Abhishek Ghosh

ME21BTECH11001

ME1020 ENGINEERING MECHANICS

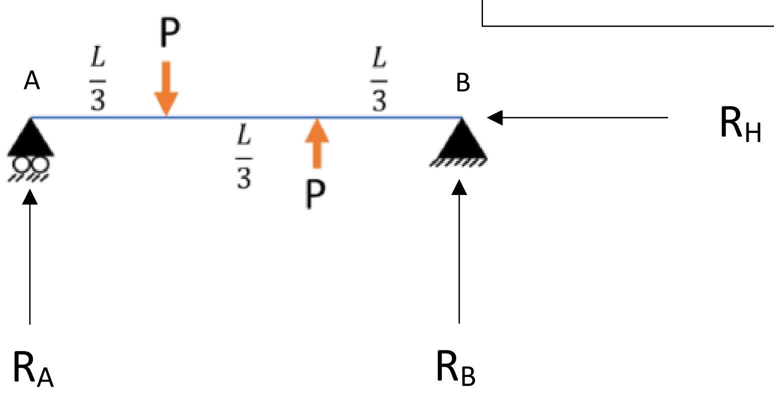
ASSIGNMENT 2

Sign Convention:-

Upward as +ve and downward as -ve

Anticlockwise as +ve and clockwise as -ve

QUESTION 1:-



Balancing forces in x and y direction:-

$\Sigma F_x = 0 \quad \Rightarrow R_h = 0$

$\Sigma F_y = 0 \quad \Rightarrow R_A - P + R_B + P = 0$

$$\Sigma M_A = 0 \quad \Rightarrow -\frac{PL}{3} + \frac{P2L}{3} + R_B L = 0$$

$$\Rightarrow R_B = -\frac{P}{3} \quad , R_A = \frac{P}{3}$$

Considering Shear force V(x) in downward direction and bending moment M(x) in clockwise direction:-

Taking x towards right side of A

For $0 < x < \frac{L}{3}$

$$\Sigma F_y = 0 \quad \Rightarrow -R_A + V = 0 \Rightarrow V = \frac{P}{3}$$

$$\Sigma M_A = 0 \quad \Rightarrow Vx + M = 0 \Rightarrow M = -\frac{Px}{3}$$

For $\frac{L}{3} < x < \frac{2L}{3}$

$$\Sigma F_y = 0 \quad \Rightarrow V + P = R_A \Rightarrow V = -\frac{2P}{3}$$

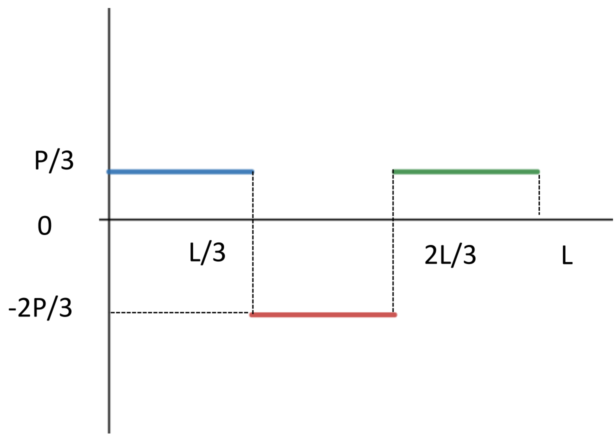
$$\Sigma M_A = 0 \quad \Rightarrow \frac{PL}{3} + Vx + M = 0 \Rightarrow M = \frac{P}{3}(2x - L)$$

For $\frac{2L}{3} < x < L$

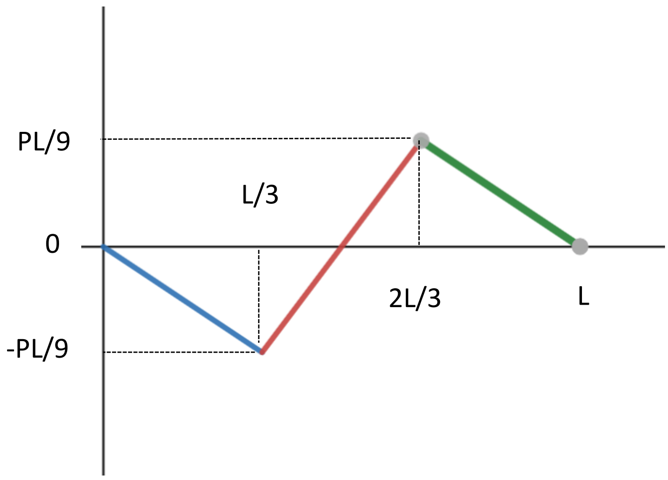
$$\Sigma F_y = 0 \quad \Rightarrow R_A + P = V + P \quad \Rightarrow V = \frac{P}{3}$$

$$\Sigma M_A = 0 \quad \Rightarrow \frac{PL}{3} - \frac{P2L}{3} + Vx + M = 0 \Rightarrow M = \frac{P}{3}(L - x)$$

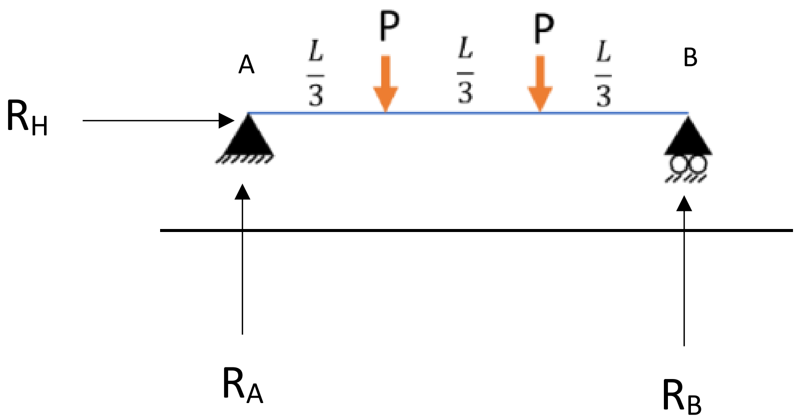
SFD:-



BMD:-



Question 2:-



Balancing forces in x and y direction:-

$\Sigma F_x = 0 \quad \Rightarrow R_h = 0$

$\Sigma F_y = 0 \quad \Rightarrow R_A - P + R_B - P = 0$

$$\Sigma M_A = 0 \quad \Rightarrow \frac{PL}{3} + \frac{P2L}{3} + R_B L = 0$$

$\Rightarrow R_B = P \ , R_A = P$

Considering Shear force V(x) in downward direction and bending moment M(x) in clockwise direction:-

Taking x towards right side of A

For $\boldsymbol{0 < x < \frac{L}{3}}$

$\Sigma F_y = 0 \quad \Rightarrow -R_A + V = 0 \ \Rightarrow V = P$

$\Sigma M_A = 0 \quad \Rightarrow Vx + M = 0 \ \Rightarrow M = -Px$

For $\boldsymbol{\frac{L}{3} < x < \frac{2L}{3}}$

$\Sigma F_y = 0 \quad \Rightarrow V + P = R_A \ \Rightarrow V = 0$

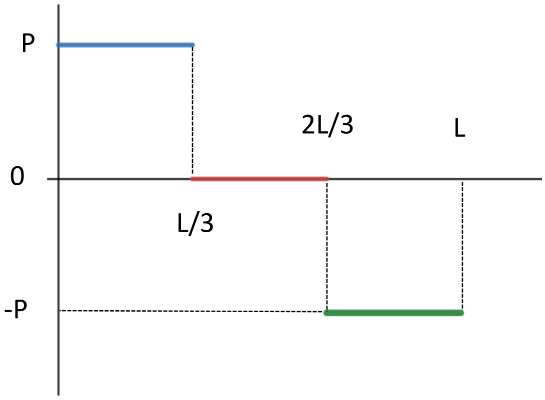
$$\Sigma M_A = 0 \quad \Rightarrow \frac{PL}{3} + Vx + M = 0 \ \Rightarrow M = -\frac{PL}{3}$$

For $\boldsymbol{\frac{2L}{3} < x < L}$

$\Sigma F_y = 0 \quad \Rightarrow R_A = V + P + P \ \Rightarrow V = -P$

$$\Sigma M_A = 0 \quad \Rightarrow \frac{PL}{3} + \frac{P2L}{3} + Vx + M = 0 \Rightarrow M = P(x - L)$$

SFD:-



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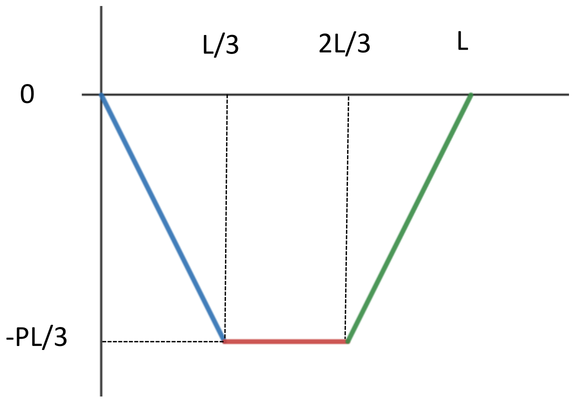
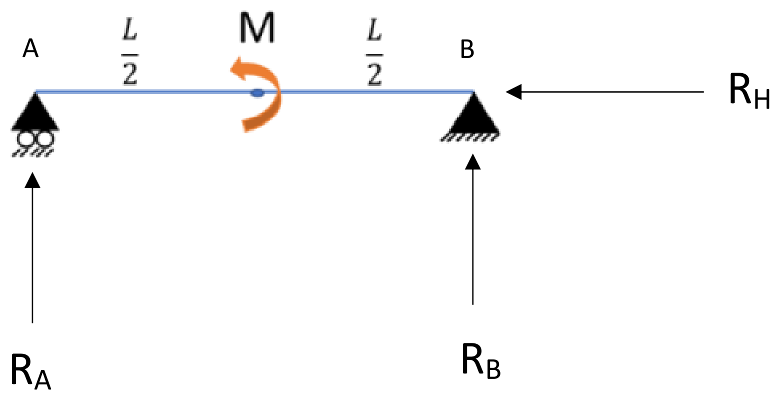


Question 3:-



Balancing forces in x and y direction:-

$\Sigma F_x = 0 \quad \Rightarrow R_h = 0$

$\Sigma F_y = 0 \quad \Rightarrow R_A + R_B = 0$

$\Sigma M_A = 0 \quad \Rightarrow M + R_B L = 0$

$\Rightarrow R_B = -\frac{M}{L} \ , R_A = \frac{M}{L}$

Considering Shear force V(x) in downward direction and bending moment M(x) in clockwise direction:-

Taking x towards right side of A

For $\boldsymbol{0 < x < \frac{L}{2}}$

$\Sigma F_y = 0 \quad \Rightarrow -R_A + V = 0 \ \Rightarrow V = \frac{M}{L}$

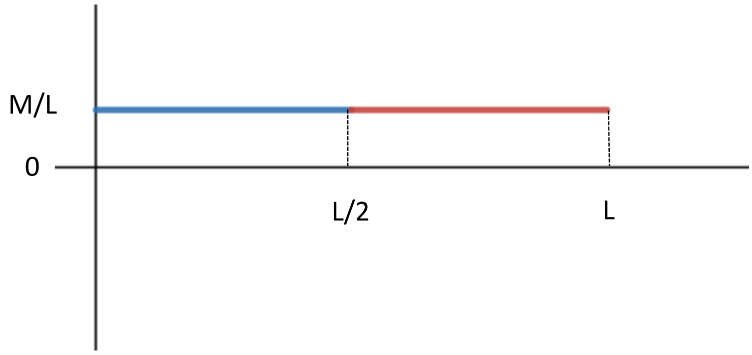
$\Sigma M_A = 0 \quad \Rightarrow Vx + M(x) = 0 \ \Rightarrow M(x) = -\frac{Mx}{L}$

For $\boldsymbol{\frac{L}{2} < x < L}$

$\Sigma F_y = 0 \quad \Rightarrow V = R_A \ \Rightarrow V = \frac{M}{L}$

$\Sigma M_A = 0 \quad \Rightarrow -M + Vx + M(x) = 0 \ \Rightarrow M(x) = \frac{M}{L}(L - x)$

SFD:-



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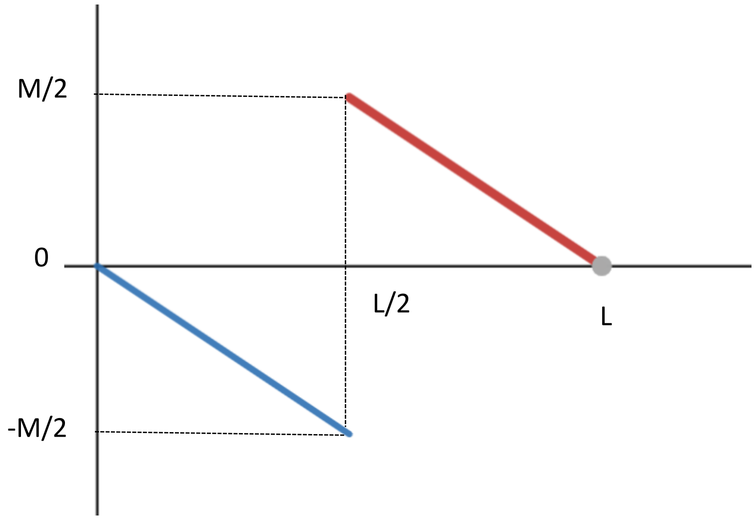
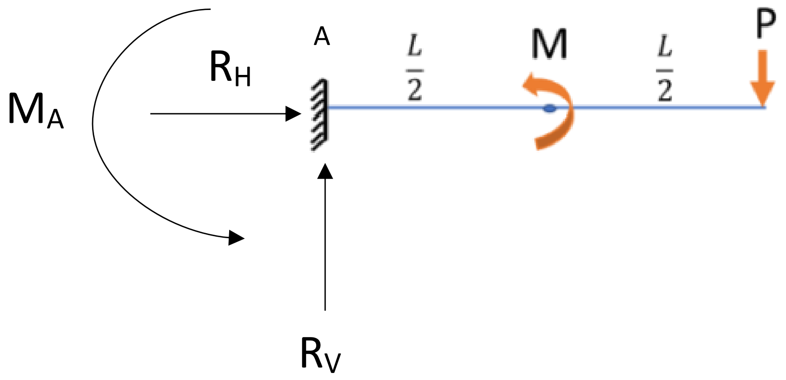


Question 4:-



Balancing forces in x and y direction:-

$\Sigma F_x = 0 \quad \Rightarrow R_h = 0$

$\Sigma F_y = 0 \quad \Rightarrow R_V - P = 0$

$\Sigma M_A = 0 \quad \Rightarrow M_A + M - PL = 0$

$\Rightarrow R_V = P \, , M_A = PL - M$

Considering Shear force V(x) in downward direction and bending moment M(x) in clockwise direction:-

Taking x towards right side of A

For $\boldsymbol{0 < x < \frac{L}{2}}$

$\Sigma F_y = 0 \quad \Rightarrow -R_V + V = 0 \ \Rightarrow V = P$

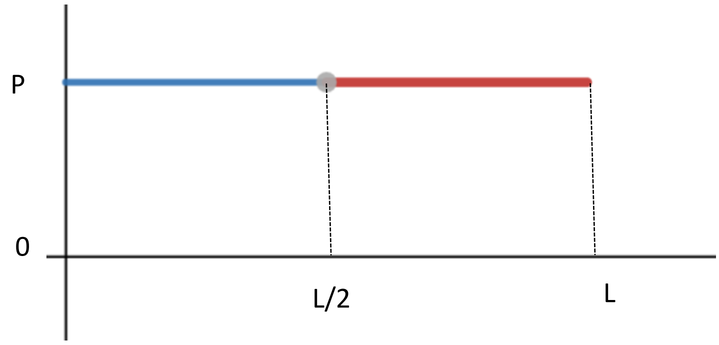
$\Sigma M_A = 0 \quad \Rightarrow -M_A + Vx + M(x) = 0 \ \Rightarrow M(x) = P(L - x) - M$

For $\boldsymbol{\frac{L}{2} < x < L}$

$\Sigma F_y = 0 \quad \Rightarrow V = R_V \ \Rightarrow V = P$

$\Sigma M_A = 0 \quad \Rightarrow -M_A - M + Vx + M(x) = 0 \ \Rightarrow M(x) = P(L - x)$

SFD:-



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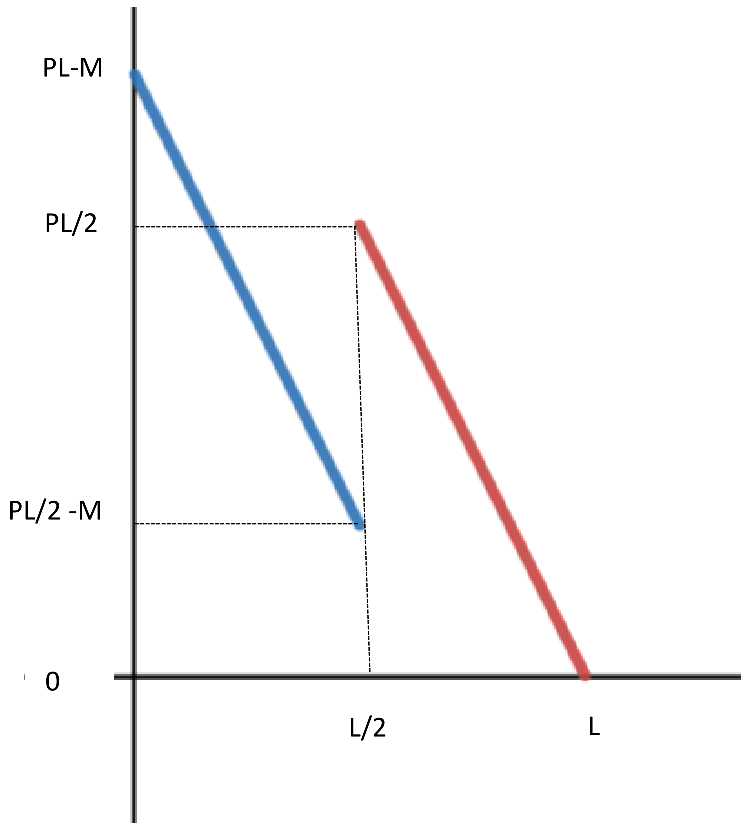
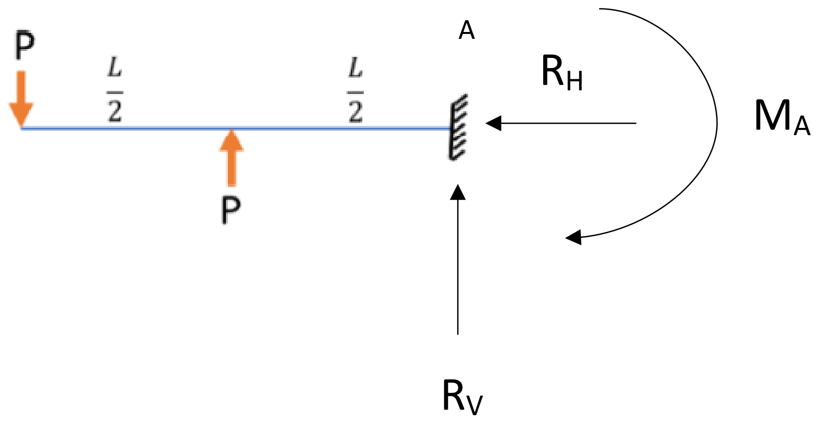


Question 5:-



Balancing forces in x and y direction: -

$\Sigma F_x = 0 \quad \Rightarrow R_h = 0$

$\Sigma F_y = 0 \quad \Rightarrow R_V - P + P = 0$

$\Sigma M_A = 0 \quad \Rightarrow M_A + \frac{PL}{2} - PL = 0$

$\Rightarrow R_V = 0\,, M_A = \frac{PL}{2}$

Considering Shear force V(x) in downward direction and bending moment M(x) in clockwise direction: -

Taking x towards left side of A

For $\boldsymbol{0 < x < \frac{L}{2}}$

$\Sigma F_y = 0 \quad \Rightarrow -R_V + V = 0 \ \Rightarrow V = 0$

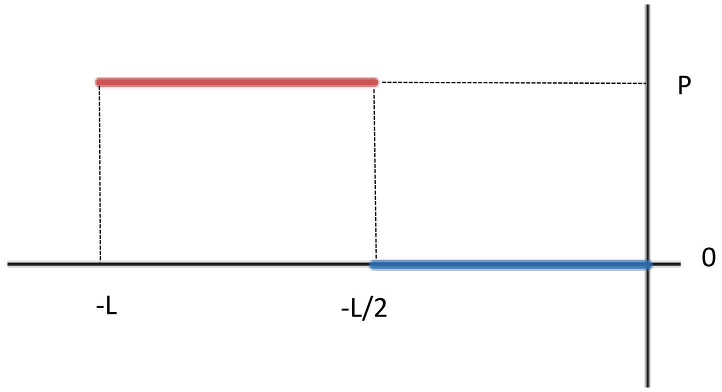
$\Sigma M_A = 0 \quad \Rightarrow -M_A + Vx - M(x) = 0 \ \Rightarrow M(x) = -\frac{PL}{2}$

For $\boldsymbol{\frac{L}{2} < x < L}$

$\Sigma F_y = 0 \quad \Rightarrow V = R_V + P \Rightarrow V = P$

$\Sigma M_A = 0 \quad \Rightarrow -M_A - \frac{PL}{2} + Vx - M(x) = 0 \ \Rightarrow M(x) = P(x - L)$

SFD:-



BMD:-