ID : 7966

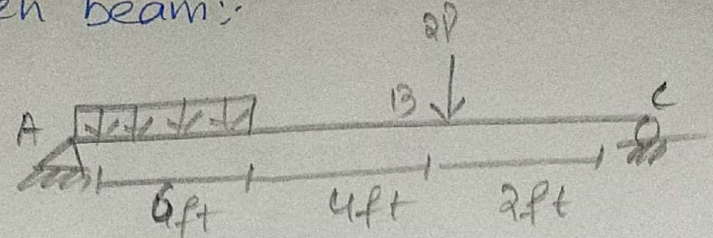
SECTION : B

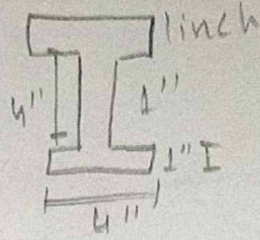
SEMESTER : 4th

DEPT : Civil

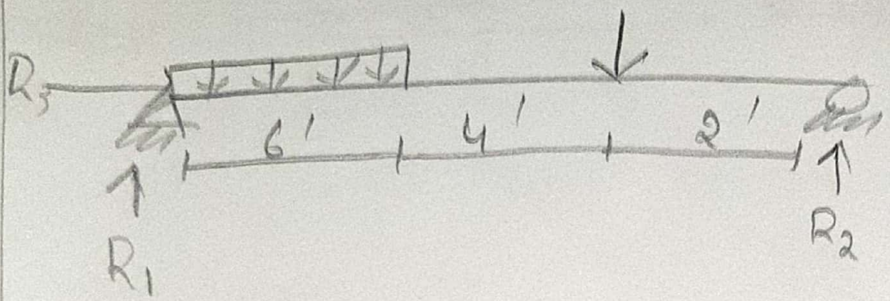
①

Given beam:-





Put the value of P=66.



find the unknown reaction at the support apply equillibrium equation

$\Sigma F_x = 0$ i.e. $\boxed{R_3 = 0}$

$\Sigma F_y = 0$ (+)↑ ↓(−)

$R_1 + R_2 = (16.5)\times(6)\ lb + 132\ lb$

$R_1 + R_2 = 99 + 132$

$R_1 + R_2 = 231$ — ①

Next $\Sigma M_A = 0$ ↺+

$R_2 \times 12 - 10 \times 132 - (16.5 \times 6) \times 6/2 = 0$

$\Rightarrow 12R_2 = 1320 + 297$

$\Rightarrow$ ~~$12R_2 = 957\ lb\ ft$~~

$\Rightarrow 12R_2 = 1617\ lb\ ft$

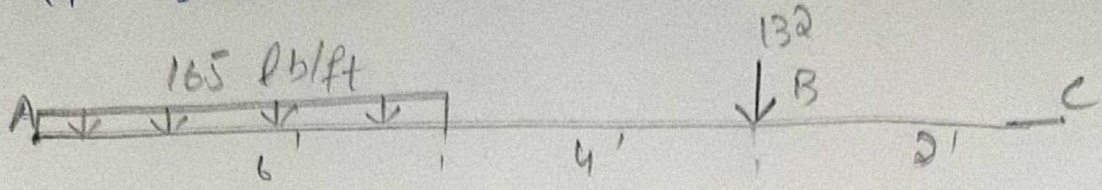
$\boxed{\Rightarrow R_2 = 134.75\ lb}$

① $R_1 + R_2 = 165$

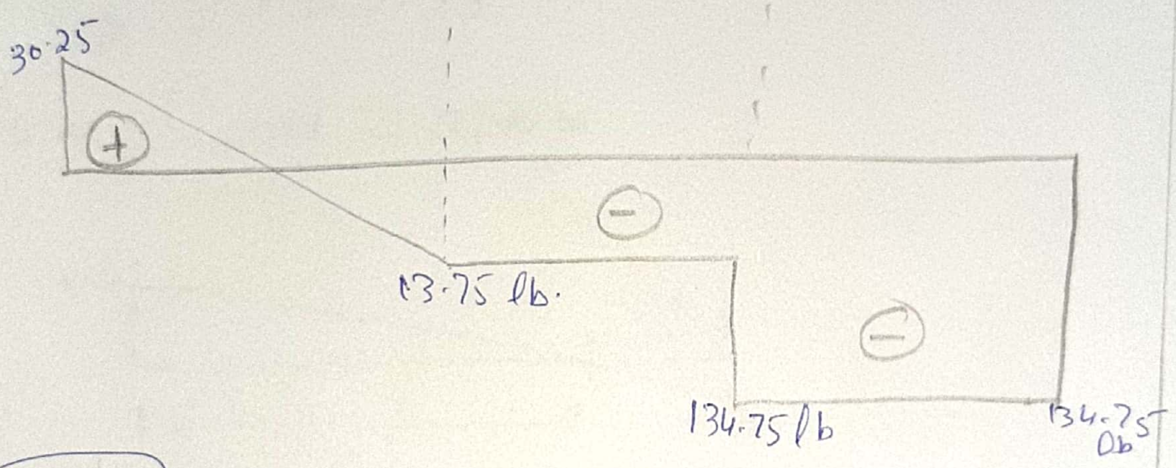
$R_1 = 165 - R_2$

$R_1 = 165 - 134.75$ lb

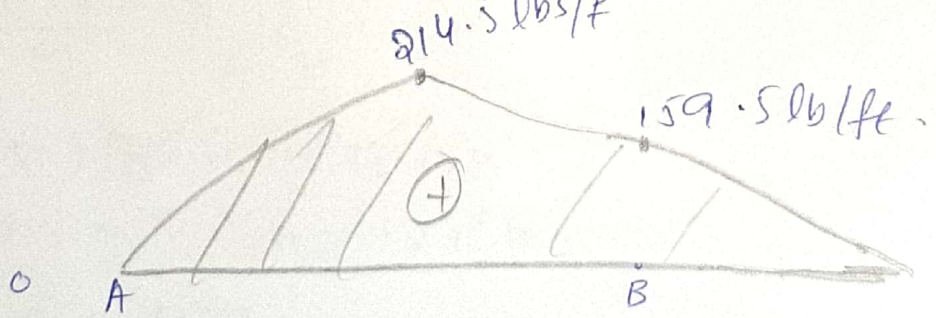
$R_1 = 30.25$ lb.



S.F.D



B.M.D



Now shear force at change point of beam
shear force at 6ft from left support

$\sum F_y = 0 \; +\uparrow -$

$30.25 - 16.5 \times 6 - V_{6ft} = 0$

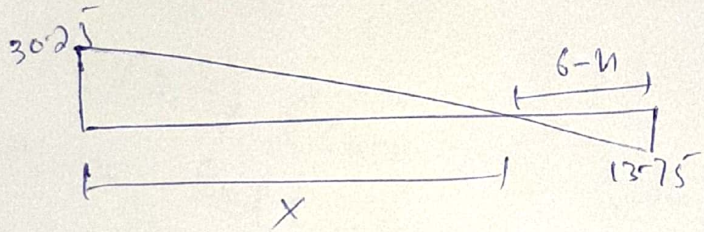
$\Rightarrow V_{6ft} = 129.25 \, lb$

At 10ft :-

$30.25 - 16.5 \times 6 - 132 - V_{10ft} = 0.$

$\Rightarrow V_{10ft} = -200.75$

from Shear diagram



We know that

$$\frac{30.25}{x} = \frac{13.75}{6-x}$$

$(6-x)(30.25) = 13.75x$

$181.5 - 30.25x = 13.75x$

$181.5 = 44x$

$$\boxed{x = 4.125 ft}$$

(4) Now determine the value of moment at 4.125 ft

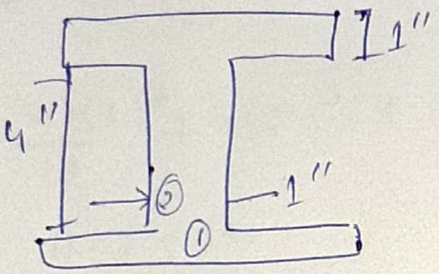
$M_{4.125} - 30.25 \times 4.125 + (10.5 \times 4.125) \times \left(\frac{4.125}{2}\right) = 0$

$\Rightarrow M_{4.125} - 124.7812 + \cancel{68.06}\ 140.37$

$\Rightarrow M_{4.125} = 15.597\ lb\ ft$

for shear stress we have $\tau = \frac{VQ}{Ib}$.

Inertia = ?



so $\bar{x} = 4/2 = 2\,inch$, $\bar{y} = 6/2 = 3\,inch$

i-e $(\bar{x}, \bar{y}) = (2, 3)$ (centre of gravity).
from extreme left and bottom.

(1) = $4 \times 1 = 4\,inch^2$

(2) = $4 \times 1 = 4\,in^2$

(3) = $4 \times 1 = 4\,in^2$

Scanned with CamScanner

(5) let G_1, G_2, G_3 be the centre of gravity of point (1), (2), (3) and k_1, k_2, k_3 the distances b/w $\bar{y}$ and y_1, y_2, y_3.

So

$$k_1 = \bar{y} - y_1 = 3 - 0.5 = 2.5\ in$$

$$k_2 = \bar{y} - y_2 = 3 - 3 = 0\ in$$

$$k_3 = \bar{y} - y_3 = 3 - 0.5 = 2.5\ inc$$

So

$$I_{xx} = \frac{b_1 h_1^3}{12} + a_1 k_1^2 + \frac{b_2 h_2^3}{12} + a_2 k_2^2 + \frac{b_3 h^3}{12} + a_3 k_3^2$$

$$I_{xx} = \frac{(4)(1)^3}{12} + 4(2.5)^2 + \frac{(1)(4)^3}{12} + a_2(0) + \frac{4(1)^3}{12} + 4(2.5)^2$$

$$I_{xx} = \frac{4 + 12(25) + 64 + 4 + 12(25)}{12}$$

$$\Rightarrow I_{xx} = 56\ in^3$$

Now

$$I_{yy} = \frac{b_1^3 h_1}{12} + \frac{b_2^3 h_2}{12} + \frac{b_3^3 h}{12}$$

$$I_{yy} = \frac{64}{12} + 4/12 + \frac{64}{12}$$

$$I_{yy} = 11\ in^4$$

Scanned with CamScanner

6

- At various points:- $\tau = \frac{VQ}{Ib}$

Centroid (2,3)

$V_{max} = 134.75$

i) At point A.

$\tau = \frac{VQ}{Ib}$ $\because Q = A\bar{y}$

$A = 0$

$0(5) = 0.$

$\tau = \frac{134.75(0)}{67(4)}$

$\tau = 0.$

ii) At point B

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

$\tau = \frac{\cancel{VQ}\ 134.75 \times (4\times1)(3-0.5)}{67\times4.}$

$\tau = 5.027\ lb/in^2$

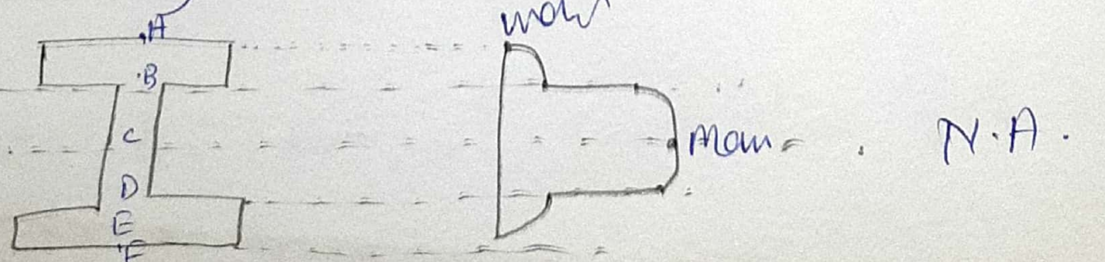
iii) At point C

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

$= \frac{134.75 \times [4\times1\times(3-0.5) + (1\times2)(2-1)]}{67\times1.}$

$\tau = 20.14\ lb/in^2.$

iv) At point D:- At this point, D and E will be the same because of the symmetry.



⑧ Flexural stress determination.

$$f = \frac{Mx}{I}$$

→ at the top fibre of point Ⓐ

$$f = \frac{my}{I}$$

$$f = \frac{15.597 \times 3}{67}$$

$M_{max} = 15.597$ lb-ft.

$f = 0.698$ lb/in²

→ At (N.A):

$$f = \frac{my}{I} = \frac{15.597 \times 0}{67}$$

$f = 0$ lb/in²

flexural stress value at point E, F, and g remains the same because of symmetry. Above the N.A is tension and below is compression.

→ At Ⓑ

$$f = \frac{15.597 \times (3-0.5)}{67} = 0.581 \text{ lb/in}^2$$

→ At Ⓒ

$$f = \frac{15.597\,(3-1)}{67}$$

$\Rightarrow 0.465$ lb/in²

(9) flexural stress diagram.