Connectors

• joining
  – lapping
  – interlocking
  – butting

• mechanical
  – “third-elements”

• transfer load at a point, line or surface
  – generally more than a point due to stresses

Wood Connectors

• adhesives
  – used in a controlled environment
  – can be used with nails

• mechanical
  – bolts
  – lag bolts or lag screws
  – nails
  – split ring and shear plate connectors
  – timber rivets

Wood Connections
**Bolted Joints**

- connected members in tension cause shear stress
- connected members in compression cause bearing stress

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**Tension Members**

- members with holes have reduced area
- increased tension stress
- $A_e$ is effective net area: $f_t = \frac{P}{A_e}$ (or $T = \frac{P}{A_e}$)

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**Effective Net Area**

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

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**Single Shear**

- seen when 2 members are connected
Double Shear

- seen when 3 members are connected

\[ \Sigma F = 0 = -P + 2\left(\frac{P}{2}\right) \]

\[ f_v = \frac{P}{2A} = \frac{P}{2} \cdot \frac{1}{\pi \frac{d^2}{4}} \]

Bolted Joints

- twisting

- tear out
  - shear strength
  - end distance & spacing

Bearing Stress

- compression & contact

- stress limited by species & grain direction to load

- projected area

\[ f_p = \frac{P}{A_{\text{projected}}} = \frac{P}{td} \]

Nailed Joints

- tension stress (pullout)

- shear stress nails presumed to share load by distance from centroid of nail pattern
Nailed Joints

- sized by pennyweight units / length
- embedment length
- dense wood, more capacity

Connectors Resisting Beam Shear

- plates with
  - nails
  - rivets
  - bolts
- splices
- $V$ from beam load related to $V_{\text{longitudinal}}$

$$V_{\text{longitudinal}} = \frac{VQ}{p}$$

$$nF_{\text{connector}} \geq \frac{VQ_{\text{connected area}}}{I} \cdot p$$

Vertical Connectors

- isolate an area with vertical interfaces