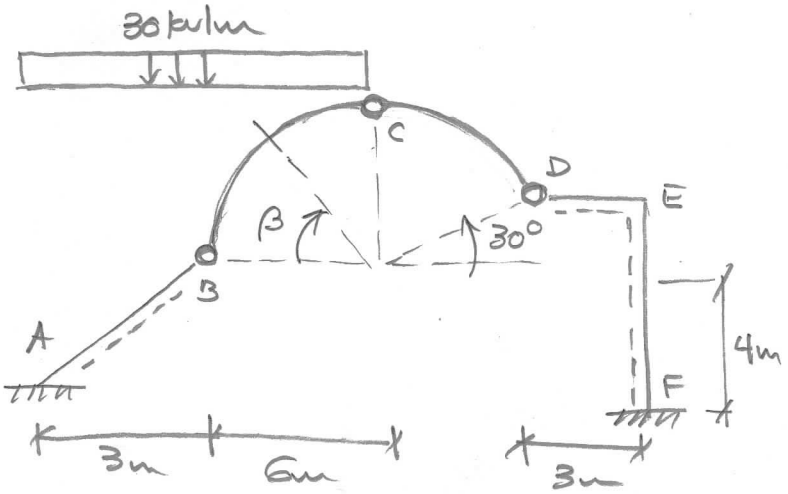
B2T4NA0614 | 0,8 PONTOS



→ ARCO CIRCULAR $\overline{BCD}$

→ Para todas as barras:

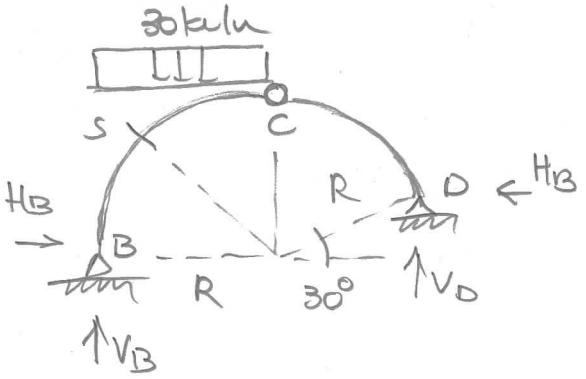
$E = 30\,GPa$

$b = 20\,cm \quad h = 70\,cm$

PEDE-SE: Q01) $V_{\overline{AB}}$ MEIO Q02) δ_D Q03) $M_{\beta=30°}$ Q04) $M_{\beta=120°}$

Q05) $V_{\beta=30°}$ Q06) $V_{\beta=120°}$ Q07) $N_{\beta=30°}$ Q08) $N_{\beta=120°}$

• REAÇÕES DE APOIO DO ARCO:



$\Sigma M_D = 0 \quad \circlearrowleft +$

$V_B \times (R + R\cos 30°) - H_B R \operatorname{sen} 30° - 30R \times (R/2 + R\cos 30°) = 0$

$\Sigma M_C = 0 \quad \circlearrowleft +$

$V_B \times R - H_B \times R - 30 \times R^2/2 = 0$

$$\begin{cases} 11{,}196 V_B - 3 H_B = 1475{,}3 \\ 6 V_B - 6 H_B = 540 \end{cases}$$

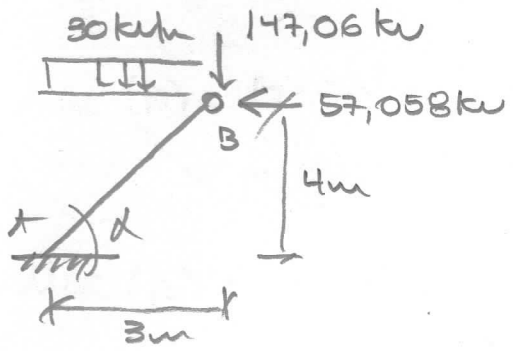
$V_D = \underline{147{,}06\ kN \uparrow}$

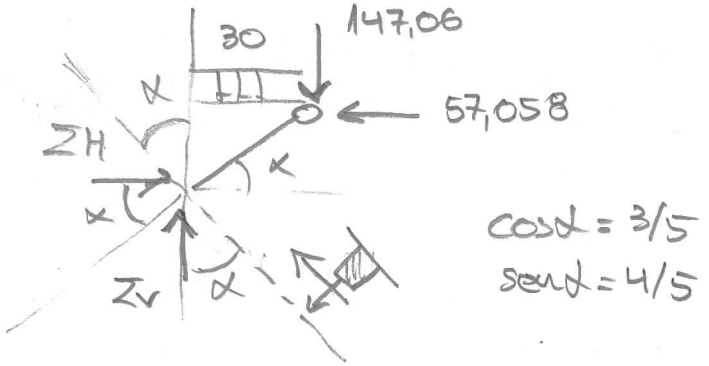
$H_B = \underline{57{,}058\ kN \rightarrow}$

$\Sigma F_V = 0 \uparrow \quad V_D - 30 \times R + 147{,}06 = 0$

$V_D = 30 \times 6 - 147{,}06 = \underline{32{,}94\ kN \uparrow}$

- Barra AB





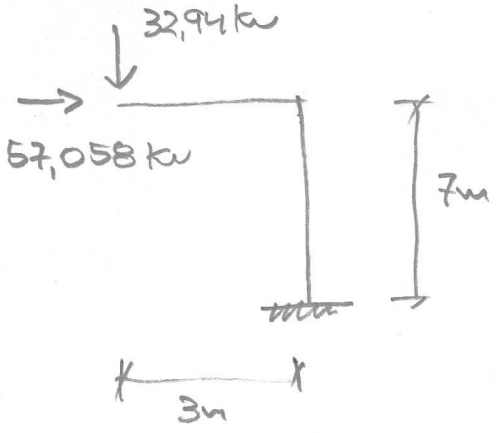
$\Sigma H = 57,058\ kN$

$\Sigma V = 30 \times 1,5 + 147,06 = 192,06\ kN$

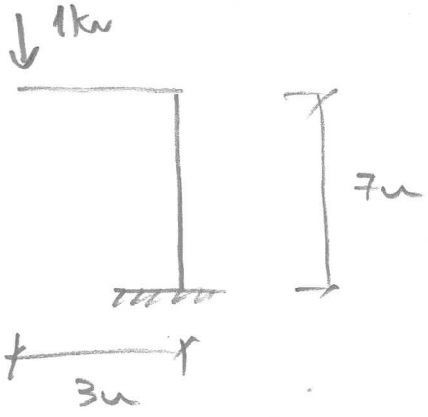
$V_{AB\ MEIO} = +192,06 \times 3/5 - 57,058 \times 4/5 = +169,590\ kN$ // (Q01)

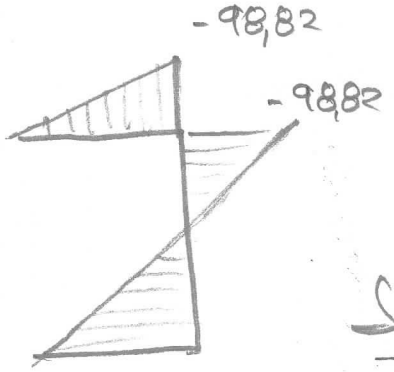
- Desloc. do Ponto D $\quad EI = 30\times10^6 \times 0,2 \times 0,7^3/_{12} = 171500\ kN.m^2$

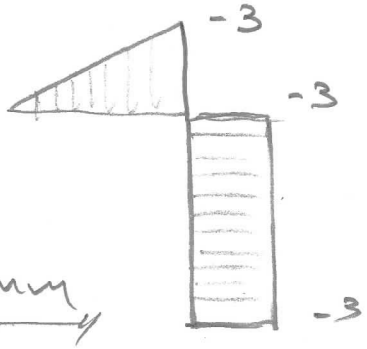
CARREG. REAL



CARREG. VIRTUAL







(Q02)

$\delta_D = +10,624\ mm$ //

* CONTRÁRIO AO CARREG. VIRT.

$$\delta_D = \frac{1}{EI}\left(\frac{1}{3} \times 3 \times (-98,82)(-3) + \frac{1}{2}\,7\,(-3)(-98,82 + 300,59)\right) = \frac{-1822,1}{171500}$$

$$M_{BC}(\beta) = V_B (R - R\cos\beta) - H_B R\,\mathrm{sen}\,\beta - q\,(R - R\cos\beta)^2/2$$

$$M_{BC}(\beta) = 147{,}06(6 - 6\cos\beta) - 57{,}058 \times 6\,\mathrm{sen}\,\beta - 30(6 - 6\cos\beta)^2/2$$

$$M_{BC}(\beta) = 197{,}64\cos\beta - 342{,}35\,\mathrm{sen}\,\beta - 540\cos^2\beta + 342{,}36$$

$$M_{\beta=30^\circ} = -62{,}654\ \text{kN.m} \quad (Q03)$$

$$M_{CD}(\beta) = V_B(R - R\cos\beta) - H_B R\,\mathrm{sen}\,\beta - qR(R - R\cos\beta - R/2)$$

$$M_{CD}(\beta) = 147{,}06(6 - 6\cos\beta) - 57{,}058 \times 6\,\mathrm{sen}\,\beta - 30 \times 6(6/2 - 6\cos\beta)$$

$$M_{CD}(\beta) = 197{,}64\cos\beta - 342{,}35\,\mathrm{sen}\,\beta + 342{,}36$$

$$M_{\beta=120^\circ} = -52{,}944\ \text{kN.m} \quad (Q04)$$

$$V_{BC}(\beta) = \Sigma VER\cos(90^\circ - \beta) - \Sigma HOR.\,\mathrm{sen}(90^\circ - \beta)$$

$$\Sigma VER = V_B - q(R - R\cos\beta)$$

$$\Sigma HOR = H_B$$

$$V_{BC}(\beta) = \left[V_B - q(R - R\cos\beta)\right]\cos(90^\circ - \beta) - H_B\,\mathrm{sen}\,(90^\circ - \beta)$$

$$V_{BC}(\beta) = \left[147{,}06 - 30(6 - 6\cos\beta)\right]\cos(90^\circ - \beta) - 57{,}058\,\mathrm{sen}\,(90^\circ - \beta)$$

$$V_{\beta=30^\circ} = +12{,}059\ \text{kN} \quad (Q05)$$

$$V_{CD}(\beta) = \Sigma VER \cos(90^\circ - \beta) - \Sigma HOR \operatorname{sen}(90^\circ - \beta)$$

$$\Sigma VER = V_B - q(R - R\cos 90^\circ) = V_B - qR$$

$$\Sigma HOR = H_B$$

$$V_{CD}(\beta) = [147{,}06 - 30 \times 6]\cos(90^\circ - \beta) - 57{,}058 \operatorname{sen}(90^\circ - \beta)$$

$$V_{\beta = 120^\circ} = 0 \quad (Q06)$$

$$N_{BC}(\beta) = -\Sigma VER \operatorname{sen}(90^\circ - \beta) - \Sigma HOR \cos(90^\circ - \beta)$$

$$N_{BC}(\beta) = -[147{,}06 - 30(6 - 6\cos\beta)]\operatorname{sen}(90^\circ - \beta) - 57{,}058 \cos(90^\circ - \beta)$$

$$N_{\beta = 30^\circ} = -135{,}00 kN \quad (Q07)$$

$$N_{CD}(\beta) = -[147{,}06 - 30 \times 6]\operatorname{sen}(90^\circ - \beta) - 57{,}058 \cos(90^\circ - \beta)$$

$$N_{\beta = 120^\circ} = -65{,}884 kN \quad (Q08)$$