

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.
- B. Section 05 31 00: Steel Decking.

1.2 DESCRIPTION OF WORK

- A. This section includes Structural Steel.

1.3 QUALITY ASSURANCE

- A. Comply with latest editions of:
 - 1. American Institute of Steel Construction (AISC) Publications:
 - a. Manual of Steel Construction ("Allowable Stress Design" or "Load and Resistance Factor Design"). (Includes "Specification for Structural Steel Buildings," "Code of Standard Practice for Steel Buildings and Bridges," "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," "LRFD Specification for Steel Hollow Structural Sections," "LRFD Specification for Single-Angle Members.")
 - b. Manual of Steel Construction, Volume II, Connections.
 - c. Hollow Structural Sections Connections Manual (includes "AISC Specification for the Design of Steel Hollow Structural Sections").
 - d. Allowable Stress Design of Simple Shear Connections, or Load and Resistance Factor Design of Simple Shear Connections.
 - 2. American Welding Society, Inc. (AWS)
 - a. AWS D1.1 "Structural Welding Code - Steel."
 - b. AWS C5.4 "Recommended Practices for Stud Welding."
 - 3. American Hot-Dip Galvanizers Association, Inc.; Zinc Institute Inc.
 - a. "Inspection Manual for Hot-Dip Galvanized Products."
 - 4. Steel Structures Painting Council (SSPC)
 - a. "Surface Preparation Specifications."
- B. Qualifications for Welding Work:
 - 1. Qualify welding processes and welding operators in accordance with AWS standards.
 - 2. Provide one of the following certifications for welders to be employed in work.
 - a. Certification of satisfactorily passing AWS qualification tests within previous 12 months to perform type of welding in work.
 - b. Work record signed by supervisor showing regular employment within previous 12 months to perform type of welding in work.

C. Qualifications for Fabricator, Detailer, and Erector:

1. Fabricator, Detailer, and Erector of structural steel shall have not less than 3 years of experience in fabrication, detailing, and erection of structural steel. Fabricators currently certified under the AISC Quality Certification Program for Structural Steel Building Fabricators are acceptable.
2. Submit written description of ability.
3. At completion of fabrication, Fabricator shall submit a Certificate of Compliance to Special Inspector and to Code Enforcement Official stating work was performed in accordance with approved Construction Documents.

1.4 SPECIAL INSPECTIONS

- A. Refer to Specification Section 01 45 29 and Schedule of Special Inspections.

1.5 MATERIAL EVALUATION/QUALITY CONTROL

- A. Contractor shall employ testing laboratory acceptable to Engineer and Architect to perform material evaluation tests.
- B. Submit testing service qualifications demonstrating experience with similar types of projects.
- C. The Registered Design Professionals (RDPs) for Structural Engineering and Architecture will visit construction site at appropriate intervals to determine if work is in general conformance with Contract Documents and specifications. Notify RDPs 48 hours before anticipated time of completion for a given section of work so they may determine if site observations are required. If site observations are required, do not conceal framing until the RDPs have had opportunity to make observations.

1.6 SUBMITTALS

- A. General: Review of submittals will be for general conformance only. Compliance with requirements for materials, fabrication, erection, and dimensioning of structural steel shall be Contractor's responsibility. Resubmitted shop drawings shall have revisions identified and dated.
- B. Connections: Submit proposed connection types and calculations for review before preparing detailed shop drawings.
- C. Shop Drawings: Submit detailed drawings showing:
 1. Reference Contract Drawing number and addendum number in each shop drawing.
 2. Shop erection details including cuts, copes, camber, connections, holes, bolts, and other pertinent information.
 3. Connection loads.
 4. Material, including ASTM designations and grades or manufacturer's data as appropriate.
 5. Welds with size, length, and type.
 6. Anchor rod locations.
 7. Location of shop-welded masonry anchors and weldable reinforcement. Coordinate with Division 4 and Masonry Contractor.
 8. Shop drawings shall be checked by detailer and noted as checked in drawings before submitting. Failure to submit checked shop drawings will be cause for their return without review.

9. If drawings are not prepared by detailer under direct control of Fabricator, Fabricator shall stamp each drawing and initial or sign stamp to certify review and approval of drawings and conformance with Fabricator's shop practice and capability.
- D. Material Data: Submit to Special Inspector and Engineer laboratory test reports and other data as required to show compliance with specifications. Submit producer's or manufacturer's specifications and installation instructions for the following products:
1. Structural steel, including certified copies of mill reports covering chemical and physical properties.
 2. High-strength bolts, including nuts and washers.
 3. Unfinished bolts and nuts.
 4. Structural steel primer paint if used.
 5. Welding electrodes.
 6. Post-installed anchors (expansion, sleeve, or chemical adhesive) if used.
- E. Bolt Certification: Submit to Special Inspector and Engineer certification that bolts, nuts, and washers furnished comply with specifications. Submit manufacturer's inspection certificates for mill tests. For fasteners to be accepted, certification numbers must appear on the product containers and correspond to identification numbers in mill test reports. Manufacturer's symbol and grade markings must appear on bolts and nuts.
- F. Field Modifications: Submit drawings showing field modifications required to correct errors in shop drawings, fabrication, or erection.
- G. LEED Submittal:
1. Recycled Content: Submit documentation that materials satisfy the requirements for recycled content as indicated in Division 1 - General Requirements. Product data shall indicate percentages, by weight, of post-consumer and pre-consumer recycled content.
 - a. Include cost for each product having a recycled content.
 2. Regional Materials: Submit documentation that materials satisfy the requirements for regional materials as indicated in Division 1 - General Requirements. Product data shall indicate location and distance from project site of material manufacturer as well as point of extraction, harvest or recovery for each raw material.
 - a. Include cost for each regional material and the percentage or fraction of weight that is considered to be regional.
 3. Low Emitting Materials: Product Data for adhesives, coatings, and sealants used on the interior of the building indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40CFR 59, Subpart D (EPA method 24). Refer to Division 1 for VOC limits and requirements.
- H. Erector's Welding Procedure Specifications: Submit welding procedure specifications for joint types detailed for field welding.

1.7 PRODUCT HANDLING

- A. Store material in horizontal position on supports above ground.
- B. Protect from weather, and keep free of dirt and debris.
- C. Handle material carefully so it is not bent or marred.
- D. Repair or replace damaged materials.

1.8 WORKMANSHIP

- A. Contractor shall be responsible for correction of work not conforming to specified requirements. Correct deficient work as directed by Architect.
- B. Remove work found to be defective. Replace with new acceptable work.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Materials shall be new and free from rust.
- B. Rolled-Steel Plates, Bars, and Angles: ASTM A 36.
- C. Rolled-Steel C and MC Shapes: ASTM A 36.
- D. Rolled-Steel W Shapes: ASTM A 992.
- E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- F. Hollow Structural Sections (HSS): ASTM A 500, Grade B or C.
- G. Unfinished Bolts, Nuts, and Washers: ASTM A 307, Grade A.
- H. High-Strength Bolts: ASTM A 325 or A 490, Type 1, plain.
- I. High-Strength Bolts, Galvanized: ASTM A 325, Type 1.
- J. Anchor Rods: ASTM F 1554, Grade 36.
- K. Threaded Rods: ASTM A 36.
- L. Nuts: ASTM A 563. Grade and finish to match bolt or rod type.
- M. Washers: ASTM F 436 (ASTM F 844 for ASTM A 307 bolts, A 36 rods, and F 1554 Grade 36 anchor rods). Finish to match bolt or rod type.
- N. Electrodes: E70 and in accordance with AWS.
- O. Headed Stud Anchors: ASTM A 108, Grades 1010 through 1020, solid fluxed and in accordance with AWS. An arc shield (ferrule) shall be used with each anchor. Size as indicated in drawings.
- P. Steel Primer Paint: For steel scheduled to receive finish paint, use primer compatible with finish paint specified in Division 9.
- Q. Hot-Dip Galvanizing: Hot-dip galvanize after fabricating in accordance with ASTM A 123. Restraighten members after galvanizing if necessary to be square and true. Items to be hot-dip galvanized are identified in drawings.
- R. Cold-Galvanizing: Zinc-rich, cathodic-acting paint. "Tneme-Zinc 90-97" by Tnemec Inc.; "ZRC Galvalite" by ZRC Worldwide; or accepted equivalent. Items to be cold-galvanized are identified in drawings for field touch up of galvanized surfaces.
- S. Below-Grade Coating: Coal-Tar Epoxy, "TNEMEC 46H-413" or accepted equivalent.
- T. Expansion Anchors: "Kwik-Bolt 3" by Hilti; "Trubolt Wedge Anchors" by ITW Ramset/Red Head; "Power-Stud" by Powers Fasteners; "Wedge-All" by Simpson/Strong-Tie; or accepted equivalent.
- U. Sleeve Anchors: "HLC Sleeve Anchor" by Hilti; "Dynabolt Sleeve Anchor" by ITW Ramset/Red Head; "Power-Bolt" by Powers Fasteners; "Sleeve-All" by Simpson/Strong-Tie; or accepted equivalent.

V. Chemical Adhesive Anchors:

1. Anchors to solid concrete, grouted CMU, solid brick, or stone:
 - a. Anchors for use when base material temperature is 0°F or greater: "HIT-Ice" by Hilti; "Epcon A7" by ITW Ramset/Red Head; "AC 100 Plus" by Powers Fasteners; "AT Acrylic-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - b. Anchors for use when base material temperature is 40°F or greater; "HIT HY 150" or "HIT HY 150 MAX" by Hilti; "Epcon C6" by ITW Ramset/Red Head; "Power-Fast" by Powers Fasteners; "ET Epoxy-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 2. Anchors to hollow masonry (brick or hollow CMU):
 - a. Anchors for use when base material temperature is 0°F or greater: "Epcon A7" by ITW Ramset/Red Head; "AC 100 Plus" by Powers Fasteners; "AT Acrylic-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - b. Anchors for use when base material temperature is 40°F or greater: "HIT HY 20" by Hilti; "Epcon C6" by ITW Ramset/Red Head; "Power-Fast" by Powers Fasteners; "ET Epoxy-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - c. Provide manufacturer's standard screen tubes for use with anchors.
- W. Weld-on Masonry Anchors: No. 317 continuous weld-on anchor rod by Heckmann Building Products for columns; No. 315 anchor rod for beams.
- X. Furnish loose masonry anchors that are to be field-attached to structural steel by others. Provide No. 316 Triangular Ties and No. 318 Web Ties, size to suit wall, by Heckmann Building Products.

2.2 FABRICATION

- A. Fabricate structural steel in strict accordance with reviewed shop drawings and referenced standards.
- B. Fabricate and assemble structural material in shop to greatest extent possible.
- C. Fit stiffeners neatly between girder flanges. Where tight fits are required to transmit bearing, mill or grind ends of stiffeners for an even bearing against flange.
- D. Provide camber as indicated in drawings. Where no camber is indicated, fabricate steel with mill camber up. Camber by mechanical means or by use of V-heats up to 1,200 degrees F maximum.
- E. Remove extension bars or runoff plates upon completing and cooling groove welds. Grind ends of welds smooth and flush with edges of abutting parts.
- F. Provide holes for securing other work to structural steel framing. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in base and bearing plates more than 3/4 inch thick.
- G. For beams to be hot-dip galvanized, predrill beam to form radius portion of copes as shown in AISC "Specification Commentary." Do not punch.
- H. Unless shown otherwise in drawings, Fabricator shall detail column splice using AISC standard details. Finish ends of column shafts for direct bearing.
- I. Finish bottom of column and weld to base plate. Use flat base plates. For base plates over 2 inches thick, press or mill both sides.

- J. Anchor Rods: Furnish anchor rods, leveling plate, or other devices necessary for setting anchoring rods required for securing structural steel to foundation, concrete, or masonry.
- K. Steel Wall Framing: Select members true and straight for fabrication of steel wall framing and lintels. Straighten as required to provide uniform, square, and true members in completed wall framing. Limit sweep to 1/8 inch for each 10 feet of length.
- L. Weld headed stud anchors with automatically timed, stud-welding equipment. Remove arc shields from studs after welding.
- M. Where headed stud anchors are to be welded to galvanized steel, the Fabricator has the following options:
 - 1. Remove galvanized coating from surfaces to receive headed stud anchors prior to welding. Touch up with cold-galvanizing paint after welding.
 - 2. Weld headed stud anchors to beams prior to galvanizing.

2.3 SHOP PAINTING

- A. Shop-paint structural steel work that will remain exposed to view in final work or where indicated in drawings. Do not paint members or portions of members to be concealed in final work, embedded in concrete or mortar, or to receive spray-on fireproofing unless noted otherwise in drawings.
- B. Do not paint the following surfaces:
 - 1. Surfaces within 2 inches of field welds.
 - 2. Top flanges of beams to receive field-installed shear connectors or weldable reinforcement. Coordinate locations with installers.
- C. Apply two coats of paint to surfaces that will be inaccessible after assembly or erection. Apply two coats to surfaces indicated to be cold-galvanized.
- D. For steel to be spray-fireproofed, clean steel to remove dirt, grease, rust, and loose mill scale in accordance with SSPC-SP3 "Power Tool Cleaning."
- E. For steel to be cold-galvanized or primed and finish-painted, clean steel to remove dirt, grease, rust, and loose mill scale in accordance with SSPC-SP6 "Commercial Blast Cleaning" unless recommended otherwise by paint manufacturer.
- F. For steel to be hot-dip galvanized, prepare steel by successive immersion in chemical baths of caustic cleaning, pickling, and flux.
- G. After surface preparation, immediately apply structural steel primer paint in accordance with manufacturer's instructions at a rate to provide uniform dry-film thickness of 2 mils. Use painting methods that will result in full coverage of joints, corners, edges, and exposed surfaces.
- H. Apply coal-tar epoxy coating to steel below slab on grade and in contact with soil or as indicated in drawings. Extend coating 1 inch into slab.

2.4 CONNECTIONS

- A. Comply with requirements of this section unless indicated otherwise in drawings.
- B. Only use connections published by AISC. Do not modify published connection details unless accepted by Engineer.

- C. Use connection dimensions and sizes complying with AISC-published recommendations and limitations.
- D. Weld or bolt shop connections.
- E. Bolt field connections wherever possible.
- F. One-sided or other eccentric connections shall be permitted if shown in drawings or if accepted by Engineer. Only AISC-published connection designs shall be used.
- G. Minimum Capacity of Beam Connections: For connections not detailed, provide connection capacity of reactions shown in drawings. If not shown, base on Load and Resistance Factor Design as follows:
 - 1. At least 50 percent of maximum total factored uniform load from Maximum Total Factored Uniform Load Tables in AISC *LRFD Manual*, Part 5, for given steel member.
 - 2. For beams and girders with shear connectors, provide connection capacity of at least 70 percent of the uniform load values unless indicated otherwise in drawings.
 - 3. Concentrated loads near supports must be added.
- H. Use AISC "Single-Plate Shear Connection" for beam connections to faces of tubes and column flanges that have a width of 6 inches or less.
- I. Use AISC "Framed Beam Connection" for beam connections to faces of tubes and column flanges that have a width greater than 6 inches and for beam-to-beam connections.
- J. Provide unfinished threaded fasteners installed snug-tight for bolted bearing connections of secondary framing members to primary members including girts, door framing systems, and roof openings.
- K. Provide high-strength fasteners for principal bolted connections unless otherwise indicated.
- L. Fabricator shall select and detail connections to properly transmit total reactions, moments, and axial forces either indicated in drawings or reasonably inferred from information provided.
- M. Provide bearing bolt (N) connections for connections unless indicated otherwise.
- N. Remove burrs that prevent solid seating of connected parts.
- O. Load indicator washers not permitted.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Examine conditions under which work shall be erected. Do not proceed until unsatisfactory conditions are corrected.

3.2 ERECTION

- A. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of a complete frame or structure before permanently fastening.
- B. Fit up connections to be field welded in compliance with AWS standard tolerances for review by the Special Inspector or Testing Agency prior to field welding.
- C. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly.

- D. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified tolerances.
- E. Contractor to field modify anchor rods and embedded structural supports incorrectly located or damaged after installation as indicated in Section 03 30 00 and tested by Testing Agency.
- F. Splice members only where shown or specified.
- G. Maintain work in stable condition during erection.
- H. Use of gas-cutting torches in field to correct fabricating errors is prohibited.
- I. Tighten bearing-bolt (N) connections to snug-tight condition.
- J. Install field connections and framing as detailed in Contract Documents and accepted shop drawings. If Contractor finds field modifications are necessary, submit documentation of proposed field modifications to Architect and Engineer for review and acceptance.

3.3 TOLERANCES

- A. Tolerances shall be within limits in AISC "Code of Standard Practice."
- B. Fabrication and mill tolerance shall be within limits in AISC "Standard Mill Practice."

3.4 TOUCH-UP PAINTING

- A. After erection is complete, touch up paint-damaged shop coats and welded areas with shop primer paint applied in accordance with manufacturer's instructions.
- B. Touch up paint-damaged galvanized surfaces and welded areas with cold-galvanizing paint applied in accordance with manufacturer's instructions.
- C. Remove weld slag before applying touch-up paint.

3.5 PROTECTION

- A. Do not use members for storage or work platforms until permanently secured.
- B. Do not exceed load capacity of members with construction loads.

3.6 WELDING TO EXISTING STEEL

- A. Clean area to be welded using mechanical grinders and solvents to remove paint, rust, and other materials.
- B. Use E7018, low hydrogen electrodes stored in ovens as prescribed by AWS. Preheat steel to be welded and maintain temperatures as prescribed by AWS.

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