



## 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 structural steel and architecturally exposed structural steel.
- 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 "Metal Fabrications" for miscellaneous steel framing.
  - 3. Division 9 Section "Painting" for surface preparation and priming requirements.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Engineering Responsibility: Engage a fabricator who utilizes a qualified registered professional structural 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 detailing fabrication of structural steel components.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
  - 3. 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.
  - 4. Include computations for all connections signed and sealed by the registered structural engineer responsible for their preparation.



- D. 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.
- E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
  - 1. Structural steel, including chemical and physical properties.
  - 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
  - 3. Direct-tension indicators.
  - 4. Shear stud connectors.

## 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.
- C. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
  - 2. AISC's "Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings."
  - 3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
  - 4. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
  - 5. AISC's "Seismic Provisions for Structural Steel Buildings."
  - 6. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
  - 7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  - 8. 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.



## 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 Shapes, Plates, and Bars: As follows:
  - 1. Rolled W Shapes & Channels: ASTM A572 Grade 50 or A992.
  - 2. Plates, Bars and Angles: ASTM A36
- B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B or C.
- C. Hot-Formed Structural Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 500, Grade B or C.
- E. Anchor Rods (Bolts), Bolts, Nuts, and Washers: As follows:
  - 1. Anchor Rods (Bolts): ASTM A307, ASTM A 449 refer to plans
  - 2. Washers: ASTM A 36 (ASTM A 36M).
- F. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
- G. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.
- H. Welding Electrodes: Comply with AWS requirements.



## 2.2 PRIMER

- A. Primer: None

## 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

## 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 (ASTM A 6M) 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. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
  2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded.
- D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- E. Steel Wall Framing: Select true and straight members for fabricating steel wall framing to be attached to structural steel framing. Straighten as required to provide uniform, square, and true members in completed wall framing.
- F. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.



1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or large holes by burning. Drill holes in bearing plates.
2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

## 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. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
  1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
  2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

## 2.6 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

## 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.

### 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 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.

#### 3.3 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."
  1. Maintain erection tolerances of architecturally exposed 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.
  2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Finish sections thermally cut during erection equal to a sheared appearance.
- I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 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.
  2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
  3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

### 3.5 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.



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.

END OF SECTION 05120