Distributed Loads on Beams

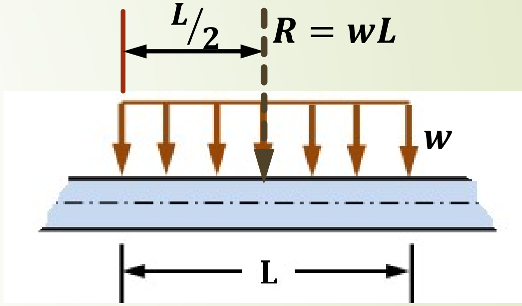
How to find the Net Force (R) acting on the beam

- R = Area under the loading diagram
- R acts through the centroid of the area

Uniformly distributed load (UDL)

Area under the loading diagram, $R = wL$

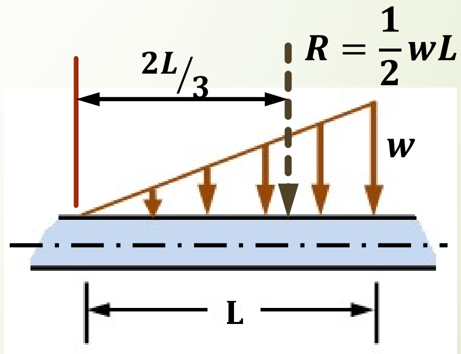
R, acts at $L/2$, i.e. the centroid of the area



Uniformly varying load (UVL)

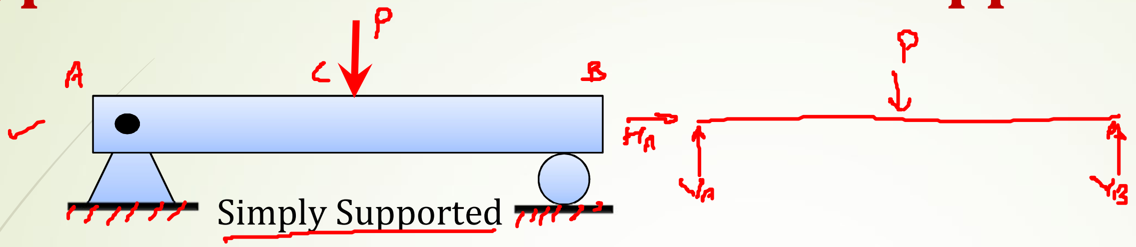
Area under the loading diagram,

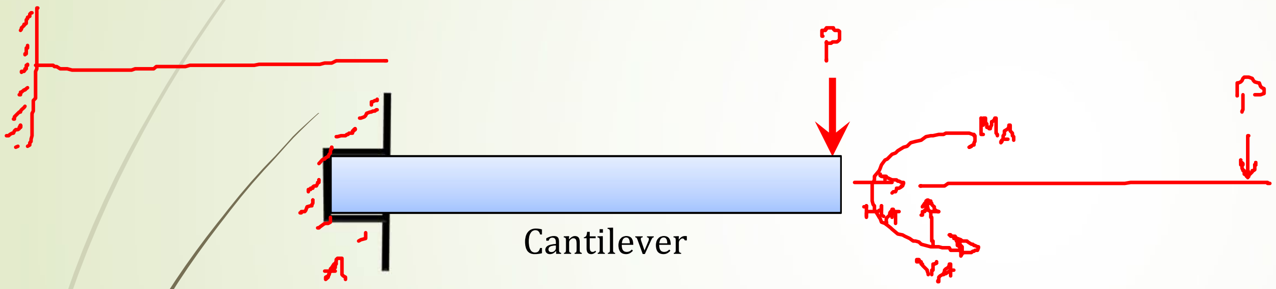
$R = \frac{1}{2}wL$ and R acts at $2L/3$, i.e. the centroid of the area

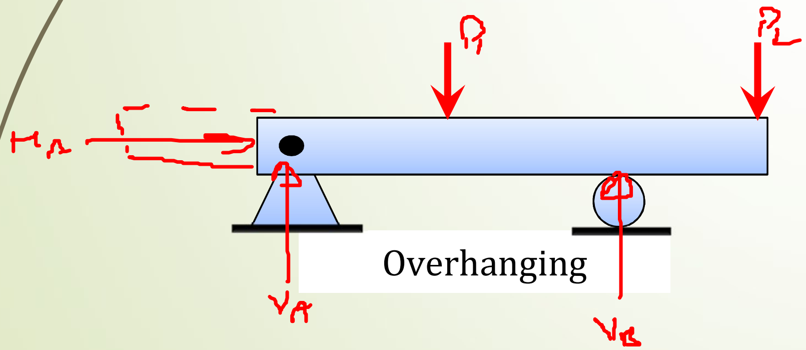


$\Sigma F_x = 0 \quad \Sigma F_y = 0 \quad \Sigma M = 0$

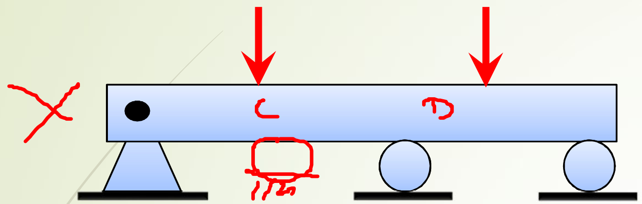
Types of Beams on the Basis of Support Conditions



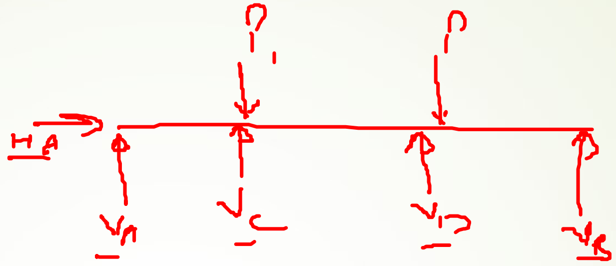


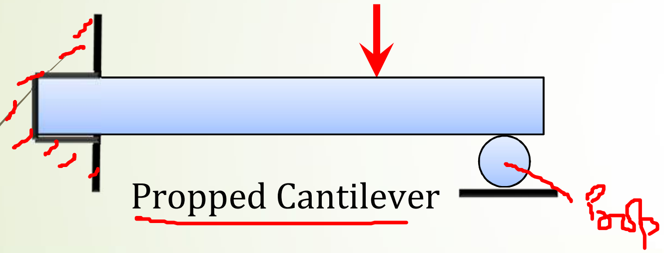


Types of Beams on the Basis of Support Conditions

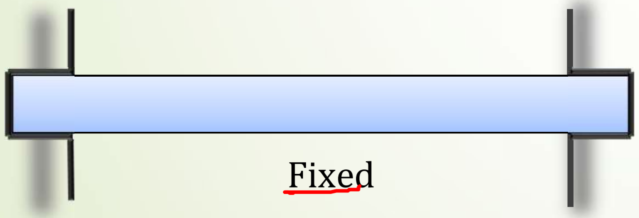


Continuous



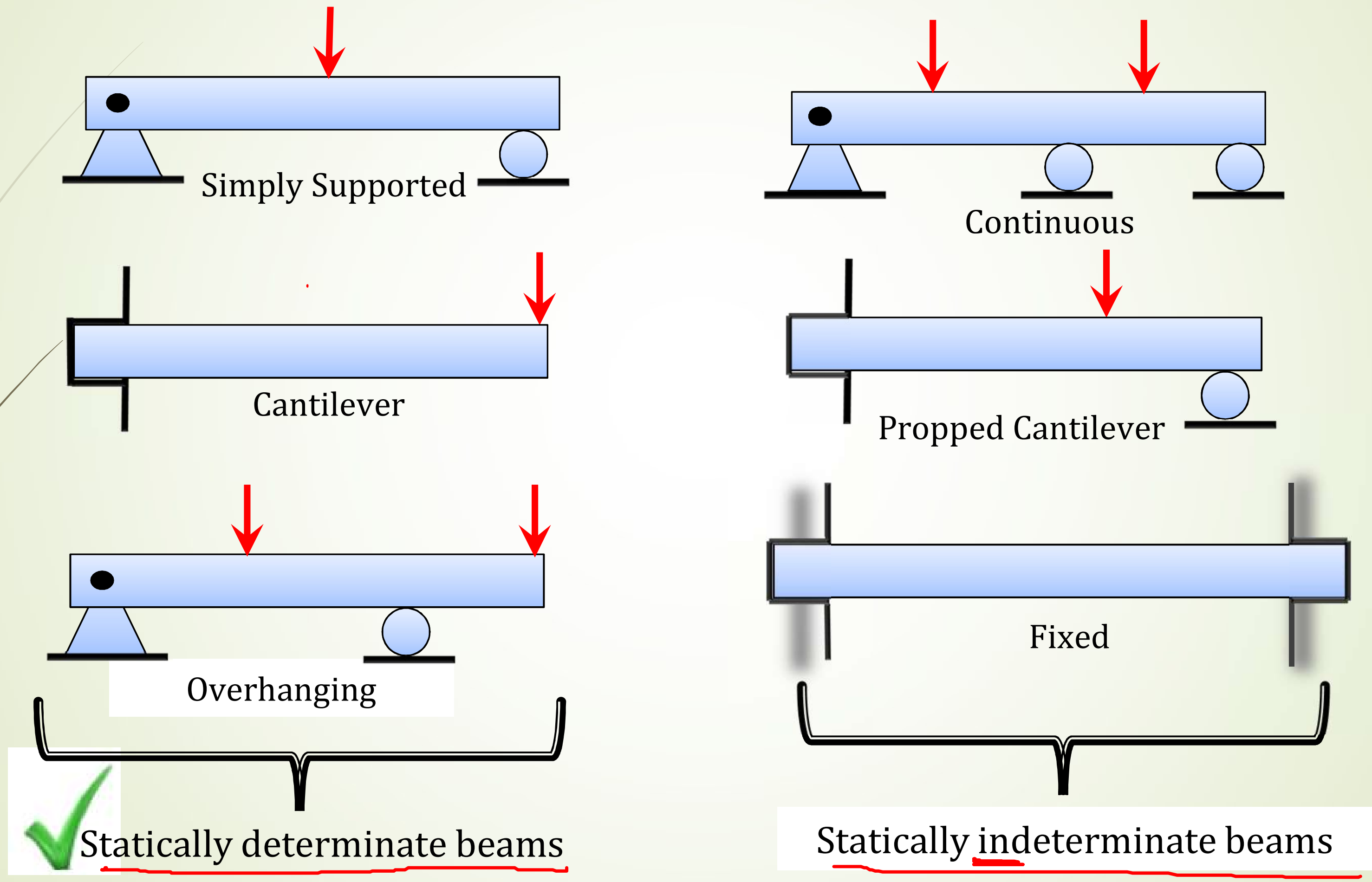


Propped Cantilever

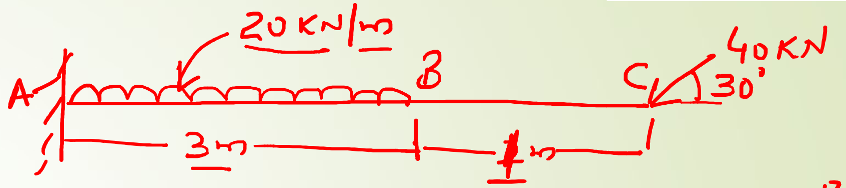


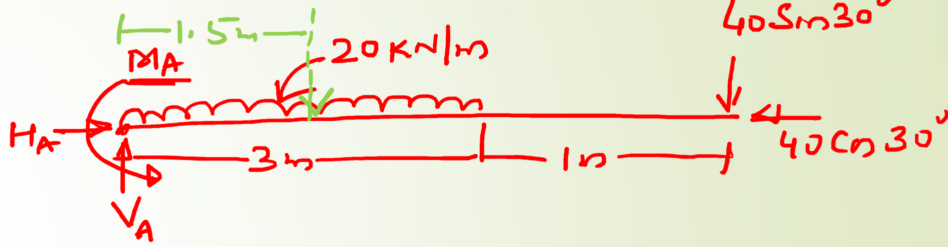
Fixed

Types of Beams on the Basis of Support Conditions



Find reactions at the fixed support.





Solution

$\Sigma F_x = 0$, $H_A - 40\cos 30 = 0$

$$\boxed{H_A = 34.64\ kN}$$

$\Sigma F_y = 0$

$$V_A - 20\times 3 - 40\times 0.5 = 0$$

$$\boxed{V_A = 80\ kN}$$

$\Sigma M_A = 0$

$$-M_A + 20\times 3\times 1.5 + 40\times 0.5\times 4 = 0$$

$$\boxed{M_A = 90 + 80 = 170\ kNm}$$

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$$\Sigma F_x = 0$$

$$H_A - T\cos 30 = 0$$

$$H_A = T\cos 30$$

$$\Sigma F_y = 0$$

$$V_A - 100\times 5 - 500 + T\sin 30 = 0$$

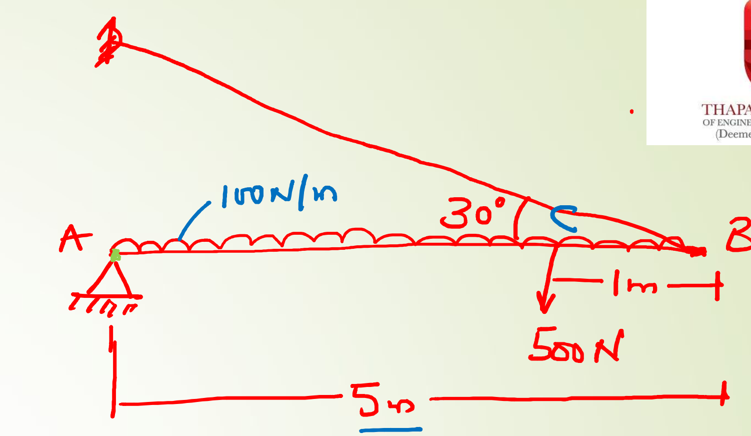
$$\Sigma M_A = 0$$

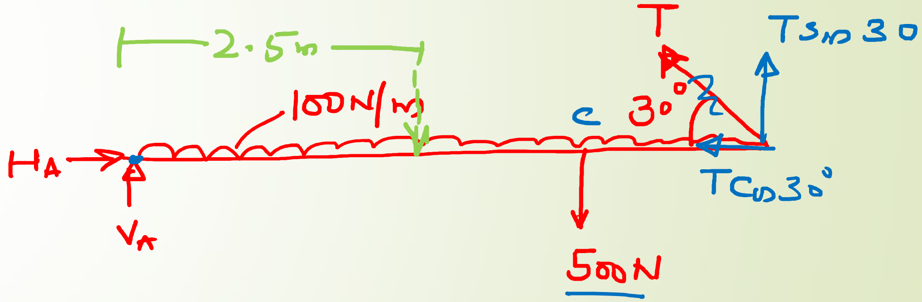
$$100\times 5\times 2.5 + 500\times 4 - T\sin 30\times 5 = 0$$

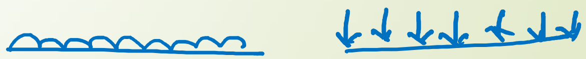
$$T = 1300\text{ N}$$

$$V_A = 350\text{ N}$$

$$H_A = 1126\text{ N}$$







Magnitude of UDL = 100 × 5 = 500N

Problem: Find reactions at the supports.

Solution:

$\Sigma F_x = 0$

$H_A + 20 \times 3 = 0$

$H_A = -60\ KN$

$\Sigma F_y = 0$

$V_A + V_c = 0$

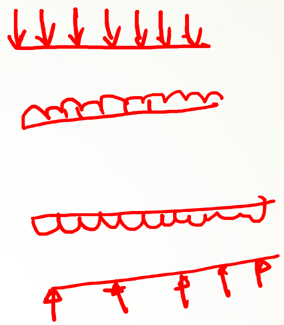
$V_A = -V_c \quad —— \mathrm{I}$

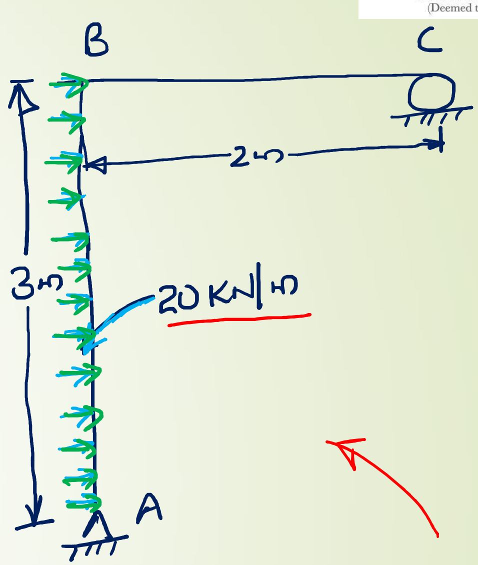
$\Sigma M_A = 0$

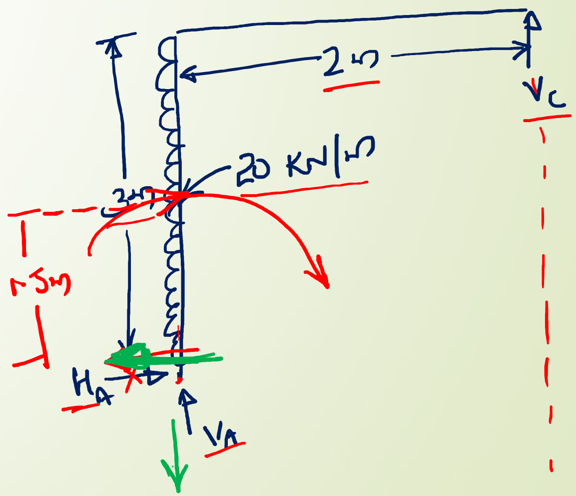
$20 \times 3 \times 1.5 - V_c \times 2 = 0$

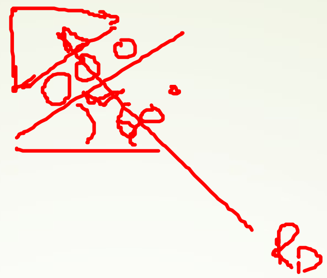
$V_c = 90/2 = 45\ KN$

$V_A = -45\ KN$









$\Sigma F_x = 0$

$H_A - R_D \cos 30 = 0$

$H_A = 0.866 R_D$ — I

$\Sigma M_A = 0$

$-2\times1 + 6\times2 + 6\times6 - R_D \sin 30 \times 8 - 0.866 R_D \times 6 = 0$

$-2 + 12 + 36 - 4R_D - 5.2R_D = 0$

$9.2 R_D = 46$

$\boxed{R_D = 5\ kN}$

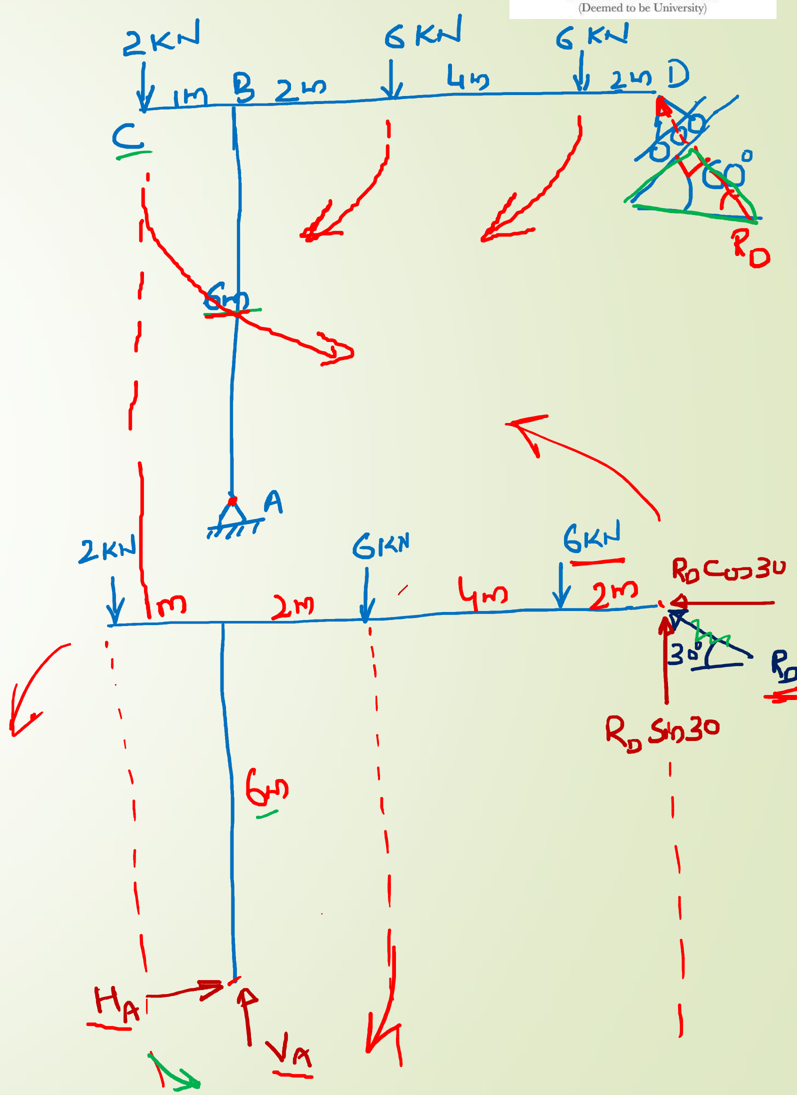
$\boxed{H_A = 0.866\times5 = 4.33\ kN}$

$\Sigma F_y = 0$

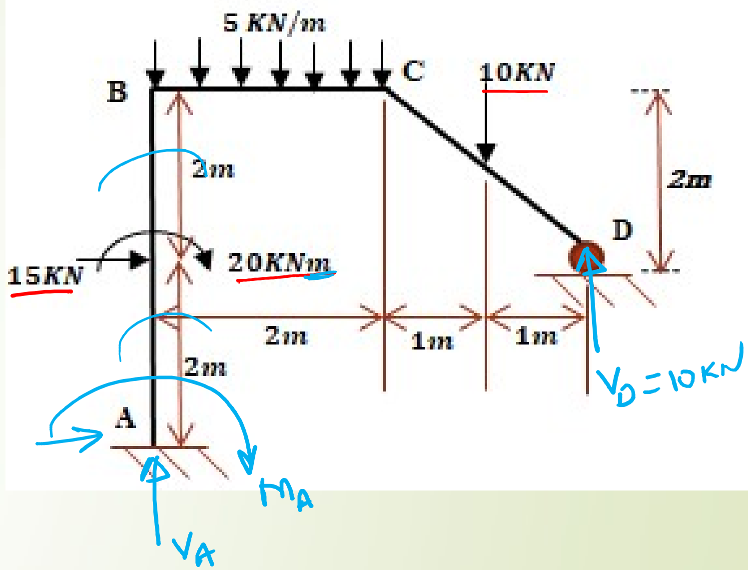
$V_A + R_D \sin 30 - 2 - 6 - 6 = 0$

$V_A + R_D/2 = 14$

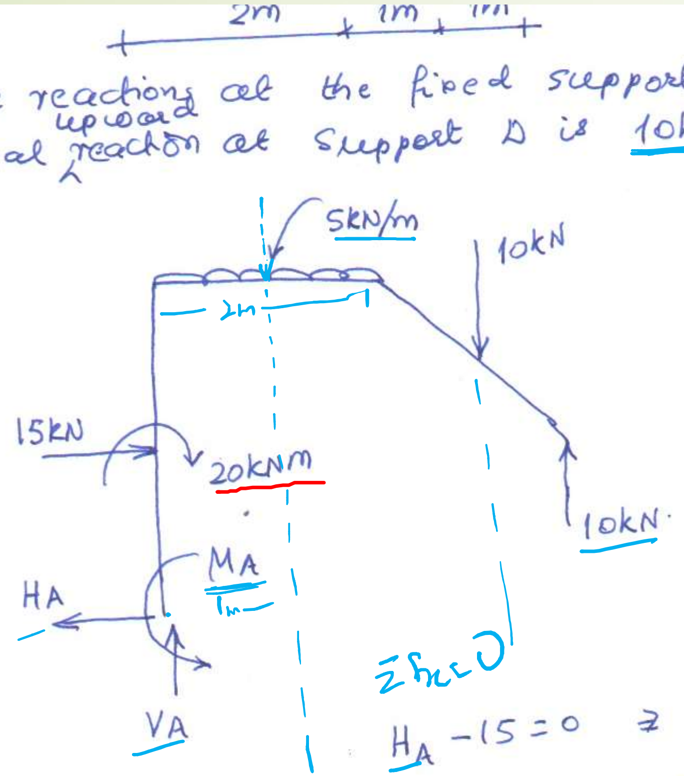
$\boxed{V_A = 11.5\ kN}$



Determine the reaction forces at the fixed support **A** for the rigid body loaded and supported as shown in the figure. Given that the vertical upward reaction at support **D** is 10 kN.



Determine reactions at the fixed support A if the upward vertical reaction at support D is 10kN.



$\Sigma F_x = 0$

$\Sigma F_y = 0$

$\Sigma M = 0$

$\Sigma F_x = 0$

$H_A - 15 = 0 \Rightarrow \boxed{H_A = 15\,kN}$

$\Sigma F_y = 0$

$-V_A + 5 \times 2 + \cancel{10} - \cancel{10} = 0$

$\boxed{V_A = 10\,kN}$

$\Sigma M_A = 0 \Rightarrow$

$15 \times 2 + 20 + 5 \times 2 \times 1 + 10 \times 3 - 10 \times 4 - M_A = 0$

$30 + 20 + 10 + 30 - 40 = M_A$

$\boxed{M_A = 50\,kNm}$

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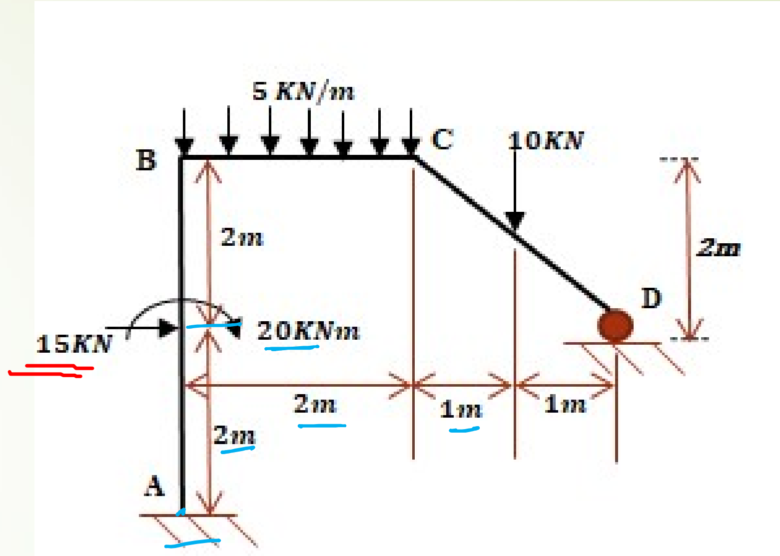

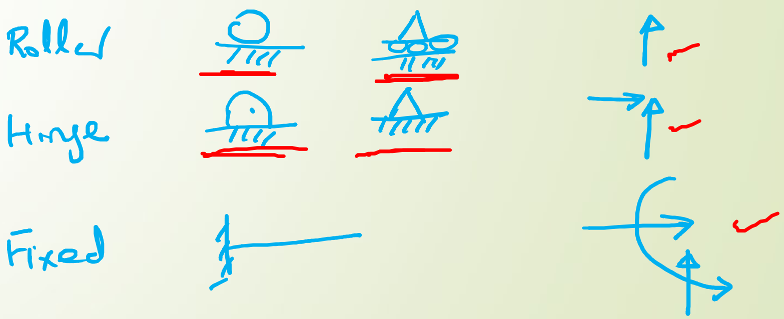

Thank You