

# OPEN WEB STEEL JOISTS, K-SERIES

## 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 (12030 N/m) LRFD or 550 plf (8020 N/m) ASD is used to check end panel bending.

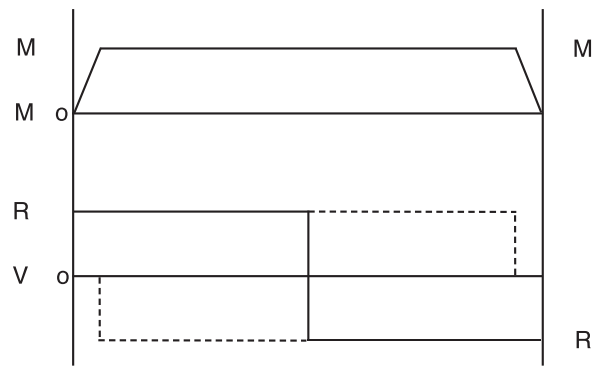
The web forces are determined based on a flat shear envelope. All webs are designed for a vertical shear equal to the specified shear capacity. Furthermore, all webs (except the first tension web which remains in tension under all simple span gravity loads) will be designed for 100% stress reversal.

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 (12030 N/m) LRFD or 550 plf (8020 N/m) ASD or if the maximum concentrated load exceeds the shear capacity of the joist, use double KCS Joists or select an **LH-Series Joist**. For the **LH-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.

Please reference SJI Technical Digest #9 "Handling and Erection of Steel Joists and Joist Girders" for further information.

**NOTE:** In the following examples joist selection is based on minimum depth and minimum weight (plf, kg/m). Other selections may be more suitable for specific job conditions.

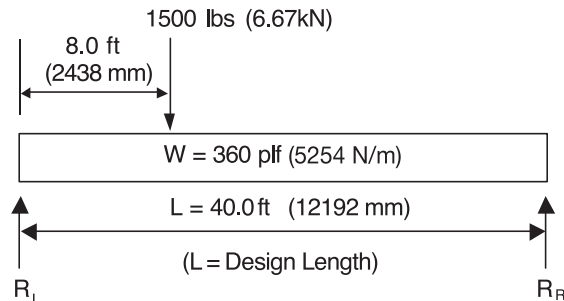


**KCS JOIST  
SHEAR AND MOMENT ENVELOPES**

## LRFD EXAMPLES

### EXAMPLE 1

#### LRFD FACTORED LOADS



$$M = 938 \text{ in.-kip (105.9 kN-m)}$$

$$R_L = 8400 \text{ lbs (37.37 kN)}, R_R = 7500 \text{ lbs (33.36 kN)}$$

Select a 22KCS3,  $M = 987 \text{ in.-kip (111.5 kN-m)}$

$$R = 9900 \text{ lbs (44.0 kN)}$$

Bridging section no. 9 for  $L = 40 \text{ ft. (12192 mm)}$

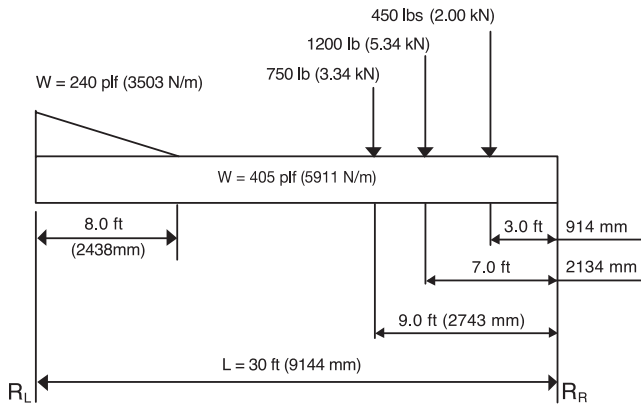
Use 22K9 to determine bridging and stability requirements.

Since a standard KCS Joist can be selected from the load table a load diagram is not required.



**EXAMPLE 2**

**LRFD FACTORED LOADS**



$M = 664 \text{ in.-kip (75.03 kN-m)}$

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

Select a 22KCS2,  $M = 732 \text{ in.-kip (82.64 kN-m)}$

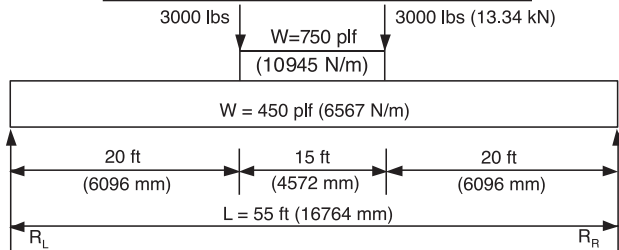
$R = 8850 \text{ lbs (39.3 kN)}$

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

Use 22K6 to determine bridging and stability requirements. Since the maximum *factored* uniform load of 645 plf (9413 N/m) (405 plf (5911 N/m) + 240 plf (3503 N/m)) does not exceed the maximum KCS Joist uniform load of 825 plf (12030 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**



$M = 4365 \text{ in.-kip (493.2 kN-m)}$

$R_L = R_R = 21000 \text{ lbs (93.41 kN)}$

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

**OPTION A:** Use double joists each having a minimum moment capacity  $M = 2183 \text{ in.-kip (246.65 kN-m)}$  and shear capacity  $R = 10500 \text{ lbs (46.71 kN)}$  and a uniform load of 600 plf (8756 N/m).

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

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:

$W_M = \frac{8M}{L^2} = 962 \text{ plf (14.04 kN/m)}$

$W_V = \frac{2R}{L} = 764 \text{ plf (11.14 kN/m)}$

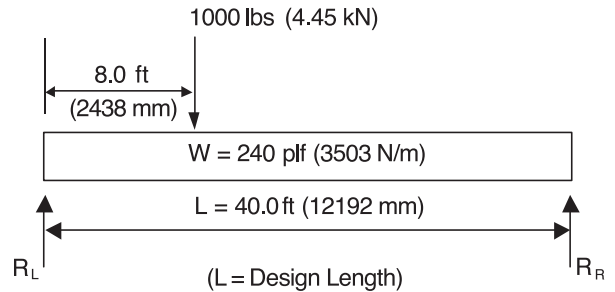
Use 962 plf (14.04 kN/m)

From the LH-Series LRFD Load Table select a 32LH13,  $W = 1035 \text{ plf (15.10 kN/m)}$  for a 55 ft. (16764 mm) clear span. Specify a 32LH13SP and present a load diagram on the structural drawings with the following note:

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

**ASD EXAMPLES**

**EXAMPLE 1**



$M = 625 \text{ in.-kip (70.6 kN-m)}$

$R_L = 5600 \text{ lbs (24.9 kN)}, R_R = 5000 \text{ lbs (22.2 kN)}$

Select a 22KCS3,  $M = 658 \text{ in.-kip (74.3 kN-m)}$

$R = 6600 \text{ lbs (29.3 kN)}$

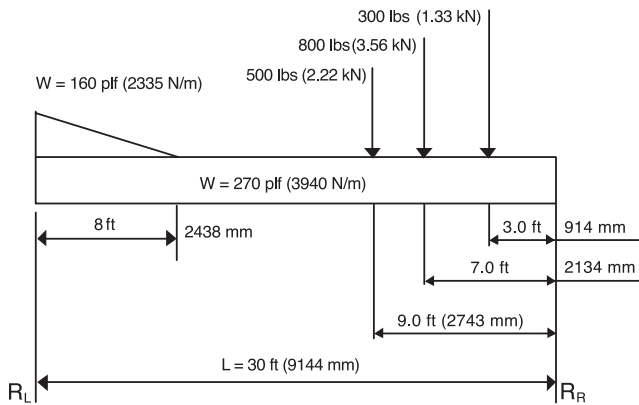
Bridging section no. 9 for  $L = 40 \text{ ft. (12192 mm)}$

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.



**EXAMPLE 2**



$M = 443 \text{ in.-kip (50.1 kN-m)}$

$R_L = 5000 \text{ lbs (22.24 kN)}, R_R = 5340 \text{ lbs (23.75 kN)}$

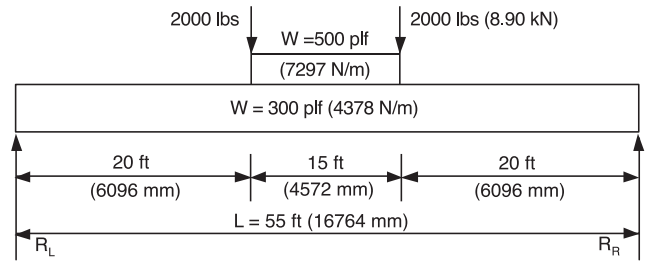
Select a 22KCS2,  $M = 488 \text{ in.-kip (55.1 kN-m)}$

$R = 5900 \text{ lbs (26.2 kN)}$

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 430 plf [6275 N/m] (270 plf (3940 N/m) + 160 plf (2335 N/m)) does not exceed the maximum KCS Joist uniform load of 550 plf (8020 N/m) and a standard KCS Joist can be selected from the load table, a load diagram is not required.

**EXAMPLE 3**



$M = 2910 \text{ in.-kip (328.8 kN-m)}$

$R_L = R_R = 14000 \text{ lbs (62.28 kN)}$

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 moment capacity  $M = 1455 \text{ in.-kip (164.4 kN-m)}$  and shear capacity  $R = 7000 \text{ lbs (31.14 kN)}$  and a uniform load of 400 plf (5838 N/m).

Select two 28KCS5,  $M = 1704 \text{ in.-kip (192.5 kN-m)}$ ,  $R = 9200 \text{ lbs (40.9 kN)}$

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:

$$W_M = \frac{8M}{L^2} = 641 \text{ plf (9.35 kN/m)}$$

$$W_V = \frac{2R}{L} = 509 \text{ plf (7.43 kN/m)}$$

Use 641 plf (9.35 kN/m)

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

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

