SECTION 05200
STRUCTURAL STEEL

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section includes specifications for structural steel, including steel designated as structural steel on the Contract Drawings.

1.02 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC):

1. Quality Certification Program for Fabricators.

B. American Railway Engineering and Maintenance-of Way Association (AREMA):

1. Manual for Railway Engineering

C. American Society of Nondestructive Testing (ASNT):

1. SNT-TC-1A Recommended Practice

D. American Society for Testing and Materials (ASTM):

1.	A588	Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi Minimum Yield Point to 4 inches Thick
2.	A709	Standard Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
3.	E94	Guide for Radiographic Testing
4.	E142	Method for Controlling Quality of Radiographic Testing
5.	E164	Practice for Ultrasonic Contact Examination of Weldments
6.	E165	Test Method for Liquid Penetrant Inspection Method
7.	E709	Guide for Magnetic Particle Examination
8.	E1032	Method for Radiographic Examination of Weldments

E. American Welding Society (AWS):

1.	B1.10	Guide for the Nondestructive Inspection of Welds
2.	D1.1	Structural Welding Code Steel
3.	D1.5	Bridge Welding Code

4. D10.9 Specification for Qualification of Welding Procedure and Welders for Piping and Tubing

5. QC1 Specification for AWS Certification of Welding Inspectors

F. State of California, Department of Transportation (Caltrans), Standard Specifications (hereafter Standard Specifications)

1. Section 55 Steel Structures

G. Steel Structures Painting Council (SSPC):

1. SP 1 Solvent Cleaning

2. SP 3 Power Tool Cleaning

2. SP 10 Near-White Blast Cleaning

3. SP 11 Power Tool Cleaning to Bare Metal

4. PA 1 Shop, Field & Maintenance Painting

5. Paint 20 Zinc-Rich Primers (Type I – Inorganic & Type II – Organic)

6. Paint 22 Epoxy-Polyamide Paints (Primers, Intermediate & Topcoats)

1.03 SUBMITTALS

A. Submit shop drawings conforming to Caltrans Standard Specifications, Section 55-1.02 Drawings, second paragraph, and AREMA Manual, Section 1.1 of Chapter 15. Shop drawings shall also show the following:

1. Profiles, sizes, spacing, locations, member identity, methods of assembly, locations of hardware, anchors, and accessories, and erection sequence and details of structural members.

2. Cuts, copes, gussets, holes, openings, fasteners, camber, fabrication and erection tolerances, type of finish, weights of members, and critical clearances. Profiles, sizes, spacing, locations, member identity, methods of assembly, locations of hardware, anchors, and accessories, and erection sequence and details of structural members.

3. Details of connections: bolted and welded. Indicate all shop and field bolts and welds.

4. Details of welded connections with symbols conforming to AWS standards. Indicate size, type, and net lengths of each weld.

5. Investigate stresses caused by the proposed erection procedure. Submit drawings showing details of required temporary supports, staying, and bracing. Include descriptive data and design calculations to illustrate the erection, transportation, and handling procedures, including sequence of erecting and transfer of loads if applicable.

B. Product data for primer including written verification from the manufacturer that the primer is compatible with the finish coats specified in Section 09900, Paints and Coatings.

C. Steel Fabricator: Submit a list of projects demonstrating a minimum of 10 years of experience in the fabrication of structural steel, and verification that the fabricator meets the specified AISC Certification program requirements.

D. Steel Erector: Submit a list of projects demonstrating a minimum of 10 years of experience in the erection of structural steel.

E. Welder Qualifications: Submit copies of qualification test records for each welder, welding operator, and tack welder to be employed in the work. Comply with requirements of AWS D1.1. For pipe and tube, comply with requirements of AWS D10.9.

1. Submit welders' identification marks (I.D.) for each welder along with qualifications.

F. Welding Procedure Specifications (WPS): Prior to commencement of welding, submit the procedure specifications that will be used for welding. The WPS shall contain all data indicated in AWS D1.1 Annex IV, and any other information necessary to produce welded joints in compliance with this specification. For procedures other than those prequalified in accordance with AWS D1.1, D1.2, and D1.5, submit a copy of procedure qualification test records in accordance with the qualification requirements of AWS D1.1, AWS D1.2, and AWS D1.5, as applicable. The WPS shall also include the mitigation of corrosion of welds, including heat treatment and chemical compatibility, as applicable.

G. Welding Records and Data:

1. Submit all radiographs upon completion of fabrication.

2. Submit certifications that magnetic particle and dye-penetrant inspections have been satisfactorily completed.

3. Submit records of ultrasonic testing upon completion.

4. If field welding is permitted, submit descriptive data for field welding equipment.

H. Mill Certificates: Submit mill certificates and certified copy of reports for analyses and tests required by referenced ASTM and AWS specifications.

1.04 DELIVERABLES

A. Quality Control Deliverables:

1. Certified Mill Test Reports: Submit certified mill test reports indicating structural strength, and destructive and non-destructive test analyses.

2. Certificates of Compliance: Submit Certificates of Compliance to certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Calculations substantiating camber, which are submitted with shop drawings in accordance with Caltrans Standard Specifications, Section 55-1.02, and erection procedures shall be prepared, sealed, and signed by a Professional Engineer hired by the Contractor who is currently registered in the State of California.

B Steel Fabricator:

1. Minimum of 10 years experience in the fabrication of structural steel, and who participates in the AISC Certification program and is designated an AISC Certified Plant, Category STD.

2. Additionally, a fabricator involved in the fabrication of structural steel for bridges shall be designated an AISC Certified Plant, Category CBR.

C. Steel Erector:

1. Minimum of 10 years experience in the erection of structural steel.

D. Qualifications of Welders and Welding Procedures: Welders, welding operators, tack welders, and welding procedures shall be prequalified or qualified in accordance with the following AWS Welding Codes and Standards:

1. Structural Steel: AWS D1.1, Section 4, Qualification

2. Steel for Bridges: AWS D1.5, Section 5, Qualification

3. Stud Welding: AWS D1.1, Section 7.6, Stud Application Qualification Requirements

4. Pipe and Tube: AWS D10.9

E Qualifications of Welding Inspector: Welds to be inspected by the Contractor shall be inspected and certified by a Contractor-employed AWS Certified Welding Inspector (CWI), certified in accordance with AWS QC 1.

F Qualification of Personnel Performing Nondestructive Testing: Personnel performing nondestructive testing, who are Contractor-employed, shall be qualified and certified in accordance with SNT-TC-1A. Only persons certified for NDT Level I and working under a NDT Level II person or persons certified for NDT Level II may perform nondestructive testing.

G Weldability of Steel: For structural steel requiring impact test qualification, the weldability of the steel and the procedures for welding it shall be established by qualification in accordance with AWS D1.1, Section 4.

H. Qualification of Stud-Connector Manufacturer: Stud shear connector manufacturer shall be qualified in accordance with AWS D1.1, Annex IX, Manufacturers' Stud Base Qualification Requirements.

I. Stud Welding Standards: For stud welding, comply with applicable requirements od AWS C5.4.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise noted in the Contract Documents, the following shall be used for structural steel members:

1. Structural Steel Members: Members shall conform to Caltrans Standard Specifications, Section 55-2, Materials, and AREMA Manual, Chapter 15.

2. Bolts, Nuts, and Washers: Bolts, nuts, and washers shall conform to Caltrans Standard Specifications, Section 55-2, Materials, and AREMA Manual, Chapter 15.

3. Stud connectors shall conform to AREMA Manual, Chapter 15.

4. Welding Materials: Welds shall conform to Caltrans Standard Specifications, Section 55-3.17, Welding, and AREMA Manual, Chapter 15.

5. Shop Primers: SSPC Paint 20 or 22. Verify compatibility of shop primer and finish coats specified in Section 09900, Paints and Coatings.

B. Section 05500, Metal Fabrications: Steel items required in construction of Shelters, except for shelter steel items designated as structural steel on the Contract Drawings.

2.02 FABRICATION

A. Fabricate structural steel in accordance with Caltrans Standard Specifications, Section 55-3, Fabrication, and as specified herein.

B. Fabricate structural steel for railroad bridges in accordance with AREMA Manual, Chapter 15.

C. Shop Assembly: Steel members shall be prefabricated and preassembled in the shop as far as practicable. Continuously seal joined members by continuous welds. Grind all exposed welds smooth.

D. Field Connections: Provide bolts for all field connections except where indicated or permitted by the Engineer.

1. Use high-strength bolts unless indicated or specified otherwise.

2. If structural steel details shown on the Contract Drawings are not compatible with selected erection procedures, submit proposed modifications for review.

E. Field welding, where indicated or permitted by the Engineer, shall be performed as herein specified for shop welding.

2.03 SHOP FINISHING

A. Interior, Non-Corrosive Applications:

1. After fabrication and immediately before shop painting, wash structural steel materials with solvent to remove dust and residue in accordance with SSPC-SP 1.

   a. Structural Steel Materials not Exposed to the Public: Power-tool cleaned in accordance with SSPC-SP 3 to remove mill scale, rust, grease, oil, and any other foreign matter.

   b. Structural Steel Materials Exposed to Public View: Blast cleaned in accordance with SSPC-SP 10 or power-tool cleaned in accordance with SSPC-SP 11 to remove all visible mill scale, rust, grease, oil, and any other foreign matter.

2. If materials are not painted immediately after cleaning then those materials shall be washed with solvent to remove dust and residue in accordance with SSPC SP 1.

3. After preparation, shop paint steel materials with one coat of corrosion-inhibitive metal primer in accordance with SSPC PA 1. Materials and application shall conform to SSPC-Paint 20 or SSPC-Paint 22.

B. Exterior Applications:

1. Steelwork to be Exposed to Weather: Blast cleaned in accordance with SSPC-SP 10, Near White Blast Cleaning, or power-tool cleaned in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal. For new steel bridges, cleaning shall be in accordance with SSPC-SP 10.

2. After cleaning, solvent wash in accordance with SSPC-SP 1, and shop paint steelwork in accordance with SSPC-PA 1. Materials and application shall conform to SSPC-Paint 20. For new steel bridges, only shop-applied Type I – Inorganic Zinc Rich Primers shall be used.

2.04 SHOP WELDING

A. Perform shop welding as indicated in accordance with the AWS D1.1 and AWS D1.5, as applicable to the work.

B. Welders shall mark adjacent to completed welds their welder I.D., using metal stamp, metal engraving, keel, paint stick, or other appropriate marking material.

C. Welding of stud shear connectors shall conform with AWS D1.1, Section 7, Stud Welding, AWS C5.4, and the stud manufacturer's instructions.

2.05 INSPECTIONS AND TESTS BY THE CONTRACTOR

A. Visual Inspection: All welds for structural steel and structural steel for bridges shall be visually examined in accordance with AWS D1.1, Sections 6 and 7.8, as applicable. Quality of welds and standards of acceptance shall be in accordance with AWS D1.1, Section 6.9.

B. Nondestructive Testing: Nondestructive testing shall conform with AWS B1.10.

C. Radiographic Testing: Radiographic testing of welds shall conform with AWS D1.1, Section 6.12 and ASTM E94, ASTM E142, and ASTM E1032, as applicable. Complete joint penetration groove welds shall be tested as follows:

1. 20 percent with thickness equal to or less than 3/4 inch

2. 50 percent with thickness greater than 3/4 inch and equal to or less than 1-1/2 inches

3. 100 percent for thickness greater than 1-1/2 inches

D. Ultrasonic Testing: Ultrasonic testing of welds shall conform with AWS D1.1, Section 6.13, and ASTM E164, as applicable. Complete joint penetration groove welds not accessible for radiographic testing shall, with Engineer's approval, be subjected to ultrasonic testing. The extent shall be the same as specified for radiographic testing.

E. Magnetic Particle Inspection: Magnetic particle inspection of welds shall conform with ASTM E709. Complete and partial joint penetration groove welds and fillet welds shall be inspected as follows:

1. 25 percent of complete joint penetration groove welds of tee and corner joints.

2. 20 percent of partial joint penetration groove welds and fillet welds.

F. Liquid Penetrant Inspection: Liquid dye penetrant inspection of welds shall conform to ASTM E165. Liquid penetrant inspection shall be used for detecting discontinuities that are open to the surface.

G. Inspections for Bridge Structural Steel Welding: In addition to the inspection requirements specified herin, inspect welding in accordance with AREMA Section 15.3.5.5 including the following non-destructive testing:

1. All full-penetration welds in girder webs and flanges shall be inspected by the radiographic method.

2. All flange to web welds shall be inspected by the ultrasound method.

3. All fillet welds on bearing stiffeners shall be inspected by the ultrasound method.

4. At least 25 percent of all other welds shall be inspected by the ultrasonic or magnetic particle method.

   a. If any defects are found, 100 percent inspection by the ultrasonic or magnetic particle shall be required.

5. Inspection of welded work for Fracture Critical Members shall be in accordance with AREMA Chapter 15.

6. Time delay prior to NDT of weld repairs to groove welds of ASTM A588 or ASTM A709 material over 2 inches in thickness subject to tensile stress, shall be 16 hours minimum.

H. Test Results: Test result information shall be forwarded to the Engineer immediately after test results are available, stating the acceptance or rejection of fabricated components, so that repairs and reinspection or testing may be performed as soon as possible.

I. Repairs: Unacceptable welds shall be repaired in accordance with AWS D1.1, Section 5.26. Repaired or corrected welds shall be reinspected or retested as specified for the original weld.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Erection:

1. Allow for erection loads, and for sufficient temporary bracing to maintain the structure safely plumb and in true alignment until completion of erection and installation of permanent bracing.

2. Do not field cut or alter structural members without prior approval of the Engineer.

3. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

4. Coordinate the installation of structural steel with the installation of miscellaneous metals to minimize the requirement for field cutting, alteration, temporary bracing, and redundant operations during erection.

B. Erection Tolerances: Maximum offset from true alignment shall be 1/4 inch.

3.02 FIELD FINISH

A. Refer to Section 09900, Paints and Coatings, for field finish for work of this Section.

1. After installation or erection of structural steelwork, abraded areas, field bolts, and welds shall be touched up and spot painted with corrosion-inhibitive primer. Field welds shall be thoroughly wire-brushed or disc-sanded prior to touch-up painting.

END OF SECTION