

V_5 ; H_M ; P_2 ; h ; A ; F_{bocal}

① Cálculo de H_M

$$H_M = \frac{V_0^2}{2g} + \frac{P_0}{\gamma} + z_0 = \frac{2 \text{ kgf} \times 10^4}{1000} + 10 \text{ m} = 30 \text{ mca.}$$

② Cálculo de V_5

$$H_0 = H_5 + \text{perdas}$$

$$H_0 = 30 \text{ mca.}$$

$$H_5 = \frac{V_5^2}{2g} + \frac{P_5}{\gamma} + z_5 \quad \text{c/ } P_5 = 0 \text{ (atmosférico)} \text{ e } z_5 = 5 \sin 45^\circ = \underline{\underline{3,53 \text{ m}}}$$

$$\text{perdas} = \sum f \frac{L}{D} \frac{V^2}{2g} + K_{s1} \frac{V_2^2}{2g} + K_{s3} \frac{V_6^2}{2g}$$

da Continuidade =

$$V_5 D_5^2 = V_2 D_2^2 \Rightarrow D V_5 = V_2 \left(\frac{D_2}{D_5} \right)^2$$

substituindo tudo, resulta:

$$30 = \frac{V_2^2}{2g} \left(\frac{D_2}{D_5} \right)^2 + 3,53 + \left[0,5 + 1,3 \left(\frac{D_2}{D_6} \right)^2 \right] \frac{V_2^2}{2g} + f \frac{35}{D} \frac{V_2^2}{2g}$$

$$\therefore 11,48 V_2^2 f + 1,865 V_2^2 = 26,47 \quad \text{I}$$

adota-se $f_0 = 0,02$, por exemplo e **I** $\rightarrow V_2 = 3,55 \text{ m/s}$

Calcula-se então

$$Re = \frac{V_2 D_2}{\nu} = \frac{3,55 \times 0,15}{10^{-6}} = 5,33 \times 10^5$$

$$\frac{\epsilon}{D} = 0,001$$

Moody $\Rightarrow f = 0,02$ (sorte!!)
 não precisa iterar.

$$\therefore V_2 = 3,55 \text{ e } V_6 = V_5 = \underline{14,2 \text{ m/s}}$$

③ P_2

Eq. da En. Cinética:

$$H_2 = H_0 - \text{perdas}$$

$$H_2 = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2 = 30 - 0,5 \frac{V_2^2}{2g} - f \frac{L}{D} \frac{V_2^2}{2g}, \text{ onde } \left. \begin{array}{l} L = 20 \text{ m} \\ f = 0,02 \end{array} \right\}$$

substituindo, resulta:

$$\underline{P_2 = 27.374 \text{ kgf/m}^2}$$

④ ~~h~~ h mercúrio.

$$\text{Como } H_2 = H_6 \Rightarrow \frac{V_2^2}{2g} + \frac{P_2}{\gamma} = \frac{V_6^2}{2g} + \frac{P_6}{\gamma} \Rightarrow \frac{P_2 - P_6}{\gamma} = \frac{V_6^2}{2g} - \frac{V_2^2}{2g} \quad \textcircled{\text{I}}$$

e da continuidade $\rho_2 V_2^2 = \rho_6 V_6^2$

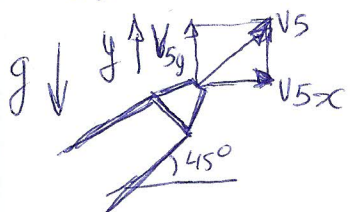
Da lei de Stevin:

$$P_2 + \gamma_{\text{água}} h = \gamma_{\text{Hg}} \cdot h = P_6 \Rightarrow \frac{P_2 - P_6}{\gamma_{\text{água}}} = \frac{(\gamma_{\text{Hg}} - \gamma_{\text{água}}) h}{\gamma_{\text{água}}} \quad \textcircled{\text{II}}$$

Igualando II e III, resulta:

$$\frac{V_6^2 - V_2^2}{2g} = \left(\frac{\gamma_{\text{Hg}} - \gamma}{\gamma} \right) h \Rightarrow \underline{\underline{h = 0,75 \text{ m}}}$$

5) Cálculo de a.



$$V_{5y} = V_5 \frac{\sqrt{2}}{2} = 14,2 \frac{\sqrt{2}}{2} = 10,04 \text{ m/s}$$

Balística $V = V_0 + at$

$$0 = 10,04 - 9,8t \Rightarrow t = 1,024 \text{ s}$$

$$e \ y = y_0 + V_{0y}t + \frac{1}{2}at^2 \Rightarrow$$

$$3,53 + 10,04 \times 1,024 - \frac{1}{2} \times 9,8 (1,024)^2 \Rightarrow$$

$$\underline{\underline{y = 8,67 \text{ m}}}$$