3.6.0 Major Characteristics of Joist Series

MAJOR CHARACTERISTICS OF JOIST SERIES **

K Series
Min. Fy=50000 psi
Depths 8" thru 30"
Spans to 60'-0

CS Series
Min. Fy=50000 psi
Depths 10" thru 30"
Spans 20'-0 thru 60'-0

LH Series
Min. Fy=50000 psi
Depths 18" thru 48"
Spans to 96'-0

DLH Series
Min. Fy=50000 psi
Depths 52" thru 72"
Spans to 144'-0

SLH Series
Min. Fy=50000 psi
Depths from 80"
Spans - Contact Vulcraft

JOIST GIRDER Series
Min. Fy=50000 psi
Depths as required
Spans as required

** Some design and/or delivery requirements may dictate yield strength other than that shown.

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.6.1 General Information on K Series Joists

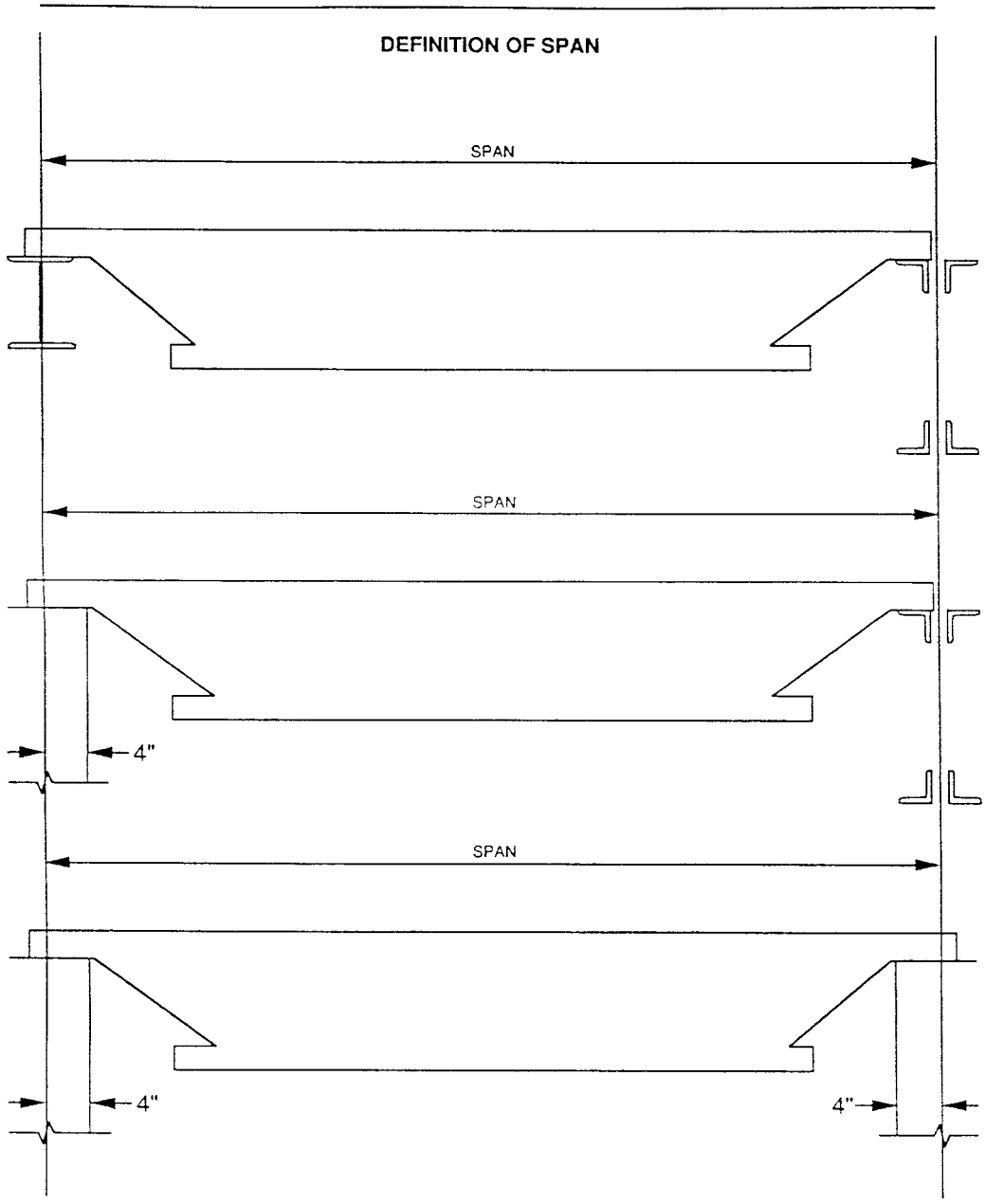
- Economical
- High strength
- *Design* Vulcraft K Series open web steel joists are designed in accordance with specifications of the Steel Joist Institute.
- SJI spans to 60'0"
- *Paint* Vulcraft joists receive a shop-coat of rust-inhibitive primer, whose performance characteristics conform to those of the Steel Joist Institute specifications 3.3.

Standing Beam Bridging

The bridging table was developed to support the top chords against lateral movement during the construction period. It is then intended that the floor or roof deck will laterally support the top chords under a full loading condition by meeting the provisions of Section 5.8 of the specifications.

Most standing-seam roof systems will not adequately brace the top chords laterally with the number of rows as required by the bridging table. We, therefore, recommend that when standing-seam roof systems are specified, the specifying engineer employ a note to have the joist manufacturer check the system and to provide bridging as required to adequately brace the top chords against lateral movement under a full-loading condition.

3.6.2 Standard Specifications for Open Web Joists (K Series)



[DESIGN LENGTH = SPAN – 0.33 FT.]

(By permission of the Steel Joist Institute, Myrtle Beach, South Carolina.)

3.6.3 K Series Open Web Steel Joists

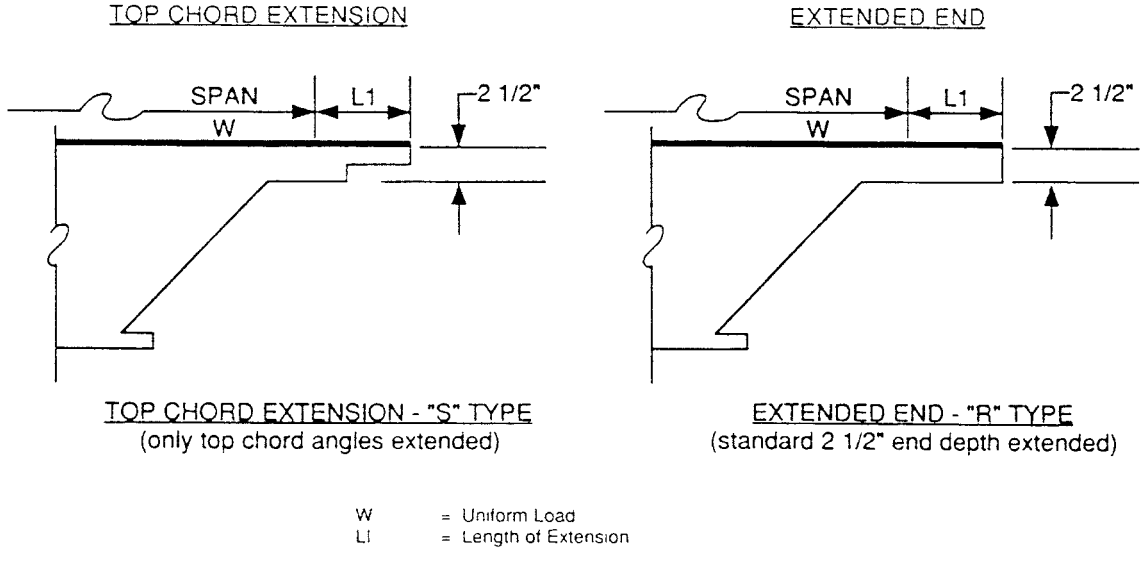
Top Chord Extensions and Extended Ends

Joist extensions are commonly furnished to support a variety of overhang conditions. The two types are pictured. The first is the top chord extension or "S" type, which has only the top chord angles extended. The second is the extended end or "R" type in which the standard 2½" end-bearing depth is maintained over the entire length of the extension. The "S" type extension is so designated because of its simple nature whereas the "R" type involves reinforcing the top chord angles. The specifying authority should be aware that an "S" type is more economical and should be specified whenever possible.

The following load tables for K-series top chord extensions and extended ends have been developed as an aid to the specifying authority. The black number in the tables is the maximum allowable uniform load in pounds per linear foot. The blue number is the uniform load, which will produce an approximate deflection of $L_1/240$, where L_1 is the length of the extension. The load tables are applicable for uniform loads only. If there are concentrated loads and/or nonuniform loads, a loading diagram must be provided by the specifying authority on the contract drawings. In cases where it is not possible to meet specific job requirements with a 2½" deep "R" type extension (refer to "S" and "I" values in the Extended End Load Table), the depth of the extension must be increased to provide greater load-carrying capacity. If the loading diagram for any condition is not shown, the joist manufacturer will design the extension to support the uniform load indicated in the K-Series Joist Load Table for the span of the joist.

When top chord extensions or extended ends are specified, the allowable deflection and the bracing requirements must be considered by the specifying authority.

Note that an "R" type extension must be specified when building details dictate a 2½" depth at the end of the extension. In the absence of specific instructions, the joist manufacturer could provide either type.

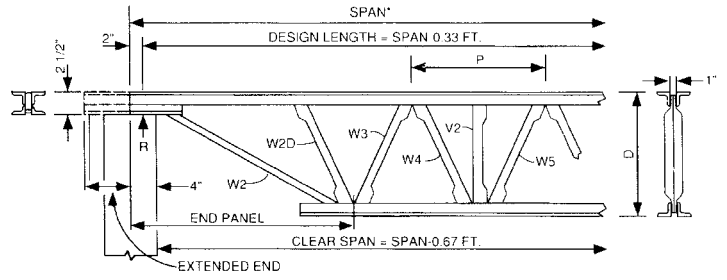


(By permission of the Steel Joist Institute, Myrtle Beach, South Carolina.)

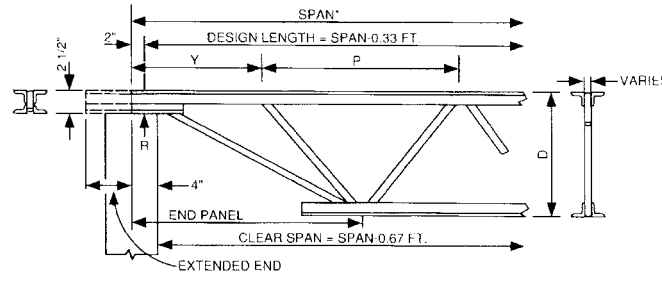
Uplift Bridging

Where uplift forces caused by wind are a design requirement, these forces must be indicated on the structural drawings in terms of net uplift in pounds per square foot or pounds per lineal foot. When these loads are specified, they must be considered in the design of joists and bridging. A single line of bottom chord bridging must be provided near the first bottom cord panel points whenever uplift from wind load is a design consideration.

CRIMPED ANGLE WEB



ROD WEB



NOTE: Actual layout may vary from that shown.

Number of Rows of Bridging***
Distances are Span Lengths

Section Number	1 Row	2 Rows	3 Rows	4 Rows**	5 Rows***
#1	Up thru 16'	Over 16' thru 24'	Over 24' thru 28'		
#2	Up thru 17'	Over 17' thru 25'	Over 25' thru 32'		
#3	Up thru 18'	Over 18' thru 28'	Over 28' thru 38'	Over 38' thru 40'	
#4	Up thru 19'	Over 19' thru28'	Over 28' thru 38'	Over 38' thru 48'	
#5	Up thru 19'	Over 19' thru 29'	Over 29' thru 39'	Over 39' thru 50'	Over 50' thru 52'
#6	Up thru 19'	Over 19' thru 29'	Over 29' thru 39'	Over 39' thru 51'	Over 51' thru 56'
#7	Up thru 20'	Over 20' thru 33'	Over 33' thru 45'	Over 45' thru 58'	Over 58' thru 60'
#8	Up thru 20'	Over 20' thru 33'	Over 33' thru 45'	Over 45 thru 58'	Over 58' thru 60'
#9	Up thru 20'	Over 20' thru 33'	Over 33' thru 46'	Over 46' thru 59'	Over 59' thru 60'
#10	Up thru 20'	Over 20' thru 37'	Over 37' thru 51'	Over 51' thru 60'	
#11	Up thru 20'	Over 20' thru 38'	Over 38' thru 53'	Over 53' thru 60'	
#12	Up thru 20'	Over 20' thru 39'	Over 39' thru 53'	Over 53' thru 60'	

*Last digit(s) of joist designation shown in Load Tables.
**Where 4 or 5 rows of bridging are required, a row nearest the midspan of the joist shall be diagonal bridging with bolted connections at chords and intersection.
***See Section 5.11 of the Specifications.

Sizes of Horizontal Bridging

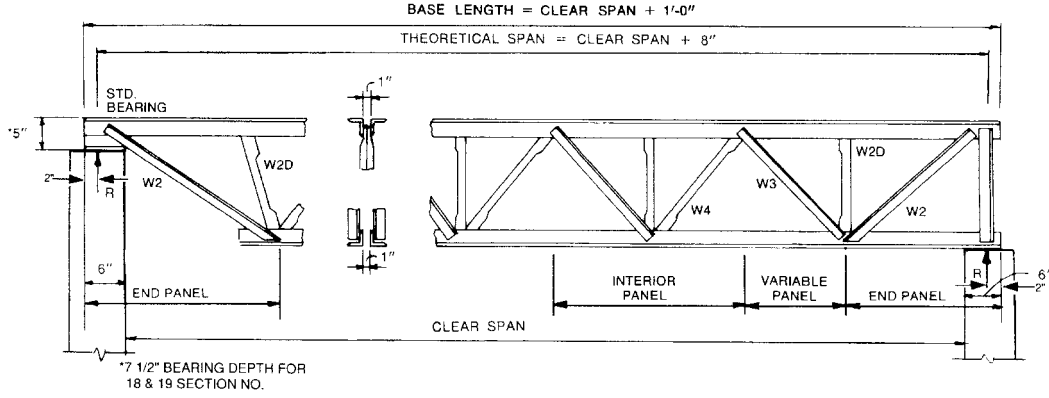
Size	Maximum Joist Spacing
L 1 x 1 x 7/64	5'-0"
L 1 1/4 x 1 1/4 x 7/64	6'-3"
L 1 1/2 x 1 1/2 x 7/64	7'-6"
L 1 3/4 x 1 3/4 x 1/8	8'-9"
L 2 x 2 x 1/8	10'-0"

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.6.4 General Information on LH and DLH Series Joists

- High strength
- Economical
- *Design* Vulcraft LH and DLH series long-span steel joists are designed in accordance with the specifications of the Steel Joist Institute.
- Roof spans to 144'
- Floor spans to 120'
- *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.

LH & DLH SERIES DETAILS



LH & DLH TABLE
MINIMUM BEARING LENGTHS

Joist Type	On Masonry	On Concrete	On Steel
LH 02 thru 17 DLH 10 thru 19	6"*	6"*	4"
MINIMUM BEARING PLATE WIDTHS			
LH 02 thru LH 12 DLH 10 thru DLH 12	9"*	9"*	
LH 13 thru LH 17 DLH 13 thru DLH 19	12"*	12"*	

*See Sect. 104.4 on page 43.

BRIDGING SPACING

Section No.*	Min. Bolt Diameter**	Maximum Spacing of Lines of Bridging
LH 02 to 09, incl.	3/8"	11'-0"
DLH 10	3/8"	14'-0"
LH 10 to 14, incl.	3/8"	16'-0"
DLH 11 to 14, incl.	3/8"	16'-0"
LH 15 to 17, incl.	1/2"	21'-0"
DLH 15 to 17, incl.	1/2"	21'-0"
DLH 18 to 19, incl.	5/8"	26'-0"

*Last two digits of joint designation shown in load table.
**Size required due to requirements as indicated for bolted x bridging connections in Section 104.5(e). Minimum A307 Bolt required for connection

JOIST SPACING FOR BRIDGING ANGLE SIZE

DIAGONAL BRIDGING CHART
Bridging Angle Size

DEPTH	L1x1x7/64	L1¼x1¼x7/64	L1½x1½x7/64	L1¾x1¾x1/8	L2x2x1/8
18	6'- 5"	8'- 2"	9'-10"	11'- 6"	
20	6'- 5"	8'- 1"	9'-10"	11'- 6"	
24	6'- 4"	8'- 1"	9'- 9"	11'- 5"	
28	6'- 2"	8'- 0"	9'- 8"	11'- 5"	
32	6'- 1"	7'-10"	9'- 7"	11'- 4"	13'- 0"
36		7'- 9"	9'- 6"	11'- 3"	12'-11"
40		7'- 7"	9'- 5"	11'- 2"	12'-10"
44		7'- 5"	9'- 3"	11'- 0"	12'- 9"
48		7'- 3"	9'- 1"	10'-11"	12'- 8"
52			9'- 0"	10'- 9"	12'- 7"
56			8'-10"	10'- 8"	12'- 5"
60			8'- 7"	10'- 6"	12'- 4"
64			8'- 5"	10'- 4"	12'- 2"
68			8'- 2"	10'- 2"	12'- 0"
72			8'- 0"	10'- 0"	11'-10"

†HORIZONTAL BRIDGING CHART
Bridging Angle Size

DEPTH	L1x1x7/64	L1¼x1¼x7/64	L1½x1½x7/64	L1¾x1¾x1/8	L2x2x1/8
ALL DEPTHS	5'- 0"	6'- 3"	7'- 6"	8'- 9"	10'- 0"

† See specification section 104.5 for the proper use of horizontal bridging.

NOTES:
1. Special designed LH and DLH can be supplied in longer lengths. See SLH Series Page 47.
2. Additional bridging may be required when joists support standing seam roof decks. The specifying engineer 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.

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.6.5 LH and DLH Series Longspan Steel Joists

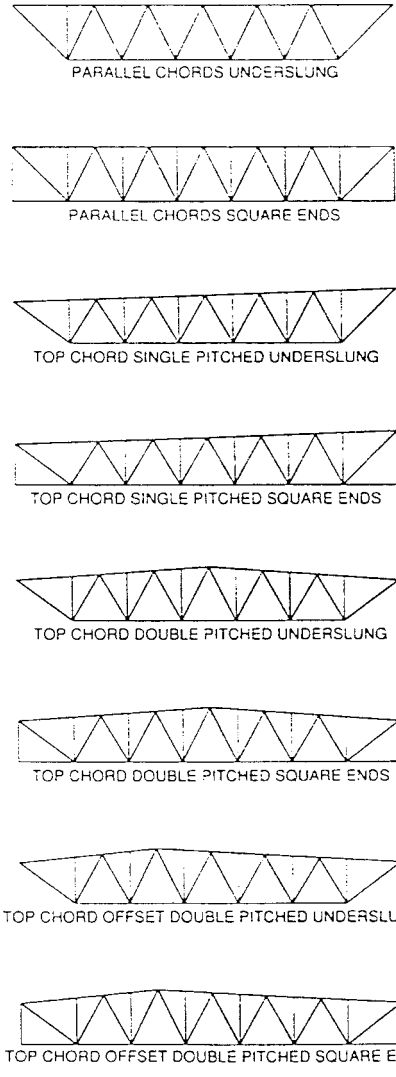
Standard Types

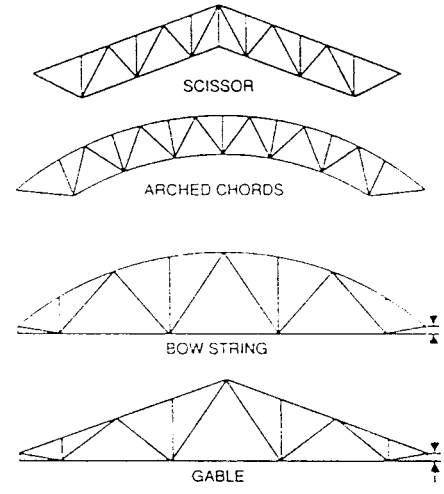
Longspan steel joists can be furnished with either underslung or square ends, with parallel chords, or with single- or double-pitched top chords to provide sufficient slope for roof drainage.

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.

Nonstandard 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 that they might have.





*Contact Vulcraft for minimum depth at ends.

CAMBER FOR STANDARD TYPES

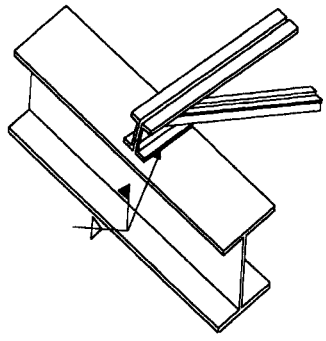
LH & DLH series joists shall have camber in accordance with the following table:**

Top Chord Length	Approx. Camber
20' 30' 40'	1/4" 3/8" 5/8"
50' 60' 70'	1" 1 1/2" 2"
80' 90' 100'	2 3/4" 3 1/2" 4 1/4"
110' 120' 130'	5" 6" 7"
140' 144'	8" 8 1/2"

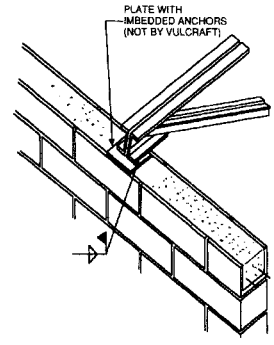
** NOTE: If full camber is not desired near walls or other structural members please note on the structural drawings.

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

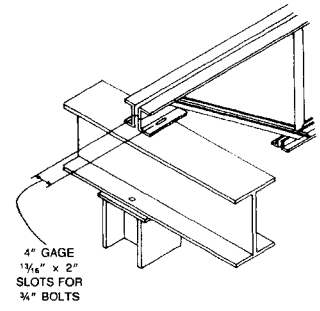
3.6.5 LH and DLH Series Longspan Steel Joists—Continued



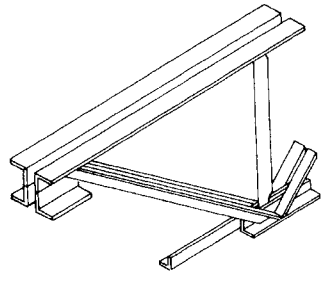
ANCHORAGE TO STEEL
SEE SJI SPECIFICATION
104.4 (b) AND 104.7 (b).



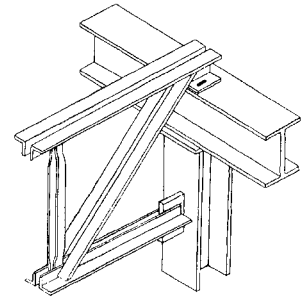
ANCHORAGE TO MASONRY
SEE SJI SPECIFICATION
104.4 (a) AND 104.7 (a).



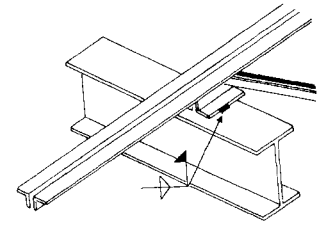
BOLTED CONNECTION (c)
Typically required at columns



CEILING EXTENSION



BOTTOM CHORD STRUT



TOP CHORD EXTENSION (a)

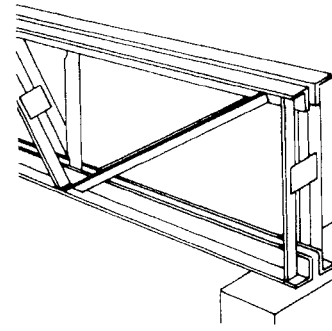
(a) Extended top chords or full depth cantilever ends require the special attention of the specifying engineer.

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 provice lateral stability during construction."



SQUARE END
See SJI Specification 104.5 (f)

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.7.0 Joist Girders—What Are They?

Joist girders are primarily framing members. The design is simple span supporting equally spaced concentrated loads from open-web steel joists. These concentrated loads are considered to act at the panel points of the joist girder. Joist girders are designed to allow for the efficient use of steel in longer spans for primary framing members.

The following weight tables list joist girders from 20" to 96" deep and spans up to 100 feet. (For depths and lengths not listed, contact Vulcraft.) The depth designation is determined by the nominal depth at the center of the span, except for offset double-pitched girders, where the depth is determined at the ridge.

The standard configuration of a joist girder is a parallel chord with underslung ends and bottom chord extensions. (Joist girders can be furnished in other configurations.) The standard depth of bearing for joist girders is 6 inches* at the end of the bearing seat.

The standard method of connecting girders to columns is two ¾" diameter A325 bolts. A loose connection of the lower chord to the column or other support is required during erection in order to stabilize the lower chord laterally and to help brace the joist girder against overturning. Caution: If a rigid connection of the bottom chord is to be made to column or other support, it is to be made only after the application of the dead loads. The joist girder is then no longer simply supported and the system must be investigated for continuous frame action by the specifying engineer.

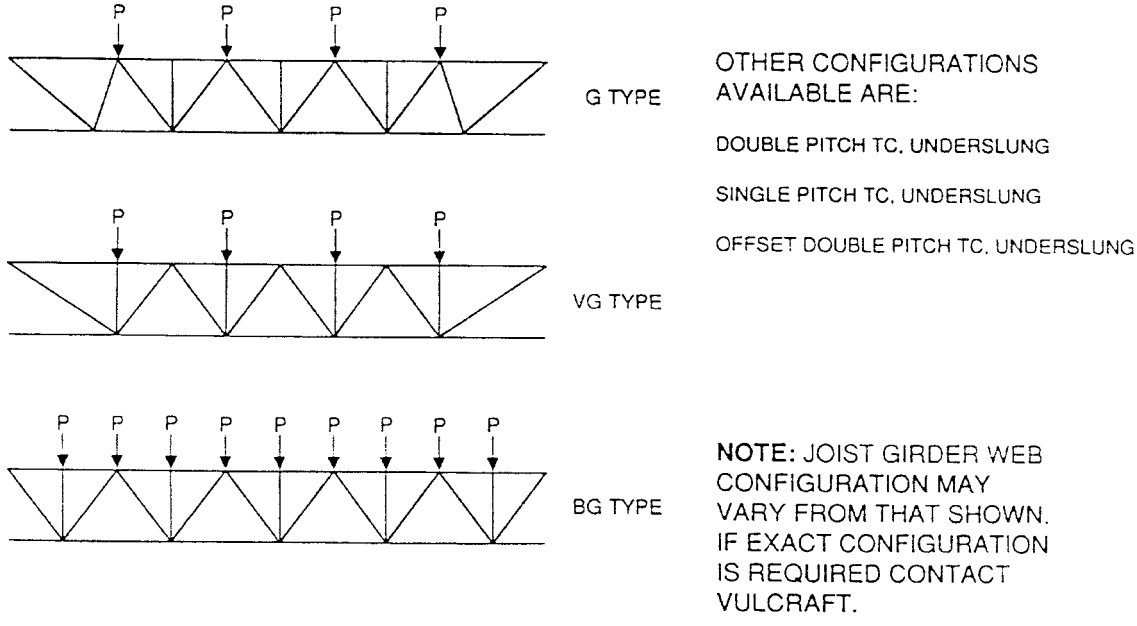
Joist girders along the perimeter, with joists coming in from one side only, and those with unbalanced loads must be designed so that the reactions pass through the center of the joist girder.

The weight tables list the approximate weight per linear foot for a joist girder supporting the panel point loads given by the specifying engineer. Note: The weight of the joist girder must be included in the panel point load.

For calculating the approximate deflection or checking ponding the following formula can be used in determining the approximate moment of inertia of the joist girder.

$$I_{JG} = 0.027\,NPLd$$

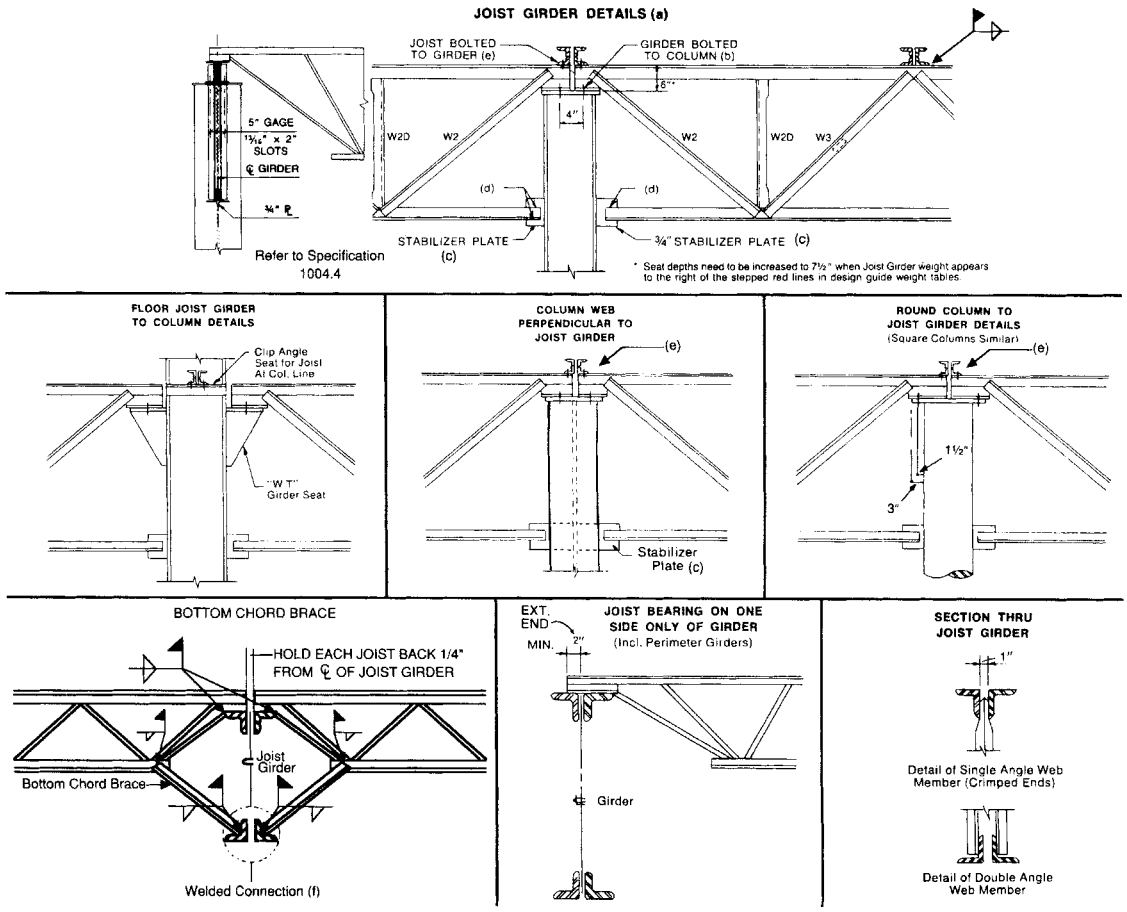
Where N = number of joist spaces, P = panel point load in kips, L = joist girder length in feet, and d = effective depth of the joist girder in inches. Contact Vulcraft if a more exact joist girder moment of inertia must be known.



(By permission of Nucor Research and Development, Norfolk, Nebraska.)

*Increase seat depth to 7½ inches if weight of joist girder appears to the right of the stepped blue lines in the weight tables.

3.7.1 Joist Girder Notes and Connection Details



(a) All Joist Girder dimensions shown are subject to change when required by the physical size of large Joist Girders. If changes are necessary Vulcraft will so note on the placing plans.

(b) The standard connection for Joist Girders to columns is 13/16 inch slots for ¾ inch bolts in girder bearings. The girder erection bolts are by others. If the specifying engineer wishes to use the Joist Girder bearing to transmit horizontal loads, he should specify the required amount of weld to connect the Joist Girder seat to the column. For additional information see the section of this catalog "JOIST GIRDERS IN MOMENT RESISTIVE FRAMES."

(c) Stabilizer plates between bottom chord angles stabilize the bottom chord laterally and brace the Joist Girder against overturning during erection. (Refer to 1004.4)

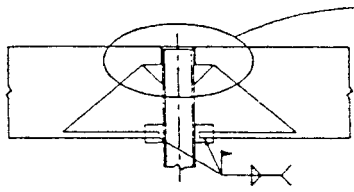
(d) Joist Girder bottom chord struts do not require welding to the stabilizer plate unless required by design to transmit horizontal forces. When welding is required, the amount of weld should be specified by the specifying engineer. UNLESS OTHERWISE SPECIFIED, BOTTOM CHORD STRUTS SHOULD NOT BE WELDED.

(e) Joists are connected to the girder by welding except that the joists at (or nearest) the column shall be bolted (O.S.H.A. Sec. 1910.12 Construction Standards Sec 1518.751).

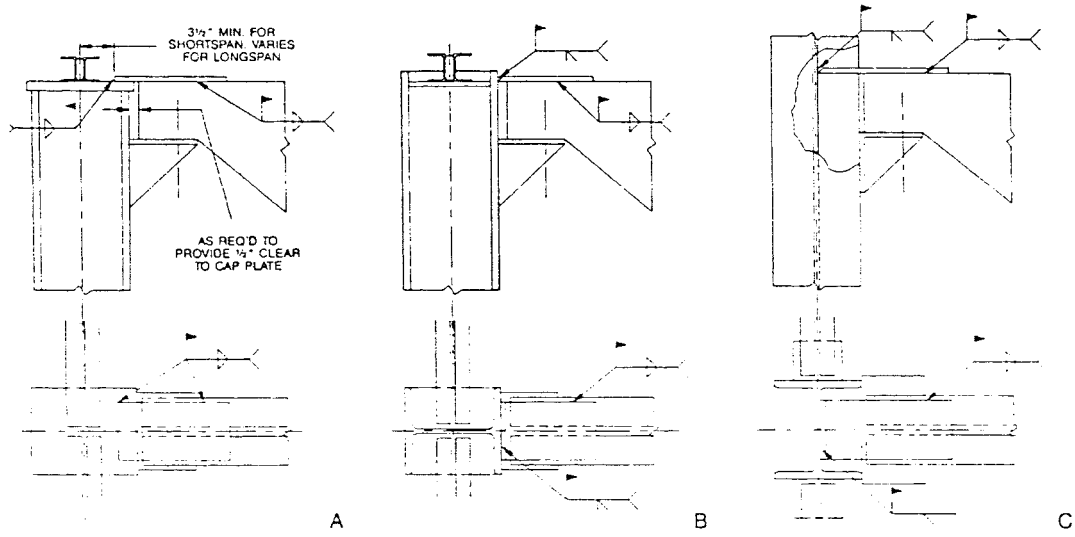
(f) The *l/r*y of the bottom chord of the Joist Girder cannot exceed 240. For STANDARD Joist Girders, the specifying engineer can use the "Joist Girder Bottom Chord Brace Chart" in conjunction with the "Design Guide Weight Table/Joist Girders, G Series" to select the correct number of bottom chord braces. Joist Girders which must resist uplift, end moments, or axial bottom chord forces may require additional braces.

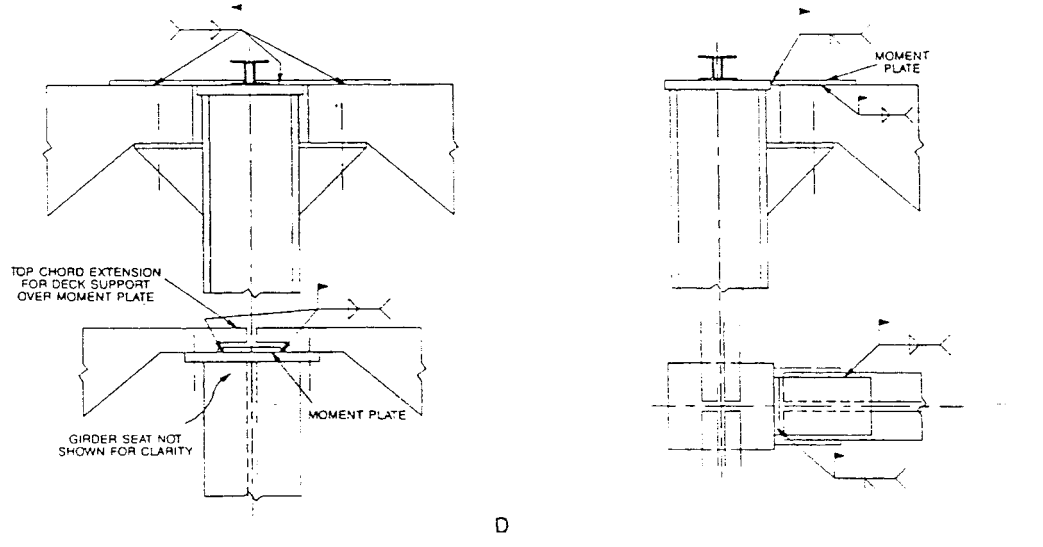
(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.7.2 Joist Girder Moment Connection Details



Presented below are five suggested details for a moment resistive connection involving roof Joist Girders. Similar details could also be utilized for longspan or even shortspan joists with end moments. In all cases, the bottom chord is to be connected to the column with a vertical stabilizer plate which is to be sized to carry the required load and obtain required weld (use 6 × 6 × ¾ plate minimum for Joist Girders).



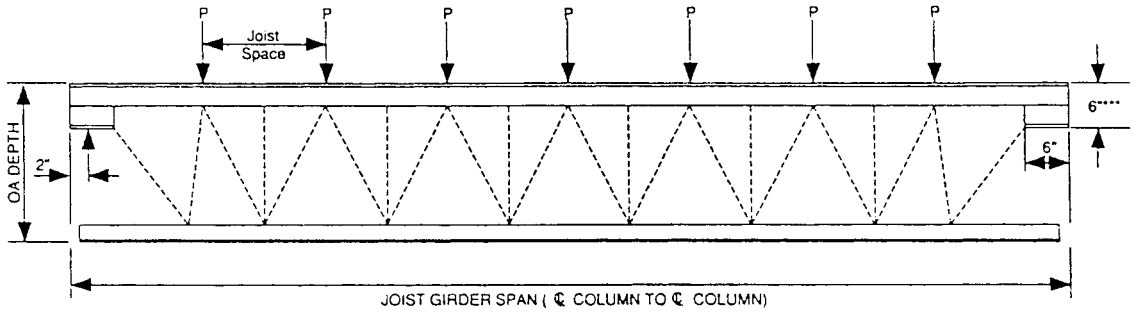


NOTES:
(1) Connections type B & C would also be recommended for floor girder details.
(2) Where a backer bar is required for groove welds, additional clearance must be provided when determining girder hold back dimension.
(3) Similar details would apply at other types of columns.
(4) Additional stiffener plates as required not shown for clarity.
(5) In all details, moment plate design and material is not by Vulcraft.

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.7.3 Specifying Joist Girders

For a given joist girder span, the designer first determines the number of joist spaces. Then the panel point loads are calculated and depth is selected. The following tables gives the Joist Girder weight per linear foot for various depths and loads.



STANDARD DESIGNATION

48**G	8N	8.8K*
Depth in Inches	Number of Joist Spaces	Kip Load on Each Panel Point (One Kip = 1000 lbs.)

Example: Given : 50'-0 x 40'-0 bay Joists spaced on 6'-3 centers

Live Load = 20 psf
Dead Load = 15 psf *
Total Load = 35 psf

Note: Web configuration may vary from that shown. Contact Vulcraft if exact layout must be known.

* Includes the approximate Joist Girder weight in panel point loads.
**See page 59 for other Girder Types.
*** Increase to 7 1/2" if weight of Joist Girder is to right of stepped lines in the weight tables.

1. Determine number of actual joist spaces (N).
   In this example, N = 8
2. Joist Selection
   a) Span = 40'-0
   b) T.L. = 6.25 x 35 = 219 plf
   c) from K-Series load tables select a 22K7
   (T.L. = 231 > 219; L.L. = 185 > 125)
   123 x 1.5 = 185 (l/240 limit applies since ceiling is not plastered)
3. Joist Girder Selection
   a) compute the concentrated load at top chord panel points P = 219 x 40 = 8,760 lbs. = 8.8 kips (use 9K for depth selection) Live load deflection rarely governs in Joist Girder selection because of their depth.
   b) Select girder depth
   The 50'-0 span 8 panel Joist Girder table on page 72 indicates that the rule of about one inch of depth for each foot of span is a good compromise of limited depth and economy. Therefore select 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 is 43 pounds per lineal foot
   e) total weight of this Joist Girder system per square foot is:

   Joists 9.7 plf/6.25 = 1.55
   Girder 43 plf/40 = 1.07
   2.62 psf

4. For rectangular bays check economy with joists and girders spanning the opposite way

   Joists (26K10) 13.8 plf/6.67 = 2.07
   Girder (40G6N12K) 41 plf/50 = .82
   2.89 psf

NOTES:
1. When it is required to have joists bear only at vertical web members to gain space for duct work, the Joist Girder should be labeled as a "VG" in lieu of a "G".
2. The following tables serve as a design guide only. Odd size joist girder lengths, depths, kip loadings, and panel lengths are available.
3. Based on tests by Underwriters Laboratories Inc., Vulcraft Joist Girders have been approved for use in designs P231, G256, G514, N732, N754 and N736 as primary framing members. For additional fire resistance information, see FIRE RATING SECTION on page 83 and the Underwriters Laboratories Fire Resistance Directory.

(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.8.0 Recommended Maximum Spans for Steel Decking

Recommended Maximum Spans for Construction and Maintenance Loads Standard 1½-Inch and 3-Inch Roof Deck

	Type	Span Condition	Span ft-In.	Maximum Recommended Spans Roof Deck Cantilever
Narrow Rib Deck	NR22	1	3'-10"	1'-0"
	NR22	2 or more	4'-9"	
	NR20	1	4'-10"	1'-2"
	NR20	2 or more	5'-11"	
	NR18	1	5'-11"	1'-7"
	NR18	2 or more	6'-11"	
Intermediate Rib Deck	IR22	1	4'-6"	1'-2"
	IR22	2 or more	5'-6"	
	IR20	1	5'-3"	1'-5"
	IR20	2 or more	6'-3"	
	IR18	1	6'-2"	1'-10"
	IR18	2 or more	7'-4"	
Wide Rib Deck	WR22	1	5'-6"	1'-11"
	WR22	2 or more	6'-6"	
	WR20	1	6'-3"	2'-4"
	WR20	2 or more	7'-5"	
	WR18	1	7'-6"	2'-10"
	WR18	2 or more	8'-10"	
Deep Rib Deck	3DR22	1	11'-0"	3'-6"
	3DR22	2 or more	13'-0"	
	3DR20	1	12'-6"	4'-0"
	3DR20	2 or more	14'-8"	
	3DR18	1	15'-0"	4'-10"
	3DR18	2 or more	17'-8"	

Type (gage)	Design Thickness		Minimum Thickness	
	in.	mm	in.	mm
28	0.0149	0.38	0.014	0.35
26	0.0179	0.45	0.017	0.43
24	0.0238	0.60	0.023	0.57
22	0.0295	0.75	0.028	0.71
20	0.0358	0.91	0.034	0.86
18	0.0474	1.20	0.045	1.14
16	0.0598	1.52	0.057	1.44

Finishes available are:

1. Galvanized (Conforming to ASTM A924-94 and or ASTM A653-94);
2. Uncoated (Black);
3. Painted with a shop coat of primer paint (one or both sides).

The uncoated finish is, by custom, referred to as "black" by some users and manufacturers; the use of the word "black" does not refer to paint color on the product.

3.8.1 Checklist for Ordering Metal Deck

DECK ORDERING CHECK LIST — Steel Deck Institute

I. Deck Profile
- Wide Rib (WR)—B
- Intermediate Rib (IR)—F
- Narrow Rib (NR)—A
- 3″ Deep Rib (3DR)—N
- Other

II. Deck Type (thickness) see SDI manual for decimal thickness
- 22
- 20
- 18
- 16
- Cellular Bottom Plate
- 20
- 18
- 16
- Other—Specify decimal thickness

III. Deck Finish
- Prime Painted—Manufacturers Standard
- G60 Galvanized
- G90 Galvanized
- Prime Paint (manufacturers standard) over G60 Galvanizing Uncoated
- Other—Specify in Separate Document

IV. Is Fire Rating Required?
- Yes—Give Appropriate U.L. Design Number and Hours Required or F.M. Number

V. Sheet Length Limits
- None or Specify

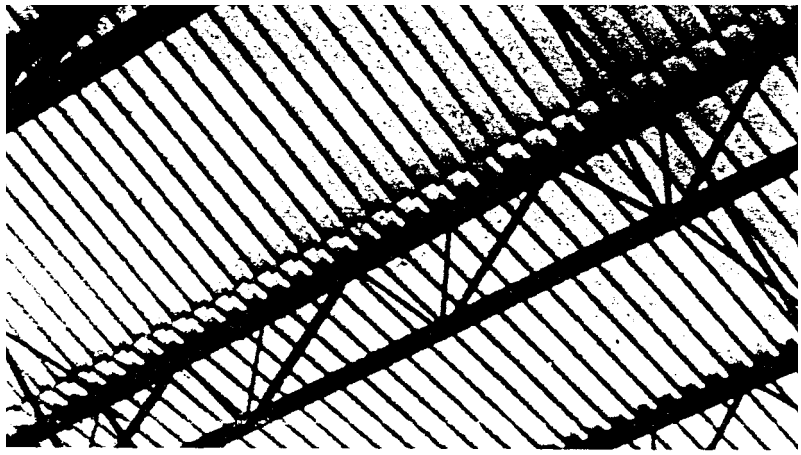
VI. Bundle Weight Restrictions
- Not to exceed _____lbs.
- No Restrictions

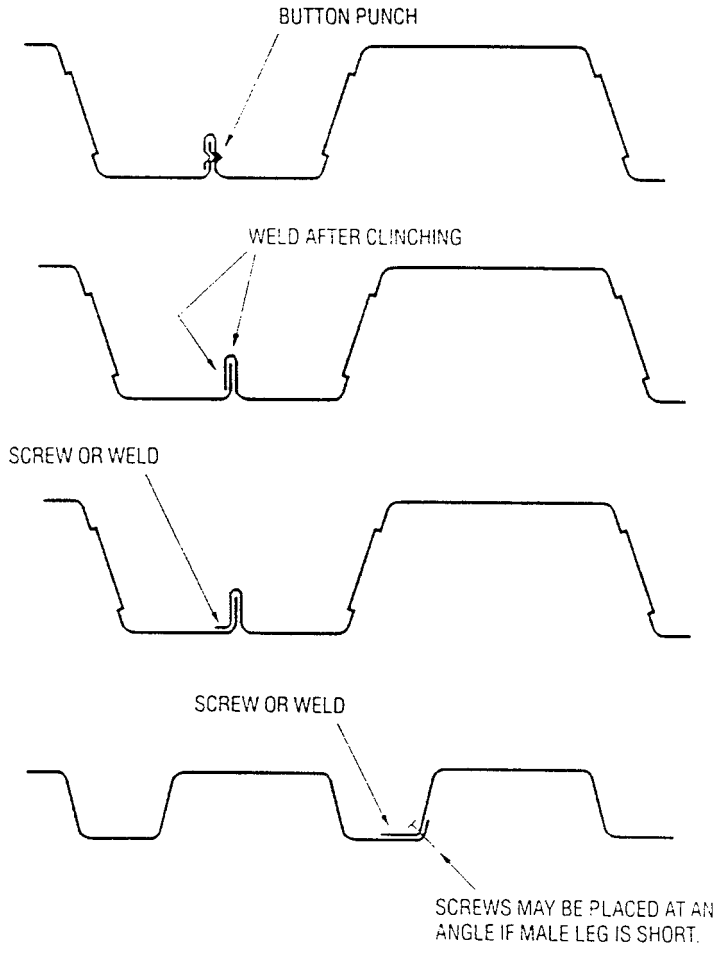
VII. Required Space between Bundles for Hoisting Devices
- Standard 1½″
- Other—Specify

VIII. Special Tagging on Bundles
- U.L. Labels
- F.M. Labels
- Other—Specify

Any special sequencing, timing or other restrictions must be provided to the deck supplier. The deck receiver must also supply a complete and accurate address for shipping.

3.8.2 Methods of Lapping Steel Deck





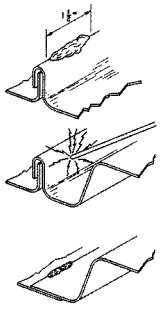
3.8.3 Side Lap Connections

Sheet to sheet connections may be required at the side laps of deck. These are frequently referred to as stitch connections. Self drilling screws, welds or button punches are the usual stitch connections. Stitch screws are usually self drilling type; #8's through ¼ inch diameter can be used but screws smaller than #10 diameter are not recommended. The installer must be sure that the underlying sheet is drawn tightly against the top sheet. Again, as when screws are used as the frame attachment, the special screw driving guns are used to prevent over torquing.

Manual button punching of side laps requires a special crimping tool. Button punching requires the worker to adjust his weight so the top of the deck stays level across the joint. Since the quality of the button punch attachment depends on the strength and care of the tool operator, it is important that a consistent method be developed. Automatic power driven crimping devices are rarely seen on deck jobs but should not be ruled out as a fastening method.

Good metal to metal contact is necessary for a good side lap welds. Burn holes are the rule rather than the exception and an inspector should not be surprised to see them in the deck. The weld develops its strength by holding around the perimeter. A good weld will have 75% or more of its perimeter working. On occasion, side lap welds will be specified for deck that has the button punchable side lap arrangement (see Figure 8 for comments on this subject; see Figures 8 and 9 for welding these deck units to the frame). Welding side laps is not recommended for decks type 22 (0.028 inch minimum) or lighter. Weld washers should never be used at side laps between supports. Just as when welding to the frame, adequate ventilation must be available and welding near combustibles prohibited.

SIDE LAP WELDS BETWEEN SUPPORTS
Figure 8A

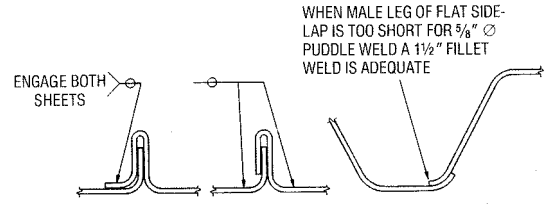


This may be a difficult weld to make. The upstanding leg must be caught by the weld.

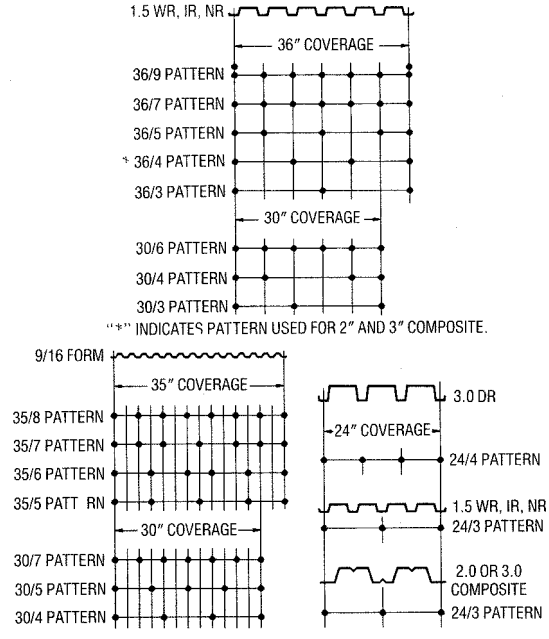
Welding from the side (after clinching metal) can be accomplished if rib does not interfere with rod.

Building a fillet on deck lighter than 20 gage is difficult. Two spot welds would be easier and would probably be just as effective.

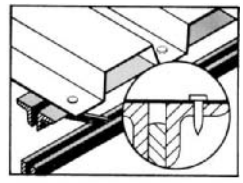
SIDE LAP WELDS AT SUPPORTS
Figure 8B

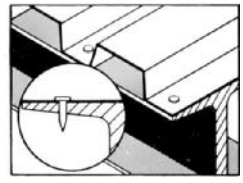


FRAME CONNECTION LAYOUTS
Connections may be arc puddle welds, screws powder-actuated, or pneumatically driven fasteners.
Figure 9



3.8.4 Welding Procedures for Metal Deck





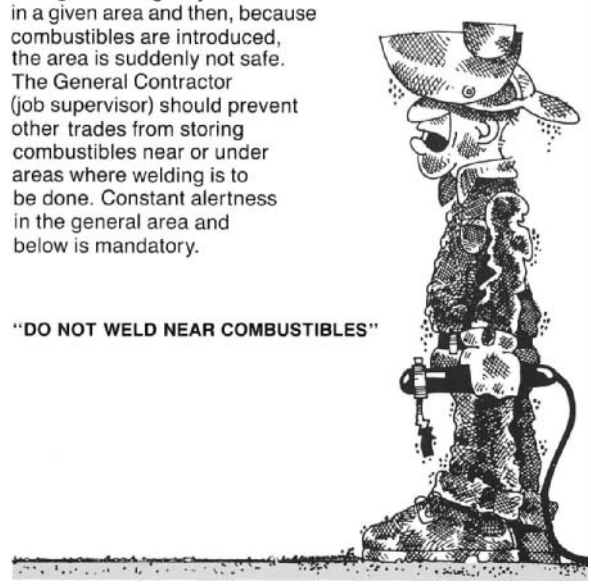
Air Driven/Pneumatic

Welding

Welding must be done by a qualified welder during proper weather conditions. Quality welding of light gage deck requires experience and the selection of proper amperage and electrodes. All welding should be done in accordance with the Structural Welding Code, AWS D1.1 or D1.3. Weld washers are not recommended for deck thicknesses of 0.028 inches thick (minimum 22 gage) and greater. Weld washers are recommended for metal thicknesses less than 0.028 inches. Proper welding requires good metal to metal contact; therefore, lapping composite deck units with shear lugs is not recommended. For the same reason, built in hanger tabs (in floor deck) that bear on structural steel should be flattened or removed.

Welding should not be done near any type of combustible material. Cutting and welding sparks can cause construction fires. Conditions at a construction site are subject to rapid change. Welding may be safe in a given area and then, because combustibles are introduced, the area is suddenly not safe. The General Contractor (job supervisor) should prevent other trades from storing combustibles near or under areas where welding is to be done. Constant alertness in the general area and below is mandatory.

"DO NOT WELD NEAR COMBUSTIBLES"



3.8.5 Placing Concrete on Metal Deck

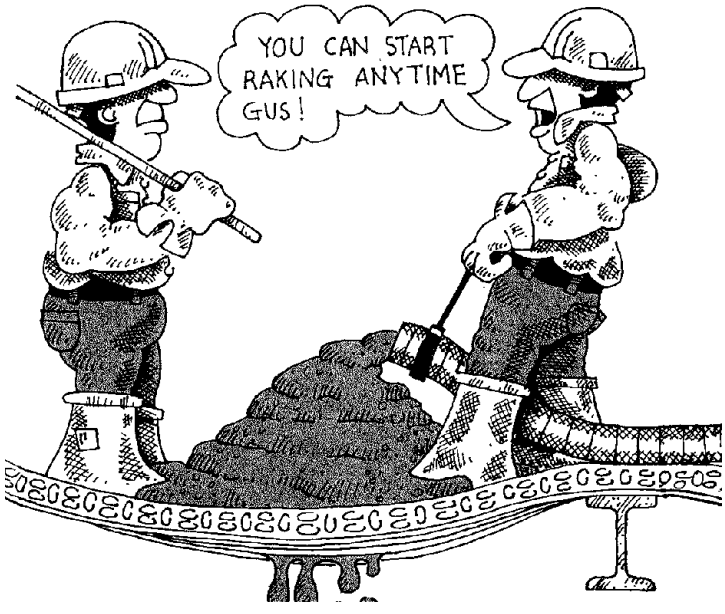
After the floor deck (or form deck) has been properly installed, it acts as a working platform for many trades. The deck should have been selected to provide at least fifty pounds per square foot capacity as a working platform. If the contractor anticipates loads on the platform that will exceed 50 psf, he should take appropriate steps to ensure the deck will carry the load.

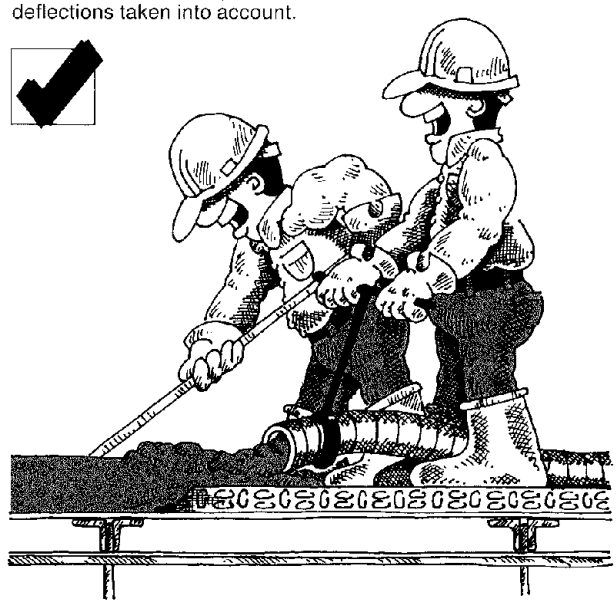
Before concrete is poured, the contractor should make sure that the deck is properly and completely fastened in accordance with approved deck erection drawings and the deck has adequate bearing on all supports. Damaged areas must be repaired or accepted. All ferrules should have been broken off the studs. All dirt and debris must be removed. All reinforcement, wires or rods, should be securely in place. The concrete contractor should review the deck shoring requirements and make sure that shores are securely in place.

Concrete should be poured from a low level to avoid impacting the deck. It should be placed uniformly over the supporting structure and spread towards the center of the deck span. Concrete should be placed in a direction so that the weight is first applied to the top sheet at the side lap, reducing the possibility of the side opening during the pour. Workers should not congregate around the concrete placement zone. If buggies are used to place the concrete, runways should be planked and the buggies should only operate on the planking. The planks should be stiff enough to transfer the buggy loads without damaging the deck. Deck damage caused by roll bars or careless placement must be avoided.

For calculating deck stresses and deflections during concreting the SDI loading schedule as shown in figure 16 is recommended. This method of analysis has been in use for many years and has provided good results. Because pouring room can be restricted, special consideration is required for single span conditions. For example, a single span condition commonly occurs between elevator shafts, and it is likely that concrete placement will be less controlled. A 50% factor is then added to the concrete weight and a deck gage selected is based on this loading. As an alternative, shoring may be specified. Although deck connections are important for all span conditions, they are extremely important for single spans. Connections should be thoroughly checked.

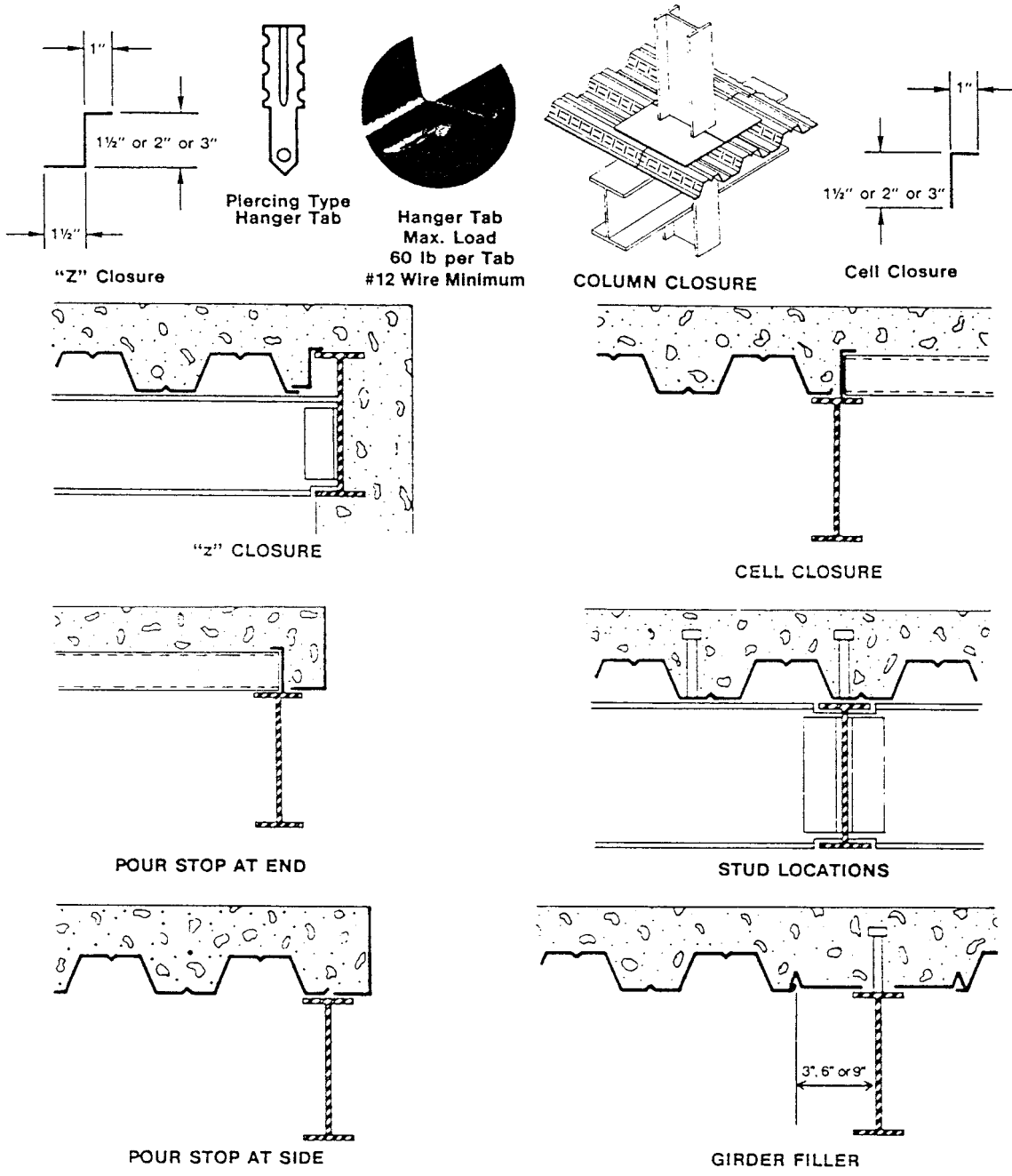
As concrete is placed, the entire frame as well as the deck will deflect. Concrete quantities should be calculated with all deflections taken into account.





(Copyright 1992 Steel Deck Institute, Fox River Grove, Illinois. Reprinted with permission.)

3.8.6 Noncomposite and Composite Deck Details



(By permission of Nucor Research and Development, Norfolk, Nebraska.)

3.8.7 Shear Studs and Composite Decks

Shear stud facts:

1. Shear studs are used to make steel beams composite. They are not necessary to make the deck composite but they enhance the load capacity of the composite slab. At times shear studs are not used to make beams composite but are present to transfer diaphragm shear loads into the frame. In this case the American Institute of Steel Construction (AISC) spacing rules for composite construction do not apply.
2. Most UL floor assembly fire ratings accept shear studs as an option.
3. The maximum shear stud diameter allowable by AISC is ¾ inch (19 mm) diameter. Each stud must be at least 1½ inches (38.1 mm) longer than the depth of the deck rib.
4. The location of the stud within the deck rib is important. Optimum construction of composite beams places the stud in the portion of deck rib closest to the beam end.
5. Shear studs can replace the welds used to attach the deck to the beam; however, if the studs are spaced greater than 12" on center (25.4 mm), welds of ⅝ inch (15.9 mm) should be used where the studs are missing.
6. Shear studs can be welded through galvanizing, but the G90 coating is the maximum recommended for this purpose. Shear studs can also be welded through cellular deck. The above information was provided by United Steel Deck, Inc., and is meant to be used as a guideline only since structural requirements may vary from project to project.

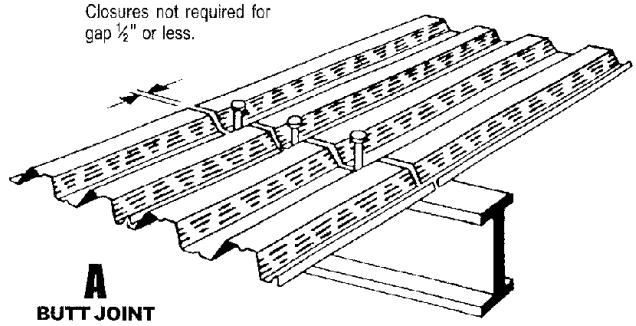
3.8.7 Shear Studs and Composite Decks—Continued

Special deck arrangements-when shear studs are present.

All LOK-FLOOR is furnished in 24 inch or 36 inch widths. Any cutting that is required shall be done in the field by the deck erector.

Lateral and longitudinal spacing is controlled by sec. I5 A.I.S.C. Manual of Steel Construction. For location of stud to edge of flange see Structural Welding Code AWS 7.4.5.

Closures not required for gap ½" or less.



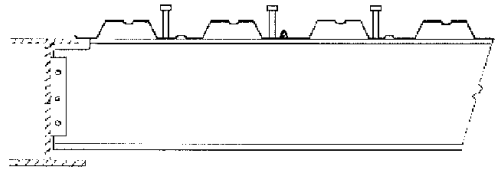
A
BUTT JOINT

When studs are used deck must not be lapped in order to permit welding of studs.

$$\text{Rib Coefficient} = \frac{0.85}{\sqrt{N}}\left(\frac{w}{h}\right)\left(\frac{H}{h} - 1.0\right) \leq 1.0$$

N = Number of studs per rib.
H = Length of stud.
h = Height of rib.
w = Average width of rib.

For best construction of composite beams place studs in the portion of the deck rib closest to the beam end.

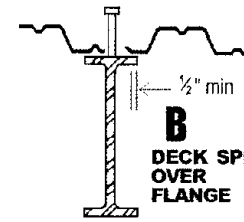


STUDS ARE ¾" DIAMETER			
CONCRETE*		STUD STRENGTH	
f_c', ksi	weight, pcf	LRFD Q_n, kips	ASD Q_n, kips
3.0	115	17.7	9.9
3.0	145	21.0	11.5
3.5	115	19.8	10.8
3.5	145	23.6	12.5
4.0	115	21.9	11.4
4.0	145	26.1	13.3

*145 pcf concrete made with ASTM C33 aggregates. 115 pcf concrete made with ASTM C330 aggregates.

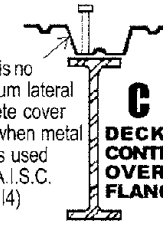
DECK RIB RATIOS	
DECK TYPE	w/h
1.5" B Lok	1.5
1.5" Inverted B Lok	2.5
1.5" Lok Floor	3.85
2" Lok Floor	3.0
3" Lok Floor	2.0

Girder Details



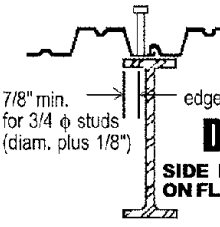
B
DECK SPLIT OVER FLANGE

There is no minimum lateral concrete cover req'd when metal deck is used (See A.I.S.C. Spec. I4)



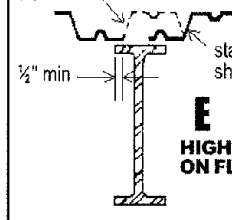
C
DECK CONTINUOUS OVER FLANGE

7/8" min. for 3/4 ϕ studs (diam. plus 1/8")



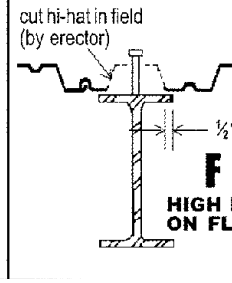
D
SIDE LAP ON FLANGE

cut hi-hat in field (by erector)



E
HIGH HAT ON FLANGE

cut hi-hat in field (by erector)



F
HIGH HAT ON FLANGE

(By permission from the Steel Deck Institute, Fox River Grove, Illinois.)

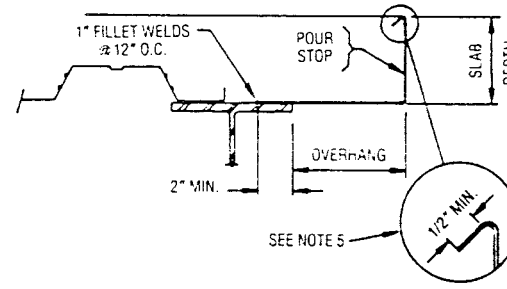
3.8.8 Pour Stop Selection Table

Allowable cantilever of metal deck where pour stops are required.

SELECTION TABLE

SLAB DEPTH (Inches)	OVERHANG (INCHES)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
	POUR STOP TYPES												
4.00	20	20	20	20	18	18	16	14	12	12	12	10	10
4.25	20	20	20	18	18	16	16	14	12	12	12	10	10
4.50	20	20	20	18	18	16	16	14	12	12	12	10	10
4.75	20	20	18	18	16	16	14	14	12	12	10	10	10
5.00	20	20	18	18	16	16	14	14	12	12	10	10	
5.25	20	18	18	16	16	14	14	12	12	12	10	10	
5.50	20	18	18	16	16	14	14	12	12	12	10	10	
5.75	20	18	16	16	14	14	12	12	12	12	10	10	
6.00	18	18	16	16	14	14	12	12	12	10	10	10	
6.25	18	18	16	14	14	12	12	12	12	10	10		
6.50	18	16	16	14	14	12	12	12	12	10	10		
6.75	18	16	14	14	14	12	12	12	10	10	10		
7.00	16	16	14	14	12	12	12	12	10	10	10		
7.25	16	16	14	14	12	12	12	10	10	10			
7.50	16	14	14	12	12	12	12	10	10	10			
7.75	16	14	14	12	12	12	10	10	10	10			
8.00	14	14	12	12	12	12	10	10	10				
8.25	14	14	12	12	12	10	10	10	10				
8.50	14	12	12	12	12	10	10	10					
8.75	14	12	12	12	12	10	10	10					
9.00	14	12	12	12	10	10	10						
9.25	12	12	12	12	10	10	10						
9.50	12	12	12	10	10	10							
9.75	12	12	12	10	10	10							
10.00	12	12	10	10	10	10							
10.25	12	12	10	10	10								
10.50	12	12	10	10	10								
10.75	12	10	10	10									
11.00	12	10	10	10									
11.25	12	10	10										
11.50	10	10	10										
11.75	10	10											
12.00	10	10											

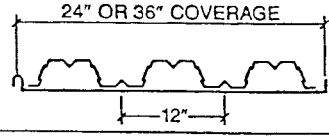
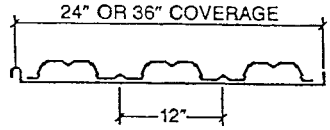
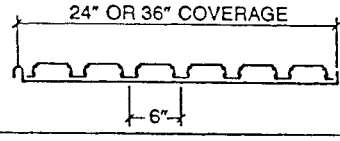
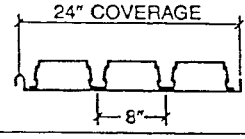
TYPES	DESIGN THICKNESS
20	0.0358
18	0.0474
16	0.0598
14	0.0747
12	0.1046
10	0.1345

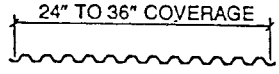
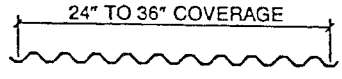
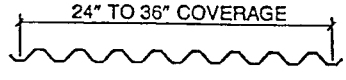
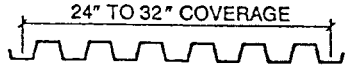


NOTES: The above Selection Table is based on following criteria:

1. Normal weight concrete (150PCF).
2. Horizontal and vertical deflection is limited to 1/4" maximum for concrete dead load.
3. Design stress is limited to 20 KSI for concrete dead load temporarily increased by one-third for the construction live load of 20 PSF.
4. Pour Stop Selection Table does not consider the effect of the performance, deflection, or rotation of the pour stop support which may include both the supporting composite deck and/or the frame.
5. Vertical leg return lip is recommended for type 16 and lighter.
6. This selection is not meant to replace the judgement of experienced Structural Engineers and shall be considered as a reference only. SDI reserves the right to change any information in this selection without notice.

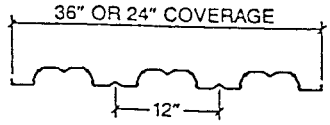
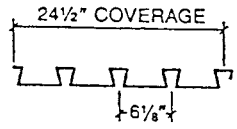
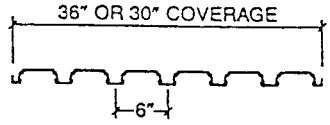
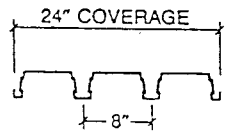
3.8.9 Cellular Floor Deck and Form Deck Profiles

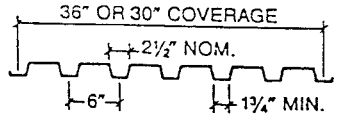
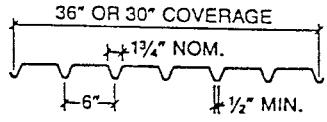
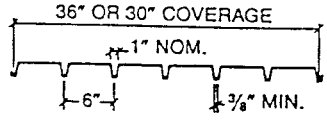
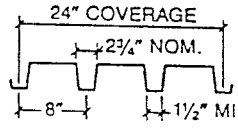
Cellular Floor Deck Profiles	Name	Nominal Thickness Range	Weight Range	Comments
	3" x 12" Composite Cellular	.03" to .06"	4 psf to 7 psf	Bottom plate may be perforated for acoustical.
	2" x 12" Composite Cellular	.03" to .06"	4 psf to 7 psf	Bottom plate may be perforated for acoustical.
	1½" x 6" Composite Cellular	.03" to .06"	4 psf to 7 psf	May also be used as roof deck. Bottom plate may be perforated for acoustical.
	3" x 8" Composite Cellular	.03" to .06"	4 psf to 7 psf	May also be used as roof deck. Bottom plate may be perforated for acoustical.

Form Deck Profiles	Name	Nominal Thickness Range	Weight Range	Comments
	9/16" x Varies Form Deck	.014" to .030"	0.8 psf to 1.5 psf	Standard form deck. Used as centering.
	15/16" x Varies Form Deck	.017" to .040"	1.0 psf to 2.0 psf	Heavy duty form deck. Used as centering.
	1 15/16" x Varies Form Deck	.017" to .047"	1.0 psf to 2.8 psf	Extra heavy duty form deck. Used as centering.
	1½" or 2" x Varies Form Deck	.023" to .047"	1.4 psf to 2.8 psf	Super duty form deck. Used as centering.

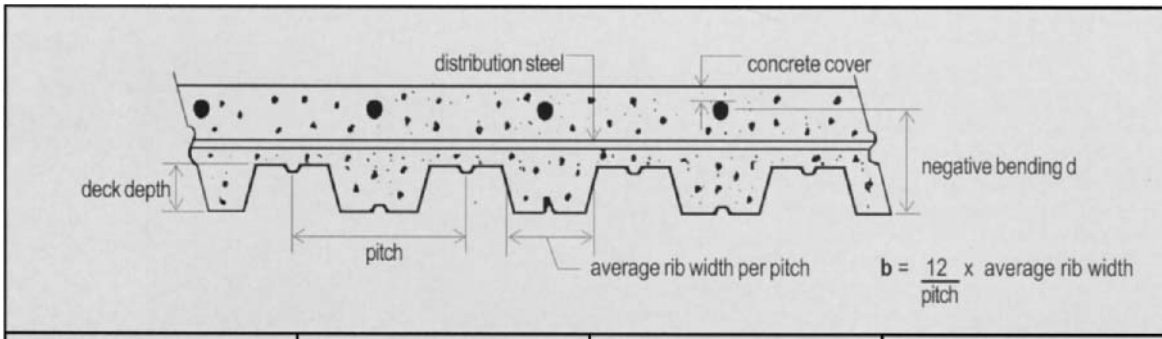
Note: All profiles may be used as roof deck (for a patented assembly)

3.8.10 Composite Floor Deck and Roof Deck Profiles

Composite Floor Deck Profiles	Name	Nominal Thickness Range	Weight Range	Comments
	1½" x 12" 2 x 12" 3" x 12" Composite	.03" to .06"	2 psf to 4 psf	Embossment patterns will vary from manufacturer to manufacturer. Side laps are flat adjustable or button punchable.
	2" x 12" Composite	.03" to .06"	2 psf to 4 psf	
	1½" x 6" Composite	.03" to .06"	2 psf to 4 psf	Embossment patterns will vary from manufacturer to manufacturer. Side laps are flat adjustable or button punchable.
	3" x 8" Composite	.03" to .06"	2 psf to 4 psf	Embossment patterns will vary from manufacturer to manufacturer. Side laps are flat adjustable or button punchable. This profile is not generally suitable for use with shear studs.

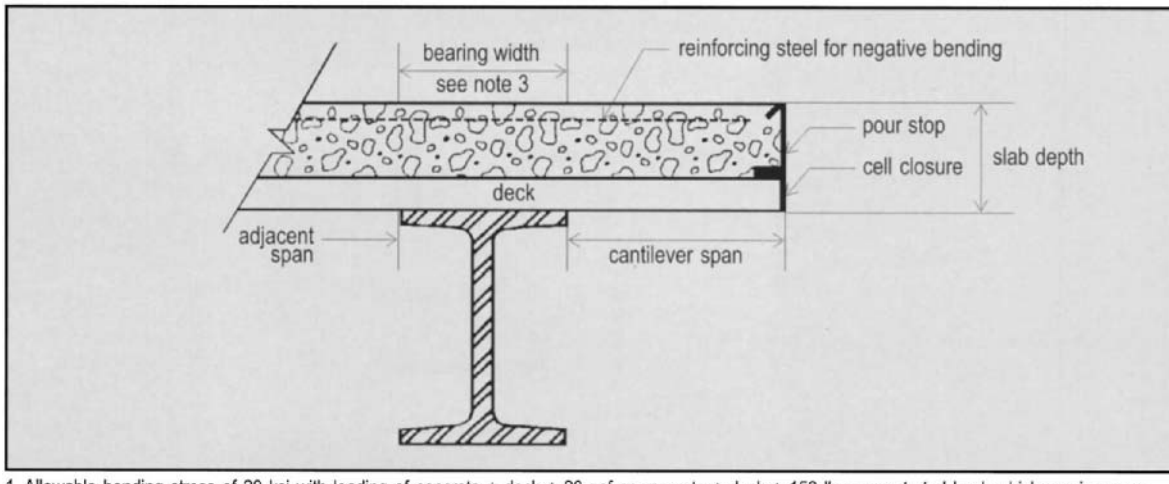
Roof Deck Profiles	Name	Nominal Thickness Range	Weight Range	Comments
	1½" x 6" Wide Rib (WR)	.03" to .06"	2 psf to 4 psf	May be referred to as "B" deck. Sidelaps may be flat adjustable or button punchable. Acoustical deck will have perforated webs.
	1½" x 6" Intermediate Rib (IR)	.03" to .06"	2 psf to 4 psf	May be referred to as "F" deck.
	1½" x 6" Narrow Rib (NR)	.03" to .06"	2 psf to 4 psf	May be referred to as "A" deck.
	3" x 8" Deep Rib (DR)	.03" to .06"	2 psf to 4 psf	May be referred to as "N" deck. Sidelaps may be flat adjustable or button punchable. Acoustical deck will have perforated webs.

3.8.11 Floor Deck Cantilevers



DECK SECTION	PITCH	AVERAGE RIB WIDTH	b WIDTH FOR NEGATIVE BENDING
B-LOK	6"	2.25"	4.5"
INV B-LOK	6"	3.75"	7.5"
LOK FLOOR	12"	6"	6"

Use Standard concrete design procedures as per ACI.



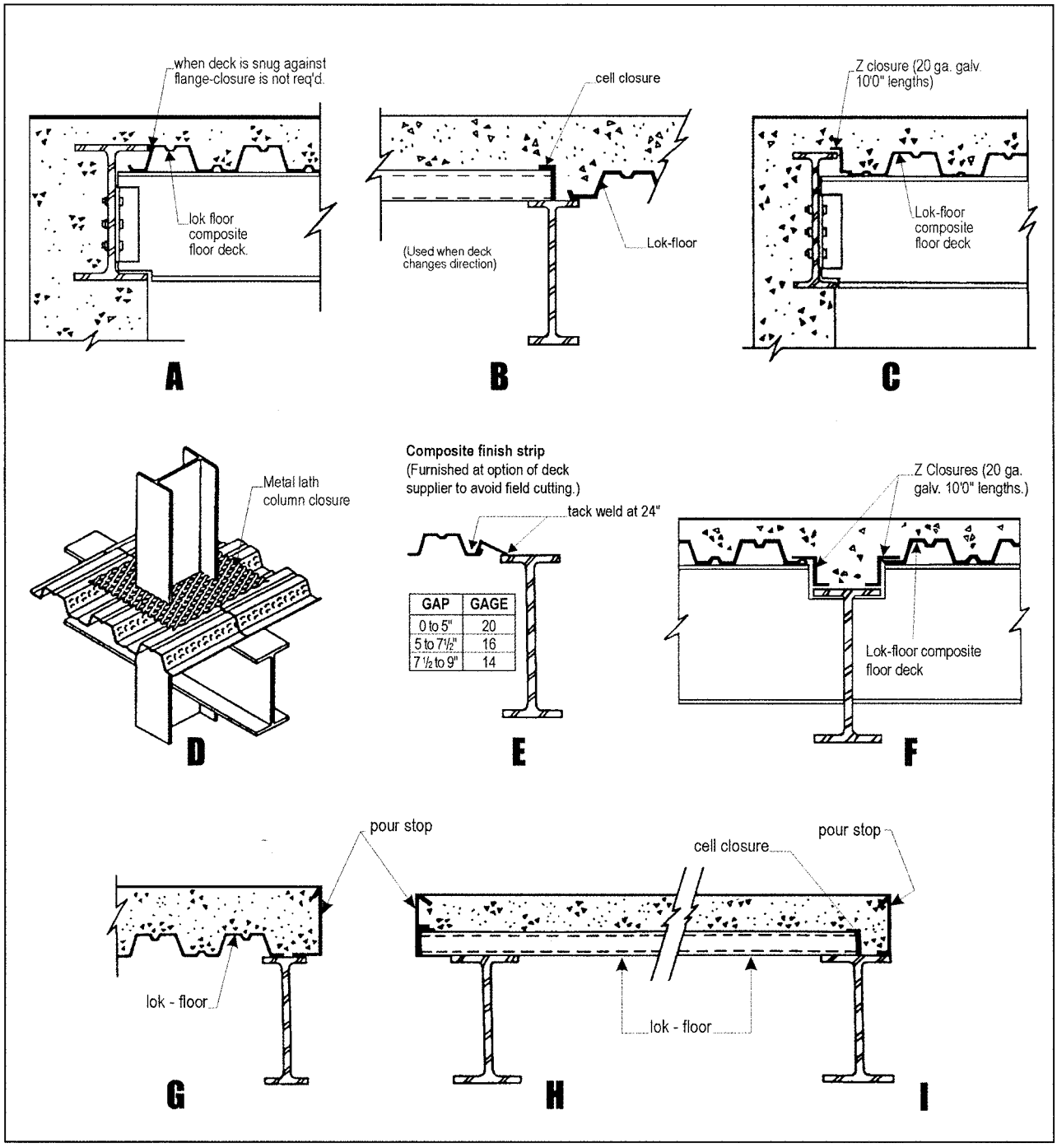
1. Allowable bending stress of 20 ksi with loading of concrete + deck + 20 psf or concrete + deck + 150 lb. concentrated load, whichever is worse.
2. Allowable deflection of free edge (based on fixed end cantilever) of 1/120 of cantilever span under loading of concrete + deck.
3. Bearing width of 3½" assumed for web crippling check; concrete + deck + 20 psf over cantilever and adjacent span: if width is less than 3½" check with the Summit, New Jersey office.

NORMAL WEIGHT CONCRETE (150 PCF)																
	United Steel Deck, Inc. DECK PROFILE															
	B-LOK				1.5 LOK-FLOOR				2.0 LOK-FLOOR				3.0 LOK-FLOOR			
SLAB DEPTH	22	20	18	16	22	20	18	16	22	20	18	16	22	20	18	16
	GAGE				GAGE				GAGE				GAGE			
4.00"	1'11"	2'3"	2'10"	3'4"	1'11"	2'4"	3'0"	3'6"								
4.50"	1'10"	2'2"	2'9"	3'3"	1'10"	2'3"	2'10"	3'4"	2'6"	2'11"	3'8"	4'3"				
5.00"	1'10"	2'2"	2'8"	3'2"	1'10"	2'3"	2'9"	3'3"	2'5"	2'10"	3'6"	4'1"	3'8"	4'3"	5'3"	6'0"
5.50"	1'9"	2'1"	2'7"	3'0"	1'9"	2'2"	2'9"	3'2"	2'4"	2'9"	3'5"	4'0"	3'7"	4'1"	5'0"	5'9"
6.00"	1'9"	2'0"	2'6"	2'11"	1'9"	2'1"	2'8"	3'1"	2'3"	2'8"	3'4"	3'10"	3'5"	3'11"	4'10"	5'7"
6.50"	1'8"	2'0"	2'6"	2'11"	1'9"	2'1"	2'7"	3'0"	2'3"	2'8"	3'3"	3'9"	3'4"	3'10"	4'8"	5'5"
7.00"	1'8"	1'11"	2'5"	2'10"	1'8"	2'0"	2'6"	2'10"	2'2"	2'7"	3'2"	3'8"	3'3"	3'9"	4'6"	5'3"
7.50"	1'8"	1'11"	2'4"	2'9"	1'8"	2'0"	2'6"	2'10"	2'2"	2'6"	3'1"	3'7"	3'2"	3'8"	4'5"	5'1"
8.00"	1'7"	1'11"	2'4"	2'8"	1'7"	1'11"	2'5"	2'10"	2'1"	2'5"	3'0"	3'6"	3'1"	3'6"	4'3"	4'11"

(By permission from the Steel Deck Institute, Fox River Grove, Illinois.)

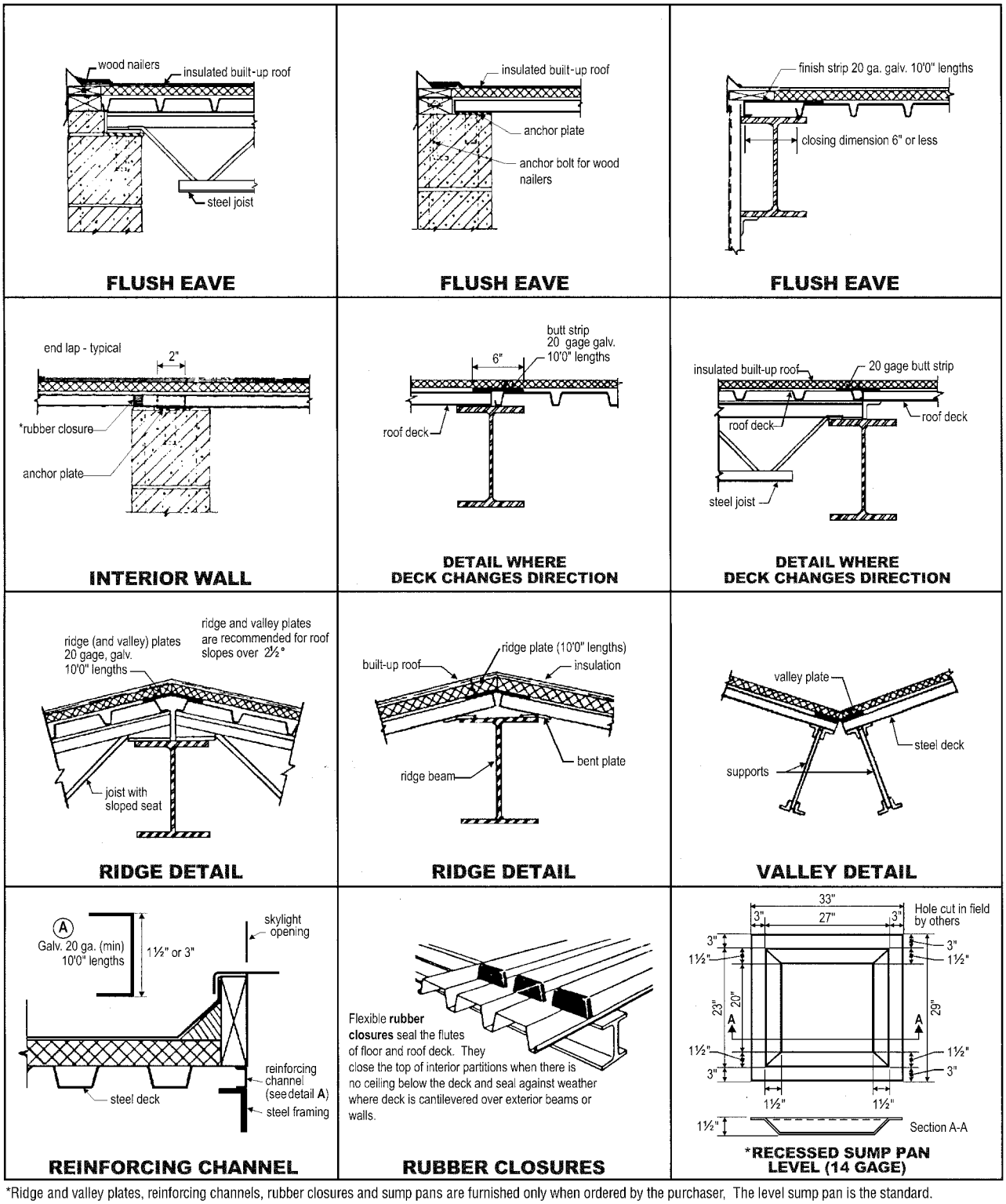
3.8.12 Deck Closure Details

The following details are used to obtain full coverage and to provide a seal against concrete leakage. B-lok details are similar.
DETAILS A THRU I ARE APPLICABLE WITH OR WITHOUT SHEAR STUDS.



(By permission from the Steel Deck Institute, Fox River Grove, Illinois.)

3.8.13 Roof Deck Closure Details



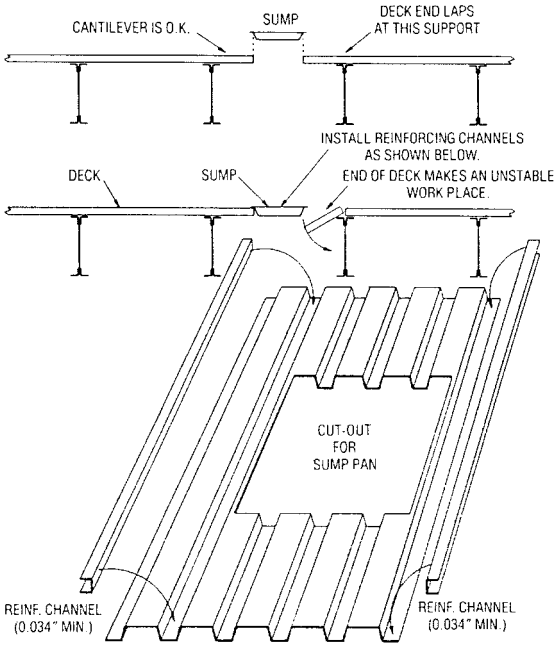
*Ridge and valley plates, reinforcing channels, rubber closures and sump pans are furnished only when ordered by the purchaser, The level sump pan is the standard.

(By permission from the Steel Deck Institute, Fox River Grove, Illinois.)

3.8.14 Reinforcing Openings in Steel Decks

Methods of cutting and reinforcing penetrations through decking.

SUMP REINFORCING AT END OF DECK



Put 1½" deep reinforcing channels in each rib at each side of opening (flush with top of deck). Channels span between joists. Attach flanges of sump pan to channels.

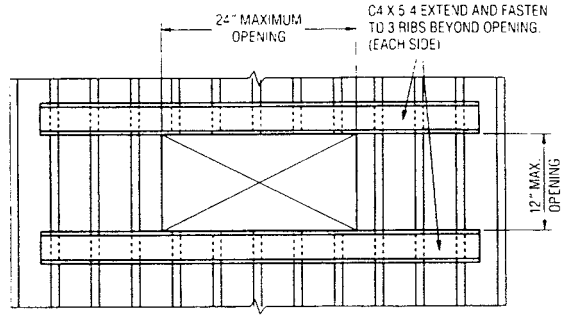
Burn holes in deck side laps, caused by welded side lap attachments, are spaced far enough apart not to cause problems. Burn holes near intermediate supports are unlikely to cause much loss of strength unless a total area greater than a 6" diameter hole is removed. These burn holes are usually caused by the welder searching for the unseen structural member; therefore, the use of chalk lines is recommended.

Distributed small dents, such as those caused by foot traffic, will not cause a structural problem; but if the denting covers a large percentage of the job, the insulation board will be better attached with mechanical fasteners rather than by adhesives. The designer must approve any change in fastening.

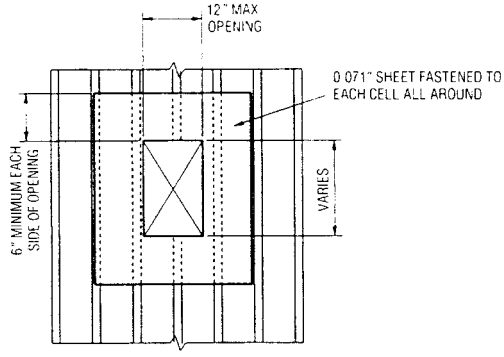
Vigilance should be maintained to detect and correct any "soft" spots in roofs that could cause insulation boards to crack under foot loading.

EXAMPLES OF DETAILS FOR OPENINGS

DETAILS FOR OPENINGS TO 2'-0" PERPENDICULAR TO DECK

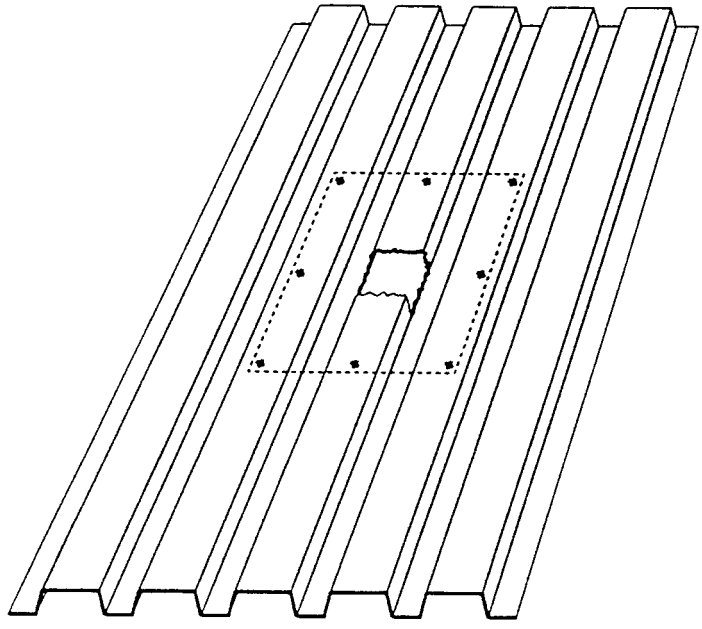


DETAILS FOR OPENINGS TO 12" PERPENDICULAR TO DECK



NOTE:
For holes 6" ∅ or less no reinforcing or minimum 0.045" plate required, depending on location.

3.8.15 Example of 6-inch Penetration in Steel Deck



SUGGESTED SCHEDULE:

One Rib Removed (6″ Diameter)	No Reinforcing Or 0.045″ Plate (Min.)
8″ Diameter	0.045″ Plate (Min.)
8″ to 13″ Diameter	0.057″ Plate (Min.)
Over 13″	Frame Opening* (Design By Project Engineer)

Check cantilever ability of deck