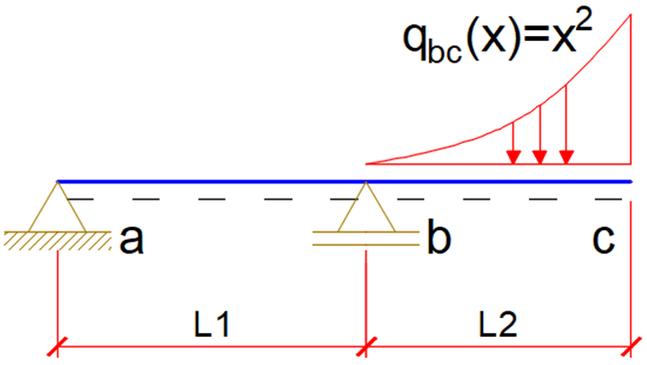
B2T4N0602B

- Calcular a deflexão do ponto "c" do modelo de viga esboçado utilizando o PTV.



$L1 := 7,0 \ \text{m}$

$L2 := 5,0 \ \text{m}$

- Carga qbc(x) pressupõe x = 0 como sendo no ponto "b";

- Seção transversal retangular:

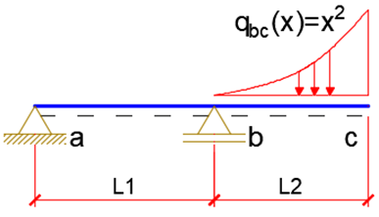
$b := 20 \ \text{cm} \qquad h := 70 \ \text{cm} \qquad \chi := \frac{6}{5}$

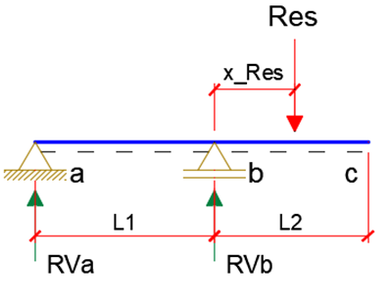
- Módulo de elasticidade e coef. de Poisson:

$E := 20 \ \text{GPa} \qquad \nu := 0,2$

Q01 - Qual o valor da deflexão do ponto "c" devido aos efeitos de esforço cortante [em "mm" e positivo para cima] ?
Q02 - Qual o valor da deflexão do ponto "c" devido aos efeitos de momento fletor [em "mm" e positivo para cima] ?
Q03 - Qual o valor da deflexão do ponto "c" considerando todos os efeitos pertinentes [em "mm" e positivo para cima]?

Reações de Apoio para o Carregamento Real:





Resultante da carga qbc(x):

$$Res := \int_0^{L2} x^2 \, dx = 41,667 \ \text{kN}$$

Posição das resultante da carga qbc(x):

$$x_Res := \frac{1}{Res} \cdot \int_0^{L2} x \cdot x^2 \, dx = 3,75 \ \text{m}$$

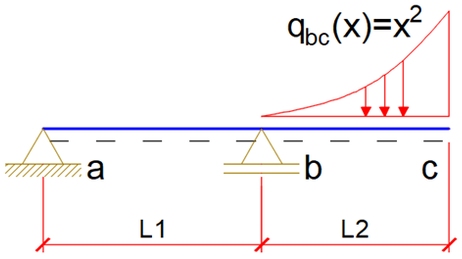
ΣMb = 0 (+) horário

$RVa \cdot L1 + Res \cdot x_Res = 0 \qquad RVa := \frac{1}{L1} \cdot (-Res \cdot x_Res) = -22,321 \ \text{kN}$

ΣFv = 0 (+) para cima

$RVb + RVa - Res = 0 \qquad RVb := -RVa + Res = 63,988 \ \text{kN}$

Equações de Momentos e Cortantes para o Carregamento Real:



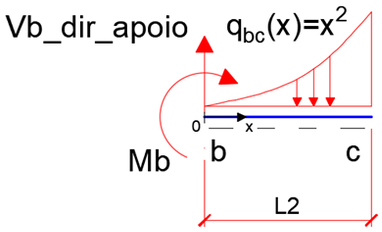
$Mab(x) := RVa \cdot x$

$Mb := Mab(L1) = -156,25 \ \text{kN m}$

$Vab(x) := RVa = -22,321 \ \text{kN}$

$Vb_esq_apoio := Vab(L1) = -22,3214 \ \text{kN}$

$Vb_dir_apoio := Vb_esq_apoio + RVb = 41,6667 \ \text{kN}$



$$Vbc(x) := -\int q_{bc}(x)\,dx$$

$$Vbc(x) := -\frac{x^3}{3} + Vb_dir_apoio$$

$$Vbc(L2) = 9,3685\cdot 10^{-14}$$

$$Mbc(x) := \int Vbc(x)\,dx$$

$$Mbc(x) := -\frac{x^4}{12} + Vb_dir_apoio\cdot x + Mb$$

$$Mbc(L2) = -2,6935\cdot 10^{-13}$$

Reações de Apoio para o Carregamento Virtual:

ΣMb = 0 (+) horário

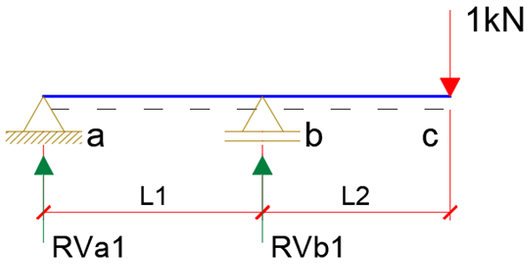
RVa1.L1 + 1.L2 = 0

$$RVa1 := \frac{1}{L1}\cdot(-L2) = -0,7143 \text{ kN}$$

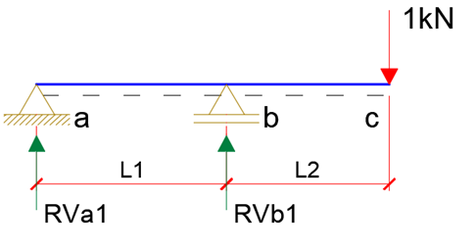
ΣFV = 0 (+) para cima

RVa1 + RVb1 - 1 = 0

$$RVb1 := -RVa1 + 1 = 1,7143 \text{ kN}$$



Equações de Momentos e Cortantes para o Carregamento Virtual:



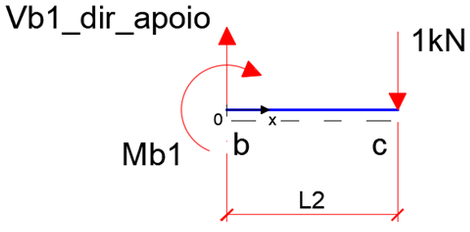
$$Mab1(x) := RVa1\cdot x = -\frac{5\cdot x}{7}$$

$$Mb1 := Mab1(L1) = -5 \text{ kN m}$$

$$Vab1(x) := RVa1 = -\frac{5}{7}$$

$$Vb1_esq_apoio := Vab1(L1) = -\frac{5}{7} \text{ kN}$$

$$Vb1_dir_apoio := Vb1_esq_apoio + RVb1 = 1 \text{ kN}$$



$$Mbc1(x) := Mb1 + Vb1_dir_apoio\cdot x = -5 + x$$

$$Mbc1(L2) = 0$$

$$Vbc1(x) := Vb1_dir_apoio = 1$$

$$Vbc1(L2) = 1$$

Cálculo de Deslocamentos

$$b := \frac{b}{100} = 0,2 \text{ m} \qquad h := \frac{h}{100} = 0,7 \text{ m} \qquad E := E\cdot 10^6 = 2\cdot 10^7 \frac{\text{kN}}{\text{m}^2}$$

$$A := b\cdot h = 0,14 \text{ m}^2 \qquad I := \frac{b\cdot h^3}{12} = 0,0057167 \text{ m}^4 \qquad G := \frac{E}{2\cdot(1+\nu)} = 8,3333\cdot 10^6 \frac{\text{kN}}{\text{m}^2}$$

$$vab := \chi \cdot \int_0^{L1} \frac{Vab1(x) \cdot Vab(x)}{G \cdot A} \, dx = 0,0001148$$

$$vbc := \chi \cdot \int_0^{L2} \frac{Vbc1(x) \cdot Vbc(x)}{G \cdot A} \, dx = 0,0002$$

$$\delta v := (-1000) \cdot (vab + vbc) = -0,27551 \text{ mm}$$

$$mab := \int_0^{L1} \frac{Mab1(x) \cdot Mab(x)}{E \cdot I} \, dx = 0,0159$$

$$mbc := \int_0^{L2} \frac{Mbc1(x) \cdot Mbc(x)}{E \cdot I} \, dx = 0,0099$$

$$\delta m := (-1000) \cdot (mab + mbc) = -25,814 \text{ mm}$$

$$\delta total := \delta v + \delta m = -26,089 \text{ mm}$$

$$Q01 := \delta v = -0,27551$$
$$Q02 := \delta m = -25,814$$
$$Q03 := \delta total = -26,0894$$
