

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for erecting structural metals.

1.2 RELATED SECTIONS

- A. Section 09972: Painting for Structural Steel.

1.3 REFERENCES

- A. AASHTO Standard Specifications for Highway Bridges.
- B. ANSI/AASHTO AWS D1.5.
- C. AASHTO M 164: High-Strength Bolts for Structural Steel Joints.
- D. AASHTO M 270: Structural Steel for Bridges.
- E. AASHTO M 291: Carbon and Alloy Steel Nuts.
- F. AASHTO M 293: Hardened Steel Washers.
- G. ASTM A 123: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products.
- H. ASTM F 606: Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets.
- I. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners.

1.4 SUBMITTALS

- A. Manufacturer's certificate of compliance for nut proof load tests as specified. AASHTO M 291.

1. Certificate must show corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of all testing.
 2. Include rotational capacity and proof load test results.
- B. Three copies of certified mill test reports for all fabricated structure materials before fabrication, including materials manufactured outside the United States.
- C. Shop Drawings: Submit five copies of shop detail drawings for all fabricated materials.
1. Submit one set on 33 inch x 23 inch sheets with a 2 inch blank margin on the left edge and four sets on 11 inch x 17 inch sheets with the department project designation data, drawing number, and sheet number in the lower right corner.
 2. All details are subject to modification or approval.
 3. Do not order materials or begin work until receiving final approval of the shop detail drawings.
 4. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.
 5. Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days for the project. This right applies each time the drawings are submitted.
 - a. If the drawings are held in excess of 14 calendar days and cause a delay in the Contractor's operations, the contract time may be increased by the number of days delayed.
 - b. Written notification and justification must be submitted within 5 working days after approval if claiming an increase in contract time.

1.5 QUALITY ASSURANCE

- A. Bolts and Nuts (Black and Galvanized): Subject to the Rotational Capacity Test, Section 8.5, and the following requirements. AASHTO M 164:
1. Go through twice the required number of turns (from snug tight condition) in a Skidmore-Wilhelm Calibrator or equivalent tension measuring device without stripping or failure as specified.

2. Modify Table 8 in AASHTO M 164 as follows:

Bolt Length Bolt Diameters	Nominal Nut Rotation, Degree (Turn)
# 4	240 degrees (2/3)
> 4 and # 8	360 degrees (1)
> 8	480 degrees (1-1/3)

3. Maximum recorded tensile strength must be equal to or greater than 1.15 times the required fastener tension as specified.
4. Measured torque necessary to produce the required fastener tension must not exceed the value obtained by the following equation:

$$\text{Where: } \begin{array}{l} \text{Torque \#} \\ \text{Torque} \\ P \\ D \end{array} = \begin{array}{l} 0.25 \text{ PD} \\ \text{Measured Torque} \\ \text{(foot-lbs)} \\ \text{Measured Bolt} \\ \text{Tension (lbs)} \\ \text{nominal diameter} \\ \text{(feet)} \end{array}$$

5. Bolts and nuts require proof load tests as specified in ASTM F 606, Method 1 (Proof Load).
6. Bolts and nuts require wedge tests as specified in AASHTO M 164, Section 8.3.

B. Foreign Materials:

1. Have inspected, sampled, and tested at a distribution point in the United States, all materials that have been manufactured outside the United States.
2. Furnish facilities and arrange for all testing beyond the Department's capability.
 - a. Engineer or Engineer's representative must witness all tests.
 - b. Reimburse Department for travel expenses if testing of foreign materials is conducted outside Utah.
 - c. Reimburse Department for all excess costs connected with out-of-state shop inspection for foreign materials including travel expenses or the services of an approved inspection agency
 - d. Pay for in-plant inspections deemed necessary.
3. Use foreign manufacturers who have previously established the ability to furnish material uniformly and consistently within the specifications.

- C. Welding operators must be prequalified. Comply with UDOT Steel and Concrete Construction Manual.

PART 2 PRODUCTS

2.1 STRUCTURAL METALS

- A. As specified unless otherwise indicated. Follow AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.3.

2.2 HIGH TENSILE STRENGTH NUTS, BOLTS, AND WASHERS

- A. Use bolts, nuts and washers displaying the manufacturer's markings.
- B. Bolts: As specified in AASHTO M 164 with the following modifications:
 - 1. Maximum hardness: Rockwell C33
 - 2. Minimum hardness: Rockwell C24
 - 3. Maximum tensile strength:
 - a. 150 ksi for bolts 1 inch or less in diameter
 - b. 120 ksi for bolts larger than 1 inch in diameter
 - 4. Lubricate bolts before installing
- C. Nuts:
 - 1. As specified in AASHTO M 291 or AASHTO M 293.
 - 2. Use heat treated Grades DH and 2H, except use Type DH3 nuts when Type 3 bolts are called for.
- D. Washers: As specified in AASHTO M 293.
- E. Load Indicator Washers: As specified in ASTM F 959.

2.3 ELASTOMERIC BEARING PADS

- A. As specified in AASHTO Standard Specifications for Highway Bridges, Division II, Article 18.2.

2.4 FABRICATION

- A. As specified in AASHTO Standard Specifications for Highway Bridges, and UDOT Steel and Concrete Construction Manual. ANSI/AASHTO/AWS D 1.5.

- B. If steel structure is to be part of a bridge structure, the fabricator must have American Institute of Steel Construction (AISC), Category III, Quality Certification.
 - 1. Category III, Quality Certification not required for railings, grates, grate frames, and drain pipes.

2.5 APPROACH SLAB DRAIN ANGLES AND GRATE

- A. AASHTO M 270M, Grade 36.
- B. Hot-dip galvanize after fabrication. ASTM A 123.

PART 3 EXECUTION

3.1 INSPECTION

- A. Notify Engineer immediately upon placing the fabrication order to allow time for shop inspection.
 - 1. Do not begin fabrication until arrangements for shop inspection have been made.
 - 2. Facilitate inspection procedures on site and supply personnel as needed to properly inspect the work.
- B. Allow authorized inspectors free and immediate access to all parts of the plant.
- C. Furnish facilities for inspection of material and workmanship in the mill and shop.
- D. The Inspector has the authority to reject any materials or work not meeting the specifications.
 - 1. Material accepted by the Inspector may be rejected if found defective at a later time.
 - 2. Replace or correct rejected material at no additional cost to the Department.
 - 3. Contractor may appeal disputes with the Inspector to the Engineer for a final decision.

3.2 INSTALLING HIGH STRENGTH BOLTS

- A. Testing:
 - 1. Provide a Skidmore-Wilhelm calibrator or other acceptable bolt tension indicating device for bolt testing at the job site.

2. Use direct-tension indicators with solid plates when the fastener-grip length is too short to be tested in a Skidmore-Wilhelm calibrator.
 3. Check the direct-tension indicators in a Skidmore-Wilhelm calibrator using bolts of sufficient length before using.
- B. Test the installed bolt/nut/washer assembly periodically to verify compliance.
- C. Use direct-tension indicator washers as specified to tighten high strength bolts.
1. ASTM F 959.
 2. Tighten bolts according to the manufacturer's methods and procedures or as modified by Engineer.
 3. Tighten the fastener to reduce the gap to .005 inch or less regardless of which element is turned for tightening.
- D. Install bolts as specified in AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.5.6.4 and in the following procedure.
1. Complete the *Bolted Field Splice Certification* form at the end of this section as bolt tightening progresses.
 2. Place direct-tension indicator washer where the washers will not be embedded in concrete.
 3. Use drift pins to align bolt holes and maintain dimensions and camber of the member.
 4. Insert bolts in open holes with washers as specified by the manufacturer, and hand tighten.
 5. Tighten at least 50 percent of the bolts (more as required) to approximately 1/2 final tension to draw all plies of the connection into firm contact. Do not tighten any bolts to indicated full tension at this time.
 6. Remove drift pins and replace with bolts.
 7. Tighten all bolts to full tension. Tighten bolts progressively from fixed or rigid points to the free edges.
- E. Store the bolts and nuts in the original containers until used.
1. Protect from dirt and moisture.
 2. Remove only as many fasteners from protected storage as can be tightened during a work shift, and return unused fasteners to protected storage at the end of each work shift.
 3. Clean and re-lubricate fasteners that accumulate rust or dirt resulting from site conditions.

3.3 WELDING

- A. As specified in ANSI/AASHTO/AWS D1.5, except as modified by the contract.

- B. Field welds must meet the same requirements as shop welds, including inspection by the Department.
- C. When AISC Category III is required for the fabrication of the element, do all field welding under the fabrication certification.
- D. Comply with welding procedures and inspection requirements. UDOT Steel and Concrete Construction Manual.
- E. For surface preparation and painting, refer to Section 09972.

3.4 BEARINGS AND ANCHORAGES

- A. Do not place masonry bearing plates upon bridge seat bearing areas that are improperly finished, deformed, or irregular. Set bearing plates level in exact position with full even bearing.
- B. Locate the anchor bolts in relation to the slotted holes in expansion shoes to correspond with the temperatures at the time of erection. Adjust nut-gap on anchor bolts as shown at the expansion ends to permit free movement of the span.
- C. Form bridge seat bearing areas and place anchor bolts according to details shown.

END OF SECTION

Bolted Field Splice Certification follows.

Bolted Field Splice Certification

Consecutively number splices looking stations ahead and increasing from left to right. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done in accordance with the specifications.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all bolts are properly tightened.

Prior to the final inspection, send a completed copy of this form to the State Bridge Engineer, 4501 South 2700 West, Salt Lake City, UT 84119.

Project Number

Structure Number

Splice No.	Top Flange		Web		Bottom Flange	
	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Plates were drawn into contact with each other before final tightening of any bolts.						
Bolts are tightened to spec. (Gap under direct tension indicator is less than or equal to 0.005 inch.)						

Splice No.	Top Flange		Web		Bottom Flange	
	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Plates were drawn into contact with each other before final tightening of any bolts.						
Bolts are tightened to spec. (Gap under direct tension indicator is less than or equal to 0.005 inch.)						

Splice No.	Top Flange		Web		Bottom Flange	
	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Plates were drawn into contact with each other before final tightening of any bolts.						
Bolts are tightened to spec. (Gap under direct tension indicator is less than or equal to 0.005 inch.)						

Change One

Revised August 29, 2002
Articles Revised
1.4 A deleted
3.3 A