NAME:- OWAIS USMAN

ID:- 7897

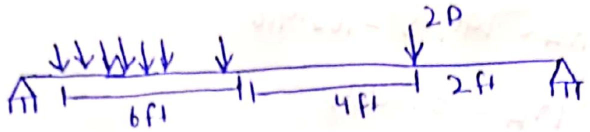
SECTION:- A

SEMESTER: 4

SUBJECT:- MOS - II

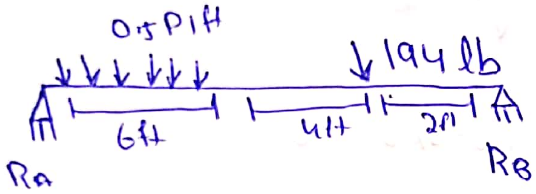
SUBMITTED TO:- ENGR. M. SAQIB

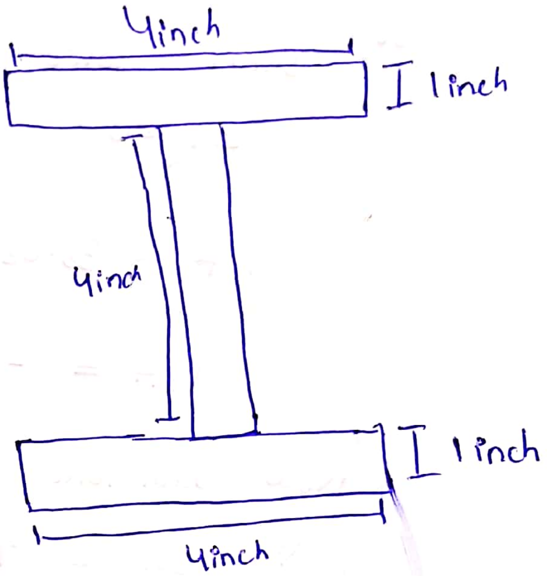
# GIVEN DATA:




Consider P as 97 because its my last two digit of ID. So P become

$$2P = 2\times 97 = 194\ lb$$




We know that

$\Sigma F_y = 0$ $\uparrow + \downarrow -$

$$R_A + R_B = 194.5$$

Now

$\Sigma M = 0$ $+ \quad -$

$$R_B \times 12 - \cancel{28}\underset{194}{} \times 10 - 3\times 3 = 0$$

$$12R_B - 1940 - 9 = 0$$

$$12R_B = 1940 + 9$$

$$R_B = \frac{1949}{12}$$

$$\boxed{R_B = 162.416}$$

②

$$R_A + R_B = 194.5$$

$$R_A + 162.416 = 194.5$$

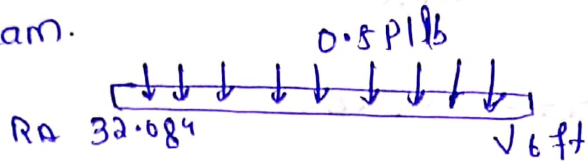
$$R_A = 194.5 - 162.416$$

$$\boxed{R_A = 32.084}$$

So

It means its in equilibrium

Now we find shear force at change point of Beam.




So shear force at 6 ft from left support

$\Sigma f_y = 0$ $\uparrow^- \downarrow^+$

$$V_{6ft} + 32.084 + 0.5 \times 6 = 0$$

$$V_{6ft} = -35.084$$

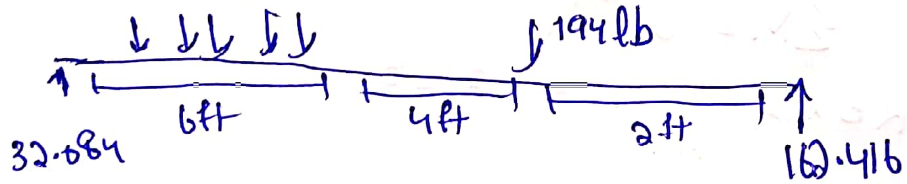
Now shear force at 10 ft

$\Sigma F_y =$ $\uparrow^- \downarrow^+$

$$-32.084 + 3 + 12 + V_{10ft} = 0$$

$$-17.084 + V_{10ft} = 0$$

$$V_{10ft} = 17.084$$



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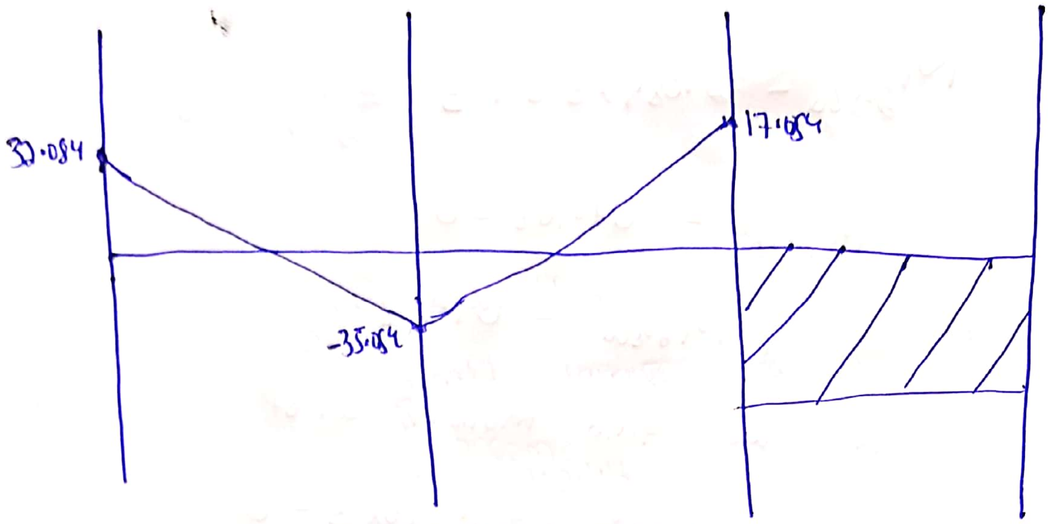
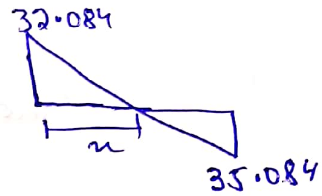



Now moment at change point find zero shear point

$$\frac{32.084}{x} = \frac{35.084}{6-x}$$




$$32.084(6-x) = 35.084(x)$$

$$192.504 - 32.084x = 35.084x$$

$$192.504 = 35.084x + 32.084x$$

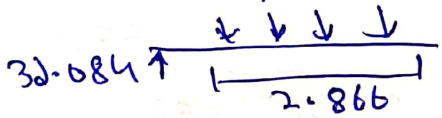
$$\frac{192.504}{67.168} = \frac{67.168x}{67.168}$$

$$2.866 = x$$

$$x = 2.866$$

As we know that moment is maximum where shear force is zero

Take section at 32.084 from left support and find moment




$$\Sigma M_{2.866} = 0$$

$$M_{2.866} - 32.084 \times 3.5 + 3\left(\frac{32.084}{2}\right) = 0$$

$$M_{2.866} - 64.168 = 0$$

$$\boxed{M_{2.866} = 64.168}$$

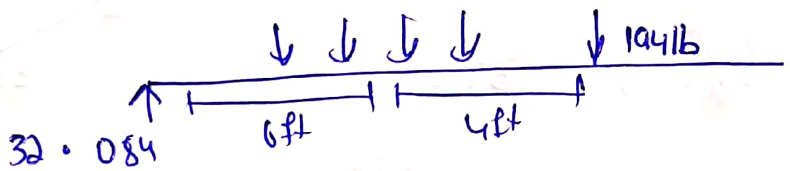
Now we find moment at 6ft

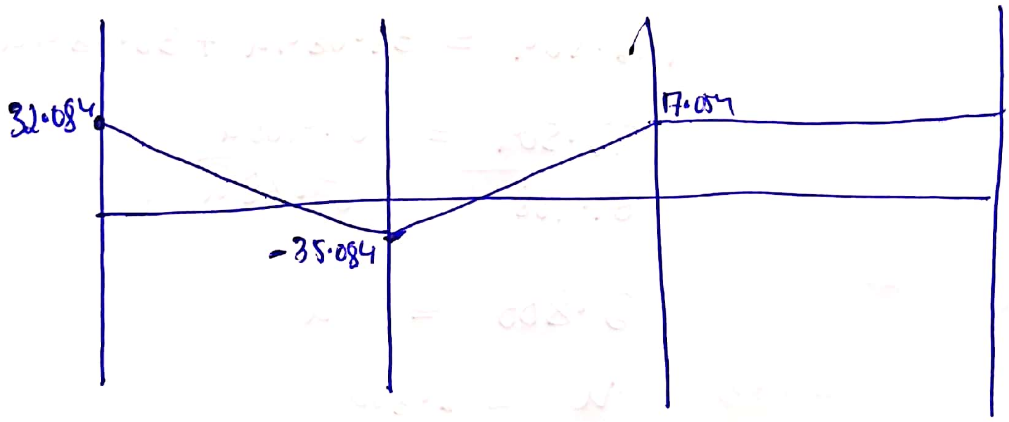
$$M_{6ft} - 32.084 \times 6 + 0.5 \times 6 \times 3 = 0$$

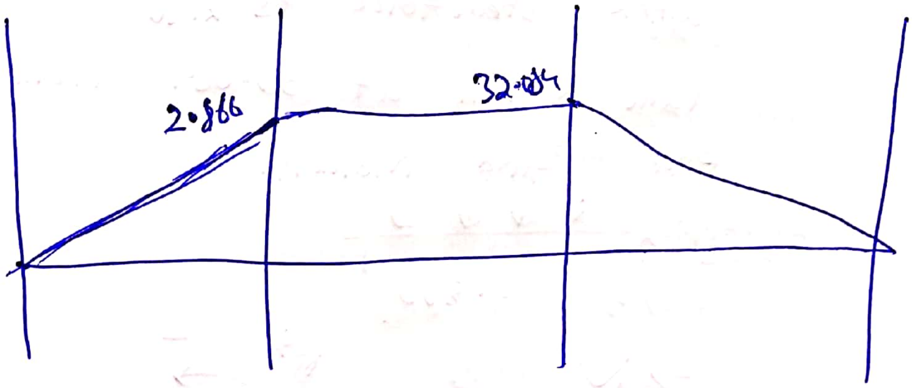
$$M_{6ft} - 183.504 = 0$$

$$\boxed{M_{6ft} = 183.504}$$

The diagram is given below



# SHEAR STRESS:

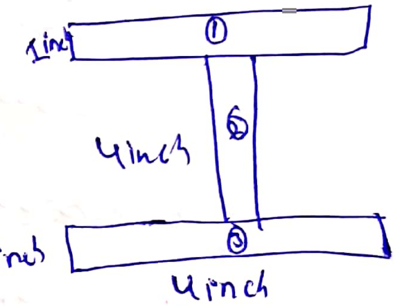
The maximum shear stress $\tau = \frac{VQ}{It}$ occur where the maximum shear force is 10.75 lb

So, To find shear stress we have following formula

$$\tau = \frac{VQ}{It}$$

we will find moment of inertia

* we will find the centroid by following formula




$$\bar{y} = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A_1 + A_2 + A_3}$$

$A_1 = 4 \times 1 = 4$
$A_2 = 4 \times 1 = 4$
$A_3 = 4 \times 1 = 4$

$$\bar{y} = \frac{4 \times 0.5 + 4 \times 3 + 4 \times 5.5}{4 + 4 + 4}$$

$$\bar{y} = 3''$$

## Moment of Inertia:

| No | A (in²) | Ix (in) | $d = d(\bar{y} - y_1)$ $(\bar{y} - y_2)$ $(\bar{y} - y_3)$ |
|---|---|---|---|
| 1 | 4 | $\frac{4 \times (1)^2}{12}$ | $= 0.333$ |
| 2 | 4 | $\frac{1 \times (4)^3}{12}$ | $= 5.333$ |
| 3 | 4 | $\frac{4 \times (1)^3}{12}$ | $= 0.333$ |

(No, 0 · d') ⑥

1. $d = (\bar{y} - y_1) = 3 - 0.5 = 2.5$

2. $d = \bar{y} - y_2 = 3 - 3 = 0$

3. $d = 3 - 5.5 = -2.5$

$d^2$

1. $4 \times (2.5)^2 = 25$

2. $4 \times (0)^2 = 0$

3. $4 \times (-2.5)^2 = 25$

Now

$$I_X = I_X + Ad^2$$

1. $0.333 + 25 = 25.333$

2. $5.333 + 0 = 5.333$

3. $0.333 + 25 = 25.333$

Total

$$I = I_{u1} + I_{u2} + I_{u3}$$

$$\boxed{I = 55.999 \text{ in}^2}$$

Now shear stress

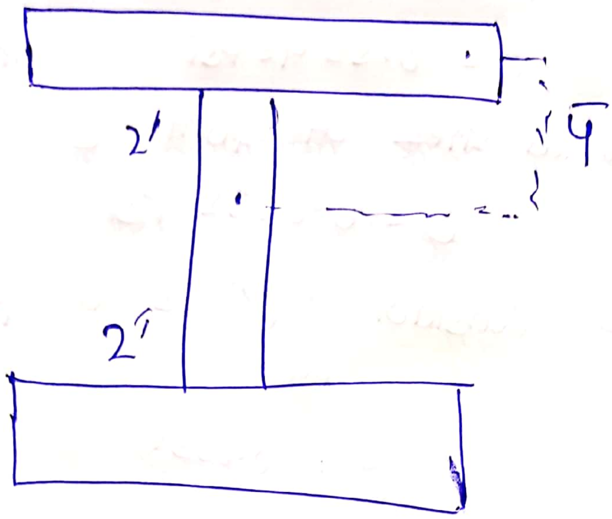
$$T = \frac{VQ}{Ib}$$

$V_{max} =$ 12.4166

$Q$ = FA

while b = bread of that fiber

→ Shear stress at point C located at centre of uniformly distributed load & 1 inch below top fiber




$$\bar{y} = 2 + 0.5 = 2.5$$

$$A = 1 \times 4 = 4$$

$$Q = 4 \times 2.5 = 10$$

As we know that

$$t = \frac{VQ}{Ib}$$

$$t = \frac{(2.43)(10)}{(55.96)(4)}$$

$$\boxed{t = 0.5543 \text{ Psi}}$$

To find flexural stress

$$\sigma = \frac{My}{I}$$

where M is maximum moment in B.M.D

$$M = 1.5$$

$$\sigma = \frac{(1.5)(2)}{55.996}$$

$$\boxed{\sigma = 0.535}$$

So we know that shear stress at Point C is

$t = 0.5543$ Psi and

Flexural stress at point C is

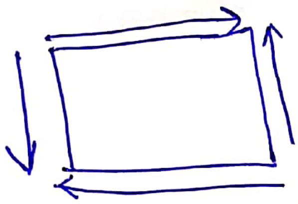
$6 = 0.0535$ Psi

Now consider 'C' is a planna element


0.0535 Psi is compresive because point C lies in compresion zone of Beam cross section.

Now Shear Stress is


Showing combine stress on 2D element



Now we can find that stress state consider of point 'C' at a degree of 20° on clockwise.

$6u = -0.0535$

$6y = 0$

$Tuy = 6.5543$

$6u' = ?$

$6y' = ?$

$\tau u'y' = ?$

Scanned with CamScanner

As we know that

$$\sigma u' = \frac{\sigma u + \sigma y}{2} + \sigma \frac{x - \sigma y}{2} \cos\theta + \tau_{xy} - \sin\theta$$

we also know that

$$\sigma u' = \frac{\sigma u + \sigma y}{2} + \frac{\sigma u - \sigma y}{2} \cos\theta + \tau_{xy} - \sin\theta$$

$$\tau u'y' = -\frac{\sigma u - \sigma y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$$

$$\sigma y' = \frac{\sigma u + \sigma y}{2} - \frac{\sigma u - \sigma y}{2} \cos 2\theta \, \tau_{xy} \sin 2\theta.$$

For $\sigma u'$

$$\sigma u' = \frac{-0.535}{2} + - \frac{0.0535}{2} \cos 2(-20) + (0.5543) \sin 2(-20)$$

$$\Rightarrow \sigma u' = -0.02675 - 0.6204 - 0.356$$

$$\sigma u' = -0.840315$$

For $\sigma y'$

$$\sigma y' = -\frac{0.0545}{2} - \frac{(-0.0535)}{2} \cos 2(-20)$$
$$- (0.5543) \sin 2(-20)$$

$$\sigma y' = -0.02675 - 0.6204 - 0.356$$

$$\sigma y' = -0.40315$$

For $\tau u'y'$

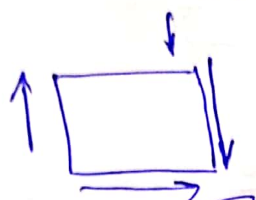
$$\tau u'y' = -\frac{(-0.535) - 0}{2} \sin 2(-20) + 0.5540 \cos 2(-20)$$

$$\tau u'y' = -0.01719$$

$$\boxed{\tau u'y' = 0.3466}$$

So, the new stress state after 20° clockwise orientation is shown

$\sigma_y' = 0.40355$



$\sigma_x' = 0.4035$

$\tau_{xy}'$ 0.3466

$\Rightarrow$ Now we will find its principle stress

$$\sigma_{12} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \{(xy)\}^2}$$

$$\sigma_{12} = \frac{-0.05 35 + 0}{2} \pm \sqrt{\left(\frac{-0.0535}{2} - 0\right)^2 + (0.05543)^2}$$

$$\sigma_{12} = -0.0267 \pm \sqrt{7.155 + 0.3072}$$

$$\sigma_{12} = -0.0267 \pm \sqrt{7.4622}$$

$$\sigma_{12} = -0.0267 \pm 2.7317$$

$\Rightarrow$ $\sigma_y = \sigma_1 = -0.267 + 2.7317 = 2.705$

$\sigma_x = \sigma_2 = -0.0267 - 2.7317 = -2.7584$

<u>Max in plane shear stress</u>

$$\tau_{xy} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2)}$$

$$\tau_{xy} = \sqrt{\left(\frac{-0.0535 - 0}{2}\right)^2 + (0.3543)^2}$$

$$\tau_{xy} = \sqrt{0.00071 + 0.3072}$$

$$= \sqrt{0.30791}$$

$$\boxed{\tau_{xy} = 0.3543 \text{ Psi}}$$

Now, we will Draw mohr's circle for the Given problem

**Solving:-**

As we know that to draw the circle we need the co-ordinate of circle as well as radius.

* we find the co-ordinate of circle by this method.

Centre co-ordinate $\left(\frac{6u+64}{2}, 0\right)$

$$(h, k) = \left(\frac{-0.0535}{2}, 0\right)$$

$$= (-0.026, 0)$$

Radius of mohr circle is

$$r = \sqrt{\left(\frac{6u-64}{2}\right)^2 + \{(x.4)\}^2}$$

$$r = \sqrt{\left(\frac{-0.0535}{2}-0\right)^2 + (0.5543)^2}$$

$$r = \sqrt{0.000715 + 0.3072}$$

$$\boxed{r = 0.5549}$$