GABARITO - EXAME - 2012/2 - MECFLU

1) $V_1 = V_2 \quad z_1 = z_2 \quad \frac{p_1 - p_2}{\rho} = h_{L-D} + h_{L-L} = f\frac{L}{D}\frac{V^2}{2} + \sum K\frac{V^2}{2}$

$\frac{p_1 - p_2}{\rho} = 0{,}0375\ \frac{8 \cdot 0{,}3}{0{,}0127}\ \frac{0{,}55^2}{2} + 7 \cdot 0{,}05 \cdot \frac{0{,}55^2}{2}$

$\frac{\varepsilon}{D} = \frac{0{,}005}{127} = 0{,}0004$

$f = 0{,}0375$

$\bar{V} = \frac{Q}{A} = \frac{7 \times 10^{-5} \cdot 4}{\pi (0{,}0127)^2} = 0{,}55\ m/s$

$\frac{p_1 - p_2}{\rho} = (7{,}087 + 0{,}35)\frac{0{,}55^2}{2} = 1{,}12$

$Re = \frac{V D}{\nu} = \frac{0{,}55 \times 0{,}0127}{1{,}6 \times 10^{-6}} = 4386$

$\Delta p = 1{,}124\ (N/m^2)$

3) $p_0 = 0 \quad z_0 = 3{,}6 \quad V_0 = 0 \quad z_1 = z_2 = 0 \quad p_2 = 0$

$g 3{,}6 = \frac{p_1}{\rho_A} + \frac{V_1^2}{2} = \frac{V_2^2}{2}$

$p_1 = p_{ATM} + 0{,}15\gamma_{Hg} - 0{,}6\gamma_A$

$\frac{p_1}{\rho_A} = 0{,}15\, g \frac{\rho_{Hg}}{\rho_A} - 0{,}6 \frac{\rho_A}{\rho_A} g = (13{,}6 \cdot 0{,}15 - 0{,}6) g$

$35{,}28 = 14{,}1 + \frac{V_1^2}{2} = \frac{V_2^2}{2}$

$\frac{p_1}{\rho_A} = 14{,}112$

$V_1 = 6{,}5\ (m/s) \quad V_2 = 8{,}4\ (m/s)$

$V_1 D_1^2 = V_2 D_2^2 \quad 6{,}5 \cdot 5^2 = 8{,}4\, D_2^2$

$D_2 = \sqrt{\frac{6{,}5}{8{,}4}} \cdot 5 \Rightarrow D_2 = 4{,}4\ (cm)$

4)

$T = F_{AP}$

$E = F_{AA} + T = F_{AA} + F_{AP}$

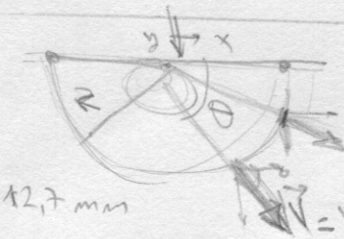
$E = C_{AA}\left(\frac{1}{2}\rho V^2\right)A_A + C_{AP}\left(\frac{1}{2}\rho V^2\right)A_A$

$E = (C_{AA} + C_{AP})\left(\frac{1}{2}\rho V^2\right)A_A = 0{,}25 \cdot \frac{1}{2} 1{,}2 (41{,}66)^2 \cdot 30$

$V = 150\ [Km/h] = 41{,}66 (m/s)$

$E = 7.812\ [N]$

2)



$\theta = 0 - \pi$

$\vec{dA} = R d\theta\, a(\cos\theta \vec{i} + \sin\theta \vec{j})$

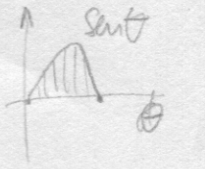
$\vec{V} = V\cos\theta \vec{i} + V\sin\theta \vec{j}$

$\vec{F}_S = \rho \int \vec{V}\, \vec{V} \cdot d\vec{A} \qquad \vec{i}\cdot\vec{i} = 1 = \vec{j}\cdot\vec{j} \qquad \vec{i}\cdot\vec{j} = 0 = \vec{j}\cdot\vec{i}$

$\vec{F}_S = \rho \int \vec{V}(VRa\cos^2\theta d\theta + VRa\sin^2\theta d\theta)$

$\vec{F}_S = \rho \int_0^{\pi} \vec{V}\, VRa\, d\theta$

$\vec{F}_S = \rho\left(\int V\cos\theta VRa\, d\theta\right)\vec{i} + \rho\left(\int V\sin\theta VRa\, d\theta\right)\vec{j}$



$\vec{F}_S = \rho V^2 Ra\left(\int_0^{\pi}\cos\theta d\theta\right)\vec{i} + \rho V^2 Ra\left(\int_0^{\pi}\sin\theta d\theta\right)\vec{j}$

$\vec{F}_S = \rho V^2 Ra [\sin\theta]_0^{\pi}\vec{i} + \rho V^2 Ra [-\cos\theta]_0^{\pi}\vec{j} \qquad [\cos\theta]_0^{\pi} = -1 - 1 = -2$

$F = 2 \times 1000 \times 10^2 \times 0{,}2 \times 0{,}0127$

$\vec{F}_S = \rho V^2 Ra\, 2\vec{j} \Rightarrow F = 508\ N$