SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members, support members, sag rods, struts, and tension rods.

B. Base plates.

C. Grouting under base plates.

D. Shop priming and field touch-up to extent specified.

E. Employment of a licensed surveyor registered in the state in which the project is located to certify lines and levels of installed structural steel.

1.02 RELATED REQUIREMENTS

A. Section 05310 - Steel Deck: Support framing for small openings in deck.

B. Section 05500 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc..

B. AISC - Specifications for the Design Fabrication and Erection of Structural Steel for Buildings, including the Commentary and Supplements thereto as issued.

C. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc..

D. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts.

E. AISC - Specification for Architectural Exposed Structural Steel.

F. AISC - Seismic Provisions for Structural Steel Buildings.

G. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel.

H. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

I. ASTM A108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.

J. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

K. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

L. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

M. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric).

N. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

O. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts.

P. ASTM A 563M - Standard Specification for Carbon and Alloy Steel Nuts [Metric].

Q. ASTM A 572/A 572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

R. ASTM A 992/A 992M - Standard Specification for Structural Steel Shapes.

S. ASTM C 1107/C 1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

T. ASTM E 94 - Standard Guide for Radiographic Examination.

U. ASTM E 164 - Standard Practice for Ultrasonic Contact Examination of Weldments.

V. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination.

W. ASTM E 709 - Standard Guide for Magnetic Particle Examination.

X. ASTM F 436 - Standard Specification for Hardened Steel Washers.

Y. ASTM F 959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.

Z. ASTM F 1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

AA. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.

AB. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.

AC. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc..

AD. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings.

AE. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings.

AF. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc..

AG. ICBO Report No. 2614 or equivalent.

1.04 SUBMITTALS

A. See Section 01350 - Submittals, for submittal procedures.

B. Shop Drawings: Submit shop drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erections. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar details as shown in the Contract Documents.

1. Include details of cuts, connections, camber, holes per figure 5.2 of AWS D1.1-02 or AISC Section J1.8 and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.
2. Provide setting drawings, templates and directions for installation of anchor bolts and other anchorages to be installed for work specified in other sections.
3. Shop drawings shall use the "United States Standards" system dimensioning (feet, inches, etc.). Shop drawings which use only metric system of measurements will be rejected.
4. Shop drawings shall be drawn on sheet sizes not less than 24" x 32".
5. During the shop drawings submittals phase if the Contractor cannot establish approved document within two submissions he will assume the responsibility for the additional cost incurred by the Architect for the additional reviews.
6. No deviation of structural details or framing shall be made in the shop drawings without prior approval by Building Department and the Architect.

7. All approved deviations from the contract documents through Request for Information (RFI) process shall be referenced on the shop drawings with appropriate RFI numbers.
8. Maximum number of shop drawing sheets in any submittal shall not exceed 200 for a minimum two week review period by the structural engineer. The review period for additional submittal will begin at the end of the previous submittal review.
9. Erection and Bracing Plan and Erection Procedure: Employ a professional engineer licensed in the state in which the project is located to prepare an erection and framing plan including column, beams, and girders. In accordance with Tile 8 CCR, Section 1710. This engineer shall be solely responsible for compliance with the plans. Keep a copy at site as required by the governing agency and the California Division of Industrial Safety. The plan shall follow the minimum procedures described below. Provide descriptive data to illustrate structural steel erection procedure including the following:
   a. Equipment and method to be used in structural steel erection
   b. Sequence of erection.
   c. Temporary guying and bracing required during erection prior to making permanent connection.
   d. Provisions to be made for stresses resulting from loads imposed by piles of materials, erection equipment or other loads on the framing during erection.
   e. Extent of completion and guying required for the intermediate floors between the floors being erected and the concrete poured floors.
10. List of beams to be galvanized.

C. Manufacturer's Mill Certificate: Structural steel (each type) indicate chemical, physical properties, destructive test analysis and non-destructive test analysis.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

E. Weld Procedures: Contractor shall submit all welding procedures, stamped and signed by a structural engineer licensed in the state in which the project is located for review by the owner's testing and inspection firm, the structural engineer of record, and the Building Department. Weld procedures shall be qualified as described in AWS D1.5, Section 5.12 or 5.13. All CJP single and/or double groove welds shall be back gouged unless otherwise noted on the drawings. Weld procedure shall indicate joints details and tolerances, back gouge, preheat and interpass temperature, postheat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last layers, electrode type and size, welding current polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged, from these averages the weld heat input shall be calculated.

F. Product Data: Submit the stud manufacturer's technical product data, including detailed equipment and installation requirements, and maintain copies available at the site.

1.05 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual" in an AISC certified shop.

B. Comply with Section 10 of AISC "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

D. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

E. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in California.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to insure uninterrupted progress of work. Protect all steel materials from damage during shipping, handling, and storage on the site. Steel showing dents, creases, deformations, weathering, or other defects is not acceptable. Deliver welding electrodes to site in unbroken packages bearing the manufacturer's name and label identifying the contents.

   1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay that work. Anchor bolts and template delivery shall be indicated as a milestone date on the project construction schedule.

B. Storage of fabricated steel at the site shall be the responsibility of the Contractor. 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 package materials from corrosion and deterioration.

C. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as required by the Architect.

D. Other material shall be stored in weather-tight containers until ready for use in the Work. Container must be stored in a dry place.

E. The Architect reserves the right to reject any material that has become damaged because of improper storage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles, Plates, and Channels: ASTM A 36/A 36M.

B. Steel W Shapes and Tees: ASTM A 992/A 992M.

C. Rolled Steel Structural Shapes: ASTM A 992/A 992M.

D. Steel Plates and Bars: ASTM A 572/A 572M, Grade 50 (345) high-strength, columbium-vanadium steel.

E. Cold-Formed Structural Tubing: ASTM A 500, Grade B.

F. Pipe: ASTM A53/A53A, Grade B.

G. Tension Rod: Macalloy 460 Stainless.

H. Sag Rods: ASTM A 36/A 36M.

I. Structural Bolts and Nuts: Carbon steel, ASTM A 307, Grade A.

J. High-Strength Structural Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, medium carbon, plain.

K. Unheaded Anchor Rods: ASTM F 1554, Grade 55, plain, with matching ASTM A 563 or A 563M nuts and ASTM F 436 Type 1 washers.

L. Headed Anchor Rods: ASTM F 1554, Grade 55, plain.

M. Studs: Standard product steel stud units intended for welding by automatically timed stud-welding equipment, furnished complete with an arc shield (ferrule) of heat-resistant ceramic or equivalent for all studs and, for studs 5/16 inch diameter or larger, a deoxidizing and arc stabilizing flux; not painted, galvanized, or cadmium plated prior to welding and all finished by cold heading, cold rolling, or machining. Furnish studs of uniform quality and condition, free of injurious laps, fins, seams, cracks, twists, bends not indicated, rust, rust pits, scale, oil, or other injurious defects or substances.

N. Stud Steel: Furnish studs manufactured of Grade C-1015 cold-drawn steel conforming to ASTM A108 and having minimum 60,000 psi tensile strength with 20 percent elongation in 2 inches and 50 percent area reduction.

O. Load Indicator Washers: Provide washers complying with ASTM F 959 at all connections requiring high-strength bolts.

P. Welding Materials: AWS D1.1; type required for materials being welded.

Q. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C 1107/C 1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days. Provide as indicated on drawings.

R. Shop and Touch-Up Primer: Fabricator's standard or SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

S. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, SSPC-Paint 20, Type I-Inorganic, or SSPC-Paint 20,Type II-Organic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

E. Cleaning and Straightening: Wire brush steel materials and clean off loose mill scale and rust. Straighten steel members by non-injurious methods prior to fabrication. Remove twists or bends after punching or working component parts of a member before the parts are assembled. Produce finished members free from twists, bends, and open joints when erected.

2.03 FINISH

A. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

B. Galvanize structural steel members to comply with ASTM A 123/A 123M. Provide minimum 1.7 oz/sq ft galvanized coating.

2.04 SOURCE QUALITY CONTROL

A. Provide shop testing as indicated on drawings.

B. Welded Connections: Visually inspect all shop-welded connections and test at least one (1) percent of welds, all other welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E 94.
   2. Ultrasonic testing performed in accordance with ASTM E 164.
   3. Liquid penetrant inspection performed in accordance with ASTM E 165.
   4. Magnetic particle inspection performed in accordance with ASTM E 709.

C. Testing laboratory shall perform conformance testing in accordance with CBC Chapter 17.
   1. Identified Structural Steel: Steel shall be identified in accordance with ASTM A6-05 and bear legible heat numbers acceptable to the Testing Laboratory which shall make positive identification of structural steel as to mill source, heat numbers, and certified mill analysis and test report for each heat. Obtain the mill test reports, and furnish report certifying identity of steel.

2. Unidentified Structural Steel: Steel not identified and certified as specified above shall be tested according to following requirements. Structural steel fabricator shall cut samples under direction of the Testing Laboratory. Testing Laboratory shall machine or otherwise prepare the specimens, and perform testing of each 5 tons or fraction thereof, for each size of unidentified steel except, in the case of random pieces or steel having Fy equal to or greater than 36 ksi, testing of each piece is required. Tests required are:
   a. For pipe, one tension and elongation test and one flattening test of each size.
   b. For all other steel, one tension and elongation test and one bend test for each size.
   c. Additional test per Section 1.6.0.3 may be required for quantity when deemed necessary by the Architects or by the governing agency.
   d. Contractor shall reimburse to the owner all cost paid by the owner for testing unidentified steel.
3. For all other identified steel having Fy equal to or greater than 36 ksi, one tension and elongation test and one bend or flattering test, as applicable, for each heat plus steel manufacturer's certified mill analysis and test report as specified above shall be performed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".

E. Do not field cut or alter structural members without approval of Alexander + Hibbs AIA, Inc. and Structural Engineer.

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

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

H. Bolted Construction:
   1. Load Indicator Washers: Manufactured and licensed by Cooper and Turner, or equal, may be used for field installation of high-strength bolts. Load indicator washers do not replace required washers but may be used in conjunction with required washers. Conform tightening to Paragraph 5e of "Reference Specifications." After sufficient bolts in a joint are snugged to bring the members into close contact, perform tightening from most rigid part to free edges until load indicators on all bolts are closed to required gap of 0.015" under bolts heads or 0.010" under the nuts. Do not completely close the gap to prevent over tightening and damage to the bolts.
   2. Tension Set of Load Indicator Bolts, Nuts, and Washers: As manufactured by Cold Form Specialties, or equal, may be used for the field installation of high-strength bolts. In multi-bolts joints, tighten the nuts in stages (a little at a time) without breaking spline in any of them until final stage, to minimize slackening of the installed bolts.

I. Field Assembly: Set structural frame accurately to lines and elevations. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure within specified tolerances.
   2. Splice members only where indicated and accepted on final shop drawings.
   3. Do not enlarge unfair holes in members by burning or by use of drift pins except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
   4. All back-up bars, dams, and runoff tabs shall be removed: the weld, base metal shall be ground flush and smooth per AWS.

J. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members which are not under stress. Finish gas-cuts sections equal to a sheared appearance when permitted.

K. Damaged Members: Remove members damaged to an extent impairing appearance, strength or serviceability, as determined by Architect and replace with new members at no extra cost to the owner.

L. Stud Welding:
   1. Conform installations to stud manufacturer's instructions and requirements herein.
      a. Welding Equipment: Furnish automatically timed stud-welding equipment together with a suitable power source, type and manufacture approved by the stud manufacturer. Interlock the welding equipment supplying current to two or more stud-welding guns so that only one gun can operate at a time and so the power source has fully recovered from making one weld before another weld is started.
      b. Installation: Do not install studs on wet surfaces, nor studs showing defects, rusting, rust pits, scale, oil, or other deleterious substances. Install studs promptly after cleaning and preparation. Hold welding gun in correct position and without movement until the weld metal has solidified. Break and remove are shield after welding. Produce welded studs free from any defect or substance that interferes with intended functions.
         1) Placing Locations: The longitudinal and lateral spacings for all stud connectors with respect to each other and to edges of member may vary 1/2 inch maximum from locations shown provided adjacent studs are not closer than 3 inches on centers. Provide a minimum distance between edges of stud bases and flange edges equal to the stud diameter plus 1/8 inch, but minimum 1-inch clearance. Location accuracy of other types of studs shall permit the assembly of attachments without alterations or reaming.
         2) Stud Lengths: Stud lengths indicated are minimum net lengths after welding. If reduction in length of a stud as it is welded is such that the length of the stud is more than 1/16-inch greater than specified by stud manufacturer, discontinue installation until cause is determined and eliminated and pre-production testing is satisfactorily repeated.
         3) Defective Fillets: Studs not showing a full 360 degree wild fillet after welding may be repaired by adding a 3/16-inch fillet weld in lieu of the missing weld fillet in accordance with AWS D1.1 and using low-hydrogen electrodes.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01410.

B. Welded Connections: Visually inspect all field-welded connections and test at least 100 percent of CIP welds and 25 percent of welds, all other welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E 94.
   2. Ultrasonic testing performed in accordance with ASTM E 164.
   3. Liquid penetrant inspection performed in accordance with ASTM E 165.
   4. Magnetic particle inspection performed in accordance with ASTM E 709.

END OF SECTION