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Section = "B"

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subject = Structure Analysis (I)

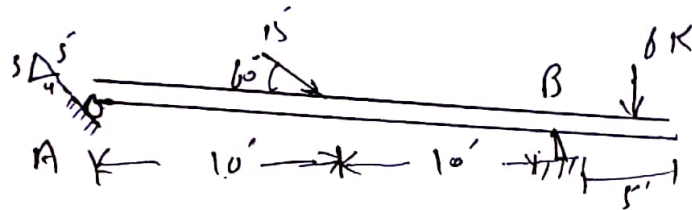
Date = 22-08-20

Q No = 1

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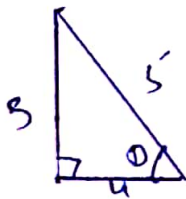
(1)

Determine the support reactions in the beam given below in figure 1 the roller support at point A in inclined beam where where the inclination is given in figure ?



⇒ Solution

first of all we have to find the angle for the roller support.



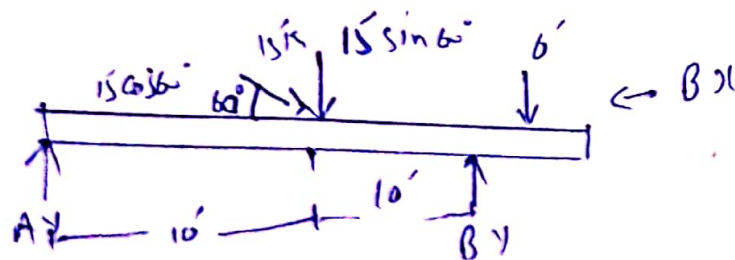
∴ using Trigonometry

$$\sin \theta = \frac{P}{H}$$

$$\sin \theta = \frac{3}{5}$$

$$\theta = 36.86^\circ$$

So now



1  $\Rightarrow$ 

$$\sum F_x = 0 \quad \rightarrow \leftarrow$$

$$15 \cos 60^\circ - B_x - A_y \sin 36.86^\circ = 0$$

$$7.5 - B_x - 0.599 A_y = 0 \quad \rightarrow (1)$$

2  $\Rightarrow$ 

$$\sum F_y = 0 \quad \uparrow + \downarrow -$$

$$A_y \cos 36.86^\circ + B_y - 6 \text{ k} - 15 \sin 60^\circ = 0.$$

$$0.80 A_y + B_y - 18.99 = 0.$$

$$0.80 A_y + B_y = 18.99 \quad \rightarrow (2)$$

3  $\Rightarrow$ 

$$\sum M_B = 0 \quad \downarrow + \uparrow$$

$$(A_y \cos 36.86^\circ \times 20) - (15 \sin 60^\circ \times 10) + 6 \times 2.5 = 0$$

$$16 A_y - 190 + 15 = 0$$

$$16 A_y - 175 = 0$$

$$A_y = \frac{175}{16}$$

$$A_y = 10.9375 \text{ k}$$

out the value in  $\text{k}$

$\Rightarrow$

$$0.80 (10.9375) + B_y = 18.99$$

$$8.75 + B_y = 18.99$$

$$B_y = 18.99 - 8.75$$

$$B_y = 10.25 \text{ K}$$

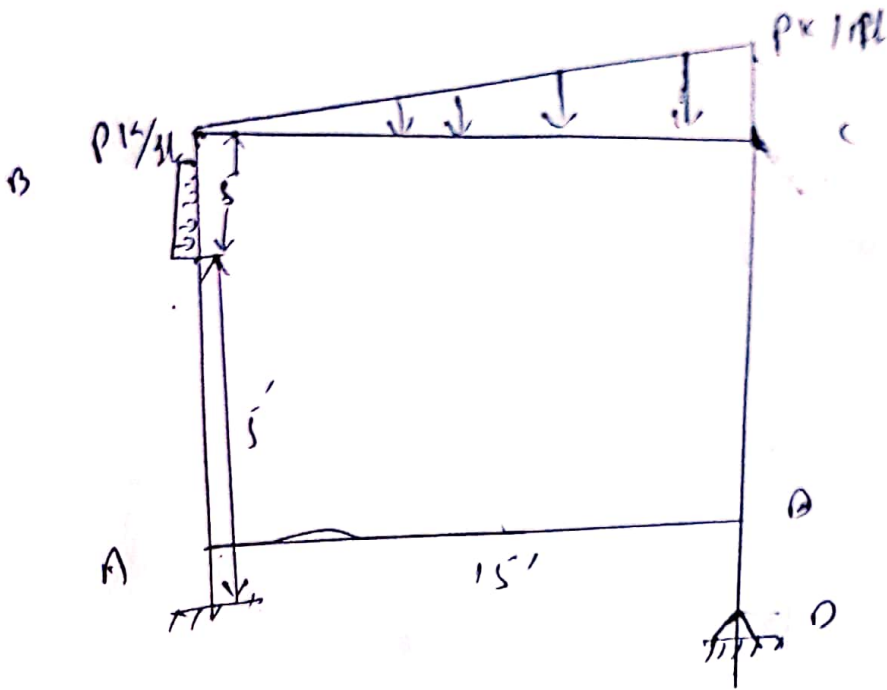
Put the value of  $A_y$  in eq (1)

$$7.5 - B_x - 0.599 (10.9375) = 0$$

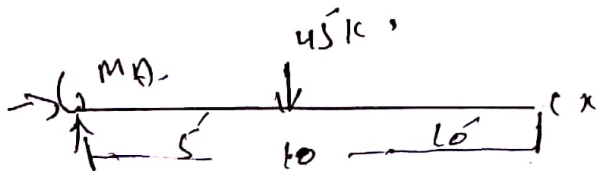
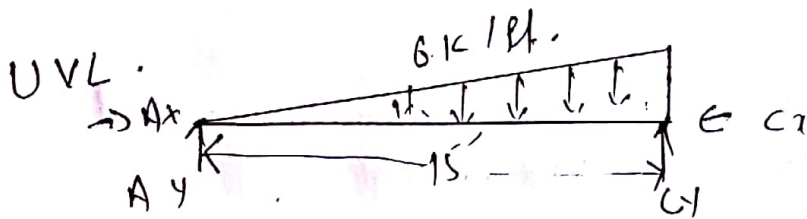
$$B_x = 0.9375 \text{ K}$$

Q2

(47)



Free body diagram.



$$\begin{aligned} \text{Area} &= \frac{1}{2} bh = \frac{1}{2} \times 15 \times 6 \\ &= 45 \text{ k} \end{aligned}$$

$$\begin{aligned} \text{Distance} &= \frac{1}{3} (b) \\ &= \frac{1}{3} (15) \\ &= 5 \end{aligned}$$

$$\Rightarrow \sum F_x = 0 \rightarrow + \leftarrow$$

$$Ax - Cx = 0 \quad (0)$$

Now

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

$$Ay + Cy - 4S = 0$$

$$Ay + Cy = 4S \quad \rightarrow \text{①}$$

$$\sum MA = 0 \downarrow +$$

$$(\cancel{4S} \times 5) - Cy \times 15 = 0$$

$$-15Cy + 225$$

$$15Cy = 225$$

$$Cy = \frac{225}{15}$$

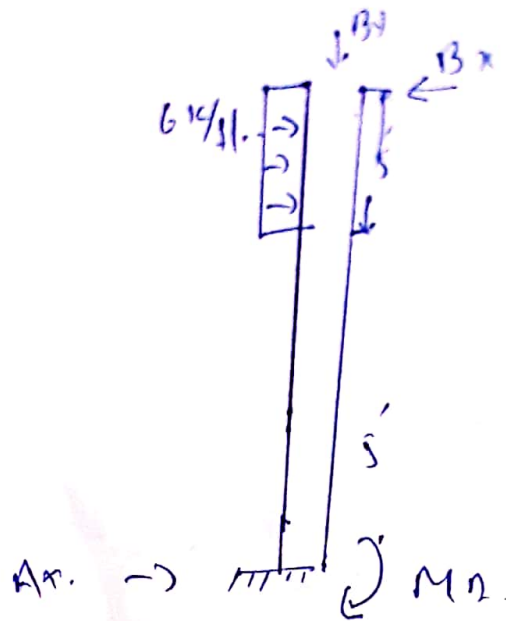
$$\boxed{Cy = 15k}$$

put in above equation

$$A_y + 15 = 45$$

(b)

$$A_y = 30 \text{ k}$$



$$(i) \sum F_x = 0 \rightarrow + \leftarrow -$$

$$A_x + (6 \times 5) - B_x = 0$$

$$A_x - B_x = -30 \rightarrow B_x$$

$$(ii) \sum F_y = 0 \uparrow + \downarrow -$$

$$A_y - B_y = 0$$

$$(iii) \sum M_2 = 0 \downarrow + \uparrow -$$

$$(6 \times 5) \times (7.5 + 5) - B_x \times 10 = 0$$

$$30 \times 12.5 - 10 B_x$$

$$375 - 10 B_x = 0$$



$$Bx = 22.5 \text{ k}$$

Put the value of  $Bx$  in eq. 1

$$Ax - 22.5 = -30$$

$$Ax = 7.5 \text{ k}$$

Put the value of  $Ax$  in eq. 2

$$30 - Bx = 6$$

$$Bx = 30 \text{ k}$$

Put the value of  $Ax$  in eq. (a)

$$7.5 - Cx = 6$$

$$Cx = 7.5 \text{ k}$$

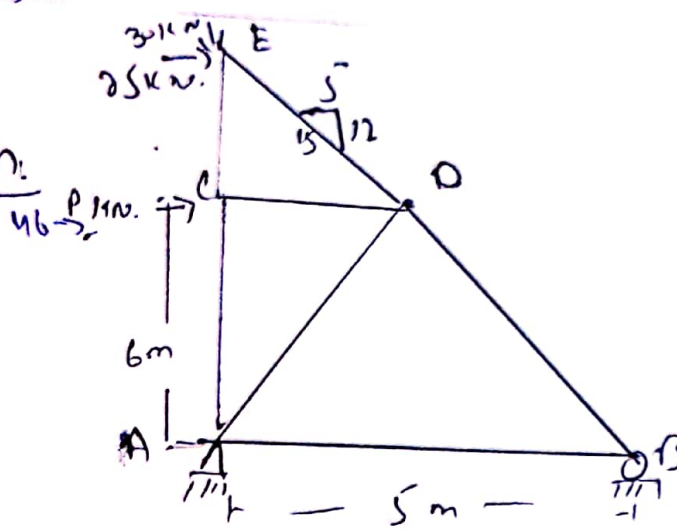
Since D is hinge and in the projection of point C  
Thus

$$Dx = -7.5 \text{ k}$$



Q 3

Solution:



(2)

$$\alpha = \tan^{-1} \frac{12}{5}$$

$$\alpha = 67.4^\circ$$

$$\beta = 90^\circ - 67$$

$$\beta = 22.6^\circ$$

$$\sum M_A = 0 \quad (\uparrow +)$$

$$25 \times 12 - 30 \times 3 + 46 \times 6 + R_{Dy} \times 5$$

$$300 - 90 + 276 + R_{Dy} \times 5$$

$$\rightarrow R_{Dy} = \frac{138}{5} = 27.6 \text{ kN}$$

$$\sum F_y = 0 \quad (\uparrow +)$$

$$27.6 - 30 + R_{Ay} = 0$$

$$R_{Ay} = 2.4 \text{ kN}$$

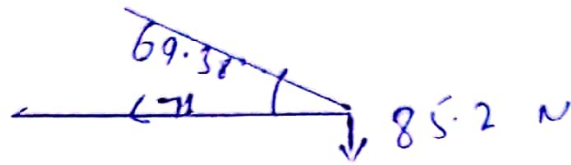
$$\sum F_x = 0 \quad (\rightarrow +)$$

$$R_{Ax} + 46 + 25 = 0$$

$$R_{Ax} = -71 \text{ kN}$$

By joints method. (9)

Joint 'B'



$$\sum F_x = 0 \quad \rightarrow + \quad \leftarrow -$$

$$-71 + F_{AB} = 0$$

$$F_{AB} = 71 \text{ N} \quad \rightarrow$$

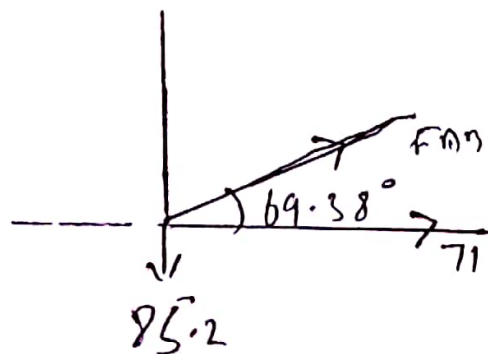
$$\sum F_y = 0 \quad \uparrow + \quad \downarrow -$$

$$-F_{BD} \cos 69.38 + 85.2 = 0$$

$$+ 0.35 F_{BD} = -85.2$$

$$F_{BD} = -243.4 \text{ N} \quad \leftarrow$$

Joint A



$$\sum F_x = 0 \quad \rightarrow + \quad \leftarrow -$$

$$F_{AB} \sin 69.38 + 71 = 0$$

$$0.94 FAD = -71$$

$$FAD = -75.53 \text{ N (C)}$$

$$\sum F_y = 0 \quad \uparrow + \quad \downarrow -$$

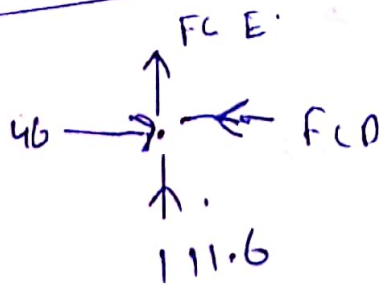
$$-85 \cdot 2 + FAC + FAD \cos 69.38 = 0$$

$$FAC + 85 \cdot 2 - 75.53 \times 0.35 = 0$$

$$FAC = \cancel{+58.88} \text{ N (C)}$$

$$FAC = 111.62 \text{ (T)}$$

Joint C:



$$\sum F_x = 0 \quad \rightarrow +$$

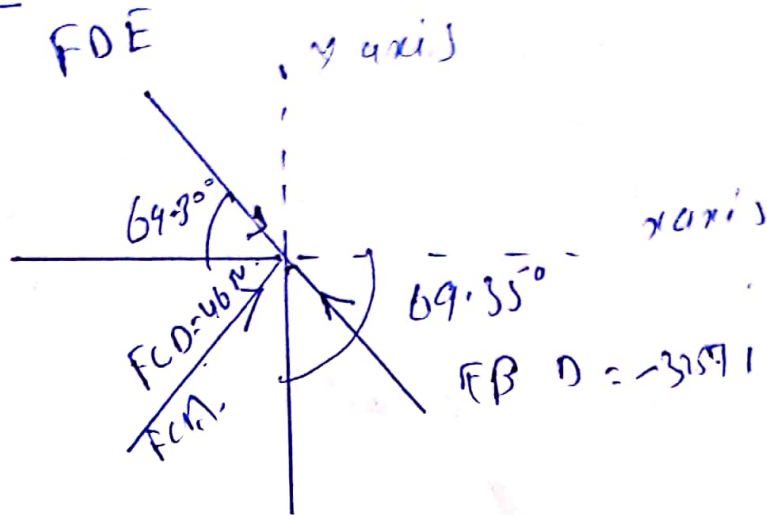
$$FCD = 46 \text{ N (T)}$$

$$\sum F_y = 0 \quad \uparrow + \quad \downarrow -$$

$$FCE = -111.62 \text{ N (C)}$$

Join D

(11)



$$\sum F_x = 0 \rightarrow +$$

~~$-46 + F_{DE} \sin 69.38^\circ - 43.4 \cos 69.38^\circ = 0$~~

$$-46 + F_{DE} \sin 69.38^\circ - 43.4 \cos 69.38^\circ = 0$$

$$0.935 F_{DE} - 46 - 85.71 = 0$$

$$0.935 F_{DE} = 131.71$$

$$F_{DE} = 140.87 \text{ N}$$