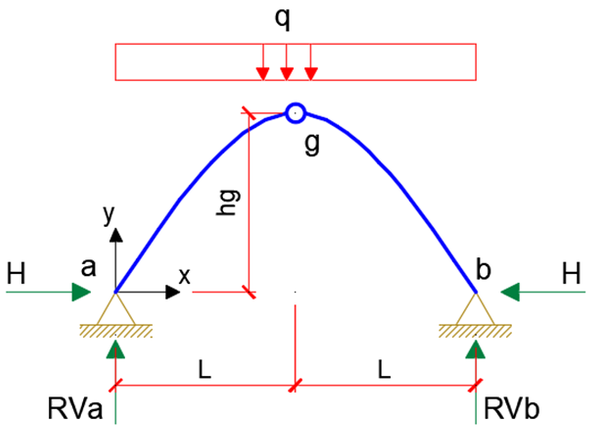
TE1_E07-05

Traçar os diagramas de momento fletor, esforço cortante e esforço axial para o arco parabólico de 2° grau abaixo:

$L := 5\ \text{m}$

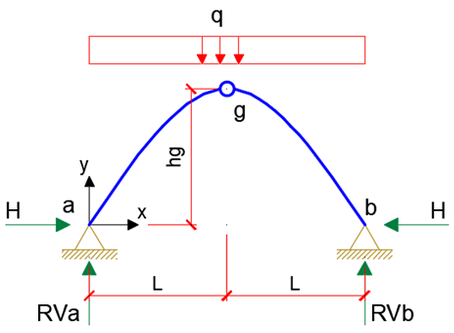
$hg := 5\ \text{m}$

$q := 50\ \frac{\text{kN}}{\text{m}}$



Reações de Apoio e Equações de Esforços na Viga Análoga:

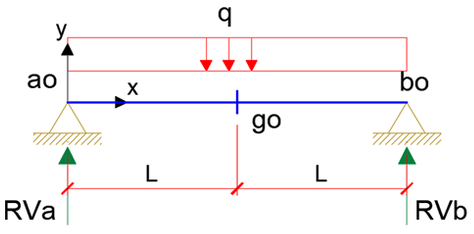
Viga Análoga:



$xa := 0$ $\quad ya := 0$

$xg := L = 5\ \text{m}$ $\quad yg := hg = 5\ \text{m}$

$xb := 2 \cdot L = 10\ \text{m}$ $\quad yb := 0$



Reações e Apoio na Viga Análoga:

Pela Simetria de Carga e Geometria: $RVa := \frac{q \cdot 2 \cdot L}{2} = 250\ \text{kN}$ $\quad RVb := RVa = 250\ \text{kN}$

Equações de Esforços da Viga Análoga:

$Mabo(x) := RVa \cdot x - \frac{q \cdot x^2}{2}$ $\quad Vabo(x) := RVa - q \cdot x$

Cálculo o Empuxo do Arco:

$Mgo := Mabo(L) = 625\ \text{kN m}$ $\quad H := \frac{Mgo}{hg} = 125\ \text{kN}$

Equação a Geometria do Arco:

$ya_ := A + B \cdot xa + C \cdot xa^2$

$yg_ := A + B \cdot xg + C \cdot xg^2$

$yb_ := A + B \cdot xg + C \cdot xg^2$

$matrizA := \begin{bmatrix} 1 & xa & xa^2 \\ 1 & xg & xg^2 \\ 1 & xb & xb^2 \end{bmatrix}$ $\quad vetorB := \begin{bmatrix} ya \\ yg \\ yb \end{bmatrix}$

$CoefABC := matrizA^{-1} \cdot vetorB = \begin{bmatrix} 0 \\ 2 \\ -0,2 \cdot \frac{1}{\text{m}} \end{bmatrix}$

$A := CoefABC_1 = 0$ $\quad B := CoefABC_2 = 2$ $\quad C := CoefABC_3 = -0,2 \cdot \frac{1}{\text{m}}$

$$y(x) := A + B \cdot x + C \cdot x^2 = 0 + 2 \cdot x + \left(-\frac{1}{5} \cdot \frac{1}{m}\right) \cdot x^2$$

Equações de Esforços do Arco:

$$M(x) := Mabo(x) - H \cdot y(x) = 0$$

$$Mabo(x) = \frac{25000\ kg \cdot x \cdot (-x + 10\ m)}{s^2}$$

$$H \cdot y(x) = \frac{25000\ kg \cdot x \cdot (-x + 10\ m)}{s^2}$$

$$\boldsymbol{V_s(x) = V_{so}(x).cos(\alpha(x)) - H.sen(\alpha(x))}$$
$$\boldsymbol{N_s(x) = -V_{so}(x).sen(\alpha(x)) - H.cos(\alpha(x))}$$

$$\alpha(x) := \operatorname{atan}\left(\frac{d}{d\,x} y(x)\right)$$

$$V(x) := Vabo(x) \cdot \cos(\alpha(x)) - H \cdot \sin(\alpha(x)) = 0$$

$$Vabo(x) \cdot \cos(\alpha(x)) = \frac{50000\ kg \cdot (-x + 5\ m)}{s^2 \cdot \sqrt{\frac{25\ m^2 + 4 \cdot (x - 5\ m)^2}{25\ m^2}}}$$

$$H \cdot \sin(\alpha(x)) = -\frac{50000\ kg \cdot (x - 5\ m)}{s^2 \cdot \sqrt{\frac{25\ m^2 + 4 \cdot (x - 5\ m)^2}{25\ m^2}}}$$

$$N(x) := (-Vabo(x)) \cdot \sin(\alpha(x)) - H \cdot \cos(\alpha(x))$$

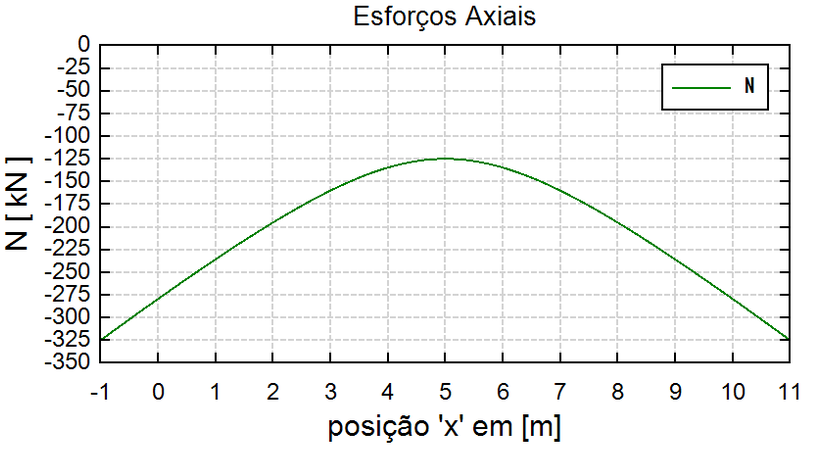
$$N(0\ m) = -279{,}5085\ kN$$

$$N(2{,}5\ m) = -176{,}7767\ kN$$

$$N(5\ m) = -125\ kN$$

$$N(7{,}5\ m) = -176{,}7767\ kN$$

$$N(10\ m) = -279{,}5085\ kN$$



$$\left\{\frac{N(\blacksquare\ m)}{kN}\right.$$