

**SECTION 05 12 00  
STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

**1.3 QUALITY ASSURANCE:**

- A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Work shall be fabricated in an AISC certified Category Std fabrication plant.
- B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the Resident Engineer.

**1.4 TOLERANCES:**

Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by AISC 303, Sections 6 and 7, Code of Standard Practice for Buildings and Bridges, except as follows:

- A. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

**1.5 REGULATORY REQUIREMENTS:**

- A. AISC 360: Specification for Structural Steel Buildings
- B. AISC 303: Code of Standard Practice for Steel Buildings and Bridges.

**1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop and Erection Drawings
  - a. Shop drawings shall include complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
  - b. Include details of cuts, connections, camber, holes, and other pertinent data. 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.
- d. Dimensions required to locate structural steel for manufactured items such as mechanical equipment, electrical equipment, dock levelers, etc., shall be coordinated and provided by the General Contractor. General Contractor shall also coordinate and provide dimensions to locate structural steel for window washing supports such as davits, tie-backs, etc.

C. Certificates:

- 1. Structural steel.
- 2. Steel for all connections.
- 3. Welding materials.
- 4. Shop coat primer paint.

D. Test Reports:

- 1. Welders' qualifying tests.

E. Record Surveys.

F. Tests and Inspections:

- 1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2012 IBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
- 2. Testing Laboratory:
  - a. An inspection and testing laboratory will be selected by the Owner for testing and inspection as required by the Contract Documents. The selected laboratory shall conform to the requirements of ASTM E329 (Recommended Practice for Inspection and Testing Agencies used in Construction). Documentary evidence of such conformance shall be submitted to the Owner and the governing agency.
  - b. All materials, work, methods and equipment shall be subject to inspection at the mill, fabricating plant and at the building site. Material or workmanship not complying fully with the Contract Documents will not be accepted. The Contractor shall give the Testing Laboratory reasonable notice when ready for

- inspection and shall supply samples and test pieces and all facilities for inspection without extra charge. The Owner will assume the expense of making the tests and inspection except as otherwise specified in Division 1.
3. Cost of Testing and Inspection: Costs of testing and inspection of structural steel, except as specified hereunder and in Division 1, will be paid for by the Contractor.
    - a. All mill tests and costs of re-test of plain materials shall be at the expense of the Contractor.
    - b. Costs of tests required due to Contractor's failure to provide steel identifiable in accordance with the indicated ASTM designation shall be at the expense of the Contractor.
  4. Structural Steel Testing and Inspection:
    - a. Structural Steel: If structural steel tests are indicated as required on the structural drawings, one tension and one bend test shall be made for each size of structural shape, plate and for each tube and pipe size. Tests to be made in accordance with requirements of appropriate ASTM designations.
    - b. If structural steel tests are not indicated as required on the structural drawings, then for shapes, plates, bars, pipe and tubing, manufacturer's certified mill test reports and analysis for each heat will be acceptable for steel identifiable in accordance with indicated ASTM designation. Mill test reports shall indicate the physical and chemical properties of all structural steel used. Correlate individual heat numbers with each specified structural section.
    - c. Unidentifiable Steel:
      - 1) For  $F_y$  less than or equal to 36.0 ksi : Provide one tension and elongation test and one bend for each 5 tons or fraction thereof for each size.
      - 2) For  $F_y$  greater than 36.0 ksi : Provide one tension and elongation test and one bend or flattening for each piece.
    - d. Costs of retests and additional testing required by the use of unidentifiable steels shall be the Contractor's responsibility.
  5. Expansion Anchors: Load test as indicated on drawings.
  6. Welding Inspection:
    - a. For Moment Resisting Frame Welding inspection and testing requirements, see specification Section 05 12 24 - Welding of Moment Resisting Frames.

- b. If shop or field welding inspection is indicated on the structural drawings, all shop and field welded operations will be inspected by a qualified welding inspector employed by the Testing Laboratory. Such inspector will be a person trained and thoroughly experienced in inspection of welds. The inspector's ability to distinguish between sound and unsound welding will be reliably established
- c. The welding inspector will make a systematic record of all welds. This record shall include:
  - 1) Identification marks of welders.
  - 2) List of defective welds.
  - 3) Manner of correction of defects.
- d. The welding inspector will check the material, equipment and procedure, as well as the welds. He will also check the ability of the welder. He will furnish the Architect with a report, duly verified by him that the welding which is required to be inspected is proper, and has been done in conformity with the Contract Documents, and that he has used all means to determine the quality of the welds.
- e. All full penetration groove welds will be subject to ultrasonic testing, as per AWS D1.1, Section 6 "Inspection, Part "C", Ultrasonic Testing of Groove Welds. All defective welds shall be repaired and retested with ultrasonic equipment at the Contractor's expense.
- f. Column Flanges: An area extending 6 inches above and below point where girder flanges are attached will be inspected. Column flange edges will be inspected visually and entire area ultrasonically for lamination, plate discontinuities, and non-metallic inclusions.
- g. All partial penetration groove welds shall be tested by ultrasonic testing.
- h. When ultrasonic indications arising from the weld root be interpreted as either a weld defect or the backing strip itself, the Engineer will be notified. The Engineer may require the removal of backing strip. The backing strip will be removed at the expense of the Contractor, and if no root defect is visible the weld will be retested. If no defect is indicated on this retest, and no significant amount of base and weld metal have been removed, no further repair of welding is necessary.

If a defect is indicated, it will be repaired and retested at Contractor's expense.

- i. The ultrasonic instrumentation will be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1.
  - j. Other methods of inspection, for example, X-Ray, gamma ray, magnetic particle, or dye penetrant, may be used on welds if felt necessary by the inspection laboratory, and with the approval of the Engineer.
  - k. Base metal thicker than 1-1/2 inches, when subjected to through thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities directly behind such weld before and after joint completion.
  - l. End-welded studs shall be sampled, tested, and inspected per the requirements of the Structural Welding Code - Steel D1.1 Chapter 7, published by the American Welding Society.
  - m. Initially, all welds requiring ultrasonic testing will be tested at the rate of 100 percent in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5 percent of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25 percent. If the reject rate increases to 5 percent or more, 100 percent testing will be re-established until the rate is reduced to less than 5 percent. The percentage of rejects will be calculated for each welder independently.
  - n. A sampling of a least 40 completed welds will be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3' in length, each 12 linear inch increment of welds, 1 inch or less in thickness, will be considered as one weld. For evaluating the reject rate of continuous welds greater than 1 inch thickness, each 6 linear inches will be considered one weld.
7. High Strength Bolting Tests and Inspection:
- a. Furnish certified test reports for each lot of bolts in accordance with Section 9 of ASTM A325 and A490. Install bolts under the supervision of a qualified inspector in accordance

with Section 9, Research Council "Specifications for Structural Joints using ASTM A325 or A490 Bolts".

- b. If high strength bolting inspection is indicated or required on the structural drawings, the testing laboratory will visually inspect all high strength bolts.
- c. While the work is in progress, the Inspector shall determine that the requirements of this Specification are met in the work. The Inspector shall observe the calibration procedures and shall monitor the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is properly used to tighten all bolts.
  - 1) In addition to the requirement of the foregoing paragraph, for all connections specified to be slip critical (SC), the Inspector shall assure that the specified procedure was followed to achieve the pretension specified in the AISC. The pretension shall be verified by the inspector for these bolts.
  - 2) Bolts in connections identified as not being slip-critical nor subject to direct tension need not be inspected for bolt tension other than to ensure that the piles of the connected elements have been brought into snug contact.

**1.7 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
  - 1. AISC 360-10 Specification for Structural Steel Buildings
  - 3. AISC 303-10 Code of Standard Practice for Steel Buildings and Bridges
- C. American National Standards Institute (ANSI):
  - B18.22.1-65(R2008).....Plain Washers
  - B18.22M-81(R2000).....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
  - A6/A6M-11.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
  - A36/A36M-08.....Standard Specification for Carbon Structural Steel

- A53/A53M-10.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A123/A123M-09.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A242/A242M-04(R2009)....Standard Specification for High-Strength Low-Alloy Structural Steel
- A283/A283M-03(R2007)....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- A307-10.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A490-12.....Standard Specification for Heat-Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength
- A500/A500M-10a.....Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- A501-07.....Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- A572/A572M-07.....Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M-11.....Standard Specification for Structural Steel Shapes
- E. American Welding Society (AWS):
  - D1.1/D1.1M-10.....Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
  - Specification for Structural Joints Using ASTM A325 or A490 Bolts
- G. Military Specifications (Mil. Spec.):
  - MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing, Repair
- H. Occupational Safety and Health Administration (OSHA):
  - 29 CFR Part 1926-2001...Safety Standards for Steel Erection

**PART 2 - PRODUCTS**

**2.1 MATERIALS:**

- A. Structural Steel: ASTM A36.
- B. Structural Tubing: ASTM A500, Grade B.

- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
  - 1. High-strength bolts, including nuts and washers: ASTM A325.
  - 2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
  - 3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
- F. Zinc Coating: ASTM A123.
- G. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.
- H. Electrodes for Welding: Comply with AWS Code, E70 Series minimum. Fabricator to select proper electrodes according to weld procedures as submitted.
- I. Shop Primer:
  - 1. Type A Material: Tnemec Company, Inc., 88HS
  - 2. Type B Material: Tnemec Company, Inc., 90-97 Tneme-Zinc.
  - 3. All paints shall meet the California Air Resources Board Standards.
  - 4. Finish paint Material (uno): Tnemec Company, Inc., Series 75-Endura-Shield. Color to be selected by owner.
- J. Expansion Bolts: Hilti Fastening Systems "Kwik-Bolt Concrete Expansion Anchors" to concrete.

**PART 3 - EXECUTION**

**3.1 CONNECTIONS (SHOP AND FIELD):**

- A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than 70% of their minimum tensile strength. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

**3.2 FABRICATION:**

Fabrication in accordance with Chapter M, AISC 360. .

**3.3 SHOP PAINTING:**

- A. General: Shop paint steel with primer in accordance with AISC 303, Section 6.

- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
  - 1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
  - 2. Surfaces which will be encased in concrete.
  - 3. Surfaces which will receive sprayed on fireproofing.
  - 4. Top flange of members which will have shear connector studs applied.
- D. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication):  
Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

**3.4 ERECTION:**

- A. General: Erection in accordance with AISC 303, Section 7B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with AISC 303, Section 7

**3.5 FIELD PAINTING:**

- A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.

**3.6 SURVEY:**

Upon completion of finish bolting or welding on any part of the work, and prior to start of work by other trades that may be supported, attached, or applied to the structural steel work, submit a certified report of survey to Resident Engineer for approval. Reports shall be prepared by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS. Report shall specify that location of structural steel is acceptable for plumbness, level and alignment within specified tolerances specified in the AISC Manual.

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