product
surfaces. This assures a clean surface for bonding of toppings or secondary casts. In curing members by this method, longer curing times will be required to achieve desired stripping or handling strengths.

C900. Repairs.

C910. General.

It is impractical to establish fixed criteria regarding the acceptability of prestressed concrete with respect to appearance. The Specification requires well-formed matching units with overall pleasing appearance with surfaces true and even, free from rough, open or honeycombed areas, depressions or projections. However, fascia units should be superior in appearance to interior units which normally may be seen only from the bottom.

The Q.A. Inspector shall issue a Discrepancy Letter for any defect found that is mentioned under Rejection of Units, Section 585. The procedure and form letter can be found in Reports, Appendix B. Prior to issuance of the letter, the Inspector shall contact the CEU by telephone.

If surface defects such as honeycombing, aggregate or mortar pockets and excessive air bubbles are being encountered, the Inspector shall notify the Fabricator and the CEU; who may request procedural changes in vibration, number, and depth of lifts, the mix or aggregate grading to produce units with acceptable surfaces.

C920. Unformed Surfaces.

In general, the only unformed surface is prestressed concrete units is the top. This surface shall be finished as indicated on the Working Drawings.
C930. Formed Surfaces.

Concrete of the consistency which is normally placed in prestressed concrete is, by virtue of its stiffness, difficult to place without some surface flaws. This is particularly true for air bubbles trapped against flat or sloping upper surfaces of forms. Surface voids (bug-holes) have no significance structurally, but are objectionable only from an appearance standpoint. However, if excessive surface defects are encountered, the Inspector may require all exposed surfaces to be finished by bag rubbing.

If required by the Working Drawings, each strand shall be recessed to a depth of approximately one inch into the unit by flame gouging. Slag and concrete damaged by the flame shall be chipped away. The holes shall then be packed and finished in accordance with the Working Drawings.

C940. Honeycombed Areas.

The evaluation of honeycomb is dependent on several factors; namely to what extent and depth and location of the defective concrete.

Honeycombed areas will often result if there has been inadequate consolidation or leaky forms. Honeycomb will usually occur in the bottom area of a unit or near the ends. The most-undesirable place on a member for honeycomb is directly over the bearing area or for an extended area along the bottom. The Q.A. Inspector shall inform the CEU of any honeycomb area for a determination of the structural adequacy of the unit.

When honeycombed areas are approved for repair, the Q.A.
Inspector shall enforce the approved repair procedure.

C950. A principal objective of prestressing is the application of sufficient forces to concrete so members can be manufactured and placed in service without cracks. Experience has indicated complete elimination of all cracks is impractical if not impossible. Some cracks which may form during the casting and curing process may be entirely superficial, have no detrimental effect on the structural capacity of the member and close entirely upon application of the full prestressing force. However, all cracks should be regarded as potential locations for disintegration of concrete and/or areas of structural deficiency. Therefore, the Inspector shall document all cracks on the "Post Pour Inspection Sheet" and "Daily Report" and notify the CEU, who will determine the structural adequacy of the unit and any repairs required.

C960 Patching Defects.

No unit shall be patched without the consent of the DCES. The Q.A. Inspector shall witness and document all patching. All patching shall be in accordance with the Working Drawings and this Manual. No cement mortar patching shall be allowed.

In general, defects which may be approved for patching are as follows: honeycombing, surface voids, shrinkage cracks, loss of section, depression or knock-off damages.

C1000 Handling And Storage of Units.

Handling of units shall always be done with all lifting loops properly engaged.

Units shall be stored on good dunnage and in a manner that will prevent beam racking.
The Units should be spaced far enough apart so that visual inspection along the beam length is possible. No stacking of beam units should be allowed, unless it is approved by the DCES. Anchor dowel holes shall be open at the bottom to allow for drainage. The storage area shall have proper drainage.

C1100. Shipping Of Units.

All units shall be properly supported at their bearing points and adequately tied to prevent movement during shipping, unless otherwise approved by the DCES. Plastic guards or other devices shall be used to protect the concrete where anchor chains would otherwise be in direct contact with the beam. The Inspector's Stamp of Approval shall be placed on all units just prior to shipping once the unit is properly tied to the shipping trailer. Form CEU No. 5 shall be given to the transporter with instructions to give it to the EIC at the project site.
Notes:
APPENDIX D

GUIDE FOR INDEPENDENT

QUALITY ASSURANCE INSPECTORS
APPENDIX D

GUIDE FOR INDEPENDENT QUALITY ASSURANCE INSPECTORS

D100. DIARY

1. One New York State Inspection Diary Per Project maintained by Senior Inspector in charge.
2. Must be bound. (No Looseleaf)
3. Separate sheet for every day.
4. Rejection record must be referenced to or included in Diary.

D200. CONTRACT DOCUMENTS

1. New York State Department Specifications - W/Addenda.
2. Proposal and Addenda.
   1. Approved prior to start of fabrication.
      a. Material ordering prior to Working Drawing approval is at Contractor's risk.

D300. REQUIRED CERTIFICATES

D300.1 From Prestressing Strand Manufacturer stating that strand conforms to ASTM-A-416, (Required For Delivery)

1. Typical load strain curves including:
   a. The breaking strength.
   b. The elongation at rupture.
   c. The load at 1% elongation.
   d. The date of making the tests.
2. Letter from DCES stating strand acceptance.
D300.2 Certificates of New York State materials acceptance. (Cement, aggregates, admixtures)

D300.3 Calibration (within the past 12 months) of the concrete cylinder testing machine.

D300.4 Calibration (within the past 12 months) of each pressure gauge and hydraulic jack combination used for initial tensioning by load.

D300.5 Calculations by the Fabricator indicating required elongation of the prestressing strand to achieve jacking force.

D300.6 Calculations for thermal effect on strand elongation. (If Necessary).

D300.7 Certificate from Manufacturer for bearing plates cast in unit.

(A.S.T.M. Designation)


D400. **INSPECTION-PRIOR TO CASTING**

D400.1 **Concrete.**

1. Storage and handling of aggregates.

2. Storage bins for cement.

3. Admixtures.

4. Proportioning of component materials.

5. Measuring equipment.

6. Discharge of materials to mixers.

7. Mixers.

8. Design mix.

   a. Compensation for any surface moisture in the aggregates. (On A Daily Basis)

D400.2 Beds.
1. Forms.
   a. Alignment.
   b. Sealed against mortar leakage.
   c. Fixed against movement.
   d. Properly cleaned.
   e. Release agents.

2. Internal voids.


4. Anchor dowel and transverse tie rod and blockouts.

5. Beam end batters.

D400.3 Tensioning.

1. Strand surfaces.

2. Stringing of strands.

3. Strand vises.

4. Tensioning of strands.
   a. Initial tensioning.
   b. Final tensioning.
      1. Measurement of elongation:
         Straight strand.
         Draped strand.

5. Wire failure in strands.

6. Strand unbonding.

D400.4 Non-Prestress Steel Reinforcement.

1. Steel cages. (If Used)

2. Tack welding of cages. (Only Additional Bars Are Allowed To Be Tack Welded)
3. Condition of reinforcement.

4. Location of reinforcement.

D400.5 Hardware.

1. Bearing plates.
   a. Condition.
   b. Location.

2. Inserts.
   a. Location.

D400.6 Curing Covers.

1. Type.

2. Condition.

D500. INSPECTION - DURING CASTING

1. Handling of Concrete.
   a. Mixing concrete.
   b. Transporting concrete.
   c. Placement of concrete in units.
   d. Vibration of concrete in units.

2. Air content test.


4. Unit weight.


6. Yield test, as determined by the Q.A. Inspector.


D600. INSPECTION - CURING AND DETENSIONING

D600.1 Curing.

   a. Placement of curing covers.
b. Placement of time-temperature clocks along bed.
c. Initial set.
d. Temperature of steam along bed.
e. Checking of clocks during curing period.

**D600.2 Testing of Concrete Cylinders for Detensioning of Bed.**

**D600.3 Detensioning of Bed.**

1. Removal of forms.
2. Strand detensioning.
   a. Burning sequence. (If Required)
   b. Hold-down release.

**D700. STORAGE**

1. Condition of storage area.
2. Condition of dunnage.
3. Handling of units to storage area.
4. Placement of units in storage area.

**D800. TOLERANCES**

1. Document all cracks.
2. Unit dimensions.
3. Camber reading.
   a. Immediately after placement in yard.
   b. Just prior to shipping.
4. Location of appurtenances.
5. Unit rejection.
   a. Note on daily report.
   b. Prepare letter of discrepancy.
   c. Diary reference.
D900. FINISHING

1. Beam ends.
2. Coating of exposed reinforcing steel with neat cement.
3. Cleaning of chamfer.
4. Remedial finishing. (If Required)
   a. Patching.
   b. Bag rubbing.
   c. Crack repair.

D1000. SHIPPING

1. Testing of cylinders for 28-day strengths.
2. Loading of units for shipment.
   a. Proper support.
3. Approval for shipping.
   a. Inspection acceptance stamp. (After Loading)
   b. Shipping form (Form CEU No. 5) completed and signed.

D1100. EQUIPMENT AND TOOLS

1. Tape measure.
2. Flashlight.
3. Feeler gauges.
4. Carpenter's square.
5. Safety attire. (Specifically - Hard Hat)
6. Thermometer. (0°F to 200°F)
7. Chase Air Indicator. (If Required)

D1200. INSPECTOR'S DAILY ROUTINE

1. Provide "In Process" plant inspection.
2. Provide "Final" unit inspection.
3. Prepare letter of discrepancy. (Form CEU No. 6)

4. Prepare shipping reports. (Form CEU No. 5)

5. Maintain prestressed post pour inspection sheet. (Form CEU No. 3)

6. Write daily report (Form CEU Nos. 1 & 2) and mail to Deputy Chief Engineer (Structures), twice a week.

7. Complete daily log in Diary before leaving plant.
APPENDIX E

REPAIRS
REPAIRS

APPENDIX E

E100. **General.** Written repair procedures, including sketches, color photographs as necessary to describe the deficiencies and the proposed repair shall be prepared by the Contractor (Fabricator) and submitted to the DCES for approval.

E100.10 **Required Information.** When written repair procedures are required for the repair of defects, repair procedure drawings shall be prepared to show the defects in plan view, elevation and section as necessary to adequately locate and describe the defect and the proposed repair. A space shall be provided on the sheet for the Inspector's signature to show that he has inspected the defect and has found that the drawing accurately describes the defect as it appears prior to repair. The proposed repair procedure shall be described in detail including, where applicable, the following information, listed in a proposed sequence of operation:

1. The reason or probable reason why the defect occurred.
2. Color pictures and sketches showing plan views and sections indicating the size of the defect.
3. Removal of Unsuitable Material. Prior to beginning the repair, all spalled, honeycombed, or disintegrated concrete shall be removed by chipping the unsuitable material away until sound concrete is reached. Sound concrete shall be as defined under Rejection of Units, Section 585. Chipping tools shall be pneumatic. The type and size of tools and the depth at which sound concrete is reached shall be determined by the Inspector.
4. Blast Cleaning Surfaces. All surfaces to be repaired shall be thoroughly blast-cleaned with No. 40 boiler slag grit or No. 2 sandblast sand, or as ordered by the Inspector.

5. A statement whether the proposed solution is a structural or a non-structural repair procedure and why.

6. Proposed repair preparation and materials requirements if different from Structural and Non-Structural Repair Procedures listed below.

E100.20 **Structural Repair.** Repair, designated as "structural" by the DCES, shall be made with an epoxy grout comprised of an epoxy resin system (721-01), or an epoxy polysulfide grout (721-03), mixed with fine aggregate. The grout shall be mixed and placed in accordance with the following:

1. **Mixing.** No mixing shall be started until all preparations have been made to use the grout. The Contractor shall be familiar with the working life limitations of the epoxy being used, and his operations shall be governed accordingly. Mixing shall be carried out in strict accordance with the Manufacturer's instructions and the following:

   a. Mixing shall be done as close as possible to the portion to be repaired.

   b. All necessary equipment for mixing and placing shall be present at the site, and in good working order, prior to the start of mixing.

   c. The grout shall be proportioned by volume in the approximate ratio of two (2) parts fine aggregate to one (1) part epoxy. The exact ratio of sand to epoxy resin system shall be determined on-site to produce a dense void-free grout.
d. Dry, fine aggregate shall be placed in the mix container first.
   It shall be thoroughly agitated prior to the addition of the epoxy.

e. The two components of the epoxy system shall be thoroughly mixed together before added to the fine aggregate.

f. The epoxy shall be added to the fine aggregate slowly, but mixing time shall not exceed three minutes.

g. All grout, in any individual batch, shall be used within 25 minutes after the start of mixing of the two components to create the epoxy system.
   All grout not used within the time limit shall be discarded.

h. The epoxy grout shall not be retempered.

i. No direct, solvent, thinner or other foreign material shall be added to either the individual components or the epoxy mixture.

2. Placing. The epoxy grout shall be placed against a clean, primed, receiving surface, in accordance with the following:

a. The receiving surface shall be cleaned of all oil, grease, or other material which may prevent effective bond, immediately prior to priming the surface with neat epoxy (epoxy without aggregate).

b. The priming of the receiving surface shall be done immediately prior to the placement of the epoxy grout.

c. The epoxy grout shall be placed quickly and continuously. It shall not be overworked.

d. The temperature of the receiving surface shall be above 50°F at the time of grout placement.

e. Grout placement shall not be permitted when ambient temperatures are 50°F or lower, unless methods of protection, acceptable to the
Inspector, are employed. Methods of protection, if permitted, shall be continued for a period of 15 hours following grout placement. The 15 hour period may be shortened, at the discretion of the Inspector, but, under no circumstances will it be less than 12 hours. Methods of protection, if permitted, are conveniences granted by the State. As such, they are not considered extra work, and, therefore, they are not entitled to extra compensation.

f. Upon completion of grout placement, the new surface of the repaired area shall be flush with the adjacent surfaces, unless the design of the unit specifically required otherwise.

g. On surfaces which will be exposed to view after installation, the repaired area shall be color matched to the adjacent surfaces by use of cement dust, or other means acceptable to the Inspector.

E100.30 Non-Structural Repair. Repair, designated as "non-structural" by the DCES, shall be made with either of the following:

1. Epoxy grout composed of epoxy resin system (§721-01) or epoxy polysylfide grout (§721-03), and fine aggregate, OR

2. Epoxy repair paste (§721-05).

The Contractor has the choice of materials.

a. Mixing. Epoxy grout shall be mixed in accordance with the requirements of "1. MIXING" as given under "Structural Repair" (E100.2).

Epoxy repair paste shall be mixed in strict accordance with the Manufacturer's instructions.

b. Placing. Placing of either material shall be done in accordance with the requirements of "2. PLACING", as given under "Structural Repair" of this Subsection.
E200. LOAD TEST PROCEDURE

1. **General.** If a load test is required, it shall generally adhere to the procedures indicated below. The actual procedure shall be as approved by the DCES.

2. The beam shall be placed in a level position on solid non-yielding supports. The bottom of the beam shall be approximately three (3) feet above the ground to permit inspection of the bottom flange.

3. The beam supports shall be at the same location along the longitudinal axis of the beam as it was designed for. The bearings shall be the project bearings or hard wood.

4. The camber in the beam with no applied load shall be measured.

5. Loads shall be applied in at least three (3) increments at the third points and deflections monitored. Three extensometers shall be provided to measure the deflection. The travel on the extensometers shall be at least three (3) inches.

6. **After the total load is on the beam, the deflection shall be measured, the load removed, and the residual deflection determined. The test will be considered satisfactory if no damage, as determined by the DCES, appears in the beam with the load being maintained for one (1) hour and provided that the recovery shall be at least 90 percent on removal of the load. The required recovery shall occur within one (1) hour after removal of the load.
APPENDIX F

SAMPLE WORKING DRAWINGS
DESCRIPTION OF FABRICATING FACILITIES FOR UNIT PRODUCTION

1. Cutting
   a. Cutting method
      i. Guillotine
      ii. Oscillating blade
   b. Type of machine

2. Forming Equipment
   a. Type of press
   b. Type of forming mold

3. Welding Equipment
   a. Type of welder
   b. Type of filler metal

4. Finishing Equipment
   a. Type of equipment
   b. Type of finish

5. Quality Control Equipment
   a. Type of test equipment
   b. Type of inspection

TENSIONING PROCEDURE:

1. Strain Shield
2. Strand Band

TOLENCES:

CURING PROCEDURE:

CONCRETE DATA:

1. Concrete Strength
   a. Compressive
   b. Flexural
   c. Split Tensile

2. Steel Reinforcement Information
   a. Diameter
   b. Grade
   c. Type

3. Test Cylinders

STEEL DATA:

Preforming Strand Manufacturer

STRAIN ELONGATION CALCULATIONS:

1. Strain
2. Elongation
3. Length
4. Stress

DETECTENTION PROCEDURES:

FINISHING:

1. Cop Action
2. Cable Cover

PRODUCTION SCHEDULE:

GUIDE LINE WORKING DRAWINGS

1. Drawing 123
   a. Dimension
   b. Scale
   c. Title

2. Drawing 124
   a. Dimension
   b. Scale
   c. Title

3. Drawing 125
   a. Dimension
   b. Scale
   c. Title
APPENDIX G

CONCRETE TEST PROCEDURES
APPENDIX G

SLUMP TEST PROCEDURE
ASTM C-143

I. SCOPE

This test method prescribes the procedure for determining the slump of concrete.

II. GENERAL

The slump test is a test used to measure the consistency or stiffness of fresh (plastic) concrete. The test is conducted by placing a sample of concrete into a mold (slump cone) in a prescribed manner, removing the mold and then measuring the distance the unsupported concrete settles or slumps. This test is an indirect measure of the amount of water within a mix. The amount of water must be controlled since, for a given mix design, large increases in water content will lower strength, durability, and will cause the mix to segregate.

III. SAMPLE

The sample of concrete shall be obtained in accordance with Sampling Freshly Mixed Concrete, ASTM C-172.

When the concrete is mixed by a mobile-concrete mixing unit, the samples must sit from 3 to 5 minutes before running the slump test.

IV. EQUIPMENT

The following equipment is required for the slump test:

1. Standard slump cone as defined in ASTM Designation C-143.

2. A round, straight steel rod, 5/8" in diameter, 24" in length, with a hemispherical tip.

3. A moist, non-absorbent, level, surface firmly supported.

4. A scoop and ruler.
1. DAMPEN INSIDE OF SLUMP CONE WITH WATER.

Place slump cone on a level, moist non-absorbent surface that is firmly supported and free from vibrations.

The cone shall be held firmly in place by the Inspector standing on the 2 foot pieces. It is imperative that the Inspector not remove his weight from the foot pieces at any time during the filling of the cone.

2. The cone is to be filled and rodded in three (3) layers; each layer equal to one-third of the volume of the slump cone.

NOTE: One-third of the volume of slump cone fills it to a depth of about 2½"; two-thirds of the volume fills it to a depth of about 6".

3. Rod each layer with 25 strokes of the tamping rod, uniformly distributing the strokes over the cross-section of each layer.

For the bottom layer, this will necessitate inclining the rod slightly and making approximately half of the strokes near the perimeter and then progressing with vertical strokes spirally toward the center.

Rod the bottom layer throughout its depth.
4. Rod the second layer and the third layer each throughout its depth, just penetrating into the underlying layer.

When filling the top layer, heap the concrete above the cone before rodding is started. While rodming the top layer, add additional concrete, when necessary, to keep an excess of concrete above the top of the cone at all times.

5. After the top layer has been rodmed, strike off the concrete by means of a screeding and rolling motion of the tamping rod, being certain that no further tamping or compaction of the material occurs.

Clear away any spilled concrete from the base of the slump cone.

6. Pressing down firmly on the slump cone handles, remove feet from the foot pieces.
7. Raise the slump cone vertically with a steady upward lift, taking approximately 5 seconds. No lateral or torsional motion shall be imparted to the concrete.

8. Immediately measure the slump to the nearest \( \frac{1}{8} \)" by determining the difference between the height of the slump cone and the height over the original center of the base of the specimen. Record the results in Diary and Daily Report.

NOTE: If a decided falling away or shearing off of concrete from one side or portion of the mass occurs, disregard the test and make a new test on another portion of the sample.

-- CLEAN YOUR EQUIPMENT --
APPENDIX G

CONCRETE CYLINDER - FABRICATION PROCEDURE
ASTM C-31

I. SCOPE

This test method prescribes procedures for the fabrication and curing of concrete compressive test specimens.

II. GENERAL

Concrete cylinders are cast so that the compressive strength properties of the mix can be determined. Cylinders are cast by placing the plastic concrete in molds in a prescribed manner. The specimens are cured at the fabrication site in the same manner as the concrete units they represent and as indicated on the Working Drawings. The compressive strength test consists of measuring the maximum load carried by a cylinder before failure. The compressive strength is calculated by dividing the failure load by the cross-sectional area of the cylinder.

III. SAMPLE

The sample of concrete shall be obtained in accordance with Sampling Freshly Mixed Concrete, ASTM C-172.

IV. EQUIPMENT

The following equipment is required for the fabrication and curing of concrete compressive test specimens:

1. Molds - Molds for compression test specimens shall be in accordance with the requirements of ASTM C-31, except that paper molds will not be allowed when steam curing is used. They shall be cylindrical in shape and have inside dimensions of 6-inches in diameter by 12-inches in height.

2. Tamping Rod - A round straight steel rod 5/8-inch in diameter and approximately 24-inches in length. The tamping end shall be rounded to a hemispherical tip.

3. Sample Container, scoop, and trowel.

4. Vibrating Element - The ratio of the diameter of the cylinder to the diameter of the vibrating element shall be 4.0 or higher (preferably 1" diameter head).
V. TEST PROCEDURE

A. Rodding

1. Place the cylinder molds on a clean, smooth firmly supported level surface, to insure that the bottom of the molds do not become dented or punctured during rodding.

2. Fill the molds in rotation, placing a scoopful of concrete first in one and then in the other, until each mold is 1/3 full. In placing each scoopful of concrete, move the scoop around the top edge of the mold to insure symmetrical distribution of the concrete within the mold. The concrete may be further distributed by use of the tampering rod prior to the start of rodding.
3. Rod the bottom layer throughout its depth 25 times with the tamping rod, evenly distributing the strokes over the cross-section of the mold. After rodding, tap the sides of the mold lightly with the mallet to close any voids.

4. Fill the molds in the same manner as Step 3 until each mold is 2/3 full. Rod this second layer with 25 strokes, just penetrating into the layer below (about 1"). Tap the sides with the mallet.
5. Fill the molds to overflowing when placing the top layer and rod 25 times in the prescribed manner.

After rodding of the top layer is completed, tap the sides of the mold with the mallet to close voids left by the rodding operation.

6. Strike-off excess concrete with a rolling and scraping motion of the tamping rod and then trowel finish to obtain a smooth surface.

Identify the cylinders with a marking pen, or other suitable means, that will not be affected by water or moisture. Do not inscribe numbers or letters on the tops of the cylinders with a sharp instrument. The tops must remain smooth.
B. Vibration

1. Same as No. 1 Rodding.

2. Same as No. 2 Rodding, except the molds shall be filled 1/2 the mold height.

3. In compacting the specimen, the vibrator shall not be allowed to rest on or touch the bottom or sides of the mold. Carefully withdraw the vibrator in such a manner that no air pockets are left in the specimen. After vibration of each layer, tap the sides of the molds to ensure removal of large entrapped air bubbles at the surface of the mold.

4. Use three insertions of the vibrator at different points for each layer. Allow the vibrator to penetrate through the layer being vibrated and into the layer below, approximately 1 inch.

5. Fill the mold to overflowing and vibrate as required by 4., above.

6. Same as No. 6 Rodding.

VI. CURING CYLINDERS

1. The specimens shall be cured with and by the same methods as the unit they represent until the unit is approved for transfer or lifting. After removal from the casting bed, the 28-day and early break cylinders shall be protected against damage but subjected to the same environment as the units they represent.
APPENDIX G

UNIT WEIGHT AND YIELD TEST PROCEDURE
ASTM C-138

I. SCOPE

This method prescribes the procedure for determining the weight per cubic foot of freshly mixed concrete, yield and relative yield.

II. GENERAL

Unit weight testing shall be performed at the same frequency and from the same concrete sample as that used for test cylinders.

III. SAMPLE

The sample of concrete shall be obtained in accordance with Sampling Freshly Mixed Concrete, ASTM C-172.

IV. EQUIPMENT

1. A container of known volume. The base container of the pressure air meter is suitable as it has a known volume of 0.25 cu. ft. and is large enough to accommodate the maximum size of aggregate normally allowed.

2. A scale of adequate capacity with graduations at least as small as 0.02 pounds.


V. TEST PROCEDURE

1. Dampen the inside of the container and then fill it with concrete in the same manner prescribed for the pressure air meter - i.e. three (3) layers of equal depth, rodding each layer 25 times with the tamping rod and rapping the sides of the bowl with the mallet to close the voids.
2. After the third layer has been rodded 25 times and the bowl tapped with the mallet, strike-off excess concrete with the strike-off bar. **EXTREME CARE** should be taken to insure that the surface is flush with the top of the container. Any error caused by the concrete surface being high or low will be multiplied by 4 when a 4 cubic foot container is used. Another satisfactory method for the final strike-off is the use of a thick glass plate.

3. Clean the outside of the container of any adhering concrete or mortar.

4. Weigh the concrete filled container to the nearest 0.02 pounds. If a glass plate is used for final strike-off, it should be left in-place during the weighing.

VI. COMPUTATIONS

A. Unit Weight

Calculate the weight per cubic foot (unit weight) of concrete as follows:

\[ \text{Unit Weight} = W = \frac{W_1 - W_T}{V} \]

Where:

- \( W \) = Weight of concrete in pounds per cubic foot.
- \( W_1 \) = Weight of concrete + container + glass plate (if used) in pounds.
- \( W_T \) = Weight of container + glass plate (if used) in pounds.
- \( V \) = Volume of container in cubic feet.

Example:

\[ V = 0.25 \text{ cu. ft.}, \ W_T = 12.74 \text{ lbs.}, \ W_1 = 49.86 \text{ lbs.} \]

Find \( W \):

\[ W = \frac{49.86 \text{ lbs.} - 12.74 \text{ lbs.}}{0.25 \text{ ft.}^3} = \frac{37.12 \text{ lbs.}}{0.25 \text{ ft.}^3} = 148.48 \text{ lbs./ft.}^3 \]
B. Yield

Determine the volume of concrete (yield) produced as follows:

\[ S = \frac{W_C + W_S + W_A + W_W}{W} \]

Where:

- \( W_C \) = Recorded batch weight of cement in pounds.
- \( W_S \) = Recorded batch weight of sand in pounds.
- \( W_A \) = Recorded batch weight of coarse aggregate in pounds.
- \( W_W \) = Total weight of mixing water added to batch in pounds.
  (1 gallon = 8.345 lbs.)
- \( S \) = Actual volume of concrete produced (in cubic feet).
- \( W \) = Measured unit weight of concrete, in pounds per cubic foot.

Example:

Find \( S \)

\[ W = 148.48 \text{ lbs./ft.}^3 \text{ from previous wt. determination.} \]
\[ W_C = 4,210 \text{ lbs.} = \text{recorded batch weight of cement.} \]
\[ W_S = 3,640 \text{ lbs.} = \text{recorded batch weight of sand.} \]
\[ W_A = 16,690 \text{ lbs.} = \text{recorded batch weight of \#1, \#2, \& \#3 stone.} \]
\[ W_W = 2,080 \text{ lbs.} = \text{weight of mixing water added to batch.} \]

For truck mixers and paving mixers, convert gage or meter readings to pounds. Central mix plants record the water added in pounds or in gallons.

\[ S = \frac{16,690 \# + 3,640 \# + 4,210 \# + 2,080 \#}{148.48 \text{ \#/ft.}^3} = 212.96 \text{ cu. ft.} \]
C. Relative Yield

Relative Yield is the ratio of actual volume of concrete produced to the volume as designed for the batch. It may be expressed in percent and shall be calculated as follows:

\[
Y = \frac{S}{V_d} \times 100
\]

Where:

\[Y\] = Relative yield expressed in percent.

\[S\] = Actual volume (yield) of concrete produced in cubic feet.

\[V_d\] = Volume of concrete which the batch was designed to produce in cubic yards.

Example:

Find \(Y\)

\[S = 212.96 \text{ cubic feet of concrete produced (yield)}\]

\[V_d = 8 \text{ cubic yards}\]

\[
Y = \frac{212.96}{27(8)} \times 100 = 98.6\%
\]

A fluctuation of ±2 percent in relative yield is considered normal. If a greater fluctuation occurs, a retest should be conducted and the reason for the fluctuation determined.
APPENDIX G

AIR CONTENT TEST PROCEDURE - PRESSURE METHOD

ASTM C-231

I. SCOPE

This test method prescribes the procedure for determining the air content of freshly mixed concrete using the Washington-type pressure air meter.

II. GENERAL

The air content test is used to measure the volume of air bubbles within a sample of plastic concrete.

Air bubbles of microscopic size are intentionally put into concrete to provide resistance to the effects of freezing and thawing on hardened concrete, to increase durability, to reduce the requirements for water in the mix, to improve the workability and finishing properties and to reduce segregation of the plastic concrete. Concrete with air contents lower than specified will not be durable. Concrete with excessively high air contents will have both lower strength and lower durability.

The pressure method described herein determines the air content of freshly mixed concrete by allowing a known volume of air at a certain initial pressure to expand into a container filled with fresh concrete, thereby compressing the entrained air. The amount of air in the concrete is proportional to the decrease in pressure and may be read directly from a gage as percent air.

This Procedure is not applicable for Lightweight Concrete. For Lightweight Concrete use ASTM C-173.

III. SAMPLE

The sample of concrete shall be obtained and remixed in accordance with Sampling Freshly Mixed Concrete, ASTM C-172.

When the sample is obtained from a mobile concrete mixing unit, the air pot should be filled, consolidated and struck off within three (3) minutes of sampling.

IV. EQUIPMENT

A. Description

The equipment described below is a Washington-type air meter manufactured by the Concrete Specialties Company. It is in general use by the Department and is called the Press-Dr-Meter. There are numerous other designs of pressure type air meters and any meeting the requirements of ASTM Designation C-231 are acceptable.
The meter consists of the following components:

1. Base Container - A flanged cylindrical metal container sufficiently rigid to limit its expansion. The upper surface of the container is machined smooth where it fits the cover so as to be pressure tight. The container has a volume of 0.25 cu. ft.

2. Cover Assembly - A metal cover assembly, the rim of which is gasketed to provide a pressure tight fit with the base container when the two are clamped together. The cover assembly includes an air chamber, a pump for developing pressure in the air chamber, a valve for bleeding the air chamber to atmospheric pressure, an operating valve for allowing air in the air chamber to enter the base container, petcocks which will release air in the container directly to the atmosphere, and a pressure gage with a suitable range and calibrated to read directly the percent of air.

3. Calibration Vessel - A cylindrical measure having a known volume which is used to calibrate the meter.

4. Calibration Tubes - A straight piece and a curved piece of tubing, threaded at one end which are utilized in the calibration of the meter.

5. Miscellaneous Equipment - Scoop, rubber syringe, mallet, strike-off bar, and a steel tampering rod of 5/8-inch diameter with hemispherical tip and at least 12-inches in length.

Air meter and equipment necessary to perform an air test. Air meter and equipment necessary to calibrate the meter.
B. Maintenance and Repair

It is essential that the air meter is cleaned thoroughly after each use, making sure that all valve orifices are clean.

The air meter should be transported in its case to protect it from damage.

Minor repairs such as replacements of gaskets, petcocks, gages, etc. may be accomplished by Plant personnel.

V. CALIBRATION

A. General

The calibration procedure described below is for the Press-Ur-Meter. Other designs should be calibrated by following the instructions supplied by the Manufacturer.

The calibration of the air meter involves filling the meter with water and then removing known volumes of water and adjusting the meter to read corresponding percentages of air. The air meter should be calibrated initially at the start of fabrication and periodically during production.

B. Procedure

1. Fill the base full of water. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Clamp cover on the base with tube extending down into the water.
2. With both petcocks open, add water with the syringe through the petcock having the pipe extension below, until all air is forced out opposite petcock. Leave both petcocks open.

3. Screw the curved tube into the petcock having the pipe extension below. Pump up the air pressure in the upper chamber to a little beyond a selected trial initial pressure line. Allow a few seconds for the compressed air to cool to normal temperature and then bring the gage needle to the selected initial pressure line by bleeding off air and tapping the gage lightly with the fingers. Close both petcocks.

4. Press the thumb lever to release the air into the measuring bowl. Depress again to check that the needle has really stabilized. The gage should read 0.02 ± 0.1.
5. By pressing on the thumb lever and controlling the flow with the petcock lever, fill the 5% calibration vessel level full of water.

6. Release the air at the free petcock. Open the other petcock and let the water in the curved pipe run back into the base. There is now a 5% air void in the base.

7. With both petcocks open, pump up the air pressure to a little beyond a selected trial initial pressure line. Allow a few seconds for the compressed air to cool to normal temperature and then bring the gage needle to the selected initial pressure line by bleeding off air and tapping the gage lightly with the fingers.
8. Close both percocks and depress the thumb lever. Holding the thumb lever down, tap the gage lightly with the fingers and allow the needle to stabilize. Release the thumb lever for several seconds and then depress again to check that the needle has really stabilized. The gage should read 5.0% ± 0.1%.

9. If the gage does not register within the desired range, select another initial line and repeat Steps 6 and 7. When the gage reads correctly, withdraw additional water in the same manner as before and check results at 10%.

10. If the gage does not register within an estimated ±0.2% of 10%, remove the glass from the pressure gage and set the gage needle to 10% by turning the recalibrating screw located just below and to the right of the gage needle. A recheck should be made on the 5% reading.

11. When the correct initial line has been determined and the meter is properly calibrated, attach a tag to the meter cover with the date of calibration, proper initial line, and name of person who calibrated the meter.
VI. TEST PROCEDURE

1. Dampen the inside of the base container and then fill it one-third full with concrete which has been properly sampled and remixed. Rod this layer throughout its depth with 15 strokes of the tamping rod, evenly distributed over the cross-section.

2. After rodding, rap the sides of the container smartly 10 to 15 times with the mallet to close the voids left by the tamping rod.

3. Fill the base container two-thirds full and rod 25 times, evenly distributing the strokes over the cross-section and just penetrating into the layer below. Rap with the mallet as before.
4. Slightly overfill the container when placing the top layer. Rod 25 times and rap with the mallet as before.

5. Remove the excess concrete by sliding the strike-off bar across the top flange with a sawing motion until the bowl is level full.

**NOTE:** Precision in strike-off is not necessary in this case. An error of about 1/8" in strike-off will only induce an error of approximately 0.08% in the air content reading.

6. Wipe the top edge of the base container clean and clamp the cover on with both petcocks open. Clamps opposite each other should be closed simultaneously.
7. Introduce water into the base container through one of the petcocks with the syringe until water flows out the other petcock free of air bubbles. While introducing the water, tap the sides of the container gently with the mallet to insure removal of all air from the top of container.

8. Leaving the petcocks open, pump up the pressure in the air chamber to slightly beyond the proper initial line.

NOTE: If the initial line is not known, then the meter must be calibrated in accordance with Section V.

9. Allow a few seconds for the compressed air to cool to normal temperature and then bring the gage needle to the proper initial pressure line by bleeding off air and tapping the gage lightly with the fingers.
10. Close both petcocks and depress the thumb lever to release air into the base container. While holding the thumb lever down, tap the sides of the airpot sharply with a mallet and then, with the thumb lever still depressed, tap the gage lightly with the fingers and allow the gage needle to stabilize.

Release the thumb lever and read or estimate the percent of air indicated on the gage to the nearest 0.1%. The test value shall be recorded in the Q.A. Inspector's Diary and Daily Report.

Release the pressure in the container by opening the petcocks. Remove the cover and thoroughly clean the equipment.