Elements of Architectural Structures: Form, Behavior, and Design

ARCH 614

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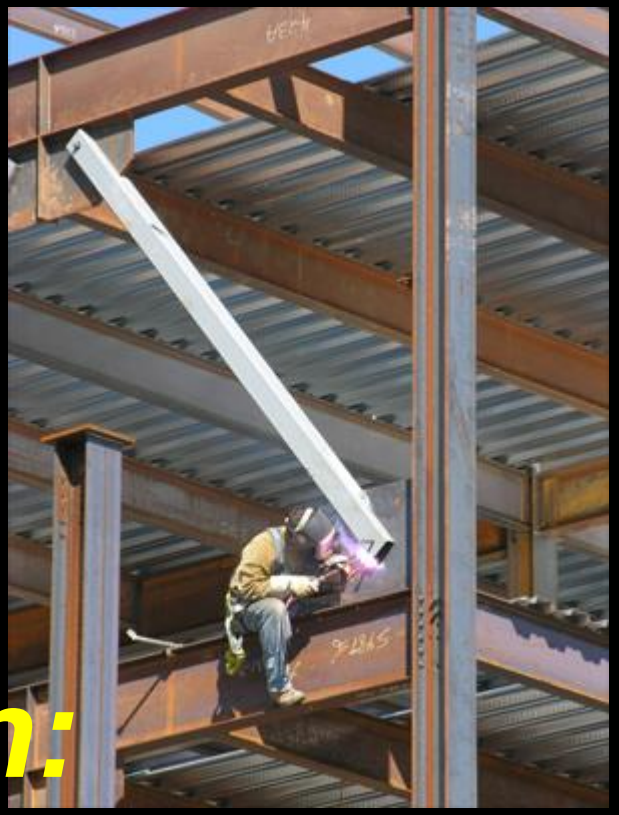
Spring 2014

lecture twenty

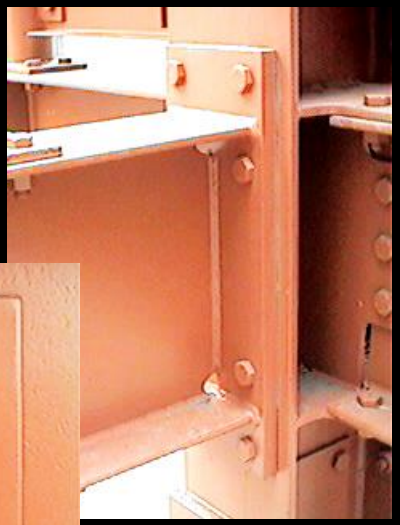


nrmc.org

steel construction: welds & light gages

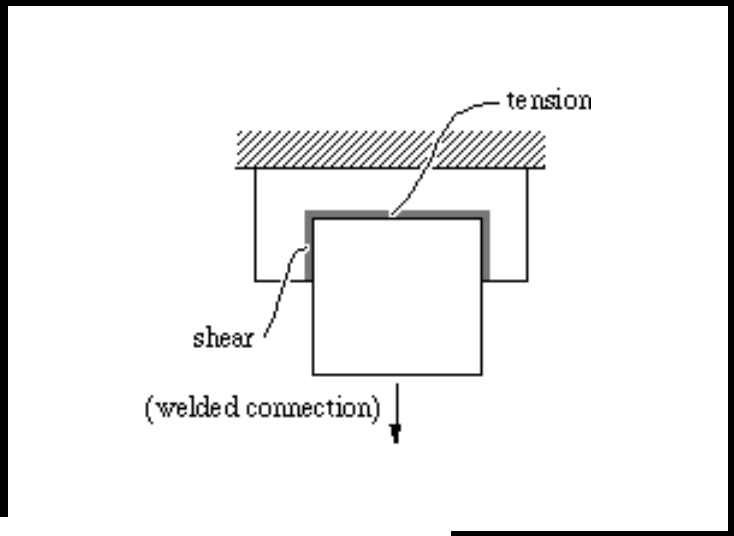
Welds

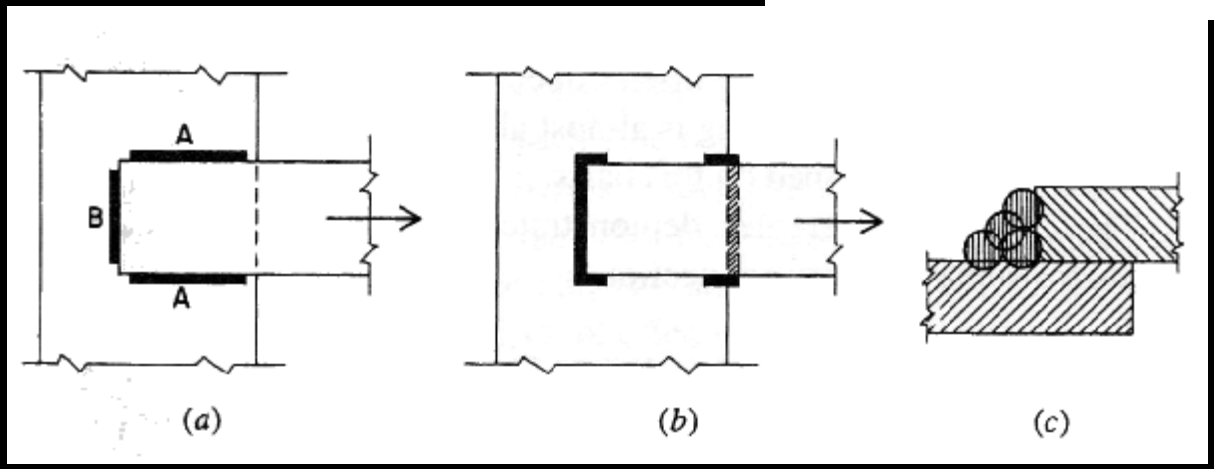
- *welded steel connections*



Welded Connection Design

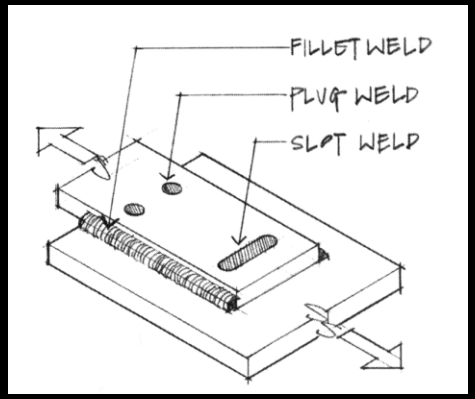
- considerations
  - shear stress
  - yielding
  - rupture

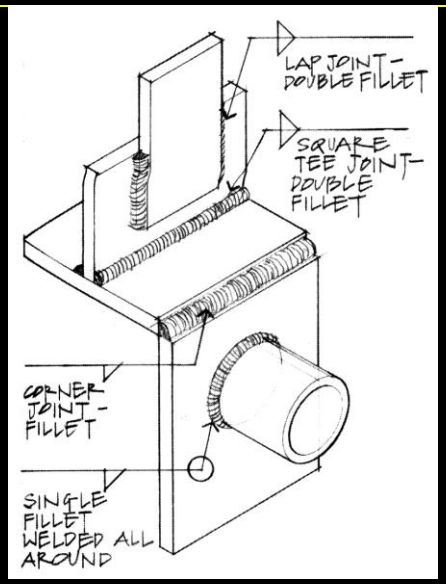


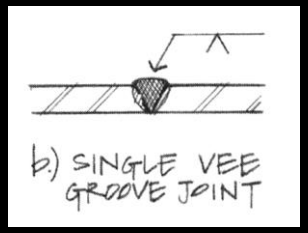


Welded Connection Design

- *weld terms*
  - *butt weld*
  - *fillet weld*
  - *plug weld*
  - *throat*
- *field welding*
- *shop welding*





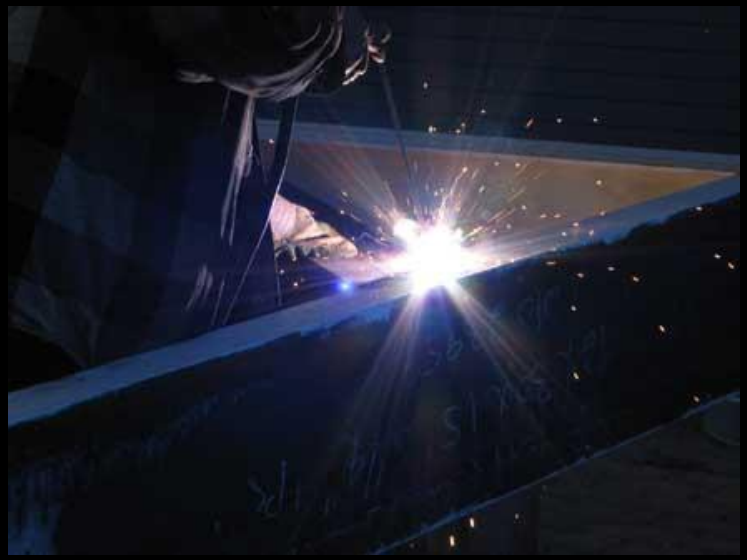


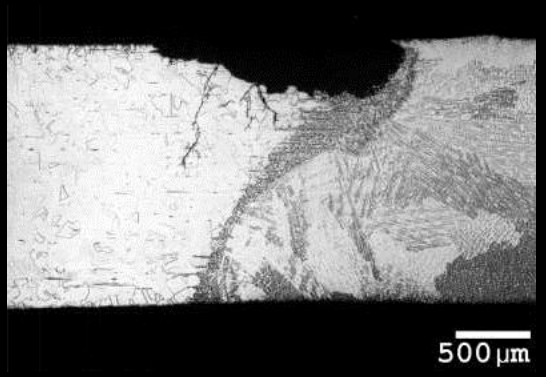
(AISC - Steel Structures of the Everyday)

Welded Connection Design

- *weld process*
  - *melting of material*
  - *melted filler - electrode*
  - *shielding gas / flux*
  - *potential defects*
- *weld materials*
  - *E60XX*
  - *E70XX*

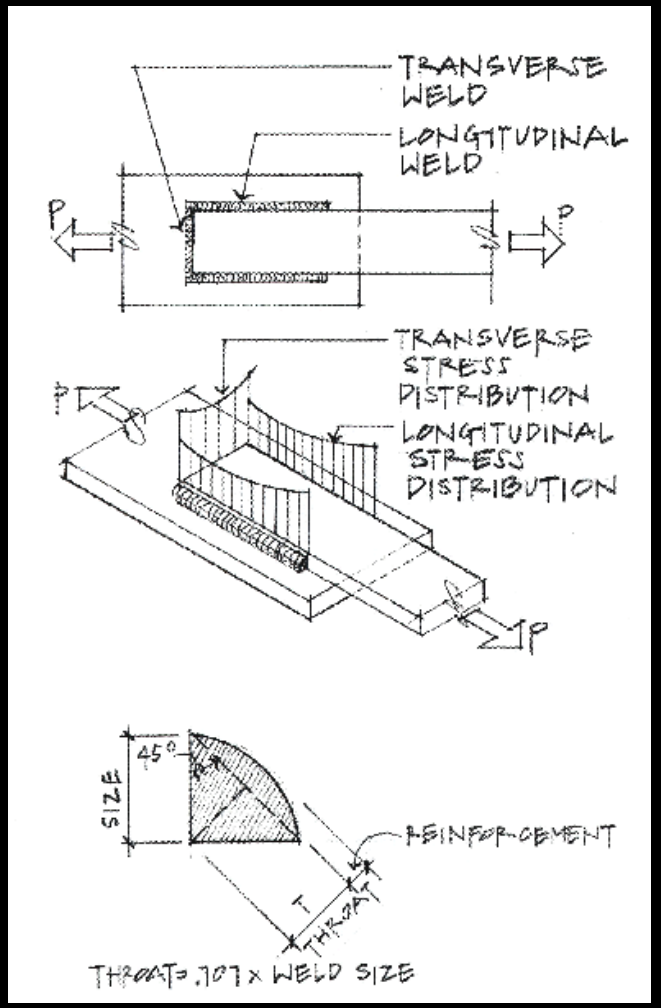
  F_{EXX} = 70 ksi





Welded Connection Design

- *shear failure assumed*
- *throat*
  - *T = 0.707 x weld size*
- *area*
  - *A = T x length of weld*
- *weld metal generally stronger than base metal (ex. F_y = 50 ksi)*



Welded Connection Design

- *minimum*
  - *table*
- *maximum*
  - *material thickness (to ¼”)*
  - *1/16” less*
- *min. length*
  - *4 x size min.*
  - *≥ 1 ½”*

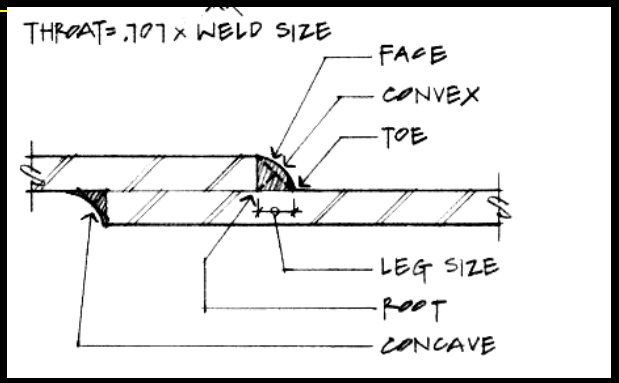


TABLE J2.4
Minimum Size of Fillet Welds

Material Thickness of Thicker Part Joined, in. (mm)	Minimum Size of Fillet Weld[a] in. (mm)
To ¼ (6) inclusive	⅛ (3)
Over ¼ (6) to ½ (13)	3/16 (5)
Over ½ (13) to ¾ (19)	¼ (6)
Over ¾ (19)	5/16 (8)

[a] Leg dimension of fillet welds. Single pass welds must be used.
[b] See Section J2.2b for maximum size of fillet welds.

Welded Connection Design

- *shear*

$$R_a \le R_n/\Omega \qquad R_u \le \phi R_n \quad \phi = 0.75$$

$$R_n = 0.6F_{EXX}\underbrace{Tl}_{\text{area}} = Sl$$

– *table for ϕS*

Available Strength of Fillet Welds per inch of weld (ϕS)		
Weld Size (in.)	E60XX (k/in.)	E70XX (k/in.)
3/16	3.58	4.18
1/4	4.77	5.57
5/16	5.97	6.96
3/8	7.16	8.35
7/16	8.35	9.74
1/2	9.55	11.14
5/8	11.93	13.92
3/4	14.32	16.70

(not considering increase in throat with submerged arc weld process)

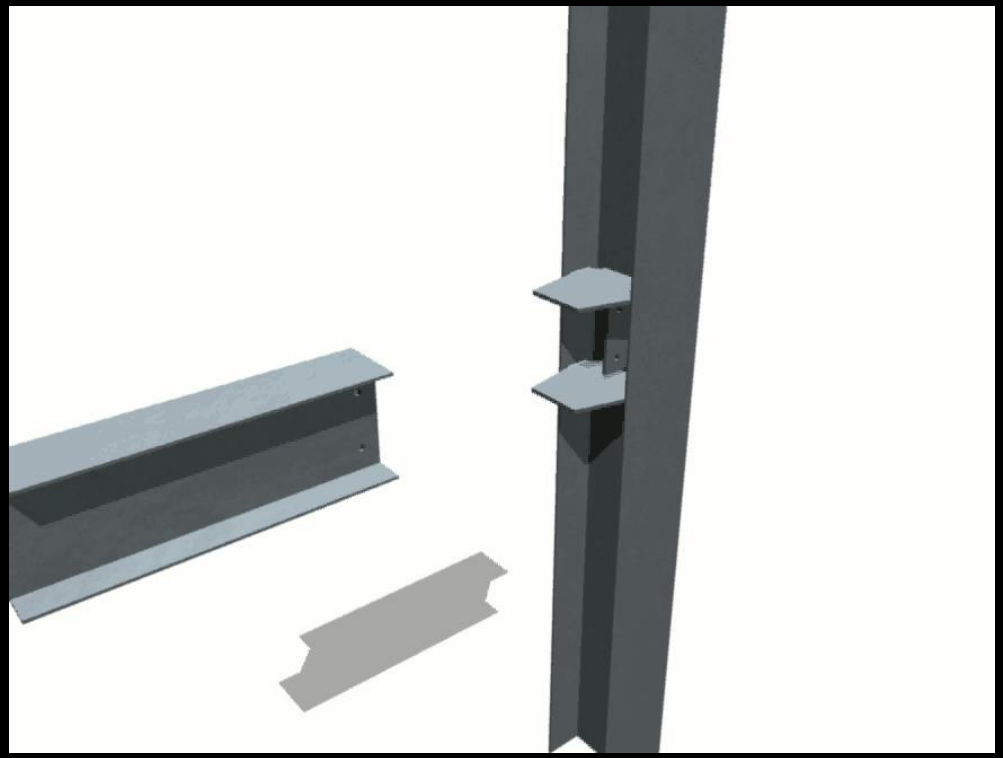
Framed Beam Connections

- *welded example (shear)*

(AISC - Steel Structures of the Everyday)

Framed Beam Connections

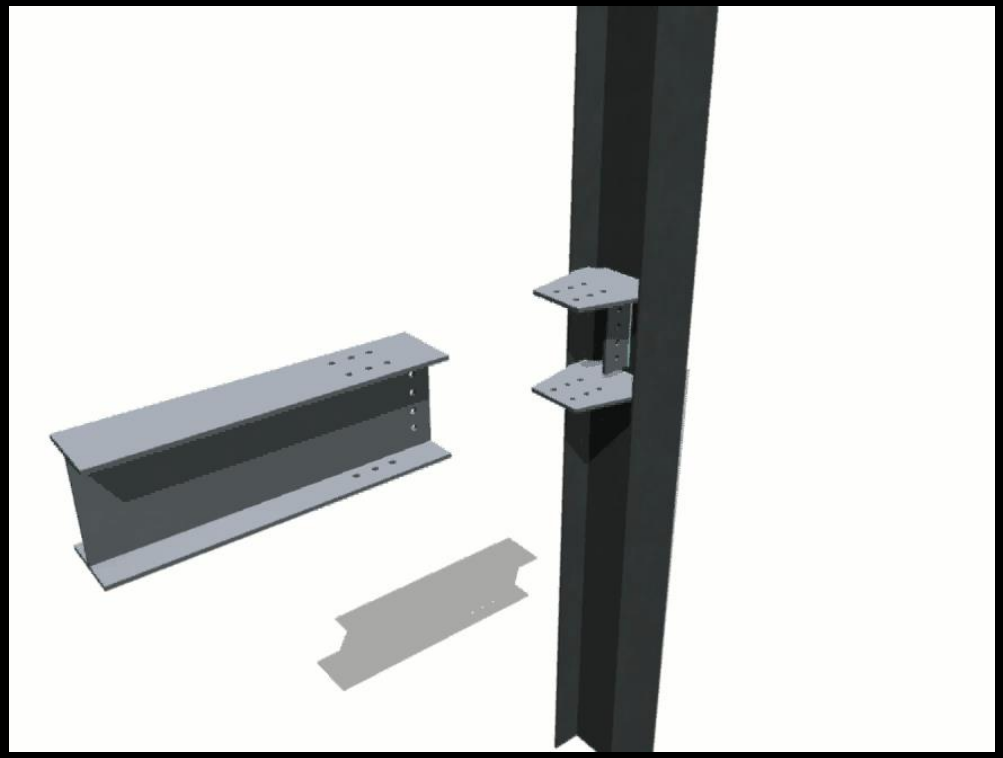
- *welded moment example*



(AISC - Steel Structures of the Everyday)

Framed Beam Connections

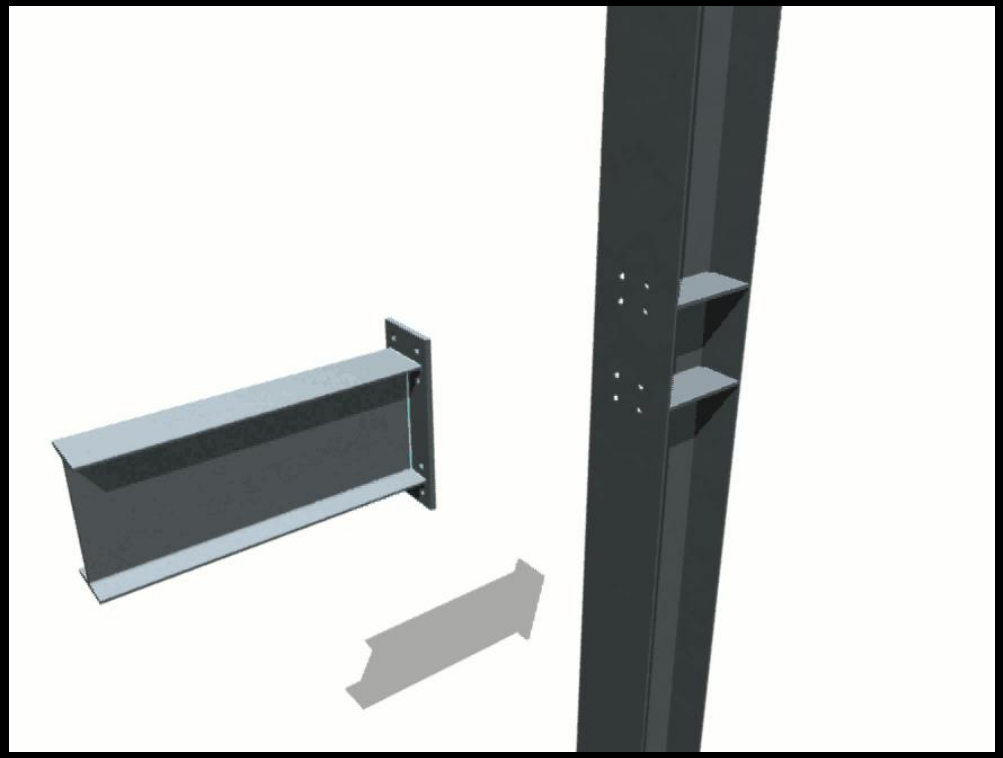
- *welded/bolted moment example*



(AISC - Steel Structures of the Everyday)

Framed Beam Connections

- *welded/bolted moment example*



(AISC - Steel Structures of the Everyday)

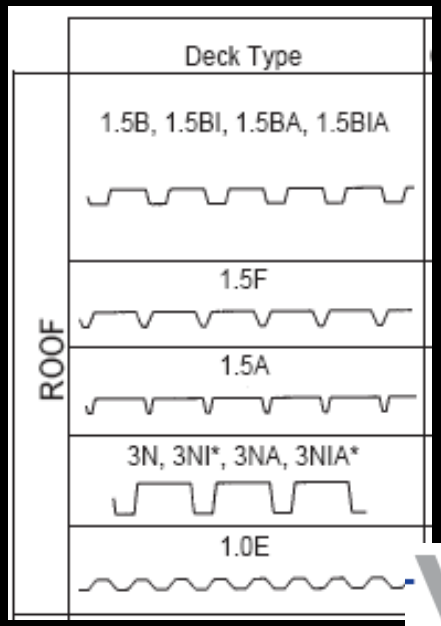
Light-gage Steel

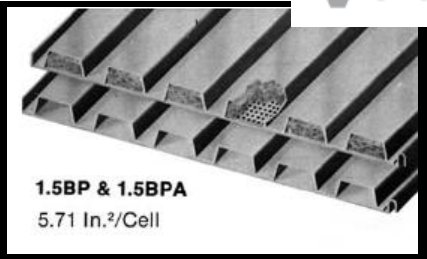
- *sheet metal*
  - *shaped*
  - *studs, panels, window frames*
  - *gage*
    - *based on weight of 41.82 lb/ft^2 / inch of thickness*
    - *24, 22, 18, 16, i.e.*
    - *0.0239, 0.0329, 0.0474, 0.0598 in*
    - *0.6, 0.85, 1.0, 1.3, 1.6 mm*

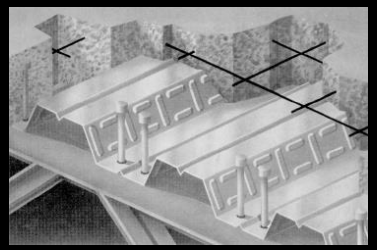
http:// nisee.berkeley.edu/godden

Steel Decks

- *"Texas" style*
  - *corrugated*
- *common*
  - *1 – 3 spans*
  - *can be insulated*
  - *composite*
    - *with concrete*

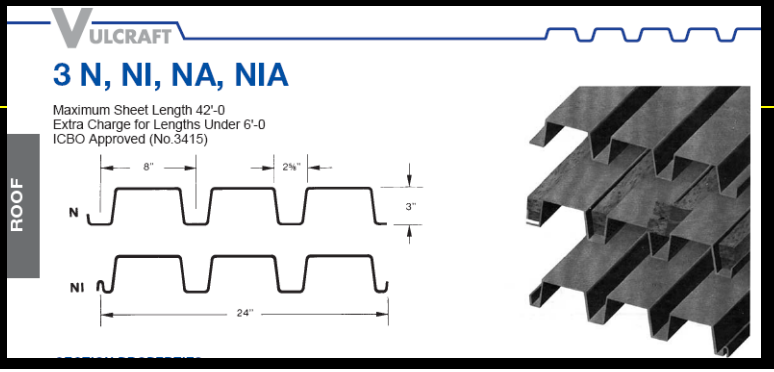






Steel Decks

- *load tables*



VERTICAL LOADS FOR TYPE 3N

No. of Spans	Deck Type	Max. SDI Const. Span	Allowable Total (Dead + Live) Uniform Load (PSF) Span (ft.-in.) C. to C. of Support										
			10'-0	10'-6	11'-0	11'-6	12'-0	12'-6	13'-0	13'-6	14'-0	14'-6	15'-0
1	N22	11'-7	51	46	42	38	35	32	30	28	26	24	23
	N21	12'-5	59	53	47	43	39	36	33	30	28	26	25
	N20	13'-2	66	58	52	47	42	38	35	33	30	28	26
	N19	14'-7	79	69	61	55	50	45	41	38	35	32	30
	N18	15'-11	91	80	71	63	57	52	47	43	40	37	34
	N16	18'-6	119	105	93	83	74	66	60	55	50	46	43
2	N22	14'-9	58	52	48	44	40	37	34	32	29	27	26
	N21	15'-9	66	60	55	50	46	42	39	36	34	32	29
	N20	16'-6	74	67	61	56	51	47	44	40	38	35	33
	N19	18'-1	88	80	73	66	61	56	52	48	45	42	39
	N18	19'-5	100	91	83	76	69	64	59	55	51	47	44
	N16	22'-3	126	114	104	95	87	81	74	69	64	60	56
3	N22	14'-9	70	65	60	55	50	46	43	40	37		
	N21	15'-9	83	75	68	63	58	53	49	45	42		
	N20	16'-6	92	83	76	70	64	59	54	50	47		
	N19	18'-1	110	100	91	83	76	70	65	60	56		
	N18	19'-5	125	113	103	94	87	80	74	68	64		
	N16	22'-3	157	143	130	119	109	101	93	86	80		

Notes:
1. Load tables are calculated using sectional properties based on the steel design thickness shown in the Steel Deck Institute (SDI) Design Manual.
2. Loads shown in the shaded areas are governed by the live load deflection not in excess of 1/240 of the span. A dead load of 10 PSF has been included.
3. 3N, NI, NA, NIA are not covered under Factory Mutual.

Steel Decks

- *common fire proofing*
  - *– cementicious spray*
  - *– composite concrete*
- *non-composite*
  - *– concrete is fill*
- *lateral bracing*
- *diaphragm action*