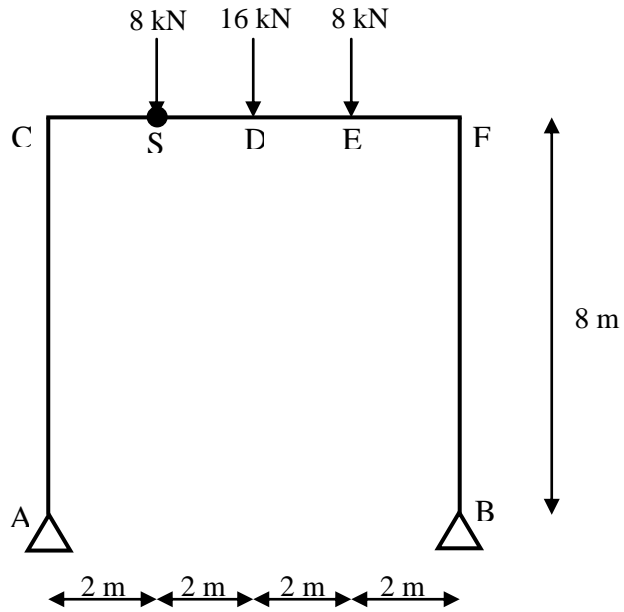
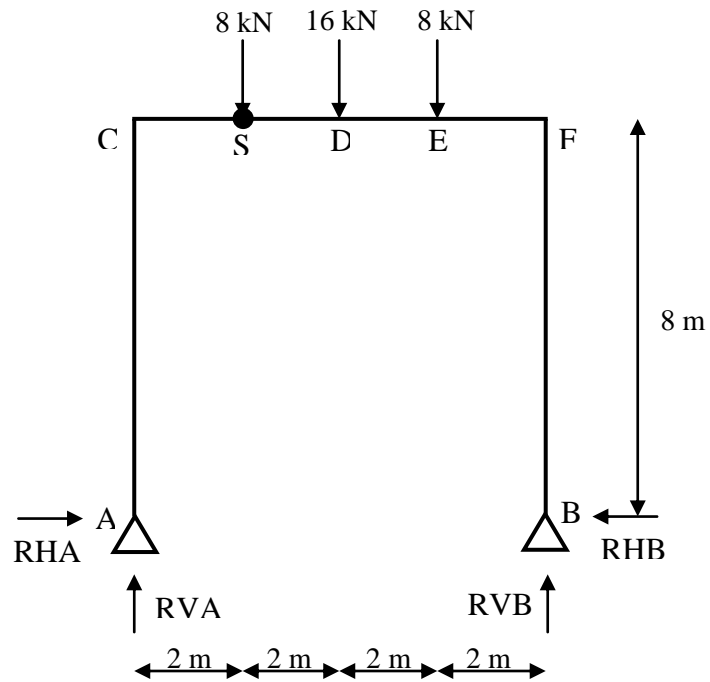


Portal 3 Sendi



Diketahui pembebanan dan ukuran portal 3 sendi pada gambar diatas. Cari Bidang Momen, Lintang, dan Normal pada portal tersebut?

Penyelesaian :



Reaksi Perletakan

Reaksi Vertikal

$$RVA \rightarrow \Sigma M_B = 0$$

$$RVA \cdot 8 + RHA \cdot 0 - 8 \cdot 6 - 16 \cdot 4 - 8 \cdot 2 + RVB \cdot 0 + RVA \cdot 0 = 0$$

$$RVA = \frac{48 + 64 + 16}{8} = 16 \text{ kN } (\uparrow)$$

$$RVB \rightarrow \Sigma M_A = 0$$

$$-RVB \cdot 8 + RHB \cdot 0 + 8 \cdot 6 + 16 \cdot 4 + 8 \cdot 2 + RVA \cdot 0 + RHA \cdot 0 = 0$$

$$RVB = \frac{48 + 64 + 16}{8} = 16 \text{ kN } (\uparrow)$$

$$\Sigma V = 0$$

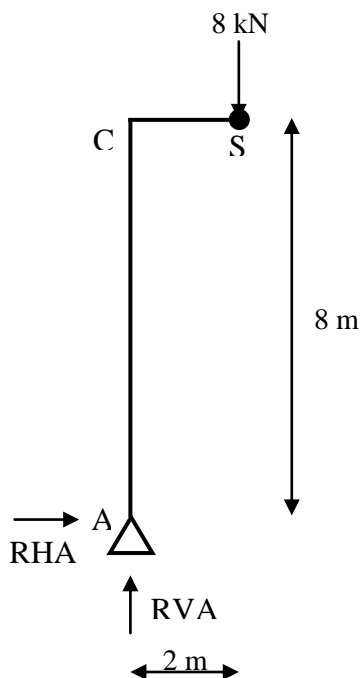
$$RVA + RVB - 8 - 16 - 8 = 0$$

$$16 + 16 - 32 = 0$$

$$0 = 0$$

Reaksi Horizontal

Untuk mencari reaksi horizontal maka ditinjau dari $\Sigma M_S = 0$.

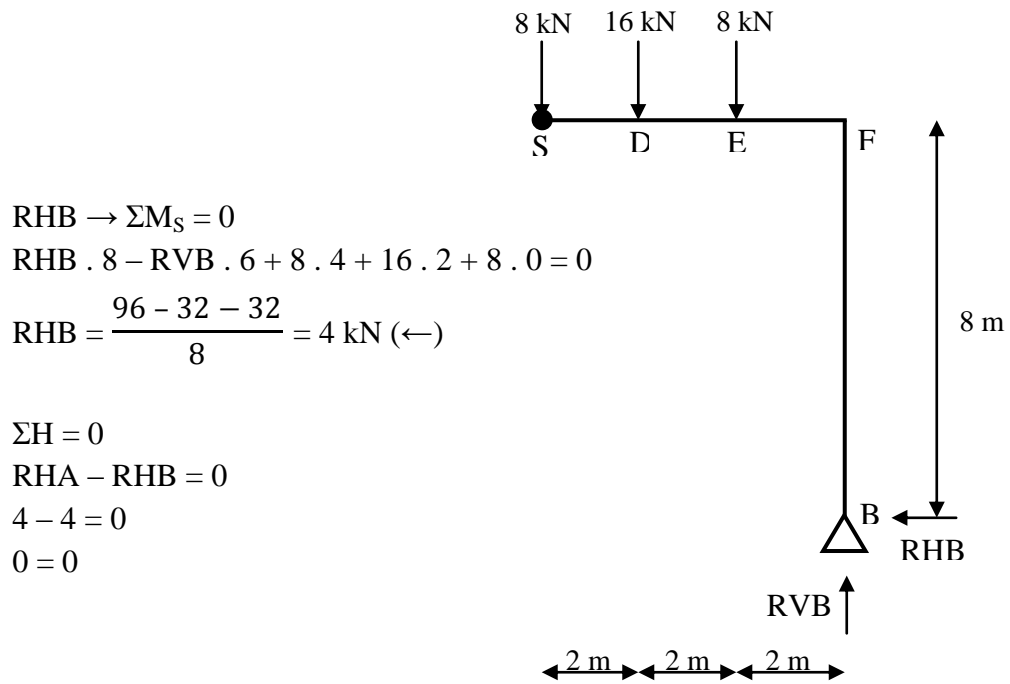


$$RHA \rightarrow \Sigma M_S = 0$$

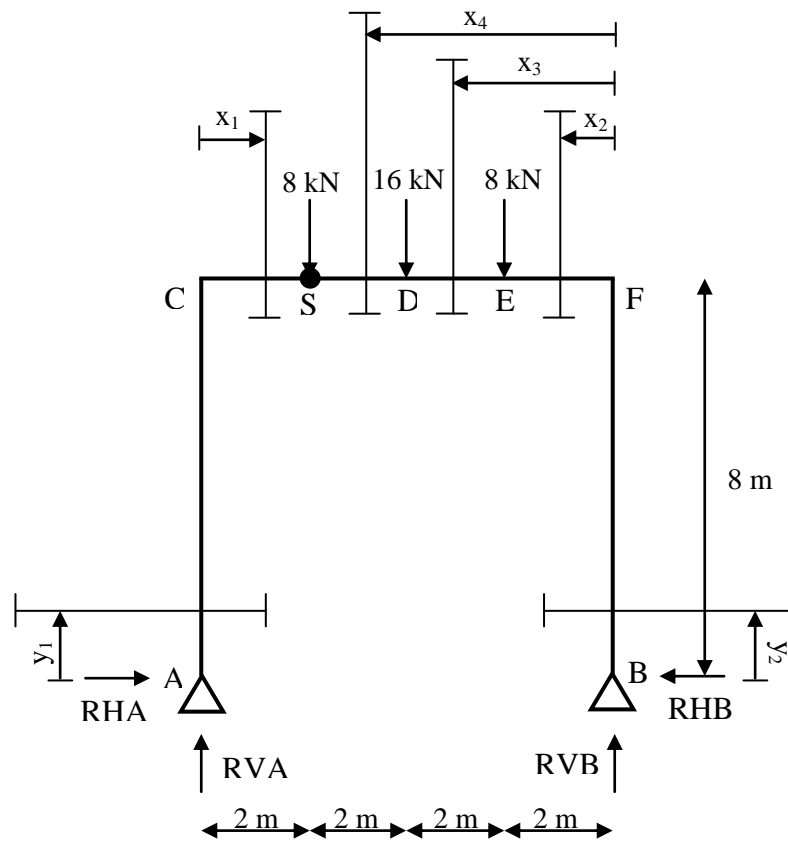
$$-RHA \cdot 8 + RVA \cdot 2 + 8 \cdot 0 = 0$$

$$RHA = \frac{32}{8} = 4 \text{ kN } (\rightarrow)$$





Bidang Momen (M), Bidang Lintang (Q), dan Bidang Normal (N)



Bidang Momen (M)

Daerah A – C ($0 \leq y_1 \leq 8$)

$$M_{y_1} = -R_{HA} \cdot y_1 = -4 y_1$$

$$y_1 = 0 \rightarrow M_A = 0 \text{ kNm}$$

$$y_1 = 8 \rightarrow M_C = -32 \text{ kNm}$$

Daerah C – S ($0 \leq x_1 \leq 2$)

$$M_{x_1} = R_{VA} \cdot x_1 - R_{HA} \cdot 8 = 16 x_1 - 32$$

$$x_1 = 0 \rightarrow M_C = -32 \text{ kNm}$$

$$x_1 = 2 \rightarrow M_S = 0 \text{ kNm}$$

Daerah B – F ($0 \leq y_2 \leq 8$)

$$M_{y_2} = -R_{HB} \cdot y_2 = -4 y_2$$

$$y_2 = 0 \rightarrow M_B = 0 \text{ kNm}$$

$$y_2 = 8 \rightarrow M_F = -32 \text{ kNm}$$

Daerah F – E ($0 \leq x_2 \leq 2$)

$$M_{x_2} = R_{VB} \cdot x_2 - R_{HB} \cdot 8 = 16 x_2 - 32$$

$$x_2 = 0 \rightarrow M_F = -32 \text{ kNm}$$

$$x_2 = 2 \rightarrow M_E = 0 \text{ kNm}$$

Daerah E – D ($2 \leq x_3 \leq 4$)

$$M_{x_3} = R_{VB} \cdot x_3 - R_{HB} \cdot 8 - 8 (x_3 - 2) = 16 x_3 - 32 - 8 (x_3 - 2)$$

$$x_3 = 2 \rightarrow M_E = 0 \text{ kNm}$$

$$x_3 = 4 \rightarrow M_D = 16 \text{ kNm}$$

Daerah D – S ($4 \leq x_4 \leq 6$)

$$M_{x_4} = R_{VB} \cdot x_4 - R_{HB} \cdot 8 - 8 (x_4 - 2) - 16 (x_4 - 4)$$

$$M_{x_4} = 16 x_4 - 32 - 8 (x_4 - 2) - 16 (x_4 - 4)$$

$$x_4 = 4 \rightarrow M_D = 16 \text{ kNm}$$

$$x_4 = 6 \rightarrow M_S = 0 \text{ kNm}$$



Bidang Lintang (Q)

Daerah A – C ($0 \leq y_1 \leq 8$)

$$Q_{y_1} = -R_{HA} = -4$$

$$y_1 = 0 \rightarrow Q_A = -4 \text{ kN}$$

$$y_1 = 8 \rightarrow Q_C = -4 \text{ kN}$$

Daerah C – S ($0 \leq x_1 \leq 2$)

$$Q_{x_1} = R_{VA} = 16$$

$$x_1 = 0 \rightarrow Q_C = 16 \text{ kN}$$

$$x_1 = 2 \rightarrow Q_S = 16 \text{ kN}$$

Daerah B – F ($0 \leq y_2 \leq 8$)

$$Q_{y_2} = R_{HB} = 4$$

$$y_2 = 0 \rightarrow Q_B = 4 \text{ kN}$$

$$y_2 = 8 \rightarrow Q_F = 4 \text{ kN}$$

Daerah F – E ($0 \leq x_2 \leq 2$)

$$Q_{x_2} = -R_{VB} = -16$$

$$x_2 = 0 \rightarrow Q_F = -16 \text{ kN}$$

$$x_2 = 2 \rightarrow Q_E = -16 \text{ kN}$$

Daerah E – D ($2 \leq x_3 \leq 4$)

$$Q_{x_3} = -R_{VB} + 8 = -16 + 8 = -8$$

$$x_3 = 2 \rightarrow Q_E = -8 \text{ kN}$$

$$x_3 = 4 \rightarrow Q_D = -8 \text{ kN}$$

Daerah D – S ($4 \leq x_4 \leq 6$)

$$Q_{x_4} = -R_{VB} + 8 + 16 = -16 + 24 = 8$$

$$x_4 = 4 \rightarrow Q_D = 8 \text{ kN}$$

$$x_4 = 6 \rightarrow Q_S = 8 \text{ kN}$$



Bidang Normal (N)

Daerah A – C ($0 \leq y_1 \leq 8$)

$$N_{y_1} = -RVA = -16$$

$$y_1 = 0 \rightarrow N_A = -16 \text{ kN}$$

$$y_1 = 8 \rightarrow N_C = -16 \text{ kN}$$

Daerah C – S ($0 \leq x_1 \leq 2$)

$$N_{x_1} = -RHA = -4$$

$$x_1 = 0 \rightarrow N_C = -4 \text{ kN}$$

$$x_1 = 2 \rightarrow N_S = -4 \text{ kN}$$

Daerah B – F ($0 \leq y_2 \leq 8$)

$$N_{y_2} = -RVB = -16$$

$$y_2 = 0 \rightarrow N_B = -16 \text{ kN}$$

$$y_2 = 8 \rightarrow N_F = -16 \text{ kN}$$

Daerah F – E ($0 \leq x_2 \leq 2$)

$$N_{x_2} = -RHB = -4$$

$$x_2 = 0 \rightarrow N_F = -4 \text{ kN}$$

$$x_2 = 2 \rightarrow N_E = -4 \text{ kN}$$

Daerah E – D ($2 \leq x_3 \leq 4$)

$$N_{x_3} = -RHB = -4$$

$$x_3 = 2 \rightarrow N_E = -4 \text{ kN}$$

$$x_3 = 4 \rightarrow N_D = -4 \text{ kN}$$

Daerah D – S ($4 \leq x_4 \leq 6$)

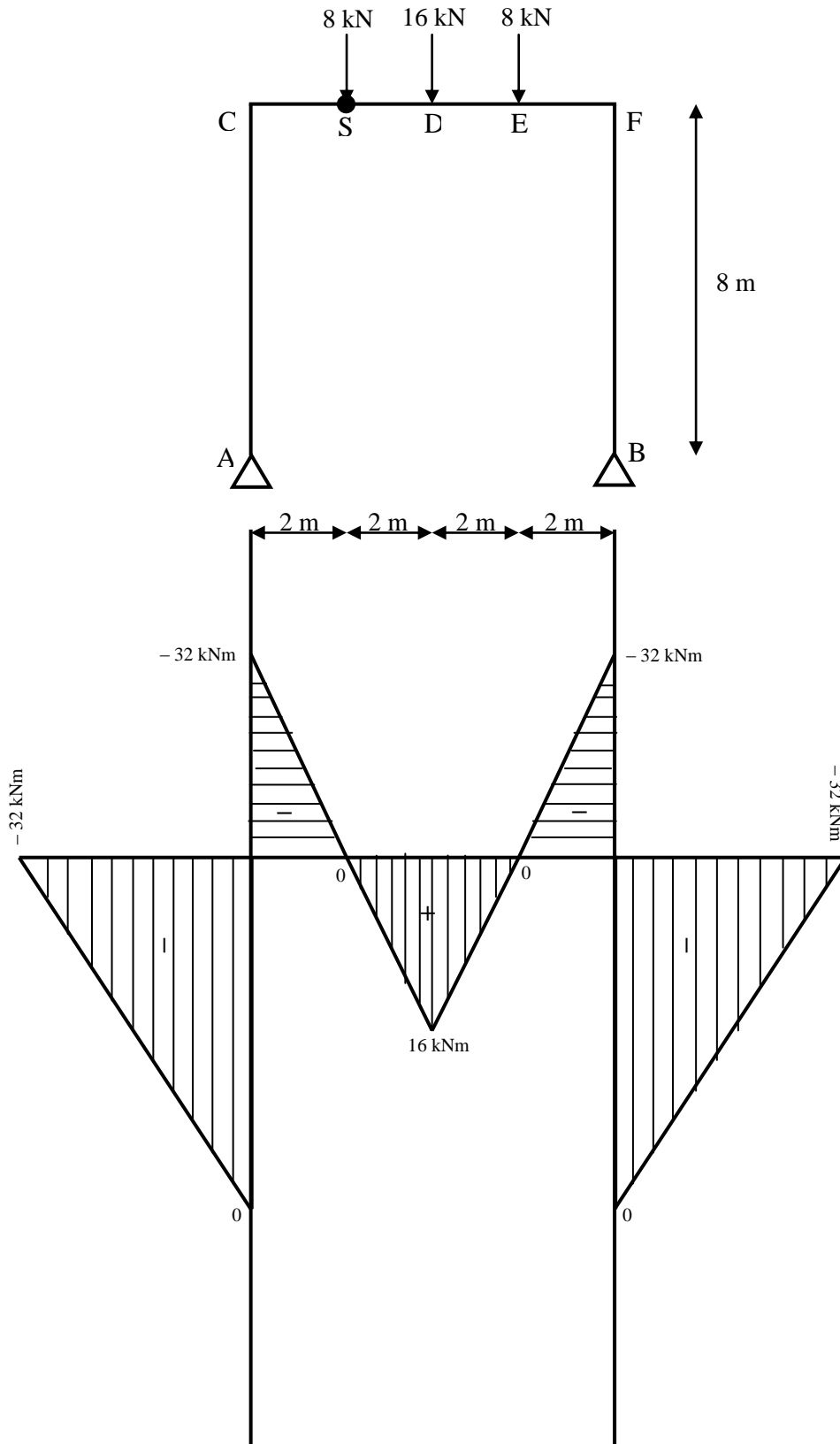
$$N_{x_4} = -RHB = -4$$

$$x_4 = 4 \rightarrow N_D = -4 \text{ kN}$$

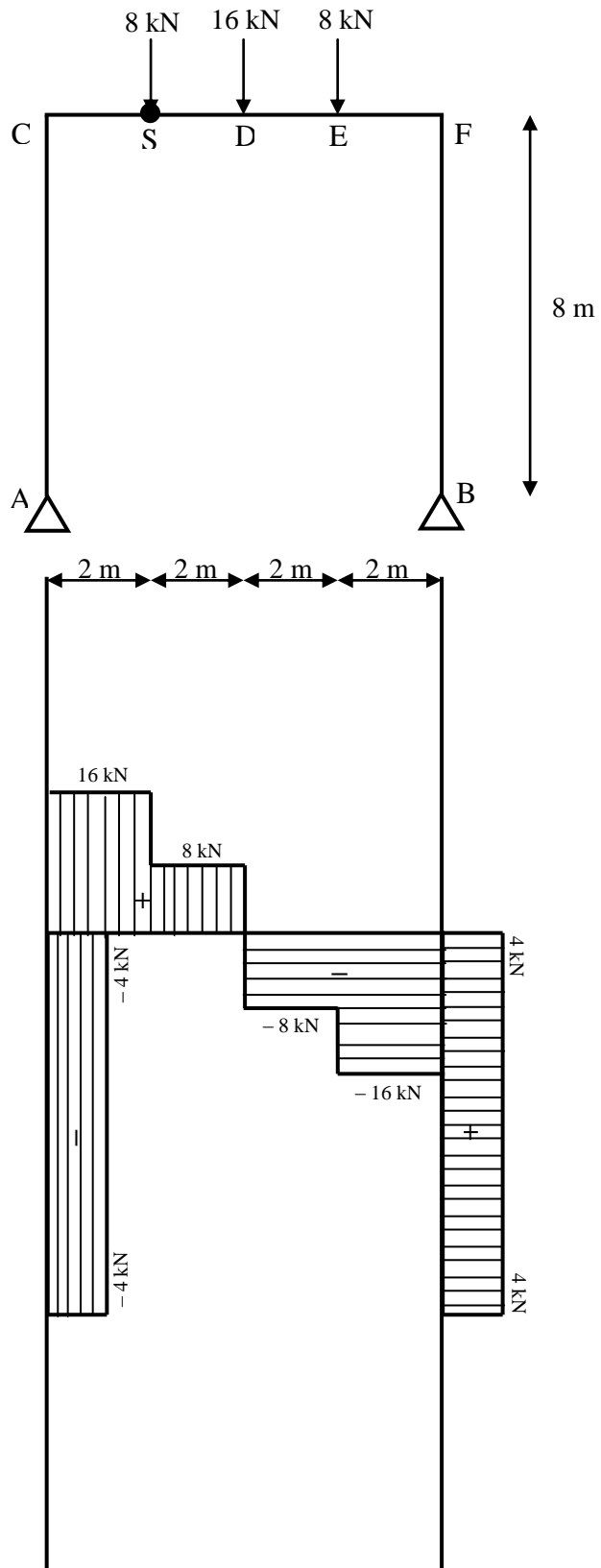
$$x_4 = 6 \rightarrow N_S = -4 \text{ kN}$$



Gambar Bidang Momen (M)



Gambar Bidang Lintang (Q)



Gambar Bidang Normal (N)

