

removed, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

426.04.01 Removal and Disposal of Existing Wearing Surface from Bridge will be measured and paid for at the Contract unit price per square yard for the actual surface area removed from the bridge deck.

426.04.02 Removal to the depth specified in the Contract Documents will be measured and paid for at the Contract unit price per square yard for the pertinent Removal of Portions of Existing Concrete Bridge Deck item.

426.04.03 Deck repairs will be measured and paid for at the Contract unit price per square yard for the pertinent Type Deck Repair item. Payment shall also include full compensation for the repair material.

426.04.04 Furnishing, placing, finishing and curing of the LMC overlay, will be measured and paid for at the Contract unit price per square yard for the pertinent Latex Modified Concrete Overlay item. The actual areas placed, finished and cured will be measured, exclusive of areas of metal expansion dams exposed on the finished surface.

426.04.05 Repair Bar for Deck Reinforcement will be measured and paid for at the Contract unit price per linear foot.

426.04.06 When traffic bearing surfaces are required, supplying and removal of them and any repairs of damage to existing deck will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

SECTION 427 THRU 429 — RESERVED

SECTION 430 — METAL STRUCTURES

430.01 DESCRIPTION. This work shall consist of furnishing, fabricating, transporting and erecting of steel beams, plate girders, trusses, grillages, columns and bents, shoes, pedestals, castings, miscellaneous steel and all incidental structural steel as specified in the Contract Documents or as directed by the Engineer.

Substitutes for Rolled Members. The Contractor/Fabricator has the option of substituting a fabricated shape for the rolled shape specified in the Contract Documents provided the substitution is at no additional cost

to the Administration and the fabricated shape conforms to the following requirements:

- (a) The substitute fabricated shape shall provide a moment of inertia equal to or greater than the rolled shape for the full length of the member.
- (b) The substitute fabricated shape shall be of equal depth or greater than the rolled shape and not decrease the underclearance shown in the Contract Documents.
- (c) The minimum web or leg thickness for fabricated shapes is 1/2 in.
- (d) The minimum flange thickness for fabricated shapes is 1 in. The minimum flange width for fabricated shapes is 12 in. The width to thickness ratio for fabricated flanges shall not exceed 12.
- (e) The fabricated shape shall be made of the same material specified for the rolled shape.
- (f) All normal criteria for creating a welded member are adhered to.

430.02 MATERIALS.

Grout	902.11(c),(d),(e)
Metals	909
Bolts	A 325
Nuts	A 194
Washers	F 436
Direct Tension Indicating Washers (DTI)	F 959

430.03 CONSTRUCTION. Unless otherwise specified, all welding and dimensional tolerances shall conform to AWS D1.5.

430.03.01 Working Drawings. Working drawings shall be provided by the Contractor as specified in TC-4.01. The Contractor is responsible for the erection of straight and curved girders and if lateral bracing is required for shipping or erection, the details shall be specified on the working drawings.

430.03.02 Work Scheduling. The Contractor shall give a minimum of two weeks notice to the Engineer when and where shop work shall begin to allow for inspection. No materials shall be fabricated until directed by the Engineer.

430.03.03 Facilities for Shop Inspection. The Contractor shall furnish all facilities for the inspection of material and workmanship in the shop. The Inspector shall be allowed free access to the required areas of the premises and shall be provided with an approved office area.

430.03.04 Material Identification. Main member material shall be identified by the Contractor by heat number.

430.03.05 Mill Orders. The Contractor shall furnish the Engineer with copies of mill orders and test reports.

430.03.06 Testing. The Contractor shall furnish, without charge, sample specimens as directed by the Engineer.

430.03.07 Defective Material and Workmanship. The acceptance of any material and workmanship by the Inspector will not deter subsequent rejection. Rejected material and workmanship shall be replaced or repaired as directed by the Engineer.

430.03.08 Marking and Shipping. Each member shall be painted or marked with an erection mark for identification. An erection diagram shall be furnished with erection marks clearly delineating the orientation of diaphragms.

Erection marks for the field identification of members and weight marks for members over 6000 lb in weight shall be painted upon surface areas previously painted with the shop coat. Material shall not be loaded for shipment until the shop coat is thoroughly dry and in any case not less than 24 hours after the paint has been applied.

Where unpainted steel is specified for a finished structure, the Contractor shall not place the Contractor's or any other company's name on any of the structural steel. Mark numbers and inspection stamps shall appear only on the top surface of the top flange of all girders, beams, and diaphragms unless otherwise directed.

Painting is prohibited after loading of materials for transport.

The Contractor shall furnish the Engineer copies of material orders, shipping statements, and erection diagrams. The weight of the individual members shall be shown on the shipping statements.

The loading, transportation, unloading, and storing of structural material shall be conducted so that the metal shall be kept clean and shall not be excessively stressed, deformed, or otherwise damaged.

When handling long steel members, handling devices shall be placed at approximately the quarter points. When storing and shipping members, blocking shall be placed at intervals that prevent sag and distortion. All beams and girders shall be stored, shipped, and handled in an upright position. Members other than beams and girders shall be handled, hauled, and stored with the stronger axis vertical to resist gravity.

All girders having stiffeners the full height of the web on both sides of the web shall be adequately blocked before shipment. This blocking shall be located at the quarter points and midpoint of the girder and at additional locations to ensure that the maximum interval between blocking does not exceed 25 ft.

Members too long to fit inside a truck or trailer shall not cantilever beyond the bed more than one quarter of its length. Members too long to comply with this requirement shall be supported on dollies, additional vehicles, or other vehicles that fully support the long pieces as approved by the Engineer.

430.03.09 Storage of Material. Fabricated material shall be stored off the ground and protected as far as practicable from surface deterioration by exposure to conditions producing rust. These materials shall be kept free of dirt accumulation, oil, or other deleterious matter.

430.03.10 Changes and Substitutions. No changes or substitutions shall be made in any approved drawing unless approved in writing by the Director, Office of Bridge Development.

430.03.11 Fabrication. Fabrication and construction shall be bolted or welded as specified in the Contract Documents or as directed by the Engineer.

When curved girder bridges are to be curved by the heat shrinkage method, the proposed method shall be submitted to the Engineer for approval.

430.03.12 Holes.

- (a) **Punched Holes.** The diameter of the die shall not exceed the diameter of the punch by more than 1/16 in. Holes requiring enlargement shall be reamed. Holes shall be clean cut with no torn or ragged edges. Holes punched full size or subpunched shall be punched so that after the steel is assembled and before any reaming is done, a cylindrical pin 1/8 in. smaller in diameter than the nominal size of the punched hole shall be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If this

requirement is not met, the nonconforming punched pieces will be rejected. Holes not passing a pin 3/16 in. smaller in diameter than the nominal size of the punched hole will be rejected. Drifting done during assembling shall be only to bring the parts into position and not sufficient to enlarge the holes or distort the material. If the required accuracy cannot be obtained otherwise, holes for connections shall be subpunched and reamed with the members assembled instead of being punched full size.

- (b) **Reamed or Drilled Holes.** Holes shall be cylindrical, perpendicular to the member, and not more than 1/16 in. larger than the nominal diameter of the bolts. Where practical, reamers shall be directed by mechanical means. Burrs on the surface shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist drills. If required by the Engineer, assembled parts shall be taken apart for removal of burrs caused by drilling. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match marked before disassembling. When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 in. between adjacent thicknesses of metal.
- (c) **Subpunching and Reaming.** Holes in all field connections and field splices of main truss or arch members, continuous beams, plate girders, and rigid frames shall be subpunched and reamed while assembled in the shop unless otherwise specified. The assembly, including camber, alignment, accuracy of holes, and milled joints shall be acceptable to the Engineer before reaming is started.

All holes for floor beam and stringer field end connections shall be subpunched and reamed utilizing a template or reamed while assembled.

If additional subpunching and reaming is required, it will be specified in the Contract Documents. The accuracy of subpunched holes shall be the same as required for punched holes.

430.03.13 Shop Assembly. Surfaces of metal that will be in contact after assembling shall be cleaned. The parts of a member shall be assembled, well pinned, and firmly drawn together with bolts before reaming or tightening of fasteners is started. The member shall be free from twists, bends and other deformations. Material that has been punched full size

shall be reamed, if necessary, prior to tightening of fasteners. Refer to 430.03.12(c).

Parts not completely fastened in the shop shall be secured by bolts as practicable to prevent damage in shipment and handling. Members assembled in the shop for reaming of field connections shall remain assembled until the Engineer's shop inspection.

430.03.14 Camber Diagram. A camber diagram shall be furnished to the Engineer showing the camber at each panel point for each truss, taken from actual measurements during truss assembly. A camber diagram shall be furnished to the Engineer showing the camber at all splice points, points of dead load inflection, and any other points designated by the Engineer for all beams and girders.

Stringers shall be cambered to the dimensions specified in the Contract Documents. The camber specified shall mean the camber as measured after all shop welding has been completed. The maximum tolerance for camber shall be zero under to 3/4 in. over.

Full provisions shall be made for dead load deflections, fabricating tolerances, and irregularities at all points along all stringers so that the superstructure concrete may be placed to match the profile grade line.

430.03.15 Match Marking. Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be matched marked, and a diagram showing these marks shall be furnished to the Engineer.

430.03.16 Use of High Strength Bolts and Lock-Pin and Collar Fasteners. High strength bolts and lock-pin and collar fasteners shall be used unless otherwise specified in the Contract Documents. Unfinished bolts or machine bolts may be used for the temporary erection of structural steel and shall be replaced with high strength bolts, lock-pin and collar fasteners or welding for final erection. Turned bolts shall only be used when specified. The heads, nuts, and washers shall be drawn tightly against the work. Where bolts or lock-pin and collar fasteners are used in beveled surfaces, beveled washers shall be provided to give full bearing to the head, nut, or collar except as otherwise specified in 430.03.17. Where high strength bolt assemblies are used for joint connections, the Contractor shall also perform the additional testing specified in MSMT 211.

430.03.17 High Strength Bolt Joint Requirements.

- (a) Only one grade of bolts, nuts, and washers shall be used in a structure. Bolts may be supplied from various manufacturers

provided that each bolt of a given length and diameter shall be made by the same manufacturer. Nuts and washers may be supplied from different manufacturers provided that the same manufacturers make all the respective nuts and washers to be used throughout the structure on all bolts having the same diameter. All bolts, nuts, and washers used with A 709, Grade 50W steel shall conform to A 325, Type 3.

- (b) The slope of surfaces of bolted parts in contact with the bolt head and nut shall not exceed 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for the lack of parallelism. When assembled, bolted parts shall fit solidly together and shall not be separated by gaskets or any other interposed compressible material. The holes shall be truly cylindrical and at right angles to the surface of the metal so that both head and nut will bear squarely against the metal. When assembled, all joint surfaces including those adjacent to the bolt heads, nuts, or washers, shall be free of scale (except tight mill scale), dirt, burrs, and other deleterious material and defects that would prevent solid seating of the parts. Contact surfaces within joints shall be free of oil, lacquer, or rust inhibitor. Refer to 435.03.04 for contact surfaces to be painted.
- (c) When all bolts in the joint are tight, every bolt shall conform to the minimum installation tension specified for its size in MSMT 211. When field conditions prevent tightening at the nut, bolts may be tightened at the head, provided that the nut is prevented from turning. All bolts shall have a washer under the element (nut or bolt head) turned in tightening. Threaded bolt connections shall be tightened by the turn-of-nut method unless the Contractor opts to use DTI's. If impact wrenches are used, they shall be of adequate capacity and have a sufficient supply of air to perform the required tightening of each bolted connection.
- (d) To provide the bolt tension specified in 430.03.17(c), there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be additionally tightened with tensioning progressing systematically from the most rigid part of connection to the free edges. During this operation there shall be no rotation of the part not turned by the wrench.

After all bolts in the joint have a snug fit, the joint shall be additionally tightened by the applicable amount of nut rotation specified in the Nut Rotation from Snug Tight Condition table below. All bolt assemblies in the completed structure shall have full thread engagement which is accomplished when the end of the bolt is flush with or extends beyond the outer face of the nut.

NUT ROTATION FROM SNUG TIGHT CONDITION			
DISPOSITION OF OUTER FACES OF BOLTED PARTS			
Bolt length (as measured from underside of head to extreme end of bolt)	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (beveled washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis (beveled washers not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn

NOTE 1: This table is for coarse thread, heavy hexagon structural bolts of all sizes and lengths and heavy hexagon semifinished nuts.

NOTE 2: Nut rotation is rotation relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation: ± 30 degrees for bolts installed by 1/2 turn or less, and ± 45 degrees for bolts installed by 2/3 turn or more.

- (e) **Inspection.** The Engineer will be present during the installation and tightening of bolts to determine that the tightening procedure is properly followed and all bolts are properly tightened.

The Contractor shall provide a sufficient number of safe working platforms at splices where high strength bolts will be checked for torque requirements. Platforms shall be maintained at splices until all checking is complete and the splice is acceptable to the Engineer.

Turn of Nut Method. The Contractor shall provide a calibrated torque wrench to be used as the inspection wrench and a calibrated bolt tension calibrator. Both have to be approved by the Engineer.

The Contractor shall conduct the following inspections unless otherwise specified in the Contract Documents. Bolts, nuts, and washers that were previously torqued to installation tension shall not be reused in the structure.

- (1) Three bolts of the same size, length, and condition as those under inspection shall be placed individually in the bolt tension calibration device. There shall be a washer under the part turned in tightening each bolt.
- (2) Each of the three bolts shall be tightened in the calibration device by any convenient means to the tension specified for its size. The inspecting wrench shall then be applied to the tightened bolt, and the torque necessary to turn the nut or head 5 degrees approximately 1 in. at 12 in. radius in the tightening direction shall be determined. The average torque measured in the tests of three bolts shall be taken as the job inspecting torque to be used in the manner specified in (3).
- (3) Bolts represented in the sample above which have been tightened in the structure shall be inspected by applying, in the tightening direction, the inspecting wrench and its job inspecting torque to 10 percent of the bolts but not less than two bolts selected at random in each connection. If no nut or bolt head is turned by this application of the job inspecting torque, the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspecting torque, this torque shall be applied to all bolts in the connection; and all bolts whose nut or head is turned by the job inspecting torque shall be tightened and reinspected. Alternatively, the fabricator or erector may opt to retighten all of the bolts in the connection and then resubmit the connection for the specified inspection.

430.03.18 Lock-Pin and Collar Fastener Requirements.

- (a) Lock-pin and collar fasteners shall conform to 430.03.17 for one manufacturer, weathering characteristics, sloped surfaces, and applicable inspection.
- (b) A representative sample of not less than three sets of lock-pin and collar fasteners of each diameter, length, and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each assembly develops a tension not less than 5 percent greater than the tension required for the comparable A 325 or A 490 bolt. Manufacturer's installation procedure shall be followed for installation of bolts in the calibration device and

in all connections. Periodic retesting shall be performed when required by the Engineer.

- (c) Fasteners shall be installed in all holes of the connection and initially tightened sufficiently to bring all plies of the joint into firm contact but without yielding or fracturing the control or indicator element of the fasteners. All fasteners shall then be additionally tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the fasteners may require more than a single cycle of systematic partial tightening prior to final twist off of the control or indicator element of individual fasteners.

430.03.19 Welding. Welding of structures shall conform to the Contract Documents and AASHTO/AWS Bridge Welding Code D1.5 unless otherwise specified.

The provisions contained herein shall apply to both shop and field welding.

All welders, welding machine operators, and tackers employed to work on structures for the Administration shall be approved by the Office of Materials and Technology.

- (a) **Qualification Testing.** Welders will be approved based on Qualification Testing conforming to AASHTO/AWS Bridge Welding Code D1.5. Qualification testing will be conducted by the Office of Materials and Technology, Metals Group.

The Contractor shall contact the Metals Group at least 30 days prior to the start of welding operations to schedule welder tests. At the time of test, welders shall have an authorization from the Contractor. This authorization shall contain the welder's name, social security number, Contract number, and the Contractor's name and phone number.

- (b) **Qualifications from Outside Sources.** Welders having certifications from outside sources in conformance with the AASHTO/AWS Bridge Welding Code D1.5 may submit that certification for approval to the Metals Group.

All field welders approved by the Metals Group shall have a current Administration Welders Certification card available at all times for inspection by the Engineer.

Unless otherwise specified by the Engineer in writing, only submerged arc welding will be permitted on members carrying primary stress. Members carrying primary stress are as specified in 909.01.

After fabrication, no welding will be permitted on tension flanges for attachments such as metal forms and ty screws, except for steel stud shear developers specified in the Contract Documents.

Welding transversely across the tension flanges of beams or girders will not be permitted and will be cause for rejection unless otherwise specified in the Contract Documents.

430.03.20 Inspection of Fabricated Metal Structures. Fabricated metal structures shall conform to AASHTO/AWS Bridge Welding Code D1.5. Quality control inspection shall be the responsibility of the Contractor.

The Contractor shall have on file with the Office of Materials and Technology a current approved quality control plan prior to receiving source approval. This plan shall specify the frequency, method of inspection and provide for documentation. The inspection frequency shall be at least the minimum specified in AASHTO/AWS Bridge Welding Code D1.5. The Administration requires 30 days to review quality control plans not previously on file.

The Contractor shall also keep complete and current records which shall be available to the Administration's representatives at all times.

When work is completed, the documentation for all quality control tests and inspections shall become the property of the Administration.

430.03.21 Planing. The top and bottom surfaces of steel slabs, base plates, and cap plates of columns and pedestals shall be planed or the plates or slabs shall be heat straightened. Parts of members in contact with them shall be faced. In planing the flat surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

430.03.22 Abutting Joints. Abutting joints in compression members and in tension members where specified in the Contract Documents shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/8 in.

430.03.23 End Connection Angles. Floor beams, stringers, and girders having end connection angles shall be built to exact length back-to-back of connection angles. If end connections are faced, the finished thickness of the angles shall not be less than specified in the Contract Documents.

430.03.24 Main Members. Principal portions of main members carrying primary stress (i.e., webs, flanges, girders and trusses) shall be fabricated so that the direction of stress and rolling are the same.

430.03.25 Web Plates. At web splices, the clearance between the ends of the web plates shall not exceed 3/8 in. The clearance at the top and bottom ends of the web splice plates shall not exceed 1/4 in.

430.03.26 Bent Plates. Unwelded, cold bent, load carrying, rolled steel plates shall be taken from the stock plates so that the bend line will be at right angles to the direction of rolling, except that cold bent ribs for orthotropic deck bridges may be bent in the direction of rolling if permitted by the Engineer and shall conform to the following:

- (a) Bending shall be so that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal shall conform to the following:

THICKNESS (t) IN INCHES					
Structural Steel	Up to 1/2	Over 1/2 to 1	Over 1 to 1-1/2	Over 1-1/2 to 2-1/2	Over 2-1/2 to 4
A 709, Grades 36, 50 & 50W	2 t	2-1/2 t	3 t	3-1/2 t	4 t

- (b) For brake press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable.
- (c) If a shorter radius is essential, the plates shall be bent at a temperature not greater than 1200 F. Hot bent plates shall be taken from stock so that the bend line will be at right angles to the direction of rolling.
- (d) Before bending, the corners of the plate shall be rounded to a radius of 1/16 in. throughout the portion of the plate where the bending is to occur.

430.03.27 Erection Plan. The Contractor shall submit for approval, an erection diagram plan outlining erection procedure of the main members. The plan shall conform to TC-4.01 and shall be submitted for approval to the Director, Office of Bridge Development, a minimum of 30 days prior to beginning erection. This plan shall include the numbers and types of equipment to be used including crane capacity, location of crane for lifting, falsework when required, and main member erection sequence and weight.

All wheels and outriggers of a crane or wheels of a structural steel delivery truck shall be at a minimum distance from the rear face of an abutment equal to the vertical distance from the top of a spread footing or to the original groundline if the footing is on piles. No other heavy construction equipment shall be operated within this minimum distance from the rear face of abutments.

The Contractor shall erect bridges with continuous main members in a manner providing the proper reactions, and avoiding overstressing main members.

The Contractor when preparing erection plans and procedures shall take into account the restrictions imposed by the Water Resources Administration relative to pollution or disturbance of existing waterways.

430.03.28 Falsework. The Contractor shall comply with the provisions specified in TC-4.01. The falsework shall be built and maintained in conformance with the approved falsework plans. Any changes subsequent to initial approval which are proposed by the Contractor through the Contractor's professional engineer will be as approved by the Engineer.

Before permitting any loads to be placed on falsework, the Engineer shall receive written certification by the Contractor's professional engineer that the falsework system has been assembled in conformance with the approved falsework drawings. This certification shall be accompanied by a Certificate of Compliance stating that all manufactured materials and assemblies fully comply with the falsework design and plans. The Engineer may either accept the certificate or invoke any provision of GP-5.08. All tests required shall be made by the Contractor at no additional cost to the Administration.

In addition to protective measures shown on the falsework plans, the Engineer may direct the Contractor to provide further protection of falsework against accidental collision by highway or construction traffic and equipment, traffic vibration, flood waters or high winds, etc., that are necessary for public safety and protection of the work.

430.03.29 Damaged or Defective Material. The correction of damaged or defective material shall not begin until a written procedure prepared by the Contractor is approved by the Director, Office of Bridge Development. Correction of damaged or defective material shall be by methods that do not produce fracture or injury. All damaged or defective material will be inspected by the Engineer before and after correction. Corrections shall be conducted in the presence of the Engineer.

430.03.30 Assembling Steel. Material shall be carefully handled and no parts shall be bent, broken, or otherwise damaged. Bearing surfaces and those to be in permanent contact shall be cleaned before the members are assembled. Before beginning the field bolting and welding, the structure shall be adjusted to correct grade and alignment and the elevations of panel points (ends of floor beams) properly regulated. Splices and field connections shall have half the holes filled using bolts and cylindrical erection pins (40 percent bolts and 10 percent pins) before torquing high strength bolts. Splices and connections in members carrying traffic during erection shall have three fourths of the holes filled before torquing. Cylindrical erection pins shall be 1/32 in. larger than the diameter of the fasteners.

430.03.31 Anchor Bolts. No anchor bolts shall be cast in the concrete. The Contractor shall create a template to locate the anchor bolt holes. This template shall be used to shift the reinforcement prior to placing the concrete to eliminate conflicts between the reinforcement and the anchor bolt holes.

Anchor bolts shall be set in round holes drilled or cast in the concrete. Bolts shall be accurately positioned by using templates set to correct location and alignment to ensure proper span lengths, and tops of bolts shall be carefully set to proper elevation. Unless otherwise noted, bolts shall be installed plumb or normal to the finished bearing surface of the masonry.

Bolts set in holes drilled or cast into the concrete shall have the portion below the bridge seat swedged. The drilled or cast holes shall have a diameter at least 1 in. larger than the bolt diameter.

Anchor bolts, nuts, and washers shall not be painted.

After anchor bolts are finally and correctly positioned, the holes shall be completely filled with grout. Grouting of anchor bolts is not permitted until all structural steel is set in its final position. After the masonry plates or shoes are set, the space between the bolts and the round holes through fixed plates or shoes shall be filled with the same material. Slotted holes in expansion devices shall remain unfilled unless otherwise specified in the Contract Documents.

The Contractor shall maintain a minimum air temperature of 40 F around the mortar surface for a period of three days unless otherwise recommended by the manufacturer.

When mortar filling is used for bolts inserted in holes drilled or cast in the concrete, the holes shall first be checked for depth by inserting and withdrawing the bolts. They shall then be partially filled with mortar into

which the bolts shall be forced by uniform pressure or light blows from a hammer (flogging and running is prohibited) so that excess mortar is pushed out at the top of the hole. The excess mortar shall be removed.

Bolts shall be set to project approximately 1/2 in. above the nut and shall be threaded to approximately 1/2 in. below the nut in their final position.

Rockers or expansion plates with slotted holes shall be set with the proper tilt or offset as determined by the temperature prevailing at the time and so that they will be in their midway position at 68 F or as specified in the Contract Documents.

430.03.32 Maintenance of Concrete. The Contractor shall be responsible for keeping all exposed concrete surfaces free from stains and discoloration. The Contractor shall prevent staining of the finished concrete surfaces where unpainted structural steel is specified. Any stains shall be removed and the concrete restored to its original color.

430.03.33 Safety Hazards. The Contractor shall be responsible for gas detection in and ventilation of confined spaces as specified in TC-3.05.

430.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all high strength bolt and lock-pin and collar fastener assembly testing, material, labor, equipment, tools, and incidentals necessary to complete the work.

430.04.01 Fabricated Structural Steel will not be measured but will be paid for at the Contract lump sum price.

430.04.02 Fabricated Structural Steel will be measured and paid for at the Contract unit price per pound computed on the theoretical weight.

Where measurement and payment of Fabricated Structural Steel is based on weight, the weight will be computed on the basis of the net finished dimensions of the parts as shown on the approved working drawings, deducting for copes, cuts, clips, and all open holes.

Computations will be made on the basis of the following:

MATERIAL	POUNDS PER CUBIC FOOT
Aluminum, cast or wrought	173.0
Bronze, cast	536.0
Copper alloy	536.0
Copper, sheet	558.0
Iron, cast	445.0
Iron, malleable	470.0
Lead, sheet	707.0
Steel, rolled, cast, copper bearing, silicone, nickel and stainless	490.0
Zinc	450.0

The weight of rolled shapes will be computed on the basis of their nominal weight per foot as specified in the Contract Documents or listed in the handbooks.

The weight of rolled shapes will be computed on the basis of their nominal weight for their width and thickness as specified in the Contract Documents, plus an estimated overrun computed as half the permissible variation in thickness and weight as tabulated in A 6.

The weight of all shop weld metal (not included in weighed unit) and field weld metal will be computed on the basis of the theoretical volume from dimensions of the welds.

The weight of temporary erection bolts, shop and field paint, boxes, crates and other containers used for shipping, and materials used for supporting members during transportation and erection is excluded from the calculation of weight for payment.

Structural members or materials which fail to conform to requirements of tests and all materials rejected as a result of these tests will not be measured or paid for under any method of payment.

430.04.03 When a pay item for Fabricated Structural Steel is not specified in the Contract Documents, the fabricated structural steel will not be measured but the cost will be incidental to other pertinent items.

430.04.04 Rotational capacity testing for high strength bolt assemblies will not be measured but the cost will be incidental to the Contract price

for the Fabricated Structural Steel item or other pertinent items specified in the Contract Documents.

SECTION 431 — STEEL STUD SHEAR DEVELOPERS

431.01 DESCRIPTION. This work shall consist of furnishing, fabricating and installing, complete in place, steel stud shear developers as specified in the Contract Documents or as directed by the Engineer.

431.02 MATERIALS.

Steel Stud Shear Developers

909.05

431.03 CONSTRUCTION. All structural steel in a particular span of a bridge shall be erected and have forming and decking complete in place in that particular span before shear developers are attached to the structural steel. Shear developers shall be installed as specified in AASHTO/AWS Bridge Welding Code D1.5. After welding is completed, an inspection of all studs will be made by the Engineer prior to placing of concrete. All defects shall be corrected at no additional cost to the Administration.

431.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

431.04.01 Steel Stud Shear Developers will not be measured but will be paid for at the Contract lump sum price.

431.04.02 Steel stud shear developers for which there is no specific pay item included in the Contract Documents will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

431.04.03 Steel Stud Shear Developers will be measured and paid for at the Contract unit price per each.

SECTION 432 — BEARINGS

432.01 DESCRIPTION. This work shall consist of furnishing and installing bearings of the type and size specified in the Contract Documents or as directed by the Engineer.