KANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION TO THE
STANDARD SPECIFICATIONS, EDITION 2015

Delete SECTION 712 and replace with the following:

SECTION 712

STRUCTURAL STEEL CONSTRUCTION

712.1 DESCRIPTION

Fabricate and erect the structural steel as designated in the Contract Documents. See **SECTION 705** for fabrication of structural steel. Provide and place the castings designated in the Contract Documents.

BID ITEMS	**UNITS**
Structural Steel (*)(**)(***)	Pound
Structural Steel (Merchant Quality)	Pound
Welded Stud Shear Connectors	Each
*Type	
**Grade	
***Use	

712.2 MATERIALS

Provide materials that comply with the applicable requirements.

Structural Steel Fabrication and Painting	**DIVISION 700**
Cast Steel	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**
Welded Stud Shear Connectors	**DIVISION 1600**
Bearings or Pads	**DIVISION 1700**

712.3 CONSTRUCTION REQUIREMENTS

a. Erecting Structural Steel.

(1) General. Erect the fabricated structure as detailed in the Contract Documents. Provide all falsework, tools, machinery and appliances, including drift pins and erection bolts required to complete the work. After the structure is erected, remove all falsework, appliances and other obstructions or debris resulting from erection.

Provide the Engineer with safe means (such as scaffolding, safety lines, snoopers or hoist buckets) to inspect any portion of the structure during the erection operations.

(2) Handling Structural Steel. Use protective devices or softeners to safeguard plate edges, when loading, transporting, unloading, storing and erecting structural steel. Store the structural steel above ground on platforms, skids or other supports. Keep the structural steel properly drained, clean and free of dirt, grease and other foreign matter. Protect the structural steel from corrosion. Store girders and beams upright with sufficient support to prevent warping or change in design camber.

(3) Erection Plans. Provide the Engineer with detailed plans for the erection of the structure, including calculations, shop details, camber diagrams, list of field bolts and a copy of shipping statements showing a list of parts and their weights. Provide erection plans, sealed by a licensed Professional Engineer, for span lengths greater than 125 feet.

(4) Falsework. Comply with **DIVISION 700**.

(5) Bearings and Anchorage. Do not place masonry bearing plates upon bridge seat bearing areas which are improperly finished, deformed or irregular and not until the elevations have been verified. Set bearing plates

level in exact position and have a full and even bearing upon the masonry. Unless otherwise shown in the Contract Documents, place bearing plates on mats or pads.

Set the anchor bolts according to **SECTION 842-DRILLING AND GROUTING** and preferably, if construction conditions permit, by first setting the bearing devices and superstructure and then drilling the holes or using preformed holes for the anchor bolts. When drilling anchor bolts use a pacometer to avoid drilling in the existing reinforcing steel. When required, cast anchor bolts in place according to the Contract Documents. Vary the location of the anchor bolts in relation to the slotted holes in the expansion shoes with the prevailing temperature. Adjust the nuts on anchor bolts at the expansion ends of spans to permit the free movement of the span, and either provide lock nuts or burr the threads of the anchor bolts.

(6) Straightening Bent Material. Do not put bent or twisted members in place until all defects are corrected. The Engineer, (based on recommendations from the State Bridge Office) will reject damaged members. Straighten plates or other shapes by approved methods that will not produce fracture or other injury to the metal (i.e. yield strength, ductility, toughness). Do not heat the metal without approval of the Engineer. Submit the heat straightening procedure to the Engineer for approval. When permitted, perform the heat straightening procedure complying with AASHTO/AWS D1.5 (edition referenced in **subsection 705.2e.**) "Bridge Welding Code" and the latest versions of AASHTO's "Standard Specifications for Highway Bridges"; AASHTO's "LRFD Bridge Construction Specifications"; and the FHWA report, "Heat-Straightening Repairs of Damaged Steel Bridges". Following the straightening of a bend or buckle, the surface of the metal will be inspected by the Engineer for evidence of fracture, using the dye penetrant or magnetic particle inspection method.

(7) Assembling the Structural Steel. Use drift pins for all main member fit-up. Main members are defined as all girders and beams, cross-frames on curved girders or as specified in the Contract Documents. Assemble the parts as shown in the Contract Documents and erection diagrams, utilizing the matchmarks. Before the members are assembled, clean bearing surfaces and surfaces to be in permanent contact. Carefully handle the material so that no parts are bent, broken or otherwise damaged. Hammering that will injure or distort the members is prohibited. Misfitting may require revision of erection details and shop drawings by the Contractor with approval of the Engineer.

(8) Erecting Weathering Steel. Erect the fabricated weathering steel according to this subsection, with these additions:

Unless shown otherwise in the Contract Documents, protect the exposed surfaces of the substructure concrete from staining caused by the weathering steel. Cover the surface of piers and front faces of the abutments with polyethylene sheeting or other material approved by the Engineer before erecting the weathering steel. Maintain the protection until the bridge deck is completed.

After the bridge is completed, but before acceptance, sandblast the piers and front face of the abutment to a uniform appearance by removing all laitance, staining, any visible form lines, etc.

b. Bolted Field Connections.

(1) General. During field erection, follow the blocking diagram shown in the shop drawings. When designated, a "no-load" condition for blocking or laydown indicates the pieces were drilled/punched from solid plates laid on their sides without the deadload deflection included. Reproduce this geometry during erection by the use of falsework or cranes to "float" adjacent pieces together to facilitate proper fit-up.

Drift Pins: Use drift pins (cylindrical body pins with tapered ends) to facilitate driving and to line up the open holes in a connection. Use hardened steel drift pins with a minimum yield strength of 50 ksi and with the same nominal diameter as that of the open hole into which they are driven. Drive drift pins only to line up the holes. Do not deform the material.

Erection Bolts: Use ASTM F3125 Grade A325 bolts the same size as the permanent bolts. Uniquely identify the erection bolts from the permanent bolts. Once erection bolts are no longer required, remove and replace with permanent bolts. Erection bolts may only be reused as such.

Fitting-Up: Accurately align all connections by driving drift pins in all corners and ¼ of the remaining holes in each plate in a well distributed pattern to align or "fair-up" the holes. Light drifting is permitted to affect this fairing-up of the holes. Heavy drifting which would deform the material is prohibited. Before removing any drift pins from structures being connected, or moving the connected members, fully tighten the bolts in a minimum of ¼ of the holes in the splices and field connections. For structures carrying workers and equipment, fully tighten the bolts in ¾ of the holes. Use high-strength erection bolts in combination with drift pins to hold the material together during fit-up.

Use pilot and driving nuts in driving pins (pin connections). Drive the pins so that the members take full bearing on them. Screw pin nuts up tight and burr the threads at the face of the nut with a pointed tool.

Immediately report to the Engineer any error in shop work that prevents the proper assembling and fitting up of parts. Reaming, chipping or cutting is prohibited without approval from the Engineer. Submit correction method for approval by the Engineer. Make the approved correction in the presence of the Engineer.

(2) Field Bolting with non-high-strength bolts. If non-high-strength bolts are specified for miscellaneous connections, use unfinished or machined bolts in bolted connections. Provide unfinished or machined bolts that have hexagonal heads and nuts and are of such length that they shall extend entirely through the nut a maximum of ¼ inch beyond the nut.

The diameter of the unfinished bolt may not be more than $^{1}/_{16}$ inch smaller than the diameter of the hole.

The threads of machined bolts must be entirely outside the grip. The grip is the area from the finished head of the bolt to the finished nut. Use approved nut locks or flat washers ¼ inch thick under nuts, with the threads burred. Ream the holes for machined bolts. The hole diameters may not be more than $^{1}/_{32}$ inch greater than the diameter of the finished bolt. In bolted connections, draw the bolts up tight and burr the threads at the face of the nut with a pointed tool.

(3) Field Bolting with High-Strength Steel Bolts and Washers. No reaming, cutting and chipping is allowed for girder flange and web splices.

The slope of surfaces of bolted parts in contact with the bolt head and nut is a maximum of 1:20 with respect to a plane normal to the bolt axis. Do not separate bolted steel parts by gaskets. Steel parts must fit solidly together after the bolts are tightened. Standard holes have a diameter nominally $^{1}/_{16}$ inch in excess of the nominal bolt diameter. Use a hardened washer under the turned elements (head or nut) for all installations.

Where shown on approved shop drawings, oversized, short-slotted and long-slotted holes may be used with high strength bolts ⅝ inch in diameter and larger in connections assembled as shown in **TABLE 712-1**.

TABLE 712-1: OVERSIZED HOLES

Bolt diameter, d (inch)	Excess of nominal bolt diameter (inch)
d ≤ ⅞	$^{3}/_{16}$
d = 1	¼
d ≥ 1 ⅛	$^{5}/_{16}$

Oversized holes may be used in only one of the connected parts of either a friction or bearing connection at an individual faying surface. Install hardened washers (of a sufficient size to completely cover the hole, after installation) over the oversized holes in an outer ply.*

Short-slotted holes shall be nominally equal to a standard hole width, and have a length that does not exceed the oversize diameter provisions for oversize holes by more than $^{1}/_{16}$ inch. Short-slotted holes may be used in only one of the connected parts of either a friction or bearing connection at an individual faying surface. The slots may be used without regard to direction of loading in friction connections, but must be normal to the direction of the load in bearing connections. Install hardened washers over short-slotted holes in the outer plies that have a size sufficient to completely cover the slots after installation.*

Long-slotted holes shall be nominally equal to a standard hole width and have a length more than allowed for short-slotted holes, but not more than 2 ½ times the nominal bolt diameter. Long-slotted holes may be used in only one of the connected parts of either a friction or bearing connection at an individual faying surface. The slots may be used without regard to direction of loading in friction connections, but must be normal to the direction of the load in bearing connections. Where long-slotted holes are used on an outer ply, provide a plate washer or continuous bar a minimum of $^{5}/_{16}$ inch thickness with standard holes. This washer or bar shall be of structural grade material, but need not be hardened. Provide washers or bars that have a size sufficient to completely cover the slots after installation. If hardened washers are required by the Contract Documents, place the hardened washers over the outer surface of the plate washer or bar.*

*When ASTM F3125 Grade A490 bolts over 1 inch in diameter are used in slotted or oversized holes in external plies, use a single hardened washer complying with ASTM F436, except with $^{5}/_{16}$ inch minimum thickness, in lieu of the standard washer.

When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts or washers, shall be free of scale, burrs, dirt and other foreign material that would prevent solid seating of the parts. Tight mill scale may be accepted.

(4) Bolting Operation. See **FIGURE 712-1.** The Bolting Operation shall require Calibration, Installation and Inspection Verification.

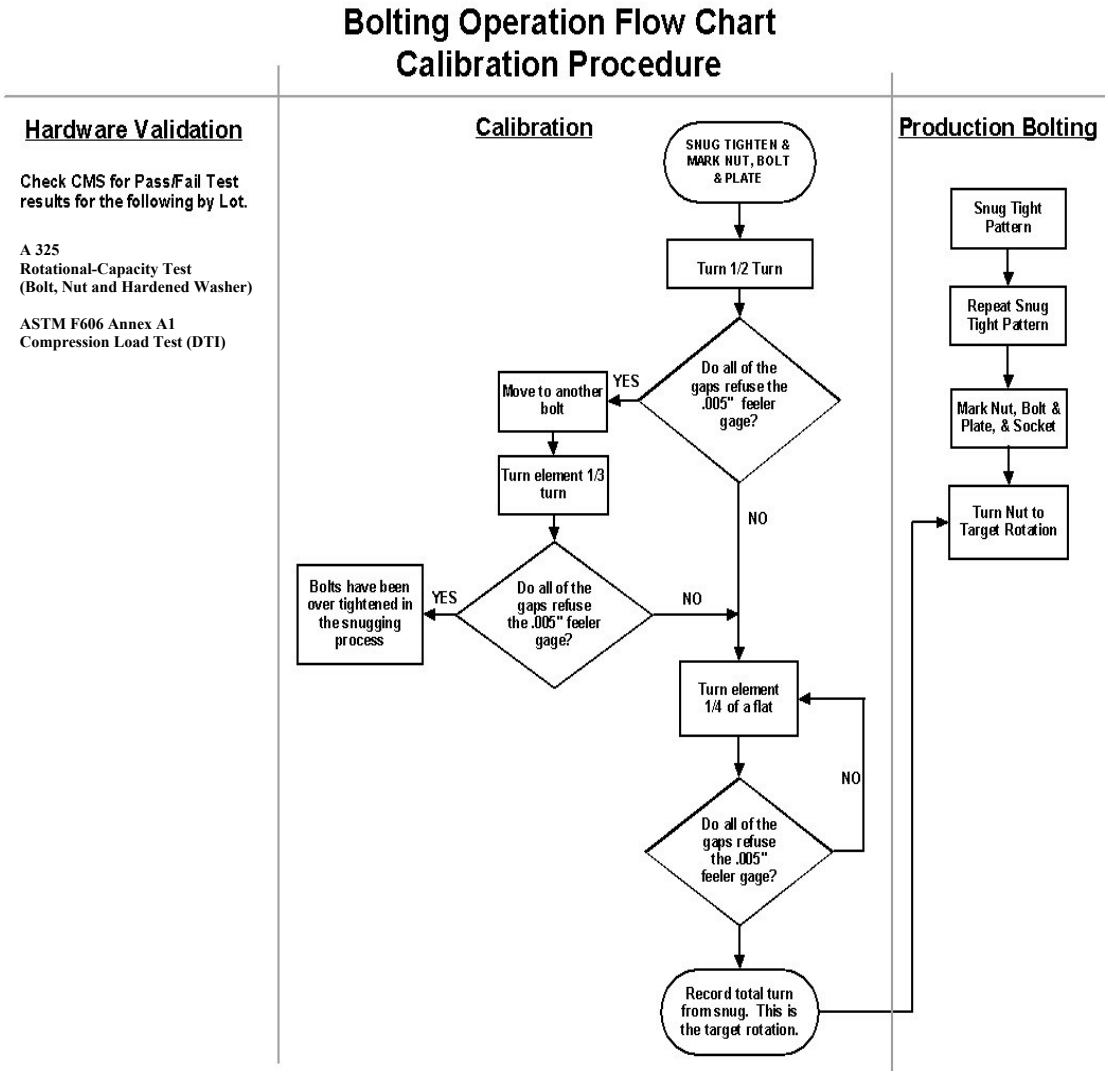
Provide the Engineer applicable test results and certifications for bolt and DTI lots being used on the project: Rotational-Capacity Test (Bolt, Nut and Hardened Washer) & ASTM F606 Annex A1 Compression Load Test (DTI).

Calibration. Calibration (**FIGURE 712-1**) is the process of determining the correct tightening procedures so that consistency and accuracy are obtained. This procedure is only applicable to calibrating the turn of fasteners using DTI's. This is only used on girder splices and diaphragm connections or as noted in the Contract Documents.

The calibration procedure is as follows:

- Using plies with equivalent grip of the connection and correct bolt hole diameter, snug-tighten the fasteners such that all plates are in uniform contact;
- Place appropriate marks on the bolt, nut and plate so that the amount of nut rotation relative to the bolt can be verified;
- Hold the static element and rotate the turned element one half a turn. Record the number of gaps that refuse the 0.005 inch gage;
- If this rotation causes all of the gaps to refuse the feeler gage, move to another bolt and rotate the turned element ⅓ of a turn and record the number of gaps that refuse the feeler gage;
- Continue rotating the turned element until all the gaps refuse the 0.005 inch gage. Record the rotation. This is the target rotation for the bolting operation for this bolt length and diameter;
- Repeat this procedure for every bolt length and diameter on the project.

FIGURE 712-1



Installation. To achieve uniform results, install bolts after performing calibration tightening procedures.

Tighten threaded bolts by methods described below. If required because of bolt entering and wrench operation clearances, tightening may be accomplished by turning the bolt while the nut is prevented from rotating.

Use impact wrenches of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately 10 seconds.

Indicate in the shop drawings where washers are required. Only use hardened washers. Use an additional hardened washer with all ASTM F3125 Grade A490 bolts under the element not turned, if the material against which it bears has a specified minimum yield point less than 40 ksi.

Where an outer face of the bolt part has a slope greater than 1:20 with respect to a plane normal to the bolt axis, use a beveled washer to compensate for the slope.

Use the turn-of-nut method to provide the required bolt tension for all bolted connections. Install bolts in a minimum of ¼ of the connection holes and bring them to a "snug tight" condition. Snug tight is defined as the condition that exists when the plies of the splice are in firm uniform contact. A few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench should attain this condition. Perform snug tightening systematically from the center of the splice to the free edges, and then re-tighten the bolts in a similar systematic manner until all bolts are snug tight and all splice plates are fully compacted. The connection is then ready for final tightening. For proper installation bring all bolts to “snug tight” in the same manner as in the calibration.

Only use a Direct Tension Indicator (DTI) for girder splices and diaphragm connections, or as noted in the Contract Documents.

Install the DTI’s by one of the following methods:

- Place a DTI under the bolt head and turn nut to tighten. This method is preferred whenever possible. Face the protrusions on the DTI to the underside of the bolt head. Place a hardened flat washer under the nut;
- Place a DTI under the nut and turn the nut to tighten. Place a hardened washer between the nut and the DTI. Place the DTI against the plates with the protrusions facing the washer;
- Place a DTI under the nut and turn the bolt. Face the protrusion on the DTI to the nut. Place a hardened flat washer under the bolt head; or
- Place a DTI under the bolt head and turn the bolt head to tighten. This method is suggested when the nut can not be turned. Place hardened flat washer between bolt head and the DTI. Face the protrusions on the DTI to the underside of the flat washer and bolt head. Place a hardened flat washer under the nut.

On connections specifying the use of DTI’s, use the turn-of-nut method and tighten all bolts in the connection as determined from the "Target Rotation" in **FIGURE 712-1**. During the tightening operation, there must be no rotation of the part not turned by the wrench. Perform tightening systematically from the most rigid part of the joint to its free edges. Place appropriate marks on the bolt, nut and plate so that the amount of nut rotation relative to the bolt can be verified. Use the turn specified in **TABLE 712-2** for all connections other than girder splices and diaphragm connections.

TABLE 712-2 - NUT ROTATION (*) FROM SNUG TIGHT CONDITION

Bolt Length (as measured from underside of head to extreme end of point)	Disposition of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (bevel washer not used)	Both faces sloped not more than 1:20 from normal bolt axis (bevel washer not used)
Up to and including 4 diameters	1/2 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
Over 12 diameters	The method of tightening bolts over 12 diameters in length is as shown on the shop details and approved by the Engineer		

*Nut rotation is relative to the bolt, regardless of the element (nut or bolt) being turned. For bolts installed by ½ turn and less, the tolerance is ± 30°; for bolts installed by ⅔ turn and more, the tolerance is ± 45°.

Lubricate all galvanized nuts with a lubricant containing a visible dye so a visual check can be made for the lubricant at the time of field installation. Black bolts must be "oily" to the touch when installed. Clean and re-lubricate weathered or rusted bolts before installation. Store bolts in closed containers, at all times when not in use.

Do not reuse ASTM F3125 Grade A490 and A325 bolts, or any bolt that has been fully tightened.

Inspection Verification. Inspection verification confirms end results of the bolting operation; the inspection provides acceptance or rejection of the finished connection. See **FIGURE 712-2**.

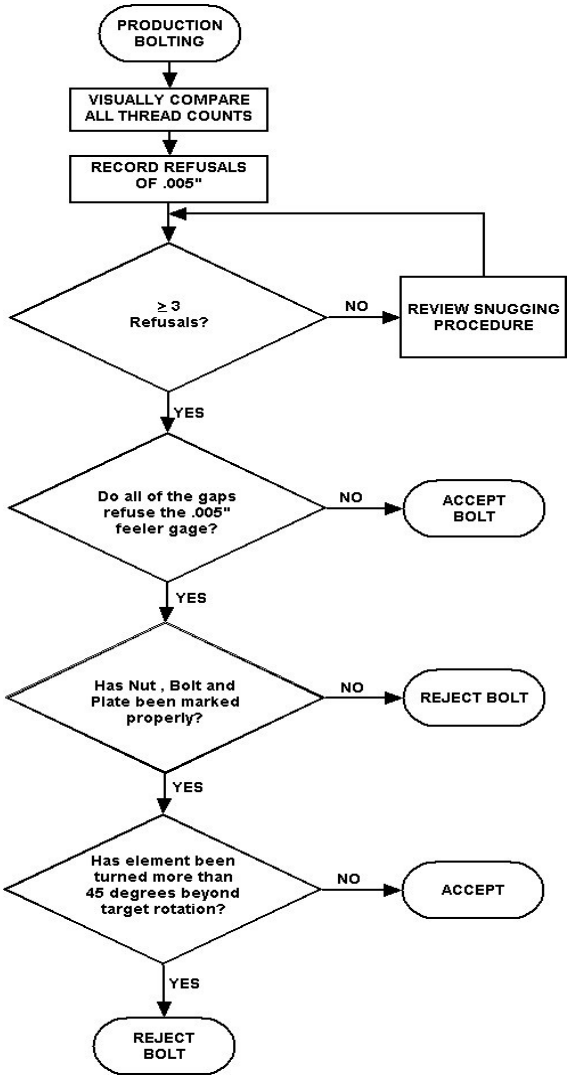
Commencing with each day's bolting operation, the Engineer will inspect each bolt until the Contractor's procedures for that day are confirmed. After the day's procedures are confirmed, a minimum of 20% of all the bolts in all splices will be checked with a feeler gauge. This check should be randomly distributed over all the plates within the splice.

Visually compare the number of threads extending past the face of the nut for uniform appearance. Record the number of refusals using the 0.005 inch gage. (Note: some DTI suppliers provide both 0.005 inch and 0.015 inch gages. Use only the 0.005 inch gage). If the number of refusals is less than 3, tighten until there are a minimum of 3 refusals. If this occurred with the proper rotation, all the plies were not in proper snug-tight condition. If the number of refusals with the 0.005 inch gage is greater than or equal to 3, but less than the number of protrusions, accept the bolt. If all the gaps refuse the 0.005 inch gage, the actual rotation must be compared with the target rotation:

- If the element has been turned more than 45° beyond the target rotation, reject the bolt.
- If the element has been turned less than 45° beyond the target rotation, accept the bolt.

If the feeler gage is refused by all gaps and the bolt, nut and plate have not been marked, the bolt will be rejected.

FIGURE 712-2 – Direct Tension Indicator Verification



Bolt Size	DTI Spaces		Minimum Installation Refusals	
	A 325	A 490	A 325	A 490
5/8	4	5	2	3
3/4	5	6	3	3
7/8	5	6	3	3
1	6	7	3	4
1-1/8	6	7	3	4
1-1/4	7	8	4	4
1-3/8	7	8	4	4

c. Welded Field Connections. Perform field welding and gas cutting of structural steel according to the applicable requirements of **SECTION 705**. The company/individual performing non-destructive testing of field welds shall be separate and independent of the company/individual that performed the field welding. The company/individual performing non-destructive testing of field welds shall be separate and independent of the company/individual that performed the field welding.

Fill erection holes in the girder webs with button head or hex head bolts equipped with regular hex nuts. Use only one type of bolt head. Place the heads of the bolts on the outside faces of the webs.

Erection bolts or other methods approved by the Engineer may be used for closing erection holes in other parts of the structure.

All permanent field welded connections of structural steel, except splices in steel piles, shall be made by welders who have qualified in accordance with the requirements of **SECTION 713**.

d. Welded Stud Shear Connectors. Welded Stud Shear Connectors may be applied during shop fabrication or in the field. If field applied, refer to **subsection 705.2d.(12)**.

e. Field Painting. Prepare the structural steel surfaces and field paint the prepared surfaces according to **DIVISION 700**.

712.4 MEASUREMENT AND PAYMENT

The Engineer will measure structural steel by the pound. The measured quantity for payment of structural steel is the quantity shown in the Contract Documents. If the Contract Documents are altered for changes in design, or if disagreement exists between the Contractor and the Engineer as to the accuracy of the quantities in the Contract Documents, either party has the right to request and cause the quantities involved to be measured. Use **TABLE 712-3** to compute the weights.

TABLE 712-3: CONVERSION UNIT WEIGHTS

Type	Unit Weight (Lb. per Cu. In.)
Structural Steel	0.2833
Bronze	0.315
Cast Iron	0.26

The Engineer will not measure fasteners including erection bolts, button head bolts used for filling erection bolt holes, high-strength bolts for permanent connections, temporary laterals or similar items. The Engineer will not measure weld metal deposited in fillets, or otherwise outside the lines and surfaces of the connected parts; but no deductions are made from the computed quantities of such work to allow for material that is removed by beveling or other cutting, and subsequently replaced with weld metal.

The Engineer will measure each welded stud shear connector either applied during fabrication or in the field.

Payment for "Structural Steel", "Structural Steel (Merchant Quality)" and "Welded Stud Shear Connectors" at the contract unit prices is full compensation for the specified work.

The Engineer will pay for structural steel according to **TABLE 712-4**.

TABLE 712-4: PAYMENT FOR STRUCTURAL STEEL

% Payment of the Contract Quantity	Milestone
90	All structural steel is completely fabricated, in place, inspected and ready to weld or bolt according to the Contract Documents.
95	All structural steel is welded or bolted according to the Contract Documents.*
100	All structural steel is painted according to the Contract Documents, when in the contract.

*If painting of structural steel is not required, pay 100%.