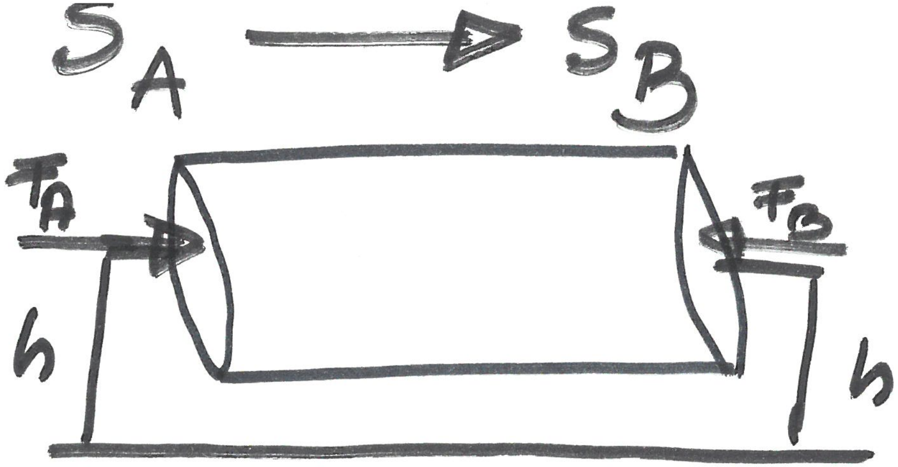


CONDOTTO RIGIDO
SEZIONE COSTANTE
ALTEZZA COSTANTE

→ NO ATTRITO

FLUIDO IDEALE

$$\cancel{\Delta E_k} + \cancel{\Delta U} + \cancel{\Delta I} = L_e$$

$v_A = v_B$
perche' $S_A = S_B$

$h_A = h_B$

$$L_e = P_A V - P_B V = 0 \longrightarrow (P_A - P_B) V = 0$$

$$\boxed{P_A = P_B}$$

FLUIDO VISCOSO

$$\cancel{\Delta E_k} + \cancel{\Delta U} + \Delta I = L_e$$

$\Downarrow$

fluido viscoso $\Delta I \neq 0$

$$\Delta I = L_e$$

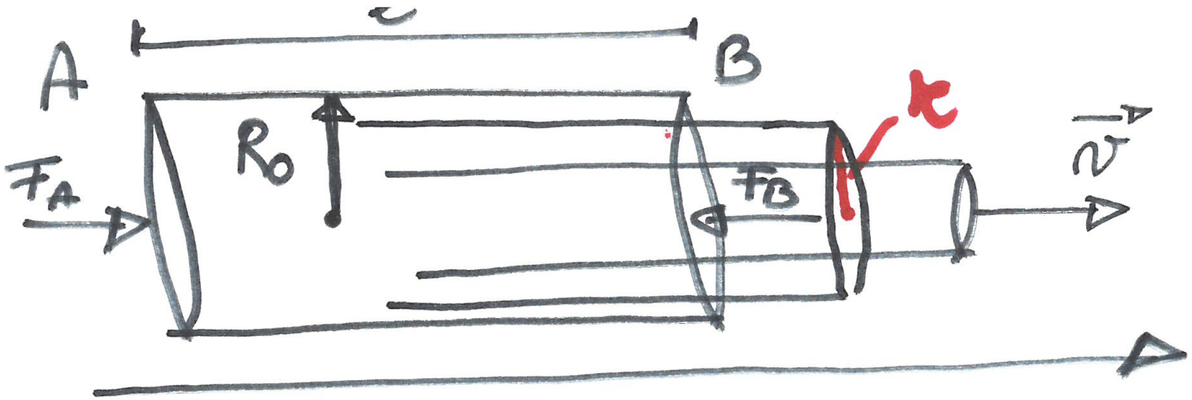
$$\Delta I = (P_A - P_B)V$$

$$\frac{\Delta I}{V} = \frac{P_A \cancel{V}}{\cancel{V}} - \frac{P_B \cancel{V}}{\cancel{V}} \longrightarrow \boxed{P_B = P_A - \frac{\Delta I}{V}}$$

$$P_B \neq P_A$$

$$P_B < P_A$$

DIMINUZIONE DELLA PRESSIONE



$$S_A = S_B$$

$$F_v = -\eta A \frac{dv}{dz} = +\eta\,(2\pi r \cdot l)\,\frac{dv \;<0}{dr \;>0}$$

$$F_p = P_A S_A - P_B S_B = (P_A - P_B)\,S = (P_A - P_B)\,\pi r^2$$

$$\vec{F_v} + \vec{F_p} = 0$$

$$\eta\,(2\cancel{\pi}\cancel{r}\,l)\,\frac{dv}{dr} + (P_A - P_B)\,\cancel{\pi}\,r^{\cancel{2}} = 0$$

$$dv = -\frac{(P_A - P_B)\,r}{2\eta\, l}\,dr$$

$$\int dv = \int -\frac{(P_A - P_B)}{2\eta e} r \, dr$$

INTEGRALE INDEFINITO $v(r)$

$$v = -\frac{P_A - P_B}{2\eta e} \frac{r^2}{2} + C$$

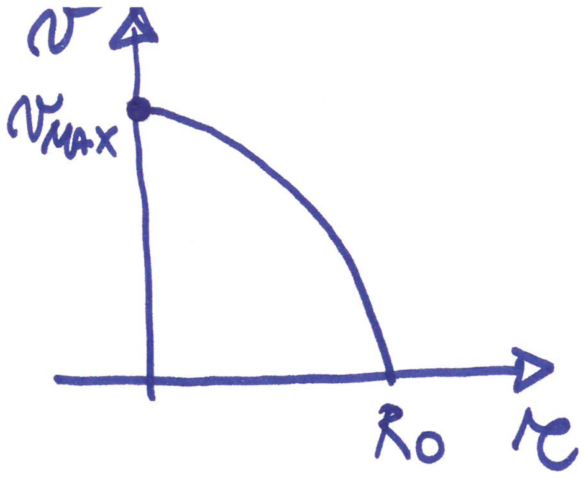
$r = R_0 \qquad v = 0 \qquad 0 = -\frac{P_A - P_B}{2\eta e} \frac{R_0^2}{2} + C$

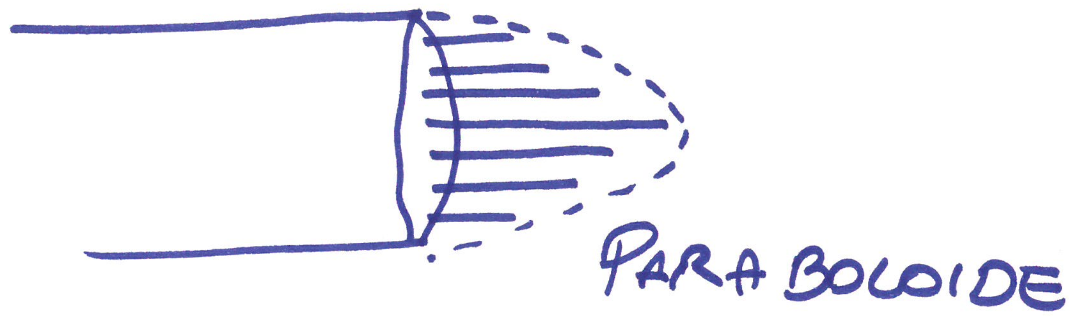
$$C = \frac{P_A - P_B}{2\eta e} \frac{r_0^2}{2}$$

$$\boxed{v = -\frac{P_A - P_B}{2\eta e} \frac{r^2}{2} + \frac{P_A - P_B}{2\eta e} \frac{R_0^2}{2}}$$

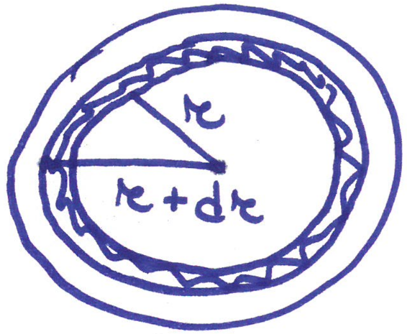
COSTANTE COSTANTE

$$\boxed{v = -C r^2 + C_1}$$





$$Q = v\,S \qquad dQ = v\,dS$$



$$\boxed{dQ = v \cdot 2\pi r\,dr}$$

$$S = \pi r^2$$

$$dS = \pi (r+dr)^2 - \pi r^2 = \cancel{\pi r^2} + \underbrace{\pi\,dr^2}_{\text{trascurabile}} + \boxed{2\pi r\,dr} - \cancel{\pi r^2} = dS = 2\pi r\,dr$$

$$dQ = \left(-\frac{P_A - P_B}{2\eta\ell}\frac{r^2}{\cancel{2}} + \frac{P_A - P_B}{2\eta\ell}\frac{R_0^2}{\cancel{2}} \right) \cdot \cancel{2}\pi r\, dr$$

$$\int_0^{R_0} dQ = \frac{(P_A - P_B)}{2\eta\ell}\pi \int_0^{R_0} \left(-r^2 + R_0^2\right) r\, dr$$

CALCOLO ⊛

$$\boxed{Q = \frac{\pi R_0^4}{8\eta\ell}(P_A - P_B)}$$

LEGGE di POSEUILLE

$$\underbrace{P_A - P_B}_{\text{CAUSA}} = \frac{8\eta\ell}{\pi R_0^4} \cdot \underbrace{Q}_{\text{EFFETTO}}$$

$$Q = \frac{(P_A - P_B)\,\overline{u}}{2\eta e} \cdot \int_0^{R_0} \left(-r^2 + R_0^2\right) r\,dr$$

CALCOLO SOLO

$$\int_0^{R_0} \left(-r^3 + R_0^2 r\right) dr = \int_0^{R_0} -r^3\,dr + \int_0^{R_0} R_0^2\, r\,dr =$$

$$= \left[-\frac{r^4}{4}\right]_0^{R_0} + R_0^2 \left[\frac{r^2}{2}\right]_0^{R_0} = -\frac{R_0^4}{4} + \frac{R_0^4}{2} = \frac{R_0^4}{4}$$

$$\Longrightarrow Q = \frac{(P_A - P_B)\,\overline{u}}{2\eta e} \cdot \frac{R_0^4}{4} = \frac{\overline{u}\,R_0^4}{8\eta e}\left(P_A - P_B\right)$$

6bis

$$\frac{8\eta l}{\pi R_0^4} = R_F$$ RESISTENZA FLUIDODINAMICA

$$\boxed{P_A - P_B = R_F \cdot Q}$$

$(\Delta V = R\, I)$ Ohm

$$R_e = \rho \frac{l}{S} = \rho \frac{l}{\pi r^2}$$

$$\Delta P_v = - R_F Q$$

VISCOSO

Th Bernoulli x FLUIDO VISCOSO

$$\boxed{\Delta P_d + \Delta P_g + \Delta P + \Delta P_v = 0}$$

MOTO VORTICOSO

$$v_{fluido} > v_{critica}$$

$$v_{critica} = R\,\frac{\eta}{\rho r_0}$$

$$R_F = a\,Q \longrightarrow \Delta P = R_F Q = (a\,Q)\,Q = a\,Q^2$$

DIRETTAMENTE PROPORZIONALE ALLA PORTATA

$\neq$ MOTO LAMINARE DOVE R E' COSTANTE

$$\Delta P = a\,Q^2$$

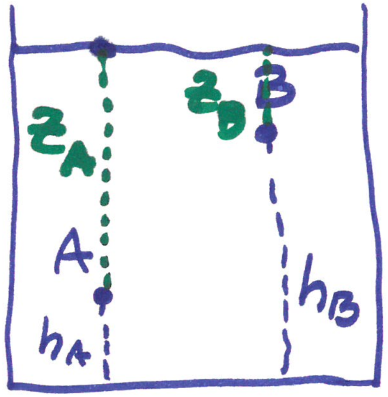
$$Q = \sqrt{\frac{\Delta P}{a}}$$

$$\boxed{Q = \sqrt{\frac{1}{a}} \cdot \sqrt{\Delta P}}$$

η UNITA' di MISURA

$$F_v = \eta \cdot A \frac{dv}{dr}$$

$$\eta = \frac{F_v \cdot dr}{A \cdot dv} = \frac{N \cdot \cancel{m}}{m^2 \, \frac{\cancel{m}}{s}} = Pa \cdot s$$



FLUIDO IN QUIETE $v = 0$

$$\cancel{\Delta P_d} + \Delta P_g + \Delta P + \cancel{\Delta P_v} = 0$$

$$\delta g h_B - \delta g h_A + P_B - P_A = 0$$

$$P_B = P_A + \delta g h_A - \delta g h_B$$

$$P_B = P_A + \delta g (h_A - h_B)$$

$$P_B = P_A + \delta g (z_B - z_A)$$

$$h_A + z_A = h_B + z_B$$

$$h_A - h_B = z_B - z_A$$

A LO PORTO SULLA SUPERFICIE $z_A = 0$

$$P_A = P_0$$

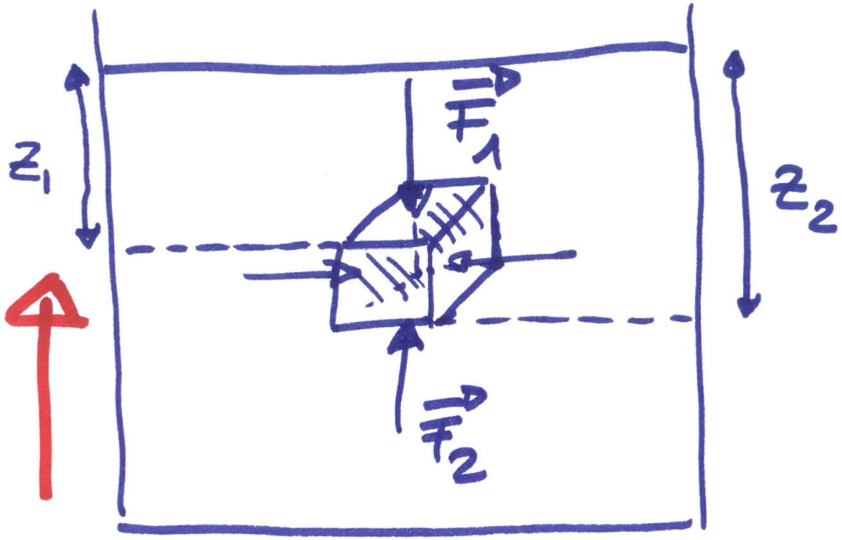
P. di PASCAL
SE $g = 0$ (NO GRAVITA')
$P = P_0$ in ogni punto

$$\boxed{P_B = P_0 + \delta g z_B}$$

LEGGE di STEVINO 10

SPINTA di ARCHIMEDE

ℓ = LATO CUBO



$$F_1 = P_1 S = (P_0 + \delta g z_1) \cdot \ell^2$$

$$F_2 = P_2 S = (P_0 + \delta g z_2) \cdot \ell^2$$

$$\vec{F} = \vec{F}_1 + \vec{F}_2$$

$$F = -F_1 + F_2 =$$

$$F = -(P_0 + \delta g z_1)\ell^2 + (P_0 + \delta g z_2)\ell^2$$

$$= \cancel{-P_0 \ell^2} - \delta g z_1 \ell^2 + \cancel{P_0 \ell^2} + \delta g z_2 \ell^2$$

$$= \delta g \ell^2 (\underbrace{z_2 - z_1}_{\ell}) = \delta g \ell^3 = \delta_F g V = m_F g$$

Spinta di Archimede:

Un corpo immerso in un fluido riceve una spinta dal basso verso l'alto pari al peso del fluido spostato