American National Standard SJI-K-2010

STANDARD SPECIFICATION
FOR OPEN WEB STEEL JOISTS, K-SERIES

Adopted by the Steel Joist Institute November 4, 1985
Revised to May 18, 2010, Effective December 31, 2010

SECTION 1.
SCOPE AND DEFINITIONS

1.1 SCOPE

The *Standard Specification for Open Web Steel Joists,* **K**-*Series*, hereafter referred to as the Specification, covers the design, manufacture, application, and erection stability and handling of Open Web Steel Joists **K**-Series in buildings or other structures, where other structures are defined as those structures designed, manufactured, and erected in a manner similar to buildings. **K-**Series joists shall be designed using Allowable Stress Design (ASD) or Load and Resistance Factor Design (LRFD) in accordance with this Specification.   Steel joists shall be erected in accordance with the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Code of Federal Regulations 29CFR Part 1926 Safety Standards for Steel Erection, Section 1926.757 Open Web Steel Joists. The KCS joists; Joist Substitutes, **K**-Series; and Top Chord Extensions and Extended Ends, **K**-Series are included as part of this Specification.

This Specification includes Sections 1 through 6.

1.2 DEFINITION

The term "Open Web Steel Joists **K**-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, suitable for the direct support of floors and roof slabs or deck.

The **K**-Series Joists have been standardized in depths from 10 inches (254 mm) through 30 inches (762 mm), for spans up through 60 feet (18288 mm). The maximum total safe uniformly distributed load-carrying capacity of a **K**-Series Joist is 550 plf (8.02 kN/m) in ASD or 825 plf (12.03 kN/m) in LRFD.

The **K**-Series standard joist designations are determined by their nominal depth, followed by the letter **"K"**, and then by the chord size designation assigned. The chord size designations range from 01 to 12. Therefore, as a performance based specification, the **K**-Series standard joist designations listed in the following Standard Load Tables shall support the uniformly distributed loads as provided in the appropriate tables:

> Standard LRFD Load Table Open Web Steel Joists, **K**-Series – U.S. Customary Units
> Standard ASD Load Table Open Web Steel Joists, **K**-Series – U.S. Customary Units

> And the following Standard Load Tables published electronically at www.steeljoist.org/loadtables

> Standard LRFD Load Table Open Web Steel Joists, **K**-Series – S.I. Units
> Standard ASD Load Table Open Web Steel Joists, **K**-Series – S.I. Units

Two standard types of **K**-Series Joists are designed and manufactured. These types are underslung (top chord bearing) or square-ended (bottom chord bearing), with parallel chords.

LRFD Top Chord Extension Load Table (R Type) – U.S. Customary Units
ASD Top Chord Extension Load Table (R Type) – U.S. Customary Units

And the following Standard Load Tables published electronically at www.steeljoist.org/loadtables

LRFD Top Chord Extension Load Table (S Type) – S.I. Units
ASD Top Chord Extension Load Table (S Type) – S.I. Units
LRFD Top Chord Extension Load Table (R Type) – S.I. Units
ASD Top Chord Extension Load Table (R Type) – S.I. Units

1.3 STRUCTURAL DESIGN DRAWINGS AND SPECIFICATIONS

The design drawings and specifications shall meet the requirements in the *Code of Standard Practice for Steel Joists and Joist Girders*, except for deviations specifically identified in the design drawings and/or specifications.

SECTION 2.
REFERENCED SPECIFICATIONS, CODES AND STANDARDS

2.1 REFERENCES

American Institute of Steel Construction, Inc. (AISC)

ANSI/AISC 360-10 *Specification for Structural Steel Buildings*

American Iron and Steel Institute (AISI)

ANSI/AISI S100-2007 *North American Specification for Design of Cold-Formed Steel Structural Members*

ANSI/AISI S100-07/S1-09, *Supplement No. 1 to the North American Specification for the Design of Cold-Formed Steel Structural Members*, 2007 Edition

ANSI/AISI S100-07/S2-10, *Supplement No. 2 to the North American Specification for the Design of Cold-Formed Steel Structural Members*, 2007 Edition

American Society of Testing and Materials, ASTM International (ASTM)

ASTM A6/A6M-09, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel

ASTM A242/242M-04 (2009), Standard Specification for High-Strength Low-Alloy Structural Steel

ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A325/325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi [830 MPa] Minimum Tensile Strength

ASTM A370-09ae1, Standard Test Methods and Definitions for Mechanical Testing of Steel Products

ASTM A500/A500M-07, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A529/A529M-05, Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

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Steel Structures Painting Council (SSPC) (2000), *Steel Structures Painting Manual, Volume 2, Systems and Specifications*, Paint Specification No. 15, Steel Joist Shop Primer, May 1, 1999, Pittsburgh, PA.

SECTION 3.
MATERIALS

3.1 STEEL

The steel used in the manufacture of **K**-Series Joists shall conform to one of the following ASTM Specifications:

- Carbon Structural Steel, ASTM A36/A36M.

- High-Strength Low-Alloy Structural Steel, ASTM A242/A242M.

- Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, ASTM A500/A500M.

- High-Strength Carbon-Manganese Steel of Structural Quality, ASTM A529/A529M.

- High-Strength Low-Alloy Columbium-Vanadium Structural Steel, ASTM A572/A572M.

- High-Strength Low-Alloy Structural Steel up to 50 ksi [345 MPa] Minimum Yield Point with Atmospheric Corrosion Resistance, ASTM A588/A588M.

- Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance, ASTM A606/A606M.

- Structural Steel Shapes, ASTM A992/A992M.

- Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, ASTM A1008/A1008M.

- Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra High Strength, ASTM A1011/A1011M.

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 3.2.

3.2 MECHANICAL PROPERTIES

Steel used for **K**-Series Joists shall have a minimum yield strength determined in accordance with one of the procedures specified in this section, which is equal to the yield strength* assumed in the design.

> *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 paragraph 3.2 of this specification.

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.

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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 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, A500/A500M, A529/A529M, A572/A572M, A588/A588M, A992/A992M 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/A606M, 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 AISI North American Specifications for the Design of Cold-Formed Steel 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 8 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 be not greater than 20 times the 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 retest specimens to meet such requirements shall be the cause for rejection of the lot represented by the specimens.

3.3 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.

SECTION 4.
DESIGN AND MANUFACTURE

4.1 METHOD

Joists shall be designed in accordance with this specification as simply-supported, 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 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 which 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.*

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Design Basis:

Steel joist designs shall be in accordance with the provisions in this Standard Specification using Load and Resistance Factor Design (LRFD) or Allowable Strength Design (ASD) as specified by the **specifying professional** for the project.

Loads, Forces and Load Combinations:

The loads and forces used for the steel joist design shall be calculated by the **specifying professional** in accordance with the applicable building code and specified and provided on the contract drawings.

The load combinations shall be specified by the **specifying professional** on the contract drawings in accordance with the applicable building code or, in the absence of a building code, the load combinations shall be those stipulated in SEI/ASCE 7. For LRFD designs, the load combinations in SEI/ASCE 7, Section 2.3 apply. For ASD designs, the load combinations in SEI/ASCE 7, Section 2.4 apply.

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, f_u, shall not exceed ϕF_n where

f_u = required stress   ksi (MPa)
F_n = nominal stress   ksi (MPa)
ϕ = resistance factor
ϕF_n = design stress

Design Using Allowable Strength Design (ASD)

Joists shall have their components so proportioned that the required stresses, f, shall not exceed F_n / Ω where

f = required stress   ksi (MPa)
F_n = nominal stress   ksi (MPa)
Ω = safety factor
F_n/Ω = allowable stress

Stresses:

For Chords: The calculation of design or allowable stress shall be based on a yield strength, F_y, of the material used in manufacturing equal to 50 ksi (345 MPa).

For all other joist elements: The calculation of design or allowable stress shall be based on a yield strength, F_y, of the material used in manufacturing, but shall not be less than 36 ksi (250 MPa) or greater than 50 ksi (345 MPa).

Note: Yield strengths greater than 50 ksi shall not be used for the design of any joist members.

(a) Tension: ϕ_t = 0.90 (LRFD), Ω_t = 1.67 (ASD)

     Design Stress = $0.9F_y$ (LRFD)   (4.2-1)

     Allowable Stress = $0.6F_y$ (ASD)   (4.2-**2**)

(b) Compression: ϕ_c = 0.90 (LRFD), Ω_c = 1.67 (ASD)

     Design Stress = $0.9F_{cr}$ (LRFD)   (4.2-3)

     Allowable Stress = $0.6F_{cr}$ (ASD)   (4.2-4)

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For members with

$$\frac{k\ell}{r} \leq 4.71\sqrt{\frac{E}{QF_y}}$$

$$F_{cr} = Q\left[0.658^{\left(\frac{QF_y}{F_e}\right)}\right]F_y \qquad (4.2\text{-}5)$$

For members with

$$\frac{k\ell}{r} > 4.71\sqrt{\frac{E}{QF_y}}$$

$$F_{cr} = 0.877F_e \qquad (4.2\text{-}6)$$

Where: F_e = Elastic buckling stress determined in accordance with Equation 4.2-7

$$F_e = \frac{\pi^2 E}{\left(\frac{k\ell}{r}\right)^2} \qquad (4.2\text{-}7)$$

In the above equations, ℓ is taken as the distance in inches (millimeters) between panel points for the chord members and the appropriate length for a compression or tension web member, and r is the corresponding least radius of gyration of the member or any component thereof. E is equal to 29,000 ksi (200,000 MPa).

For hot-rolled sections and cold formed angles, Q is the full reduction factor for slender compression members as defined in the AISC *Specification for Structural Steel Buildings* except that when the first primary compression web member is a crimped-end angle member, whether hot-rolled or cold formed:.

$$Q = [5.25/(w/t)] + t \leq 1.0 \qquad (4.2\text{-}8)$$

   Where: w = angle leg length, inches
            t = angle leg thickness, inches

   or,

$$Q = [5.25/(w/t)] + (t/25.4) \leq 1.0 \qquad (4.2\text{-}9)$$

   Where: w = angle leg length, millimeters
            t = angle leg thickness, millimeters

For all other cold-formed sections the method of calculating the nominal compression strength is given in the AISI, *North American Specification for the Design of Cold-Formed Steel Structural Members*.

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(c) Bending: ϕ_b = 0.90 (LRFD), Ω_b = 1.67 (ASD)

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

For chords and web members other than solid rounds: $F_n = F_y$

$$\text{Design Stress} = \phi_b F_n = 0.9F_y \text{ (LRFD)} \tag{4.2-10}$$

$$\text{Allowable Stress} = F_n/\Omega_b = 0.6F_y \text{ (ASD)} \tag{4.2-11}$$

For web members of solid round cross section: $F_n = 1.6 F_y$

$$\text{Design Stress} = \phi_b F_n = 1.45F_y \text{ (LRFD)} \tag{4.2-12}$$

$$\text{Allowable Stress} = F_n/\Omega_b = 0.95F_y \text{ (ASD)} \tag{4.2-13}$$

For bearing plates used in joist seats: $F_n = 1.5 F_y$

$$\text{Design Stress} = \phi_b F_n = 1.35F_y \text{ (LRFD)}$$
$$\tag{4.2-14}$$

$$\text{Allowable Stress} = F_n/\Omega_b = 0.90F_y \text{ (ASD)} \tag{4.2-15}$$

(d) Weld Strength:

Shear at throat of fillet welds, flare bevel groove welds, partial joint penetration groove welds, and plug/slot welds:

$$\text{Nominal Shear Stress} = F_{nw} = 0.6F_{exx} \tag{4.2-16}$$

LRFD: ϕ_w = 0.75

$$\text{Design Shear Strength} = \phi R_n = \phi_w F_{nw} A = 0.45F_{exx} A_w \tag{4.2-17}$$

ASD: Ω_w = 2.0

$$\text{Allowable Shear Strength} = R_n/\Omega_w = F_{nw}A/\Omega_w = 0.3F_{exx} A_w \tag{4.2-18}$$

Made with E70 series electrodes or F7XX-EXXX flux-electrode combinations F_{exx} = 70 ksi (483 MPa)

Made with E60 series electrodes or F6XX-EXXX flux-electrode combinations F_{exx} = 60 ksi (414 MPa)

A_w = effective throat area, where:

For fillet welds, A_w = effective throat area, (other design methods demonstrated to provide sufficient strength by testing shall be permitted to be used);

For flare bevel groove welds, the effective weld area is based on a weld throat width, T, where:

$$T \text{ (inches)} = 0.12D + 0.11 \tag{4.2-19}$$

Where: D = web diameter, inches

or,

$$T \text{ (mm)} = 0.12D + 2.8 \tag{4.2-20}$$

Where: D = web diameter, mm

For plug/slot welds, A_w = cross-sectional area of the hole or slot in the plane of the faying surface provided that the hole or slot meets the requirements of the American Institute of Steel Construction *Specification for Structural Steel Buildings* (and as described in SJI Technical Digest No. 8, "Welding of Open-Web Steel Joists and Joist Girders").

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Strength of resistance welds and complete-joint-penetration groove or butt welds in tension or compression (only when the stress is normal to the weld axis) is equal to the base metal strength:

$\phi_t = \phi_c = 0.90$ (LRFD) $\Omega_t = \Omega_c = 1.67$ (ASD)

Design Stress = $0.9F_y$ (LRFD)   (4.2-21)

Allowable Stress = $0.6F_y$ (ASD)   (4.2-22)

4.3 MAXIMUM SLENDERNESS RATIOS

The slenderness ratios, $1.0 \, \ell/r$ and $1.0 \, \ell_s/r$ of members as a whole or any component part shall not exceed the values given in Table 4.3-1, Parts A.

The effective slenderness ratio, $k\ell/r$ to be used in calculating the nominal stresses, F_{cr} and F'_e, is the largest value as determined from Table 4.3-1, Parts B and C.

In compression members when fillers or ties are used, they shall be spaced so that the ℓ_s/r_z ratio of each component does not exceed the governing ℓ/r ratio of the member as a whole. The terms used in Table 4.3-1 are defined as follows:

ℓ = length center-to-center of panel points, except ℓ = 36 inches (914 millimeters) for calculating ℓ/r_y of top chord member, in. (mm) or the appropriate length for a compression or tension web member, in. (mm).

ℓ_s = maximum length center-to-center between panel point and filler (tie), or between adjacent fillers (ties), in. (mm).

r_x = member radius of gyration in the plane of the joist, in. (mm).

r_y = member radius of gyration out of the plane of the joist, in. (mm).

r_z = least radius of gyration of a member component, in. (mm).

Compression web members are those web members subject to compressive axial loads under gravity loading.

Tension web members are those web members subject to tension axial loads under gravity loading, and which may be subject to compressive axial loads under alternate loading conditions, such as net uplift.

For top chords, the end panel(s) are the panels between the bearing seat and the first primary interior panel point comprised of at least two intersecting web members.

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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:

$$r_y \geq \ell_{br} \Big/ \left(124 + 0.67\, d_j + 28\, \frac{d_j}{L} \right) \text{ , in.} \tag{4.4-1a}$$

$$r_y \geq \ell_{br} \Big/ \left(124 + 0.026\, d_j + 0.34\, \frac{d_j}{L} \right) \text{ , mm} \tag{4.4-1b}$$

or,

$$r_y \geq \ell_{br} / 170 \tag{4.4-2}$$

Where:

d_j is the steel joist depth, in. (mm)

L is the design length for the joist, ft. (m)

r_y is the out-of-plane radius of gyration of the top chord, in. (mm)

ℓ_{br} 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 5.8(e) of these specifications.

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:

$$f_{au} + f_{bu} \leq 0.9 F_y \tag{4.4-3}$$

at the mid panel:

$$\text{for, } \frac{f_{au}}{\phi_c F_{cr}} \geq 0.2 \text{ ,}$$

$$\frac{f_{au}}{\phi_c F_{cr}} + \frac{8}{9} \left[\frac{C_m f_{bu}}{\left[1 - \left(\frac{f_{au}}{\phi_c F'_e} \right) \right] Q \phi_b F_y} \right] \leq 1.0 \tag{4.4-4}$$

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for, $\dfrac{f_{au}}{\phi_c F_{cr}} < 0.2$,

$$\left(\frac{f_{au}}{2\phi_c F_{cr}}\right) + \left[\frac{C_m f_{bu}}{\left[1 - \left(\dfrac{f_{au}}{\phi_c F'_e}\right)\right] Q \phi_b F_y}\right] \le 1.0 \tag{4.4-5}$$

f_{au} = P_u/A = Required compressive stress, ksi (MPa)

P_u = Required axial strength using LRFD load combinations, kips (N)

f_{bu} = M_u/S = Required bending stress at the location under consideration, ksi (MPa)

M_u = Required flexural strength using LRFD load combinations, kip-in. (N-mm)

S = Elastic Section Modulus, in.^{3} (mm^3)

F_{cr} = Nominal axial compressive stress in ksi (MPa) based on ℓ/r as defined in Section 4.2(b),

C_m = 1 - 0.3 $f_{au}/\phi F'_e$ for end panels

C_m = 1 - 0.4 $f_{au}/\phi F'_e$ for interior panels

F_y = Specified minimum yield strength, ksi (MPa)

F'_e = $\dfrac{\pi^2 E}{(K\ell/r_x)^2}$, ksi (MPa)

Where ℓ is the panel length, in inches (millimeters), as defined in Section 4.2(b) and r_x is the radius of gyration about the axis of bending.

Q = Form factor defined in Section 4.2(b)

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

For **ASD**:

at the panel point:

$$f_a + f_b \le 0.6 F_y \tag{4.4-6}$$

at the mid panel:

for, $\dfrac{f_a}{F_a} \ge 0.2$,

$$\frac{f_a}{F_a} + \frac{8}{9}\left[\frac{C_m f_b}{\left[1 - \left(\dfrac{1.67 f_a}{F'_e}\right)\right] Q F_b}\right] \le 1.0 \tag{4.4-7}$$

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for $\dfrac{f_a}{F_a} < 0.2$,

$$\left(\frac{f_a}{2F_a}\right) + \left[\frac{C_m f_b}{\left[1 - \left(\frac{1.67 f_a}{F'_e}\right)\right] Q F_b}\right] \leq 1.0 \tag{4.4-8}$$

f_a = P/A required compressive stress, ksi (MPa)

P = Required axial strength using ASD load combinations, kips (N)

f_b = M/S = required bending stress at the location under consideration, ksi (MPa)

M = Required flexural strength using ASD load combinations, k-in (N-mm)

F_a = Allowable axial compressive stress based on ℓ/r as defined in Section 4.2(b), ksi (MPa)

F_b = Allowable bending stress; $0.6F_y$, ksi (MPa)

C_m = 1 - 0.50 f_a/F'_e for end panels

C_m = 1 - 0.67 f_a/F'_e for interior panels

The top chord and bottom chord shall be designed such that at each joint:

$$f_{vmod} \leq \phi_v f_n \qquad\qquad \text{(LRFD, } \phi = 1.00\text{)} \tag{4.4-9}$$

$$f_{vmod} \leq f_n / \Omega_v \qquad\qquad \text{(ASD, } \Omega = 1.50\text{)} \tag{4.4-10}$$

Where:

f_n = nominal shear stress = $0.6F_y$, ksi (MPa)

f_t = axial stress = P/A, ksi (MPa)

f_v = shear stress = V/bt, ksi (MPa)

f_{vmod} = modified shear stress = $\left(\frac{1}{2}\right)\left(f_t^2 + 4f_v^2\right)^{1/2}$

b = length of vertical part(s) of cross section, in. (mm)

t = thickness of vertical part(s) of cross section, in. (mm)

It shall not be necessary to design the top chord and bottom chord for the modified shear stress when a round bar web member is continuous through a joint. The minimum required shear Section 4.4(b) (25 percent of the end reaction) shall not be required when evaluating Equation 4.4-9 or 4.4-10.

KCS Joist chords shall be designed for a flat positive bending moment envelope where the moment capacity is constant at all interior panels. The top chord end panel(s) is designed for an axial load based on the force in the first tension web resulting from the specified shear. A uniform load of 550 plf (8020 N/m) in ASD or 825 plf (12030 N/m) in LRFD shall be used to check bending in the end panel(s).

(b) Web

The vertical shears to be used in the design of the web members shall be determined from full uniform loading, but such vertical shears shall be not less than 25 percent of the end reaction. Due consideration shall be given to the effect of eccentricity. The effect of combined axial compression and bending shall be investigated using the provisions of Section 4.4(a), letting C_m = 0.4 when bending due to eccentricity produces reversed curvature.

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Interior vertical web members used in modified Warren type web systems shall be designed to resist the gravity loads supported by the member plus an additional axial load of ½ of 1.0 percent of the top chord axial force.

KCS Joist web forces shall be determined based on a flat shear envelope. All webs shall be designed for a vertical shear equal to the specified shear capacity. In addition, all webs shall be designed for 100 percent stress reversal except for the first tension web which will remain in tension under all simple span gravity loads.

(c) Joist Extensions

Joist extensions are defined as one of three types, top chord extensions (TCX), extended ends, or full depth cantilevers.

Design criteria for joist extensions shall be specified using one of the following methods:

(1)   A Top chord extension (TCX), extended end, or full depth cantilevered end shall be designed for the load from the Standard Load Tables based on the design length and designation of the specified joist. In the absence of other design information, the joist manufacturer shall design the joist extension for this loading as a default.

(2)   A loading diagram shall be provided for the top chord extension, extended end, or full depth cantilevered end. The diagram shall include the magnitude and location of the loads to be supported, as well as the appropriate load combinations.

(3)   Joist extensions shall be specified using extension designations found in the Top Chord Extension Load Table (S Type) for TCXs or the Top Chord Extension Load Table (R Type) for extended ends.

Any deflection requirements or limits due to the accompanying loads and load combinations on the joist extension shall be provided by the **specifying professional**, regardless of the method used to specify the extension. Unless otherwise specified, the joist manufacturer shall check the extension for the specified deflection limit under uniform live load acting simultaneously on both the joist base span and the extension.

The joist manufacturer shall consider the effects of joist extension loading on the base span of the joist. This includes carrying the design bending moment due to the loading on the extension into the top chord end panel(s), and the effect on the overall joist chord and web axial forces. In the case of a K-Series Standard Type 'R' Extended End or 'S' TCX, the design bending moment is defined as the tabulated extension section modulus (S) multiplied by the appropriate allowable (ASD) or design (LRFD) flexural stress.

Bracing of joist extensions shall be clearly indicated on the structural drawings.

4.5 CONNECTIONS

(a) Methods

Joist 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 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 mm) for welds oriented parallel to the principal stress.

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

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

(2) Welded Connections for Crimped-End Angle Web Members

The connection of each end of a crimped angle web member to each side of the chord shall consist of a weld group made of more than a single line of weld. The design weld length shall include, at minimum, an end return of two times the nominal weld size.

(3) 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 and Joist Girders.)

(4) Weld Inspection by Outside Agencies (See Section 5.12 of this specification)

The agency shall arrange for visual inspection to determine that welds meet the acceptance standards of Section 4.5(a)(1) above. Ultrasonic, X-Ray, and magnetic particle testing are inappropriate for joists due to the configurations of the components and welds.

(b) Strength

(1) <u>Joint Connections</u> - 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) <u>Shop Splices</u> - Shop splices shall be permitted to 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. All component parts comprising the cross section of the chord or web member (including reinforcing plates, rods, etc.) at the point of the splice, shall develop an ultimate tensile force of at least 1.2 times the product of the yield strength and the full design area of the chord or web. The "full design area" is the minimum required area such that the required stress will be less than the design (LRFD) or allowable (ASD) stress.

(c) Eccentricity

Members connected at a joint shall have their centroidal axes meet at a point whenever possible. Between joist ends where the eccentricity of a web member is less than 3/4 of the over-all dimension, measured in the plane of the web, of the largest member connected, the additional bending stress from this eccentricity shall be permitted to be neglected in the joist design. Otherwise, due consideration shall be given to the effect of eccentricity. The eccentricity of any web member shall be the perpendicular distance from the centroidal axis of that web member to the point on the centroidal axis of the chord which is vertically above or below the intersection of the centroidal axis of the web member(s) forming the joint. Joist ends shall be proportioned to resist bending produced by eccentricity at the support.

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4.6 CAMBER

Joists shall have approximate camber in accordance with the following:

TABLE 4.6-1

Top Chord Length		Approximate Camber	
20'-0″	(6096 mm)	1/4″	(6 mm)
30'-0″	(9144 mm)	3/8″	(10 mm)
40'-0″	(12192 mm)	5/8″	(16 mm)
50'-0″	(15240 mm)	1″	(25 mm)
60'-0″	(18288 mm)	1 1/2″	(38 mm)

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 SJI 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, 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.

(c) Tests of Joints and Connections

Each manufacturer shall, at the time of design review by the Steel Joist Institute, verify by shear tests on representative joints of typical joists that connections will meet the provision of Section 4.5(b). Chord and web members shall be permitted to be reinforced for such tests.

(d) In-Plant Inspections

Each manufacturer shall verify their ability to manufacture **K-**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 are not a guarantee of the quality of any specific joists; this responsibility lies fully and solely with the individual manufacturer.

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SECTION 5.
APPLICATION

5.1 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 loading as prescribed in Section 4.1, they shall be investigated and modified when necessary to limit the required stresses to those listed in Section 4.2.

When a rigid connection of the bottom chord is to be made to a column or other structural support, the joist is then no longer simply supported, and the system shall be investigated for continuous frame action by the **specifying professional**. The magnitude and location of all loads and forces 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 structural 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 other than the joist manufacturer.

> *For further reference, refer to Steel Joist Institute Technical Digest 11, "Design of Lateral Load Resisting Frames Using Steel Joists and Joist Girders."

5.2 SPAN

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

5.3 END SUPPORTS

(a) Masonry and Concrete

A **K**-Series Joist end supported by masonry or concrete shall bear 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 mm) over the masonry or concrete support unless it is deemed necessary to bear less than 4 inches (102 mm) over the support. Special consideration shall then be given to the design of the steel bearing plate and the masonry or concrete by the **specifying professional**. **K**-Series Joists shall be anchored to the steel bearing plate and shall bear a minimum of 2 1/2 inches (64 mm) on the plate.

The steel bearing plate shall be located not more than 1/2 inch (13 mm) from the face of the wall, otherwise special consideration shall then be given to the design of the steel bearing plate and the masonry or concrete by the **specifying professional**. When the **specifying professional** requires the joist reaction to occur at or near the centerline of the wall or other support, then a note shall be placed on the contract drawings specifying this requirement and the specified bearing seat depth shall be increased accordingly. If the joist reaction is to occur more than 2 1/2 inches (64 mm) from the face of the wall or other support, the minimum seat depth shall be 2 1/2 inches (64 mm) plus a dimension equal to the distance the joist reaction is to occur beyond 2 1/2 inches (64 mm).

The steel bearing plate shall not be less than 6 inches (152 mm) wide perpendicular 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.

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(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 **K**-Series Joists shall extend a distance of not less than 2 ½ 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. 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 (mm) 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 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 ℓ 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.

(c) Quantity and Spacing

Bridging shall be properly spaced and anchored to support the decking and the employees prior to the attachment of the deck to the top chord. The maximum spacing of lines of bridging, ℓ_{brmax} shall be the lesser of,

$$\ell_{brmax} = \left(124 + 0.67\,d_j + 28\frac{d_j}{L}\right)r_y \text{ , in.} \tag{5.4-1a}$$

$$\ell_{brmax} = \left(124 + 0.026\,d_j + 0.34\frac{d_j}{L}\right)r_y \text{ , mm} \tag{5.4-1b}$$

or,
$$\ell_{brmax} = 170\,r_y \tag{5.4-2}$$

Where:

d_j is the steel joist depth, in. (mm)

L is the Joist Span length, ft. (m)

r_y is the out-of-plane radius of gyration of the top chord, in. (mm)

The number of rows of top chord bridging shall not be less than as shown in Bridging Tables 5.4-1 and 5.4-2 and the spacing shall meet the requirements of Equations 5.4-1 and 5.4-2. The number of rows of bottom chord bridging, including bridging required per Section 5.11, 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 4.3 and any specified strength requirements.

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(d) Sizing of Bridging

Horizontal and diagonal bridging shall be capable of resisting the nominal unfactored horizontal compressive force, P_{br} given in Equation 5.4-3.

$$P_{br} = 0.0025 \, n \, A_t \, F_{construction} \text{ , lbs (N)} \tag{5.4-3}$$

Where:

$n = 8$ for horizontal bridging

$n = 2$ for diagonal bridging

A_t = cross sectional area of joist top chord, in.^{2} (mm^2)

$F_{construction}$ = assumed ultimate stress in top chord to resist construction loads

$$F_{construction} = \left(\frac{\pi^2 E}{\left(\frac{0.9 \, \ell_{brmax}}{r_y} \right)^2} \right) \geq 12.2 \, \text{ksi} \tag{5.4-4a}$$

$$F_{construction} = \left(\frac{\pi^2 E}{\left(\frac{0.9 \, \ell_{brmax}}{r_y} \right)^2} \right) \geq 84.1 \, \text{MPa} \tag{5.4-4b}$$

Where: E = Modulus of Elasticity of steel = 29,000 ksi (200,000 MPa) and $\dfrac{\ell_{brmax}}{r_y}$ is determined from

Equations 5.4-1a, 5.4-1b or 5.4-2

The bridging nominal unfactored horizontal compressive forces, P_{br} , are summarized in Table 5.4-3.

TABLE 5.4-3

*Section Number	Horizontal P$_{br}$ (n=8)		Diagonal P$_{br}$ (n=2)	
	lbs	(N)	lbs	(N)
#1 thru #8	340	(1512)	85	(378)
#9, #10	450	(2002)	113	(503)
#11, #12	560	(2491)	140	(623)
*Last digit(s) of joist designation shown in Load Table				

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(e) Connections

Attachments to the joist chords shall be made by welding or mechanical means and shall be capable of resisting the nominal (unfactored) horizontal force, P_{br}, of Equation 5.4-3, but not less 700 pounds (3114 N).

(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 cable(s) is released.

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 BEARING SEAT ATTACHMENTS

(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 mm) fillet welds 2 inches (51 mm) long, or with two 1/2 inch (13 mm) 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 mm) fillet welds 2 inches (51 mm) long, or with two 1/2 inch (13 mm) 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 shall be permitted to 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.

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(b) Thickness

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

(c) Centering

Centering for cast-in-place slabs shall be permitted to 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.

(e) Attachments

The spacing for slab or deck attachments along the joist top chord shall not exceed 36 inches (914 mm), and shall be capable of resisting a nominal (unfactored) lateral force of not less than 300 pounds (1335 N), i.e., 100 plf (1.46 kN/m).

(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(e).

(g) Joist With Standing Seam Roofing or Laterally Unbraced Top Chords

When the roof system does not provide lateral stability for the joists in accordance with Section 5.8 (e), (i.e. as may be the case with standing seam roofs or extended skylights and openings) sufficient stability shall be provided to brace the joists laterally under the full design load. The compression chord shall 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). In any case where the attachment requirement of Section 5.8(e) is not achieved, out-of-plane strength shall be achieved by adjusting the bridging spacing and/or increasing the compression chord area and the y-axis radius of gyration. The effective slenderness ratio in the y-direction equals $0.94 \, L/r_y$; where L is the bridging spacing in inches (millimeters). The maximum bridging spacing shall not exceed that specified in Section 5.4(c).

Horizontal bridging members attached to the compression chords and their anchorages shall be designed for a compressive axial force of $0.001nP + 0.004 \, P\sqrt{n} \geq 0.0025nP$, 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 compression chord shall be $0.01P$. 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.

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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.
            1/240 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.

5.10 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 the AISC Specification for Structural Steel Buildings.

5.11 UPLIFT

Where uplift forces due to wind are a design requirement, these forces shall 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 shall be considered in the design of joists and/or bridging. A single line of **bottom chord** bridging shall 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, he shall be permitted to reserve the right to do so in his "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 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.

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DEFINITION OF SPAN
(U. S. Customary Units)
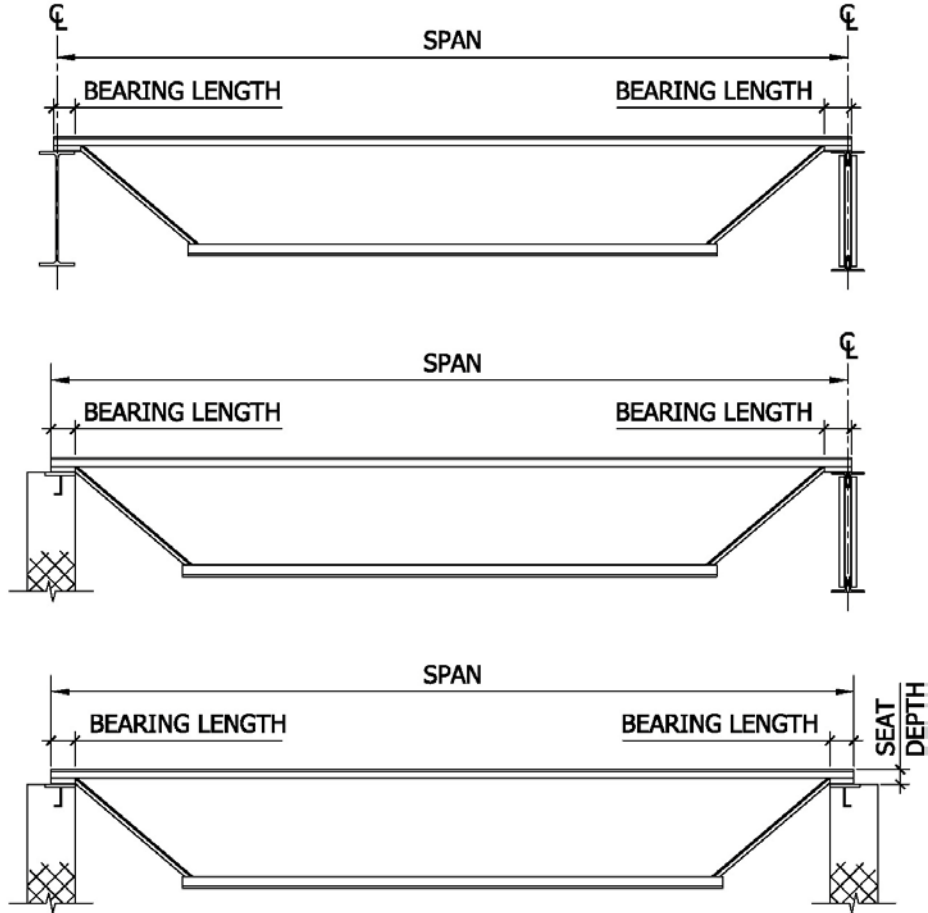
NOTES:
1) **DESIGN LENGTH = SPAN - 0.33 FT.**
2) **BEARING LENGTH FOR STEEL SUPPORTS SHALL NOT BE LESS THAN 2½ INCHES ; FOR MASONRY AND CONCRETE NOT LESS THAN 4 INCHES.**
3) **PARALLEL CHORD JOISTS INSTALLED TO A SLOPE GREATER THAN ½ INCH PER FOOT SHALL USE SPAN DEFINED BY THE LENGTH ALONG THE SLOPE.**
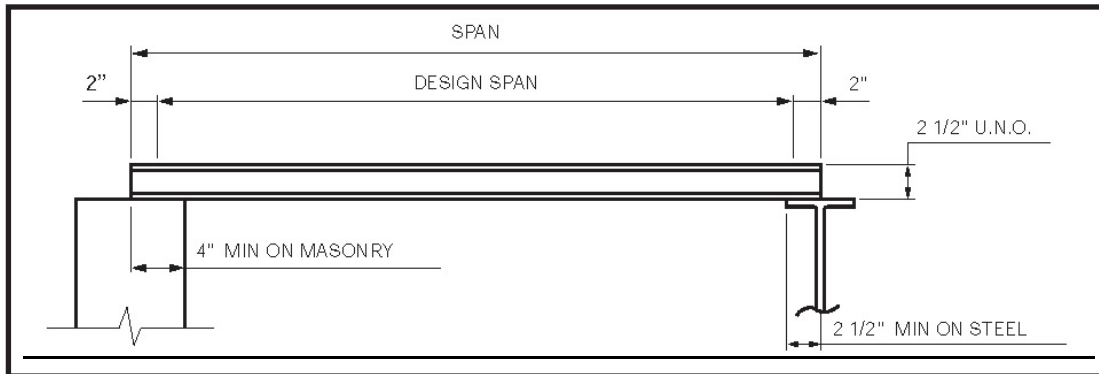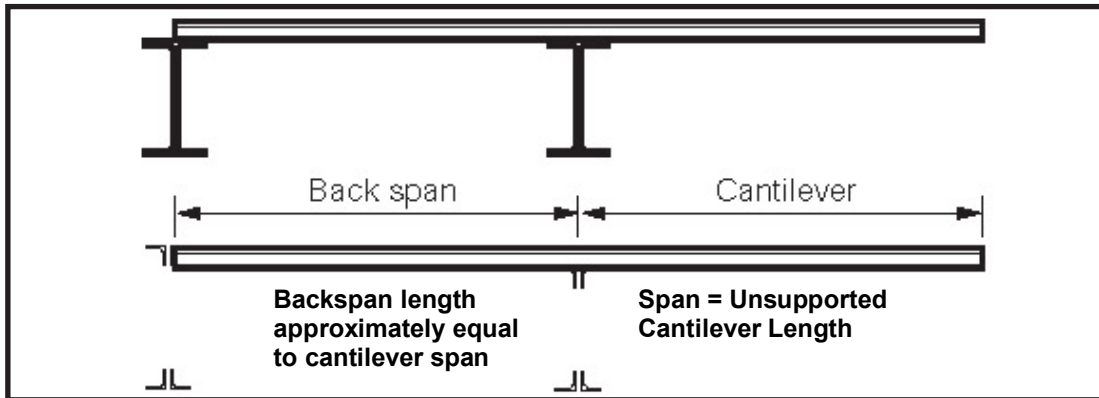
ACCESSORIES AND DETAILS

FABRICATION

- Depth   2.5 in
- Maximum Length   10 ft
- Minimum Length   3 ft
- Contact your local Vulcraft plant for sloped or pitched seat information.

2.5K JOIST SUBSTITUTE PROPERTIES

2.5K TYPE	2.5K1	2.5K2	2.5K3
S in^3	0.62	0.86	1.20
I in^4	0.77	1.07	1.50
Approximate weight (lbs/ft)	3.0	4.2	6.4

NOTE: 2.5K SERIES NOT U.L. APPROVED.

Backspan length approximately equal to cantilever span

Span = Unsupported Cantilever Length

NOTE: 2.5K SERIES NOT U.L. APPROVED.

LRFD

	LOAD TABLES FOR 2.5 INCH JOIST OUTRIGGERS, K-SERIES								
	TOTAL ALLOWABLE LOAD FOR UNSUPPORTED CANTILEVER PLF								
OUTRIGGER TYPE	SPAN ft-in								
	2'-0"	2'-6"	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"
2.5K1	825	744	516	379	291	229	186	153	129
2.5K2	825	825	717	526	403	318	258	213	179
2.5K3	825	825	825	735	562	444	360	297	250

ASD

	LOAD TABLES FOR 2.5 INCH JOIST OUTRIGGERS, K-SERIES								
	TOTAL ALLOWABLE LOAD FOR UNSUPPORTED CANTILEVER PLF								
OUTRIGGER TYPE	SPAN ft-in								
	2'-0"	2'-6"	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"
2.5K1	550	496	344	253	194	153	124	102	86
2.5K2	550	550	478	351	269	212	172	142	119
2.5K3	550	550	550	490	375	296	240	198	167

*Serviceability requirements must be checked by the specifying professional.

K SERIES OPEN WEB STEEL JOISTS
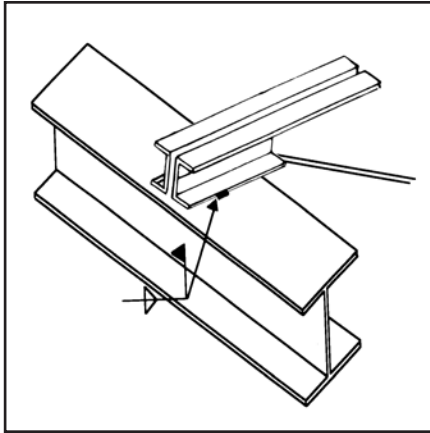
ANCHORAGE TO STEEL
SEE SJI SPECIFICATION 5.3 (b) AND 5.6
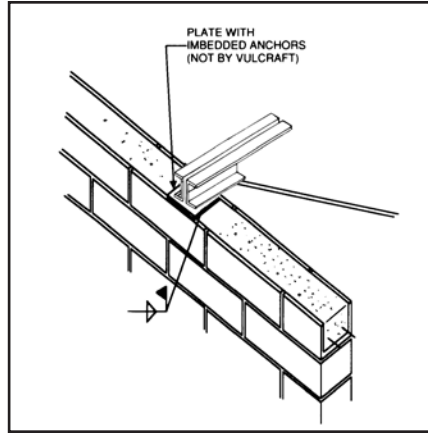
ANCHORAGE TO MASONARY
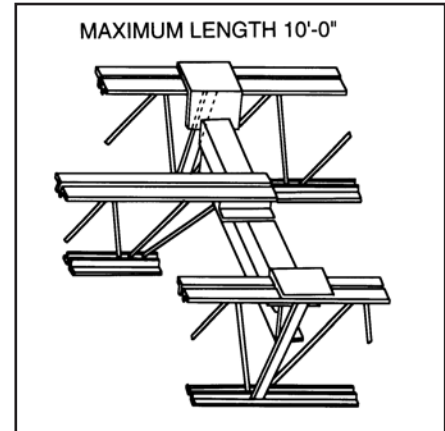SEE SJI SPECIFICATION 5.3 (a) AND 5.6
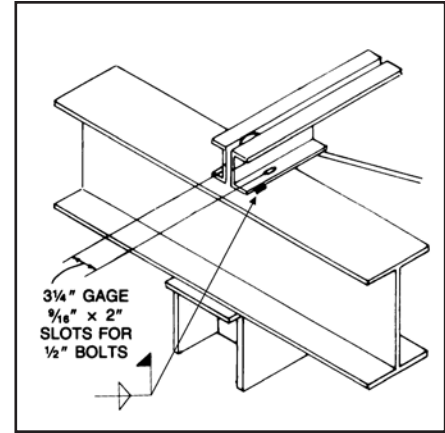
BOLTED CONNECTION*
TYPICALLY REQUIRED AT COLUMNS
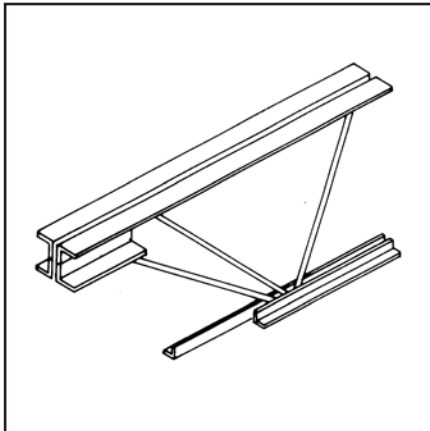
CEILING EXTENSION
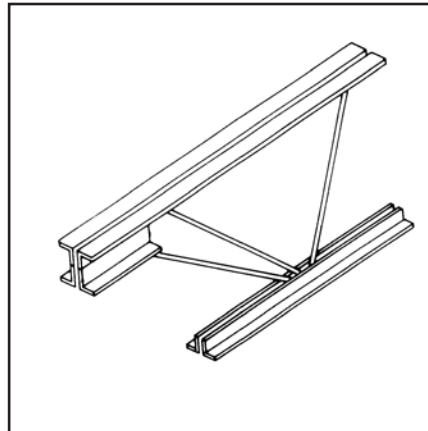
BOTTOM CHORD STRUT

HEADERS
Note: If header does not bear at a Joist Panel
Point add extra web in field as shown.
EW or Panel Point by Vulcraft

APPROXIMATE DUCT OPENING SIZES

JOIST DEPTH	ROUND	SQUARE	RECTANGLE
10 INCHES	5 INCHES	4 x 4 INCHES	3 x 7 INCHES
12 INCHES	7 INCHES	5 x 5 INCHES	3 X 8 INCHES
14 INCHES	8 INCHES	6 X 6 INCHES	5 X 9 INCHES
16 INCHES	8 INCHES	6 X 6 INCHES	5 X 9 INCHES
18 INCHES	9 INCHES	7 X 7 INCHES	5 X 9 INCHES
20 INCHES	10 INCHES	8 X 8 INCHES	6 X 11 INCHES
22 INCHES	10 INCHES	9 X 9 INCHES	7 X 11 INCHES
24 INCHES	12 INCHES	10 X 10 INCHES	7 X 13 INCHES
28 INCHES	15 INCHES*	12 X 12 INCHES*	9 X 18 INCHES*
28 INCHES	16 INCHES*	13 X 13 INCHES*	9 X 18 INCHES*
30 INCHES	17 INCHES*	14 X 14 INCHES*	10 X 18 INCHES*

SEE SJI SPECIFICATION - SECTION 6.
FOR HANDLING AND ERECTION OF
K-SERIES OPEN WEB STEEL JOISTS AND
SJI TECHNICAL DIGEST NO. 9.

SPECIFYING PROFESSIONAL <u>MUST</u> INDICATE ON <u>STRUCTURAL</u> DRAWINGS SIZE AND LOCATION OF ANY DUCT THAT IS TO PASS THRU JOIST. THIS DOES NOT INCLUDE ANY FIREPROOFING ATTACHED TO JOIST. FOR DEEPER LH- AND DLH- SERIES JOISTS, CONSULT MANUFACTURER.

*FOR ROD WEB CONFIGURATION, THESE WILL BE REDUCED. CONSULT MANUFACTURER.
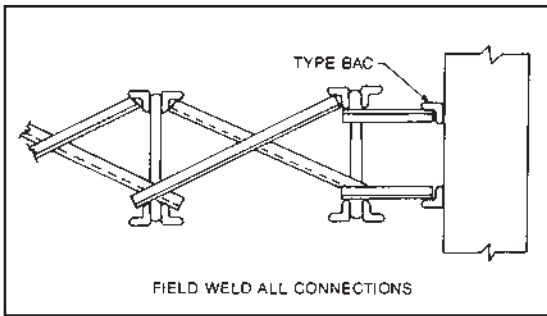
K SERIES OPEN WEB STEEL JOISTS
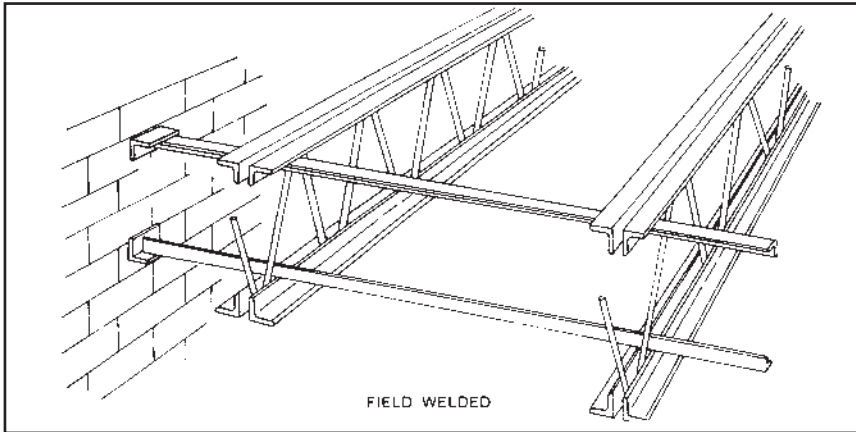
HORIZONTAL BRIDGING
SEE SJI SPECIFICATION 5.5 AND 6.

NOTE: DO NOT WELD BRIDGING TO JOIST WEB MEMBERS.
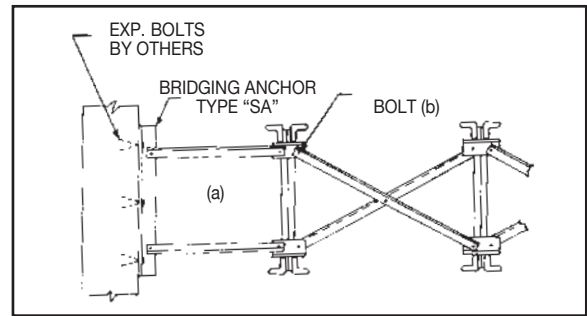DO NOT HANG ANY MECHANICAL, ELECTRICAL, ETC. FROM BRIDGING.
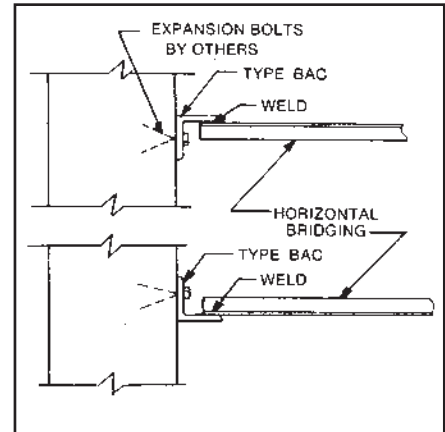
BRIDGING ANCHORS
SEE SJI SPECIFICATION 5.5 AND 6.


WELDED CROSS BRIDGING
SEE SJI SPECIFICATION 5.5 AND 6.
HORIZONTAL BRIDGING SHALL BE USED IN SPACE
ADJACENT TO THE WALL TO ALLOW FOR PROPER
DEFLECTION OF THE JOIST NEAREST THE WALL.

BOLTED CROSS BRIDGING
SEE SJI SPECIFICATION 5.5 AND 6.

(a) Horizontal Bridging units shall be used in the space adjacent to the wall to allow for proper deflection of the joist nearest the wall.

(b) For required bolt size refer to bridging table on page 184. NOTE: Clip configuration may vary from that shown.
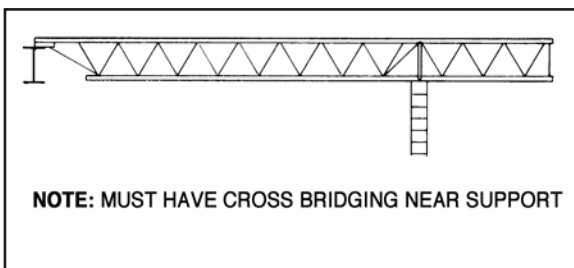
FULL DEPTH CANTILEVER END
SEE SJI SPECIFICATION 5.4 (d) AND 5.5 FOR BRIDGING
REQUIREMENTS.
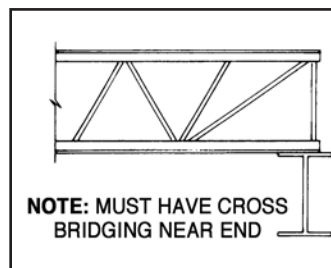
SQUARE END
SEE SJI SPECIFICATION 5.4
(d) AND 5.5 FOR BRIDGING
REQUIREMENTS.
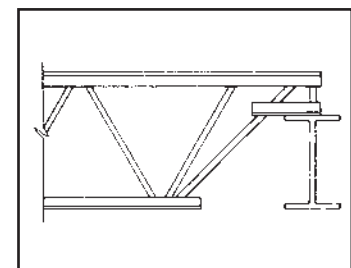

DEEP BEARINGS
CONFIGURATION MAY VARY

STANDARD TYPES

Longspan steel joists can be furnished with either underslung or square ends, with parallel chords or with single or double pitched top chords to provide sufficient slope for roof drainage.

The Longspan joist designation is determined by its nominal depth at the center of the span, except for offset double pitched joists, where the depth should be given at the ridge. A part of the designation should be either the section number or the total design load over the design live load (TL/LL given in plf).

All pitched joists will be cambered in addition to the pitch unless specified otherwise.
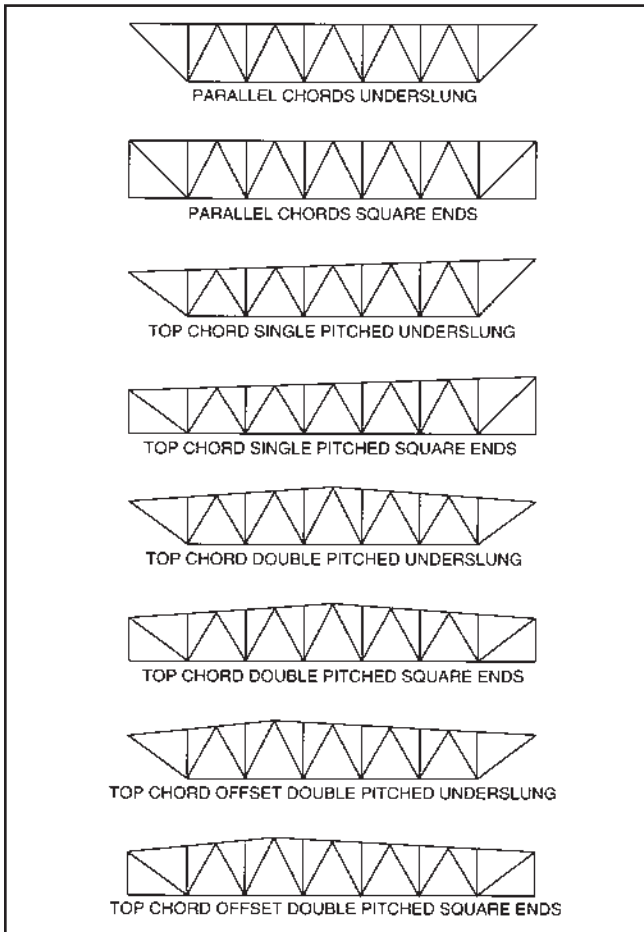
CAMBER

Non-Standard Types: The design professional shall provide on the structural drawings the amount of camber desired in inches. If camber is not specified, Vulcraft will use the camber values for LH and DLH joists based on top chord length or possibly no camber for certain scissor, arched, bowstring, or gable profiles.

Standard Types: The camber listed in the table will be fabricated into the joists unless the design professional specifically states otherwise on the structural drawings.

NON-STANDARD TYPES

The following joists can also be supplied by Vulcraft, however, **THE DISTRICT SALES OFFICE OR MANUFACTURING FACILITY NEAREST YOU SHOULD BE CONTACTED FOR ANY LIMITATIONS IN DEPTH OR LENGTH.**
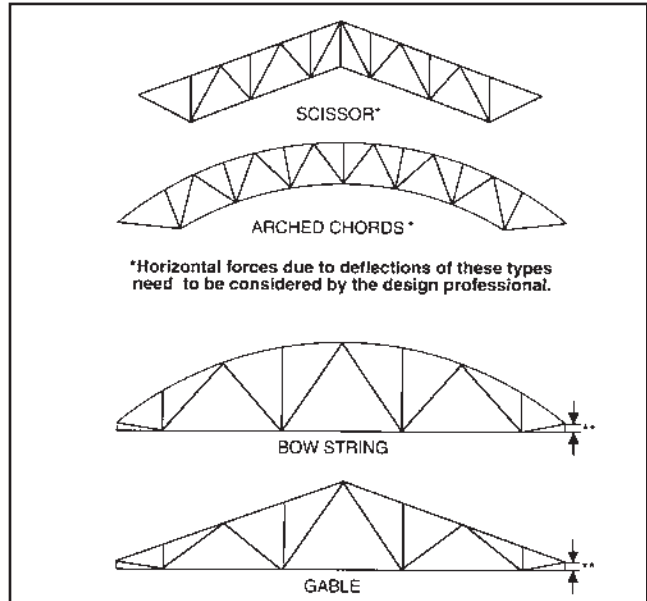

**Contact Vulcraft for minimum depth at ends.

CAMBER FOR STANDARD TYPES

LH &DLH series joists shall have camber in accordance with the following table:***

Top Chord Length	Approximate Camber
20'-0"	1/4"
30'-0"	3/8"
40'-0"	5/8"
50'-0"	1"
60'-0"	1 1/2"
70'-0"	2"
80'-0"	2 3/4"
90'-0"	3 1/2"
100'-0"	4 1/4"

** NOTE: If full camber is not desired near walls or other structural members please note on the structural drawings. For joist lengths exceeding 100'-0" a camber equal to Span/300 shall be used. The specifying professional shall give consideration to coordinating joist camber with adjacent framing.
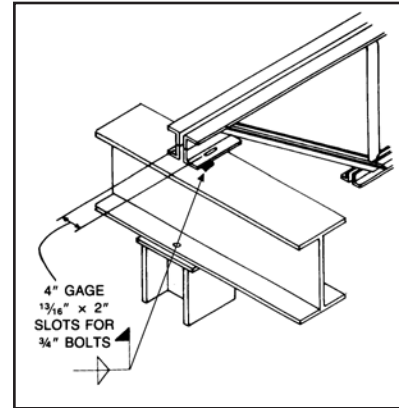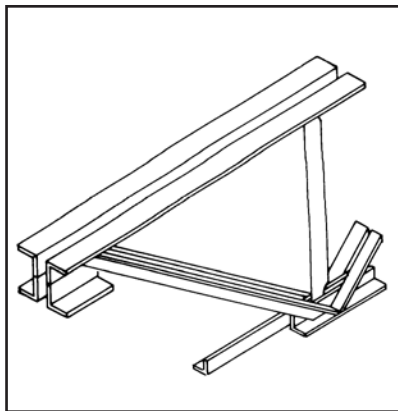
LH & DLH SERIES LONGSPAN STEEL JOISTS
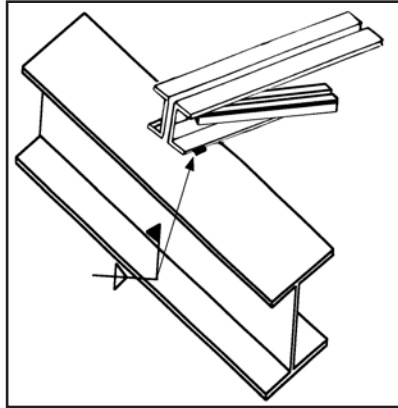
ANCHORAGE TO STEEL
SEE SJI SPECIFICATION
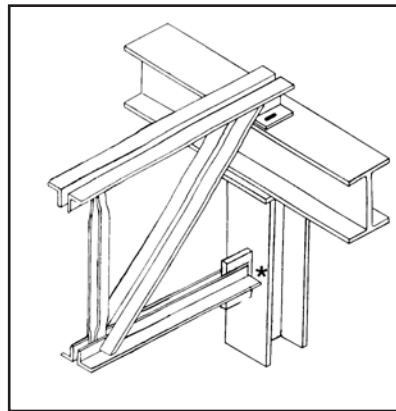104.4 (b) AND 104.7 (b)
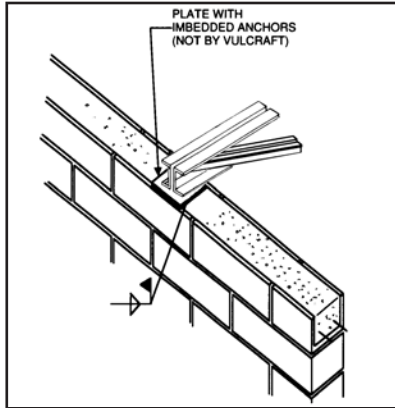
ANCHORAGE TO MASONRY
SEE SJI SPECIFICATION
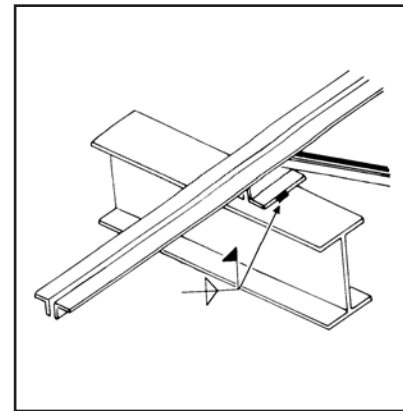104.4 (a) AND 104.7 (a)

BOLTED CONNECTION
See Note (c)
Typically required at columns

CEILING EXTENSION

BOTTOM CHORD EXTENSION
*If bottom chord extension is to be bolted
or welded the specifiying professional must
provide axial loads on structural drawings.

TOP CHORD EXTENSION
See Note (a)

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

(b) See SJI Specification - Section 105 for Handling
and Erection of LH and DLH joists.

(c) The Occupational Safety and Health Administration
Standards (OSHA), Paragraph 1910.12 refers to
Paragraph 1518.751 of "Construction Standards"
which states:
"In steel framing, where bar joists are utilized, and
columns are not framed in at least two directions
with structural steel members, a bar joist shall be
field-bolted at columns to provide lateral stability
during construction."

NOTE: Configurations may vary from
that shown.
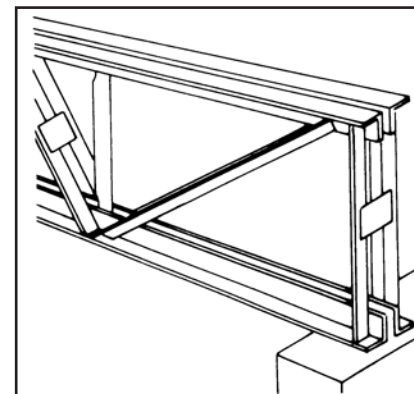
SQUARE END
See SJI Specification 104.5 (f).
Cross bridging required near the
end of bottom bearing joist.

VULCRAFT LH & DLH SERIES / GENERAL INFORMATION

HIGH STRENGTH

ECONOMICAL

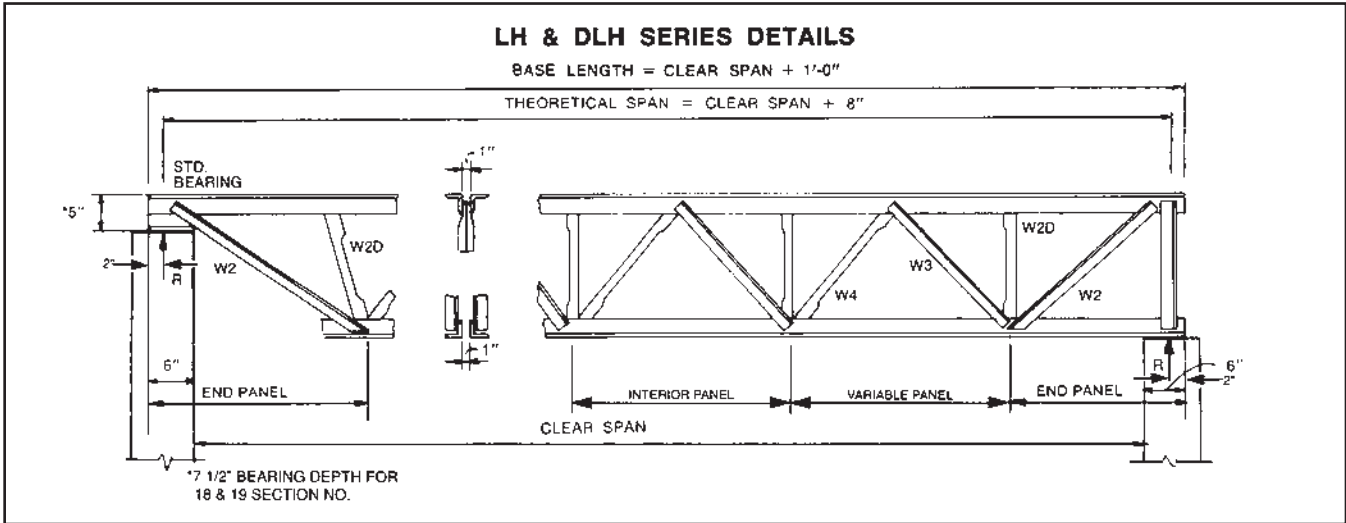**DESIGN** – Vulcraft LH & DLH Series long span steel joists are designed in accordance with the specifications of the Steel Joist Institute.

ACCESSORIES see page 69.

ROOF SPANS TO 144'-0

FLOOR SPANS TO 120'-0

PAINT – Vulcraft joists receive a shop-coat of rust inhibitive primer whose performance characteristics conform to those of the Steel Joist Institute specification 102.4.
SPECIFICATIONS see page 76.

LH & DLH SERIES DETAILS
BASE LENGTH = CLEAR SPAN + 1'-0"
THEORETICAL SPAN = CLEAR SPAN + 8"

K, LH, and DLH SERIES JOISTS MAXIMUM JOIST SPACING FOR DIAGONAL BRIDGING								
	BRIDGING ANGLE SIZE – (EQUAL LEG ANGLE)							
JOIST DEPTH	1 x 7/64 r = 0.20"	1-1/4 x 7/64 r = 0.25"	1-1/2 x 7/64 r = 0.30"	1-3/4 x 7/64 r = 0.35"	2 x 1/8 r = 0.40"	2 ½ x 5/32 r = 0.50"	3 x 3/16 r = 0.60"	3 ½ x 1/4 r = 0.70"
in.	ft.- in.	ft.- in.	ft.- in.	ft.- in.	ft.- in.	ft.- in.	ft.- in.	ft.- in.
32"	6'-1"	7'-10"	9'-7"	11'-4"	13'-0"	16'-5"	19'-9"	23'-2"
36"	5'-11"	7'-9"	9'-6"	11'-3"	12'-11"	16'-4"	19'-9"	23'-1"
40"	5'-9"	7'-7"	9'-5"	11'-2"	12'-10"	16'-4"	19'-8"	23'-1"
44"	5'-6"	7'-5"	9'-3"	11'-0"	12'-9"	16'-3"	19'-7"	23'-0"
48"	5'-4"	7'-3"	9'-2"	10'-11"	12'-8"	16'-2"	19'-7"	22'-11"
52"	5'-0"	7'-1"	9'-0"	10'-10"	12'-7"	16'-1"	19'-6"	22'-11"
56"	4'-9"	6'-10"	8'-10"	10'-8"	12'-5"	16'-0"	19'-5"	22'-10"
60"	4'-4"	6'-8"	8'-7"	10'-6"	12'-4"	15'-10"	19'-4"	22'-9"
64"	**	6'-4"	8 -5"	10'-4"	12'-2"	15'-9"	19'-3"	22'-8"
68"	**	6'-1"	8'-2"	10'-2"	12'-0"	15'-8"	19'-2"	22'-7"
72"	**	5'-9"	8'-0"	10'-0"	11'-10"	15'-6"	19'-1"	22'-6"
80"	**	5'-0"	7'-5"	9'-6"	11'-6"	15'-3"	18'-10"	22'-4"
88"		**	6'-9"	9'-0"	11'-1"	14'-11"	18'-7"	22'-1"
96"		**	6'-0"	8'-5"	10'-8"	14'-7"	18'-4"	21'-11"
104"			**	7'-9"	10'-1"	14'-2"	18'-0"	21'-8"
112"			**	7'-0"	9'-6"	13'-9"	17'-8"	21'-4"
120"				**	8'-9"	13'-4"	17'-3"	21'-1"

**INTERPOLATION BELOW THE MINIMUM VALUES SHOWN IS NOT ALLOWED.
SEE TABLE 2.7-3 FOR MINIMUM JOIST SPACE FOR DIAGONAL ONLY BRIDGING.

NOTES: 1. Special designed LH and DLH can be supplied in longer lengths as required.

2. Additional bridging may be required when joists support standing seam roof decks. The specifying professional should require that the joist manufacturer check the system and provide bridging as required to adequately brace the joists against lateral movement. For bridging requirements due to uplift pressures refer to sect. 104.12.