

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 01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of structural steel work is shown on drawings including schedules, notes and details that show size and location of members, typical connections, and type of steel required. Furnish all labor, materials, services, equipment and appliances required in conjunction with or related to the furnishing, fabrication, delivery, and erection of all structural steel defined below. Include all supplementary parts, members and connections necessary to complete the structural steel work, regardless of whether all such items are specifically shown or specified on the drawings.
- B. Structural steel shall be defined as that work prescribed in Section 2.1 of the AISC "Code of Standard Practice for Steel Buildings and Bridges" and all steel supports for elevator guide rails and catwalks (including support members and attached structural steel shapes and plates such as hangers, toeplates, and the (grating) (checkered plate) walking surface).
- C. Miscellaneous metal fabrications, architecturally exposed structural steel, metal stairs and ladders, steel joists and joist girders, cold-formed metal framing, and metal deck are specified elsewhere in these Specifications.

1.3 ENVIRONMENTAL OBJECTIVES

- A. The Owner has established environmental goals and strategies for achieving them based upon the LEED[®] Green Building Rating System for New Construction & Major Renovations Version 2009, as developed by the U.S. Green Building Council. Refer to Division 01 Section "Sustainable Design Requirements."
- B. Manufacturer to supply documentation of level of compliance or non-compliance with the following requirements before consideration as an "acceptable manufacturer:"
 - 1. The following are mandatory requirements for the overall project:
 - a. The material(s) in the product(s) supplied should have a recycled content such that the sum of the post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 50% of the total value of the material in the project.
 - b. 20% of the product(s) supplied is extracted, processed, and manufactured regionally within a radius of 500 miles of this Project.
 - c. Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.

- C. Products that conform to requirements of the Environmental Objectives yet do not fully meet other requirements of this Section may still be considered for use at the sole discretion of the Owner and Architect.

1.4 QUALIFICATIONS

A. Fabricator:

1. The structural steel fabricator shall have not less than 10 years experience in the successful fabrication of structural steel including not less than three projects using heavy trusses.
2. The structural steel fabricator must participate in the AISC Quality Certification Program and be designated an AISC Certified Plant in Category STD, Standard for Steel Building Structures.
3. The structural steel fabricator must be registered and approved by the local building official to perform fabrication work without special inspection. Should the fabricator not be so approved, the fabricator shall reimburse the Owner for the cost of the special inspections required by the local building official.

B. Detailer:

1. The structural steel detailer shall have not less than (5) years experience in the successful detailing of structural steel similar to this project including experience in selecting or completing structural steel connection details using information found in tables in the AISC "Steel Construction Manual.
2. The structural steel detailer firm shall be certified under the Quality Procedures Program of the National Institute of Steel Detailing. The project shall be detailed by qualified structural steel detailers who are either personally certified under the National Institute of Steel Detailing as a Class I or Class II Detailer in the Structural/Miscellaneous discipline or are supervised by a detailer certified as a Class I Senior Detailer in the Structural/Miscellaneous discipline.

C. Erector:

1. The structural steel erector shall have not less than (5) years successful experience in the erection of structural steel of a similar nature to this project.
2. The structural steel erector must participate in the AISC Erector Certification Program and be designated an AISC (Advanced) Certified Steel Erector.
3. The structural steel erector shall have not less than 5 years successful experience in the erection of structural steel including not less than three projects using heavy trusses.

- A. Professional Engineer: A professional engineer who is licensed to practice engineering in the state the 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,

1. The Professional Engineer employed by the Fabricator for connection design shall be experienced in the specific area of structural steel connection design with demonstrated experience of not less than three projects of similar scope and complexity.
 2. The Professional Engineer employed by the Erector for preparation of Erection Bracing Drawings shall be experienced in the specific area of structural frame bracing during erection design with demonstrated experience of not less than three projects of similar scope and complexity
- B. Independent Testing Laboratory: Any testing laboratory retained to perform tests that are required by this specification shall meet the basic requirements of ASTM E329

1.5 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated. For codes and standards for which no specific version is referenced, the version that is referenced in the applicable building code shall govern, or, if there is no reference in the building code, the latest version of the code or standard shall govern except as otherwise noted in the AISC Steel Construction Manual, 13th edition. Certain sections in this specification contain requirements that are more restrictive and/or different than contained in the standards listed. In such cases, the requirements of this specification shall control.
1. All federal (OSHA), state and local laws that govern safety requirements for steel erection and other requirements if more stringent than the codes and standards enumerated below. OSHA requirements include regulation 29 CFR 1926, Part R, "Safety Standard for Steel Erection".
 2. AISC "Code of Standard Practice for Steel Buildings and Bridges," adopted March 18, 2005, except as noted herein.
 - a. Certain sections in this specification contain requirements that are more restrictive and/or different than contained in this standard. In such cases, the requirements of this specification shall control.
 3. ANSI/AISC 360, "Specification for Structural Steel Buildings".
 4. RCSC "Specification for Structural Joints using ASTM A325 or A490 Bolts".
 5. AISC "Steel Construction Manual", Thirteenth Edition, 2005
 6. ANSI/AISC 341, "Seismic Provisions for Structural Steel Buildings", Including "Supplement No. 1".
 7. ANSI/AWS D1.1 "Structural Welding Code - Steel.
 8. ANSI/AWS D1.8 "Structural Welding Code – Seismic Supplement"
 9. "SSPC Painting Manual", Volumes 1 and 2.

10. AASHTO "LRFD Bridge Design Specifications", U.S. Customary Units.
 11. AASHTO "LRFD Bridge Construction Specifications"
- B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Structural Welding Code - Steel". In addition, welding operators making complete-joint-penetration welds on the bottom beam flange connection to column flanges in Seismic Load Resisting Systems as designated on the drawings and that are designated as Demand Critical Welds shall be qualified in accordance with AWS D1.8, Section 5. Specialty Welding Consultant: The Fabricator shall hire a specialty welding consultant that is a registered engineer in the State of Texas and shall have a minimum of 5 years experience in weld engineering. The specialty welding consultant shall review the heavy weldments that are shown on the drawings for any stress relieving requirements there may be and to specify the welding sequence that will be required. The specialty welding consultant shall also write the Welding Procedure Specifications for the welds in those details.
- C. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field by the Owner's testing laboratory. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. The Contractor shall promptly remove and replace materials or fabricated components which do not comply.
- D. Questions about Contract Documents: The Contractor shall promptly notify the Architect/Engineer whenever design of members and connections for any portion of the structure are not clearly indicated or when other questions exist about the Contract Documents. Such questions shall be resolved prior to the submission of shop drawings.
- E. Owner's Testing Laboratory Services: Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents
- F. Surveyor: The General Contractor shall employ a qualified land surveyor to perform surveys required by this specification.

1.6 SUBMITTALS

- A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products; include laboratory test reports and other data to show compliance with specifications (including the specified standards):
1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties. For structural steel for which evidence exists that the steel may not conform to ASTM requirements, the contractor, where permitted by the engineer, shall engage the services of an independent testing laboratory to test the material according to ASTM A6 and submit certified test reports that verify conformity to ASTM standards. Tests shall be made for each 10 tons of affected material unless otherwise directed by the Engineer.
 2. High-strength bolts (each type), including nuts and washers, including certified copies of mill reports covering physical and chemical properties.
 3. Shrinkage-resistant grout.

4. Unfinished bolts and nuts.
5. Welding electrodes (each type).
6. Structural steel primer paint.
7. Inorganic or other protective paint.
8. Shear studs.
9. Direct tension indicators.
10. Forged steel clevises and turnbuckles, including certified copies of test reports verifying strength capacities in accordance with these specifications.

B. LEED Submittals

1. Recycled Content- Credit MR4.1/MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.
2. Material Proximity- Credit MR 5.1/MR 5.2: When the distance to the project site is 500 miles or less, indicate location and distance to project site of extraction, harvesting, recovery, and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

C. Shop Drawing and Erection Drawings:

1. All drawings submitted for review shall have the approved shop drawing stamp of the Design Team as part of the title block. The approved shop drawing stamp will be provided in electronic format to the successful bidder.
2. Definitions:
 - a. Shop Drawings: Drawings of the individual structural steel shipping pieces that are to be produced in the fabrication shop.
 - b. Erection Drawings: Field-installation or member-placement drawings that are prepared by the Fabricator to show the location and attachment of the individual shipping pieces.
 - c. Erection-Bracing Drawings: Drawings that are prepared by the Erector to illustrate the sequence of erection, any requirements for temporary supports and the requirements for raising, bolting, and/or welding. These drawings are in addition to and separate from the Erection Drawings.
3. Shop Drawings: Submit for review and approval shop drawings showing complete details and schedules for fabrication and assembly of structural steel members. The licensed professional engineer responsible for the design of any of the connections shown on the shop drawings shall submit a letter that is sealed attesting that the connection design engineer has reviewed the shop drawings and that the connections designed by the engineer conform to the

engineer's design. Structural steel shop drawings shall include the following minimum information:

- a. 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. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Holes, flange cuts, slots and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
 - b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
4. Erection Drawings: Submit for review and approval complete erection drawings showing field-installation and member-placing instructions for locating and attaching the individual shipping pieces.
 5. Erection-Bracing Drawings: Submit for record purposes only complete erection-bracing drawings to illustrate the sequence of erection, any requirements for temporary supports and the requirements for raising, bolting, and/or welding.
 6. Preliminary Connection Review with Steel Fabricator: The fabricator shall submit for review and approval preliminary details of proposed connections for Engineer's review not less than 14 days in advance of the start of preparation of detailed shop drawings. Proposed variations from the details shown on the drawings will be considered and such variations must have preliminary approval from the Engineer prior to the preparation of detailed shop drawings. Failure to adhere to the requirements of this section obligates the Contractor to take responsibility for any and all resulting delays in the detailing and fabrication of structural steel.
 7. The fabricator alone shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.
 8. All fabricated material and connections shall fit within architectural constraints.
 9. Structural steel members for which shop drawings have not been reviewed and approved shall not be fabricated.
 10. The omission from the shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though the shop drawings may have been reviewed and approved.
 11. Shear Connector Placement Drawing: Provide shop drawing showing proper placement (longitudinal and transverse spacing) of shear connectors on each composite beam requiring such connectors. The shop drawing shall show the proper relationship of the shear connectors to the flutes in the metal deck and the arrangement of shear connectors along the span of the composite beam. Show the method of attachment of shear connectors and proposed brand and model of equipment to be used.
- D. Calculations: The fabricator's engineer shall submit complete signed and sealed design calculations showing all information as specified in Part 2- Connections. The Engineer

reserves the right to reject all shop drawings submitted without complete design calculations.

- E. Surveys: Submit the information requested for all surveys required by this specification.
- F. Test Reports: Submit certified reports of tests required by this Specification Section. Include data on type(s) of tests conducted and test results.
- G. Qualification Data:
 - 1. Submit qualification data, including required certifications, for firms and persons specified in Article 1.4 "Qualifications" 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.
 - 2. Submit Welding Procedure Specifications (WPS) in accordance with ANSI/AWS D1.1 for all welded joints. Submit test reports showing successful passage of qualification tests for all non-prequalified WPSs.
 - 3. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests as specified in section 1.05-B. If recertification of welders is required, retesting will be at Contractor's responsibility.
 - 4. A fabricator that is registered with the local building official and is approved to perform fabrication without special inspection shall submit a certificate of compliance stating that the work was performed in accordance with the approved construction documents.
- H. Substitutions:
 - 1. Substitutions for the member sizes, type(s) of steel connection details or any other modifications proposed by the Contractor will be considered by the Architect/Engineer only under the following conditions:
 - a. That the request has been made and accepted prior to the submission of shop drawings. All substitutions shall be clearly marked and indicated on the shop drawings as a substitute.
 - b. That there is a substantial cost advantage or time advantage to the Owner; or that the proposed revision is necessary to obtain the required materials or methods at the proper times to accomplish the work in the time scheduled.
 - c. That sufficient sketches, engineering calculations, and other data have been submitted to facilitate checking by the Architect/Engineer, including cost reductions or savings in time to complete the work.
 - d. In no case shall such revisions result in additional cost to the Owner.
- I. Longspan Steel Erection Procedure: Submit a written, detailed erection procedure for the longspan steel system that has been reviewed and approved by the General Contractor, Fabricator, Steel Erector and his registered Engineer. Submit calculations and drawings prepared under the supervision of a licensed professional engineer for the final erection procedure.

1.7 PRE-CONSTRUCTION CONFERENCE

- A. At least 14 days prior to beginning structural steel erection, the Contractor shall hold a meeting to review the detailed quality control and construction requirements and to determine the procedures for producing proper structural steel construction. Also review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing and certifications.
- B. The Contractor shall require responsible representatives of every party who is concerned with the structural steel work to attend the conference, including but not limited to the following:
- Contractor's Superintendent
 - Laboratory responsible for field quality control
 - Structural Steel Detailer
 - Structural Steel Fabricator
 - Structural Steel Erector
 - Owner's and Architect's/Engineer's Representative
- C. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
- Owner's Representative
 - Architect
 - Engineer-of-Record
- D. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least 7 days prior to the scheduled date of the conference.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time so as not to delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Do not store materials on structure in a manner that might exceed allowable loads on or cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Architect/Engineer.
- D. Furnish all fuel, maintenance, and equipment required for hoisting and placement of materials under this contract.
- E. Process, pay for and maintain all permits and certificates of on-site inspection required for derricks, cranes and hoisting equipment. No derrick, crane or hoisting equipment shall be operated without a certificate of operation and a certificate of on-site inspection, as required by governing authorities.

1. In addition to the above, all hoisting equipment shall be installed, operated and maintained in accordance with all applicable regulations of authorities having jurisdiction.
2. The Contractor shall furnish street storage and sidewalk crossing permits.

1.9 JOB CONDITIONS

- A. The Contractor shall coordinate the fabrication and erection of all structural steel work with the work of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: All hot rolled steel plates, shapes, sheet piling, and bars shall be new steel conforming to ASTM A6.
- B. Structural steel shall comply with the provisions of the following ASTM Specifications as appropriate for the grades and types, and at the locations as specified on the drawings:
 1. Structural Steel Wide Flange and WT Shapes - High Strength Steel, ASTM A992. ASTM A572, Grade 50 is acceptable as a substitute for A992.
 2. Structural Steel Wide Flange and WT Shapes – High Strength Steel, ASTM A572, Grade 60.
 3. Structural Steel Wide Flange and WT Shapes – High Strength Steel, ASTM A572, Grade 65.
 4. Structural Steel Wide Flange and WT Shapes – High Strength Steel, ASTM A913, Grade 50.
 5. Structural Steel Wide Flange and WT Shapes – High Strength Steel, ASTM A913, Grade 60.
 6. Structural Steel Wide Flange and WT Shapes – High Strength Steel, ASTM A913, Grade 65.
 7. Structural Steel Wide Flange and WT Shapes – High Strength Steel, ASTM A913, Grade 70.
 8. M-Shapes, S-Shapes, and Channels - Carbon Steel, ASTM A36.
 9. M-Shapes, S-Shapes, and Channels - High Strength Steel, ASTM A572, Grade 50.
 10. Angle Shapes – Carbon Steel, ASTM A36.
 11. Angle Shapes – High Strength Steel, ASTM A529, Grade 50.
 12. Angle Shapes - High Strength Steel, ASTM A572, Grade 50.

13. Angle Shapes - High Strength Steel, ASTM A572, Grade 60.
14. Structural Steel Plates and Bars - Carbon Steel, ASTM A36.
15. Structural Steel Plates and Bars - High Strength Steel, ASTM A572, Grade 50.
16. Structural Shapes, Plates and Bars - Weathering Steel, ASTM A588 or ASTM A242.
17. Steel Pipe - ASTM A53 (Type E or S) Grade B(Fy = 35 ksi).
18. Round HSS - ASTM A500 Grade B (Fy = 42 ksi) or ASTM A501 with written approval from the engineer.
19. Round HSS – ASTM A500, Grade C (Fy = 46 ksi).
20. Square and Rectangular HSS – ASTM A500, Grade B (Fy = 46 ksi).
21. Square and Rectangular HSS – ASTM A500, Grade C (Fy = 50 ksi).
22. Round, Square, and Rectangular HSS – Weathering Steel, ASTM A847.
23. Seamless Large Diameter Pipe: API 5L X42
24. Seamless Large Diameter Pipe: API 5L X52
25. Welded Large Diameter Pipe ASTM A 500, Grade B
26. Pins - ASTM A36 and ASTM A108.
27. Pins – AISI C1030.
28. Requirements for Heavy Shapes and Plates in Welded Connections:
 - a. Structural Shapes: ASTM A6 structural shapes with a flange thickness greater than 2 inches used as members subject to primary tensile forces due to tension or flexure and spliced or connected using complete-joint penetration welds that fuse through the thickness of the member shall be supplied with Charpy V-Notch impact test results in accordance with ASTM A6, Supplementary Requirement S30, “Charpy V-Notch Impact Test for Structural Shapes: Alternate Core Location”.
 - b. Plates: Plates greater than 2 inches thick used in built-up cross sections used as members subject to primary tensile forces due to tension or flexure and spliced or connected using complete-joint penetration welds that fuse through the thickness of the member shall be supplied with Charpy V-Notch impact test results in accordance with ASTM A6, Supplementary Requirement S5, “Charpy V-Notch Impact Test”. The impact test shall comply with ASTM A673, Frequency P, and shall meet a minimum average value of 20 ft-lbs absorbed energy at +70 F.

- c. Shop Inspection: Members in designated joints shall be inspected by the fabricator prior to fabrication according to the requirements of specification section 05122 for rolled shapes or ASTM A770 for plates as applicable. The following joints are included:
 - (1) **truss knuckles**
29. Requirements for Heavy Shapes in Seismic Load Resisting Systems: Structural steel that is part of the Seismic Load Resisting System as identified on the drawings and has the following properties shall comply with the provisions of Part 1, Section 6.3 of ANSI/AISC 341.
- a. Structural Shapes: ASTM A6 shapes with flange thickness 1 ½ inch thick and thicker
 - b. Plates: 2 inches thick and thicker used in the following conditions.
 - (1) Members of built-up sections
 - (2) Connection plates where inelastic strain under seismic loading is expected as identified on the drawings.
 - (3) As the steel core of buckling-restrained braces as identified on the drawings.
30. Connection Material: Unless noted otherwise on the drawings, column stiffener plates and doubler plates at moment connections shall be the same grade of steel as the beam connecting the column (highest grade if more than one grade is used). All other connection material except as noted otherwise on the drawings including bearing plates, gusset plates, stiffener plates, filler plates, angles, etc. shall be A36 steel unless a higher or matching grade of steel with the members connected is required by strength or stiffness calculations and provided the resulting sizes are compatible with the members connected.
- C. Structural Steel Surfaces: For fabrication of work which will be exposed to view in the completed structure, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- D. Cellular and/or Castellated Beams: Specially fabricated steel beams formed by splitting a rolled-shape beam longitudinally with a wave pattern (cellular) or zig-zag pattern (castellated), separating, and re-welding the halves together to make a beam with round or hexagonal, regularly spaced holes shall be designed and fabricated in accordance with the AISC "Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, June 1, 1989" or Load and Resistance Factor Design Specification For Structural Steel Buildings, December 27, 1999". The steel used shall conform to ASTM A572-50, A529-50, or A992. Welding shall conform to the American Welding Society Specification D1.1, "Structural Welding Code – Steel".
- Subject to compliance with requirements, acceptable manufacturers include:
- SMI Steel Products, Hope, Arkansas, a division of CMC Steel Group
- E. Structural Bolts and Threaded Fasteners: Structural bolts and threaded fasteners shall comply with the following ASTM Specifications as appropriate for the types and at the locations as specified on the drawings:

1. ASTM A325 Type 1.
2. ASTM A490 Type 1.
3. ASTM A449 Type 1 to be used only for bearing type connections with a bolt diameter greater than 1 1/2".
4. Alternative Design Fasteners: Fasteners that incorporate a design feature intended to indicate a predetermined tension or torque (load indicator bolts or "twist-off" bolts) shall conform to the requirements of section 2.8 of the RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
 - a. Bolts that are manufactured to conform to ASTM A325 shall additionally conform to ASTM F1852.
 - b. Bolts that are manufactured to conform to ASTM A490 shall additionally conform to ASTM F2280.
 - c. Subject to conformance with specified requirements, acceptable manufacturers include but are not limited to:
 - (1) Nucor Fastener, A Division of Nucor Corporation, Conway, AR and St. Joe, IN.
 - (2) Lake Erie Screw Corp., Lakewood, OH.
 - (3) Vermont Fasteners Manufacturing, Swanton, VT.
 - (4) Lohr Structural Fasteners, Humble TX.
5. Threaded Round Stock:
 - a. ASTM A36.
 - b. ASTM A572 Grade 50 (to 2 inches in diameter).
 - c. ASTM A572 Grade 42 (greater than 2 inches and up to six inches in diameter).
 - d. ASTM A588 (corrosion resistant).
 - e. ASTM A354 Grade BD, 130 ksi (to 2 ½ inches in diameter).
 - f. ASTM A354 Grade BD, 115 ksi (greater than 2 ½ inches to 4 inches in diameter).
 - g. ASTM A354 Grade BC, 109 ksi (to 2 ½ inches in diameter).
 - h. ASTM A354 Grade BC, 99 ksi (greater than 2 ½ inches to 4 inches in diameter).
6. Bolts and Nuts, High Strength Bolts: Bolts and nuts for all high strength bolts shall be heavy hex head conforming to ANSI Standards B18.2.1 and B18.2.2 respectively. Nuts shall conform to ASTM A563.
7. Washers: All washers shall be circular, flat and smooth and shall conform to the requirements of Type A washers in ANSI Standard B23.1. Washers for high strength bolts shall be hardened and conform to ASTM F436. Beveled washers for American Standard Beams and channels shall be square or rectangular, shall taper in thickness (16 2/3% slope) with an average thickness of 5/16". When an outer face of a bolted part has a slope greater than 1:20 with respect to a plane normal to the bolt axis, a beveled washer shall be used. Washers to be used with A490 bolts larger than 1 inch in diameter and installed over oversized or short-slotted holes and other similar situations shall conform to ASTM F436 except with 5/16 inch minimum thickness.
8. Zinc-Coated Bolts: ASTM A325 bolts, with their nuts and washers, that are used to connect steel called for on the drawings or in the specifications as hot-dip

galvanized after fabrication shall be zinc-coated either by the hot-dip process in accordance with ASTM A153, Class C or by the mechanical deposition process in accordance with ASTM B695, Class 50, Type 1. The bolts, nuts, and washers shall all be zinc-coated using the same process and they shall be considered together as an assembly and shall be tested and shipped together as such. Comply with all the requirements of ASTM A325 and ASTM A563 as they relate to zinc-coated materials. ASTM F1852 bolts with their nuts, and washers shall be zinc-coated only by the mechanical deposition process in accordance with ASTM B695, Class 50, Type 1. Do not zinc-coat ASTM A490 bolts.

9. Atmospheric Corrosion Resistant Bolts: High strength bolts, nuts and washers connecting steel specified as ASTM A588 or A242 weathering steel shall be weather resistant Type 3 bolts and similarly treated nuts and washers.
10. Direct Tension Indicators: Compressible washer-type direct-tension indicators conforming to ASTM F959.

Subject to conformance with specified requirements, acceptable manufacturers include but are not limited to:

Applied Bolting Technology, Ludlow, VT
Turnasure, LLC. Langhorne, PA

11. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts will not be allowed.
12. New Bolts: All bolts shall be new and shall not be reused.

F. Electrodes for Welding:

1. Provide electrodes that comply with AWS D1.1, "Structural Welding Code - Steel" and that can produce welds that have a minimum Charpy V-notch toughness of 20 ft-lbs at 40° F, unless noted otherwise in these specifications or on the drawings.
2. For welds made in members and connections that are a part of the Seismic Load Resisting System as identified on the drawings, provide electrodes that comply with the provisions of ANSI/AWS D1.8, Section 6.3
3. Electrodes for various welding processes shall be as specified below:
 - a. SMAW:
 - (1) E70XX low hydrogen
 - (2) E80XX for Grade 60 & 65 Steel with CJP welds or as indicated on the drawings
 - b. SAW:
 - (1) F7X-EXXX
 - (2) E8X-EXX-XX for Grade 60 & 65 Steel with CJP welds or as indicated on the drawings
 - c. GMAW:
 - (1) ER70S-X
 - (2) ER80S-X for Grade 60 & 65 Steel with CJP welds or as indicated on the drawings
 - d. FCAW:
 - (1) E7XT-X

- (2) E8XT-X for Grade 60 & 65 Steel with CJP welds or as indicated on the drawings
4. Weathering Steel Electrodes shall conform to Table 3.3 of the ANSI/AWS D1.1 Manual.
 5. Electrodes shall be compatible with parent metal joined.
- G. Shear Connectors (Headed Studs): Shear connectors and their installation shall meet all requirements specified in Section 7, Type B of AWS D1.1 "Structural Welding Code-Steel". Sizes of shear connectors shall be as specified on the drawings.
- H. Steel Forgings: ASTM A668, Class A.
- I. Steel Forgings: ASTM A668, Class B. Ultimate strength design capacity shall meet or exceed requirements shown on the drawings.
- J. Steel Castings: ASTM A27, Grade 65-35, medium strength carbon steel.
- K. Anchor Rods:
1. All anchor rods shall conform to ASTM F 1554. unless noted otherwise on the drawings and shall be of the yield strength as specified below as appropriate for the types and at the locations as specified on the drawings:
 - a. Grade 36, additionally conforming to Supplementary Requirement S1 of ASTM F 1554 (1/4 inch to 4 inches in diameter).
 - b. Grade 55 (1/4 inch to 4 inches in diameter).(Also comply with Supplementary Requirement S1 of ASTM F1554)
 - c. Grade 105 (1/4 inch to 3 inches in diameter).
 2. Anchor rods used with ASTM A588 baseplates shall be threaded round stock conforming to ASTM A588, grade 50.
 3. Anchor rods used with galvanized baseplates shall be galvanized.
 4. Nuts: All nuts with anchor rods shall be heavy hex head conforming to ASTM A563.
 5. Washers: Unless indicated otherwise, washers for all base plates shall be in accordance with the AISC "Steel Construction Manual", Table 14-2 with holes 1/16" larger than the anchor rod diameter. Washers shall conform to ASTM A36 steel.
- L. Structural Steel Primer Paint:
1. Primer paint shall produce a class B coating on all painted faying surfaces that are a part of a slip-critical connection as noted on the drawings; surface prepared according to SSPC-SP-6 (Commercial Blast Cleaning) and shall be of the following types.
 - a. Organic zinc-rich primer utilizing either an epoxy or urethane binder with a minimum volume solids ratio of 50 percent with a minimum zinc content of 80 percent by weight in the dry film. Apply primer at a rate to

- achieve a dry film thickness of 3.0 to 4.0 mils. The primer shall comply with the AISC class B slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
- b. Ethyl Silicate Inorganic zinc-rich primer with a minimum volume solids ratio of 60 percent and with a minimum zinc content of 75 percent by weight in the dry film. The primer shall comply with the AISC class B slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
 - c. Polyamide Epoxy with a minimum volume solids ratio of 65 percent. The primer shall comply with the AISC class A slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
2. Unless noted otherwise, primer paint shall be one of the following types with the indicated surface preparation:
 - a. SSPC-Paint 25.1, Type II; zinc oxide, raw linseed oil and alkyd primer, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification.
 - b. Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification. The contractor is responsible for supplying a paint that complies with the VOC requirements of all local governing agencies.
 - c. SSPC-Paint 23 acrylic primer, surface prepared according to SSPC-SP-6 (Commercial Blast Cleaning).
 3. Hydrophobic Acrylic Polymer with dry film thickness of not less than 2.0 mils: Tnemec Series 30, "Spra-Saf EN" or Sherwin Williams, "Spraylastic Exterior Waterborn Dryfall" (SSPC-SP6 Commercial Blast Cleaning).
 4. Refer to Architect's drawings and specifications for final paint finish requirements of structural steel. Primer paint shall be compatible with final paint requirements.
- M. Non-Shrink Grout: Provide grout type(s) as specified on the drawings:
1. Non-Metallic Non-Shrink Grout: Premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents, and fluidity improving compounds. Conform to ASTM C1107. Provide the minimum strength as shown below as determined by grout cube test at 28 days:
 - a. 6,000 PSI for supporting concrete 3000 psi and less.
 - b. 8,000 PSI for supporting concrete greater than 3000 psi and less than or equal to 4000 psi.
 - c. Unless noted otherwise on the drawings, grout strength on supporting concrete greater than 4000 psi shall be 8000 psi.

Subject to conformance with specified requirements, acceptable non-shrink grouts include:

"Crystex" and "Duragrout" as manufactured by L&M Construction Chemicals, Inc.

"Sure Grip High Performance Grout," and "1107 Advantage Grout" as manufactured by Dayton-Superior Corporation.

Masterflow 555", and "Set Grout" as manufactured by BASF Construction Chemicals, MBT Protection and Repair Products.

"Five Star Grout" as manufactured by U.S. Grout Corp.

"NS Grout" as manufactured by The Euclid Chemical Company.

"CG 200 PC", Hilti, Inc.

2. High Flow, Non-Metallic Grout: Use high-flow grout where high fluidity and/or increased placing time is required and for base plates that are larger than 10 square feet. The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 18" x 36" base plate. Provide one of the following:

"Hi-Flow Grout," as manufactured by The Euclid Chemical Co.

"Masterflow 928 Grout," as manufactured by BASF Construction Chemicals., MBT Protection and Repair Products.

3. Metallic Non-Shrink Grout: Premixed, factory packaged, ferrous aggregate grout conforming to Corps of Engineers CRD-C621. Provide minimum strength of 8,000 psi at 28 days as determined by grout cube tests.

Subject to conformance with specified requirements acceptable products include:

"MasterFlow 885", as manufactured by BASF Construction Chemicals, MBT Protection and Repair Products.

"NS Metallic Grout" and "Hi-Flow Metallic Grout" as manufactured by Euclid Chemical Company.

4. Epoxy Grout: A three-part grout system consisting of a blend of epoxy resin, curing agent and specialty aggregates conforming to Corps of Engineers CRD-590.

Subject to conformance with specified requirements, acceptable products include:

"EpogROUT 758" as manufactured by L&M Construction Chemicals, Inc.

"E³-G", E³-F and "E³-HP" as manufactured by The Euclid Chemical Company.

"Sure-Grip High-Flow Epoxy Grout" as manufactured by Dayton-Superior Corporation.

"Masterflow 648" and "Masterflow MP" as manufactured by BASF Construction Chemicals, MBT Protection and Repair Products.

- N. Grating: Welded steel bar grating of the type, depth and finish noted on the drawings capable of carrying not less than the stated live load and deflecting not more than span/360 under that load.
- O. Checkered Plate: ASTM A786
- P. Hot Dip Galvanizing:
1. Scope: All structural steel items and their connections permanently exposed to exterior conditions or that are within areas of unconditioned airspace, whether specified on the drawings or not, shall be hot-dipped galvanized after fabrication unless indicated on the drawings or in Specification Section 09900 to receive a primer and/or finish coat. Such items include, but are not limited to:
 - a. Base plates and anchor rods supporting galvanized members shall also be galvanized.
 - b. Shelf angles.
 - c. Parapet wall supporting members.
 - d. Screen wall supporting members.
 - e. Window washing support members.
 - f. Embedded plates in concrete exposed to unconditioned airspace.
 - g. Garage guardrail steel and connections.
 - h. Cooling tower support steel.
 - i. Building skin support steel exposed to moisture outside the exterior waterproofing surface.
 - j. ***ADDITIONAL GALVANIZED ITEMS***

Examine the architectural and structural drawings for other items required to be hot dipped galvanized.

Zinc-coat all ASTM A325 bolts nuts, and washers used in the connection of such steel. Field welded connections shall have welds protected and the exposed portions of ASTM A490 bolts, nuts and washers shall be protected with galvanizing repair paint.
 2. Surface Preparation: All steel to be hot dip galvanized shall undergo the following surface preparation as specified by the Steel Structures Painting Council (SSPC), Volume 2.
 - a. Remove all grease, oil, grime and foreign contaminants by thorough cleaning with an alkaline or organic solvent followed by thorough rinsing in cold water.
 - b. Remove scale by pickling in diluted sulfuric or hydrochloric acid. Pickling shall be followed by a rinse in warm water and a second rinse in cold water. As an alternative to pickling, the steel may be white metal blast cleaned according to SSPC-SP-5.
 - c. Dip in a flux solution of zinc ammonia chloride followed by drying at room temperature.
 3. Zinc Coating: The zinc coating for steel shapes and plates shall conform to ASTM A123. Weight of zinc coating per square foot of surface for 1/8 inch and 3/16" thick steels shall average not less than 2.0 oz. with no individual thickness less than 1.8 oz. The coating weight shall average not less than 2.3 oz. with no individual thickness less than 2.0 oz. for 1/4" thick and heavier steel.

- Q. Galvanizing Repair Paint: Galvanizing repair paint shall be "ZRC Cold Galvanizing Compound" as manufactured by ZRC Chemical Products or a paint complying with SSPC-Paint 20.
- R. Frictionless Bearing Pads: Provide frictionless bearing pads at all beam or slab elements where expansion joints are indicated and only a single support is provided.
1. Types:
 - a. Frictionless bearing pads shall be a nominal 3/32" glass filled virgin Tetrafluoroethylene (TFE) conforming to ASTM D4745 with a 10 gauge A36 steel backing plate factory bonded with a tested epoxy performed in a heated bonding process under a controlled pressure. Provide one sliding pad tack welded to the lower supporting surface and one tack welded to the upper surface. Unless detailed otherwise on the drawings, the upper element shall be larger than the lower element on all sides by the amount of the expansion joint width shown on the drawings.
 - b. The lower frictionless bearing pads shall be a nominal 1/16" glass filled virgin Tetrafluoroethylene (TFE) conforming to ASTM D4745 with a 10 gauge A36 steel backing plate factory bonded with a tested epoxy performed in a heated bonding process under a controlled pressure. The upper frictionless bearing pad shall be a 20 gauge stainless steel sheet (RMS<20) resistance welded to a 10 gauge A36 steel backing plate. The lower sliding pad shall be tack welded to the lower supporting surface and the upper pad tack welded to the upper surface. Unless detailed otherwise on the drawings, the upper element shall be larger than the lower element on all sides by the amount of the expansion joint width shown on the drawings.
 2. Design: The pad size and design shall conform to AASHTO "LRFD Bridge Design Specifications", Section 14. Design bearing pressure under total service load shall not exceed the manufacturer's recommendation. If Neoprene is used the compressive load shall be limited to 800 psi.
 3. Corrosion Resistance: Frictionless bearing pads for exterior or exposed usage shall be manufactured for use in an exposed climate of heat, cold, moisture, and ultraviolet rays. All backing steel in an exposed or open environment shall be shop painted with a zinc rich paint or field painted with "ZRC Cold Galvanizing Compound".
 4. Acceptable Manufacturers: The following manufacturers are acceptable:
 - a. Con-Serv, Inc., Georgetown, S.C.
 - b. Seismic Energy Products, L.P., Athens, TX.

Other manufacturers will be acceptable only with Engineer approval prior to bid.

- S. Elastomeric Bearing Pads:
1. Type: All bearing pads shall be AASHTO grade chloroprene pads manufactured from 100 percent chloroprene (neoprene) as the only elastomer. The pads shall conform to the requirements of the AASHTO "LRFD Bridge Construction Specifications", Section 18. Provide pads with a durometer Shore A hardness of sixty plus or minus five.

2. Design: The design of all bearing pads shall conform to the AASHTO "LRFD Bridge Design Specifications", Section 14,.
3. Beveled Bearing Pads: Provide beveled bearing pads between non-parallel load surfaces.
4. Manufacturers: Acceptable manufacturers are listed below:
 - a. Con-Serv Inc., Georgetown, S.C.
 - b. Seismic Energy Products, L.P., Athens, TX.

Other manufacturers will be acceptable only with Engineer approval prior to bid.

T. Pot Bearings:

1. General: Provide prefabricated pot bearing assemblies at locations shown on the drawings meeting the material, fabrication, testing, and installation requirements of AASHTO "LRFD Bridge Construction Specifications", Section 18, and the dimensions and movement criteria as specified on the drawings. Each pot bearing assembly shall include all hardware required for a complete installation.
2. Design Requirements: the rotational element of all units (pot, piston, elastomer) shall be designed to provide a maximum load eccentricity of 4 percent of pot diameter under 0.01 rads of rotation. The clearance between pistons and pot shall be sufficient to permit unimpeded rotation up to 150 percent of contract requirements and simultaneous secure sealing at 150 percent of the maximum design load.
3. Finish: All exposed pot bearing steel shall be painted in the field after installation with "Z.R.C. Cold Galvanizing Paint" except for steel conforming to ASTM A588.
4. Load Test: Manufacturer shall perform a minimum of one load test on an actual pot bearing assembly proposed for use on the job. The load test shall verify the coefficient of friction, rotational capacity and load capacity and shall simulate actual anticipated range of field conditions as much as practical. The load test procedure shall be submitted for Engineer review and approval. The results of the load test shall be documented and submitted for review and approval.
5. Shop Drawings and Submittals: Submit complete shop drawings of each bearing for Engineer review and approval prior to fabrication. Submit material certificates of steel, PTFE, and neoprene.
6. Acceptable Manufacturers: Subject to conformance with specified requirements, the following manufacturers are acceptable:

Con-Serv, Inc., Georgetown, S.C.
Cosmec, Inc., Walpole MA.
Techstar, Inc., Findlay, OH.

2.2 FABRICATION

A. Shop Fabrication and Assembly:

1. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specification and as indicated on approved final shop drawings. Provide camber in structural members where indicated. Fabricator shall coordinate connection details, joint fit-up procedures, and field adjustment requirements with erector. The General Contractor shall coordinate provision of all erection bolts, lifting lugs or other devices required for erection with the fabricator and the erector and for interference with architectural finishes and constraints.
 2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 3. Clearly mark the grade of steel on each piece, distinguishable in the field from floor surfaces, for purpose of field inspection and confirmation of grade of steel.
 4. Milled surfaces of built-up sections shall be completely assembled or welded before milling.
 5. Fitted stiffeners shall be fabricated neatly between flanges, and the ends of stiffeners shall be milled or ground to secure an even bearing against abutting surfaces. All milled or ground joints shall bear throughout their contact length.
 6. Continuity plates and stiffeners placed in the webs of rolled shapes that are a part of the Seismic Load Resisting System designated on the drawings shall comply with the requirements of Part 1, paragraph 7.5 of ANSI/AISC 341.
 7. Bolted joints in the Seismic Load Resisting Systems shall have a class A faying surface unless noted otherwise and except in end-plate moment connections. The bolts shall be pre-tensioned high-strength bolts.
- B. Dimensional Tolerances: Dimensional tolerances of fabricated structural steel shall conform to Section 6.4 of the AISC Code of Standard Practice.
- C. Camber:
1. Camber of structural steel members is indicated on the drawings.
 2. Where possible, camber of beams shall be applied by a cold bend process.
 3. The local application of heat may be used to introduce or correct camber, curvature, or straightness provided the temperature of the heated area, as measured by temperature crayons or other approved means, does not exceed 1200°F.
 4. Where indicated on the drawings in a camber diagram, cantilever or double cantilever beams shall be cambered for the main span and cantilever end separately, either by a staged cold bending process or by the application of heat.
 5. Beams and trusses detailed without specified camber shall be fabricated so that after erection any natural camber due to rolling or shop fabrication is upward.
 6. Specified camber for beams shall be in accordance with the AISC "Code of Standard Practice".

7. Truss Camber Tolerances: Unless noted otherwise, the tolerance for any specified camber point shall be plus or minus 1/1600 (three-quarter inch per 100 feet) of the distance from the nearest specified support point.
- D. Splices in Structural Steel: Splicing of structural steel members in the shop or the field is prohibited without prior approval of the Engineer. Any member having a splice not shown and detailed on approved shop drawings will be rejected.
- E. Compression Joints: Ends of columns, except as otherwise noted, and other compression joints at splices and other connections as noted on the drawings which depend on contact bearing as part of the splice strength shall be finished to bear in accordance with AISC Specification M2.6 so as to provide complete true bearing in accordance with AISC Specification M4.4.
- F. Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. An unguided torch may be used provided the cut is not within 1/8 inch of the finished dimension and final removal is completed by means such as chipping or grinding to produce a smooth surface quality free of notches or jagged edges. All corners shall be smooth and rounded to a minimum 1/2" radius.
- G. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members as shown on the contract documents, and/or the final shop drawings.
 1. Provide specialty items as indicated to receive other work.
 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
- H. Lifting and Erection Devices: The fabricator shall be responsible for designing, detailing and furnishing all lifting devices and erection aids required for erection. Such devices shall be removed after erection if they interfere with architectural finish requirements.
- I. Special Fabrication Requirements for Welded Tension Splices and Moment Connections Using Complete-Joint-Penetration Groove Welds in Large Members:
 1. Scope: Requirements specified herein shall apply to all complete-joint-penetration groove welds that are fused through the thickness of a flange or plate 2 inches thick or thicker and that are subjected to tensile forces due to either direct tension or flexure in the member being connected.
 2. Material Verification: The fabricator shall verify that all special material requirements in Part II of this specification are met.
 3. Weld Sequencing: Sequence individual passes of multipass welds to minimize the restraint produced against the contraction of subsequent passes. For wide flange shape members with double bevel flanges, weld the inside flanges first, then the outside flanges, and lastly the web.
 4. Edge Preparations: Comply with the requirements of AISC Specification Section J1.6 and M2.2 for beam copes and weld access holes.
- J. Drainage Holes: Provide 1 inch diameter drainage (weep) holes in all members (trusses, girders, beams, etc.) exposed to weather where rain water could collect (at low points

and/or behind dams caused by connections, stiffener plates, etc.). Show all holes on shop drawings for review by the Engineer.

2.3 WELDING

- A. Code: All shop and field welding shall conform to all requirements in the "Structural Welding Code - Steel", ANSI/AWS D1.1, as published by the American Welding Society (AWS).
- B. Welder Certification: All shop and field welders shall be certified according to AWS procedures for the welding process and welding position used. Each welder shall be assigned an identifying symbol or mark and all shop and field welded connections containing complete or partial joint penetration welds, multi-pass fillet welds, and fillet welds greater than 5/16" shall be identified by the symbol or mark of the welder responsible for the connection.
- C. Minimum Size and Strength:
 - 1. Fillet Welds: Minimum size of fillet welds shall be as specified in Table J2.4 in AISC Specification, Chapter J.
 - 2. Partial-Penetration Groove Welds: The minimum effective throat thickness of partial-penetration groove welds shall be as specified in Table J2.1 in AISC Specification, Chapter J.
 - 3. Minimum Strength of Welded Connections: Except as specified below in "Connections" or noted otherwise on the drawings, all shop and field welds shall develop the full tensile strength of the member or element joined. All members with moment connections as indicated on the drawings shall be welded to develop the full flexural capacity of the member, unless noted otherwise on the drawings.
- D. Filler Metal Requirements: Weld metal shall be as specified in Table J2.5 in AISC Specification, Chapter J and other requirements of this specification.
- E. Welding Procedure Specification:
 - 1. All welding shall be performed in accordance with a Welding Procedure Specification (WPS) as required in AWS D1.1 and approved by the Owner's Testing Laboratory and the Architect/Engineer. The WPS variables shall be within the parameters established by the filler-metal manufacturer. Engage the services of an independent testing laboratory to provide the qualification testing required by AWS D 1.1, chapter 4, part B to qualify any non-prequalified WPS needed for the project. The testing laboratory shall prepare Welding Procedure Qualification Records (WPQR) documenting the successful qualification of each Welding Procedure Specification.
 - 2. Welding Procedure Specifications for welds designated as Demand Critical Welds shall additionally comply with the requirements of ANSI/AWS D1.8, Paragraph 6.1.
- F. Welding Procedures:

1. All welding processes shall comply with the requirements of ANSI/AWS D1.1 unless noted otherwise.
 2. Welding processes for welds that are a part of the Seismic Load Resisting System shall additionally comply with the requirements of ANSI/AWS D1.8, chapter 6.
 3. Built-up sections assembled by welding shall be free of warpage and all axes shall have true alignment.
 4. Welds not specified shall, if possible, be continuous fillet welds developing the minimum strength, as specified above, using not less than the minimum fillet welds as specified by AISC.
 5. The toughness and notch sensitivity of the steel shall be considered in the formation of all welding procedures to prevent brittle and premature fracture during fabrication and erection.
 6. Before welding is started, the fabricator shall submit for the approval of the Owner's Testing Laboratory in consultation with the Architect/Engineer, written Welding Procedure Specification for all joints to be welded. After approval, the Welding Procedure Specification shall be followed without deviation unless specific approval for change is obtained from the Owner's Testing Laboratory and the Architect/Engineer.
 7. Before welding, particular attention shall be paid to surface preparation, fit up and cleanliness of surfaces to be welded.
 8. Minimum preheat and interpass temperatures for structural steel welding shall be as specified in ANSI/AWS D1.1, except that no welding shall be performed when the ambient temperature is lower than 0 degrees F. The temperature shall be measured from the side opposite that upon which the preheat is applied.
 9. The heat, input, length of weld and sequence of weld shall be controlled to prevent distortions. The surfaces to be welded and the filler metals to be used shall be subject to inspection before any welding is performed.
 10. Welds shall be sound throughout. There shall be no crack in any weld or weld pass. Welds shall be considered sound if they conform to AWS requirements, as confirmed by non-destructive testing.
 11. Welds shall be free from overlap.
 12. Craters shall be filled to the full cross section of the welds.
 13. For high-strength low-alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.
 14. Fabricator and erector shall coordinate welding responsibility at all welded joints.
- G. Stress Relieving: All welding sequences shall be such as to reduce the residual stresses due to welding to a minimum value. If high residual stresses are present, stress relieving of joints shall be required. Welded connections shall be detailed and designed to minimize the accumulation and concentration of through-thickness strains due to weld

shrinkage. Heavy weldments that are to be reviewed for stress relieving requirements by a Specialty Welding Consultant are identified on the drawings.

2.4 BOLTING

- A. Bolt Diameter: Minimum bolt diameter shall be 3/4 inch. The difference in diameter between bolts of differing sizes used on the project shall be not less than 1/4".
- B. Connection Type: Unless noted otherwise on the drawings, all bolted connections shall be snug-tightened using high-strength bolts in standard holes (hole diameter nominally 1/16 inch greater than the nominal bolt diameter) with threads included in the shear planes. Notwithstanding, the contractor shall be responsible to adhere to provisions of AISC Specification Section J1.10, which lists circumstances under which certain connections require pretensioned high strength bolts.
- C. Oversize, Short Slotted and Long Slotted Holes: The dimensions and washer requirements of oversize, short slotted, and long slotted holes shall conform to the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- D. Fastener Tension:
 - 1. High strength bolts in snug-tightened joints shall be tightened to a snug tight condition only. Do not pretension bolts in snug-tightened joints the same as if they were in slip-critical joints. The snug-tightened condition is defined as the tightness that exists when all plies are in firm contact. This may usually be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.
 - 2. High-strength Bolts in Slip-critical and Pretensioned Joints:
 - a. High-strength bolts in slip-critical and pretensioned joints shall be tightened to achieve the minimum bolt tension as specified in the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" when all the fasteners of a joint are tight.
 - b. Any of the four methods to tighten bolts specified in the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" may be used to achieve the minimum bolt tension. The tightening procedure that uses direct tension indicator washers shall conform to the requirements of ASTM F959.
 - c. The Contractor shall cooperate with the Owner's Testing Laboratory when Arbitration Testing and Inspection is called for due to a disagreement regarding the tension in installed bolts that have been inspected according to the (Structural Laboratory Services Specification) (Testing and Inspection portion of this specification section).
- E. Washers: Washers under the bolt head and/or nut shall be used as required by the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- F. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts will not be allowed.
- G. Impact Wrenches: Properly sized and lubricated air impact wrenches with adequate air pressure shall be utilized for all bolt installation.

- H. New Bolts: All bolts shall be new and shall not be reused.

2.5 CONNECTIONS

- A. Conceptual connection details with the required member design forces are shown on the drawings for bidding purposes and are applicable to all connections not designed and completely detailed on the drawings. The conceptual details are provided only to indicate the connection type required and may not fully represent the complexity of the connection as required by the final connection design for the forces they must resist. Except as noted below, the fabricator is responsible for engaging the services of a connection specialty engineer to prepare a final connection design for submission that meets the requirements of the conceptual connection details and resists the indicated design forces. Refer to the drawings and specifications for complete requirements. By bidding this project, the fabricator acknowledges that additional connection elements may not be specifically shown in the conceptual details but may be required by the final connection design, such as stiffener plates, doubler plates, supplement/reinforcing plates or other connection material. The fabricator is responsible to include within his bid all material and labor required to conform to the intent of the conceptual details and to carry the design forces indicated, regardless of whether or not all connection elements (such as stiffener plates, doubler plates, supplement/reinforcing plates or any other connection material) required by final connection design are shown in the conceptual detail.
- B. Typical Connection details are indicated on the drawings.
- C. Design and Detailing Procedure:
1. Unless noted otherwise or specifically detailed on the drawings, end connections of beams, girders, and trusses shall be designed as flexible and the connection shall accommodate end rotations of the unrestrained beams. Restrained end connections, as indicated on the drawings, shall be designed for the combined effect of bending moment and shears induced by the rigidity of the connection. Forces to be used in the design are described below.
 2. The fabricator's licensed professional engineer shall design and submit sealed calculations documenting the design and showing details of the assembled joint with the bolts and welds required for the conditions noted below:
 - a. For each connection not otherwise completely detailed on the drawings
 - b. Where connections are of the type that would normally be selected or completed using information found in tables in the AISC "Steel Construction Manual" or related publications but where conditions are encountered on the project that do not match those assumed in the AISC Manual or other similar publication.
 3. Where connections are of the type than can be selected or completed using information found in tables in the AISC "Steel Construction Manual" or related publications, sealed calculations need not be submitted provided the project design conditions precisely match those assumed in the referenced publications. For conditions encountered on the project that do not conform to the AISC Manual or other similar publication, a complete design shall be prepared and submitted for engineer's review.
 4. The fabricator's detailer shall complete connection detailing using predesigned connections taken directly from the AISC "Steel Construction Manual" or related publications. Where connections are of the type that would normally be selected

or completed using information found in tables in the AISC "Steel Construction Manual" or related publications but where conditions are encountered on the project that do not match those assumed in the AISC Manual or other similar publication, the fabricator shall retain a profession engineer, licensed in the jurisdiction the project is located, to design and submit sealed calculations documenting the design and showing details of the assembled joint with the bolts and welds required.

5. The fabricator, his detailer and supervising engineer shall coordinate all connection requirements with the erector. The fabricator is responsible to detail connections that contain the adjustability and all other requirements that allow the erector to erect the structural steel in conformance to all specified tolerances. The fabricator shall be responsible for providing adjustability in all connections between exterior-cladding systems, skylights, and other architectural features and the supporting structural steel as required in achieving the specified tolerances for the architectural feature as specified in the contract documents.
 6. The fabricator's licensed professional engineer shall seal all design calculations.
 7. The Engineer reserves the right to reject all shop drawings submitted without complete design calculations if required. Failure to adhere to the requirements of this section obligates the Contractor to take responsibility for any and all resulting delays in the detailing and fabrication of structural steel.
- D. Design Intent: It is the intention of the plans and specifications that shop connections be welded or bolted and that field connections be bolted, unless detailed otherwise on the drawings.
- E. Preliminary Connection Review: The fabricator shall submit preliminary details of proposed typical connections for Engineer review not less than 14 days prior to the start of preparation of detailed shop drawings. Proposed variations from the details shown on the drawings will be considered and such variations must obtain preliminary approval from the Engineer prior to preparation of detailed shop drawings.
- F. Flexible (Simple) Beam Connections:
1. All typical beam simple connections shall conform to requirements of the AISC specifications. Refer to the drawings for typical connection types.
 2. Seated Beam Connections and Stiffened Seated Beam Connections shall not be used unless indicated on the drawings or unless Engineer approval is obtained to verify capacity of supporting member for the resulting eccentricity. The fabricator must verify and bear responsibility that the use of such connections does not interfere with architectural or MEP requirements.
 3. Simple Beam Connection Capacity: Support a factored load reaction R equal to the reaction shown on the plans. Contact the Engineer if no reaction for a beam is shown on the plan. Each connection shall contain not less than the minimum number of bolts shown in the AISC connection tables for each beam size.
- G. Restrained (Moment) Connections:
1. Refer to the drawings for Moment Connection Details.

2. Design Reactions for Moment Connected Beams: Shear connections for moment-connected beams shall be designed for the factored reaction shown on the drawings.
 3. Design and Furnishing of Reinforcement in Moment Connected Joints: As part of the design responsibility outlined above, the fabricator shall design and furnish all additional reinforcement in moment connected joints to resist the specified design forces unless otherwise specifically detailed on the drawings. Column sections shall be investigated for web shear, web yielding, web buckling, and tension. Stiffeners and/or doubler plates shall be furnished as required by the AISC Specification Section K1.
- H. Tightening of Bolts in Welded Moment Connections. At moment connections where beams are complete-joint penetration welded directly to columns or girders in the field, welds shall be made after installation of erection bolts to draw the pieces together and before the final shear connection bolts are tightened. Where loose moment plates are used, such plates shall be groove welded to columns prior to connecting these plates to the beams.
- I. The geometry and welding process for complete-joint-penetration-welded-moment connections in Seismic Load Resisting Systems shall comply with the requirements of ANSI/AWS D1.8, chapter 6 and the groove welds of those connections are Demand Critical Welds.
- J. Column Splices:
1. Compression Splice: Unless indicated otherwise on the drawings all column splices shall be either a bolted compression splice using high strength snug-tightened bolts or a welded compression splice. Splice and filler plate sizes, thicknesses, and number of fasteners or weld information shall be as shown in Table 14-3 of AISC "Steel Construction Manual". It shall be the fabricator's responsibility to examine the architectural drawings to verify that splice plates and fasteners do not violate architectural finish requirements.
 2. A complete-joint penetration welded column splice for a column that is a part of the Seismic Load Resisting System is a Demand Critical Weld.
 3. Remove weld tabs from complete-joint-penetration-weld column splices in Seismic Load Resisting Systems.
 4. Bearing and Fit-Up of Column Compression Joints: All column splices, except those that are direct welded with complete-joint penetration welds, shall be considered as a compression joint as defined herein unless noted otherwise on the drawings.
- K. Base Plates and Bearing Plates:
1. Finish: All baseplates and bearing plates shall be finished in accordance with AISC Specification M2.8.
 2. Attachment to Column: Unless shown otherwise on the drawings, all baseplates and bearing plates shall be welded all around to the column with minimum fillet welds as specified in AISC Specification Table J2.4.

3. A complete-joint penetration weld that joins a column that is a part of the Seismic Load Resisting System to a base is a Demand Critical Weld.
 4. Anchor Rod Holes in Baseplates: Hole sizes in baseplates for anchor rods shall be made oversized as described in the AISC "Steel Construction Manual", Table 14-2.
- L. Trusses:
1. Truss Geometry: Chord and web lines shown on truss elevations represent the centroid of the truss member unless detailed otherwise.
 2. Design Forces: Truss connections shall be designed for the forces indicated on the drawings, but not less than 30 percent of the effective tensile strength of the member except in cases where there is only a compression force noted. In that case the connection design force shall be not less than 50 percent of the effective compression strength of the member.
 3. Net Area: Tension members in bolted trusses have been proportioned based on yielding in the gross section. Therefore, connections removing more than $(1 - (.9F_y / .75F_u))$ of the gross member area at any cross section shall have steel plates welded to the member cross section and extended along the member length to develop the tensile strength of the plate in order to replace material removed so that the member does not fail by fracture of the net section. The responsibility for the design and furnishing of these plates shall rest with the fabricator.
 4. Preassembly of Trusses: Trusses shall be preassembled in the shop to verify proper fit-up of connections.
- M. Hangers and Braces:
1. Connections for all hangers and braces shall have connections designed to develop the factored axial force shown on the drawings. Contact the Engineer if no force for a member is shown on the drawings.
 2. Compression members composed of two or more rolled shapes separated from one another by intermittent fillers shall be connected to one another at such fillers at intervals (not to exceed 48") so that the slenderness ratio l/r of either shape, between the fasteners, does not exceed 75% of the governing slenderness ratio of the built-up member. The least radius of gyration, r , shall be used in computing the slenderness ratio of each component part.
- N. Stiffeners: Provide stiffeners finished to bear under load concentrations where shown on the drawings.
- O. Steel Shelf Angles: Shelf angles supporting veneer shown on the drawings to be continuous shall be furnished to a maximum length of 25'-0". Provide a 1/4" gap at each joint. The gap shall not be welded. The distance from the joint to the first supporting bolt shall not exceed 40% of the bolt spacing. Shelf angles shall be continuous around corners with corner joint complete-joint penetration welded.
- P. Limitations on Use of A307 Bolts: ASTM A307 bolts shall not be used in any permanent steel-to-steel or concrete-to-steel connection.

- Q. Bolts in Combination with Welds: Bolts shall not be considered as sharing the load in combination with welds, except as allowed in AISC Specification Section J1.8.

2.6 SURFACE PREPARATION AND SHOP PRIME PAINTING

- A. Specification: Surface preparation, paint, and painting practices shall conform to the "SSPC Painting Manual", Volumes 1 and 2.

- B. Scope: All steel shall remain unpainted, except the following:

1. Shop paint surfaces that are to remain exposed to view in the final construction.
2. Shop paint any steel other than weathering steel that, in the final construction, will not be in a controlled environment and is therefore subject to moisture or high humidity infiltration and that has not been specified to be galvanized.
3. Shop paint any steel that is shown on the drawings to receive a finished paint system as defined in Specification Section 09 90 00.
4. Coordinate all shop painting of structural steel with Architect's painting requirements as specified on the architectural drawings and in the specifications. The Fabricator shall be responsible for determining all painting requirements (which surfaces are to be painted or left unpainted) on the project prior to fabrication.

- C. Additional Painting Requirements

1. Extend shop paint to 2" from location of welds on surfaces that are to be field welded.
2. All unpainted mating surfaces of all elements that are welded together into an assembly that is permanently exposed to the exterior shall be seal welded in addition to structural welding requirements.
3. If individual elements (including the mating surfaces) of an assembly that is required to be painted are painted prior to welding into an assembly, then all painted surfaces affected by welding shall be touched-up and repaired (according to manufacturer's instructions, if any) to prevent corrosion bleeding.
4. The fabricator shall be responsible to ensure that all elements of all assemblies that are to be painted are fabricated so that no exposed surface shall be subject to stains due to corrosion bleeding during the warranty period of the paint.
5. Structural steel elements that are bolted with slip-critical joints and are required on the drawings to be painted shall have all faying surfaces (including all surfaces of filler plates, member end supplement plates and welds) painted to comply with the specified slip-critical coating requirement.

- D. Surface Preparation - Unpainted Steel: All structural steel that is not specified to receive a shop coat of primer paint shall be prepared in accordance with Society for Protective Coatings specifications as follows:

1. SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning" unless otherwise specified.

2. SSPC-SP 6, "Commercial Blast Cleaning" shall be applied to the faying surfaces of connections that are noted on the drawings as slip-critical connections requiring a Class B surface. Apply this surface preparation to the area surrounding all bolt holes including the area up to 2" outside the outer-most holes.
- E. Surface Preparation and Primer Paint - Shop Painted Steel:
1. Surface Preparation: Prepare the surface of all structural steel specified to be shop painted as required by the paint manufacturer or the Society for Protective Coatings specifications, but not less than the following:
 - a. SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning" unless otherwise specified.
 - b. SSPC-SP 6, "Commercial Blast Cleaning" shall be applied to the faying surfaces (including filler and member-end supplement plates, if any) of connections that are noted on the drawings as requiring a slip-critical coating. At a minimum, apply this surface preparation to the area between and surrounding all bolt holes including the area up to 2" outside the outer-most holes.
 2. Priming: Immediately after surface preparation, apply primer to all structural steel specified to be shop primed in strict accordance with manufacturer's instructions and the Society for Protective Coatings specifications. Apply paint at a rate to conform to the manufacturer's written instructions and 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, welds, and all exposed surfaces. Apply two coats to surfaces that are inaccessible after assembly or erection. Change the color of the second coat to distinguish it from the first coat.
 3. Finish Coat: Coordinate shop primer paint requirements with architectural drawings and specifications. The primer selected must be compatible with any specified finish coat.
- F. Shop Touch-Up Painting: The Fabricator shall provide for cleaning and touch-up painting of welds, bolted connections (including nuts, bolts, washers, filler plates, member end supplement plates and welds, if any), and abraded areas. Prior to shipment, apply paint to exposed areas using same materials and surface preparation as used for shop painting. Paint shall be applied by brush or spray with minimum dry film thickness of 1.5 mils.

PART 3 - EXECUTION

3.1 ERECTION

- A. The Erection work shall comply with the requirements of AISC Specification Section M4.
- B. Inspection: Erector shall examine areas and conditions under which structural steel work is to be installed and notify the Contractor and the Architect/Engineer in writing of conditions detrimental to proper and timely completion of the work.
- C. Surveys: The following surveys shall be performed.
 1. Initial Survey: Check elevations of concrete and masonry bearing surfaces and anchor bolt locations prior to erection and submit any discrepancies to the

Engineer prior to the start of erection. Corrections or compensating adjustments to the structural steel shall be made and approved prior to the start of erection.

2. Intermediate Survey: Measure and submit elevations of column splices at every 4th floor. Do not proceed with erection until after discrepancies are reported and compensated for by instructions from the Engineer and the surveyor submits a report certifying compliance with specified tolerances.
 3. Final Survey: Upon completion of erection of the steel frame, and before the start of work by other trades that may be supported, attached, or applied to the frame, a final survey shall be made and a report submitted certifying compliance with specified tolerances.
- D. Erection Tolerances: Erection tolerances of anchor rods, embedded items, and all structural steel shall conform to the AISC Code of Standard Practice, Section 7, unless stricter tolerances are specified elsewhere in the contract documents.
- E. Temporary Shoring and Bracing:
1. The lateral-load resisting or stability-providing system and connecting diaphragms are identified on the drawings. Comply with the provisions of the Code of Standard Practice regarding stability of the structure during the erection process, except where stricter requirements are noted herein.
 2. The Erector shall design and provide all required temporary shoring and bracing to hold structural framing securely in position and to safely withstand all loads as specified in the Code of Standard Practice and ASCE 37 unless larger loads are required by the local building code or specified herein. Provide all bracing, any additional structural members, and increase member sizes and/or connections shown on the drawings as required to accommodate the erection loads, methods, sequence of erection, and equipment until the lateral-load resisting or stability-providing system is completely installed. Clearly show all temporary supports and modifications to designed members on the Shop Drawings and the Erection-bracing Drawings. A qualified licensed professional engineer, hired by the Erector, shall design the temporary shoring and bracing and shall seal the erection-bracing drawings.
 3. Where architectural or MEP requirements do not allow for any temporary supports, members, erection devices, or connections to be left in place permanently or where such items affect the final structural behavior, they shall be removed by the erector. All costs associated therewith shall be included in the bid price.
 4. Erection Bracing for Composite Frame: Erection of the bare steel frame shall not proceed more than 12 floors above the point where concrete is poured around the composite columns steel core nor 6 floors above the point where concrete is poured on the metal deck floors. Bracing required to maintain frame stability until concrete is poured around the composite columns steel core is shown on the drawings.
 5. Erection of Longspan Steel
 - a. Longspan steel is defined as custom-fabricated steel with spans that are greater than 100 feet.

- b. Refer to the Structural Drawings for an approved steel erection sequence. A detailed written erection procedure that has been reviewed and approved by the Steel Erector and the General Contractor shall be submitted for review and approval by the Engineer-of-Record.
 - c. Design, provide all material for, and construct all erection towers as required to erect the longspan steel system.
 - d. An alternate erection procedure may be proposed by the contractor as a substitution under the Division 01 specifications. The contractor shall hire a registered professional engineer to do a complete structural analysis of the longspan system to ensure strength and stability requirements are met during all stages of the erection. Calculations prepared under the supervision of the registered professional engineer showing the size and stability checks of the longspan system shall be submitted for review and approval by the Engineer-of-Record. Detailed shop drawings prepared under the supervision of the registered professional engineer of all necessary hardware and any reinforcing of the longspan system shall be submitted for review and approval by the Engineer-of-Record.
- F. Wherever the erection equipment is supported by the structure, the Contractor shall be responsible for the retention of a licensed professional engineer to determine the adequacy of the member supporting the erection equipment in relation to the loads imposed thereon. The Contractor shall submit to the Architect/Engineer, for review, the loads that will be imposed by the erection equipment on the building structure. Where the imposed load exceeds the allowable strength, the Contractor shall be responsible for any additional materials, supports, bracing, connections and similar measures required to support the imposed load of the equipment while in use, subject to review by the Architect/Engineer.
- G. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work. Furnish 1/8" minimum steel templates for presetting bolts and other anchors to accurate locations. Tighten anchor rods 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. Use only steel wedges or shims.
- H. Base Plates and Bearing Plates: Remove loose latent material from bearing surfaces and base and bearing plates. Set plates to the elevation indicated on the drawings and level using steel shims (plastic shims will not be allowed) or by three leveling screws with weldments at the plate edges. After all protruding plates have been trimmed, grout plates solidly between bearing surfaces using the specified grout, ensuring no voids are present. Finish exposed surfaces, protect installed materials, and allow to wet cure. For proprietary grout materials, comply with manufacturer's instructions. The Contractor shall provide a qualified manufacturer's representative to provide field supervision for installation of grout. Tighten anchor bolts after supported members have been positioned and plumbed.
- I. Splices: Splices will be permitted only where indicated on the contract drawings and approved shop drawings. Fastenings of splices of compression members shall be done after the abutting surfaces have been brought completely into contact within AISC tolerances. Bearing surfaces and surfaces that will be in permanent contact are to be cleaned before the members are assembled.
- J. Cellular and/or Castellated Beams: The handling and erection of cellular and/or castellated beams shall be in accordance with the manufacturer's recommendations and the applicable rules of OSHA.

- K. Field Assembly of Structural Steel:
1. As erection of the steel progresses, the work shall be fastened securely to safely carry all dead load, wind and erection forces. Particular care shall be exercised to ensure straightness and tautness of bracing immediately upon raising a steel column.
 2. Provide temporary planking and working platforms as necessary to effectively complete work.
 3. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified AISC tolerances. The Contractor shall coordinate with Erector and Fabricator regarding possible discrepancies in member lengths between temperature at time of fabrication and temperatures during erection, and shall make necessary adjustments to ensure plumbness within AISC tolerances at 70°F. Compensate for cumulative welding draw, construction loadings, sequential applications of dead loads, or any other predictable conditions that could cause distortions to exceed tolerance limitations.
 4. On welded construction exposed to view or weather, remove erection bolts, fill holes with plug welds or filler and grind smooth at exposed surfaces.
 5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces receiving field welds.
 6. Comply with all bolting and welding requirements of Part 2 of this specification section.
- L. Protected Zones of Seismic Load Resisting Systems: Where a protected zone of any member of a seismic load resisting system is designated on the drawings, the provisions of Part 1, paragraph 7.4 of the ANSI/AISC 341 shall apply.
- M. Field Modifications to Structural Steel: Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and structural fitting of parts shall be reported immediately to the Architect/Engineer, and approval of the method of correction shall be obtained. Approved corrections shall be made at no additional cost to the Owner. Do not use cutting torches, reamers, or other devices in the field for unauthorized correction of fabrication errors.
- N. Miscellaneous Framing: Provide supplemental structural steel support framing for metal deck where columns, or other framing members or floor openings interrupt normal deck bearing whether shown or not on the architectural, mechanical, or structural drawings.
- O. Removal of Erection Aids and Devices: The erector shall remove all erection aids and devices that interfere with architectural finish or MEP requirements.
- P. Field Touch-Up Painting:

1. Clean field welds, unpainted areas of bolted connections (including all exposed areas of nuts, bolts, washers, filler plates, member end supplement plates, and welds), and any shop painted areas that are abraded. Apply paint to all exposed areas using same material and surface preparation as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.
2. Clean field welds, ungalvanized areas of bolted connections (including all exposed areas of nuts, bolts, washers, filler plates, member end supplement plates, and welds), and any galvanized areas that are abraded. Prepare surfaces and apply specified galvanizing repair paint in accordance with ASTM A780.
3. The Contractor shall ensure that, at the substantial completion of the project, all structural steel, bolted and/or welded, required to be painted shall have all necessary steel surfaces painted (including touch-up painting as required) to prevent corrosion bleeding.

Q. Shear Connector Installation:

1. Composite Beams:

- a. Studs shall be welded in the field (not the shop) using automatically timed stud welding equipment.
- b. The top flange of the beams must be unpainted and free of heavy rust, mill scale, dirt, sand or other foreign material which will interfere with the welding operation.
- c. The metal deck must be free of dirt, sand, oil, or other foreign material and must be dry and free of moisture. Metal deck must rest tightly on the beam flange. Welding must take place through only one thickness of deck.
- d. Stud Spacing: Studs shall be spaced on beams and girders as shown on the drawings.

2. Steel Plates Embedded in Concrete:

- a. Studs shall be welded using automatically timed stud welding equipment.
- b. Plates must be unpainted and free of heavy rust, mill scale, dirt, sand or other foreign material that will interfere with the welding operation.

R. Crane Runways: Install runways complete with columns, girders, beams, bracing, rails, crane stops and other required items. Set and adjust gauge, alignment and elevation of crane rails to tolerances of Association of Iron and Steel Engineers (AISE) Standard No. 13, "Specifications for the Design and Construction of Mill Buildings", unless otherwise indicated. Stagger joint locations in opposite rails. Do not locate joints in rails over crane girder joints.

S. Clean Up: Clean up all debris caused by the Work of this Section, keeping the premises neat and clean at all times.

3.2 QUALITY ASSURANCE TESTING AND INSPECTION DURING CONSTRUCTION

A. See Testing Laboratory Services section, 01 45 29, of these Specifications for structural steel materials and welding and bolting inspection and test requirements..

END OF SECTION 05 12 00

SECTION 05 21 00- STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

- A. Extent of steel joists is shown on drawings, including basic layout and type of joists required.
- B. Quantity of joists required shall be determined from the contract drawings.

1.3 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

Qualifications:

- A. The steel joist manufacturer shall be a firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance for a minimum of 2 years.
- B. The steel joist manufacturer must show evidence of compliance with the submittal, testing, and inspection requirements of the Steel Joist Institute (SJI) Standard Specifications for verification of design and manufacturing.
- C. Design and Manufacturing: Provide joists designed and manufactured in compliance with the following, and as herein specified.
 - 1. Steel Joist Institute (SJI) Standard Specifications, Load Tables and Weight Tables for K and LH/DLH Series Steel Joists and Joist Girders, latest edition.
 - 2. Recommended Code of Standard Practice for Steel Joists and Joist Girders, latest edition.
 - 3. SJI Technical Digest #8 "Welding of Open Web Steel Joists"
 - 4. Comply with all OSHA requirements.
- D. Load Test of Joists: Full scale load tests of joists are required for the project as specified herein.
 - 1. Frequency of Testing: Load tests shall be performed on one joist out of every 200 or fraction thereof up to a maximum of 5 tests for the project. The joists series to be tested shall be indicated by the Engineer-of-Record on the approved shop drawings. Actual joists to be tested shall be selected on a random basis by the Owner's Testing Laboratory from joists fabricated for this project.

2. Test Load Procedure:

- a. First, the joist shall be loaded to design load in 25% increments and deflection measurements at midspan shall be taken.
- b. Secondly, the joist shall be loaded to 1.2 times the dead load (including self weight) plus 1.60 times the design live load and the midspan deflection measurement taken while the load is still in place.
- c. All test loads shall then be removed and the final deflection measured.
- d. All test loads shall be applied to the joists either uniformly or at panel points. In no case shall the test load be applied in a manner that would cause overload in any of the members.
- e. The weight of the steel joist and any weight applied by the test apparatus itself shall be included in the total test load.
- f. The top and bottom chords of the joist shall be laterally supported in accordance with the SJI specifications or as shown otherwise on the contract drawings.

3. Acceptance Criteria: The load test shall be considered successful if the following criteria are satisfied:

- a. No evidence of failure has occurred in any member, connection, splice, or bearing seat.
- b. The permanent deflection immediately upon removal of all test load shall not exceed 20% of the deflection under full test loading.

4. Failure of Load Test:

- a. Final decision as to passage or failure of any load test shall rest solely with the Engineer-of-Record.
- b. The Owner reserves the right, at no cost penalty, to reject usage of the joist manufacturer's product if any load test has failed.
- c. The Owner reserves the right to perform further inspections of any or all joists proposed to be used on the project at his own cost.
- d. All repair costs required by the Engineer-of-Record to be implemented on joists proposed for use on the project in order to bring them in compliance with this specification shall be borne by the joist manufacturer.
- e. One additional successful load test shall be performed if requested by the Owner for each test that fails, at no additional cost to the Owner.

5. Joists Used in Load Test: Joist used in any load test shall not be utilized in the project.

E. Qualification of Field Welding: Qualify field welding processes and welding operators in accordance with American Welding Society (AWS) qualification procedure.

1.4 SUBMITTALS

- A. Qualification Data: Submit evidence of compliance with the requirements listed in section 1.03 A and B.
- B. Shop Drawings:

1. Submit detailed drawings showing layout of joist units, connections, jointing and accessories. Include length, camber, mark, number, type, location and spacing of joists and bridging. Submit details for member splices.
 2. Provide templates or location drawings for installation of anchorage devices and bearing plates in other construction materials.
- C. Design Calculations: Submit design calculations for all joists showing complete geometry and member sizes, including web and chord member splices to verify compliance with these specifications, contract drawings, and SJI specifications. Calculations shall be signed and sealed by a licensed engineer in the state where the project is located.
- D. Mill Certificates: Submit mill reports for the structural steel used in the joists and for the bolts certifying compliance with specified requirements.
- E. Certificate of Compliance: Submit certificate of compliance to Architect and Building Official certifying that manufacturing work was done in accordance with approved construction documents and with SJI Standard Specifications.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. Deliver, store and handle steel joists as recommended in SJI specifications. Handle and store these in a manner to avoid deforming members and to avoid excessive stresses.
- 1.6 SHOP INSPECTION
- A. The manufacturer's quality assurance inspector shall inspect joists before shipment to insure compliance of materials and workmanship with the documents specified in this specification. Repair any defects found prior to shipment of the joists.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI specifications for chord and web members
- B. Steel Bearing Plates: ASTM A 36
- C. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular hexagon type, low carbon steel.
- D. High-Strength Threaded Fasteners: ASTM A 325 heavy hexagon structural bolts with nuts and hardened washers.
- E. Steel Prime Paint: Comply with SJI specifications.
- F. Welding Electrodes: Comply with AWS standards.

2.2 FABRICATION

- A. General: Fabricate steel joists in accordance with all documents listed in "Quality Assurance", except as noted below.

- B. Splices in Chord Members: All splices shall be designed and provided in accordance with SJI Specifications. The splices in each of the two angles or bars of all members shall not be at the same location, but shall be staggered a minimum of 6 inches.
- C. Holes in Chord Members: Provide holes in chord members where shown in contract drawings for securing other work to steel joists; however, deduct area of holes from the area of chord when calculating strength of member.
- D. Joists shall be cambered for dead loads: Provide all joists with SJI standard camber unless specified otherwise on the drawings. Review the Structural Drawings and Specifications for information concerning dead loads for joists requiring other than standard camber. Joist camber must be shown on shop drawings submitted for review. Not showing camber information on shop drawings shall be cause for rejection of shop drawings.
- E. Joist Bearing: Provide minimum end bearing of joists as required by SJI specifications but subject to requirements below: Provide sloped shoes if joist slope exceeds $\frac{1}{4}$ inch per 12 inches (1:48).
 - 1. Joists Less than 60-Foot Span:
 - a. If two joists do not abut each other at a support, provide required joist bearing centered on the supporting member unless detailed otherwise on the drawings.
 - b. If two joists abut each other at a support and sufficient minimum bearing for each joist exists, provide $\frac{1}{4}$ " space between joist ends centered over the support unless detailed otherwise on the drawings.
 - c. If two joists abut each other at a support and sufficient minimum bearing for each joist does not exist at the support, offset the ends of each joist and center joist bearing on the center of the support.
 - d.
 - 2. Joists Greater than or Equal to 60-Foot Span: All joists having a span greater than or equal to sixty feet must have required minimum bearing centered over the support. Joists abutting each other at a support must be offset at the bearing end to satisfy this requirement.
- F. Top Chord Extensions and Extended Ends: Provide top chord extensions and extended ends on joists where shown in contract drawings complying with the requirements of SJI specification and load tables.
- G. Ceiling Extensions: Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit, to suit manufacturer's standards, of sufficient strength to support ceiling construction. Extend ends to within $\frac{1}{2}$ " of finished wall surface unless otherwise indicated.
- H. Bridging: Provide horizontal and/or diagonal type bridging for all joists, complying with SJI specifications at a minimum.
 - 1. Examine the drawings carefully for special bridging requirements such as may be required to resist net uplift forces as shown on the drawings or to provide special bracing.
 - 2. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

- I. End Anchorage: Provide end anchorages to secure joists to adjacent construction, complying with SJI specifications, unless otherwise indicated.
- J. Header Units: Any situation requiring heading of joists not shown on the structural drawings shall be referred to engineer for framing.
- K. Shop Painting: Remove loose scale, heavy rust, grease, oil and other foreign materials from fabricated joists and accessories by rotary wire brushes and/or solvents before application of shop paint.

Apply one shop coat of primer paint to steel joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 0.50 mil.

PART 3 - EXECUTION

3.1 ERECTION

- A. Place and secure steel joists strictly in accordance with SJI code of standard practice, SJI specifications, final shop drawings, and as herein specified.
- B. Bearing Plates: Furnish steel bearing plates to be built into concrete and masonry construction.
 - 1. Refer to Division-03 sections for installation of plates set in concrete.
 - 2. Refer to Division-04 sections for installation of plates set in masonry.
- C. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.
 - 1. Comply with SJI specifications regarding required bridging, connections, and anchors to ensure lateral stability during construction. Remove as required for architectural, structural, and mechanical clearances after erection.
 - 2. Where members support joists from both sides and the supporting width does not meet the SJI recommendations for bearing lengths of both joists, the joists shall be offset to provide recommended bearing lengths. Such offsets shall be subject to approval by the Architect/Engineer.
- D. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

3.2 ANCHORING JOISTS

- A. Anchor steel joists to supporting steel framework with welds, bolts, or a combination of the two in accordance with SJI specifications for type of joists used. Joists on column lines shall be field bolted with high-strength threaded fasteners installed snug tight.
- B. Joists where shown with bottom chord extensions shall not have the bottom chords connected to the supporting members until the full dead load is applied.

- C. Anchor joists resting on masonry or concrete to steel bearing plates embedded therein with welds, bolts, or a combination of the two in accordance with SJI specifications for type of joists used.
- D. Touch-Up Painting: After joist installation, paint field bolt heads and nuts, welded areas, and abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

3.3 ATTACHMENTS TO JOISTS

- A. The Contractor shall ensure that no cuts or holes are made in the members of the erected joists for attachment of ceiling, ducts, pipes, or any other items not specifically shown in the contract drawings. Use of power driven fasteners in the diagonal and bottom chord members of the joists is prohibited.
- B. The Contractor shall not hang any elements from the top or bottom chords of joists except ceiling, ducts, pipes or other items specifically shown on the Contract Documents, without the written authorization of the Engineer.
 - 1. All pipes, ducts, and other mechanical, electrical, and plumbing equipment suspended from the joists' top or bottom chord and producing hanger loads exceeding 60 pounds shall have the hanger attached at a joist panel point only except if the chord member is stiffened according to the typical detail shown on the drawings.
 - 2. All ceilings hung from the joists and producing a concentrated load of 60 pounds or less may have the grid hung anywhere along the bottom chord. Hung ceilings producing more than a 60 pound concentrated load shall have the grid hung only at joist panel points except if the chord member is stiffened according to the typical detail shown on the drawings.
 - 3. Heavy pipes, ducts, or other equipment hung from joists may require additional reinforcement and shall be referred to the Engineer for framing.

3.4 QUALITY ASSURANCE TESTING AND INSPECTION DURING FABRICATION AND ERECTION

- A. See Testing Laboratory Services section of these Specifications for inspection and test requirements.

END OF SECTION 05 21 00

SECTION 05 31 13 – STEEL FLOOR DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 - Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

- A. Supplier: The metal deck supplier shall furnish all metal deck materials and accessories indicated on the Architectural, Structural, and Mechanical Drawings required to produce a complete job including but not necessarily limited to deck units, cover plates, pour stops, hanger slots or clips, metal deck edge closures, cell closures, and all related accessories.
- B. Erector: The Subcontractor responsible for erecting the metal deck shall provide all labor and equipment as required to place all metal deck components and accessories as described above.

1.3 QUALIFICATIONS

The metal deck supplier shall be a manufacturer with a minimum of two years successful experience and with a minimum of two successful jobs of a comparable size and scope to this project.

1.4 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of the following codes and standards except as otherwise indicated or specified:
 - 1. "Design Manual for Composite Decks, Form Decks, and Roof Decks", as published by the Steel Deck Institute (SDI).
 - 2. "Specification for the Design of Cold Formed Steel Structural Members", as published by the American Iron and Steel Institute (AISI).
 - 3. "Structural Welding Code – Sheet Steel", D1.3, as published by the American Welding Society (AWS).
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with AWS procedures.
- C. Underwriters Label: Provide metal deck units which are listed and conform to Underwriters Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed.
- D. Cellular Decks: Provide cellular floor deck units complying with UL 209 and listed in UL "Electrical Construction Equipment Directory" with each cellular metal floor deck unit

bearing UL labels and marking. Provide units which will permit use of standard header ducts and outlets for electrical distribution systems.

1.5 SUBMITTALS

- A. Product Certification: Submit manufacturer's specifications and installation instructions for each type of deck specified. Also submit a certificate of product compliance with SDI Standards as specified.
- B. Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, pans, deck openings, special jointing, supplementary framing, and all other accessories.
- C. Calculations: If the submitted deck does not comply with the minimum properties shown on the drawings, the metal deck manufacturer shall submit design calculations sealed by a registered professional engineer in the state where the project is located verifying compliance with the specifications for all load and span conditions shown on the drawings.
- D. Welding Certificates: Submit Copies of certificates for welding procedures and personnel.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. See the drawings for location of metal deck types and for depth of deck, design deck properties, design deck yield strength, concrete type, total slab thickness, slab reinforcing, and design superimposed loads. The average rib width to depth of deck ratio shall be greater than or equal to 2.0. The deck properties specified are the values used for the design of the deck shown on the drawings. Provide deck with the depth as noted and other properties equal to or greater than the values stated on the drawings except that a deck with properties less than those stated, other than depth, may be used provided that the deck manufacturer take responsibility for the design of the deck. The design shall include the ability to carry the construction dead loads and design superimposed loads indicated for all the spans shown on the drawings and to meet all performance criteria as specified by the SDI. Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck".
- B. Acceptable manufacturers include the following

ASC Steel Deck
Canam Steel Corp.
CMC Joist and Deck
Steel Dynamics, Inc.
Cordeck
DACS, Inc.
Marlyn Steel Decks, Inc.
Roof Deck, Inc.
Valley Joist/Div. Ebsco Industries, Inc.
Verco Manufacturing Co.

Vulcraft/Div. Nucor Corp.
Wheeling Corrugating Co.

Other manufacturers may be used only with Architect/Engineer approval.

2.2 GRADE OF STEEL

Composite metal deck shall be cold formed from steel sheets conforming to ASTM A611 Grade C or D or ASTM A653, Structural Steel Grade, with a minimum yield strength as stated on the drawings but not less than 33 ksi. The delivered thickness of the uncoated steel shall not be less than 95% of design thickness. Sheet metal accessories shall conform to the same material specification as the deck product.

2.3 FINISH

- A. Galvanized: Composite metal deck shall be galvanized with a protective zinc coating conforming to ASTM A653 G90.
- B. Phosphatized Painted: Composite metal deck shall be phosphatized painted with the steel chemically cleaned of all oil, grease and dirt and then phosphate coated. The deck shall then receive a two coat baked-on primer on the bottom side. The contractor shall be responsible for protecting the deck from excessive oxidation that would materially reduce the concrete bond strength or decrease the strength of the deck.
- C. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces complying with Department of Defense Specifications DOD-P-21035.

2.4 RELATED PRODUCTS

- A. Flexible Closure Strips: Provide manufacturers standard vulcanized closed cell, synthetic rubber.
- B. Acoustic Sound Barrier Closures: Provide manufacturers standard mineral fiber closures.

2.5 FABRICATION

- A. Metal Deck Spans: The deck properties shown on the drawings are selected so that the spans do not exceed the maximum clear spans with unshored construction as required by SDI criteria unless indicated otherwise on the drawings. The deck manufacturer shall be responsible for supplying a deck that meets that criterion. Where possible, all metal deck shall extend over three or more spans. Simple span deck will not be permitted unless it is shored at midspan. Any additional concrete topping specified over the composite slab shall be placed after the slab has reached 75% of its design strength.
- B. Cellular Composite Units: Fabricate cellular metal floor deck units with top fluted section cells combined on a lower flat plate and interlocking side laps.
- C. Metal Cover Plates - Cellular Deck: Fabricate metal cover plates for end abutting floor deck units of not less than same thickness as decking, formed to match contour of deck units.
- D. Cell Closure at Ends of Metal Deck Flutes: Fabricate metal closure strips of not less than 0.0358" minimum (20 gage) cold formed sheet steel. Form to provide tight fitting cell

closures at open ends of cells or flutes to prevent wet concrete from leaking through open cells.

- E. Pour Stop Closures at Slab Edges: Provide sheet metal pour stop closures at all slab edges, columns, walls, and openings unless steel angles or bent plates are specified in details on the drawings. The closures shall be fabricated from light gage steel not less than the thickness shown in the table below when the slab edge is parallel to the deck span. Provide a return lip on the vertical leg in accordance with the SDI Design Manual. The overhang dimension is measured from the edge of the flange to the edge of the slab.

Overhang	=	0"-2"	2"-4"	4"-6"	6"-8"	8"-10"
<u>Slab Thickness</u>						
5.25		18	16	14	12	10
6.25		16	14	12	12	10
6.5		16	14	12	12	10
8.0		12	12	10	10	NA

2.6 COMPOSITE SLAB REINFORCEMENT

See drawings for reinforcement in composite slabs. See Section [03300] [03 30 00], "Cast-in-Place Concrete", for minimum reinforcement requirements.

2.7 OPENINGS IN METAL DECK

For unframed openings, provide block out in slab for opening with deck uncut. Cut deck at opening after concrete has reached 75% of its design strength. See Section 03 30 00, "Cast-in-Place Concrete", for reinforcing in the slab around all unframed openings in metal deck that are greater than 10" in width in either direction.

2.8 CHLORIDE ADMIXTURES

The use of admixtures in concrete containing chloride salts shall not be permitted for metal deck concrete.

2.9 EXTRA CONCRETE REQUIRED BY DECK DEFLECTION

The General Contractor shall include in his bid additional concrete required for metal deck slabs to account for deck deflection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install deck units as accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:

1. Place deck units on supporting framework and adjust to final position with ends accurately aligned and bearing 1 1/2" minimum on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
2. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.

3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
 4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
 5. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
- B. Attachment of Composite Deck:
1. Typical Welding of Deck: Metal deck units shall be welded to the structural support members with 5/8" ϕ puddle welds at each end of sheet and each intermediate support at each low flute, unless more frequent attachment is specified on the drawings. Where two deck units abut each other, each unit shall be so welded. Puddle welds may be replaced with welded shear studs when applicable. The Contractor is responsible for temporary deck fastening to meet OSHA requirements to use the floor deck unit as a storage or working platform before final attachment is installed.
 2. Side Laps: Unless noted otherwise on the drawings, side laps of adjacent units shall be fastened by welding (1-1/2 inch long), sheet metal screws (No. 10 or larger) or button punching at maximum intervals not exceeding the lesser of 1/2 of the span or 36".
 3. Welding to Girder: Metal deck units shall be welded to girders (steel framing that is parallel to span of deck) with 5/8" ϕ puddle welds at 12" o.c. If the metal deck is not continuous across the girder, the deck on each side of the girder shall each be welded to the girder with 5/8" ϕ puddle welds at 12" o.c.
 4. Welding Washers: Welding washers shall be used when welding steel deck units less than 0.028" thickness.
 5. Welding of Composite Deck used on Roof: In addition to the minimum attachment specified above, typical areas of the roof deck shall be welded to resist the net uplift pressures as specified in the General Notes on the drawings
 6. Minimum Bearing: Provide a minimum deck bearing of 1 1/2" over all supports with butted end joints.
 7. Cellular Decks: Keep the interiors of cells that will be used as raceways free of welds or screw edges having sharp points or edges.
- C. Welding Requirements: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.
- E. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work.

- F. Hanger Slab or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers or lighting fixtures.
 - 1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
 - 2. Locate slots or clips at not more than 14" o.c. in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless otherwise shown.
 - 3. Provide manufacturer's standard hanger attachment devices.
 - 4. Loads hanging from metal deck slabs shall not exceed 100 pounds unless specifically detailed otherwise on the drawings.
- G. Joint Covers and Cell Closures: Weld steel sheet joint covers at abutting ends, except where taped joints are specified. Weld steel sheet column closures, cell closures and Z-closures to deck with 1" long weld at 12" maximum centers to provide tight-fitting closures at open ends of ribs, unless shown otherwise on the drawings.
- H. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated. Provide minimum 2" bearing over steel support.

3.2 TOUCH-UP PAINTING

- A. After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.
- B. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.
- C. Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.
- D. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.3 QUALITY ASSURANCE INSPECTION DURING CONSTRUCTION

- A. The method of attaching the deck to the frame is subject to inspection by the Owner's designated Testing Laboratory. The Contractor shall, at its own expense, remove work found to be defective and replace with new acceptable work.
- B. See Testing Laboratory Services of these Specifications for deck attachment inspection requirements.

END OF SECTION 05 31 13

SECTION 05 31 23 - STEEL ROOF DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 - Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

- A. Supplier: The steel deck supplier shall furnish all steel deck materials and accessories indicated on the Architectural, Structural, and Mechanical Drawings required to produce a complete job including but not necessarily limited to deck units, cover plates, steel deck edge closures, cell closures, cant strips, sump pans, and all related accessories.
- B. Erector: The Subcontractor responsible for erecting the steel deck shall provide all labor and equipment as required to place all steel deck components and accessories as described above.

1.3 QUALIFICATIONS

- A. The steel deck supplier shall be a manufacturer with a minimum of two years successful experience and with a minimum of two successful jobs of a comparable size and scope to this project.

1.4 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of the following codes and standards except as otherwise indicated or specified:
 - 1. "Design Manual for Composite Decks, Form Decks, and Roof Decks", as published by the Steel Deck Institute (SDI).
 - 2. "Specification for the Design of Cold Formed Steel Structural Members", as published by the American Iron and Steel Institute (AISI).
 - 3. "Structural Welding Code – Sheet Steel", D1.3 as published by the American Welding Society (AWS).
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with AWS procedures.
- C. Underwriters Laboratories Classifications:
 - 1. Provide steel deck units which are listed and conform to Underwriters Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific fire-resistant system detailed.
 - 2. Provide units and construction meeting the requirements of Construction No. 58] [76] [157] [192] [234] [241] [266] as listed in the 2000 UL "Roofing Materials &

Systems Directory” under Roof Deck Constructions (TGKX) and rated as a Class [30] [60] [90] assembly. and with each deck unit bearing the UL label and marking for specific wind-rated system detailed.

- D. Factory Mutual Listing: Provide steel roof deck units which have been evaluated by Factory Mutual Research Corporation and are listed as an approved product in "Factory Mutual Research Approval Guide 2006- Building Materials".

1.5 SUBMITTALS

- A. Product Certification: Submit manufacturer's specifications and installation instructions for each type of deck specified. Also submit a certificate of product compliance with SDI Standards as specified.
- B. Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, supplementary framing, and all other accessories.
- C. Insurance Certification: Assist Architect and Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire, windstorm, and extended coverage insurance.
- D. Welding Certificates: Submit Copies of certificates for welding procedures and personnel.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. See General Notes on the drawings for the location, depth of deck, design thickness, and type of deck required.
- B. Acoustic Steel Roof Deck Units:

- 1. Single-Pan Units: Single-pan fluted units with vertical webs perforated sufficiently to meet the following minimum sound absorption criteria in the table below. The steel thickness, depth and width shall be as indicated on the drawings. Provide mineral fiber acoustical insulation strips, encapsulated in clear PVC plastic that is between 0.5 and 3.0 mil thick for moisture protection, with profile to fit void space between vertical ribs.

Deck Type	Frequency (HZ)					
	125	250	500	1000	2000	4000
1 ½"- WR	.44	.93	1.06	.94	.54	.23
3" – DR	.53	1.00	1.01	.87	.44	.24
“specify deck”	.30	.60	1.18	.98	1.00	.91

WR= Wide Rib Deck per SDI nomenclature
 DR= Deep Rib Deck per SDI nomenclature

- 2. Double-Pan Cellular Units: Composite units consisting of upper fluted-section combined with lower flat plate section having interlocking side laps and perforations in the lower flat plate section sufficient to meet the following minimum sound absorption criteria in the table below. The steel thickness, depth and width shall be as indicated on the drawings. Provide

mineral fiber acoustical insulation strips, encapsulated in clear PVC plastic that is between 0.5 and 3.0 mil thick for moisture protection, with profile to fit void space of each cell.

Deck Type	Frequency (HZ)					
	125	250	500	1000	2000	4000
1 ½"- WR	.38	.47	.63	.84	.74	.48
3" – DR	.44	.56	.95	.88	.72	.47
"specify deck"	.30	.60	1.18	.98	1.00	.91

WR= Wide Rib Deck per SDI nomenclature
 DR= Deep Rib Deck per SDI nomenclature

C. Acceptable manufacturers include:

- ASC Steel Deck.
- Canam Group.
- Steel Dynamics
- Cordeck
- Epic Metals Corp.
- Loadmasters Systems, Inc.
- Marylyn Steel Decks, Inc.
- United Steel Deck, Inc.
- Valley Joist, Inc.
- Verco Manufacturing Co.
- Vulcraft/Div. Nucor Corp.
- Wheeling Corrugating Co.

Other manufacturers may be used only with Architect/Engineer approval.

2.2 GRADES OF STEEL

- A. Steel deck shall be manufactured from steel conforming to ASTM A1008 Grades C, D, or E for painted deck or A653, Structural Steel Grade for galvanized deck or Engineer approved equal, having a minimum yield strength of 33,000 PSI.

2.3 FINISH

- A. Galvanizing: Steel deck shall be galvanized with a protective zinc coating conforming to ASTM A653 G90.
- B. Painting: Shop prime deck with gray or white baked-on, lead- and chromate-free rust inhibitive primer complying with performance requirements of FS TT-P-664. See Architect's drawings and painting specifications for steel deck finish paint requirements.
- C. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces complying with Department of Defense Specifications DOD-P-21035.

2.4 ROOF DECK ACCESSORIES

- A. Provide minimum 20 gauge ridge and valley plates, minimum 20 gauge cant strips, minimum 14 gauge sump pans, minimum 20 gauge inside or outside closure channels

angles or plates, minimum 20 gauge butt strips at change of deck directions, and minimum 20 gauge filler sheets.

2.5 MECHANICAL FASTENERS

- A. Powder-Actuated or Pneumatically Driven Pins: Provide corrosion-resistant, powder-actuated or pneumatically driven fasteners manufactured from steel conforming to AISI 1060 or 1061 steel, austempered to a core hardness of 52 to 58 Rockwell C. Fasteners shall have a knurled shank and shall be zinc-plated in accordance with ASTM B633, Sc. I, Type III.

Subject to compliance with requirements, provide products of one of the following manufacturers:

Hilti, Inc.
ITWBuildex
Pneutek, Inc.

- B. Self-Drilling Screw Fasteners: Provide corrosion-resistant, hexagonal head, steel self drilling screws, austempered to a core hardness of Rockwell C 50.

Subject to compliance with requirements, provide products of one of the following manufacturers:

ITWBuildex
Grabber Construction Products
SFS Intec Fastening Systems, Inc., Wyomissing
Textron Fastening Systems

2.6 SIDE-LAP FASTENERS:

- A. Provide Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

2.7 FABRICATION

- A. General: Fabricate deck panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck", in SDI Publication No. 29, and the following.
- B. Steel Deck Spans: Where possible, all steel deck shall extend over three or more supports. Single span deck is prohibited.

2.8 ROOF OPENINGS

- A. Provide a 20 gage galvanized flat plate to reinforce openings in roof deck that are greater than 6" and less than 10" in any one direction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install deck units and accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:

1. Place deck units on supporting framework and adjust to final position with accurately aligned side laps and ends bearing 2" minimum on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks. Place the end joint over a chord angle for deck bearing on steel bar joists.
2. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
3. Place deck units flat and square (relative to supporting members), secured to adjacent framing without warp or excessive deflection.
4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
5. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
6. Do not use roof deck units for storage or working platforms until permanently secured.

B. Attachment of Roof Deck:

1. The method of attachment, attachment pattern, and side lap fastener type and spacing shall be as shown on the drawings and comply with the requirements noted below.
2. Method of Attachment: The attachment method noted in the drawings shall comply with the applicable requirements below.
 - a. Welding: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting member. Welding washers shall be used only when welding steel deck less than 0.028" thickness. The diameter of the puddle weld on the supporting member shall be, at a minimum, the diameter stated in the drawings but no less than 1/2 inch.
 - b. Powder-Actuated or Pneumatically Driven Pins: An operator licensed by the pin manufacturer shall install all pins. Comply with the manufacturer's requirements to install the pins through all layers of the deck material and the manufacturer's required embedment into the supporting member.
 - c. Self-Drilling Fasteners: Comply with the manufacturer's requirements to install the screws through all layers of the deck material and the manufacturer's required embedment into the supporting member.
3. Side Lap Fastening: Unless required otherwise by provisions of this specification, side laps of adjacent units shall be fastened by #10 (min.) TEK screws so that spacing between supports and fasteners does not exceed the value prescribed on the drawings. Button Punching is not allowable as a side-lap fastener.
4. End Bearing: Provide a minimum end bearing of 2" over supports.

5. End Joints: End joints of sheets shall be lapped 2" minimum over supports. Decks that slope 1/4 inch or more in 12 inches in the long direction shall be erected beginning at the low side to insure that end laps are shingle fashion.
 6. Underwriters Laboratories Wind Uplift Classification Requirements: Unless a more stringent attachment requirement is specified elsewhere in this specification or on the drawings, roof deck units shall be attached to the supporting structure as required by the Construction Number specified elsewhere in this section.
 7. Attachment to Girders: At locations noted in the drawings, attach the deck to steel members that are parallel to the deck flutes in accordance with the requirements noted in the drawings.
- C. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.
 - D. Reinforcement at Openings: Roof openings less than 6" square or diameter require no reinforcement. Openings 6" to 10" inclusive shall be reinforced with a 20 gauge galvanized plate welded to the deck at each corner and 6" maximum centers with a 5/8" diameter puddle weld or sheet metal screws. For openings greater than 10" in diameter or width, refer to the drawings and structural steel specifications for additional framing to support the deck around the opening.
 - E. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld in each corner.
 - F. Joint Covers: Provide steel joint covers at changes in direction of deck units, except where taped joints are specified.
 - G. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

3.2 TOUCH-UP PAINTING

- A. After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.
- B. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.
- C. Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.
- D. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.3 QUALITY ASSURANCE INSPECTION DURING CONSTRUCTION

- A. The method of attaching the deck to the frame is subject to inspection by the Owner's designated Testing Laboratory. The Contractor shall, at its own expense, remove work found to be defective and replace with new acceptable work.
- B. See Testing Laboratory Services of these Specifications for deck attachment inspection requirements.

END OF SECTION 05 31 23

SECTION 05 31 33 - STEEL FORM DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 - Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

- A. Supplier: The steel deck supplier shall furnish all steel deck materials and accessories indicated on the Architectural, Structural, and Mechanical Drawings required to produce a complete job including but not necessarily limited to deck units, cover plates, pour stops, steel deck edge closures, cell closures, cant strips, sump pans, and all related accessories.
- B. Erector: The Subcontractor responsible for erecting the steel deck shall provide all labor and equipment as required to place all steel deck components and accessories as described above.

1.3 QUALIFICATIONS

- A. The steel deck supplier shall be a manufacturer with a minimum of two years successful experience and with a minimum of two successful jobs of a comparable size and scope to this project.

1.4 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of the following codes and standards except as otherwise indicated or specified:
 - 1. "Design Manual for Composite Decks, Form Decks, and Roof Decks", as published by the Steel Deck Institute (SDI).
 - 2. "Specification for the Design of Cold Formed Steel Structural Members", as published by the American Iron and Steel Institute (AISI).
 - 3. "Structural Welding Code – Sheet Steel", D1.3, as published by the American Welding Society (AWS).
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with AWS procedures.
- C. Underwriters Laboratories Classifications:
 - 1. Underwriters Label: Provide steel deck units which are listed and conform to Underwriters Laboratories' "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific fire-resistant system detailed.

2. Provide units and construction that are found in Underwriters Laboratories' "Roofing Materials & Systems Directory" and conform to UL Wind Uplift Class [1-30/1-60/1-90](#) construction and with each deck unit bearing the UL label and marking for specific wind-rated system detailed.
- D. Factory Mutual Listing: Provide steel roof deck units which have been evaluated by Factory Mutual Research Corporation and are listed in "Factory Mutual Research Approval Guide 2000- Building Materials" for "Class 1" or "Non-Combustible" fire rated construction and [60/75/90/120/150/190](#) Windstorm Classification.

1.5 SUBMITTALS

- A. Product Certification: Submit manufacturer's specifications and installation instructions for each type of deck specified. Also submit a certificate of product compliance with SDI Standards as specified.
- B. Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, pans, deck openings, special jointing, supplementary framing, and all other accessories.
- C. Welding Certificates: Submit Copies of certificates for welding procedures and personnel.
- D. Insurance Certification: Assist Architect and Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire, windstorm, and extended coverage insurance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. See General Notes on the drawings for location of steel deck types and for depth of deck, minimum deck thickness, section properties of deck, concrete type, total slab thickness, slab reinforcement, and suggested manufacturer.
- B. Acceptable deck manufacturers include the following:

BHP Steel Building Products USA, Inc.
Canam Steel Corp.
Consolidated Systems, Inc.
Epic Metals Corp.
United Steel Deck, Inc.
Valley Joist, Inc.
Vulcraft/Div. Nucor Corp.
Wheeling Corrugating Co.
- C. Other manufacturers may be used only with Architect/Engineer approval.

2.2 GRADES OF STEEL

- A. Steel Form Deck shall be manufactured from steel conforming to ASTM A611 Grades C, D, or E or ASTM A653, Structural Steel Grade Grades having a minimum yield strength of 33,000 PSI. The delivered thickness of uncoated steel shall not be less than 95% of the design thickness. Sheet steel accessories shall conform to the same material specification as the deck product.

2.3 FINISH

- A. Roof Deck: Roof deck shall be galvanized with a protective zinc coating conforming to ASTM A653 G90 class.
- B. Floor Deck:
 - 1. Galvanized: Floor deck shall be galvanized with a protective zinc coating conforming to ASTM A653 G90 class.
 - 2. Painted: Floor deck shall be phosphatized painted with the steel chemically cleaned of all oil, grease, dirt and then phosphate coated. The deck shall then receive a two-coat baked-on lead- and chromate- free rust inhibitive primer on the bottom side complying with the performance requirements of FS TT-P-664.
- C. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanizing surfaces complying with Department of Defense Specifications DOD-P-21035.

2.4 ROOF DECK ACCESSORIES

- A. Provide minimum 20 gauge ridge and valley plates, minimum 20 gauge cant strips, minimum 14 gauge sump pans, minimum 20 gauge inside or outside closure channels, minimum 20 gauge butt strips at change of deck direction, minimum 20 gauge filler sheets and minimum 20 gauge pour stops as required to provide a finished surface for the application of insulation and roofing.

2.5 VENTING

- A. All steel form deck supporting lightweight insulating concrete shall have built in slot vents at the bottom or sides of each rib having a minimum uniformly distributed open area of 1.5%.

2.6 MECHANICAL FASTENERS

- A. Powder-Actuated or Pneumatically Driven Pins: Provide corrosion-resistant, powder-actuated or pneumatically driven fasteners manufactured from steel conforming to AISI 1060 or 1061 steel, austempered to a core hardness of 52 to 58 Rockwell C. Fasteners shall have a knurled shank and shall be zinc-plated in accordance with ASTM B633, Sc. I, Type III.

Subject to compliance with requirements, provide products of one of the following manufacturers:

Hilti, Inc., Tulsa, OK
ITWBuildex, Itasca, IL
Pneutek, Inc., Hudson, NH

- B. Self-Drilling Screw Fasteners: Provide corrosion-resistant, hexagonal head, steel self drilling screws, austempered to a core hardness of Rockwell C 50.

Subject to compliance with requirements, provide products of one of the following manufacturers:

ITWBuildex, Itasca, IL

2.7 SIDE-LAP FASTENERS

- A. Provide Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

2.8 FABRICATION

- A. General: Fabricate deck panels to comply with “SDI Specifications and Commentary for Non-composite Steel Floor Deck”, in SDI Publication No. 29, and the following.
- B. Steel Deck Spans: Where possible, all steel deck shall extend over three or more supports. Single span deck is prohibited.
- C. Factory Mutual Windstorm Classification Requirements: Provide steel deck panels that comply with the requirements of the Factory Mutual Research Approval Guide 2000 – Building Materials for Windstorm Classification 1-90 for the following manufacturers of lightweight insulating concrete:
 - 1. Celcore, Inc.
 - 2. Cellular Concrete, LLC, Mearlcrete Div.
 - 3. Concrecel International, Inc.
 - 4. Elastizell Corp. of America
 - 5. Siplast, Inc.
- D. Underwriters Laboratories Wind Uplift Classification: Provide steel deck panels meeting the requirements of Construction No. [110/143/155/250/434](#) as listed in the 2000 UL Roofing Materials & Systems Directory under Roof Deck Constructions (TGKX) and rated as a Class [1-30/1-60/1-90](#) assembly.
- E. Cell Closure at Ends of Steel Deck Flutes: Fabricate steel closure strips of not less than 0.0358" minimum (20 gage) cold formed sheet steel. Form to provide tight fitting cell closures at open ends of cells or flutes to prevent wet concrete from leaking through open cells.
- F. Pour Stop Closures at Slab Edges: Provide sheet steel pour stop closures at all slab edges, columns, walls, and openings unless steel angles or bent plates are specified in details on the drawings. The closures shall be fabricated from light gage steel not less than the thickness shown in the table below. Provide a return lip on the vertical leg in accordance with the SDI Design Manual. The overhang is defined as the distance from the edge of the steel beam flange to the edge of the slab.

Overhang	0"-2"	2"-4"	4"-6"	6"-8"	8"-10"	10"-12"
Slab Thickness						
2.5 to 4 inches	20	18	16	12	12	10

2.9 FLOOR SLAB REINFORCEMENT

- A. See Section [03300] [03 30 00], “Cast-In-Place Concrete”, [03200] [03 20 00], “Concrete Reinforcing”, for reinforcement in Steel Deck form slabs.

2.10 ROOF OPENINGS

- A. Provide a 20 gage galvanized flat plate to reinforce openings in roof deck that are greater than 6" and less than 10" in any one direction.

2.11 FLOOR OPENINGS

- A. For unframed openings, provide blockout in slab for opening with deck uncut. Cut deck at opening after concrete has been poured and obtained 75% of its design strength. See Section [03300] [03 30 00], "Cast-In-Place Concrete", [03200] [03 20 00], "Concrete Reinforcing", for reinforcing in the slab around all unframed openings in steel deck that are greater than 10" width in either direction.

2.12 CHLORIDE ADMIXTURES

- A. The use of admixtures in concrete containing chloride salts shall not be permitted for steel deck concrete.

2.13 EXTRA CONCRETE REQUIRED FOR DECK DEFLECTION

- A. The General Contractor shall include in his bid additional concrete required for steel deck slabs to account for deck deflection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install deck units as accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:
 - 1. Place deck units on supporting framework and adjust to final position with ends accurately aligned and bearing 2" minimum on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
 - 2. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
 - 3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
 - 4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
 - 5. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
 - 6. Do not use floor deck units for storage or working platforms until permanently secured.
- B. Attachment of Roof Form Deck:
 - 1. The method of attachment, attachment pattern, and side lap fastener type and spacing, shall be as shown on the drawings and comply with the requirements noted below.

2. Method of Attachment: The deck shall be fastened to the structural support members using one of the following methods.
 - a. Welding: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting member. Welding washers shall be used only when welding steel deck less than 0.028" thickness.
 - b. Powder-Actuated or Pneumatically Driven Pins: Comply with the manufacturers requirements to install the pins through all layers of the deck material and the manufacturer's required embedment into the supporting member.
 - c. Self-Drilling Fasteners: Comply with the manufacturer's requirements to install the screws through all layers of the deck material and the manufacturer's required embedment into the supporting member.
3. Definition of Perimeter and Corner
 - a. Definition of Roof Height: Roof height shall be defined as eave height for roofs that slope less than 10% and mean roof height for roofs with a greater slope.
 - b. Buildings with roof heights of 60 feet or less
 - (1) Perimeter: The width of the perimeter strip shall be the smaller of one-tenth the least building dimension and four-tenths the roof height but not less than 4 feet. The strip either side of a ridgeline shall be considered as a perimeter strip for the purposes of deck fastening for roofs that slope between 10° and 45°.
 - (2) Corner: On an exterior (not re-entrant) corner, a strip the width of a perimeter strip defined above and extending for a length equal to the dimension of one perimeter strip each direction from the exterior corner.
 - c. Buildings with roof heights greater than 60 feet
 - (1) Perimeter: The width of the perimeter strip shall be one-tenth the least dimension of the building but not less than four feet.
 - (2) Corner: On an exterior (not re-entrant) corner, a strip the width of a perimeter strip defined above and extending for a length equal to the dimension of two perimeter strips each direction from the exterior corner.
4. Underwriters Laboratories Wind Uplift Classification Requirements: Unless a more stringent attachment requirement is specified elsewhere in this specification or on the drawings, roof deck units shall be attached to the supporting structure as required by Construction Number specified elsewhere in this section.
5. Attachment to Girders: At locations where the deck flutes are parallel to the span of the steel framing and the top of the framing is at the bottom of the deck elevation, the deck shall be attached to the girder using one of the specified fastening methods at 18 inches on center.

C. Attachment of Floor Form Deck:

1. Floor deck units shall be fastened to each end support at each side lap and half way in between. At each interior support floor deck units shall be fastened at each side lap.

2. Method of Attachment: The deck shall be fastened to the structural support members using one of the following methods.
 - a. Welding: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting member. Welding washers shall be used only when welding steel deck less than 0.028" thickness. Welding washers shall be a minimum thickness of 0.0568 inches and have a nominal 3/8" diameter hole. Where welding washers are not required, a nominal 5/8" diameter puddle weld shall be used.
 - b. Powder-Actuated or Pneumatically Driven Pins: An operator licensed by the manufacturer shall install all pins. Comply with the manufacturer's requirements to install the pins through all layers of the deck material and the manufacturer's required embedment into the supporting member.
 - c. Self-Drilling Fasteners: Comply with the manufacturer's requirements to install the screws through all layers of the deck material and the manufacturer's required embedment into the supporting member.
 3. Attachment to Girders: At locations where the deck flutes are parallel to the span of the steel framing and the top of the framing is at the bottom of the deck elevation, the deck shall be attached to the girder using one of the specified fastening methods at 18 inches on center.
- D. Side Laps: Unless required otherwise by provisions of Factory Mutual or Underwriters Laboratories, side laps of adjacent units shall be fastened by welding (on 20 gauge or heavier deck only) or #10 (min.) TEK screws so that spacing between supports and fasteners does not exceed the value prescribed on the drawings. Nest side laps one-half corrugation. Button punching is not allowable as a side-lap fastener.
- E. End Bearing: Provide a minimum end bearing of 2" over supports.
- F. End Joints: End joints of sheets shall be butted or lapped 2" minimum over supports unless a more stringent requirement is specified by Factory Mutual or Underwriters Laboratory. Decks that slope 1/4 inch or more in 12 inches in the long direction shall be erected beginning at the low side to insure that end laps are shingle fashion.
- G. Welding Requirements: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
- H. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.
- I. Reinforcement at Roof Openings: Roof openings less than 6" square or in diameter require no reinforcement. Openings 6" to 10" inclusive shall be reinforced with a 20 gauge galvanized plate welded to the deck at each corner and 6" maximum centers with a 5/8" diameter puddle weld or sheet metal screws. For openings greater than 10" in diameter or width, refer to the drawings and structural steel specifications for additional framing to support the deck around the opening.
- J. Hanger Slots or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.

1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
 2. Locate slots or clips at not more than 14" o.c. in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless otherwise shown.
 3. Provide manufacturer's standard hanger attachment devices.
 4. Loads hanging from steel deck slabs shall not exceed 100 pounds unless specifically detailed otherwise on the drawings.
- K. Joint Covers and Cell Closures: Weld steel sheet joint covers at abutting ends, except where taped joints are specified. Weld steel sheet column closures, cell closures and Z-closures to deck with 1" long weld at 12" maximum centers to provide tight-fitting closures at open ends of ribs, unless shown otherwise on the drawings.
- L. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated. Provide minimum 2" bearing over steel support.

3.2 TOUCH-UP PAINTING

- A. After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.
- B. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.
- C. Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.
- D. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.3 INSPECTION

- A. The method of attaching the deck to the frame is subject to inspection by the Owner's designated Testing Laboratory. The Contractor shall, at its own expense, remove work found to be defective and replace with new acceptable work.
- B. See Testing Laboratory Services of these Specifications for deck attachment inspection requirements.

END OF SECTION 05 31 33

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. *Uniform General Conditions for Construction Contracts, State of Texas, 2010 (UGC).*
 - 2. *The University of Houston's Supplemental General Conditions and Special Conditions for Construction.*

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Roof rafter framing.
 - 3. Soffit framing.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
 - 3. Section 09 22 16 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

Retain "Preinstallation Conference" Paragraph below if Work of this Section is extensive or complex enough to justify a conference.

- A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. LEED Submittals (Projects authorized for LEED certification only):
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following :
1. ClarkDietrich Metal Framing; a Worthington Industries Company, www.clarkdietrich.com
 2. MarinoWARE, www.marinoware.com.
 3. SCAFCO Corporation, www.scafco.com.
 4. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated .
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Select deflection ratios to suit finish material(s) to be used on the specific project. Exterior Non-Load-Bearing Framing: Horizontal deflection of **[1/240] 1/360 [1/600] [1/720]** of the wall height.
 - b. Roof Rafter Framing: Vertical deflection of **[1/120] 1/240 [1/360]** of the horizontally projected span for live loads.
 - c. Soffit Framing: Vertical deflection of **[1/120] [1/240] [1/360]** of the span for live loads and 1/240 for total loads of the span.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

Retain first subparagraph below for non-load-bearing and load-bearing walls if design responsibility for cold-formed framing is assigned to Contractor. Indicate locations on Drawings if different movement is anticipated for different building elements. If preferred, change deflection limits to ratios such as L/300 for floors and L/200 for roofs.

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch .

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

Retain subparagraphs below, as applicable, if Project includes floor and roof systems, wall studs, headers for load-bearing walls, or lateral design requirements.

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance .
2. Coating: G90 or equivalent .

Retain "Steel Sheet for (Vertical Deflection) (Drift) Clips" Paragraph below if applicable.

- C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

Retain grade requirements from options in "Grade" Subparagraph below.

1. Grade: As required by structural performance.
2. Coating: G90.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

Retain one steel thickness from "Minimum Base-Metal Thickness" Subparagraph below or revise to suit Project. Sequence corresponds to common thickness designators 33, 43, 54, 68, and 97 and obsolete 20-, 18-, 16-, 14-, and 12-gage designations.

1. Minimum Base-Metal Thickness: 0.0538 inch .

Flange widths vary with application. If sheathing or masonry ties are required, consider minimum flange width of 1-5/8 inches (41 mm). Sequence corresponds to common flange width designators 137, 162, 200, and 250.

2. Flange Width: 1-5/8 inches .

- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

Retain one steel thickness from "Minimum Base-Metal Thickness" Subparagraph below or revise to suit Project. Sequence corresponds to common thickness designators 33, 43, 54, 68, and 97 and obsolete 20-, 18-, 16-, 14-, and 12-gage designations.

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches .

- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following :
 - a. ClarkDietrich Metal Framing; a Worthington Industries Company, www.clarkdietrich.com.
 - b. MarinoWARE, www.marinoware.com.
 - c. SCAFCO Corporation, www.scafco.com.
 - d. Substitutions: See Section 01 25 00 - Substitution Procedures.

- D. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths required, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch .
2. Flange Width: 2 inches , minimum.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths required, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0538 inch .
 - 2. Flange Width: 2 inches , minimum.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

Revise list below to suit Project.

- 1. Supplementary framing.
- 2. Bracing, bridging, and solid blocking.
- 3. Web stiffeners.
- 4. Anchor clips.
- 5. End clips.
- 6. Foundation clips.
- 7. Gusset plates.
- 8. Stud kickers and knee braces.
- 9. Joist hangers and end closures.
- 10. Hole reinforcing plates.
- 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

Retain "Expansion Anchors" Paragraph below if expansion anchors are acceptable. Verify safety factor with Project's structural engineer. Revise as required or insert specific load requirements and names of acceptable products.

- A. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

- C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- C. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

Retain first paragraph below if insulation for exterior framing is required.

- F. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

Revise "Erection Tolerances" Paragraph below to suit Project. Coordinate with limitations of subsequent finish materials.

- H. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support, as detailed on drawings.

Retain one of first two subparagraphs below if using deflection track with infill wall framing. Delete both subparagraphs and retain third if deflection clips are required for bypassing or infill wall framing. Vertical deflection clips are used if wall is stick built or panelized. Single deflection track is used if stud wall is stick built; double deflection track is used with wall panels. Drift clips may be used in seismic areas.

- 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to **[bypassing]** **[infill]** studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

Retain "Top Bridging for Single Deflection Track" Subparagraph below if required.

- 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within **[12 inches]** **[18 inches]** of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at centers indicated .
 - 2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

Insert additional article titles here if other framing classifications warrant more detailed installation requirements than those in "Installation, General" Article.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain, in a manner acceptable to manufacturer and Installer, conditions that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. *Uniform General Conditions for Construction Contracts, State of Texas, 2010 (UGC).*
 - 2. *The University of Houston's Supplemental General Conditions and Special Conditions for Construction.*

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for ceiling-hung toilet compartments.
 - 2. Steel framing and supports for overhead doors .
 - 3. Steel framing and supports for countertops.
 - 4. Steel framing and supports for mechanical and electrical equipment.
 - 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 6. Mounting brackets and anchorages for window-washing equipment.
 - 7. Elevator machine beams, hoist beams, and divider beams.
 - 8. Steel shapes for supporting elevator door sills.
 - 9. Shelf angles.
 - 10. Metal ladders.
 - 11. Ladder safety cages.
 - 12. Metal ships' ladders and pipe crossovers.
 - 13. Metal floor plate and supports.
 - 14. Structural-steel door frames.
 - 15. Miscellaneous steel trim including steel angle corner guards steel edgings and loading-dock edge angles.
 - 16. Metal bollards.
 - 17. Pipe guards.
- B. Products furnished, but not installed, under this Section:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 05 12 00 "Structural Steel Framing."
4. Section 12 93 00 "Site Furnishings" for bicycle racks.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and alternating tread devices, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of loads and stresses within limits and under conditions specified in ICC's International Building Code.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 2. Paint products.
 3. Grout.
- B. LEED Submittals (Projects authorized for LEED certification only):
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Samples for Verification: For each type and finish of extruded nosing and tread.

- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 23 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: As indicated.
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.

2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3.
- H. Lag Screws: ASME B18.2.1.
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1.
- L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- N. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting," Section 09 91 23 "Interior Painting," and Section 09 96 00 "High-Performance Coatings."
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch

embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with primer specified in Section 09 91 13 "Exterior Painting", Section 09 91 23 "Interior Painting", or Section 09 96 00 "High-Performance Coatings".

2.8 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3 unless otherwise indicated.
 - 2. For elevator pit ladders, comply with ASME A17.1.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch- diameter steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 - 6. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
 - 7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
 - 8. Galvanize ladders, including brackets and fasteners.

2.9 LADDER SAFETY CAGES

- A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 3/16-by-1-1/2-inch flat bars secured to each hoop.
4. Galvanize ladder safety cages, including brackets and fasteners.

2.10 METAL [SHIPS' LADDERS] [AND] [PIPE CROSSOVERS]

- A. Provide metal ships' ladders and pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Fabricate ships' ladders and pipe crossovers, including railings from steel .
2. Fabricate treads and platforms from welded or pressure-locked steel bar grating . Limit openings in gratings to no more than 1/2 inch in least dimension.
3. Fabricate treads from rolled-steel floor plate .
4. Comply with applicable railing requirements in Section 05 52 13 "Pipe and Tube Railings."

- B. Galvanize steel ships' ladders and pipe crossovers, including treads, railings, brackets, and fasteners.

2.11 METAL FLOOR PLATE

- A. Fabricate from rolled-steel floor plate of thickness indicated below:

1. Thickness: As indicated.

- B. Provide grating sections where indicated fabricated from welded or pressure-locked steel bar grating . Limit openings in gratings to no more than 1/2 inch [**1 inch**] in least dimension.

- C. Provide steel angle supports as indicated.

- D. Include steel angle stiffeners, and fixed and removable sections as indicated.

- E. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

2.12 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
 - 1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

C. Galvanize exterior steel frames.

2.13 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

- 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.14 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe .
 - 1. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
 - 2. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

- D. Fabricate internal sleeves for removable bollards from Schedule 80 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4 inch steel machine bolt.
- E. Prime bollards with primer specified in Section 09 96 00 "High-Performance Coatings."

2.15 PIPE GUARDS

- A. Fabricate pipe guards from 3/8-inch-thick by 12-inch-wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.
- B. Galvanize pipe guards.

2.16 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.17 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.18 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.19 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.20 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with **[expansion anchors] [anchor bolts] [through bolts]**. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 - 1. Embed anchor bolts at least 4 inches in concrete.
- C. Anchor bollards in concrete **[with pipe sleeves preset and anchored into concrete] [in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard]**. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in **[concrete by inserting into pipe sleeves preset into concrete] [formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of sleeve]**. Fill annular space around internal sleeves solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.

- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.4 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00