Mechanics of Solid - I

Code: CE502

Final Term paper

Ans to the Question No- 01

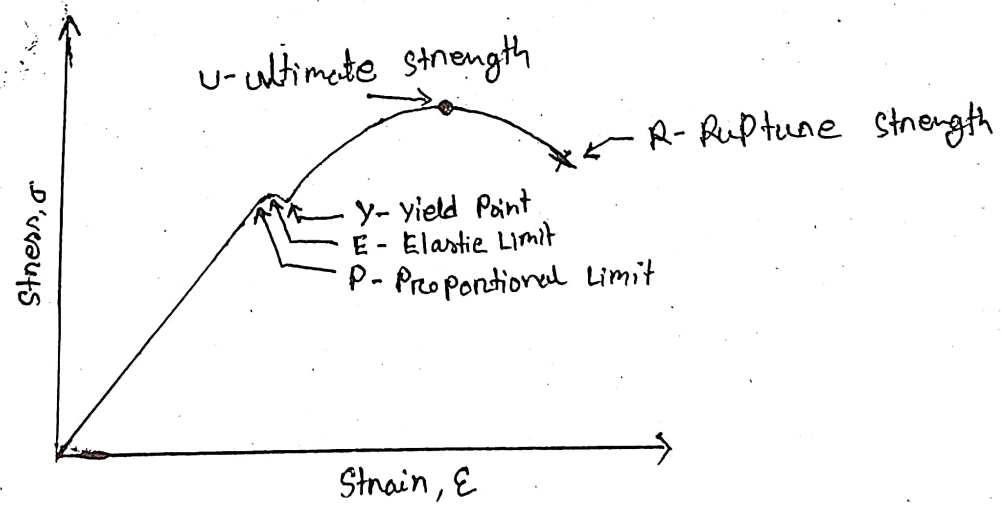
a) **Stress:** The term stress is used to express the loading in term of force applied to a certain cross-sectional area of an object.

$$\text{Stress}, \sigma = \frac{\text{Force}}{\text{Cross-Sectional Area}} = \frac{F}{A_o}$$

Strain: when a material is loaded with a force, it produces stress, which then cause a material to deform.

$$\text{Strain} = \frac{\text{Elongation}}{\text{Original length}} = \frac{\Delta L}{L_o}$$

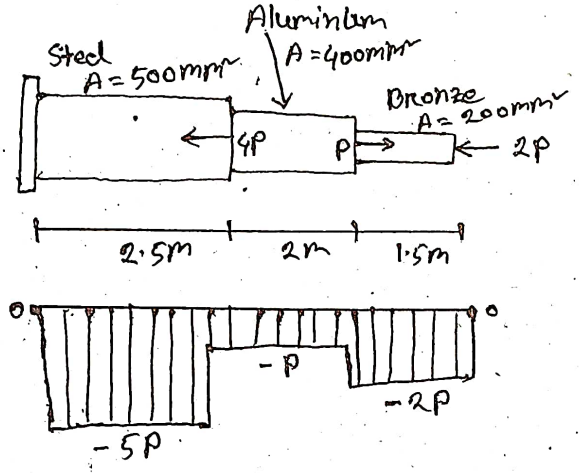
Stress - Strain Curve:



mild Steel Stress-Strain Curve

Mild steel bar be placed in tension compression testing machine. As the axial load is gradually increased in increments, the total elongation over the gage length is masured at each increment of the load and thus is continued until failure take place.

b)



Given,

$\sigma_{st} = 140 \text{ mpa}$

$\sigma_{al} = 90 \text{ mpa}$

$\sigma_{br} = 100 \text{ mpa}$

For steel:

$P = \sigma_{st} A_{st}$

$\Rightarrow 5P = 140 \times 500$

$\Rightarrow P = 14000 \text{ N}$

For Bronze:

$P = \sigma_{br} A_{br}$

$= 100 \times 200$

$= 10000 \text{ N}$

For Aluminum:

$P = \sigma_{al} A_{al}$

$= 90 \times 400$

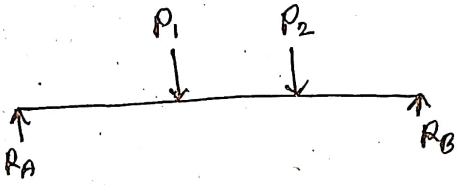
$= 36000 \text{ N}$

$\therefore$ maximum value of $P = 10000 \text{ N} = 10 \text{ kN}$ (Ans)

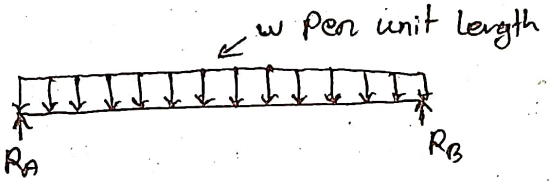
Ans to the Question NO-02

a) **Different type of load:** Through there are many types of loading, yet flowing are Important:

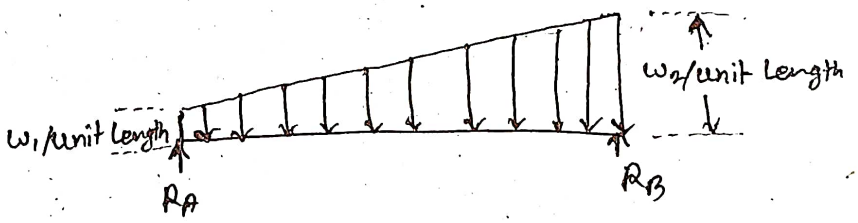
1. Concentrated or Point Load.



2. uniformly distributed load:



3. uniformly varing Load:



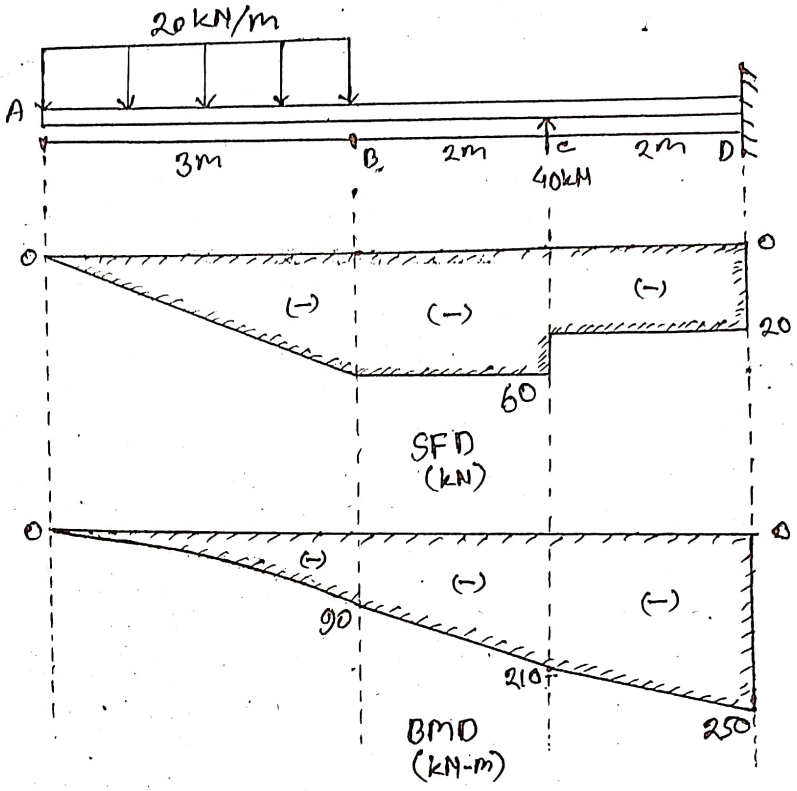
b)

$R_D = -20\times3 + 40 = -20\,kN$

$\Sigma M_D\ (+\circlearrowleft)$

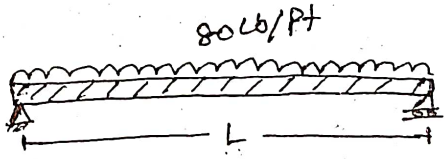
$\Rightarrow -20\times3\times5.5 + 40\times2$

$= -250\ kN\cdot m$



Ans to the Question No - 03(a)

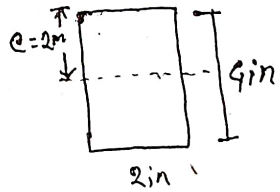
Given, $f_{(b)max} = 3000\ psi$



Here,

maximum moment,

$$M = \frac{wL^2}{8} = \frac{80\times L^2}{8} = 10L^2$$



$$I = \frac{6d^3}{12} = \frac{2\times6^3}{12} = \frac{32}{3}$$

Now,

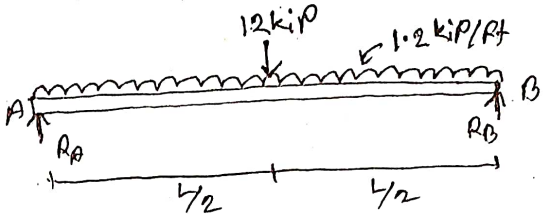
$$f_{(b)max} = \frac{Mc}{I}$$

$$\Rightarrow 3000 = \frac{10L^2\times12\times2}{\frac{32}{3}}$$

$$\therefore L = 11.55\ ft \quad \underline{Ans.}$$

Ans to the Question No-03(b)

Given,



Flexural Stress, $f_{(b)max} = 20$ ksi

$S = 20.7$ in

Maximum moment,

$$M = \frac{WL}{4} + \frac{wL^2}{8}$$

$$= \frac{12 \times L}{4} + \frac{1.2L^2}{8}$$

$$= 3L + 0.15L^2$$

Now,

$$f_{(b)max} = \frac{M}{S}$$

$$\Rightarrow 20 \times 10^3 = \frac{(3L + 0.15L^2) \times 12 \times 1000}{20.7 \times 2}$$

$$\therefore L = 13.66 \text{ ft}$$ Ans

Ans to the Question No-04(a)

Given,

$t = 7$ mm

$S_t = 90$ mpa $\quad S_s = 60$ mpa $\quad S_c = 120$ mpa

The diameter of rivet hole is selected equating shear strength to the crushing strength.

$$2\left(\frac{\pi}{4} \times d^2\right) S_s = 2dt S_c$$

$$\Rightarrow 2\left(\frac{\pi}{4} \times d^2\right) 60 = 2d \times 7 \times 120$$

$$d = 17.82 \text{ mm} \approx 18 \text{ mm}$$ Ans

Pitch Length:

$$S_t (P-d)t = 2\left(\frac{\pi}{4} \times d^2\right) S_s$$

$$\Rightarrow 90(P-18)\times 7 = 2\left(\frac{\pi}{4} \times 18^2\right) \times 60$$

$$\Rightarrow P = 66.47 \approx 67 \text{ mm}$$ Ans

Distance between two rivet row:

$$P_d = \frac{P}{3} + \frac{2}{3} d$$

$$= \frac{67}{3} + \frac{2}{3} \times 18$$

$$= 34.3 \text{ mm}$$

$$= 35 \text{ mm}$$ Ans

Ans to the Question No-04(b)

In a parallel fillet welding two liner of welding are to be provide.

Each line shares a load of $P = \frac{50}{2} = 25$ kN

maximum shear stress in the parallel fillet weld is

$$\frac{P}{lt}$$ where, t = throat length $= \frac{12.5}{\sqrt{2}}$ mm

Since $\frac{P}{lt} \leq S_s = 56 \times 10^6$. Hence the minimum length

of the weld is $\frac{25 \times 10^3 \times \sqrt{2}}{56 \times 12.5 \times 10^3} = 50.5$ mm

How even some extra length of the weld is to be provided as allowance for starting on stopping of the bead. An. usual allowance of 12.5 mm is kept.