

## DIVISION 5 – METALS

### SECTION 05120 – STRUCTURAL STEEL

#### Part 1 GENERAL

##### 1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- 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.

##### 1.03 RELATED WORK

1. Section 05500 - Metal Fabrications

##### 1.04 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-March 7, 2000”.
    - a. Exclude the word “structural” in reference to the “Design Drawings” in section 3.1 of the Code.
  2. AISC “Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design”, June 1, 1989 including “Commentary” and Supplements issued thereto.
  3. AISC “Specifications for Structural Joints using ASTM A 325 or A 490 Bolts” approved by the Research Council on Structural Connections of the Engineering Foundation.
  4. AISC “Seismic Provisions for Steel Buildings”.
  5. AWS D1.1 - 2004 “Structural Welding Code” - Steel.
  6. AWS D1.3 - 2004 “Structural Welding Code” - Sheet Steel.
  7. ASTM A6 “General Requirements for Delivery of Rolled Steel Plates, Shapes,

Sheet Piling and Bars for Structural Use.”

8. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).
- 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 re-certification 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 for SBD – Conventional Steel Building Structures, STD – Standard for Steel Building Structures, or be a member of the Structural Steel Fabricators of New England (SSFNE). Provide certification of at least one of the above.

#### 1.05 SUBMITTALS

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with this section and Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner’s Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. INCOMPLETE SUBMITTALS WILL NOT BE REVIEWED.
- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Product Data: Submit producer’s or manufacturer’s specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
  1. Structural steel certified mill reports for each grade of steel covering chemical and physical properties and yield strengths.
  2. High-strength bolts (each type), including nuts and washers.
  3. Structural steel primer paint (where applicable).
  4. Structural steel top coat paint (where applicable). (Refer to Section 09900.)
  5. Welder certifications.

6. Expansion/Adhesive Anchors (coordinate with section 03300).

H. Shop Drawings:

1. Shop Drawing Review: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings.
  - a. Review of the shop drawings will be made for the size and arrangement of the members and strength of the connections. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility. Submit one print and one reproducible. Print will be reviewed and a reproducible will be returned to Contractor for printing and distribution. Multiple copies will not be marked by Engineer.
  - b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided and shall include; erection and piece drawings indicating all members, braced frames, moment frames and connections. Incomplete submittals will not be reviewed.
2. Alternate Connection Design: Connections for all beam, braced frame, and moment connections not tabulated in the AISC "Manual of Steel Construction" (ASD or LRFD) have been designed and detailed in the drawings. Alternate connection design shall be allowed only with prior approval of the Structural Engineer. If such approval is granted, all redesigned connections shall be designed by the fabricator's engineer, registered in the State of Maine. Calculations for redesigned connections shall signed and sealed.
3. 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.

1.06 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, 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. Steel materials shall be stored in a manner to avoid ponding of precipitation on members. Repair or replace damaged materials or structures as directed.

Part 2 PRODUCTS

2.01 MATERIALS:

- A. Structural Steel Shapes, Plates and Bars (U.N.O): ASTM A 36 minimum, higher strength steel is acceptable.
- B. Structural Steel Hot Rolled Wide Flange Shapes: ASTM A 992 Grade 50 (ASTM A572 Grade 50 with special requirements per AISC Technical Bulletin #3, dated March 1997)

- C. Steel Tube: ASTM A 500, Grade B,  $F_y = 46$  ksi.
- D. Steel Pipe: ASTM A 53, Grade B.
- E. Anchor Bolts: ASTM F1554, Grade 36 weldable steel, unless noted otherwise on drawings. Anchor rods that are to be exposed to weather, located in unheated enclosures, or in contact with pressure treated lumber shall be hot dipped galvanized. All anchor bolts shall be headed or double nuted. "J" or "L" type anchor bolts are not permitted.
- F. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts. Provide hexagonal heads and nuts for all connections.
- G. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
  1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325 or ASTM A490. Refer to drawings for diameter.
  2. Direct tension indicator washers or bolts may be used at Contractor's option.
  3. Provide hot-dipped galvanized fasteners at relieving angles.
- H. Electrodes for Welding: E70XX and comply with AWS Codes with proper rod to produce optimum weld joint considering material, weld position and size of joint. All filler metal used for complete penetration groove welds shall have a minimum Charpy V Notch value of 20 ft-lbs. at 40 degrees F for enclosed and heated structures and 20 ft-lbs. at 0 degrees F for all other structures. Electrodes shall be compatible with steel of both connected elements.
- I. Structural Steel Coatings shall be as specified in the Structural Steel Coatings section of this specification, and as specified in Division 9.
- J. Steel Coatings for Exterior Exposed Steel: Except where indicated to be primed and painted, Hot Dipped Galvanized per ASTM A123/A123M (latest edition). Galvanizing shall be applied in a manner to provide Class C faying surfaces for slip critical connections. See Structural Steel Coatings section for additional requirements for galvanizing and painting.
- K. Non Shrink Cement-Based Grout: See Section 03300
- L. Drilled Anchors: Expansion and adhesive by HILTI, SIMPSON or POWERS/RAWL as indicated on the drawings.

## 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. Connections: Weld or bolt shop connections, as indicated.
  - 1. Provide field bolted connections, except where welded connections or other connections are indicated.
  - 2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
- C. 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.
- D. Welded Construction: Comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work.
- E. 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.
- F. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
- G. Camber, if any, is indicated on the drawings. Camber indicated is the required camber at time of erection. Contractor shall survey camber prior to placing metal deck.

## 2.03 STRUCTURAL STEEL COATINGS

- A. Coordinate coating requirements with the Architect, and with Division 9 of the specifications.
- B. To the greatest extent possible, structural steel coatings shall be shop applied.
- C. Galvanizing, priming and painting for structural steel permanently exposed to view shall meet the requirements of Section 10 of the Code of Standard Practice, "Architecturally Exposed Structural Steel".
- D. General: Shop priming of structural steel is **generally not required**. Shop priming and/or top coat are required only for steel permanently exposed to weather and/or view, unheated steel, or as otherwise indicated on the drawings and herewithin.
- E. Steel which is to receive spray-on fireproofing shall not be primed or painted, unless specified by the Architect.
- F. Coatings: The following guidelines are provided for structural steel coatings. Final coating locations are to be coordinated by the Contractor with the Architect on the structural steel fabrication drawings.
  - 1. The followings structural steel elements shall be PRIMED ONLY, with the fabricator's standard rust inhibitive alkyd primer, Tnemec Series 10. Substitution shall be equal to the above specified products, and shall be submitted for review.
    - a. Unheated structural steel to be enclosed with architectural finishes, including all canopy members, and roof popup members.
  - 2. The following structural steel elements shall be HOT DIPPED GALVANIZED, unless noted otherwise on the drawings:

- a. Structural steel elements exposed to the weather and exterior, but not to be painted per the drawings.
  - b. All steel embedded in or supporting brick masonry and/or exposed to weather and not architecturally enclosed as referenced above.
  - c. Brick masonry loose lintels and relieving angle assemblies.
3. Steel Coatings for Embedded Steel: Steel which is embedded in concrete, below grade/slab level, or as otherwise indicated on the drawings, shall be field painted with TNEMEC FIBRETAR No 250 Coal Tar Epoxy. Paint embedded areas only. Do not paint surfaces which are to be welded until welding is complete.

H. Application:

- 1. Surface Preparation: After inspection and before shipping, clean steel work to be painted or galvanized. Remove loose mill scale, splatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) SP-2 or SP-3 "Hand Tool Cleaning," for alkyd primer, and SP-6, "Commercial Blast Cleaning", for zinc rich primer or hot dipped galvanizing, unless shown otherwise on drawings.
- 2. Painting: 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 manufacturer's specification. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces. Following proper cure times and temperatures, apply top coat in accordance with manufacturer's instructions, at a rate to provide dry film thickness specified by manufacturer.

Part 3 EXECUTION

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. Erection Procedures: Comply with "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).
- C. Surveys: Employ a Registered Land Surveyor elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect and Structural Engineer. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been approved by Structural Engineer of Record. Additional surveys required to verify out-of-alignment work and/or corrective work shall be performed at the contractor's expense.
- D. Temporary Shoring and Bracing: This is the sole responsibility of the Contractor. Provide temporary shoring and bracing members with connections of sufficient strength to support imposed loads. Remove temporary members and connections when all permanent members are in place, and all final connections are made, including the floor and roof diaphragms. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Comply with OSHA Standard referenced previous. Retain the services of a Specialty Structural Engineer (Not the Engineer of Record) to design specialty shoring and bracing.

- E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
  - 1. 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.
  - 2. Welding to anchor bolts for corrective measures is strictly prohibited without prior written approval from the Engineer.
- F. 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 the project 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.
  - 4. Pack non-shrink 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.
- G. When installing expansion bolts or adhesive anchors, the contractor shall take measures to avoid drilling or cutting any existing reinforcement or damaging adjacent concrete. Holes shall be blown clean with compressed air and/or cleaned per manufacturer's recommendations prior to the installation of anchors.
- H. Field Assembly:
  - 1. Set structural frames accurately to lines and elevations indicated.
  - 2. Align, adjust, level and plumb members of complete frame in to the tolerances indicated in the AISC Code of Standard Practice and in accordance with OSHA regulations.
  - 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. Splice members only where indicated and accepted on shop drawings.
  - 6. 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.
- I. Coat columns, base plates, and brace elements encased in concrete and/or below grade with coal tar epoxy. Coordinate coating with concrete work.
- J. Erection bolts: Remove erection bolts. On exposed welded construction fill holes with plug welds and grind smooth at exposed surface.

- K. 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 accepted by the Engineer of Record. Finish gas-cut sections equal to a sheared appearance when permitted.
- L. Paint Damage: Touch up shop applied paint or galvanizing whenever damaged or bare. Clean surface and touch up with shop primer noted and top coat, as required.
- M. Welders shall have current evidence of passing the appropriate AWS Qualifications test available in the field.
- N. Welding electrodes, welding process, minimum preheat and interpass temperatures shall be in accordance with AISC and AWS specifications. Any structural steel damaged in welding shall be replaced.
- O. Field Welded Moment Connections: Backing materials for top and bottom flanges for field welded moment connections shall be removed, backgouge the weld root, and apply a reinforcing fillet weld. Where top flange steel backing materials are utilized, the backing may be left in place and shall be welded with a continuous fillet.

### 3.02 QUALITY CONTROL:

- A. General: Contractor is responsible for maintaining quality control in the field and for providing a structure that is in strict compliance with the Contract Documents.
  - 1. 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: Owner 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.
  - 1. Testing agency shall conduct tests and state in each report which specific connections were examined or tested, whether the connections comply with requirements, and specifically state any deviations therefrom.
  - 2. 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. Testing agency may inspect structural steel at plant before shipment. The Engineer, however, reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.
- C. Inspection Requirements (to be performed by the Independent Testing Agency):
  - 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.
  - 2. Snug Tight Bolted Connections:
    - a. 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.



- b. 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.
- 3. Slip Critical Bolted Connections:
  - a. 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.
  - b. 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.
- 4. Field Welded Connections: inspect and test during fabrication of structural steel assemblies, and during erection of structural steel all welded connections in accordance with procedures outline in AWS D1.1. Record types and location of defects found in work. Record work required and performed to correct deficiencies.
  - a. Certify welders and conduct inspections and tests as required. Submit welder certifications to Engineer of Record. Perform visual inspection of all welds. Primary and secondary welds, including fillet welds, full penetration welds, and deck puddle welds, applied in the field and/or shop, shall be visually inspected.
  - b. Welds deemed questionable by visual inspection shall receive non-destructive testing. In addition, all partial and full penetration welds, and any other welds indicated on the drawings are to receive non-destructive testing. Non destructive testing methods include the following:
    - 1. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".
    - 2. Ultrasonic Inspection: ASTM E 164.
  - c. All welds deemed unacceptable shall be repaired and retested at the Contractor's expense.
- D. Testing and inspection reports shall be submitted to the Owner, Architect and Engineer within 48 hours of completion of each test or inspection.
- E. 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 and/or surveys 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 works shall be borne by the Contractor.

## SECTION 05500 - METAL FABRICATIONS

### Summary:

1. Provide metal fabrications: guardrails and other misc. metals.
2. Rough hardware.
3. Miscellaneous steel trim.
4. Tolerances: Fabrication tolerance 1/8 inch in 10 feet; erection tolerance, 1/16 inch.

### Submittals:

1. Submit product data, shop drawings.

### Products:

1. Steel Plates, Shapes and Bars: ASTM A 36.
2. Steel Tubing: ASTM A 500 or A 501.
3. Steel Pipe: ASTM A 53.
4. Steel Finish: Primed
5. Fasteners: non-corrosive, suitable for service intended.
6. Zinc-Coating: Hot-dip galvanized coating for materials in exterior assemblies or exterior walls.

### Installation:

1. Comply with requirements of Section 01000 - Project Requirements.
2. Comply with ASTM E 985 for handrail and railing structural performance.
3. Comply with AISC codes and specifications and with AWS Structural Welding Code.

END OF DIVISION 5