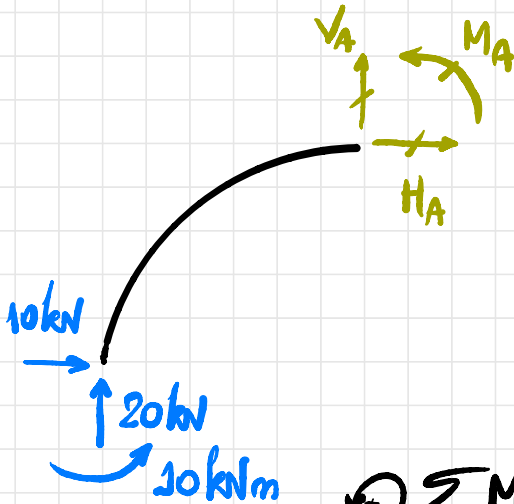
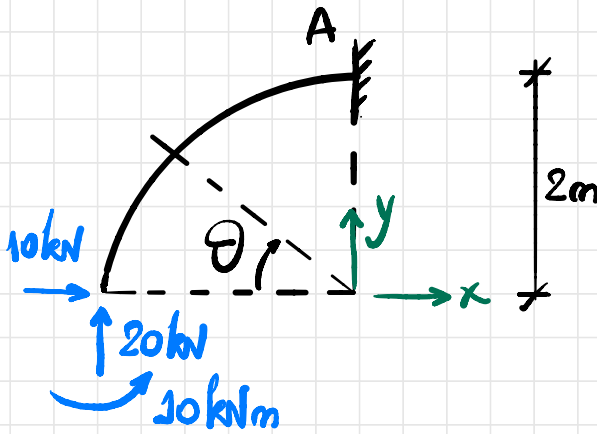


# Vigas Curvas

Como obter os esforços solicitantes em vigas curvas.

→ obter em função da coordenada angular  $\theta$ :



$$\sum F_H = 0: H_A + 10 = 0$$

$$H_A = -10 \text{ kN}$$

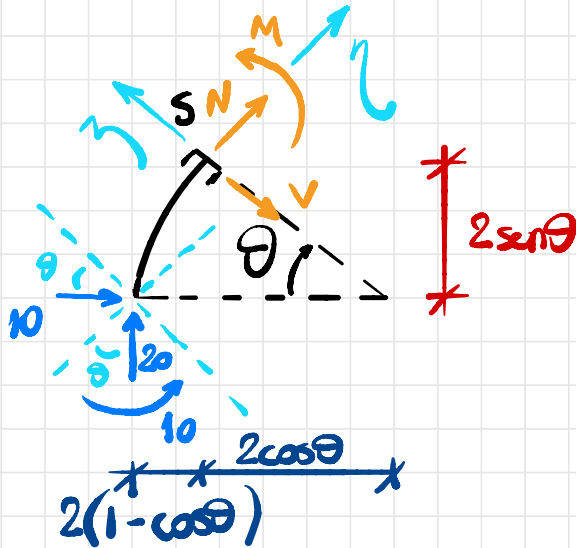
$$\sum F_V = 0: V_A + 20 = 0$$

$$V_A = -20 \text{ kN}$$

$$\sum M_{(A)} = 0: M_A + 10 \rightarrow 10 \cdot 2 - 20 \cdot 2 = 0$$

$$M_A = 10 \text{ kNm}$$

Fazendo um corte na posição  $\theta$ :



$$\sum F_y = 0: N + 10 \sin \theta + 20 \cos \theta = 0$$

$$N = -10 \sin \theta - 20 \cos \theta$$

$$\sum F_x = 0: -V - 10 \cos \theta + 20 \sin \theta = 0$$

$$V = 20 \sin \theta - 10 \cos \theta$$

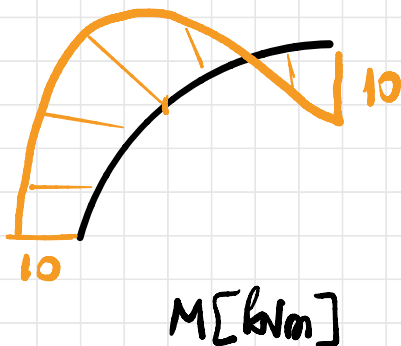
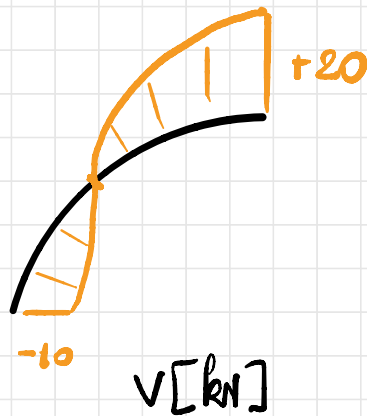
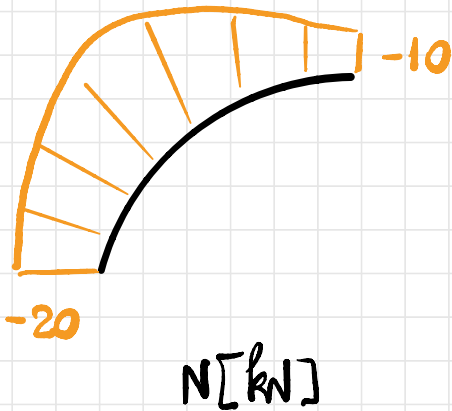
$$\text{a)} \sum M_B = 0: M + 10 + 10 \cdot 2 \sin \theta - 20 \cdot 2 \cdot (1 - \cos \theta) = 0$$

$$M = -40 \cos \theta - 20 \sin \theta + 30$$

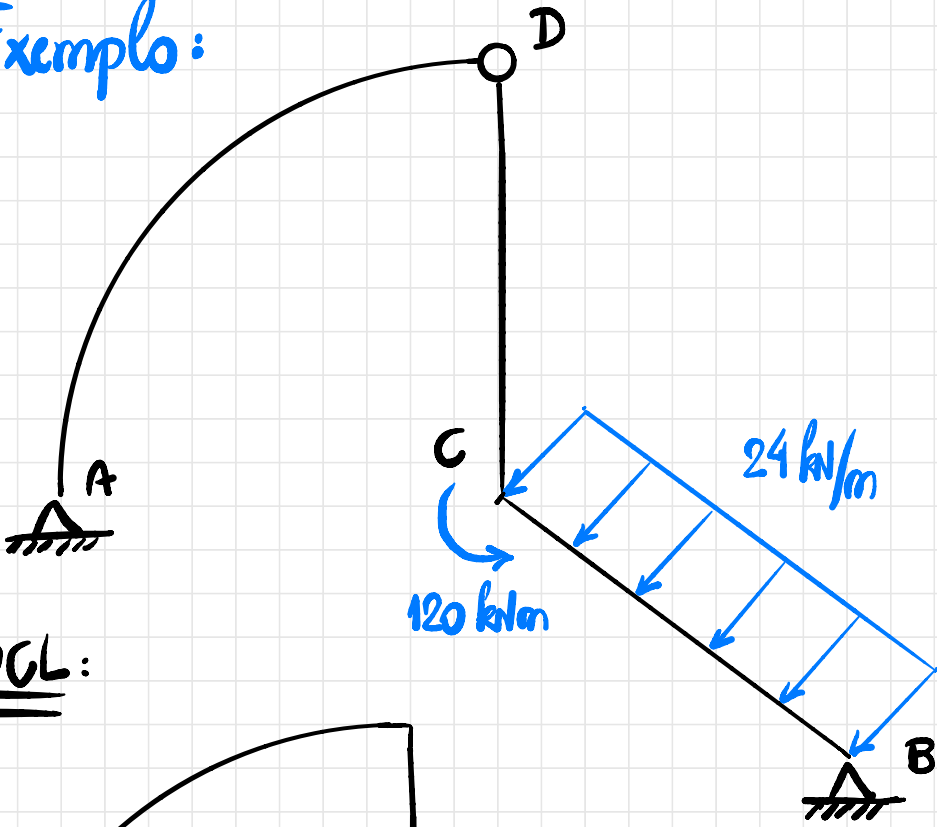
Note que  $\frac{1}{R} \frac{dM}{d\theta} = V$ : \*coordenadas cilíndricas

$$\frac{1}{2} \left( -40 \cdot (-\sin\theta) - 20 \cdot (\cos\theta) \right) = 20 \sin\theta - 10 \cos\theta = V$$

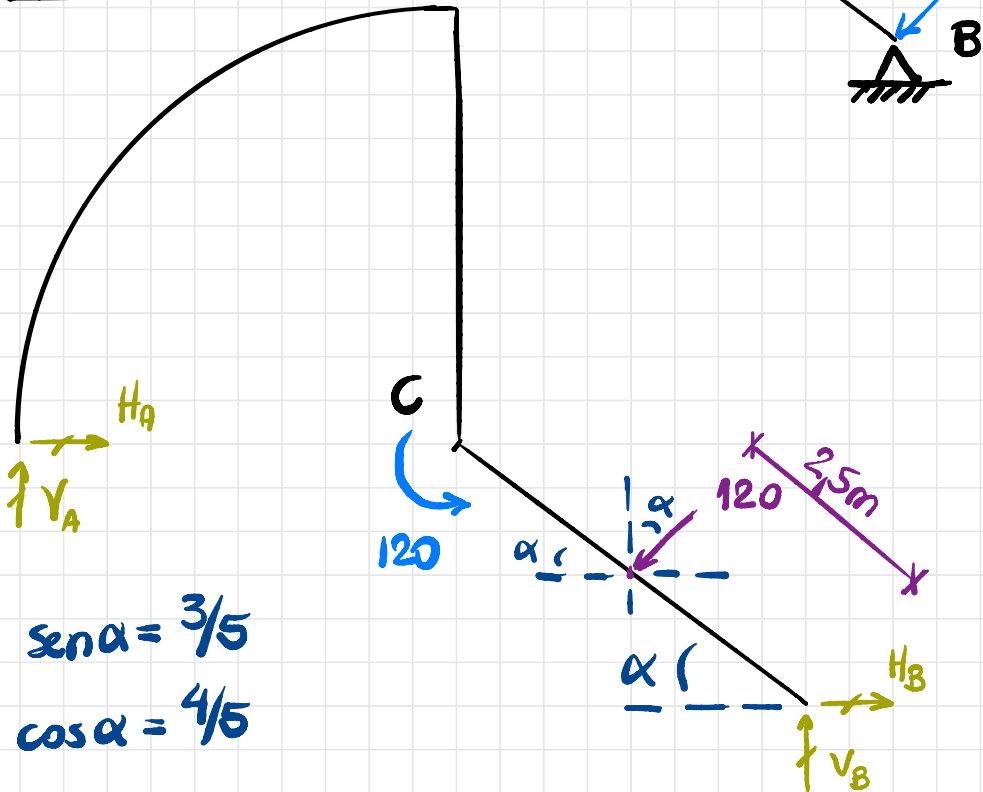
Diagramas:



Exemplo:



DGL:



$$\sin \alpha = \frac{3}{5}$$

$$\cos \alpha = \frac{4}{5}$$

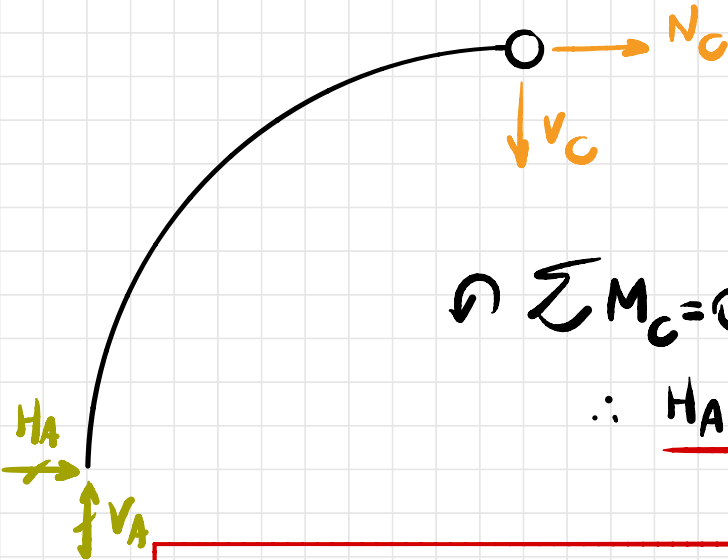
$$\sum \bar{F}_H = 0: H_A + H_B - 120 \cdot \sin \alpha = 0 \Rightarrow \underline{H_A + H_B = 72}$$

$$\sum F_V = 0: V_A + V_B - 120 \cdot \cos \alpha = 0 \Rightarrow \underline{V_A + V_B = 96}$$

$$\odot \sum M_B = 0: 120 \cdot 2,5 + 120 - H_A \cdot 3 - V_A \cdot 9 = 0$$

$$\Rightarrow \underline{3V_A + H_A = 140}$$

Fazendo um corte em C:



$$\odot \sum M_C = 0: H_A \cdot 5 - V_A \cdot 5 = 0$$

$$\therefore \underline{H_A = V_A}$$

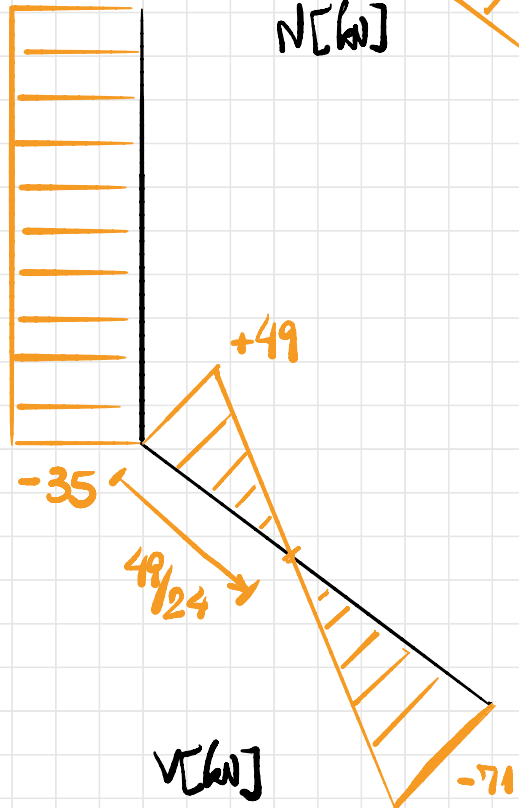
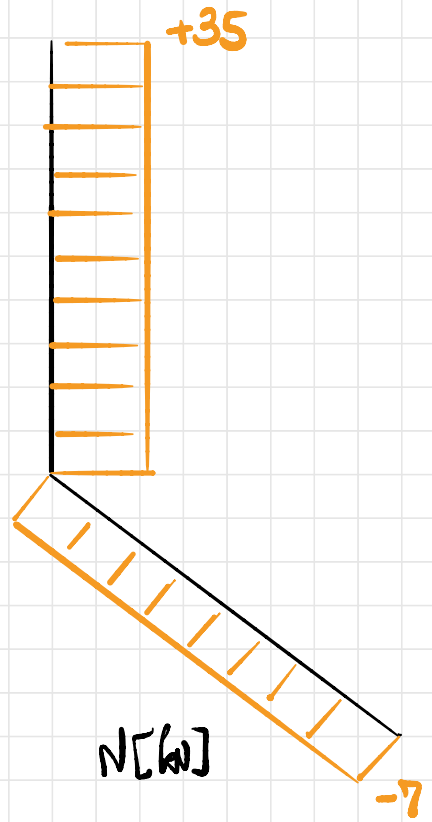
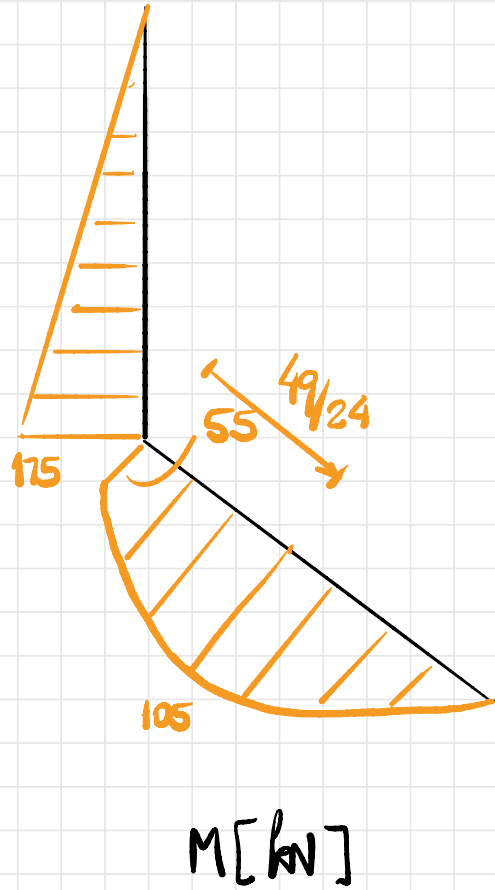
$$H_A = 35 \text{ kN}$$

$$H_B = 37 \text{ kN}$$

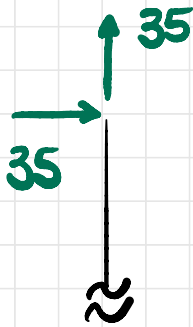
$$V_A = 35 \text{ kN}$$

$$V_B = 61 \text{ kN}$$

# Diagramas dos trechos retos:

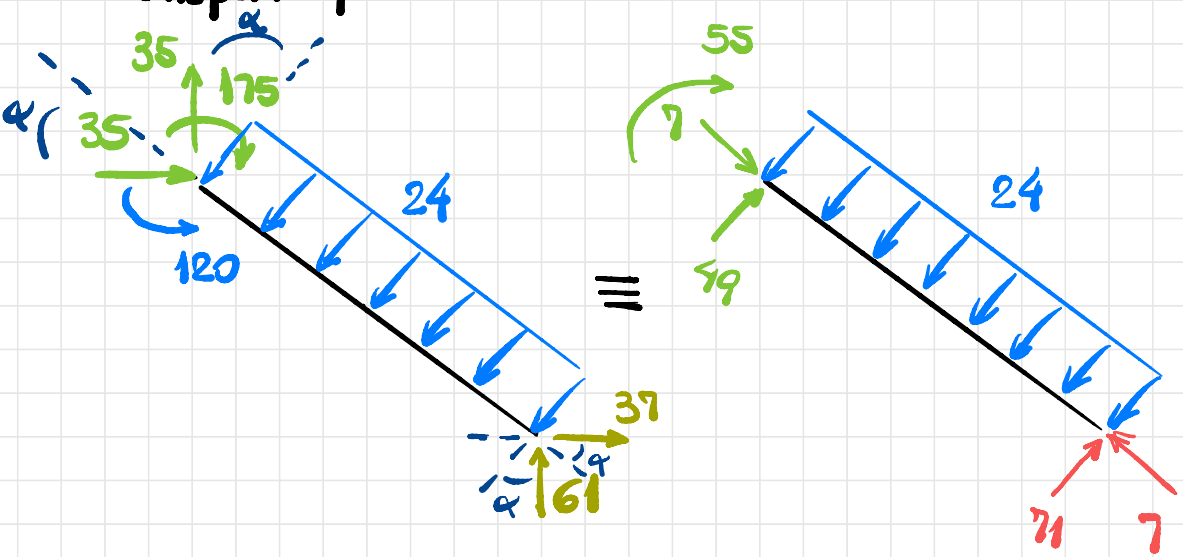


Transferir para D:

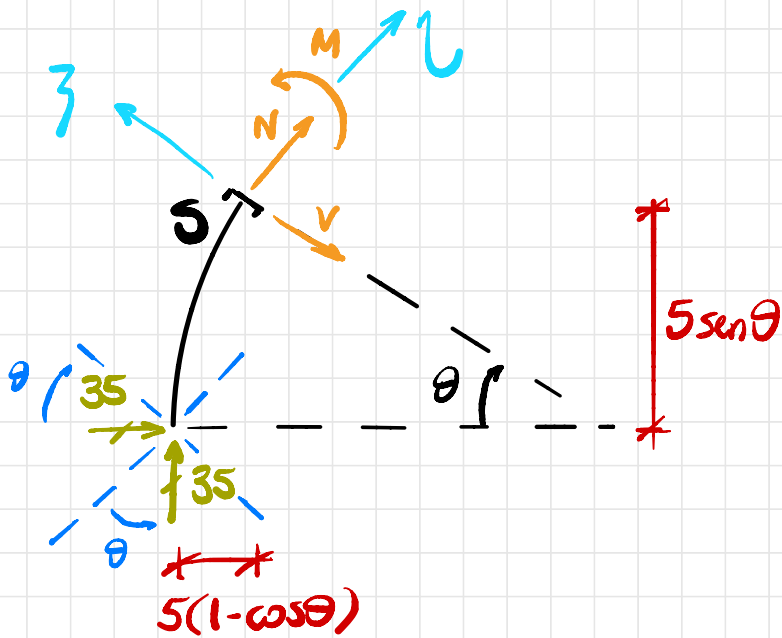


\* momento nulo na articulação!

Transferir para C:



$$24 \cdot \gamma = 49 \Rightarrow \gamma = 2,041\bar{6} \text{ m}$$



$$\sum F_y = 0: N + 35 \sin \theta + 35 \cos \theta = 0$$

$$N = -35(\sin \theta + \cos \theta)$$

$$\sum F_x = 0: -V - 35 \cos \theta + 35 \sin \theta = 0$$

$$V = 35(\sin \theta - \cos \theta)$$

$$\circlearrowleft \sum M_S = 0: M + 35 \cdot 5 \cdot \sin \theta - 35 \cdot 5(1 - \cos \theta) = 0$$

$$M = 175(1 - \sin \theta - \cos \theta)$$