

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. All labor, materials and equipment necessary for the design, fabrication, delivery and erection of all structural steel including anchor bolts, plates and structural framing accessories.
- B. Anchor bolts, bearing plates, lintels and angles to be embedded into masonry or concrete shall be furnished but not installed under this section.

1.02 RELATED SECTIONS

- A. Section 03300: Cast-In-Place Concrete.
- B. Section 04200: Unit Masonry.
- C. Section 05210: Steel Joists.
- D. Section 05310: Steel Roof Deck.
- E. Section 05311: Steel Form Deck and Composite Steel Floor Deck.

1.03 REFERENCES

- A. Manual of Steel Construction Allowable Stress Design, AISC, 9th Edition.
 - 1. AISC Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design.
 - 2. AISC Code of Standard Practice.
 - 3. Specification for Structural Joints Using ASTM A325 or A490 Bolts, Research Council on Structural Connections.
- B. AWS D1.1-02 "Structural Welding Code - Steel," American Welding Society.
- C. "Systems and Specifications: Steel Structures Painting Manual," Volume 2; Steel Structures Painting Council (SSPC).
- D. "BOCA National Building Code 1999," Building Officials and Code Administrators International, Inc.
- E. ASTM A36: Structural Steel.
- F. ASTM A325: High-Strength Bolts for Structural Steel Joints.
- G. ASTM A500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- H. ASTM A 6/A 6M: General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.
- I. ASTM A307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- J. ASTM A563: Carbon and Alloy Steel Nuts.
- K. ASTM A992: Structural Steel.

- L. ASTM F4366: Hardened Steel Washers.
- M. ASTM F959: Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
- N. ASTM A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- O. ASTM A501: Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- P. ASTM A618: Hot-Formed Welded and Seamless High Strength Low-Alloy Structural Tubing.
- Q. ASTM A108: Steel Bars, Carbon, Cold Finished, Standard Quality.
- R. ASTM A123: Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
- S. ASTM A242/A 242M: High-Strength Low-Alloy Structural Steel.
- T. ASTM A441/A 441M: High-Strength Low-Alloy Structural Manganese Vanadium Steel.
- U. ASTM A490: Heat-Treated Steel Structural Bolts, 150 ksi, Minimum Tensile Strength.
- V. ASTM A572/A 572M: High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
- W. ASTM A588/A 588M: High-Strength Low Alloy Structural Steel with 50 ksi Minimum Yield Point to 4 in. thick.

1.04 SYSTEM DESCRIPTION

- A. General: Unless otherwise specifically approved in writing, furnish exact sections, weights, and kinds of material specified, using details and dimensions shown and furnish design calculations for all structural steel connections.
 - 1. Not all connections are detailed; similar details apply to similar conditions, unless otherwise indicated. Contact the Architect promptly to verify design of members or connections in any situation where design requirements are unclear.

1.05 SUBMITTALS

- A. Shop Drawings will not be reviewed until the following items have been submitted for Architect's records.
 - 1. Certification of fabrication plant's membership in AISC or Structural Steel Fabricators of New England (SSFNE).
 - 2. Description of Quality Control Program for shop fabrication which insures all work shall be done in accordance with this specification and referenced standards.
- B. Submit Certificates of Compliance as evidence of conformity with ASTM and AWS Standards specified for Architect's records.
 - 1. Provide certified laboratory or mill reports in accordance with ASTM A6 for structural steel.
 - 2. Provide manufacturer's Certificate of Compliance for high strength connection bolts, nuts and washers.
 - 3. Provide manufacturer's Certificate of Compliance for weld filler materials.
- C. Product Data: Submit manufacturer's data for products as follows, including sufficient data to show compliance with specified requirements:
 - 1. Test reports and manufacturer's installation instructions for Load Indicating bolts to be used in shop and field.
 - 2. Specifications for primer paint, including manufacturer's data on chemical composition, adhesion of spray fireproofing, and dry film thickness per applied coat.

3. Specifications for faying surface coating and certified test report.
 4. Manufacturer's data, installation instructions, and load tables for expansion anchor bolts and chemical anchor bolts.
- D. Shop Drawings: Submit complete Shop Drawings including detail drawings and erection drawings for structural steel. Include information on location, type, and size of bolts and welds, distinguishing between those made in the shop and those made in the field.
1. Indicate weld lengths and sizes, using standard AWS welding symbols.
 2. Include setting drawings and templates for anchorages to be installed as work of other sections.
 3. Indicate tightening procedure for shop and field installed bolts.
 4. Detail drawings shall indicate steel members and parts of steel members which are to receive no paint, faying surface coating, or galvanizing, as applicable.
 5. Detail drawings shall show complete details and schedules for fabrication and shop assembly of members including profiles, sizes, steel yield strengths, spacing, location, connections, fasteners and cambers.
 6. Beam and column mark numbers shall be cross referenced to the corresponding erection plan and to the column grid location.
 7. Detail drawings shall show the name of the shop paint and dry film thickness to be used.
 8. Include complete details of all prefabricated fireproofed steel columns, showing provisions for connections and hourly rating for each type.
- E. Submit design calculations for all structural steel connections simultaneously with Shop Drawing submittal. Connection design shall reference and follow Tables IA through IG and II through XXVI of AISC Manual of Steel Construction.
1. Beam reactions shall be calculated based on one half the value from the tables "Allowable Uniform Load Capacity for Beams Laterally Supported" or the reaction indicated on Contract Drawings.
 2. Connection design shall be cross referenced to actual piece marks.
 3. Coped beams shall be designed in accordance with "Engineering for Steel Construction," Appendix B.
 4. The connection design shall show all applicable checks for the type of connection, including but not limited to:
 - a. Bolt shear and bolt bearing on the web and connecting pieces, including consideration for eccentric loads.
 - b. Web shear, block shear, web bending and web bucking.
 - c. Shear and bending on the connecting piece (angle or plate).
 - d. Weld shear and bending stresses including consideration for eccentric loads.
 - e. Tension on bolt and connecting pieces.
 5. The above list is not intended to preclude any particular connection design or fabrication technique, provided said design follows AISC and AWS Standards.
 6. Connection design shall be stamped by Professional Engineer registered in the state where the project is located.
- F. The testing and inspection agency will submit test reports directly to the Architect, for all tests of connections and reports of inspection.
- G. Submit welders qualifications before any shop or field work is started.
1. Submit a list of embossing marks to identify each welder.
- H. Submit Shop Drawings and calculations in accordance with Section 01300.

1.06 QUALITY ASSURANCE

- A. Welding Procedures: Establish that joint welding procedures are prequalified or test in accordance with AWS qualification procedures.

- B. Welder Qualifications: Welders must be currently certified under American Welding Society qualification procedures. Welders shall emboss each piece of work that they produce with a mark that identifies them.
- C. Testing and Inspection Agency: The Owner will hire an independent testing and inspection agency for shop and field inspection. The independent inspector shall perform testing, inspect and evaluate connections, prepare test reports and verify conformance to this specification and referenced standards.
 - 1. Only AWS Certified Welding Inspectors shall inspect and evaluate welds.
 - 2. Correct deficiencies in the structural steel work identified by the testing and inspection agency at no additional expense to the Owner. Subsequent tests to confirm the adequacy of corrected work will be at the Contractor's expense.
- D. Field Sample: Prepare field sample as detailed and of size indicated on drawings for architecturally exposed structural steel (AESS). Upon acceptance of visual qualities by the Architect, maintain field sample exposed to view for duration of AESS work.
 - 1. Approved sample may be incorporated in the work, at the Contractor's option.

PART 2 - PRODUCTS

2.01 MATERIALS AND COMPONENTS

- A. Structural Steel Shapes: Enhanced ASTM A572, Grade 50, as per AISC Technical Bulletin No. 3.
- B. Angles, Rods, Plates and Bars: Shall conform to requirements of ASTM A-36.
- C. Anchor Bolts: ASTM F1554, with cut threads and heavy hex nuts. Provide ASTM A325, Type 1 where high strength anchor bolts are indicated.
- D. High-Strength Bolts, Nuts and Washers: ASTM A325, Type 1, with matching ASTM A563 nuts and ASTM F436 washers; except provide Type 1 galvanized bolts, nuts and washers for galvanized steel members.
- E. Welding Materials: E70 or Type required for materials being welded and conforming to applicable A.W.S. Specifications.
- F. Load Indicating Bolts: Provide snap off high-strength bolts that shall be certified to provide the minimum fastener tension per AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- G. Primer Paint: Shop prime all structural steel, except steel encased in concrete or otherwise called for. Primer shall be Gray "Combatit" Metal Primer as manufactured by Wilbur & Williams Company, or "10-1009 Gray Metal Primer" as manufactured by Tnemec.
- H. Pipe Columns: Shall meet the requirements of ASTM A-53, standard weight, ASTM A-501, extra-strong, or ASTM A-618, double extra strong, seamless, Grade B.
- I. Tube Columns: Square or rectangular HSS structural tubing columns shall meet the requirements of ASTM A-500, Grade B, FY = 46KSI.
- J. Concrete Filled Pipe Columns: Shall meet the requirements of ASTM A-501 or ASTM A-53, seamless, Grade B. The concrete shall develop a minimum compressive strength of 5,000 psi in 28 days.
- K. Fireproof Columns: Fireproof columns shall be prefabricated units consisting of load-bearing concrete filled columns or structural steel W shapes, encased in insulating material, and covered by an outer steel shell. Columns shall bear U. L. label with required hourly rating clearly marked.
- L. Expansion Bolts and Chemical Bolts:

1. In Concrete: Hilti Kwik Bolt II, or approved equal.
 2. In Solid Block: Hilti sleeve anchor, or approved equal.
 3. In Solid Brick or as Noted: Hilti Hit Renovation anchor.
- M. AESS Materials: Members which will be exposed in the finished work and have been identified as AESS on the drawings, provide only materials which are free of surface blemishes such as pitting, roller marks, rolled trade names, and surface roughness.
- N. High-Strength, Low-Alloy Corrosion Resistant Structural Steel: ASTM A242 or ASTM A588.
- O. High-Strength, Low-Alloy Structural Manganese Vanadium Steels: ASTM A441.
- P. High-Strength, Low-Alloy Columbium-Vanadium Steels: ASTM A572.
- Q. Steel Stud Shear Connectors: ASTM A108 cold-drawn bar stock and complying with requirements of ANSI/AWS D1.1.
- R. High-Strength Structural Bolts: ASTM A490, Type 1, with matching ASTM A563 nuts and ASTM F436 washers.
- S. Faying Surface Coatings: Paint used on the faying surfaces of bolted friction connections, shall be qualified by test in accordance with "Test Methods to Determine the Slip Coefficient for Coatings Used in Bolted Joints" as adopted by the Research Council on Structural Connections. Manufacturer's certification shall include a certified copy of the test report.

2.02 FABRICATION

- A. Coordination With Testing and Inspection Agency:
1. Fabricator shall submit fabrication schedule to Contractor at least 3 working days prior to beginning work.
 2. Connections shall not receive primer until inspection is completed.
 3. Fabricator shall provide access for testing and inspection agency so that specified testing and inspection can be completely and safely accomplished.
- B. Shop Assembly - General: Comply with requirements of AISC Specifications. Shop fabricate and assemble to greatest extent possible.
1. AESS: Comply with requirements of AISC Code for architecturally exposed structural steel. Appearance: Cut, fit, and assemble units with exposed surfaces smooth, square, and free from cutting marks, shear distortion, burrs, and nicks. Tolerances: As specified in AISC Code for AESS, unless more stringent requirements are indicated on the drawings.
- C. Connections:
1. Bolts: High-strength steel bolts, except as otherwise indicated:
 - a. Bolting: Comply with requirements of AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" and this Specification.
 2. Welds: Comply with requirements of AWS Code for procedures, appearances and quality of welds.
 3. Shop and field connections shall be fully tensioned bearing type "N" or welded, unless noted otherwise.
 4. Bolted moment connections shall be slip critical type and shall meet requirements set forth by referenced standards.
 - a. Slotted holes are not allowed.
 5. Holes in Steel Members: Make all holes by means of cutting, drilling, or punching at right angles to surface of metal. Do not make or enlarge holes by burning.
- D. Shear Connectors: Automatic end welding shall be in accordance with the AWS Code and manufacturer's printed instructions.

1. Fillet Welding: At Contractor's option, shear connectors to be fillet welded, following procedure specified in the AWS Code.

E. Shop Coating - Galvanizing:

1. Preparation: Thoroughly clean members to be galvanized, removing loose rust and mill scale.
2. Galvanizing: Perform galvanizing in accordance with requirements of ASTM A123 [G60][G90].
3. Galvanized faying surfaces for slip critical bolted connections shall be roughened by means of hand wire brushing. Power wire brushing is not allowed.

2.03 SHOP COATING - PAINT

A. General: Shop paint structural steel, except those members or portions of members which will be embedded in concrete or masonry.

1. Do not paint the following surfaces:
 - a. Surfaces adjacent to field welds.
 - b. Other surfaces when specifically noted on drawings or schedules.
 - c. Surfaces which are to receive sprayed-on fireproofing.

B. Preparation: Thoroughly clean steel surfaces to be shop primed, removing loose rust, loose mill scale, dirt, oil, and grease. Clean steel in accordance with SSPC-SP3: Power Tool Cleaning.

C. Painting: Apply specified primer paint at a rate sufficient to provide a finished thickness of not less than 1.5 mils and an average thickness of 2.0 mils.

2.04 SHOP QUALITY CONTROL

A. Testing and Inspection:

1. Verify that material identification markings (steel, bolts, and weld filler materials) match manufacturer's certificate of compliance submitted to the Architect.
2. Verify AWS certification of welders. Verify embossing practice.
3. Provide visual inspection of welds and bolted connections after fabrication.
4. Review fabrication procedures for general conformance with this Specification and Referenced Standards.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Temporary Support: Provide temporary guys, braces, falsework, cribbing, or other elements required to secure the steel framing against loads equal in intensity to design loads. Remove such temporary support only when permanent connections have been made and the steel framing is fully capable of supporting design loads, including any temporary construction loads.

3.02 ERECTION

A. General: Erect structural steel in compliance with AISC Code of Standard Practice.

B. Assembly: Set structural members accurately to locations and elevations indicated.

C. Columns and Bearing Surfaces:

1. Clean bearing and contact surfaces before assembly.
2. Set base plates accurately, using 1/4" thick leveling plates.

D. Welding:

1. Do not perform field welding when ambient temperature is at 0°F or below, or when surfaces are wet, exposed to rain, snow, or high wind.
 2. Perform field welding in accordance with AWS Code.
 3. Remove erection bolts used in field-welded construction.
- E. Touch-Up Painting: Immediately after inspection of structural steel, clean painted areas which have been abraded or otherwise damaged by welding or other field operations. Use touch-up paint not matching shop paint.
- F. Shear stud connectors shall be welded in strict accordance with manufacturer's instructions. Studs, deck material, and structural steel shall be clean and dry. Do not weld through more than one layer of steel deck.

3.03 FIELD QUALITY CONTROL

- A. Testing and Inspection:
1. General: Provide access to testing and inspection agency so that specified testing and inspection can be safely accomplished.
 2. Field-Bolted Connections: Comply with testing and verification procedures in AISC "Specification for Structural Joints using ASTM A325 or A490 Bolts."
 3. Field-Welded Connections: Inspect all field-fabricated welds and verify certification and embossing of welders.
 4. Review erection procedures for general conformance to this Specification and Referenced Standards.
- B. Shear Stud Inspection and Testing: Visually inspect weld fillets. A fillet of less than 360° is cause for further inspection. Such studs shall be hammer tested, bending the stud 15° from the vertical toward the closest end of the embedment plate or steel member. One stud in each 100 shall be tested by bending 15° from vertical. One stud in each 200 shall be tested by bending 30° from vertical. Bending without failure indicates a satisfactory weld. Single bent studs may be left bent. When failure occurs additional testing of 10 studs on each side of failed stud shall be done. Bend studs 30° from vertical. If failure occurs from additional testing, repeat testing of ten studs on each side of failed stud until there are no failures. If no failure occurs from additional testing, straighten all bent studs, and continue regular testing. Replace all studs that fail.

END OF SECTION

