

Lecture Objectives

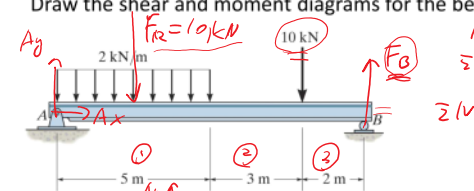


Internal Forces

1

Example

Draw the shear and moment diagrams for the beam.



Region ①:

$$\sum F_y = A_y - V - 2 \cdot x = 0$$

$$V = A_y - 2x = -2x + 9.5$$

$$\sum M_A = M - V \cdot x - 2 \cdot x \cdot \frac{x}{2} = 0$$

$$M = x^2 + (-2x + 9.5)x$$

$$= -x^2 + 9.5x$$

At B:

$$A_x = 0$$

$$\sum F_y = A_y + F_B - 10 - 10 = 0$$

$$\sum M_A = 10 F_B - 10 \cdot 8 - 10 \cdot 2.5 = 0$$

$$F_B = 8 + 2.5 = 10.5 \text{ kN}$$

$$A_y = 20 - F_B = 9.5 \text{ kN}$$

Region ②:

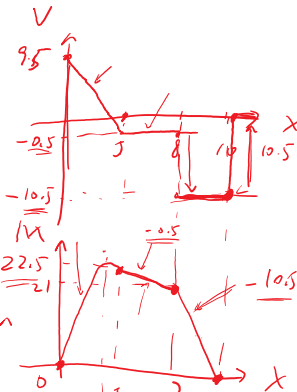
$$\sum F_y = A_y - V - 10 = 0$$

$$V = -A_y + 10 = -0.5 \text{ kN}$$

$$\sum M_A = M - V \cdot x - 10 \cdot 2.5 = 0$$

$$M = 25 + Vx$$

$$= -0.5x + 25$$



Region ③:

$$\sum F_y = A_y - 10 - 10 - V = 0$$

$$V = A_y - 20 = -10.5 \text{ kN}$$

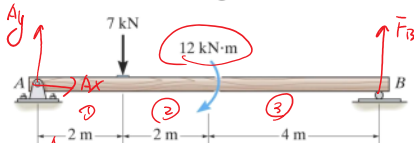
$$\sum M_A = M - 10 \cdot 2.5 - 10 \cdot 8 - Vx = 0$$

$$M = 10.5 - 10.5x$$

$$x \leq 0 \quad \Rightarrow \quad 0$$

Example

Draw the moment diagrams for the beam.



Region ①:

$$V = 3.75 \text{ kN}$$

$$\sum M_A = M - V \cdot x = 0$$

$$M = Vx = 3.75x$$

Region ②:

$$A_y - 7 - V = 0 \quad V = A_y - 7 = -3.25 \text{ kN}$$

$$M - 7 \cdot 2 - Vx = 0 \quad M = Vx + 14 = -3.25x + 14$$

Region ③:

$$A_y - 7 - V = 0 \quad V = -3.25 \text{ kN}$$

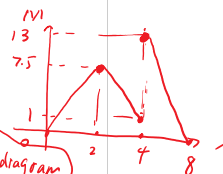
$$M - 7 \cdot 2 - V \cdot x - 12 = 0$$

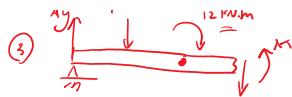
$$M = -3.25x + 26$$

$$F_B = \frac{13}{4} \text{ kN}$$

$$A_y = 3.75 \text{ kN}$$

clockwise
External M.
+ jump in M diagram





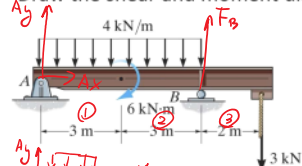
$$A_y - 7 - V = 0 \quad V = -3.25 \text{ kN}$$

$$M - 7 \cdot 2 - V \cdot x - 12 = 0$$

$$M = -3.25x + 26$$

Example

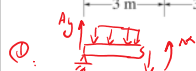
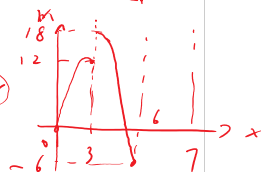
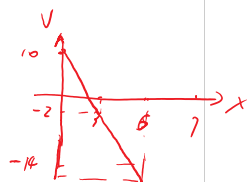
Draw the shear and moment diagrams for the beam.



$$F_b = 17 \text{ kN}$$

$$A_y = 10 \text{ kN}$$

$$A_x = 0 \text{ kN}$$



$$A_y - V - 4 \cdot x = 0 \quad V = A_y - 4x = 10 - 4x$$

$$M - Vx - 4x \cdot \frac{x}{2} = 0 \quad M = Vx + 2x^2 = -2x^2 + 10x$$



$$A_y - V - 4 \cdot x = 0 \quad V = 10 - 4x$$

$$M - V \cdot x - 4 \cdot x \cdot \frac{x}{2} - 6 = 0$$

$$M = 10x - 4x^2 + 6 + 2x^2 = -2x^2 + 10x + 6$$