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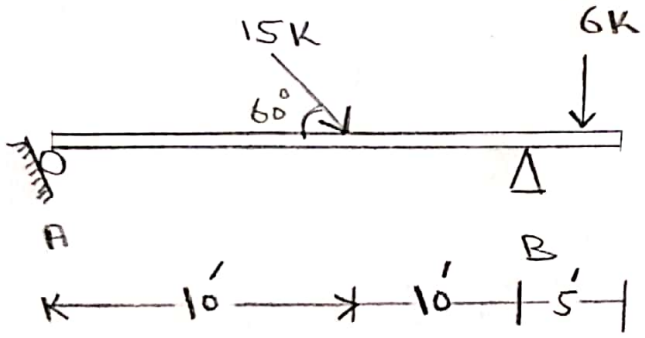
ID# 7793

Subject Structure Analysis I

Submitted to Sir Saqib

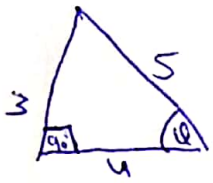
Date 22-8-2020

Ans 1



Solution

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



Using Trigonometry

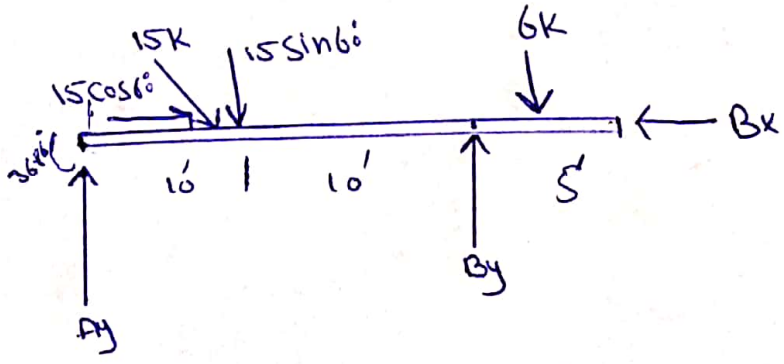
$$\sin\theta = \frac{\text{Per}}{\text{hyp}}$$

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

$$\theta = \sin^{-1}\left(\frac{3}{5}\right)$$

$$\theta = 36.86^\circ$$

So Now



1) $\Sigma F_x = 0 \quad \xrightarrow{+} \xleftarrow{-}$

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

$$7.5 - B_x - 0.599 A_y = 0 \quad \text{— (1)}$$

2) $\Sigma F_y = 0 \quad \uparrow + \downarrow -$

$$A_y \cos 36.86^\circ + B_y - 6K - 15\sin 60^\circ = 0$$

$$0.80 A_y + B_y = 18.99 \quad \text{— (2)}$$

3) $\Sigma M_B = 0 \quad \circlearrowleft + \circlearrowright -$

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

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

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

$$A_y = 10.9375K$$

Put the value in eqn (2)

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

$$8.75 + By = 18.99$$

$$By = 18.99 - 8.75$$

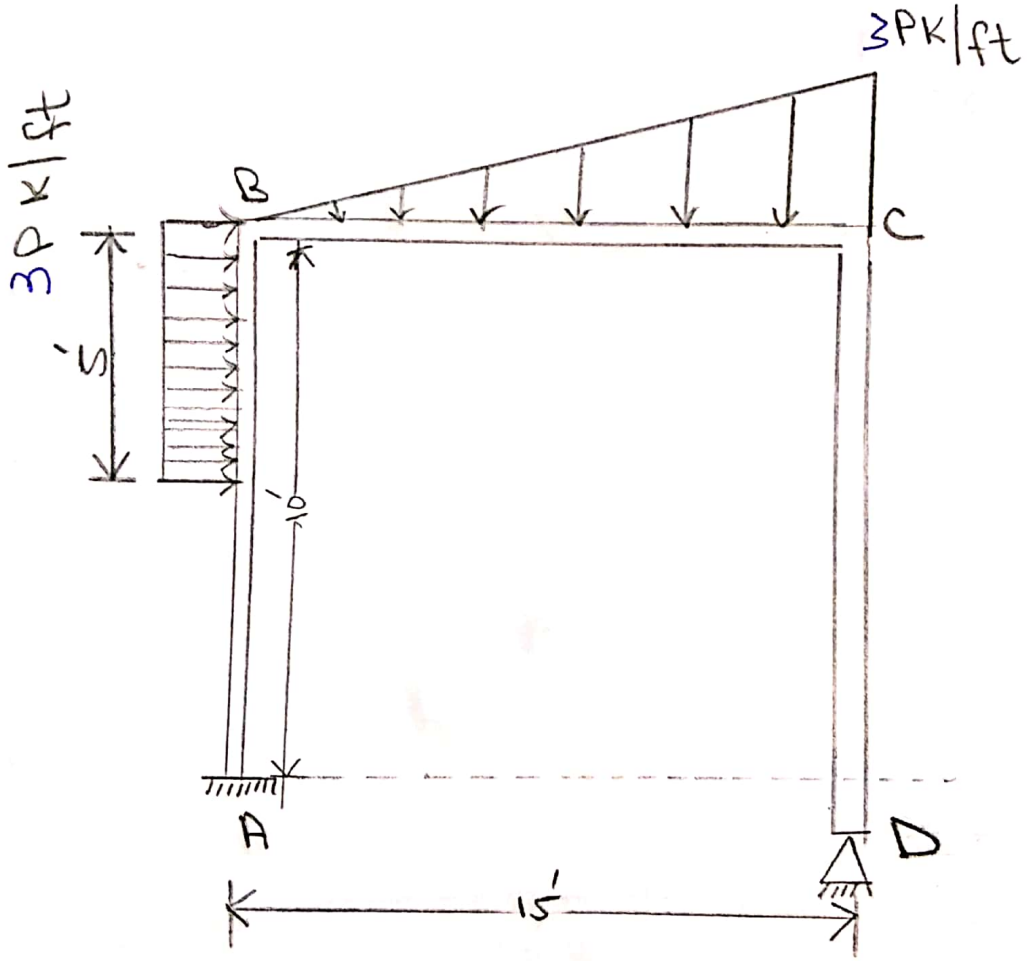
$$By = 10.25K$$

Now Put the value of Ay in eq(1)

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

$$Bx = 0.9375K$$

$A_{wy} = 2$



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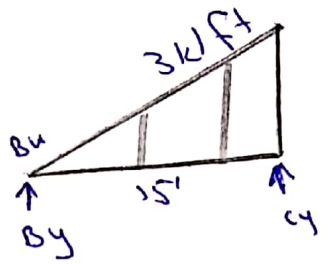
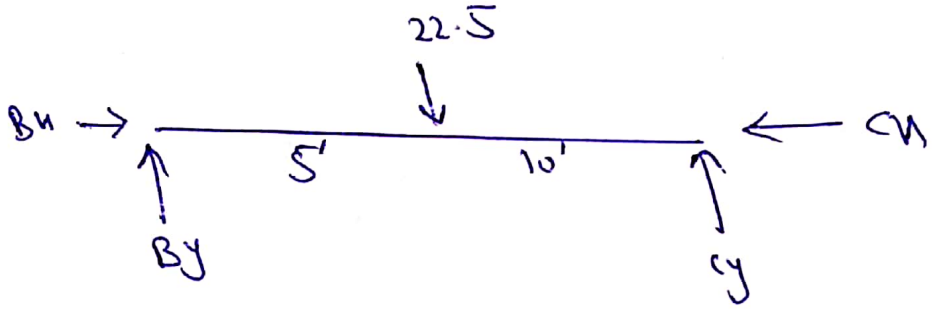
1) Free body Diagram



B.D.



$$\text{Area} = \frac{1}{2} bh$$

$$= \frac{1}{2} (15 \times 3)$$

$$= 22.5$$

$$\text{Distance} = \frac{1}{3} (b) = \frac{1}{3} (15) = 5'$$

1) $\Sigma F_x = 0 \quad \pm\rightarrow$

$$B_x - C_x = 0 \quad \text{—(1)}$$

ii) $\Sigma F_y = 0 \quad +\uparrow$

$$B_y + C_y = 22.5\,K \quad \text{—(2)}$$

iv) $\Sigma M_B = 0 \quad \circlearrowleft +$

$$(22.5 \times 5) - C_y \times 15 = 0$$

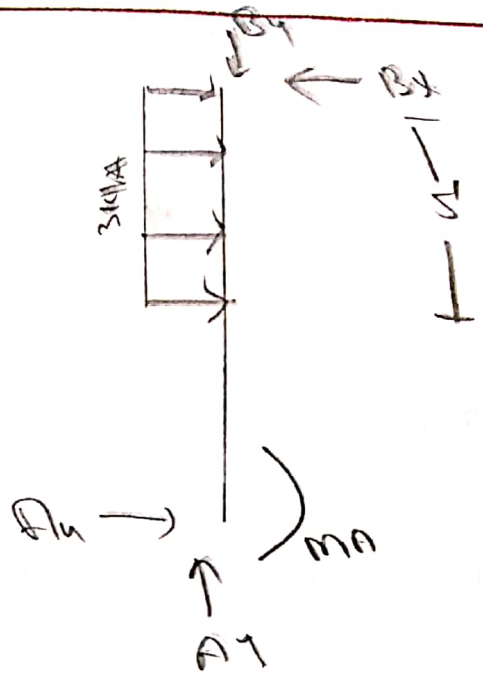
$$112.5 = 15 C_y$$

$$\boxed{C_y = 7.5K}$$

Put the Values in eqn (2)

$$B_y + 7.5 = 22.5$$

$$\boxed{B_y = 15\,K}$$



i) $\Sigma F_x = 0 \xrightarrow{+}$

$$A_x + (3 \times 5) - B_x = 0$$

$$A_x - B_x = -15 \quad \text{---} (3)$$

ii) $\Sigma F_y = 0 \uparrow^{+}$

$$A_y - B_y = 0$$

iii) $\Sigma M = 0 \; \circlearrowleft +$

$$(3 \times 5)(2.5 + 5) - B_x \times 10 = 0$$

$$B_x = 11.25 \text{ K}$$

Put the Value in eqn (3)

$A_H - 11.25 = -15$

$A_H = -3.75K$

Now since C & D are same line that load is transfered so

$$C_y = -7.5K$$

put the value of B_y in (2)

$A_y - 15 = 0$

$$A_y = 15K$$

put the value of B_H in eq (1)

$11.25 - C_H = 0$

$$C_H = 11.25K$$

So $$D_H = 11.25K$$

$M_b = 0$ ↺ +

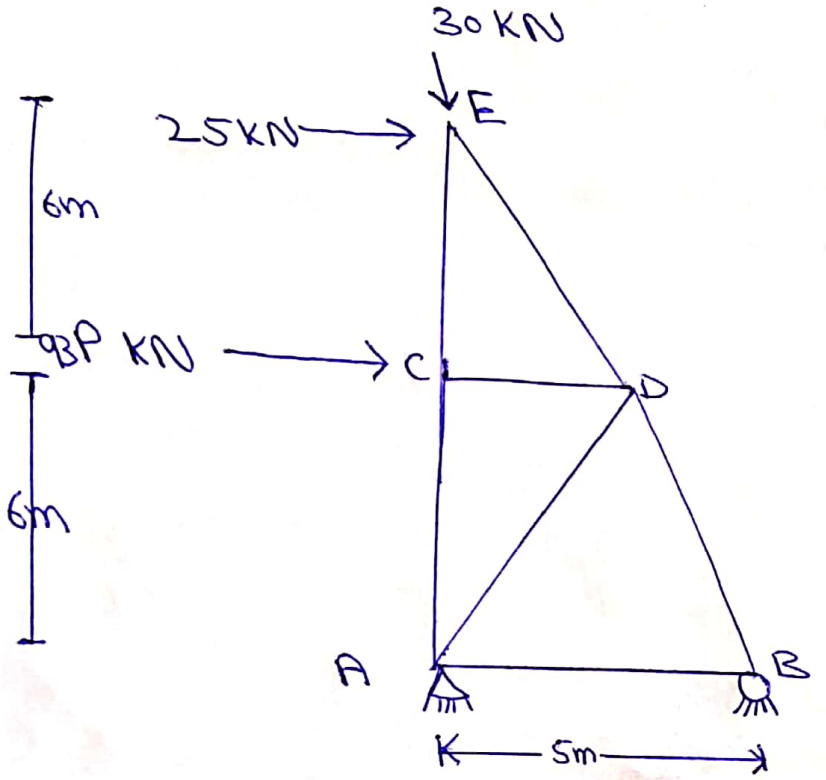
$-(3\times5)(2.5) - (A_H \times 10) + M_A = 0$

$$-(37.5) - (-3.75) \times 10 + M_A = 0$$

$$-37.5 + 37.5 + M_A = 0$$

$$\boxed{M_A = 0}$$

Ans 3



Solution:-

$$\Sigma M_A = 0 \quad \curvearrowleft +$$

$$-5By + 93 \times 6 + 25 \times 12 = 0$$

$$-5By + 558 + 300 = 0$$

$$\frac{858}{5} = \frac{5By}{5}$$

$$By = 171.6 \text{ KN}$$

$$\Sigma Fy = 0 \quad \uparrow + \downarrow -$$

$$-30 + Ay + By = 0$$

$A_y = 30 - B_y$

$A_y = 30 - 171.6\,kN$

$A_y = -141.6\,kN$

$\Sigma F_H = 0$

$A_H = 25 + 93 = 118\,kN$

$A_H = 118\,kN$

$\theta = ?$

$\tan\theta = \frac{12}{5}$

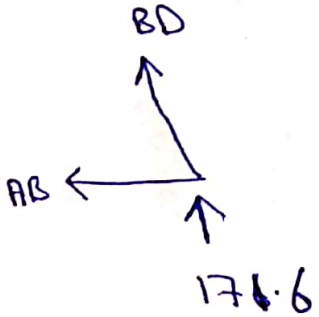
$\theta = \tan^{-1}\left(\frac{12}{5}\right) = 67.38°$

$\theta = 67.38°$

Using Method of joints

Joint B

$\Sigma F_y = 0 \quad \uparrow +$



$171.6 + BD\sin\theta = 0$

$BD = \frac{-171.6}{\sin(67.38)} = \frac{-171.6}{0.92}$

$BD = -186.52\ KN$

$\Sigma F_H = 0 \quad \rightarrow +$

$-AB - BD\cos\theta = 0$

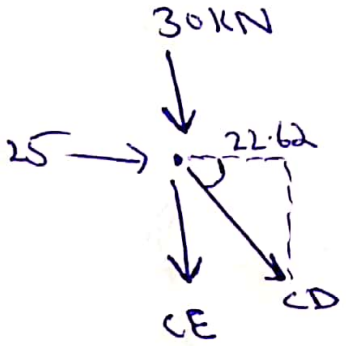
$AB = -BD\cos\theta$

$-(-186.52)\cos 67.38'$

$AB = (186.52)\ 0.384$

$\boxed{AB = 71.73\ KN}$

Joint E



$\Sigma F_H = 0$

$25 + ED\cos 22.62 = 0$

$ED = \frac{-25}{0.923}$

$\boxed{ED = -27.08\ KN}$

$\Sigma F_y = 0 \uparrow^{+}$

$-30 - CE - ED\sin(22.62) = 0$

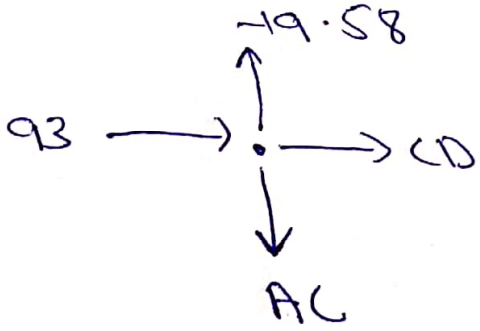
$-30 - CE - (-27.08)\sin 22.62^{\circ} = 0$

$CE = -19.58\ KN$

joint C

V

Joint C



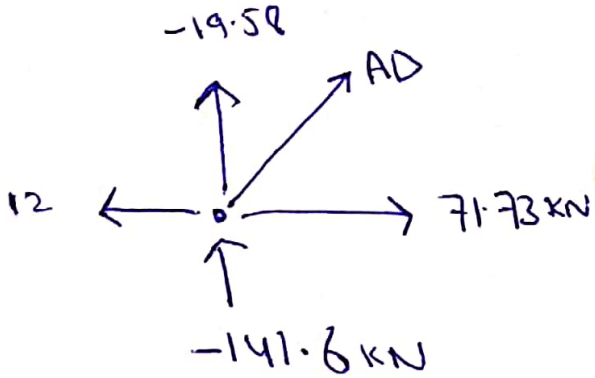
$\Sigma F_x = 0$

$$CD = -93$$

$\Sigma F_y = 0$ $\uparrow^{+}$

$$AC = -19.58$$

joint A



let θ is the Angle b/w AD & AB

$$\frac{5}{12} = \frac{x}{6}$$

$$x = 2.5$$

$$\tan\theta = \frac{6}{2.5} \qquad \theta = \tan^{-1}\frac{6}{(2.5)}$$

$$\theta = 67.38^{\circ}$$

Now $\Sigma F_H = 0 \quad \rightarrow +$

$$-118 + 71.73 + AD \cos 67.38^\circ = 0$$

$$AD = \frac{118 - 71.73}{\cos 67.38}$$

$$AD = \frac{46.27}{0.384}$$

$$AD = 120\,kN$$

So the forces in each member is calculated.