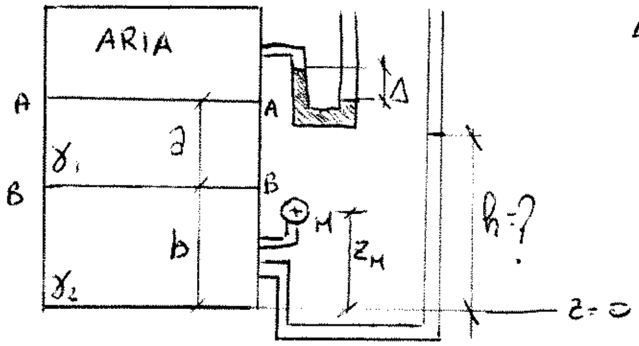
Esercizio 1



$\Delta = 2$ cm $a = b = 1$ m $z_M = 0{,}7$ m

$\gamma_1 = 9800$ N/m³ $\gamma_2 = 11240$ N/m³

$\gamma_m = 133300$ N/m³

INCOGNITE: $h = ?$ $m = ?$

$P_{ARIA} = -\Delta\gamma_M = (-0{,}02 \cdot 133300)\,Pa = -2666\ Pa$

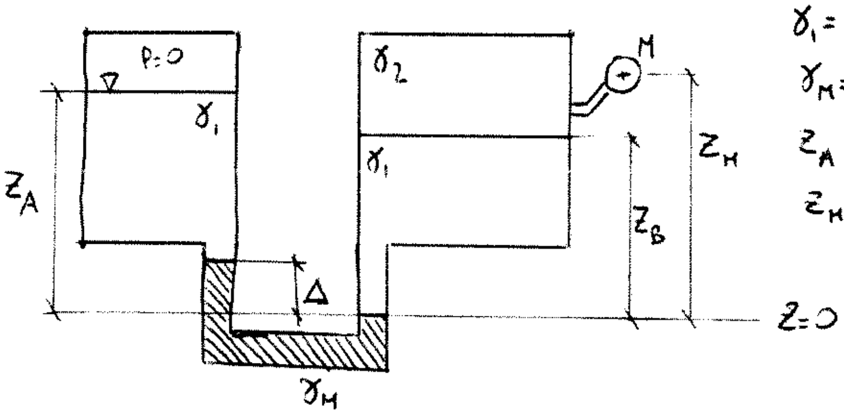
$P_{AA} = P_{ARIA}$ $P_{BB} = P_{AA} + \gamma_1 \cdot a = (-2666 + 9800 \cdot 1)\,Pa = 7134\ Pa$

$P_{z=0} = P_{BB} + \gamma_2 \cdot b = (7134 + 11240 \cdot 1)\,Pa = 18374\ Pa$

$h = \dfrac{P_{z=0}}{\gamma_2} = \dfrac{18374}{11240}\ m = 1{,}635\ m$

$m = P_{z=0} - z_M\,\gamma_2 = (18374 - 0{,}7 \cdot 11240)\,Pa = 10506\ Pa = 0{,}104\ atm$

Esercizio 2



$\gamma_1 = 9800$ N/m³ $\gamma_2 = 7840$ N/m³

$\gamma_M = 133\,300$ N/m³ $\Delta = 0{,}3$ m

$z_A = 1$ m $z_B = 0{,}9$ m

$z_M = 1{,}4$ m

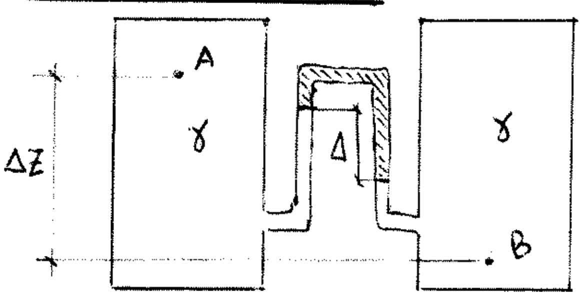
INCOGNITA: $m = ?$

$\delta = \Delta\,\dfrac{\gamma_M - \gamma_1}{\gamma_1} = 0{,}3\ \dfrac{133\,300 - 9800}{9800}\ m = 3{,}78\ m$

$P_B = (z_A + \delta - z_B) \cdot \gamma_1 = 38030\ Pa$

$m = P_B - (z_m - z_B)\,\gamma_2 = 34110\ Pa = 0{,}348\ Kg/cm^2$

Esercizio 3



$\gamma = 9500$ N/m³ $\gamma_m = 8600$ N/m³

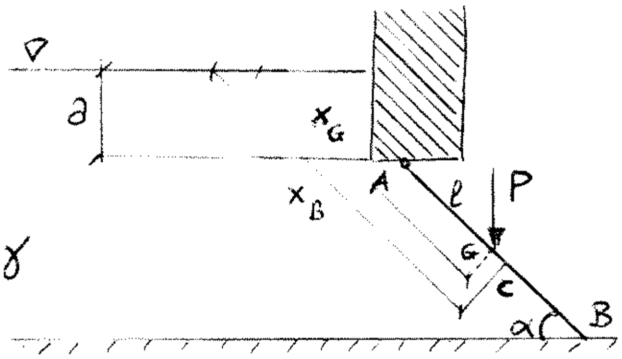
$\Delta = 0{,}15$ m $\Delta z = 0{,}50$ m

INCOGNITA: Δp tra A e B ?

$$\delta = \Delta \frac{\gamma - \gamma_m}{\gamma} = \left(0{,}15 \; \frac{9500-8600}{9500}\right) m = 0{,}01421 \text{ m}$$

$$\Delta p = (\Delta z - \delta)\,\gamma = 4615 \text{ Pa}$$

Esercizio 4



Dati: $a = 0{,}1$ m $\alpha = 45°$
$l = 2$ m $\gamma = 9800 \; N/m^3$

INCOGNITE:
P.? se superficie AB incernierata in A
P'.? se superficie AB incernierata in B

$$p_G = \left(a + \frac{l}{2}\sin\alpha\right)\gamma = \left(0{,}1 \cdot \frac{\sqrt{2}}{\cancel{2}} \cdot \frac{\cancel{2}}{2}\right) 9800 \text{ Pa} = 7909{,}65 \text{ Pa}$$

$$S = \Omega \cdot p_G = l \cdot 1 \cdot p_G = (2 \cdot 1 \cdot 7909{,}65)\text{ N} = 15819{,}3 \text{ N}$$

$$x_G = \frac{l}{2} + \frac{a}{\sin\alpha} = \left(\frac{2}{2} + \frac{0{,}1\sqrt{2}}{\sqrt{2}}\right) m = 1{,}141 \text{ m}$$

$$GC = \frac{h^3 b/12}{x_G \cdot \Omega} = \frac{l^3 \cdot 1/12}{x_G \cdot l \cdot 1} = \frac{2^2}{12 \cdot 1{,}141} = 0{,}292 \text{ m}$$

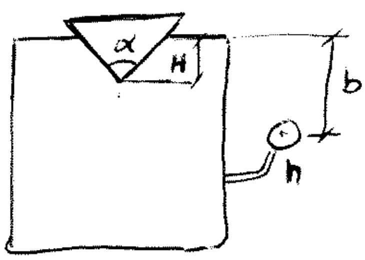
$$AC = GC + AG = (0{,}292 + 1)\,m = 1{,}292 \text{ m}$$

A) $\frac{P}{\sqrt{2}} \cdot \frac{l}{2} = S \cdot AC \Rightarrow P = \sqrt{2} \cdot \frac{2}{l} \cdot S \cdot AC = 28904$ N

$BC = l - AC = 0{,}708$ m

B) $\frac{P'}{\sqrt{2}} \cdot \frac{l}{2} = S \cdot BC \Rightarrow P' = \sqrt{2} \cdot \frac{2}{l} \cdot S \cdot BC = 15839$ N

Esercizio 5



$n = 0{,}07 \; \frac{kg}{cm^2}$ $H = 0{,}10$ m $b = 0{,}30$ m

$\alpha = 60°$ $\gamma = 9800 \; N/m^3$

INCOGNITE $S = ?$ spinta che agisce sulla valvola per garantirne la chiusura

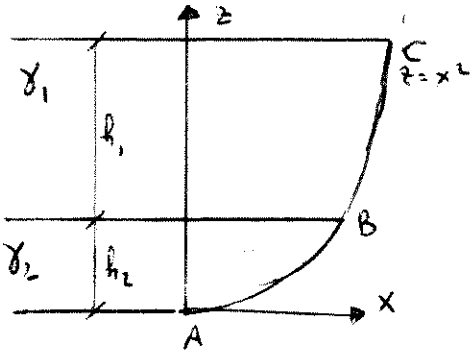
$$V_{valv} = \frac{1}{3}\,\frac{\ell^2}{4}\cdot H\cdot\pi = \frac{1}{3}\left(\frac{2H}{\sqrt{3}}\right)^2\cdot\frac{H\pi}{\cancel{4}} = \frac{H^3}{9}\pi$$

$$V_{cil\ equiv} = \frac{\ell^2}{4}\pi\cdot H' = \frac{4}{3}H^2\frac{\pi}{\cancel{4}}H' = V_{valv}$$

$$H' = \frac{H}{3} = \cancel{0{,}00333\ m}\ \ 0{,}0333\ m$$

$$S = \left(\frac{n}{\gamma} + b + H'\right)\gamma\cdot\frac{1}{3}H^2\pi = 44{,}52\ N$$

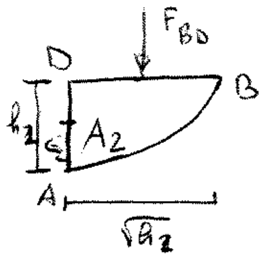
Esercizio 6



$\gamma_1 = 9800\ N/m^3$ $\quad\gamma_2 = 11760\ N/m^3$

$h_1 = 1\ m$ $\quad h_2 = 0{,}5\ m$

INCOGNITA: trovare la spinta sulla superficie $\widehat{ABC}$

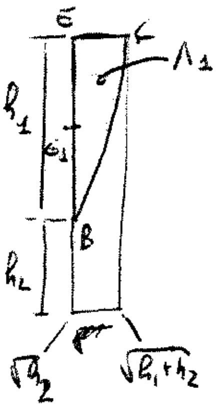


$$A_2 = h_2\sqrt{h_2} - \int_0^{\sqrt{h_2}} x^2\,dx = \sqrt{h_2^3} - \frac{1}{3}\sqrt{h_2^3} = 0{,}2357\ m^2$$

$$\cancel{P_{2D} = \gamma_2 A_2}\quad P_2 = \gamma_2 A_2\cdot 1 = 2771{,}83\ N$$

$$p_{BD} = \gamma_1 h_1 = 9800\ Pa \Rightarrow F_{BD} = p_{BD}\sqrt{h_2} = 6929{,}65\ N$$

$$p_{G_2} = \gamma_1 h_1 + \gamma_2\frac{h_2}{2} = 12740\ N \Rightarrow F_{AD} = p_{G_2}\cdot h_2\cdot 1 = 6370\ N$$



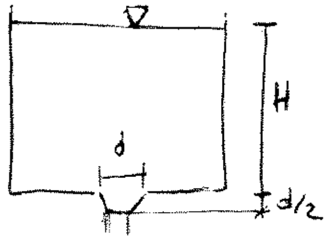
$$A_1 = \left(\sqrt{h_1+h_2} - \sqrt{h_2}\right)(h_1+h_2) - \int_{\sqrt{h_2}}^{\sqrt{h_1+h_2}} x^2\,dx = 0{,}28184\ m^2$$

$$P_1 = \gamma_1 A_1\cdot 1 = 2763\ N \qquad F_{EC} = 0\ N$$

$$F_{G1} = \frac{h_1}{2}\cdot\gamma_1\cdot h_1\cdot 1 = 4900\ N$$

$$\left.\begin{aligned} S_v &= P_1 + P_2 + F_{BD} = 12464{,}5\ N \\ S_o &= F_{G1} + F_{AD} = 11270\ N \end{aligned}\right\}\quad \begin{aligned} S &= \sqrt{S_v^2 + S_o^2} = 16804\ N \\ \alpha &= \arctan\left(\frac{S_v}{S_o}\right) \approx 47{,}9° \end{aligned}$$

Esercizio 7



$\Omega = 7\,m^2 \quad H = 3\,m \quad d = 0{,}15\,m \quad C_c = 0{,}6$

INCOGNITA: tempo di svuotamento del serbatoio

$u = \sqrt{2gh} \qquad 0 < h \leq H$

$$dV = C_c \pi \frac{d^2}{4}\sqrt{2gh}\,dt = \Omega\, dh$$

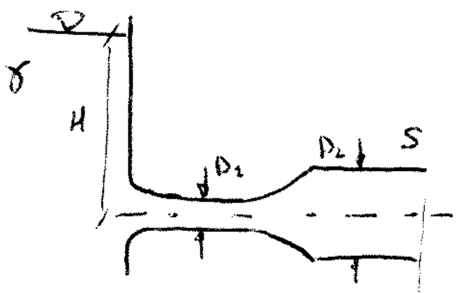
$$\Downarrow$$

$$C_c \pi \frac{d^2}{4}\sqrt{2g}\,dt = \Omega \frac{dh}{\sqrt{h}} \qquad \text{integrano}$$

$$C_c \pi \frac{d^2}{4}\int_0^T dt\,\sqrt{2g} = \Omega \int_0^H \frac{dh}{\sqrt{h}} \Rightarrow C_c \pi \frac{d^2}{4}\sqrt{2g}\,T = \Omega \frac{1}{2}\sqrt{H}$$

$$T = \frac{\frac{1}{2}\Omega\sqrt{H}}{\pi\frac{d^2}{4}C_c\sqrt{2g}} \cong 516\ s$$

Esercizio 8



$\gamma = 9800\ N/m^3 \quad H = 2m \quad D_1 = 0{,}05m$

$D_2 = 0{,}075\,m \quad P_S = 0\ Pa$

Trovare portata nella tubazione e pressione relativa nel condotto 1

Sulla sezione S si ha: $H = \frac{u_2^2}{2g} \Rightarrow u = \sqrt{2gH} = 6{,}264\ m/s$

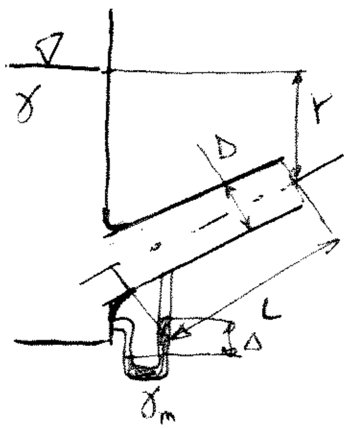
$$Q_1 = Q_2 \Rightarrow u_1 = u_2 \frac{\Omega_2}{\Omega_1} = u_2 \cdot \frac{D_2^2}{D_1^2} = 14{,}094\ m/s$$

$$Q = u_2 \Omega_2 = u_2 \frac{D_2^2}{4}\pi = 0{,}02767\ \frac{m^3}{s} = 27{,}67\ l/s$$

Nel tubo 1 si ha che

$$H = \frac{u_1^2}{2g} + \frac{p_1}{\gamma} \Rightarrow p_1 = \gamma\left(H - \frac{u_1^2}{2g}\right) = -79625\ Pa$$

Esercizio 9



$D = 0{,}025\ m$ $L = 5\ m$ $\nu = 10^{-6}\ \frac{m^2}{s}$

$\Delta = 0{,}01\ m$ $Y = 1\ m$ $\gamma = 9800\ N/m^3$

$\gamma_m = 133300\ N/m^3$

Bisogna trovare la portata Q ponante nella tubazione e la scabrezza ε della tubazione

$$Y = jL + \frac{u^2}{2g} \quad , \quad j = \frac{\lambda}{D}\frac{u^2}{2g}$$

$$\delta = \frac{u^2}{2g} = \Delta\,\frac{\gamma_m - \gamma}{\gamma} = 0{,}126\ m \Rightarrow u = \sqrt{2g\delta} = 1{,}572\ \frac{m}{s}$$

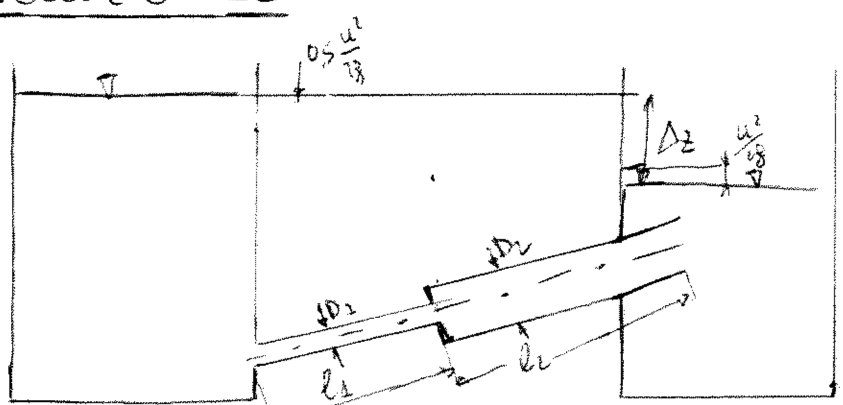
$$Re = \frac{D\,u}{\nu} = 39300$$

$$j = \left(Y - \frac{u^2}{2g}\right)\cdot\frac{1}{L} = 0{,}175 \Rightarrow \lambda = \frac{jD}{u^2/2g} = 0{,}035$$

Leggendo il diagramma di Moody troviamo $\frac{\varepsilon}{D}$ pari a 0,008.

$$\varepsilon = \frac{\varepsilon}{D}\cdot D = 0{,}008\cdot 0{,}025\ m = 2\cdot 10^{-4}\ m$$

Esercizio 10



$D_1 = 125\ mm$ $D_2 = 200\ mm$

$L_1 = 5\ m$ $L_2 = 10\ m$

$\Delta z = 1{,}2\ m$ $\beta' = 0{,}0018\ s^2\ m^{-2/3}$

Incognita: $Q = ?$

$$\Delta z = \frac{1}{2}\frac{u_1^2}{2g} + j_1 l_1 + \frac{(u_2 - u_1)^2}{2g} + j_2 l_2 + \frac{u_2^2}{2g} \qquad j = \beta'\frac{Q^2}{D^{5,33}}$$

$$\Delta z = Q^2\left(\frac{1}{4g\Omega_1^2} + \frac{\beta' l_1}{D^{5,33}} + \frac{\left(\frac{1}{\Omega_2} - \frac{1}{\Omega_1}\right)^2}{2g} + \frac{\beta' l_2}{D^{5,33}} + \frac{1}{\Omega_2^2\,2g}\right) \Rightarrow$$

$$\Rightarrow Q = 0{,}033\ \frac{m^3}{s}$$