Wood 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
  \[
  f_t = \frac{P}{A_e} \left( \text{or} \frac{T}{A_e} \right)
  \]

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

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

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

**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

[www.timber.org.au](http://www.timber.org.au)

Taylor & Line 2002
Nailed Joints

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

**TABLE 7.1 Lateral Load Capacity of Common Wire Nails (lb/nail)**

<table>
<thead>
<tr>
<th>Side Member Thickness, $t_i$ (in.)</th>
<th>Nail Length, $l$ (in.)</th>
<th>Nail Diameter, $D$ (in.)</th>
<th>Pennyweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.113</td>
<td>6d</td>
<td>48</td>
</tr>
<tr>
<td>2½</td>
<td>0.131</td>
<td>8d</td>
<td>63</td>
</tr>
<tr>
<td>3</td>
<td>0.148</td>
<td>10d</td>
<td>76</td>
</tr>
</tbody>
</table>

Vertical Connectors

- isolate an area with vertical interfaces

Connectors Resisting Beam Shear

- plates with
  - nails
  - rivets
  - bolts
- splices
- $V_{longitudinal}$ related to $V_{longitudinal}$

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

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