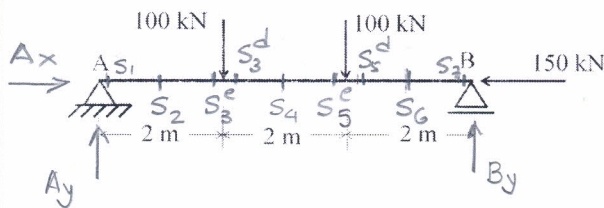


## Vigas Simplesmente Apoiadas – Forças Concentradas

Para a viga carregada como mostra a figura, calcule todos os esforços internos (N, Q e M) nas seções transversais localizadas a 0 m, 1 m, 2 m, 3 m, 4 m, 5 m e 6 m do apoio do segundo gênero (à esquerda). Plote seus resultados.



$$\sum F_x = 0;$$

$$A_x = 150 \text{ kN}$$

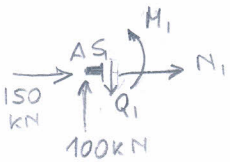
$$+\uparrow \sum M_A = 0;$$

$$B_y (6) - 100(2) - 100(4) = 0$$

$$B_y = 100 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow A_y - 100 - 100 + 100 = 0 \Rightarrow A_y = 100 \text{ kN}$$

Seção  $S_1$ :  $x = 0 \text{ m}$

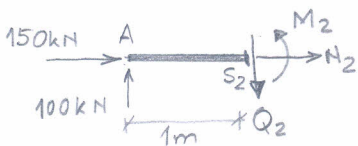


$$+\rightarrow \sum F_x = 0; N_1 = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0; 100 - Q_1 = 0 \Rightarrow Q_1 = 100 \text{ kN}$$

$$+\curvearrowright \sum M_{S_1} = 0; M_1 = 0$$

Seção  $S_2$ :  $x = 1 \text{ m}$

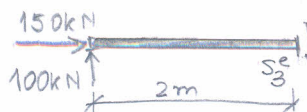


$$+\rightarrow \sum F_x = 0; N_2 = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0; 100 - Q_2 = 0 \Rightarrow Q_2 = 100 \text{ kN}$$

$$+\curvearrowright \sum M_{S_2} = 0; M_2 - 100(1) = 0 \Rightarrow M_2 = 100 \text{ kN}\cdot\text{m}$$

Seção  $S_3^e$ :  $x = 2 \text{ m}$  (à esquerda da força de 100 kN)



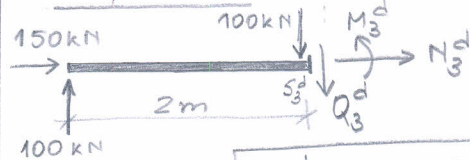
$$\sum F_x = 0; N_3^e = -150 \text{ kN}$$

$$\sum F_y = 0; 100 - Q_3^e = 0$$

$$\therefore Q_3^e = 100 \text{ kN}$$

$$+\curvearrowright \sum M_{S_3^e} = 0; M_3^e - 100(2) = 0 \Rightarrow M_3^e = 200 \text{ kN}\cdot\text{m}$$

Seção  $S_3^d$ :  $x = 2 \text{ m}$

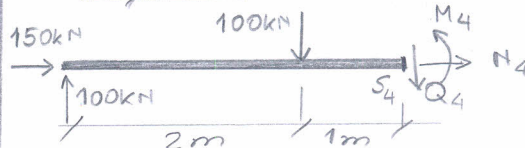


$$\sum F_x = 0; N_3^d = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0; 100 - 100 - Q_3^d = 0 \Rightarrow Q_3^d = 0$$

$$+\curvearrowright \sum M_{S_3^d} = 0; M_3^d - 100(2) = 0 \Rightarrow M_3^d = 200 \text{ kN}\cdot\text{m}$$

Seção  $S_4$ :  $x = 3 \text{ m}$

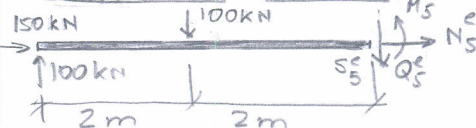


$$\sum F_x = 0; N_4 = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0 \Rightarrow 100 - 100 - Q_4 = 0 \Rightarrow Q_4 = 0$$

$$+\curvearrowright \sum M_{S_4} = 0 \Rightarrow M_4 - 100(3) + 100(1) = 0 \Rightarrow M_4 = 200 \text{ kN}\cdot\text{m}$$

Seção  $S_5^e$ :  $x = 4 \text{ m}$

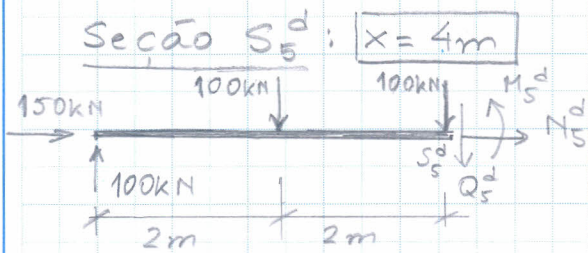
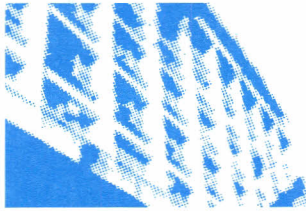


$$\sum F_x = 0; N_5^e = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0; 100 - 100 - Q_5^e = 0 \Rightarrow Q_5^e = 0$$

$$+\curvearrowright \sum M_{S_5^e} = 0; M_5^e + 100(2) - 100(4) = 0$$

$$\Rightarrow M_5^e = 200 \text{ kN}\cdot\text{m}$$



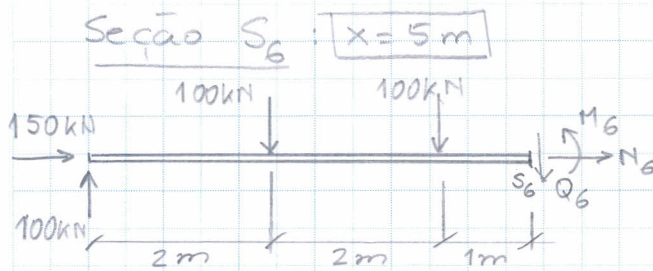
$$\sum F_x = 0 \Rightarrow N_5^d = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0 \Rightarrow 100 - 100 - 100 - Q_5^d = 0$$

$$Q_5^d = -100 \text{ kN}$$

$$+\curvearrowright \sum M_{S_5^d} = 0; M_5^d + 100(2) - 100(4) = 0$$

$$M_5^d = 200 \text{ kN}\cdot\text{m}$$



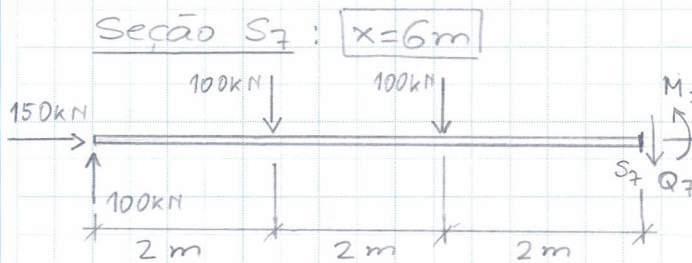
$$\sum F_x = 0 \Rightarrow N_6 = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0 \Rightarrow 100 - 100 - 100 - Q_6 = 0$$

$$Q_6 = -100 \text{ kN}$$

$$+\curvearrowright \sum M_{S_6} = 0 \Rightarrow M_6 - 100(5) + 100(3) + 100(1) = 0$$

$$\therefore M_6 = 100 \text{ kN}\cdot\text{m}$$



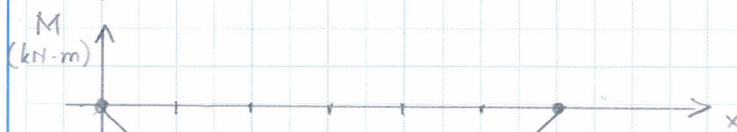
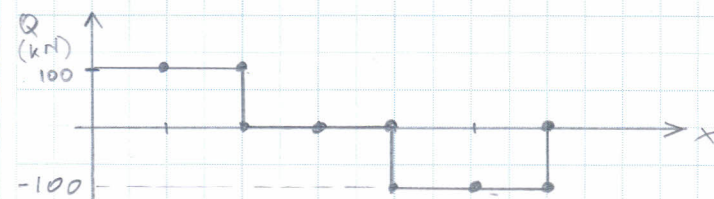
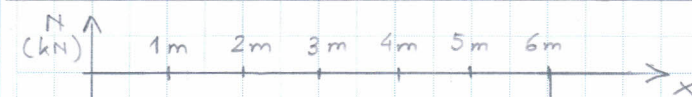
$$\sum F_x = 0 \Rightarrow N_7 = -150 \text{ kN}$$

$$+\uparrow \sum F_y = 0 \Rightarrow 100 - 100 - 100 - Q_7 = 0$$

$$Q_7 = -100 \text{ kN}$$

$$+\curvearrowright \sum M_{S_7} = 0 \Rightarrow M_7 - 100(6) + 100(4) + 100(2) = 0$$

$$M_7 = 0$$



(-)

(+)