

JOIST DESIGN INFORMATION

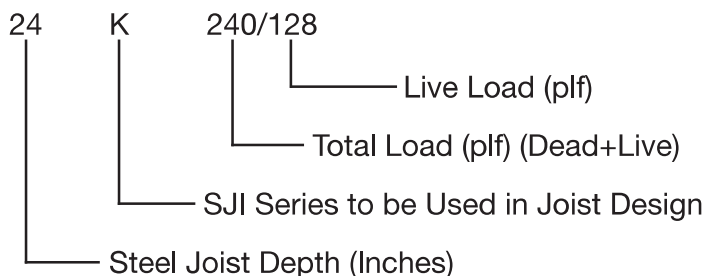
Standard Steel Joist Institute open web steel joists are designed for simple span uniform loads which result in a linearly sloped shear diagram for web forces and a parabolic moment diagram for chord forces. Projects often require that the open web joist support loads that are non-uniform or concentrated loads which alter the shape of the shear and moment diagrams. When specifying joists for these loads, the specifying professional should first attempt to specify a larger standard joist or possibly a KCS series joist (K-series Constant Shear). The interior webs for KCS joists are designed for 100% stress reversal and the chords are designed for a flat positive bending moment. The specified joist must have adequate moment and shear resistance throughout the entire length of the joist. To aid the specifying professional, Vulcraft has developed a free [Joist Analysis Aid](#) available at www.vulcraft.com. The SJI Code of Standard Practice [Section 2.4](#) provides several options for Specifying Joist Design Loads.

When it becomes unrealistic to select a standard joist to support all the applied loads, Vulcraft will design the open web joists for the loads selected by the specifying professional ([Option 5](#) in the SJI Code of Standard Practice Section 2.4). When choosing this option, it is crucial that the joist design loads be clearly presented with load diagrams or joist schedules so that Vulcraft can estimate and design the joists for the project. [Examples](#) of open web joist load diagrams are provided in the SJI Code of Standard Practice. To avoid confusion when using load diagrams, the specifier should avoid indicating web members. This allows Vulcraft to choose an efficient web configuration for the open web joist considering manufacturing efficiency and load carrying capability without questioning the intent of the indicated web members.

Load Combinations

For projects that have wind or seismic loads, it is important that Vulcraft be given the dead load and live load to properly design the open web joist for the building code required load combinations. The traditional SJI joist designation (i.e. 24K4) does not provide this information. The SJI joist designation specifies the total allowable uniform load for a given span and the uniform load which will cause a deflection of L/360 for that span. This does not provide Vulcraft with the actual load breakdown necessary for the required building code combinations.

As an alternative to the specification of SJI joist designations, it is possible to specify joists using the uniform load per foot designation. This designation follows the format show here:

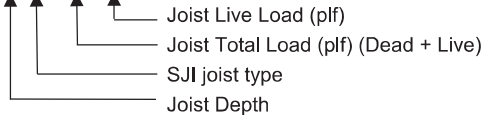


As can be seen, this designation clearly provides the breakdown necessary for the proper application of the building code required load combinations. In addition, for LH and DLH joists it allows specification of depths not included in the standard load tables. The total load / live load format can also be used for specification of panel point loads on Joist Girders and for the specification of concentrated loads applied to the joists.

The Open Web Joist / Joist Girder table on the following page gives examples of communicating the joist design information using either of the methods described above.

JOIST SCHEDULE ⁽²⁾⁽³⁾⁽⁴⁾					
Joist Mark Number	Designation ⁽¹⁾ (Total Load/ Live Load)	Axial Load ⁽⁵⁾		Add-Load (kips)	Comments
		Wind Load 1.0W (kips)	Seismic Load 1.0E (kips)		
J1	20K 288/160	10.5	23.0	1.0	Office
J2	32LH 224/128	10.5	23.0	0.5	

(1) 26LH 245/135 (values noted at left are to define callout)



(2) Deflection Criteria: Live Load Deflection $\leq L/240$.

(3) See Net Wind Uplift Diagram for uplift loads on joists.

(4) See framing plan for additional loads to be included in joist design, including mechanical loads.

(5) Top chord axial load, Tension or Compression Load.

JOIST SCHEDULE						
Joist Mark Number	Designation ⁽¹⁾	Loads for Combined Bending and Axial Check ⁽²⁾				
		Wind Top Chord Axial Load 0.6W	Dead Load	Roof Live Load L_r	Downward Wind load 0.6W	Net Wind Uplift load ⁽³⁾
J1	30K7	20.0 kips	44 plf	63 plf	32 plf	150 plf

(1) Standard designation is minimum requirement. Joist Manufacturer to modify joist design as required for combined loading requirements.

(2) Joist manufacturer to use these load in the applicable code load combinations to design the joist for combined bending and axial.

(3) Net Wind Uplift is the result of the 0.6D+0.6W load combination.

JOIST SCHEDULE ⁽¹⁾⁽²⁾ - PART 1							
Joist Mark Number	Joist Depth & Series	Uniform Loads				Axial Load ⁽⁴⁾	
		Dead Load (plf)	Roof Live Load L_r (plf)	Downward Wind load 0.6W (plf)	Net Wind Uplift load (plf) ⁽³⁾	Wind Axial Load 0.6W (kips)	Seismic Axial Load 0.7E (kips)
J1	24LH	63	50	32	150	14.4	17.5

JOIST SCHEDULE ⁽¹⁾⁽²⁾ - PART 2							
End Moments ⁽⁶⁾						Min. Moment of Inertia I_j (in ⁴)	Addload (kips) ⁽⁵⁾
Live Load Continuity Moment L_r (kip-ft)		Wind Moment 0.6W (kip-ft)		Seismic Moment 0.7E (kip-ft)			
Left	Right	Left	Right	Left	Right		
6.7	6.7	± 22.0	∓ 22.0	± 27.5	∓ 27.5	216	0.5

(1) Joist manufacturer to use these loads in the applicable code load combinations.

(2) Deflection Criteria: Live Load Deflection $\leq L/240$.

(3) Net Wind Uplift is the result of the 0.6D+0.6W load combination.

(4) Top chord axial load, Tension or Compression Load.

(5) Addload is to be treated as a Dead Load "D" for load combinations.

(6) End Moment Sign Convention, Positive moments:

(Note: schedule was split into 2 parts just to fit onto page. Schedule on plans should be one table)

JOIST DESIGN INFORMATION

Wind Uplift

Net Uplift

It is the responsibility of the specifying professional to determine the net uplift required for joist and Joist Girder design (Reference [SJI Specification 5.12](#), [SJI Code of Standard Practice Section 2.10](#) and SJI Technical Digest 6, “Structural Design of Steel Joists to Resist Uplift Loads”). While it may appear as an easy calculation, it is up to the specifying professional to determine the amount of dead load available to resist wind uplift loading. As an example, a project has a 26 psf dead load for joist design that includes 10 psf collateral load for future equipment. Because the collateral load may not actual be present on all joists, the design professional may determine that it is appropriate to only use a dead load = 26.0 psf - 10 psf = 16 psf in the load combinations with wind uplift loading. When specifying wind uplift loads on the structural plans, if the gross wind uplift load is specified, the specifying professional needs to also call out the dead load D to be used in the load combinations with wind uplift.

Net Uplift on ‘K’ Series Joist

Typically, the end web of ‘K’ series joists is a round bar which allows Vulcraft to manufacture these joists with 2 ½” deep bearing seats while maintaining the proper working point for the intersection of the end web and top chord. When net uplift is a design consideration the end web (a tension member under gravity loads) becomes a compression member. These round bars have limited capacity to resist compression and it may become necessary to use double angles. Should this occur it is no longer possible to fit the end webs and the bearing seats into the 2 ½” bearing depth and maintain the correct working point. The table below indicates net uplift reactions that can be reasonably expected to work with the standard 2 ½” bearing depth. If the net uplift reaction exceeds the values shown in this table, 5” bearing depths (like ‘LH’ series joists) will be required to accommodate the double angle end webs.

Joist Depth (in)	Net Uplift Unfactored Reaction (kips)
10	3.3
12	3.3
14	2.8
16	7.4
18	6.6
20	5.7
22	4.6
24	3.9
26	4.2
28	3.6
30	3.2

End Anchorage for Uplift

Chapter 5 of SJI Technical Digest 6, “Structural Design of Steel Joists to Resist Uplift Loads” provides the following guidance for end anchorage of steel joists due to uplift forces:

Welded Anchorage

The strength of the joist bearing seat for an uplift combination is a function of both the joist seat thickness and the length of the end anchorage welds. The minimum anchorage welds from the SJI Specifications may not develop the full capacity of the joist seat assembly for the specified uplift resistance. Where appropriate, a longer end anchorage weld length aids Vulcraft in providing an economical design of the joist bearing seat. Vulcraft will provide a seat of sufficient thickness and strength to resist the specified uplift end reaction.

Bolted Anchorage

Typically, joists and Joist Girders with bolted end anchorage also require a final connection by welding in order to provide lateral stability to the supporting member. However, only the bolts are relied on to provide uplift anchorage. The bolt type and diameter designated by the specifying professional shall provide sufficient tensile strength to resist the specified uplift end reaction. Higher strength bolts than the minimums required by the SJI specification may be required.

If the bearing seats are detailed for a bolted connection, bolts must be installed. If the bolts are not installed an equivalent welded connection may be permitted by the specifying professional, provided that the weld is deposited in the slot on the side farthest from the edge of the seat. Additional weld required to meet that specified for the welded connection shall be placed at a location on the seat away from the outer edge of the slot as shown in Figure 5.1.

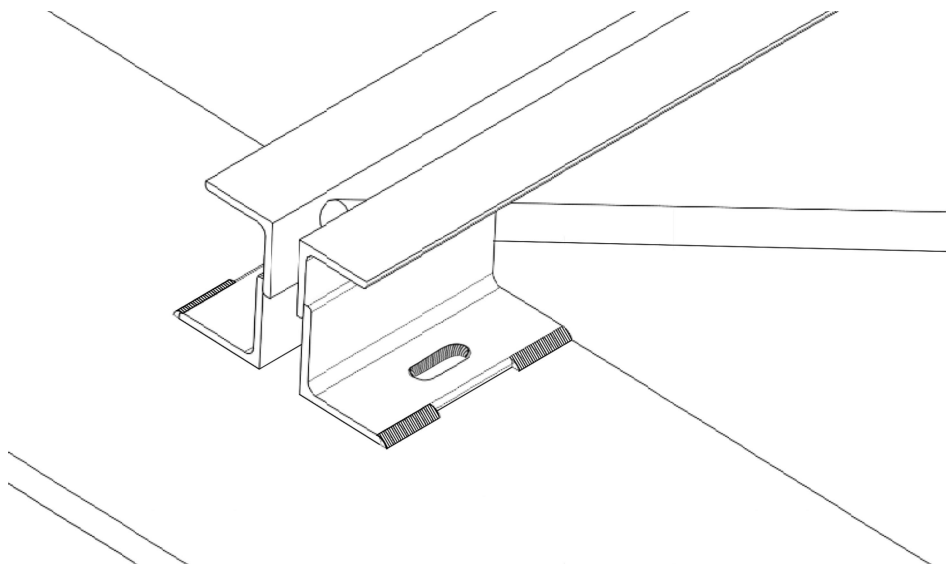


Figure 5.1 Detail for welding bearing seats detailed for a bolted connection

JOIST DESIGN INFORMATION

Bridging Requirements for Net Uplift

[SJI Specification 5.12](#) requires where net uplift is a design requirement that a single line of bottom chord bridging shall be provided near the first bottom chord panel points. On Joist Girders, if the ends are not strutted and extended to the column stabilizer plates, bracing shall be provided near the first bottom chord panel points. It should also be noted that per [SJI Specification 5.5.3.2](#) that the bottom chord bridging is permitted to be spaced independently of the row of top chord bridging. In simplified terms, this indicates that bridging need not align from top chord to bottom chord of the joist as shown below.

