Mechanics of Materials

Deals with the relation between the external force and their effects on bodies, the deformations and the resisting stresses inside the materials

Ch 1 Simple Stresses

Axial Stress

Axial Stress is the force action on a cross-Section area which is perpendicular to the force.

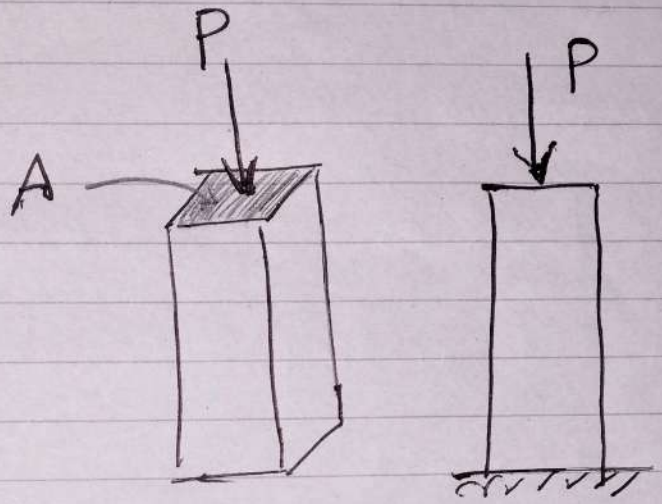
$$\text{Axial Stress} = \frac{\text{force}}{\text{Area}}$$

$$\sigma = \frac{P}{A}$$

σ = Axial Stress (MPa)

P = Axial force (N, KN, ...)

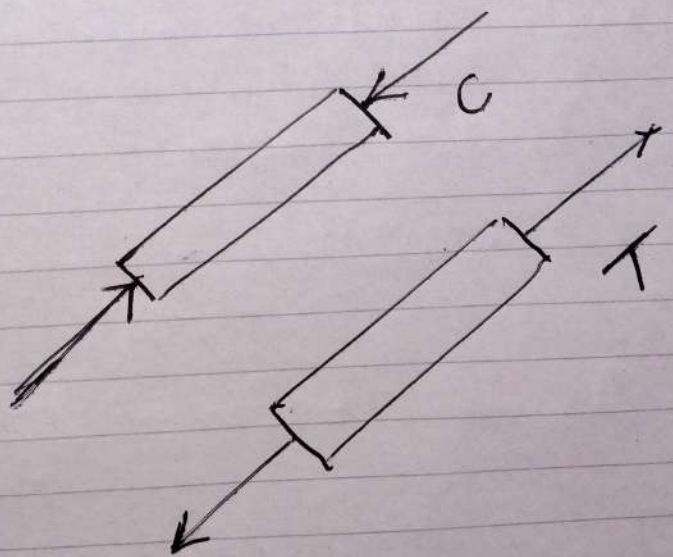
A = Area



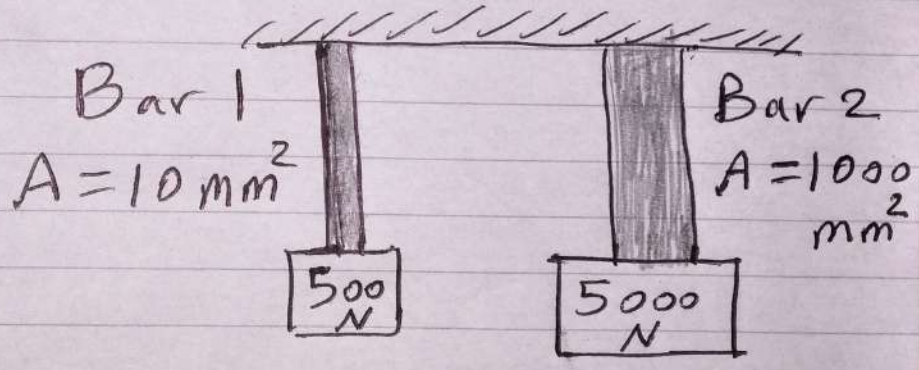
Pascal

$$Pa = \frac{N}{m^2}$$

$$MPa = 10^6\ Pa \qquad 1\ MPa = 1\ \frac{N}{mm^2}$$



Example: Consider two bars of equal length but different Materials. Bar 1 Can support a maximum load of 500 N and Bar 2 Supports a maximum load of 5000 N. If the Cross-Sectional area for Bar 1 is 10 mm^2 and for Bar 2 is 1000 mm^2, which material is Stronger?



Solution:

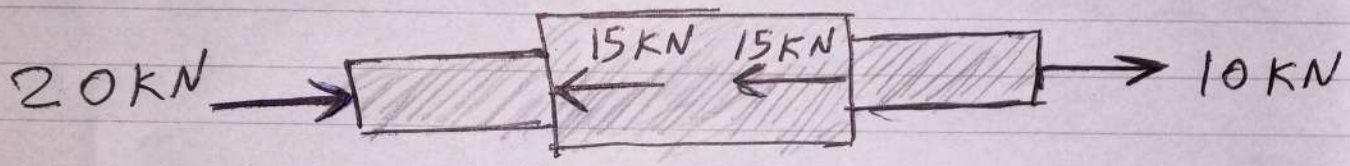
$$\sigma = \frac{P}{A}$$

$$\sigma_1 = \frac{500}{10 * 10^{-6}} = 50 * 10^6 \ N/m^2 = 50 \ MPa$$

$$\sigma_2 = \frac{5000}{1000 * 10^{-6}} = 5 * 10^6 \ N/m^2 = 5 \ MPa$$

Material of Bar 1 is Stronger than Material of Bar 2

Example: An aluminum tube is fastened between bronze and steel rods as shown. Determine the axial Stress for each material.

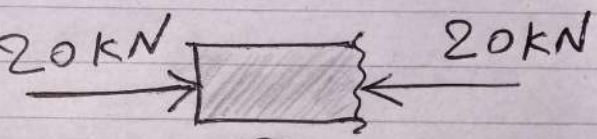


	Bronze	Aluminum	Steel
$A\ (mm^2)$:	700	1000	800

Solution:

$$\sigma = \frac{P}{A}$$

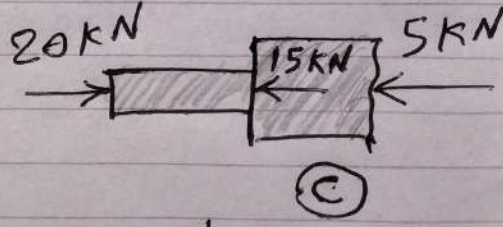
<u>Bronze</u>



$$\sigma_b = \frac{20 * 10^3}{700} = 28.6\ MPa$$

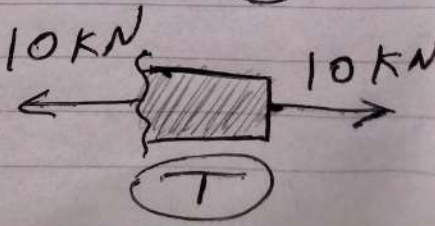
<u>Aluminum</u>

$$\sigma_a = \frac{5 * 10^3}{1000} = 5\ MPa$$



<u>Steel</u>

$$\sigma_s = \frac{10 * 10^3}{800} = 12.5\ MPa$$



Shearing Stress

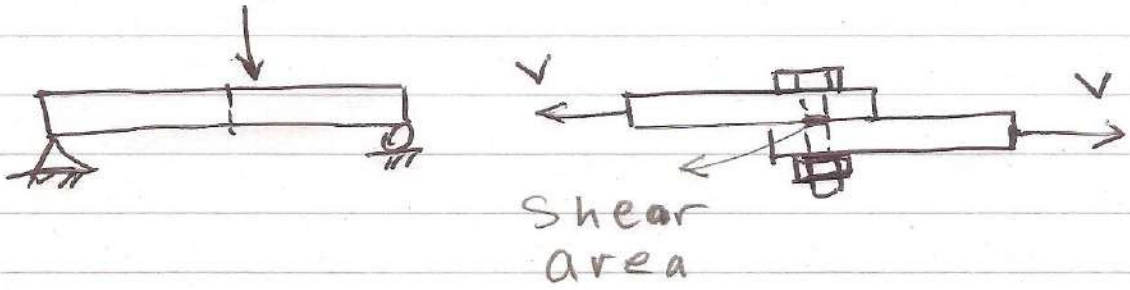
Shearing Stress is a stress caused by load along or parallel to the resisting cross-Sectional area.

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

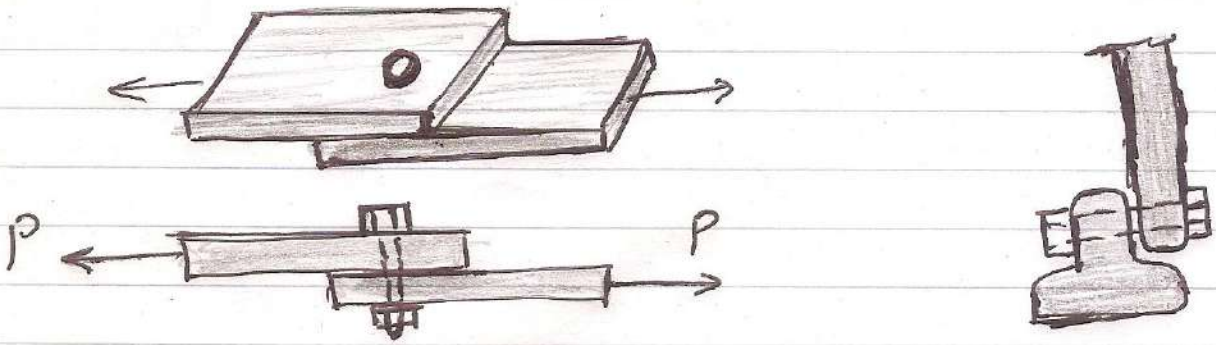
τ : Shearing Stress (MPa)

V : Shear force (N)

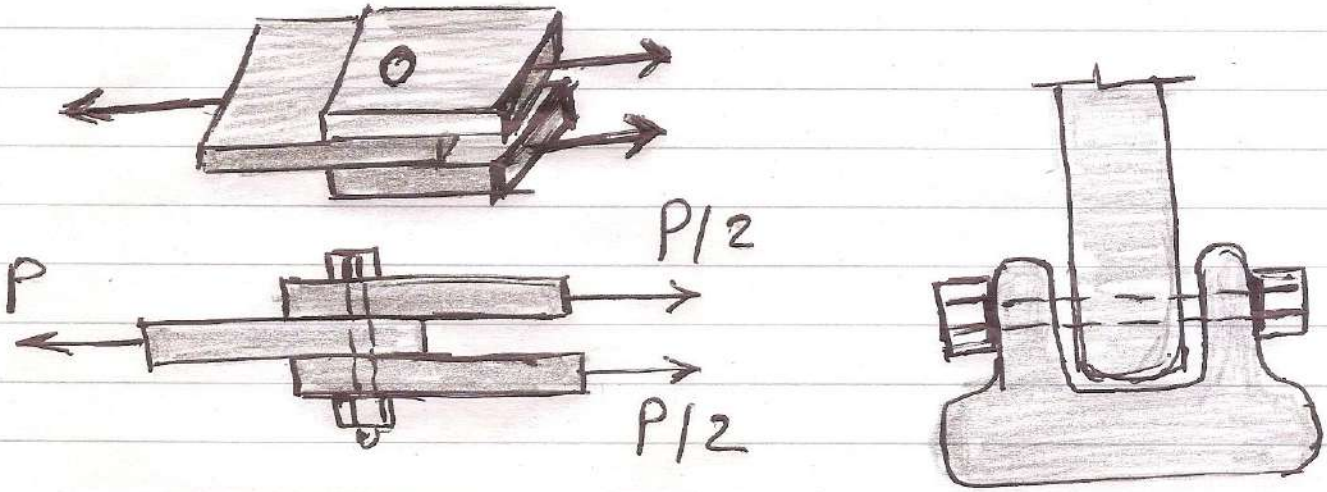
A : Cross-Section area (mm^2)



Rivets, Bolts



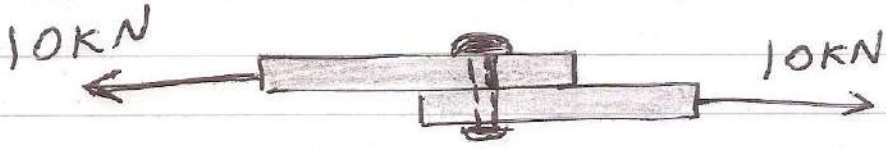
One Shear area (Single Shear)



Double Shear area (Double Shear)

Example

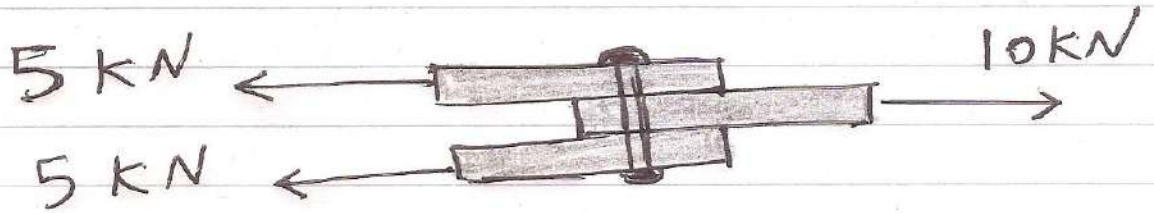
Determine the shear stress in the 20 mm diameter bolt shown in the figure.



$$\tau = \frac{V}{A} = \frac{10 * 1000}{\pi (10)^2} = 31.818 \text{ MPa}$$

Example

Determine the Shear Stress in the 20 mm diameter bolt Shown in the figure.



$$\tau = \frac{V}{A} = \frac{10 * 1000}{2\pi (10)^2} = 15.909 \text{ MPa}$$