Introduction of Open Web Steel Joist, Deck and Composite Steel Joist

ENCE710 – Advanced Steel Structures

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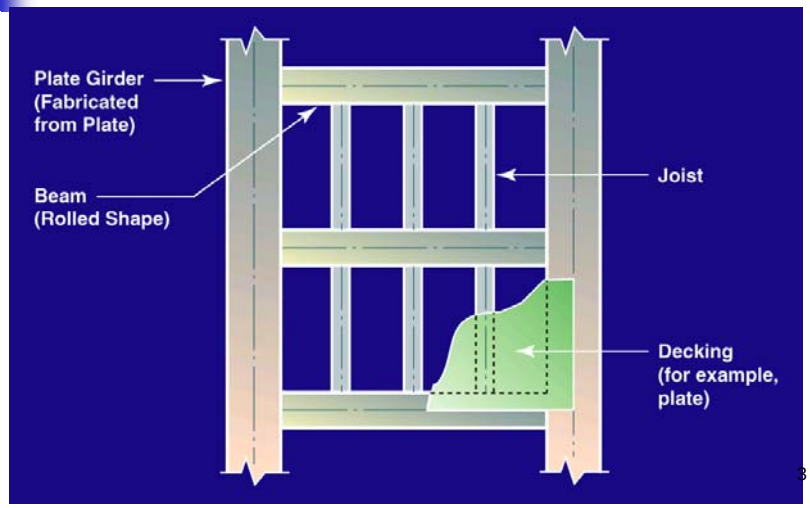
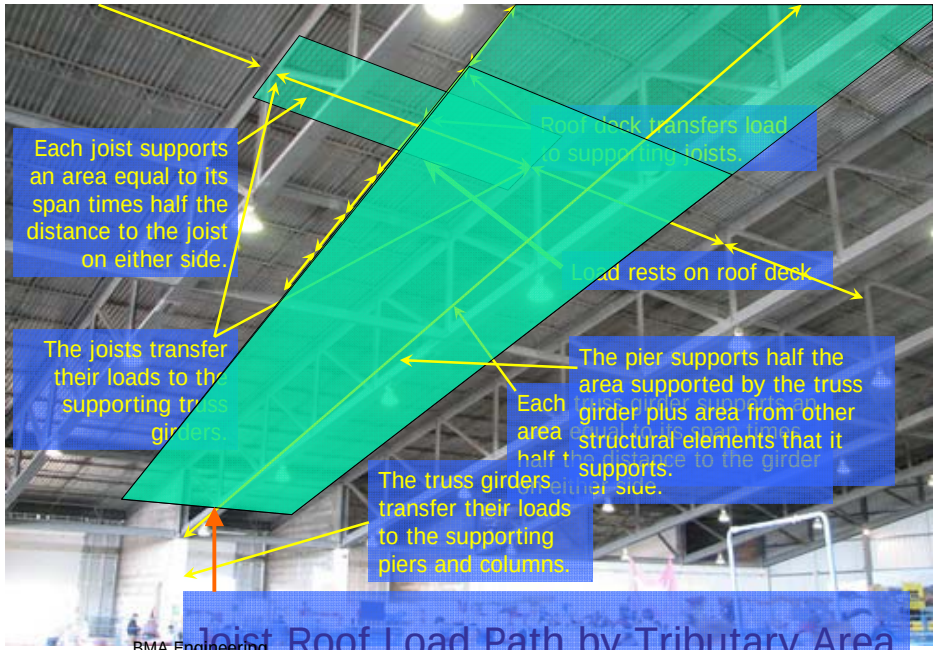
SJI Recommended Code of Standard Practice for Steel Joists and Joist Girders

- 1.4 DESIGN
  - In the absence of ordinances or specifications to the contrary, all designs prepared by the specifying professional shall be in accordance with the applicable Steel Joist Institute Specifications and Load Table of latest adoption.
- 1.5 RESPONSIBILITY FOR DESIGN AND ERECTION
  - When material requirements are specified, the seller shall assume no responsibility other than to furnish the items listed in Section 5.2 (a). When Material requirements are not specified, the Seller shall furnish the items listed in Section 5.2(a) in accordance with applicable Steel Joist Institute Specifications of latest adoption, and this code. The Seller shall identify material by showing size and type. In no case shall the Seller assume any responsibility for the erection of the item furnished.

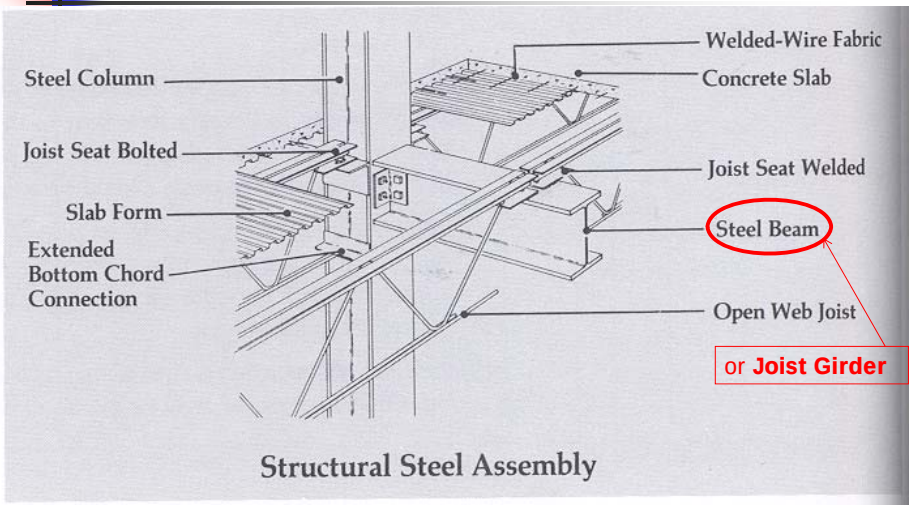
Example of a Typical Floor Plan





Joist Roof Load Path by Tributary Area

Steel Construction

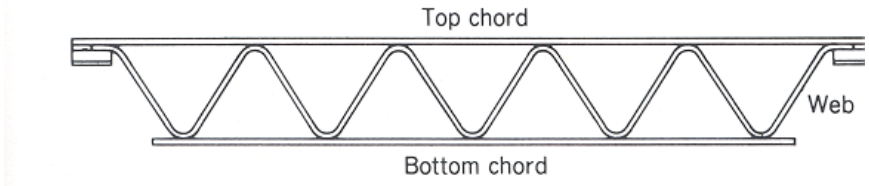


Structural Steel Assembly

Open Web Steel Joists

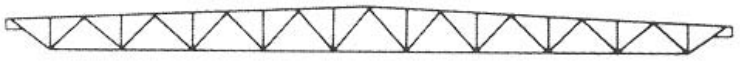
- Steel joists are prefabricated lightweight trusses that are available in different series:
  - K series- 8" through 30" in 2" increment with 64 designations; clear spans to 60' (short span)
    (KCS series for special loading conditions)
  - LH series – 18" through 48"; clear spans to 96' (long-span)
  - DLH series – 52" through 72"; clear spans to 144' (deep long-span)
- For Composite Steel Joists, see David Samuelson's paper (AISC Engineering Journal, 3rd Quarter, 2002)

Open Web Steel Joist - 2



Designation: 12K4
12 = depth in inches
K = joist series
4 = designation within series (the higher the number, the heavier the joist)

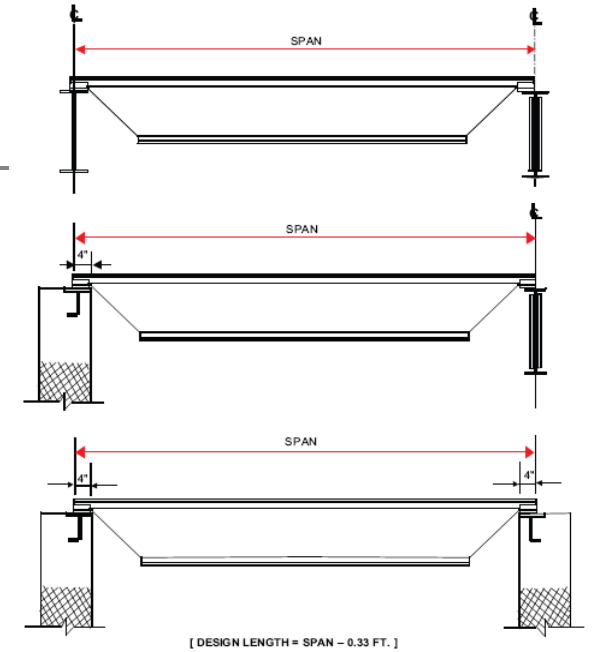
Pitched Top Chord Joists


Two ways, underslung


Two ways, square ends

Pitched top chord joists (Note: Standard pitch is $\frac{1}{8}$" per ft)

Span Length



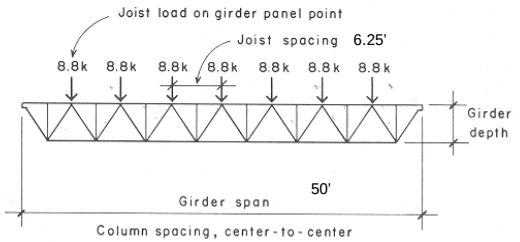
[DESIGN LENGTH = SPAN – 0.33 FT.]

Parallel chord joists installed to a slope greater than ½ inch per foot shall use span defined by the length along the slope.

Joist Girders

- Designed to carry the regularly spaced, concentrated loads consisting of the end supports of joists.
- Designation: 48G 8N 8.8K
  - 48G = depth in inches
  - 8N = number of joist spaces
  - 8.8K = load on each panel point in kips

Joist Girder – 2 (ASD)

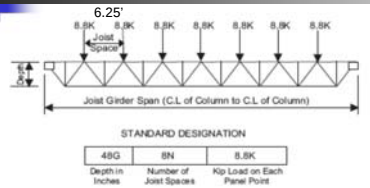


Standard Designation:

48G	8N	8.8K
Depth in inches	Number of joist spaces	Load on each panel point in kips

Specify: 48G8N8.8K

Joist Girder - 3



STANDARD DESIGNATION

48G	8N	8.8K
Depth in Inches	Number of Joist Spaces	Kip Load on Each Panel Point

Given 50'-0" x 40'-0" bay. Joists spaced on 6'-3" centers.

Live Load = 20 psf
Dead Load = 15 psf (includes the approximate Joist Girder Weight)
Total Load = 35 psf

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

1. Determine number of actual joist spaces (N).
   In this example, N = 8.
2. Compute total load:
   Total load = 6.25 x 35 psf = 218.75 plf
3. Joist Girder Selection: (Interior)
   a) Compute the concentrated load at top chord panel points P = 218.75 x 40 = 8,750 lbs. = 8.8 kips (use 9K for depth selection).
   b) Select Joist Girder depth:
   Refer to the Joist Girder Design Guide Weight Table for the 50'-0" span, 8 panel, 9.0K Joist Girder. The rule of about one inch of depth for each foot of span is a good compromise of limited depth and economy. Therefore, select a depth of 48 inches.
   c) The Joist Girder will then be designated 48G8N8.8K.
   d) The Joist Girder table shows the weight for a 48G8N9K as 43 pounds per linear foot. The designer should verify that the weight is not greater than the weight assumed in the dead load above.
   e) Check live load deflection:
   Live load = 20 psf x 40 ft. = 800 plf. Approximate Joist Girder moment of inertia = 0.027 NPLd = 0.027 x 8 x 9 x 50 x 48 = 4666 in⁴.

Allowable deflection for plastered ceilings = L/360 = $\frac{50 \times 12}{360}$ = 1.67 in.

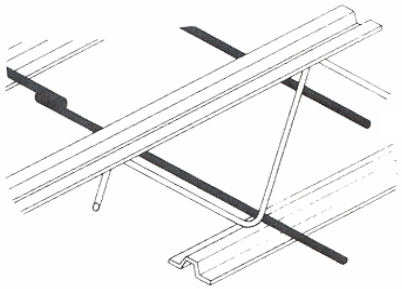
Deflection = $1.15\left[\frac{5wL^4}{384EI}\right] = \frac{1.15 \times 5\left(\frac{0.800}{12}\right)(50 \times 12)^4}{384 \times 29{,}000 \times 4666}$

= 0.96 in. < 1.67 in., Okay

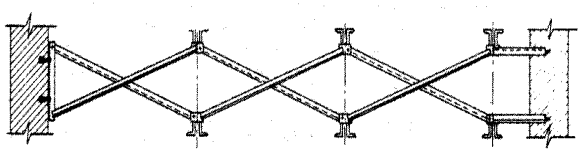
Live load deflection rarely governs because of the relatively small span-depth ratios of Joist Girders.

1. The purpose of the Design Guide Weight Table for Joist Girders is to assist the specifying professional in the selection of a roof or floor support system.
2. It is not necessary to use only the depths, spans, or loads shown in the tables.
3. Holes in chord elements present special problems which must be considered by both the specifying professional and the Joist Girder Manufacturer. The sizes and locations of such holes shall be clearly indicated on the structural drawings.

Bridging

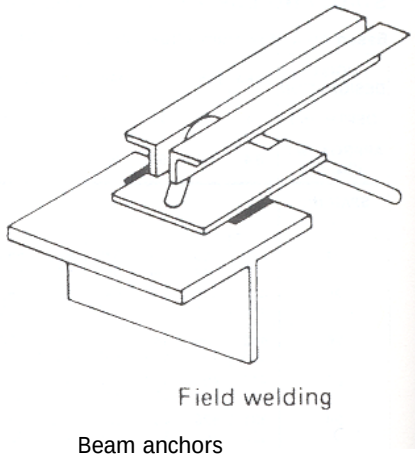


Horizontal Bridging
(for span L < 60')

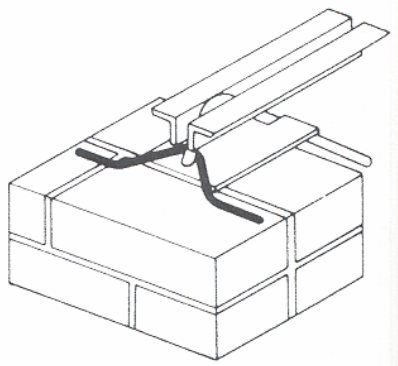


Diagonal Bridging
(for span L > 60')

End Anchorage - Beam



Beam anchors



Wall anchors

Standard Load Table/Open Web Steel Joists, K-Series (ASD)

Joist Designation	18K3	18K4	18K5	18K6	18K7	18K9	18K10	20K3	20K4	20K5	20K6	20K7	20K9	20K10	22K4	22K5	22K6	22K7	22K9	22K10	22K11
Depth (In.)	18	18	18	18	18	18	18	20	20	20	20	20	20	20	22	22	22	22	22	22	22
Approx. Wt. (lbs./ft.)	6.6	7.2	7.7	8.5	9	10.2	11.7	6.7	7.6	8.2	8.9	9.3	10.8	12.2	8	8.8	9.2	9.7	11.3	12.6	13.8
Span (ft.) ↓																					
18	550 550	550 550	550 550	550 550	550 550	550 550	550 550														
19	514 494	550 523	550 523	550 523	550 523	550 523	550 523														
20	463 423	550 490	550 490	550 490	550 490	550 490	550 490	517 517	550 550	550 550	550 550	550 550	550 550	550 550							
21	420 364	506 426	550 460	550 460	550 460	550 460	550 460	468 453	550 520	550 520	550 520	550 520	550 520	550 520							
22	382 316	460 370	518 414	550 438	550 438	550 438	550 438	426 393	514 461	550 490	550 490	550 490	550 490	550 490	550 548	550 548	550 548	550 548	550 548	550 548	550 548
23	349 276	420 323	473 362	516 393	550 418	550 418	550 418	389 344	469 402	529 451	550 468	550 468	550 468	550 468	518 491	550 518	550 518	550 518	550 518	550 518	550 518
24	320 242	385 284	434 318	473 345	526 382	550 396	550 396	357 302	430 353	485 396	528 430	550 448	550 448	550 448	475 431	536 483	550 495	550 495	550 495	550 495	550 495
25	294 214	355 250	400 281	435 305	485 337	550 377	550 377	329 266	396 312	446 350	486 380	541 421	550 426	550 426	438 381	493 427	537 464	550 474	550 474	550 474	550 474

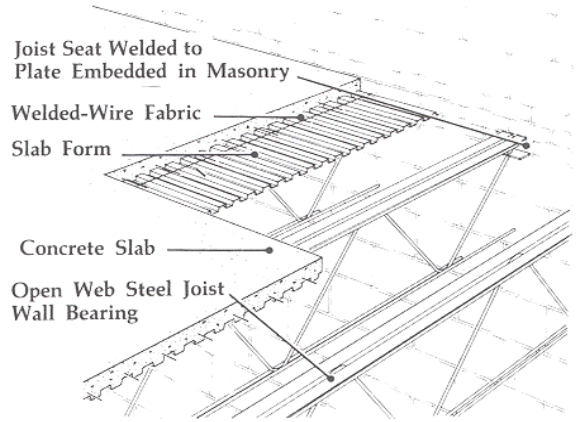
Black figures: TOTAL safe uniformly distributed load-carrying capacities (lb/ft)

Red figures: LIVE loads (lb/ft) which will produce an approximate deflection of L/360.

Metal Decking

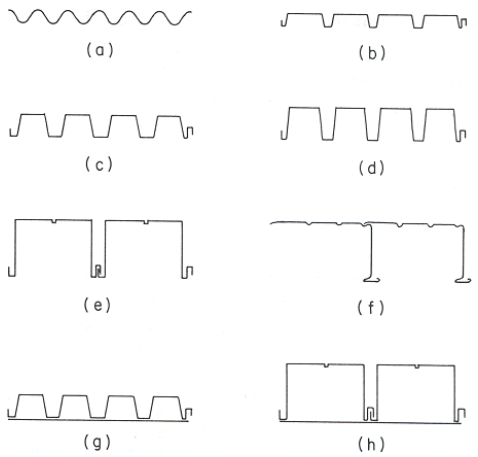
- Metal decking is used for floor and roof applications.
- Determine type of decking, thickness, gage of metal, finish required, and method of attachment
- Unit: square (100 sf)

Steel Joist and Metal Deck



Open-Web Steel Joists and Metal Deck Construction

Steel Deck Units



Finish, Depths, Gages and Grades

- Finish:
  - unpainted
  - primed
  - painted
  - galvanized
- Depths: from 9/16” to 7.6”
- Gages: from 10 (0.135”) to 28 (0.0149”)
- Grades: Yield points from 33 to 80 ksi
  (See Richard Heagler’s paper “Form Deck – A Versatile Family of Products,” by AISC, 2003)

Quantity takeoff

- Determine the LF of each different type of joist, use manufacturer’s table to find the weight per ft and total weight.
- Note type and number of accessories:
  - bridging (diagonal or horizontal)
  - end anchorage (beam or wall)