1. Problem: Determine the load P that caused failure.

Given:
- 1" diameter bolt
- 1/2" neck
- 1/4" thick

Steel: \( \tau_{\text{ult}} = 36 \text{ ksi} \)

Failure:
- \( \frac{P}{2} \)
- \( \frac{1}{2} \) of \( A_v \)

Solution:
- \( A_v = (2 \text{ sides})(0.25\")(0.5\") = 0.25 \text{ in}^2 \)
- \( \tau = \frac{V}{A} \) \Rightarrow \( V = P \cdot A \cdot \tau = (0.25 \text{ in}^2)(36 \text{ ksi}) = 9 \text{ kips} \)
- \( P = 9 \text{ kips} \)
2. A 1” diameter vertical shaft is supported by a 1.5” diameter thrust collar that rests on the bearing plate as shown. If
the average shear stress between the collar and the shaft cannot exceed 18 ksi, the bearing stress cannot exceed 22
ksi, and the normal stress in the shaft cannot exceed 24 ksi, determine the maximum axial load P that can be applied
to the shaft.

\[
\begin{align*}
\text{IF BEARING STRESS } \tau &= 22 \text{ ksi} & \text{CONTROLS:} \\
A_d &= \pi (0.75^2 - 0.5^2) \\
&= 0.9817 \text{ in}^2 \\
\Rightarrow P_{\text{max}} &= (22)(0.9817) = 21.5 \text{ k} \\
\text{IF NORMAL STRESS } \sigma &= 24 \text{ ksi} & \text{CONTROLS:} \\
A &= \pi (0.5^2) \\
&= 0.7853 \text{ in}^2 \\
\Rightarrow P_{\text{max}} &= (24)(0.7853) = 18.8 \text{ k} \\
\text{IF SHEAR STRESS } \tau &= 18 \text{ ksi BETWEEN COLLAR \& SHAFT CONTROLS:} \\
A_v &= \pi (1”)(0.5”) = 1.571 \text{ in}^2 \\
\Rightarrow P_{\text{max}} &= (18)(1.571) = 28.3 \text{ k} \\
\therefore P &= 18.8 \text{ k (}\sigma\text{ ON SHAFT CONTROLS)}
\end{align*}
\]
3. Member B is subjected to a compressive force of 800 lb. If the dimension $h$ is insufficient, the ledge that B sits on will shear off, vertically. If A and B are both made of wood and are 3/8 in thick, determine to the nearest ¼ in the smallest dimension $h$ of the support so that the average shear stress does not exceed $\tau_{\text{allow}} = 300$ psi.
4. Problem: Determine the bearing stress when the punch press sifies the slug.

Given: ½" thick plate

\[ \sigma_{ult} = 30 \text{ ksi} \]

Solved:

Shear Force

\[ A_v = \text{Circum} \times \text{Thickness} \]

\[ = \left[ 0.75\pi + (2)(3\text{"}) \right] \times \frac{1}{2} = 4.178 \text{ in}^2 \]

\[ \Rightarrow P = (30 \text{ ksi}) (4.178 \text{ in}^2) = 125.3 \text{ kips} \]

Bearing Stress

\[ \sigma_b = \frac{P}{A_b} = \frac{\pi (0.375)^2 + 3 (0.75)}{2.692 \text{ in}^2} = 46.5 \text{ ksi} \]