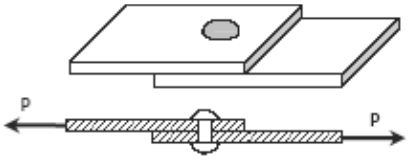
Shearing Stress

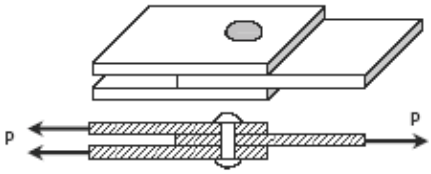
Forces parallel to the area resisting the force cause shearing stress. It differs to tensile and compressive stresses, which are caused by forces perpendicular to the area on which they act. Shearing stress is also known as tangential stress.

$$\tau = \frac{V}{A}$$

where (V) is the resultant shearing force which passes which passes through the centroid of the area A being sheared.



Single Shear



Double Shear

Ex: What force is required to punch a 20mm diameter hole in a plate that is 25 mm thick? The shear strength is 350 MN/m^2.

Sol:

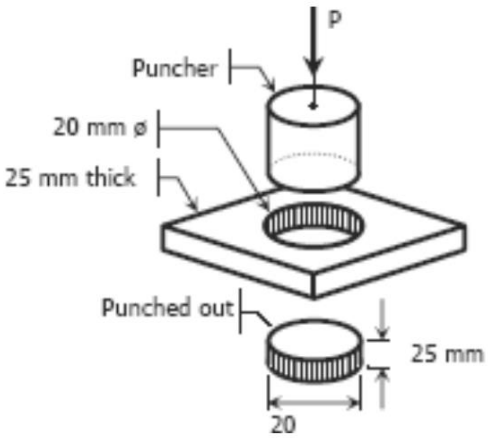
The resisting area is the shaded area along the perimeter and the shear Force (V) is equal to the punching Force (P)

$\tau = \frac{V}{A}$ $\quad \therefore V = \tau * A$

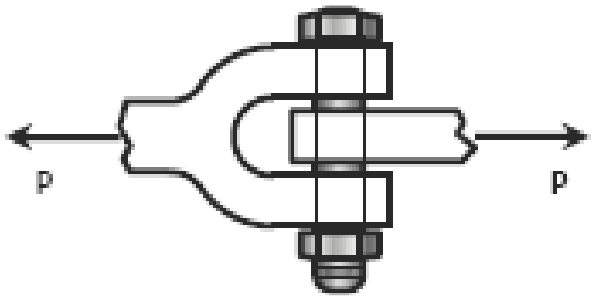
$V = P \qquad \tau = 350 \frac{MN}{m^2} = 350 \frac{N}{mm^2}$

$A = \pi * 20 * 25 = 1570\ mm$

$\therefore P = 350 * 1570 = 549500\ N = 549.5\ KN$



Ex; Find the smallest diameter bolt that can be used in the clevis shown in Fig if P = 400 kN. The shearing strength of the bolt is 300 MPa.



Sol.

The bolt is subjected to double shear

$\tau = \frac{V}{A}$ $\quad \tau = 300\ MPa$

$V = P = 400\ kN$

$A = \tau * \frac{\pi}{4_2} * D^2$

$A = \frac{\pi}{2} * D^2$

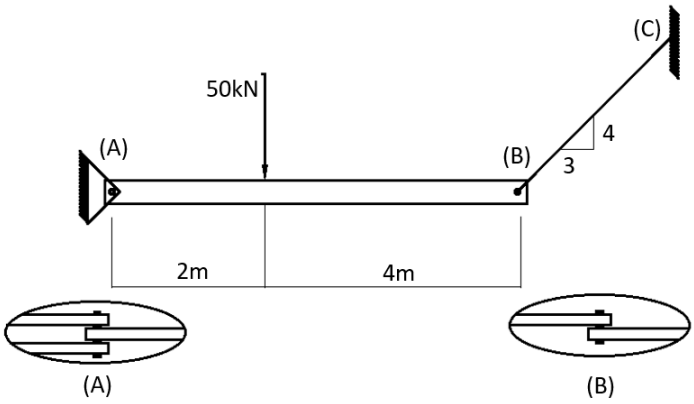
$\therefore 300 = \frac{400 * 10^3}{\frac{\pi}{2} * D^2}$

$\frac{\pi}{2} * D^2 = \frac{400 * 10^3}{300} = 1333.33$

$D^2 = \frac{1333.33 * 2}{\pi} = 849.25$

$\therefore D = 29.141\ mm$

Ex; find the shear stress at (A) and (B) in the 20mm pins



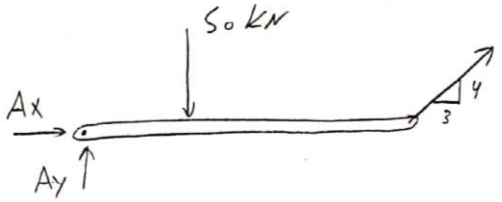
Sol;-

$$\tau = \frac{V}{A}$$

$$\therefore \tau_B = \frac{B_C}{A}$$

$$= \frac{20,83 * 1000}{\frac{\pi}{4} * 20^2}$$

$$= 66,33 \text{ Mpa}$$



$$\Sigma M_A = 0$$

$$0 = 50 * 2 - B_C * \frac{4}{5} * 6$$

$$100 = B_C * 4,8$$

$$\therefore B_C = 20,83 \text{ Tension}$$

$$\tau_A = \frac{F_A}{A}$$

$$= \frac{F_A}{2A}$$

$$= \frac{35,601 * 1000}{2 * \frac{\pi}{4} * 20^2}$$

$$= 56,689 \text{ Mpa}$$

$$\Sigma F_Y = 0$$

$$0 = A_Y - 50 + B_C * \frac{4}{5}$$

$$\therefore 0 = A_Y - 50 + 20,83 * \frac{4}{5}$$

$$\therefore A_Y = 50 - 16,664$$

$$A_Y = 33,336 \uparrow$$

$$\Sigma F_X = 0$$

$$0 = A_X + 20,83 * \frac{3}{5}$$

$$\therefore A_X = -12,498$$

$$\therefore A_X = 12,498 \leftarrow$$

$$\therefore F_A = \sqrt{(12,498)^2 + (33,336)^2}$$

$$\therefore F_A = 35,601 \text{ KN}$$