Connections

- needed to:
  - support beams by columns
  - connect truss members
  - splice beams or columns

- transfer load
- subjected to
  - tension or compression
  - shear
  - bending

Bolts

- bolted steel connections

Welds

- welded steel connections
Fasteners

- wood connections

Bolted Connection Design

- considerations
  - bearing stress
    - yielding
  - shear stress
    - single & double
  - member
    - rupture

Bolted Connection Design

- ASD steel
  - shear:
    \[ f_v \leq F_v \]
    - bolt strengths
    - single & double
  - bolt types
    - A325-SC, A490-SC
    - A325-N, A490-N
    - A325-X, A490-X

Bolted Connection Design

- ASD steel
  - bearing:
    - bolts rarely fail by bearing
    - other part fails first
**Tension Members**

- steel members can have **holes**
- reduced area
- increased stress

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**Effective Net Area**

- likely path to “rip” across
- bolts divide transferred force too

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**ASD – Tension Members**

- non-pin connected members:
  - \( F_t = 0.60F_y \) on gross area
  - \( F_t = 0.50F_u \) on net area
- pin connected members:
  - \( F_t = 0.45F_y \) on net area
- threaded rods of approved steel:
  - \( F_t = 0.33F_u \) on major diameter
  - (for static loading only)

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**LRFD - Tension Members**

- limit states for failure \( P_u \leq \phi_t P_n \)
  1. yielding \( \phi_t = 0.9 \) \( P_n = F_y A_g \)
  2. rupture* \( \phi_t = 0.75 \) \( P_n = F_u A_e \)

\( A_g \) - gross area
\( A_e \) - effective net area
\( F_u \) - tensile strength of the steel (ultimate)
Welded Connection Design

- **considerations**
  - shear stress
  - yielding
  - rupture

Welded Connection Design

- **weld terms**
  - butt weld
  - fillet weld
  - plug weld
  - throat

- **weld materials**
  - E60XX
  - E70XX
  \( F_{EXX} = 70 \text{ ksi} \)

Framed Beam Connections

- **angles**
  - bolted
  - welded
Framed Beam Connections

• terms
  – coping

Framed Beam Connections

• tables for standard bolt holes & spacings
  • n = # bolts
  • angle leg thickness
  • length needed

Beam Connections

• LRFD provisions
  – shear yielding
  – shear rupture
  – block shear rupture
  – tension yielding
  – tension rupture
  – local web buckling
  – lateral torsional buckling

Beam Connections

• block shear rupture
• tension rupture