

## SECTION 05 21 00- STEEL JOIST FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SCOPE OF WORK

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

#### 1.3 QUALITY ASSURANCE

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

##### Qualifications:

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

2. Test Load Procedure:

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

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

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

4. Failure of Load Test:

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

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

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

1.4 SUBMITTALS

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

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

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

### 2.2 FABRICATION

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

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

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

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

### PART 3 - EXECUTION

#### 3.1 ERECTION

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

#### 3.2 ANCHORING JOISTS

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

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

### 3.3 ATTACHMENTS TO JOISTS

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

### 3.4 QUALITY ASSURANCE TESTING AND INSPECTION DURING FABRICATION AND ERECTION

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

END OF SECTION 05 21 00