

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. RELATED DOCUMENTS: The drawings and the general provisions of the Contract.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK:

- A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.
- B. Structural steel is that work defined in AISC "Code of Standard Practice" and as otherwise shown on drawings.
- C. Miscellaneous Metal Fabrications are specified elsewhere in Division 5.

1.03 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges-Latest Edition."

Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the Fabricator as part of his preparation of these shop drawings."
 - 2. AISC "Specification for Structural Steel Buildings-1989" including "Commentary" and Supplements thereto as issued.

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3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connection of the Engineering Foundation.
4. AWS D1.1 - Latest Edition "Structural Welding Code" - Steel.
5. AWS D1.3 - Latest Edition "Structural Welding Code" Sheet Steel.
6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS D1.1 "Standard Qualification Procedure."

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
2. If recertification of welders is required, retesting will be the Contractor's responsibility.

C. Fabricator Qualifications: Fabricator must be a member of the American Institute of Steel Construction (AISC), be certified in Category I of the AISC Quality Certification Program, or be a member of the Structural Steel Fabricators of New England (SSFNE). Provide certification of at least one of the above.

1.04 SUBMITTALS

A. The Engineer of Record (EOR) shall receive all submittals a minimum of two weeks prior to the start of fabrication. The Contractor shall have received and approved all submittals prior to review by the Engineer. All review by the Architect, Engineer, and Contractor of submittals shall be completed prior to fabrication and installation of any material or product.

B. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
2. High-strength bolts (each type), including nuts and washers.

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3. Structural steel primer paint.

C. Shop Drawings:

1. General:

- a. Submit shop drawings prepared under the supervision of a registered professional engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams. Include details of cuts, connections, camber, holes and other pertinent data. Re-use of structural contract documents as erection or detail drawings will not be permitted.
- b. Indicate welds by standard AWS symbols, and show size, length and type of each weld.
- c. Provide setting drawings, templates and directions for installation of anchor bolts and other anchorages to be installed by others.

2. Connection Design: Submit design calculations for those connections not specifically addressed by the AISC "Manual of Steel Construction" (ASD or LRFD), prepared and stamped by a registered professional engineer.

3. Submittals: Submit (1) blue line print and (1) reproducible transparency (Sepia) of each shop drawing. Submit (2) copies of the connection calculations.

4. Shop Drawing Review: Review of the shop drawings will be made for the size and arrangement of members and the strength of connections. Conformance of the Shop Drawings to the Design Drawing Set remains the responsibility of the General Contractor. This review in no way relieves the General Contractor of this responsibility.

5. The Engineer/Architect reserve the right to make revisions during the shop drawing review. These revisions shall be incorporated into the shop drawings at no additional cost.

6. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of test conducted and test results.

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1.05 DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Structural Steel Shapes, Plates and Bars: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500, Grade B, $F_y = 46$ ksi.
- C. Steel Pipe: ASTM A 53, Grade B.
- D. Anchor Bolts:
 - 1. ASTM A 307, headed type unless otherwise indicated.
 - 2. ASTM A 325, headed type as indicated on drawings.
- E. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.
 - 1. Provide hexagonal heads and nuts for all connections.
- F. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

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1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325.
 2. Direct tension indicator washers or bolts may be used at Contractor's option.
- G. Electrodes for Welding: E70XX and comply with AWS Codes.
- H. Structural Steel Primer Paint: TNEMEC 10-99 alkyd rust inhibitive primer, 2.0 to 3.5 mils dry thickness, or approved alternate.
- I. Structural Steel Top Coat for steel permanently exposed to view: TNEMEC Series 2 TNEMEC-gloss enamel, 3.0 to 5.0 mils dry thickness, or approved equal unless otherwise noted on drawings. Approval shall be made by the owner's representative. Paint color shall comply with Architectural Specifications.
- J. Non Shrink Cement-Based Grout: See section 03300
- K. Galvanizing: ASTM A 125, Hot-Dipped.
- 2.02 FABRICATION:
- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.
1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.
- B. High-Strength Bolted Connection: Install high-strength threaded fasteners in accordance with AISC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts". Unless otherwise indicated, all bolted connections are to be tightened to the snug tight condition as defined by AISC.

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- C. Welded Construction: Comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work.

- D. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.03 SHOP PAINTING

A. General:

1. Shop paint structural steel, except those members or portions of members to be embedded in mortar or concrete.
2. Paint embedded steel which is partially exposed on exposed portions and initial 2" of embedded areas only. Do not paint surfaces which are to be welded.

- B. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose mill scale, splatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) SP-2 "Hand Tool Cleaning."

C. Painting:

1. Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions. Apply primer at a rate to provide dry film thickness given in this specification. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.
2. Structural steel exposed to weather or as otherwise indicated in drawings shall be top coated with a minimum of two coats of gloss enamel. Apply top coat to meet thickness requirements given in this specification.

PART 3 - EXECUTION

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3.01 ERECTION:

- A. General: Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- B. Surveys: Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been approved by Engineer of Record. Refer to Section 3.03 B.
- C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- D. Anchor Bolts:
 - 1. Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
- E. Setting Plates and Base Plates:
 - 1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations. Refer to division 3 of these specifications for anchor bolt installation requirements in concrete.
 - 2. Clean concrete bearing surfaces of bond-reducing materials. Clean bottom surface of setting and bearing plates.
 - 3. Set loose and attached base plates for structural members on wedges or other adjusting devices.

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4. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.

F. Field Assembly:

1. Set structural frames accurately to lines and elevations indicated.
2. Align and adjust various members forming part of complete frame or structure before permanently fastening.
3. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly.
4. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
5. Level and plumb individual members of structure within specified AISC tolerance.
6. Splice members only where indicated and accepted on shop drawings.
7. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

G. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surface.

H. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to the Engineer of Record. Finish gas-cut sections equal to a sheared appearance when permitted.

I. Paint Damage: Touch up shop applied paint whenever damaged or bare. Clean surface and touch up with shop primer noted in Section 2.01 H and top coat, if required.

3.02 QUALITY CONTROL:

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A. General:

1. Contractor is responsible for maintaining quality control in the field and for providing a structure that is in strict compliance with the contract documents.
2. Required inspection and testing services are intended to assist the Contractor in complying with the Contract Documents. These specified services, however, do not relieve the Contractor of his responsibility for compliance, nor are they intended to limit the Contractor's quality control efforts in the field.

B. Testing Agency:

1. Contractor shall engage an independent testing agency to inspect all high-strength bolted and welded connections, to perform tests and prepare reports of their findings. All connections must pass these inspections prior to the installation of subsequent work which they support.
2. Testing agency reports shall state which specific connections were examined or tested, whether the connections comply with the contract documents and what deviations, if any, were noted. Copies of these reports shall be sent to the Architect for review.
3. Contractor shall provide access for testing agency to places where structural steel work is being fabricated, produced or erected so that required inspection and testing can be accomplished.
4. Testing agency may inspect structural steel at plant before shipment. The Engineer, however, reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

C. Inspection Requirements:

1. Bolted Connections: Inspect all bolted connections in accordance with procedures outlined in the AISC "Specification for Structural Joints using ASTM A325 or A490 Bolts."

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- a. Snug Tight Connections:
 1. The inspector shall monitor the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is used to tighten all bolts.
 2. If the inspector does not monitor the installation of bolts, he shall visually inspect the connection to determine that all plies of connected material have been drawn together and conduct tests on a sampling connection bolts to determine if they have been tightened to the snug tight condition. The test sample shall consist of 10% of the bolts in the connection, but not less than two bolts, selected at random. If more than 10% of the tested bolts fail the initial inspection, the engineer reserves the right to increase the number of bolts tested.
- b. Slip Critical Connections:
 1. The inspector shall monitor the calibration of torquing equipment and the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is used to tighten all bolts.
 2. If the inspector does not monitor the calibration or installation procedures, he shall test all bolts in the affected connection using a manual torque wrench to assure that the required pretension has been reached.
2. Welding: Inspect all welded connections in accordance with the procedures outlined in AWS D1.1.
 - a. Certify welders and conduct inspections and tests as required. Record work required and performed to correct deficiencies.
 - b. Perform visual inspection of all welds. Welds deemed questionable by visual inspection, all partial and full

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penetration welds, and any other welds indicated on the drawings shall be tested by one of the following:

1. Liquid penetrant inspection: ASTM E 165.
2. Magnetic particle inspection: ASTM E 109; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".
4. Ultrasonic Inspection: ASTM E 164.

All welds deemed unacceptable shall be repaired and retested at the Contractor's expense.

- D. Nonconforming Work: Contractor shall be responsible for correcting deficiencies in structural steel work which inspections laboratory test reports have indicated to be not in compliance with requirements. Additional tests shall be performed, at the Contractor's expense, as may be necessary to show compliance of corrected work. Any costs associated with the Engineer's review and disposition of faulty work shall be borne by the Contractor.

3.03 ENGINEER'S REVIEW

- A. The Engineer of Record will conduct periodic reviews of the construction for general compliance with the provisions of the Specifications and Drawings during the construction period.
- B. The General Contractor shall employ a licensed professional engineer to analyze and design modifications and repairs for construction not in conformance with the provisions of the Contract Documents. These modifications and repair details shall be stamped by an engineer licensed to practice in the **State of Maine** and submitted with calculations for approval by the Engineer of Record. Modifications shall not be made without express written approval.

END OF SECTION