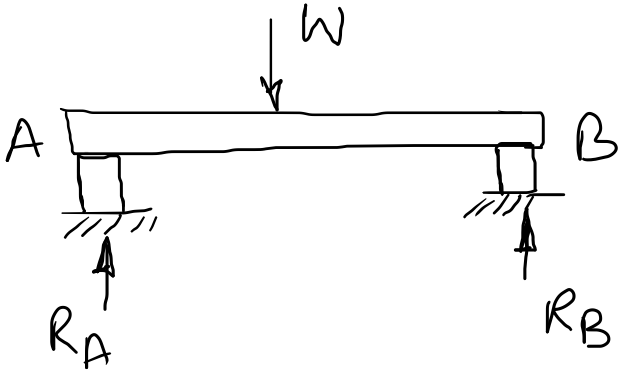
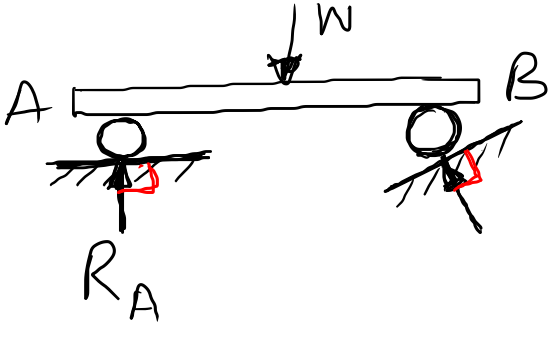
Beam: It is a structural member to support external loads.

- **Types of Supports**

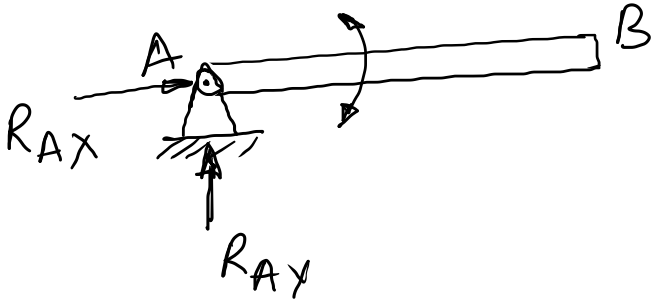
(1.) simple support



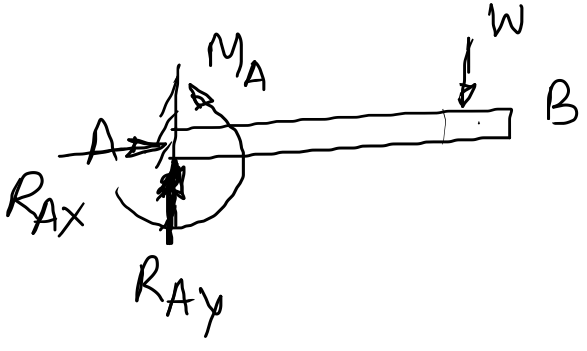
(2.) Roller support



(3.) Hinged / pinned support

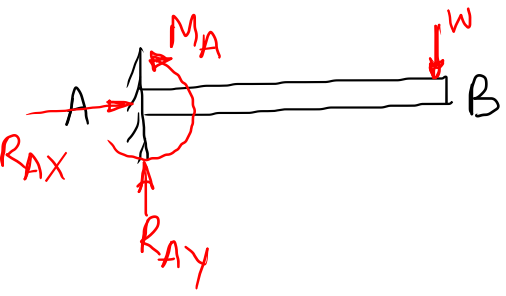


(4.) fixed support

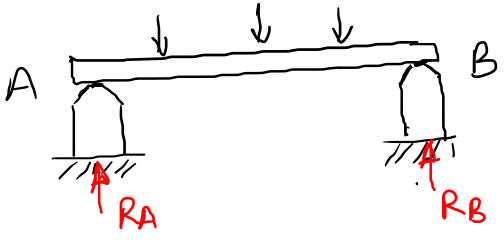


Types of Beams

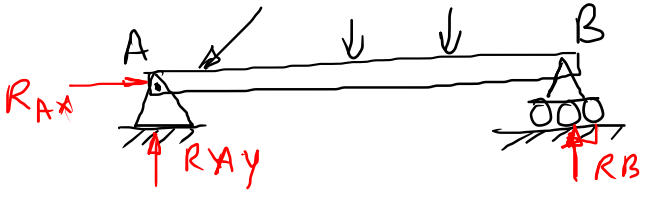
(1.) cantilever



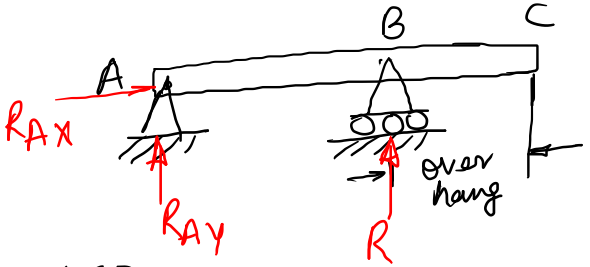
(2.) Simply supported



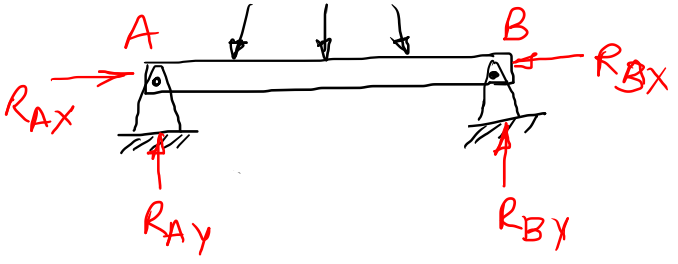
(3.) one end hinged and other on roller



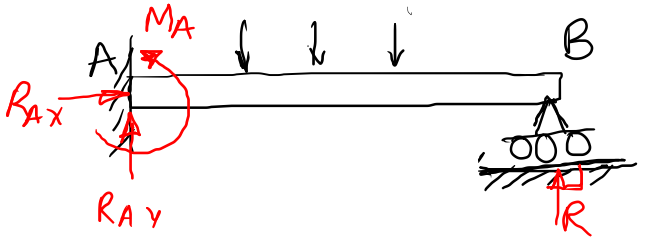
(4.) overhanging



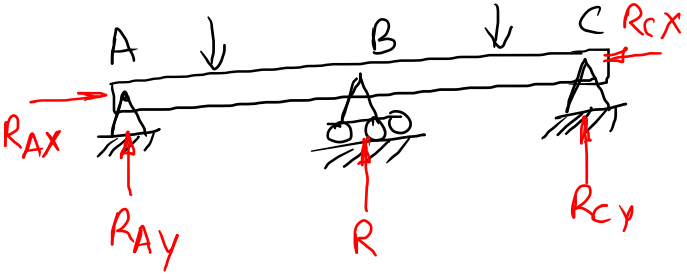
(5.) Both ends hinged



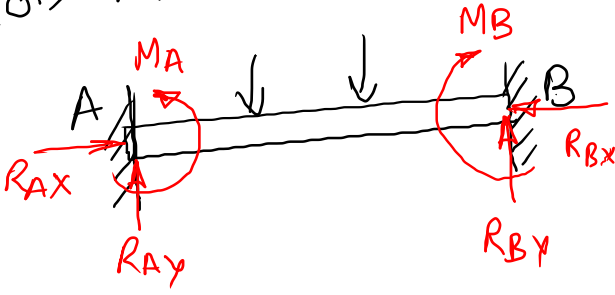
(6) Propped cantilever



(7.) continuous

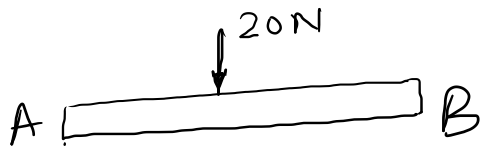


(8.) Fixed

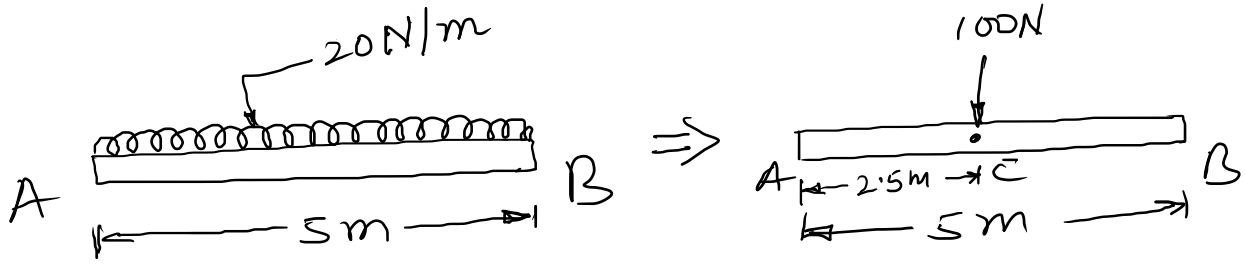


- Types of loading

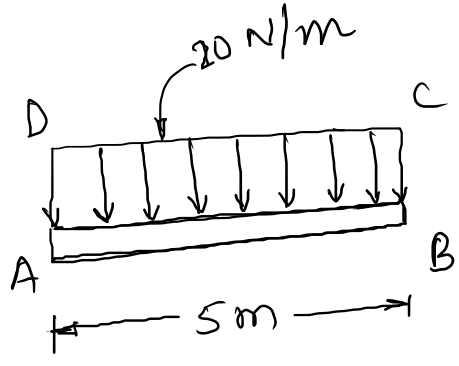
(1.) Point load



(2.) Uniformly Distributed load (UDL)

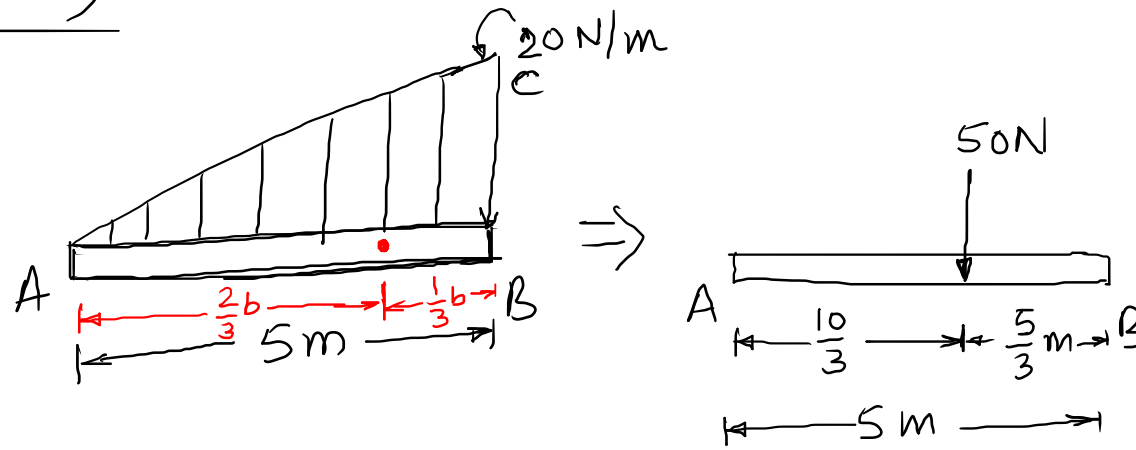


Total load = 20X5 = 100N
on beam AB



Total load = Area of rectangle
on beam AB ABCD
= 20 X 5 = 100N

(3.) Uniformly Varying Load (UVL)



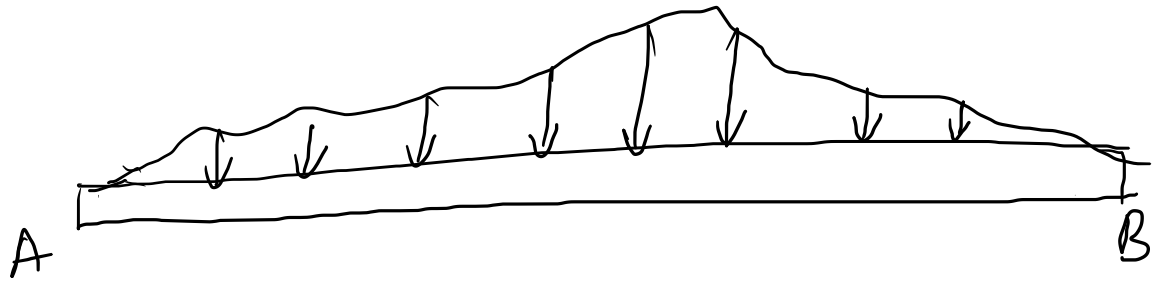
Total load = Area of
on beam AB ΔABC

$= \frac{1}{2} \times 5 \times 20$

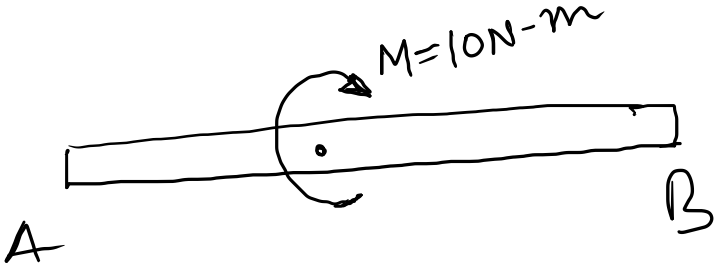
$= 50N$

This total load (50N) will act at centroid of the ΔABC.

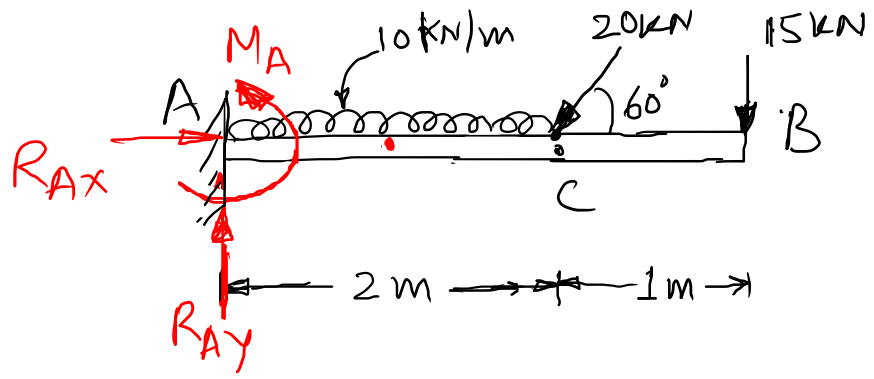
(4.) General loading



(5.) External moment



Q: 1 Determine the reactions in the cantilever beam



Sol^n:

For equilibrium of beam

$\Sigma F_x = 0, \quad R_{AX} - 20\cos 60^\circ = 0$

$\Rightarrow R_{AX} = 10\,KN$

$\Sigma F_y = 0, \quad R_{AY} - 20\sin 60^\circ - 15 - (10 \times 2) = 0$

$\Rightarrow R_{AY} = 52.32\,KN$

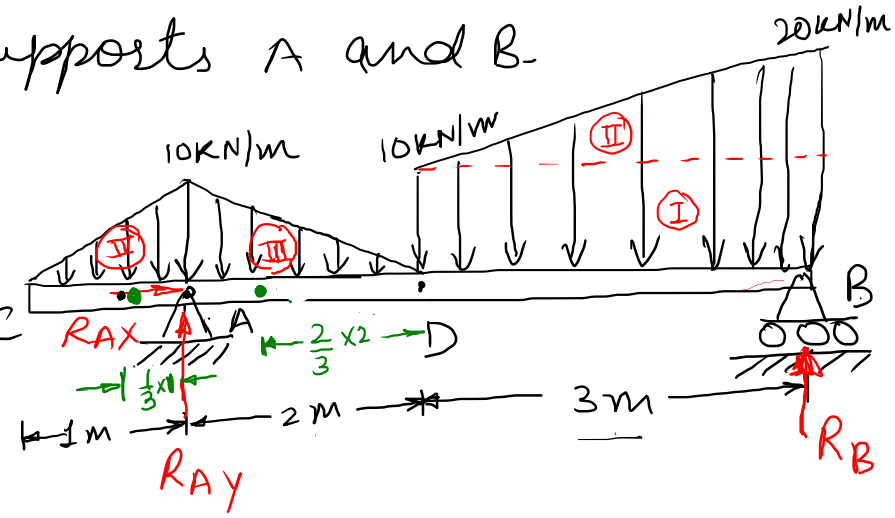
$\Sigma M_A = 0, \quad M_A - (10 \times 2) \times 1 - 20\sin 60 \times 2 - 15 \times 3 = 0$

$\Rightarrow M_A = 99.64\,KN\text{-}m$

Resultant reaction at A, $R_A = \sqrt{R_{AX}^2 + R_{AY}^2} = 53.27\,KN$

$\theta = \tan^{-1}\left(\frac{R_{AY}}{R_{AX}}\right) = 79.18^\circ$

Q:2 Find the reactions at supports A and B.



Sol:

$$\Sigma F_x = 0, \quad R_{AX} = 0 \qquad -(1)$$

$$\Sigma F_y = 0, \quad R_{AY} + R_B - \frac{1}{2}\times 1\times 10 - \frac{1}{2}\times 2\times 10 - 3\times 10 - \frac{1}{2}\times 3\times 10 = 0$$

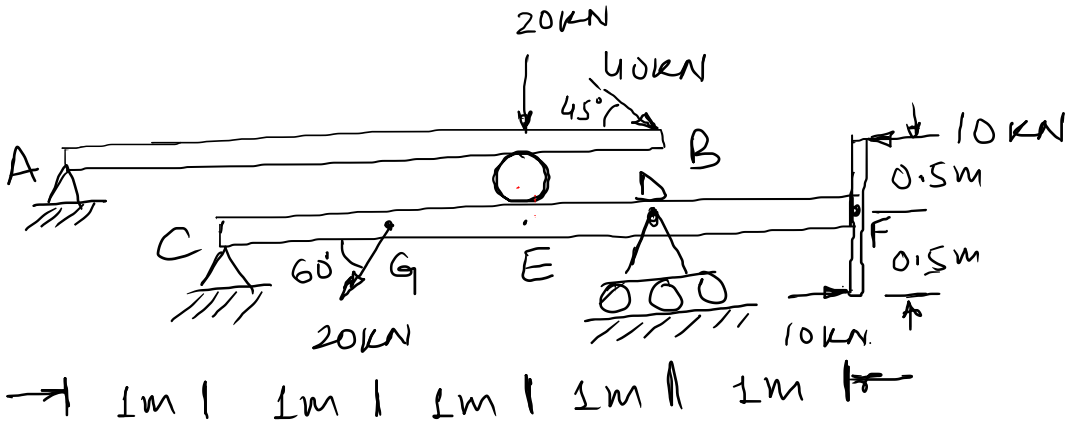
$$\Rightarrow R_{AY} + R_B = 60 \qquad -(2)$$

$$\Sigma M_B = 0, \; -R_{AY}\times 5 + (3\times 10)\times 1.5 + \left(\frac{1}{2}\times 3\times 10\right)\times\frac{1}{3}\times 3 + \left(\frac{1}{2}\times 2\times 10\right)\left(3+\frac{2}{3}\times 2\right) + \left(\frac{1}{2}\times 1\times 10\right)\left(3+2+\frac{1}{3}\times 1\right) = 0$$

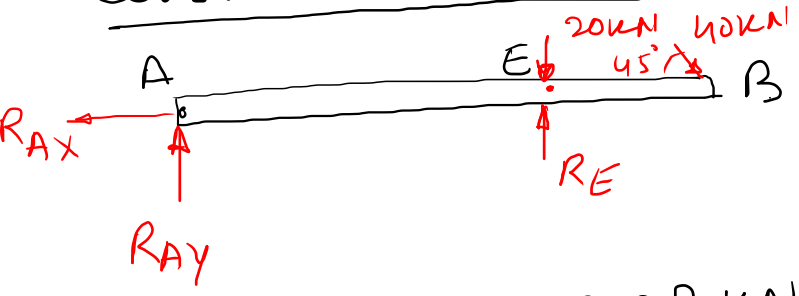
$$\Rightarrow R_{AY} = 26 \text{ kN}$$

$$\therefore R_B = 34 \text{ kN}$$

Q:3 Determine the reactions at A, C and D.



consider beam AB:

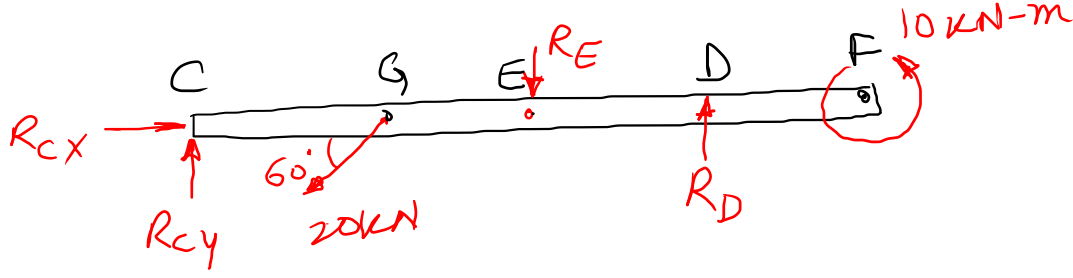


$\Sigma F_x = 0$, $R_{AX} = 28.28$ KN

$\Sigma F_y = 0$, $R_{Ay} = -9.43$ KN

$\Sigma M_A = 0$ $R_E = 57.71$ KN

consider beam CF:



$\Sigma F_x = 0$, $R_{CX} = 10$ KN,

$\Sigma F_y = 0$, $R_{Cy} = 34.12$ KN

$\Sigma M_C = 0$, $R_D = 40.91$ KN