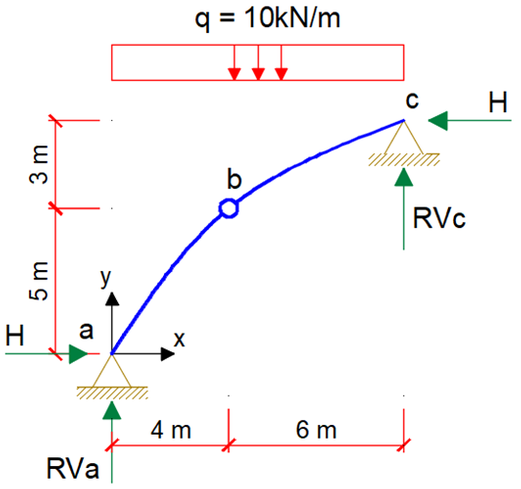
TE1_E07-06

- Traçar os diagramas de esforços internos para o arco parabólico de 2° grau esboçado abaixo.



$Lab := 4,0$

$Lbc := 6,0$

$hb := 5,0$

$hc := 8,0$

$Lvao := Lab + Lbc = 10$

$q := 10$

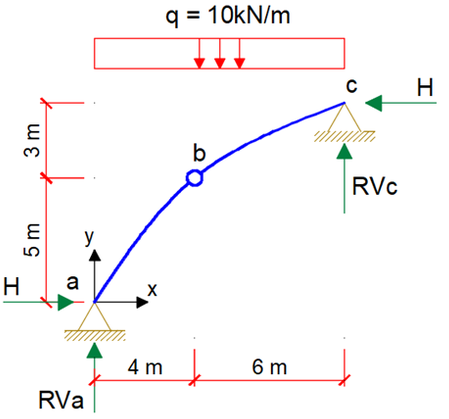
Reações de Apoio:

ΣMb = 0 (+) horário - olhando para "a"

```
RVa.Lab - H.hb - q.Lab^2 / 2 = 0
```

ΣMc = 0 (+) horário

```
RVa.Lvao - H.hc - q.Lvao^2 / 2 = 0
```



Sistema de equações:

```
RVa.Lab - H.hb = q.Lab^2 / 2
RVa.Lvao - H.hc = q.Lvao^2 / 2
```

$matrizA := \begin{bmatrix} Lab & -hb \\ Lvao & -hc \end{bmatrix} = \begin{bmatrix} 4 & -5 \\ 10 & -8 \end{bmatrix}$ $vetorB := \begin{bmatrix} \frac{q \cdot Lab^2}{2} \\ \frac{q \cdot Lvao^2}{2} \end{bmatrix} = \begin{bmatrix} 80 \\ 500 \end{bmatrix}$

$vetorX := matrizA^{-1} \cdot vetorB = \begin{bmatrix} 103,33 \\ 66,667 \end{bmatrix}$

$RVa := vetorX_1 = 103,33$

$H := vetorX_2 = 66,6667$

ΣFh = 0 (+) para direita: H igual em módulo porém com sentido contrário.

ΣFv = 0 (+) para cima

```
RVa + RVc - q.Lvao = 0
```

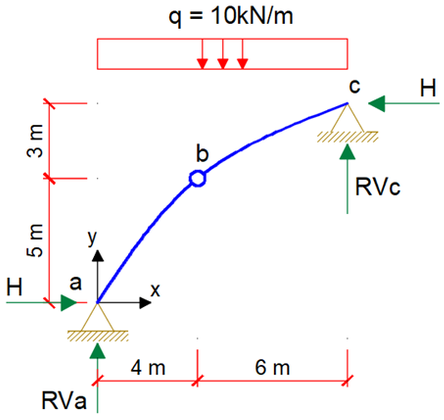
$RVc := -RVa + q \cdot Lvao = -3,3333$

Equação do Arco Parabólico de 2° Grau:

$xa := 0 \qquad ya := 0$

$xb := Lab = 4 \qquad yb := hb = 5$

$xc := Lvao = 10 \qquad yc := hc = 8$



$$matrizA := \begin{bmatrix} 1 & xa & xa^2 \\ 1 & xb & xb^2 \\ 1 & xc & xc^2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 4 & 16 \\ 1 & 10 & 100 \end{bmatrix} \qquad vetorB := \begin{bmatrix} ya \\ yb \\ yc \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \\ 8 \end{bmatrix}$$

$$vetorX := matrizA^{-1} \cdot vetorB = \begin{bmatrix} 0 \\ 1,55 \\ -0,075 \end{bmatrix}$$

$a := vetorX_1 = 0$

$b := vetorX_2 = 1,55$

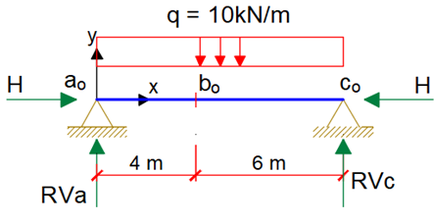
$c := vetorX_3 = -0,075$

$$y(x) := a + b \cdot x + c \cdot x^2 = 0 + \frac{31}{20} \cdot x + \left(-\frac{3}{40}\right) \cdot x^2$$

Equações da Viga Análoga (esforços verticais considerando somente a variação ao longo do eixo "x"):

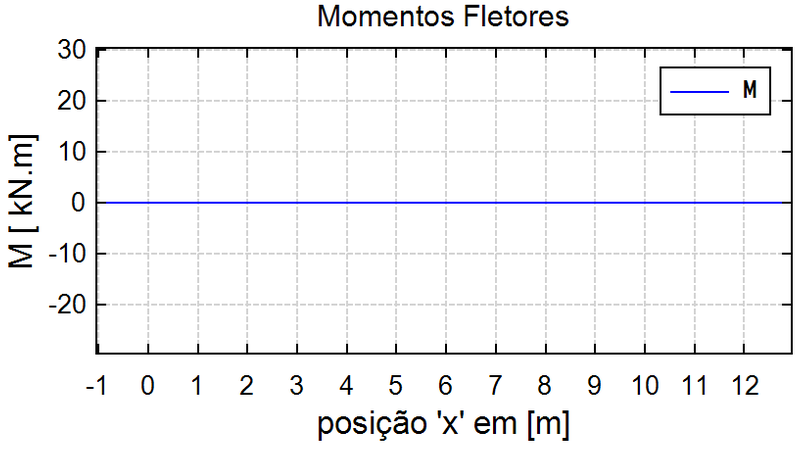
$$Mo_ac(x) := RVa \cdot x - \frac{q \cdot x^2}{2} = \frac{310}{3} \cdot x - \frac{10 \cdot x^2}{2}$$

$$Vo_ac(x) := RVa - q \cdot x = \frac{310}{3} - 10 \cdot x$$



Momentos Fletores:

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



Esforços Cortantes e Axiais:

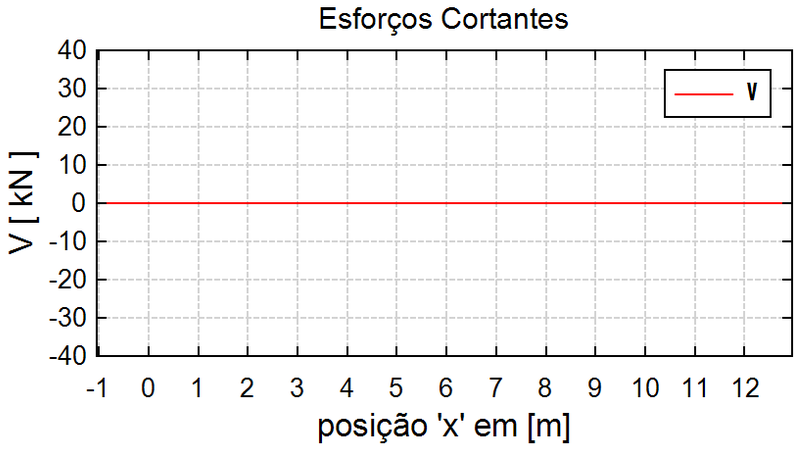
$$V_s(x) = V_{so}(x).cos(\alpha(x)) - H.sen(\alpha(x))$$
$$N_s(x) = -V_{so}(x).sen(\alpha(x)) - H.cos(\alpha(x))$$

$$\alpha(x) = arctg\left(\frac{dy(x)}{dx}\right)$$

$$\alpha(x) := \operatorname{atan}\left(\frac{d}{dx} y(x)\right) = -\operatorname{atan}\left(\frac{-31 + 3 \cdot x}{20}\right)$$

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

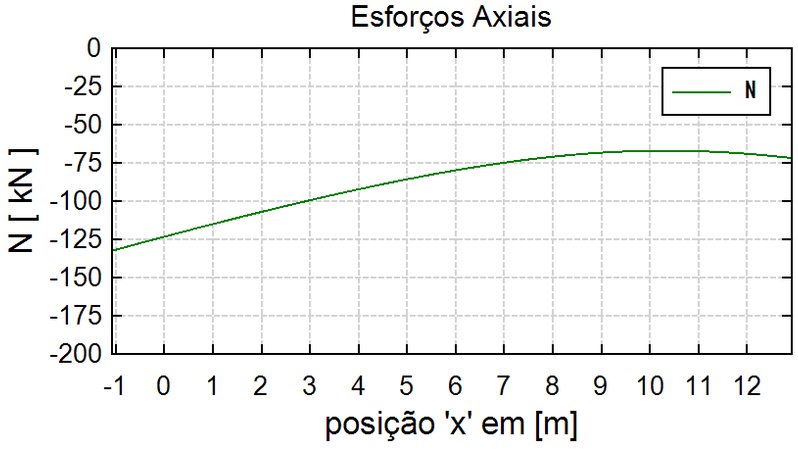
$$V(x) = 0$$



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

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

$$N(x) = -\left(\frac{310}{3} - 10 \cdot x\right) \cdot \sin\left(\operatorname{atan}\left(-\frac{16000 \cdot (-62 + 3 \cdot x + 3 \cdot x)}{640000}\right)\right) - \frac{200}{3} \cdot \cos\left(\operatorname{atan}\left(-\frac{16000 \cdot (-62 + 3 \cdot x + 3 \cdot x)}{640000}\right)\right)$$



* CONCLUSÃO: o arco em questão é uma linha de pressões pois trabalha somente com esforços de compressão (diagramas de momento e cortante são nulos)