

lecture
twenty

steel construction:
welds & light gages



nrmc.org

Steel Welding 1
Lecture 20

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Welds

- welded steel connections



<http://courses.civil.ualberta.ca>

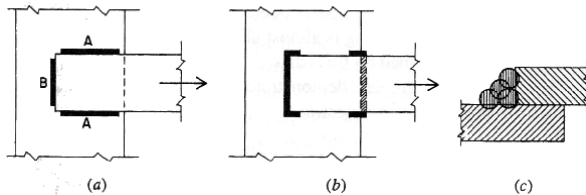
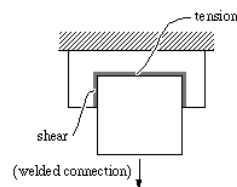
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Welded Connection Design

- considerations
 - shear stress
 - yielding
 - rupture



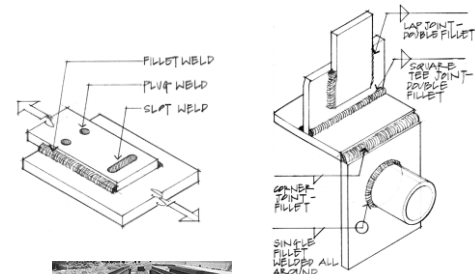
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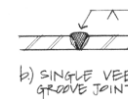
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Welded Connection Design

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



(AISC - Steel Structures of the Everyday)



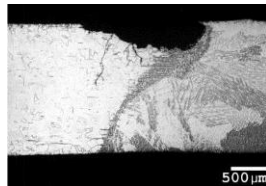
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Welded Connection Design

- weld process
 - melting of material
 - melted filler - electrode
 - shielding gas / flux
 - potential defects
- weld materials
 - E60XX
 - E70XX
 - $F_{EXX} = 70 \text{ ksi}$



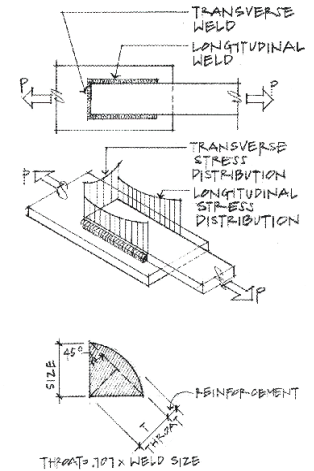
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Welded Connection Design

- shear failure assumed
- throat
 - $T = 0.707 \times \text{weld size}$
- area
 - $A = T \times \text{length of weld}$
- weld metal generally stronger than base metal (ex. $F_y = 50 \text{ ksi}$)



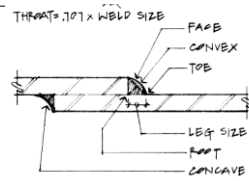
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Welded Connection Design

- minimum
 - table
- maximum
 - material thickness (to $1/4''$)
 - $1/16''$ less
- min. length
 - $4 \times \text{size min.}$
 - $\geq 1 \frac{1}{2}''$



| Material Thickness of Thicker Part Joined, in. (mm) | Minimum Size of Fillet Weld [a], in. (mm) |
|---|---|
| To $1/4$ (6) Inclusive | $3/16$ (3) |
| Over $1/4$ (6) to $5/8$ (13) | $1/8$ (5) |
| Over $5/8$ (13) to $3/4$ (19) | $1/4$ (6) |
| Over $3/4$ (19) | $5/16$ (8) |

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

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Welded Connection Design

- shear

$$R_a \leq \frac{R_n}{\Omega} \quad R_u \leq \phi R_n$$

$\phi = 0.75$

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

– table for 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)

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Framed Beam Connections

- welded example (shear)



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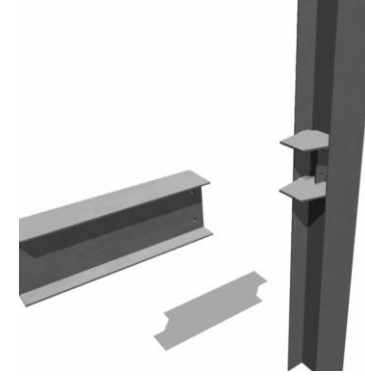
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Framed Beam Connections

- welded moment example



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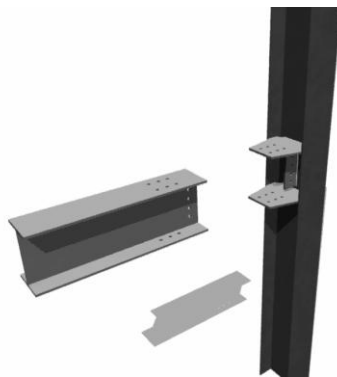
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Framed Beam Connections

- welded/bolted moment example



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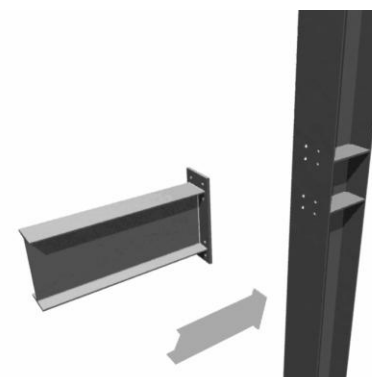
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Framed Beam Connections

- welded/bolted moment example



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Light-gage Steel

- sheet metal
 - shaped
 - studs, panels, window frames
 - gage
 - based on weight of 41.82 lb/ft² / 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

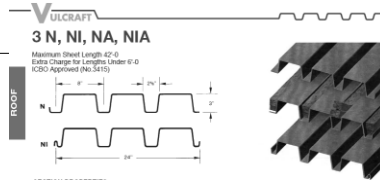
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Steel Decks

- load tables



VERTICAL LOADS FOR TYPE 3N

| No. of Spans | Deck Type | Max. SDI Const. Span | Allowable Total (Dead + Live) Uniform Load (PSF) | | | | | | | | | | | | |
|--------------|-----------|----------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|
| | | | 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 | | |
| | | 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 | | |
| | | 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 | | |
| | | 15'-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 | | |
| | | 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 | | |
| | | 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 | | |
| | | 22'-3" | 128 | 114 | 104 | 95 | 87 | 81 | 74 | 69 | 64 | 60 | 56 | | |
| 3 | N22 | 14'-9" | 70 | 65 | 60 | 56 | 50 | 46 | 43 | 40 | 37 | 35 | 33 | | |
| | | 15'-9" | 83 | 75 | 68 | 63 | 58 | 53 | 49 | 45 | 42 | 40 | 37 | | |
| | N20 | 16'-6" | 92 | 83 | 76 | 70 | 64 | 59 | 54 | 50 | 47 | 44 | 41 | | |
| | | 18'-1" | 110 | 100 | 91 | 83 | 76 | 70 | 65 | 60 | 56 | 52 | 49 | | |
| | N18 | 19'-5" | 125 | 113 | 103 | 94 | 87 | 80 | 74 | 69 | 64 | 60 | 56 | | |
| | | 22'-3" | 157 | 143 | 130 | 119 | 109 | 101 | 93 | 86 | 80 | 74 | 70 | | |

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.

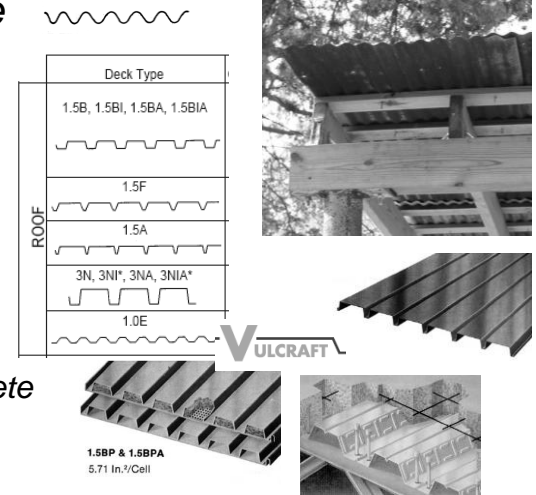
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Steel Decks

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



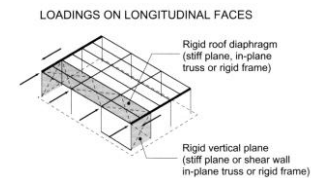
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Steel Decks

- common fire proofing
 - cementitious spray
 - composite concrete
- non-composite
 - concrete is fill
- lateral bracing
- diaphragm action



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