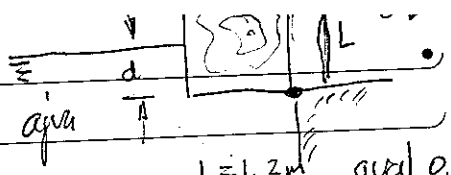
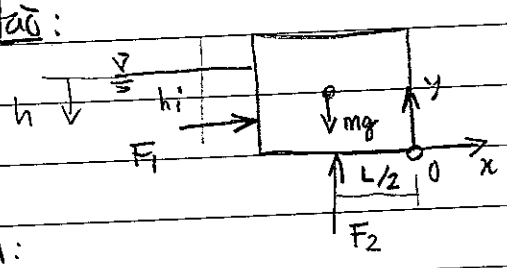
SOLUCAO DO P2



$L = 1,2\,m$ qual o
$d = 0,6\,cm$ $\rho_{madeira}$?

Primeira questão:



b = largura para dentro do papel

Sup. Vertical:

$$F_1 = p_{c_1} A_1 = \rho g \frac{d}{2} d\,b = \frac{1}{2} \rho g b d^2$$

ponto de aplicação de F_1: $h_1 = \frac{2}{3} d$ $\left\{ h_1 = h_{c_1} + \frac{bd^3}{12\, y_{cA}} = \frac{d}{2} + \frac{d^2}{12 \frac{d}{2}} \right.$ ($h_c\, bd$)

Sup Horizontal:

$$m = \rho_m \forall = \rho_m L^2 b$$

$$F_2 = p_c A_2 = \rho g d\, bL$$

ponto de aplicação: $L/2$

Somatório dos momentos em relação a "0"

$$mg \frac{L}{2} - F_1 \left(d - \frac{2}{3} d\right) - F_2 \frac{L}{2} = 0$$

$$\rho_m L^2 b \cancel{g} \frac{L}{2} - \frac{1}{2} \rho \cancel{g} b d^2 \left(\frac{1}{3} d\right) - \rho \cancel{g} d b L \frac{L}{2} = 0$$

$$\rho_m \frac{L^3 b}{2} - \frac{1}{6} \rho b d^3 - \rho \frac{d b L^2}{2} = 0$$

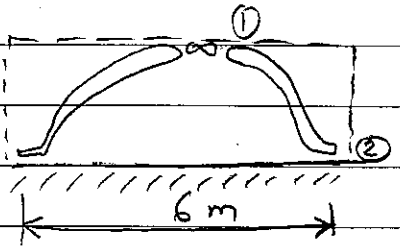
$$\rho_m = \frac{\frac{1}{6} \rho b d^3 + \frac{1}{2} \rho d b L^2}{\frac{L^3 b}{2}} \quad \therefore \quad \boxed{\frac{\rho_m}{\rho} = \frac{1}{3} \left(\frac{d}{L}\right)^3 + \frac{d}{L}}$$

$$\frac{\rho_m}{\rho} = \frac{1}{3} \left(\frac{0.6}{1.2}\right)^3 + \frac{0.6}{1.2} = \frac{1}{24} + \frac{1}{2} = 0.542$$

$\rho = 1000\ kg/m^3$ $\therefore$ $\boxed{\rho_m = 542\ kg/m^3}$

- Segunda questão: não foi pedida

Terceira questão:



a) massa específica do ar externo: $p = \rho R T$ $\quad R_{ar} = 287 \frac{Nm}{kgK}$

$$\therefore \rho = \frac{(101 \times 10^3)}{(287)(20+273)} = 1.201 \ kg/m^3$$

b) $(p_i - p_{atm}) A = W \quad \therefore \quad p_i = \frac{W}{A} + p_{atm}$

$$p_i = \frac{50 \times 10^3}{\frac{(\pi)(6)^2}{4}} + 101 kPa \qquad p_i = (1768 + 101000) \ Pa$$

c) aplicando a eq de Bernoulli de um ponto no interior (or parado) até a saída

$$\frac{p_i}{\rho} + \frac{V_i^2}{2} + g z_i = \frac{p_e}{\rho} + \frac{V_e^2}{2} + g z_e \qquad (z_i \approx z_e \approx 0)$$

$$\frac{V_e^2}{2} = \frac{p_i - p_e}{\rho} \quad \therefore \quad V_e = \sqrt{\frac{2(p_i - p_e)}{\rho}} \qquad p_e = p_{atm} = 101 kPa$$

$$\therefore V_e = \sqrt{\frac{2(1768)}{1.201}} \quad \therefore \quad V_e = 54.3 \ m/s$$

Vazão: $\dot{\forall}_e = V_e A_e = V_e \pi D h = (54.3)(\pi)(6)(3 \times 10^{-2})$

$\dot{\forall}_e = 30.7 \frac{m^3}{s}$ vazão mássica $\dot{m} = \rho \dot{\forall}_e \quad \therefore \quad \dot{m} = (30.7)(1.201)$

$\dot{m}_e = 36.86 \ kg/s$

(d) $\cancel{\dot{Q}} - \dot{W}_{eixo} - \cancel{\dot{W}_{cis}} - \cancel{\dot{W}_{outros}} = \int_{VC} e\rho d\forall + \int_{SC} \left(u + p\upsilon + \frac{V^2}{2} + gz\right) \rho \vec{V} \cdot d\vec{A}$

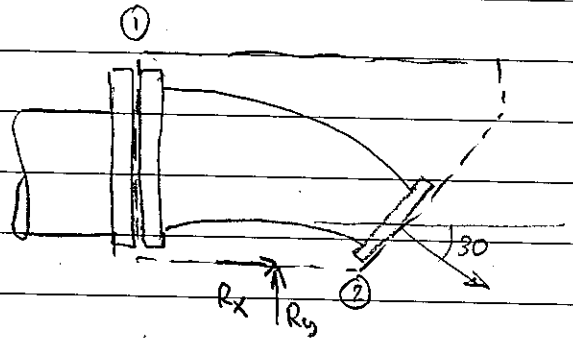
$$-\dot{W}_{eixo} = \underbrace{(-\rho_1 A_1 V_1)}_{\dot{m}} \left[\frac{p_1}{\rho} + \frac{V_1^2}{2} + gz_1\right] + \underbrace{(\rho_2 V_2 A_2)}_{\dot{m}} \left[\frac{p_2}{\rho} + \frac{V_2^2}{2} + gz_2\right]$$

$$-\dot{W}_{eixo} = \dot{m}\left\{\underbrace{\frac{p_2 - p_1}{\rho}}_{=0} + \frac{V_2^2 - V_1^2}{2} + \underbrace{g(z_2 - z_1)}_{=0}\right\}$$

$$-\dot{W}_{eixo} = \dot{m}\frac{V_2^2}{2} = (36.86)\frac{(54.3)^2}{2} = -54333\ W$$ (negativo = potência fornecida)

$$\dot{W}_{eixo} = -54.3\ kW$$

Quarta questão



Avalia a força horizontal em cada um dos 4 parafusos que suportam a curva com redução mostrada

$Q = 0{,}11\ m^3/s$

$A_1 = 0{,}0182\ m^2$

$A_2 = 0{,}0081\ m^2$

$p_1 = 200\ kPa$

$p_2 = 101\ kPa$

$$F_{Sx} + \cancel{F_{Bx}}^{=0} = \frac{\partial}{\partial t}\int_{VC} u\rho d\forall + \int_{SC} u\rho \vec{V} \cdot d\vec{A}$$

$$(p_1 - p_2)A_1 + R_x = \underbrace{(-\rho_1 V_1 A_1)}_{\dot{m}} u_1 + \underbrace{(\rho_2 A_2 V_2)}_{\dot{m}} u_2$$

$u_1 = V_1$, $u_2 = V_2 \cos 30$

$Q = A_1 V_1 = A_2 V_2 \quad \therefore \quad V_1 = \frac{Q}{A_1}, \quad V_2 = \frac{Q}{A_2}$

$\dot{m} = \rho Q$

$$R_x = \dot{m}(u_2 - u_1) - (p_1 - p_2)A_1$$

$$R_x = \dot{m}(u_2 - u_1) - (p_1 - p_2)A_1$$

$$u_2 = V_2 \cos 30 = \frac{Q}{A_2}\cos 30 \qquad u_1 = V_1 = \frac{Q}{A_1}$$

$$R_x = \dot{m}\left[\frac{Q}{A_2}\cos 30 - \frac{Q}{A_1}\right] - (p_1 - p_2)A_1$$

$$R_x = \rho Q^2\left[\frac{1}{A_2}\cos 30 - \frac{1}{A_1}\right] - (p_1 - p_2)A_1$$

$$R_x = \frac{\rho Q^2}{A_1}\left[\frac{A_1}{A_2}\cos 30 - 1\right] - (p_1 - p_2)A_1$$

$$R_x = \frac{(1000)(0.11)^2}{(0.0182)}\left[\frac{(0.0182)}{(0.0081)}\frac{\sqrt{3}}{2} - 1\right] - (200 - 101)(10^3)(0.0182)$$

$628,86$

$R_x = -1173\ N$ para a esquerda

força em cada parafuso (tração)

$$F_{\text{parafuso}} = \frac{1173}{4} \quad \therefore \quad F_{\text{parafuso}} = 293N$$