Structure Analysis

Name :- Afrasiyab

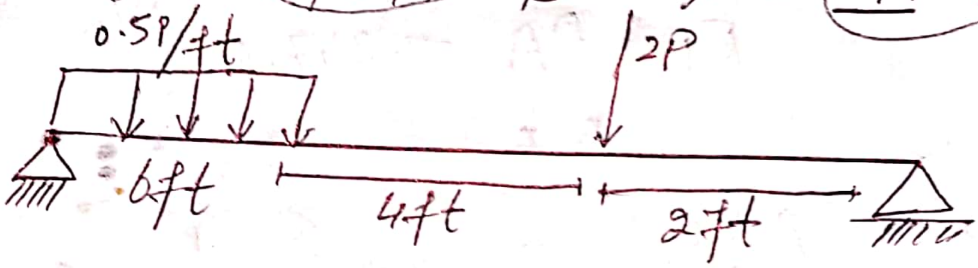
ID :- 7899

Sec :- A

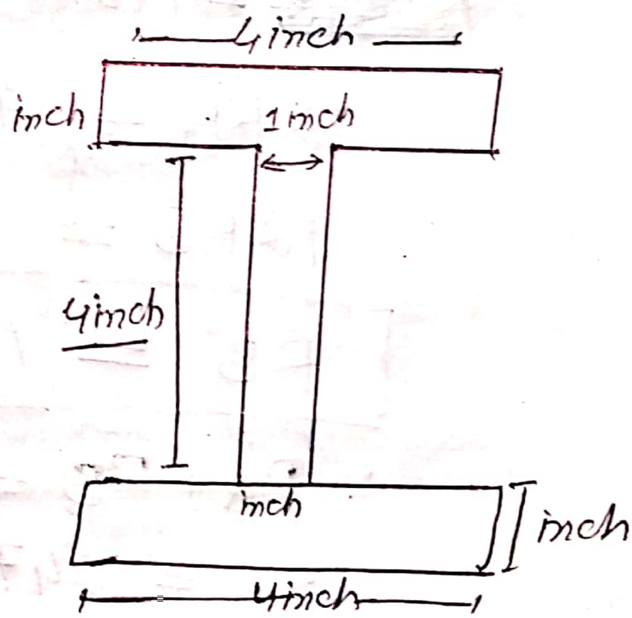
Q No. 1.

Ans :-

Hints :- P, where P that will be last two digits of my registration no that 7899 So last 99.



So $2P = 2 \times 99 \Rightarrow 198\,lb$

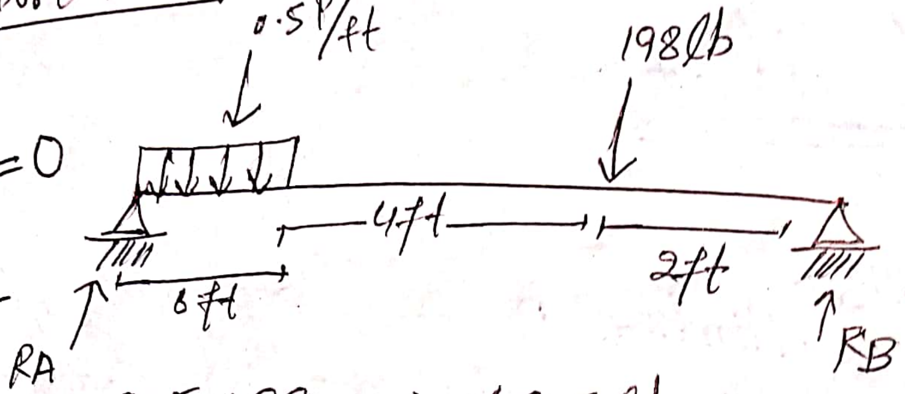


Force body diagram

Support reactions

$\Sigma fy = 0$

$+\uparrow \quad \downarrow -$



$0.5 \times 99 \Rightarrow 49.5\,lb$

total Load $\Rightarrow$ $198 + 49.5$ $247.5\,lb$

$RB + RA = 247.5\,lb$

Now

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

$RB \times 12$ ~~$RB \times 198$~~ $- 198 \times 10 - 49.5 \times 3 = 0$

$12RB - 1980 - 148.5 = 0$

$12RB = 2128.5$

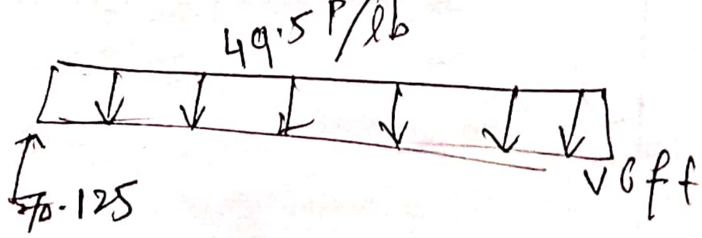
$\boxed{RB = 177.375}$

$RA + RB = 247.5$

$RA = 247.5 - RB \Rightarrow 247.5 - 177.375$

$\boxed{RA = 70.125}$

Now shear force at change point of Beam.



So

Shear force at 6ft from left support

$\Sigma F_y = 0 \quad \overset{-}{\uparrow} \overset{+}{\downarrow}$

$+V_{6ft} - 70.125 + 49.5 \times 6 = 0$

$+V_{6ft} + 226.875 = 0$

$V_{6ft} = -226.875$

$\boxed{V_{6ft} = -226.875 \text{ lb}}$

Now shear force at V_{10ft}

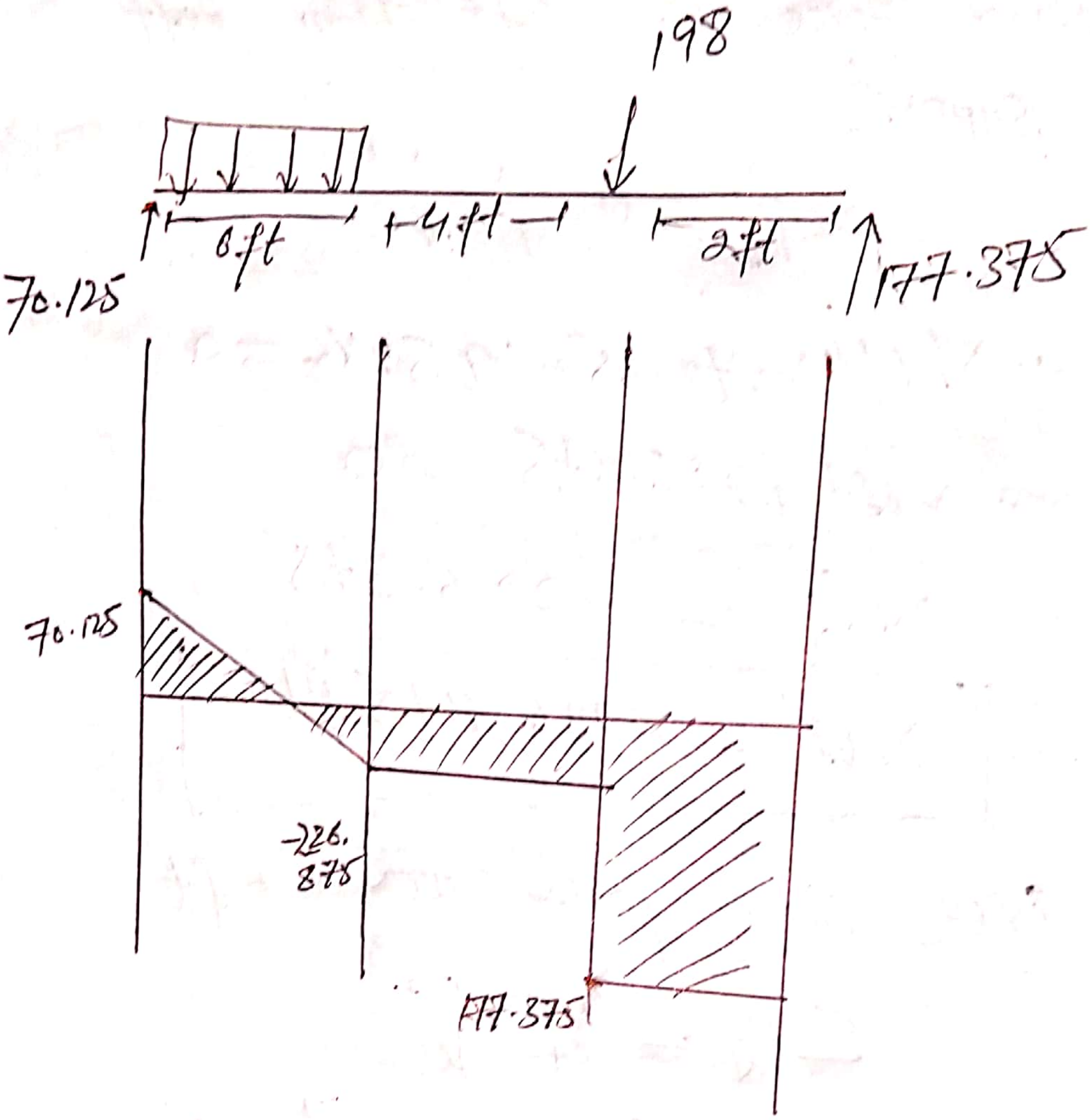
$\Sigma F_y = \quad \overset{-}{\uparrow} \overset{+}{\downarrow}$

$-70.125 + 49.5 + 198 + V_{10ft} = 0$

$V_{10ft} = -177.375$

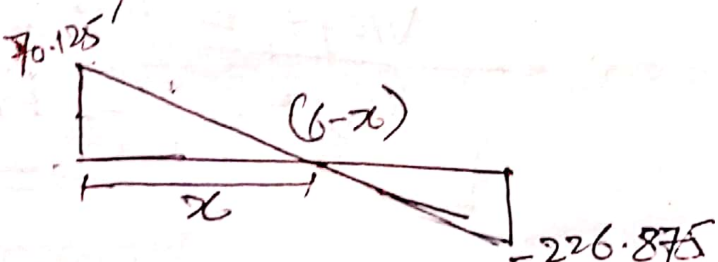
$\boxed{V_{10ft} = -177.375}$

Scanned with CamScanner



Now moment at charge point

Find zero shear point.



$$\frac{70.125}{x} = \frac{-226.875}{(6-x)}$$

$$(70.125)(6-x) = -226.875x$$

$$420.75 - 70.125x = -226.875x$$

$$420.75 = -226.875x + 70.125x$$

$$= x(-226.875 + 70.125)$$

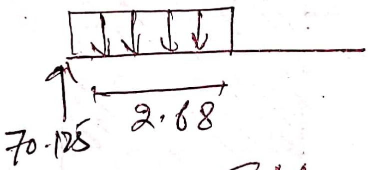
$$=$$

$420.75 = 156.75x$

$x = 2.68$

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

Take section at 2.68 from left support and find moment.



$\Sigma M_{2.68} = 0$ +

$M_{2.68} - 70.125 \times 2.68 + 49.5\left(\frac{2.68^2}{2}\right) = 0$

$\boxed{M_{2.68} = 121.605}$

Now $M_{6ft} \Rightarrow 70.125 \times 6 + 49.5 \times 6 \times 3 = 0$

$\boxed{M_{6ft} \Rightarrow 24.75}$

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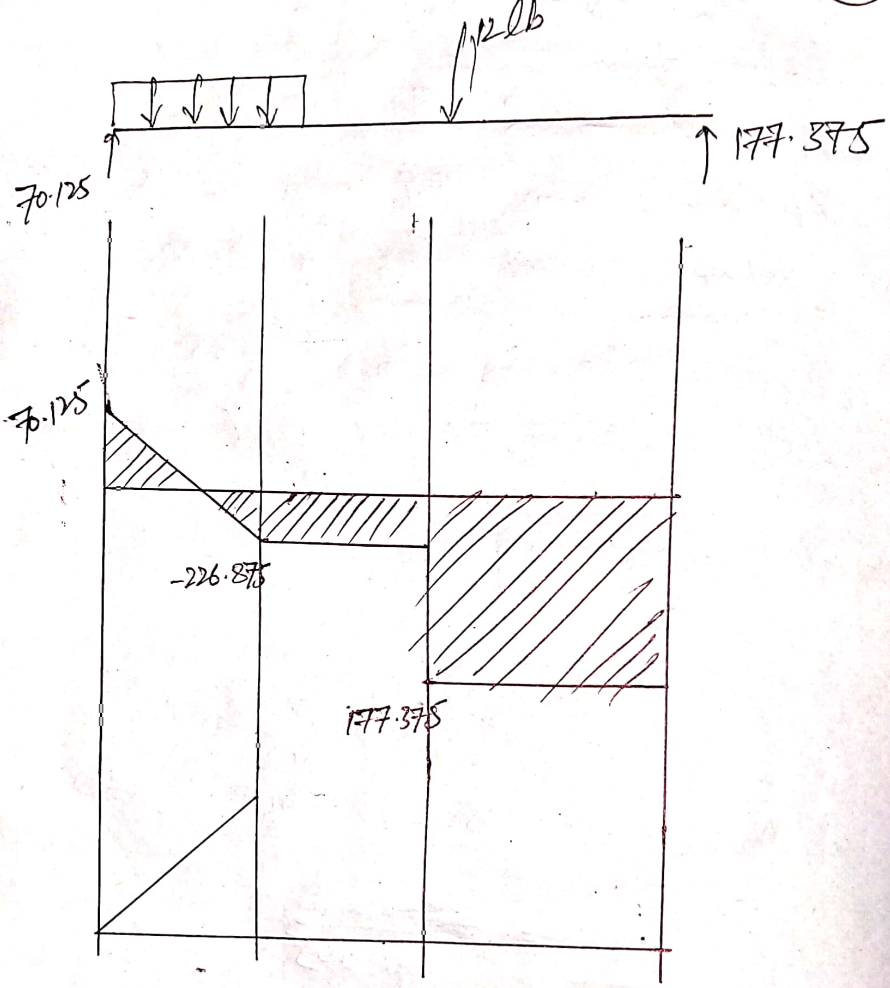


Now

Shear stress

As per Question

The maximum shear stress

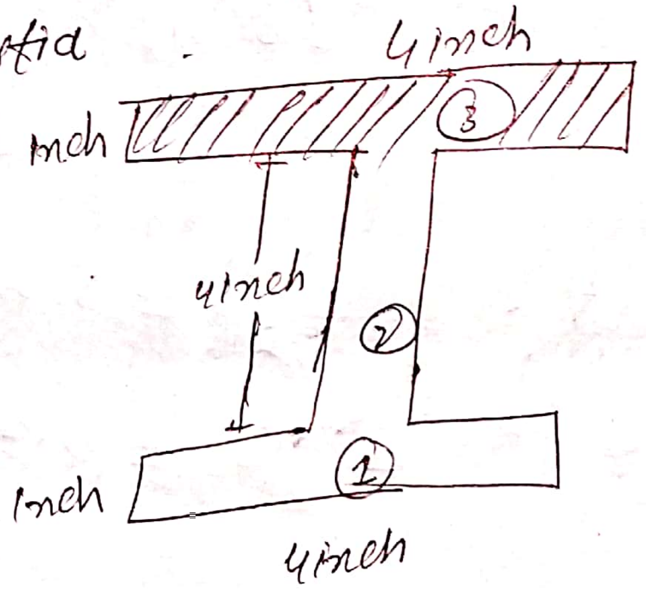
$J = \frac{VQ}{It}$ occure where the

maximum shear force lies in above diagram max shear force is ____

So to find the shear stress we have the following formula

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

we first find the moment of inertia



As we know that to find Centriord we have the following formula

$$\bar{y} = \frac{A_1 y_1 + A_2 y_2 + A_3 y_3}{A_1 + A_2 + A_3}$$

$A_1 = 4 \times 1 = 4$

$A_2 = 4 \times 1 = 4$

$A_3 = 4 \times 1 = 4$

$$\bar{y} = \frac{4 \times}{4+4+4}$$

$\bar{y} =$

Now moment of Inertia

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

(Now "d")

1. $d = (\bar{y} - y_1) = (3 - 0.5) = 2.5$
2. $d = (\bar{y} - y_1) = (3 - 3) = 0$
3. $d = (3 - 5.5) = -2.5$

(Now 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. $0.333 + 25 = 25.333$

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

Now shear stress

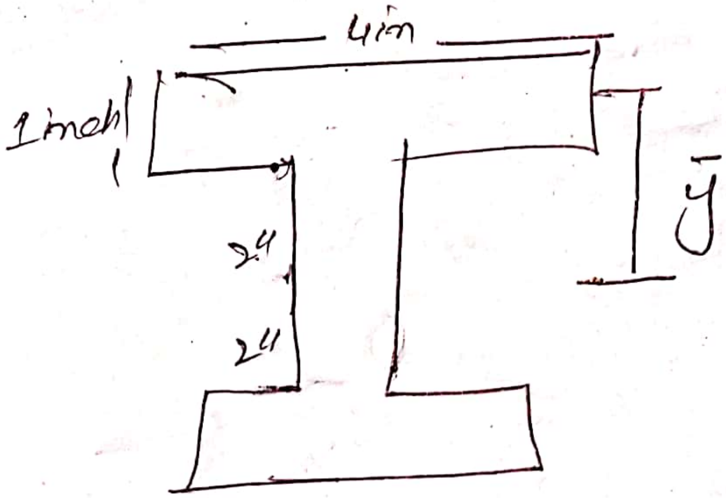
$$\tau = \frac{VQ}{Ib}$$

$V_{max} = \underline{177.375}$

$Q = \tau A$

b = breath of that fiber.

Shear stress at point C located Centre of uniformly distributed load and 1inch below the top fiber.



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

$A = 1 \times 4 = 4$

$Q = 4 \times 2.5 = 10$

As we know that

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

$$t = \left(\frac{177.375 \times 10}{(55.996)(4)}\right)$$

$$\boxed{\tau \Rightarrow 7.919 \text{ psi}}$$

Now flexural stress Analysis (11)

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

Where M is maximum moment in BMA.

$$M = 1.5$$

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

$$\boxed{\sigma = 0.0535}$$

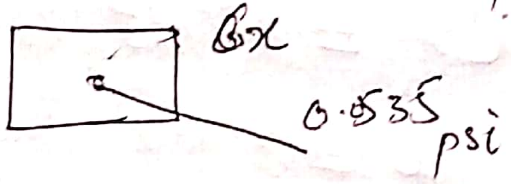
So shear stress at point "C" is

$$t = 7.919 \text{ psi}$$

Flexural stress at point C

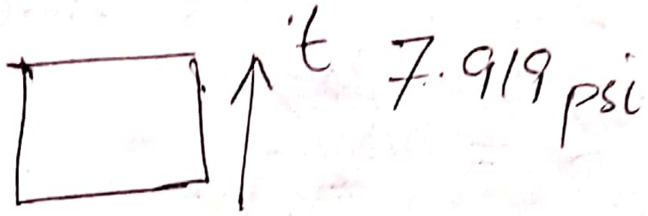
$$\sigma = 0.0535 \text{ psi}$$

Now consider "i" is a planner element

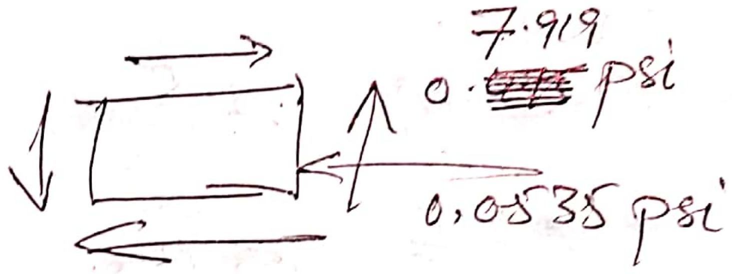


0.0535 is compressive because point C lies in compression zone of Beam cross

Now



Combine stress on 2D element.



Now stress can find the stress state consider of point "C" at a degree of 20° clockwise orientation.

<u>Solve:</u> Given stress state

$\sigma_x = -0.0535$

$\sigma_y = 0$

$\tau_{xy} = 0.475$

$\sigma_{x'} = ?$

$\sigma_{y'} = ?$

$\tau_{x'y'} = ?$

As we derive the following formula of equation for stress transformation.

As we derived the following formula equation for stress transformation

$$\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta .$$

$$\sigma_{y'} = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta .$$

$$\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta .$$

So First

$$\sigma_{x'} = \frac{-0.0535 + 0}{2} + \frac{-0.0535 - 0}{2} \cos 2(-20)$$

$$+ (0.475) \sin 2(-20)$$

$$= -0.047 \text{ Compression}$$

σ_y' Now

$$\sigma_y = \frac{-0.0535+0}{2} + \frac{(-0.0535)-0}{2}\cos(2(-10)) - (0.475)\sin 2(-20)$$

$= -0.00635$ Compression

Now $\tau_{x'y'}$

$$\tau_{x'y'} = -\frac{0.0535-0}{2}\sin^2(-20) + 0.475\cos 2(-20)$$

$= 0.01706$ psi

Find the principle stress

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$$\sigma_{1,2} = \frac{-0.0535+0}{2} \pm \sqrt{\left(\frac{-0.0535-0}{2}\right)^2 + (0.47\ldots}$$

$$= -0.0265 \pm \sqrt{0.00071 + 0.22}$$

$$= -0.0265 \pm \sqrt{0.469}$$

so it become

$$\sigma_y = \sigma_1 = -0.0265 + 0.464 = 0.4425$$

$$\sigma_x = \sigma_2 = -0.0265 - 0.464 = -0.495$$

Now

max in plane shear stress

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

$$\tau_{xy} = \sqrt{\left(-\frac{0.0535}{\theta} - 0\right)^2 + (0.475)^2}$$

$$= \sqrt{0.00071 + 0.22}$$

$$\boxed{\tau_{xy} = 0.469}$$

to Draw mohr's circle for the Give problem

First we find centre cordinates

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

$$= (-0.026, 0)$$

Now Radius

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

$$r = \sqrt{\left(\frac{-0.0525 + 0}{2}\right)^2 + (0.473)^2}$$

$\tau_{xy} = 0.464$