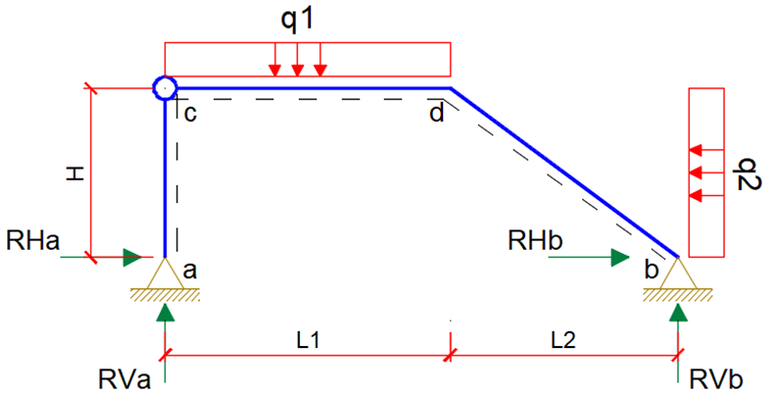
B2T4MA0608A

- Considerando somente os efeitos de momentos fletores calcular o deslocamento vertical e a rotação do ponto "d".



$L1 := 5,0$ m $\quad q1 := 20,0$ kN/m

$L2 := 4,0$ m $\quad q2 := 7,0$ kN/m

$H := 3,0$ m

- Todas as barras tem seção transversal retangular com dimensões:

$b := 0,15$ m base (entrante no plano do papel)

$h := 0,45$ m altura (assente ao plano do papel)

- Módulo de elasticidade e coef. de Poisson para todas as barras:

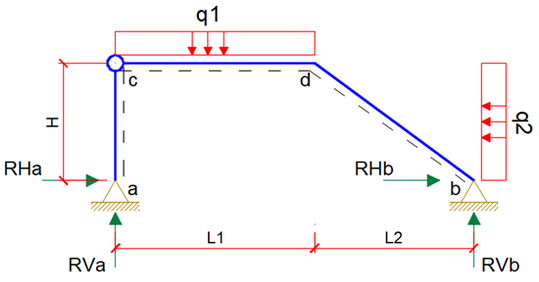
$E := 30 \cdot 10^{6}$ kN/m² $\quad \nu := 0,2$

Q01 - Qual o valor do deslocamento vertical do ponto "d" [em "mm" e positivo para cima] ?

Q02 - Qual o valor da rotação do ponto "d" [em "rad" e positivo para antihorário] ?

Carregamento Real

$G := \frac{E}{2 \cdot (1 + \nu)} = 1,25 \cdot 10^{7}$ $\quad A := b \cdot h = 0,0675$ $\quad I := \frac{b \cdot h^{3}}{12} = 0,001139$ $\quad \chi := \frac{6}{5}$



Reações de Apoio:

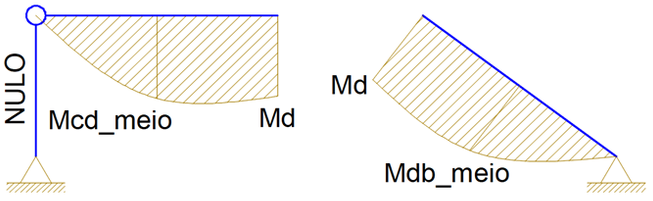
$RHa := 0$

$RHb := q2 \cdot H = 21$

$RVb := \frac{1}{(L1 + L2)} \cdot \left(-RHb \cdot H + \frac{q1 \cdot L1^{2}}{2} + \frac{q2 \cdot H^{2}}{2} \right) = 24,278$

$RVa := q1 \cdot L1 - RVb = 75,722$

Diagrama e Momentos Fletores do Carregamento Real



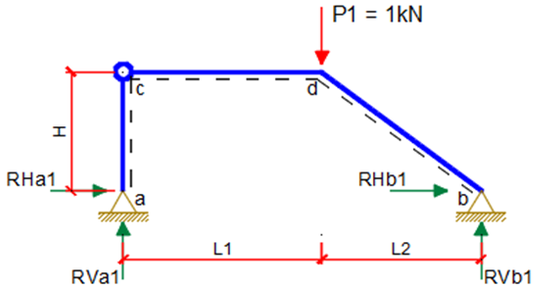
$Mcd_meio := RVa \cdot \frac{L1}{2} - \frac{q1 \cdot \left(\frac{L1}{2}\right)^{2}}{2} = 126,81$

$Md := RVa \cdot L1 - \frac{q1 \cdot L1^{2}}{2} = 128,61$

$Md := RVb \cdot L2 + RHb \cdot H - \frac{q2 \cdot H^{2}}{2} = 128,61$

$Mdb_meio := RVb \cdot \frac{L2}{2} + RHb \cdot \frac{H}{2} - \frac{q2 \cdot \left(\frac{H}{2}\right)^{2}}{2} = 72,181$

Carregamento Virtual para cálculo do deslocamento de translação vertical em "d":

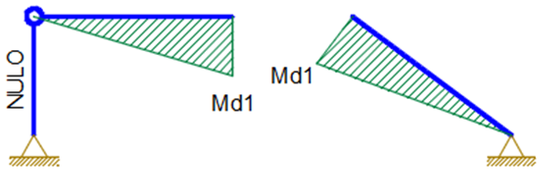


Reações de Apoio: $P1 := 1$

$RHa1 := 0$ $RHb1 := 0$

$RVb1 := \frac{1}{(L1 + L2)} \cdot P1 \cdot L1 = 0,55556$

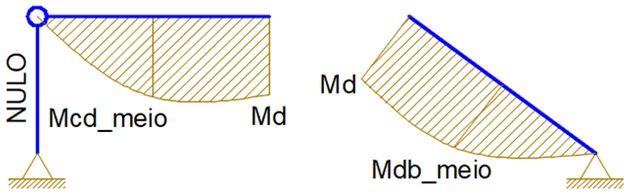
$RVa1 := P1 - RVb1 = 0,44444$

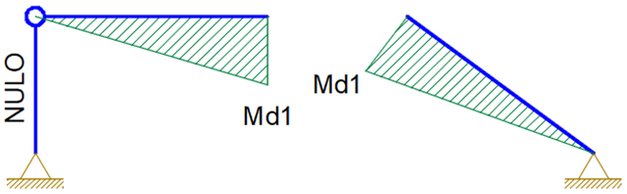


$Md1 := RVa1 \cdot L1 = 2,2222$

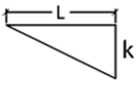
$Md1 := RVb1 \cdot L2 = 2,2222$

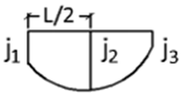
Cálculo do deslocamento vertical no ponto "d":





Barra "cd":



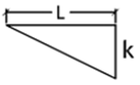


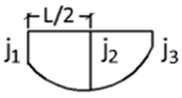
1/6 Lk(2j2+j3)

$k := Md1 = 2,222$ $j3 := Md = 128,6$ $j2 := Mcd_meio = 126,8$

$mcd1 := \frac{1}{6} \cdot L1 \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{E \cdot I} = 0,02071$

Barra "db":





1/6 Lk(2j2+j3)

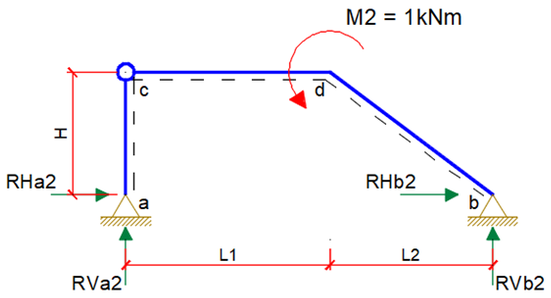
$k := Md1 = 2,222$ $j3 := Md = 128,6$ $j2 := Mdb_meio = 72,18$

$Ldb := \sqrt{H^2 + L2^2} = 5$

$mdb1 := \frac{1}{6} \cdot Ldb \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{E \cdot I} = 0,0148$

$\delta_vert_c := -1000 \cdot (mcd1 + mdb1) = -35,506$

Carregamento Virtual para cálculo do deslocamento de rotação em "d":

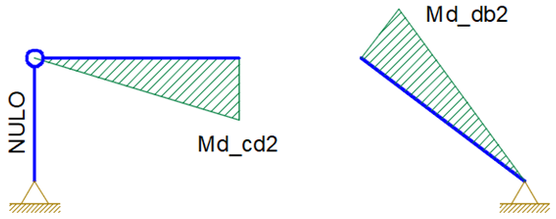


Reações de Apoio: $M2 := 1$

$RHa1 := 0$ $RHb1 := 0$

$RVb2 := \frac{1}{(L1 + L2)} \cdot (-M2) = -0,1111$

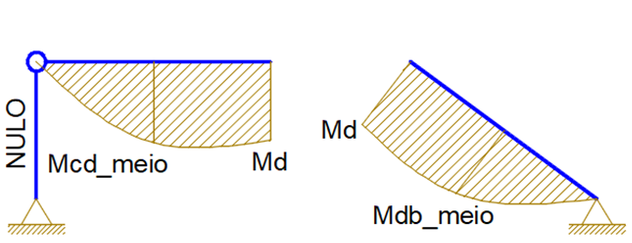
$RVa2 := -RVb2 = 0,1111$

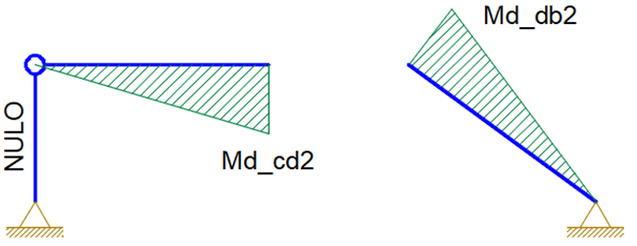


$Md_cd2 := RVa2 \cdot L1 = 0,5556$

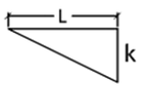
$Md_db2 := RVb2 \cdot L2 = -0,4444$

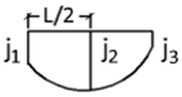
Cálulo da Rotação em "d":





Barra "cd":



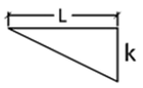


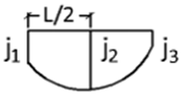
1/6 Lk(2j₂+j₃)

$k := Md_cd2 = 0,5556$ $j3 := Md = 128,6$ $j2 := Mcd_meio = 126,8$

$mcd2 := \frac{1}{6} \cdot L1 \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{E \cdot I} = 0,005178$

Barra "db":





1/6 Lk(2j₂+j₃)

$k := Md_db2 = -0,4444$ $j3 := Md = 128,6$ $j2 := Mdb_meio = 72,18$

$mdb2 := \frac{1}{6} \cdot L1 \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{E \cdot I} = -0,002959$

$\varphi_rot_c := mcd2 + mdb2 = 0,002220$

$Q01 := \delta_vert_c = -35,506$
$Q02 := \varphi_rot_c = 0,0022198$