

SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes:

- 1. Structural steel Shapes, plates and angles
- 2. Beams
- 3. Columns

- B. Related Sections: The following Sections contain requirements that relate to this Section:

- 1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
- 2. Division 5 Section "Steel Deck" for field installation of shear connectors.
- 3. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.
- 4. Division 9 Section "Painting" for surface preparation and priming requirements.
- 5. Division 13 Section "Hazardous Material Remediation" for Lead coating removals prior to cutting and welding on existing steel.

1.3 PERFORMANCE REQUIREMENTS

- A. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product Data for each type of product specified.

- C. Shop Drawings: A complete set shall include the following items. Partial submittals will not be reviewed and will be returned bearing the label "Not Approved".

- 1. Shop Drawings detailing fabrication of structural steel components.
 - a. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - b. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

2. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
3. Include design calculations sealed by a professional engineer licensed to practice in the State of Maine for all connections.
4. Certification:
 - a. Submit a letter of certification from the material fabricator sealed by a professional engineer licensed to practice in the State of Maine attesting that all shop drawings were prepared under his direct supervision.
 - b. Submit certification that field welders are AWS certified.
5. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
6. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
 - a. Edit list below to suit requirements. Add twist-off tension control bolts or other alternative design bolts, if required.
 - b. Structural steel, including chemical and physical properties.
 - c. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - d. Direct-tension indicators.
 - e. Shear stud connectors.
 - f. Shop primers.
 - g. Nonshrink grout.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
 1. Fabricator must hold current membership and be a member in good standing in either AISC or Structural Steel Fabricators of New England (SSFNE).
- C. Comply with applicable provisions of the following specifications and documents:
 1. AISC's "Code of Standard Practice.
 2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 4. AISC's "Seismic Provisions for Structural Steel Buildings."
 5. ASTM A 992/A 992M "Specifications for High-Strength Low-Allow Columbium-Vanadium Structural Steel"

6. ASTM A 307 "Specifications for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength"
 7. ASTM A 325 "Specifications for Structural Bolts, Steel Heat Treated, 120/105 ksi Minimum"
 8. ASTM A 500 "Specifications for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
 9. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 10. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 11. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.
- E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- F. Structural Steel Painting Manual: Comply with applicable provisions of the "Structural Steel Painting Manual.
- G. Structural Steel Painting Council: Comply with provisions as follows:
1. SSPC-SP3 - Power Tool Cleaning
 2. SSPC-SP6 – Commercial Blast Cleaning
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 2. 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.

1.7 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural steel W-shapes shall conform to ASTM Specification, Serial Designation A 992, as amended to date. Structural steel shapes (other than W-shapes), plates and bars shall conform to ASTM Specification for Bridges and Buildings, Serial Designation A 36, as amended to date. No secondhand materials shall be used.
- B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B ($F_y = 46$ ksi). Hot-Formed Steel
- C. Pipe: ASTM A 53, Type E or S, Grade B.
- D. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.
- E. Anchor Rods, Bolts, Nuts, and Washers: As follows:
 - 1. Unheaded Rods: ASTM A 36.
 - 2. Headed Bolts: ASTM A 307, Grade A; carbon-steel, hex-head bolts; and carbon-steel nuts.
 - 3. Headed Bolts: ASTM A 325, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
 - 4. Headed Bolts: ASTM A 490, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
 - 5. Washers: ASTM A 36.
- F. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated.
- G. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain, uncoated.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325.
 - a. Optional: Snap off tension indicating high-strength bolts certified to provide the minimum fastener tension per AISC "Specifications for Structural Joints Using ASTM A 325 or ASTM A 490"
 - 1) Finish: Plain, uncoated.
- H. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.

1. Direct-Tension Indicators: ASTM F 959, Type 490, uncoated.
 - a. Optional: Snap off tension indicating high-strength bolts certified to provide the minimum fastener tension per AISC "Specifications for Structural Joints Using ASTM A 325 or ASTM A 490"

I. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

- A. Primer: All structural steel exposed in the building shall be sandblasted and shop painted with primer paint - Fabricator's Standard Lead – and Chromate-Free, Non-Asphaltic, Rust-inhibiting Primer, except that paint shall conform to AISC specifications and shall be suitable for top coating. (At areas where structural steel is scheduled to receive a finish coat, verify compatibility of primer).

2.3 GROUT

- A. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water-reducing and plasticizing agents capable of minimum compression strength of 2,400 lbs. Non-shrink grout shall be "Eucon "N-S" (non-metallic) by the Euclid Chemical Co., "Masterflow 713" (non-metallic) by Master Builders, Five Star Grout by U.S. Grout Corp., or approved equal.

2.4 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
1. Camber structural steel members where indicated.
 2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
 3. Mark and match-mark materials for field assembly.
 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded.
- C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.

2.5 SHOP CONNECTIONS

- A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
- B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.
- D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed-on fireproofing.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
 - 1. SSPC-SP 3 "Power Tool Cleaning."
 - 2. SSPC-SP 6 "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.7 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 - 2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 - 4. Ultrasonic Inspection: ASTM E 164.
- F. In addition to visual inspection, shop-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
 - 1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 WORKMANSHIP - GENERAL

- A. Workmanship shall be equal to the best practice in modern structural shops. Material shall be clean and straight. All holes shall be accurately drilled or punched. Burning and drifting to enlarge holes will not be permitted. Holes that must be enlarged shall be reamed. Particular care shall be taken to protect all materials from injury of any kind, either in transportation, storage or erection. Material that is damaged must be replaced by perfect material or repaired in a manner approved and accepted by the Engineer. The use of drift pins will be allowed only to bring together the several parts, and they must not be driven with such force as to distort or injure the material. Material that has been distorted by drift pins will not be accepted.
- B. All shop and field welding shall be performed by certified welders in conformance with American Welding Society's "Code for Arc and Gas Welding in Building Construction."
- C. No holes shall be burned in steel members under any circumstances without express approval and instructions from the Engineer.
- D. Bolted members shall have all parts well pinned-up and firmly drawn together. Abutting joints shall be dressed or cut true and straight and fitted closely together. In compression joints,

depending upon contact bearing, the surfaces shall be truly faced so as to have even bearing after they are bolted up complete; and, when properly aligned, the several pieces forming one built-up member shall be straight and shall fit closely together. Finished members shall be free from twists, bends or open joints. Abutting joints in compression members faced for bearing shall be spliced sufficiently to hold the connecting members accurately in place. All other joints in bolted work, whether in tension or compression, shall be fully spliced.

3.3 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.4 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 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.
 - 3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Protect steel embedded in concrete or gravel with a liberal brushed coat of asphalt mastic.

3.5 FIELD CONNECTIONS

- A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
- B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- D. This project includes the removal and or preparations of lead coated surfaces, under Section 013280 "Hazardous Material Remediation" of this project manual, as required on all existing steel to facilitate the new connections. The following surfaces have been identified by a lead survey conducted by a state licensed inspector to contain lead coated surfaces.
 - 1. All existing steel members.
 - 2. The contractor shall be responsible to coordinate with section 013280 to ascertain the locations requiring removal of lead coatings to facilitate the renovations.
 - 3. The contractor shall be responsible for all requirements under 29 CFR part 1926.62. Although the lead coatings will be removed, employee exposure assessment monitoring required for work under this section is the responsibility of this section.

3.6 FIELD QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 - 4. Ultrasonic Inspection: ASTM E 164.

- F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
 2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.7 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.
- B. Finish Painting: Finish painting of steel surfaces are included in Division 9 "Painting"

END OF SECTION 05120