

PRECAST CONCRETE TECHNICIAN STUDY GUIDE

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GEORGIA DEPARTMENT OF TRANSPORTATION OFFICE OF MATERIALS AND RESEARCH

STANDARD OPERATING PROCEDURE 3 QUALITY CONTROL AND QUALITY ASSURANCE OF PRECAST/PRESTRESSED CONCRETE MEMBERS AND STRUCTURAL PRECAST CONCRETE MEMBERS

I. GENERAL

This Standard Operating Procedure presents basic principles of a program which insures that precast/prestressed concrete members and structural precast concrete members are produced in compliance with the Plans, approved drawings, and specifications. The Office of Materials and Research will administer the program. Precast/prestressed concrete members and structural precast concrete members produced under this program may be accepted at the jobsite without additional inspection or testing, provided they arrived properly documented and undamaged.

Precast/prestressed concrete members and structural precast concrete members that are used in Department work shall be manufactured at a Certified Plant. Certified Plants are defined as those plants with a Department approved quality assurance program and with an acceptable record of production of quality products. Certified plants will be classified into one of two groups: "A" Plants or "B" Plants.

Classification A Plants are defined as those plants that have a quality control supervisor within the company organization who supervises a Department approved quality assurance program in accordance with the procedures outlined in this SOP.

Classification B Plants are defined as those plants which employ a testing firm or consultant to perform the necessary quality assurance functions. The consultant in charge of quality control will be approved by the Department and shall have the same responsibilities as the quality control supervisor for Class A Plants.

The objective of the program is to assure that only those materials that meet the Department standards are used for Department work and that production procedures produce acceptable concrete members.

Precast/Prestressed Concrete Members and Structural Precast Concrete Members are defined as precast concrete items for bridges and structures produced at a casting facility and transported to the project site and incorporated into the construction work. This Standard Operating Procedure is to be used for both prestressed and non-prestressed concrete members as it applies to each of these different precast items. Items included are precast/pretensioned, precast/posttensioned, precast/pretensioned-post tensioned, precast bridge, and structural precast, concrete members. The terms "precast/prestressed concrete" and "structural precast concrete" hereinafter will be referred to as "concrete members".

II. PREREQUISITE AND PROCEDURE FOR PLANT CERTIFICATION

Precast/Prestressed and Structural Precast concrete producers shall submit a written application for Plant Certification to the State Materials and Research Engineer annually. This application shall be submitted no later than December 1 of each year in order to remain an approved source for the following year. This application shall include the following items:

1. The company name, the plant address, and the principal officers of the company, including the plant manager, plant engineer, production superintendent, and the quality control supervisor or consultant in

charge of quality control.

2. An outline of the producer's quality assurance program. The program must equal the program outlined herein and specify the sampling and acceptance testing frequencies of all materials used in production inspections which insures, (1) stressing compliance, (2) proper tendon and reinforcement location, and (3) dimensional tolerances.

3. A producer's guarantee stating that all concrete members furnished for use in Georgia Department of Transportation projects are warranted to meet the specifications. The certification to be submitted by the producer shall contain the following or similar wording:

"The undersigned guarantees that all concrete members to be furnished by (Producer) from (Location) for use on Department of Transportation projects in the State of Georgia have been manufactured under strict quality control, and will meet the applicable specifications for the type of concrete member shipped, and that all tests are performed in accordance with the latest AASHTO Standard Methods. (Producer) agrees to have the plant and plant laboratory checked at regular intervals by a representative of the Georgia Department of Transportation, Office of Materials and Research. (Producer) will comply with the Georgia Department of Transportation Standard Operating Procedures for "Quality Control and Quality Assurance of Precast/Prestressed Concrete Members and Structural Precast Concrete Members," Laboratory SOP-3."

The guarantee shall be signed by a responsible officer of the company with authority to bind the company to contract and shall be notarized.

Producers applying (or reapplying after any period of unapproved status) for certification after January 1, 2011 shall be certified as follows:

Producers of prestressed concrete bridge beams shall be certified by the Precast / Prestressed Concrete Institute (PCI) in Category B4 (or higher).

Producers of prestressed products other than bridge beams shall be certified by the Precast / Prestressed Concrete Institute (PCI) in Category B2 (or higher).

Producers of precast non-prestressed shall be certified by either the Precast / Prestressed Concrete Institute (PCI) in Category B1 (or higher) or the National Precast Concrete Association (NPCA).

Producers shall submit proof of certification as an active member in good standing with PCI or NPCA as part of the initial application and yearly application.

The PCI or NPCA certification requirement shall not apply to producers approved prior to January 1, 2011 who maintain continuous GDOT certification. Any period of unapproved status for any reason, either voluntary or involuntary, will require PCI or NPCA certification as outlined above for approval.

Applicants for plant certification will schedule an initial inspection for plant approval with the Department. If the results of the initial inspection and examination indicate an apparent ability to consistently furnish uniform concrete members which conform to the Specifications, the plant may be certified to perform work for the Department.

III. INITIAL INSPECTION AND PLANT CERTIFICATION

The initial plant inspection shall include the approval of quality control personnel to perform the required test, and the inspection of the producer's laboratory and facilities. The inspection will include, but is not limited to, a review of form condition and dimensions, pallet profile and alignment, concrete batching procedures and plant records and stressing operation for precast/prestressed concrete plants.

A. Quality Assurance

The producer will have a Department approved quality assurance program which shall be operated under the direct supervision of the quality control supervisor.

1. The quality control supervisor will be responsible for the following functions:

- a. Maintain a materials control program in accordance with schedules outlined herein.
 - b. Compensate for free moisture in aggregates, and compensate for the effects of admixtures on concrete mixes.
 - c. Control all requisites for concrete mixes and determine their acceptability.
 - d. Insure stressing operations conform to specified procedures for precast/prestressed concrete plants.
 - e. Inspection of dimensions for positions of bulkheads, strand, reinforcement, inserts, voids, and other integral items.
 - f. Inspect the finished product for dimensional accuracy and appearance.
 - g. Report deviation from allowable tolerance to the Office of Materials and Research for disposition.
 - h. Provide the Office of Materials and Research with documentation of quality control, pre-pour inspection reports, post-pour inspection reports, concrete cover reports, daily production reports, shipping reports, and any other reports or documentation required or requested by the Office of Materials and Research Plant Inspector. Applicable forms for documentation are attached.
 - i. Placing the company or consulting laboratory stamp and Precast Technician or Prestress Technician stamp on members which meet all applicable requirements.
2. The quality control supervisor will be examined by the Department for their ability to perform the above functions in accordance with the Department's procedure. This examination will usually be written and oral. The quality control supervisor may be required to travel to the Forest Park Laboratory for examination.
 3. Quality control personnel responsible for batching concrete and personnel responsible for sampling and testing fresh concrete (slump, air, temperature and cylinder fabrication) will be examined for their ability to perform these functions. This examination will usually be written and oral. Quality control personnel may be required to travel to the Forest Park Laboratory for examination.
 4. The official record of personnel certification shall be the Technician Certification Database located on the GDOT website. Possession of a certification card shall not be proof of certification. Personnel certifications may be revoked, at any time, by the State Materials and Research Engineer. All personnel certifications shall expire after a period of no longer than five (5) years. The Office of Materials and Research Plant Inspector should be contacted sixty (60) days prior to expiration of personnel certification to schedule a time for re-examination. The re-examination will usually be written and oral. Personnel may be required to travel to the Forest Park Laboratory for re-examination.
 5. The producer shall have a plant Laboratory which is adequately supplied with the equipment necessary to perform the required testing.

B. Casting Beds

Prior to construction of concrete members, the producer is required to submit plans of casting beds to the State Materials and Research Engineer for review of structural stability. The proposed method and equipment for deflected strand hold down anchorages shall be included in the precast/prestressed producer's plan.

1. Profile and Alignment

Sufficient pallet supports shall be placed at regular intervals transverse to the longitudinal axis of the bed to insure that the pallet remains within a grade tolerance of 1/8 inch per ten feet (3 millimeters per 3 meters) as measured from a plane. Place additional pallet supports directly under the ends of beams if required to maintain the grade tolerance. If wood supports are used, all supports should be of the same type (dressed or undressed) and kind of wood. This will minimize discrepancies in the pallet profile due to unequal compression, shrinkage, expansion, or deterioration of wood supports. After the pallet and pallet supports are in place, a profile shall be taken along the top face of the pallet by the producer. There should be at least one elevation taken for each ten foot (3 meter) length of pallet. Elevations shall be taken along both edges of the pallet to reveal any transverse slope. In addition, using a straightedge of at least ten feet (3 meters) in length, verify the entire pallet is smooth and free of defects within a tolerance of 1/8 inch per ten

feet (3 millimeters per 3 meters). The final results of profiling and correction of pallet grade and straightedge test shall produce units that meet tolerances specified herein. Profiles of a pallet grades and straightedge tests shall be done before the first pour on any new project. For beams and SIP deck panels, the pallet profile and straightedge test shall be done at an interval of every five pours or as needed. For piling, the profile and straightedge test shall be done every two months or as needed. A current plot of the pallet elevations and the results of the straightedge test of each individual bed shall be submitted to Office of Materials and Research Plant Inspector and remain on file at the producer's plant. Adequate provisions shall be provided for pallet and form expansion and pallets shall be anchored to prevent lateral movement.

2. Anchorage System and Strand Location for Precast/Prestressed Concrete Members.

From the pallet profile, the elevation of the individual strands are determined and checked against the strand template of the header assembly.

All anchorage systems shall be capable of withstanding 150 percent of the maximum design load with no significant yielding.

C. Stressing Equipment For Precast/Prestressed Concrete Members

All load measuring devices used in stressing shall have a current certified calibration. The calibration shall be performed by an independent calibration company. Certified calibration of dynamometers, load cells, hydraulic gages, and jacking systems, issued by the calibration company, shall be on file for each device at the prestressed plant. All jacks and gages shall be recalibrated at six month intervals or as needed to verify accuracy. Provide a certified copy of all calibration certificates to the Office of Materials and Research Plant Inspector at the time of calibration.

D. Concrete Testing Equipment

All concrete testing equipment shall be in good working order and free of concrete buildup. Certified calibration of compressive testing machines, issued by the calibration company shall be on file at the precast/prestressed plant. All compressive testing machines shall be recalibrated, by an independent calibration company, at twelve month intervals or as needed to verify accuracy. Provide a certified copy of all calibration certificates to the Office of Materials and Research Plant Inspector at the time of calibration.

E. Concrete Plant

The Batch Plant mechanical inspection should be performed by an independent scale calibration company or may be done by the producer provided it is witnessed by the Office of Materials and Research Plant Inspector. All batching systems for aggregates, cement, water, and admixtures as well as all mixers shall comply with Specifications. A certification of plant mechanical acceptability issued by the calibration company shall be on file at the plant. Provide a certified copy of all calibration certificates to the Office of Materials and Research Plant Inspector at the time of calibration. This inspection shall be made once each four months during construction.

F. Removal From the Approved List

The Department reserves the right to remove any producer from the approved list at any time confidence is lost in a producer's ability to produce material of uniform characteristics complying with the Specifications.

The Department reserves the right to remove any producer from the Qualified Products List when the source has not produced products for a Departmental project for a period of twelve (12) months.

G. Reinstatement to the Approved List

Once removed from the approved list, a producer may request reinstatement in the following manner:

1. Producers shall make a written request to the State Materials and Research Engineer requesting to be reinstated to the approved list. The request will detail the causes and solutions to the problem areas which caused removal from the approved list. In addition, the supplier shall state measures taken to prevent reoccurrence of problems.

2. If, after review of the request for reinstatement, it appears the producer's problems have been solved, an inspection of facilities will be made and all products in stock will be inspected.
3. After examination of data gained from subparagraph 1 and 2 above, the State Materials and Research Engineer will decide if the producer may be reinstated to the approved list. Some cases may warrant conditional reinstatement.

IV. MATERIALS CONTROL PROGRAM

A. Concrete Mix Designs

Concrete mixes shall be approved by the Office of Materials and Research. The design of mixes may be done either by a commercial laboratory, or by qualified concrete plant personnel. Concrete mixes shall be submitted for review and approval with the annual application for plant certification.

B. Concrete Materials

The sampling and testing of materials must begin early enough to insure acceptability of materials. Department inspectors will secure initial samples to verify the quality of materials as received from the sources. Plant control sampling or testing of materials from approved sources unless noted is not required. Materials shall be sampled and tested in accordance with the following guide:

1. Portland Cement shall be obtained from an approved source. One Independent Assurance sample per month is to be obtained by the Office of Materials and Research Plant Inspector and sent to the Forest Park Laboratory.
2. Fine and coarse aggregates shall be obtained from approved sources. The gradation shall be consistent. One Independent Assurance sample per month is to be obtained by the Office of Materials and Research Plant Inspector and sent to the nearest Office of Materials and Research Laboratory.
3. Admixtures shall be obtained from approved sources. One Independent Assurance sample per year is to be obtained by the Office of Materials and Research Plant Inspector and sent to the Forest Park Laboratory.

C. Steel

1. Tendons

Acceptance of prestressing steel will be made on the results of physical tests made by the Department in addition to a required certification from the manufacturer showing results of the required test, including stress/strain curves.

For pretensioning Steel Wire Strand, three Independent Assurance samples shall be obtained from each heat or lot, fifty-three (53) inches (1.4 meters) in length, and transmitted to the Forest Park Laboratory by the Office of Materials and Research Plant Inspector.

2. Reinforcement Steel Bars shall be obtained from approved sources. Two Independent Assurance samples per size, per project, thirty (30) inches (765 millimeter) in length, are to be obtained by the Office of Materials and Research Plant Inspector.
3. Plain Steel Diaphragm Bars, Bolts, Nuts, and Washers
The manufacturer and/or the fabricator shall furnish a certification setting forth the physical and chemical properties of the materials and conformance to the Specifications before they may be used in the work.

D. Bearing Devices

1. Bearing Assemblies, Plates and Hardware

The manufacturer and/or the fabricator shall furnish a certification setting forth the physical and chemical properties of the materials and conformance to the Specifications before they may be used in the work.

2. Elastomeric Bearing Pads

The acceptance of elastomeric pads will be based on the manufacturer's certification showing physical and chemical properties of the materials and conformance with Standard Specifications, Article 885.01, and upon the results of tests performed by the Department on each size and lot.

V. PRODUCTION INSPECTION

Producers shall provide the State Materials and Research Engineer with the following information well in advance of the fabrication of members:

1. Shop drawings approved by the Office of Bridge and Structural Design for precast/prestressed concrete members, including elongation calculations, detensioning pattern, and erection drawings. A complete set of shop drawings bearing the original stamp from a representative of the Office of Bridge and Structural Design shall be at the plant which is producing the product before any work may begin.
2. Project number.
3. Location at which members are to be fabricated.
4. Probable casting date.
5. Sources of all materials to be incorporated into the members.
6. The earliest date prior to fabrication that the facilities may be inspected.

A. Pretensioning for Precast/Prestressed Concrete Members.

1. Threading of Strands and Pre-Loading

Normally, the first operation will be threading and pre-loading of strands. The application of the pre-load shall be observed by the producer's Quality Control Supervisor. The force applied should be concentric with the strand. Strands shall be observed to detect crossed strands.

2. Tensioning Procedure

The producer's calculations of elongation shall be checked by the producer's Quality Control Supervisor and will include allowances for losses due to slippage through grips, and movement of anchorage. When temperature differential between steel at stressing and concrete at placement exceeds 20°F (10°C) include allowances for losses due to slippage through grips, and movement of anchorage shall be observed and recorded by the producer's Quality Control Supervisor.

Measurement of elongation shall be the primary control. The hydraulic pressure gauge readings at the time of the measured elongation shall be within 5 percent of the calculated gauge reading. The two measurements shall agree with their computed theoretical values within a tolerance of plus or minus 5%. Additionally, the measurements of force and elongation shall algebraically agree with each other within a 5% tolerance. If the measurements vary by more than 5 percent all work shall be stopped and the defect corrected before proceeding.

B. Placement of Reinforcement Steel, Final Inspection Prior to Concrete Placement

Prior to the placement of the side forms for beams and prior to the placement of concrete for piling and all other members, the producer shall provide for a formal inspection of the reinforcement. For beams, the producer shall provide a method to reduce friction between the bearing area of the beam and the pallet to prevent end spalls when stress is transferred into the member. Sufficient measurements will be made to determine compliance of reinforcement with Plans and Specifications. The producer shall document in writing the actual measurements and any required corrections on a pre-pour report. The pre-pour report shall be submitted to the Office of Materials and Research Inspector and a copy shall remain on file at the producer's plant.

C. Placement of Forms

When the side forms have been anchored in position and after all headers have been secured, the producer's quality control supervisor shall make a stringline inspection of the forms. A stringline shall be blocked off a uniform distance from one side of an inside face of the side forms. The distance between the stringline and side of the form shall be checked at regular intervals. At each interval the width between the inside faces of the forms shall be measured for deviations in alignment. Alignment tolerance shall be a maximum of 1/8 inch per ten feet (3 millimeters per 3 meters) as measured from the stringline. The inside face of the forms shall be plumb or at angles established by the Plans. All joints shall be flush with no separations. The headers shall be in their correct and final position.

During this inspection, particular attention shall be given to any bearing or embedded plates. They shall be in their correct position and anchored so that placement of concrete will not displace them. A final check of strands and reinforcement shall be made to determine that proper concrete cover can be achieved.

D. Concrete Inspection

While the concrete placement operation is in progress, the producer's Quality Control Supervisor shall be instantly available to determine cause and remedy for any undesirable changes which occur in the mix. Each batch of concrete shall be judged for acceptance. Uniformity of concrete is of the utmost importance in producing uniform development of strength.

1. Sampling and Testing of Fresh Concrete

Initial samples of concrete shall be obtained for determining compliance with air content, and slump specifications before any of the concrete is placed.

A representative sample of concrete shall then be obtained for each placement to conduct a slump test, air content determination, and to manufacture the predetermined number of cylinders. The concrete temperature shall be obtained immediately after sampling. Results of all tests shall be recorded immediately after completion of the test.

The sample of concrete for the test shall be selected at random between the first delivery of concrete and the last delivery of concrete. The cylinders shall represent the entire period of concrete placement.

A sufficient number of concrete test cylinders are necessary from each placement of concrete to insure an adequate number of tests for determination of curing, transfer of stress, and erection or driving strength. The exact number of test cylinders and concrete placement procedure will be established for each operation. One set of three 28-day (56-day for HPC) strength cylinders for each day's production shall be made and moisture cured by the producer for product acceptance. If required, one set of two chloride permeability cylinders shall be made and moisture cured by the producer for product acceptance. Extra cylinders may be necessary for additional testing as required. Each set of cylinders shall represent no more than 50 cubic yards of concrete. The acceptance cylinders shall be submitted for test to the Office of Materials and Research or an approved independent laboratory. Independent laboratories shall be prequalified by the Department to perform laboratory materials testing and shall meet the requirements of the GDOT's Manual of Guidance - Class 6.04(a) - Laboratory Materials Testing. Testing by independent laboratories shall be done at no expense to the Department.

The producer is responsible for delivery of cylinders. The Office of Materials and Research will not accept cylinders for testing unless they are delivered at least 7 days prior to the required testing date. Cylinders not delivered on time shall be tested at an approved independent testing facility prequalified by GDOT, at no expense to the Department. Reports of testing at independent labs, on the laboratory's letterhead, shall be submitted to the Engineer.

2. Sequence of Concrete Placement

Inspections by the producer's Quality Control Supervisor shall be performed during concrete placement to insure that the placement procedures result in properly consolidated concrete.

- a. For Beams: AASHTO Type IV beams and larger sizes shall be placed in a minimum of three lifts; bottom flange, web, and top flange. AASHTO Type III and smaller sized beams shall be placed in a minimum of two lifts.

- b. For Piling: All solid piles may be placed in one lift. 24 inch (610 millimeter) voided piles may also be placed in one lift. For 30 inch (765 millimeter), and 36 inch (915 millimeter) voided piles, the forms shall be placed in a minimum of two lifts.
 - c. Bridge Slabs: The placement of concrete shall be performed in a manner that will keep the work alive and free of cold joints. Precast or prestressed bridge slabs may be placed in one lift. Voided box beams shall be placed in a minimum of two lifts. However, no layer shall exceed 24 inches (610 millimeters).
 - d. Bridge Caps: Bridge caps may be placed in one lift provided the cap depth is not greater than 24 inches (610 millimeters).
 - e. All Other Members: All other members are to be cast as set forth in the Standard Specification or Special Provision or Plans.
3. Curing Concrete
- Special care shall be taken to prevent excessive evaporation or drying out of concrete. The surface of the concrete throughout the curing period shall be covered with a film of free moisture. Curing mats or curing enclosures shall completely enclose the members. There shall be no gaps or openings in the curing mats or enclosures which allow the concrete surface to become dry. The relative humidity of the atmospheres immediately surrounding the concrete shall be maintained at approximately 100 percent.
- The producer's method of steam curing will be reviewed to conform to Specification requirements.

E. Surface Finishes

- 1. Type I Finish
- All concrete members shall have an acceptable and uniform Type I finish before they are shipped to the project. The initial finish and all pointing shall be completed immediately following the removal of forms.
- 2. Type III Finish
- The Type III finish shall not be attempted until a satisfactory Type I finish has been obtained. Members that require the Type III finish will be given a surface preparation at the casting yard. The Project Contractor will notify the producer when final finish is to be applied at the casting yard to insure compatibility with other finished areas of the structure.

F. Identification of Members

Immediately after the forms have been removed, the members shall be individually identified with an identification number and dated by the producer. This is necessary to insure that a record will be available of the exact location on the bed and date of placement of each member.

G. Transfer of Stress for Precast/Prestressed Concrete Members

The Producer's procedure for transfer of stress shall be an approved pattern and schedule of strand release. Particular care shall be taken to insure that transfer of stress is in accordance with Specifications.

H. Handling Precast Members

Precast, non-prestress, members shall not be lifted from the casting bed until the concrete has reached a compressive strength as specified on the Plans or at least 1500 psi (10 MPa) nor shall there be any evidence of damage to the unit. Units shall not be transported or erected until they have reached the required design strength.

VI. ACCEPTANCE INSPECTION

A. Dimensional Tolerances

Each member shall be checked for construction tolerances by the producer's Quality Control Supervisor. Tolerances, as referenced by the Specifications, are attached.

The limits of tolerances do not necessarily represent fully acceptable construction but are the limits at which construction may become unacceptable. The producer shall work at a level of quality that is well within the tolerance limits.

The producer shall document in writing the actual measurements and any required corrections on a post-pour report. The post-pour report shall be submitted to the Office of Materials and Research Inspector and a copy shall remain on file at the producer's plant.

Concrete cover tests over reinforcement and prestressing steel shall be made on each member by the producer's Quality Control Supervisor and on randomly selected members by the Office of Materials and Research Plant Inspector. These measurements will be made with a cover meter and may require selective storage of specific members. The producer shall document in writing the actual measurements and any out of tolerance measurement on a Concrete Cover Report. The Concrete Cover Report shall be submitted to the Office of Materials and Research Inspector and a copy shall remain on file at the producer's plant.

B. Patching and/or Repair

Voids, honeycombs, spalls, damaged areas which are not cause for rejection of the unit shall be repaired in accordance with the directions from the Office of Materials and Research Plant Inspector. All spalls, honeycombs, or voids which extend to the reinforcement steel or the prestressed strands are potential cause for rejection and shall be brought to the attention of the Office of Materials and Research Plant Inspector for disposition. Submit, in writing, the details of any area requiring repair along with the proposed repair method and materials to the Office of Materials and Research Plant Inspector for approval prior to beginning any repair. Any patches and / or repaired areas shall be inspected by the Office of Materials and Research Plant Inspector. All patching materials used for the repair shall meet the 28-day (56-day for HPC) design strength of the repaired unit prior to shipment. Any repair initiated prior to approval by the Office of Materials and Research Plant Inspector shall be cause for rejection of the member.

C. Cracks

Submit, in writing, the details of all cracks, along with the proposed repair method and materials to the Office of Materials and Research Plant Inspector for disposition.

D. Storage of Members

Provisions for storage of units shall be in accordance with Specification requirements. Storage shall be reinspected periodically by the producer's Quality Control Supervisor for adverse changes in dunnage or supports.

VII. ACCEPTANCE IDENTIFICATION

A. Beams

The Office of Materials and Research Plant Inspector shall receive at least 72 hours notice from the producer prior to shipment of members. All necessary identification shall be applied to each member, all finishing and dressing of members shall be completed, members shall be properly stored and acceptable for shipment before the company or consulting laboratory stamp and Prestress Technician stamp is placed on the member. The company or consulting laboratory stamp and the Prestress Technician stamp shall be on the member before the GDOT stamp can be placed on the member by the Office of Materials and Research Plant Inspector. The Prestress Technician stamp will be provided by the producer and shall include the Certification ID number located on the GDOT prestress technician's certification card.

B. Piling, Precast or Prestressed Bridge Slabs, Foot Bridges, Caps, and Other Structural Precast Members

The Office of Materials and Research Plant Inspector shall receive at least 24 hours notice from the producer prior to shipment of members. All necessary markings shall be applied to each member, all finishing and dressing shall be completed, the members shall be properly stored, pick up points shall be marked on piling, by the producer, conforming to Georgia Standard No. 3215 or the approved shop drawings and members shall be acceptable for shipment before the company or consulting laboratory stamp and Precast Technician or Prestress

Technician stamp is placed on them. The Precast Technician stamp will be provided by the producer and shall include the Certification ID number located on the GDOT precast technician's certification card. The Prestress Technician stamp will be provided by the producer and shall include the Certification ID number located on the GDOT prestress technician's certification card.

Precast non-prestressed concrete members shall be stamped with both the company or consulting laboratory stamp and Precast Technician or Prestressed Technician stamp. The Precast Technician or Prestress Technician stamp shall not be placed on any member until all required tests are completed and found to meet requirements of all applicable specifications.

Prestressed concrete members shall be stamped with both the company or consulting laboratory stamp and Prestressed Technician stamp. The Prestress Technician stamp shall not be placed on any member until all required tests are completed and found to meet requirements of all applicable specifications.

VIII. SHIPPING

A. Loading

Piling shall be transported with bolster supports conforming to Georgia Standard No. 3215 or the approved shop drawings and beams shall be transported with supports within 3 feet (1 meter) of the bearing area or as specified on the approved shop drawings. Bolsters for loading bridge slabs and caps shall be spaced at the lifting points. No member shall be shipped from the plant until it carries the official GDOT stamp, the approved company stamp, the consultant laboratory stamp, the Precast Technician stamp, or Prestress Technician stamp whichever is applicable per Section VII.

B. Project Acceptance

The Project Manager may accept all undamaged members arriving on the project preinspected and "Stamped", provided the members are identified on the accompanying copy of the Office of Materials and Research shipping form. The producer shall transmit the original shipping form to the Office of Materials and Research. The form will be reviewed, authenticated, and distributed as the acceptance document for each shipment of members.

IX. DOCUMENTATION

A. Plant Records

The producer is required to have orderly record files maintained and readily available at the plant for inspection. All records shall be fully accessible to the Office of Materials and Research Plant Inspectors at all times. Copies of any records requested by the Office of Materials and Research shall be provided. These records are as follows:

1. Maintain test results and test reports on all materials that are used in the work.
2. Maintain records of all stressing operation, pre-load, elongation, and gauge readings for precast/prestressed concrete members.
3. Maintain records of concrete production reports.
4. Maintain accurate records of all members cast and shipped.
5. Maintain records of cover readings.
6. Maintain records of pre-pour and post-pour inspection.
7. Maintain records of bed profile and straightedge tests and any corrections made to casting beds.
8. Maintain certified calibration certificates of all stressing equipment, concrete testing equipment, and concrete plant.

B. Office of Materials and Research Records

The Office of Materials and Research Plant Inspector is required to keep the following records at the Office of Materials and Research:

1. The Office of Materials and Research will maintain records of all plant certifications, quality control personnel and producer's guarantee.
2. Maintain records of test results of all control samples and independent assurance samples.
3. Maintain records of all daily concrete production reports, shipping reports, and materials certifications.

C. Project Records

The Department of Transportation area construction office must keep records for the acceptance of the members and furnished materials.

1. The Project Manager will maintain records of all shipping reports for each shipment of members to the project.
2. Maintain records of all acceptance documents furnished by the Office of Materials and Research.

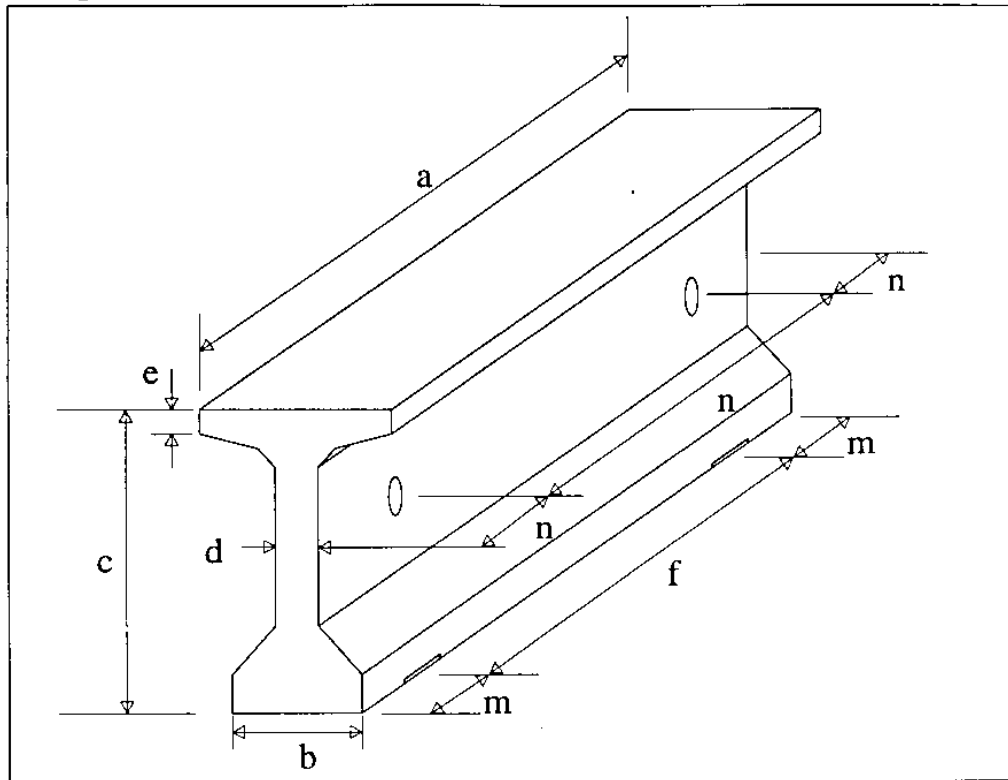
Georgene M. Geary, P.E.
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Director of Construction

**DIMENSIONAL TOLERANCES
FOR MANUFACTURE OF
PRECAST/PRESTRESSED CONCRETE MEMBERS
AND
STRUCTURAL PRECAST CONCRETE MEMBERS**

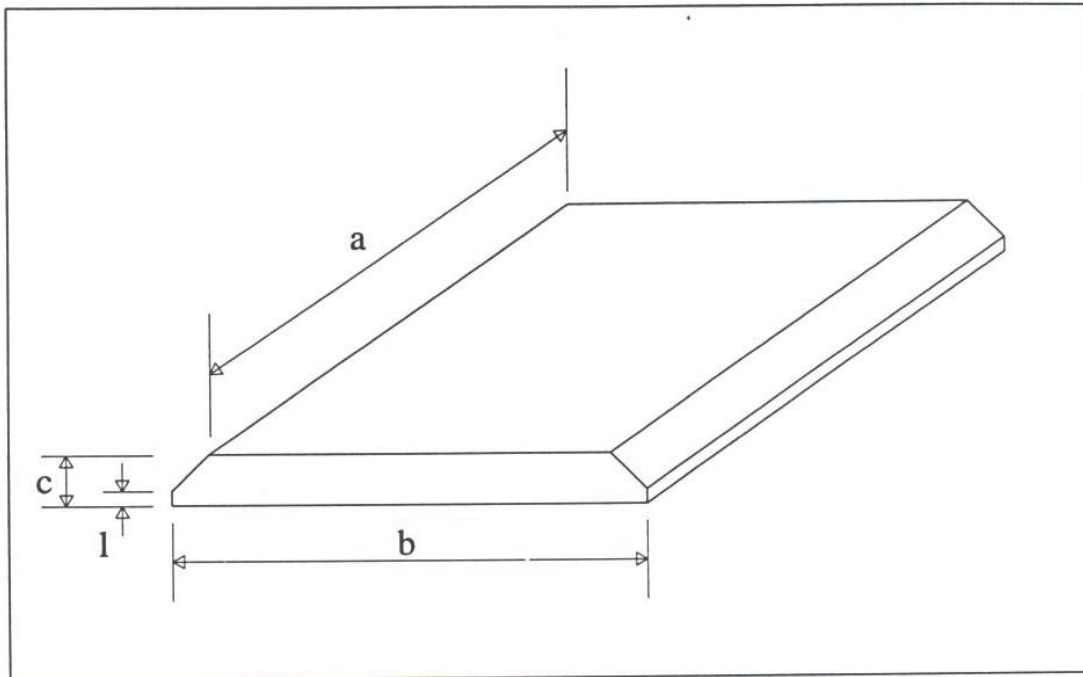
**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
OFFICE OF MATERIALS AND RESEARCH**

Bridge I-Beams



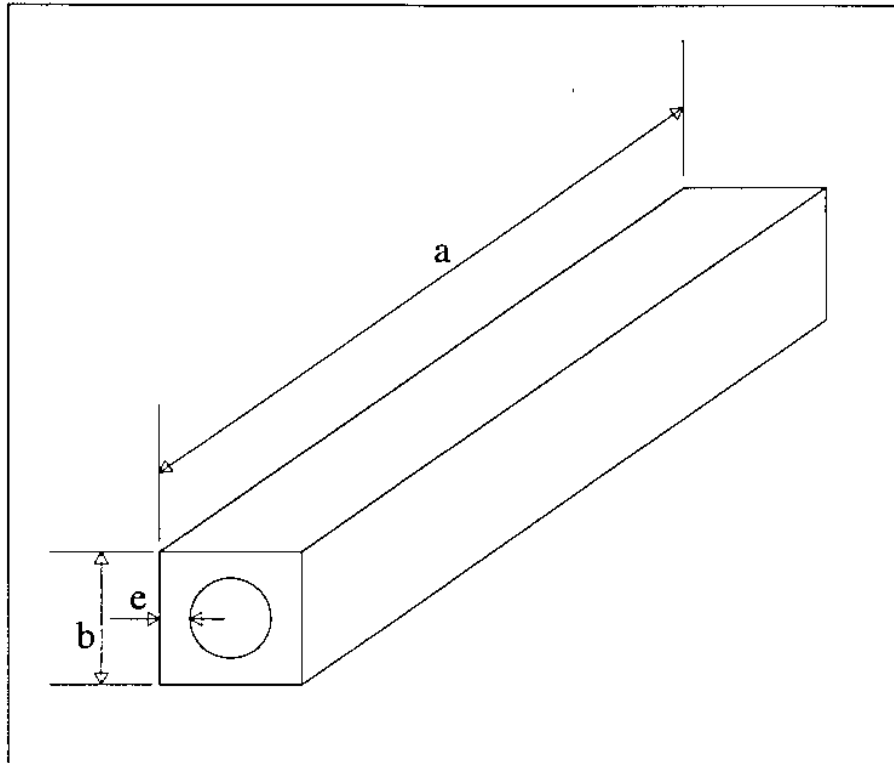
- a. Length: $\pm 3/4$ inch (± 20 mm)
- b. Width (flanges and fillets): $+3/8$ inch, $-1/4$ inch ($+10$ mm, -5 mm)
- c. Depth (overall): $+1/2$ inch, $-1/4$ inch ($+12$ mm, -5 mm)
- d. Width (web): $+3/8$ inch, $-1/4$ inch ($+10$ mm, -5 mm)
- e. Depth (flanges and fillets): $\pm 1/4$ inch (± 5 mm)
- f. Bearing Plates (center to center): $\pm 1/2$ inch (± 12 mm)
- g. Horizontal Alignment (deviation from straight line parallel to centerline on member)
 - 1/2 inch for up to 40 foot lengths (12 mm for up to 12 m lengths)
 - 3/4 inch for 40 to 60 foot lengths (20 mm for 12 m to 18 m lengths)
 - 1 inch for 60 to 100 foot lengths (25 mm for 18 m to 30 m lengths)
 - 1 1/2 inches for greater than 100 foot lengths (40 mm for greater than 30 m lengths)
- h. Camber deviation from design camber: $\pm 1/8$ inch per 10 feet (± 3 mm per 3 m)
- i. Stirrup bars (projection above top of beam): $+1/4$ inch, $-3/4$ inch ($+5$ mm, -20 mm)
- j. Tendon position: $\pm 1/4$ inch (5 mm) center of gravity of strand group and individual tendons
- k. Position of deflection points for deflected strand: ± 6 inches (± 150 mm)
- l. Position of handling devices: ± 6 inches (± 150 mm)
- m. Bearing plates (center to end of beam): $\pm 1/4$ inch (± 5 mm)
- n. Tie rod holes (center to center and center to end): ± 1 inch (± 25 mm)
- o. Exposed beam ends (deviation from square or designated skew)
 - Horizontal: $\pm 1/4$ inch per foot (5 mm per meter) of beam width
 - Vertical: $\pm 1/8$ inch per foot (3 mm per meter) of beam depth
- p. Bearing area deviation from plane: $\pm 1/8$ inch (± 3 mm)
- q. Stirrup Bars (longitudinal spacing): ± 1 inch (± 25 mm)
- r. Position of post tensioning duct: $\pm 1/4$ inch (± 5 mm)
- s. Position of weld plates: ± 1 inch (± 25 mm)

Composite Bridge Deck Panels or SIP (Stay in Place) Panels



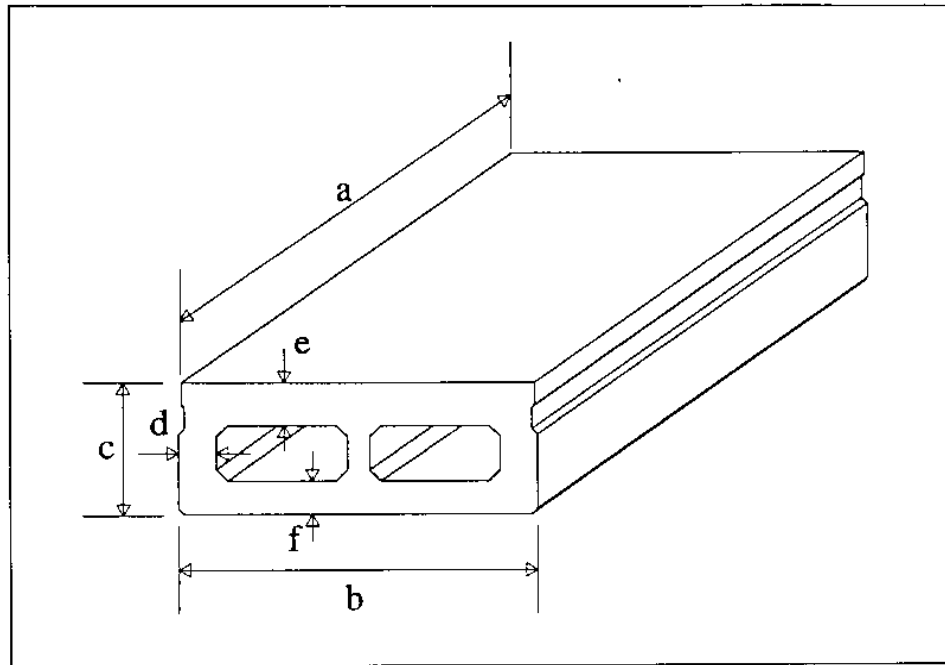
- a. Length: ± 1 inch (± 25 mm)
- b. Width: $\pm 1/4$ inch (± 5 mm)
- c. Depth: $+1/8$ inch, $-1/4$ inch ($+3$ mm, -5 mm)
- d. Position of strand (vertical): $\pm 1/8$ inch (± 3 mm)
- e. Position of strand (horizontal): $\pm 1/2$ inch (12 mm)
- f. Position of ribs: $\pm 1/4$ inch (± 5 mm)
- g. Position of handling devices: ± 6 inches (± 150 mm)
- h. Position of weld plates: ± 1 inch (± 25 mm)
- i. Camber deviation from design camber: $\pm 1/8$ inch per 1 feet (± 3 mm per 3 m)
- j. Differential vertical offset between adjacent members of the same design:
 $1/4$ inch per 10 feet, but not greater than $1/2$ inch
 (6 mm per 3 m, but not greater than 12 mm)
- k. Squareness of ends (vertical and horizontal alignment): $\pm 1/2$ inch (12 mm)
- l. Mating surface: 1 inch (25 mm) maximum, $1/4$ inch (5 mm) minimum
- m. Mating surface deviation from a straight line: $\pm 1/8$ inch per 10 feet (± 3 mm per 3 m)

Piling, Solid or Voided



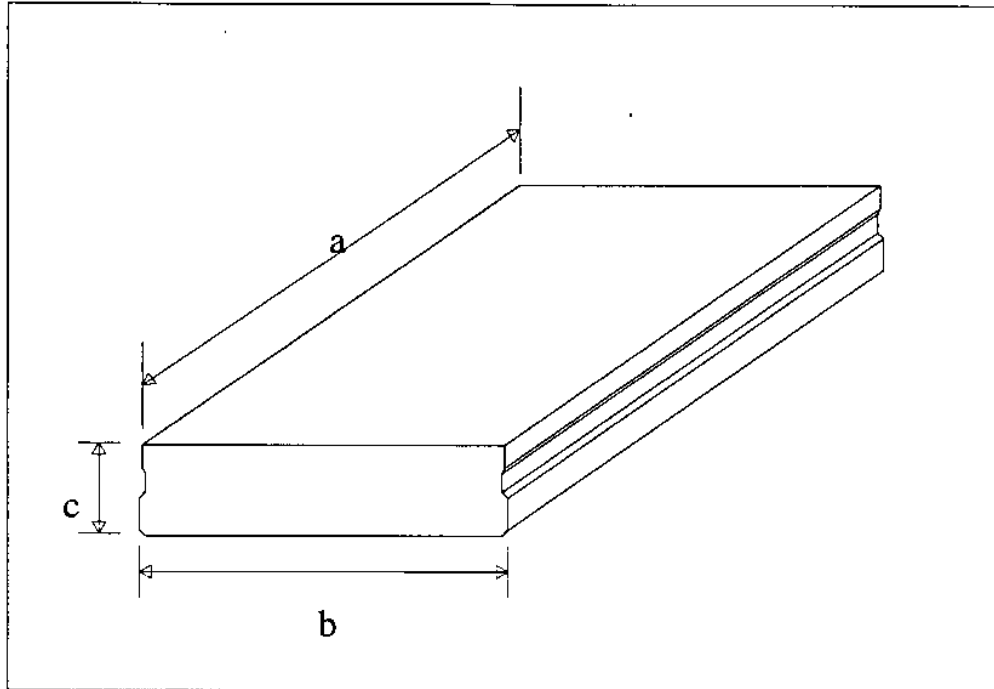
- a. Length: ± 1 inch (25 mm)
- b. Width or Diameter: $-1/4$ inch, $+3/8$ inch (-5 mm, +10 mm)
- c. Head out of square: $1/8$ inch per 12 inch of width (3 mm per meter of width)
- d. Horizontal alignment (deviation from straight line parallel of centerline of pile)
 $1/8$ inch per 10 feet of pile (3 mm per 3m of pile)
- e. Position of void: $\pm 1/2$ inch (± 12 mm)
- f. Position of stirrup bars and spirals: $\pm 3/4$ inch (± 20 mm)
- g. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- h. Position of handling devices: ± 6 inches (150 mm)
- i. Position of steel driving tips: $\pm 1/2$ inch (± 12 mm)

Bridge Box Beams



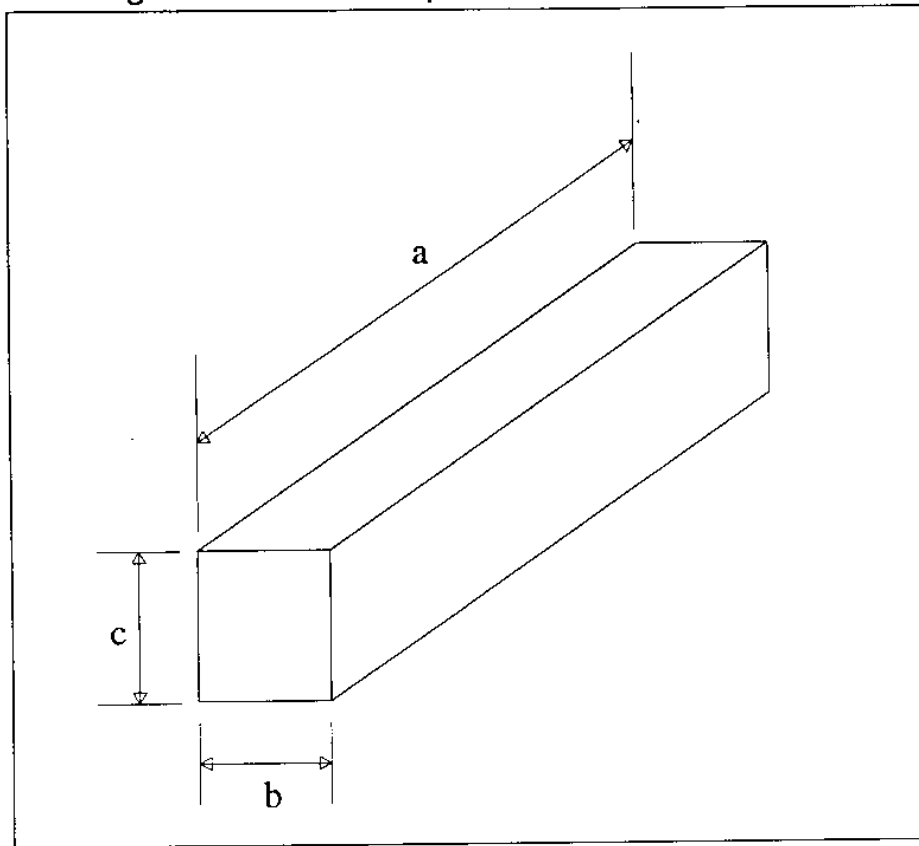
- a. Length: +0 inch, -3/4 inch (+0 mm, -20 mm)
- b. Width (overall): $\pm 1/4$ inch (± 5 mm)
- c. Depth (overall): $\pm 1/4$ inch (± 5 mm)
- d. Width (web): $\pm 3/8$ inch (10 mm)
- e. Depth (top slab): $\pm 1/2$ inch (± 10 mm)
- f. Depth (bottom slab): +1/2 inch, -1/8 inch (+12 mm, -5mm)
- g. Horizontal alignment (deviation from straight line parallel to centerline of member)
 - 3/8 inch for up to 40 foot lengths (10 mm for up to 12 m lengths)
 - 1/2 inch for 40 to 60 foot lengths (12 mm for 12 m to 18 m lengths)
 - 3/4 inch for greater than 60 foot lengths (20 mm for greater than 18 m lengths)
- h. Camber deviation from design camber: $\pm 1/8$ inch per 10 feet (± 3 mm per 3 m)
- i. Differential vertical offset between adjacent units:
 - 1/4 inch per 10 feet, but not greater than 3/4 inch
 - (6 mm per 3 m, but not greater than 20 mm)
- j. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- k. Position of stirrup bar: ± 1 inch (± 25 mm)
- l. Position of handling devices: ± 6 inches (± 150 mm)
- m. Slab void position:
 - $\pm 1/2$ inch (12 mm) from end of void to center tie hole, ± 1 inch (25 mm) adjacent to end block
- n. Square ends (deviation from square): $\pm 1/4$ inch (± 5 mm)
- o. Skew ends (deviation from designated skew): $\pm 1/2$ (± 12 mm)
- p. Beam seat bearing area (variation from plane surface when tested with a straightedge):
 - $\pm 1/8$ inch (± 3 mm)
- q. Dowel tubes (spacing between the centers of tubes and from the centers of tubes to the end of the member):
 - $\pm 1/2$ inch (± 12 mm)
- r. Tie rod tubes (spacing between the centers of tubes and from the centers of tubes to the end of the member):
 - $\pm 1/2$ inch (± 12 mm)
 - s. $\pm 1/2$ inch (± 12 mm)
- t. Total width of deck: Theoretical width +1/2 inch (+12 mm) per joint
- u. Position of side inserts: $\pm 1/2$ inch (± 12 mm)
- v. Position of weld plates: ± 1 inch (± 25 mm)

Flat Slab Deck Units



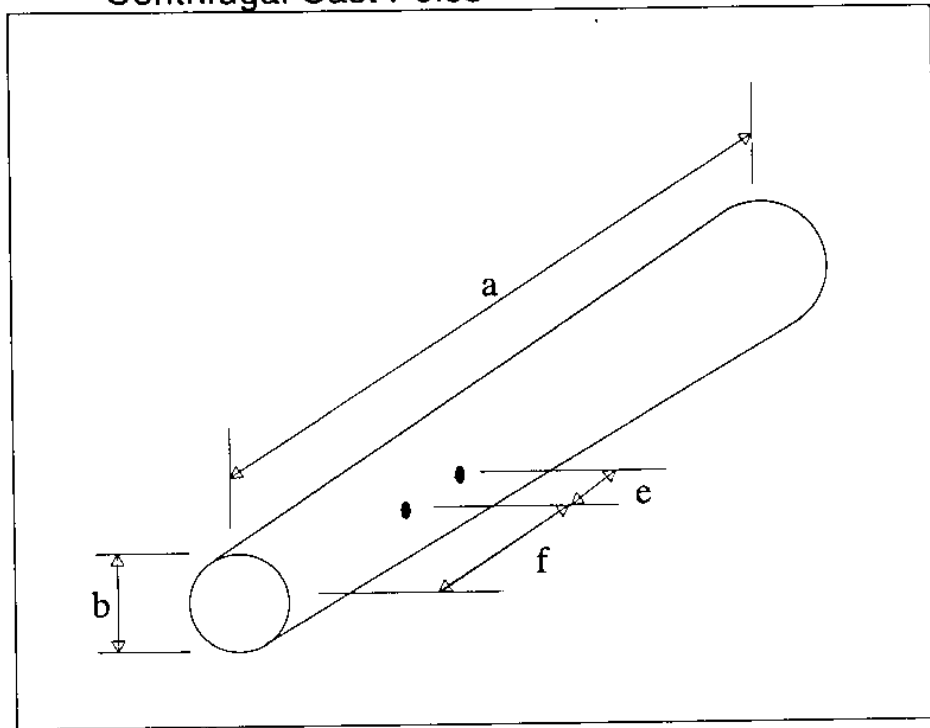
- a. Length: +0 inch, -3/4 inch (+0 mm, -20 mm)
- b. Width: $\pm 1/4$ inch (± 5 mm)
- c. Depth: $\pm 1/4$ inch (± 5 mm)
- d. Position of voids (vertical): $\pm 1/4$ inch (± 5 mm)
- e. Position of voids (horizontal): $\pm 1/4$ inch (± 5 mm)
- f. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- g. Position of handling devices: ± 6 inches (± 150 mm)
- h. Position of weld plates: ± 1 inch (± 25 mm)
- i. Camber deviation from design camber: $\pm 1/8$ inch per 10 feet (± 3 mm per 3 m)
- j. Differential vertical offset between adjacent members of the same design:
 $1/4$ inch per 10 feet, but not greater than $3/4$ inch
 (6 mm per 3 m, but not greater than 20 mm)
- k. Squareness of ends (vertical and horizontal alignment): $\pm 1/4$ inch (± 5 mm)
- l. Bearing area (variation from plane surface when tested with a straightedge): $\pm 1/8$ inch (± 3 mm)
- m. Dowel tubes (spacing between the centers of tubes and from the centers of tubes to the ends and sides of member): $\pm 1/2$ inch (± 12 mm)
- n. Tie rod tubes: $\pm 1/2$ inch (± 12 mm)
- o. Horizontal alignment (deviation from straight line parallel to centerline of member):
 $1/8$ inch per 10 feet, but not greater than $3/8$ inch
 (3 mm per 3 m, but not greater than 10 mm)

Rectangular Beam or Cap



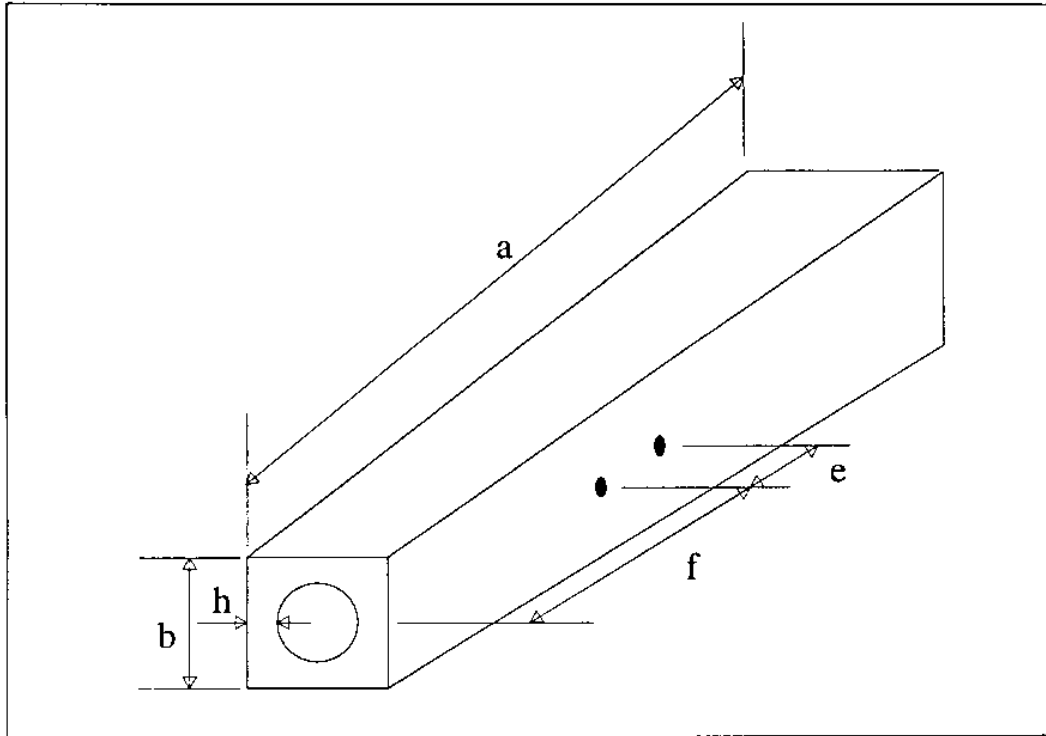
- a. Length: $\pm 3/4$ inch (± 20 mm)
- b. Width: $\pm 1/4$ inch (± 5 mm)
- c. Depth: $\pm 1/4$ inch (± 5 mm)
- d. Horizontal alignment (deviation from straight line parallel to centerline of member)
 - $3/8$ inch for up to 40 foot lengths (10 mm for up to 12 m lengths)
 - $1/2$ inch for 40 to 60 foot lengths (12 mm for 12 m to 18 m lengths)
 - $3/4$ inch for greater than 60 foot lengths (20 mm for greater than 18 m lengths)
- e. Camber deviation from design camber: $\pm 1/8$ inch per 10 feet (3 mm per 3 m)
- f. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- g. Position of handling devices: ± 6 inches (± 150 mm)
- h. Position of deflection point for deflected strands: ± 6 inches (± 150 mm)
- i. Position of weld plates: $\pm 1/2$ inch (± 12 mm)
- j. Squareness of ends (vertical and horizontal alignment): $\pm 1/4$ inch (± 5 mm)
- k. Beam seat bearing area (variation from plane surface when tested with a straightedge):
 - $\pm 1/8$ inch (± 3 mm)
- l. Dowel tubes (spacing between the centers of tubes and from the center of tubes to ends and sides of members): $\pm 1/2$ inch (± 12 mm)
- m. Position of stirrup bars: ± 1 inch (25 mm)
- n. Position of bearing plates: $\pm 1/4$ inch (± 5 mm)
- o. Bearing surface deviation from specified plane: $\pm 1/8$ inch (± 3 mm)

Concrete Strain Poles Centrifugal Cast Poles



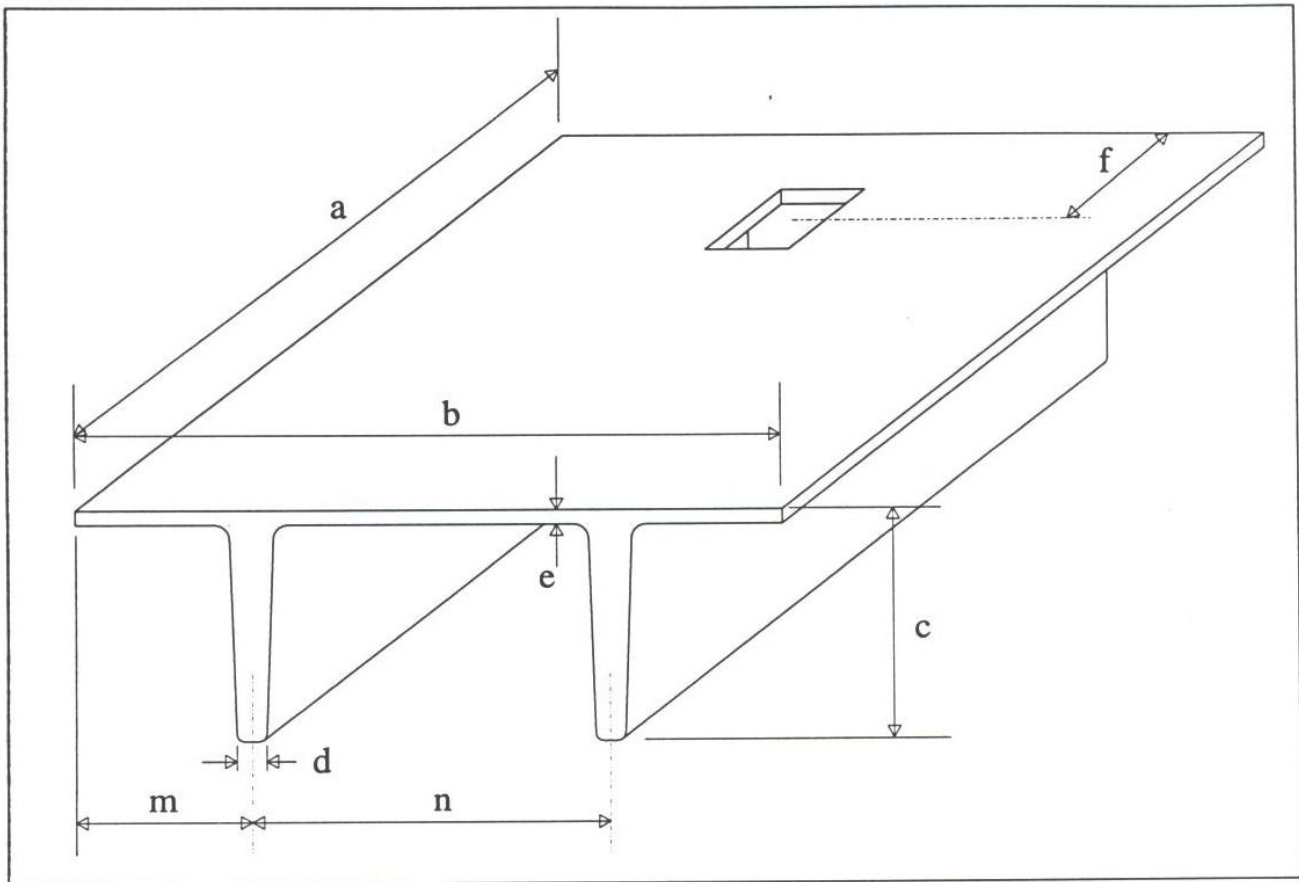
- a. Length: ± 3 inch (± 75 mm)
- b. Width of diameter: $\pm 5/8$ inch (± 15 mm)
- c. Sweep: $3/8$ inch per 10 feet (± 10 mm per 3 m)
- d. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- e. Position of paired holes: $\pm 1/8$ inch (± 3 mm)
- f. Position of individual or paired holes from tip: ± 1 inch (± 25 mm)
- g. Blockouts: ± 1 inch (± 25 mm)
- h. Tip wall thickness: $+1/2$ inch, $-1/4$ inch ($+12$ mm, -5 mm)
- i. Butt wall thickness: ± 1 inch (± 25 mm)

Concrete Strain Poles Static Cast Poles



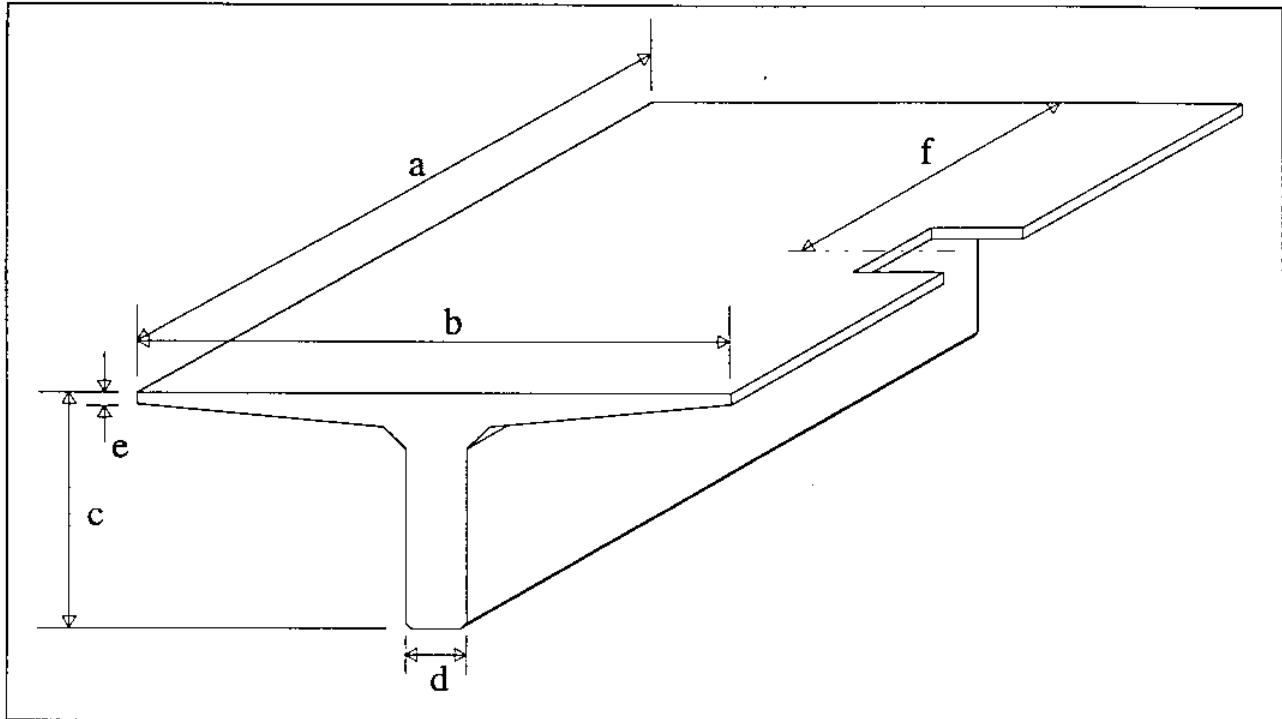
- a. Length: ± 3 inch (± 75 mm)
- b. Width of diameter: $+5/8$ inch, $-1/4$ inch ($+15$ mm, -5 mm)
- c. Sweep: $3/8$ inch per 10 feet (± 10 mm per 3 m)
- d. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- e. Position of paired holes: $\pm 1/8$ inch (± 3 mm)
- f. Position of individual or paired holes from tip: ± 1 inch (± 25 mm)
- g. Blockouts: ± 1 inch (± 25 mm)
- h. Position of void: ± 1 inch (± 25 mm)

Double Tee



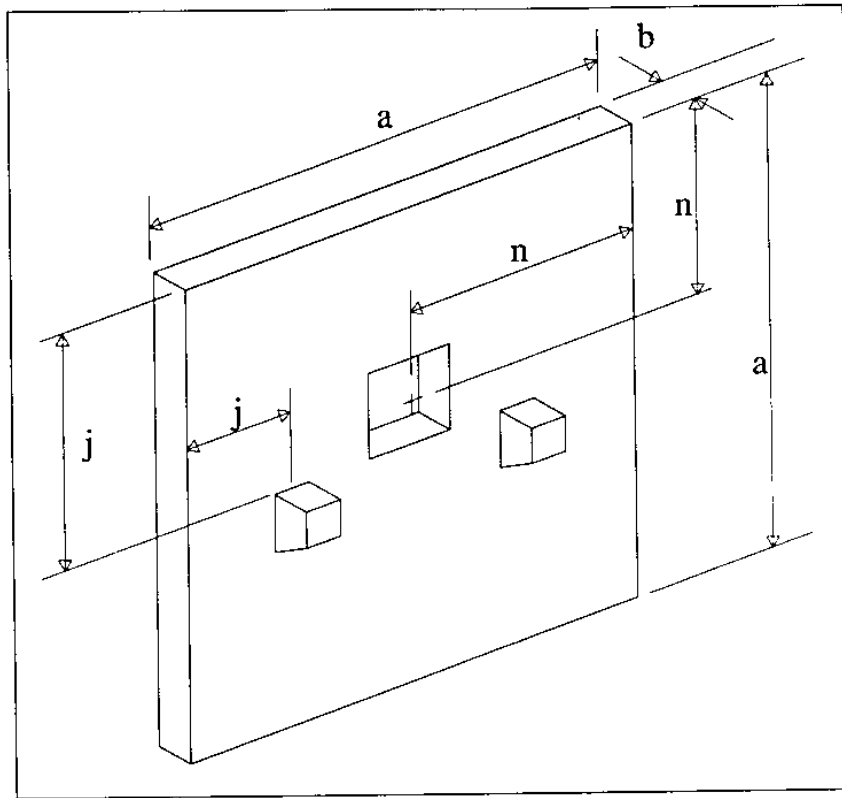
- a. Length $\pm 1/2$ inch (± 12 mm)
- b. Width (overall): $\pm 1/4$ inch (± 5 mm)
- c. Depth: $\pm 1/4$ inch (± 5 mm)
- d. Stem thickness: $+1/4$ inch, $-1/8$ inch ($+5$ mm, -3 mm)
- e. Flange thickness: $+1/4$ inch, $-1/8$ inch ($+5$ mm, -3 mm)
- f. Position of blockout: $\pm 1/2$ inch (± 12 mm)
- g. Horizontal alignment (deviation from straight line parallel to centerline of member):
 - $1/4$ inch for up to 40 foot lengths (5 mm for up to 12 m lengths)
 - $3/8$ inch for 40 to 60 foot lengths (10 mm for 12 m to 18 m lengths)
 - $1/2$ inch for greater than 60 foot lengths (12 mm for greater than 18 m lengths)
- h. Camber deviation from design camber:
 - $\pm 1/4$ inch per 10 feet, but not greater than $\pm 3/4$ inch (± 5 mm per 3 m, but not greater than ± 20 mm)
- i. Differential camber between adjacent members of the same design:
 - $\pm 1/4$ inch per 10 feet, but not greater than $\pm 3/4$ inch (± 5 mm per 3 m, but not greater than ± 20 mm)
- j. Position of tendons: $\pm 1/8$ inch (± 3 mm)
- k. Position of handling devices: ± 6 inches (± 150 mm)
- l. Position of deflection points for deflected strand: ± 6 inches (± 150 mm)
- m. Stem to edge of top flange: $1/8$ inch (± 3 mm)
- n. Distance between stems: $1/8$ inch (± 3 mm)
- o. Position of weld plates: ± 1 inch (± 25 mm)
- p. Squareness of ends (vertical and horizontal alignments) $\pm 1/4$ inch (± 5 mm)
- q. Bearing plates (center to end) $\pm 1/2$ inch (± 12 mm)

Single Tee



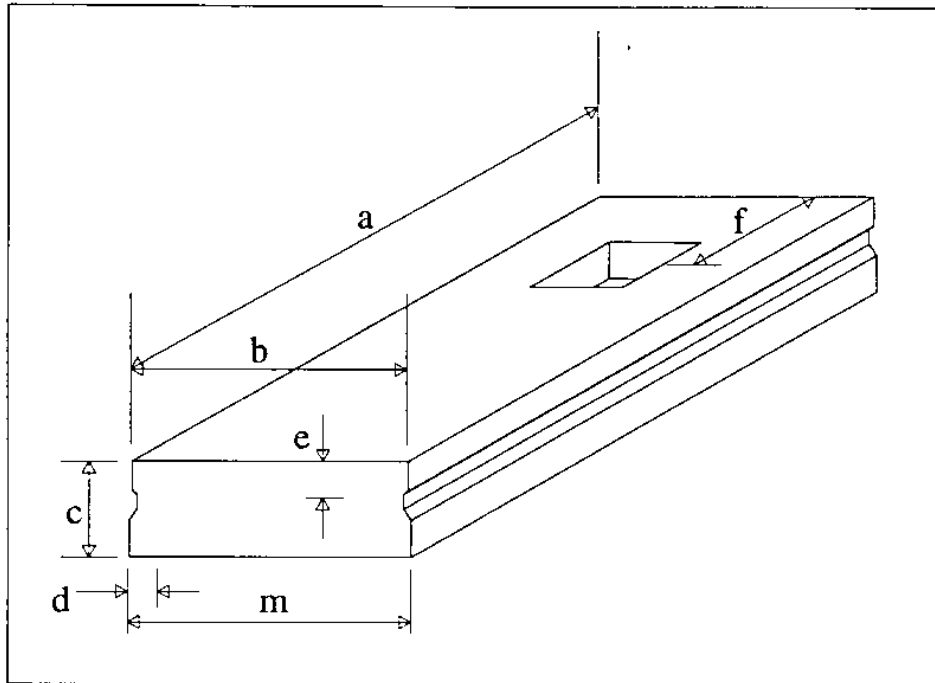
- a. Length: $\pm 3/4$ inch (± 20 mm)
- b. Width (overall): $\pm 1/4$ inch (± 5 mm)
- c. Depth: $\pm 1/4$ inch (± 5 mm)
- d. Width (stem): $\pm 3/16$ inch (± 5 mm)
- e. Flange thickness: $+1/4$ inch, $-1/8$ inch ($+5$ mm, -3 mm)
- f. Position of blockouts: $\pm 1/2$ inch (± 12 mm)
- g. Horizontal alignment (deviation from straight line parallel to centerline of member):
 - $1/4$ inch for up to 40 foot lengths (5 mm for up to 12 m lengths)
 - $3/8$ inch for 40 to 60 foot lengths (10 mm for 12 m to 18 m lengths)
 - $1/2$ inch for greater than 60 foot lengths (12 mm for greater than 18 m lengths)
- h. Camber deviation from design camber:
 - $\pm 1/4$ inch per 10 feet, but not greater than $\pm 3/4$ inch (± 5 mm per 3 m, but not greater than ± 20 mm)
- i. Differential camber between adjacent members of the same design:
 - $\pm 1/4$ inch per 10 feet, but not greater than $\pm 3/4$ inch (± 5 mm per 3 m, but not greater than ± 20 mm)
- j. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- k. Position of handling devices: ± 6 inches (± 150 mm)
- l. Position of deflection point for deflected strand: ± 6 inches (± 150 mm)
- m. Position of weld plates: ± 1 inch (± 25 mm)
- n. Squareness of ends (vertical and horizontal alignment): $\pm 1/2$ inch (± 12 mm)
- o. Bearing plates (center to end): $\pm 1/2$ inch (± 12 mm)

Flat Wall Panels



- a. Length and width:
 - $\pm 1/8$ inch for less than 10 feet (± 3 mm for less than 3m)
 - $+1/8$ inch, $-3/16$ inch for 10 to 20 feet ($+3$ mm, -5 mm for 3 to 9 m)
 - $\pm 1/4$ inch maximum for greater than 30 feet (± 5 mm maximum for greater than 9 m)
- b. Thickness: $+1/4$ inch, $-1/8$ inch ($+5$ mm, -3 mm)
- c. Horizontal and vertical alignment (deviation from straight lines parallel to center line(s) and/or designated skew:
 - $1/16$ inch per 10 feet of length, $1/4$ inch maximum (2 mm per 3 m of length, 5 mm maximum)
- d. Differential bowing between adjacent members: $1/4$ inch (5 mm)
- e. Warpage (one corner out of plane with of the other three) $1/4$ inch (5 mm)
- f. Difference in length of the two diagonal measurements:
 - $1/8$ inch per 6 feet with $1/4$ inch maximum, $1/4$ inch square openings and blockouts
 - (3 mm per 2 m with 6 mm maximum, 6 mm square openings and blockouts)
- g. Position of tendons: $\pm 1/8$ inch (± 3 mm)
- h. Position of reinforcement: $\pm 1/4$ inch (± 5 mm)
- i. Position of haunches: $\pm 1/4$ inch (± 5 mm)
- j. Dimensions of haunches: $\pm 1/4$ inch (± 5 mm)
- k. Haunch bearing surface deviation from specified plane: $\pm 1/8$ inch (± 3 mm)
- l. Difference in relative position of adjacent haunch bearing surfaces from specified relative position: $\pm 1/4$ inch (± 5 mm)
- m. Position of openings and blockouts: $\pm 1/4$ inch (± 5 mm)
- n. Dimensions of openings and blockouts: $\pm 1/4$ inch (± 5 mm)
- o. Position of sleeves and inserts: $\pm 1/4$ inch (± 5 mm)
- p. Position of weld plates: $\pm 1/2$ inch (± 12 mm)
- q. Position of handling devices: ± 3 inches (± 75 mm)

Precast Deck Units



- a. Length: $+0, -3/4$ inch ($+0, -20$ mm)
- b. Width: $\pm 1/4$ inch (± 5 mm)
- c. Depth: $\pm 1/4$ inch (± 5 mm)
- d. Stem thickness: $+1/4$ inch, $-1/8$ inch ($+5$ mm, -3 mm)
- e. Deck thickness: $+1/4$ inch, $-1/8$ inch ($+5$ mm, -3 mm)
- f. Position of blockouts: $\pm 1/2$ inch (± 12 mm)
- g. Horizontal alignment (deviation from straight line parallel to centerline of member):
1/8 inch per 10 feet (3 mm per 3 m)
- h. Vertical deviation from design: $\pm 1/8$ inch per 10 feet (± 3 mm per 3 m)
- i. Differential vertical offset between adjacent members of same design:
1/4 inch per 10 feet, but not greater than 3/4 inch (6 mm per 3 m, but not greater than 20 mm)
- j. Position of handling devices: ± 6 inches (± 150 mm)
- k. Distance between stems: $\pm 1/4$ inch (± 5 mm)
- l. Position of weld plates: ± 1 inch (± 25 mm)
- m. Squareness of ends (vertical and horizontal alignment): $\pm 1/4$ inch (± 5 mm)

OMR-CONC.

10/2008

QUALITY CONTROL PRE/POST POUR INSPECTION REPORT

Plant No. and Name: _____

DOT Project No.: _____ County: _____ Job #: _____

Stress Date: _____ Cast Date: _____ Type of Structure: _____ F/c: _____

Piece Number(s):								
------------------	--	--	--	--	--	--	--	--

PRE-POUR INSPECTION:

Form Condition/Cleanliness								
Cast Length								
Hold Down 1								
Hold Down 2								
Reinforcement Steel								
Bearing MK								
Bearing UM								
Diaphragm 1								
Diaphragm 2								
Flange Cut MK								
Flange Cut UM								
End Cut MK								
End Cut UM								
Lifting Loops								
CASTING:								
Deck Clips								
Overhang Brackets								
Top Finish								
Cylinders Cast for Release/Shipping								

POST-POUR INSPECTION:

Is Product Identified?								
In Place Length								
Cracks or Spalls								
Chamfer								
Flange Cut MK								
Flange Cut UM								
End Cut MK								
End Cut UM								
Bearing MK								
Bearing UM								
Diaphragm 1								
Diaphragm 2								
Additional Holes/Inserts								
Deck Clips								
Overhang Brackets								
DUNNAGE:								
Proper Storage (3' per end)								
Patching and Finishing								
Date QC Accepted								

Inspected by: _____

NOTES:

MK – MARKED END
UM – UNMARKED END

(PLOT STRANDS ON GRID)

BED NO. _____ BED LENGTH _____
STRAND SIZE/TYPE _____
STRAND MFG. _____
MODULUS _____ psi HEAT # _____
REEL # _____
PRELOAD _____ lbs RAM ID _____

CALCULATED ELONGATION

STRAIGHT _____ ins. DRAPED _____ ins.

+ 5% _____ + 5% _____

- 5% _____ - 5% _____

+ 5% _____ + 5% _____

- 5% _____ - 5% _____

CALCULATED TENSION

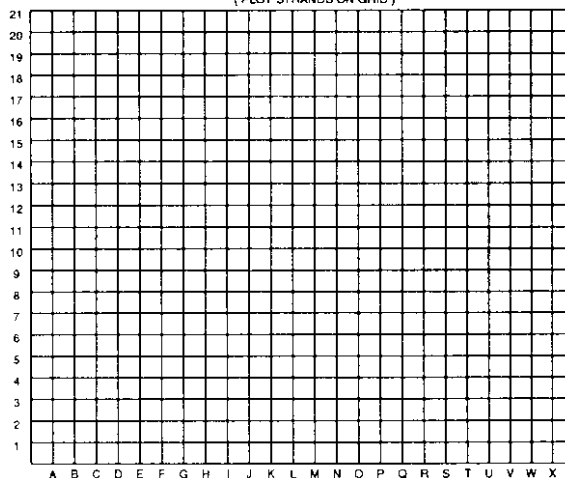
STRAIGHT _____ lbs DRAPED _____ lbs

+ 5% _____ + 5% _____

- 5% _____ - 5% _____

+ 5% _____ + 5% _____

- 5% _____ - 5% _____



TENSIONING REPORT

[illegible]

CONCRETE AND CURING INFORMATION

D.O.T. MIX NUMBER:

MATERIALS		SCALE WEIGHTS	% MOIS
CEMENT (lbs.)	TYPE		
FLYASH (lbs.)			
SAND (lbs.)			
STONE (lbs.)	SIZE		
WATER (gals.)			
AEA (ozs.)			
HRWR (ozs.)			
OTHER			

CONCRETE CYLINDERS

[illegible]

NAME OF PERSONS PERFORMING TEST

NO.	_____	_____
STATION	_____	_____
TIME	_____	_____
SLUMP	_____	_____
% AIR	_____	_____
PLACEMENT TEMP	_____	_____

AMBIENT CONCRETE TEMPERATURES

TYPE CURING: STEAM ☐ WATER ☐ OTHER ☐

LOCATIONS AND TEMPERATURES

[illegible]

Q.C. SUPERVISOR _____

801-3176
 REV 8/70

SHEET A 1

DEPARTMENT OF TRANSPORTATION
 OFFICE OF MATERIALS AND RESEARCH
 CONCRETE TEST REPORT

REPORT NO. 719476

CLASS CONCRETE 43

CONTRACT NO. 27

PROJECT NO. 41

COUNTRY USA

PLANT LOCATION CONCRETE PLANT

TOTAL CUBIC YARDS 69

DAY 73

WEEK 73

CODE	CLASS OF CONCRETE	CODE	TYPE, STRUCTURE	MATERIALS	CODE	TYPE	SIZE	SPECIFIC GRAVITY	WEIGHT PER YARD
1	A	01	CULVERT AND END WALL	CEMENT	76		79	1	32
2	B	02	BRIDGE						
3	AA	03	BRIDGE DECK						
4	AAI	04	APPROACH SLAB						
5	AAA	05	SLOPE PAVING	FLY ASH	85		88	1	91
6	SEAL	06	RETAINING WALL	SLAG	94		97	1	100
7	CS	07	CURB AND GUTTER	SAND 1	103		107	1	114
8	ACCELERATED	08	DITCH PAVING	SAND 2	116		120	1	127
9	PAVEMENT	09	MEDIAN	COARSE AGGREGATE 1	129				
0	OTHER	10	MISCELLANEOUS	COARSE AGGREGATE 2	142				
CODE	TYPE, ADMIXTURE	11	SIDE WALK	WATER					157
1	RETARDING	12	PRESTRESSED BEAM	AIR ENTRAINING					160
2	WATER REDUCING	13	PRESTRESSED PILE	OTHER ADMIXTURE	162				165
3	ACCELERATING	14	PRECAST BRIDGE						
4	OTHER	15	PRECAST MISCELLANEOUS						
		16	PAVEMENT						
		17	SPECIAL PURPOSE						
		18	OTHER						

REMARKS:

SAMPLE NO. 1	SAMPLE NO. 2	DESCRIPTION AND PLACEMENT LOCATION	TYPE	STRT	CUBIC YARDS	AIR (%)	SLUMP (IN.)	DATE MADE	MO	DAY	YR	AGE DAYS	UNIT LOAD (PSI)	CYLINDER 1	CYLINDER 2	LAB NUMBER
163	172		176	178		182	184		187			193	199			
183	197		211	213		217	219		222			228	234			
238	242		246	248		252	254		257			263	269			
273	277		281	283		287	289		292			298	304			
313	312		316	318		322	324		327			333	339			

ABOVE SAMPLES MEET FAIL TO MEET
 REQUIREMENTS SECTION EXCEPT NUMBERS LISTED

SUBMITTED BY _____ STATE MATERIALS AND RESEARCH ENGINEER

PRECAST SHIPPING REPORT
OMR-122
REV. 7/01

**GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS AND RESEARCH
FOREST PARK, GEORGIA**

4604

Contract ID No.: _____

Project No.: _____ County: _____

Date Shipped: _____ Ticket No.: _____

Type Unit Shipped: PRESTRESSED () PRECAST ()
 I - Beams () Box Beams () Rect. Beams () Bridge Slabs () Bridge Caps () Bridge Barriers () Piling ()
 Wall Panels () Strain Poles () SIPS [Deck Panels] () Temp. Median Barriers () Other _____

Produced By: _____ Location (City): _____

Bridge No./Wall Location: _____ GDOT or Company Stamp No.: _____

Product Shipped To (Contractor): _____

QUANTITY	LENGTH	AREA	SIZE OR TYPE	DATE CAST	IDENTIFICATION NUMBER	*STRENGTH
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

* IF SHIPPED PRIOR TO 28 DAY ACCEPTANCE COMPRESSIVE STRENGTH, ENTER SHIPPING STRENGTH.

Remarks: _____

We, _____ hereby certify that all phases of construction and the materials used to fabricate the above listed units were in accordance with the Plans and the Specifications of the Georgia Department of Transportation.

Quality Control Supervisor_____
Notary Public_____
Plant Manager

This the _____ day of _____, 20 ____

THIS SPACE TO BE FILLED IN BY OFFICE OF MATERIALS AND RESEARCH

Remarks: _____

Meets the requirements of Article _____

Report No.:

Technical Services Engineer/Technician_____
State Materials and Research Engineer

GEORGIA DEPARTMENT OF TRANSPORTATION STUDY GUIDE FOR CONCRETE TECHNICIANS

I. Procedure for Selecting Proportions

A. Establishing Limiting Criteria

Before starting to establish mix proportions, information must be assembled on the characteristics of Department approved materials and the requirements of the concrete. Information on materials should include:

1. Relationships of strength to water/cement ratio for available combinations of materials, including cement.
2. Specific gravities and absorptions of fine and coarse aggregates.
3. Gradings of fine and coarse aggregates.
4. Effects of any admixtures to be used, and addition rates.

B. The job Specification, or other sources of information should be examined in detail to ascertain requirements for:

1. Maximum water/cement ratio
2. Minimum cement factor
3. Air content
4. Slump
5. Maximum size of aggregate and limitations or grading
6. Strength
7. Required admixtures

C. In the case of Department of Transportation work, the second list of criteria will govern. This information can be found on the chart containing uses of concrete in the Standard Specifications.

II. Definition of Terms

Before you begin proportioning, it would be helpful to review the terms and definitions as follows:

1. Specific Gravity. The specific gravity of a material is expressed as a ratio of its weight to the weight of the same volume of water.

Specific gravity of water is equal to one.

The specific gravity of cement is equal to 3.14; or we could say (cement is 3.14 times as dense as water).

2. "Solid" weight per cubic foot. The solid weight per cubic foot of a material is expressed as the product of the materials specific gravity times the weight of one cubic foot of water (62.4 lbs).

The solid weight per cubic foot of cement is equal to:

$$3.14 \times 62.4 \text{ lbs} = 195.94 \text{ lbs/ft}^3$$

3. **Absolute Volume.** The absolute volume of a material is the volume exclusive of the void spaces between particles. It is expressed as the ratio of the loose materials weight to the solid weight per cubic foot of the same material.

One sack of cement (94 lbs) occupies approximately one cubic foot of bulk volume, but the absolute volume of the solid cement particles is only about 0.48 ft³.

$$\frac{94 \text{ lbs}}{195.94 \text{ lbs/ft}^3} = 0.48 \text{ ft}^3$$

III. Determining Proportions

Determination of proportions can best be done by establishing a list of requirements needed in finding proportions and then fulfilling these requirements according to the Specifications.

1. **Selection of Cement Factor**

The Department of Transportation has already established a minimum cement factor for all classes of concrete. This factor can be obtained from the Specifications.

2. **Determining Mix Water Requirement**

The Department of Transportation has established a maximum amount of water for a given amount of cement. Actual mixing water required to produce the desired slump will be somewhat less than the maximum. Even though tables have been established which can aid in determining the actual amount of mixing water needed for certain size and shape aggregates and corresponding slump values, we must rely largely on experience. Therefore, a concrete technician who works with a given combination of materials daily should be familiar enough with his materials to determine the actual mixing water required.

3. **Specific Gravities**

Specific gravities can be obtained from the List of Approved Aggregate Sources (QPL 1 & 2) published by the Department.

4. **Determination of Aggregate Volume**

In determining the ratio of fine aggregate volume to coarse aggregate volume, we must again rely on experience or other acceptable published design procedures. This should be easy enough for a concrete technician who is familiar with the characteristics of the material he is using.

5. **Allowance for Volume of Air**

The Specification establishes the design air content and a range of air contents for all Classes of concrete used by the Department. These volumes of air should be taken into consideration in your design.

IV. Example Problems

Example 1: Establish the proportions for a Class “A” mix using the following materials:

<u>Materials</u>	<u>Sp. Gr.</u>	<u>Absorption</u>	<u>Solid Wt./ft³</u>
Medusa Cement	3.14		$3.14 \times 62.4 = 195.94$
Howard Sand	2.61	0.43	$2.61 \times 62.4 = 162.86$
Dalton Rock	2.74	0.62	$2.74 \times 62.4 = 170.98$

		<u>Volumes</u>
Cement	611	3.12 ft ³
Sand	1168	7.17 ft ³
Stone	1918	11.22 ft ³
Water	33.0 gals.	4.41 ft ³
Air	4 %	1.08 ft ³
Total Volume =		27.00 ft ³

$$\text{Absolute Vol.} = \frac{\text{Weight}}{\text{Solid Wt./ft}^3}$$

$$\text{Absolute Vol. Cement} = \frac{611 \text{ lbs}}{195.94 \text{ lbs/ft}^3} = 3.12 \text{ ft}^3$$

$$\text{Absolute Vol. Water} = \frac{33.0 \text{ gals} \times 8.33 \text{ lbs/gal}}{62.4} = 4.41 \text{ ft}^3$$

$$\text{Absolute Vol. Air} = 27.00 \times 0.04 = 1.08 \text{ ft}^3$$

$$\text{Total Vol. of Cement, Water, Air} = 8.61 \text{ ft}^3$$

$$\text{Total Vol. Aggregate} = 27.00 - 8.61 = 18.39 \text{ ft}^3$$

$$\text{Volume of Sand} = 18.39 \times 0.39 = 7.17 \text{ ft}^3$$

$$\text{Volume of Stone} = 18.39 - 7.17 = 11.22 \text{ ft}^3$$

$$\text{Batch Weights} = \text{Absolute Volume} \times \text{Solid Wt./ft}^3$$

$$\text{Batch Wt. Sand} = 7.17 \times 162.86 = 1168 \text{ lbs}$$

$$\text{Batch Wt. Stone} = 11.22 \times 170.98 = 1918 \text{ lbs}$$

Example 2: Listed below are the one cubic yard proportions for a Class A concrete mix. It has been determined that this mix produces concrete that has excessive slump (6.0"). Reduce the water by 2.0 gallons per cubic yard and make the necessary adjustment in the sand so as to keep the same volume of concrete. Remember, in general, one gallon of water per cubic yard will change slump measurements approximately 1.0 inch.

<u>Materials</u>	<u>Proportions (lbs)</u>	<u>Sp. Gr.</u>	<u>Adj. Abs. Vol. (ft³)</u>	<u>Adjusted Proportions</u>
Cement	611	3.14	3.12	611 lbs
Sand	1155	2.63	7.09	1164 lbs
Stone	1899	2.66	11.44	1899 lbs
Water (gals)	(34.0) 32.0		4.27	32.0 gals
Air	4 %		1.08	

Reduce water by 2 gallons = $34.0 - 2.0 = 32.0$

$$\text{Absolute Vol. Cement} = \frac{611 \text{ lbs}}{195.94 \text{ lbs/ft}^3} = 3.12 \text{ ft}^3$$

$$\text{Absolute Vol. Water} = \frac{32.0 \text{ gals} \times 8.33 \text{ lbs/gal}}{62.4 \text{ lbs/ft}^3} = 4.27 \text{ ft}^3$$

$$\text{Absolute Vol. Stone} = \frac{1899 \text{ lbs}}{165.98 \text{ lbs/ft}^3} = 11.44 \text{ ft}^3$$

$$\text{Absolute Vol. Air} = 27.00 \times 0.04 = 1.08 \text{ ft}^3$$

$$\text{Total Volume of Cement, Water, Stone, Air} = 19.91 \text{ ft}^3$$

$$\text{Volume of Sand} = 27.00 - 19.91 = 7.09 \text{ ft}^3$$

Adjusted Proportions

$$\text{Cement} = 3.12 \times 195.94 = 611 \text{ lbs}$$

$$\text{Sand} = 7.09 \times 164.11 = 1164 \text{ lbs}$$

$$\text{Stone} = 11.44 \times 165.98 = 1899 \text{ lbs}$$

Example 3: Listed below are the proportions for a Class B concrete mix. It has been determined that the mix will not produce workable concrete because of a lack of sand. Increase the sand by 110 pounds per cubic yard and make no changes in the cement, water, and air. Retain the same volume of concrete which is one cubic yard.

<u>Materials</u>	<u>Proportions (lbs)</u>	<u>Sp. Gr.</u>	<u>Absolute Vol. (ft³)</u>	<u>Adjusted Proportions</u>
Cement	470	3.14	2.40	470 lbs
Sand	1063	2.63	7.15	1173 lbs
Stone	2075	2.66	11.83	1964 lbs
Water	34.0 gals		4.54	34.0 gals
Air	4 %		1.08	4 %

Add 110 lbs to sand weight = 1063 lbs + 110 lbs = 1173 lbs

$$\text{Absolute Vol. Sand} = \frac{1173 \text{ lbs}}{164.11 \text{ lbs/ft}^3} = 7.15 \text{ ft}^3$$

$$\text{Absolute Vol. Cement} = \frac{470 \text{ lbs}}{195.94 \text{ lbs/ft}^3} = 2.40 \text{ ft}^3$$

$$\text{Absolute Vol. Water} = \frac{34.0 \text{ gals} \times 8.33 \text{ lbs/gal}}{62.4 \text{ lbs/ft}^3} = 4.54 \text{ ft}^3$$

$$\text{Absolute Vol. Air} = 27.00 \times 0.04 = 1.08 \text{ ft}^3$$

$$\text{Total Volume of Sand, Cement, Water, Air} = 15.17 \text{ ft}^3$$

$$\text{Absolute Volume of Stone} = 27.00 - 15.17 = 11.83 \text{ ft}^3$$

Adjusted Proportions

$$\text{Stone} = 11.83 \times 165.98 = 1964 \text{ lbs}$$

Example 4: The one cubic yard mix proportions listed below will not produce concrete of the desired consistency on the job. Increase the water by 1.5 gallons per yard and keep the same coarse to fine aggregate ratio.

<u>Materials</u>	<u>Proportions (lbs)</u>	<u>Sp. Gr.</u>	<u>Absolute Vol. (ft³)</u>	<u>Adjusted Weights</u>
Cement	611	3.14	3.12	611 lbs
Sand	1193	2.66	7.09	1177 lbs
Stone	1894	2.71	11.10	1877 lbs
Water (gals)	33.0 gals		4.61	34.5 gals
Air	4 %		1.08	4 %

Determine coarse to fine aggregate ratio by volume.

$$\text{Sand} = \frac{1193 \text{ lbs}}{165.98 \text{ lbs/ft}^3} = 7.19 \text{ ft}^3$$

$$\text{Stone} = \frac{1894 \text{ lbs}}{169.10 \text{ lbs/ft}^3} = 11.20 \text{ ft}^3$$

$$\% \text{ fine aggregate to coarse} = \frac{7.19 \text{ ft}^3}{18.39 \text{ ft}^3} = 0.39 \times 100 = 39\%$$

$$\text{Increase water } 1.5 \text{ gallons} = 33.0 + 1.5 = 34.5 \text{ gallons}$$

$$\text{Absolute Vol. Water} = \frac{34.5 \text{ gals} \times 8.33 \text{ lbs/gal}}{62.4 \text{ lbs/ft}^3} = 4.61 \text{ ft}^3$$

$$\text{Absolute Vol. Cement} = \frac{611 \text{ lbs}}{195.94 \text{ lbs/ft}^3} = 3.12 \text{ ft}^3$$

$$\text{Absolute Vol. Air} = 27.00 \times 0.04 = 1.08 \text{ ft}^3$$

$$\text{Total Absolute Vol. of Cement, Water, Air} = 8.81 \text{ ft}^3$$

$$\text{Total Absolute Volume of Aggregate} = 27.00 - 8.81 = 18.19 \text{ ft}^3$$

$$\text{Absolute Vol. of fine aggregate} = 18.19 \text{ ft}^3 \times 0.39 = 7.09 \text{ ft}^3$$

$$\text{Absolute Vol. of coarse aggregate} = 18.19 \text{ ft}^3 - 7.09 \text{ ft}^3 = 11.10 \text{ ft}^3$$

Adjusted Weights

$$\text{Cement} = 3.12 \times 195.94 = 611 \text{ lbs}$$

$$\text{Sand} = 7.09 \times 165.98 = 1177 \text{ lbs}$$

$$\text{Stone} = 11.10 \times 169.10 = 1877 \text{ lbs}$$

$$\text{Water} = 34.5 \text{ gallons}$$

$$\text{Air} = 4.0 \%$$

Example 5: Listed below are the proportions for a Class A concrete mix. The contractor has elected to use a fly ash mix with a 15% cement reduction and a 1.25 lbs. to 1.0 lb. replacement factor. Make this adjustment and maintain the same stone, water, and air volume.

<u>Materials</u>	<u>Proportions (lbs)</u>	<u>Sp. Gr.</u>	<u>Absolute Vol. (ft³)</u>	<u>Adjusted Weights</u>
Cement	611	3.14	2.65	519 lbs
Fly Ash	0	2.40	0.77	115 lbs
Sand	1193	2.66	6.89	1144 lbs
Stone	1894	2.71	11.20	1894 lbs
Water (gals)	33.0 gals		4.61	33.0 gals
Air	4 %		1.08	4 %

Determine the amount of cement and fly ash required.

$$\text{Cement} = 611 \times 0.15 = 92.0 \text{ lbs}$$

$$611 - 92.0 = 519 \text{ lbs}$$

$$\text{Fly Ash} = 92 \times 1.25 = 115 \text{ lbs}$$

$$\text{Absolute Vol. Cement} = \frac{519 \text{ lbs}}{195.94 \text{ lbs/ft}^3} = 2.65 \text{ ft}^3$$

$$\text{Absolute Vol. Fly Ash} = \frac{115 \text{ lbs}}{149.76 \text{ lbs/ft}^3} = 0.77 \text{ ft}^3$$

$$\text{Absolute Vol. Stone} = \frac{1894 \text{ lbs}}{169.10 \text{ lbs/ft}^3} = 11.20 \text{ ft}^3$$

$$\text{Absolute Vol. Water} = \frac{33.0 \text{ gals} \times 8.33 \text{ lbs/gal}}{62.4 \text{ lbs/ft}^3} = 4.41 \text{ ft}^3$$

$$\text{Absolute Vol. Air} = 27.00 \times 0.04 = 1.08 \text{ ft}^3$$

$$\text{Total Absolute Vol. of Cement, Fly Ash, Stone, Water, Air} = 20.11 \text{ ft}^3$$

$$\text{Absolute Volume of Sand} = 27.00 - 20.11 = 6.89 \text{ ft}^3$$

Adjusted Batch Weights

$$\text{Cement} = 2.65 \times 195.94 = 519 \text{ lbs}$$

$$\text{Fly Ash} = 0.77 \times 149.76 = 115 \text{ lbs}$$

$$\text{Sand} = 6.89 \times 165.98 = 1144 \text{ lbs}$$

$$\text{Stone} = 11.20 \times 169.10 = 1894 \text{ lbs}$$

$$\text{Water} = 33.0 \text{ gallons}$$

$$\text{Air} = 4.0 \%$$

V. Test Procedures

The Technician Examination will also contain questions related to accepted methods of testing fresh Portland cement concrete.