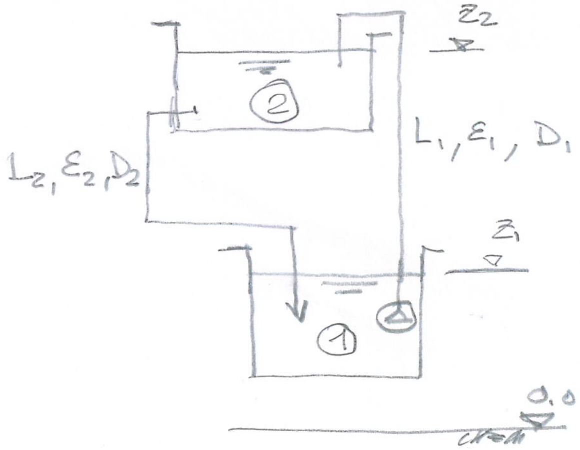
	1	2
z	0,7 m	2,50 m
ε	0,1 mm	0,1 mm
L	3,5 m	5,0 m
D	1,2 cm	0,8 cm
$\sum_i \beta_i$	6,5	21,0



1) Prevalenza pompa
2) β aggiuntivo in L2 per avere una velocità di $1\,m/10'' = 0,20\ m/s$

1)

$$H_1 = H_2 + H_p - \Delta H_d^{12} - \Delta H_c^{12}$$

ipotesi assolutamente turbolento

$$\Delta H_d = \frac{\lambda}{D}\frac{U^2}{2g}\cdot L \quad \text{con} \quad \frac{1}{\sqrt{\lambda}} = -2\lg\left(\frac{\frac{\varepsilon}{D}}{3,71}\right)$$

$$\Rightarrow \lambda = 0,03564$$

$$U_1 \geq U_2$$

$$\begin{cases} z_1 - z_2 + \frac{\lambda}{D}\frac{U^2}{2g}\cdot L + \sum_i \beta_i \frac{U^2}{2g} = H_p \\ Q = \Omega \cdot u \quad \text{dove } \Omega = \pi \frac{D^2}{4} \end{cases}$$

$$\Rightarrow H_p = z_1 - z_2 + \frac{U^2}{2g}\cdot\left(\frac{\lambda}{D}\cdot L + \sum_i \beta_i\right)$$

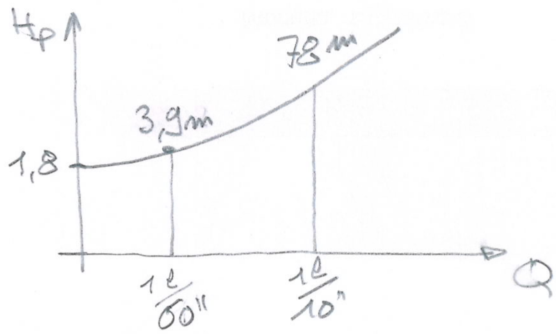
$$= H_s + \frac{Q^2}{2g\Omega^2}\left(\frac{\lambda}{D}\cdot L + \sum_i \beta_i\right)$$

chiamo $K = \frac{1}{2g\Omega^2}\cdot\left(\frac{\lambda}{D}L + \sum_i \beta_i\right)$

$$= 450,89\,(10,395 + 6,5)$$

$$= 7617,8$$

$$H_p = 1,8 + 7618\cdot Q^2$$



2) $v = 0{,}20 \text{ m/s}$

$$H_2 = H_1 + \Delta H_d^{21} + \Delta H_c^{21}$$

$$\Delta H_d^{21} = \frac{\lambda}{D}\frac{U^2}{2g}\cdot L \qquad \frac{1}{\sqrt{\lambda}} = -2\lg\left(\frac{\varepsilon/D}{3{,}71}\right)$$

ma forse siamo in laminare

$$Re = \rho\frac{UD}{\mu} = 10^6 \cdot 0{,}20 \cdot 0{,}008 = 1600 \quad \text{Laminare}$$

$$\Rightarrow \quad \lambda = \frac{64}{Re} = 0{,}04$$

$$\Delta H_c^{21} = \sum_i \beta_i \frac{U^2}{2g} + \beta\frac{U^2}{2g}$$

$$\Rightarrow H_2 - H_1 = \frac{\lambda}{D}\frac{U^2}{2g}\cdot L + \sum_i \beta_i \frac{U^2}{2g} + \beta\frac{U^2}{2g}$$

$$\beta = \frac{H_s - \frac{\lambda}{D}\frac{U^2}{2g}\cdot L - \sum_i \beta_i \frac{U^2}{2g}}{\frac{U^2}{2g}}$$

$$= \frac{H_s}{\frac{U^2}{2g}} - \frac{\lambda}{D}L - \sum \beta_i$$

$$= 882{,}9 - 25 - 21$$

$$= 836{,}9$$