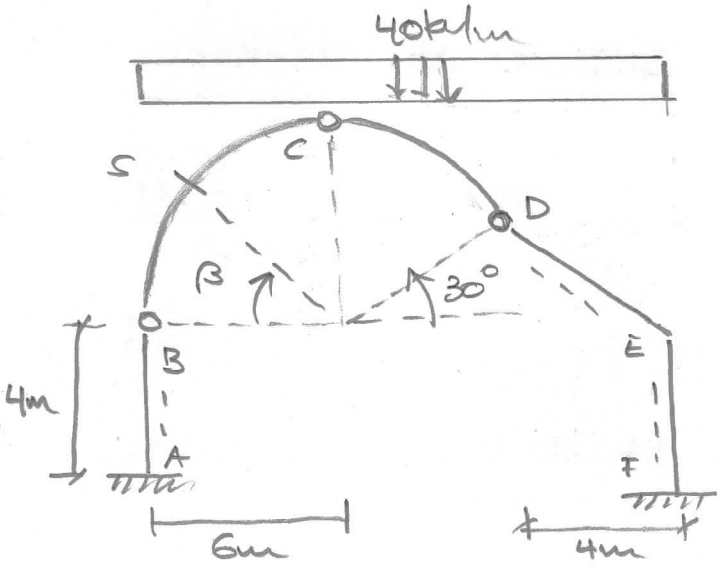
B2T4 NB 0613



- Arco Circular em BCD
- $E = 30\,GPa$ $\begin{cases} b = 20\,cm \\ h = 45\,cm \end{cases}$

em $\bar{AB}$, $\bar{DE}$ e $\bar{EF}$

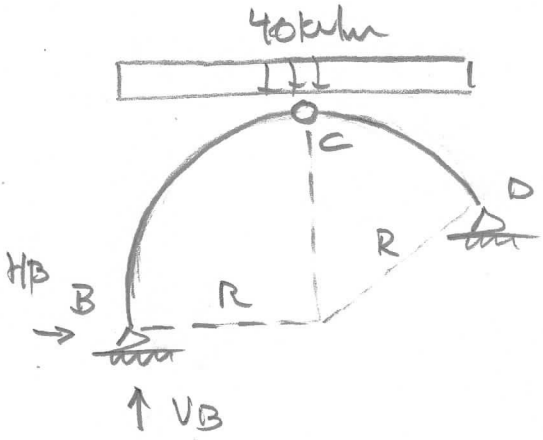
Q01) M_S $\beta = 30°$ Q05) N_S $\beta = 30°$

Q02) M_S $\beta = 120°$ Q06) N_S $\beta = 120°$

Q03) V_S $\beta = 30°$ Q07) M_E

Q04) V_S $\beta = 120°$ Q08) δ_D

* Reações de Apoio do Arco BCD



$\Sigma M_D = 0$ ↻ (+)

$V_B \times (R + R\cos 30°) - H_B \times R \operatorname{sen} 30° - 40 \times (R + R\cos 30°)^2/2 = 0$

$\Sigma M_C^{\rightarrow +} = 0$ ↻ (+)

$V_B \times R - H_B \times R - 40 \times R^2/2 = 0$

P/ R = 6

$$\begin{cases} 11{,}196\,V_B - 3\,H_B = 2507{,}1 \\ 6\,V_B - 6\,H_B = 720 \end{cases}$$

$V_B = 261{,}96\,kN$ ↑

$H_B = 141{,}96\,kN$ →

$\Sigma F_V = 0$ ↑ (+) $V_D + 261{,}96 - 40\,(R + R\cos 30°) = 0$

$V_D = 185{,}89\,kN$

$\Sigma F_H = 0$ → (+) $H_D = -141{,}96\,kN$ ←

* ESFORÇOS NO ARCO

$$M_S(\beta) = 261,96 \times (R - R\cos\beta) - 141,96\, R \operatorname{sen}\beta - \frac{40}{2}(R - R\cos\beta)^2$$

$$M_S(\beta) = -851,76 \operatorname{sen}\beta - 131,76\cos\beta - 720\cos^2\beta + 851,77$$

$M_S(\beta = 30°) = -228,23$ kNm // Q01

$M_S(\beta = 120°) = -0,00579 \rightsquigarrow$ ZERO kNm // Q02

$$V_S(\beta) = \Sigma VER \cdot \cos(90° - \beta) - \Sigma HOR \operatorname{sen}(90° - \beta)$$

$$V_S(\beta) = [261,91 - 40(R - R\cos\beta)] \times \cos(90° - \beta) - [141,96] \operatorname{sen}(90° - \beta)$$

$V_S(\beta = 30°) = -8,0629$ kN // Q03

$V_S(\beta = 120°) = -13,968$ kN // Q04

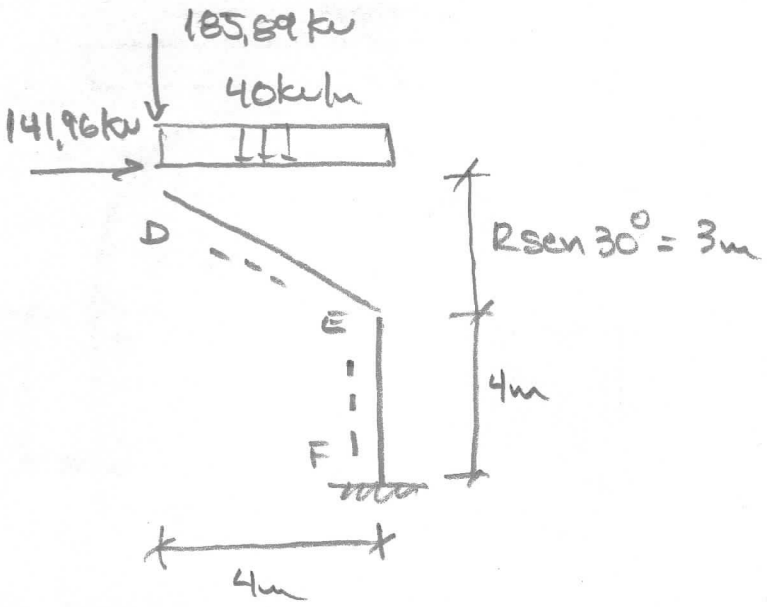
$$N_S(\beta) = -\Sigma VER \cdot \operatorname{sen}(90° - \beta) - \Sigma HOR \cos(90° - \beta)$$

$$N_S(\beta) = -[261,91 - 40(R - R\cos\beta)] \times \operatorname{sen}(90° - \beta) - [141,96] \cos(90° - \beta)$$

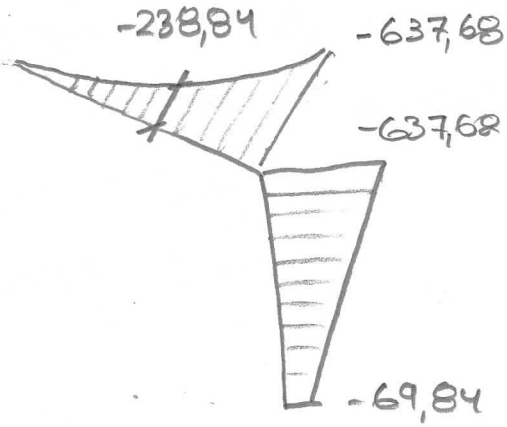
$N_S(\beta = 30°) = -269,95$ kN // Q05

$N_S(\beta = 120°) = -171,99$ kN // Q06

* TRECHO DEF



MREAL



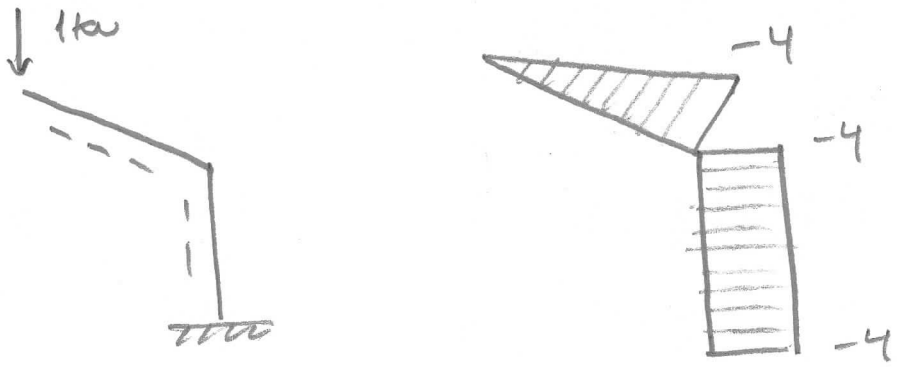
MREAL

$M_E = -185,89 \times 4 - 40 \times 4^2/2 + 141,96 \times 3 = \boxed{-637,68 \text{ kNm}}$ Q07

$M_F = -185,89 \times 4 - 40 \times 4^2/2 + 141,96 \times 7 = -69,84 \text{ kNm}$

$M_{DEMEIO} = -185,89 \times 2 - 40 \times 2^2/2 + 141,96 \times 1,5 = -238,84 \text{ kNm}$

MVIRTUAL



$$\delta_E = \frac{1}{EI}\left[1/6\ 5 \cdot (-4)(2(-238,84) - 637,68) + 1/2\ 4(-4)(-637,68 - 69,84) \right] = \frac{1}{EI}\ 9378,0$$

$EI = 30 \times 10^6 \text{ kN/m}^2 \times 0,2\text{m} \times (0,8\text{m})^3/12 = 256000 \text{ cm}^4$

$\delta_E = -9378/256000 = \underline{-36,633 \text{ mm}}$ Q08