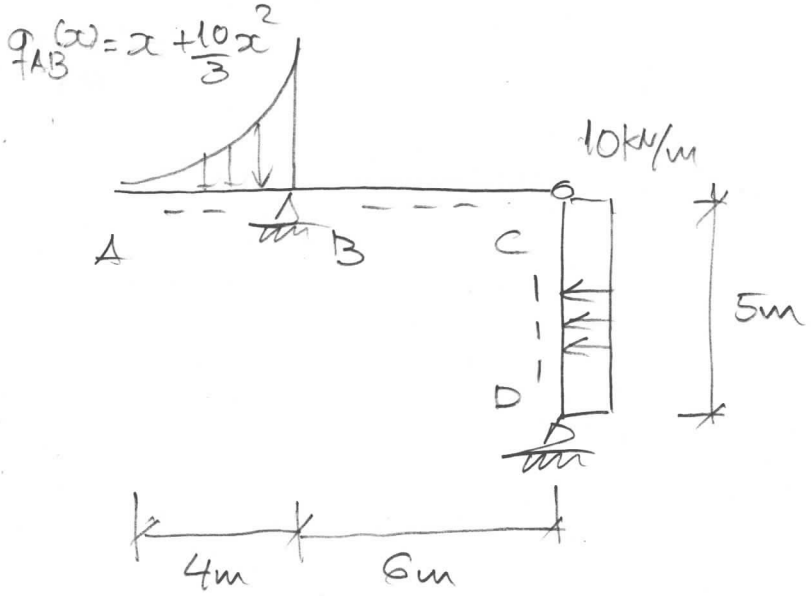
TE17 - B1 - 1000

PEDE-SE:
EQUAÇÃO DE MOMENTOS FLETORES DO TRECHO BC [COM ORIGEM EM B]

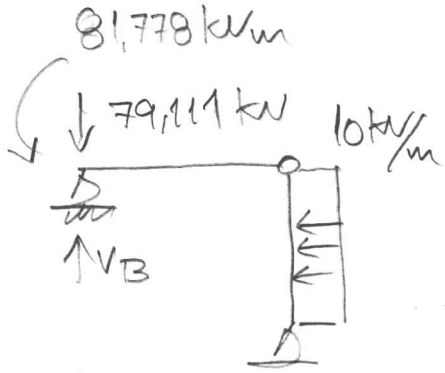


$$V_{AB}(x) = -\frac{10}{3}\frac{x^3}{3} - \frac{x^2}{2} + C_1 \quad \therefore C_1 = 0$$

$$M_{AB}(x) = -\frac{10}{3}\frac{x^4}{12} - \frac{x^3}{6} + C_2 \quad \therefore C_2 = 0$$

$$V_B = -\frac{10}{9}\cdot 4^3 - \frac{4^2}{2} = -79{,}111\ kN$$

$$M_B = -\frac{10}{36}4^4 - \frac{4^3}{6} = -81{,}778\ kN\,m$$



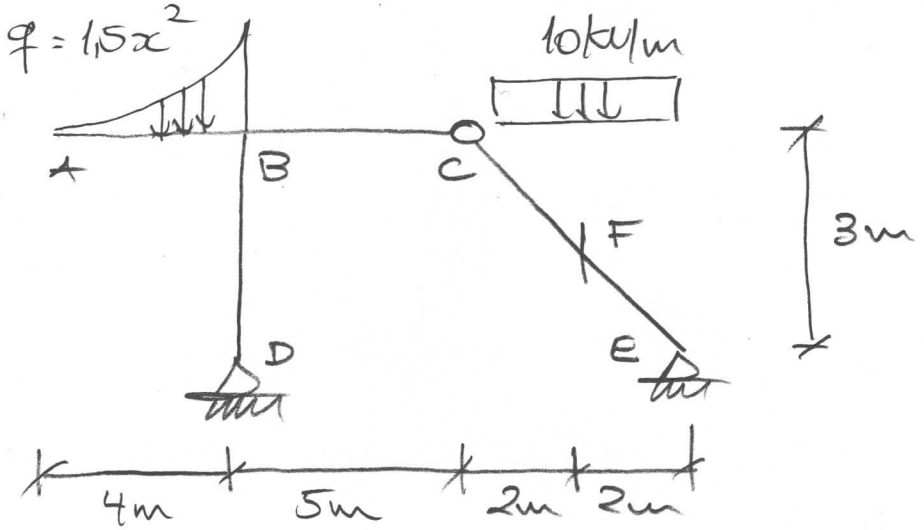
$$\sum \overset{\rightarrow A}{M_C} = 0 \quad \curvearrowleft \oplus \quad V_B \times 6m - 81{,}778\ kN/m - 79{,}111\ kN \times 6m = 0$$

$$V_B = \frac{1}{6}[81{,}778 + 79{,}111 \times 6] = 92{,}741\ kN \uparrow$$

$$M_{BC}(x) = (92{,}741 - 79{,}111)x - 81{,}778$$

$$\boxed{M_{BC}(x) = 13{,}630x - 81{,}778}$$

TE17 - B1 - 2000



PEDE-SE:

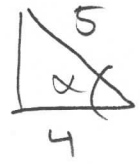
ESFORÇO AXIAL INFINITESIMALMENTE ADIRETA DO PONTO F EM kN;

$$V_{AB}(x) = -1,5\,x^3/3 + C_1 \therefore C_1 = 0 \quad (x=0 \quad V=0)$$

$$M_{AB}(x) = -1,5\,x^4/12 + C_2 \therefore C_2 = 0 \quad (x=0 \quad M=0)$$

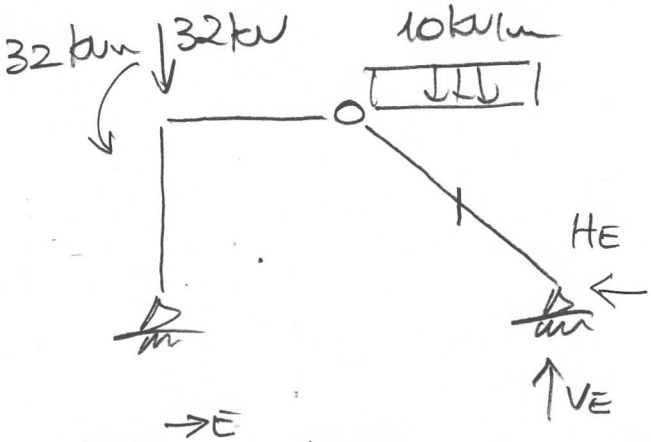
$$V_{AB}(x=4) = -1,5 \cdot 4^3/3 = -32\ kN$$

$$M_{AB}(x=4) = -1,5 \cdot 4^4/12 = -32\ kN\,m$$



$\cos\alpha = 4/5$

$\operatorname{sen}\alpha = 3/5$



$$\Sigma M_D = 0 \ \circlearrowleft \oplus$$

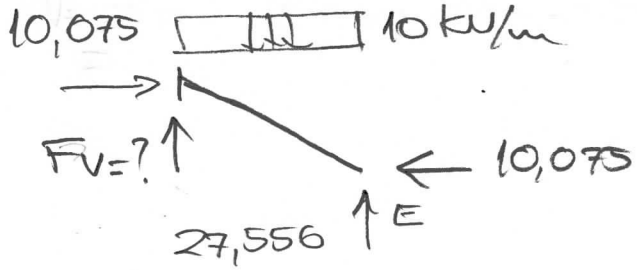
$$V_E \times 9m + 32\,kN\,m - \frac{10\,kN}{m} \times 4m \times 7m = 0$$

$$V_E = \frac{1}{9}[-32 + 10 \times 4 \times 7] = 27,556\,kN$$

$$\Sigma M_C = 0 \ \circlearrowleft \oplus \quad -H_E \times 3m + 27,556\,kN \times 4m - \frac{10\,kN}{m} \times (4m)^2/2 = 0$$

$$H_E = \frac{1}{3}[27,556 \times 4 - 5 \times 16] = 10,075\ kN$$

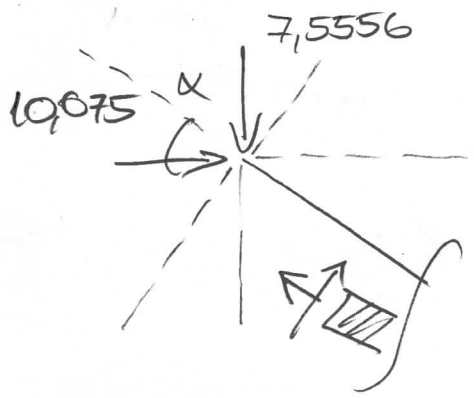
EQUILÍBRIO DO TRECHO FE:



$\sum F_V^{FE} = 0 \quad F_V - 10\,kN/m \times 2m + 27{,}556\,kN = 0$

$F_V = 10 \times 2 - 27{,}556 = -7{,}5556\,kN$

PONTO F:

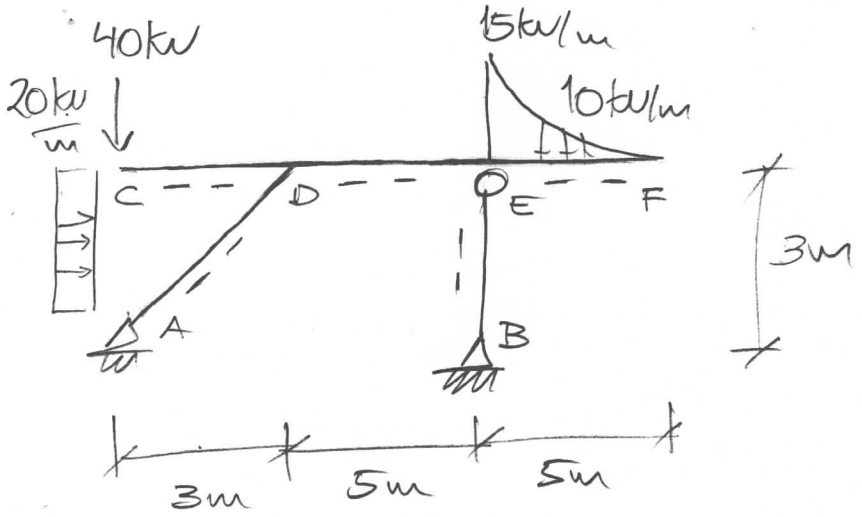


$N_F^{ESQ} = N_F^{DIR} = -10{,}075 \times \cos\alpha - 7{,}5556 \operatorname{sen}\alpha$

$N_F^{DIR} = -10{,}075 \times 4/5 - 7{,}5556 \times 3/5$

$N_F^{DIR} = -12{,}593\,kN$

TE17 - 01 - 2001



PEDE-SE:

EQUAÇÃO DE MOMENTOS FLETORES DO TRECHO DE;

* A CARGA EM EF É PARABÓLICA DE 2º GRAU;

$\Sigma M_E = 0 \circlearrowleft (+) \quad \therefore \quad H_B = 0$

$\Sigma F_H = 0 \rightarrow (+) \quad 20kN/m \times 3m + H_A = 0 \quad H_A = 60kN \leftarrow$

EQUAÇÃO DE CARGA FE:

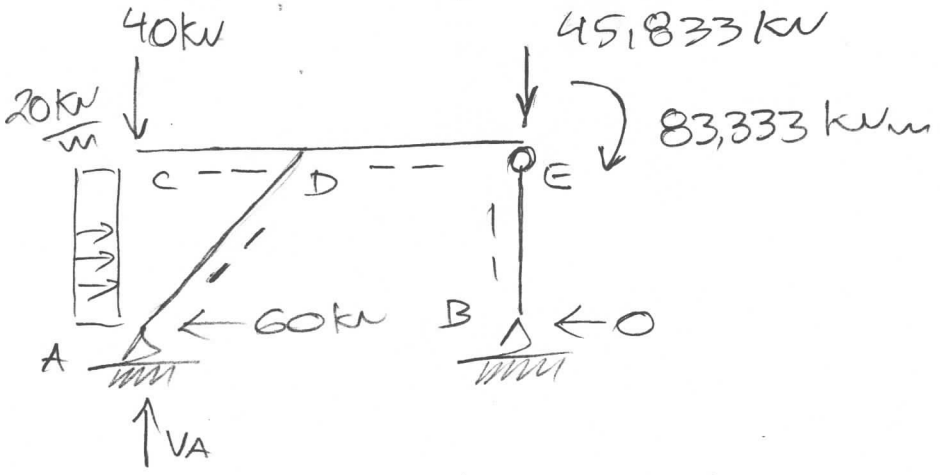
$$\begin{bmatrix} 1 & 0 & 0 \\ 1 & 2{,}5 & 2{,}5^2 \\ 1 & 5 & 5^2 \end{bmatrix} \begin{Bmatrix} a \\ b \\ c \end{Bmatrix} = \begin{Bmatrix} 0 \\ 10 \\ 15 \end{Bmatrix} \qquad q_{FE}(x) = 5x - 0{,}4x^2$$

$$V_{FE}(x) = \int 5x - 0{,}4x^2\,dx = 5x^2/2 - 0{,}4x^3/3 + C_1 \quad \therefore C_1 = 0$$

$$M_{FE}(x) = -\int 5/2\,x^2 - 0{,}4/3\,x^3\,dx = -\frac{5x^3}{6} + \frac{0{,}4x^4}{12} + C_2 \quad \therefore C_2 = 0$$

$$V_E = 5 \times 5^2/2 - \frac{0{,}4}{3} \times 5^3 = 45{,}833\,kN$$

$$M_E = -5/6 \times 5^3 + \frac{0{,}4}{12} \times 5^4 = -83{,}333\,kNm$$



$\Sigma M_B = 0 \quad \curvearrowleft +$

$$V_A \times 8m + 83{,}333\,kNm + \frac{20\,kN}{m} \times \frac{(3m)^2}{2} - 40\,kN \times 8m = 0$$

$$V_A = \frac{1}{8}\left[-83{,}333 - 10 \times 9 + 40 \times 8\right] = 18{,}333\,kN \uparrow$$

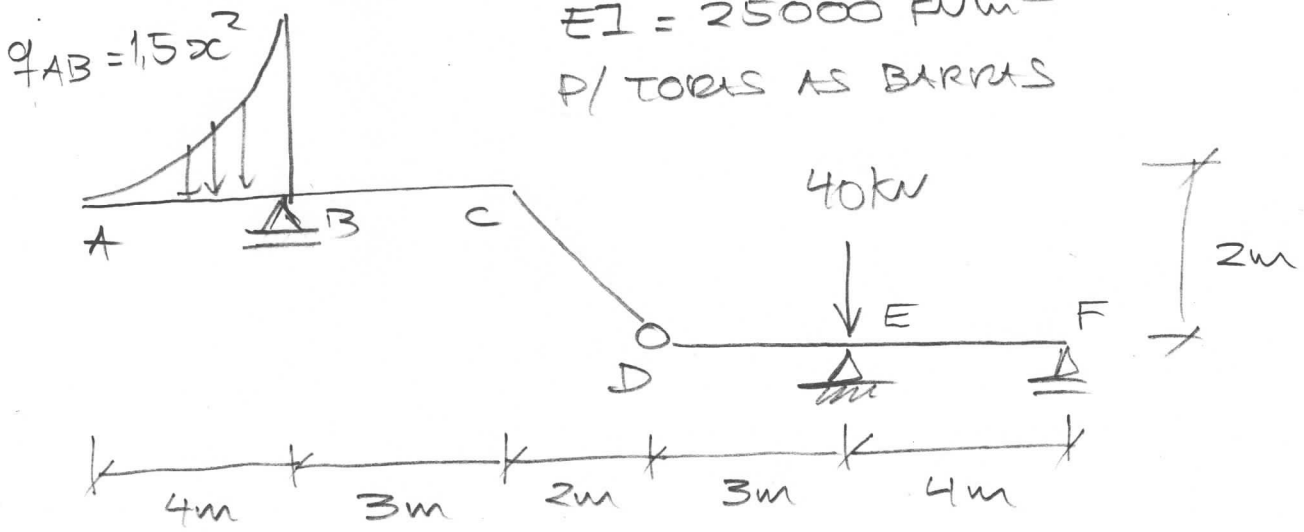
$$M_D = 18{,}333\,kN \times 3m - 40\,kN \times 3m - \frac{20\,kN}{m} \times \frac{(3m)^2}{2} + 60\,kN \times 3m$$

$$M_D = 25\,kNm$$

$$V_D = 18{,}333\,kN - 40\,kN = -21{,}667\,kN$$

$$\boxed{M_{DE}(x) = -21{,}667\,x + 25}$$

TE17 - B1 - 4000



$EI = 25000\ kNm^2$
P/ TODAS AS BARRAS

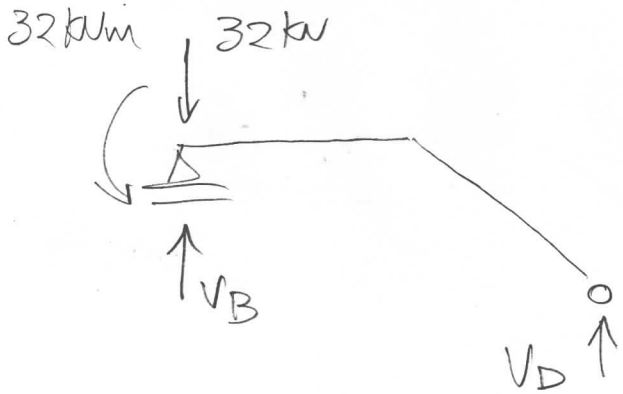
PEDE-SE: A DEFLEXÃO DE UM PONTO NO MEIO DA BARRA EF [EM "m" COM POSITIVO P/ CIMA]

$$V_{AB}(x) = -1{,}5\,x^3/3 + C_1 \qquad C_1 = 0$$

$$M_{AB}(x) = -1{,}5\,x^4/12 + C_2 \qquad C_2 = 0$$

$$V_B = -1{,}5/3\ 4^3 = -32\ kN$$

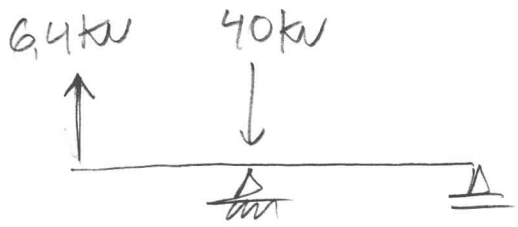
$$M_B = -1{,}5/12\ 4^4 = -32\ kNm$$



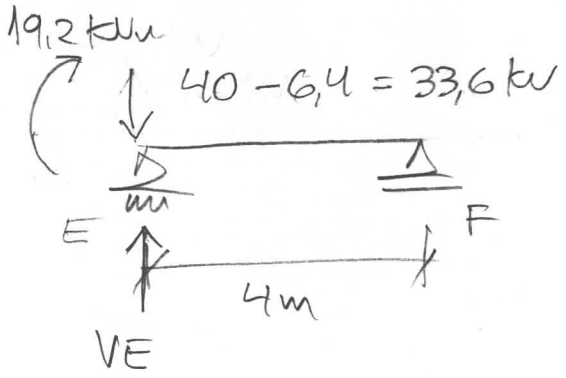
$$\Sigma M_B = 0 \quad \circlearrowleft +$$

$$V_D \times 5m + 32kNm = 0$$

$$V_D = 1/5\,[-32] = -6{,}4\ kN \downarrow$$



$M_E = 6{,}4\,kN \times 3m = 19{,}2\,kNm$ ↺



$\Sigma_F = 0$ ↻ (+)

$V_E \times 4m - 33{,}6kN \times 4m + 19{,}2kNm = 0$

$V_E = \frac{1}{4}\left[+33{,}6 \times 4 - 19{,}2\right]$

$V_E = 28{,}8\,kN$

$M_{EF}(x) = (28{,}8 - 33{,}6)x + 19{,}2$

$M_{EF}(x) = -4{,}8x + 19{,}2$

$\theta_{EF}(x) = \frac{1}{EI}\left(-4{,}8\frac{x^2}{2} + 19{,}2x + C_1\right)$

$v_{EF}(x) = \frac{1}{EI}\left(-4{,}8\frac{x^3}{6} + 19{,}2\frac{x^2}{2} + C_1x + C_2\right)$

$P/x = 0 \quad v = 0 \quad \therefore C_2 = 0$

$P/x = 4m \quad v = 0$

$C_1 = \frac{1}{4}\left[+4{,}8 \cdot \frac{4^3}{6} - 19{,}2 \cdot \frac{4^2}{2}\right] = -25{,}6$

$v_{EF}(x) = \frac{1}{25000}\left(-0{,}8x^3 + 9{,}6x^2 - 25{,}6x\right)$

$v_{EF}(x=2) = \frac{1}{25000}\left(-0{,}8 \cdot 2^3 + 9{,}6 \cdot 2^2 - 25{,}6 \cdot 2\right)$

$v_{EF}(x=2) = -0{,}000768\,m$