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## SECTION 052100 - STEEL JOIST FRAMING

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

Adjust list below to suit Project.

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Long-span steel joists.
5. Joist girders.
6. Joist accessories.

- B. Related Sections include the following:

List below only products and construction that the reader might expect to find in this Section but are specified elsewhere.

1. Division 03 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Division 04 Section "Unit Masonry" for installing bearing plates in unit masonry.

#### 1.3 DEFINITIONS

- A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

## 1.4 PERFORMANCE REQUIREMENTS

Retain this Article and revise as necessary if nonuniform, unequal, or special loading conditions invalidate SJI load or weight tables and if joist manufacturer is required to design special joists. Indicate locations of special joists on Drawings and identify them as "special." SJI's "Specifications" usually calls for loading diagrams, net uplift loads, and end moments, as applicable, to allow joist manufacturer to design special joists.

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Design special joists to withstand design loads with live load deflections no greater than the following:

Deflection limits in subparagraphs below are examples only. Select from options or insert other limits as appropriate for floor, roof, and ceiling materials.

- 1. Floor Joists: Vertical deflection of [**1/360**] [**1/240**] of the span.
- 2. Roof Joists: Vertical deflection of [**1/360**] [**1/240**] of the span.

Add other performance and design criteria that apply to special joists. Examples may include stress level reduction for special joists that are part of a fire-resistance-rated assembly, joist extensions with nonuniformly distributed loads, or special joists with rigid end connections.

## 1.5 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. LEED Submittal:

Retain subparagraph below if recycled content is required for LEED-NC or LEED-CI Credits MR 4.1 and MR 4.2. An alternative method of complying with Credit MR 4.1 and MR 4.2 requirements is to retain requirement in Division 01 Section "Sustainable Design Requirements" that gives Contractor the option and responsibility for determining how Credit MR 4.1 and MR 4.2 requirements will be met.

- 1. Product Data for Credit MR 4.1[ **and Credit MR 4.2**]: 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: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.

Delete subparagraph below if bearing plates are specified in Division 05 Section "Metal Fabrications."

- 1. Indicate locations and details of bearing plates to be embedded in other construction.

Retain subparagraph below if "Performance Requirements" Article is retained for special joists. Delete or modify if Architect assumes or is required by law to assume design responsibility.

2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

Retain paragraph below if procedures for welder certification are retained in "Quality Assurance" Article.

- D. Welding certificates.

Retain first paragraph below if "Manufacturer Qualifications" Paragraph is retained in "Quality Assurance" Article.

- E. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.
- F. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

Coordinate paragraph below with qualification requirements in Division 01 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.

- G. Qualification Data: For **[manufacturer]** **[professional engineer]**.

Retain paragraph below if Contractor is responsible for field quality-control testing and inspections.

- H. Field quality-control test and inspection reports.

Insert specific model code organization in paragraph below or revise if report must be from another source.

- I. Research/Evaluation Reports: For joists.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."
  1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.

Delete paragraph below if no field welding. Retain "Welding certificates" Paragraph in "Submittals" Article if retaining below. AWS states that welding qualifications remain in effect indefinitely unless welding personnel have not welded for more than six months or there is a specific reason to question their ability.

- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

## 1.8 SEQUENCING

Retain this Article if steel bearing plates are furnished under this Section for installation in Division 03 Section "Cast-in-Place Concrete" or Division 04 Section "Unit Masonry."

- A. Deliver steel bearing plates to be built into [cast-in-place concrete] [and] [masonry] construction.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

See SJI's "Specifications" for a current list of ASTM standards for steel.

- A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

Retain subparagraph below if recycled content is required for LEED-NC or LEED-CI Credits MR 4.1 and MR 4.2. USGBC allows a default value of 25 percent to be used for steel, without documentation; higher percentages can be claimed if they are supported by appropriate documentation. The Steel Recycling Institute indicates that hollow structural shapes, pipe, and steel plates are made by the basic oxygen furnace method, which typically has 23 percent postconsumer recycled content and 1.5 percent preconsumer recycled content, and rolled structural shapes and bars are made by the electric arc furnace method, which typically has 57.5 percent postconsumer recycled content and 6.5 percent preconsumer recycled content.

- 1. Recycled Content: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than [25] [50] [60] <Insert number> percent.

Delete paragraph below if steel bearing plates are specified in Division 05 Section "Metal Fabrications."

- B. Steel Bearing Plates: ASTM A 36/A 36M.

ASTM A 307 defines the term "studs" as including stud stock and threaded rods.

- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

Select one finish from options in subparagraph below.

1. Finish: **[Plain, uncoated] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C] [Mechanically deposited zinc coating, ASTM B 695, Class 50].**
- D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

Select one finish from options in subparagraph below.

1. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C] [Mechanically deposited zinc coating, ASTM B 695, Class 50].**

Retain paragraph below if field welding is required.

- E. Welding Electrodes: Comply with AWS standards.

Retain paragraph below if galvanized bolts or bearing plates are included in this Section.

- F. Galvanizing Repair Paint: **[MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A 780].**

## 2.2 PRIMERS

Delete this Article if shop priming is not permitted. If shop priming is required, usually retain paragraph below. SJI's "Specifications" recognizes SSPC-Paint 15 and other types of primers complying with its performance requirements. See Evaluations for discussion of sprayed fire-resistive materials and primers.

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

Usually delete paragraph below unless requiring a special primer to be shop-applied. Coordinate with applicable Division 09 painting Section.

- B. Primer: Provide shop primer that complies with Division 09 **[painting Sections.] [Section "High-Performance Coatings."]**

## 2.3 K-SERIES STEEL JOISTS

Retain this Article if Project uses open-web K-series steel joists.

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: **[K-series steel joists] [and] [KCS-type K-series steel joists].**

Retain first paragraph below if K-series joist substitutes of 2-1/2-inch- (64-mm-) deep sections are required for spans less than 96 inches (2400 mm).

- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

SJI advises proportionately reducing carrying capacity for reduction in chord area.

- D. Provide holes in chord members for connecting and securing other construction to joists.
- E. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

Delete paragraph above or first paragraph below if not required. SJI distinguishes between Type S and Type R joist extensions to K-series joists. See Evaluations and SJI's "Specifications."

- F. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- G. Do not camber joists.

Retain paragraph above or first paragraph below. SJI's "Specifications" states that camber is optional with K-series steel joist manufacturers, and it lists camber that varies according to top-chord length. Coordinate with roof slope requirements.

- H. Camber joists [**according to SJI's "Specifications."**] [**as indicated.**] <**Insert camber requirements.**>
- I. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

## 2.4 LONG-SPAN STEEL JOISTS

Retain this Article if Project uses either LH- or DLH-series steel joists. LH-series joists may be used in floor or roof decks; DLH-series joists are limited to use in roof decks.

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements [**as follows:**] [**as indicated.**]

Delete three subparagraphs below if joist type and end and top-chord arrangements are indicated on Drawings.

1. Joist Type: [**LH-series steel joists**] [**and**] [**DLH-series steel joists**].

Select one end arrangement from options in subparagraph below for either LH- or DLH-series steel joists.

2. End Arrangement: [**Underslung**] [**Square**].

Select top-chord arrangement from options in subparagraph below. LH- and DLH-series joists are available parallel, pitched one way, or pitched two ways. SJI's load tables are based on a standard pitch of 1/8 inch per 12 inches (1:96). Coordinate with roof slope requirements.

3. Top-Chord Arrangement: [**Parallel**] [**Pitched 1/8 inch per 12 inches (1:96), 1 way**] [**Pitched 1/8 inch per 12 inches (1:96), 2 ways**] <Insert pitch>.

- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

SJI advises proportionately reducing carrying capacity for reduction in chord area.

- C. Provide holes in chord members for connecting and securing other construction to joists.

SJI's "Specifications" lists long-span joist manufacturer's standard camber that varies according to top-chord length.

- D. Camber long-span steel joists [**according to SJI's "Specifications."**] [**as indicated.**] <Insert camber requirements.>
- E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

## 2.5 JOIST GIRDERS

Retain this Article if Project uses steel joist girders.

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements [**as follows:**] [**as indicated.**]

Delete both subparagraphs below if end and top-chord arrangements are indicated on Drawings.

Select one end arrangement from options in subparagraph below. Bottom-chord extensions provided for lateral bracing of bottom chords of joist girders will be manufacturer's standard unless design of this connection is detailed by the design professional.

1. End Arrangement: [**Underslung**] [**Underslung with bottom-chord extensions**] [**Square**].

Select top-chord arrangement from options in subparagraph below. Joist girders are available parallel, pitched one way, or pitched two ways. SJI's load tables are based on a standard pitch of 1/8 inch per 12 inches (1:96). Coordinate with roof slope requirements.

2. Top-Chord Arrangement: [**Parallel**] [**Pitched 1/8 inch per 12 inches (1:96), 1 way**] [**Pitched 1/8 inch per 12 inches (1:96), 2 ways**] <Insert pitch>.

- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

SJI advises proportionately reducing carrying capacity for reduction in chord area. Predrilled holes in chord members are needed if bolting wood nailers to top chords.

- C. Provide holes in chord members for connecting and securing other construction to joist girders.

SJI's "Specifications" lists joist girder manufacturer's standard camber that varies according to top-chord length.

- D. Camber joist girders [**according to SJI's "Specifications."**] [**as indicated.**] <Insert camber requirements.>
- E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

## 2.6 JOIST ACCESSORIES

Retain one of three paragraphs below. Bridging refers to permanent bridging.

- A. Bridging: Provide bridging anchors and number of rows of [**horizontal**] [**or**] [**diagonal**] bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

Retain one of two paragraphs below if joists bear on masonry or concrete construction. Retain first paragraph if steel bearing plates are specified in this Section; retain second if steel bearing plates are specified in Division 05 Section "Metal Fabrications."

- D. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. [**Shop prime paint**] [**Hot-dip zinc coat according to ASTM A 123/A 123M**].
- E. Steel bearing plates with integral anchorages are specified in Division 05 Section "Metal Fabrications."

Retain first paragraph below if ceiling will be attached to bottom of joists. See Evaluations.

- F. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.
- G. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

## 2.7 CLEANING AND SHOP PAINTING

Retain this Article if shop cleaning is required with or without shop priming.

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by [**hand-tool cleaning, SSPC-SP 2**] [or] [**power-tool cleaning, SSPC-SP 3**].

Retain paragraph below if priming is not permitted or is not permitted in selected locations. Standard fabrication practice is to prime paint joists.

- B. Do not prime paint joists and accessories[ **to receive sprayed fire-resistive materials**].

SSPC-Paint 15 requires the minimum paint film thickness in paragraph below. Verify that joist manufacturer complies with this minimum.

- C. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

Delete paragraph above and retain paragraph below if shop priming is specified in Division 09 painting Sections.

- D. Shop priming of joists and joist accessories is specified in Division 09 [**painting Sections.**] [**Section "High-Performance Coatings."**]

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
1. Before installation, splice joists delivered to Project site in more than one piece.
  2. Space, adjust, and align joists accurately in location before permanently fastening.
  3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

SJI's "Specifications" cautions that a rigid connection of bottom chord to column be made only after application of dead loads. Revise subparagraph below to suit Project. Add other limitations as required.

4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

Retain paragraph below if field welding joists to steel bearing plates or steel framework.

- C. Field weld joists to supporting steel [**bearing plates**] [**and**] [**framework**]. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

Retain one of first two paragraphs below for bolting joists to steel framework. Retain first paragraph if mild-strength carbon-steel bolts are required; retain second if high-strength structural bolts are required.

- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 FIELD QUALITY CONTROL

Delete this Article if not required. Retain first option in first paragraph below if Owner engages agency; retain second option if Contractor engages agency. If retaining second option, retain requirement for field quality-control test and inspection reports in Part 1 "Submittals" Article.

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified independent testing and inspecting agency to inspect [**field welds**] [**and**] [**bolted connections**] and to perform field tests and inspections and prepare test and inspection reports.
- B. Field welds will be visually inspected according to AWS D1.1/D1.1M.

Retain paragraph above or first paragraph and applicable subparagraphs below, and revise to suit Project. If retaining below, consider indicating extent of weld inspections here or on Drawings, for Contractor's information.

- C. In addition to visual inspection, field welds will be tested according to AWS D1.1/D1.1M and the following procedures, as applicable:
  1. Radiographic Testing: ASTM E 94.
  2. Magnetic Particle Inspection: ASTM E 709.
  3. Ultrasonic Testing: ASTM E 164.
  4. Liquid Penetrant Inspection: ASTM E 165.

- D. Bolted connections will be visually inspected.
- E. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."
- F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

### 3.4 REPAIRS AND PROTECTION

Retain paragraph below if repairs to galvanized bolts or bearing plates are required.

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

Retain paragraph and subparagraphs below if on-site paint repair is included in this Section. Touchup painting may be unnecessary if building is closed in immediately and building in-service conditions require no permanent paint protection.

- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists[, **bearing plates,**] [**abutting structural steel,**] and accessories.
  - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

Delete paragraph and subparagraphs above and retain first paragraph below if touchup painting is required for Project but is not part of the Work of this Section.

- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 [**painting Sections.**] [**Section "High-Performance Coatings."**]
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100