

19/8a National University Peshawar

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Subject Structural Analysis I

Department BE (civil)

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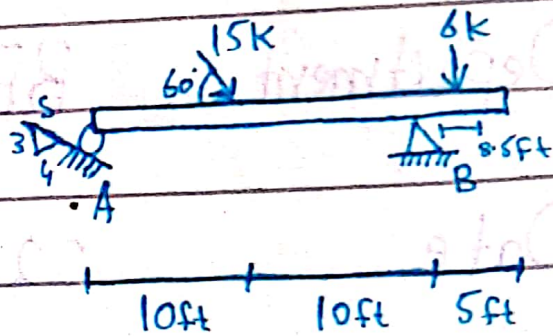
Submitted to Engr M-Saqib Khan

(1)

## Question # 1

Determine the support reactions in the beam given below in figure. The roller support at point A is inclined to the beam where the inclination is given in figure.

Solution;



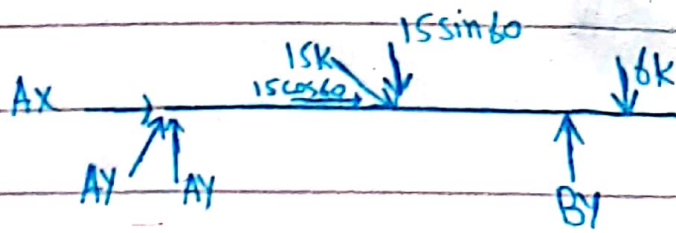
Support reaction - ?

Using equation of equilibrium;

Steps;

- Draw free body diagram.
- Identify the type of support provided.
- Resolve the inclined force into its component.

(2)



Now;

Using Equation of equilibrium

As;

$$\tan \theta = (3/4)$$

$$\theta = \tan^{-1}(3/4)$$

$$\theta = 36^\circ$$

$$\sum F_y = 0 \quad \uparrow$$

$$A_y + B_y - 15 \sin 60 - 6 = 0$$

$$A_y + B_y - 12.99 - 6 = 0$$

$$A_y + B_y = 18.99 \text{ k}$$

(3)

~~MB~~

$$\sum F_x = 0 \quad \rightleftarrows$$

$$A_x + 15 \cos 60 = 0$$

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

(opposite to the  
assume direction)

$$\sum M_B = 0 \quad \curvearrowright \curvearrowleft$$

$$A_y \cos 36 (20) - 15 \sin 60 (10) + 6(2.5) = 0$$

$$A_y (16.18) - 129 + 15 = 0$$

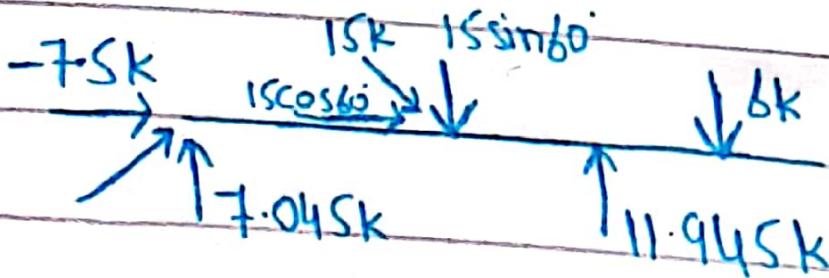
$$A_y = 114 / 16.18$$

$$A_y = 7.045 \text{ k}$$

By putting in eq (1)

$$B_y = 11.945 \text{ k}$$

(4)



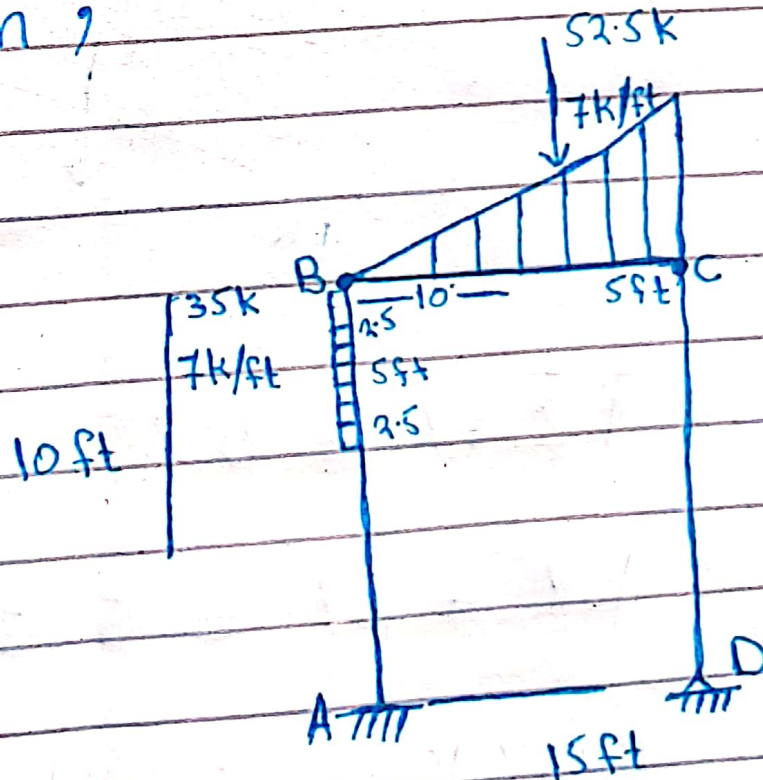
(5)

## Question # 2

Determine the support reaction of the given frame in figure 2 where the support reaction at point A is fixed and point B, C, D are all pin supports and the value of P is the last digit of your registration number.

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Solution ;



$$\frac{1}{2} (7 \times 15) = 52.5$$

$$\frac{2}{3} (15) = 10$$

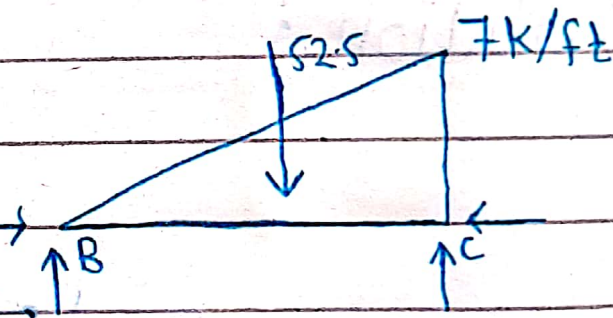
(6)

As we know that from equilibrium equation ;

$$(i) \uparrow \sum F_y = 0$$

$$(ii) \rightarrow \sum F_x = 0$$

$$(iii) + \curvearrowright \sum M_o = 0$$



$$\uparrow \sum F_x = 0$$

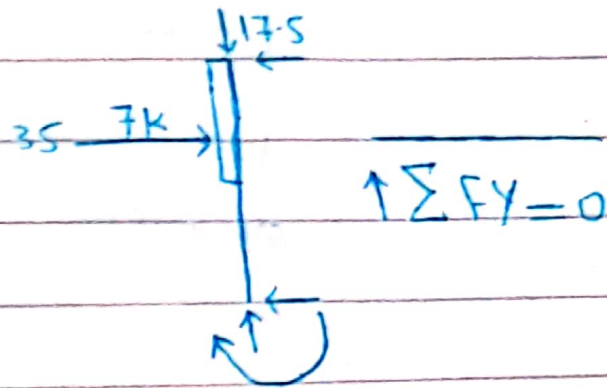
$$B_y + C_y = 52.5$$

$$C_y \times 15 - 52.5 \times 10 = 0$$

$$C_y = \frac{52.5}{15} = 35$$

(7)

$$B_y = 17.5 \text{ k}$$



$$\rightarrow \sum F_x = 0$$

$$-B_x - A_x = 35$$

$$\uparrow \sum F_y = 0$$

$$-17.5 + A_y = 0$$

$$A_y = 17.5$$

$$\circlearrowleft \sum M_A = 0$$

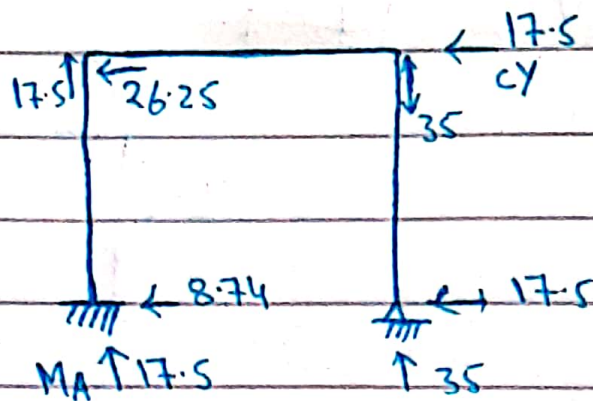
$$B_x \times 10 - 35 \times 7.5 = 0$$

$$10 B_x - 262.5 = 0$$

$$B_x = 262.5/10 = 26.25$$



(8)



$$\rightarrow \sum F_x = 0$$

$$-26.25 - 8.74 + D_x + C_x = 0$$

$$34.99 - D_x + C_x = 0$$

$$\sum M_o = 0$$

$$C_x \times 10 + 26.25 \times 10 - 17.5 \times 15 - 17.5 \times 10 = 0$$

$$10 \times C_x = -26.25 \times 10 + 17.5 \times 15 + 17.5$$

$$C_x = 17.5$$

$$D_x + C_x = 34.99$$

(9)

$$DX = 34.99 - 17.5$$

$$= 17.49$$

$$+\uparrow \sum MA = 0$$

$$MA - 26.25 \times 10 - 17.5 \times 15 + 35 \times 10 + 35 \times 15 = 0$$

$$MA = 26.25 \times 10 + 17.5 \times 15 - 350 - 525$$

$$MA = -435.5$$

So;

Our direction is wrong, its  
rotate Anti-clockwise

$$MA = 435.5 \text{ k}\cdot\text{ft}$$

$$AY = 17.5 \text{ k}$$

$$AX = 8.74 \text{ k}$$

(10)

$$B_x = 26.25 \text{ k}$$

$$B_y = 17.5 \text{ k}$$

$$C_y = 35 \text{ k}$$

$$C_x = 17.5$$

$$D_x = 17.5$$

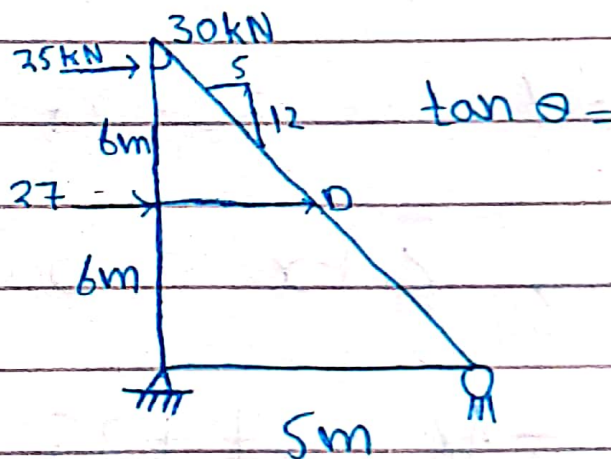
$$D_y = 35$$

(11)

### Question # 3

Find the member forces in the given truss shown in figure 3 value of  $P$  loading at point  $C$  is last two digit of your registration number and loading at point  $E$  is given where the  $s$  30 kN vertical and 25 kN horizontal.

Solution;



$$\sum F_x = 0$$

$$\uparrow \sum F_y = 0$$

$$\rightarrow \sum F_x = 0$$

$$A_y + B_y = 30 \quad (1)$$

(12)

$$+\circlearrowleft \Sigma MA = 0$$

$$BY \times 5 + 25 \times 12 + 27 \times 6 = 0$$

$$BY \times 5 = 300 - 162$$

$$= 138$$

$$BY = 27$$

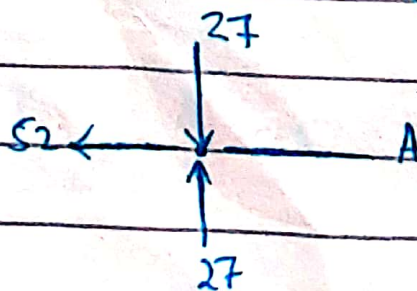
$$AY = 30 - 27 = 3$$

$$\rightarrow \Sigma F_x = 0$$

$$-Ax + 27 + 25 = 0$$

$$Ax = 52$$

Join 'A'

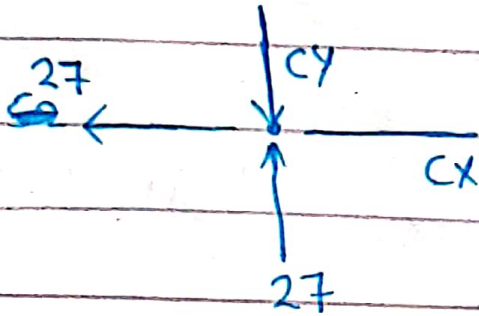


(13)

$$\sum F_x = 0$$

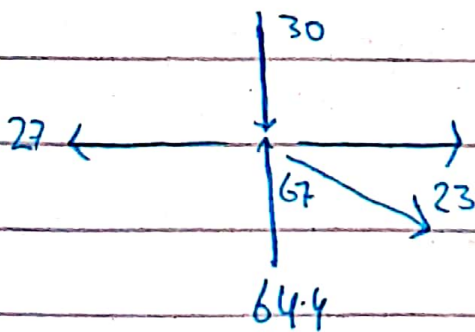
$$A_x = 52$$

Joint 'C'



$$\theta = \tan^{-1} = (12/5)$$

$$\theta = 67^\circ$$



$$\rightarrow \sum f_x = 0$$

$$25 - E_x \sin 23 = 0$$

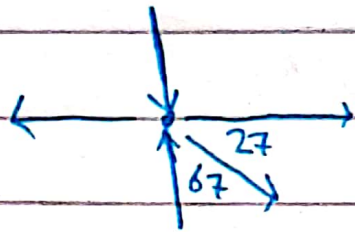
$$E_x = 64$$

(14)

$$\sum F_y = 0$$

$$-64 - 30 + E_y \sin 23 = 0$$

$$E_y = 240$$



Join 'E'

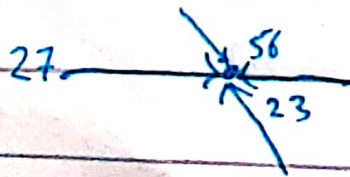
$$\rightarrow \sum F_x = 0$$

$$25 - 27 - 30 + E_x \cos 23 = 0$$

$$E_x = 56.490$$

$$\uparrow \sum F_y = 0 \quad , \quad E_y = 8$$

Join 'D'



$$\sum F_x = 0$$

$$27 - 56 - D_x \sin 23 = 0$$

(15)

$$Dx = 74.22$$

$$\Sigma Fy$$

$$-56 \sin 23 + Dy \sin 23 = 0$$

$$Dy = 55$$

Join 'B'

