# PART 1 - GENERAL

## 1.1 SUMMARY

A. Section Includes:
1. Structural steel framing.
2. Steel pipe and tube framing.
3. Steel shelf angle for brick veneer.
4. Shop priming and field touch-up to extent specified.
5. Shop and Field inspections by University.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 01 “Sustainable Design Requirements.”
3. Division 03 Section “Concrete Formwork” for Setting of anchor bolts and inserts in concrete.
4. Division 05 Section “Steel Decking” for Metal decking installation.
5. Division 03 Section “Concrete Reinforcement” for reinforcing steel.
6. Division 05 Section “Metal Fabrications” for steel embed plates, angles, and anchors.
7. Division 07 Section “Applied Fireproofing” for fireproofing for structural steel.
8. Division 09 Sections “Exterior High-Performance Coatings,” “Exterior Painting” and “Interior Painting” for field painting except as specified herein.
9. Division 05 Section “Cold-Formed Metal Framing” for Contractor-engineered framing systems.

## 1.2 REFERENCES

A. AISC Standards: Code of Standard Practice for Steel Buildings and
1. Bridges; Specification for the Design, Fabrication and Erection of
2. Structural Steel for Buildings; and Steel Construction Manual; as amended by Building Department.

B. AWS Standards: AWS D1.1, Structural Welding Code.

## 1.3 SUBMITTALS

A. General: Submit each item in this Article according to the General Conditions of the Contract and Division 1 Specification Section “Submittal Procedures.”

B. LEED Submittals: Credits MRc4 & MRc5. Refer to Section 018113 “Sustainable Design Requirements” for additional submittal requirements.

C. Product Data: Submit copies of producer's or manufacturer's data and installation instructions for the following products. Include laboratory test reports and other data required to show compliance with these specifications:
1. Structural steel, including certified copies of mill test reports covering chemical and physical properties.
2. Unfinished bolts and nuts.
3. High strength bolts, including nuts and washers.

C. Shop Drawings: Submit Shop Drawings covering all structural steel including welding, accessories, and fastenings. Fully detail minor connections and fastenings not shown or

specified to meet required conditions. Include detailed sequence plan for shop and field welding that minimizes locked-in stresses and distortion.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article and for the testing and inspection agency 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.

1.4 QUALITY ASSURANCE

A. Qualifications of Fabricator: Fabricate structural steel in shop of a licensed fabricator approved by the University's Representative.

B. Requirements of Regulatory Agencies: Work of this section shall conform to Applicable Building Code and Title 8, CCR.

C. Source Quality Control:
1. Identified mill order steel: If steel can be identified by heat and melt numbers, and is accompanied by mill analyses and test reports, commercial stock may be used without physical testing. Submit an affidavit attesting to compliance in accord with the Specifications.
2. Identified local stock steel: For hot-rolled structural steel shapes, plate and tube required to meet a minimum specified yield mill analyses and test reports certified by the manufacturer may constitute sufficient evidence of conformity with specifications provided materials can be identified in fabricating shop in accordance with ASTM designations by a qualified representative of an independent testing laboratory. When in compliance with these conditions, physical testing will not be required.
3. Unidentified Structural Steel:
   a. When material required to meet a minimum specified yield of 36,000 psi cannot be identified or its source is questionable, make one set of tension tests and one set or bend tests for each 20 tons or fractional part thereof of each heat. Additional tests may be ordered when deemed necessary.
   b. When material required to meet a minimum specified yield greater than 36,000 psi cannot be identified or its source is questionable, make one set of tension tests and one set of bend tests for each piece.
4. High Strength Bolts: Furnish certified copy of manufacturer's test reports stating that high strength bolts and heat-treated steel structural bolts meet the requirements of ASTM A325 and ASTM A490, respectively.
   a. Testing laboratory shall take samples and test not less than 3 samples including nuts, bolts and washers from each lot and each size of each lot.

D. Erection and Bracing Plan and Procedure: Refer to Section 1710, Title 8, CCR, and Applicable Building Code. Employ and pay a California registered civil engineer to prepare an erection and bracing plan and erection procedure for structural steel including columns, beams, and girders, who shall be solely responsible for its compliance. Follow the plan and procedure exactly. Keep a copy at the job site as required by California Division of Industrial Safety. File two copies of stamped erection and bracing plan and procedure for record purposes only, not for review or approval.

E. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the State of California and who is experienced in providing engineering services of the kind indicated for a minimum of five years. Engineering services are defined as those

performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

F. Preinstallation Conference: Conduct conference at project site to coordinate the work with work of other Sections.

1.5 PRODUCT DELIVERY AND HANDLING

A. Delivery and Handling: Protect all materials from damage during shipping, handling and storage on the site. Steel showing dents, creases, deformations, weathering, or other defects are not acceptable.

B. Welding Electrodes: Deliver to the site in unbroken packages bearing the manufacturer's name and label identifying the contents.

C. Comply with Division 1 Section “Material & Equipment.”

1.6 PROJECT SITE CONDITIONS

A. Site Measurements: Take field measurements as required. Report any major discrepancy between drawings and field dimensions.

B. Protection of Floors: Use caution to protect floor slab and adjacent work from damage. Do not overload floors. Use rubber-tired equipment to handle and move steel. Do not place steel members directly on floor; use pads of timber or like material for cushioning.

C. Temporary Flooring: Provide necessary temporary planking, scaffolding, and flooring for erection of structural steel or support of erection machinery. Conform use of temporary floors or steel decking to Applicable Building Code.

D. Connection of Steel Decking Temporary Flooring: Temporarily weld steel decking to supports where used as a working platform. Distribute concentrated loadings from welding machines and other heavy machinery with planking or equal. Replace decking damaged by use as a working platform at no additional contract cost.

E. Sequencing: Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

B. Recycled Content: All structural steel shall contain a minimum of 90 percent recycled-content material based on 75 percent post-consumer steel.

C. Steel shapes: ASTM A36, A572, Grade 50, or A992 as per the drawings.

D. Steel pipe: ASTM A53, Type E or S, Grade B.

E. Structural tubing HSS shapes: ASTM A500, Grade B, Fy=46 Ksi for rectangular shapes, Fy=42 Ksi for round shapes.

F. Bar stock for anchor bolts: ASTM A36 or A675, Grade 75.

G. Machine bolts and nuts: ASTM A307, Grade A.

H. High strength bolts, nuts, and washers: ASTM A325.

I. Anchor Bolts: ASTM A307, non-headed type, or ASTM A449. Threaded Rods: ASTM F 1554, Grade 36 or as indicated on the Contract Documents. with ASTM A 563 heavy hex carbon steel nuts, ASTM F 436 hardened washers and plain finish.

J. Heat treated steel structural bolts, 150 ksi minimum tensile strength: ASTM A490.

K. Welded stud connectors: See also Section 050650 “Welded Stud Connectors.” Welded stud connectors: qualified in accordance with UBC, AWS D1.1, latest revision, and installed in accordance with the procedures and quality control requirements of AWS D1.1, latest revision.

L. Welding electrodes:
   1. Carbon steel covered arc welding electrodes for A36 steels: AWS A5.1, E70XX Series, and low hydrogen.
   2. Electrodes and fluxes for submerged arc welding: AWS A5.17, E70XX Series.
   3. Gas-shielded arc welding: AWS A5.18.
   4. Flux-cored arc welding: AWS A5.20.

M. Shop Primer for Steel Scheduled to Receive High-Performance Coating: Meeting AISC requirements of a Class B surface with a mean slip coefficient no less than 0.50 and a tension creep not in excess of 0.005 inches conforming to SSPC-PS12.01. Primer shall be by same manufacturer as specified in Division 09, Section “High-Performance Coatings”.
   1. Tnemec; 90-97 Tneme-Zinc Primer with a dry film thickness of 2.5 to 3.5 mils.
   2. Carboline; equal product with a dry film thickness of 2.5 to 3.5 mils.
   3. Or equal.

N. Primer: Use types acceptable to South Coast Air Quality Management District.
   1. For exposed locations (Not Scheduled to Receive High Performance Coatings): Comply with Division 09 Sections “Exterior Painting” and “Interior Painting.”
      a. Shop Primer shall be fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

   2. For concealed above-grade locations: Lead free metal primer, Tnemec 115 Uni-Bond or Rust-Oleum X-60, or equal.
   3. For below grade applications: EMACO P-24, water based rebar/steel coating, as manufactured by Master Builders, Inc., or equal. All substitutions must be considered

environmentally safe, and will be subject to the approval of the University's Representative. Touch-up on job site with EMACO P-24, match finish coat thickness.

4. General: Refer to and comply with requirements of Division 09 Sections "Exterior Painting," "Interior Painting" and "Exterior High Performance Coatings."

O. Non-shrink grout: Conform to requirements of Section 03300.

P. Dielectric shims: Korolath Material.

## 2.2 FABRICATION

A. Fabricate structural steel in accordance with the approved submittals, reference standards as applicable, and requirements herein. Fabricate and form the work to meet actual installation conditions verified at the site.

B. Cleaning and Straightening: Thoroughly wire brush material, clean of loose mill scale and rust, and straighten by methods that will not injure the steel 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.

C. Contact: Pin components parts of built-up members and maintain in close contact using clamps or temporary bolting during welding operations. Accurately mill compression bearing surfaces of joints depending on contact bearings or saw cut square to axis, or as detailed. Cut other joints straight and true.

D. Joining: Provide members of the sizes, weights, shapes, and arrangements indicated, closely fitted and finished true to line and in precise position as necessary to allow proper joining of parts in the field. Drifting to enlarge unfair holes is not allowed without prior approval.

E. Drilling, Punching, and Reaming: Hole burning to make or enlarge previous holes is allowed only with prior approval. Prepare required holes in structural steel members for attachment or passage of work of other trades. Precisely locate finished holes to ensure passage of all bolts through steel assemblies without drifting. Enlarge holes only by reaming. Poor matching of holes is cause for rejection.

F. Holes For Anchor Bolts: Punch and drill or ream holes in base and bearing plates. Do not make or enlarge the holes by burning except for grouting holes in column bases.

G. Base Plates: Press or mill steel column base plates 4" thick or less for straight contact bearing between plate and column.

H. Gas Cutting: Use of a cutting torch is allowed where the metal being cut is not stressed during the operation, and provided stresses are not transmitted through a flame-cut surface. Make all gas cuts with a smooth regular contour. Deduct 1/8" from width of gas cut edges to determine effective width of members that are gas cut. Make radius of reentrant gas cuts as large as possible, but 1" minimum.

## 2.3 CONNECTIONS

A. Make connections with common bolts unless otherwise shown.

B. High-Strength Steel Bolting: For joints connected by high strength steel bolts, hardened washers, and nuts tightened to high tension, conform materials, method of installation and tension control, type of wrenches, and inspection to the reference standards and the following requirements:
   1. High-strength bolts shall have a suitable identifying mark placed on top of the head at the factory.
   2. Tightening of nuts shall be done with calibrated wrenches or by the turn of the nut method. Minimum bolt tension for the size of bolt used shall conform to tables listed in reference standards.
   3. Calibrated wrenches shall be checked individually for accuracy at least once daily for actual conditions of application.
   4. Fully tightened bolts shall be marked with identifying symbol.
   5. Hardened washers shall be installed in accordance with AISC standards.
   6. Clean all contact surfaces of bolted parts and threads free of scale, slag, burrs, and pits, as well as dirt and foreign materials which would prevent solid seating of parts.
   7. Bolt lengths shall equal the grip plus 1-1/4-inch.

C. Load Indicator Washers: As manufactured and licensed by Cooper and Turner, Bethlehem Steel, or equal, may be used for the field installation of the high-strength bolts. Load indicator washers may not be substituted for any required washer, but may be used in conjunction with the required washers. Conform tightening to Paragraph 5e of the Reference Standard. After sufficient bolts in a joint are snugged to bring the members into close contact, tightening shall progress from the most rigid part to the free edges until the load indicators on all bolts are closed to the required gap of 0.015" under bolt heads or 0.010" under the nuts. Do not completely close the gap to prevent over tightening and damage to the bolts.

D. Tension Set or Load Indicator Bolts, Nuts, and Washers: As manufactured by Cold Form Specialties, Bethlehem Steel, or equal, may be used for field installation of the high-strength bolts. In multi-bolt joints, the nuts shall be tightened in stages (a little at a time) without breaking the spline in any of them until the final stage, to minimize slackening of the installed bolts.

## 2.4 WELDING

A. Conform to AWS D1.1 and AWS D1.8, as modified by referenced AISC Standards, and as indicated or noted on the Drawings. Employ certified welding operators who are thoroughly trained and experienced in arc welding and produce uniformly reliable groove and fillet welds in flat, vertical, and overhead positions, and make neat and consistent welds. Weld structural steel joints by the shielded electric-arc method unless otherwise shown or specified. Provide inspection and testing of welds as required under Article "Field Quality Control" hereinafter.

B. Weld Finishing: Grind exposed welds smooth, free of holes, slag, or other defects, flush with the adjoining surfaces. No finish treatment is required for permanently concealed welds and other exposed welds.

C. Storage and Care of Electrodes: Coatings of low-hydrogen type electrodes shall be thoroughly dry as used. Conform to AWS D1.1 and AWS D1.8; use electrodes as taken from hermetically sealed packages within time limit specified therein after package is opened. Electrodes not used within allowable time period and electrodes that have been exposed more than one hour to air having a relative humidity of 75% or greater shall be dried according to AWS D1.1 and AWS D1.8 before they are used, or shall be reconditioned according to electrode manufacturer's recommendations. Electrodes so dried or reconditioned not used within

allowable time period after drying is completed shall be redried before use. Electrodes of any class that have been wet shall not be used under any conditions.

D. Preparation: Clean steel surfaces to be welded of paint, grease, oil, mill scale, and foreign matter. Clean weld each time the electrode is changed. Chip full surface of hand guided and controlled flame cut edges before welding. Surfaces prepared with automatic or mechanically guided and controlled equipment need not be ground or chipped before welding.

E. Shop Ultrasonic Testing: The University's Testing and Inspection Laboratory shall ultrasonically test all column materials greater than 1-1/2" in thickness for laminations within 12-inches (6-inches on each side) of direct groove welds from column splices and girder flange connections prior to welding. Conform to ultrasonic testing procedures specified under "Field Quality Control", hereinafter.

F. Procedures: During assembling and welding, hold components of a built-up member with adequate clamps or other means to keep parts straight and in close contact. Do no welding in wind until adequate protective screening is set up. Cut out defective welds or parts of welds with a chisel or air arc and replace.

G. Weld Characteristics: Clean and wire brush all welds. Visual inspection of finished welds must show uniform section, smoothness of welded metal, feather edges without undercuts or overlays, freedom from porosity and inclusions, and good fusion and penetration into base metal at edges and ends of fillet welds.

H. Lamination Checking: Prior to welding, ultrasonically test column materials greater than 1-1/2" in thickness for lamination within 12" (6" on each side) of a direct groove weld from column splices and girder flange connections. Conform to the ultrasonic testing procedures specified under "Field Quality Control" hereinafter.

## 2.5 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. When using wedge-type concrete inserts, furnish the inserts, complete with fasteners, to work specified in other Sections, to attach shelf angles to cast-in-place concrete.

## 2.6 SHOP PRIMING

A. Clean surfaces according to AISC Specifications. Apply one shop coat of specified metal primer to minimum 1.0 mil dry film thickness. Work primer into joints. Do not prime the following:

1. Steel surfaces embedded in concrete or masonry.
2. Permanently concealed structural steel surfaces.
3. Contact surfaces of high-strength bolted connections.
4. Surfaces to receive directly adhered fireproofing.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

PART 3 – EXECUTION

3.1 ERECTION OF STRUCTURAL STEEL

A. Brace and secure structural steel members until permanent connections are completed. Provide accessories and fasteners to secure steel in place as shown and required. Conform to Applicable Building Code, AISC Standards, and erection and bracing plan and procedure.

B. Employ qualified riggers and plan erection to require minimum cutting. Erect members plumb, true to line and level, and in precise positions. Provide temporary bracing and guying to resist loads and stresses to which the structure may be subjected, including those due to erection equipment and its operation.

C. Exposed Structural Steel Welds: Provide continuous full-penetration welds, ground smooth.

D. Damaged Members: During erection, straighten or replace members, which are bent, twisted, or damaged as directed. If heating is required, perform heating by methods that ensure a uniform temperature throughout the entire member. Remove members damaged to an extent impairing appearance, strength, or serviceability and replace with new members at no extra cost to the University.

E. Anchor Bolts: Furnish and deliver anchor bolts with setting drawings and templates. Verify position of bolts prior to delivery of steel; report errors or deviation for correction.

F. Steel Columns: Set column bases in exact position for alignment, plumb and straight, supported on adjustable bolt supports or shims until grout has set. Set center of base true to column center within 1/16" and adjust column height exactly. Maintain bases at exact position and level during grouting. Fill grout space solid with non-shrink grout.

G. Connections: Hold steel in correct position during welding and bolting, and provide for dead loads, wind, and all erection stresses. Do no welding or final bolting until members have been aligned and plumbed.
   1. Field Welding: Conform to requirements for shop fabrication.
   2. Common Bolts: Tighten and upset bolt threads to preclude loosening, or use approved self-locking nuts.
   3. High-Strength Bolting: Tighten by turn of the nut method or with calibrated torque wrenches as specified for the shop high-strength bolting and according to Applicable Building Code, AISC Standards and the Reference Standard.

H. Tolerances: Erect members to the tolerances conforming to referenced AISC Standards and Applicable Building Code, and as follows:
   1. Vertical Dimensions: Measured from top of beams at their connection at any column, variation not more than 1/4" plus or minus per story or, when variations are accumulative from floor to floor, not exceeding 3/8" per story exclusive of column shortening due to dead load.
   2. Plumb Displacement: Center line of columns from established column line, not more than 1" toward or away from established centerline.
   3. Floor Elevation: Floor elevation will be considered level if floor-framing members on any one floor, measured from top of column connections, do not vary more than 1/2" plus or minus.
   4. Horizontal Dimension Variances: Governed by specified column plumb displacement.

## 3.2 FIELD TOUCH-UP PAINTING

A. After structural steel erection and connections are completed and approved, clean all connections to be painted and damage to shop painted surfaces, and apply a field touch-up coat of same metal primer used for shop coat. Touch-up galvanizing worn off by construction operations.

## 3.3 FIELD QUALITY CONTROL

A. Inspection: According to Reference Standards. Inspector shall visually inspect welds, shall be present to inspect and approve all groove and penetration welding, and shall inspect all erection including the grouting under base plates.

B. Tests of Welding and Bolting: The University's Testing Laboratory shall inspect all shop and field welding, conform to requirements of Applicable Building Code, and certify in writing, after completion of work, that welding has been performed in accordance with the drawings, specifications, and Applicable Building Code.

C. Inspection of High-Strength Bolts: The University's Testing Laboratory shall check bolt tightness on a minimum of 10 percent of the bolts, selected at random, for each high-strength bolted joint. Inspection procedure shall conform to the reference standard.

D. Full Penetration and Groove Weld Inspection: The University's Testing Laboratory shall inspect full penetration and groove welds for connections of column to column, column to girder, girder to girder, and similar connections by ultrasonic testing or other approved non-destructive tests. Conform to Applicable Building Code requirements for reinspection of the welds after installation.

E. Ultrasonic Testing: The University's Testing Laboratory's specially trained and fully qualified technician shall operate ultrasonic testing equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. All defective welds shall be repaired and costs for retesting defective welds shall be paid by the Contractor.
   1. Rate of Testing: Test welds requiring ultrasonic testing at 100 percent. No reduction in testing rate will be permitted.
   2. Backing Strips: Remove backing strips whenever ultrasonic indications arising from weld roots can be interpreted as either a weld defect or a backing strip, and retest weld if no root defect is visible. If no defect is disclosed by retest and no significant amount of the

base and weld metal is removed, joint needs no further repair or welding. Repair all defects disclosed. Contractor shall bear the cost of removals and repairs.

3. Questionable Root Indications: Root indications that prove not to be defective welds shall not count against the welder to increase the test rate.
4. Ultrasonic Instrumentation: Calibrated by technician to evaluate the quality of the welds in accordance with AWS D1.1, Sections 5 and 6.

## 3.4 WASTE MANAGEMENT

A. Collect metal cutoffs and scrap and place in designated area for recycling, in accordance with the Waste Management Plan.

END OF SECTION