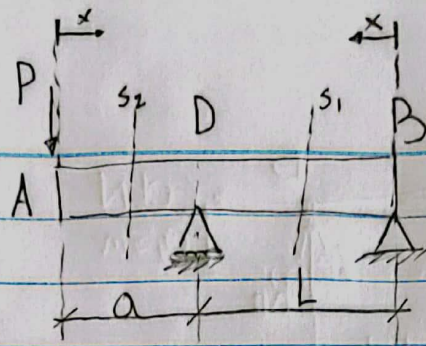7)

Trecho BD : $M(x) = -Pax/L$

$$U_{BD} = \int \frac{M^2 dx}{2EI} = \int_0^L \frac{1}{2EI} \left(-\frac{Pax}{L}\right)^2 dx = \frac{P_a^2 L}{6EI}$$

Trecho AD : $M(x) = -Px$

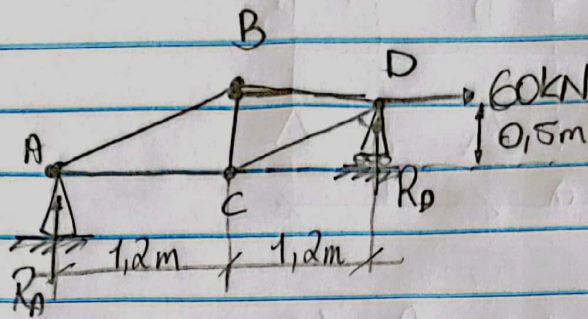$$U_{AD} = \int \frac{M^2 dx}{2EI} = \int_0^a \frac{1}{2EI} (-Px)^2 dx = \frac{P^2 a^3}{6EI}$$

Energia total de deformação

$$U_T = U_{BD} + U_{AD} = \frac{P_a^2 L}{6EI} + \frac{P^2 a^3}{6EI} = \boxed{\frac{P^2 a^2 (L+a)}{6EI}}$$
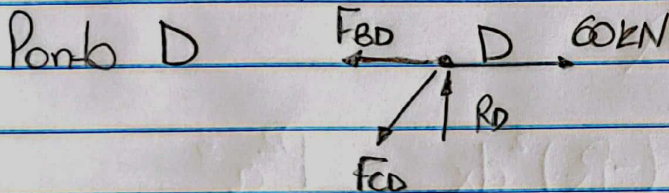
10)

$$\Sigma Ma = 0$$

$$R_D \, (2 \cdot 1,2) - 60(0,5) = 0$$
$$R_D = 12,5 \, kN$$
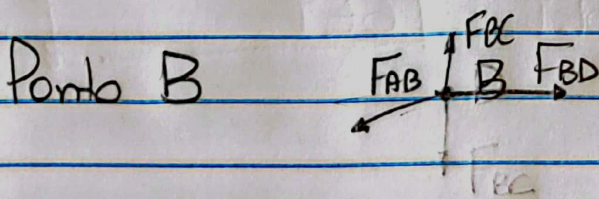
Ponto D

$$\Sigma Fy = 0 : 12,5 - \frac{0,5}{1,3} \, F_{CD} = 0 \longrightarrow F_{CD} = 32,5 \, kN$$

$$\Sigma Fx = 0 : \quad 60 - F_{BD} - \frac{1,2}{1,3} \, F_{CD} = 0$$

$$\longrightarrow F_{BD} = 30 \, kN$$
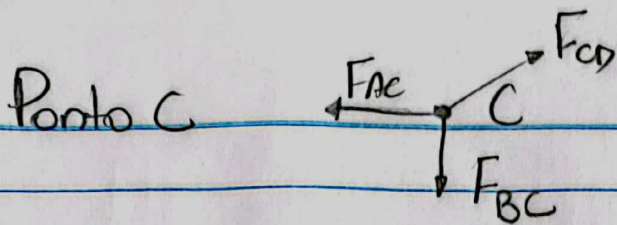
Ponto B

$$\Sigma Fx = 0 :$$
$$30 - \frac{1,2}{1,3} \, F_{AB} = 0$$

$$\longrightarrow F_{AB} = 32,5 \, kN$$

$$\Sigma Fy = 0 : \quad + \frac{0,5}{1,3} \, F_{AB} + F_{BC} = 0 \longrightarrow F_{BC} = 12,5 \, kN$$

Ponto C

$\sum F_x = 0$ $- F_{AC} + \dfrac{1,2}{1,3} \ 32,5 = 0 \longrightarrow F_{AC} = 30kN$

$$U = \sum \dfrac{F^2 L}{2EA} = \dfrac{1}{2E} \sum \dfrac{F^2 L}{A}$$

trecho	força	comprimento	Área	$U \ (N^2/m)$
CD	32,5kN	1,3m	$400 \cdot 10^{-6} m^2$	$3,44 \cdot 10^{12}$
BD	30kN	1,2m	$400 \cdot 10^{-6} m^2$	$2,7 \cdot 10^{12}$
AB	32,5kN	1,3m	$400 \cdot 10^{-6} m^2$	$3,44 \cdot 10^{12}$
BC	12,5kN	0,5m	$800 \cdot 10^{-6} m^2$	$0,097 \cdot 10^{12}$
AC	30 kN	1,2m	$400 \cdot 10^{-6} m^2$	$2,7 \cdot 10^{12}$
				$12,36 \cdot 10^{12}$

$$\therefore U = \dfrac{12,36 \cdot 10^{12}}{2 \cdot 200 \cdot 10^{9}} = 30,908 J$$

Logo determina-se o deslocamento horizontal:

$$\dfrac{1}{2} P\Delta = U \longrightarrow \Delta = \dfrac{2U}{P} = \dfrac{2 \cdot 30,908}{60 \cdot 10^3} = 1,030 \cdot 10^{-3} m$$

$$\therefore \boxed{\Delta = 1,030 mm}$$

tilibra