Wood Construction: Connections

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
Bolted Joints

- connected members in tension cause shear stress

- connected members in compression cause bearing stress

Tension Members

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

Effective Net Area

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

Single Shear

- seen when 2 members are connected

\[ f_v = \frac{P}{A} = \frac{P}{\pi \frac{d^2}{4}} \]
Double Shear

- seen when 3 members are connected

$$\sum F = 0 = -P + 2\left(\frac{P}{2}\right)$$

$$f_v = \frac{P}{2A} \quad A = \frac{P}{\pi \frac{d^2}{4}}$$

Bearing Stress

- compression & contact
- stress limited by species & grain direction to load
- projected area

$$f_p = \frac{P}{A_{projected}} = \frac{P}{td}$$

Bolted Joints

- twisting
- tear out
  - shear strength
  - end distance & spacing

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 $V_{\text{longitudinal}}$

\[
\frac{V_{\text{longitudinal}}}{p} = \frac{VQ}{I} \\

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

Vertical Connectors

- isolate an area with vertical interfaces

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