Steel Joists, Joist Girders and Steel Deck

Roof Design
using
Steel Joists and Joist Girders

Presented by NUCOR/Vulcraft
with
Contributions by the Steel Joist Institute and the Steel Deck Institute

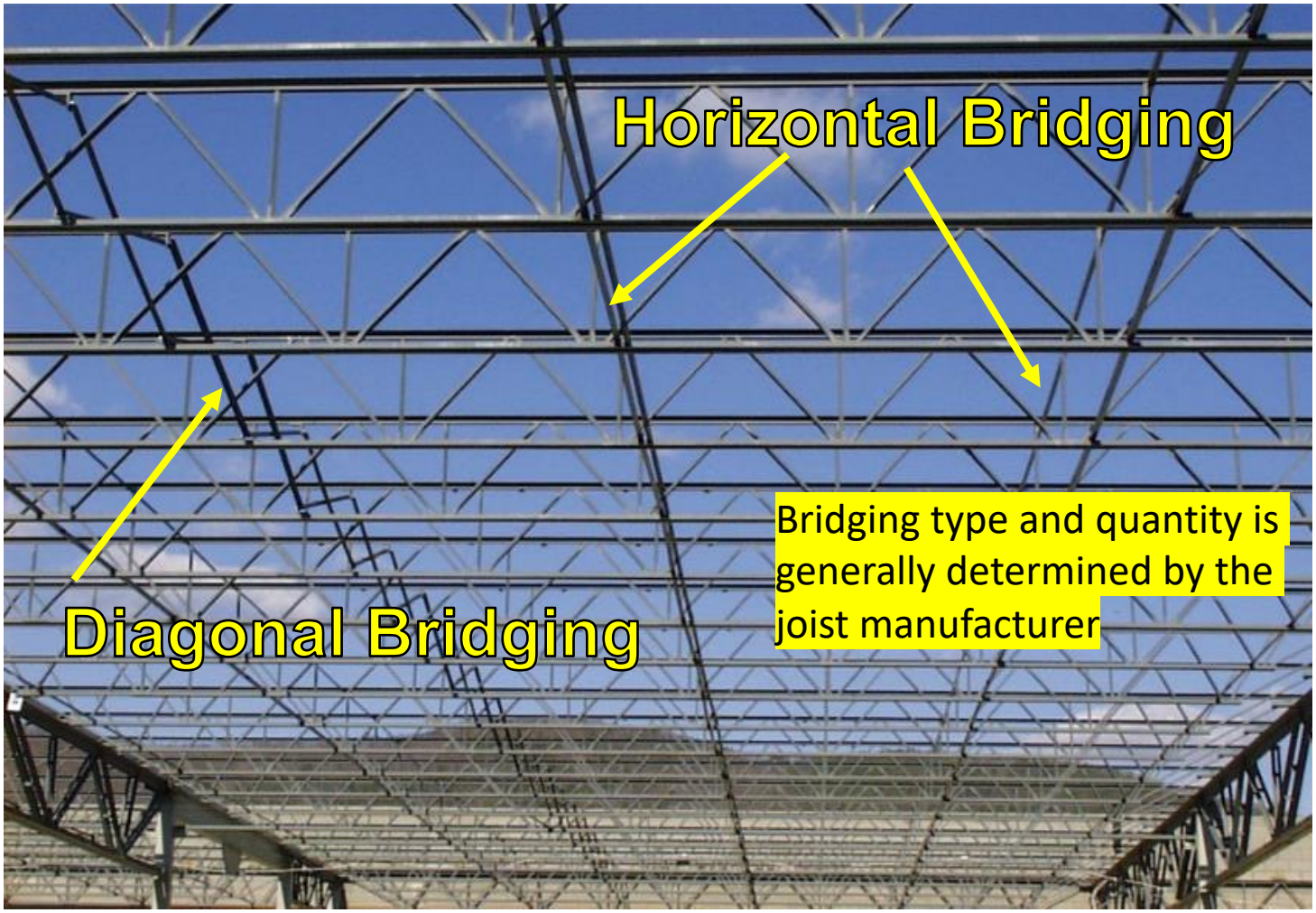
Topics

- Advantages of using Open Web Steel Joists
- Joist Basics and Components
- Glossary of Terms
- Understanding Standard Products and Specifying
  - K-Series Joists
  - KCS Joists
  - LH- and DLH-Series Joists
  - Joist Girders

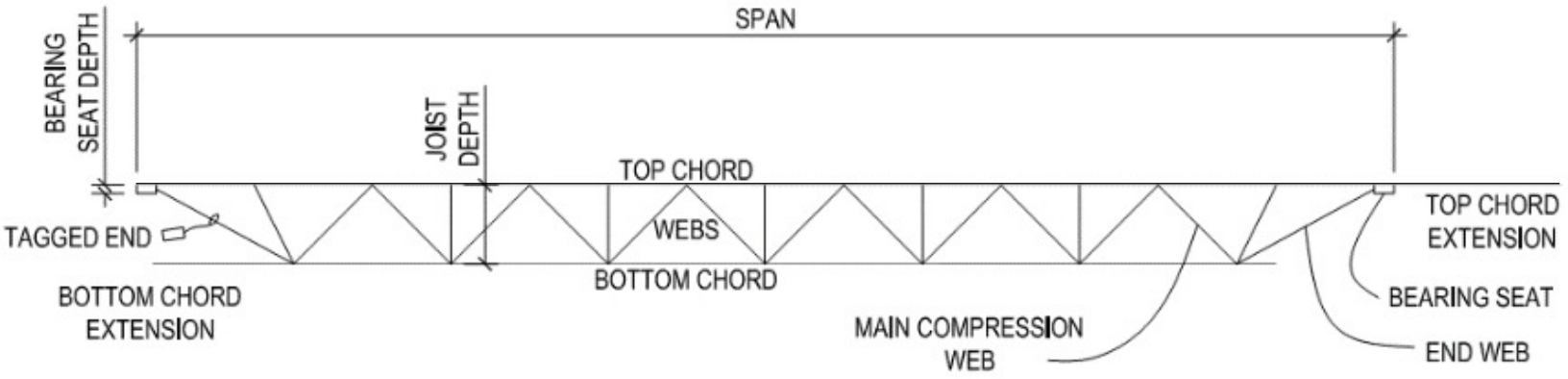
Joist Basics

Joist Basics

Add slides on selection of bridging



Joist Glossary of Terms



Components of Joists

- Chords are typically hot rolled or cold formed double angles
- Web members can be rods, crimped angles and double angles

Rod Webs

Crimped Angle Webs

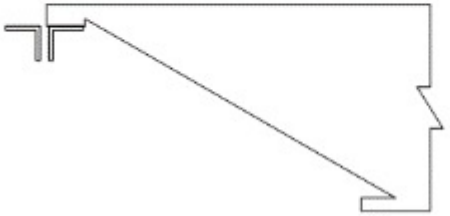
Double Angle Webs

Top Chord Extensions and Extended Ends

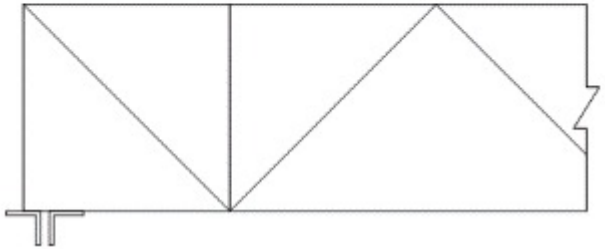
- Top Chord (S Extensions)
- Joist End (R Extensions)
- Special Seat Depth Extensions

Bearing Condition

UNDERSLUNG



BOTTOM CHORD BEARING



Standard Products and Specifying

- K-Series and KCS Joists and other related accessories
- LH-Series and DLH-Series Joists
- Joist Girders
- Properly Specifying Steel Joists and Joist Girders

K-Series Joists

- Most Common Joist for Roof Construction
- Designations: 10K1 to 30K12
- Depths: 10 to 30 in.
- Standard Seat Depth (Height): 2.5 in.
- Span Range: 10 to 60 ft.
- ASD Load Range: 127 to 550 plf
- LRFD Load Range: 190 to 825 plf

KCS Joists

- Often used for non-uniform loads (snow drift and roof equipment)
- CS stands for Constant Shear
- Constant Moment Capacity
- Maximum uniform load = 550 plf (ASD) 825 plf (LRFD)
- Depths: 10 to 30 in.
- Seat Depth (Height): 2.5 in.
- Span Range: 10 to 60 ft.
- Designations: 10KCS1 to 30KCS5

KCS Joists

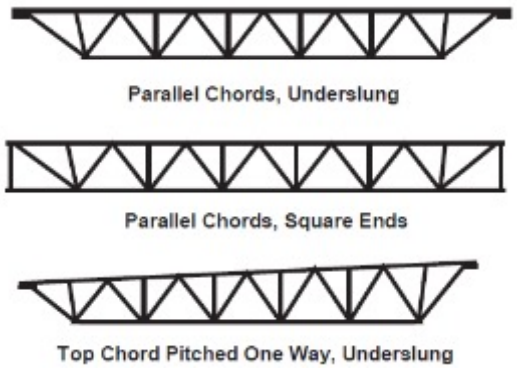
- Designations: 10KCS1 to 30KCS5
- Depths: 10 to 30 in.
- Seat Depth (Height): 2.5 in.
- Span Range: 10 to 60 ft.
- Constant Moment Capacity
- Constant Shear Capacity
- Maximum Span/Depth: 24

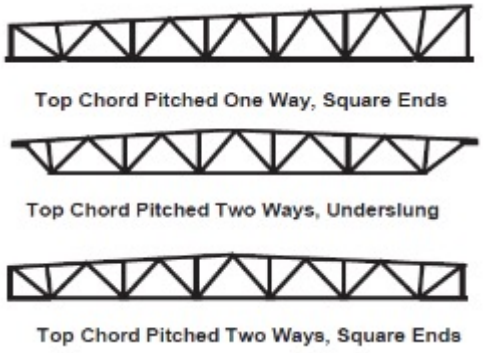
LH- and DLH-Series Joists

- LH-Series Standard Products
- DLH-Series Standard Products

LH-Series Joists

- Used for Roof and Floor Construction
- Designations: 18LH02 to 48LH25
- Depths: 18 to 48 in.
- Standard Seat Depth (Height): 5 in. up to #17
- Span Range: 18 to 96 ft.;
- ASD Load Range: 199 to 3000 plf;
- LRFD Load Range: 298 to 4500 plf;
- Types: Parallel Chord, Single Pitch, Double Pitch; Underslung or Bottom Chord Bearing



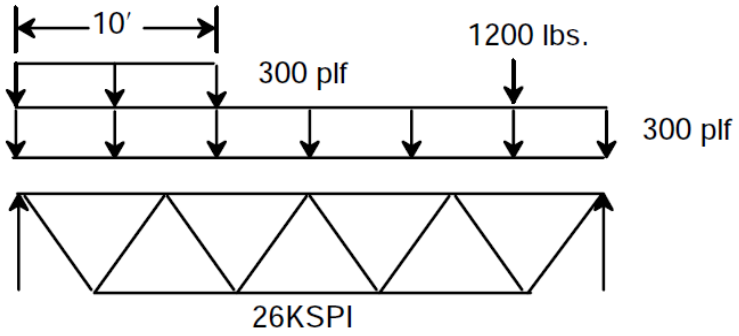


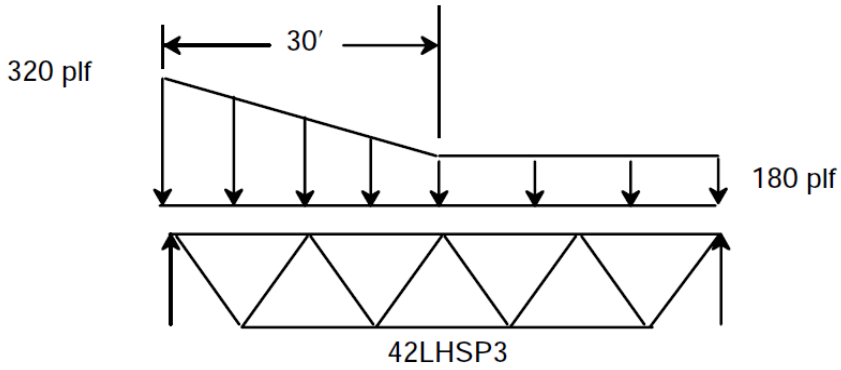
DLH-Series Joists

- Designations: 52DLH10 to 120DLH25
- Depths: 52 to 120 in.
- Standard Seat Depth (Height): 5 in. up to #17 chords, 7.5 in. for #18 and #25 chords
- Span Range: 90 to 240 ft.
- ASD Load Range: 211 to 1300 plf;
- LRFD Load Range: 316 to 1956 plf;
- Maximum Span/Depth Ratio: 24
- Types: Parallel Chord, Single Pitch, Double Pitch; Underslung or Bottom Chord Bearing

Specifying Joists with Non-Uniform Loads

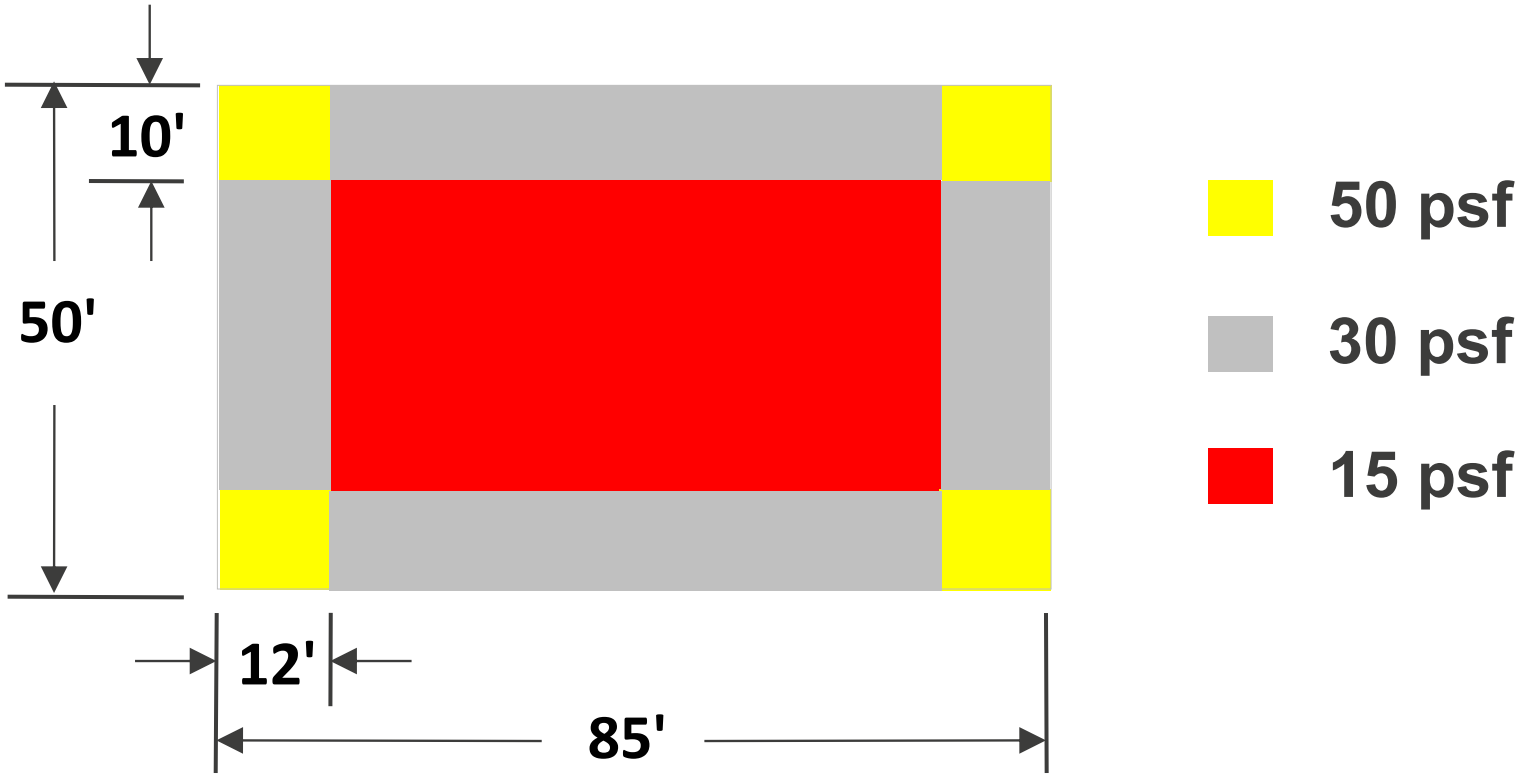
When K, LH and DLH-Series joists are **not** subjected to uniform loading a load diagram or a table must be used to convey the loading information to the joist manufacturer. A typical load diagram is shown below. Additional load diagrams and tables are provided in Chapter 6 of the Vulcraft Book.





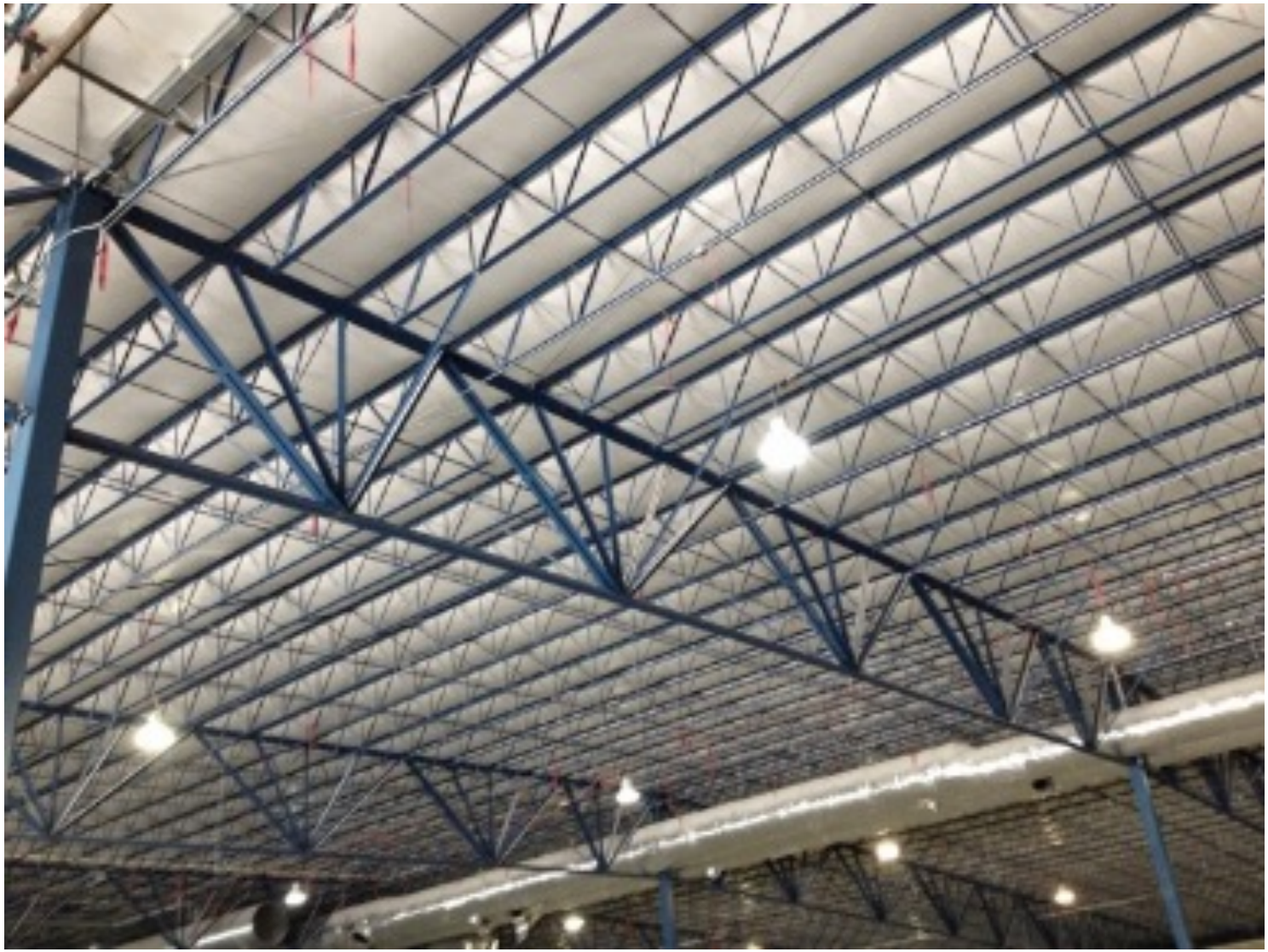
Specifying Joists with Wind Uplift

A typical zone uplift diagram:



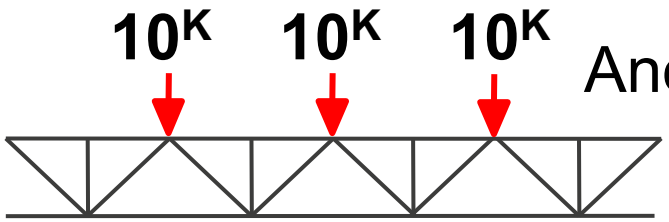
Be sure to dimension the width of the zones

Joist Girders



Joist Girders

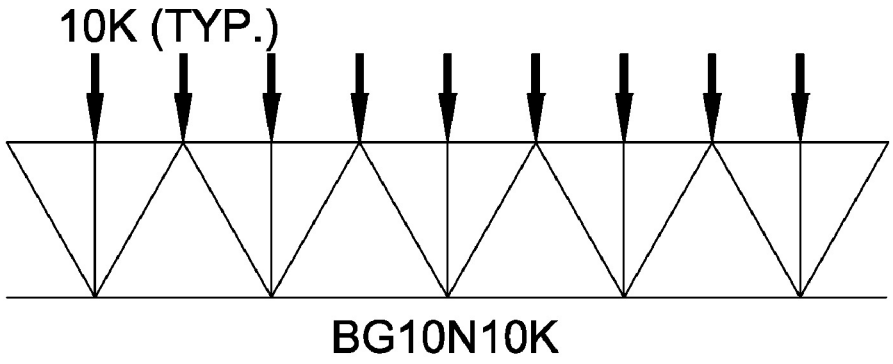
- Designation: 48G8N9K or for LRFD 48G8N13.5F
  - ✓48G is the Depth in inches
  - ✓8N is the Number of Joist Spaces
  - ✓9K is the unfactored load at each panel point
  - ✓13.5F is the factored load at each panel point
- Depths: 20 to 120 in.
- Standard Seat Depth (Height): 7.5 in.
- Spans: 20 to 120 ft.
- ASD Panel Point Loads: 4 to 56 kips
- LRFD Panel Point Loads: 6 to 84 kips
- Can have Various Web Configurations



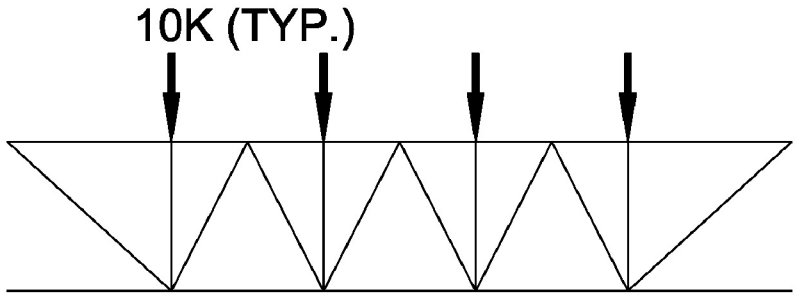
Another Example

36G4N10K

BG and VG Joist Girders



BG10N10K

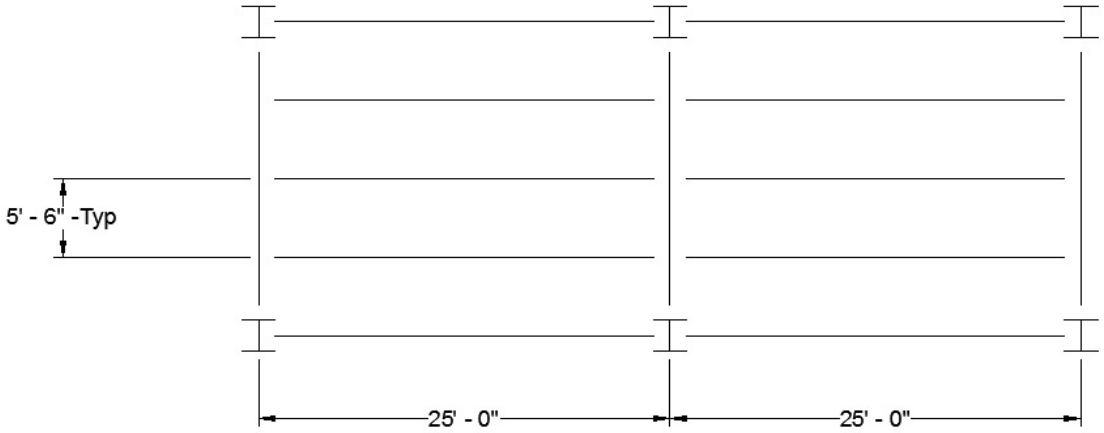


VG5N10K

Example: Selection of a K-Series Joist

Select a K-series joist to support the following loads for the framing shown.

The span and loads are appropriate for K-series joists rather than LH-series joists



Given:

Roof Dead Load = 30 psf

Snow Load = 35 psf

Snow Load Deflection Limit L/240

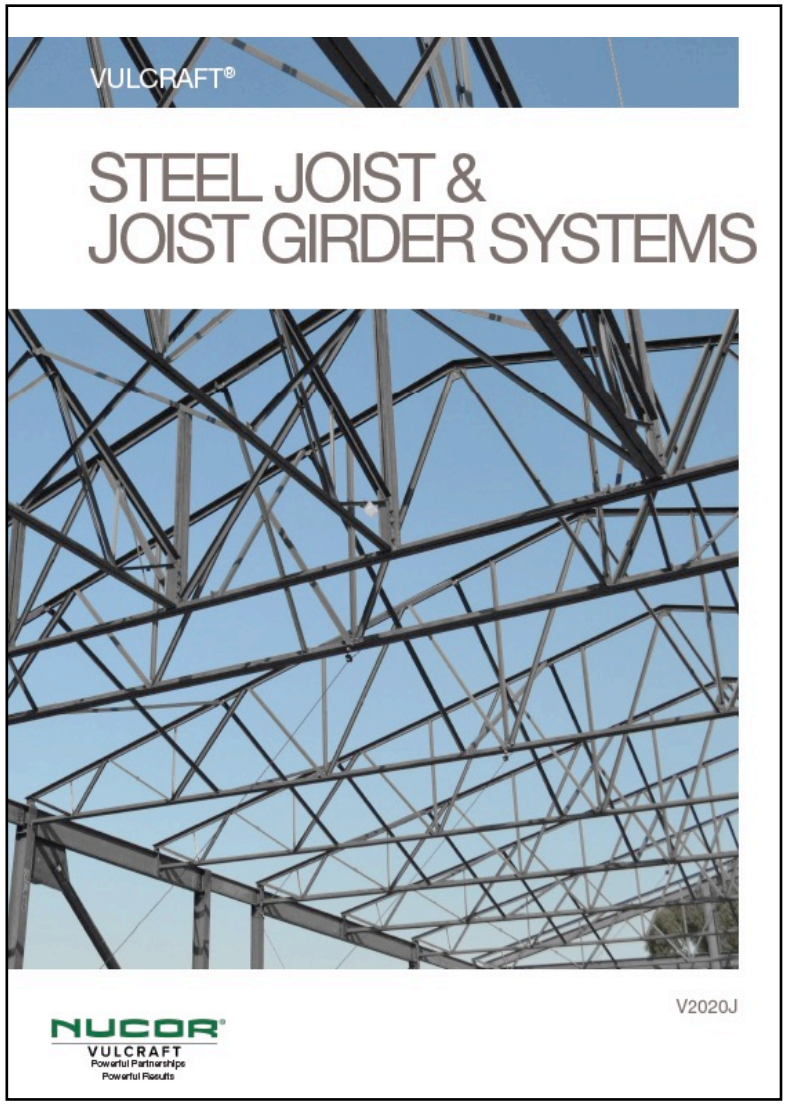
Example: Selection of a K-Series Joist

- ASD Load Combination: D + S
  (30 psf)(5.5 ft) + (35 psf)(5.5 ft) = 358 plf
- LRFD Load Combination: 1.2D + 1.6S
  (1.2)(30 psf)(5.5 ft) + (1.6)(35 psf)(5.5 ft) = 506 plf

Load for snow load deflection D + 0.5S
= [(30 psf +0.50(35 psf)](5.5 ft) = 261 plf

Use the Nucor/Vulcraft Steel Joist & Joist Girder Systems Catalog Economical Joist Guide to determine least weight K-series joist

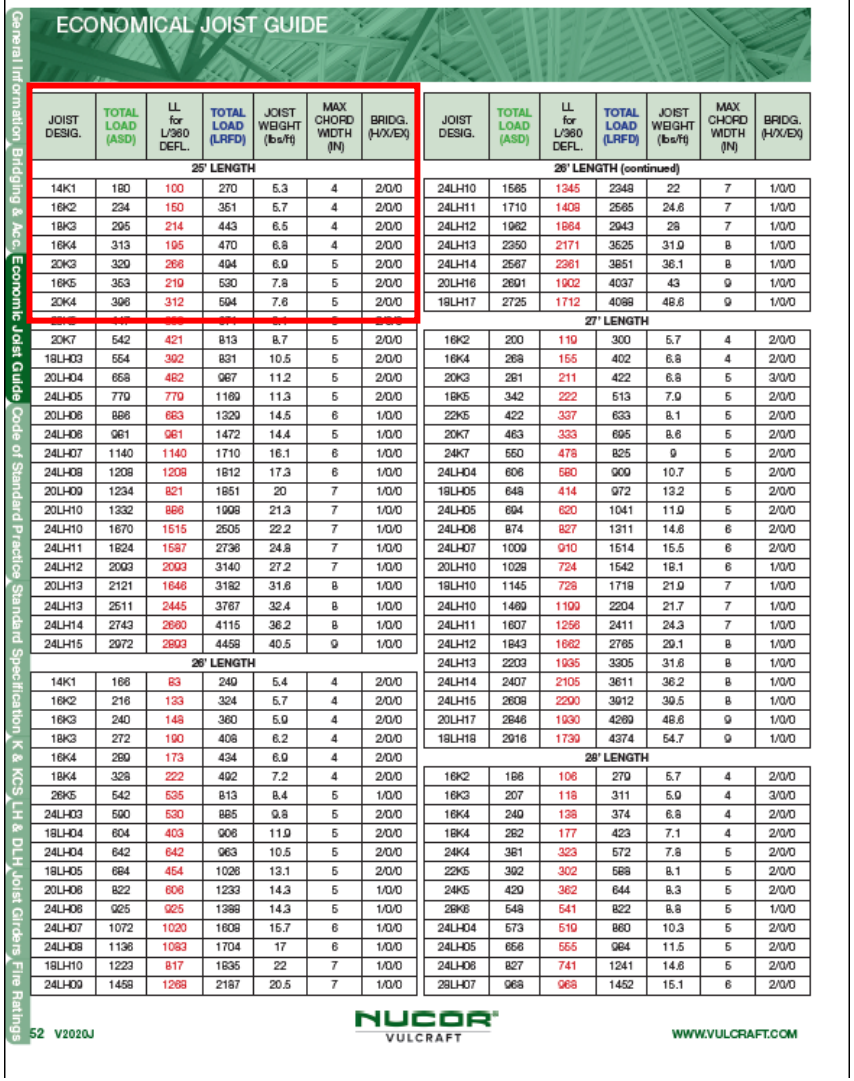
Vulcraft Economical Joist Guide



Book Reference

Vulcraft also has a Tool, “Joist Depth Selection Aid”. The aid can be accessed from the Vulcraft website.

Steel Joists & Joist Girder Systems



ECONOMICAL JOIST GUIDE

JOIST DESIG.	TOTAL LOAD (ASD)	LL for L/360 DEFL.	TOTAL LOAD (LRFD)	JOIST WEIGHT (lbs/ft)	MAX CHORD WIDTH (IN)	BRIDG. (H/X/EX)
25' LENGTH						
14K1	180	100	270	5.3	4	2/0/0
16K2	234	150	351	5.7	4	2/0/0
18K3	295	214	443	6.5	4	2/0/0
18K4	313	195	470	6.8	4	2/0/0
20K3	329	266	494	6.9	5	2/0/0
18K5	353	219	530	7.8	5	2/0/0
20K4	396	312	594	7.6	5	2/0/0
[illegible]						
20K7	542	421	813	8.7	5	2/0/0
18LH03	554	392	831	10.5	5	2/0/0
20LH04	658	482	987	11.2	5	2/0/0
24LH05	779	779	1169	11.3	5	2/0/0
20LH06	886	683	1329	14.5	6	1/0/0
24LH06	961	961	1472	14.4	5	1/0/0
24LH07	1140	1140	1710	16.1	6	1/0/0
24LH08	1208	1208	1812	17.3	6	1/0/0
20LH09	1234	821	1851	20	7	1/0/0
20LH10	1332	886	1998	21.3	7	1/0/0
24LH10	1670	1515	2505	22.2	7	1/0/0
24LH11	1824	1587	2736	24.8	7	1/0/0
24LH12	2093	2093	3140	27.2	7	1/0/0
20LH13	2121	1646	3182	31.8	8	1/0/0
24LH13	2511	2445	3767	32.4	8	1/0/0
24LH14	2743	2660	4115	36.2	8	1/0/0
24LH15	2972	2893	4458	40.5	9	1/0/0
26' LENGTH						
14K1	166	83	249	5.4	4	2/0/0
16K2	216	133	324	5.7	4	2/0/0
16K3	240	148	360	5.9	4	2/0/0
18K3	272	190	408	6.2	4	2/0/0
16K4	289	173	434	6.9	4	2/0/0
18K4	328	222	492	7.2	4	2/0/0
26K5	542	535	813	8.4	5	1/0/0
24LH03	590	530	885	9.8	5	2/0/0
18LH04	604	403	906	11.9	5	2/0/0
24LH04	642	642	963	10.5	5	2/0/0
18LH05	684	454	1026	13.1	5	2/0/0
20LH06	822	606	1233	14.3	5	1/0/0
24LH06	925	925	1388	14.3	5	1/0/0
24LH07	1072	1020	1608	15.7	6	1/0/0
24LH08	1136	1083	1704	17	6	1/0/0
18LH10	1223	817	1835	22	7	1/0/0
24LH09	1458	1268	2187	20.5	7	1/0/0
24LH10	1565	1345	2348	22	7	1/0/0
24LH11	1710	1408	2565	24.6	7	1/0/0
24LH12	1962	1864	2943	28	7	1/0/0
24LH13	2350	2171	3525	31.9	8	1/0/0
24LH14	2567	2361	3851	36.1	8	1/0/0
20LH16	2691	1902	4037	43	9	1/0/0
18LH17	2725	1712	4088	48.6	9	1/0/0
27' LENGTH						
16K2	200	119	300	5.7	4	2/0/0
16K4	268	155	402	6.8	4	2/0/0
20K3	281	211	422	6.8	5	3/0/0
18K5	342	222	513	7.9	5	2/0/0
22K5	422	337	633	8.1	5	2/0/0
20K7	463	333	695	8.6	5	2/0/0
24K7	550	478	825	9	5	2/0/0
24LH04	606	580	909	10.7	5	2/0/0
18LH05	648	414	972	13.2	5	2/0/0
24LH05	694	620	1041	11.9	5	2/0/0
24LH06	874	827	1311	14.6	6	2/0/0
24LH07	1009	910	1514	15.5	6	2/0/0
20LH10	1029	724	1542	18.1	6	1/0/0
18LH10	1145	728	1718	21.9	7	1/0/0
24LH10	1469	1199	2204	21.7	7	1/0/0
24LH11	1607	1256	2411	24.3	7	1/0/0
24LH12	1843	1662	2765	29.1	8	1/0/0
24LH13	2203	1935	3305	31.6	8	1/0/0
24LH14	2407	2105	3611	36.2	8	1/0/0
24LH15	2608	2290	3912	39.5	8	1/0/0
20LH17	2646	1930	4269	48.6	9	1/0/0
18LH18	2916	1739	4374	54.7	9	1/0/0
28' LENGTH						
16K2	186	106	279	5.7	4	2/0/0
16K3	207	118	311	5.9	4	3/0/0
16K4	249	138	374	6.8	4	2/0/0
18K4	282	177	423	7.1	4	2/0/0
24K4	381	323	572	7.8	5	2/0/0
22K5	392	302	588	8.1	5	2/0/0
24K5	429	362	644	8.3	5	2/0/0
28K6	548	541	822	8.8	5	1/0/0
24LH04	573	519	860	10.3	5	2/0/0
24LH05	656	555	984	11.5	5	2/0/0
24LH06	827	741	1241	14.6	5	2/0/0
28LH07	968	968	1452	15.1	6	2/0/0

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General Information Bridging & Acc. Economic Joist Guide Code of Standard Practice Standard Specification K & KCS LH & DLH Joist Girders Fire Ratings

JOIST DESIG.	TOTAL LOAD (ASD)	LL for L/360 DEFL.	TOTAL LOAD (LRFD)	JOIST WEIGHT (lbs/ft)	MAX CHORD WIDTH (IN)	BRIDG. (H/X/EX)
25' LENGTH						
14K1	180	100	270	5.3	4	2/0/0
16K2	234	150	351	5.7	4	2/0/0
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18K4	313	195	470	6.8	4	2/0/0
20K3	329	266	494	6.9	5	2/0/0
18K5	353	219	530	7.8	5	2/0/0
20K4	396	312	594	7.6	5	2/0/0
[illegible]						

From the table a 20K4 has an available strength = 396 plf (ASD) or a design strength = 594 (LRFD).
Load deflection at service loads = (312 plf)(1.5) = 468 plf > 193 plf ok.
Specify a 20K4

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