SECTION 1029

FABRICATING PRESTRESSED CONCRETE MEMBERS FOR BRIDGES

1029.1 Scope. This specification covers the fabrication of prestressed concrete members for bridges. This specification covers both pretensioned and post-tensioned members.

1029.2 Acceptance. Unless otherwise specified in the contract, acceptance of prestressed units will be based on tests of the material and inspection of the completed product. Acceptability of all types of sections covered by these specifications will be determined by the material tests required in the referenced sections of Sec 1029.3, by crushing tests on concrete cores or cured concrete cylinders, and by inspection of the finished sections, including quantity and placement of reinforcement, and freedom from defect.

1029.3 Material.

1029.3.1 Cement. Cement shall be in accordance with Sec 1019.

1029.3.2 Aggregate. Fine and coarse aggregate shall be in accordance with Sec 1005, except that requirements for gradation and percent passing the No. 200 (75 µm) sieve will not apply.

1029.3.3 Steel Reinforcement. Reinforcement shall be in accordance with Sec 1036.

1029.3.4 Steel Strand. Steel strand shall be in accordance with AASHTO M 203.

1029.3.5 Structural Steel. Structural steel shall be in accordance with ASTM A 36. Structural steel for anchorage plates shall be in accordance with AASHTO M 270, Grade 50.

1029.3.6 Wire and Parallel Lay Wire Cables. Wire and parallel lay wire cables shall be in accordance with AASHTO M 203.

1029.3.7 High-Strength Steel Bars. High-Strength Steel Bars shall be in accordance with AASHTO M 275.

1029.3.8 Enclosures. Enclosures for post-tensioning tendons shall be mortar tight, semi-rigid metal tubes with an internal diameter at least 1/4 inch (6 mm) larger than the bar, cable, strand or wire group to be enclosed, and shall be provided with suitable entrance and discharge ports for grouting.

1029.3.9 Mortar. Mortar for grouting tendons in post-tensioned members shall consist of a mixture of cement and fine sand in the approximate proportions of four parts cement to three parts sand, by volume, with sufficient water to form a grout having the consistency of heavy paint.

1029.3.10 Concrete Mixture. Concrete material, proportioning, air-entraining, mixing, slump and transporting of concrete shall be in accordance with Sec 501, except as noted herein. Concrete for prestressed members shall conform to all requirements of Class A-1 concrete, except as noted herein. The contractor may use Type I, IP, I(PM), IS, I(SM), Type II or Type III cement. Alternate mix designs may be submitted to Construction and Materials for approval. Trial batches may be required. Independent laboratory testing may be required.

Submissions shall include all mix design, testing and production detail requested by the engineer.

1029.4 Documentation. All wire, strand, bars and anchorage assemblies shall be assigned a lot number and tagged for identification. The contractor shall furnish one copy of the certified mill test report giving the chemical analysis and results of physical tests on the material furnished, except chemical analysis will not be required for steel strand in accordance with AASHTO M 203. The contractor shall also furnish one certified copy of the stress-strain curve representative of the lot to be used.

1029.5 Equipment.

1029.5.1 Prestressing. The contractor shall provide all equipment necessary for the construction and the prestressing of concrete members. Prestressing shall be done with approved jacking equipment. If hydraulic jacks are used, the jacks shall be equipped with accurate pressure gauges. All gauges, load cells, dynamometers and other devices for measuring the stressing load shall have an accuracy within two percent. The combination of jack and gauge shall be calibrated by a testing laboratory meeting the approval of the engineer. A certified graph or table showing the calibration shall be furnished to the engineer. The total load as determined from the strand elongation shall check that indicated by the gauge within five percent of the total load required to achieve the designated elongation. If other types of jacks are used, proving rings or other devices calibrated by a testing laboratory meeting the approval of the engineer shall be furnished such that the jacking forces may be accurately determined. Calibration shall be repeated at intervals not exceeding one year and after each overhaul. While work is in progress, if any jack or gauge appears, in the judgment of the engineer, to be giving erratic results, or if gauge pressure and elongation indicate materially different stresses, recalibration may be required. The contractor shall furnish means of accurately measuring the elongation of the tendons to within 1/16 inch (1.5 mm). Elongation upon completion of stressing operations shall be within five percent of that specified. No tensioning of strands shall be done when strand temperatures are below 30 F (-1 C).

1029.5.2 End Anchorages. End anchorages and stressing blocks for pretensioned members shall be adequately designed to withstand the forces incidental to prestressing and to maintain the tension in all prestressed tendons of any member until the concrete has been placed and attained its specified transfer strength.

1029.5.3 Concrete Testing Equipment. Equipment for field determination of compressive strength of concrete shall be furnished by the contractor at the location of manufacture of prestressed concrete members. The testing machine may be of any mechanical or hydraulic type, shall be power operated in accordance with AASHTO T 22, Section 1.2.1, shall be capable of testing cylinders to failure, and shall comply with the accuracy tolerances and corrections specified in AASHTO T 67, Sections 16.1 and 17. Approximately the last one-half of the load shall be applied at a rate between 1200 and 3000 psi (8 and 21 MPa) per minute. The contractor shall furnish a sufficient number of 6 x 12-inch (152.4 x 304.8 mm) or 4 x 8-inch (101.6 x 203.2 mm) compression test cylinder molds of a type meeting the approval of the engineer. The contractor shall furnish sufficient personnel for cleaning and preparing reusable molds. The contractor shall, at the option of the engineer, furnish technicians to assist the engineer with concrete testing and the making of test cylinders during the placing of concrete.

1029.5.4 Field Laboratory. When requested, a Type 1 field laboratory in accordance with Sec 601 shall be furnished.

1029.6 Construction Requirements.

1029.6.1 Shop Drawings. Shop drawings showing in detail the type, size, number of units, location of tendons, enclosures, method and sequence of releasing the strands, anchorage details and details of proposed lifting loops and lifting procedure shall be submitted to the engineer for approval. The contractor may select the method of prestressing, provided an approved specific method is used and the total prestressing force and the center of gravity of the prestressing tendons as shown on the plans are maintained. The shop drawings shall show a tabulation of the design computations and the total prestress force, size and spacing of all reinforcing steel and concrete compressive strengths for strand release and design. No inspection will be conducted until the plant inspector has received a copy of the approved shop drawings. Prior to making shop drawings, the contractor shall submit in writing for approval of the engineer any proposed tack welding in lieu of tying of the reinforcing bars of prestressed members. If approved by the engineer, the location of tack welding of reinforcing bars shall be shown on the shop drawings submitted for approval. No heat or welding will be permitted in the proximity of prestressing tendons in the members. Shop drawings for the prestressed concrete solid, voided slab and box girder beams shall be required to include the alignment of the holes for the tie rods. The holes shall be aligned in such a way as to prevent damage to the precast units during the placement of the precast units on the beam caps and the installation and tensioning of the tie rods through the precast units.

1029.6.2 Forms and Formwork. Forms and formwork, placing and tying of reinforcing bars and placing and vibrating of concrete shall be in accordance with Secs 703 and 706, with the following additions:

(a) Clamps, bolts or other devices connecting the bulk-head to the side forms, inserts and blockouts shall be capable of being removed or loosened before steam curing is applied.

(b) The casting bed shall have a concrete deck on which the form grillage and soffit plates may be adequately centered, aligned and leveled to the same plane.

(c) Exterior forms for prestressed members shall be metal other than aluminum, mortar-tight and of adequate design to produce members within the tolerances specified. Supplemental forms, such as those used to form steps or to establish slopes, may be made of a material other than metal, so long as dimensional tolerances and mortar-tightness are maintained.

(d) The temperature of the mixed concrete when placed shall be no higher than 90 F (32 C). The forms and reinforcing steel shall be cooled by acceptable methods to an ambient temperature of 90 F (32 C) or lower.

(e) Fabricating plants with demonstrated facilities for protection of the concrete during cold weather may, with the approval of the engineer, cast prestressed units when the ambient temperature is below 40 F (5 C). When the ambient temperature is below 40 F (5 C), the forms or enclosures and reinforcing steel shall be heated to attain and maintain a temperature of at least 40 F (5 C). No concrete shall be placed when the concrete temperature is below 60 F (15 C).

(f) Concrete for girders shall be placed in a minimum of two continuous lifts. No more than 30 minutes shall elapse between the placing of contiguous lifts of concrete. The thickness of the first layer for I-girder beam sections shall be such that the top of the concrete is slightly above the top of the bottom fillet. The casting procedure shall be modified if the length of girders and placement conditions are such that an initial set of concrete may result if each lift is continued full length before another lift is placed.

1029.6.3 Prestressing Tendons. Prestressing tendons for pretensioned members, and metal enclosures for post-tensioned members, shall be accurately placed and securely held during placing and curing of the concrete. Strand chucks for pretensioning shall anchor the strand positively without slippage after seating. Strand chuck components shall be cleaned and inspected between each use and lubricated as necessary. All strands shall be free of contaminants such as dirt, oil, paint, wax, corrosion or other foreign material that may prevent a bond between the strands and the concrete. The use of prestressing strands having kinks, bends, nicks or other defects shall not be permitted. A light coating of rust will not be cause for rejection, provided that the loose rust is removed and the surface of the strands is not visibly damaged. Tensioned strands shall be protected against excessive temperatures such as those produced by torches, welding equipment or sparks. Strands from more than one source shall not be used in any one tensioning operation.

1029.6.4 Strand Splices. One approved splice per strand will be permitted provided the splices are located outside of the prestressed member. For single strand tensioning, the number of strands per bed that may be spliced is not restricted. If multi-strand jacking is used, either all strands shall be spliced or no more than 10 percent of the strands shall be spliced. Spliced strands shall be similar in physical properties, from the same source, and have the same twist or lay. Previously tensioned strands may be reused one time provided the strands meet all requirements of these specifications.

1029.6.5 Wire Failures. Wire failures may be accepted, provided no more than one wire in any strand is broken and the area of broken wires does not exceed two percent of the total area of the strands.

1029.6.6 Stressing Requirements. The contractor shall provide a technician skilled in the use of the system of prestressing to supervise the prestressing operations.

1029.6.7 Elongation. The contractor shall compute the required elongation. Two copies of the computations shall be submitted to the engineer. The length of the strand to be used in calculating elongations shall be the actual length of the strand along the strand's trajectory between the fixed anchorage and the reference point at jacking end of the strand. Stress losses due to slippage of strand anchorages, splice chucks and movement of anchorage abutments shall be included in the elongation computations.

1029.6.8 Pretensioned Members. Prestressing tendons shall be uncoated seven-wire low relaxation strands in accordance with AASHTO M 203, Grade 270. Several pretensioned members may be cast in one continuous line. The time intervening between the casting of the first and last member on a bed shall not exceed four days unless otherwise permitted by the engineer. When the temperature at the time of tensioning is such that correction must be made to compensate for change in strand stresses, all members on the bed shall be cast in a continuous pour. The tension in the strand as determined from the elongation at the time of placing concrete shall be within five percent of that specified. The stress to be given each strand shall be as shown on the plans. Pretensioning shall be by either the single strand or multi-strand jacking method. Each strand shall be brought to a uniform initial tension. The initial tension of each strand shall be accurately measured by a dynamometer or other approved means. The initial tension shall be within 50 pounds (200 N) or two percent of that required, whichever is the larger. The same jack used for single strand tensioning may be used for initial tensioning provided the jack is equipped with a proper gauging system for measuring the initial tension. Measurement of elongation shall not begin until initial tensioning has been completed. Strands tensioned as a group shall have the same initial tension, be from the same source, and have essentially the same modulus of elasticity. Coil ties shall be held in place in the forms by setting studs projecting through the forms. Studs shall be left in place until girders are erected and then replaced by coil tie rods. Alternate

methods may be used, provided acceptable results are achieved. Coil ties shall have a concrete pull-out strength of at least 9000 pounds in 3000 psi (40 kN in 21 MPa) concrete.

1029.6.9 Post-Tensioned Members. Post-tensioned members shall be stressed in such a manner that the tension being applied and the elongation of the tendon may be measured at all times. The contractor shall furnish a certified record of gauge pressures and elongations to the engineer. Friction losses in the enclosures, elastic shortening and anchorage set shall be included in the computations for the required elongation of the tendon. In cases of discrepancies between gauge readings and the stress indicated by the elongation of the tendon, the elongation method of stress determination shall govern. Loads shall not be applied to the concrete until the concrete has attained the design compressive strength shown on the plans. Tendons shall be stressed in a sequence to produce the least eccentricity of the load. Post-tensioning elements shall be placed in metal enclosures and after stressing shall be bonded by pressure grouting the space between the enclosure and the tendon. Enclosures shall be thoroughly cleaned of all foreign material prior to grouting. The discharge ports shall be closed after all air has been forced out of the enclosure, as evidenced by the steady discharge of grout at the grout's proper consistency, and a pump pressure of at least 50 psi (345 kPa) maintained on the grout for a sufficient length of time to ensure completely filling all voids in the enclosure. Post-tensioned members shall not be removed from their supports for at least 24 hours after grouting.

1029.6.10 Strand Release. Strands shall not be released until the concrete has attained the required compressive strength shown on the approved shop drawings. The compressive strength shall be determined by tests of standard cylinders made of concrete from the same batches and cured in the same manner as the members. The strands or prestressing elements shall be cut or released in a sequence that produces the least eccentricity of the load. If steam curing is used, strand release shall be performed while the members are still warm. Forms, hold down devices, or other appurtenances that may restrict movement of the members shall be removed or loosened prior to strand release. The sequence of release for hold down devices and strands shall be indicated on the shop drawings. Release shall be in accordance with the approved shop drawings.

1029.6.11 Curing. Concrete members shall be kept continuously wet until the conclusion of the curing period. Curing shall be accomplished by covering with burlap or jute mats kept continuously wet by moist air, live steam or any combination of these methods. Other moist curing methods that will keep the member moist may be used provided the details of the proposed method are submitted to the engineer and approved. As soon as the concrete has set sufficiently that no marring of the surface or distortion will result, wet burlap or jute mats shall be applied, covering the exposed surface. Curing shall be continued until the concrete has attained the design compressive strength shown on the plans. The concrete shall not be exposed to temperatures below freezing until the curing has been completed.

1029.6.11.1 Steam Curing. A preset period of no less than four hours shall be allowed before steam cure is applied. When the ambient temperature is below 50 F (10 C), steam shall be applied also during the preset period, but only at a rate sufficient to keep the air surrounding the member at a temperature between 50 and 70 F (10 and 20 C). After the preset period, steam shall be applied at a rate that will not increase the temperature of the air surrounding the members more than 40 F (20 C) per hour. The maximum curing temperature shall not exceed 160 F (70 C), and the difference in temperature adjacent to the concrete at different locations within the enclosure shall not exceed 30 F (15 C) at any time. Fluctuations of the temperature adjacent to the concrete during the curing period at any one location shall vary no more than 30 F (15 C). The contractor shall furnish and place, at the direction of the engineer, a minimum of two portable recording thermometers and no less than one for each 150 feet (45 m) of enclosure, for use in determining the magnitude and degree of uniformity of temperatures within the enclosure. The temperature recording system shall be capable of

automatically producing a temperature record during the entire curing period. The temperature record shall show the temperature at each location at intervals of no more than 15 minutes and have a range of approximately zero to 200 F (-20 to 95 C). The temperature recording system shall be accurate within plus or minus 5 F (3 C). Steam shall be applied from pipes with perforations at suitable intervals laid along each side of the member, or by other approved arrangements. Jets of steam will not be permitted to impinge directly against the member, forms or test specimens. Provisions shall be made for effective circulation of the steam around all portions of the members. The concrete shall be kept continuously moist during the steam curing period. Steam curing shall continue until the required strength for transfer of load has developed. Steam or other curing methods shall continue until the concrete has attained the design compressive strength shown on the plans. After the expiration of the steam curing period, the temperature inside the chamber shall be reduced at a rate of no more than 40 F (20 C) per hour until a temperature has been reached approximately 40 F (20 C) above the temperature of the air to which the concrete will be exposed.

1029.6.12 Form Removal. Forms shall not be stripped from prestressed concrete members sooner than 12 hours after casting. If strand release strength has then been attained, forms may be removed and members moved without unnecessary delay to a curing area. If forms are removed before the concrete has attained the strength which will permit the units to be moved or stressed, only the minimum area of the curing enclosure that is necessary to remove each individual form section shall be removed at any one time. The open area in the enclosure shall immediately be closed as each form section is removed. When the surrounding air temperature is below 30 F (-1 C), no portion of the enclosure shall be removed before the unit has attained the required transfer strength. Forms of test specimens shall be stripped at the same time the forms are removed from the members.

1029.6.13 Handling. Handling and storage of prestressed members shall be performed with the members in an upright position and with points of support in approximately the same position as designated for the final position of the members in the structure. Members shall not be transported nor erected until the concrete has attained the design compressive strength shown on the plans. In storage, the members shall be fully supported across their width on battens that are no less than 4 inches (100 mm) wide. During transportation, the ends of I-beams shall not extend a distance of more than the depth of the beam beyond the bolsters or other supports on the transporting vehicle. Other beams shall not extend more than 1 1/2 times their depth beyond the supports on the transporting vehicle. During storage, the supports shall maintain the members in essentially a level position without twisting. Stacking of members in storage shall be done only with the approval of the engineer. If such permission is granted, the supports of all members shall be in the same vertical planes and shall be of adequate thickness to prevent damage to the lifting devices.

1029.6.14 Surface Finish, I-Girders. Surface finish shall be in accordance with Sec 703.3.5.8, except that no cracks of any kind in post-tensioned members shall be filled before the stressing is completed. The engineer will determine the kind, type and extent of cracks and surface defects, such as honeycomb and chipped edges or corners, that will be tolerated. Repairs may be permitted with mortar in accordance with Sec 703.3.2.9. Commercially available patching material may be used if approved by the engineer. The top surface of members shall be scored transversely to a depth of approximately 1/4 inch (6 mm) with a wire brush, stiff broom or other approved method. A 3-inch (75 mm) wide strip across the top flange of the member shall be smooth finished to accurate top flange depth at each point designated on the plans. No laitance shall remain on surfaces to be embedded in concrete. After removal of hold-down devices, holes shall be plugged. If the method for plugging these holes is not shown on the shop drawings, written approval of the proposed method shall be obtained from the engineer. Exposed reinforcing steel shall be thoroughly cleaned of all concrete before delivery of members. The portions of girders to be embedded in the diaphragms at supports shall be roughened by sandblasting or other approved methods to

provide suitable bond between girder and diaphragm. Mechanical benders, without the use of heat, shall be used to bend the strands on girders.

1029.6.15 Surface Finish, Tee Girders. Surface finish shall be in accordance with Sec 703.3.5.8, except that no cracks of any kind in post-tensioned members shall be filled before the stressing is completed. The engineer will determine the kind, type and extent of cracks and surface defects, such as honeycomb and chipped edges or corners, that will be tolerated. Repairs may be permitted with mortar in accordance with Sec 703.3.2.9. Commercially available patching material may be used if approved by the engineer. The top surface of members shall be scored transversely to a depth of approximately 1/8 inch (3 mm). A 6-inch (150 mm) square area at each end and at each point designated on the plans, centered on each stem, shall be smooth finished to accurate top flange depth. Laitance on surfaces to be embedded in concrete shall be removed by sandblasting, waterblasting or other approved methods. After removal of hold down devices, holes shall be plugged. If the method for plugging these holes is not shown on the shop drawings, written approval of the proposed method shall be obtained from the engineer. Exposed reinforcing steel shall be thoroughly cleaned of all concrete before delivery of members. The portion of girders to be embedded in the diaphragms at supports shall be roughened by sandblasting or other approved methods to provide suitable bond between girder and diaphragm. Mechanical benders, without the use of heat, shall be used to bend the strands on girders.

1029.6.16 Surface Finish, Deck Panels. The top surface of the panel shall be scored to facilitate bond with the cast-in-place deck. The scoring shall be perpendicular to the prestressing strands in the panel and shall be approximately 1/8 inch (3 mm) in depth.

1029.7 Dimensional Tolerances. The dimensional tolerances shall be as shown in Table I, II or III.

1029.8 Marking. Each precast unit shall be identified with the date, manufacturer and identification number. Markings may be indented on the unit or painted thereon with waterproof paint, and shall be located as shown on the plans or as directed by the engineer.

Table I **Dimensional Tolerances – I–Girders, Solid Slab Beams, Voided Slab Beams, Box Girder Beams and Miscellaneous Prestress Units**	
ENGLISH	
Length of Beam	±1/8 inch per 10 feet of beam length, but no greater than 3/4 inch
Width (Flanges, Web and Fillets)	+3/8 inch, -1/4 inch
Depth (Flanges, Web and Fillets)	±1/4 inch
Depth (Overall)	+1/2 inch, -1/4 inch
Horizontal Alignment - I-Girders and Miscellaneous Prestressed Units (Deviation from a straight line parallel to centerline of member)	1/2 inch max., to 40-foot lengths 3/4 inch max., 40 to 60-foot lengths 1 inch max., 60-foot or greater lengths
Horizontal Alignment - Solid Slab, Voided Slab and Box Girder Beams (Deviation from a straight line parallel to centerline of member)	1/4 inch max., to 40-foot lengths 3/8 inch max., 40 to 60-foot lengths 1/2 inch max., 60-foot or greater lengths
Camber (Deviation from design camber within 7 days of strand release)	±1/2 inch, to 80-foot lengths ±1 inch, greater than 80-foot lengths
Stirrup Bars (Projection above top of beam)	± 3/4 inch
Stirrup Bars (Longitudinal spacing)	± 2 inches
Tendon Position- I-Girders and Miscellaneous Prestressed Units	± 1/4 inch center of gravity of strand group and individual tendons
Tendon Position - Solid Slab, Voided Slab and Box Girder Beams	± 1/8 inch center of gravity of strand group and individual tendons
Position of Deflection Points for Deflected Strands	± 6 inches, longitudinal
Position of Lifting Devices	± 6 inches, longitudinal
Side Inserts (Centerline to centerline and centerline to end)	± 1/2 inch
Coil Inserts (Centerline to centerline and centerline to end)	± 2 inches horizontal, except must be 3 inches or more from end of beam and within reinforcement cage of bent, ±1 inch vertical
Slab Drain Inserts	± 1/2 inch from designated location, engineer may approve location ± 6 inches from design, multiple inserts for single drain must be within ± 1/2 inch of vertical line
Exposed Beam Ends (Deviation from square or designated skew)	± 1/4 inch horizontal, ± 1/8 inch vertical per foot of beam height
Bearing Area (Deviation from plane)	±1/8 inch
Bearing Plates (Centerline to centerline)	±1/8 inch per 10 feet of beam length, but no greater than 3/4 inch
Bearing Plates (Centerline to end of beam)	±1/2 inch
Diaphragm Hole Location	±1 1/2 inches for centerline of group ±1/2 inch within group
Scupper holes, blockouts and voids	Placed as close as possible to design location after reinforcement steel and strands are properly located

Table I **Dimensional Tolerances – I–Girders, Solid Slab Beams, Voided Slab Beams, Box Girder Beams and Miscellaneous Prestress Units**	
METRIC	
Length of Beam	±1 mm per meter of beam length, but not greater than 18 mm
Width (Flanges, Web and Fillets)	+9 mm, -6 mm
Depth (Flanges, Web and Fillets)	±6 mm
Depth (Overall)	+12 mm, -6 mm
Horizontal Alignment - I-Girders and Miscellaneous Prestressed Units (Deviation from a straight line parallel to centerline of member)	12 mm max., to 12 m lengths 18 mm max., 12 to 18 m lengths 25 mm max., 18 m or greater lengths
Horizontal Alignment - Solid Slab, Voided Slab and Box Girder Beams (Deviation from a straight line parallel to centerline of member)	6 mm max., to 12 m lengths 9 mm max., 12 to 18 m lengths 12 mm max., 18 m or greater lengths
Camber (Deviation from design camber within 7 days of strand release)	± 12 mm, to 24 m lengths ± 25 mm, greater than 24 m lengths
Stirrup Bars (Projection above top of beam)	± 18 mm
Stirrup Bars (Longitudinal spacing)	± 50 mm
Tendon Position - I-Girders and Miscellaneous Prestressed Units	± 6 mm center of gravity of strand group and individual tendons
Tendon Position - Solid Slab, Voided Slab and Box Girder Beams	± 3 mm center of gravity of strand group and individual tendons
Position of Deflection Points for Deflected Strands	± 150 mm, longitudinal
Position of Lifting Devices	± 150 mm, longitudinal
Side Inserts (Centerline to centerline and centerline to end)	± 12 mm
Coil Inserts (Centerline to centerline and centerline to end)	± 50 mm horizontal, except must be 75 mm or more from end of beam and within reinforcement cage of bent, ± 25 mm vertical
Slab Drain Inserts	± 12 mm from designated location, engineer may approve location ± 150 mm from design, multiple inserts for single drain must be within ± 12 mm of vertical line
Exposed Beam Ends (Deviation from square or designated skew)	± 6 mm horizontal, ± 10 mm vertical per foot of beam height
Bearing Area (Deviation from plane)	± 3 mm
Bearing Plates (Centerline to centerline)	± 1 mm per meter of beam length, but not greater than 18 mm
Bearing Plates (Centerline to end of beam)	± 12 mm
Diaphragm Hole Location	± 38 mm for centerline of group ± 12 mm within group
Scupper holes, blockouts and voids	Placed as close as possible to design location after reinforcement steel and strands are properly located

Table II Dimensional Tolerances – Tee Girders	
ENGLISH	
Length of Beam	± 1/8 inch per 10 feet of beam length, but not greater than 1/2 inch
Width (Overall)	± 1/4 inch
Depth (Overall)	± 1/4 inch
Flange Thickness and Stem Thickness	± 1/8 inch
Horizontal Alignment (Deviation from a straight line parallel to centerline of member)	1/4 inch max., to 40-foot lengths 3/8 inch max., 40 to 60-foot lengths 1/2 inch max., 60-foot or greater lengths
Camber (Deviation from design camber within 7 days of strand release)	± 1/2 inch, to 80-foot lengths ± 1 inch, greater than 80-foot lengths
Stirrup Bars (Projection above top of beam)	± 3/4 inch
Stirrup Bars (Longitudinal spacing)	± 2 inches
Tendon Position	± 1/8 inch center of gravity of strand group and individual tendons
Strand Projection	± 1 inch
Diagonal Tolerance	± 1/4 inch
Position of Deflection Points for Deflected Strands	± 6 inches, longitudinal
Position of Lifting Devices	± 6 inches, longitudinal
Side Inserts (Centerline to centerline and centerline to end)	± 1/2 inch
Coil Inserts (Centerline to centerline and centerline to end)	± 2 inches horizontal, except must be 3 inches or more from end of beam and within reinforcement cage of bent, ± 1 inch vertical
Exposed Beam Ends (Deviation from square or designated skew)	± 1/4 inch horizontal, ± 1/8 inch vertical per foot of beam height
Bearing Area (Deviation from plane)	± 1/8 inch
Bearing Plates (Centerline to centerline)	± 1/8 inch per 10 feet of beam length, but not greater than 3/4 inch
Bearing Plates (Centerline to end of beam)	± 1/2 inch
Center of Stem to Outside Edge of Top Flange	± 1/8 inch
Center to Center Distance Between Stems	± 1/8 inch
Stem End to End of Top Flange	± 1/4 inch
Diaphragm Hole Location	± 1 1/2 inches for centerline of group ± 1/2 inch within group
Scupper holes, blockouts and voids	Placed as close as possible to design location after reinforcement steel and strands are properly located

Table II Dimensional Tolerances – Tee Girders	
METRIC	
Length of Beam	± 1 mm per meter of beam length, but not greater than 12 mm
Width (Overall)	± 6 mm
Depth (Overall)	± 6 mm
Flange Thickness and Stem Thickness	± 3 mm
Horizontal Alignment (Deviation from a straight line parallel to centerline of member)	6 mm max., to 12 m lengths 9.5 mm max., 12 to 18 m lengths 12 mm max., 18 m or greater lengths
Camber (Deviation from design camber within 7 days of strand release)	± 12 mm, to 24 m lengths ± 25 mm, greater than 24 m lengths
Stirrup Bars (Projection above top of beam)	± 18 mm
Stirrup Bars (Longitudinal spacing)	± 50 mm
Tendon Position	± 3 mm center of gravity of strand group and individual tendons
Strand Projection	± 25 mm
Diagonal Tolerance	± 6 mm
Position of Deflection Points for Deflected Strands	± 150 mm, longitudinal
Position of Lifting Devices	± 150 mm, longitudinal
Side Inserts (Centerline to centerline and centerline to end)	± 12 mm
Coil Inserts (Centerline to centerline and centerline to end)	± 50 mm horizontal, except must be 75 mm or more from end of beam and within reinforcement cage of bent, ± 25 mm vertical
Exposed Beam Ends (Deviation from square or designated skew)	± 6 mm horizontal, ± 10 mm vertical per foot of beam height
Bearing Area (Deviation from plane)	± 3 mm
Bearing Plates (Centerline to centerline)	± 1 mm per meter of beam length, but not greater than 18 mm
Bearing Plates (Centerline to end of beam)	± 12 mm
Center of Stem to Outside Edge of Top Flange	± 3 mm
Center to Center Distance Between Stems	± 3 mm
Stem End to End of Top Flange	± 6 mm
Diaphragm Hole Location	± 38 mm for centerline of group ± 12 mm within group
Scupper holes, blockouts and voids	Placed as close as possible to design location after reinforcement steel and strands are properly located

Table III Dimensional Tolerances – Deck Panels	
ENGLISH	
Length	+ 1/8 inch, -1/2 inch
Width	± 1/4 inch
Depth	± 1/8 inch
Stirrup Bars (Projection above top of panel)	± 1/4 inch
Stirrup Bars (Longitudinal spacing)	± 1 inch
Tendon Position	± 1/8 inch center of gravity of strand group and individual tendons
Strand Projection	± 1 inch
Diagonal Tolerance	± 1/4 inch
Scupper holes, blockouts and voids	Placed as close as possible to design location after reinforcement steel and strands are properly located
Metric	
Length	+ 3 mm, -12 mm
Width	± 6 mm
Depth	± 3 mm
Stirrup Bars (Projection above top of panel)	± 6 mm
Stirrup Bars (Longitudinal spacing)	± 25 mm
Tendon Position	± 3 mm center of gravity of strand group and individual tendons
Strand Projection	± 25 mm
Diagonal Tolerance	± 6 mm
Warpage of corner (one corner out of plane of other three)	Be 1/16 in./ft (5 mm/m) times the distance from the nearest adjacent corner
Bowing or camber, concave or convex, of any part of a flat surface	Shall not exceed length of bow in inches (mm) divided by 360, with maximum of 3/4 inch (19 mm); and differential bowing or camber between the adjacent members of the same design shall not exceed 1/4 inch (6 mm)
Scupper holes, blockouts and voids	Placed as close as possible to design location after reinforcement steel and strands are properly located