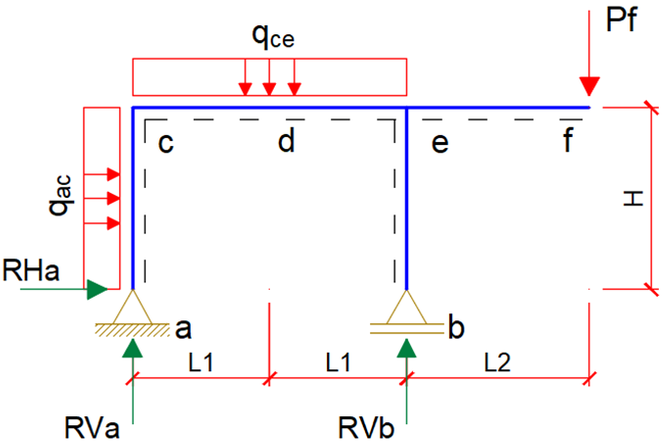
TE1_E09-02

- Considerando somente efeitos de momentos fletores, calcular o deslocamento horizontal do ponto “c” e a deflexão do ponto “f”.



Dados:

Vigas - Seção Transversal Retangular :

$b_viga := 15\ cm$ $h_viga := 60\ cm$

Pilares - Seção Transversal Retangular :

$b_pilar := 15\ cm$ $h_pilar := 30\ cm$

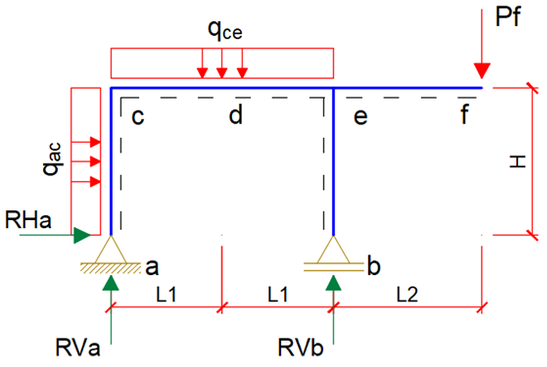
$E := 20000\ MPa$

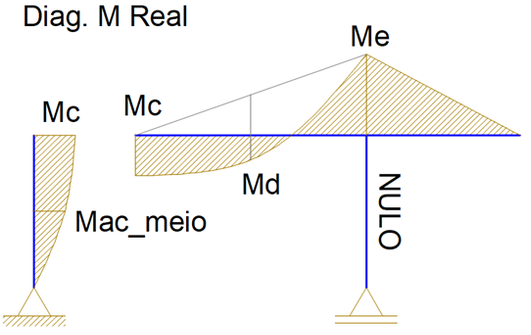
$L1 := 3,0\ m$ $qac := 10,0\ kN/m$

$L2 := 4,0\ m$ $qce := 30,0\ kN/m$

$H := 4,0\ m$ $Pf := 40,0\ kN$

Diagrama de Momentos Fletores do Carregamento Real:



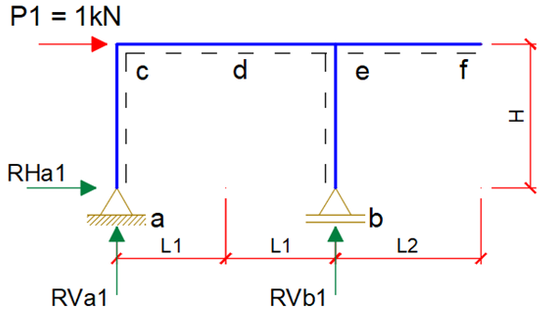


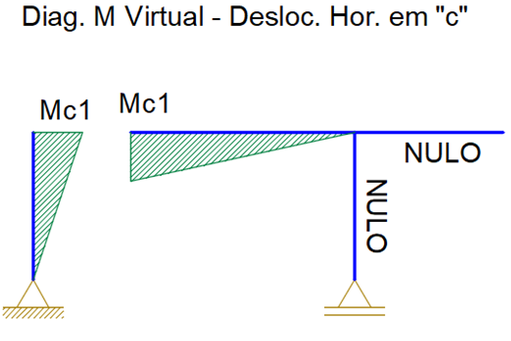
$Me := -Pf \cdot L2 = -160$ $RHa := -qac \cdot H = -40$

$Mc := -RHa \cdot H - qac \cdot H \cdot \frac{H}{2} = 80$ $Mac_meio := -RHa \cdot \frac{H}{2} - qac \cdot \frac{H}{2} \cdot \frac{H}{4} = 60$

$Md := \frac{Mc + Me}{2} + \frac{qce \cdot (L1 + L1)^2}{8} = 95$

Diagrama de Momentos Fletores do Carregamento Virtual Relativo ao Deslocamento Horizontal do Ponto "c":

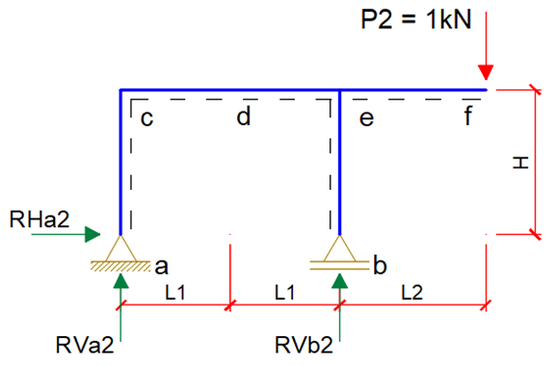


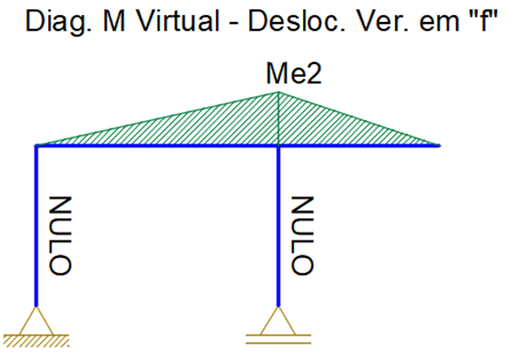


$RHa1 := -1$

$Mc1 := -RHa1 \cdot H = 4$

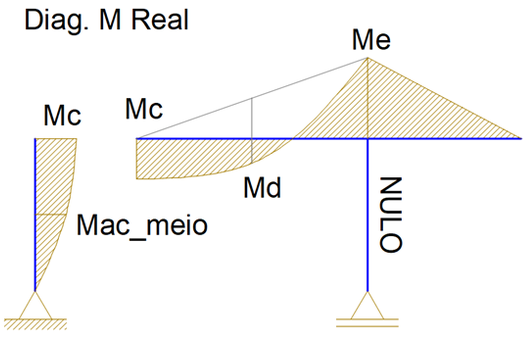
Diagrama de Momentos Fletores do Carregamento Virtual Relativo à Deflexão do Ponto "f":

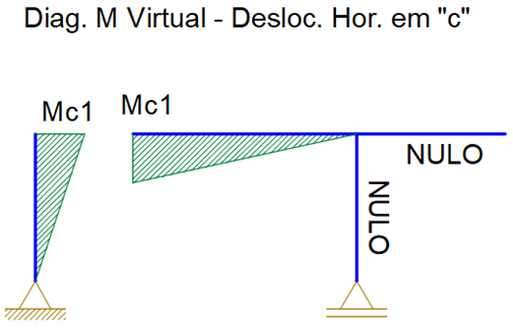




$RHa2 := 0$ $Me2 := -1 \cdot L2 = -4$

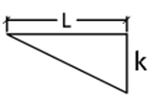
Cálculo do Deslocamento Horizontal do Ponto "c" :

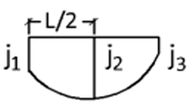




* as barras "ef" e "eb" apresentam pelo menos um dos dois diagramas nulos, logo, não participam do referido deslocamento do ponto.

Barra "ac":





1/6 Lk(2j₂+j₃)

* j3 é sempre o valor do momento fletor no diagrama parabólico de 2° grau que está para o mesmo lado do momento "k" no diagrama triangular.

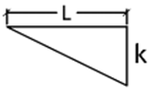
$k := Mc1 = 4$ $L := H = 4$

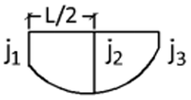
$j2 := Mac_meio = 60$ $j3 := Mc = 80$

$$EI_pilar := \frac{E \cdot b_pilar \cdot h_pilar^{3}}{12} \cdot \frac{1}{kN\ m^{2}} = 6750$$

$$mac1 := \frac{1}{6} \cdot L \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{EI_pilar} = 0,079012\ m$$

Barra "cde":





1/6 Lk(2j₂+j₃)

$k := Mc1 = 4$ $L := 2 \cdot L1 = 6$

$j2 := Md = 95$ $j3 := Mc = 80$

$$EI_viga := \frac{E \cdot b_viga \cdot h_viga^{3}}{12} \cdot \frac{1}{kN\ m^{2}} = 54000$$

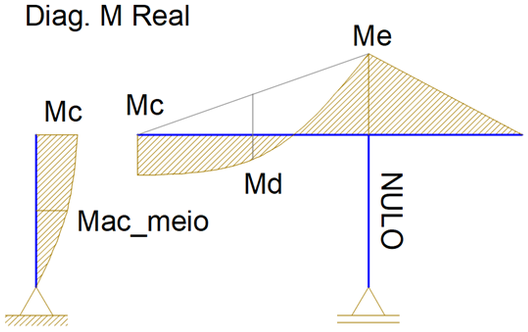
$$mcde1 := \frac{1}{6} \cdot L \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{EI_viga} = 0,02\ m$$

$\delta_hor_c := 1000 \cdot (mac1 + mcde1) = 99,012$ mm para direita

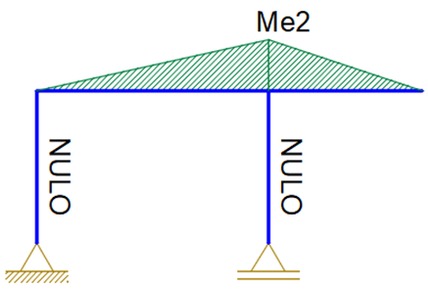
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Cálculo do Deslocamento Vertical do Ponto "f":

Diag. M Real

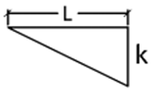


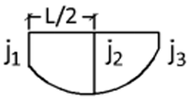
Diag. M Virtual - Desloc. Ver. em "f"



* as barras "ac" e "eb" apresentam pelo menos um dos dois diagramas nulos, logo, não participam do referido deslocamento do ponto.

Barra "cde":





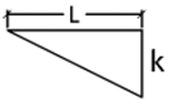
1/6 Lk(2j2+j3)

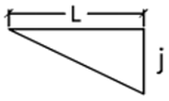
$k := Me2 = -4$ $L := 2 \cdot L1 = 6$

$j2 := Md = 95$ $j3 := Me = -160$

$mcde2 := \frac{1}{6} \cdot L \cdot k \cdot (2 \cdot j2 + j3) \cdot \frac{1}{EI_viga} = -0,0022$ m

Barra "ef":





1/3 Ljk

$k := Me2$ $j := Me$

$L := L2 = 4$

$mef2 := \frac{1}{3} \cdot L \cdot j \cdot k \cdot \frac{1}{EI_viga} = 0,0158$ m

$\delta_ver_f := 1000 \cdot (mcde2 + mef2) = 13,5802$ mm para baixo

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