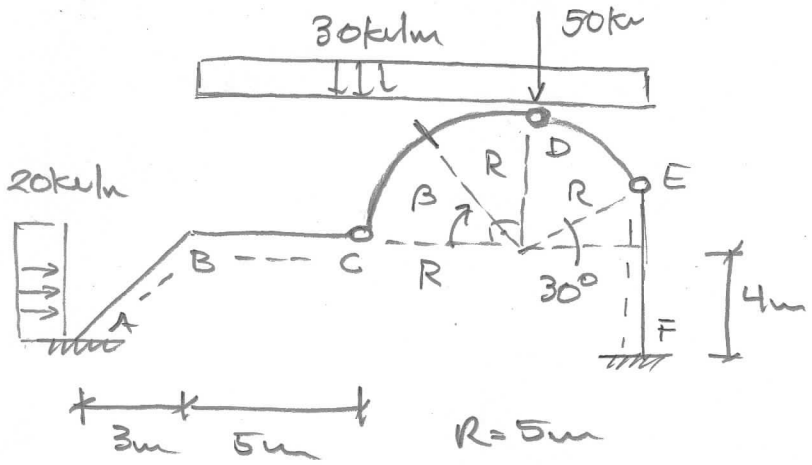
B2 T4 MA 0617 0,8 PONTOS



P/ TODAS AS BARRAS:

$E = 30GPa$ $b = 25cm$

$h = 80cm$

Q01) $M_\beta = 30°$ Q07) M_{AB} MEIO

Q02) $M_\beta = 120°$ Q08) δ_C

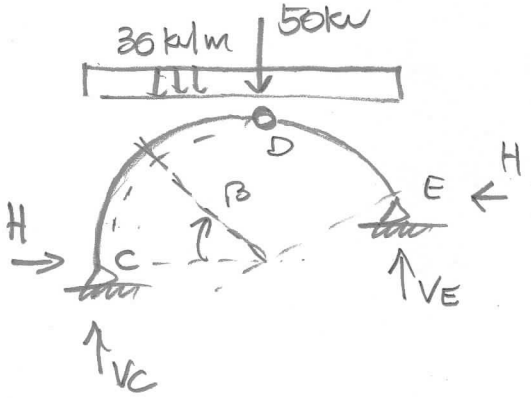
Q03) $V_\beta = 30°$

Q04) $V_\beta = 120°$

Q05) $N_\beta = 30°$

Q06) $N_\beta = 120°$

- Reações de Apoio no Arco:



$\Sigma M_E = 0$ ↻+

$V_C \times (R + R\cos 30°) - H R \operatorname{sen} 30°$

$- 50 R\cos 30° - 30 (R + R\cos 30°)^2/2 = 0$

$\Sigma M_D = 0$ ↻+

$V_C \times R - H \times R - 30 R^2/2 = 0$

$$\begin{cases} 9{,}3301\, V_C - 2{,}5H = 1522{,}3 \\ 5V_C - 5H = 375 \end{cases}$$

$V_C = 195{,}42$ kN ↑

$H = 120{,}42$ kN →

$\Sigma F_V = 0$ ↑+ $V_E - 30(5 + 5\cos 30°) - 50 + 195{,}42 = 0$

$V_E = 30(5 + 5\cos 30°) + 50 - 195{,}42 = 134{,}48$ kN ↑

- Equacionamento de Momentos no Arco

TRECHO CD: $M^{CD}(\beta) = V_C (R - R\cos\beta) - H R \operatorname{sen}\beta$

$- q (R - R\cos\beta)^2/2$

$$M^{CD}_{(\beta)} = 195{,}42(5-5\cos\beta) - 120{,}42 \cdot 5 \cdot \operatorname{sen}\beta - 30\,(5-5\cos\beta)^2/2$$

$$M^{CD}_{(\beta)} = -375\cos^2\beta - 227{,}1\cos\beta - 602{,}1\operatorname{sen}\beta + 602{,}1$$

$M_{\beta=30^\circ} = -176{,}87$ kNm // Q01

TRECHO DE: $M^{DE}_{(\beta)} = M^{CD}_{(\beta)} - P(R - R\cos\beta - R)$

$$M^{DE}_{(\beta)} = -375\cos^2\beta - 227{,}1\cos\beta - 602{,}1\operatorname{sen}\beta + 602{,}1 + 50{,}5\cos\beta$$

$$M^{DE}_{(\beta)} = -375\cos^2\beta + 22{,}9\cos\beta - 602{,}1\operatorname{sen}\beta + 602{,}1$$

$M_{\beta=120^\circ} = -24{,}533$ kNm // Q02

- Equacionamento de cortantes e Axiais

$$\Sigma VER_{CD} = V_C - q(R - R\cos\beta) = 150\cos\beta + 45{,}42$$

$$\Sigma VER_{DE} = V_C - q(R - R\cos\beta) - P = 150\cos\beta - 4{,}58$$

$$\Sigma HOR_{CD} = \Sigma HOR_{DE} = H = 120{,}42\text{ kN}$$

$$V^{CD}_{(\beta)} = (150\cos\beta + 45{,}42)\cos(90^\circ - \beta) - 120{,}42\operatorname{sen}(90^\circ - \beta)$$

$V_{\beta=30^\circ} = -16{,}625$ kN // Q03

$$V^{DE}_{(\beta)} = (150\cos\beta - 4{,}58)\cos(90^\circ - \beta) - 120{,}42\operatorname{sen}(90^\circ - \beta)$$

$V_{\beta=120^\circ} = -8{,}7083$ kN // Q04

$$N^{CD}_{(\beta)} = -(150\cos\beta + 45{,}42)\,\text{sen}(90^\circ-\beta) - 120{,}42\cos(90^\circ-\beta)$$

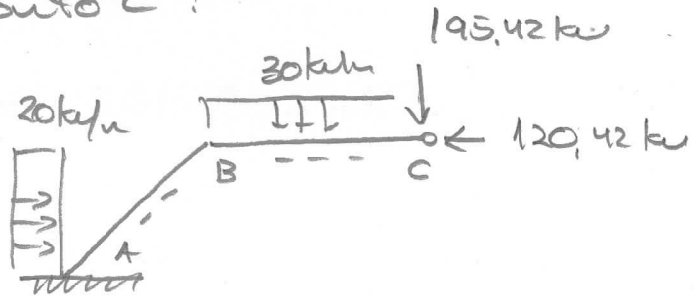
$$N_{\beta=30^\circ} = -212{,}05\ \text{kN}$$

$$N^{DE}_{(\beta)} = -(150\cos\beta - 4{,}58)\,\text{sen}(90^\circ-\beta) - 120{,}42\cos(90^\circ-\beta)$$

$$N_{\beta=120^\circ} = -144{,}08\ \text{kN}$$

• Deflexão do ponto C:

Carreg. Real:

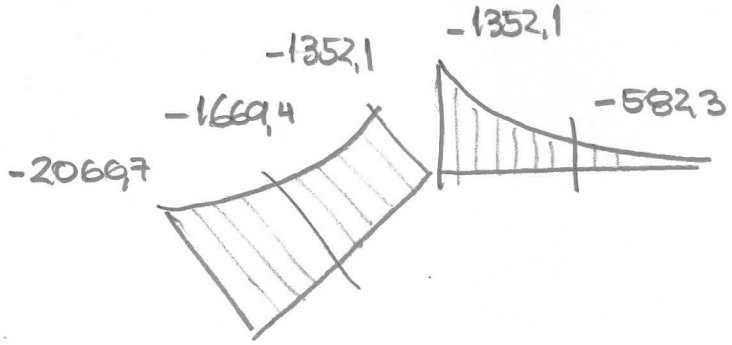


$$M_{CB} = -30\times\frac{5^2}{2} - 195{,}42\times 5 = -1352{,}1\ \text{kNm}$$

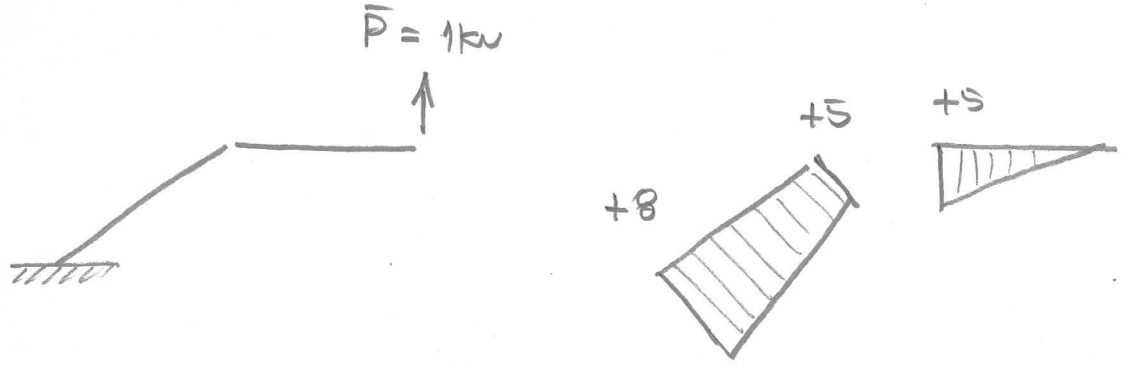
$$M^{MEIO}_{CB} = -30\times\frac{2{,}5^2}{2} - 195{,}42\times 2{,}5 = -582{,}3\ \text{kNm}$$

$$M_A = -20\times\frac{4^2}{2} - 30\times 5\times 5{,}5 - 195{,}42\times 8 + 120{,}42\times 4 = -2066{,}7\ \text{kNm}$$

$$M^{MEIO}_{AB} = -20\times\frac{2^2}{2} - 30\times 5\times 4 - 195{,}42\times 6{,}5 + 120{,}42\times 2 = -1669{,}4\ \text{kNm}$$



Carreg. Virtual:



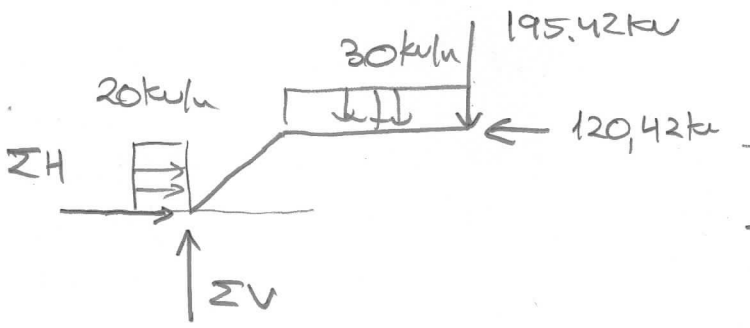
$$\delta c = \frac{1}{EI}\left(\frac{1}{6}\,5\times5\,(2\times(-583{,}3)-1352{,}1) + \frac{1}{6}\,5\left[(-20697)\times8 + 2(-1669{,}4)(+8+5) + (-1352{,}1)\times5\right]\right)$$

$$\delta c = \frac{1}{EI}(-66068) = \frac{-66068}{320000} = -0{,}20646 = \underline{-206{,}46\,mm}$$

Q08

$$EI = 30\times10^{6}\times 0{,}25\times980^{3}/12 = 320000$$

Axial no meio da Barra AB:

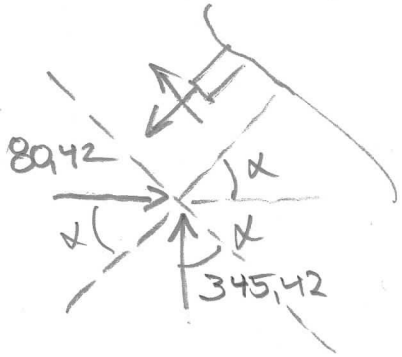


$$\Sigma H + 20\times2 - 120{,}42 = 0$$

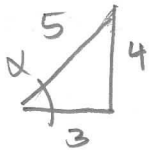
$$\Sigma H = 80{,}42\,kN \rightarrow$$

$$\Sigma V - 30\times5 - 195{,}42 = 0$$

$$\Sigma V = 345{,}42\,kN \uparrow$$



$$N_{AB}^{MEIO} = -80{,}42\cos\alpha - 345{,}42\,\mathrm{sen}\,\alpha$$



$$\cos\alpha = 3/5 \quad \mathrm{sen}\,\alpha = 4/5$$

Q07

$$N_{AB}^{MEIO} = -80{,}42\times3/5 - 345{,}42\times4/5 = \boxed{-324{,}59\,kN}$$