

ITEM 423

PRESTRESSED CONCRETE UNITS

423.1 Description. This item shall govern for the casting, prestressing, and erection of precast, prestressed concrete units in accordance with the plans, approved shop drawings and these specifications.

423.2 General. The method of construction and prestressing shall comply with the requirements of the plans and in accordance with the approved shop drawings. Prior to beginning the casting of units, the Contractor shall give the Engineer ample notice as to the location of the casting site and the date on which work will begin.

An inspector representing the Engineer shall have free entry, at all times while the work is being performed, to all parts of the manufacturer's works which concerns the manufacture of the units ordered.

Clean and legible shop drawings will be electronically submitted on sheets 22" x 34", showing the following information, and shall be submitted for approval. The margin at the left end shall be 1-1/2 inches wide and the others 1/2 inch wide. Each sheet shall have a title in the lower right hand corner. The sheets shall include a title in the lower right hand corner, sheet numbering, name of structure, name of fabricator and name of contractor. Preparation and submittal of drawings will be electronically submitted on 11 x 17 inch sheets, or full size drawings may be reduced to one-half scale, provided they are completely clear and legible.

A. Erection Drawings. An erection drawing shall be submitted for approval, showing information for field erection (location, type member, erection mark of member, bearing pads with marks, etc.). The erection mark system employed shall not conflict with the beam designations shown on the contract drawings. On projects requiring numerous types of beams of various length and strand patterns, the erection mark system shall indicate the structure number, superstructure unit number and beam number. The Contractor shall submit six prints for approval.

B. Fabrication Details. Complete information necessary for fabrication shall be submitted for approval (member lengths, type, skew angle, dimensions for diaphragm holes, bearing pad data bevels, erection devices, details of reinforcement, inserts to be used in forming, etc.). On projects requiring several types of beams of various lengths and strand patterns, an index sheet showing all beam and concrete data (cast lengths, pay length, concrete strengths, strand data, special casting devices, etc.) shall be furnished. Index sheets shall reflect the plant locations where each member is to be fabricated.

- C. Prestressing Details. Complete prestressing details shall be submitted showing details of the member, forms, devices for holding prestress steel in place, methods and details of draping strand, anchorage details, methods and details of prestressing the steel, elongations, jack pressures and all other features of proposed prestressing. Calculations shall be included to justify the system and method of prestressing to be used. Fabricator shall submit six prints for handling. The submittal of prestressing details shall be a "one-time" action of each fabricator.
- D. Methods of Handling and Transportation. Details of handling and transporting need not be submitted for approval, except that inserts used for pick-up shall be shown on the shop drawings.

All drawings and details shall be checked by the Fabricator before submittal for approval. Submission of drawings shall be in accordance with Harris County Engineering Department methods.

After completion of fabrication, a corrected set of final "as-built" drawings shall be submitted. In addition, when a railroad crossing structure(s) is constructed under this item, the fabricator shall furnish reproducible tracings of the approved "as-built" shop drawings for railroad crossings, for submission to the railroad.

A casting schedule shall be prepared on standard forms and submitted to the Engineer, prior to stressing.

Prior to the casting of members, detailed drawings reflecting the complete facilities to be used in fabrication is required by the Engineer.

The design of casting beds and facilities for pretensioned construction, including plans and specifications, shall be done by a Professional Engineer registered in the State of Texas and shall bear his seal. The Fabricator shall furnish a certificate bearing his signature, or that of a responsible Officer of the Company, that the bed, facilities and hardware have been constructed in accordance with the above plans and specifications.

The Fabricator shall specify the maximum loading for which the bed is to be used. Prior to approval for that loading, the facilities shall be proof loaded to a minimum ten percent overload for eight hours. Additional proof loads shall be performed every twelve months at a ten percent overload for four hours, if deemed necessary by the Engineer. Minor changes in facilities will not require proof loading, but will require submission of the details of changes accompanied with design calculations.

423.3

Materials. Materials for concrete and water for curing shall be in accordance with the applicable portions of the Item, "Structural Concrete". Material for reinforcing steel (non-prestressed) shall be in accordance with

the Item, "Reinforcing Steel". Other steel shall be in accordance with this item.

The steel used to apply the prestressing load to precast prestressed concrete members shall conform to the requirements of ASTM A416, "Uncoated Seven Wire Stress - Relieved Strand for Prestressed Concrete". The cables shall be of the size and number shown on the plans. The Contractor shall furnish representative samples and have them tested in accordance with the provisions for testing. Cables shall be free of rust, dirt, oil or other injurious material before placing concrete.

Contractor shall furnish and install bridge bearing pads in accordance with Item 437, "Elastomeric Materials."

All concrete materials and their preparation and placing shall be in accordance with the Item, "Structural Concrete", except that the concrete shall be proportioned to develop a compressive strength of not less than 5,000 psi, in 28 days. The following limiting requirements will also be complied with:

Minimum Cement Content	6.25 sacks per cubic yard
Maximum Cement Content	7.00 sacks per cubic yard
*Maximum Water	6.0 gallons per sack
Maximum Slump	4-inches or as approved by the Engineer
Minimum Compressive Strength	5,000 psi at 28 days
Minimum Compressive Strength at Prestress Transfer	4,000 psi

An admixture must be used with Type I or Type III Portland Cement in lieu of Air-entrained Portland Cement. Entrained air must not exceed four (4) percent. Admixtures shall be in accordance with the Item, "Structural Concrete", and must be approved by the Engineer prior to use.

\*Water per sack of cement shall be reduced to the minimum amount that the required workability will permit.

When tested in accordance with ASTM C136, coarse aggregate shall conform to the following grading requirements.

TABLE NO. 1

Retained On	Percent Retained, By Weight
1 1/2" Screen	0
1" Screen	0 - 5
3/4" Screen	20 - 50
1/2" Screen	50 - 75
No. 4 Sieve	95 - 100
Loss by Decantation	0 - 1%

Fine aggregate shall consist of clean, hard durable uncoated grains of washed sand, free from soft or flaky particles and all other injurious materials. It shall be graded from coarse to fine and when tested by approved methods, shall meet the following grading requirements.

Retained On	Percent Retained, By Weight
3/8" Screen	0
No. 4 Sieve	0 - 5
No. 20 Sieve	15 - 50
No. 100 Sieve	85 - 100

When subjected to the color test for organic impurities, fine aggregate shall not show a color darker than the standard color.

423.4 Pretensioning. For pretensioning, bring the tendons to be prestressed in a group to a minimum uniform initial tension of 1,000 pounds (plus or minus 50 pounds) per tendon prior to being given their full pretensioning. Measure this uniform tension by some suitable means, such as a dynamometer, so that this amount can be used as a check against elongation computed and measured.

After this initial stressing, the strand group shall be stressed to the total tension required, by means of hydraulic jacks equipped with gauges graduated to read correctly to one percent of total load and calibrated to measure accurately, stress induced in the steel.

Measure induced stress by elongation of tendons and check by gauge pressure. Results shall agree within 5 percent. Provide means for measuring elongation to an accuracy of 1/16-inch for each 100-feet of length between jacking heads. In the event of apparent discrepancies between stresses indicated by gauge pressure and elongation of more than 5-percent, check the entire operation and determine the source of error and correct before proceeding further. Establish independent references adjacent to each anchorage, to indicate any yielding or slippage between time of initial stressing and final release of tendons.

With the tendons stressed to full tension, as prescribed above and with reinforcing steel in place, cast members to the lengths necessary to provide plan lengths, after shrinkage and elastic shortening has occurred.

Maintain tendon stress between anchorages, until concrete has reached the compressive strength specified, as determined by test cylinders made for each continuous pour.

423.5 Construction Methods. Reinforcing steel shall be fabricated and placed in accordance with the plans and as required herein.

Post tensioning ducts, when required, shall be checked and cleaned of all obstructions and placed in accordance with the approved prestressing details, and in accordance with this specification. Immediately after concrete placement they shall be cleaned of any concrete, mortar or grout leakage which might clog the duct.

The construction of forms and the placing, curing and finishing of concrete shall be in accordance with the provisions contained herein and requirements of the plans.

A. Forms. All side and bottom forms for precast prestressed concrete construction shall be constructed of steel, unless otherwise noted on the plans. End headers and inside forms may be of other material as approved on the shop drawings.

Forms shall be of sufficient thickness, with adequate external bracing and stiffeners, and shall be sufficiently anchored to withstand the forces due to placement and vibration of concrete. Internal bracing and holding devices in forms will not be permitted if such would remain in the finished prestressed member. Joints shall be maintained reasonably mortar tight.

The grade and alignment of forms shall be checked each time they are set and shall be maintained during the casting of concrete.

Metal forms shall be free from rust, grease or other foreign materials. All forms shall be cleaned thoroughly prior to each casting operation.

Materials used for forming internal voids shall be inert, non-absorptive and be of adequate strength to maintain sufficient rigidity to withstand the forces of flow, vibration, buoyancy and weight of the plastic concrete during placing.

The soffit for casting members shall be constructed and maintained to provide not more than one-fourth inch variation in any 50 foot length of the bed from the theoretical plane of the bottom of the member.

Forms for internal voids in members shall be anchored securely to prevent movement or misalignment during the placing of concrete. For forming internal voids with a mandrel, special attention shall be given to maintaining the correct position and alignment of the mandrel throughout the casting operation.

The facing of all forms shall be treated with form oil or other bond breaking coating prior to placing of concrete. The oil or other materials used for this purpose shall be of a consistency and composition to facilitate form removal.

Materials which appreciably stain or react with the concrete will not be permitted.

All forms shall be constructed to facilitate removal without damage to the concrete. At the Contractor's option, side forms for piling and panels may be constructed with a one-eighth inch draft to permit ease of removal.

- B. Placing Concrete. All concrete shall be placed in accordance with the Item, "Structural Concrete" and in accordance with the following. All concrete shall be placed during daylight hours unless the fabrication plant or site is provided with an approved lighting system.

The method of concrete placement shall avoid segregation of the aggregate or displacement of the reinforcing steel, prestressing steel or conduit. Concrete shall be deposited as near as possible in its final position in the forms. Depositing large quantities of concrete at one location in the forms and running or working it along the forms will not be permitted.

Special attention shall be directed toward working the coarse aggregate back from the face of the concrete and to forcing the concrete under and around the reinforcing steel, prestressing steel or conduit.

Placement of concrete in large members shall be subject to approval of the Engineer. Concrete may be placed in beams and girders in one lift or in multiple continuous horizontal layers. In the

latter case the thickness of the first layer shall be slightly above the juncture of the bottom flange and web.

Vibration of subsequent layers of concrete shall extend into the previously placed layers as specified in this Item.

When casting concrete piling or concrete slab units, the concrete shall be placed in one continuous horizontal layer.

Concrete placement will not be permitted when impending weather conditions will impair the quality of the finished work. If rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work. In case of a drop in temperature the provisions set forth in Placing Concrete in Cold Weather shall be applied.

- (1) Placing Concrete in Cold Weather. When members are produced in a fabricating plant which has adequate provisions to protect the concrete when placed and which has approved elevated temperature curing facilities, concrete may be placed under any low temperature conditions provided;
  - a. The temperature of the concrete is not less than 50°F. nor more than 85°F. when placed in the forms.
  - b. The framework and covering are in place and heat is provided for the concrete and forms within one hour after the concrete is placed. This shall not be construed to be one hour after the last concrete is placed but that no concrete shall remain unprotected and unheated for longer than one hour.
  - c. The air surrounding the concrete shall be kept between 50°F. and 85°F. for a minimum of three hours prior to beginning the temperature rise which is required for elevated temperature curing. The temperature of the concrete shall not be less than 50°F. at any time after all materials are added and mixing commences.
  - d. For central fabricating plants or job site casting operations which do not provide facilities necessary to accomplish the above provisions, concrete may be placed when the atmospheric temperature is 35°F. or greater, and rising. The temperature of the concrete at the time of placement shall not be less than 50°F. nor more than 85°F. The concrete shall not be placed in contact with any material having a temperature less than 32°F. or any material coated with frost.

- e. Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum temperature specified above, the aggregate and/or the water shall be heated uniformly in accordance with the following. Water shall be heated to a temperature not to exceed 180°F. and/or the aggregate shall be heated to a temperature not to exceed 150°F. The equipment furnished shall be capable of heating the aggregate uniformly to eliminate overheated areas in the stockpile which might cause flash set of the cement. The temperature of the mixture of the aggregate and water shall be between 50°F. and 85°F. before introduction of the cement.
  - f. Protection shall be provided to maintain the temperature of the concrete at all surfaces above 50°F. until release strength is reached. Protection shall consist of providing additional covering and, if necessary, supplementing such covering with artificial heating. When weather conditions indicate the possibility of the need for such temperature protection, all necessary heating equipment and covering material shall be on hand ready for use before permission is granted by the Engineer to begin placement of concrete.
- (2) Placing Concrete in Hot Weather. When concrete is to be placed during hot weather, it shall be placed without the addition of more water to the concrete than required by the design (slump and consistency), and it shall be finished properly without adding water to the surface. Control of the initial set of the concrete and lengthening the time for finishing operations, under adverse wind, humidity and hot weather conditions, may be accomplished with the use of an approved retarder.

The maximum time interval between the addition of mixing water and/or cement to the batch, and the placing of concrete in the forms shall not exceed the following:

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER)	MAXIMUM TIME ADDITION OF WATER OR CEMENT TO PLACING IN FORMS
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NON-AGITATED CONCRETE

Over 80°F

15 Minutes



50°F to 79°F 30 Minutes

AGITATED CONCRETE

90°F or Above 45 Minutes  
75°F to 89°F 60 Minutes  
50°F to 74°F 90 Minutes

The use of an approved retarder in the concrete will permit the extension of each of the above temperature time maximum by 30 minutes, except that for non-agitated concrete, the maximum time shall not exceed 30 minutes.

Under conditions of extreme temperature, wind or humidity, when the specified temperature-time maximums are excessive, the Engineer may require the use of an approved retarder, or may suspend concrete placing operations, if quality concrete is not being placed.

The values which govern for minimum concrete strengths during different phases of construction shall be as shown on approved shop drawings.

The control of the concrete shall be by compressive tests of cylinders. An adequate number of cylinders will be made for each pertinent strength test required. Tests for determining "Release Strength" and/or "Handling Strength" of members, will be the average of the breaking strength of two cylinders.

All test specimens, beams or cylinders representing tests for removal of forms and/or falsework and for "Release Strength" shall be cured under the same conditions, be subjected to the same curing materials and to the same weather conditions as the concrete represented.

"Design Strength" cylinders for acceptance of members shall be cured with the member which the cylinders represent until release of stress or until partial tensioning strength is obtained. These cylinders shall then be cured for the remainder of the test period in accordance with T.H.D. TxDOT Test Method TEX-704-I.

- C. Vibration of Concrete. All concrete shall be thoroughly compacted with approved high frequency vibrators operating. When the forms are of steel, either external or internal vibrators or a combination of both may be used except that internal vibrators will be required, supplemented by external vibration if desired, for prestressed concrete beams and prestressed concrete box beams.

At least one stand-by vibrator of the type(s) being used shall be provided for emergency use.

Internal vibrators shall be inserted systematically into the concrete immediately after deposit. When the concrete is placed in more than one layer, the vibrators shall be operated so that they will penetrate the previously placed layer of concrete.

The size and spacing of external vibrators shall provide sufficient intensity of vibration to the desired area of form. The spacing, frequency and/or amplitude of external vibrators shall be varied to produce uniform consolidation of the concrete.

Supplemental vibrators or a modification of the vibration system shall be provided when it is deemed necessary by the Engineer to accomplish thorough compaction of the concrete and complete embedment of the reinforcing steel and prestressed tendons.

- D. Finishing of Concrete. Top surfaces of prestressed concrete beams, against which cast-in-place concrete will be placed later shall be screeded or rough floated to bring grout to the surface and cover all aggregate. At the approximate time of initial set, the surface shall be roughened by brushing, brooming or other approved methods. Sound concrete shall not be removed or aggregate loosened. Concrete shall be removed from exposed reinforcing steel prior to shipment.

The top surfaces of beams upon which panels are to be placed shall be finished relatively smooth with a metal trowel, from the reinforcing bar (R-bar) out to the outside edges. The center portion of these beams shall be roughened.

When the plans require that a concrete overlay be placed on prestressed concrete box members, the top slab of the box shall be given a metal trowel finish having an average texture depth of approximately 0.050 inches.

When the plans require that an asphaltic seal and overlay be placed on prestressed concrete box beams or for an additional slab to be placed on prestressed concrete panels, the top slab of the box, and the top surface of prestressed panels shall be given a lightly textured broom finish, similar to a sidewalk finish with the depth of striations not exceeding approximately 1/16 inch.

Erection holes (lifting eyes, form anchors, etc.) in exterior beams shall be filled with mortar and made flush with the surrounding surface. Holes in interior beams need not be filled unless steel is exposed. Erection or fabrication hole in the bottom of all beams shall be filled with non-stain, non-shrink mortar and made flush with the surrounding surface.

Form marks in excess of that permitted in Item 425.7, and all fins and rough edges along chamfer lines shall be removed in an acceptable manner.

Unless otherwise shown on the plans, strands shall be removed flush with the end of the member, or recessed approximately three-eighths of an inch.

In either case, the ends of the strands and a minimum of one inch around each strand shall be cleaned and coated with approximately 10 mils of an approved epoxy or epoxy grout.

After slab placement, the outside and bottom surfaces, of exterior beams or members shall be given the grade of surface finish specified for the structure. Other members shall be given the grade or class of finish required by the plans.

- E. Curing of Concrete. Careful attention shall be given to the proper curing of concrete. The Contractor shall inform the Engineer regarding the methods and procedures proposed for curing; shall provide the proper equipment and necessary materials; and shall have approval of the Engineer of such methods, equipment and materials prior to placing concrete.

Inadequate curing facilities or lack of attention to the proper curing of concrete shall be cause for the Engineer to stop all concrete placement until approved curing is provided. Inadequate curing may be cause for rejection of the member.

Side forms may be removed at any time after the concrete has reached sufficient strength to prevent physical damage to the member. Weight supporting forms shall remain in place until the concrete has reached the "Handling Strength" shown on the plans. Removal of the forms shall be done in such a manner that curing is not interrupted on any member by more than 30 minutes.

All concrete shall be cured with elevated temperature or water. An approved water or membrane cure (when permitted) shall be used as an interim measure prior to elevated temperature or other methods of curing.

Curing shall be commenced prior to the formation of surface shrinkage cracks. The mats, sheets, or blankets shall not be placed in contact with the prestressed concrete member until such time that damage will not occur to the surfaces.

Concrete shall be cured continuously, except as provided for form removal, until the concrete strength as indicated by compressive test of cylinders cured with the members, has reached the

"Release Strength" or "Handling Strength" designated on the plans and/or shop drawings. Piling and roadway surfaces of prestressed concrete box beams shall be water cured an additional three days with the temperature of the concrete maintained above 32°F for this period.

A period not to exceed four hours will be permitted for removal to a storage area prior to resuming the balance of water curing for piling and box beams.

- (1) Water Curing. All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as specified in the Item, "Concrete Structures". Sea water will not be permitted. Water which stains or leaves an unsightly residue shall not be used.

Water curing will be permitted as follows:

- (a) Wet Mat Method. For water curing by the wet mat method, cotton mats, polyethylene sheeting, or polyethylene burlap blankets may be used.

The mats, sheets, or blankets shall be adequately anchored and weighted to provide continuous contact with all concrete surfaces. Any concrete surfaces which cannot be cured by contact shall be enclosed by mats, adequately anchored, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all of the surfaces of the concrete wet for the required curing time.

- (b) Water Spray Method. For water curing by the water spray method, overlapping sprays or sprinklers shall be used so that all concrete surfaces are kept wet continuously.

- (2) Elevated Temperature Curing. Curing by elevated temperatures will be permitted as follows:

- (a) Steam Curing. (Steam curing is defined as use of steam above 85°F). When steam curing of concrete is provided, the temperature inside the curing jacket shall not exceed 165°F for more than one hour during the entire steam curing period. Concrete exposed to temperatures exceeding 180°F will not be accepted.

Sufficient moisture shall be provided inside the curing jacket so that all surfaces of the concrete are wet.

An unobstructed air space of not less than six inches shall be provided between all surfaces of the concrete and the curing jacket. Steam outlets shall be positioned so that live steam is not applied directly on the concrete, reinforcing steel or tendons.

The location of steam lines, location of control points for discharge of steam into the curing jacket, and the number and type of openings for steam distribution within the curing jacket shall be arranged so that temperature variation between any points in the enclosure shall not exceed 20°F.

Steam curing shall not commence until the concrete has been in place a minimum of three hours, or until initial set of the concrete, as determined in accordance with ASTM C 403, is attained.

During the application of steam the temperature inside the curing jacket shall be raised uniformly at a rate not to exceed 40°F per hour.

- (b) Alternate Methods. Other methods of elevated temperature curing may be permitted by the Engineer provided temperature maximums, rate of temperature variation, humidity control, etc., are in accordance with the requirements for steam curing. Permission shall be obtained from the Engineer, in writing, for use of any alternate method.

423.6 Handling, Hauling and Erection. The Fabricator and Contractor shall be responsible for proper handling, lifting, storing, hauling and erection of all members so that they may be placed in the structure without damage.

Unless approved on erection and/or shop drawings, prestressed members shall be maintained in an upright position at all times and shall be picked up and supported near the ends of the member in such a way to prevent torsion. Members may be lifted with the lifting devices as approved on the shop plans or by other methods approved by the Engineer in writing.

No member shall be moved from the casting yard until all requirements for tensioning (when pertinent), curing and strength requirements have been attained.

Prior to shipping to the job site, all beams, box beams, panels, and other prestressed members shall be marked for identification, as shown on approved shop drawings, with other project identification as required by the Engineer.

Storing of prestressed members shall be done with adequate blocking so that warpage or cracking will not occur. The blocking shall be of such nature that uneven settlement due to wet ground or inadequate material underneath the blocking will not occur. Members which are improperly stored and which become cracked, warped or otherwise damaged in storage will be subject to rejection. Concrete box beams shall be supported by the solid end block area during handling, storage, hauling and erection.

All concrete beams or girders, placed over a traveled roadway or railroad, shall be securely tied and/or braced to prevent overturning until diaphragms capable of providing lateral stability are permanently in place. When railroad or roadway traffic must be maintained beneath girders or beams already placed, traffic shall be protected against falling objects during the erection of diaphragms and other structural members, during the placing of cast-in-place concrete and during the erection and dismantling of forms therefor. The protection shall consist of safety nets (1 inch mesh maximum) or a flooring with openings not larger than 1 inch.

423.7 Defects and Breakage. Failure of individual wires in a seven wire strand, or of wires in a parallel wire tendon is acceptable provided the total area of wire failure is not more than two percent of the total cross-sectional area of tendons in any member. Failure of entire strand will be subject to structural review.

Fine hair cracks or checks on the surface of the member which, as determined by the Engineer, do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Diagonal cracks, which indicate damage from torsion, will be subject to a structural review prior to acceptance. Vertical or horizontal cracks, which are one-sixteenth inch or less in width and which tend to close upon transfer of stress to the concrete, are acceptable. Cracks in excess of this are subject to review prior to acceptance.

Cracks which extend into the plane of reinforcing steel and/or prestressed tendons, but are acceptable otherwise, shall be repaired by sealing with an approved epoxy.

Small damaged or honeycombed areas which are purely surface in nature, (not over one inch deep) may be repaired with an approved epoxy grout. Damage or honeycomb in excess of this will be tentatively rejected, but will be subject to structural review.

For prestressed concrete box beams only, areas requiring repair work, except as noted herein, which will be covered by cast-in-place concrete (shear keys and end diaphragms) shall be explored and evaluated but, if structurally adequate, will not require repair at the plant. Areas of honeycomb which expose strands (except for the end of the box) will require evaluation and repair at the plant.

Any of the following conditions will be cause for rejection of prestressed panels:

- A. Any crack that comes within one inch of two adjacent strands.
- B. Corner cracks or breaks that involve two strands.
- C. Isolated damage or honeycomb larger than approximately 6" in diameter or length that involves more than one strand.
- D. Narrow honeycomb lines caused by grout leakage over 1/2" in depth involving more than one strand.

Any condition not covered by the above shall be subject to structural review.

423.8 Workmanship and Tolerance. Reinforcing steel shall not project above the top of the member more than ¼ of an inch from plan dimension. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than one-fourth of an inch, or one-twelfth of the spacing between bars, whichever is greater. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than one-fourth of an inch.

Where sections of forms are to be joined, an offset of one-sixteenth of an inch for flat surfaces and one-eighth of an inch for corners and bends will be permitted. Offsets between adjacent end header sections shall not exceed one-fourth of an inch.

Allowable tolerances for the dimensions and configuration shown on the approved shop drawings shall be as shown in this table.

	Beams	Boxes
Length (Normal to strands for beams)	±3/4"	* ±1"
Width (Parallel to strands for beams)	+3/4"-1/4"	±1/4"
Depth Nominal (Thickness in case of beams)	+1/2"-1/4"	±1/4"
Top Slab or Flange	+1/2"-1/4"	±1/2"
Thickness-Bottom Slab or Flange	+1/2"-1/4"	±1/2"
Web or Wall	+3/4"-1/4"	±1/2"
Horizontal Alignment-Upon Release of Stress Deviation from Straightness of mating edge of beams of length	±1/8" per10'	±1/4"

Deviation of bearing edge of beam from designated skew (out of square) Horizontal	1/4"	1/4"
Deviation of ends from designated skew or bevel Vertical	1/4"	1/4"
Bearing Surfaces - Perpendicular to Vertical Axis	±1/8"	N/A
- Deviation from Plane	±1/16"	±1/8"
Anchor Hole Location-from End of Member	+3/4"-1/4"	±1/4"
Longitudinal Spacing	±3/4"	±1/2"
Transverse Location	±1/4"	±1/4"
Diaphragm or Lateral Tie Location	±1/2"	±1/2"
Position of Void** Longitudinal	N/A	1"
Position of Strands	±1/4"	±1/4"
Position of Hold-Down Points	±6"	±6"
Position of Handling Devices	±6"	±6"

\* Measured from Central Axis of Box

\*\*Length of Void Material +1" - 6"

Variations greater than specified above shall be corrected to within these tolerances or be subject to structural review. Horizontal alignment (sweep) in beams and girders only, which may increase at a later time over that shown in the table, will be acceptable if the member can be hauled, erected and aligned to within the above tolerance without being damaged.

For prestressed concrete box beams only, variation from tolerances set forth in the specifications, which do not affect appearance or fit-up of the finished structure, and which will be covered with concrete as stated in Defects and Breakage, will not require correction.



When prestressed panels are erected, the fit of mating surfaces shall be such that excessive grout leakage will not occur. If such fit is not provided the joint shall be filled with grout or sealed with an acceptable caulking compound prior to the placing of the cast-in-place portion of the slab.

423.9 Measurement. Precast Prestressed Concrete Beams, Girders and Box Beams, of the type specified, cast and stressed as required by the plans, will be measured by the linear foot, as established on approved shop drawings.

423.10 Payment. Precast Prestressed Concrete Beams, Girders and Box Beams will be paid for at the unit price bid per linear foot for the structural member specified complete in place.

The above price shall be full compensation for constructing the members, furnishing and tensioning prestressed steel, conduit, when required, furnishing and placing reinforcing steel, bearing plates, bearing pads; all bars, anchorage plates and appurtenances which become an integral part of the structure; for grouting of holes; for any necessary repair and for any special treatment of end anchorages and shoes as indicated on the plans; and for furnishing all materials, tools, equipment, labor and materials necessary to fabricate, transport and erect the members in the structure as indicated on the plans.

There are line code(s), description(s), and unit(s) for this item.

END OF ITEM 423