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Lista Nº 5. Çengel.

~~6.18~~, ~~6.22~~, ~~6.24~~, ~~6.26~~, ~~6.30~~, ~~6.31~~, ~~6.34~~, (6.36) ~~6.49~~.

$\theta = 90°$ a) P_{man}

$\dot{m} = 25\ Kg/s$ b) f. ancoragem

$d = 10cm$

$P_2 = Patm$ Como $\dot{m} = \rho . A . V$, temos que $V = \frac{\dot{m}}{\rho A}$

$h = 35cm$.

$\beta = 1,03$ $V_1 = V_2 = V = \frac{\dot{m}}{\rho . A} = \frac{25\ Kg/s}{1000 . \frac{(\pi . 0,1^2)}{4}}$, $V = \frac{25}{7,8539} = 3,18\ m/s$

Encontrando a pressão manométrica através de bernoulli, temos.

$P_2 = Patm$, $V_1 = V_2$, logo,

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + h_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + h_2$$

$$\frac{P_1}{\rho g} + h_1 = \frac{P_2}{\rho g} + h_2$$

$$(P_1 - Patm) = (h_2 - h_1) . \rho . g$$

$P_{man} = (0,35) . 1000 . 9,81 = 3,43\ KPa$.

Equação do momento do escoamento unidimensional permanente

$$\Sigma \vec{F} = \sum_S \beta . \dot{m} \vec{V} - \Sigma \beta \dot{m} . \vec{V}$$

$\Sigma F_x = F_{Rx} + P_1 . A = \beta . \dot{m} . V_2 \cos\theta - \beta \dot{m} V_1$, logo $F_{Rx} = \beta \dot{m} . V_2 \cos\theta - \beta \dot{m} V_1 - P_1 . A$.

$F_{Rz} = \beta \dot{m} V_2 \operatorname{sen}\theta$

$F_{Rx} = 1,03 . V_2 . \cos 90° - 1,03 . 25 . 3,18 - 3,43 \times 10^3 . (\frac{\pi . 0,1^2}{4}) = -108,82\ N$.

$F_{RZ} = 1,03 . 3,18 . 25 . 1 = 81,9\ N$

$F = \sqrt{(-108,82)^2 + 81,9^2} = 136,19\ N$ $\theta = tg^{-1} \frac{F_{RZ}}{F_{RX}} = tg^{-1} \frac{81,9}{-108,82} = -36,96° = 143,03°$.

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6.24 - $\dot{m} = 30\ Kg/s$ Como $V = \frac{\dot{m}}{\rho . A}$

$\theta = 45°$

$P_2 = Patm$

$A_1 = 150\ cm^2$ $V_1 = \frac{30}{1000 . 150 . 10^{-4}} = 2\ m/s$.

$A_2 = 25\ cm^2$

$h = 40\ cm$. $V_2 = \frac{30}{1000 . 25 . 10^{-4}} = 12\ m/s$.

$m = 50\ Kg$

$\beta = 1,03$.

Utilizando Bernoulli, temos

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + h_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + h_2$$

$$(P_2 - P_2) = \rho \left(\frac{V_2 - V_1}{2}\right) + (h_2 - h_1) . \rho g$$

$$P_{man} = 1000 . \left(\frac{12 - 2}{2}\right) + (0,4)\ 1000 . 9,81$$

$$P_{man} = 73,92\ KPa$$

Logo aplicando na equação dos momentos temos

$F_{Rx} + P_1 . A_1 = \beta . \dot{m} . V_2 \cos\theta - \beta . \dot{m} . V_1$

$F_{Rx} = \beta . \dot{m} . V_2 \cos\theta - \beta . \dot{m} . V_1 - P_{man} . A_1$

$F_{Rx} = 1,03 . 30 . 12 . \cos 45 - 1,03 . 30 . 2 - 73,92 . 150 . 10^{-4}$

$F_{Rx} = 262,19 - 61,8 - 1108,8 = -908,4\ N$.

$F_{Rz} - W = \beta . \dot{m} . V_2 . \operatorname{sen}\theta$

$F_{Rz} = \beta . \dot{m} . V_2 . \operatorname{sen}\theta + W$

$F_{Rz} = 1,03 . 30 . 12 . \operatorname{sen} 45 . 50 . 9,81$.

$F_{Rz} = 752,69$

$F = \sqrt{(908,4)^2 + 752,69^2} = 1179,72\ N$

$\theta = tg^{-1} \frac{F_{Rz}}{F_{Rx}} = -39,64°$.

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6.26 $V_{água} = 15\ m/s$

$V_{carro} = 5\ m/s$

$\dot{m} = 25\ kg/s$

a) $V_R = V_{água} - V_{carro} = 15 - 5 = 10\ m/s = V_1$ como $V_2 = 0$ temos

$$\Sigma F = \cancel{\Sigma \beta \dot{m} V_2}^{0} - \Sigma \beta \dot{m} V_1$$

$$-F_R = -\beta \cdot \dot{m} V_1 \quad = \quad -F_R = -1.$$

Encontrando a vazão relativa temos

$$\dot{m}_r = \frac{V_R}{V_{jato}} \cdot V_{jato} = \frac{10 \cdot 25}{15} = 16{,}67\ kg/s$$

$$F_e = 1 \cdot 16{,}67 \cdot 10 = 166{,}7\ N.$$

$$P = F_{reio} \cdot V_{carro} = 166{,}7 \cdot 5 = 833{,}5\ W.$$

6.30 $D = 90\ m$ $\quad P = F \cdot V \quad \dot{m} = \rho \cdot A \cdot V$

$P = ?$

$V_{vento} = 25\ km/h$

$$\dot{m} = 1{,}25\ kg/m^3 \cdot \frac{\pi \cdot 90^2}{4} \cdot 25 \cdot 3{,}6 = 55223{,}3\ kg/s$$

eficiência $= 32\%$

$\rho_{ar} = 1{,}25\ kg/m^3$

$$W_{máx} = \dot{m} \cdot \frac{V_1^2}{2} = 55223{,}3 \cdot \frac{\left(\frac{25}{3{,}6}\right)^2}{2} = 1331{,}58\ kW$$

a) Temos que $\eta = \frac{W_{eixo}}{W_{máx}} \Rightarrow W_{eix} = \eta \cdot W_{máx}$

$$W_{eixo} = 0{,}32 \cdot 1331{,}58 = 426{,}1\ kW.$$

b) $\cancel{\dot{m}} \frac{V_2^2}{\cancel{2}} = \cancel{\dot{m}} \frac{V_1^2}{\cancel{2}} (1 - \eta)$

$$V_2 = V_1 \cdot \sqrt{1 - \eta_{mec}} \quad \Rightarrow V_2 = \frac{25}{3{,}6} \cdot \sqrt{1 - 0{,}32} = 5{,}72\ m/s$$

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$F = \beta \cdot \dot{m} \cdot \vec{V}_2 - \beta \cdot \dot{m} \cdot \vec{V}_1$, sendo $\beta = 1$ temos

$f = \dot{m}(\vec{V}_2 - \vec{V}_1) = 55{,}22\,(5{,}72 - 6{,}94) = -67{,}3\ KN$.

6.31. $d_{saída} = 6cm$ a) Velocidade média $\frac{5\,m^3}{1\,min} \cdot \frac{1\,min}{60s} = \frac{5}{60}\ m^3/s$.

$\dot{V} = 5\ m^3/min$ b) Força horizontal.

$\dot{V} = V \cdot A \Rightarrow V = \frac{\dot{V}}{A} \Rightarrow \frac{5/60\ m^3/s}{\pi \cdot 0{,}03^2} = 29{,}5\ m/s$.

b)

$\dot{m} = \dot{V} \cdot \rho = 8{,}34 \times 10^{-2} \cdot 1000 = 83{,}4\ Kg/s$.

$f = \dot{m}(\vec{V}_2 - \vec{V}_1^{\,0})$

$f = 83{,}3 \cdot (29{,}5) \cong 2460\ N$.

6.34. $m_{helicóptero} = 10.000\ Kg$ a) $F = \beta \cdot \dot{m} \cdot \vec{V}_2 - \beta \cdot \dot{m} \cdot \vec{V}_1^{\,0}$, $F = -W_{(peso)}$

rotação em carga $= 400\ rpm$ ↓

$d_{hélice} = 15\ m$ $W = \dot{m} \cdot \vec{V}_2$, $\dot{m} = \rho \cdot V \cdot A$

$V_{máx} = 400\ rpm$ $W = (\rho \cdot \vec{V}_2 \cdot A) \cdot \vec{V}_2$

$m_{Carga} = 15.000\ Kg$ $V^2 = \frac{W}{\rho \cdot A} \Rightarrow V = \sqrt{\frac{10000 \cdot 9{,}81}{1{,}18 \cdot \frac{\pi \cdot 15^2}{4}}} = 21{,}69\ m/s$

Encontrando a vazão volumétrica.

$\dot{V} = V \cdot A = 21{,}69 \cdot 176{,}71 = 3832{,}8\ m^3/s$

$\dot{m} = \dot{V} \cdot \rho = 3832{,}8 \times 1{,}18 = 4522{,}70\ Kg/s$.

Encontrando a potência

$W = \dot{m} \frac{V_2^2}{2} = 4522{,}7 \cdot \frac{21{,}69^2}{2} \cong 1063{,}86\ KW$.

b) $W = m \cdot V_2$ $V_2 = \sqrt{\frac{(15000+10000) \cdot 9{,}81}{1{,}18 \cdot \frac{15^2 \pi}{4}}} = 34{,}3\ m/s$.

$W = \rho \cdot A \cdot V_2 \cdot V_2$

$V_2 = \sqrt{\frac{W}{\rho A}}$.

Vazão volumétrica

$\dot{V} = A \cdot V = \frac{15^2 \cdot \pi}{4} \cdot 34{,}3 = 6061{,}31$

$\dot{m} = \rho \cdot \dot{V} = 1{,}18 \cdot 6061{,}31 = 7152{,}34\ Kg/s$.

$W = \dot{m} \frac{V^2}{2} = 7152{,}34 \cdot \frac{34{,}3^2}{2} = 4207{,}32\ KW$.

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V_2 = RPm $V_{2\,corr}$ = RPM corrig.

$V_{2\,desc}$ = RPM desc

34,3 → RPm ⇒ RPM corrig. = 632,54 RPM.

21,69 → 400

6.49. ① $P = 200 KPa$ ② $P = 150 KPa$ ③ $\dot{m} = 8\ kg$ $\beta = 1,03$

$\dot{m} = 30 kg/s$ $\dot{m} = 22\ kg/s$ $P = 100\ KPa$

$d = 5\ cm$ $d = 10\ cm$ $d = 3\ cm$

$fx = ?$ $\dot{m} = \rho . V . A$ $V = \frac{\dot{m}}{\rho A}$ $V_1 = \frac{30}{1000 . 0,05^2 . \pi / 4} = 15,27\ m/s$

$Fy = ?$

$V_2 = \frac{22}{1000 \times \pi . 0,1^2 / 4} = 2,8\ m/s$

$V_3 = \frac{8}{1000 \times \pi . 0,03^2 / 4} = 11,31\ m/s.$

$\Sigma F_x = \beta \dot{m}_2 V_2 - \beta \dot{m}_1 V_1$

Logo $F_{Rx} + P_1 . A_1 + P_2 . A_2 = (\beta \dot{m}_2 (-V_2) - \beta . \dot{m}_1 . V_1$ | $\times 1000$

$F_{Rx} + (200 \cdot 1000) \frac{\pi . 0,05^2}{4} + (150 \cdot 1000) \frac{\pi . 0,1^2}{4} = 1,03 . 22 . (-2,8) - 1,03 . 30 . 15,27$

$F_{Rx} = -0,14 - 0,109 - 0,39 = -690,15\ N.$

$F_{Rz} = \Sigma F_z = \beta . \dot{m}_3 . V_3$ ⇒ $F_z = 1,03 . 8 . 11,31 = 93,1\ N.$