

**SECTION 05120  
STRUCTURAL STEEL**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
1. Structural steel framing members and all related accessories such as structural embeds, connections, bolts, welds, fasteners, threaded rods, headed studs, including fabrication, erection and all related work and accessories.
  2. Connections and other performance specified items, including related design by contractor's specialty structural engineer.
  3. Temporary bracing and shoring, including related design by contractor's specialty structural engineer.
  4. Architecturally exposed structural steel.
  5. Shop applied finishes and coatings, including preparation, primers, special paint systems or galvanizing on steel exposed to exterior or aggressive environments, and bitumastic coating on steel below grade in soil.
  6. Grouting for base plates, seats and bearing areas.
- B. Related Sections include the following:
1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
  2. Division 03 Section "Concrete" for items attached to formwork, anchors and embeds to be cast in concrete.
  3. Division 04 Section "Unit Masonry" for items attached to masonry, anchors and embeds to be set in masonry.
  4. Division 05 Section "Steel Decking" for field installation of shear connectors.
  5. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
  6. Division 09 painting Sections and Division 09 Section "High-Performance Coatings" for surface preparation and priming requirements.
  7. Division 13 Section "Metal Building Systems" for requirements related to structural steel.

**1.3 DEFINITIONS**

- A. Structural Steel: Elements of structural steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads, and as indicated on the structural contract documents.
- B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the Contract Documents.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Connections: Provide details of simple shear and moment connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD (service) or LRFD loads as indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Load and Resistance Factor Design," Volume 2, Part 9 or AISC's

- "Manual of Steel Construction, Allowable Stress Design," Part 4, as indicated in the contract documents.
2. Engineering Responsibility: Fabricator's responsibilities include engaging a specialty structural engineer to prepare structural analysis data and submit calculations for structural-steel connections.
- B. Construction: Type FR, fully restrained.
- C. Construction: Type 2 simple framing.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittal:
1. LEED Credit: Product Data for Credit MR 4.1 and Credit MR 4.2 (if required): For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings and related submittals: Show complete information for fabrication and erection of structural-steel components.
1. Submit shop drawings under provisions of Division 1 Section "Submittal Procedures". Phase submittals to match sequence of actual construction to avoid delay of work. Field verify all existing conditions impacting this work and add relevant field information to shop drawings, prior to submittal of shop drawings.
  2. Indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, fasteners, cambers, loads, welds, and headed studs. Cut erection details where details are cut on structural plans and add erection details as needed. Provide erection plans, erection details and member detail sheets. If partial area submittals are made, submit all related sheets and cloud related plan areas. Reference specific structural plans and details from which information is drawn or submittals will be rejected.
  3. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths and weld capacities. Indicate shop and field welds and sequence of erection.
  4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
  5. Provide setting drawings, templates and directions for the installation of the anchor rods and other anchoring devices, including embedments.
  6. Welders Certificates: Submit under provisions of Division 1 Section "Submittal Procedures". Welder's Certificates, certifying welders employed on the Work obtained appropriate AWS qualification within the previous 12 months.
  7. Calculations: Contractor shall engage a specialty structural engineer to perform final design calculations and submit same, for all connections not fully designed and detailed on the drawings by the Structural Engineer of Record (SER). Design for the criteria indicated here-in and as shown on the drawings. Submit signed calculations same day as steel framing shop drawings to which they relate, to ensure compatibility between specialty engineers calculations and shop drawing detailers drawings.

## 1.6 QUALITY ASSURANCE

- A. Installer(erecator) Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Cbd or Sbd. Fabricator shall be experienced in preparation of shop drawings using integrated three-dimensional modeling

software parametrically linking all major structural piece marks and overall building framing model.

- C. Specialty Structural Engineer Qualifications: Employ professional Engineer, registered in the State of Minnesota, to perform design of connections to meet structural performance requirements. Sign and seal design Shop Drawings submitted to Owner for review.
- D. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- F. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
  - 3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" or "Load and Resistance Factor Design Specification for Structural Steel Buildings."
  - 4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
  - 5. AISC's "Specification for Allowable Stress Design of Single-Angle Members" or "Specification for Load and Resistance Factor Design of Single-Angle Members."
  - 6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- G. Mockups: Build mockups of architecturally exposed structural steel to set quality standards for fabrication and installation.
  - 1. Prior to construction, verify size, quantity and configuration of markups with Architect and verify whether mockups must be separately fabricated and delivered to specified locations, or if they can be a part of the original design integrated in the completed work.
  - 2. Coordinate finish painting requirements with Division 9 painting Sections.
  - 3. Approved mockups may become part of the completed Work if integrated mockups are approved by the Architect, and are undamaged at time of Substantial Completion.
- H. Contractor shall assign a qualified staff member to perform quality control on their own work in the field on a daily basis, for each day work is performed. The Contractor's quality control staff shall review their own work for compliance with contract documents before the Contractor notifies the design team or others, of readiness for required inspections, tests and observations to be provided by the Owner's Representatives.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
  - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

## **1.8 FIELD MEASUREMENTS**

- A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication. Show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to

pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

## 1.9 COORDINATION

- A. Deliver anchor rods and other anchorage devices to be embedded in concrete or masonry construction to site in time for installation without impact on schedule. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992, Grade 50.
- B. Channels, Angles, Plate and Bar: ASTM A 36.
- C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B, Finish.
  - 1. Weight Class: As indicated on the documents.
  - 2. Finish: Black, except where indicated to be galvanized.
- E. Welding Electrodes: E70XX, comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
    - a. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
- C. Shear Connectors or Headed Concrete Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B. The ferules shall be specifically designed for the weld-through technique.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36 or as indicated on Drawings.
  - 1. Configuration: Straight with nut and washer, unless specifically indicated to be hooked on the drawings.
  - 2. Nuts: ASTM A 563 heavy hex carbon steel.
  - 3. Plate Washers: ASTM A 36 carbon steel.
  - 4. Washers: ASTM F 436 hardened carbon steel.
  - 5. Finish: Plain
- E. Headed Anchor Rods: ASTM F 1554, Grade 36 unless otherwise indicated.
  - 1. Nuts: ASTM A 563 heavy hex carbon steel.
  - 2. Plate Washers: ASTM A 36 carbon steel.
  - 3. Washers: ASTM F 436 hardened carbon steel.
  - 4. Finish: Plain.

- F. Threaded Rods: ASTM A 36.
  - 1. Nuts: ASTM A 563 heavy hex carbon steel.
  - 2. Washers: [ASTM F 436 hardened] [ASTM A 36] carbon steel.
  - 3. Finish: Plain.
  
- G. Deformed Bar Anchors (DBA):
  - 1. Manufactures:
    - a. Nelson Stud Welding, Inc.
  - 2. ASTM A496, uniform diameter with minimum tensile strength of 80ksi.
  
- H. Expansion Bolts:
  - 1. Manufactures:
    - a. Liebig International, Ultraplus
    - b. Hilti, Kwik-Bolts II
    - c. ITW Ramset/Redhead, Trubolt
    - d. Wej-it Expansion Products, Inc. Wej-it Bolts
  - 2. If embedment length is not indicated on the drawings, provide embedment length recommended by the manufacturer to develop full strength of bolt.
  
- I. Adhesive Anchors into Hollow Masonry:
  - 1. Manufacturers:
    - a. Hilti, HIT HY 150
  - 2. Rods: Standard rods per ASTM A36.
  - 3. If embedment length is not indicated on the Drawings, provide embedment length recommended by manufacturer to develop full strength of bolt.
  
- J. Clevises and Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

### **2.3 PRIMER**

- A. Primer:
  - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
  - 2. Color: Fabricator's standard. [Light gray] or [White].
  
- B. Galvanizing Repair Paint: ASTM A 780.
  
- C. Bituminous Protection Coating: Carboline, Bitumastic 50

### **2.4 GROUT**

- A. Nonmetallic, High Strength, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time. F'c=4000 psi minimum at 24 hours.

### **2.5 FABRICATION**

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" or "Load and Resistance Factor Design Specification for Structural Steel Buildings" as indicated on the documents.
  - 1. Camber structural-steel members where indicated.
  - 2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
  - 3. Mark and match-mark materials for field assembly.
  - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

- B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
  - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
  - 2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Fabricate heavy shapes and connections (ASTM A6-Group 4 and 5 Rolled shapes) in accordance with AISC Manual of Steel Construction, Part 5, Paragraph A.3.C and related requirements for finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning or SSPC-SP 2, "Hand Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened or as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
  - 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
    - a. Grind butt welds flush.
    - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces to be high-strength bolted with slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials.

5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  1. SSPC-SP 2, "Hand Tool Cleaning."
  2. SSPC-SP 3, "Power Tool Cleaning."
- C. Painting: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC 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, and exposed surfaces.
  1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first

## **2.8 GALVANIZING**

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
  1. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
  2. Fill vent holes and grind smooth after galvanizing.

## **2.9 SOURCE QUALITY CONTROL**

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports in accordance with the quality control program indicated for Field Quality Control, unless the fabricator maintains AISC Certification.
  1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
  1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  3. Ultrasonic Inspection: ASTM E 164.
  4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
  1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
  2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify elevations of new and existing support surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements. Verify dimensions that affect the new work including gridlines, column and beam centerlines, face of wall, etc.
- B. Remove and replace existing finishes, utilities and other obstructions that may impede proper access for verification of conditions and installation of new work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

### **3.3 ERECTION**

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" or "Load and Resistance Factor Design Specification for Structural Steel Buildings", as indicated on the drawings.
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
  - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of base plate.
  - 3. Snug-tighten or Pretension anchor rods, as indicated on the drawings, 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 before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated on the drawings.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

- G. Do not use thermal cutting during erection unless approved by structural engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions. The top flanges of the beams receiving stud shear connectors shall be free of any substances that might interfere with the welding operations. During welding the steel decking panels shall be free of detrimental substances and rest tightly upon the top flange of the beam.
- J. No trades may field cut or alter structural members without specific approval of the Structural Engineer. Submit dimensioned plan and detail sketch of proposed modification under cover of a "Request for Information" (RFI) or cloud proposed changes on shop drawings.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened or as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" or "Load and Resistance Factor Design Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds. Contractor shall remove all weld slag using pick and brush to expose bright steel for self-verification of workmanship by the contractor and for Quality Assurance access by testing agency. This shall be done on a daily basis as welding proceeds.
  - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
  - 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
    - a. Grind butt welds flush.
    - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
- C. Tension Control Devices:
  - 1. Install using electric power wrench as recommended by bolt manufacturer.
  - 2. Tighten until splined end of bolt is sheared off.
- D. Shear Connectors:
  - 1. Do not weld when the temperature is below 0 degrees F.
  - 2. Remove standing water in deck ribs so that water is not trapped between beams and deck during welding.
  - 3. Ensure that surfaces of steel beams to which studs are to be welded are dry and free of paint, dirt and debris and that deck bottom is in firm contact with beam.
  - 4. Install studs after steel framing and metal decking are in place.
  - 5. Use automatic welding equipment powered to weld studs satisfactorily under site conditions.

6. Prior to starting each day's operations, weld at least two shear studs to determine proper generator control unit and stud welder settings.
7. Test that studs are capable of being bent 45 degrees from vertical without weld failure.
8. Weld additional trial shear studs at request of ITL.
9. Minimum projection of stud above top of deck: 1-1/2 inches.

### 3.5 FIELD QUALITY CONTROL

- A. The Owner will engage a qualified testing and inspection agency to provide special inspection and testing services and prepare reports in accordance with Division 1, Section "Structural Tests and Special Inspections", and IBC Chapter 17 as adopted by the current Minnesota State Building Code, and the CASE/Mn Guideline for Special Structural Inspection and Testing, and other items which in the professional judgement of the Structural Engineer of Record, are critical to the integrity of the building structure.
- B. Special Inspection and Testing Criteria
  1. General
    - a. If special inspection of fabricators work is required in the shop, testing agent may test and inspect structural steel at plant before shipment. Owner and SER reserve right to reject material not complying with Contract Documents at any time before final acceptance.
  2. Definitions
    - a. Refer to Division 1, Section "Structural Tests and Special Inspections" for standard requirements.
    - b. A.S.N.T.: The American Society for Non-destructive Testing
    - c. N.D.E.: Non-destructive Evaluation
    - d. A.W.S./C.A.W.I.: American Welding Society / Certified Associate Weld Inspector
    - e. A.W.S./C.W.I.: American Welding Society / Certified Weld Inspector
    - f. Special Inspector – Technical: Shall be employed by a testing agency and shall be supervised by an A.W.S./C.W.I. with a minimum of 10 years experience, or an A.S.N.T. Level III with a minimum of 10 years experience. These individuals shall satisfy the following requirements:
      - 1) Technical I: Non-destructive Testing Technician A.S.N.T.-TC-1A Level I, and/or A.W.S. Certified Associate Weld Inspector (C.A.W.I.)
      - 2) Technical II: Nondestructive Testing Technician A.S.N.T.-TC-1A Level II (NDE Technician II), A.W.S./C.A.W.I. with minimum 3 years experience, or an A.W.S./C.W.I
      - 3) Technical III: A.S.N.T. Level III with a minimum of 10 years experience or an A.W.S./C.W.I with a minimum of 10 years experience.
    - g. Special Inspector – Structural
      - 1) Structural I: Graduate civil/structural engineer, or other personnel acceptable to the SER, with experience in the design of structural systems of this type. Inspections shall be performed under the direct supervision of a licensed civil/structural engineer.
      - 2) Structural II: Civil/structural engineer regularly engaged in the design of structural systems of this type, licensed in the state in which the project is located. The licensed engineer shall review and approve all inspection reports.
      - 3) Special Inspector – Structural may be an employee of the SER.
  3. Special Testing and Inspection Requirements
    - a. High Strength Bolting (Field Installed).
      - 1) General (Technical II)
        - a) Visually inspect mating surfaces and bolt type for all slip-critical bolted connections for general conformance with the contract documents prior to bolting.
        - b) Determine the requirements for bolts, nuts, washers, paint and installation/tightening standards are met.

- c) Observe calibration procedures when such procedures are required in the contract documents and verify that selected procedure is used to tighten bolts.
- 2) Slip Critical Bolts and Tension Bolts (Technical II)
  - a) Test bolt tightening in 10% of all bolts. Test a minimum of two bolts in each connection. Verify that all plies of connected elements have been brought into contact, at 100% of connection. Verify all tips are removed from "twist-off" bolts.
- 3) Bearing Bolts (Technical II)
  - a) Visually inspect to conform all plies of connected elements have been brought into contact, at 100% of connections. (Applies only to bolts designed for values not requiring exclusion of threads from failure plane, all other bolts require testing as for tension bolts.)
- 4) Standard
  - a) Test High Strength bolted connections per R.C.S.C. Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
- b. High Strength Bolting (Shop Installed) (Technical II)
  - 1) For shop fabricated work, perform tests required for field installation, except that bolt testing may be reduced or deleted, if fabrication shop satisfies AISC Quality Certification Program – Category I, or more stringent criteria, or is approved by SER.
- c. Welding (General): The Special Inspector shall perform the following (Technical II):
  - 1) Prior to start of fabrication, determine if fabrication shop meets the criteria for exempting shop welds from inspection and confirm in writing to SER.
  - 2) Verify qualifications of all welders as AWS certified.
  - 3) Verify proposed welding procedures and materials.
  - 4) Verify adequate preparation of faying surfaces.
  - 5) Verify preheat and interpass temperature of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
- d. Welding (Field)
  - 1) Fillet Welds (Technical II)
    - a) Visually inspect 100% of all fillet welds for size, length and quality per AWS D1.1.
  - 2) Partial Penetration Welds (Technical II)
    - a) Test 100% of all partial penetration welds exceeding 5/16 inch, using Ultrasonic Tester per AWS D1.1. Test 25% of all partial penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E109, performed on root pass on finished weld.
  - 3) Full Penetration Welds (Technical II)
    - a) Test 100% of all full penetration welds exceeding 5/16 inch, using Ultrasonic Tester per AWS D1.1. Test 25% of all full penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E109, performed on root pass on finished weld.
  - 4) Stud Shear Connector Welds (Technical I)
    - a) Visually inspect 100% of installed studs for full 360 degree flash. Test all questionable studs, not showing full 360 degree flash by bending studs 15 degrees from vertical, away from weld discontinuity, per AWS D1.1. All ceramic welding ferrules shall be removed by contractor. Randomly test all other studs by bending to 15 degrees from vertical as noted:
      - Studs welded through deck: 15%
      - Studs welded to bare steel: 5%Alternatively, sound 100% of installed studs, for full penetration weld, using an 8 lb. Maul. Test questionable studs as noted above. Welding ferrules need not be removed.
  - 5) Deck Welds and Fasteners (Technical I)

- a) Visually inspect size, location, length and burn through for 100% of puddle welds on metal deck designed as a structural element, per AWS D1.3.
- b) Visually inspect sidelap fasteners to meet spacing and size specified.
- 6) Welding of Reinforcing Bars (Technical II)
  - a) Be continuously present during welding and visually inspect 100% of all reinforcing bar welds as the welding is performed, per AWS D1.4. Verify proper joint preparation is provided and proper electrodes are used and properly store and dried.
- e. Welding (Shop)
  - 1) Perform inspections as for field welding except weld testing may be reduced or deleted, if fabrication shop satisfies AISC Quality Certification Program – Category I, or more stringent criteria, or is approved by SER.
- f. Mechanical Fasteners (Misc.)
  - 1) Fasteners (Technical I)
    - a) Visually inspect specified size, spacing, embedment, and location of expansion bolts and adhesive bonded bolts in connections shown on the structural drawings.
- g. Structural Configuration
  - 1) Submittals (Structural I)
    - a) Verify mill test reports and other submitted documentation for compliance with contract documents.
  - 2) Materials (Technical I)
    - a) Verify materials delivered to site comply with contract documents and approved shop drawings. Materials include bolts, electrodes, mechanical fasteners and deck gauge.
  - 3) Detail Compatibility (Structural I) On a periodic basis:
    - a) Review project documents affecting integrity of the structure, including contract documents and pertinent submittals (approved shop drawings)
    - b) Visit site, at intervals appropriate to the stage of construction, to perform review of the structure and visually confirm general compliance with the project documents.
    - c) Inspect the following to verify member orientation, configuration, type and size comply with details indicated on the contract documents and approved shop drawings:
      - Bracing and stiffening members.
      - Proper applications of joint details at connections for structural members.
      - Other work critical to the integrity of the building structure.
4. Conventional Testing and Inspection Requirements
  - a. High Strength Bolting
    - 1) Bolt Material Test (Technical II)
      - a) Test a minimum of two bolts of each ASTM class specified, for bolt hardness and tensile properties.
    - 2) Fabrication and Erection Tolerances (Owner's Construction Manager)
      - a) Verify in-place structure satisfies specified tolerances

### 3.6 REPAIRS AND PROTECTION

- A. If tests or inspections indicate Work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- B. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

**END OF SECTION 051200**