

GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS AND TESTING

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 ensures 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 Testing (OMAT) 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.

Precast Plants shall be approved and monitored annually by OMAT Prestress/Precast Division with addition to the Qualified Products List when the Plant is at an established permanent location and not located within the Project limits.

Temporary Precast Plants are approved on a temporary basis for Project-specific, on-site casting, if the Prime Contractor elects to cast their own items. These Temporary Precast Plants will be approved by OMAT in the same manner as a Permanent Precast Plant with the exception of not being added to the GDOT QPL listing since these are project specific temporary plants and are located within the Project limits or within close proximity if approved by the Department

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/post tensioned, 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 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 ensures, (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 Testing. (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 April 1, 2022, 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 products shall be certified by either the Precast/Prestressed Concrete Institute (PCI) in Category B1 (or higher) or the National Precast Concrete Association (NPCA).

Producers of Precast concrete bridge members shall be certified and monitored annually by OMAT and added to the GDOT QPL listing with the exception noted in section I for “Temporary on-site Precast Plant” casting.

Producers shall submit proof of certification as an active, certified 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 April 1, 2022, 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 Manager.

1. The quality control manager 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. Ensure 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. Actively monitor concrete placement to assure proper consolidation requirements and all other requirements are met.
 - g. Inspect the finished product for dimensional accuracy and appearance.
 - h. Report deviation from allowable tolerance to the Office of Materials and Testing for disposition.
 - i. Provide the Office of Materials and Testing 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 Testing Plant Inspector. Applicable forms for documentation are attached.
 - j. 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 manager will be examined by the Department initially 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 manager may be required to travel to the Forest Park Laboratory for examination. Suspension of certification for failure to comply to approved casting standards by the Certified Quality control manager shall be approved by the OMAT Bureau Chief based upon notification by the GDOT Plant Technician when deemed necessary to correct infraction. Certification shall be restored when non-compliance issue is corrected to the satisfaction of the OMAT Plant technician.
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. Suspension of certification for failure to comply to approved casting standards by the Certified Quality Control personnel shall be approved by the OMAT Bureau Chief based upon notification by the GDOT Plant Technician when deemed necessary to correct infraction. Certification shall be restored when non-compliance issue is corrected to the satisfaction of the OMAT Plant technician. Producer personnel that are certified by the GDOT are the only Technicians allowed to perform inspection, testing, and data collection on DOT assigned Projects.
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 Engineer. All personnel certifications shall expire after a period of no longer than 5 years. The Office of Materials and Testing Plant Inspector should be contacted 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 quality control 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 Engineer for review. 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 ensure that the pallet remains within a grade tolerance of 1/8 inch per 10 feet 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 10 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 10 feet in length, verify the entire pallet is smooth and free of defects within a tolerance of 1/8 inch per 10 feet. If the initial profile requires corrections and after corrections are made, additional profiles shall be done until the pallet meets the tolerances. 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 beam and piling beds, the pallet profile and straightedge test shall be done at an interval of every 5 pours or as needed. For piling, the profile and straightedge test shall be done every 2 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 Testing 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. Repairs or corrections to the pallet or forms shall be completed permanent and shall be made with materials approved by the State Materials Engineer that will maintain dimensions required of the product when forms are removed.

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 % 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 6 month intervals or sooner when needed to verify accuracy. Provide a certified copy of all calibration certificates to the Office of Materials and Testing 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 12 month intervals or sooner if needed to verify maintained accuracy. Provide a certified copy of

all calibration certificates to the Office of Materials and Testing Plant Inspector at the time of calibration. Air meters shall be recalibrated quarterly or sooner if needed to ensure accuracy. Air meter calibration records shall be maintained by the producer. All concrete test equipment shall be inspected periodically for conformity with applicable specifications and standards.

E. Concrete Batch Plant

The Batch Plant mechanical inspection and calibration should be performed by an independent scale calibration company. All batching systems for aggregates, cement, water, and admixtures as well as all mixers shall comply with Specifications and SOP-10. 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 Testing Plant Inspector at the time of calibration. This inspection shall be made once each 6 months during production or as directed by the GDOT Plant Technician.

All scales used for weighing concrete materials shall have an accuracy of plus or minus 1% under operating conditions. Cement and Supplementary Cementitious Materials shall be measured by weight on scales to an accuracy of plus or minus 1% of the required weight. Aggregates shall be measured by weight on scales to an accuracy of plus or minus 2% of the required weight of each material. Water shall be measured by weight or volume to an accuracy of plus or minus 1% of the required amount. Admixtures shall be measured by weight or volume to an accuracy of plus or minus 3% of the required amount. Cement, Supplementary Cementitious Materials, and Aggregates shall not be proportioned by volume.

Free moisture in aggregates shall be checked and compensated for immediately prior to batching concrete and as necessary during concrete production to maintain a consistent mix daily. The results of all free moisture tests shall be documented daily.

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 (QPL) when the source has not produced products for a Departmental project for a period of 12 months.

G. Reinstatement to the Approved List

Once removed from the approved list, a producer may request reinstatement, after a minimum of 3 months, in the following manner:

1. Producers shall make a written request to the State Materials 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 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 mix designs shall be approved or rejected, in writing, by the Office of Materials and Testing. The design of mixes may be done either by an AASHTO accredited 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 ensure 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 will not be required unless specifically noted. 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 Testing 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 Testing Plant Inspector and sent to the nearest Office of Materials and Testing 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 Testing 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, 3 Independent Assurance samples shall be obtained from each heat or lot, 53 inches in length, and delivered to the Forest Park Laboratory by the producer.

2. Reinforcement Steel Bars
Shall be obtained from approved sources. Two Independent Assurance samples per size, per project, 30 inches in length, are to be obtained and delivered to the Forest Park Laboratory by the producer.
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.

E. Buy America

All materials and products permanently incorporated in precast/prestressed concrete members and structural precast concrete members shall meet all of the requirements of Buy America. Provide documentation certifying that all materials and products meet these requirements to the State Materials Engineer upon request. All Buy America exception requests shall be made in writing to the State Materials Engineer. Buy America exception requests may or may not be approved.

F. Site Manager Participation

All Producers are required to participate in the GDOT Site Manager material reporting system. Producer's must designate personnel to input data and retrieve reports generated in Site Manager. Producers must go to the external GDOT portal and follow the sign up processs. Access is as follows:
<http://www.dot.ga.gov/PS/Training/SiteManager>

V. PRODUCTION INSPECTION

Producers shall provide the State Materials 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 Manager. 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 Manager and shall 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, a correction in elongation shall be made. The strand stressing operation shall be observed and recorded by the producer's Quality Control Manager.

3. Measurement of elongation

The measurements of elongation shall be the primary control. The hydraulic pressure gauge readings at the time of the measured elongation shall be within 5% 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% all work shall be stopped and the defect corrected before proceeding.

Strand that has been tensioned, by any amount, shall not be used. If it is necessary to detension a strand, for any reason, the strand shall be replaced with a new strand.

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 Testing 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 Manager 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 10 feet 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 ensure 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 3 - 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 2 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 Testing 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 Testing 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 ensure 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 3 lifts; bottom flange, web, and top flange. AASHTO Type III and smaller sized beams shall be placed in a minimum of 2 lifts.
- b. For Piling: All solid piles may be placed in 1 lift. Twenty-four inch voided piles may also be placed in 1 lift. For 30 inch , and 36 inch voided piles, the concrete shall be placed in a minimum of 2 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 1 lift. Voided box beams shall be placed in a minimum of 2 lifts. However, no layer shall exceed 24 inches.
- d. Bridge Caps: Bridge caps may be placed in one lift provided the cap depth is not greater than 24 inches .
- 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

Type I Finish

All concrete members shall have an acceptable and uniform GDOT Section 500 Type I finish before they are shipped to the project.

For Beams: Apply Type I wet rub finish to all Beams and rub off excess sack material in a uniform manner. Interior Beams within each span will be left to cure as applied. Exterior faces of Beams in the Span that are visible upon approach by the traveling public will be sacked to remove all latent finish material and will be a uniform steel form finish.

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 ensure 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. Each strand shall be detensioned simultaneously at the end of each individual member on a bed in accordance with the approved detensioning sequence. Particular care shall be taken to ensure 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 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 outlined within GDOT approved shop drawings by the producer's Quality Control Supervisor. Tolerances, as referenced by the Specifications, are attached.

The limits of tolerances outlined in approved shop drawings are the governing dimensional tolerances and any deviation from outlined details will be rejected. 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 Testing Plant 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 Testing 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 Testing 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 Testing 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 Testing 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 Testing Plant Inspector for approval prior to beginning any repair. Any patches and / or repaired areas shall be inspected by the Office of Materials and Testing Plant Inspector. All patching materials used for the repair shall meet the 28/56-day for HPC design strength of the repaired unit prior to shipment. Any repair initiated prior to approval by the Office of Materials and Testing Plant Inspector shall be cause for rejection of the member.

C. Cracks

Submit NCR report in writing, the details of all cracks, along with the proposed repair method and materials to the Office of Materials and Testing Plant Inspector for disposition. The Department will determine the severity of the cracking and will reject any product found to be cracked in excess of acceptable structural limits. If the Producer submits a repair request, the Department will conduct a review of the repair and determine it's acceptance or denial.

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 Manager for adverse changes in dunnage or supports.

E. Rejection of Members

Members may be rejected, in writing, by the Department, for non-compliance. The Department will notify the Producer in writing when rejection is determined. If a review is requested by the producer, the producer must provide, in writing, from a licensed Professional Engineer in the state of Georgia a structural analysis of the member, along with severity of the cracks, the repair service life and the expected service life of the member. The Department will make a determination if the repair will be allowed within 10 business days after receiving all of the required documentation.

VII. ACCEPTANCE IDENTIFICATION

A. Beams

The Office of Materials and Testing 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, all non-conformance reports and concerns shall be resolved to the satisfaction of the State Materials Engineer, 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 Testing 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 Testing 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, all non-conformance reports and concerns shall be resolved to the satisfaction of the State Materials Engineer, 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 the Producer's 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 Producer 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.

C. Precast Concrete Noise Barriers

Noise Barrier Panels may be shipped to the Project prior to 28 day GDOT Lab verification breaks, provided, the Producer's GDOT Certified Precast Technician verifies required 28 day strength is attained by breaking 2 Cylinders. GDOT Plant Technicians must be notified of the attained cylinder strengths prior to shipping. All other DOT controlled items will require a DOT Plant Technician to witness cylinder breaks if shipping is prior to 28 day acceptance breaks.

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 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 Testing shipping form. The producer shall transmit the original shipping form to the Office of Materials and Testing. The form will be reviewed, authenticated, and distributed as the acceptance document for each shipment of members. Members may be rejected, in writing, by the Department, for non-compliance. The GDOT Project Manager shall notify the GDOT Plant Technician immediately of any damage or defect found when the product is delivered.

IX. DOCUMENTATION

A. Producer 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 Testing Plant Inspectors at all times. Copies of any records requested by the Office of Materials and Testing 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 batch plant.
9. Maintain documentation certifying that all materials and products permanently incorporated into members meet the requirements of Buy America.

B. Office of Materials and Testing Records

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

1. The Office of Materials and Testing 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. Area Construction Office 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 Testing.

State Materials Engineer

Director of Construction

Appendix 1
Precast/Prestress Certification/Re-certification Program

Precast/Prestress Concrete Certification Program

***Initial Certification requires GDOT Testing and Certification**

I. Plant Concrete Tester

Study Guides: GDOT Field Concrete Technician Study Guide

Examination Required: GDOT Field Concrete Technician (written & practical test)

Description:

- 1) Ability to use all testing equipment
- 2) Perform slump, air, temperature tests and; fabricate and test concrete test cylinders
- 3) Document all test results

II. Concrete Batcher

Study Guides: GDOT Field Concrete Technician Study Guide and Batchers Study Guide

Examinations Required: GDOT Field Concrete Technician (written & practical test) and Concrete Batchers

Description:

- 1) Responsible for requisites as outlined for Plant Concrete Tester
- 2) Combine raw materials to produce the approved concrete mix
- 3) Recognize and report any malfunction of proportioning equipment and perform necessary correction

III. Precast Concrete Technician

Study Guides: GDOT Field Concrete Technician Study Guide, Batchers' Study Guide, and Precast Concrete Technician Study Guide

Examinations Required: GDOT Field Concrete Technician (written & practical test), Concrete Batchers, and Precast Concrete Technician

Description:

- 1) Responsible for requisites as outlined for Plant Concrete Tester and Concrete Batchers
- 2) Control all materials for concrete mixes
- 3) Compensate for free moisture in aggregates
- 4) Adjust mixes as necessary
- 5) Pre-pour and post-pour product inspections
- 6) Responsible for acceptance and shipping documentation for production of precast products
- 7) Responsible for all pertinent documentation
- 8) Responsible for stamping APPROVED precast products

IV. Prestress Concrete Technician

Study Guides: GDOT Field Concrete Technician Study Guide, Batchers' Study Guide, Precast Concrete Technician Study Guide, and Georgia's Standard Specifications Sections 500 and 865

Examinations Required: GDOT Field Concrete Technician (written & practical test), Concrete Batchers, Precast Concrete Technician and Prestress Concrete Technician

Description:

- 1) Responsible for requisites as outlined for Plant Concrete Tester, Concrete Batchers, Precast Technician
- 2) Responsible for stressing operations
- 3) Responsible for accepting and stamping of APPROVED products
- 4) Meeting requirements as outlined in SOP-3 under Quality Control Supervisor

Precast/Prestress Concrete Re-Certification Program

The requirements below apply to re-certifications only. Initial personnel certifications shall be obtained in compliance with the Precast/Prestress Concrete Certification Program. The requirements below shall not be used to obtain a higher level of certification, only to maintain current certification level prior to their expiration.

All personnel certifications and re-certifications shall expire after a period of no longer than five (5) years. If ACI or PCI certification is used for gaining GDOT re-certification, the expiration dates of the GDOT cards shall be based

on the expiration of the ACI Concrete Field Technician Grade I Card, PCI Level II Card, or PCI Level III card whichever is earlier.

The Office of Materials and Testing Plant Inspector shall be contacted sixty (60) days prior to expiration of personnel certification to resubmit documentation or to schedule a time for re-examination.

Requirements of all re-certifications:

Photocopy of valid Driver's License or valid Government Issued Picture Identification Card

Photocopy of valid GDOT certification card for the same level of certification or higher

Signed copy of the Falsifying Results/Documents Policy

I. Plant Concrete Tester Recertification Requirements

Examination Required: Field Concrete Technician (written & practical test)

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher

II. Concrete Batcher Recertification Requirements

Examinations Required: Field Concrete Technician (written & practical test) and Concrete Batcher

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher

Examination Required: Concrete Batcher

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher

Photocopy of valid PCI Plant Quality Personnel Certification Level II or higher

III. Precast Concrete Technician Recertification Requirements

Examinations Required: Field Concrete Technician (written & practical test) and Precast Concrete Technician

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher

Examination Required: Precast Concrete Technician

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher
Photocopy of valid PCI Plant Quality Personnel Certification Level II or higher

IV. Prestress Concrete Technician Recertification Requirements

Examinations Required: Field Concrete Technician (written & practical test) and Prestress Concrete Technician

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher

Examination Required: Prestress Concrete Technician

OR

Submit the following: Photocopy of Valid ACI Concrete Field Technician Grade 1 or higher

Photocopy of valid PCI Plant Quality Personnel Certification Level II or higher

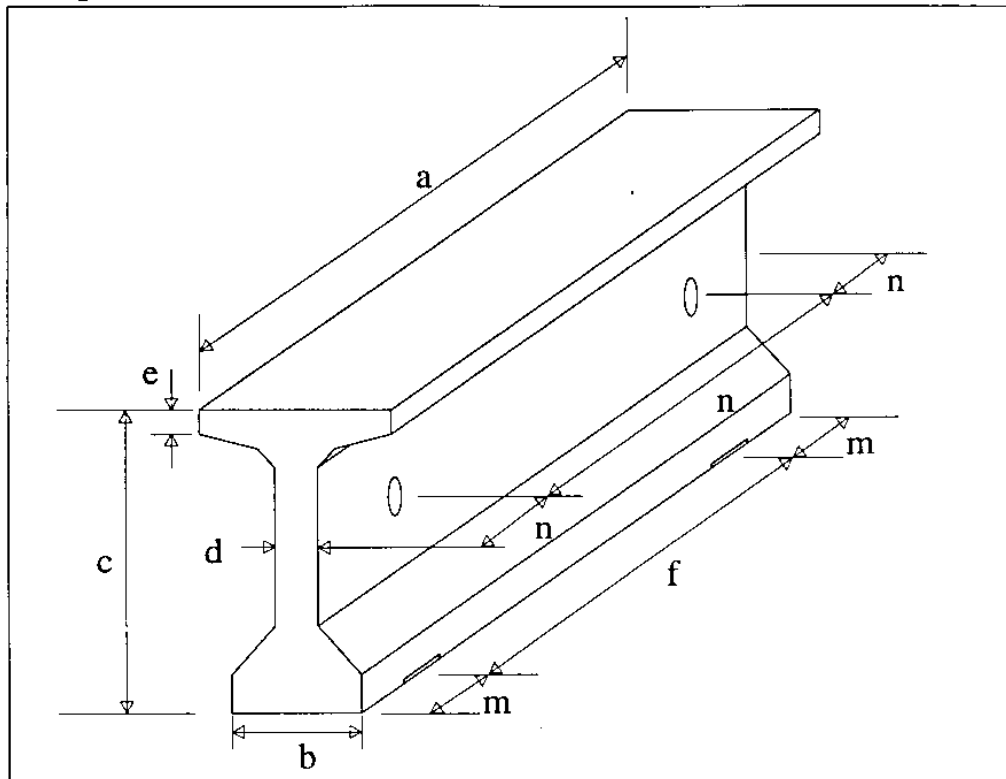
APPENDIX 2

Dimensional Tolerances for the manufacture of Precast/ Prestressed Concrete Products

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

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
OFFICE OF MATERIALS AND TESTING

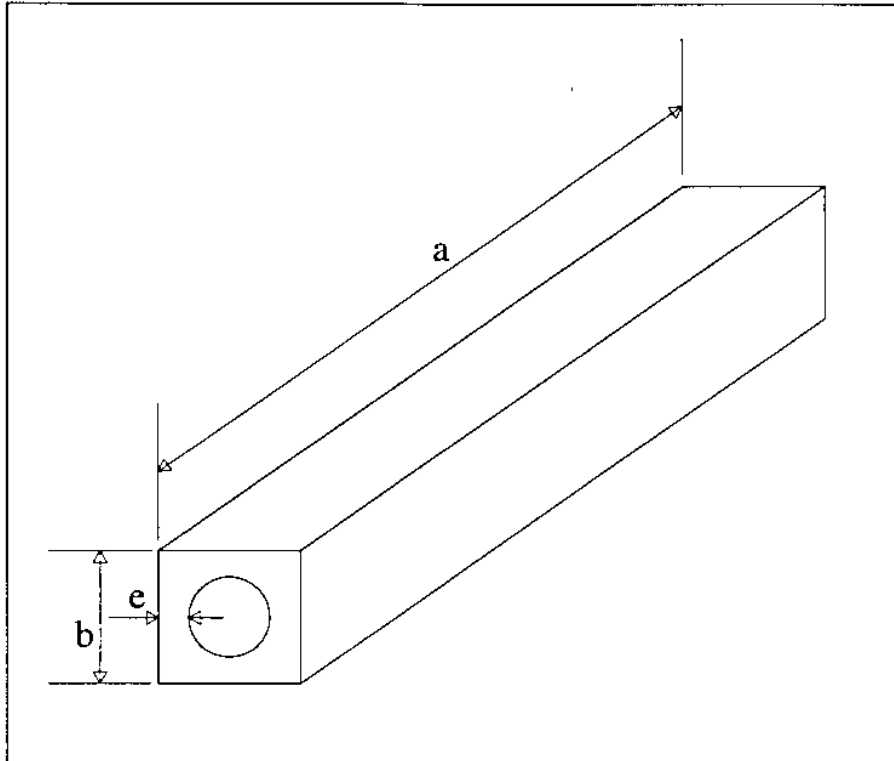
Bridge I-Beams



- a. Length: $\pm 1/4$ " per 25feet, 1"max.
- 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): $\pm 1/4$ "per 25ft, 1"max
- 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)

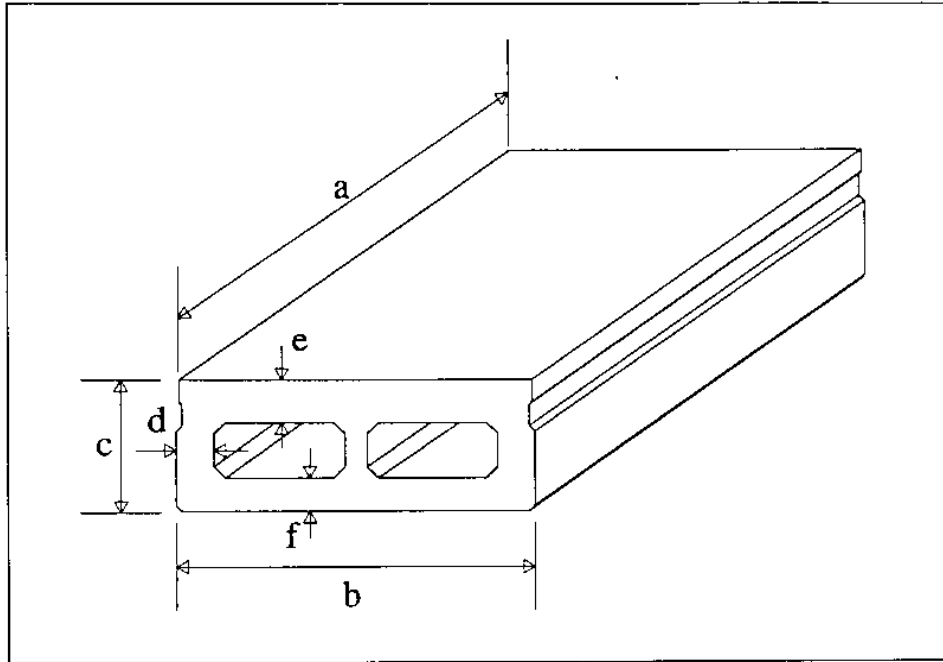
- h. Camber deviation from design camber: $\pm 1/8$ inch per 10 feet (± 3 mm per 3 m)
- i. Stirrup bars (projection above top of beam): $+1/4$ inch, $-3/4$ inch ($+5$ mm, -20 mm)
- j. Tendon position: $\pm 1/4$ inch (5 mm) center of gravity of strand group and individual tendons
- k. Position of deflection 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)

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)

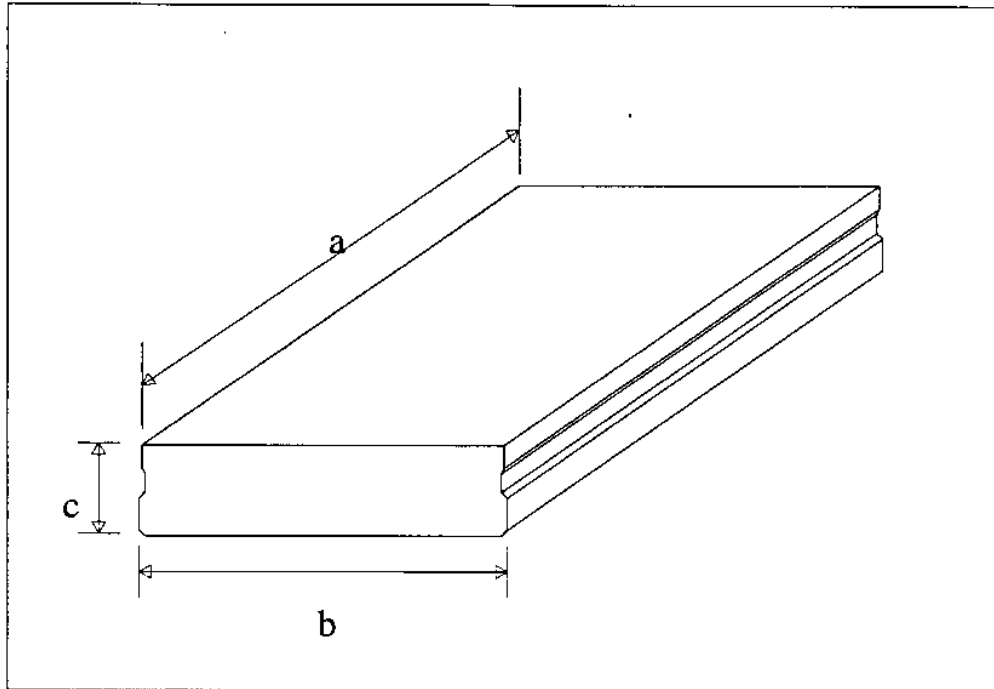
Bridge Box Beams



- 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 $+1/4$ inch ($+5$ mm) per joint
- u. Position of side inserts: $\pm 1/2$ inch (± 12 mm)
- v. Position of weld plates: ± 1 inch (± 25 mm)

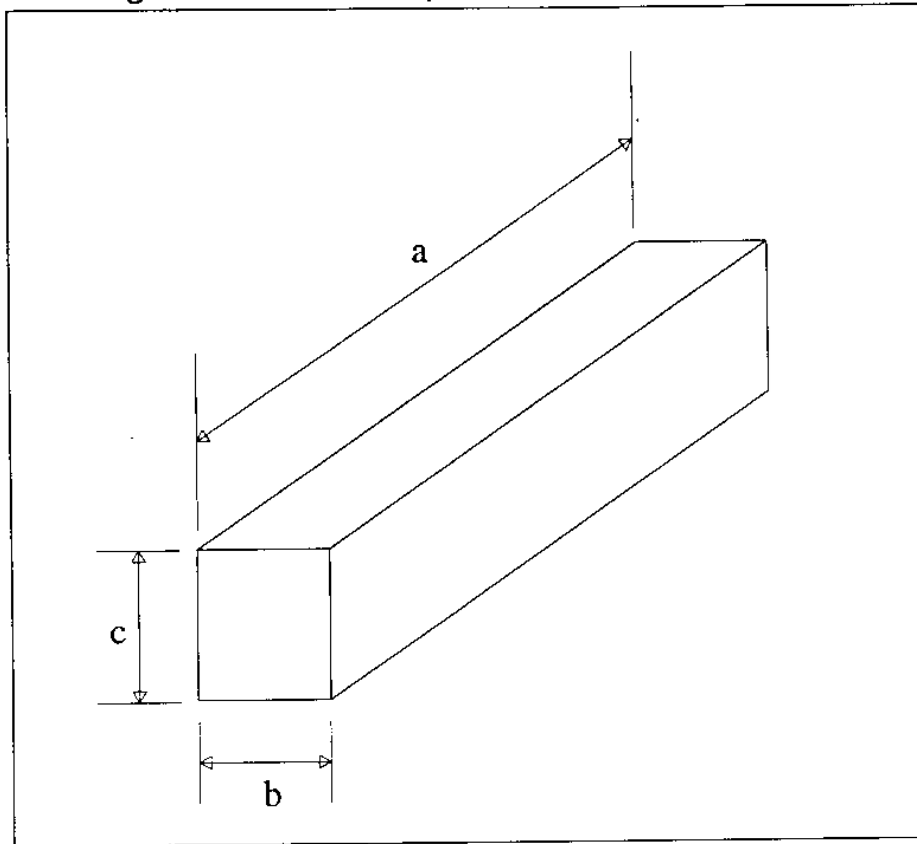
Flat Slab Deck Units



- 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)

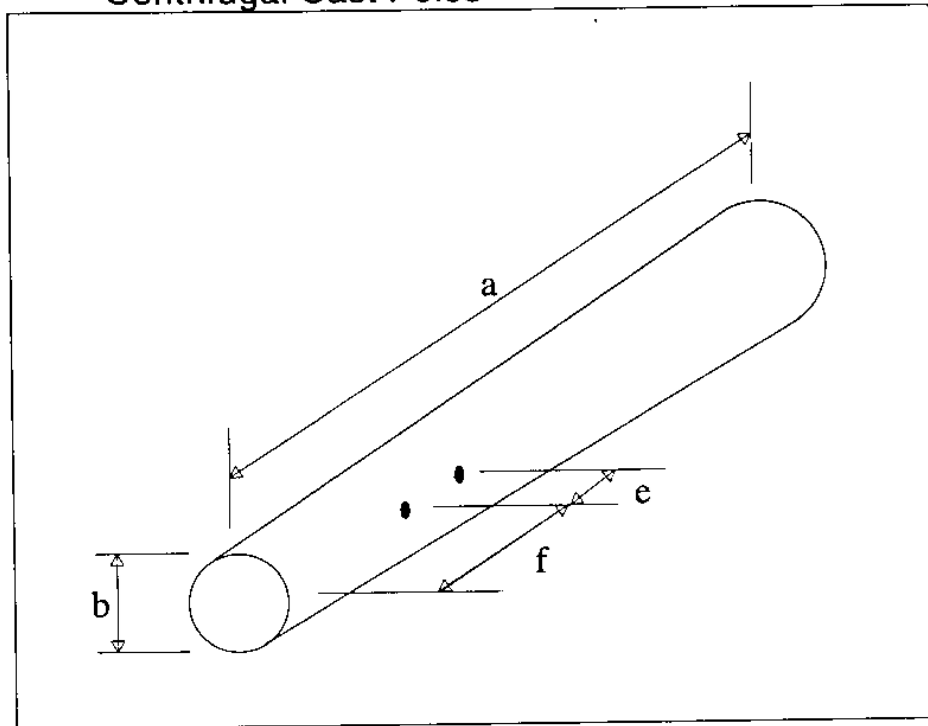
Rectangular Beam or Cap



- 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)

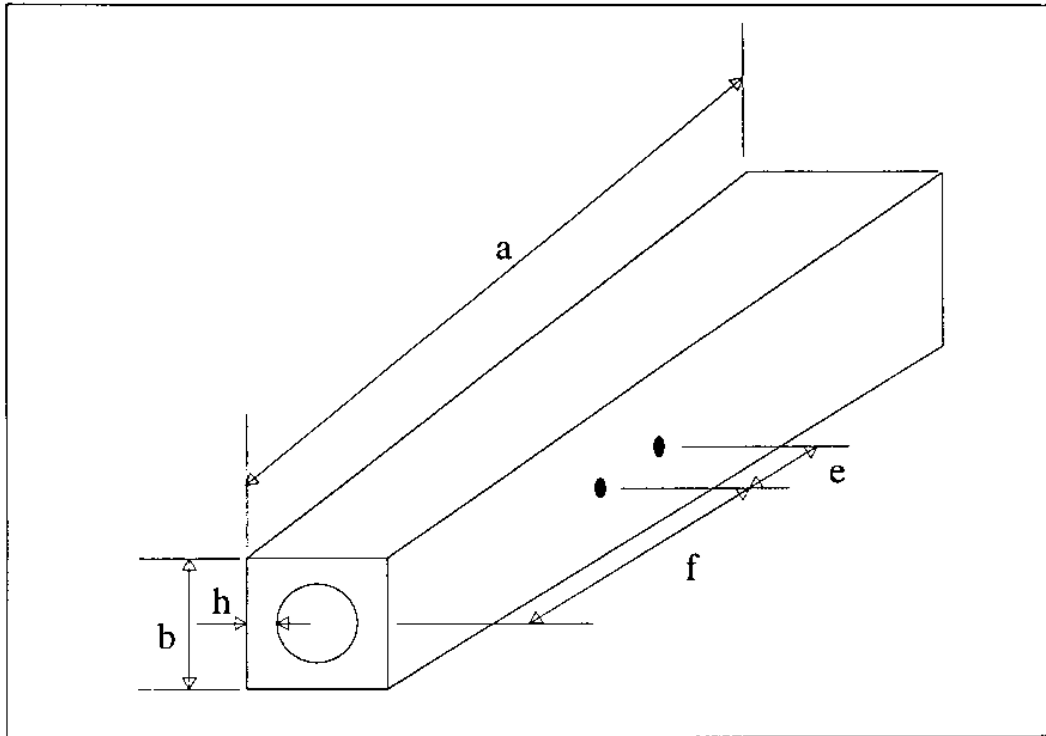
- l. Dowel tubes (spacing between the centers of tubes and from the center of tubes to ends and sides of members): $\pm 1/2$ inch (± 12 mm)
- m. Position of stirrup bars: ± 1 inch (25 mm)
- n. Position of bearing plates: $\pm 1/4$ inch (± 5 mm)
- o. Bearing surface deviation from specified plane: $\pm 1/8$ inch (± 3 mm)

Concrete Strain Poles Centrifugal Cast Poles



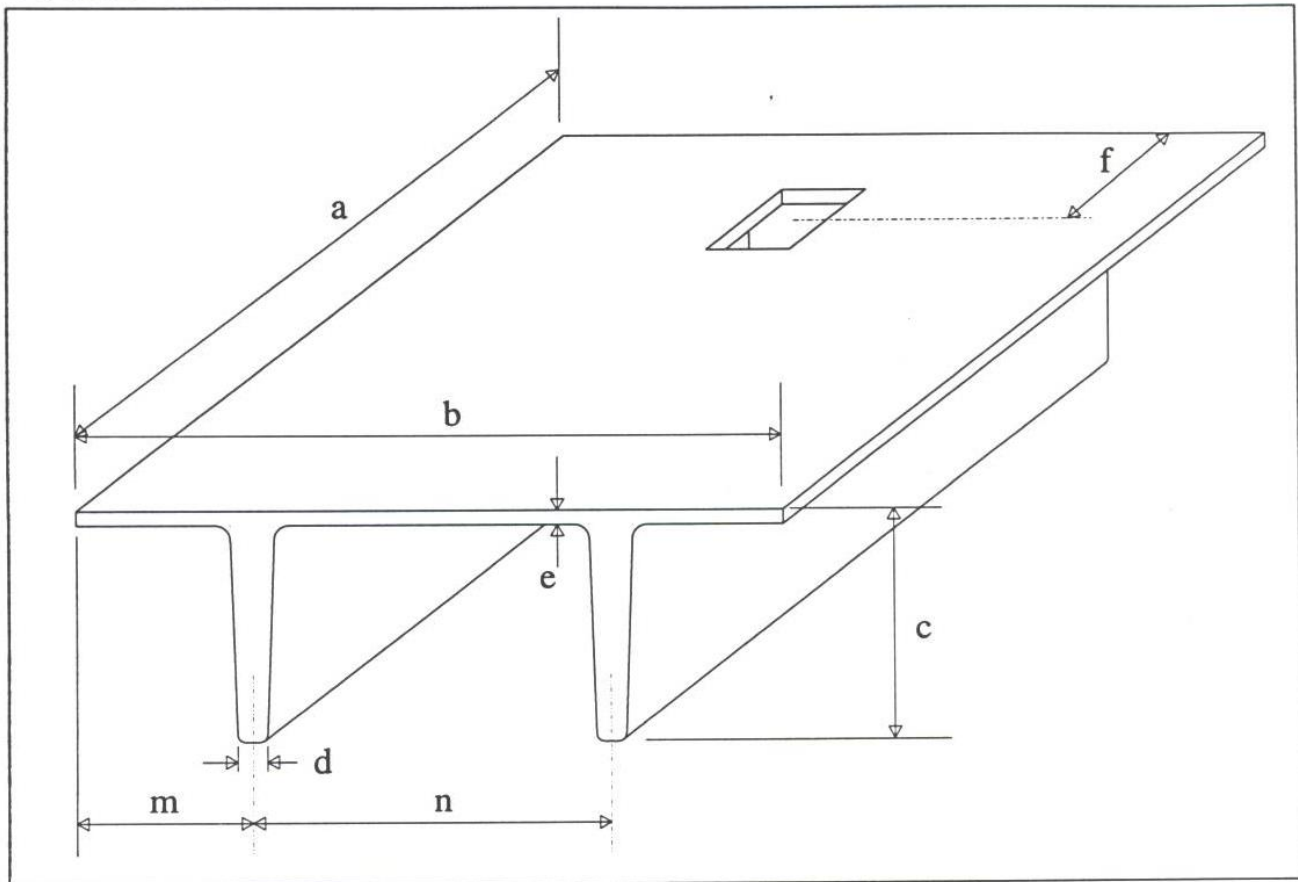
- a. Length: ± 3 inch (± 75 mm)
- b. Width of diameter: $\pm 5/8$ inch (± 15 mm)
- c. Sweep: $3/8$ inch per 10 feet (± 10 mm per 3 m)
- d. Position of tendons: $\pm 1/4$ inch (± 5 mm)
- e. Position of paired holes: $\pm 1/8$ inch (± 3 mm)
- f. Position of individual or paired holes from tip: ± 1 inch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

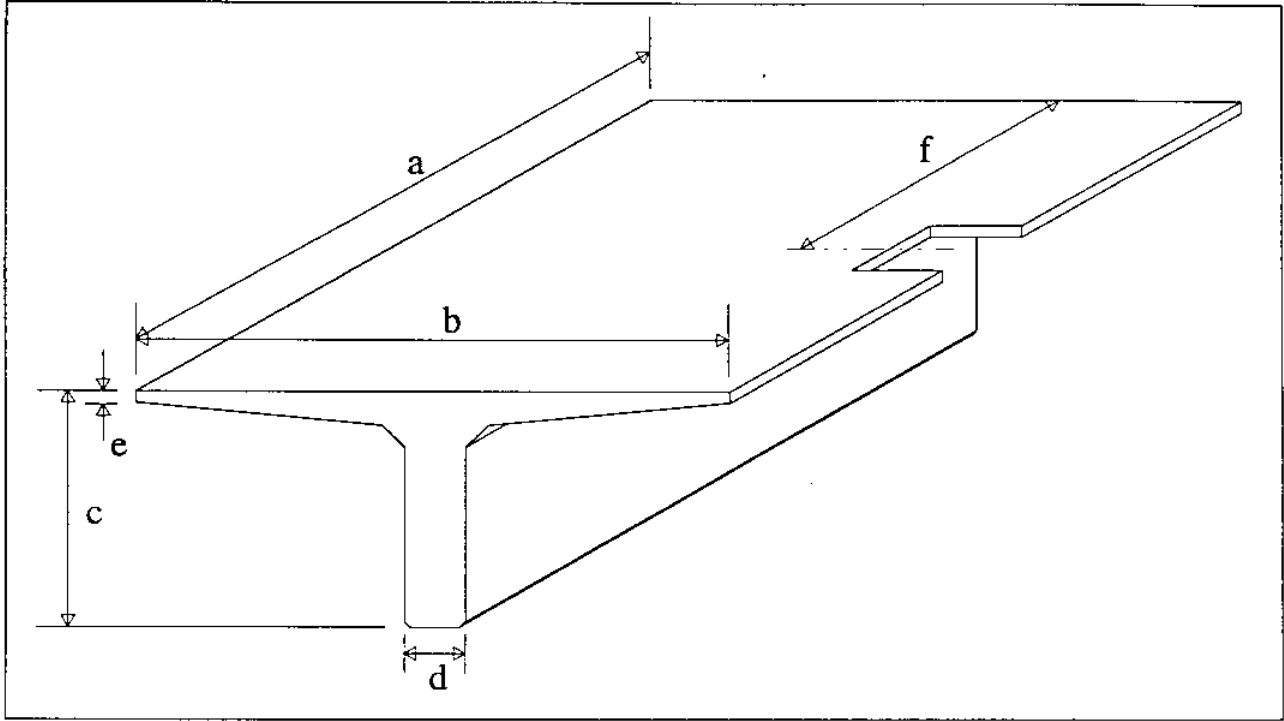
Double Tee



- 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)

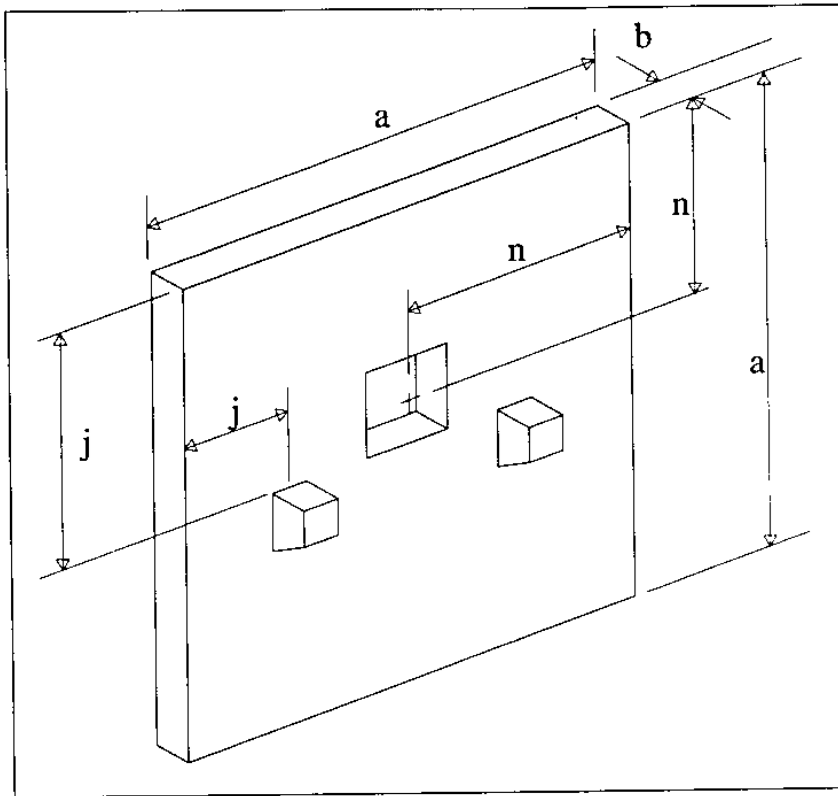
Single Tee



- 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)

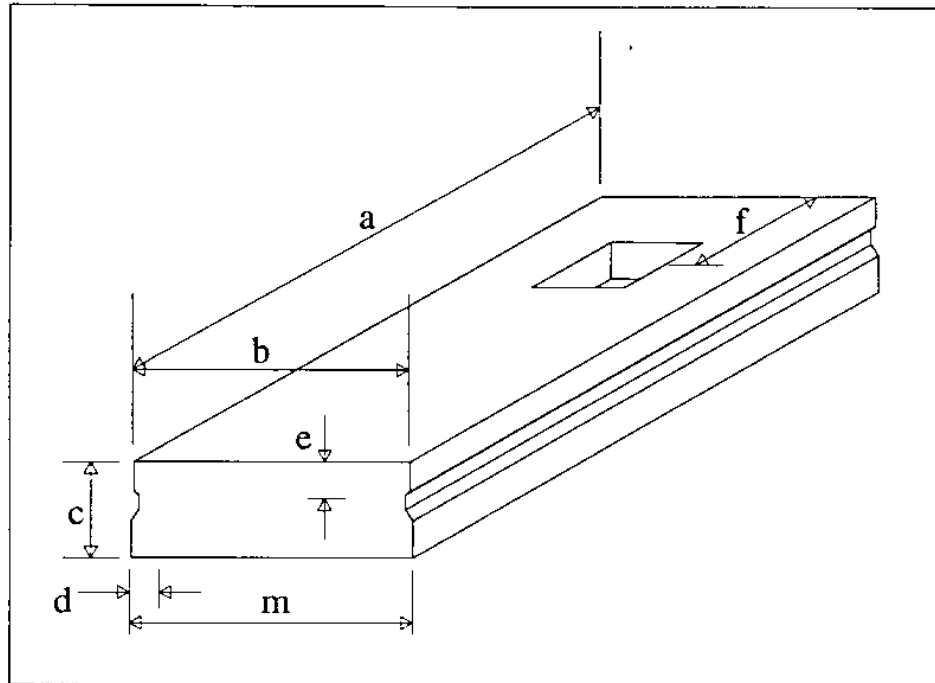
Flat Wall Panels



- 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. Warp (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)