Properties of Water

$$\rho = 10^3\,\mathrm{kg/m^3}$$
$$\mu = 10^{-3}\,\mathrm{Pa\cdot s}$$
$$\gamma = 72.9\,\mathrm{mN/m}\ \text{(air interface)}$$

Properties of Air at 27°C and 100 kPa

$$\rho = 1.18\,\mathrm{kg/m^3}$$
$$\mu = 1.86\times10^{-5}\,\mathrm{Pa\,s}$$

Unit Conversions & Constants

$$1\,\mathrm{m} = 3.2808\,\mathrm{ft}$$
$$1\,\mathrm{kPa} = 0.1450\,\mathrm{psi}$$
$$1\,\mathrm{atm} = 101.3\,\mathrm{kPa} = 14.7\,\mathrm{psi}$$
$$1\,\mathrm{kg} = 2.2056\,\mathrm{lbm}$$
$$1\,\mathrm{slug} = 32.174\,\mathrm{lbm}$$
$$1\,\mathrm{lbf} = 4.448\,\mathrm{N} = 1\,\mathrm{slug\cdot ft/s^2}$$
$$g = 9.807\,\mathrm{m/s^2} = 32.17\,\mathrm{ft/s^2}$$

Equations

$$x_{n+1} = x_n - f(x_n)/f'(x_n)$$

$$\tau = \mu s$$

$$\tau_w = -\frac{A}{C}\frac{\Delta\mathcal{P}}{L}$$

$$D_H = \frac{4A}{C}$$

$$f = \frac{-\Delta\mathcal{P}}{L}\frac{D_H}{2\rho U^2}$$

$$\mathcal{P}_i = P_i + \rho g h_i$$

$$f = \begin{cases} \dfrac{16}{\mathrm{Re}}, & \mathrm{Re} < 2100 \\ \left[3.6\log\left(\dfrac{\mathrm{Re}}{6.9}\right)\right]^{-2}, & \mathrm{Re} > 5000 \end{cases}$$

$$\frac{1}{\sqrt{f}} = -4\log\left(\frac{1.26}{\mathrm{Re}\sqrt{f}} + \frac{k}{3.7D}\right)$$

$$f = \left\{3.6\log\left[\frac{6.9}{\mathrm{Re}} + \left(\frac{k}{3.7D}\right)^{1.11}\right]\right\}^{-2}$$

$$\tau = m s^n$$

$$\mathrm{Re_{PL}} = \frac{8\rho U^{2-n} D^n}{m\left[\frac{2(3n+1)}{n}\right]^n}$$

$$f = \frac{16}{\mathrm{Re_{PL}}}$$

$$\frac{1}{\sqrt{f}} = \frac{4.0}{n^{0.75}}\log\left(\mathrm{Re_{PL}}\, f^{1-n/2}\right) - \frac{0.4}{n^{1.2}}$$

$$C_D = \frac{2F_D}{\rho U^2 A_\perp}$$

$$C_{D,\mathrm{sphere}} = \begin{cases} \dfrac{24}{\mathrm{Re}}, & \mathrm{Re} < 1 \\ 0.445, & 750 < \mathrm{Re} < 2\times10^5 \\ 0.2, & \mathrm{Re} > 10^6 \end{cases}$$

$$C_{D,\mathrm{disk}} = \begin{cases} \dfrac{64}{\pi\mathrm{Re}}, & \mathrm{Re} < 1 \\ 1.17, & \mathrm{Re} > 133 \end{cases}$$

$$C_{D,\mathrm{cylinder}} = \begin{cases} \dfrac{8\pi}{\mathrm{Re}\ln(7.4/\mathrm{Re})}, & \mathrm{Re} \ll 1 \\ 1.2, & 10^2 < \mathrm{Re} < 2\times10^5 \\ 0.3, & \mathrm{Re} > 2\times10^5 \end{cases}$$

$$C_f = \frac{2F_D}{\rho U^2 L W}$$

$$C_f = \begin{cases} 1.328\,\mathrm{Re}^{-1/2}, & 10^2 < \mathrm{Re} < 3\times10^5 \\ \dfrac{0.455}{(\log\mathrm{Re})^{2.58}} - \dfrac{1050}{\mathrm{Re}}, & \mathrm{Re} > 3\times10^5 \end{cases}$$

$$\frac{\delta}{L} \approx \mathrm{Re}_L^{-1/2}$$

$$\nabla P = \rho \boldsymbol{g}$$

$$\boldsymbol{F}_P = -\int \boldsymbol{n} P\, dS$$