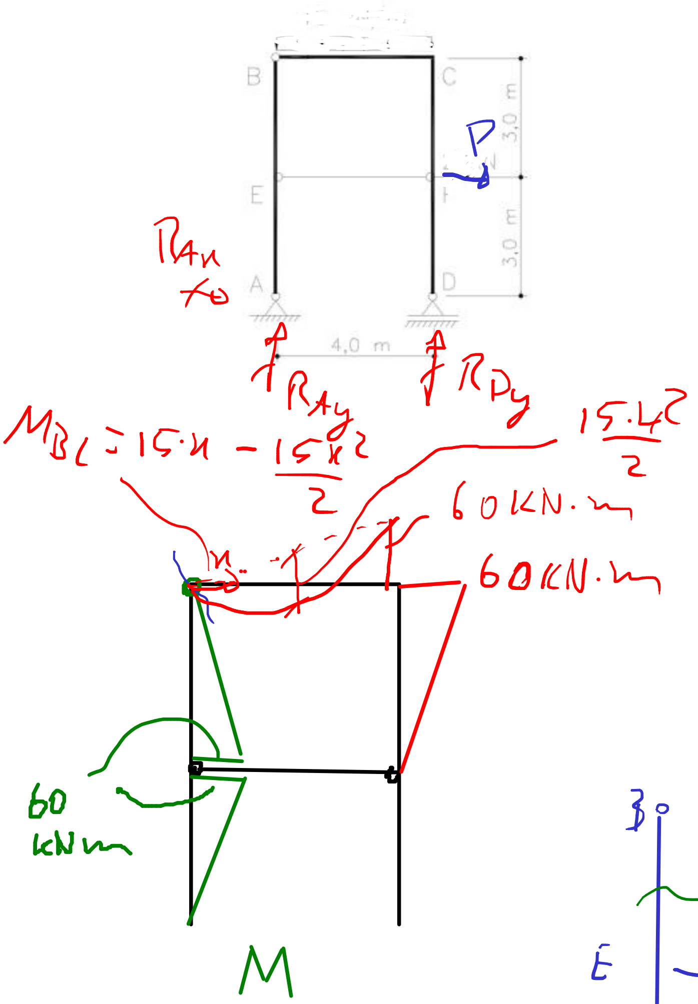
7) Calcular o deslocamento horizontal do ponto F.

Dados: trechos **AB, BCD**: E.A=16x10^5 kN;

E.I = 2x10^8 kN.cm^2.

trecho **EF**: E.A=10^5 kN;

E.I = 4x10^4 kN.cm^2.



1º) Reações:

$\Sigma M_A = 0$:

$$R_{Dy} = \frac{20 \cdot 3 + 120}{4} = 45 \text{ kN}$$

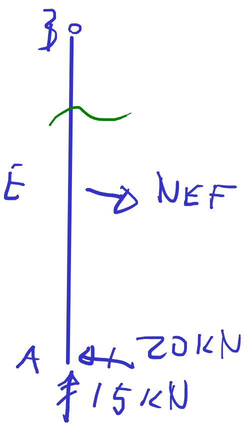
$\Sigma F_y = 0$:

$$-60 + 45 + R_{Ay} = 0$$

$$\underline{R_{Ay} = 15 \text{ kN}}$$

$\Sigma F_x = 0$

$$R_{Ax} = -20 \text{ kN}$$



$$M_{B_{A-B}} = 0$$

$$-20 \cdot 6 + 3 N_{EF} = 0$$

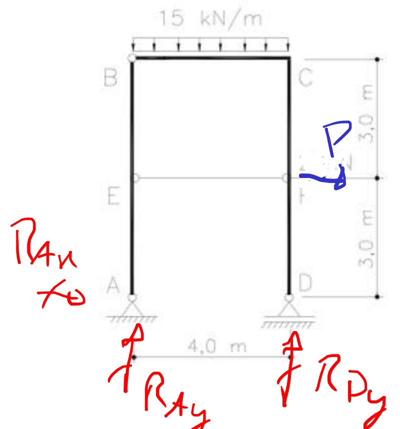
$$\boxed{N_{EF} = 40 \text{ kN}}$$

$$M_{B_{A-B}} = 20 \cdot 6 - 40 \cdot 3 = 0$$

7) Calcular o deslocamento horizontal do ponto F.

Dados: trechos **AB, BCD**: $E.A = 16 \times 10^5$ kN;
$E.I = 2 \times 10^8$ kN.cm^2.

trecho **EF**: $E.A = 10^5$ kN;
$E.I = 4 \times 10^4$ kN.cm^2.



$\Sigma M_A = 0$:

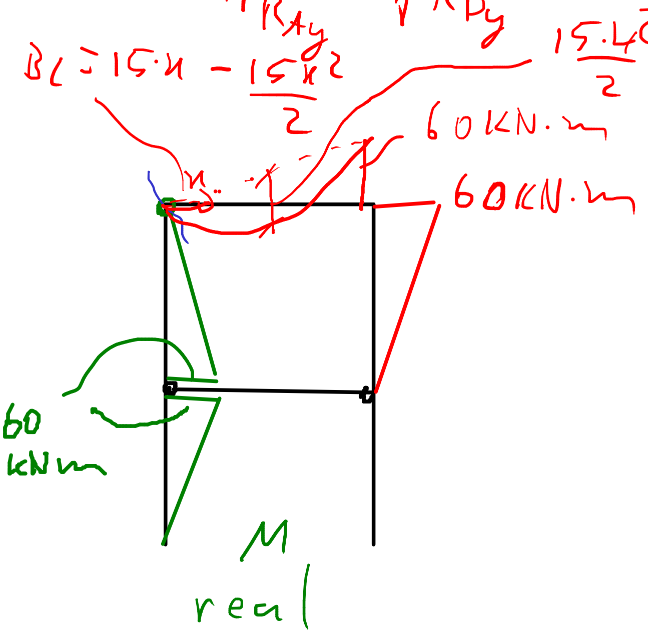
$R_{Dy} = \frac{3P}{4}$

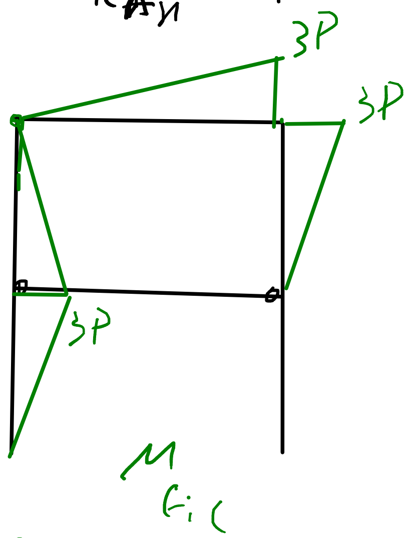
$\Sigma F_y = 0$:

$R_{Ay} = -\frac{3}{4} P$

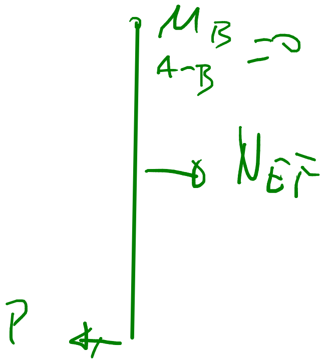
$\Sigma F_x = 0$

$R_{Ax} = -P$





$M_{B\,(A-B)} = 0$: $6P - 3N_{EF} = 0$

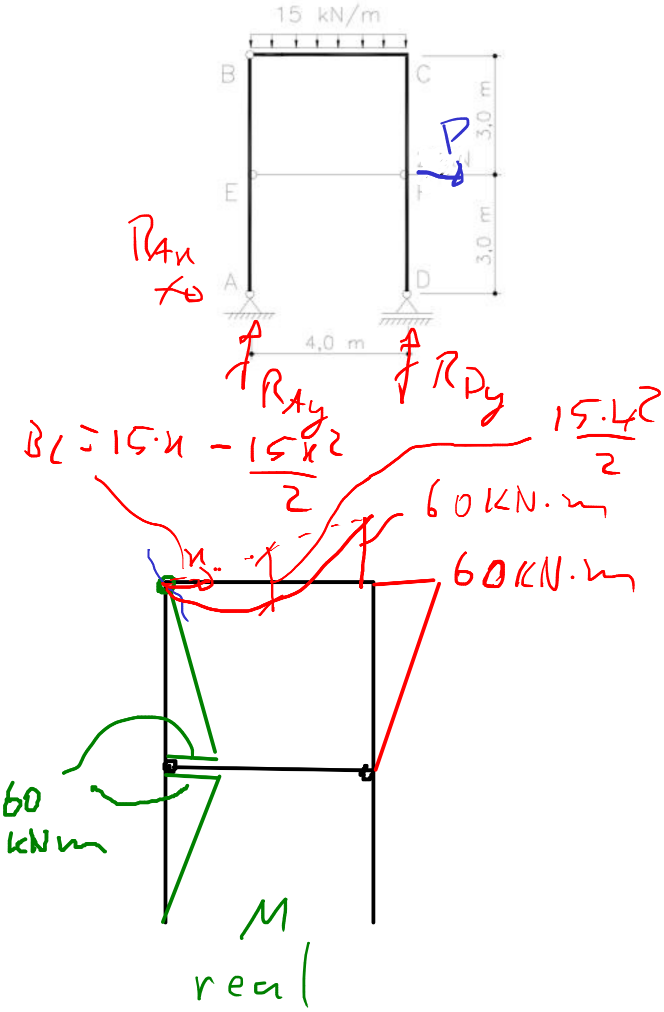


$N_{EF} = 2P$

$E.I = 2x10^8$ kN.cm^2.

trecho EF: $E.A=10^5$ kN;

$E.I = 4x10^4$ kN.cm^2.



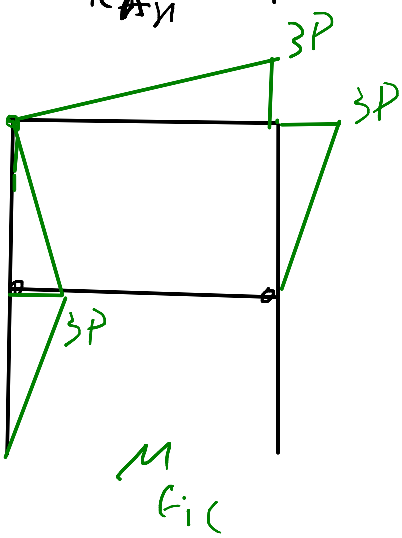
$$R_{Dy} = \frac{3P}{4}$$

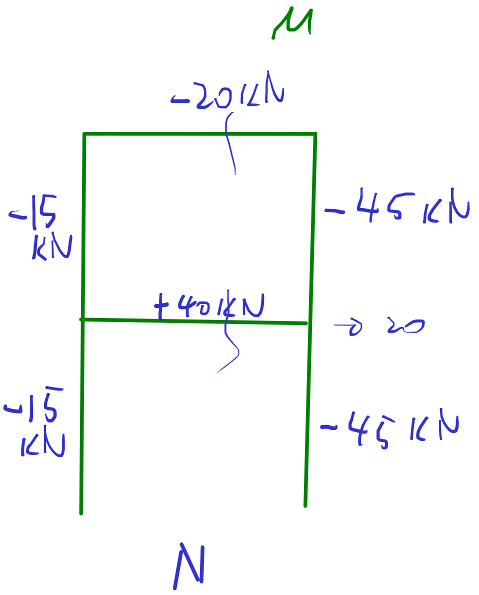
$$\Sigma F_y = 0 :$$

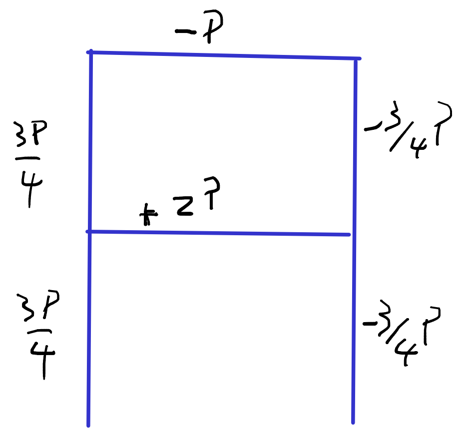
$$R_{Ay} = -\frac{3}{4}P$$

$$\Sigma F_x = 0$$

$$R_{Ax} = -P$$





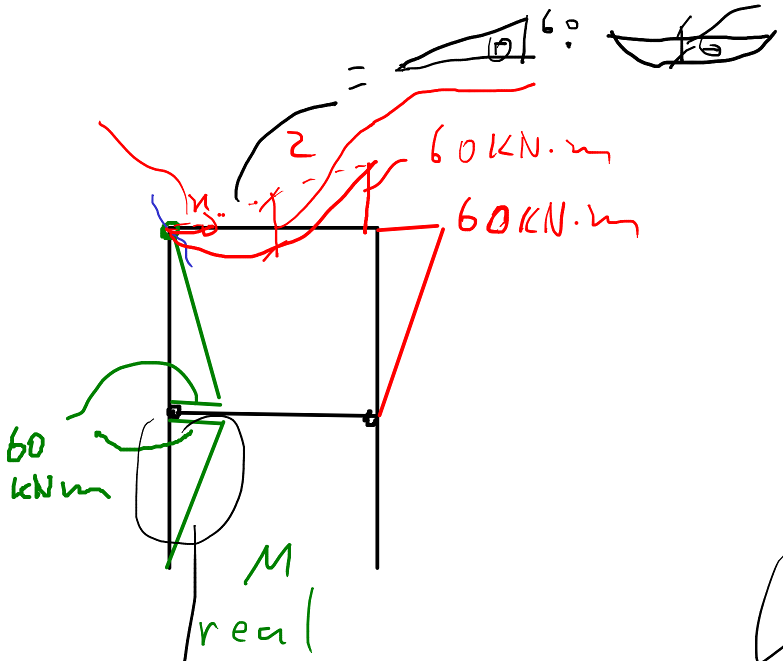


Castigliano:

$$\underline{\Delta} = \frac{\partial U_e}{\partial P} = \frac{\partial}{\partial P}\left(\sum_{i=1}^{n}\int_0^{L_i}\frac{(M+M_f)^2}{2EI}\,dx + \sum_{i=1}^{n}\frac{(N+N_f)^2}{2EA}\cdot L_i\right)$$

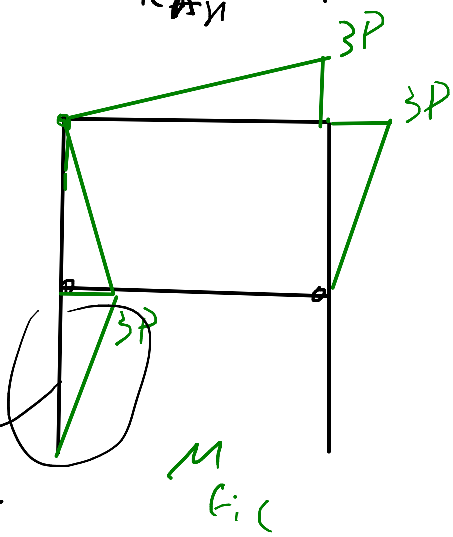
$$\sum_{i=1}^{n}\int_0^{L_i}\frac{(M+M_f)\cdot\frac{\partial(M+M_f)}{\partial P}}{EI}\,dx + \Sigma\frac{(N+N_f)}{EA}\frac{\partial(N+N_f)}{\partial P}\cdot L_i$$

$$\frac{15\cdot 4^2}{8} = 30\,\mathrm{kN\cdot m}$$



$\Sigma F_x = 0$

$R_{Ax} = -P$



∂/P

$$\Delta = \frac{1}{EI}\int_0^{3m}\left(60 + \cancel{3P}^{\to 0}\right)\cdot 3\,dx + \frac{1}{EI}\int_0^{3m}\left(60 + 3P^{\to 0}\right)\cdot 3P\,dx$$

$$+\frac{1}{EI}\int_0^{4}\left(60 - \cancel{30} + 3P^{\to 0}\right)$$

$$\left(\;\; ^{3} \right) \, dx$$

$$+ \frac{1}{EI} \int_{0}^{3} \left(\; ^{60} \; + \; ^{3 = 0} \right) \cdot \; ^{3} \, dx$$

$$+ \left(-\frac{15 \cdot 3}{4} \cdot \frac{6}{EA} \right) + \frac{80 \cdot 4}{EA} + \frac{20 \cdot 4}{EA} + \frac{45 \cdot 3}{4EA} \cdot 3$$