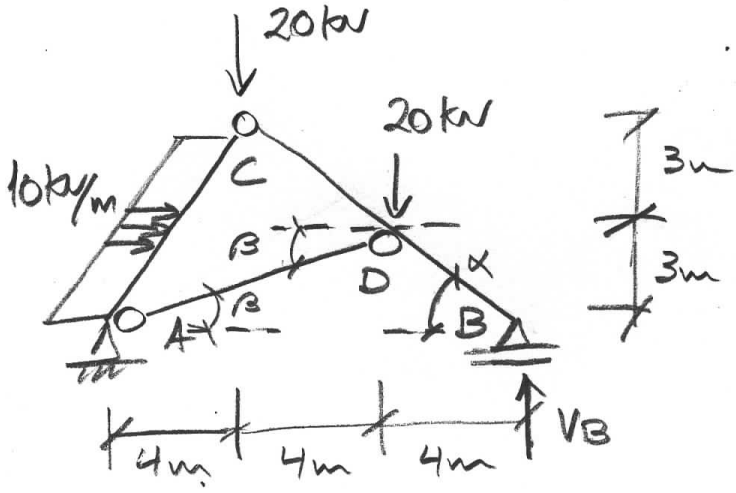
TE15 – B2 – 1000



PEDE-SE:

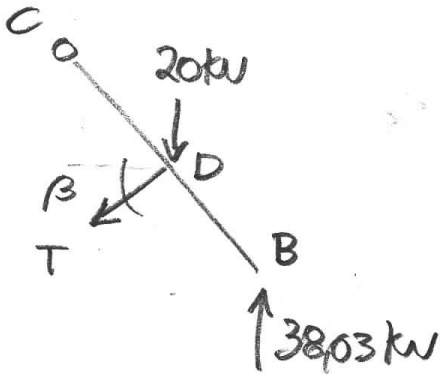
* ESFORÇO AXIAL NA BARRA AD

$\Sigma M_A = 0 \quad \circlearrowright^{+} \quad -V_B \times 12m + 20kN \times 4m + 20kN \times 8m + 10kN/m \times d_{AC} \times 3m = 0$

$d_{AC} = \sqrt{4^2 + 6^2} = 7{,}211\ m$

$V_B = \frac{1}{12}(80 + 160 + 30 \times 7{,}211) = \underline{38{,}03\ kN \uparrow}$

$\Sigma M_C = 0 \quad \circlearrowright^{+}$



$d_{AD} = \sqrt{8^2 + 3^2} = 8{,}544m$

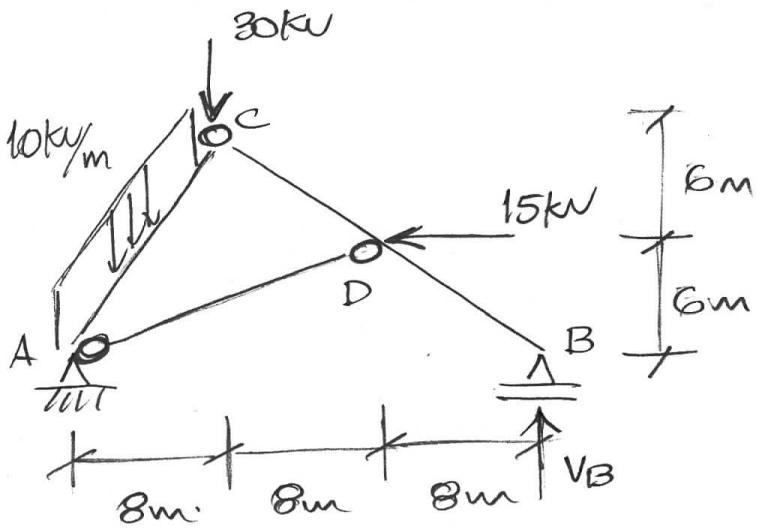
$\cos\beta = 8/8{,}544 = 0{,}9363$

$\operatorname{sen}\beta = 3/8{,}544 = 0{,}3511.$

$20kN \times 4m - 38{,}03kN \times 8m + T\cos\beta \times 3m + T\operatorname{sen}\beta \times 4m = 0$

$T = \dfrac{38{,}03 \times 8 - 20 \times 4}{0{,}9363 \times 3 + 0{,}3511 \times 4} = \boxed{+53{,}22\ kN}$ TIRANTE

TE15 - B2 - 1001



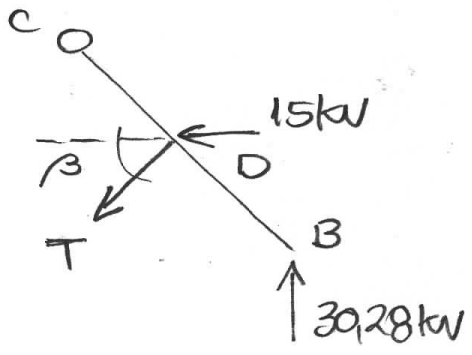
PEDE-SE:
ESFORÇO AXIAL NA BARRA $\overline{AD}$

$\Sigma M_A = 0 \quad \circlearrowleft^{+}$ $\quad -V_B \times 24m + 30kN \times 8m - 15kN \times 6m + 10kN/m \times d_{AC} \times 4m = 0$

$d_{AC} = \sqrt{8^2 + 12^2} = 14{,}42m$

$V_B = \frac{1}{24}(30 \times 8 - 15 \times 6 + 10 \times 14{,}42 \times 4) = \underline{30{,}28\,kN \uparrow}$

$\Sigma M_C = 0 \quad \circlearrowleft^{+}$



$d_{AD} = \sqrt{16^2 + 6^2} = 17{,}09m$

$\cos\beta = 16/17{,}09 = 0{,}9362$

$\operatorname{sen}\beta = 6/17{,}09 = 0{,}3511$

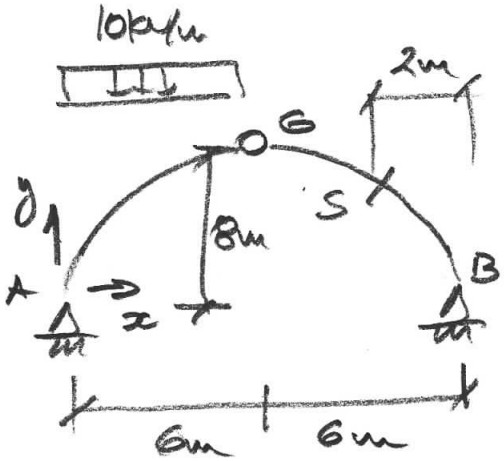
$15kN \times 6m - 30{,}28kN \times 16m + T\cos\beta \times 6m + T\operatorname{sen}\beta \times 8m = 0$

$T = \dfrac{-15 \times 6 + 30{,}28 \times 16}{0{,}9362 \times 6 + 0{,}3511 \times 8} = \boxed{+46{,}82kN}$ TRAÇÃO

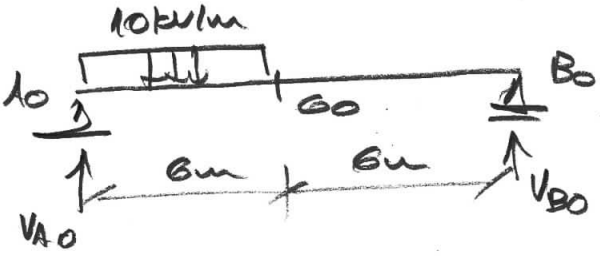
Te15 - B2-2000

ARCO PARABÓLICO DO 2º GRAU

→ DETERMINAR O ESFORÇO CORTANTE NA SEÇÃO S;



VIGA AUXILIAR



$\Sigma M_{A0} = 0 \circlearrowleft \quad V_{B0} \times 12m - 10kN/m \times (6m)^2/2 = 0$

$V_{B0} = 5 \times 36/12 = \underline{15kN\uparrow} \quad V_{A0} = 60kN - 15kN = \underline{45kN\uparrow}$

$M_{G0} = V_{B0} \times 6m = 15kN \times 6m = 90kNm$

$H = M_{G0}/f = 90kNm/8m = \underline{11,25kN} \leftarrow$

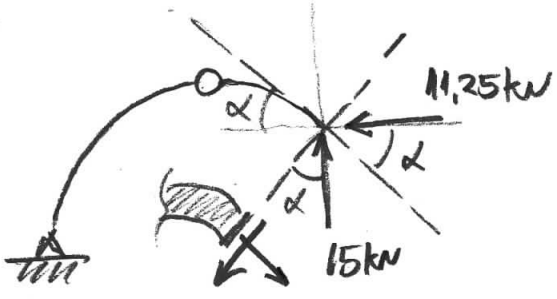
Eq do Arco: A(0,0) G(6,8) B=(12,0)

$$\begin{Bmatrix} 0 \\ 8 \\ 0 \end{Bmatrix} = \begin{bmatrix} 1 & 0 & 0^2 \\ 1 & 6 & 6^2 \\ 1 & 12 & 12^2 \end{bmatrix} \begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$$

$y(x) = 2,6667x - 0,22222x^2$

$\alpha(x=10) = \arctg(2,66667 - 2 \times 0,22222 \times 10) = -1,0583 rad$

$\cos|\alpha| = 0,49028 \qquad \sen|\alpha| = 0,87157$



$Q_S = -15\cos\alpha + 11,25\sen\alpha$

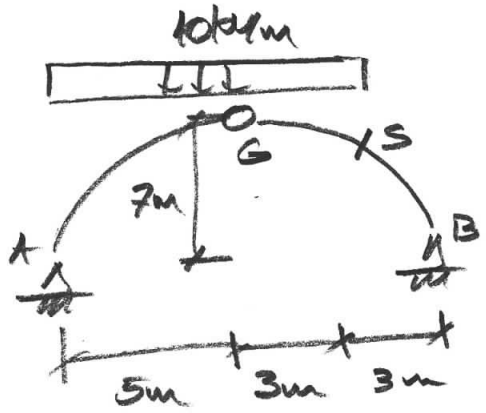
$Q_S = -15 \times 0,49028 + 11,25 \times 0,87157$

$$\boxed{Q_S = +2,451\ kN}$$

TE15 - B2 - 2001

ARCO PARABÓLICO (2º GRAU)

→ DETERMINAR O ESFORÇO AXIAL NA SEÇÃO "S" DO ARCO;

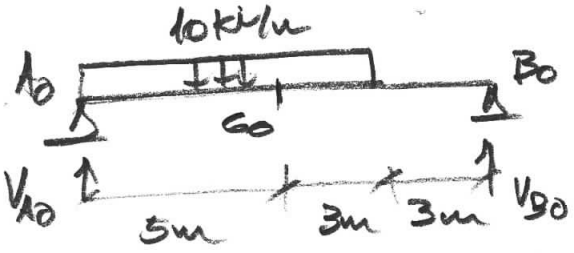


EQ DO ARCO: A(9,0) G(5,7) B(11,0)

$$\begin{Bmatrix} 0 \\ 7 \\ 0 \end{Bmatrix} = \begin{bmatrix} 1 & 0 & 0^2 \\ 1 & 5 & 5^2 \\ 1 & 11 & 11^2 \end{bmatrix} \begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$$

$$y(x) = 2{,}5667x - 0{,}23333x^2$$

VIGA ANÁLOGA



$\Sigma M_{Ao} \circlearrowleft = 0 \quad V_{Bo} \times 11 - 10 \times 8^2/2 = 0$

$V_{Bo} = 5 \times 64/11 = 29{,}091\ kN \uparrow$

$\Sigma F_V \uparrow = 0 \quad V_{Ao} + 29{,}091 - 10 \times 8 = 0$

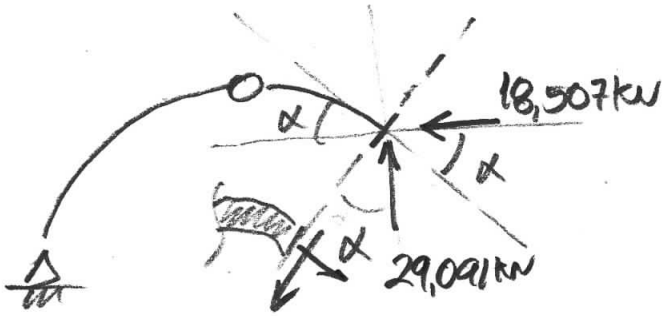
$V_{Ao} = 50{,}909\ kN \uparrow$

$M_{Go} = 50{,}909 \times 5 - 10 \times 5^2/2 = 129{,}55\ kN\,m$

$H = M_{Go}/f = 129{,}55\ kN\,m / 7m = 18{,}507\ kN \rightleftarrows$

$\alpha_S = \operatorname{arctg}(2{,}5667 - 2 \times 0{,}23333 \times 8) = -9862133$

$\cos|\alpha_S| = 0{,}65082 \qquad \operatorname{sen}|\alpha_S| = 9{,}75923$

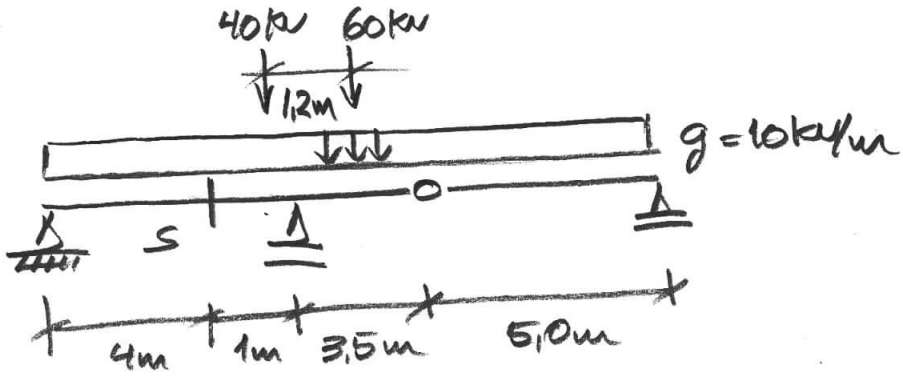


$N_S = -29{,}091\ kN \operatorname{sen}\alpha - 18{,}507\ kN \cos\alpha$

$N_S = -29{,}091 \times 0{,}75923 - 18{,}507 \times 0{,}65082$

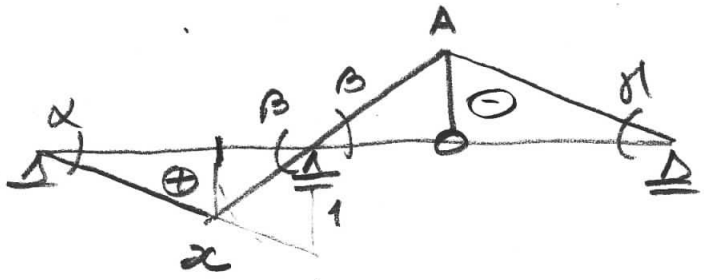
$\boxed{N_S = -34{,}13\ kN}$

TE15-B2-3000



PEDE-SE:
DETERMINAR
M_S MÁX E
Q_S MIN

LI M_S



$\frac{x}{4} = \frac{1}{5}$ $x = 4/5$

$tg\alpha = 4/5 \times 1/4 = 1/5$

$tg\beta = 4/5 \times 1/1 = 4/5$

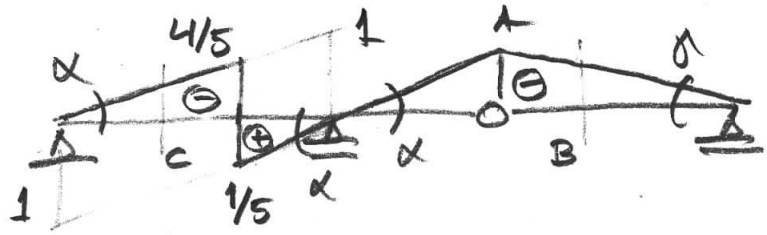
$A = tg\beta \times 3,5 = 4/5 \times 3,5 = 2,8$

$A\oplus = 5m \times 4/5 m \times 1/2 = 2,0 m^2$

$A\ominus = 8,5m \times -2,8m \times 1/2 = -11,9 m^2$

$M_{SMÁX} = 10 \times (2,0 - 11,9) + 60 \times 4/5 + 40 \times 1/5 \times (4 - 1,2) = \boxed{-28,6 kNm}$ //

LI Q_S



$tg\alpha = 1/5$

$A = 1/5 \times 3,5 \cdot 0,7$

$tg\gamma = \frac{0,7}{5} = 0,14$

$A\oplus = 1/5 \times 1 \times 0,5 = 0,1 m$ $A\ominus = 4/5 \times 4 \times 0,5 + 8,5 \times 0,7 \times 0,5$

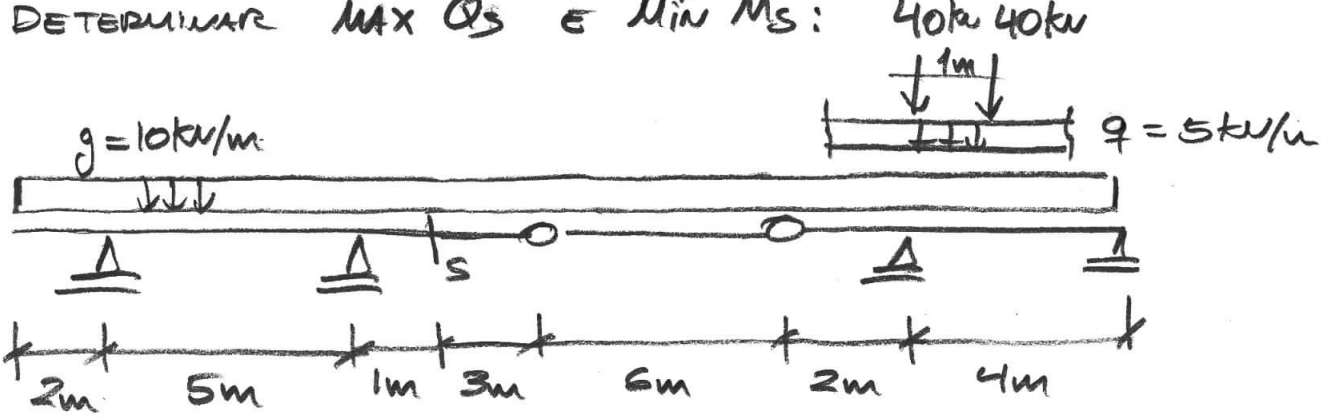
$A\ominus = 4,575 m$ $B = 0,14 \times (5 - 1,2) = 0,532$

$C = 1/5 \times (4 - 1,2) = 0,56$

$Q_{S\,MIN} = 10(+0,1 - 4,575) + 60 \cdot -4/5 + 40 \cdot -0,56 = \boxed{-115,15 kN}$ //

TE15-B2-4000

→ DETERMINAR MÁX Q_S E MÍN M_S:



LI Q_S

$tg\alpha = 1/6$



$A_{\oplus} = (1 \times 3m) + (1 \times 6m)/2 = 6m$

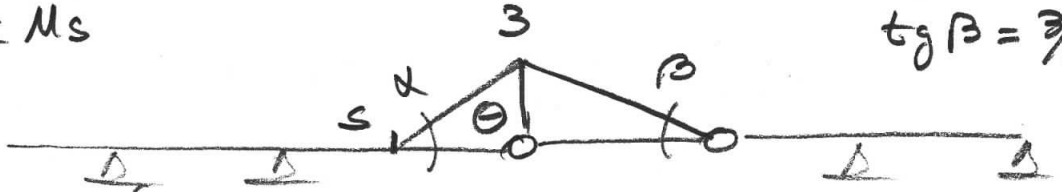
$Q_{S\,MÁX} = 10\frac{kN}{m} \times 6m + 5\frac{kN}{m} \times 6m + 40kN \times 1m + 40kN\,1m$

$Q_{S\,MÁX} = +170{,}0\ kN$

LI M_S

$tg\alpha = 1$

$tg\beta = 3/6 = 1/2$



$A_{\ominus} = (9m \times 3m)/2 = 27/2\ m^2$

$M_{S\,MÍN} = 10\frac{kN}{m} \times \left(-\frac{27}{2}\right)m^2 + 5\frac{kN}{m} \times \left(-\frac{27}{2}\right)m^2 + 40kN(-3m) + 40kN(6-1) \times \frac{1}{2}m$

$M_{S\,MÍN} = -422{,}5\ kNm$