## STANDARD SPECIFICATIONS FOR OPEN WEB STEEL JOISTS, K-SERIES

Adopted by the Steel Joist Institute November 4, 1985
Revised to November 10, 2003 - Effective March 01, 2005

### SECTION 1. SCOPE

This specification covers the design, manufacture and use of Open Web Steel Joists, K-Series. Load and Resistance Factor Design (LRFD) and Allowable Strength Design (ASD) are included in this specification.

### SECTION 2. DEFINITION

The term "Open Web Steel Joists, K-Series" as used herein refers to open web, parallel chord, load-carrying members suitable for the direct support of floors and roof decks in buildings, utilizing hot-rolled or cold-formed steel, including cold-formed steel whose yield strength has been attained by cold working. K-Series Joists shall be designed in accordance with this specification to support the uniformly distributed loads given in the Standard Load Tables for Open Web Steel Joists, K-Series, attached hereto.

The KCS Joist is a K-Series Joist which is provided to address the problem faced by specifying professionals when trying to select joists to support uniform plus concentrated loads or other non-uniform loads.

The design of chord sections for K-Series Joists shall be based on a yield strength of 50 ksi (345 MPa). The design of web sections for K-Series Joists shall be based on a yield strength of either 36 ksi (250 MPa) or 50 ksi (345 MPa).

Steel used for K-Series Joists chord or web sections shall have the properties specified in Section 3.2.

### SECTION 3. MATERIALS

#### 3.1 STEEL

The steel used in the manufacture of chord and web sections shall conform to one of the following ASTM Specifications:

- Carbon Structural Steel, ASTM A36/A36M.
- High-Strength, Low-Alloy Structural Steel, ASTM A242/A242M.
- High-Strength Carbon-Manganese Steel of Structural Quality, ASTM A529/A529M, Grade 50.
- High-Strength Low-Alloy Columbium-Vanadium Structural Steel, ASTM A572/A572M, Grade 42 and 50.
- High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inches (100 mm) Thick, ASTM A588/A588M.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A665.
- Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1011/A1011M.
- Steel, Sheet, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1011/A1011M.

#### 3.2 MECHANICAL PROPERTIES

The yield strength used as a basis for the design stresses presented in Section 4 shall be either 36 ksi (250 MPa) or 50 ksi (345 MPa). Evidence that the steel furnished meets or exceeds the design yield strength shall, if requested, be provided in the form of an affidavit or by witnessed or certified test reports.

For material used without consideration of increase in yield strength resulting from cold forming, the specimens shall be taken from as-rolled material. In the case of material, the mechanical properties of which conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to those of such specifications and to ASTM A370.
4.2 DESIGN AND ALLOWABLE STRESSES

Design Using Load and Resistance Factor Design (LRFD)

Joints shall have their components so proportioned that the required stresses, $\phi F_n$, shall not exceed $F_{cr}$, where:

- $F_n$ = nominal stress ksi (MPa)
- $\phi$ = resistance factor
- $F_{cr}$ = design stress

Design Using Allowable Strength Design (ASD)

Joints shall have their components so proportioned that the required stresses, $\phi F_n$, shall not exceed $F_n = 0.90 F_y$ (LRFD) (4.2-11)

For bearing plates:

- $F_{n}$ = Allowable Stress = 0.85 $F_y$ (LRFD) (4.2-10)

For web members of solid round cross section:

- $F_{w}$ = Allowable Stress = 0.90 $F_y$ (LRFD) (4.2-13)

4.3 MAXIMUM SLENDERNESS RATIOS

The slenderness ratio, $l/r$, where $l$ is as used in Section 4.2 and $r$ is the corresponding least radius of gyration, shall not exceed the following:

Top chord interior panels: $l/r = 300$ (200,000 MPa).

Top chord end panels: $l/r = 240$ (200,000 MPa).

Compression members other than top chord: $l/r = 200$ (200,000 MPa).

4.4 MEMBERS (a) Chords

The bottom chord shall be designed as an axially loaded tension member.

The radius of gyration of the top chord about its vertical axis shall not be less than $l/45$ where $l$ is the spacing in inches (millimeters) between lines of bridging as specified in Section 5.4(c).

The top chord shall be considered as stayed laterally by the floor slab or roof deck when attachments are in accordance with the requirements of Section 5.4(e) of these specifications.
SECTION 4

4.1 METHOD

Joists shall be designed in accordance with these specifications as simply supported, uniformly loaded trusses supporting a floor or roof deck so constructed as to brace the top chord of the joist against lateral buckling. Where any applicable design feature is not specifically covered herein, the design shall be in accordance with the following specifications:

a) Where the steel used consists of hot-rolled shapes, bars or plates, the American Institute of Steel Construction, Specification for Structural Steel Buildings shall be used.

b) For members that are cold-formed from sheet or strip steel, use the American Iron and Steel Institute, North American Specification for the Design of Cold-Formed Steel Structural Members.

Design Basis:

Designs shall be made according to the provisions in this Specification for either Load and Resistance Factor Design (LRFD) or for Allowable Strength Design (ASD).

Load Combinations:

LRFD:
When load combinations are not specified to the joist manufacturer, the required stress shall be calculated for the factored loads based on the factors and load combinations as follows:

\[ D = 1.2D + 1.6L \]

Where:

- \( D \) = dead load due to the weight of the structural elements and the permanent features of the structure
- \( L \) = live load due to occupancy and movable equipment
- \( R \) = snow load

ASD:
When load combinations are not specified to the joist manufacturer, the required stress shall be calculated on the basis of load combinations as follows:

\[ D = 1.5(D + L + O + S) \]

For web members of solid round cross section:

\[ F_{cr} = 0.877F_e \] (4.2-4)

For chords and web members other than solid rounds:

\[ F_{cr} = Q 0.658F_y \] (4.2-3)

Allowable Stress Design (ASD):

\[ \frac{F_{n}}{F_{y}} \leq 0.6 \]

For web members of solid round cross section:

\[ F_{n} = 0.85F_{cr} \] (4.2-9)

For chords and web members other than solid rounds:

\[ F_{n} = 0.9F_{cr} \] (4.2-1)

Allowable Stress = 0.6Fy (ASD)

4.2 DESIGN AND ALLOWABLE STRESSES

Design Using Load and Resistance Factor Design (LRFD)

Joists shall have their components so proportioned that the required stresses, \( \frac{F}{F_y} \), shall not exceed \( \frac{F_{cr}}{F_y} \), where:

- \( F \) = nominal stress ksi (MPa)
- \( F_{cr} \) = resistance factor
- \( F_y \) = nominal stress ksi (MPa)

For CHORDS:

\[ F_{cr} = 0.877F_e \] (4.2-4)

For web members:

\[ F_{cr} = Q 0.658F_y \] (4.2-3)

For web members of solid round cross section:

\[ F_{n} = 0.85F_{cr} \] (4.2-9)

For chords and web members other than solid rounds:

\[ F_{n} = 0.9F_{cr} \] (4.2-1)

Allowable Stress = 0.6Fy (ASD)

4.3 MAXIMUM SLENDERNESS RATIOS

The slenderness ratio, \( \lambda \), where \( \mu = \frac{L}{r} \), is as used in Section 4.2

b) \( \lambda \) and \( \mu \) are the corresponding least radius of gyration, shall not exceed the following:

| Top chord interior panels | 90 |
| Top chord end panels | 120 |

4.4 MEMBERS

a) Chords

The bottom chord shall be designed as an axially loaded tension member.

The radius of gyration of the top chord about its vertical axis shall not be less than \( \frac{45}{74} \) where \( L \) is the spacing in inches (millimeters) between lines of bridging as specified in Section 5.4(c).

The top chord shall be considered as stayed laterally by the floor slab or roof deck when attachments are in accordance with the requirements of Section 5.4(c) of these specifications.
OPEN WEB STEEL JOISTS, K-SERIES

The top chord shall be designed for only axial compressive stress when the panel length, \( l \), does not exceed 24 inches (609 mm). When the panel length exceeds 24 inches (609 mm), the top chord shall be designed as a continuous member subject to combined axial and bending stresses and shall be so proportioned that:

For LRFD:

- at the panel point:
  \[ \frac{Pu}{Fy} = 0.67f_{au} \]  
  \[ \frac{Pu}{Fy} = 0.67f_{au} \times (1 + C_m) \]  

- at the mid panel:
  \[ \frac{Pu}{F_y} \leq 0.2 \]  
  \[ \frac{Pu}{F_y} = 0.67f_{au} \times (1 + C_m) \]

The top chord shall be designed for only axial compressive stress when the panel length, \( l \), does not exceed 24 inches (609 mm). When the panel length exceeds 24 inches (609 mm), the top chord shall be designed as a continuous member subject to combined axial and bending stresses and shall be so proportioned that:

For ASD:

- at the panel point:
  \[ \frac{Pu}{F_y} = 0.67f_{au} \]  

- at the mid panel:
  \[ \frac{Pu}{F_y} \leq 0.2 \]

4.5 CONNECTIONS

(a) Methods

Joint connections and splice shall be made by attaching the members to one another by arc or resistance welding or other accredited methods.

(1) Welded Connections

a) Selected welds shall be inspected visually by the manufacturer. Prior to this inspection, weld slag shall be removed.

b) Cracks are not acceptable and shall be repaired.

c) Thorough fusion shall exist between weld and base metal for the required design length of the weld; such fusion shall be verified by visual inspection.

d) Unfilled weld craters shall not be included in the design length of the weld.

e) Undercut shall not exceed 1/16 inch (2 millimeters) for welds oriented parallel to the principal stress.

f) The sum of surface (pitting) porosity diameters shall not exceed 1/16 inch (2 millimeters) in any 1 inch (25 millimeters) of design weld length.

g) Weld spatter that does not interfere with paint coverage is acceptable.

(2) Welding Program

Manufacturers shall have a program for establishing welding procedures and operator qualification, and for weld sampling and testing. (See Technical Digest #8 - Welding of Open Web Steel Joists.)

(3) Inspection

(a) Joint Connections shall be capable of withstanding forces due to an ultimate load equal to at least 1.35 times the LRFD, or 2.0 times the ASD load shown in the applicable Standard Load Table.

(b) Shop Splices - Splices may occur at any point in chord or web members. Members containing a butt weld splice shall develop an ultimate tensile force of at least 57 ksi (390 MPa) times the full design area of the chord or web. The term “member” shall be defined as all component parts comprising the chord or web, at the point of the splice.

4.6 CAMBER

Joists shall have approximate camber in accordance with the following:

<table>
<thead>
<tr>
<th>Top Chord Length</th>
<th>Approximate Camber</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'-0&quot; (6096 mm)</td>
<td>1/4&quot; (6 mm)</td>
</tr>
<tr>
<td>30'-0&quot; (9144 mm)</td>
<td>3/8&quot; (10 mm)</td>
</tr>
<tr>
<td>40'-0&quot; (12192 mm)</td>
<td>5/8&quot; (16 mm)</td>
</tr>
<tr>
<td>50'-0&quot; (15240 mm)</td>
<td>1&quot; (25 mm)</td>
</tr>
<tr>
<td>60'-0&quot; (18288 mm)</td>
<td>1 1/2&quot; (38 mm)</td>
</tr>
</tbody>
</table>

The specifying professional shall give consideration to coordinating joist camber with adjacent framing.

4.7 VERIFICATION OF DESIGN AND MANUFACTURE

(a) Design Calculations

Companies manufacturing K-Series Joists shall submit design data to the Steel Joist Institute (or an independent agency approved by the Steel Joist Institute) for verification of compliance with the Full Specifications. Design data shall be submitted in detail and in the format specified by the Institute.

(b) Tests of Chord and Web Members

Each manufacturer shall, at the time of design review by the Steel Joist Institute or other independent agency, verify by tests that the design, in accordance with Sections 4.1 through 4.5 of this specification, will provide the theoretical strength of critical members. Such tests shall be evaluated considering the actual yield strength of the members of the test joists.

Material tests for determining mechanical properties of component members shall be conducted.

(e) Tests of Joints and Connections

Each manufacturer shall verify by shear tests on representative joints of typical joints that connections will meet the provision of Section 4.5(b). Chord and web members may be reinforced for such tests.
### 4.5 CONNECTIONS

#### (a) Methods

Joist connections and splice shall be made by attaching the members to one another by arc or resistance welding or other accredited methods.

1. **Welded Connections**
   - Selected welds shall be inspected visually by the manufacturer. Prior to this inspection, weld slag shall be removed.
   - Cracks are not acceptable and shall be repaired.
   - Thorough fusion shall exist between weld and base metal for the required design length of the weld, such fusion shall be verified by visual inspection.
   - Unified weld crater shall not be included in the design length of the weld.
   - Undercut shall not exceed 1/16 inch (2 millimeters) for welds oriented parallel to the principal stress.
   - The sum of surface (piping) porosity diameters shall not exceed 1/16 inch (2 millimeters) in any 1 inch (25 millimeters) of weld length.
   - Weld spatter that does not interfere with paint cover is acceptable.

2. **Welding Program**

   - Manufacturers shall have a program for establishing weld procedures and operator qualification, and for weld sampling and testing. (See Technical Digest #8 - Welding of Open Web Steel Joists.)

3. **Weld Inspection by Outside Agencies (See Section 4.4(a))**

   - **(1) Joint Connections**
     - Welded connections of typical joists shall be evaluated considering the actual yield strength of the members forming the joint. Ends of joists shall be proportioned to resist bending produced by eccentricity at the support.

#### (b) Testsof Chord and Web Members

Each manufacturer shall, at the time of design review by the Steel Joist Institute or other independent agency, verify that the design, in accordance with Sections 4.1 through 4.5 of this specification, will provide the theoretical strength of critical members. Such tests shall be evaluated considering the actual yield strength of the members of the test joists.

- Material tests for determining mechanical properties of component members shall be conducted.
- **(c) Tests of Joints and Connections**

   - Each manufacturer shall verify by shear tests on representative joints of typical joints that connections will meet the provision of Section 4.5(b). Chord and web members may be reinforced for such tests.
5.4 BRIDGING

Top and bottom chord bridging is required and shall consist of one or both of the following types.

(a) Horizontal

Horizontal bridging shall consist of continuous horizontal steel members.Attachments to the joist chords shall be made by welding or mechanical means and shall be capable of resisting a nominal (unfactored) horizontal force of not less than 700 pounds (3114 Newtons).

The ratio of unbraced length to least radius of gyration, \( l/r \), of the bridging member shall not exceed 300, where \( l \) is the distance in inches (millimeters) between connections and \( r \) is the least radius of gyration of the bracing member. Where cross-bracing members are connected at their point of intersection, the distance shall be taken as the distance in inches (millimeters) between connections at the point of intersection of the bracing members and the connections to the chord of the joists. Connections to the chords of steel joists shall be made by welded mechanical means or by welding.

(b) Diagonal

Diagonal bridging shall consist of cross-bracing with a \( l/r \) ratio of not more than 200, where \( l \) is the distance in inches (millimeters) between connections and \( r \) is the least radius of gyration of the bracing member. Where cross-bracing members are connected at their point of intersection, the distance shall be taken as the distance in inches (millimeters) between connections at the point of intersection of the bracing members and the connections to the chord of the joists. Connections to the chords of steel joists shall be made by mechanical means or by welding.

**Diagonal**

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</tbody>
</table>

* Last digit(s) of joist designation shown in Load Table

** See Section 5.11 for additional bridging required for uplift design.
SECTION 5. APPLICATION

5.1 USAGE
These specifications shall apply to any type of structure where floors and roofs are to be supported directly by steel joists installed as hereinafter specified. Where joists are used other than on simple spans, uniformly distributed loading as described in Section 4.1, shall be investigated and modified if necessary to limit the required stresses to those listed in Section 4.2.

CAUTION: If a rigid connection of the bottom chord is to be made to the column or other support, it shall be made only after the application of the dead loads. The joist is then no longer simply supported, and the system must be investigated for continuous frame action by the specifying professional.

The designed detail of a rigid type connection and moment capacity shall be furnished by the specifying professional. The joists shall be shown on the structural drawings by the specifying professional if necessary to limit the required bending moment capacity of the bottom chord.

5.2 SPAN
The span of a joist shall not exceed 24 times its depth.

5.3 END SUPPORTS
(a) Masonry and Concrete
K-Series Joists supported by masonry or concrete are to be supported directly on steel bearing plates and shall be designed as steel bearing. Due consideration of the end reactions and all other vertical or lateral forces shall be taken by the specifying professional in the design of the steel bearing plate and the masonry or concrete. The ends of K-Series Joists shall extend a distance of not less than 4 inches (102 millimeters) over the masonry or concrete support and shall be anchored to the steel bearing plate. The plate shall be located not more than 1/2 inch (13 millimeters) from the face of the wall and shall be not less than 6 inches (152 millimeters) wide parallel to the length of the joist. The plate is to be designed by the specifying professional and shall be furnished by other than the joist manufacturer.

(b) Quantity and Spacing
The number of rows of top chord bridging shall not be less than one or both of the following types.

(c) Steel
Due consideration of the end reactions and all other vertical and lateral forces shall be taken by the specifying professional in the design of the steel support. The ends of K-Series Joists shall extend a distance of not less than 2 1/2 inches (64 millimeters) over the steel supports.

5.4 BRIDGING
Top and bottom chord bridging is required and shall consist of one or both of the following types.

(a) Horizontal
Horizontal bridging shall consist of continuous horizontal steel members. Attachments to the joists shall be made by welding or mechanical means and shall be capable of resisting a nominal (unfactored) horizontal force of not less than 700 pounds (3114 Newtons). The ratio of unbraced length to radius of gyration, l/r, of the bridging member shall not exceed 300, where l is the distance in inches (millimeters) between connections and r is the least radius of gyration of the bridging member. Where cross-bracing members are connected at their point of intersection, the distance shall be taken as the distance in inches (millimeters) between connections at the point of intersection of the bracing members and the connections to the chord of the joist. Connections to the chords of steel joists shall be made by mechanical means or by welding.

(b) Diagonal
Diagonal bridging shall consist of cross-bracing with a l/r ratio of not more than 200, where l is the distance in inches (millimeters) between connections and r is the least radius of gyration of the bridging member. Where cross-bracing members are connected at their point of intersection, the distance shall be taken as the distance in inches (millimeters) between connections at the point of intersection of the bracing members and the connections to the chord of the joist. Connections to the chords of steel joists shall be made by mechanical means or by welding.

(c) Bottom Chord Bearing Joists
Where bottom chord bearing joists are utilized, a row of diagonal bridging shall be provided near the supporting collar. This bridging shall be installed and anchored before the hoisting cable is released.

TABLE 5.4-1
U.S. UNITS
NUMBER OF ROWS OF TOP CHORD BRIDGING**
Refer to the K-Series Load Table and Specification Section 6 for required bolted diagonal bridging. Distances are Joist Span lengths in feet - See "Definition of Span" preceding Load Table.

<table>
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<tr>
<th>Section Number</th>
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<td>Over 39 thru 53</td>
</tr>
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* Last digit(s) of joist designation shown in Load Table
** See Section 5.11 for additional bridging required for uplift design.

TABLE 5.4-2
METRIC UNITS
NUMBER OF ROWS OF TOP CHORD BRIDGING**
Refer to the K-Series Metric Load Table and Specification Section 6 for required bolted diagonal bridging. Distances are Joist Span lengths in millimeters - See "Definition of Span" preceding Load Table.

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</tbody>
</table>

* Last digit(s) of joist designation shown in Load Table
** See Section 5.11 for additional bridging required for uplift design.
5.5 INSTALLATION OF BRIDGING
Bridging shall support the top and bottom chords against lateral movement during the construction period and shall hold the steel joists in the approximate position as shown on the joist placement plans. The ends of all bridging lines terminating at walls or beams shall be anchored thereto.

5.6 END ANCHORAGE
(a) Masonry and Concrete
Ends of K-Series Joists resting on steel bearing plates on masonry or structural concrete shall be attached thereto with a minimum of two 1/8 inch (3 millimeters) fillet welds 1 inch (25 millimeters) long, or with two 1/2 inch (13 millimeters) ASTM A307 bolts, or the equivalent.

(b) Steel
Ends of K-Series Joists resting on steel supports shall be attached thereto with a minimum of two 1/8 inch (3 millimeters) fillet welds 1 inch (25 millimeters) long, or with two 1/2 inch (13 millimeters) ASTM A307 bolts, or the equivalent. When K-Series Joists are used to provide lateral stability to the supporting member, the final connection shall be made by welding or as designated by the specifying professional.

(c) Uplift
Where uplift forces are a design consideration, roof joists shall be anchored to resist such forces (Refer to Section 5.11 Uplift).

5.7 JOIST SPACING
Joists shall be spaced so that the loading on each joist does not exceed the design load (LRFD or ASD) for the particular joist designation and span as shown in the applicable load tables.

5.8 FLOOR AND ROOF DECKS
(a) Material
Floor and roof decks may consist of cast-in-place or precast concrete or gypsum, formed steel, wood, or other suitable material capable of supporting the required load at the specified joist spacing.

(b) Thickness
Cast-in-place slabs shall be not less than 2 inches (51 millimeters) thick.

(c) Centering
Centering for cast-in-place slabs shall be ribbed metal lath, corrugated steel sheets, paper-backed welded wire fabric, removable centering or any other suitable material capable of supporting the slab at the designated joist spacing. Centering shall not cause lateral displacement or damage to the top chord of joists during installation or removal of the centering or placing of the concrete.

(d) Bearing
Studs or decks shall bear uniformly along the top chords of the joists.

(e) Attachments
The spacing for slab or deck attachments along the joist top chord shall not exceed 36 inches (914 millimeters), and shall be capable of resisting a nominal (unfactored) lateral force of not less than 300 pounds (1365 Newtons), i.e., 100 psf (146 N/m²).

(f) Wood Nails
Where wood nails are used, such nails in conjunction with deck or slab shall be attached to the top chords of the joists in conformance with Section 5.8(c).

(g) Joist With Standing Seam Roofing
The stiffness and strength of standing-seam roof clips varies from one manufacturer to another. Therefore, some roof systems cannot be counted on to provide lateral stability to the joists which support the roof. Sufficient stability must be provided to brace the joists laterally under the full design load. The compression chord must resist the chord axial design force in the plane of the joist (i.e., x-x axis buckling) and out of the plane of the joist (i.e., y-y axis buckling). Out-of-plane stability may be achieved by adjusting the bridging spacing and/or increasing the compression chord area, the joist depth, and the y-axis radius of gyration. The effective slenderness ratio in the y-direction equals 0.94 L/A, where L is the bridging spacing in inches (millimeters). The maximum bridging spacing may not exceed that specified in Section 5.4(c).

Horizontal bridging members attached to the compression chords and their anchorages must be designed for a compressive axial force of 0.005Fp where Fp is the number of joists between end anchors and P is the chord design force in kips (Newton). The attachment force between the horizontal bridging member and the compression chord is 0.005Fp. Horizontal bridging attached to the tension chords shall be proportioned so that the slenderness ratio between attachments does not exceed 300. Diagonal bridging shall be proportioned so that the slenderness ratio between attachments does not exceed 200.

5.9 DEFLECTION
The deflection due to the design nominal live load shall not exceed the following:
Floors: 1/360 of span.
Roofs: 1/360 of span where a plaster ceiling is attached or suspended.
1/400 of span for all other cases.

The specifying professional shall give consideration to the effects of deflection and vibration in the selection of joists.

1) For further reference, refer to Steel Joist Institute Technical Digest #5, "Vibration of Steel Joist-Concrete Slab Floors" and the Institute’s Computer Vibration Program.

5.10 PONDING
The ponding investigation shall be performed by the specifying professional.

For further reference, refer to Steel Joist Institute Technical Digest #9, "Structural Design of Steel Joist Roofs to Resist Ponding Loads" and AISC Specifications.

5.11 UPLIFT
Where uplift forces due to wind are a design requirement, these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascals). The contract documents shall indicate if the net uplift is based upon LRPD or ASD. When these forces are specified, they must be considered in the design of joists and/or bridging. A single line of bottom chord bridging must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

For further reference, refer to Steel Joist Institute Technical Digest #6, "Structural Design of Steel Joist Roofs to Resist Uplift Loads".

5.12 INSPECTION
Joists shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of these specifications. If the purchaser wishes an inspection of the steel joists by someone other than the manufacturer’s own inspectors, they may reserve the right to do so in their “Invitation to Bid” or the accompanying “Job Specifications.” Arrangements shall be made with the manufacturer for such inspection of the joists at the manufacturing shop by the purchaser’s inspectors at purchaser’s expense.

5.13 PARALLEL CHORD SLOPED JOISTS
The span of a parabolic chord sloped joist shall be defined by the length along the slope. Minimum depth, load-carrying capacity, and bridging requirements shall be determined by the sloped definition of span. The Standard Load Table capacity shall be the component normal to the joist.

SECTION 6
ERECTION STABILITY AND HANDLING
When it is necessary for the erector to climb on the joists, extreme caution must be exercised since untended joists may exhibit some degree of instability under the erector’s weight.

(a) Stability Requirements

1) Before an employee is allowed on the steel joist, both ends of all column (or joists designated as columns) shall be attached to its supports. For all other joists a minimum of one end shall be attached before the employee is allowed on the joist. The attachment shall be in accordance with Section 5.6 – End Anchorage.

When a bolted connection is used for erection purposes, as a minimum, the bolts must be snug tightened. The snug tight condition is defined as the tightness that exists when all piles of a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of an employee using an ordinary spud wrench.

2) On steel joists that do not require erection bridging as shown by the unshaded area of the Load Tables, only one employee shall be allowed on the steel joist unless all bridging is installed and anchored.*

* For a thorough coverage of this topic, refer to SJI Technical Digest #9, “Handling and Erection of Steel Joists and Joist Girders”.

3) Where the span of the steel joist is within the Red shaded area of the Load Table, the following shall apply:

a) The row of bridging nearest the mid span of the steel joists shall be bolted diagonal erection bridging; and
b) Existing cables shall not be released until this bolted diagonal erection bridging is installed and anchored, unless an alternate method of stabilizing the joist has been provided; and
c) No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.

4) When permanent bridging terminus points cannot be used during erection, additional temporary bridging terminus points are required to provide stability.

5) In the case of bottom chord bearing joists, the ends of the joist must be restrained laterally per Section 5.4(d).

6) After the joist is straightened and plumbed, and all bridging is completely installed and anchored, the ends of the joists shall be fully connected to the supports in accordance with Section 5.6 End Anchorage.
5.5 INSTALLATION OF BRIDGING
Bridging shall support the top and bottom chords against later- al movement during the construction period and shall hold the steel joists in the approximate position as shown on the joist placement plans. The ends of all bridging lines terminating at walls or beams shall be anchored thereto.

5.6 END ANCHORAGE
(a) Masonry and Concrete
Ends of K-Series Joists resting on steel bearing plates on masonry or structural concrete shall be attached thereto with a minimum of two 1/8 inch (3 millimeters) fillet welds 1 inch (25 millimeters) long, or with two 1/2 inch (13 millimeters) ASTM A307 bolts, or the equivalent. When K-Series Joists are used to provide lateral stability to the supporting member, the final connection shall be made by welding or as designated by the specifying professional.

(b) Steel
Ends of K-Series Joists resting on steel supports shall be attached thereto with a minimum of two 1/8 inch (3 millimeters) fillet welds 1 inch (25 millimeters) long, or with two 1/2 inch (13 millimeters) ASTM A307 bolts, or the equivalent. When K-Series Joists are used to provide lateral stability to the supporting member, the final connection shall be made by welding or as designated by the specifying professional.

(c) Uplift
Where uplift forces are a design consideration, roof joists shall be anchored to resist such forces (Refer to Section 5.11 Uplift).

5.7 JOIST SPACING
Joists shall be spaced so that the loading on each joist does not exceed the design load (LRFD or ASD) for the particular joist designation and span as shown in the applicable load tables.

5.8 FLOOR AND ROOF DECKS
(a) Material
Floor and roof decks may consist of cast-in-place or pre- cast concrete or gypsum, formed steel, wood, or other suitable material capable of supporting the required load at the specified joist spacing.

(b) Thickness
Cast-in-place slabs shall be not less than 2 inches (51 millimeters) thick.

(c) Centering
Centering for cast-in-place slabs shall be ribbed metal lath, corrugated steel sheets, paper-backed welded wire fabric, removable centering or any other suitable material capable of supporting the slab at the designated joist spacing. Centering shall not cause lateral displacement or damage to the top chord of joists during installation or removal of the centering or placing of the concrete.

(d) Bearing
Studs or decks shall bear uniformly along the top chords of the joists.

(e) Attachments
The spacing for slab or deck attachments along the joist top chord shall not exceed 36 inches (914 millimeters), and shall be capable of resisting a nominal (unfactored) lateral force of not less than 300 pounds (1336 Newtons), i.e., 100 psf (1.46 kPa).

(f) Wood Nailers
Where wood nailers are used, such nailers in conjunction with deck or slab shall be attached to the top chords of the joists in conformance with Section 5.8(a).

(g) Joist With Standing Seam Roofing
The stiffness and strength of standing-seam roof clips varies from one manufacturer to another. Therefore, some roof systems cannot be counted on to provide lateral stability to the joists which support the roof. Sufficient stability must be provided to brace the joists laterally under the full design load. The compression chord must resist the chord axial design force in the plane of the joist (i.e., x-x axis buckling) and out of the plane of the joist (i.e., y-y axis buckling). Out-of-plane stability may be achieved by adjusting the bridging spac- ing and/or increasing the compression chord area, the joist depth, and the y-axis radius of gyration. The effective slenderness ratio in the y-direction equals 0.94 Lp/L, where L is the bridging spacing in inches (millimeters). The maximum bridging spacing may not exceed that specified in Section 5.8(c).

Horizontal bridging members attached to the compres- sion chords and their anchorage in K-Series Joists shall be designed for a compressive axial force of 0.005nP, where n is the number of joists between end anchors and P is the chord design force in kips (Newtons). The attachment force between the horizontal bridging member and the comp- ression chord is 0.005nP. Horizontal bridging attached to the tension chords shall be proportioned so that the slen- derness ratio between attachments does not exceed 300. Diagonal bridging shall be proportioned so that the slen- derness ratio between attachments does not exceed 200.

5.9 DEFLECTION
The deflection due to the design nominal live load shall not exceed the following:
- Floors: 1/360 of span.
- Roofs: 1/360 of span where a plaster ceiling is attached or suspended; 1/400 of span for all other cases.

The specifying professional shall give consideration to the effects of deflection and vibration in the selection of joists.

1) For further reference, refer to Steel Joist Institute Technical Digest #5, “Vibration of Steel Joist-Concrete Slab Floors” and the Institute’s Computer Vibration Program.

5.10 PONDING
The ponding investigation shall be performed by the specifying professional.

1) For further reference, refer to Steel Joist Institute Technical Digest #3, “Structural Design of Steel Joist Roofs to Resistant Ponding Loads” and ASCE Specifications.

5.11 UPLIFT
Where uplift forces due to wind are a design requirement, these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascals). The contract documents shall indicate if the net uplift is based upon LRFD or ASD. When these forces are specified, they must be considered in the design of joists and/or bridging. A single line of bottom chord bridging must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

1) For further reference, refer to Steel Joist Institute Technical Digest #6, “Structural Design of Steel Joist Roofs to Resistant Uplift Loads”.

5.12 INSPECTION
Joists shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of these specifications. If the purchaser wishes an inspection of the steel joists by someone other than the manufacturer’s own inspectors, they may reserve the right to do so in their “Invitation to Bid” or the accompanying “Job Specifications”. Arrangements shall be made with the manufacturer for such inspection of the joists at the manufacturing shop by the pur- chaser’s inspectors at purchaser’s expense.

5.13 PARALLEL CHORD SLOPED JOISTS
The span of a parallel chord sloped joist shall be defined by the length along the slope. Minimum depth, load-carrying capacity, and bridging requirements shall be determined by the sloped definition of span. The Standard Load Table capacity shall be the component normal to the joist.

SECTION 6 * ERECTION STABILITY AND HANDLING
When it is necessary for the erecto to climb on the joists, extreme caution must be exercised since untied girds may exhibit some degree of instability under the erecto’s weight.

(a) Stability Requirements
1) Before an employee is allowed on the steel joist, both ends of each column (or joists designated as column joists) shall be attached to its supports. For all other joists a minimum of one end shall be attached before the employee is allowed on the joist. The attachment shall be in accordance with Section 5.6 – End Anchorage.

When a locked center connection is used for erection pur- poses, as a minimum, the bolts must be snug tightened. The snug tight condition is defined as the tightness that exists when all piles of a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of an employee using an ordinary spud wrench.

2) On steel joists that do not require erection bridging as shown by the unshaded area of the Load Tables, only one employee shall be allowed on the steel joist unless all bridging is installed and anchored.

1) For a thorough coverage of this topic, refer to SJI Technical Digest #5, “Handling and Erection of Steel Joists and Joist Girders”.

3) Where the span of the steel joist is within the red shaded area of the Load Table, the following shall apply:
   a) The row of bridging nearest the mid span of the steel joists shall be bolted diagonal erection bridging; and
   b) Hosing cables shall not be released until this bolted diagonal erection bridging is installed and anchored, unless an alternate method of stabilizing the joist has been provided; and
   c) No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.
   d) When permanent bridging terminus points cannot be used during erection, additional temporary bridging ter- minus points are required to provide stability.

5) In the case of bottom chord bearing joists, the ends of the joists must be restrained laterally per Section 5.4(d).

6) After the joist is straightened and plumbed, and all bridg- ing is completely installed and anchored, the ends of the joists shall be fully connected to the supports in accor- dance with Section 5.6 End Anchorage.
(b) Landing and Placing Loads

1) Except as stated in paragraphs 6(b)(3) and 6(b)(4) of this section, no “construction loads” are allowed on the steel joists until all bridging is installed and anchored, and all joist bearing ends are attached.

2) During the construction period, loads placed on the steel joists shall be distributed so as not to exceed the capacity of the steel joists.

3) The weight of a bundle of joist bridging shall not exceed a total of 1000 pounds (464 kilograms). The bundle of joist bridging shall be placed on a minimum of 3 steel joists that are secured at one end. The edge of the bridging bundle shall be positioned within 1 foot (0.30 m) of the secured end. (See Appendix E for definition of “construction load”.

4) No bundle of deck may be placed on steel joists until all bridging has been installed and anchored and all joist bearing ends attached, unless the following conditions are met:

   a) The contractor has first determined from a “qualified person” and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load;

   b) The bundle of decking is placed on a minimum of 3 steel joists;

   c) The joists supporting the bundle of decking are attached at both ends;

   d) At least one row of bridging is installed and anchored;

   e) The total weight of the decking does not exceed 4000 pounds (1816 kilograms); and

   f) The edge of the decking shall be placed within 1 foot (0.30 meters) of the bearing surface of the joist end.

(c) Field Welding

1) All field welding shall be performed in accordance with the contract documents. Field welding shall not damage the joists.

2) On cold-formed members whose yield strength has been attained by cold working, and whose as-formed strength is used in the design, the total length of weld at any one point shall not exceed 50 percent of the overall length of weld.

(d) Handling

Care shall be exercised at all times to avoid damage to the joists and accessories.

(e) Fall Arrest Systems

Steel joists shall not be used as anchorage points for fall arrest systems unless written direction to do so is obtained from a “qualified person”.

See Appendix E for OSHA definition of “qualified person”.

### KCS JOISTS

**The KCS Joists:**

1. Provide a versatile K-Series Joist that can be easily specified to support uniform loads plus concentrated and non-uniform loads.

2. Eliminate many repetitive load diagrams required on contract documents and allow some flexibility of load locations.

KCS joists are designed in accordance with the Standard Specification for K-Series Joists.

**Standard K-Series Joists** are designed for simple span uniform loading which results in a parabola moment diagram for chord forces and a linearly sloped shear diagram for web forces. When non-uniform and/or concentrated loads are encountered the shear and moment diagrams required may be shaped quite differently and may not be covered by the shear and moment design envelopes of a standard K-Series Joist.

KCS joist chords are designed for a flat positive moment envelope. The moment capacity is constant at all interior panels. The top chord and panel is designed for axial load based on the force in the first tension web, which is based on the specified shear. A uniform load of 825 plf (12030 N/m) LRFD or 650 plf (8020 N/m) ASD is used to check end panel bending.

The web forces are determined based on a flat shear envelope. All webs are designed for a vertical equal to the specified shear capacity. Furthermore, all webs (except the first tension web which remains in tension under all simple span gravity loads) will be designed for 100% stress reversal. Both LRFD and ASD KCS Joist load tables list the shear and moment capacity of each joist. The selection of a KCS Joist requires the specifying professional to calculate the maximum moment and shear imposed and select the appropriate KCS Joist. If a KCS Joist cannot be selected from the load table, a load diagram is not required.

**Examples:**

- **Example 1**
  - **LRFD FACTORED LOADS**

  - **M = 938 in.-kip (105.9 kN-m)**
  - **V = 500 lbs (6.67kN)**

  - **L = 40.0 ft (12192 mm)**
  - **R = 800 lbs (3.57 kN)**

  - **R = 7500 lbs (33.36 kN)**

  Select a 22K9 to determine bridging and stability requirements.

  Bridging section no. 9 for L = 40 ft (12192 mm)

  Use 22K9 to determine bridging and stability requirements.

Since a standard KCS Joist can be selected from the load table a load diagram is not required.
**OPEN WEB STEEL JOISTS, K-SERIES**

(b) **Landing and Placing Loads**

1. Except as stated in paragraphs 6(b)(3) and 6(b)(4) of this section, no "construction loads" (1) are allowed on the steel joists until all bridging is installed and anchored, and all joist bearing ends are attached.

2. During the construction period, loads placed on the steel joists shall be distributed so as not to exceed the capacity of the steel joists.

3. The weight of a bundle of joist bridging shall not exceed a total of 1000 pounds (464 kilograms). The bundle of joist bridging shall be placed on a minimum of 3 steel joists that are secured at one end. The edge of the bridging bundle shall be positioned within 1 foot (0.30 m) of the securred end.

   1) See Appendix E for definition of "construction load". A copy of the OSHA Steel Erection Standard §1926.757, Open Web Steel Joists, is included in Appendix E for reference purposes.

4. No bundle of deck may be placed on steel joists until all bridging has been installed and anchored and all joist bearing ends attached, unless the following conditions are met:

   a) The contractor has first determined from a "qualified person" (2) and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load.

   b) The bundle of decking is placed on a minimum of 3 steel joists;

   c) The joists supporting the bundle of decking are attached at both ends;

   d) At least one row of bridging is installed and anchored;

   e) The total weight of the decking does not exceed 4000 pounds (1816 kilograms); and

   f) The edge of the decking shall be placed within 1 foot (0.30 meters) of the bearing surface of the joist end.

(d) **Field Welding**

1. All field welding shall be performed in accordance with the contract documents. Field welding shall not damage the joists.

2. On cold-formed members whose yield strength has been attained by cold working, and whose as-formed strength is used in the design, the total length of weld at any one point shall not exceed 50 percent of the overall developed width of the cold-formed section.

(e) **Handling**

Care shall be exercised at all times to avoid damage to the joists and accessories.

(f) **Fall Arrest Systems**

Steel joists shall not be used as anchorage points for a fall arrest system unless written direction to do so is obtained from the "qualified person".

See Appendix E for OSHA definition of "qualified person".

---

**KCS JOISTS**

The KCS Joists:
1. Provide a versatile K-Series Joist that can be easily specified to support uniform loads plus concentrated and non-uniform loads.

2. Eliminate many repetitive load diagrams required on contract documents and allow some flexibility of load locations.

KCS joists are designed in accordance with the Standard Specification for K-Series Joists.

Standard K-Series Joists are designed for simple span uniform loading which results in a parabolic moment diagram for chord forces and a linearly sloped shear diagram for web forces. When non-uniform and/or concentrated loads are encountered the shear and moment diagrams required may be shaped quite differently and may not be covered by the shear and moment design envelopes of a standard K-Series Joist.

KCS Joist chords are designed for a flat positive moment envelope. The moment capacity is constant at all interior panels. The top chord end panel is designed for axial load based on the force in the first tension web, which is based on the specified shear. A uniform load of 825 plf (12300 N/m) LRFD or 650 plf (8020 N/m) ASD is used to check and panel bending.

The web forces are determined based on a flat shear envelope. All webs are designed for a vertical shear equal to the specified shear capacity. Furthermore, all webs (except the first tension web which remains in tension under all simple span gravity loads) will be designed for 100% stress reversal. Both LRFD and ASD KCS Joist (load) tables list the shear and moment capacity of each joist. The selection of a KCS Joist requires the specifying professional to calculate the maximum moment and shear imposed and select the appropriate KCS Joist. If a KCS Joist cannot be selected from the load table or if any uniform load exceeds 825 plf (12300 N/m) LRFD or 650 plf (8020 N/m) ASD or if the maximum concentrated load exceeds the shear capacity of the joist, use doubles of KCS Joists or select an LM-Series Joist. For the LM-Series Joist, supply a load diagram. When net uplift loads, end moments or other external horizontal loads are a design consideration; these loads shall be provided to the joist manufacturer by the specifying professional.

---

**LRFD EXAMPLES**

**EXAMPLE 1**

**LRFD FACTORED LOADS**

<table>
<thead>
<tr>
<th>W = 360 plf (5262 N/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M = 938 in.-kip (105.9 kN·m)</td>
</tr>
<tr>
<td>R = 9900 lbs (44.0 kN)</td>
</tr>
<tr>
<td>L = 40 ft (12192 mm)</td>
</tr>
</tbody>
</table>

The moment capacity is constant at all interior panels. The top chord end panel is designed for axial load based on the force in the first tension web, which is based on the specified shear. A uniform load of 825 plf (12300 N/m) LRFD or 650 plf (8020 N/m) ASD is used to check and panel bending.

The web forces are determined based on a flat shear envelope. All webs are designed for a vertical shear equal to the specified shear capacity. Furthermore, all webs (except the first tension web which remains in tension under all simple span gravity loads) will be designed for 100% stress reversal. Both LRFD and ASD KCS Joist (load) tables list the shear and moment capacity of each joist. The selection of a KCS Joist requires the specifying professional to calculate the maximum moment and shear imposed and select the appropriate KCS Joist. If a KCS Joist cannot be selected from the load table or if any uniform load exceeds 825 plf (12300 N/m) LRFD or 650 plf (8020 N/m) ASD or if the maximum concentrated load exceeds the shear capacity of the joist, use doubles of KCS Joists or select an LM-Series Joist. For the LM-Series Joist, supply a load diagram. When net uplift loads, end moments or other external horizontal loads are a design consideration; these loads shall be provided to the joist manufacturer by the specifying professional.

As is the case with standard K, LH- and DLH-Series Joists, chord bending due to concentrated loads must be addressed. In the case of concentrated loads, the specifying professional shall handle them in one of two ways: 1) specify on the structural drawings that an extra web must be field applied at all concentrated loads not occurring at joist panel points, or 2) provide exact locations of all concentrated loads for which the joist manufacturer shall provide necessary reinforcement.
EXAMPLE 2

LRFD FACTORED LOADS

<table>
<thead>
<tr>
<th>W = 450 plf (3503 N/m)</th>
<th>W = 270 plf (2028 N/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>650 lb (2.90 kN)</td>
<td>450 lb (2.00 kN)</td>
</tr>
<tr>
<td>800 lb (3.56 kN)</td>
<td>600 lb (2.67 kN)</td>
</tr>
</tbody>
</table>

\[ R_L = 7500 \text{ lbs (33.36 kN)}, \quad R_R = 8010 \text{ lbs (35.63 kN)} \]

Select a 22KCS2, \( M = 443 \text{ in.-kip (50.1 kN-m)} \), \( R = 5900 \text{ lbs (26.2 kN)} \)

Bridging section no. 6 for \( L = 30 \text{ ft (9144 mm)} \)

Use 22K6 to determine bridging and stability requirements.

Since the maximum uniform load of 639 plf (9318 N/m) (405 plf (5911 N/m) + 240 plf (3503 N/m)) does not exceed the maximum KCS Joist uniform load of 825 plf (12040 N/m) and a standard KCS Joist can be selected from the load table, a load diagram is not required.

EXAMPLE 3

LRFD FACTORED LOADS

<table>
<thead>
<tr>
<th>W = 450 plf (3503 N/m)</th>
<th>W = 240 plf (1630 N/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>650 lb (2.90 kN)</td>
<td>450 lb (2.00 kN)</td>
</tr>
<tr>
<td>800 lb (3.56 kN)</td>
<td>600 lb (2.67 kN)</td>
</tr>
</tbody>
</table>

\[ M = 4365 \text{ in.-kip (492.81 kN-m)} \]

EXCEEDS CAPACITY OF 30KCS5 (MAXIMUM KCS JOIST) AND EXCEEDS MAXIMUM UNIFORM LOAD OF 825 plf (12040 N/m).

**OPTION A:**

Use double joists each having a minimum \( M = 2183 \text{ in.-kip (246.65 kN-m)} \) and \( R = 10500 \text{ lbs (46.71 kN)} \) and a uniform load of 594 lb (2.67 kN).

Select two 28KCS5, \( M = 2556 \text{ in.-kip (288.7 kN-m)}, \quad R = 13800 \text{ lbs (61.3 kN)} \)

Bridging section no. 12 for \( L = 55 \text{ ft (16764 mm)} \)

Use 28K12 to determine bridging and stability requirements.

**OPTION B:**

Select an LH-Series Joist. Calculate an equivalent uniform load based on the maximum moment or shear:

\[ W_M = 692 \text{ plf (10.06 kN/m)} \]

\[ W_V = 509 \text{ plf (7.43 kN/m)} \]

From the LH-Series LRFD Load Table select a 32LH13, \( W = 690 \text{ plf (10.06 kN/m)} \) for a 55 ft. (16764 mm) span. Specify a 32LH13SP and present a load diagram on the structural drawings with the following note:

**JOIST MANUFACTURER SHALL DESIGN FOR THE LOAD SHOWN IN THE LOAD DIAGRAM.**
EXAMPLE 2

M = 664 in.-kip (75.03 kN-m)
RL = 7500 lbs (33.36 kN), RR = 8010 lbs (35.63 kN)

Select a 22KCS2, M = 732 in.-kip (82.64 kN-m)
R = 8850 lbs (39.38 kN)

Bridging section no. 6 for L = 30 ft. (9144 mm)
Use 22K6 to determine bridging and stability requirements.

Since the maximum factored uniform load of 639 plf (9318 N/m) (405 plf (5911 N/m) + 240 plf (3503 N/m)) does not exceed the maximum KCS Joist uniform load of 825 plf (12040 N/m) and a standard KCS Joist can be selected from the load table, a load diagram is not required.

EXAMPLE 3

M = 4365 in.-kip (492.81 kN-m)
RL = R R = 21000 lbs (93.41 kN)

EXCEEDS CAPACITY OF 30KCS5 (MAXIMUM KCS JOIST)
AND EXCEEDS MAXIMUM UNIFORM LOAD OF 550 plf (8027 N/m).

OPTION A:
Use double joists each having a minimum M = 1455 in.-kip (164.3 kN-m) and R = 7000 lbs (31.14 kN) and a uniform load of 400 plf (5838 N/m).
Select two 28KCS5, M = 1704 in.-kip (192.5 kN-m), R = 9200 lbs (40.9 kN)

Bridging section no. 12 for L = 55 ft. (16764 mm) Use 28K12 to determine bridging and stability requirements.

OPTION B:
Select an LH-Series Joist. Calculate an equivalent uniform load based on the maximum moment or shear:
WM = = 641 plf (9.35 kN/m)
WV = = 509 plf (7.43 kN/m)

Use 32LH13SP and present a load diagram on the structural drawings with the following note:
JOIST MANUFACTURER SHALL DESIGN FOR THE LOAD SHOWN IN THE LOAD DIAGRAM.
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

102.1 STEEL

The steel used in the manufacture of chord and web sections shall conform to one of the following ASTM Specifications:

- Carbon Structural Steel, ASTM A36/A36M.
- High-Strength, Low-Alloy Structural Steel, ASTM A42/A42M.
- High-Strength Carbon-Manganese Steel of Structural Quality ASTM A522/A522M, Grade 50.
- High-Strength Low-Alloy Columbium-Vanadium Structural Steel, ASTM A572/A572M Grade 42 or 50.
- High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inches (100 mm) Thick, ASTM A588/A588M.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A660.
- Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1011/A1011M.
- Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, ASTM A1015/A1015M, or shall be of suitable quality ordered or produced to other than the listed specifications, provided that such material in the state used for final assembly and manufacture is weldable and is proved by tests performed by the producer or manufacturer to have the properties specified in Section 102.2.

102.2 MECHANICAL PROPERTIES

The yield strength used as a basis for the design stresses prescribed in Section 103 shall be at least 36 ksi (250 MPa), but shall not be greater than 50 ksi (345 MPa). Evidence that the steel furnished meets or exceeds the yield design strength shall, if requested, be provided in the form of an affidavit or by witnessed or certified test reports.

For material used without consideration of increase in yield strength resulting from cold forming, the specimens shall be taken from as-rolled material. In the case of material, the mechanical properties of which conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to those of such specifications and to ASTM A370.

In the case of material, the mechanical properties of which do not conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to the applicable requirements of ASTM A370, and the specimens shall exhibit a yield strength equal to or exceeding the design yield strength and an elongation of not less than (a) 2 percent in 2 inches (51 millimeters) for sheet and strip, or (b) 18 percent in 8 inches (203 millimeters) for plates, shapes and bars with adjustments for thickness for plates, shapes and bars as prescribed in ASTM A36/A36M, A42/A42M, A572/A572M, A588/A588M, whichever specification is applicable on the basis of design yield strength.

The number of tests shall be as prescribed in ASTM A660M for plates, shapes, and bars, and ASTM A660, A1008/A1008M and A1011/A1011M for sheet and strip.

If as-formed strength is utilized, the test reports shall show the results of tests performed on full section specimens in accordance with the provisions of the A5S North American Specification for the Design of Cold-Formed Structural Members. They shall also indicate compliance with these provisions and with the following additional requirements:

a) The yield strength calculated from the test data shall equal or exceed the design yield strength.

b) Where tension tests are made for acceptance and control purposes, the tensile strength shall be at least 6 percent greater than the yield strength of the section.

c) Where compression tests are used for acceptance and control purposes, the specimen shall withstand a gross shortening of 2 percent of its original length without cracking. The thickness of the specimen shall be not greater than 20 times its least radius of gyration.

d) If any test specimen fails to pass the requirements of subparagraphs (a), (b), or (c) above, as applicable, two retests shall be made of specimens from the same lot. Failure of one of the retest specimens to meet such requirements shall be the cause for rejection of the lot represented by the specimen.

102.3 WELDING ELECTRODES

The following electrodes shall be used for arc welding:

a) For connected members both having a specified yield strength greater than 36 ksi (250 MPa).

AWS A5.1: E70XX
AWS A5.6: E70XX
AWS A5.17: F7XX-EXXX, F7XX-ECXXX flux electrode combination
AWS A5.18: ER70S-X, E70CC-X, E70CM-X
AWS A5.20: E6XT-X, E6XT-XM
AWS A5.23: F7XX-XXX, F7XX-ECXXX-XX
AWS A5.28: ER70S-XXX, E70CC-XXX
AWS A5.29: E7XX-XXX, E7XX-XX

b) For connected members both having a specified minimum yield strength of 36 ksi (250 MPa) or one having a specified minimum yield strength of 36 ksi (250 MPa), and the other having a specified minimum yield strength greater than 36 ksi (250 MPa).

AWS A5.1: E60XX
AWS A5.17: F6XX-EXXX, F6XX-ECXXX flux electrode combination
AWS A5.20: E6XT-X, E6XT-XM
AWS A5.29: E6XT-XM or any of those listed in Section 102.3(a).

Other welding methods, providing equivalent strength as demonstrated by tests, may be used.

102.4 PAINT

The standard shop paint is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional coating.

When specified, the standard shop paint shall conform to one of the following:

a) Steel Structures Painting Council Specification, SSPC No. 15.

b) Or, shall be a shop paint which meets the minimum performance requirements of the above listed specification.

Design Basis:

Designs shall be made according to the provisions in this Specification for either Load and Resistance Factor Design (LRFD) or for Allowable Strength Design (ASD).

Load Combinations:

LRFD:

When load combinations are not specified to the joint manufacturer, the required stress shall be computed for the
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH- SERIES

Standard Specifications and Load Tables. Longspan Steel Joists LH-Series And Deep Longspan Steel Joist DLH-Series

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SECTION 100. SCOPE

This Specification covers the design, manufacture and use of Longspan Steel Joists LH-Series, and Deep Longspan Steel Joists, DLH-Series. Load and Resistance Factor Design (LRFD) and Allowable Strength Design (ASD) are included in this specification.

SECTION 101. DEFINITION

The term “Longspan Steel Joists LH-Series and Deep Longspan Steel Joists DLH-Series”, as used herein, refers to open web, load-carrying members utilizing hot-rolled or cold-formed steel, including cold-formed steel whose yield strength has been attained by cold working. LH-Series are suitable for the direct support of roofs and roof decks in buildings, and DLH-Series are suitable for direct support of roof decks in buildings.

The design of LH- and DLH-Series joist chord and web sections shall be based on a yield strength of at least 36 ksi (250 MPa), but not greater than 50 ksi (345 MPa). Steel used for LH- and DLH-Series joist chord or web sections shall have a minimum yield strength determined in accordance with one of the procedures specified in Section 102.2, which is equal to the yield strength assumed in the design. LH- and DLH-Series joists shall be designed in accordance with those specifications to support the loads given in the Standard Load Tables for Longspan and Deep Longspan Steel Joists, LH- and DLH-Series, attached hereto.

The term “Yield Strength” as used herein shall designate the yield level of a material as determined by the applicable method outlined in paragraph 13.1, “Yield Point”, and in paragraph 13.2, “Yield Strength”, of ASTM A370. “Standard Test Methods and Definitions for Mechanical Testing of Steel Products”, or as specified in Section 102.2 of this Specification.

SECTION 102. MATERIALS

102.1 STEEL

The steel used in the manufacture of chord and web sections shall conform to one of the following ASTM Specifications:

- Carbon Structural Steel, ASTM A36/A36M.
- High-Strength, Low-Alloy Structural Steel, ASTM A522/A522M, Grade 60.
- High-Strength Low-Alloy Columbium-Vanadium Structural Steel, ASTM A572/A572M Grade 42 or 50.
- High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inches (100 mm) Thick, ASTM A588/A588M.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A606.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A606.

Steel used for LH- and DLH-Series joist chord or web sections shall have a minimum yield strength determined in accordance with one of the procedures specified in Section 102.2, which is equal to the yield strength assumed in the design. LH- and DLH-Series joists shall be designed in accordance with those specifications to support the loads given in the Standard Load Tables for Longspan and Deep Longspan Steel Joists, LH- and DLH-Series, attached hereto.

102.2 MECHANICAL PROPERTIES

The yield strength used as a basis for the design stresses prescribed in Section 103 shall be at least 36 ksi (250 MPa), but shall not be greater than 50 ksi (345 MPa). Evidence that the steel furnished meets or exceeds the design yield strength shall, if requested, be provided in the form of an affidavit by or witnessed or certified test reports.

For material used without consideration of increase in yield strength resulting from cold forming, the specimens shall be taken from as-rolled material. In the case of material, the mechanical properties of which conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to those of such specifications and to ASTM A370.

In the case of material, the mechanical properties of which do not conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to the applicable requirements of ASTM A370, and the specimens shall exhibit a yield strength equal to or exceeding the design yield strength and an elongation of not less than (a) 20 percent in 2 inches (51 millimeters) for sheet and strip, or (b) 18 percent in 4 inches (203 millimeters) for plates, shapes and bars with adjustments for thinness for plates, shapes and bars as prescribed in ASTM A36/A36M, A522/A522M, A588/A588M, A572/A572M, A588/A588M, whichever specification is applicable on the basis of design yield strength.

The number of tests shall be as prescribed in ASTM A6/A6M for plates, shapes, and bars; and ASTM A606, A1006A1008M and A1011A1011M for sheet and strip.

If as-formed strength is utilized, the test reports shall show the results of tests performed on full section specimens in accordance with the provisions of the API North American Specification for the Design of Cold-Formed Structural Members. They shall also indicate compliance with these provisions and with the following additional requirements:

- The yield strength calculated from the test data shall equal or exceed the design yield strength.
- When tension tests are made for acceptance and control purposes, the tensile strength shall be at least 6 percent greater than the yield strength of the section.
- Where compression tests are used for acceptance and control purposes, the specimen shall withstand a gross shortening of 2 percent of its original length without cracking. The length of the specimen shall be at least greater than 20 times its least radius of gyration.
- Where any test specimen fails to pass the requirements of subparagraphs (a), (b), or (c) above, as applicable, two retakes shall be made of specimens from the same lot. Failure of one of the retake specimens to meet such requirements shall be the cause for rejection of the lot represented by the specimens.

102.3 WELDING ELECTRODES

The following electrodes shall be used for arc welding:

- For connected members both having a specified yield strength greater than 36 ksi (250 MPa).
  - AWS A5.1: E70XX
  - AWS A5.6: E70XX-X
  - AWS A5.17: F7XX-EXXX, F7XX-ECXXX flux electrode combination
  - AWS A5.18: ER70S-X, E70C-XC, E70C-XM
  - AWS A5.20: E70T-X, E70T-XM
  - AWS A5.23: F7XX-EXX-XX, F7XX-ECXXX-XX
  - AWS A5.28: ER70S-X, E70C-XC
  - AWS A5.29: E70T-X, E70T-XM

b) For connected members both having a specified minimum yield strength of 250 MPa or one having a specified minimum yield strength of 36 ksi (250 MPa), and the other having a specified minimum yield strength greater than 36 ksi (250 MPa),

- AWS A5.1: E60XX
- AWS A5.17: F6XX-EXXX, F6XX-ECXXX flux electrode combination
- AWS A5.20: E6XT-X, E6XT-XM
- AWS A5.29: E6XT-X, E6XT-XM

Any of those listed in Section 102.3(a).

Other welding methods, providing equivalent strength as demonstrated by tests, may be used.

102.4 PAINT

The standard shop paint is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional coating.

When specified, the standard shop paint shall conform to one of the following:

- Steel Structures Painting Council Specification, SSPC No. 15
- Or, shall be a shop paint which meets the minimum performance requirements of the above listed specification.

SECTION 103. DESIGN AND MANUFACTURE

103.1 METHOD

Joists shall be designed in accordance with these specifications as simply supported, uniformly loaded trusses supporting a floor or roof deck so constructed as to brace the top chord of the joists against lateral buckling. Where any applicable design feature is not specifically covered herein, the design shall be in accordance with the following indications:

- Where the steel used consists of hot-rolled shapes, bars or plates, use the American Institute of Steel Construction, Specification for Structural Steel Buildings.
- For members that are cold-formed from sheet or strip steel, use the American Iron and Steel Institute, North American Specification for the Design of Cold-Formed Structural Members.

Design Basis:

Designs shall be made according to the provisions in this Specification for either Load and Resistance Factor Design (LRFD) or for Allowable Strength Design (ASD).

Load Combinations:

LRFD:

When load combinations are not specified to the joist manufacturer, the required stress shall be computed for
1.2D + 1.6 (L₁ or L₂ or S₁ or R₁) ASD:
When load combinations are not specified to the joist manufacturer, the required stress shall be computed based on the load combinations as follows:

A: Dead load due to the weight of the structural elements and the permanent features of the structure.
L: Live load due to occupancy and movable equipment.
S: Snow load.
R: Live load due to rainwater or ice exclusive of the ponding condition.

When special loads are specified and the specifying professional does not provide the load combinations, the provisions of ASCE 7, “Minimum Design Loads for Buildings and Other Structures” shall be used for LRFD and ASD load combinations.

103.2 DESIGN AND ALLOWABLE STRESSES

Design Using Load and Resistance Factor Design (LRFD):
Joints shall have their components so proportioned that the required stresses, Ω, shall not exceed $F_{ny}$ where:

- $F_{ny}$ = nominal stress ksi (MPa)
- $\phi$ = resistance factor
- $\Omega$ = allowable stress

Design Using Allowable Stress Design (ASD):
Joints shall have their components so proportioned that the required stresses, $\Omega$, shall not exceed $F_{ny}$.

Allowable Stress = 0.6Fy (ASD) (103.2-9)
Allowable Stress = 0.9Fy (LRFD) (103.2-10)
Allowable Stress = 0.95Fy (ASD) (103.2-11)
Allowable Stress = 0.9Fy (LRFD) (103.2-12)
Allowable Shear Strength = $wF_{nx}$ (103.2-13)
Allowable Shear Strength = $0.6F_{nx}$ (103.2-14)

The slenderness ratios, $l_1/r$ and $l_2/r$, to be used in calculating the nominal column strength is given in Table 103.3-1, Parts A.

The effective slenderness ratio, $l_1/r$, to be used in calculating the nominal stresses $F_{ny}$. $F_{ny}$ is the largest value which does not exceed the governing $l_1/r$ ratio of the member as a whole.

In compression members when fillers or ties are used, they shall be spaced so that the $l_1/r$ ratio of each component does not exceed the governing $l_1/r$ ratio of the member as a whole.

The terms used in Table 103.3-1 are defined as follows:
- $l_1$ = Length center-to-center of panel points, except $l_1 = 96$ in. (914 mm) for calculating $l_1/r$ of top chord member.
- $r_1$ = maximum length center-to-center between panel point and filler (tie), or between adjacent fillers (ties).
- $r_2$ = member radius of gyration in the plane of the joint.
- $r_3$ = least radius of gyration of a member component.

* See P.N. Chow and T.V. Galambos, Compression Chords Without Fillers in Longspan Steel Joists, Research Report No. 36, June 1975 Structural Division, Civil Engineering Department, Washington University, St. Louis, MO.
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

103.2 DESIGN AND ALLOWABLE STRESSES

Design Using Load and Resistance Factor Design (LRFD)

Joists shall have their components so proportioned that the required stresses, $f_u$, shall not exceed $F_n / \Omega$ for the member when a moment-resistant weld group is not used for this member, where $\Omega$ is the corresponding least radius of gyration of the member as a whole or any component part.

For chords and web members other than solid rounds:

\[
F_n = 0.65Fy(103.2-3)
\]

\[
F_n = 0.65Fy(103.2-3)
\]

\[
F_n = 0.65Fy(103.2-3)
\]

For chord members and the appropriate length for web members, and $r_x$ shall be taken as the distance in inches (millimeters) between panel points for the chord member when fillers or ties are used, they shall be spaced so that the $l / r_x$ ratio of each component does not exceed the governing $l / r$ ratio of the member as a whole.

When special loads are specified and the specifying professional does not provide the load combinations, the provisions of ASCE 7, "Minimum Design Loads for Buildings and Other Structures" shall be used for LRFD and ASD load combinations.

103.3 MAXIMUM SLENDERNESS RATIOS

The slenderness ratios, $1.0 l / r$ and $1.0 l / r_1$ of members as a whole or any component part shall not exceed the values given in Table 103.3-1, Parts A and B.

The effective slenderness ratio, $K l / r$, to be used in calculating the nominal stresses $F_n$ and $F_n / \Omega$ is the largest value as determined from Table 103.3-1, Parts B and C.

In compression members when fillers or ties are used, they shall be spaced so that the $l / r_x$ ratio of each component does not exceed the governing $l / r_x$ ratio of the member as a whole.

The terms used in Table 103.3-1 are defined as follows:

- $l = $ Length center-to-center of panel points, except $l = 96$ in. ($914$ mm) for calculating $l / r_x$ of top chord member.
- $r_x = $ maximum length center-to-center between panel point and filler (tie), or between adjacent fillers (ties).
- $r_1 = $ member radius of gyration in the plane of the joint.
- $l / r_x$ = least radius of gyration of a member component.

412.3 Bending: $\phi = 0.90$ (LRFD) $\Omega = 1.67$ (ASD)

Bending calculations are to be based on using the elastic section modulus.

For chords and web members other than solid rounds:

\[
F_y = 50 \text{ ksi (345 MPa)} \quad \text{or} \quad F_y = 36 \text{ ksi (250 MPa)}
\]

Design Stress = $0.9F_y$ (LRFD) (103.2-8)

For chords and web members other than solid rounds:

\[
F_y = 50 \text{ ksi (345 MPa)} \quad \text{or} \quad F_y = 36 \text{ ksi (250 MPa)}
\]

Design Stress = $0.9F_y$ (LRFD) (103.2-10)

For web members of solid round cross section:

\[
F_y = 50 \text{ ksi (345 MPa)} \quad \text{or} \quad F_y = 36 \text{ ksi (250 MPa)}
\]

Design Stress = $1.45F_y$ (LRFD) (103.2-10)

For bearing plates:

\[
F_y = 50 \text{ ksi (345 MPa)} \quad \text{or} \quad F_y = 36 \text{ ksi (250MPa)}
\]

Design Stress = $1.35F_y$ (LRFD) (103.2-12)

Allowable Stress = $0.9F_y$ (ASD) (103.2-13)

Aluminum Specification for the Design of Cold-Formed Steel Structural Members.
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

### TABLE 103.3-1

**MAXIMUM AND EFFECTIVE SLENDERNESS RATIOS**

#### I TOP CHORD INTERIOR PANEL

A. The slenderness ratios, $1.0/r_x$ and $1.0/r_y$, of members as a whole or any component part shall not exceed 90.

B. The effective slenderness ratio to determine $F_{cr}$
   1. With fillers or ties $0.75/r_x$ $1.0/r_y$ $1.0/r_x$
   2. Without fillers or ties $0.75/r_x$ $1.0/r_y$
   3. Single component members $0.75/r_x$ $1.0/r_y$

C. The effective slenderness ratio to determine $F_{e}$
   1. With fillers or ties $0.75/r_x$ $1.0/r_y$ $1.0/r_x$
   2. Without fillers or ties $0.75/r_x$ $1.0/r_y$
   3. Single component members $0.75/r_x$ $1.0/r_y$

#### II TOP CHORD END PANEL

A. The slenderness ratios, $1.0/r_x$ and $1.0/r_y$, of members as a whole or any component part shall not exceed 120.

B. The effective slenderness ratio to determine $F_{cr}$
   1. With fillers or ties $1.0/r_x$ $1.0/r_y$ $1.0/r_x$
   2. Without fillers or ties $1.0/r_x$ $1.0/r_y$
   3. Single component members $1.0/r_x$ $1.0/r_y$

C. The effective slenderness ratio to determine $F_{e}$
   1. With fillers or ties $1.0/r_x$ $1.0/r_y$ $1.0/r_x$
   2. Without fillers or ties $1.0/r_x$ $1.0/r_y$
   3. Single component members $1.0/r_x$ $1.0/r_y$

#### III TENSION MEMBERS - CHORDS AND WEBS

A. The slenderness ratios, $1.0/r_x$ and $1.0/r_y$, of members as a whole or any component part shall not exceed 240.

#### IV COMPRESSION WEB MEMBERS

A. The slenderness ratios, $1.0/r_x$ and $1.0/r_y$, of members as a whole or any component part shall not exceed 200.

B. The effective slenderness ratio to determine $F_{cr}$
   1. With fillers or ties $0.75/r_x$ $1.0/r_y$ $1.0/r_x$
   2. Without fillers or ties $0.75/r_x$ $1.0/r_y$
   3. Single component members $0.75/r_x$ $1.0/r_y$

### 103.4 MEMBERS

#### (a) Chords

The bottom chord shall be designed as an axially loaded tension member.

### SJI STANDARD SPECIFICATIONS

### III TENSION MEMBERS - CHORDS AND WEBS

#### 103.4 MEMBERS

(a) Chords

The bottom chord shall be designed as an axially loaded tension member.

The radius of gyration of the top chord about its vertical axis shall not be less than $l/170$ where $l$ is the spacing in inches (millimeters) between lines of bridging as specified in Section 104.5(d).

The top chord shall be considered as stayed laterally by the floor slab or roof deck provided the requirements of Section 104.9(a) of this specification are met.

The top chord shall be designed as a continuous member subject to combined axial and bending stresses and shall be so proportioned that

For LRFD:

- at the panel point:
  \[ F_{w} + F_{b} = 0.9F_{y} \]  
  \[ F_{w} + F_{b} = 0.9F_{y} \]  
- at the mid panel:
  \[ F_{w} + F_{b} = 0.9F_{y} \]  
  \[ F_{w} + F_{b} = 0.9F_{y} \]

For ASD:

- at the panel point:
  \[ F_{w} + F_{b} = 0.6F_{y} \]  
- at the mid panel:
  \[ F_{w} + F_{b} = 0.6F_{y} \]  

Where

- $F_{w} = \text{Required axial strength using LRFD load combinations, kips (N)}$
- $F_{b} = \text{Required flexural strength using LRFD load combinations, kips (N-mm)}$
- $F_{w} = \text{Required axial strength using ASD load combinations, kips (N)}$
- $F_{b} = \text{Required flexural strength using ASD load combinations, kips (N-mm)}$
- $S_{j} = \text{Elastic Section Modulus, in.}^{2} (\text{mm}^{3})$
- $C_{m} = \text{Area of the top chord, in.}^{2} (\text{mm}^{2})$
- $Q = \text{Form factor defined in Section 103.2(b)}$
- $A = \text{Area of the top chord, in.}^{2} (\text{mm}^{2})$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
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- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
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- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
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- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
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- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
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- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
- $F_{cr} = \text{Nominal axial compressive stress in ksi (MPa)}$
- $F_{e} = \text{Required bending stress at the location under consideration, ksi (MPa)}$
- $F_{y} = \text{Specified minimum yield strength, ksi (MPa)}$
**TABLE 103.3-1**

MAXIMUM AND EFFECTIVE SLENDERNESS RATIOS

| TOP CHORD INTERIOR PANEL | The slenderness ratios, 1.0 \( l/r \) and 1.0 \( l/r \), of members as a whole or any component part shall not exceed 90.
| B. The effective slenderness ratio to determine \( F'_e \) | 0.75 \( l/r \), 1.0 \( l/r \), 1.0 \( l/r \), 0.75 \( l/r \) |
| C. The effective slenderness ratio to determine \( F_c \) | 0.75 \( l/r \), 1.0 \( l/r \), 0.75 \( l/r \), 0.75 \( l/r \) |

| TOP CHORD END PANEL | The slenderness ratios, 1.0 \( l/r \) and 1.0 \( l/r \), of members as a whole or any component part shall not exceed 120.
| B. The effective slenderness ratio to determine \( F'_e \) | 1.0 \( l/r \), 1.0 \( l/r \), 1.0 \( l/r \), 1.0 \( l/r \) |
| C. The effective slenderness ratio to determine \( F_c \) | 1.0 \( l/r \), 1.0 \( l/r \), 1.0 \( l/r \), 1.0 \( l/r \) |

| TENSION MEMBERS - CHORDS AND WEEBS | The slenderness ratios, 1.0 \( l/r \) and 1.0 \( l/r \), of members as a whole or any component part shall not exceed 240.
| IV COMPRESSION WEB MEMBERS | The slenderness ratios, 1.0 \( l/r \) and 1.0 \( l/r \), of members as a whole or any component part shall not exceed 200.

**103.4 MEMBERS**

**(a) Chords**

The bottom chord shall be designed as an axially loaded tension member.

The radius of gyration of the top chord about its vertical axis shall not be less than \( 0.170 \) where \( r \) is the spacing in inches (millimeters) between lines of bridging as specified in Section 104.5(d).

The top chord shall be considered as stayed laterally by the floor slab or roof deck provided the requirements of Section 104.5(d) of this specification are met.

The top chord shall be designed as a continuous member subject to combined axial and bending stresses and shall be so proportioned that

For LRFD:

at the panel point:

\[ f_{au} + f_{bu} \leq 0.9F_e \]  

at the mid panel:

\[ \frac{f_{au}}{F_e} \leq 0.2 \]  

For ASD:

at the panel point:

\[ f_{au} + f_{bu} \leq 0.6F_e \]  

at the mid panel:

\[ \frac{f_{au}}{F_e} \leq 0.2 \]  

**For Design**

\[ F_e = \frac{P}{A} = \text{Required compressive stress, ksi (MPa)} \]

\[ Fa = \text{Allowable axial compressive stress, based on } F_e \]

\[ M = \text{Required axial strength using ASD load combinations, kip-in. (N-mm)} \]

\[ S = \text{Elastic Section Modulus, in.}^3 (\text{mm}^3) \]

\[ F_b = \text{Allowable bending stress, 0.6}F_y \text{, ksi (MPa)} \]

\[ F_m = \text{Specified minimum yield strength, ksi (MPa)} \]

\[ F_a = \frac{4}{3} \frac{F_y}{C_m} \text{ksi (MPa)} \]

Where \( r \) is the panel length, in inches (millimeters), as defined in Section 103.2(b) and \( C_m \) is the radius of gyration about the axis of bending.

\[ Q = \text{Form factor defined in Section 103.2(b)} \]

\[ A = \text{Area of the top chord, in.}^2 (\text{mm}^2) \]

**For ASD:**

at the panel point:

\[ \frac{f_{au}}{F_e} \leq 0.2 \]  

at the mid panel:

\[ \frac{f_{au}}{F_e} \leq 0.2 \]  

\[ \frac{f_{au}}{F_e} \leq 0.2 \]  

**Note:** Use 1.2 \( l/r \) for a cramped, first primary compression web member when a moment-resisting weld group is not used for this member.
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

103.6 CAMBER

Joints shall have approximate cambers in accordance with the following.

**TABLE 103.6-1**

<table>
<thead>
<tr>
<th>Top Chord Length</th>
<th>Approximate Camber</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'-0&quot; (6096 mm)</td>
<td>1/8&quot; (6 mm)</td>
</tr>
<tr>
<td>30'-0&quot; (9144 mm)</td>
<td>3/8&quot; (10 mm)</td>
</tr>
<tr>
<td>40'-0&quot; (12192 mm)</td>
<td>5/8&quot; (16 mm)</td>
</tr>
<tr>
<td>50'-0&quot; (15240 mm)</td>
<td>1&quot; (25 mm)</td>
</tr>
<tr>
<td>60'-0&quot; (18288 mm)</td>
<td>1 1/2&quot; (38 mm)</td>
</tr>
<tr>
<td>70'-0&quot; (21336 mm)</td>
<td>2&quot; (51 mm)</td>
</tr>
<tr>
<td>80'-0&quot; (24834 mm)</td>
<td>2 3/4&quot; (70 mm)</td>
</tr>
<tr>
<td>90'-0&quot; (27432 mm)</td>
<td>3 1/2&quot; (89 mm)</td>
</tr>
<tr>
<td>100'-0&quot; (30480 mm)</td>
<td>4 1/4&quot; (108 mm)</td>
</tr>
<tr>
<td>110'-0&quot; (33528 mm)</td>
<td>5&quot; (127 mm)</td>
</tr>
<tr>
<td>120'-0&quot; (36576 mm)</td>
<td>6&quot; (152 mm)</td>
</tr>
<tr>
<td>130'-0&quot; (39621 mm)</td>
<td>7&quot; (178 mm)</td>
</tr>
<tr>
<td>140'-0&quot; (42672 mm)</td>
<td>8&quot; (203 mm)</td>
</tr>
<tr>
<td>144'-0&quot; (43896 mm)</td>
<td>8 1/2&quot; (216 mm)</td>
</tr>
</tbody>
</table>

The weld spatter shall not interfere with paint coverage acceptable to the specified manufacturer.

103.7 VERIFICATION OF DESIGN AND MANUFACTURE

(a) Design Calculations

Compliance with the provisions of any LH- or DLH-Series Joists shall be verified by data supplied by the Steel Joist Institute (or an independent agency approved by the Steel Joist Institute) for verification of compliance with the full specifications.

(b) In-Plant Inspections

Each manufacturer shall verify their ability to manufacture LH- and DLH-Series Joists through periodic In-Plant Inspections. Inspections shall be performed by an independent agency approved by the Steel Joist Institute. The frequency, manner of inspection, and manner of reporting shall be determined by the Steel Joist Institute. The plant inspections shall not be a guarantee of the quality of any specific joists; this responsibility lies fully and solely with the individual manufacturer.

104.1 USAGE

This specification shall apply to any type of structure where floors and roofs are supported directly by steel joists installed as hereinafter specified. Where joists are used other than on simple spans under uniformly distributed loading as prescribed in Section 103.1, they shall be investigated and modified if necessary to limit the required stresses to those listed in Section 103.2.

CAUTION: If a rigid connection of the bottom chord is to be made to a column or other support, it shall be made only after the fabrication of the dead loads. The joint is not then subject to any simple simply supported, and the system must be investigated for continuous frame action by the specifying professional.

The design detail of a rigid type connection and moment plates shall be shown on the structural drawings by the specifying professional. The moment plates shall be furnished by the joist manufacturer.

104.2 SPAN

The clear span of a joint shall not exceed 24 times its depth. The term "Span" as used herein is defined as the clear span plus 8 inches (203 millimeters).

104.3 DEPTH

The nominal depth of sloping chord joists shall be the depth at mid-span. The standard slope of the top chord shall be 1/8 inch per foot (1/96). The term "Span" as used herein is defined as the clear span plus 8 inches (203 millimeters).

104.4 END SUPPORTS

(a) Masonry and Concrete

LH- and DLH-Series Joists supported by masonry or concrete are to be bear on steel bearing plates and shall be designed as steel bearing. Due consideration of the end reactions and all other vertical and lateral forces shall be taken by the specifying professional in the design of the steel bearing plate and the masonry or concrete. The ends of LH- and DLH-Series Joists shall extend a distance of not less than 6 inches (152 millimeters) over the masonry or concrete support and be anchored to the steel bearing plate. The plates shall be located not more than 1/2 inch (13 millimeters) from the face of the wall and shall be not less than 9 inches (229 millimeters) wide perpendicular to the length of the joint. The plate is to be designed by the specifying professional and shall be furnished by other than the joint manufacturer.

Where it is deemed necessary to bear less than 6 inches (152 millimeters) over the masonry or concrete support, special consideration is to be given to the design of the steel bearing plate and the masonry or concrete by the specifying professional. The joints must bear a minimum 4 inches (102 millimeters) on the steel bearing plate.

(b) Steel

Due consideration of the end reactions and all other vertical and lateral forces shall be taken by the specifying professional in the design of the steel support. The ends of LH- and DLH-Series Joists shall extend a distance of not less than 4 inches (102 millimeters) over the steel supports. Where it is deemed necessary to butt opposite joints over a narrow steel support with bearing less than that noted above, special ends must be specified, and such ends shall have positive attachment to the support, either by bolting or welding.

104.5 BRIDGING

Top and bottom chord bridging is required and shall consist of one or both of the following types:

(a) Horizontal

Horizontal bridging lines shall consist of continuous horizontal steel members. The "r" of the bridging member shall not exceed 300, where "r" is the distance in inches (millimeters) between attachments and "r" is the least radius of gyration of the bridging member.

(b) Diagonal

Diagonal bridging shall consist of cross-bracing with a "r" ratio of not more than 200, where "r" is the distance in inches (millimeters) between connections, and "r" is the least radius of gyration of the bridging member. Where cross-bracing members are connected at their point of intersection, "r" is to be taken as the distance in inches (millimeters) between connections at the point of intersection of the bridging members and the connections to the chord of the joist.

(c) Bridging Lines

For spans up through 60 feet (18288 mm), welded horizontal bridging may be used except where the row of bridging...
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

JOINT CONNECTIONS

(d) Depth
Joints may have either parallel chords or a top chord slope of 1/8 inch per foot (1:96). The depth, for the purpose of design, in all cases shall be the depth at mid-span.

(e) Eccentricity
Members connected at a joint shall have their center of gravity lines meet at a point, if practical. Eccentricity on either side of the neutral axis of chord members may be neglected when it does not exceed the distance between the neutral axis and the back of the chord. Otherwise, provision shall be made for the stresses due to eccentricity. Ends of joints shall be proportioned to resist bend- ing produced by eccentricity at the support.

In those cases where a single angle compression member is attached to the outside of the stem of a tee or dou- ble angle chord, due consideration shall be given to the special attention of the specifying professional. The magni tude and location of the loads to be supported, deflection requirements, and proper bracing shall be clearly indicated on the structural drawings.

103.5 CONNECTIONS

(a) Methods
Joint connections and splices shall be made by attaching the members to one another by arc or resistance welding or other accredited methods.

(1) Welded Connections
a) Selected welds shall be inspected visually by the manufacturer. Prior to this inspection, weld slag shall be removed.

b) Cracks are not acceptable and shall be repaired.

c) Thorium fusion shall exist between layers of weld metal and between weld metal and base metal for the required design length of the weld, such fusion shall be verified by visual inspection.

d) Unified weld crawlers shall not be included in the design length of the weld.

e) Undercut shall not exceed 1/16 inch (2 mm) for welds oriented parallel to the principal stress.

f) The sum of surface (piping) porosity diameters shall not exceed 1/16 inch (2 mm) in any one inch (25 mm) of design weld length.

g) Weld spatter that does not interfere with paint cov erage is acceptable.

(2) Welding Procedure
Manufacturers shall have a program for establishing weld procedures and operator qualification, and for weld sampling and testing.

(3) Weld Inspection by Outside Agencies (See Section 103.13 of this specification)
The agency shall arrange for visual inspection to deter- mine that welds meet the acceptance standards of Section 103.5(a)(1). Ultrasonic, X-Ray, and magnetic particle testing are inappropriate for joints due to the configurations of the components and welds.

(b) Strength

(1) Joint Connections – Joint connections shall develop the maximum force due to any of the design loads, but not less than 50 percent of the strength of the member in tension or compression, whichever force is the controlling factor in the selection of the member.

(2) Shop Splices – Shop splices may occur at any point in chord or web members. Splices shall be designed for the member force but not less than 50 percent of the member strength. Members containing a butt weld splice shall develop an ultimate tensile force of at least 57 ksi (390 MPa) times the full design area of the chord or web. The term “member” shall be defined as all component parts comprising the chord or web, at the point of splice.

(c) Field Splices
Field Splices shall be designed by the manufacturer and may be either bolted or welded. Splices shall be designed for the member force, but not less than 50 per cent of the member strength.

103.6 CAMBER

Joists shall have approximate cambers in accordance with the following: TABLE 103.6-1

<table>
<thead>
<tr>
<th>Top Chord Length</th>
<th>Approximate Camber</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'-0&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>30'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>40'-0&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>50'-0&quot;</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>60'-0&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>70'-0&quot;</td>
<td>1 1/4&quot;</td>
</tr>
<tr>
<td>80'-0&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>80'-0&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>90'-0&quot;</td>
<td>2 1/4&quot;</td>
</tr>
<tr>
<td>100'-0&quot;</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td>110'-0&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>120'-0&quot;</td>
<td>3 1/2&quot;</td>
</tr>
<tr>
<td>130'-0&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>140'-0&quot;</td>
<td>4 1/2&quot;</td>
</tr>
<tr>
<td>150'-0&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td>160'-0&quot;</td>
<td>5 1/2&quot;</td>
</tr>
<tr>
<td>170'-0&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>180'-0&quot;</td>
<td>6 1/2&quot;</td>
</tr>
<tr>
<td>190'-0&quot;</td>
<td>7&quot;</td>
</tr>
<tr>
<td>200'-0&quot;</td>
<td>7 1/2&quot;</td>
</tr>
<tr>
<td>210'-0&quot;</td>
<td>8&quot;</td>
</tr>
</tbody>
</table>

(2) Welding
Welds shall be made by processes for which the manufacturers have established that they shall develop the design forces and are approved by the Steel Joist Institute.

103.7 VERIFICATION OF DESIGN AND MANUFACTURE

(a) Design Calculations
Companies selecting any LH- or DLH-Series Joists shall submit design data to the Steel Joist Institute (or an independent agency approved by the Steel Joist Institute) for verification of compliance with the full Specifications.

(b) In-Plant Inspections
Each manufacturer shall verify their ability to manufac- ture LH- and DLH-Series Joists through periodic In-Plant Inspections. Inspections shall be performed by an inde- pendent agency approved by the Steel Joist Institute. The frequency, manner of inspection, and manner of reporting shall be determined by the Steel Joist Institute. The plant inspections are not a guarantee of the quality of any specific joints, this responsibility lies fully and solely with the individual manufacturer.

SECTION 104. APPLICATION

104.1 USAGE
This specification shall apply to any type of structure where floors and roofs are to be supported directly by steel joists installed as hereinafter specified. Where joists are used other than on simple spans under uniformly distributed load as prescribed in Section 103.1, they shall be investigat- ed and modified if necessary to limit the required stresses to those listed in Section 103.2.

CAUTION: If a rigid connection of the bottom chord is to be made to a column or other support, it shall be made only after the application of the dead loads. The joint is then no longer simply supported, and the system must be investigated for continuous frame action by the specifying professional.

The designed detail of a rigid type connection and moment plates shall be shown on the structural drawings by the spec- ifying professional. The moment plates shall be furnished by other than the joist manufacturer.

104.2 SPAN
The clear span of a joint shall not exceed 24 times its depth. The term “Span” as used herein is defined as the clear span plus 8 inches (203 millimeters).

104.3 DEPTH
The nominal depth of sloping chord joints shall be the depth at mid-span. The standard slope of the top chord shall be 1/8 inch per foot (1:96).

104.4 END SUPPORTS
(a) Masonry and Concrete
LH- and DLH-Series Joists supported by masonry or concrete are to be supported directly by steel joists installed as hereinafter specified. Where joists are used other than on simple spans under uniformly distributed load, special attention is to be given to the design of the steel bearing plate and the masonry or concrete. The ends of LH- and DLH-Series Joists shall extend a distance of not less than 8 inches (152 millimeters) over the masonry or concrete support and be anchored to the steel bearing plate. The joists shall be located not more than 1.25 inches (32 millimeters) from the face of the wall and shall be not less than 9 inches (229 millimeters) wide perpendicular to the length of the joint. The joists are to be designed by the specifying professional and shall be furnished by other than the joist manufacturer.

Where it is deemed necessary to bear less than 6 inches (152 millimeters) over the masonry or concrete support, special consideration is to be given to the design of the steel bearing plate and the masonry or concrete by the specifying professional. The joints must bear a minimum 4 inches (102 millimeters) on the steel bearing plate.

(b) Steel
Due consideration of the end reactions and all other ver- tical and lateral forces shall be taken by the specifying professional in the design of the steel bearing plate and the masonry or concrete. The ends of LH- and DLH-Series Joists shall extend a distance of not less than 8 inches (152 millimeters) over the masonry or concrete support and be anchored to the steel bearing plate. The plant inspections are not a guarantee of the quality of any specific joints, this responsibility lies fully and solely with the individual manufacturer.

104.5 BRIDGING
Top and bottom chord bridging is required and shall consist of one or both of the following types:

(a) Horizontal
Horizontal bridging lines shall consist of continuous hori- zontal steel members. The ratio of the bridging member shall not exceed 300, where r is the distance in inches (millimeters) between attachments and r is the least radius of gyration of the bridging member.

(b) Diagonal
Diagonal bridging shall consist of cross-bracing with a ratio of not more than 200, where r is the distance in inches (millimeters) between connections, and r is the least radius of gyration of the bridging member. Where cross-bracing members are connected at their point of intersection, the distance in inches (millimeters) between connections shall be taken by the specifying professional and the connections to the chord of the joints.

(c) Bridging Lines
For spans up through 60 feet (18288 mm), welded horizon- tal bridging may be used except where the row of bridging
nearest the center is required to be bolted diagonal bridging as indicated by the shaded area in the Load Table. For spans over 60 feet (18288 mm) bolted diagonal bridging shall be used as indicated by the blue and gray shaded area of the Load Table.

(d) Quantity and Spacing

The maximum spacing of lines of top chord bridging shall not exceed the values in Table 104.5-1. The number of rows of bottom chord bridging, including bridging required per Section 104.12, shall not be less than the number of top chord rows. Rows of bottom chord bridging are permitted to be spaced independently of rows of top chord bridging. The spacing of rows of bottom chord bridging shall meet the slenderness requirement of Section 103.4(a) and any specified strength requirements.

### Table 104.5-1

<table>
<thead>
<tr>
<th>LH DLH SECTION</th>
<th>MAX. SPACING OF TOP CHORD BRIDGING</th>
<th>NOMINAL* LATERAL BRIDGING FORCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>02,03,04</td>
<td>11&quot; (3352 mm)</td>
<td>400 (1779)</td>
</tr>
<tr>
<td>06,06</td>
<td>12&quot; (3657 mm)</td>
<td>500 (2224)</td>
</tr>
<tr>
<td>07,08</td>
<td>13&quot; (3962 mm)</td>
<td>650 (2911)</td>
</tr>
<tr>
<td>09,10</td>
<td>14&quot; (3667 mm)</td>
<td>800 (3568)</td>
</tr>
<tr>
<td>11,12</td>
<td>16&quot; (4787 mm)</td>
<td>1000 (4448)</td>
</tr>
<tr>
<td>13,14</td>
<td>18&quot; (4787 mm)</td>
<td>1200 (5337)</td>
</tr>
<tr>
<td>15,16</td>
<td>21&quot; (5440 mm)</td>
<td>1600 (7117)</td>
</tr>
<tr>
<td>17,18</td>
<td>23&quot; (6400 mm)</td>
<td>1800 (8006)</td>
</tr>
<tr>
<td>18,19</td>
<td>26&quot; (7117 mm)</td>
<td>2000 (8886)</td>
</tr>
</tbody>
</table>

* Number of lines of bridging is based on joint clear span dimensions. 4/12 roof assembly is not considered. 5/12 roof assembly is shown in load table.

(e) Connections

Connections to the chords of the steel joists shall be made by positive mechanical means or by welding, and capable of resisting a horizontal force not less than that specified in Table 104.5-1.

(f) Bottom Chord Bearing Joists

Where bottom chord bearing joists are utilized, a row of diagonal bridging shall be provided near the support(s). This bridging shall be installed and anchored before the hoisting cables is released.

104.6 INSTALLATION OF BRIDGING

Bridging shall support the top and bottom chords against lateral movement during the construction period and shall hold the steel joists in the approximate position as shown on the joint placement plans.

The ends of all bridging lines terminating at walls or beams shall be anchored to resist the nominal force shown in Table 104.5-1.

104.7 END ANCHORAGE

(a) Masonry and Concrete

Ends of LH and DLH-Series Joists resting on steel bearing plates on masonry or structural concrete shall be attached thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) ASTM A307 bolts (minimum, or the equivalent).

(b) Steel

Ends of LH and DLH-Series Joists resting on steel support shall be attached thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) ASTM A307 bolts, or the equivalent. When LH/DLH series joists are used to provide lateral stability to the supporting member, the final connection shall be made by welding or as designated by the specifying professional.

(c) Uplift

Where uplift forces are a design consideration, roof joists shall be anchored to resist such forces (Refer to Section 104.12).

104.8 JOIST SPACING

Joists shall be spaced so that the loading on each joist does not exceed the design load (LRFD or ASD) for the particular joist designation and span as shown in the applicable load tables.

104.9 FLOOR AND ROOF DECKS

(a) Material

Floor and roof decks may consist of cast-in-place or precast concrete or gypsum, formed steel, wood, or other suitable material capable of supporting the required load at the specified joist spacing.

(b) Thickness

Cast-in-place slabs shall not be less than 2 inches (51 millimeters) thick.

(c) Centering

Centering for structural slabs may be ribbed metal lath, corrugated steel sheets, paper-backed welded wire fabric, removable centering or any other suitable material capable of supporting the slab at the designated joist spacing. Centering shall not cause lateral displacement or damage to the top chord of joists during installation or removal of the centering or placing of the concrete.

(d) Bearing

Slabs or decks shall bear uniformly along the top chords of the joists.

### Attachments

The spacing of attachments along the top chord shall not exceed 36 inches (914 millimeters). Such attachments of the slab or deck to the top chords of joists shall be capable of resisting the following forces:

<table>
<thead>
<tr>
<th>Section*</th>
<th>Number</th>
<th>Nominal** Force Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 to 04 inc.</td>
<td>120 lbs/ft (177 kN/m)</td>
<td></td>
</tr>
<tr>
<td>05 to 09 inc.</td>
<td>150 lbs/ft (219 kN/m)</td>
<td></td>
</tr>
<tr>
<td>10 to 17 inc.</td>
<td>200 lbs/ft (292 kN/m)</td>
<td></td>
</tr>
<tr>
<td>18 and 19</td>
<td>250 lbs/ft (365 kN/m)</td>
<td></td>
</tr>
</tbody>
</table>

* Last two digits of joist designation shown in load table.

** Nominal force is unfactored.

(f) Wood Nailers

Where wood nailers are used, such nailers in conjunction with deck or slab shall be firmly attached to the top chords of the joists in conformance with Section 104.9(e).

(g) Joist with Standing Seam Roofing

The stiffness and strength of standing-seam roof clips varies from one manufacturer to another. Therefore, some roof systems cannot be counted on to provide lateral stability to the joists which support the roof. Sufficient stability must be provided to brace the joists laterally under the full design load. The compression chord must resist the chord axial design force in the plane of the joint (i.e., x-x axis buckling) and out of the plane of the joint (i.e., y-y axis buckling). Out of plane strength may be achieved by adjusting the bridging spacing and/or increasing the compression chord area, the joist depth, and the y-y axis radius of gyration. The effective slenderness ratio in the y-y direction equals 0.94 Lc, where Lc is the bridging spacing in inches (millimeters). The maximum bridging spacing may not exceed that specified in Section 104.9(d).

Horizontal bridging members attached to the compression chords and their anchorages must be designed for a compressive axial force of 0.0305P, where P is the number of joists between end anchors and P is the chord design force in kips (Newtons). The attachment force between the horizontal bridging member and the compression chord is 0.006P. Horizontal bridging attached to the tension chords shall be proportioned so that the slenderness ratio between attachments does not exceed 300. Diagonal bridging shall be proportioned so that the slenderness ratio between attachments does not exceed 200.

104.10 DEFLECTION

The deflection due to the design live load shall not exceed the following:

- Floors: 1/60 of span.
- Roofs: 1/600 of span where a plaster ceiling is attached or suspended.
- 1/640 of span for all other cases.

The specifying professional shall give consideration to the effects of deflection and vibration* in the selection of joists.

* For further reference, refer to Steel Joist Institute Technical Digest #5, "Vibration of Steel Joist-Concrete Slab Floors" and the Institute's Computer Vibration Program.

104.11 PONDING*

The ponding investigation shall be performed by the specifying professional.

* For further reference, refer to Steel Joist Institute Technical Digest #3, "Structural Design of Steel Joist Roofs to Resist Ponding Loads" and A650 Specifications.

104.12 UPLIFT

Where uplift forces due to wind are a design requirement, these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascals). The contract documents shall indicate if the net uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of joists and/or bridging. A single line of bottom chord bridging must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

* For further reference, refer to Steel Joist Institute Technical Digest #3, "Structural Design of Steel Joist Roofs to Resist Uplift Loads".

104.13 INSPECTION

Joists shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of these specifications. If the purchaser wishes an inspection of the steel joists by someone other than the manufacturer’s own inspectors, they may reserve the right to do so in their "Invitation to Bid" or the accompanying "Bid Specifications.

Arrangements shall be made with the manufacturer for such shop inspection of the joists at the manufacturing shop by the purchaser’s inspectors at purchaser’s expense.

104.14 PARALLEL CHORD SLOPED JOISTS

The span of a parallel chord sloped joist shall be defined by the length along the slope. Minimum depth, load-carrying capacity and bridging requirements shall be determined by the sloped definition of span. The Load Table capacity shall be the component normal to the joist.
nearest the center is required to be bolted diagonal bridging as indicated by the Red shaded area in the Load Table. For spans over 60 feet (18288 mm) Red diagonal bridging shall be used as indicated by the Blue and Gray shaded area of the Load Table.

(d) Quantity and Spacing

The maximum spacing of lines of top chord bridging shall not exceed the values in Table 104.5.1. The number of rows of bottom chord bridging, including bridging required per Section 104.12, shall not be less than the number of top chord rows. Rows of bottom chord bridging are permitted to be spaced independently of rows of top chord bridging. The spacing of rows of bottom chord bridging shall meet the slenderness requirement of Section 103.4(a) and any specified strength requirements.

Table 104.5-1

<table>
<thead>
<tr>
<th>LH-DLH SERIES</th>
<th>MAX. SPACING OF TOP CHORD BRIDGING</th>
<th>NOMINAL FORCE REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>02,03,04</td>
<td>11&quot;-0&quot; (3352 mm)</td>
<td>400 (1779)</td>
</tr>
<tr>
<td>06,06</td>
<td>12&quot;-0&quot; (3657 mm)</td>
<td>500 (2224)</td>
</tr>
<tr>
<td>07,08</td>
<td>13&quot;-0&quot; (3962 mm)</td>
<td>650 (2891)</td>
</tr>
<tr>
<td>09,10</td>
<td>14&quot;-0&quot; (4267 mm)</td>
<td>800 (3574)</td>
</tr>
<tr>
<td>11,12</td>
<td>15&quot;-0&quot; (4572 mm)</td>
<td>1000 (4448)</td>
</tr>
<tr>
<td>13,14</td>
<td>16&quot;-0&quot; (4878 mm)</td>
<td>1200 (5337)</td>
</tr>
<tr>
<td>15,16</td>
<td>21&quot;-0&quot; (5460 mm)</td>
<td>1600 (7117)</td>
</tr>
<tr>
<td>17,18</td>
<td>23&quot;-0&quot; (5840 mm)</td>
<td>1800 (8096)</td>
</tr>
<tr>
<td>19,20</td>
<td>24&quot;-0&quot; (6096 mm)</td>
<td>2000 (8986)</td>
</tr>
</tbody>
</table>

Number of lines of bridging is based on joint clear span dimensions.

*1/2 inch (12 mm) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) ASTM A307 bolts, or the equivalent.

**Nominal force is unfactored.

104.7 END ANCHORAGE

(a) Masonry and Concrete

Ends of LH-DLH-Series Joists resting on steel bearing plates on masonry or structural concrete shall be attached thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) ASTM A307 bolts (minimum), or the equivalent. Where LH-DLH series joists are used to provide lateral stability to the supporting member, the final connection shall be made by welding or as designated by the specifying professional.

(b) Steel

Ends of LH- and DLH-Series Joists resting on steel support shall be attached thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) ASTM A307 bolts, or the equivalent. Where LH-DLH series joists are used to provide lateral stability to the supporting member, the final connection shall be made by welding or as designated by the specifying professional.

(c) Uplift

Where uplift forces are a design consideration, roof joists shall be anchored to resist such forces (Refer to Section 104.12).

104.8 JOIST SPACING

Joists shall be spaced so that the loading on each joist does not exceed the design load (LRFD or ASD) for the particular joist designation and span as shown in the applicable load tables.

104.9 FLOOR AND ROOF DECKS

(a) Material

Floor and roof decks may consist of cast-in-place or precast concrete or gypsum, formed steel, wood, or other suitable material capable of supporting the required load at the specified joist spacing.

(b) Thickness

Cast-in-place slabs shall be not less than 2 inches (51 millimeters) thick.

(c) Centering

Centering for structural slabs may be ribbed metal lath, corrugated steel sheets, paper-backed wet wire fabric, removable centering or any other suitable material capable of supporting the slab at the designated joist spacing. Centering shall not cause lateral displacement or damage to the top chord of joists during installation or removal of the centering or placing of the concrete.

(d) Bearing

Slabs or decks shall bear uniformly along the top chords of the joists.

(e) Attachments

The spacing of attachments along the top chord shall not exceed 36 inches (914 millimeters). Such attachments of the slab or deck to the top chords of joists shall be capable of resisting the following forces:

Table 104.9-1

<table>
<thead>
<tr>
<th>SECTION* NUMBER</th>
<th>NOMINAL** FORCE REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 to 04 incl.</td>
<td>120 lbs/ft (1.75 kN/m)</td>
</tr>
<tr>
<td>05 to 09 incl.</td>
<td>150 lbs/ft (2.19 kN/m)</td>
</tr>
<tr>
<td>10 to 17 incl.</td>
<td>200 lbs/ft (2.92 kN/m)</td>
</tr>
<tr>
<td>18 and 19</td>
<td>250 lbs/ft (3.65 kN/m)</td>
</tr>
</tbody>
</table>

*Last digit of joist designation shown in the load table.

**Nominal force is unfactored.

104.10 DEFLECTION

The deflection due to the design live load shall not exceed the following:

Floors: 1/360 of span.

Roofs: 1/360 of span where a plaster ceiling is attached or suspended.

1/40 of span for all other cases.

The specifying professional shall give consideration to the effects of deflection and vibration* in the selection of joists.

* For further reference, refer to Steel Joist Institute Technical Digest #6, “Vibration of Steel Joist-Concrete Slab Floors” and the Institute’s Computer Vibration Program.

104.11 PONDING*

The ponding investigation shall be performed by the specifying professional.

* For further reference, refer to Steel Joist Institute Technical Digest #3, “Structural Design of Steel Joist Roofs to Resist Ponding Loads” and AISC Specifications.

104.12 UPLIFT

Where uplift forces due to wind are a design requirement, these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascals). The contract documents shall indicate if the net uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of joists and/or bridging. A single line of bottom chord bridging must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

* For further reference, refer to Steel Joist Institute Technical Digest #6, “Structural Design of Steel Joist Roofs to Resist Uplift Loads”.

104.13 INSPECTION

Joists shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of these specifications. If the purchaser wishes an inspection of the steel joists by someone other than the manufacturer’s own inspectors, they may reserve the right to do so in their “Invitation to Bid” or the accompanying “Job Specifications”.

Arrangements shall be made with the manufacturer for such shop inspection of the joists at the manufacturing shop by the purchaser’s inspectors at purchaser’s expense.

104.14 PARALLEL CHORD SLOPED JOISTS

The span of a parallel chord sloped joist shall be defined by the length along the slope. Minimum depth, load-carrying capacity, and bridging requirements shall be determined by the slope definition of span. The Load Table capacity shall be the component normal to the joist.
LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

SECTION 105.*

ERECTION STABILITY AND HANDLING

When it is necessary for the erector to climb on the joists, extreme caution must be exercised since unbridged joists may exhibit some degree of instability under the erector’s weight.

(a) Stability Requirements

1) Before an employee is allowed on the steel joist: BOTH ends of joists at columns (or joists designated as column joists) shall be attached to its supports. For all other joists a minimum of one end shall be attached before the employee is allowed on the joist. The attachment shall be in accordance with Section 104.7 – End Anchorage.

When a bolted seat connection is used for erection purposes, as a minimum, the bolts must be snug tightened. The snug tight condition exists when all plies of a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of an employee using an ordinary sput wrench.

2) On steel joists that do not require erection bridging as shown by the unshaded area of the Load Table, only one employee shall be allowed on the joist unless all bridging is installed and anchored.

* For a thorough coverage of this topic, refer to SJI Technical Digest #8, “Handling and Erection of Steel Joists and Joist Girders”.

3) Where the span of the steel joist is within the Red shaded area of the Load Table, the following shall apply:

a) The row of bridging nearest the mid span of the steel joist shall be bolted diagonal erection bridging; and
b) Hoisting cables shall not be released until this bolted diagonal erection bridging is installed and anchored, unless an alternate method of stabilizing the joist has been provided; and

No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.

4) Where the span of the steel joist is within the Blue shaded area of the Load Table, the following shall apply:

a) All rows of bridging shall be bolted diagonal bridging; and
b) Hoisting cables shall not be released until the two rows of bolted diagonal erection bridging nearest the third points of the steel joist are installed and anchored; and

No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

5) Where the span of the steel joist is in the Gray shaded area of the Load Table, the following shall apply:

a) All rows of bridging shall be bolted diagonal bridging; and
b) Hoisting cables shall not be released until all bridging is installed and anchored; and

No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

6) When permanent bridging termi- minus points cannot be used during erection, additional temporary bridging termi- minus points are required to provide lateral stability.

7) In the case of bottom chord bearing joists, the ends of the joist must be restrained laterally per Section 104.5(f) before releasing the hoisting cables.

8) After the joist is straightened and plumbed, and all bridging is completely installed and anchored, the ends of the joists shall be fully connected to the supports in accordance with Section 104.7 – End Anchorage.

(b) Landing and Placing Loads

1) Except as stated in paragraph 105(b)(3) of this section, no “construction loads” (1) are allowed on the steel joists until all bridging is installed and anchored, and all joist bearing ends are attached.

2) During the construction period, loads placed on the joists shall be distributed so as not to exceed the capacity of the joists.

3) No bundle of decking may be placed on steel joists until all bridging has been installed and anchored and all joist bearing ends are attached. Unless the following conditions are met:

a) The contractor has first determined from a “qualified person” (2) and documented in a site specific erection plan that the structure or portion of structure is capable of supporting the load;
b) The bundle of decking is placed on a minimum of 3 steel joists;
c) The joists supporting the bundle of decking are attached at both ends;
d) At least one row of bridging is installed and anchored;
e) The total weight of the decking does not exceed 4000 pounds (1814 kilograms); and

The edge of the construction load shall be placed within 1 foot (0.30 meters) of the bearing surface of the joist end.

(c) Field Welding

1) All field welding shall be performed in accordance with contract documents. Field welding shall not damage the joists.

2) On cold-formed members whose yield strength has been attained by cold working, and whose as-formed strength is used in the design, the total length of weld at any one point shall not exceed 50 percent of the overall developed width of the cold-formed section.

(1) See Appendix E for definition of “construction load”. A copy of the OSHA Steel Erection Standard §1926.757, Open Web Steel Joists, is included in Appendix E for reference purposes.

(d) Handling

Particular attention should be paid to the erection of Longspan and Deep Longspan Steel Joists. Care shall be exercised at all times to avoid damage to the joists and accessories.

Each joist shall be adequately braced laterally before any loads are applied. If lateral support is provided by bridging, the bridging lines as defined in Section 105(a), paragraphs 2, 3, 4 and 5, must be anchored to prevent lateral movement.

(e) Fall Arrest Systems

Steel joists shall not be used as anchorage points for a fall arrest system unless written approval to do so is obtained from a “qualified person” (2).

(2) See Appendix E for OSHA definition of “qualified person.”

LONGSPAN AND DEEP LONGSPAN STEEL JOISTS, LH- AND DLH-SERIES

This page contains technical details related to the stability and handling of steel joists and joist girders, including requirements for stability, anchorage, and handling during erection. The text outlines specific procedures and guidelines to ensure the safe and efficient installation of these structural components, emphasizing the importance of proper technique and adherence to safety standards.
**SECTION 105.**

**ERECTION STABILITY AND HANDLING**

When it is necessary for the erector to climb on the joists, extreme caution must be exercised since unbridged joists may exhibit some degree of instability under the erector’s weight.

(a) **Stability Requirements**

1) Before an employee is allowed on the steel joist:
   a) All field welding shall be performed in accordance with Section 104.7 – End Anchorage.
   b) Hoisting cables shall not be released until this bolt-diagonal erection bridging is installed and anchored; and
   c) The row of bridging nearest the mid span of the steel joist shall be bolted diagonal erection bridging; and
   d) At least one row of bridging is installed and anchored; and
   e) All rows of bridging shall be bolted diagonal bridging; and
   f) The edge of the construction load shall be placed within 1 foot (0.30 meters) of the bearing surface of the joist end.

2) On steel joists that do not require erection bridging as shown by the unshaded area of the Load Table, only one employee shall be allowed on the joist unless all bridging is installed and anchored.

3) Where the span of the steel joist is within the **Red shaded area** of the Load Table, the following shall apply:
   a) The row of bridging nearest the mid span of the steel joist shall be bolted diagonal erection bridging; and
   b) Hoisting cables shall not be released until this bolted diagonal erection bridging is installed and anchored, unless an alternate method of stabilizing the joist has been provided; and
   c) No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.

4) Where the span of the steel joist is within the **Blue shaded area** of the Load Table, the following shall apply:
   a) All rows of bridging shall be bolted diagonal bridging; and
   b) Hoisting cables shall not be released until the two rows of bolted diagonal erection bridging nearest the third points of the steel joist are installed and anchored; and
   c) No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

5) Where the span of the steel joist is in the **Gray shaded area** of the Load Table, the following shall apply:
   a) All rows of bridging shall be bolted diagonal bridging; and
   b) Hoisting cables shall not be released until all bridging is installed and anchored; and
   c) No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

6) When permanent bridging terminus points cannot be used during erection, additional temporary bridging terminus points are required to provide lateral stability.

7) In the case of bottom chord bearing joists, the ends of the joist must be restrained laterally per Section 104.5(f) before releasing the hoisting cables.

8) After the joist is straightened and plumbed, and all bridging is completely installed and anchored, the ends of the joists shall be fully connected to the supports in accordance with Section 104.7 – End Anchorage.

(b) **Landing and Placing Loads**

1) Except as stated in paragraph 105(b)(3) of this section, no “construction load”(1) are allowed on the steel joists until all bridging is installed and anchored, and all joist bearing ends are attached.

2) During the construction period, loads placed on the joists shall be distributed so as not to exceed the capacity of the joists.

3) No bundle of decking may be placed on steel joists until all bridging has been installed and anchored and all joist bearing ends are attached, unless the following conditions are met:
   a) The contractor has first determined from a “qualified person”(2) and documented in a site specific erection plan that the structure or portion of structure is capable of supporting the load;
   b) The bundle of decking is placed on a minimum of 3 steel joists;
   c) The joists supporting the bundle of decking are attached at both ends;
   d) At least one row of bridging is installed and anchored;
   e) The total weight of the decking does not exceed 4000 pounds (1816 kilograms); and
   f) The edge of the bundle of decking shall be placed within 1 foot (0.30 meters) of the bearing surface of the joist end.

(c) **Fall Arrest Systems**

Steel joists shall not be used as anchorage points for a fall arrest system unless written approval to do so is obtained from a “qualified person”(2).

(d) **Handling**

Particular attention should be paid to the handling of Longspan and Deep Longspan Steel Joists. Care shall be exercised at all times to avoid damage to the joists and accessories.

Each joist shall be adequately braced laterally before any loads are applied. If lateral support is provided by bridging, the bridging lines as defined in Section 105(a), paragraphs 2, 3, 4 and 5, must be anchored to prevent lateral movement.

(1) See Appendix E for OSHA definition of “qualified person”.

(2) See Appendix E for OSHA definition of “qualified person”.

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* For a thorough coverage of this topic, refer to SJI Technical Digest #9, “Handling and Erection of Steel Joists”.

APPENDIX

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Longspan and Deep Longspan Steel Joists. Care shall be exercised at all times to avoid damage to the joists and accessories. Each joist shall be adequately braced laterally before any loads are applied. If lateral support is provided by bridging, the bridging lines as defined in Section 105(a), paragraphs 2, 3, 4 and 5, must be anchored to prevent lateral movement.</td>
</tr>
<tr>
<td>Method</td>
<td>Steel joists shall not be used as anchorage points for a fall arrest system unless written approval to do so is obtained from a “qualified person”.</td>
</tr>
</tbody>
</table>
STANDARD SPECIFICATIONS
FOR JOIST GIRDERS

SECTION 1000.
SCOPE

This specification covers the design, manufacture and use of Joist Girders. Load and Resistance Factor Design (LRFD) and Allowable Strength Design (ASD) are included in this specification.

SECTION 1001.
DEFINITION

The term “Joist Girders”, as used herein, refers to open web, load-bearing members utilizing hot-rolled or cold-formed steel, including cold-formed steel whose yield strength* has been attained by cold working.

* The term “Yield Strength” as used herein shall designate the yield level of a material as determined by the applicable method outlined in paragraph 13.1, “Yield Point” and in paragraph 13.2, “Yield Strength”, of ASTM Standard A370, “Standard Test Methods and Definitions for Mechanical Testing of Steel Products”, or as specified in Section 1002.2 of this Specification.

The design of Joist Girders is equal to the yield strength determined in accordance with one of the procedures specified in Section 1002.2, which is equal to the yield strength assumed in the design. Joist Girders shall be designed in accordance with this specification to support panel point loadings.

The yield strength as used herein shall designate the yield level of a material as determined by the applicable method outlined in paragraph 13.1, “Yield Point” and in paragraph 13.2, “Yield Strength”, of ASTM Standard A370, “Standard Test Methods and Definitions for Mechanical Testing of Steel Products”, or as specified in Section 1002.2 of this Specification.

SECTION 1002.
MATERIALS

1002.1 STEEL

The steel used in the manufacture of chord and web sections shall conform to one of the following ASTM Specifications:
- Carbon Structural Steel, ASTM A36/A36M.
- High-Strength, Low-Alloy Structural Steel, ASTM A242/A242M.
- High-Strength Carbon-Manganese Steel of Structural Quality ASTM A520/A520M, Grade 50.
- High-Strength Low-Alloy Columbium-Vanadium Structural Steel, ASTM A522/A522M, Grade 42 and 50.
- High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inches (100 mm) Thick, ASTM A588/A588M.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A460.
- Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1008/A1008M.
- Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A411/A411M or shall be of suitable quality ordered or produced to other than the listed specifications, provided that such material in the state used for final assembly and manufacture is weldable and is proved by tests performed by the producer or manufacturer to have the properties specified in Section 1002.2.

1002.2 MECHANICAL PROPERTIES

The yield strength used as a basis for the design stresses prescribed in Section 1003 shall be at least 36 ksi (250 MPa), but shall not be greater than 50 ksi (345 MPa). Evidence that the steel furnished meets or exceeds the design yield strength shall, if requested, be provided in the form of an affidavit or by certified or certified test reports.

For material used without consideration of increase in yield strength resulting from cold forming, the specimens shall be taken from as-rolled material. In the case of material properties of which conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to the applicable requirements of ASTM A370 and the specimens shall exhibit a yield strength equal to or exceeding the design yield strength and an elongation of not less than (a) 20 percent in 2 inches (51 millimeters) for sheet and strip, or (b) 18 percent in 8 inches (203 millimeters) for plates, shapes and bars with adjustments for thickness for plates, shapes and bars as prescribed in ASTM A36/A36M, A242/A242M, A522/A522M, A522/A522M, A588/A588M, whichever specification is applicable on the basis of design yield strength.

The number of tests shall be as prescribed in ASTM A6/A6M for plates, shapes, and bars; and ASTM A569, A1008/A1008M and A1011/A1011M for sheet and strip.

If as-formed strength is utilized, the test shall show the results of tests performed on full section specimens in accordance with the provisions of the A516 Specifications for the Design of Cold-Formed Steel Structural Members and shall indicate compliance with these provisions and with the following additional requirements:

a) The yield strength calculated from the test data shall equal or exceed the design yield strength.

b) Where tension tests are made for acceptance and control purposes, the tensile strength shall be at least 6 percent greater than the yield strength of the section.

c) Where compression tests are used for acceptance and control purposes, the specimen shall withstand a gross shortening of 2 percent of its original length without cracking. The length of the specimen shall not be greater than 20 times its least radius of gyration.

d) If any test specimen fails to pass the requirements of the subparagraphs (a), (b), or (c) above, as applicable, two retests shall be made of specimens from the same lot. Failure of either of the retest specimens to meet such requirements shall be the cause for rejection of the lot represented by the specimen.

1002.3 WELDING ELECTRODES

The following electrodes shall be used for arc welding:

a) For connected members both having a specified yield strength greater than 36 ksi (250 MPa),
AWS A5.1: E70XX
AWS A5.5: E701XX
AWS A5.17: F7XX-EXXX, F7XX-EXXX flux electrode combination
AWS A5.18: ER70S-X, E70C-XC, E70C-XXM
AWS A5.20: E7XX-X, E7XX-XM
AWS A5.23: F7XX-EXXX-XX, F7XX-EXXX-XX
AWS A5.28: ER70S-XXX, E70C-XXX
AWS A5.29: E7XX-XX, E7XX-XM

b) For connected members both having a specified minimum yield strength of 36 ksi (250 MPa) or one having a specified minimum yield strength of 36 ksi (250 MPa) and the other having a specified minimum yield strength greater than 36 ksi (250 MPa),
AWS A5.1: E60XX
AWS A5.17: F6XX-EXXX, F6XX-XXM flux electrode combination
AWS A5.20: E6XX-X, E6XX-XM
AWS A5.29: E6XX-XX, E6XX-XM or any of those listed in Section 1002.3(a).

Other welding methods, providing equivalent strength as demonstrated by tests, may be used.

SECTION 1003.
DESIGN AND MANUFACTURE

1003.1 METHOD

Joist Girders shall be designed in accordance with this specification as simply supported primary members. All loads shall be applied through steel joists, and will be equal in magnitude and evenly spaced along the joist girder top chord. Where any applicable design feature is not specifically covered herein, the design shall be in accordance with the following specifications:

a) Where the steel used consists of hot-rolled shapes, bars or plates, use the American Institute of Steel Construction, Specification for Structural Steel Buildings.

b) For members that are cold-formed from sheet or strip steel, use the American Iron and Steel Institute, North American Specification for the Design of Cold-Formed Steel Structural Members.

Design Basis:
Designs shall be made according to the provisions in this Specification for either Load and Resistance Factor Design (LRFD) or for Allowable Strength Design (ASD).
STANDARD SPECIFICATIONS
FOR JOIST GIRDERS

This specification covers the design, manufacture and use of Joist Girders. Load and Resistance Factor Design (LRFD) and Allowable Strength Design (ASD) are included in this specification.

SECTION 1000. SCOPE

This specification covers the design, manufacture and use of Joist Girders. Load and Resistance Factor Design (LRFD) and Allowable Strength Design (ASD) are included in this specification.

SECTION 1001. DEFINITION

The term “Joist Girders”, as used herein, refers to open web, load-bearing members utilizing hot-rolled or cold-formed steel, including cold-formed steel whose yield strength has been attained by cold working. The design of Joist Girder chord and web sections shall be based on a yield strength of at least 36 ksi (250 MPa), but not greater than 50 ksi (345 MPa). Steel used for Joist Girder chord or web sections shall have a minimum yield strength determined in accordance with one of the procedures specified in Section 1002.2, which is equal to the yield strength assumed in the design. Joist Girders shall be designed in accordance with this specification to support panel loadings.

The term “Yield Strength” as used herein shall designate the yield level of a material as determined by the applicable method outlined in paragraph 13.1, “Yield Point” and in paragraph 13.2, “Yield Strength”, of ASTM Standard A370, “Standard Test Methods and Definitions for Mechanical Testing of Steel Products”, or as specified in Section 1002.2 of this Specification.

1002.1 STEEL

This steel used in the manufacture of chord and web sections shall conform to one of the following ASTM Specifications:

- Carbon Structural Steel, ASTM A36/A36M.
- Low-Alloy Structural Steel, ASTM A242/A242M.
- High-Strength Carbon-Manganese Steel of Structural Quality ASTM A520/A520M, Grade 50.
- High-Strength Low-Alloy Columbium-Vanadium Structural Steel, ASTM A572/A572M, Grades 42 and 50.
- High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inches (100 mm) Thick, ASTM A588/A588M.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A606.
- Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1008/A1008M.
- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Corrosion Resistance, ASTM A606.
- Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, ASTM A1008/A1008M.

The number of tests shall be as prescribed in ASTM A6/A6M, A572/A572M, A588/A588M, whenever specification is applicable on the basis of design yield strength.

The number of tests shall be as prescribed in ASTM A6/A6M for plates, shapes, and bars, and ASTM A606, A1008/A1008M and A1011/A1011M for sheet and strip.

If as-formed strength is utilized, the test reports shall show the results of tests performed on full section specimens in accordance with the provisions of the AAS Specifications for the Design of Cold-Formed Steel Structural Members and shall indicate compliance with these provisions and with the following additional requirements:

a) The yield strength calculated from the test data shall equal or exceed the design yield strength.

b) Where tension tests are made for acceptance and control purposes, the tensile strength shall be at least 6 percent greater than the yield strength of the section.

c) Where compression tests are used for acceptance and control purposes, the specimen shall withstand a gross shortening of 2 percent of its original length without crushing. The length of the specimen shall not be greater than 20 times its least radius of gyration.

d) If any test specimen fails to pass the requirements of the subparagraphs (a), (b), or (c) above, as applicable, two retests shall be made of specimens from the same lot. Failure of one of the retests shall meet such requirements shall be the cause for rejection of the lot represented by the specimen.

1002.2 MECHANICAL PROPERTIES

The yield strength used as a basis for the design stresses prescribed in Section 1003 shall be at least 36 ksi (250 MPa), but shall not be greater than 50 ksi (345 MPa). Evidence that the steel furnished meets or exceeds the design yield strength shall, if requested, be provided in the form of an affidavit or by witnessed or certified test reports.

For material used without consideration of increase in yield strength resulting from cold forming, the specimens shall be taken from as-rolled material. In the case of material properties of which conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to those of such specifications and to ASTM A370.

1003.1 METHOD

Joist Girders shall be designed in accordance with this specification as simply supported primary members. All loads shall be applied through steel joists, and will be equal in magnitude and evenly spaced along the joist girder top chord. Where any applicable design feature is not specifically covered herein, the design shall be in accordance with the following specifications:

a) Where the steel used consists of hot-rolled shapes, bars or plates, use the American Iron and Steel Institute, North American Specification for the Design of Cold-Formed Steel Structural Members.

b) For connected members both having a specified yield strength greater than 36 ksi (250 MPa), and the other having a specified minimum yield strength greater than 36 ksi (250 MPa),

- AWS A5.1: E60XX
- AWS A5.17: F6XX-EXXX, F6XX-ECXXX flux electrode combination
- AWS A5.20: E6XX-X, E6XX-XM or any of those listed in Section 1003.2.

Other welding methods, providing equivalent strength as demonstrated by tests, may be used.

1003.2 WELDING ELECTRODES

The following electrodes shall be used for arc welding:

a) For connected members both having a specified yield strength greater than 36 ksi (250 MPa),

- AWS A5.1: E70XX
- AWS A5.17: F7XX-EXXX, F7XX-ECXXX flux electrode combination
- AWS A5.18: ER70S-6, E70C-XG, E70C-XM
- AWS A5.20: E7XX-T, E7XX-XM
- AWS A5.23: F7XX-EXXXX, F7XX-ECXXXX
- AWS A5.28: ER70S-XXXX, E70C-XXX
- AWS A5.29: E7XXXT-T, E7XXT-XM

b) For connected members both having a specified minimum yield strength of 36 ksi (250 MPa) or one having a specified minimum yield strength of 36 ksi (250 MPa), and the other having a specified minimum yield strength greater than 36 ksi (250 MPa),

- AWS A5.1: E60XX
- AWS A5.17: F6XX-EXXX, F6XX-ECXXX flux electrode combination
- AWS A5.20: E6XX-X, E6XX-XM
- AWS A5.29: E6XXT-T, E6XXT-XM or any of those listed in Section 1003.2.

Other welding methods, providing equivalent strength as demonstrated by tests, may be used.

DESIGN AND MANUFACTURE

1003.1 METHOD

Joist Girders shall be designed in accordance with this specification as simply supported primary members. All loads shall be applied through steel joists, and will be equal in magnitude and evenly spaced along the joist girder top chord. Where any applicable design feature is not specifically covered herein, the design shall be in accordance with the following specifications:

a) Where the steel used consists of hot-rolled shapes, bars or plates, use the American Iron and Steel Institute, North American Specification for the Design of Cold-Formed Steel Structural Members.

b) For connected members that are cold-formed from sheet or strip steel, use the American Iron and Steel Institute, North American Specification for the Design of Cold-Formed Steel Structural Members.

design Basis:

Designs shall be made according to the provisions in this Specification for either Load and Resistance Factor Design (LRFD) or for Allowable Strength Design (ASD).

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JOIST GIRDERS

Stresses:

(a) Tension: $f_t = 0.90$ (LRFD) $\phi = 1.67$ (ASD)

For Chords: $F = 50$ ksi (345 MPa)

For Webs: $F = 50$ ksi (345 MPa), or $F = 36$ ksi (250 MPa)

Design Stress = 0.9Fy (LRFD) (1003.2-1)

Allowable Stress = 0.6Fy (ASD) (1003.2-2)

(b) Compression: $f_c = 0.90$ (LRFD) $\phi = 1.67$ (ASD)

For members with $l / r > 4.71$: $F_o = Q / E = \frac{Q}{6.65 / \Omega F_y}$ (1003.2-3)

For members with $l / r > 4.71$: $F_o = 0.677F_{y}$ (1003.2-4)

Where $F_{y}$ = Elastic buckling stress determined in accordance with Equation 1003.2-5.

(c) Bending: $\phi = 0.90$ (LRFD) $\omega = 1.67$ (ASD)

Bending calculations are to be based on using the elastic section modulus.

For chords and web members other than solid rounds: $F = 50$ ksi (345 MPa)

Design Stress = 0.9Fy (LRFD) (1003.2-8)

Allowable Stress = 0.6Fy (ASD) (1003.2-9)

For web members of solid round cross section: $F = 50$ ksi (345 MPa), or $F = 36$ ksi (250 MPa)

Design Stress = 1.45Fy (LRFD) (1003.2-10)

Allowable Stress = 0.95Fy (ASD) (1003.2-11)

For bearing plates: $F = 50$ ksi (345 MPa), or $F = 36$ ksi (250 MPa)

Design Stress = 1.35Fy (LRFD) (1003.2-12)

Allowable Stress = 0.9Fy (ASD) (1003.2-13)

(d) Weld Strength

Shear at throat of fillet welds:

Nominal Shear Stress = $F_{ww} A / l = 0.45F_{exx} A$ (1003.2-15)

LRFD: $\phi = 0.75$

Design Shear Stress = $0.4F_{y} + 0.6F_{ww} A = 0.4F_{exx} A$ (1003.2-16)

ASD: $\phi = 2.0$

Allowable Shear Stress = $0.3F_{exx} A$ (1003.2-16)

In compression members composed of two components, when fillers, ties or welds are used, they shall be spaced so the $r / l$ ratio for each component does not exceed the $r / l$ ratio of the member as a whole. In tension members composed of two components, when fillers, ties or welds are used, they shall be spaced so that the $r / l$ ratio of each component does not exceed 240. The least radius of gyration shall be used in computing the $r / l$ ratio of a component.

(e) Eccentricity

Members connected at a joint shall have their center of gravity lines meet at a point, if practical. Eccentricity on either side of the centroid of chord members may be neglected when it does not exceed the distance between the centroid and the back of the chord. Otherwise, provision shall be made for the sheaves due to eccentricity. Ends of Joist Girders shall be proportioned to resist bending produced by eccentricity at the support.

In those cases where a single angle compression member is attached to the outside of the stem of a tee or double angle chord, due consideration shall be given to eccentricity.

Extended Ends

Extended top chords or full depth cantilever ends require the special attention of the specifying professional. The magnitude and location of the loads to be supported, deflection requirements, and proper bracing shall be clearly indicated on the structural drawings.
Load Combinations:

**LRFD:**
- When load combinations are not specified to the joist manufacturer, the required stress shall be computed for the factored loads based on the factors and load combinations as follows:
  - 1.4D
  - 1.2D x 1.6 (L, or Lr, or S, or R)
- **ASD:**
- When load combinations are not specified to the joist manufacturer, the required stress shall be computed based on the load combinations as follows:
  - D
  - D x (L, or Lr, or S, or R)

**Where:**
- D = dead load due to the weight of the structural elements and the permanent features of the structure
- L = live load due to occupancy and movable equipment
- Lr = roof live load
- S = snow load
- R = load due to initial rainwater or ice exclusive of the ponding contribution

When special loads are specified and the specifying professional does not provide the load combinations, the provisions of ASCE 7, “Minimum Design Loads for Buildings and Other Structures” shall be used for LRFD and ASD load combinations.

### 1003.2 DESIGN AND ALLOWABLE STRESSES

**Design Using Load and Resistance Factor Design (LRFD):**
- Joist Girders shall have their components so proportioned that the required stresses, \( f \), shall not exceed \( Fb \) ksi, where:
  - \( f \) = required stress ksi (MPa)
  - \( Fb \) = nominal stress ksi (MPa)
  - \( \phi \) = resistance factor
  - \( Fb \) = design stress

**Design Using Allowable Stress Design (ASD):**
- Joist Girders shall have their components so proportioned that the required loads, \( f \), shall not exceed \( Fb \) ksi, where:
  - \( f \) = required stress ksi (MPa)
  - \( Fb \) = nominal stress ksi (MPa)
  - \( \Omega \) = safety factor
  - \( Fb/\Omega \) = allowable stress

### Stresses:

**(a) Tension:** \( \phi = 0.90 \) (LRFD) \( \Omega = 1.67 \) (ASD)

For chords: \( Fc = 50 \) ksi (345 MPa)
- **Design Stress:** \( 0.9F \) (LRFD) (1003.2-1)
- **Allowable Stress:** \( 0.6F \) (ASD) (1003.2-2)

**(b) Compression:** \( \phi = 0.90 \) (LRFD) \( \Omega = 1.67 \) (ASD)

For members with \( l/r \) > 4.71:
- \( Fc = \frac{E}{\Omega \phi} \) (1003.2-3)

For members with \( l/r \) ≤ 4.71:
- \( Fc = \frac{E}{\phi} \) (1003.2-4)

Where \( Fc \) = Elastic buckling stress determined in accordance with Equation 1003.2-5.

### Bending:

**(a) Bending:** \( \phi = 0.90 \) (LRFD) \( \Omega = 1.67 \) (ASD)

Bending calculations are to be based on using the elastic section modulus.

For chords and web members other than solid rounds:
- **Design Stress:** \( 0.9F \) (LRFD) (1003.2-8)
- **Allowable Stress:** \( 0.6F \) (ASD) (1003.2-9)

For web members of solid round cross section:
- **Design Stress:** \( 1.45F \) (LRFD) (1003.2-10)
- **Allowable Stress:** \( 0.95F \) (ASD) (1003.2-11)

For bearing plates:
- **Design Stress:** \( 1.35F \) (ASD) (1003.2-12)
- **Allowable Stress:** \( 0.90F \) (ASD) (1003.2-13)

### Weld Strength

Shear at throat of fillet welds:
- **Nominal Shear Stress:** \( Fsw = 0.6Fexx \) (1003.2-14)
- **Allowable Stress:** \( 0.9Fsw \) (ASD) (1003.2-15)

LRFD:
- **Design Shear Stress:** \( Fexx = 0.45Fsw \) (1003.2-15)
- **Allowable Shear Stress:** \( 0.2Fexx \) (1003.2-16)

ASD:
- **Design Shear Stress:** \( Fsw = 0.8Fexx\) (1003.2-15)
- **Allowable Shear Stress:** \( 0.6Fsw \) (ASD) (1003.2-16)

### Eccentricity

Members connected at a joint shall have their center of gravity lines meet at a point, if practical. Eccentricity on either side of the centroid of chord members may be neglected when it does not exceed the \( l/r \) ratio for each component. Eccentricity on the back of the chord is attached to the outside of the stem of a tee or double angle chord due consideration shall be given to eccentricity.

### Ends

Extended ends:

Extended top chords or full depth cantilever ends require special attention of the specifying professional. The magnitude and location of the loads to be supported, deflection requirements, and proper bracing shall be clearly indicated on the structural drawings.
1003.5 CONNECTIONS

(a) Methods
Joint connections and splices shall be made by attaching the members to one another by arc or resistance welding or other accredited methods.

(1) Welded Connections
a) Selected welds shall be inspected visually by the manufacturer. Prior to this inspection, weld slag shall be removed.
b) Cracks are not acceptable and shall be repaired.
c) Thorough fusion shall exist between layers of weld metal and between weld metal and base metal for the required design length of the weld; such fusion shall be verified by visual inspection.
d) Unfused weld crater shall not be included in the design length of the weld.
e) Undercut shall not exceed 1/16 inch (2 millimeters) for welds oriented parallel to the principal stress.
f) The sum of surface (piping) porosity shall not exceed 0.01 square inch (0.65 square millimeter) per inch length (2.54 millimeters) of design weld length.
g) Weld spatter that does not interfere with paint coverage is acceptable.

(2) Welding Program
Manufacturers shall have a program for establishing weld procedures and operator qualification, and for weld sampling and testing.

(3) Weld Inspection by Outside Agencies (See Section 1003.10 of this specification).
The agency shall arrange for visual inspection to determine that welds meet the acceptance standards of Section 1003.5(A). Ultrasonic, X-ray and magnetic particle testing are inappropriate for Joist Girders due to the configurations of the components and welds.

(b) Strength
(1) Joint Connections – Joint connections shall develop the maximum force due to any of the design loads, but not less than 50 percent of the strength of the member in tension or compression, whichever force is the controlling factor in the selection of the member strength.

(2) Shop Splices - Shop splices may occur at any point in the chord or web members. Splices shall be designed for the member force but not less than 50 percent of the member strength.

(c) Field Splices
Field Splices shall be designed by the manufacturer and may be either bolted or welded. Splices shall be designed for the member force, but not less than 50 percent of the member strength.

1003.6 CAMBER

Joist Girders shall have approximate cambers in accordance with the following:

<table>
<thead>
<tr>
<th>Top Chord Length</th>
<th>Approximate Camber</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'-0&quot; (6096 mm)</td>
<td>1/8&quot; (3 mm)</td>
</tr>
<tr>
<td>30'-0&quot; (9144 mm)</td>
<td>3/32&quot; (2.4 mm)</td>
</tr>
<tr>
<td>40'-0&quot; (12192 mm)</td>
<td>5/64&quot; (2 mm)</td>
</tr>
<tr>
<td>50'-0&quot; (15240 mm)</td>
<td>1&quot; (25 mm)</td>
</tr>
<tr>
<td>60'-0&quot; (18288 mm)</td>
<td>1 1/2&quot; (38 mm)</td>
</tr>
<tr>
<td>70'-0&quot; (21336 mm)</td>
<td>2&quot; (51 mm)</td>
</tr>
<tr>
<td>80'-0&quot; (24384 mm)</td>
<td>2 3/4&quot; (70 mm)</td>
</tr>
<tr>
<td>90'-0&quot; (27342 mm)</td>
<td>3 1/2&quot; (90 mm)</td>
</tr>
<tr>
<td>100'-0&quot; (30480 mm)</td>
<td>4 1/4&quot; (108 mm)</td>
</tr>
<tr>
<td>110'-0&quot; (33528 mm)</td>
<td>5&quot; (127 mm)</td>
</tr>
<tr>
<td>120'-0&quot; (36576 mm)</td>
<td>5 3/4&quot; (152 mm)</td>
</tr>
</tbody>
</table>

The specifying professional shall give consideration to coordinating Joist Girder camber with adjacent framing.

1003.7 VERIFICATION OF DESIGN AND MANUFACTURE

(a) Design Calculations
Companies manufacturing Joist Girders shall submit design data to the Steel Joist Institute (or an independent agency approved by the Steel Joist Institute) for verification of compliance with the Full Specifications.

(b) In-Plant Inspections
Each manufacturer shall verify their ability to manufacture Joist Girders through periodic In-Plant Inspections. Inspections shall be performed by an independent agency approved by the Steel Joist Institute. The frequency, manner of inspection, and manner of reporting shall be determined by the Steel Joist Institute. The In-Plant Inspections are not a guarantee of the quality of any specific Joist Girder; this responsibility lies fully and solely with the individual manufacturer.

1004.4 END SUPPORTS

(a) Masonry and Concrete
Joist Girders supported by masonry or concrete are to be anchor by means of bearing plates. End connections must be met:

b) No other loads shall be placed on the Joist Girder until the ends of Joist Girders resting on steel bearing plates on masonry or structural concrete shall be attached thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) bolts, or the equivalent.

(b) Steel
Ends of Joist Girders resting on steel supports shall be anchor by means of bearing plates. End connections must be met:

(a) Masonry and Concrete
Joist Girders supported by masonry or concrete are to be anchor by means of bearing plates. End connections must be met:

b) No other loads shall be placed on the Joist Girder until the ends of Joist Girders resting on steel bearing plates on masonry or structural concrete shall be attached thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/4 inch (19 millimeters) bolts, or the equivalent.

(c) Uplift
Where uplift forces are a design consideration, roof Joist Girders shall be anchored to resist such forces (Refer to Section 1004.9).

1004.7 DEFLECTION
The deflections due to the design live load shall not exceed the following:

Roof: 1/600 of span.
Root: 1/600 of span where a plaster ceiling is attached or suspended.
1/540 of span for all other cases.

The specifying professional shall give consideration to the specified professional. The girders must bear a minimum of 4 inches (102 millimeters) on the steel bearing plate.
JOIST GIRDER CONNECTIONS

(a) Methods
Joint connections and splices shall be made by attaching the members to one another by arc or resistance welding or other accredited methods. 

(1) Welded Connections

a) Selected welds shall be inspected visually by the manufacturer. Prior to this inspection, weld slag shall be removed.

b) Cracks are not acceptable and shall be repaired.

(3) Thorough fusion shall exist between layers of weld metal and between weld metal and base metal for the required design length of the weld; such fusion shall be verified by visual inspection.

d) Unfilled weld craters shall not be included in the design length of the weld.

e) Undercut shall not exceed 0.075 inch (2 millimeters) for welds oriented parallel to the principal stress.

f) The sum of surface (piping) porosity diameters shall not exceed 0.075 inch (2 millimeters) in any 1 inch (25 millimeters) of design weld length.

g) Weld spatter that does not interfere with paint coverage is acceptable.

(2) Welding Program
Manufacturers shall have a program for establishing weld procedures and operator qualification, and for weld sampling and testing.

(3) Weld Inspection by Outside Agencies (See Section 1004.10 of this specification)
The agency shall arrange for visual inspection to determine that welds meet the acceptance standards of Section 1003.6.1(a). Ultrasonic, X-Ray, and magnetic particle testing are inappropriate for Joist Girders due to the configurations of the components and welds.

(b) Strength

(1) Joint Connections – Joint connections shall develop the maximum force due to any of the design loads, but not less than 50 percent of the strength of the member in tension or compression, whichever force is the controlling factor in the selection of the member strength.

(2) Shop Splices - Shop splices may occur at any point in chord or web members. Splices shall be designed for the member force but not less than 50 percent of the member strength. Members containing a butt weld splice shall develop an ultimate tensile force of at least 57 ksi (393 MPa) times the full design area of the chord or web. The term “member” shall be defined as all component parts comprising the chord or web, at the point of splice.

(c) Field Splices
Field Splices shall be designed by the manufacturer and may be either bolted or welded. Splices shall be designed for the member force, but not less than 50 percent of the member strength.

1003.6 CAMBER

Joint Girders shall have approximate cambers in accordance with the following:

Table 1003.6-1

<table>
<thead>
<tr>
<th>Top Chord Length</th>
<th>Approximate Camber</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'-0&quot; (6006 mm)</td>
<td>1/4&quot; (6 mm)</td>
</tr>
<tr>
<td>30'-0&quot; (9144 mm)</td>
<td>3/8&quot; (10 mm)</td>
</tr>
<tr>
<td>40'-0&quot; (12192 mm)</td>
<td>5/8&quot; (16 mm)</td>
</tr>
<tr>
<td>50'-0&quot; (15240 mm)</td>
<td>1&quot; (25 mm)</td>
</tr>
<tr>
<td>60'-0&quot; (18288 mm)</td>
<td>1 1/2&quot; (38 mm)</td>
</tr>
<tr>
<td>70'-0&quot; (21336 mm)</td>
<td>2&quot; (51 mm)</td>
</tr>
<tr>
<td>80'-0&quot; (24384 mm)</td>
<td>3 3/4&quot; (70 mm)</td>
</tr>
<tr>
<td>90'-0&quot; (27334 mm)</td>
<td>3 1/2&quot; (89 mm)</td>
</tr>
<tr>
<td>100'-0&quot; (30480 mm)</td>
<td>4 1/4&quot; (108 mm)</td>
</tr>
<tr>
<td>110'-0&quot; (33528 mm)</td>
<td>5&quot; (127 mm)</td>
</tr>
<tr>
<td>120'-0&quot; (36576 mm)</td>
<td>5 1/2&quot; (152 mm)</td>
</tr>
</tbody>
</table>

The specifying professional shall give consideration to coordinating Joist Girder camber with adjacent framing.

1003.7 VERIFICATION OF DESIGN AND MANUFACTURE

(a) Design Calculations

Companies manufacturing Joint Girders shall submit design data to the Steel Joist Institute (or an independent agency approved by the Steel Joist Institute) for verification of compliance with the Full Specifications.

(b) In-Plant Inspections

Each manufacturer shall verify their ability to manufacture Joint Girders through periodic In-Plant Inspections. Inspections shall be performed by an independent agency approved by the Steel Joist Institute. The frequency, manner of inspection, and manner of reporting shall be determined by the Steel Joist Institute. The In-Plant Inspections are not a guarantee of the quality of any specific Joint Girder; this responsibility lies fully and solely with the individual manufacturer.

1004.1 USEAGE

This specification shall apply to any type of structure where steel joists are to be supported directly by Joint Girders installed as hereinafter specified. Where Joint Girders are used other than on simple spans under equal concentrated gravity loading, as prescribed in Section 1003.1, they shall be investigated and modified if necessary to limit the unit stresses to those listed in Section 1003.2. The magnitude and location of all loads and forces, other than equal concentrated gravity loading, shall be provided on the structural drawings. The specifying professional shall design the supporting structure, including the design of columns, connections, and moment plates. This design shall account for the stresses caused by lateral forces and the stresses due to connecting the bottom chord to the column or other support. The designed detail of a rigid type connection and moment plates shall be shown on the structural drawings by the specifying professional. The moment plates shall be furnished by others than the joint manufacturer.

1004.2 SPAN

The span of a Joint Girder shall not exceed 24 times its depth.

1004.3 DEPTH

Joint Girders may have either parallel top chords or a top chord slope of 1/8 inch per foot (1:96). The nominal depth of sloping chord Joint Girders shall be the depth at mid-span.

1004.4 END SUPPORTS

(a) Masonry and Concrete

Joint Girders supported by masonry or concrete are to be anchored thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/16 inch (19 millimeters) bolts, or the equivalent.

(b) Steel

Ends of Joint Girders resting on steel supports shall be anchored thereto with a minimum of two 1/4 inch (6 millimeters) fillet welds 2 inches (51 millimeters) long, or with two 3/16 inch (19 millimeters) bolts, or the equivalent.

Steel Joist Girders shall be anchored to resist such forces (Refer to Section 1004.9).

1004.7 DEFLECTION

The deflections due to the design live load shall not exceed the following:

Roofs: 1/960 of span.

Ramps: 1/960 of span where a plaster ceiling is attached or suspended.

1/940 of span for all other cases.

The specifying professional shall give consideration to the
**JOIST GIRDER DESIGN**

Effects of deflection and vibration* in the selection of Joist Girders.

- For further reference, refer to Steel Joist Institute Technical Digest #5, "Vibration of Steel Joist-Concrete Slab Floors" and the Institute’s Computer Vibration Program.

**1004.6 UPLIFT**

The uplift due to wind forces is a design consideration.*

- For further reference, refer to Steel Joist Institute Technical Digest #3, “Structural Design of Steel Joist and Joist Girders to Resist Ponding Loads” and AISI Specifications.

**1004.9 UPLIFT**

Where uplift forces due to wind are a design requirement, these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascals). The contract drawings should indicate if the net uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of Joist Girders and/or bracing. If the ends of the chord are not strutted, bracing must be provided near the first bottom chord panel point whenever uplift due to wind forces is a design consideration.*

- For further reference, refer to Steel Joist Institute Technical Digest #6, “Structural Design of Steel Joist Roofs to Resist Uplift Loads”.

**1004.10 INSPECTION**

Joist Girders shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of this specification. If the purchaser wishes an inspection of the Joist Girders by someone other than the manufacturer’s own inspectors, they may reserve with the manufacturer for such inspection of the Joist Girders at the manufacturing shop by the purchaser’s inspector at purchaser’s expense.

**SECTION 1005.**

**HANDLING AND ERECTION**

- Particular attention should be paid to the erection of Joist Girders. Care shall be exercised at all times to avoid damage through careless handling during unloading, storing and eracting. Dropping of Joist Girders shall not be permitted.

In steel framing, where Joist Girders are utilized at column lines, the Joist Girder shall be field-bolted at the column. Before hoisting cables are released and before an employee is allowed on the Joist Girder the following conditions must be met:

a) The seat at each end of the Joist Girder is attached in accordance with Section 1004.6.

b) Where uplift due to wind forces is a design consideration, Joist Girders shall be field-bolted at the column. Before the Joist Girder shall be field-bolted at the column. Before hoisting cables are released and before an employee is allowed on the Joist Girder the following conditions must be met:

- For further reference, refer to Steel Joist Institute Technical Digest #9, “Design of Steel Joist Girders to Resist Ponding Loads” and AISI Specifications.

**Example using Load and Resistance Factor Design (LRFD) and U.S. Customary units:**

**JOIST GIRDER**

a) Check live load deflection:

- Live load = 30 psf x 50 ft = 1500 lb

Approximate Joist Girder moment of Inertia:

- I = 0.016 NPLd

- I = 0.018 x 8 x 17.4 x 42 x 44 = 4630 in.4

Allowable deflection for plastered ceilings:

- L/360 = 11.9K = 1.40 in.

B) Where stabilizer plates are required the Joist Girder bottom chord must engage the stabilizer plate. During the construction period, the contractor shall provide means for the adequate distribution of loads so that the carrying capacity of any Joist Girder is not exceeded.

b) Joist Girders shall not be used as anchorage points for a fall arrest system unless written direction to do so is obtained from a “qualified person”.

 Field welding shall not damage the Joist Girder. The total length of weld at any one cross-section on cold-formed members whose yield strength has been attained by cold working and whose as-formed strength is used in the design, shall not exceed 50 percent of the overall developed width of the cold-formed section.

- For a thorough coverage of this topic, refer to SJI Technical Digest #1, “Handling and Erection of Steel Joists and Joist Girders”.

(1) See Appendix E for OSHA definition of a “qualified person.”

**SECTION 1006.**

**HOW TO SPECIFY JOIST GIRDER**

For a given Joist Girder span, the specifying professional first determines the number of joist spaces. Then the panel point loads are calculated and a depth is selected. The following tables give the Joist Girder weight in pounds per linear foot (kilograms per meter) for various depths and loads.

1. The purpose of the Joist Girder Design Guide Weight Table is to assist the specifying professional in the selection of a roof or floor support system.

2. It is not necessary to use only the depths, spans, or loads shown in the tables.

3. Holes in chord elements present special problems which must be considered by both the specifying professional and the Joist Girder Manufacturer. The sizes and locations of such holes shall be clearly indicated on the structural drawings.

**STANDARD DESIGNATION**

<table>
<thead>
<tr>
<th>Joist Girder Span (C.L. of Column to C.L. of Column)</th>
<th>Joist Spaces</th>
<th>Number of Factored Load in Kips at Each Panel Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>42'-0&quot; x 50'-0&quot; bay</td>
<td>8</td>
<td>17.4K 17.4K 17.4K 17.4K 17.4K 17.4K 17.4K 17.4K</td>
</tr>
</tbody>
</table>

Given 42'-0" x 50'-0" bay Joists spaced on 5'-3" centers

- Live Load = 30 psf x 1.6

- Dead Load = 15 psf x 1.2

- Total Load = 66 psf (factored)

Note: Web configuration may vary from that shown. Contact Joist Girder manufacturer if exact layout must be known.

1. Determine number of actual joist spaces (N).

In this example, N = 8

2. Compute total factored load

- Total load = 525 x 8 x 56 = 346.5 psf

3. Joist Girder Section: (Interior)

a) Compute the factored concentrated load at top chord panel points

- P = 346.5 x 50 = 17,325 lbs = 17.4 kips

(use 18K for depth selection).

b) Select Joist Girder depth:

Refer to the LRFD Joist Girder Design Guide Weight Table for the 42'-0" span, 8 panel. 18.0K Joist Girder.

The rule of about one inch of depth for each foot of span is a good compromise of limited depth and economy. Therefore, select a depth of 44 inches.

c) The Joist Girder will then be designated 44G8N17.4F.

d) The LRFD Joist Girder Design Guide Weight Table shows the weight for a 44G8N17.4K as 49 pounds per linear foot. The designer should verify that the weight is not greater than the weight assumed in the Dead Load above.

- Given 42'-0" x 50'-0" bay Joists spaced on 5'-3" centers.

Live Load = 30 psf

Dead Load = 15 psf

Total Load = 45 psf

Note: Web configuration may vary from that shown. Contact Joist Girder manufacturer if exact layout must be known.

1. Determine number of actual joist spaces (N).

In this example, N = 8

2. Compute total load:

- Total load = 5.25 x 45 psf = 236.25 psf

- (includes the approximate Joist Girder weight)

- Total Load = 45 psf

3. Joist Girder Section: (Interior)

a) Compute the factored concentrated load at top chord panel points

- P = 236.25 x 50 = 11,813 lbs = 11.9 kips

(use 12K for depth selection).

b) Select Joist Girder depth:

Refer to the ASD Joist Girder Design Guide Weight Table for the 42'-0" span, 8 panel, 12.0K Joist Girder.
JOIST GIRDERS

SECTION 1005.

HANDLING AND ERECTION

Particular attention should be paid to the erection of Joist Girders. Care shall be exercised at all times to avoid damage through careless handling during unloading, storing and erecting. Dropping of Joist Girders shall not be permitted.

In stock trimming, where Joist Girders are utilized at column lines, the Joist Girder shall be field-bolted at the column. Before hoisting cables are released and before an employee is allowed on the Joist Girder the following conditions must be met:

a) The seat at each end of the Joist Girder is attached in accordance with Section 1004.6.

b) When a bolted seat connection is used for erection purposes, as a minimum, the bolts must be snug tight. The snug tight condition is defined as the tightness that exists when all plies of a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of an employee using an ordinary spud wrench.

c) Where stabilizer plates are required the Joist Girder bottom chord must engage the stabilizer plate.

d) Where uplift forces due to wind are a design requirement, Pf must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascal). The contract drawings shall indicate if the uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of Joist Girders and/or bracing. If the ends of the bottom chord are not strutted, bracing must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

* For further reference, refer to Steel Joist Institute Technical Digest #3, “Design of Steel Joist Roofs to Resist Uplift Loads” and AISC Specifications.

1004.8 PONDING

The ponding investigation shall be performed by the specifying professional.

* For further reference, refer to Steel Joist Institute Technical Digest #9, “Structural Design of Steel Joist Roofs to Resist Ponding Loads” and AISC Specifications.

1004.9 UPLIFT

Where uplift forces due to wind are a design requirement, these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascal). The contract drawings shall indicate if the uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of Joist Girders and/or bracing. If the ends of the bottom chord are not strutted, bracing must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

* For further reference, refer to Steel Joist Institute Technical Digest #9, “Structural Design of Steel Joist Roofs to Resist Uplift Loads”.

1004.10 INSPECTION

Joist Girders shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of this specification. If the purchaser wishes an inspection of the Joist Girders by someone other than the manufacturer’s own inspectors, they may reserve such an inspection by notifying the manufacturer. The sizes and locations of these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascal). The contract drawings shall indicate if the uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of Joist Girders and/or bracing. If the ends of the bottom chord are not strutted, bracing must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

* For further reference, refer to Steel Joist Institute Technical Digest #9, “Structural Design of Steel Joist Roofs to Resist Uplift Loads”.

1004.10 INSPECTION

Joist Girders shall be inspected by the specifying professional to conform to the ASD and LRFD Specifications.

* For further reference, refer to Steel Joist Institute Technical Digest #9, “Structural Design of Steel Joist Roofs to Resist Uplift Loads”.

1004.10 INSPECTION

Joist Girders shall be inspected by the manufacturer before shipment to verify compliance of materials and workmanship with the requirements of this specification. If the purchaser wishes an inspection of the Joist Girders by someone other than the manufacturer’s own inspectors, they may reserve such an inspection by notifying the manufacturer. The sizes and locations of these forces must be indicated on the contract drawings in terms of NET uplift in pounds per square foot (Pascal). The contract drawings shall indicate if the uplift is based on ASD or LRFD. When these forces are specified, they must be considered in the design of Joist Girders and/or bracing. If the ends of the bottom chord are not strutted, bracing must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration.

* For further reference, refer to Steel Joist Institute Technical Digest #9, “Structural Design of Steel Joist Roofs to Resist Uplift Loads”.

JOIST GIRDERS

Example using Load and Resistance Factor Design (LRFD) and U.S. Customary units:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Span (C.L. of Column to C.L. of Opposite Column)</th>
<th>11.5K</th>
<th>14.0K</th>
<th>17.4K</th>
</tr>
</thead>
<tbody>
<tr>
<td>44G</td>
<td>8N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.4F</td>
<td>17.4K 17.4K 17.4K 17.4K 17.4K 17.4K 17.4K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44G8N</td>
<td>44 inches</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Given 42'-0" x 50'-0" bay. Joists spaced on 5'-3" centers.

1. Determine number of actual joist spaces (N).
2. Compute total factored load:
   Total Load = 52.5 x 66 = 346.5 psf
3. Joist Girder Section: (Interior)
   a) Compute the factored concentrated load at top chord panel points
   P = 346.5 x 5.0 = 17,325 lbs = 17.4 kips (use 18Kk for depth selection).
   b) Select Joist Girder depth:
   Refer to the LRFD Joist Girder Design Guide Weight Table for the 42'-0" span, 8 panel, 18.0K Joist Girder. The rule of about one inch of depth for each foot of span is to assist the specifying professional in the selection of a roof or floor support system.
   c) The LRFD Joist Girder Design Guide Weight Table shows the weight for a 44G8N17.4K as 49 pounds per linear foot. The designer should verify that the weight is not greater than the weight assumed in the Dead Load above.

Example using Allowable Strength Design (ASD) and U.S. Customary units:

Given 42'-0" x 50'-0" bay. Joists spaced on 5'-3" centers.

1. Determine number of actual joist spaces (N).
2. Compute total load:
   Total load = 52.5 x 46 psf = 236.25 psf
3. Joist Girder Section: (Interior)
   a) Compute the concentrated load at top chord panel points
   P = 236.25 x 5.0 = 11,813 lbs = 11.9 kips (use 12Kk for depth selection).
   b) Select Joist Girder depth:
   Refer to the ASD Joist Girder Design Guide Weight Table for the 42'-0" span, 8 panel, 12.0K Joist Girder.
JOIST GIRDER DESIGN EXAMPLE USING ALLOWABLE STRENGTH DESIGN (ASD) AND METRIC UNITS

1. Determine number of actual joist spaces (N).

\[ N = \frac{12800}{1.600} = 8 \]

2. Compute total load:

\[ P = 5.056 \text{ kN/m} \times 15.24 \text{ m} = 77.0 \text{ kN (use 80.0 kN)} \]

3. Joist Girder Selection: (Interior)

a) Compute the factored concentrated load at top chord panel points:

\[ P_f = \frac{P}{1.436} = \frac{77.0}{1.436} = 53.0 \text{ kN} \]

b) Select Joist Girder:

Refer to the LRFD Metric Joist Girder Design Guide Weight Table for the 12800 mm span, 8 panel, 80.0 kN Joist Girder. The rule of about one millimeter of depth for each 12 millimeters of span is a good compromise of limited depth and economy. Therefore, select a depth of 1118 mm.

c) The Joist Girder will then be designated 1118G8N1118.

Note that the letter “F” is included at the end of the designation to clearly indicate that this is a factored load.

d) The ASD Metric Joist Girder Design Guide Weight Table shows the weight for a 1118G8N1118F as 73 kg/m. To convert the mass to a force multiply 73 kg/m x 0.0098 = 0.715 kN/m. The designer should verify that the weight is not greater than the weight assumed in the Dead Load above.

e) Check live load deflection:

\[ \text{Deflection} = 1.15 \times \frac{P_f}{L} = 1.15 \times \frac{53.0}{12800} = 0.027 \text{ m} \]

\[ = 27.7 \text{ mm} < 35.56 \text{ mm}, \text{Okay} \]

3. Joist Girder Selection: (Interior)

a) Compute the factored concentrated load at top chord panel points:

\[ P_f = \frac{P}{1.436} = \frac{77.0}{1.436} = 53.0 \text{ kN} \]

b) Select Joist Girder:

Refer to the ASD Metric Joist Girder Design Guide Weight Table for the 12800 mm span, 8 panel, 52.5 kN Joist Girder. The rule of about one millimeter of depth for each 12 millimeters of span is a good compromise of limited depth and economy. Therefore, select a depth of 1118 mm.

c) The Joist Girder will then be designated 1118G8N52.5.

Note that the letter “F” is included at the end of the designation to clearly indicate that this is a factored load.

d) The ASD Metric Joist Girder Design Guide Weight Table shows the weight for a 1118G8N52.5F as 73 kg/m. To convert the mass to a force multiply 73 kg/m x 0.0098 = 0.715 kN/m. The designer should verify that the weight is not greater than the weight assumed in the Dead Load above.

e) Check live load deflection:

\[ \text{Deflection} = 1.15 \times \frac{P_f}{L} = 1.15 \times \frac{53.0}{12800} = 0.027 \text{ m} \]

\[ = 27.7 \text{ mm} < 35.56 \text{ mm}, \text{Okay} \]
**JOIST GIRDERS**

The rule of about one inch of depth for each foot of span is a good compromise of limited depth and economy. Therefore, select a depth of 44 inches.

c) The Joist Girder will then be designated 44G8N11.9K.

d) The ASD Joist Girder Design Guide Weight Table shows the weight for a 44G8N12K as 49 pounds per linear foot. The designer should verify that the weight is not greater than the weight assumed in the Dead Load above.

e) Check live load deflection:

\[
\text{Live load} = 0.027 \times 8 \times 11.9 \times 42 = 4750 \text{ in.}^4
\]

Allowable deflection for plastered ceilings = \(L_d = 0.0098 \times 360 = 35.56 \text{ mm}\). Therefore, select a depth of 44 inches.

**JOIST GIRDERS**

**3. Joist Girder Selection:** (Interior)

a) Compute the factored concentrated load at top chord panel points:

\[
P = 5.056 \text{ kN/m} \times 15.24 \text{ m} = 77.0 \text{ kN (use 80.0 kN)}.
\]

b) Select Joist Girder depth:

Refer to the LRFD Metric Joist Girder Design Guide Weight Table for the 12800 mm span, 8 panel, 80.0 kN Joist Girder. The rule of about one millimeter of depth for each 12 millimeters of span is a good compromise of limited depth and economy. Therefore, select a depth of 1118 mm.

c) The Joist Girder will then be designated 1118G8N11.9F.

Note: The letter “F” is included at the end of the designation to clearly indicate that this is a factored load.

d) The LRFD Metric Joist Girder Design Guide Weight Table shows the weight for a 1118G8N12K as 73 kg/m. To convert the mass to a force multiply 73 kg/m \(\times 10.0 \times 0.715 = 51.55 \text{ kN/m.}\) The designer should verify that the weight is not greater than the weight assumed in the Dead Load above.

e) Check live load deflection:

\[
\text{Live load} = 1.436 \text{ kN/m}^2 \times 15.24 \text{ m} = 21.88 \text{ kN/m}.
\]

Approximate Joist Girder moment of inertia:

\[
I_G = 0.2197 \times 8 \times 77.0 \times 12800 \times 1118 = 1937 \times 10^6 \text{ mm}^4
\]

Allowable deflection for plastered ceilings:

\[
L_d = 0.0098 \times 360 = 35.56 \text{ mm}
\]

Deflection = \(1.15 \times \frac{384EI}{384(20000)(1937x10^6)}\) = 0.027 mm in. < 35.56 mm, Okay

Given 12.80 m x 15.24 m bay. Joists spaced on 1.600 m centers.

- **Live Load:** 1.436 kN/m² x 1.6 = 2.30 kN/m² (includes approximate Joist Girder weight)
- **Dead Load:** 0.718 kN/m² x 1.2 = 0.86 kN/m² (includes approximate Joist Girder weight)
- **Total Load:** 3.160 kN/m² (includes approximate Joist Girder weight)

<table>
<thead>
<tr>
<th>Joist Girder Space (CL of Column to CL of Column)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1118G</td>
</tr>
<tr>
<td>mm</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>52.5 kN</td>
</tr>
</tbody>
</table>

77.0F

44G8N

35.56 mm

22.20 mm < 35.56 mm. Okay
CODE OF STANDARD PRACTICE FOR STEEL JOISTS AND JOIST GIRDERS

Adopted by the Steel Joist Institute April 7, 1931
Revised to May 1, 2000 - Effective May 03, 2005

SECTION 1 GENERAL

1.1 SCOPE
The practices and customs set forth herein are in accordance with good engineering practice, tend to ensure safety in steel joist and joist girder construction, and are standard within the industry. There shall be no contract between this code and any legal building regulation. This code shall only supplement and amplify such laws. Unless specific provisions to the contrary are made in a contract for the purchase of steel joists or joist girders, this code is understood to govern the interpretation of such a contract.

1.2 APPLICATION
This Code of Standard Practice is to govern as a standard unless otherwise covered in the architectural and engineers plans and specifications.

1.3 DEFINITIONS

Material. Steel joists, Joist Girders, and accessories as provided by the seller.
Seller. A company certified by the Steel Joist Institute engaged in the manufacture and distribution of steel joists, Joist Girders, and accessories.
Buyer. The entity that has agreed to purchase Material from the manufacturer and has also agreed to the terms of sale.
Owner. The entity that is identified as such in the Contact Documents.
Erector. The entity that is responsible for the safe and proper erection of the Materials in accordance with all applicable codes and regulations.
Specifying Professional. The licensed professional who is responsible for selling the building Contact Documents, which indicates that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

Structural Drawings. The graphic or pictorial portions of the Contact Documents showing the design, location and dimensions of the work. These documents generally include plans, elevations, sections, details, connections, all loads, schedules, diagrams and notes.
Placement Plans. Drawings that are prepared depicting the interpretation of the Contact Documents requirements for the Material to be supplied by the Seller. These plans and/or roof plans are approved by the Specifying Professional. Buyer or owner for conformance with the design requirements. The Seller uses the information contained on these drawings for final Material design.

A unique piece mark number is typically shown for the individual placement of the steel joists, Joist Girders and accessories along with sections that describe the end bearing conditions and minimum attachment required so that material is placed in the proper location in the field.

1.4 DESIGN
In the absence of ordinances or specifications to the contrary, all designs prepared by the specifying professional shall be in accordance with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

1.5 RESPONSIBILITY FOR DESIGN AND ERECTION
When Material requirements are specified, the Seller shall assume no responsibility other than to furnish the items listed in Section 5.2 (a). When Material requirements are not specified, the Seller shall furnish the items listed in Section 5.2 (a) in accordance with Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption, and this code. Partner design information shall be provided to the Seller as stipulated in Section 6.1. The Seller shall identify material by showing size and type. In no case shall the Seller assume any responsibility for the erection of the item furnished.

1.6 PERFORMANCE TEST FOR K-SERIES STEEL JOIST CONSTRUCTION
When performance tests on a structure are required, joists in the test panel shall have bridging and top deck applied as used. In addition to the full dead load, the test panel shall sustain for one hour a test load of 1.65 times the nominal live load. After this test load has been removed for a minimum of 30 minutes, the remaining deflection shall not exceed 20% of the deflection caused by the test load. The weight of the test panel itself shall constitute the dead load of the construction and shall include the weight of the joists, bridging, top deck, slab, ceiling materials, etc. The nominal live load shall be the live load specified and in no case shall it be more than the published joist capacity less the dead load. The cost of such joists shall be borne by the purchaser.

SECTION 2 JOISTS AND ACCESSORIES

2.1 STEEL JOISTS AND JOIST GIRDERS
Steel joists and Joist Girders shall carry the designations and meet the requirements of the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

K-series joists are furnished with parallel chords only, and with minimum standard and bearing depth of 2 1/2 inches (64 mm). LH- and DLH-Series joists are furnished either underlined or squared ended, with top chords either parallel, pitched one way or pitched two ways. Underlined types are furnished with a standard and bearing depth of 2 1/2 inches (64 mm). The nominal depth of a pitched Longspan Joist is taken at the center of the span.

Joist Girders are furnished either underlined or squared ended with top chords either parallel, pitched one way or pitched two ways. Underlined types are furnished with a standard and bearing depth of 7 1/2 inches (91 mm). The standard pitch is 1 1/2 inches (19 mm). The nominal depth of a pitched Joist Girder is taken at the center of the span.

Because LH- and DLH-Series joists may have exceptionally high end reactions, it is recommended that the supporting structure be designed to provide a nominal minimum unit bearing pressure of 750 pounds per square inch (5171 kilos Pascal).

2.2 JOIST LOCATION AND SPACING
The maximum bearing length shall be in accordance with the requirements of the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

Where sidewalks, wall beams or tie beams are capable of supporting the floor slab or roof deck, the first adjacent joists may be placed one full space from these members. Joists are provided with camber and may have a significant difference in elevation with respect to the adjacent structure because of this camber. This difference in elevation should be given consideration when locating the first joist adjacent to a side wall, wall beam or tie beam.

Open Web Steel Joists, K-Series, should be placed no closer than 6 inches (152 mm) to supporting walls or members.

TABLE 2.6-1a K-SERIES JOISTS
MAXIMUM JOIST SPACING FOR HORIZONTAL BRIDGING

<table>
<thead>
<tr>
<th>Round Rod</th>
<th>Equal Leg Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECTION NUMBER</td>
<td>10&quot; (13 mm)</td>
</tr>
<tr>
<td>r = 0.13&quot;</td>
<td>(25 mm x 3 mm)</td>
</tr>
<tr>
<td>r = 0.20&quot;</td>
<td>(38 mm x 5 mm)</td>
</tr>
<tr>
<td>r = 0.25&quot;</td>
<td>(51 mm x 6 mm)</td>
</tr>
<tr>
<td>r = 0.30&quot;</td>
<td>(62 mm x 7 mm)</td>
</tr>
<tr>
<td>r = 0.35&quot;</td>
<td>(73 mm x 8 mm)</td>
</tr>
<tr>
<td>r = 0.40&quot;</td>
<td>(91 mm x 9 mm)</td>
</tr>
<tr>
<td>r = 0.50&quot;</td>
<td>(114 mm x 10 mm)</td>
</tr>
</tbody>
</table>

* Refer to last digit(s) of Joist Designation
** Connection to Joist must resist a nominal unfactored 700 pound force (3114 N)

Steel joists extended ends shall be in accordance with Manufacturer’s Standard and shall meet the requirements of ~ Appendix B.

2.5 CEILING EXTENSIONS
Ceiling extensions shall be furnished to support ceilings which are to be attached to the bottom of the joists. They are not furnished for the support of suspended ceilings. The ceiling extension shall be either an extended bottom chord element or a loose unit, whichever is standard with the manufacturer, and shall be of sufficient strength to properly support the ceiling.

Where partitions occur parallel to joists, there shall be at least one joist provided under each such partition, and more than one such joist shall be provided if necessary to safely support the weight of such partition and the adjacent floor less the live load, on a strip of floor one foot (306 mm) in width. When partitions occur perpendicular to the joists, they shall be treated as concentrated loads, and joists shall be investigated as indicated in Section 6.1.

2.6 SLOPED END BEARINGS
Where steel joists or Joist Girders are sloped, beveled ends or sloped end bearings may be provided where the slope exceeds 14% in 12 inches (1:48). When sloped end bearings are required, the seat depths shall be adjusted to maintain the standard height at the shallow end of the sloped bearing. For Open Web Steel Joists, K-Series, bearing ends will not be beveled for slopes of 14% or less in 12 inches (1:48).

2.7 WOOD OVERSTEERING
Steel joists extended ends shall be in accordance with Manufacturer’s Standard and shall meet the requirements of ~ Appendix B.

Where partitions occur parallel to joists, there shall be at least one joist provided under each such partition, and more than one such joist shall be provided if necessary to safely support the weight of such partition and the adjacent floor less the live load, on a strip of floor one foot (306 mm) in width. When partitions occur perpendicular to the joists, they shall be treated as concentrated loads, and joists shall be investigated as indicated in Section 6.1.

2.8 SLOPED END BEARINGS
Where steel joists or Joist Girders are sloped, beveled ends or sloped end bearings may be provided where the slope exceeds 14% in 12 inches (1:48). When sloped end bearings are required, the seat depths shall be adjusted to maintain the standard height at the shallow end of the sloped bearing. For Open Web Steel Joists, K-Series, bearing ends will not be beveled for slopes of 14% or less in 12 inches (1:48).

2.9 WOOD OVERSTEERING
Steel joists extended ends shall be in accordance with Manufacturer’s Standard and shall meet the requirements of ~ Appendix B.

Where partitions occur parallel to joists, there shall be at least one joist provided under each such partition, and more than one such joist shall be provided if necessary to safely support the weight of such partition and the adjacent floor less the live load, on a strip of floor one foot (306 mm) in width. When partitions occur perpendicular to the joists, they shall be treated as concentrated loads, and joists shall be investigated as indicated in Section 6.1.

2.10 SLOPED END BEARINGS
Where steel joists or Joist Girders are sloped, beveled ends or sloped end bearings may be provided where the slope exceeds 14% in 12 inches (1:48). When sloped end bearings are required, the seat depths shall be adjusted to maintain the standard height at the shallow end of the sloped bearing. For Open Web Steel Joists, K-Series, bearing ends will not be beveled for slopes of 14% or less in 12 inches (1:48).

2.11 WOOD OVERSTEERING
Steel joists extended ends shall be in accordance with Manufacturer’s Standard and shall meet the requirements of ~ Appendix B.
SECTION 1

GENERAL

1.1 SCOPE
The practices and customs set forth herein are in accordance with good engineering practice, tend to ensure safety in steel joist and joist girder construction, and are standard within the industry. There shall be no conflict between this code and any legal building regulation. This code shall only supplement and amplify such laws. Unless specific provisions to the contrary are made in a contract for the purchase of steel joists or joist girder, this code is understood to govern the interpretation of such a contract.

1.2 APPLICATION
This Code of Standard Practice is to govern as a standard unless otherwise provided in the architect's and engineers plans and specifications.

1.3 DEFINITIONS

Material. Steel joists, joist girders, and accessories as provided by the seller.

Seller. A company certified by the Steel Joist Institute engaged in the manufacture and distribution of steel joists, joist girders, and accessories.

Buyer. The entity that has agreed to purchase Material from the manufacturer and has also agreed to the terms of sale.

Owner. The entity that is identified as such in the Contract Documents.

Erector. The entity that is responsible for the safe and proper erection of the Material in accordance with all applicable codes and regulations.

Specifying Professional. The licensed professional who is responsible for selecting the building Contract Documents, which indicates that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

Structural Drawings. The graphic or pictorial portions of the Contract Documents showing the design, location and dimensions of the work. These documents generally include structural drawings, structural analysis, and design and document preparation for the structure and shall include the weight of the joists, bridging, top deck, slab, ceiling materials, etc. The nominal live load shall be the live load specified and in no case shall it be greater than the more than published joist capacity less the dead load. The cost of such work shall be borne by the purchaser.

SECTION 2

JOISTS AND ACCESSORIES

2.1 STEEL JOISTS AND JOIST GIRDERS
Steel joists and joist girders shall carry the designations and meet the requirements of the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption. The practices and customs set forth herein are in accordance with good engineering practice, tend to ensure safety in steel joist and joist girder construction, and are standard within the industry. There shall be no conflict between this code and any legal building regulation. This code shall only supplement and amplify such laws. Unless specific provisions to the contrary are made in a contract for the purchase of steel joists or joist girders, this code is understood to govern the interpretation of such a contract.

1.4 DESIGN
In the absence of ordinances or specifications to the contrary, all designs prepared by the specifying professional shall be in accordance with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

1.5 RESPONSIBILITY FOR DESIGN AND ERECTION
When Material requirements are specified, the Seller shall assume no responsibility other than to furnish the items listed in Section 5.2 (a) in accordance with Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption, and this Code. Partner design information shall be provided to the Seller as stipulated in Section 6.1. The Seller shall identify material by showing size and type. In no case shall the Seller assume any responsibility for the erection of the item furnished.

1.6 PERFORMANCE TEST FOR K-SERIES STEEL JOIST CONSTRUCTION
When performance tests on a structure are required, joists in the test panel shall have bridging and top deck applied as used. In addition to the full dead load, the test panel shall sustain for one hour a test load of 1.5 times the nominal live load. After this test load has been removed for a minimum of 30 minutes, the remaining deflection shall not exceed 20% of the deflection caused by the test load. The weight of the test panel itself shall constitute the dead load of the construction and shall include the weight of the joists, bridging, top deck, slab, ceiling materials, etc. The nominal live load shall be the live load specified and in no case shall it be greater than the published joist capacity less the dead load. The cost of such work shall be borne by the purchaser.

TABLE 2.6-1a
K-SERIES JOISTS
MAXIMUM JOIST SPACING FOR HORIZONTAL BRIDGING

<table>
<thead>
<tr>
<th>Round Rod</th>
<th>Equal Leg Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BRIDGING MATERIAL SIZE</strong></td>
<td></td>
</tr>
<tr>
<td>SECTION NUMBER</td>
<td>1/2” round</td>
</tr>
<tr>
<td>1</td>
<td>1-9</td>
</tr>
<tr>
<td>10</td>
<td>1-9</td>
</tr>
</tbody>
</table>

* Refer to last digit(s) of Joist Designation
** Connection to Joist must resist a nominal unfactored 700 pound force (3134 N)


## TABLE 2.6-1b

<table>
<thead>
<tr>
<th><strong>SECTION NUMBER</strong></th>
<th><strong>SECTION</strong></th>
<th><strong>BRIDGING ANGLE SIZE</strong> – (EQUAL LEG ANGLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 - 05</td>
<td>1 x 7/64 (25 mm x 3 mm)</td>
<td>r = 0.20&quot; (5.08 mm)</td>
</tr>
<tr>
<td></td>
<td>1-1/4 x 7/64 (32 mm x 3 mm)</td>
<td>r = 0.25&quot; (6.35 mm)</td>
</tr>
<tr>
<td></td>
<td>1-1/2 x 7/64 (38 mm x 3 mm)</td>
<td>r = 0.30&quot; (7.62 mm)</td>
</tr>
<tr>
<td></td>
<td>1-3/4 x 7/64 (45 mm x 3 mm)</td>
<td>r = 0.35&quot; (8.89 mm)</td>
</tr>
<tr>
<td></td>
<td>2 x 1/8 (52 mm x 3 mm)</td>
<td>r = 0.40&quot; (10.16 mm)</td>
</tr>
<tr>
<td>02, 03, 04</td>
<td>2 x 1/8 (52 mm x 3 mm)</td>
<td>r = 0.40&quot; (10.16 mm)</td>
</tr>
<tr>
<td></td>
<td>2-1/2 x 5/32 (64 mm x 4 mm)</td>
<td>r = 0.50&quot; (12.70 mm)</td>
</tr>
</tbody>
</table>

**Notes:**
- Refer to last two digits of Joist Designation
- * Refer to last digit(s) of Joist Designation

### 2.6 BRIDGING AND BRIDGING ANCHORS

2.6.1 Bridging standard with the manufacturer and complying with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption shall be used for bridging all joists furnished by the manufacturer. Positive anchorage shall be provided at the ends of each bridging row at both top and bottom chords.

2.6.2 For K- and LH-Series Joists horizontal bridging is recommended for spans up to and including 60 feet (18.3 m) except where the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption shall be used.

Diagonal cross bridging, when used, shall have an r/l ratio of 20:1. When the bridging members are connected at their point of intersection, the material sizes shown in Table 2.6-2 will meet the above specification.

### TABLE 2.6-2

<table>
<thead>
<tr>
<th>JOIST DEPTH</th>
<th>1 x 7/64 (25 mm x 3 mm)</th>
<th>1-1/4 x 7/64 (32 mm x 3 mm)</th>
<th>1-1/2 x 7/64 (38 mm x 3 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r = 0.20&quot; (5.08 mm)</td>
<td>r = 0.25&quot; (6.35 mm)</td>
<td>r = 0.30&quot; (7.62 mm)</td>
</tr>
<tr>
<td>12&quot;</td>
<td>6 - 6&quot; (1981 mm)</td>
<td>6 - 3&quot; (2514 mm)</td>
<td>5 - 11&quot; (3022 mm)</td>
</tr>
<tr>
<td>14&quot;</td>
<td>6 - 6&quot; (1981 mm)</td>
<td>6 - 3&quot; (2514 mm)</td>
<td>5 - 11&quot; (3022 mm)</td>
</tr>
<tr>
<td>16&quot;</td>
<td>6 - 6&quot; (1981 mm)</td>
<td>6 - 2&quot; (2486 mm)</td>
<td>5 - 10&quot; (2967 mm)</td>
</tr>
<tr>
<td>18&quot;</td>
<td>6 - 6&quot; (1981 mm)</td>
<td>6 - 2&quot; (2486 mm)</td>
<td>5 - 10&quot; (2967 mm)</td>
</tr>
<tr>
<td>20&quot;</td>
<td>6 - 5&quot; (1955 mm)</td>
<td>6 - 2&quot; (2486 mm)</td>
<td>5 - 10&quot; (2967 mm)</td>
</tr>
<tr>
<td>22&quot;</td>
<td>6 - 4&quot; (1900 mm)</td>
<td>6 - 1&quot; (2463 mm)</td>
<td>5 - 9&quot; (2911 mm)</td>
</tr>
<tr>
<td>24&quot;</td>
<td>6 - 4&quot; (1900 mm)</td>
<td>6 - 1&quot; (2463 mm)</td>
<td>5 - 9&quot; (2911 mm)</td>
</tr>
<tr>
<td>26&quot;</td>
<td>6 - 3&quot; (1905 mm)</td>
<td>6 - 0&quot; (2438 mm)</td>
<td>5 - 8&quot; (2891 mm)</td>
</tr>
<tr>
<td>28&quot;</td>
<td>6 - 2&quot; (1879 mm)</td>
<td>6 - 0&quot; (2438 mm)</td>
<td>5 - 8&quot; (2891 mm)</td>
</tr>
<tr>
<td>30&quot;</td>
<td>6 - 2&quot; (1879 mm)</td>
<td>7 - 1&quot; (2431 mm)</td>
<td>5 - 7&quot; (2849 mm)</td>
</tr>
<tr>
<td>32&quot;</td>
<td>6 - 1&quot; (1854 mm)</td>
<td>7 - 10&quot; (2387 mm)</td>
<td>5 - 6&quot; (2751 mm)</td>
</tr>
<tr>
<td>36&quot;</td>
<td>7 - 9&quot; (2362 mm)</td>
<td>6 - 25&quot; (3855 mm)</td>
<td>5 - 3&quot; (2655 mm)</td>
</tr>
<tr>
<td>40&quot;</td>
<td>7 - 9&quot; (2362 mm)</td>
<td>6 - 25&quot; (3855 mm)</td>
<td>5 - 3&quot; (2655 mm)</td>
</tr>
<tr>
<td>44&quot;</td>
<td>7 - 8&quot; (2381 mm)</td>
<td>6 - 20&quot; (3667 mm)</td>
<td>5 - 2&quot; (2590 mm)</td>
</tr>
<tr>
<td>48&quot;</td>
<td>7 - 7&quot; (2349 mm)</td>
<td>6 - 15&quot; (3520 mm)</td>
<td>5 - 1&quot; (2503 mm)</td>
</tr>
<tr>
<td>52&quot;</td>
<td>7 - 6&quot; (2317 mm)</td>
<td>6 - 10&quot; (3352 mm)</td>
<td>4 - 9&quot; (2362 mm)</td>
</tr>
<tr>
<td>56&quot;</td>
<td>7 - 5&quot; (2286 mm)</td>
<td>6 - 5&quot; (3244 mm)</td>
<td>4 - 8&quot; (2251 mm)</td>
</tr>
<tr>
<td>60&quot;</td>
<td>7 - 4&quot; (2251 mm)</td>
<td>6 - 5&quot; (3244 mm)</td>
<td>4 - 7&quot; (2140 mm)</td>
</tr>
<tr>
<td>64&quot;</td>
<td>7 - 3&quot; (2217 mm)</td>
<td>6 - 4&quot; (3149 mm)</td>
<td>4 - 6&quot; (2039 mm)</td>
</tr>
<tr>
<td>68&quot;</td>
<td>7 - 2&quot; (2183 mm)</td>
<td>6 - 3&quot; (3048 mm)</td>
<td>4 - 5&quot; (1938 mm)</td>
</tr>
<tr>
<td>72&quot;</td>
<td>7 - 1&quot; (2150 mm)</td>
<td>6 - 2&quot; (2946 mm)</td>
<td>4 - 4&quot; (1837 mm)</td>
</tr>
</tbody>
</table>

**Notes:**
- Refer to last digit(s) of Joist Designation

### MINIMUM A307 BOLT REQUIRED FOR CONNECTION

<table>
<thead>
<tr>
<th>SERIES</th>
<th><strong>SECTION NUMBER</strong></th>
<th><strong>BOLT DIAMETER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>3/8&quot; (10 mm)</td>
<td></td>
</tr>
<tr>
<td>LH, DLH</td>
<td>2 - 12</td>
<td>3/8&quot; (10 mm)</td>
</tr>
<tr>
<td>LH, DLH</td>
<td>13 - 17</td>
<td>1/2&quot; (13 mm)</td>
</tr>
<tr>
<td>DLH</td>
<td>18 and 19</td>
<td>5/8&quot; (16 mm)</td>
</tr>
</tbody>
</table>

**Notes:**
- Refer to last digit(s) of Joist Designation

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**CODE OF STANDARD PRACTICE FOR STEEL JOISTS AND JOIST GIRDERS**

### 2.6 BRIDGING AND BRIDGING ANCHORS

(a) Bridging standard with the manufacturer and complying with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption shall be used for bridging all joists furnished by the manufacturer. Positive anchorage shall be provided at the ends of each bridging row at both top and bottom chords.

(b) For K- and LH-Series Joists horizontal bridging is recommended for spans up to and including 60 feet (18.3 m) except where the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption shall be used.

Diagonal cross bridging, when used, shall have an r/l ratio of 20:1. When the bridging members are connected at their point of intersection, the material sizes shown in Table 2.6-2 will meet the above specification.
**CODE OF STANDARD PRACTICE FOR STEEL JOISTS AND JOIST GIRDERS**

### TABLE 2.6-1b
**LH-SERIES JOISTS**

<table>
<thead>
<tr>
<th>SECTION NUMBER</th>
<th><strong>BRIDGING ANGLE SIZE</strong> – (EQUAL LEG ANGLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>02, 03, 04</td>
<td><strong>K</strong></td>
</tr>
<tr>
<td>05 – 06</td>
<td>6 – 9&quot; (159 mm)</td>
</tr>
<tr>
<td>07 – 08</td>
<td>6 – 8&quot; (203 mm)</td>
</tr>
<tr>
<td>09 – 10</td>
<td>6 – 7&quot; (1372 mm)</td>
</tr>
<tr>
<td>11 – 12</td>
<td>6 – 6&quot; (1254 mm)</td>
</tr>
<tr>
<td>13 – 14</td>
<td>6 – 5&quot; (1143 mm)</td>
</tr>
<tr>
<td>15 – 16</td>
<td>6 – 4&quot; (1206 mm)</td>
</tr>
<tr>
<td>17</td>
<td>6 – 3&quot; (1219 mm)</td>
</tr>
</tbody>
</table>

* Refer to last two digits of Joist Designation

**Connection to Joist must resist force listed in Table 104.5-1**

### TABLE 2.6-2
**K, LH AND DLH SERIES JOISTS**

<table>
<thead>
<tr>
<th>JOIST DEPTH</th>
<th><strong>BRIDGING ANGLE SIZE</strong> – (EQUAL LEG ANGLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 7/6&quot; (25 mm x 3 mm)</td>
<td><strong>K</strong></td>
</tr>
<tr>
<td>1-1/4 x 7/6&quot; (32 mm x 3 mm)</td>
<td>6 – 6&quot; (1254 mm)</td>
</tr>
<tr>
<td>1-3/4 x 7/6&quot; (38 mm x 3 mm)</td>
<td>6 – 5&quot; (1143 mm)</td>
</tr>
<tr>
<td>2 x 1/8 (50 mm x 3 mm)</td>
<td>6 – 4&quot; (1206 mm)</td>
</tr>
</tbody>
</table>

* Refer to last two digits of Joist Designation

### 2.6 BRIDGING AND BRIDGING ANCHORS

**(a) Bridging standard with the manufacturer and complying with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption shall be used for bridging all joists furnished by the manufacturer. Positive anchorage shall be provided at the ends of each bridging row at both top and bottom chords.**

**(b) For K- and LH-Series Joists horizontal bridging is recommended for spans up to and including 60 feet (18.3 m) except where the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption are used. Horizontal bridging shall consist of continuous horizontal steel members. The r/l ratio for horizontal bridging shall not exceed 300. The material sizes shown in Tables 2.6-1a and 2.6-1b meet the criteria.**

**(c) Diagonal cross bridging consisting of angles or other shapes connected to the top and bottom chords, of K-, LH-, and DLH-Series Joists shall be used when required by the applicable Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.**

Diagonal bridging, when used, shall have an r/l ratio not exceeding 200. When the bridging members are connected at their point of intersection, the material sizes shown in Table 2.6-1c meet the above specification.

Refer to Appendix E for OSHA steel joist erection stability requirements.

**MINIMUM A307 BOLT REQUIRED FOR CONNECTION SERIES**

<table>
<thead>
<tr>
<th>SERIES</th>
<th><strong>SECTION NUMBER</strong></th>
<th><strong>BOLT DIAMETER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>3/8&quot; (10 mm)</td>
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<tr>
<td>LH, DLH</td>
<td>3/8&quot; (10 mm)</td>
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<td>LH, DLH</td>
<td>1/2&quot; (16 mm)</td>
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<tr>
<td>DLH</td>
<td>5/8&quot; (16 mm)</td>
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</table>

* Refer to last two digits of Joist Designation
STAND. PRACTICE

Specifications

Load Tables & Weight Tables of latest adoption.

shall comply with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

The bottom chord lateral bracing may be furnished to prevent lateral movement of the bottom chord of the Joist Girder and to prevent the ratio of chord length to chord radius of gyration from exceeding that specified in the Steel Joist Institute Standard Specifications. Load Tables & Weight Tables of latest adoption.

The bottom bracing shall be that which is standard with the manufacturer, and shall be sufficient to properly brace the bottom chord of the Joist Girder.

SECTION 4. INSPCTION

5.1 PLANS FOR BIDDING

Plans to serve as the basis for bids shall show the character of the work with sufficient clarity to permit making an accurate estimate and shall show the following:

Designation and location of Materials (See Section 5.2 (b), including any special design or configuration requirements. Locations and elevations of all steel and concrete supporting members and bearing walls. Location and length of joist extended ends. Location and size of all openings in floors and roofs. Location of all partitions. Loads and their locations as defined in Section 6.1. Construction and thickness of floor slabs, roof deck, ceilings and partitions. Joists or Joist Girders requiring extended bottom chords. Paint, if other than manufacturer’s standard.

5.2 SCOPE OF ESTIMATE

(a) Unless otherwise specified, the following items shall be included in the estimate and requirements shall be determined as outlined in Section 6.1.

Steel Joists. Joist Girders. Joist Buckstretches. Joist Extended Ends. Ceiling Extensions. Extended bottom chord used as strut. Bridging and bridging anchors. Joist Girder bottom chord bracing. Headers which are defined as members supported by and carrying Open Web Steel Joists, K-Series. One shop coat of paint, when specified, shall be in accordance with Section 3.2.

(b) The following items shall not be included in the estimate but may be quoted and identified by the joist manufacturer as separate items:

Headers for Longspan Steel Joists, DLH-Series.

Joist Girder Loads. This includes all special loads (drift loads, mechanical units, net uplift, axial loads, moments, structural bracing loads, or other applied loads which are contributing to the load on the joist or Joist Girder design. For Joist Girders, reactions from supported members shall be clearly denoted as point loads on the Joist Girder. When necessary to clearly convey the information, a Load Diagram or Load Schedule shall be provided.

The specifying professional shall give due consideration to the following loads and load effects:

1. Ponded rain water.
2. Accumulation of snow in the vicinity of obstructions such as parapets, signs, parapets, adjacent build-

ings, etc.
3. Wind.
4. Type and magnitude of end moments and/or axial forces at the joist and Joist Girder end supports shall be shown on the structural drawings. For moment resisting joists or Joist Girders framing near the end of a column, due consideration shall be given to extend the column length to allow a plate type con-
nection between the top of the joist or Joist Girder top chord and the column.

Avoid resolving joist or Joist Girder moments and axial forces through the bearing seat connection.

A note shall be provided on the structural drawings stating that all moment resisting joists shall have all dead loads applied to the joist before the bottom chord struts are welded to the supporting connection. When the moments provided do not include dead load.

The top and bottom chord moment connection details shall be designed by the specifying professional. The joist designer shall furnish the specifying profes-
sional with the joist detail information if requested.

The nominal loads, as determined by the specifying professional, shall be less than that specified in the applicable building codes.

Where concentrated loads occur, the magnitude and location of these concentrated loads shall be shown on the structural drawings when, in the opinion of the specifying professional, they may require considera-
tion by the joist manufacturer.

The specifying professional shall use one of the following options that is best suited to the project:

- Estimator to price the joists.
- Joist manufacturer to design the joists properly.
- Owner to obtain the most economical joists.

Option 1: Select a Standard Steel Joist Institute joist for the uniform design loading and provide the load location of any additional loads on the structural plan with a note “Joist manufacturer shall design joists for additional loads as shown”. This option works well for a few added loads per joist with known locations.

Helmet - Owner to obtain the most economical joists.

This option works well for a few added loads per joist with known locations.
2.7 HEADERS
Headers for Open Web Steel Joists, K-Series as outlined and defined in Section 5.2 (a) shall be furnished by the Seller. Such headers shall be any type standard with the manufacturer. Conditions involving headers shall be investigated and, if necessary, provisions made to provide a safe condition. Headers are not provided for Longspan Steel Joists, LH-Series, and Deep Longspan Steel Joists, DLH-Series.

2.8 BOTTOM CHORD LATERAL BRACING FOR JOIST GIRDERS

Bottom chord lateral bracing may be furnished to prevent lateral movement of the bottom chord of the Joist Girder and to prevent the ratio of chord length to chord ratio of gusset from exceeding that specified in the Steel Joist Institute Standard Specifications. Load Tables & Weight Tables of latest adoption. The lateral bracing shall be that which is standard with the manufacturer, and shall be sufficient to properly brace the bottom chord of the Joist Girder.

SECTION 3. MATERIALS

3.1 STEEL

The steel used in the manufacture of joists and Joist Girders shall comply with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

3.2 PAINT

(a) Standard Shop Paint - The shop coat of paint, when specified, shall comply with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption.

(b) Disclamer - The typical shop applied paint that is used to coat steel joists and Joist Girders is a dip applied, air dried paint. The paint is intended as an accompaniment and pro-

visional coating which will protect the steel for only a short period of exposure in ordinary atmospheric conditions. Since most steel joists and Joist Girders are painted using a standard dip coating, the coating may not be uni-

form and may include drips, runs, and sags. Compatibility of any coating including fire protective coatings applied over a standard shop paint shall be the responsibility of the specifier and/or painting contractor.

The shop applied paint may require field touch-up as a result of, but not limited to, the following:

1. Abrasions from: Bundling, banding, loading and unload-

ing, chains, dunnage during shipping, cables and chains during erection, bridging, installation, and other handling at the joists.

NOTE: Rusting should be expected at any abrasion.

2. Dirt.

3. Coal smoke.

4. Road salt.

5. Weather conditions during storage.

The joist manufacturer shall not be responsible for the condition of the paint if it is not properly protected after delivery.

SECTION 4. INSPECTION

Inspections shall be made in accordance with the Steel Joist Institute Standard Specifications Load Tables & Weight Tables Section 5.12 for K-Series, Section 104.13 for LH-

and DLH-Series, and Section 104.10 for Joist Girders.

SECTION 5. ESTIMATING

5.1 PLANS FOR BIDDING

Plans to serve as the basis for bids shall show the character of the work with sufficient clarity to permit making an accu-

rate estimate and shall show the following:

Designation and location of Materials (see Section 5.2 (b)), including any special design or configuration requirements.

Locations and elevations of all steel and concrete supporting members and bearing walls.

Location and length of joist extended ends.

Location and size of all openings in floors and roofs.

Location of all partitions.

 Loads and their locations as defined in Section 6.1.

Construction and thickness of floor slabs, roof deck, ceilings and partitions.

Joists or Joist Girders requiring extended bottom chords.

Paint if other than manufacturer’s standard.

5.2 SCOPE OF ESTIMATE

(a) Unless otherwise specified, the following items shall be included in the estimate, and requirements shall be determined as outlined in Section 6.1.

Steel Joists.

Joist Girders.

Joist Stubs/Trusses.

Joist Extended Ends.

Ceiling Extensions.

Extended bottom chord used as strut.

Bridging and bridging anchors.

Joist Girder bottom chord bracing.

Headers which are defined as members supported by and carrying Open Web Steel Joists, K-Series.

One shop coat of paint, when specified, shall be in accordance with Section 3.2.

(b) The following items shall not be included in the estimate but may be quoted and identified by the joist manufactur-

er as separate items:

Headers for Longspan Steel Joists, DLH-Series.

Heads for Deep Longspan Steel Joists, DLH-Series.

Reinforcement in slabs over joists.

Controlling material, decking, and attachments.

Miscellaneous framing between joists for openings at ducts, dumbwaiters, ventilators, skylights, etc.

Loose individual or continuous bearing plates and bolts or anchors for such plates.

Erection bolts for joist and Joist Girder and anchorage.

Horizontal bracing in the plane of the top and bottom chords from joist to joist or joist to structural framing and walls.

Wood nailing.

Moment plates.

Special joist configuration or bridging layouts for ductwork or sprinkler systems.

Shear Studs.

SECTION 6. PLANS AND SPECIFICATIONS

6.1 PLANS FURNISHED BY BUYER

The Buyer shall furnish the Seller plans and specifications as prepared by the specifying professional showing all Material requirements and steel joist and/or steel joist Girder designations, the layout of walls, columns, beams, girders and other supports, as well as floor and roof open-

ings and partitions correctly dimensioned. The live loads to be used, the wind uplift if any, the weights of partitions and the location and amount of any special loads, such as mono-

rail, fans, blowers, tanks, etc., shall be indicated. The eleva-

tion of finished floors, roofs, and ceilings shall be shown with due consideration taken for the effects of dead load deflections.

(a) Loads

The Steel Joist Institute does not presume to establish the loading requirements for which structures are designed.

The Steel Joist Institute Load Tables are based on uni-

form loading conditions and are sole for use in selecting joist sizes for gravity loads that can be expressed in terms of “pounds per linear foot” (kip/kiloNewtons per Meter) of joist.

The Steel Joist Institute Joist Girders Weight Tables are based on uniformly spaced panel point load-

ing conditions and are valid for use in selecting Joist Girder sizes for gravity conditions that can be expressed in kips (kip/kiloNewtons) on panel point on the Joist Girder.

The specifying professional shall provide the nominal loads and load combinations as stipulated by the appli-

cable code under which the structure is designed and shall provide the design basis (ASD or LRFD).

The specifying professional shall calculate and pro-

vide the magnitude and location of ALL JOIST and JOIST GIRDERS LOADS. This includes all special loads (drift loads, mechanical units, net uplift, axial loads, moments, structural bracing loads, or other applied loads) which are not considered as part of the joist or Joist Girder design. For Joist Girders, reactions from sup-

ported members shall be clearly denoted as point loads on the Joist Girder. When necessary to clearly convey the information, a Load Diagram or Load Schedule shall be provided.

The specifying professional shall give due considera-

tion to the following loads and load effects:

1. Ponded rain water.

2. Accumulation of snow in the vicinity of obstructions such as parapets, signs, parapets, adjacent build-

ings, etc.

3. Wind.

4. Type and magnitude of end moments and/or axial forces at the joist and Joist Girder and supports shall be shown on the structural drawings. For moment resisting joists or Joist Girder framing near the end of a column, due consideration shall be given to extend the column length to allow a plate type con-

nection between the top of the joist or Joist Girder top chord and the column.

Avoid resolving joist or Joist Girder moments and axial forces through the bearing seat connection.

A note shall be provided on the structural drawings stating that all moment resisting joists shall have all dead loads applied to the joist before the bottom chord struts are welded to the supporting connection when, ever the moments provided do not include dead load.

The top and bottom chord moment connection details shall be designed by the specifying professional. The joist designer shall furnish the specifying profes-

sional with the joist detail information if required.

The nominal loads, as determined by the specifying professional, shall be less than that specified in the applicable building codes.

Where concentrated loads occur, the magnitude and location of these concentrated loads shall be shown on the structural drawings when, in the opinion of the specifying professional, they may require considera-

tion by the joist manufacturer.

The specifying professional shall use one of the fol-

lowing options:

- Estimator to price the joists.

- Joist manufacturer to design the joists properly.

- Owner to obtain the most economical joists.

Option 1: Select a Standard Steel Joist Institute joist for the uniform design loading and provide the load and location of any additional loads on the structural plan with a note “Joist manufacturer shall design joists for additional loads as shown.” This option works well for a few added loads per joist with known locations.
CODE OF STANDARD PRACTICE FOR STEEL JOISTS AND JOIST GIRDERS

Option 2: Select a KCS joist using moment and end reaction criteria. This option works well for concentrated loads for which exact locations are not known or for multiple loading. See examples and limitations on the pages accompanying the KCS Joist Load Tables.

a) Determine the maximum moment
b) Determine the maximum reaction (shear)
c) Select the required KCS joist that provides the required moment and end reaction (shear).

Option 3: Specify a SPECIAL joist with load diagrams. This option is preferred when the joist includes loading that cannot clearly be denoted on the structural drawings.

a) Provide a load diagram to clearly define all loads.
b) Place the designation (i.e., 18K SP or 18LH SP) under the load diagram with the following note: “Joist manufacturer to design joist to support loads as shown above.”

CAUTION: The specifying professional shall compare the estimated uniform loads derived from the maximum load and shear to the uniform loads tabulated in the K-Series Load Table. An equivalent factored uniform load in excess of 550 psf (2670 kN/m²) or a maximum factored end reaction exceeding 3000 lbs (13.9 kN) indicates that the specifying professional shall consider using additional joists to reduce the loading or use an LHS Series joist and make provisions for 5 inch (127 mm) deep bearing seats.

SPECIAL LOADING: Please note the load combinations shown are for referenced examples only and it is not to be presumed that the joist designer is responsible for the applicable building code load combinations. If the resisting members are too complex to adequately communicate in a single load diagram, then the specifying professional shall provide a load schedule showing the specified design loads, load categories, and required load combinations with applicable load factors.

ASD EXAMPLE:

U.S. CUSTOMARY UNITS AND (METRIC UNITS)

Load diagram per ASCE 7.

LRF Example:

U.S. CUSTOMARY UNITS AND (METRIC UNITS)

Factored Load diagram per ASCE 7.4.3(2)

F + S

LRFD EXAMPLE:

U.S. CUSTOMARY UNITS AND (METRIC UNITS)

Factored Load diagram per ASCE 7.4.3(2) 1.2D + 1.6S

(2.54 m)

(0.91 m)

(1.83 m)

(0.91 m)

(457 mm)

5'-0" (1.52 m)

6'-0" (1.83 m)

18K SP

LRFD

1000 lb/ft (14.7 kN/m)

600 lb (2.67 kN)

1000 lb/ft (14.7 kN/m)

600 lb (2.67 kN)

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1000 lb/ft (14.7 kN/m)

600 lb (2.67 kN)
Special Loading: Please note the load combinations accompanying the KCS Joist Load Tables. Loading. See examples and limitations on the pages under the load diagram with the following note: “Joist manufacturer to design joist to support loads as shown above.”

CAUTION: The specifying professional shall compare the evaluated uniform loads derived from the maximum moment and shear to the uniform loads tabulated in the K-Series Load Table. An equivalent unfactored uniform load in excess of 550 psi (38 MPa) or a maximum unfactored end reaction exceeding 3000 lbs (13.6 kN) indicates that the specifying professional shall consider using additional joists to reduce the loading or use an LNS-series joist and make provisions for 5 inch (127 mm) deep bearing seats.

Special Loadings: Please note the load combinations shown are for referenced examples only and it is not to be presumed that the joist designer is responsible for the applicable building code load combinations. If the referenced load combinations are too complex to adequately communicate in a simple load diagram, then the specifying professional shall provide a load schedule showing the specified designs, load categories, and required load combinations with applicable load factors.

6.2 PLANS Furnished by Seller

The Seller shall furnish the Buyer with steel joist place- ment plans to show the Material as specified on the construction documents and are to be utilized for field installation in accordance with specified shop requirements as stated in Section 6.1. Steel placement plans shall include, at a minimum, the following:

1. Listing of all applicable loads as stated in Section 6.1 and used in the design of the steel costs and Joist Girders as specified in the construction documents.

2. Profiles for non-standard joist and Joist Girders configurations. (Standard joist and Joist Girdler configurations are as indicated in the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption).

3. Connection requirements for:
   - Joists supports
   - Joist Girders supports
   - Field splices
   - Bridging attachments

4. Deflection criteria for live load and total loads for non-SJI standard joists.

5. Size, location, and connections for all bridging

6. Joists headers

All Material shall be identified with its mark which appears on the bill of material. The shop paint shall be as noted on the joist placement plans. Steel joist placement plans do not require the seal and signature of the joist manufacturer’s registered design professional.

6.3 Discrepancies

The specifying professional’s bid plans and specifications will be assumed to be correct in the absence of written notice from the Buyer to the contrary. When plans are furnished by the Buyer which do not agree with the Architect’s bid plans, such discrepancies shall be considered as a written notice of change of plans. However, it shall be the Buyer’s responsibility to advise the Seller of those changes which affect thejoists or Joists Girders.

6.4 APPROVAL

When joist placement plans are furnished by the Seller, plans shall be approved by the Buyer and owner for examination and approval. The Seller allows a maximum of fourteen (14) calendar days in their schedule for the return of placement plans noted with the owner’s and customer’s approval, or approval subject to corrections as noted. The Seller makes the corrections, furnishes corrected prints for field use to the owner/customer and is released by the owner/customer to start joist manufacture.

Approval by the owner/customer of the placement plans, sections, notes and shop schedule prepared by the Seller indicates that the Seller has correctly interpreted the contract requirements, and is released by the owner/customer to start joist manufacture. This approval constitutes the owner/customer’s acceptance of all responsibility for the design adequacy of any detail configuration of joist support connections made by the Seller as part of the preparation of those placement plans.

Approval does not relieve the Seller of the responsibility for accuracy or dimensions on the plans, nor the general fit-up of joists to be placed in the field.

6.5 Changes

When any changes in plans are made by the Buyer (or the buyer’s representative) either prior to or after approval of detailed plans, or when any Material is required and was not shown on the plans used as the basis of the bid, the cost of such changes and/or extra Material shall be paid by the Buyer at a price to be agreed upon between Buyer and Seller.

6.6 Calculations

The Seller shall design the steel joists and/or steel Joist Girders in accordance with the current Steel Joist Institute Standard Specifications Load Tables & Weight Tables to support the load requirements of Section 6.1. The specifying professional may require submission of the steel joist and Joist Girders calculations as prepared by a registered design professional responsible for the product design. If requested by the specifying professional, the steel joist manufacturer shall submit design calculations with a cover letter bearing the seal and signature of the joist manufacturer’s registered design professional. In addition to standard calculations under this seal and signature, submit the following shall be included:

1. Non-SJI standard bridging details (e.g. for cantilevered conditions, net uplift, etc.)

2. Connection details for:
   - Non-SJI standard connections (e.g. flush framed or framed connections)
   - Field splices
   - Joist headers

Handling and Erection

The current OSHA SAFETY STANDARDS FOR STEEL ERECTION, 29 CFR PART 1926, SUBPART R, STEEL ERECTION, refers to certain joists at or near columns to be designed with sufficient rigidity to allow one employee to safely release the hoisting cable without the need for erection bridging. This provision shall not be interpreted that any joist at or near a column line is safe to support an employee without bridging installed. Many limitations exist that prevent these joists from being designed to safely allow an employee on an un-bridged joist. Because of these limitations these joists must be erected by incorporating erection methods ensuring joist stability and either:

1) Installing bridging or otherwise stabilizing the joist prior to releasing the hoisting cable, or

2) Releasing the hoisting cable without having a worker on the joist.

A steel joist or Joist Girdler shall not be placed on any sup- port structure unless such structure is stabilized. When steel joists or Joist Girders are landed on a structure, they shall be secured to prevent unintentional displacement prior to installation.

A bridging term point shall be established before joist bridging is installed.

Steel joists and Joist Girders shall not be used as anchorages for points of a fall arrest system unless written directions to do so is obtained from a qualified person(2).
CODE OF STANDARD PRACTICE FOR STEEL JOISTS AND JOIST GIRDERS

No modification that affects the strength of a steel joist or Joist Girder shall be made without the written approval of the project engineer of record.

The Buyer and/or Erector shall check all materials on arrival at job site and promptly report to Seller any discrepancies and/or damages. The Buyer and/or Erector shall comply with the requirements of the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption in the handling and erection of Material.

The Seller shall not be responsible for the condition of paint finish on Material if it is not properly protected after delivery.

* For thorough coverage of this topic, refer to SJI Technical Digest #9, “Handling and Erection of Steel Joists and Joist Girders”.

SECTION 8.

BUSINESS RELATIONS

8.1 PRESENTATION OF PROPOSALS

All proposals for furnishing Material shall be made on a Sales Contract Form. After acceptance by the Buyer, these proposals must be approved or executed by a qualified official of the Seller. Upon such approval the proposal becomes a contract.

8.2 ACCEPTANCE OF PROPOSALS

All proposals are intended for prompt acceptance and are subject to change without notice.

8.3 BILLING

Contracts on a lump sum basis are to be billed proportionately as shipments are made.

8.4 PAYMENT

Payments shall be made in full on each invoice without retention.

8.5 ARBITRATION

All business controversies which cannot be settled by direct negotiations between Buyer and Seller shall be submitted to arbitration. Both parties shall sign a submission to arbitration and if possible agree upon an arbitrator. If they are unable to agree, each shall appoint an arbitrator and these two shall appoint a third arbitrator. The expenses of the arbitration shall be divided equally between the parties, unless otherwise provided for in the agreements to submit to arbitration. The arbitrators shall pass final judgment upon all questions, both of law and fact, and their findings shall be conclusive.

REFERENCED SPECIFICATIONS, CODES AND STANDARDS

The following documents are referenced in the Open Web Steel Joists, K-Series, Longspan and Deep Longspan Steel Joists, LH-and DLH-Series and Joist Girder Specifications:

- American Institute of Steel Construction, Inc. (AISC) (2005), Specification for Structural Steel Buildings, Chicago, IL.
- American Society of Civil Engineers (ASCE) (2002), Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, Reston, VA.
- American Welding Society, AWS A5.5-96, Specification for Low Alloy Steel Electrodes for Shielded Metal Arc Welding, Miami, FL.
- American Welding Society, AWS A5.20-95, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding, Miami, FL.
No modification that affects the strength of a steel joist or Joist Girder shall be made without the written approval of the project engineer of record.

The Buyer and/or Erector shall check all materials on arrival at job site and promptly report to Seller any discrepancies and/or damages. The Buyer and/or Erector shall comply with the requirements of the Steel Joist Institute Standard Specifications Load Tables & Weight Tables of latest adoption in the handling and erection of Material.

The Seller shall not be responsible for the condition of paint finish on Material if it is not properly protected after delivery.

The Seller shall not be responsible for improper fit of Material due to inaccurate construction work.

* For thorough coverage of this topic, refer to SJI Technical Digest #9, “Handling and Erection of Steel Joists and Joist Girders”.

(1) See Appendix E for OSHA definition of a qualified person.

SECTION 8.
BUSINESS RELATIONS

8.1 PRESENTATION OF PROPOSALS

All proposals for furnishing Material shall be made on a Sales Contract Form. After acceptance by the Buyer, these proposals must be approved or executed by a qualified official of the Seller. Upon such approval the proposal becomes a contract.

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All proposals are intended for prompt acceptance and are subject to change without notice.

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Contracts on a lump sum basis are to be billed proportionately as shipment is made.

8.4 PAYMENT

Payments shall be made in full on each invoice without retention.

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All business controversies which cannot be settled by direct negotiations between Buyer and Seller shall be submitted to arbitration. Both parties shall sign a submission to arbitration and if possible agree upon an arbitrator. If they are unable to agree, each shall appoint an arbitrator and these two shall appoint a third arbitrator. The expenses of the arbitration shall be divided equally between the parties, unless otherwise provided for in the agreement to submit to arbitration. The arbitrators shall pass final judgment upon all questions, both of law and fact, and their findings shall be conclusive.

REFERENCE SPECIFICATIONS, CODES AND STANDARDS

The following documents are referenced in the Open Web Steel Joists, K-Series, Longspan and Deep Longspan Steel Joists, LH-and DLH-Series and Joist Girder Specifications:

- American Institute of Steel Construction, Inc. (AISC) (2005), Specification for Structural Steel Buildings, Chicago, IL.
- American Society of Civil Engineers (ASCE) (2002), Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, Reston, VA.
- American Institute of Steel Construction, Inc. (2005), Specification for Structural Steel Buildings, Chicago, IL.
- American Welding Society, AWS A5.5-96, Specification for Low Alloy Steel Electrodes for Shielded Metal Arc Welding, Miami, FL.
- American Welding Society, AWS A5.20-95, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding, Miami, FL.
**REFERENCES SPECIFICATIONS, CODES AND STANDARDS**


American Welding Society, AWS A5.29-98, Specification for Low Alloy Steel Electrodes for Flux Cored Arc Welding, Miami, FL.


Steel Joist Institute (SJI) (2006), Technical Digest #3, Structural Design of Steel Joist Roofs to Resist Ponding Loads, Myrtle Beach, SC.

Steel Joist Institute (SJI) (1998), Technical Digest #5, Vibration of Steel Joist-Concrete Slab Floors, Myrtle Beach, SC.

Steel Joist Institute (SJI) (2006), Technical Digest #6, Structural Design of Steel Joist Roofs to Resist Uplift Loads, Myrtle Beach, SC.

Steel Joist Institute (SJI) (1983), Technical Digest #8, Welding of Open Web Steel Joists, Myrtle Beach, SC.

Steel Joist Institute (SJI) (2006), Technical Digest #9, Handling and Erection of Steel Joists and Joist Girders, Myrtle Beach, SC.

Steel Joist Institute (SJI) (2003), Technical Digest #10, Design of Fire Resistive Assemblies with Steel Joists, Myrtle Beach, SC.

Steel Joist Institute (SJI) (1999), Technical Digest #11, Design of Joist-Girder Frames, Myrtle Beach, SC.


**GLOSSARY**


* These terms are usually qualified by the type of load it affects, e.g. nominal tensile strength, available compressive strength, design flexural strength.

** Term usually qualified by the type of component, e.g. local web buckling, local flange buckling, etc.

**NOTES:**

Buyer. The entity that has agreed to purchase material from the manufacturer and has also agreed to the terms of sale.

Camber. An upward curvature of the chords of a joist or Joist Girder induced during shop fabrication. Note this is in addition to the pitch of the top chord.

Ceiling Extension. A bottom chord extension except that only one angle of the bottom chord is extended from the first bottom chord panel point towards the end of the joist.

Chords. The top and bottom members of a joist or Joist Girder. When a chord is comprised of two angles there is usually a gap between the members.

Clear Span. The actual clear distance or opening between supports for a joist, that is the distance between walls or the distance between the edges of flanges of beams.

Cold-Fomed Steel Structural Member. A shape manufactured by press-braking blanks sheared from sheets, cut lengths of coils or plates, or by roll forming cold- or hot-rolled coils or sheets; both forming operations being performed at ambient room temperature, that is, without manifest addition of heat such as would be required for hot forming.

Collateral Load. All additional dead loads other than the weight of the building, such as sprinklers, pipes, ceilings, and mechanical or electrical components.

Connection. Combination of structural elements and joints used to transmit forces between two or more members. See also Splice.

Deck. A floor or roof covering made out of gage metal attached by welding or mechanical means to joists, beams, purlins, or other structural members and can be galvanized, painted, or unpainted.

Design Load. Applied load determined in accordance with either LRFD load combinations or ASD load combinations, whichever is applicable.

Design Strength*. Design strength or allowable strength as appropriate.

Diaphragm. Roof, floor or other membrane or bracing system that transfers in-plane forces to the lateral force resisting system.

Effective Length. Length of an otherwise identical column that transfers in-plane forces to the lateral force resisting system.

Elastic Analysis. Structural analysis based on the assumption that the structure returns to its original geometry on removal of the load.

Factory. The entity that manufactures the material.

Fire Resistance. A property of materials or structures that resists passage of heat and/ or flame from one side to the other.
**NOTES:**


* These terms are usually qualified by the type of load effect, e.g., nominal tensile strength, available compressive strength, design flexural strength.

** Term usually qualified by the type of component, e.g. local web buckling, local flange buckling, etc.

- **Appendix A:**
  - **Bridging:** In general, a member connected to a joist to brace it from lateral movement. See also Diagonal Bridging and Horizontal Bridging.
  - **Buckling:** Limit state of sudden change in the geometry of a structure or any of its elements under a critical loading condition.
  - **Buckling Strength:** Nominal strength for buckling or instability limit state.
  - **Build:** The entity that has agreed to purchase material from the manufacturer and has also agreed to the terms of sale.
  - **Buyer:** The entity that has agreed to purchase material from the manufacturer and has also agreed to the terms of sale.
  - **Camber:** An upward curvature of the chords of a joist or Joist Girder.
  - **Chord:** The top and bottom members of a joist or Joist Girder.
  - **Clear Span:** The actual clear distance or opening between supports for a joist, that is the distance between walls or the distance between the edges of flanges of beams.
  - **Collateral Load:** All additional dead loads other than the weight of the building, such as sprinklers, pipes, ceilings, and mechanical or electrical components.
  - **Connection:** Combination of structural elements and joints used to transmit forces between two or more members. See also Splice.
  - **Deck:** A floor or roof covering made out of gage metal attached by welding or mechanical means to joists, beams, purlins, or other structural members and can be galvanized, painted, or unpainted.
  - **Design Load:** Applied load determined in accordance with either LRFD load combinations or ASD load combinations, whichever is applicable.
  - **Diaphragm:** Roof, floor or other membrane or bracing system that transfers in-plane forces to the lateral force resisting system.
  - **Effective Length:** Length of an otherwise identical column with the same strength when analyzed with pin-ended boundary conditions.
  - **Elastic Analysis:** Structural analysis based on the assumption that the structure returns to its original geometry on removal of the load.
Gravity Load. Load, such as that produced by dead and live loads, acting in the downward direction.

Horizontal structural member that supports wall panels and is primarily subjected to bending under horizontal loads, such as wind load.

Flexural Buckling. Buckling mode in which a compression member deflects laterally without twist or change in cross-sectional shape.

Flexural-Torsional Buckling. Buckling mode in which a compression member bends and twists simultaneously with twist about the shear center of the cross section.

Limit State. Condition in which a structure or component becomes unfit for service and is judged either to be no longer useful for its intended function (serviceability limit state) or to have reached its ultimate load-carrying capacity (strength limit state).

Load. Forces, other action that results from the weight of building materials, occupants and their possessions, environmental effects, differential movement, or restrained dimensional changes.

Load Effect. Forces, stresses, and deformations produced in a structural component by the applied loads.

Load Factor. Factor that accounts for deviations of the nominal load from the actual load, for uncertainties in the analysis that transforms the load into a load effect, and for the probability that more than one extreme load will occur simultaneously.

Local Buckling*. Limit state of buckling of a compression element within a cross section.

LRFD (Load and Resistance Factor Design). Method of proportioning structural components such that the design strength equals or exceeds the required strength of the component under the action of the LRFD load combinations.

Required Strength*. Force, stress, and deformations produced in a structural component determined by either structural analysis, for the LRFD or ASD load combinations, as appropriate, or as specified by these Standard Specifications.

Resistance Factor, \( \Omega \). Factor that accounts for unavoidable deviations of the nominal strength from the actual strength and for the manner and consequences of failure.

Serviceability Limit State. Limiting condition affecting the serviceability of the structure, in which the ultimate load-carrying capacity is reached.

Service Load. Load under which serviceability limit states are evaluated.

Serviceability Limit State. Limiting condition affecting the ability of a structure to preserve its appearance, maintenance, durability, or the comfort of its occupants or function of machinery, not to exceed normal usage.

Tensile Strength. Maximum tensile stress of material that a material is capable of sustaining as defined by ASTM.

Span. The centerline-to-centerline distance between structural steel supports such as a beam, column or Joist Girder or the clear span distance plus four inches into a masonry or concrete wall.

Specifying Professional. The licensed professional who is responsible for selecting the building Contract Documents, which indicates that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

 Joey Girders. A primary structural load-carrying member with an open web system which supports floors and roofs utilizing hot rolled or cold-formed steel and is designed as a single span member.

K-Series, LH-Series and DLH-Series. A series of joists and joist girders that are manufactured using cold-formed steel and are designed to be used in open web steel joist and girder systems.
End Diagonal or Web. The first web member on either end of a joist or joist girder which begins at the top chord at the seat and ends at the first bottom chord panel point.

Erector. The entity that is responsible for the safe and proper erection of the materials in accordance with all applicable codes and regulations.

Extended End. The extended part of a joist top chord with the seat angles also being extended from the end of the joist extension back into the joist and maintaining the standard end bearing depth over the entire length of the extension.

Factored Load. Product of a load factor and the nominal load.

Filter. A rod, plate or angle welded between a two angle web member or between a top or bottom chord panel to tie them together, usually located at the middle of the member.

Flexural Buckling. Buckling mode in which a compression member deflects laterally without twist or change in cross-sectional shape.

Flexural-Torsional Buckling. Buckling mode in which a compression member involving deflection normal to the plane of bending.

Girt. Horizontal structural member that supports wall panels and is primarily subjected to bending under horizontal loads, such as wind load.

Gravity Load. Load, such as that produced by dead and live loads, acting in the downward direction.

Header. A structural member located between two joists or between a joist and a wall which carries another joist or joists. It is usually made up of an angle, channel, or beam with saddle angle connections on each end for bearing.

Horizontal Bridging. A continuous angle or other structural shape connected to the top and bottom chord of a joist.

Inelastic Analysis. Structural analysis that takes into account inelastic material behavior, including plastic analysis.

Instability. Limit state reached in the loading of a structural component, frame or structure in which a slight disturbance in the loads or geometry produces large displacements.

Joint. Area where two or more ends, surfaces or edges are attached. Categorized by type of fastener or weld used and the method of force transfer.

Joist. A structural load-carrying member with an open web system which supports floors and roofs utilizing hot rolled or cold formed steel and is designed as a single span member. Currently, the SJI has the following joint designations: K-Series including KCS, LH-Series and DLH-Series.

Joist Girders. A primary structural load-carrying member with an open web system designed as a single span supporting equally spaced concentrated loads of a floor or roof system acting at the panel points of the member and utilizing hot-rolled or cold-formed steel.

Joist Substructure. A structural member who’s intended use is for very short spans (10 feet or less) where open web steel joists are impractical. They are usually used for short spans in skewed bays, over corridors or for outbuildings. It can be made up of two or four angles to form channel sections or box sections.

Lateral Buckling. Buckling mode of a flexural member involving deflection normal to the plane of bending.

Lateral-Torsional Buckling. Buckling mode of a flexural member involving deflection normal to the plane of bending occurring simultaneously with twist about the shear center of the cross-section.

Limit State. Condition in which a structure or component becomes unfit for service and is judged either to be no longer useful for its intended function (serviceability limit state) or to have reached its ultimate load-carrying capacity (strength limit state).

Load. Forces or other action that result from the weight of building materials, occupants and their possessions, environmental effects, differential movement, or restrained dimensional changes.

Load Effect. Forces, stresses, and deformations produced in a structural component by the applied loads.

Load Factor. Factor that accounts for deviations of the nominal load from the actual load, for uncertainties in the analysis that transforms the load into a load effect and for the probability that more than one extreme load will occur simultaneously.

Local Buckling*. Limit state of buckling of a compression element within a cross section.

LRFD (Load and Resistance Factor Design). Method of proportioning structural components such that the design strength equals or exceeds the required strength of the component under the action of the LRFD load combinations.

LRFD Load Combination. Load combination in the applicable building code intended for strength design (load and resistance factor design). 

Material. Joists, Joist Girders and accessories as provided by the Seller.

Nailers. Strips of lumber attached to the top chord of a joist so plywood or other flooring can be nailed directly to the joist.

Nominal Load. Magnitude of the load specified by the applicable building code.

Nominal Strength*. Strength of a structure or component (without the resistance factor or safety factor applied) to resist the load effects as determined in accordance with these Standard Specifications.

Owner. The entity that is identified as such in the Contract Documents.

Permanent Load. Load in which variations over time are rare or of small magnitude. All other loads are variable loads.

Placement Plans. Drawings that are prepared depicting the interpretation of the Contract Documents requirements for the material to be supplied by the Seller. These floor and/or roof plans are approved by the Specifying Professional, Buyer or Owner for conformance with the design requirements. The Seller uses the information contained on these drawings for final material design. A unique piece mark number is typically shown for the individual placement of joists, Joist Girders and accessories along with sections that describe the end bearing conditions and minimum attachment required so that material is placed in the proper location in the field.

Ponding. Retention of water at low or irregular areas on a roof due solely to the deflection of flat roof framing.

Purlin. Horizontal structural member that supports roof deck and is primarily subjected to bending under vertical loads such as dead, snow or wind loads.

Quality Assurance. System of shop and field activities and controls implemented by the owner or his/her designated representative to provide confidence to the owner and the building authority that quality requirements are implemented.

Quality Control. System of shop and field controls implemented by the seller and enforcer to ensure that contract and company fabrication and erection requirements are met.

Required Strength*. Forces, stress, and deformations produced in a structural component, determined by either structural analysis, for the LRFD or ASD load combinations, as appropriate, or as specified by these Standard Specifications.

Resistance Factor, \( \Omega \). Factor that accounts for unavoidable deviations of the nominal strength from the actual strength and for the manner and consequences of failure.

Safety Factor, \( G \). Factor that accounts for deviations of the actual strength from the nominal strength; deviations of the actual load from the nominal load, uncertainties in the analysis that transforms the load into a load effect and for the manner and consequences of failure.

Seller. A company certified by the Joist Institute engaged in the production of building materials, occupants and their possessions, environmental effects, differential movement, or restrained dimensional changes.

Serviceability Limit State. Limiting condition affecting the safety of the structure, in which the ultimate load-carrying capacity is reached.

Stability. Condition reached in the loading of a structural component, frame or structure in which a slight disturbance in the loads or geometry does not produce large displacements.

Stabilizer Plate. A steel plate at a column or wall inserted between the end of a bottom chord of a joist or Joist Girder.

Standard Specifications. Documents developed and maintained by the Steel Joist Institute for the design and manufacture of open web steel joists and joist girders. The term “SJI Standard Specifications” encompasses by reference the following:


Strength Limit State. Limiting condition affecting the safety of the structure, in which the ultimate load-carrying capacity is reached.

Structural Analysis. Determination of load effects on members and connections based on principles of structural mechanics.

Structural Drawings. The graphic or pictorial portions of the Contract Documents showing the design, location and dimensions of the work. These documents generally include plans, elevations, sections, details, connections, all loads, schedules, diagrams and notes.

Tagged End. The end of a joist or Joist Girder where an identification or piece mark is shown by a metal tag. The member must be erected with this tagged end in the same position as the tagged end and noted on the place as the status of the member and utilizing hot-rolled or cold-formed steel.

Tie Joist. A joist that is bolted at a column.

Span. The centerline-to-centerline distance between structural steel supports such as a beam, column or joist girder or the clear span distance plus four inches onto a masonry or concrete wall.

Specified Minimum Yield Stress. Lower limit of yield stress specified for a material as defined by ASTM.

Specifying Professional. The licensed professional who is responsible for selecting the building Contract Documents, which indicates that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

Splice. Connection between two structural members joined at their ends by either bolting or welding to form a single, longer member.

Strength Limit State. Limiting condition affecting the safety of the structure, in which the ultimate load-carrying capacity is reached.

Tie Joist. A joist that is bolted at a column.
Top Chord Extension (TCX). The extended part of a joist top chord. This type of extension only has the two top chord angles extended past the joist seat.

Torsional Buckling. Buckling mode in which a compression member twists about its shear center axis.

Unbraced Length. Distance between braced points of a member, measured between the centers of gravity of the bracing members.

Variable Load. Load not classified as permanent load.

Webs. The vertical or diagonal members joined at the top and bottom chords of a joist or Joist Girder to form triangular patterns.

Yield Point. First stress in a material at which an increase in strain occurs without an increase in stress as defined by ASTM.

Yield Stress. Stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain as defined by ASTM.

Yield Strength. Generic term to denote either yield point or yield strength, as appropriate for the material.

The Underwriters Laboratories (U.L.) Fire Resistance Directory lists hundreds of assemblies and their fire resistance ratings. The Specifying Professional can choose between numerous Floor-Ceiling and Roof-Ceiling assemblies that include steel joists and Joist Girders.

As a convenience, a selected number of assemblies are listed on the following pages. In addition, the Steel Joist Institute’s Technical Digest #10 “Design of Fire Resistant Assemblies with Steel Joists” has a complete listing of steel joist assemblies and additional information about fire ratings. However, the listing that follows and the Technical Digest are intended as a guide only, and the Specifying Professional must refer to the current U.L. Fire Resistance Directory for complete design requirements.

Hundreds of fire tests on steel-joist-supported assemblies have been conducted at nationally recognized testing laboratories in accordance with ASTM Standard E119, ANSI-A2.1,UL 263, and NFPA 261. Because of practical loading restrictions and limitations of furnace dimensions, the vast majority of these tests were run using lightweight joists—normally from 8 inches to 14 inches (203 mm to 356 mm) deep. This practice was advantageous in that it established the minimum acceptable joists at the shallow and lightweight end of the joist load tables. This also resulted in a specified minimum joist designation being listed in the U.L. Fire Resistance Assembly, which is the joist that combines the required minimum depth and minimum weight per foot. Joists of the same series that predate the K-Series joist. Assemblies with Steel Joists” has a complete listing of steel joists and Joist Girders.

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Where a U.L. Fire Resistance Assembly is being utilized, the Specifying Professional shall indicate the assembly number being used on the structural contract drawings. In addition, the Specifying Professional shall consider the following, as applicable:

- Joist designations specified on the structural contract drawings shall not be less than the minimum size for that assembly. The assembly may also require a minimum bridging size that may be larger than required by the SJI Specifications for the particular designation and joist spacing.
- Some assemblies stipulate minimum size materials or minimum cross sectional areas for individual joist and Joist Girder components. It is the responsibility of the Specifying Professional to show all special requirements on the contract drawings.
- Note that the maximum joist spacing shown for Floor-Ceiling Assemblies may be increased from the spacing listed in the U.L. Fire Resistance Directory to a maximum of 48 inches on center, provided the floor slab meets the structural requirements and the spacing of hanger wires supporting the ceiling is not increased.

Some assemblies stipulate an allowable maximum joist design stress level less than the 30 ksi (207 MPa) used in the joist and Joist Girder Specifications. It is the responsibility of the Specifying Professional to apply the proper stress level reductions (when applicable) when selecting joists and/or Joist Girders. This is accomplished by prorating the joist and/or Joist Girder capacities. To adjust the stress level of joists or Joist Girders, multiply the design load by the ratio of the joist design stress to the required maximum (e.g. 30/26 (207/179), 30/24 (207/165), 30/22 (207/152)), and then using this increased load, select a joist or Joist Girder from the load and/or weight tables.

Some U.L. Roof-Ceiling Assemblies using direct applied protection limit the spacing of the joists for certain types and gages of metal decking – refer to the U.L. Fire Resistance Directory for this information.

Where fire protective materials are to be applied directly to the steel joists or Joist Girders, it is often desired to have the joist furnished as unpainted. The Specifying Professional should indicate on the structural contract drawings if the joists or Joist Girders are to be painted or not.

Certain older U.L. fire rated assemblies may refer to joist series that predate the K-Series joists. Where one of these assemblies is selected, refer to the U.L. Fire Resistance Directory for special provisions for substituting a K-Series joist in lieu of an S-, J-, or H-Series joist.
Top Chord Extension (TCX). The extended part of a joist top chord. This type of extension only has the two top chord angles extended past the joist seat.

Torsional Buckling. Buckling mode in which a compression member twists about its shear center axis.

Unbraced Length. Distance between braced points of a member, measured between the centers of gravity of the bracing members.

Variable Load. Load not classified as permanent load.

Yield Point. First stress in a material at which an increase in strain occurs without an increase in stress as defined by ASTM.

Yield Stress. Generic term to denote either yield point or yield strength, as appropriate for the material.
### FLOOR - CEILING ASSEMBLIES WITH MEMBRANE PROTECTION

<table>
<thead>
<tr>
<th>Restrained Assembly Rating</th>
<th>Protection Material</th>
<th>Minimum Joist Size</th>
<th>Concrete</th>
<th>Maximum Joint Spacing (in.)</th>
<th>Minimum Primary Support Member</th>
<th>UL Design Number</th>
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* Special Area Requirements
NL = Not Listed
NS = Not Specified
### FLOOR – CEILING ASSEMBLIES WITH MEMBRANE PROTECTION

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<tr>
<th>Restricted Assembly Rating</th>
<th>Protection Material</th>
<th>Minimum Joist Size</th>
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<th>Maximum Joint Spacing (in.)</th>
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* Special Area Requirements
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
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### ROOF - CEILING ASSEMBLIES WITH MEMBRANE PROTECTION

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<th>Built Up Roof Insulation</th>
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### ROOF – CEILING ASSEMBLIES WITH MEMBRANE PROTECTION

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**ROOF – CEILING ASSEMBLIES WITH SPRAY APPLIED FIRE RESISTIVE MATERIALS**

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*Special Area Requirements
NS = Not Specified

**ROOF – CEILING ASSEMBLIES WITH SPRAY APPLIED FIRE RESISTIVE MATERIALS**

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*Special Area Requirements
NS = Not Specified

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### ROOF – CEILING ASSEMBLIES WITH SPRAY APPLIED FIRE RESISTIVE MATERIALS

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<th>Restricted Assembly Rating</th>
<th>Protection Material</th>
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### ROOF – CEILING ASSEMBLIES WITH SPRAY APPLIED FIRE RESISTIVE MATERIALS

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* Special Area Requirements
NS = Not Specified
OSHA SAFETY STANDARDS FOR STEEL ERECTION

BAY LENGTH DEFINITIONS

- Joist Girders
- Steel Beam
- Steel Channel
- Steel Column
- Steel Tube
- Masonry or Tilt-Up
- Masonry with Pilaster
- Masonry with Face Brick
OSHA SAFETY STANDARDS FOR STEEL ERECTION

**BAY LENGTH DEFINITIONS**

- **JOIST GIRDERS**
- **STEEL BEAM**
- **STEEL CHANNEL**
- **STEEL COLUMN**
- **STEEL TUBE**
- **STEEL COLUMN**
- **STEEL TUBE**
- **MASONRY OR TILT-UP**
- **MASONRY OR TILT-UP**
- **MASONRY WITH PILASTER**
- **MASONRY OR TILT-UP**
- **MASONRY OR TILT-UP**
- **MASONRY WITH FACE BRICK**
§ 1926.751 DEFINITIONS
(Selected items only).

Anchored bridging means that the steel joist bridging is connected to a bridging terminus point.
Bolted diagonal bridging means diagonal bridging that is bolted to a steel joist or joists.
Bridging clip means a device that is attached to the steel joist to allow the bolting of the bridging to the steel joist. Bridging terminus point means a wall, a beam, tandem joists (with all bridging installed), and a horizontal truss in the plane of the top chord) or other element at an end or intermediate point(s) of a line of bridging that provides an anchor point for the steel joist bridging.
Column means a load-carrying vertical member that is part of the primary skeletal framing system. Columns do not include posts.
Constructibility means the ability to erect structural steel members in accordance with subpart R without having to alter the over-all structural design.
Construction load (for joist erection) means any load other than the weight of the employee(s), the joists and the bridging bundle.
Erection bridging means the bolted diagonal bridging that is required to be installed prior to releasing the hoisting cables from the steel joists.
Personal fall arrest system means a system used to arrest an employee in a fall from a working level. A personal fall arrest system consists of an anchorage connectors, a body harness and may include a lanyard, deceleration device, helmet, or suitable combination of these. The use of a body belt for fall arrest is prohibited.
Project structural engineer means the registered, licensed professional responsible for the design of structural steel framing and whose seal appears on the structural contract documents.
Qualified person (also defined in § 1926.32) means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive training, education, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.
Steel joist means an open web, secondary load-carrying member of 144 feet (43.9 m) or less, designed by the manufacturer, used for the support of floors and roofs. This does not include structural steel trusses.
Structural steel means a steel member, or a member made of a substitute material (such as, but not limited to, fiber-glass, aluminum or composite members). These members include, but are not limited to, steel joists, joist girders, purlins, columns, beams, trusses, splices, seats, metal decki ng, girts, and all bridging, and cold-formed metal framing which is integrated with the structural steel framing of a building.

§ 1926.757 OPEN WEB STEEL JOISTS

(a) General.
(1) Except as provided in paragraph (a)(2) of this section, where steel joists are used and columns are not framed in at least two directions with cold web structural steel members, a steel joist shall be field-bolted at the column to provide lateral stability to the column during erection. For the installation of this joist:
   (i) A vertical stabilizer plate shall be provided on each column for steel joists. The plate shall be a minimum of 6 inches by 6 inches (152 mm by 152 mm) and shall extend at least 3 inches (76 mm) below the bottom chord of the joint with a 13/16 inch (21 mm) hole to provide an attachment point for guy or plumbing cables.
   (ii) The bottom chords of steel joists at columns shall be stabilized to prevent rotation during erection.
   (iii) Hoisting cables shall not be released until the seat at each end of the steel joist is field-bolted and each end of the bottom chord is restrained by the column stabilizer plate.
(2) Where constructibility does not allow a steel joist to be placed on the support structure with a minimum of two 1/4-inch (6 mm) fillet welds 1 inch (25 mm) long or with two 3/8-inch (19 mm) bolts, or the equivalent.
(b) Attachment of steel joists and steel joist girders.
(1) Each end of "K" series steel joists shall be attached to the support structure with a minimum of two 1/8-inch (3 mm) fillet welds 1 inch (25 mm) long or with two 1/2-inch (13 mm) bolts, or the equivalent.
(2) Each end of "LH" and "DLH" series steel joists and steel joist girders shall be attached to the support structure with a minimum of two 1/4-inch (6 mm) fillet welds 2 inches (51 mm) long, or with two 3/8-inch (19 mm) bolts, or the equivalent.
(3) Except as provided in paragraph (b)(1) of this section, each steel joist or steel girder shall be attached to the support structure, at least at one end on both sides of the seat, immediately upon placement in the final erection position and before additional joists are placed.
(4) Panels that have been pre-assembled from steel joists with bridging shall be attached to the structure at each corner before the hoisting cables are released.
(c) Erection of steel joists.
(1) Both sides of the seat of one end of each steel joist that requires bridging under Tables A and B shall be attached to the support structure before hoisting cables are released.
(2) For joists over 60 feet, both ends of the joist shall be attached as specified in paragraph (b) of this section and the provisions of paragraph (d) of this section met before the hoisting cables are released.
(3) On steel joists that do not require erection bridging under Tables A and B, only one employee shall be allowed on the joist until all bridging is installed and anchored.
§ 1926.751 DEFINITIONS
(Selected items only)

- Anchored bridging means that the steel joist bridging is connected to a bridging termi
  - nus point. 
- Bolted diagonal bridging means diagonal bridging that is bolted to a steel joist or 
  - posts. 
- Bridging clip means a device that is attached to the steel joist to allow the bolting of 
  - the bridging to the steel joist. 
- Bridging termi
  - nus point means a wall, a beam, tandem joists 
  - with all bridging installed and a horizontal truss in the plane of the top chord) or other element at an end or intermediate 
  - points) of a line of bridging that provides an anchor point for 
  - the steel joist bridging 
- Column means a load-carrying vertical member that is part of the primary skeletal 
  - framing system. Columns do not include posts. 
- Constructibility means the ability to erect structural steel members in accordance with 
  - subpart R without having to alter the over-all structural design. 
- Construction load (for joist erection) means any load other than the weight of the employee(s), 
  - the joists and the bridging bundle. 
- Erection bridging means the bolted diagonal bridging that is required to be included prior to 
  - releasing the hoisting cables from the steel joists. 
- Erection stabilizer means a column that is provided for the purpose of maintaining or 
  - supporting the column during erection. 
- Personal fall arrest system means a system used to arrest an employee in a fall from a 
  - working level. A personal fall arrest system consists of an anchorage, connectors, a body 
  - harness and may include a lanyard, deceleration device, 
  - arrest system. 
- Project structural engineer means the registered, licensed professional responsible for 
  - the design of structural steel framing and whose seal appears on the structural contract 
  - documents. 
- Qualified person (also defined in § 1926.32) means one 
  - who, by possession of a recognized degree, certificate, or 
  - professional standing, or who by extensive knowledge, train 
  - ing, and experience, has successfully demonstrated the 
  - ability to solve or resolve problems relating to the subject 
  - matter, the work, or the project. 
- Steel joist means an open web, secondary load-carrying member of 144 feet (43.9 m) or less, 
  - designed by the manufacturer, used for the support of floors and roofs. This does not include structural steel 
  - trusses. 

§ 1926.757 OPEN WEB STEEL JOISTS

(a) General. 

(1) Except as provided in paragraph (a)(2) of this section, where steel joists are used and columns are not framed in at 
  - least two directions with solid web structural steel members, a steel joist shall be field-bolted at the column to provide lateral 
  - stability to the column during erection. For the installation of 
  - this joist: 
  - (i) A vertical stabilizer plate shall be provided on each 
    - column for 
    - steel joists. The plate shall be a mini 
    - mum of 6 inches long (152 mm) and 
    - shall extend at least 3 inches (17 mm) below the bottom 
    - chord of the joist with a 13/8 inch (21 mm) hole to provide an attachment point for guying or 
    - plumbing cables. 
  - (ii) The bottom chords of steel joists at columns shall 
    - be stabilized to prevent rotation during erection. 
  - (iii) Hoisting cables shall not be released until the 
    - seat at each end of the steel joist is field-bolted, and 
    - all the connection of the steel joist is restrained by 
    - the column stabilizer plate. 
  - (2) Where constructibility does not allow a steel joist to be installed at the 
    - column: 
  - (i) An alternate means of stabilizing joists shall be 
    - installed on both sides near the column and shall: 
    - (A) Provide stability equivalent to paragraph (a)(1) of this section; 
    - (B) be designed by a qualified person; 
    - (C) be shop installed; and 
    - (D) be included in the erection drawings. 
  - (b) Attachment of steel joists and steel joist girders. 
  - (1) Each end of “K” series steel joists shall be attached to 
    - the support structure with a minimum of two 1/8 inch (3 mm) 
    - fillet welds 1 inch (25 mm) long or with two 1/2 inch (13 mm) 
    - bolts, or the equivalent. 
  - (2) Each end of “LH” and “DLH” series steel joists and steel 
    - joist girders shall be attached to the support structure with 
    - a minimum of two 1/4 inch (6 mm) fillet welds 2 inches (51 
    - mm) long, or with two 3/4 inch (19 mm) bolts, or the 
    - equivalent. 
  - (3) Except as provided in paragraph (b)(4) of this section, each 
    - steel joist shall be attached to the support structure, at 
    - least at one end on both sides of the seat, immediately upon 
    - placement in the final erection position and before addition 
    - al joists are placed. 
  - (4) Panels that have been pre-assembled from steel joists 
    - with bridging shall be attached to the support at each cor 
    - ner before the hoisting cables are released. 
  - (c) Erection of steel joists. 
  - (1) Both sides of the seat of one end of each steel joist that 
    - requires bridging under Tables A and B shall be attached to 
    - the support structure before hoisting cables are released. 
  - (2) For joists over 60 feet, both ends of the joist shall be 
    - attached as specified in paragraph (b)(3) of this section and the 
    - provisions of paragraph (d) of this section met before the 
    - hoisting cables are released. 
  - (3) On steel joists that do not require erection bridging under 
    - Tables A and B, only one employee shall be allowed on the 
    - joist until all bridging is installed and anchored. 

| Table A — Erection Bridging for Short Span Joists |
|---|---|
| Joist | Sp |
| 8K1 | NM |
| 10K1 | NM |
| 12K1 | 29–0 |
| 12K2 | 30–0 |
| 12K5 | NM |
| 14K1 | 27–0 |
| 14K2 | 30–0 |
| 14K4 | NM |
| 14K6 | 32–0 |
| 14K10 | NM |
| 16K1 | 33–0 |
| 16K2 | 35–0 |
| 16K6 | NM |
| 16K7 | NM |
| 16K8 | 31–0 |
| 16K9 | 32–0 |
| 18K1 | NM |
| 18K2 | 33–0 |
| 18K3 | 35–0 |
| 18K7 | NM |
| 18K8 | 31–0 |
| 18K9 | 32–0 |
| 20K1 | NM |
| 20K2 | 34–0 |
| 20K4 | 36–0 |
| 20K5 | NM |
| 22K1 | 39–0 |
| 22K2 | 40–0 |
| 22K6 | NM |
| 24K1 | NM |
| 24K2 | 34–0 |
| 24K5 | 36–0 |
| 24K6 | NM |
| 26K1 | 40–0 |
| 26K2 | NM |
| 28K1 | NM |
| 28K2 | 39–0 |
| 30K1 | NM |
| 30K2 | 38–0 |
| 32K1 | NM |
| 32K2 | 38–0 |
| 34K1 | NM |
| 34K2 | 38–0 |
| 36K1 | NM |
| 36K2 | 39–0 |

* NM = diagonal bolted bridging not mandatory
(d) Erection bridging

(1) Where the span of the steel joist is equal to or greater than the span shown in Tables A and B, the following shall apply:

(a) A row of bolted diagonal erection bridging shall be installed near the midspan of the steel joist.

(b) Holding cables shall not be released until this bolted diagonal erection bridging is installed and anchored.

(c) No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.

(2) Where the span of the steel joist is over 60 feet (18.3 m) through 100 feet (30.5 m), the following shall apply:

(a) All rows of bridging shall be bolted diagonal bridging;

(b) Two rows of bolted diagonal erection bridging shall be installed near the third points of the steel joist;

(c) Holding cables shall not be released until this bolted diagonal erection bridging is installed and anchored;

(d) No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

(3) Where the span of the steel joist is over 100 feet (30.5 m) through 144 feet (43.9 m), the following shall apply:

(a) All rows of bridging shall be bolted diagonal bridging;

(b) Holding cables shall not be released until this steel joist is installed and anchored;

(c) No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

(4) For steel members spanning over 144 feet (43.9 m), the erection methods used shall be in accordance with § 1926.757(d).

(5) Where any steel joist specified in paragraphs (c)(2) and (d)(1)(i) are not used, the provisions of § 1926.757(d)(1)(i) shall apply.

(v) Bridging attachments shall not protrude above the top chord of the steel joist.

(e) Landing and placing loads.

(1) During the construction period, the employer placing a load on steel joists shall ensure that the load is distributed so as not to exceed the carrying capacity of any steel joist.

(2) Except for paragraph (e)(4) of this section, no construction loads are allowed on the steel joists until all bridging is installed and anchored.

(3) The weight of a bundle of joist bridging shall not exceed a total of 1,000 pounds (454 kg). A bundle of joist bridging shall be placed on a minimum of three steel joists that are secured at one end. The edge of the bridging bundle shall be positioned within 1 foot (0.3 m) of the secured end.

(4) No bundle of decking may be placed on steel joists until all bridging has been installed and anchored and all joist-bearing ends are attached.

(6) When bolted diagonal erection bridging is required by this section, the following shall apply:

(i) The bridging shall be indicated on the erection drawing.

(ii) The erection drawing shall be the exclusive indicator of the proper placement of this bridging.

(iii) Shop-installed bridging clips, or functional equivalents, shall be used where the bridging bolts to the steel joists.

(iv) When two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging shall not be removed from the bolt for the attachment of the second; and

(v) Bridging attachments shall not protrude above the top chord of the steel joist.
### TABLE A. — ERECTION BRIDGING FOR SHORT SPAN JOISTS (continued)

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NM = diagonal bolted bridging not mandatory

### TABLE B. — ERECTION BRIDGING FOR LONG SPAN JOISTS

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NM = diagonal bolted bridging not mandatory

(4) Employees shall not be allowed on steel joints where the span of the steel joist is equal to or greater than the span shown in Tables A and B except in accordance with § 1926.757(d).

(5) When permanent bridging terminus points cannot be used during erection, additional temporary bridging terminus points are required to provide stability. (See appendix C of this subpart.)

(6) Employees shall not be permitted to work within any bridging system unless all of the following conditions are met:

(i) The employer has first determined from a qualified person and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load.

(ii) The erection drawing shall be the exclusive indicator of the proper placement of this bridging.

(iii) Shop-installed bridging clips, or functional equivalents, shall be used where the bridging bolts to the steel joints.

(iv) When two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging shall not be removed from the bolt for the attachment of the second.

(v) Bridging attachments shall not protrude above the top chord of the steel joist.

(e) Landing and placing loads.

(1) During the construction period, the employer placing a load on steel joints shall ensure that the load is distributed so as not to exceed the carrying capacity of any steel joist.

(2) Except for paragraph (e)(4) of this section, no construction loads are allowed on the steel joints until all bridging is installed and anchored and all joint-bearing ends are attached.

(3) The weight of a bundle of joist bridging shall not exceed a total of 1,000 pounds (454 kg). A bundle of joist bridging shall be placed on a minimum of three steel joists that are secured at one end. The edge of the bridging bundle shall be positioned within 1 foot (30.3 m) of the secured end.

(4) No bundle of decking may be placed on any joints until all bridging has been installed and anchored and all joist-bearing ends are attached, unless all of the following conditions are met:

(i) The employer has first determined from a qualified person and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load.

(ii) The bundle of decking is placed on a minimum of three steel joists.

(iii) The joists supporting the bundle of decking are attached at both ends.

(iv) At least one row of bridging is installed and anchored.

(v) The total weight of the bundle of decking does not exceed 4,000 pounds (1816 kg).

(vi) Placement of the bundle of decking shall be in accordance with paragraph (e)(5) of this section.

(5) The edge of the construction load shall be placed within 1 foot (30.3 m) of the bearing surface of the joint end.
Guidelines for Complying with OSHA Steel Erection Standard, Paragraph §1926.757(a)(10) and §1926.757(c)(5).

ILLUSTRATIONS OF OSHA BRIDGING TERMINUS POINTS (NON-MANDATORY)

Horizontal Bridging
Terminus at Wall

Horizontal Bridging
Terminus at Panel Wall

Horizontal Bridging
Terminus at Structural Shape with Optional "X-Bridging"

Bolted Diagonal Bridging
Terminus at Wall

Bolted Diagonal Bridging
Terminus at Wall
ILLUSTRATIONS OF OSHA BRIDGING TERMINUS POINTS
NON-MANDATORY

Guidelines for Complying with OSHA Steel Erection Standard, Paragraph §1926.757(a)(10) and §1926.757(c)(5).

HORIZONTAL BRIDGING TERMINUS AT WALL

HORIZONTAL BRIDGING TERMINUS AT PANEL WALL

HORIZONTAL BRIDGING TERMINUS AT STRUCTURAL SHAPE

HORIZONTAL BRIDGING TERMINUS AT STRUCTURAL SHAPE WITH OPTIONAL "X-BRIDGING"

BOLTED DIAGONAL BRIDGING TERMINUS AT WALL

BOLTED DIAGONAL BRIDGING TERMINUS AT WALL

LAG WITH SHIELD OR EMBEDDED ANCHOR

BOLTED CONNECTION
JOISTS PAIR BRIDGING TERMINUS POINT

HORIZONTAL TRUSS WEBBING

TERMINUS POINT

HORIZONTAL BRIDGING TERMINUS POINT

SECURED BY TEMP. GUY CABLES

DIAGONAL BRIDGING TERMINUS POINT

SECURED BY TEMP. GUY CABLES

POSITIVE ANCHORAGE POINT

INDEPENDENT TEMP. GUY CABLES

INDEPENDENT TEMP. GUY CABLES

LOOped AROUND TOP CHORD

HORIZ. BRDG.

OSHA SAFETY STANDARDS

NOTES