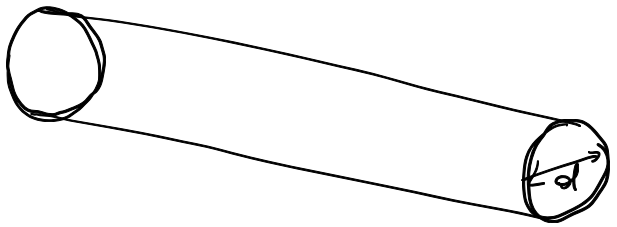
ESERCIZIO - ESEMPIO

PORTATA VOLUMETRICA : $q = 6.5 \frac{m^3}{h}$

SEZIONE della CONDOTTA : $d = 3$ pollici $\simeq 80$ mm



PORTATA per l'equazione di continuità

Quanto vale la velocità dell'acqua?

$q = A \cdot v$

$v = \frac{s}{t}$ → Definizione

$A = \pi r^2 = \frac{\pi d^2}{4} = \frac{\pi 80^2}{4} mm^2 = 5027 mm^2$

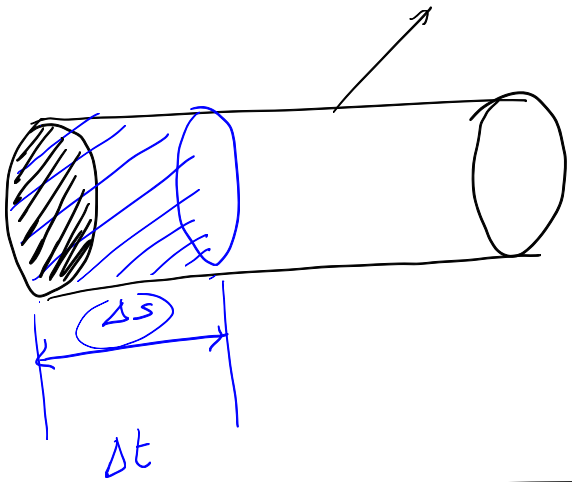
$v = \frac{q}{A} = \frac{6.5 \frac{m^3}{h}}{5027 mm^2} = \frac{6.5 \frac{m^3}{h}}{5027 \cdot 10^{-6} m^2} =$

$= \frac{6.5 \frac{m^3}{h}}{0.005027 m^2} = 1293 \frac{m}{h} \frac{1h}{3600 s} =$

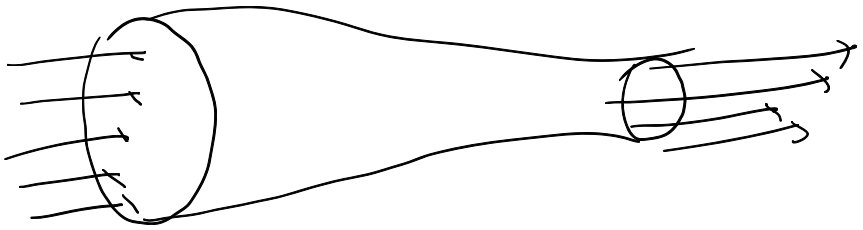
$\simeq 0.4 \frac{m}{s}$

$q = A \cdot v$

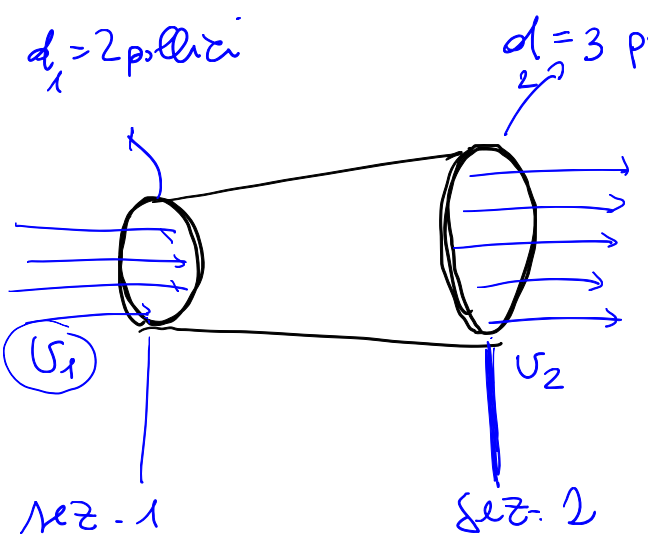
$q = \frac{\text{VOLUME}}{\Delta t} = \frac{A \cdot \Delta s}{\Delta t} = A \cdot v$



Δs → spostamento
Δt → tempo
, v



$q = A \cdot v = \text{costante}$



$q = 6.5 \frac{m^3}{h}$

$d_2 = 3$ pollici $= 80$ mm

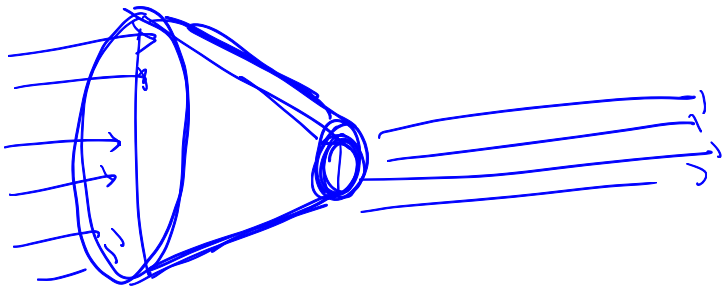
$v_2 = 0.4 \frac{m}{s}$, $d_1 = 2$ pollici $= 50$ mm

Quanto vale v_1 ?

$q = A_2 \cdot v_2 = A_1 \cdot v_1 \Rightarrow v_1$!

$$v_1 = v_2 \cdot \frac{A_2}{A_1} = 0.4 \frac{m}{s} \quad \frac{5027 \text{ mm}^2}{1963 \text{ mm}^2} = 1.02 \frac{m}{s}$$

$$A_1 = \pi \frac{d_1^2}{4} = \pi \frac{50^2}{4} = 1963 \text{ mm}^2$$



PORTATA VOLUMETRICA $q = \frac{\Delta V}{\Delta t} = A \cdot v$

EQ. di CONTINUITÀ : $A \cdot v$ = costante nelle varie sezioni di una condotta

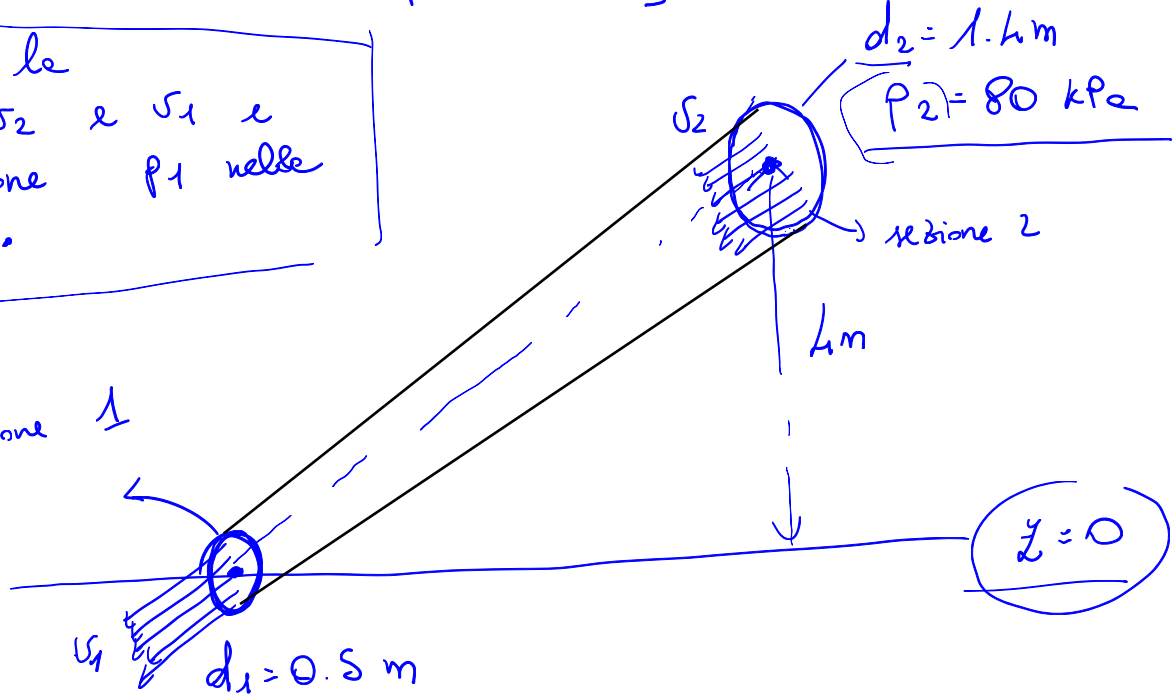
EQ. di BERNOULLI : $z + \frac{v^2}{2g} + \frac{p}{\rho g}$ = costante nelle varie sezioni

ESERCIZIO

FLUIDO → ACQUA : $\rho = 1000 \frac{kg}{m^3}$

PORTATA : $q = 0.1 \frac{m^3}{s}$

Calcolare le velocità v_2 e v_1 e la pressione p_1 nella sezione 1.



$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi \cdot 0.5^2}{4}\ m^2 = 0.196\ m^2$$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi \cdot 1.4^2}{4}\ m^2 = 1.54\ m^2$$

$q = A \cdot v$

$$v_1 = \frac{q}{A_1} = \frac{0.1\ \frac{m^3}{s}}{0.196\ m^2} = 0.510\ \frac{m}{s}$$

$$v_2 = \frac{q}{A_2} = \frac{0.1\ \frac{m^3}{s}}{1.54\ m^2} = 0.065\ \frac{m}{s}$$

Nella sezione (1)

$v_1 = 0.51 \frac{m}{s}$

$z_1 = 0$

$p_1 = ?$

Nella sezione (2)

$v_2 = 0.065 \frac{m}{s}$

$z_2 = 4\ m$

$p_2 = 80\ kPa = 80 \cdot 10^3 \frac{N}{m^2}$

Applico Bernoulli.

$$z_1 + \frac{v_1^2}{2g} + \frac{p_1}{\rho g} = z_2 + \frac{v_2^2}{2g} + \frac{p_2}{\rho g}$$

Conosco $g = 9.81 \frac{m}{s^2}$

$\rho = 1000 \frac{kg}{m^3}$

$$p_1 = \left(\rho g \left(z_2 - z_1 + \frac{v_2^2}{2g} - \frac{v_1^2}{2g} + \frac{p_2}{\rho g}\right)\right) =$$

$$= 9810 \left(4 - 0 + \frac{0.065^2}{2 \cdot 9.81} - \frac{0.51^2}{2 \cdot 9.81} + \frac{80 \cdot 10^3}{9810}\right) =$$

$$= 9810 \left(4 + 0.0002 - 0.013 + 8.15\right) =$$

$$= 9810 \frac{N}{m^3} \left(12.1\ m\right) = 118701\ Pa =$$

$$\cong 119\ kPa$$

$\rho \cdot g = \gamma \left[\frac{N}{m^3}\right]$

EQ. DI BERNOULLI

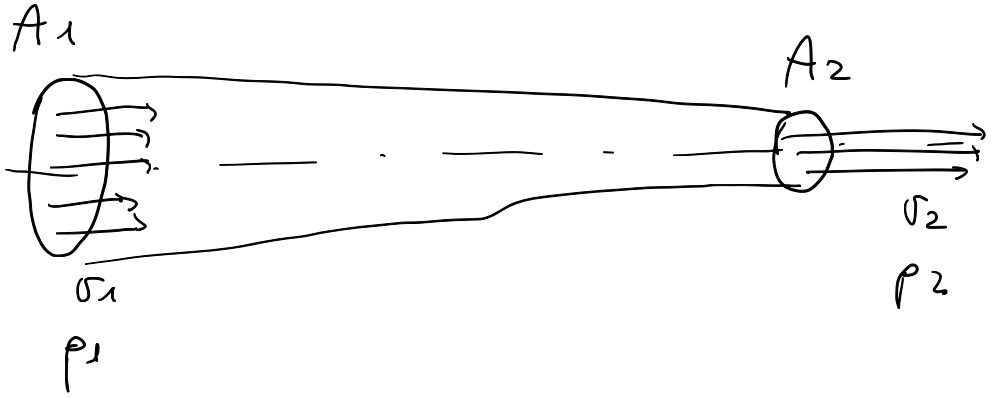
$$\rightarrow \quad z + \frac{v^2}{2g} + \frac{p}{\rho g} = \text{costante} \qquad [m]$$

EQ. di CONTINUITÀ

$$\rightarrow \quad A \cdot v = \text{costante}$$

ESEMPIO

- CONDOTTA ORIZZONTALE



$q = A \cdot v = \text{costante}$

$\Rightarrow \quad A_1 \cdot v_1 = A_2 \cdot v_2$

$q = 0.1 \ \frac{m^3}{s}$

$A_1 = 1.5 \ m^2 \Rightarrow \quad v_1 = \frac{q}{A_1} = \frac{0.1 \ \frac{m^3}{s}}{1.5 \ m^2} = 0.07 \ \frac{m}{s}$

$A_2 = 0.5 \ m^2 \Rightarrow \quad v_2 = \frac{q}{A_2} = \frac{0.1 \ \frac{m^3}{s}}{0.5 \ m^2} = 0.2 \ \frac{m}{s}$

$p_1 = 80 \ kPa$

$$z + \frac{v^2}{2g} + \frac{p}{\rho g} = \text{costante} \rightarrow \text{BERNOULLI}$$

$$z_1 + \frac{v_1^2}{2g} + \frac{p_1}{\rho g} = z_2 + \frac{v_2^2}{2g} + \frac{p_2}{\rho g} \qquad z_1 = z_2$$

$$\frac{p_2}{\rho g} = \frac{v_1^2}{2g} - \frac{v_2^2}{2g} + \frac{p_1}{\rho g}$$

$$p_2 = \rho g \left(\frac{v_1^2}{2g} - \frac{v_2^2}{2g} + \frac{p_1}{\rho g} \right) =$$

$$= 1000 \cdot 9.81 \left(\frac{0.07^2}{2 \cdot 9.81} - \frac{0.2^2}{2 \cdot 9.81} + \frac{80 \cdot 10^3}{1000 \cdot 9.81} \right)$$

$=$

$$\frac{p}{\rho g} + \frac{v^2}{2g} = \text{cost}$$