6.31 The built-up beam shown is made by gluing together two 20 × 250-mm plywood strips and two 50 × 100-mm planks. Knowing that the allowable average shearing stress in the glued joints is 350 kPa, determine the largest permissible vertical shear in the beam.

\[ \tau = \frac{VQ}{It} \]

\[ \tau_{\text{max}} \text{ is given, find } V \]

\[ I = 154,167 \times 10^{-6} \text{ m}^4 \]

\[ V = \frac{It\tau_{\text{max}}}{\delta} \]

\[ V = 10.29 \text{ kN} \]

Suppose same overall dimensions, \( \tau_{\text{max}} \) then find \( V \) allowable.
6.34 Knowing that a W360 x 122 rolled-steel beam is subjected to a 250-kN vertical shear, determine the shearing stress (a) at point A, (b) at the centroid C of the section.

Look up Appendix for details on W360 x 122

\[ I = 365 \times 10^{-6} \text{ m}^4 \]

(a) Section in imbalance

\[ A = 2278.5 \text{ mm}^2 \]

\[ g = 170.65 \text{ mm} \]

\[ \theta = gA \]

\[ \varepsilon = 21.7 \text{ mm} \]

\[ V = 250 \text{ kN} \]

\[ \tau = \frac{V \theta}{I t} = 12.27 \text{ MPa} \]

(b) \[ \tau = 58.9 \text{ MPa} \] (work out the details)

Suppose you had 2 choices

Which one would you prefer?
Knowing that a given vertical shear $V$ causes a maximum shearing stress of $75 \text{ MPa}$ in the hat-shaped extrusion shown, determine the corresponding shearing stress at (a) point $a$, (b) point $b$.

**Solution:**

**Step 1:** Shear at $h$ is $12 \text{ mm}

**Step 2:** Now finding the shear at $h$ is a bit more interesting. Alternatively, $\frac{V}{h} = \frac{12 \text{ mm}}{75 \text{ MPa}}$

**Step 3:** Shear at $h$ is $12 \text{ mm}$

**Diagram:**

Fig. P6.36

For all symmetric shapes, assume that $T_{\text{max}}$ occurs at $V$ is not given but $T_{\text{max}}$ is given.
A beam consists of five planks of 1.5 X 6-in. cross section connected by steel bolts with a longitudinal spacing of 9 in. Knowing that the shear in the beam is vertical and equal to 2000 lb. and that the allowable average shearing stress in each bolt is 7500 psi, determine the smallest permissible bolt diameter that may be used.

\[
\tau_{12} = \frac{V Q_{12}}{I t_{12}}
\]

\[
Q_{12} = 7.2 \text{ in}^3
\]

\[
F_{12} = \tau_{12} t_{12} \Delta x = \frac{V Q_{12} \Delta x}{I}
\]

\[
\Delta x \text{ (spacing)} = 7.2''
\]

\[
F_{12} = 809 \text{ lb} \Rightarrow d_{\text{bolt}} = 0.371 \text{ in}
\]

Then check

\[
Q_{23} = 5.4 \text{ in}^3 < Q_{12}
\]

\[
\Rightarrow d_{\text{bolt}} = 0.371 \text{ in}
\]