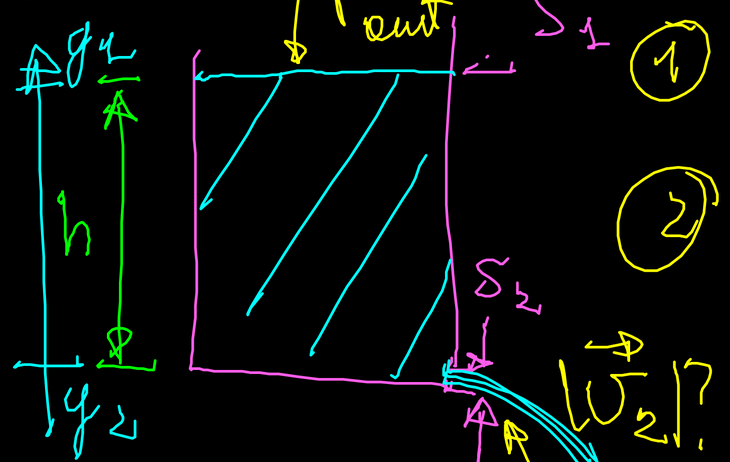
EQ. DI BERNOULLI

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$$



① $p_1 = p_{atm}$, $y_1 = h$ v_1

② $p_2 = p_{atm}$, $y_2 = 0$ v_2 ?

$$\frac{1}{2}\rho v_1^2 + \rho g h = \frac{1}{2}\rho v_2^2$$

$v_1 S_1 = v_2 S_2 \Rightarrow v_1 = v_2 \frac{S_2}{S_1}$

h grande

$S_1 \gg S_2$

$\Rightarrow$ flusso stazionario

$$\frac{1}{2}\rho v_1^2 + \rho g h = \frac{1}{2}\rho v_2^2$$

$$v_1 S_1 = v_2 S_2 \Rightarrow v_1 = v_2 \frac{S_2}{S_1}$$

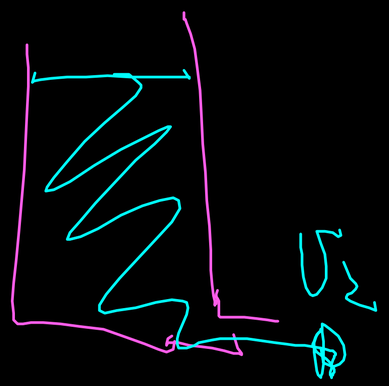
$$\Rightarrow \frac{1}{2} v_2^2 \left(\frac{S_2}{S_1}\right)^2 + g h = \frac{v_2^2}{2}$$

$$2 g h = v_2^2 \left(1 - \left(\frac{S_2}{S_1}\right)^2\right)$$

$$v_2 = \sqrt{\frac{2 g h}{1 - \left(\frac{S_2}{S_1}\right)^2}}$$

$$\frac{S_2}{S_1} \ll 1$$

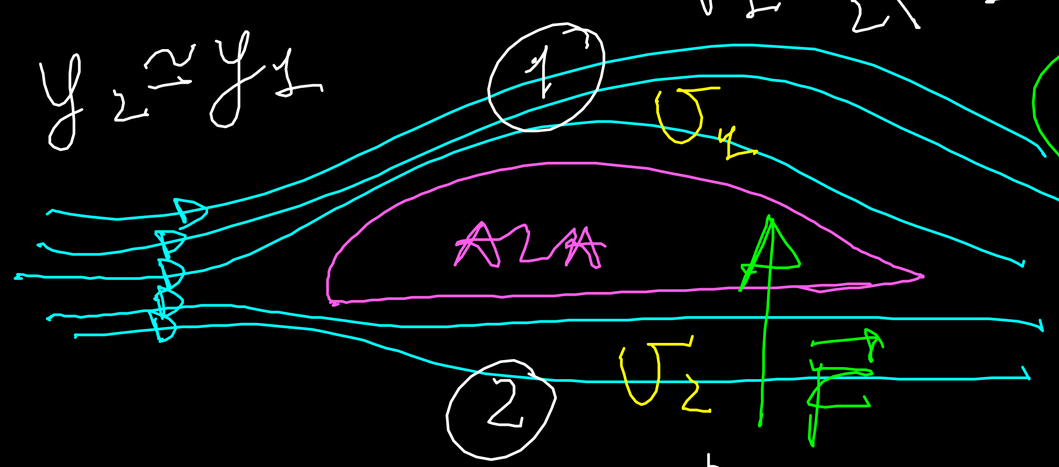
S_2



ESEMPI

$$p_1 + \frac{1}{2}\rho v_1^2$$

$y_2 \simeq y_1$

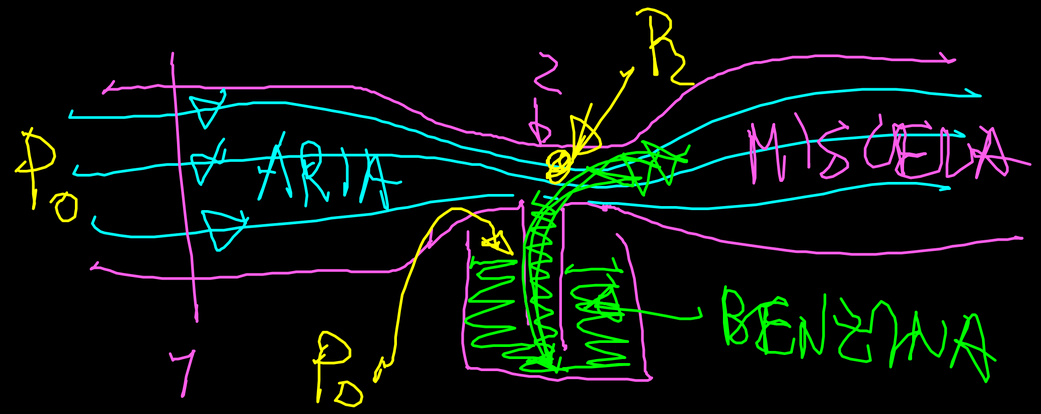


$$p_2 + \frac{1}{2}\rho v_2^2$$

$$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$$

$$v_1 > v_2 \longrightarrow p_2 - p_1 = \frac{1}{2}\rho(v_1^2 - v_2^2) > 0$$

TUBO DI VENTURI



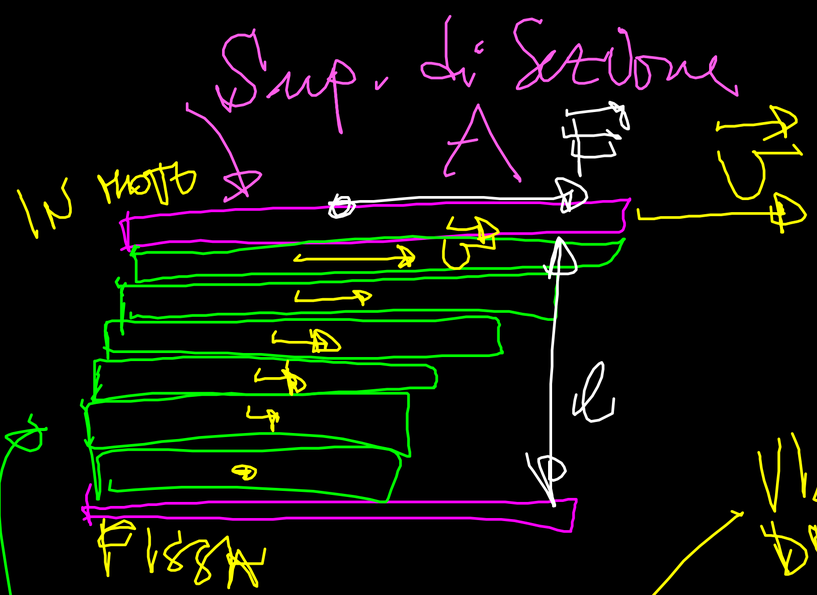
$$S_1 > S_2 \Rightarrow v_2 > v_1$$

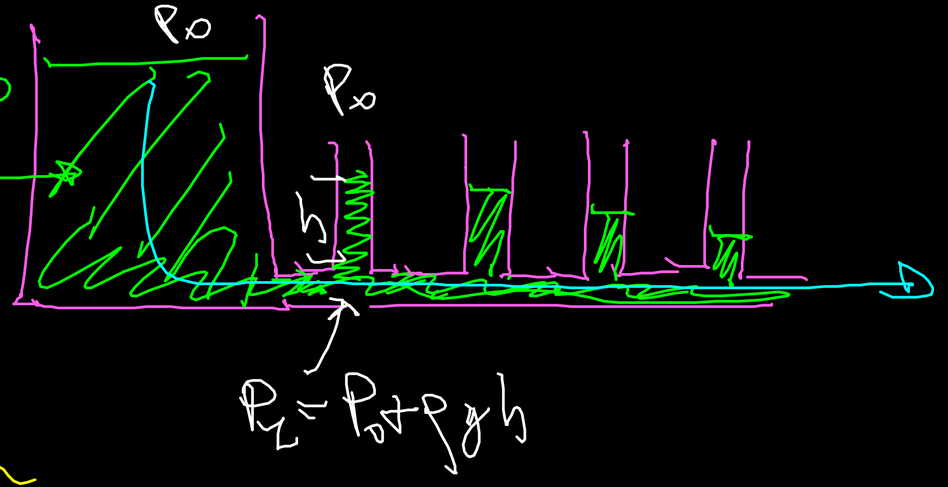
$$\frac{1}{2}\rho_a v_1^2 + p_0 = \frac{1}{2}\rho_a v_2^2 + p_2$$

$$p_2 = p_0 + \frac{1}{2}\rho_0(v_1^2 - v_2^2) < 0$$

VISCOSITÀ

Forze interne al fluido non conservative





FLUIDO IN MOTO LAMINARE → FLUIDO NEWTONIANO

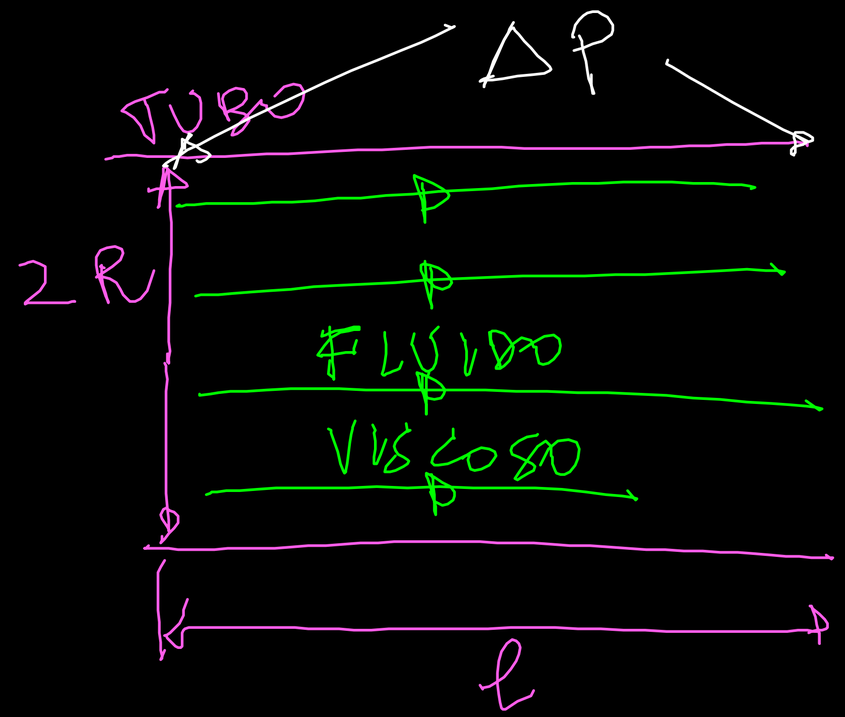
$$F = \eta \frac{A U}{l}$$

η = VISCOSITÀ DEL FLUIDO

$$\left[\frac{N \cdot s}{m^2}\right]$$

$$0.1 \frac{N \cdot s}{m^2} = 1 \text{ POISE}$$

VISCOSITA' (2)



$Q \equiv$ portata di volume

$$Q = \frac{\pi (\Delta P) R^4}{8 \eta l}$$

$$\Delta p = \frac{8 \eta l Q}{\pi R^4}$$

FENOMENI TERMICI

- ~~DESCRIZIONE MICROSCOPICA (LEGGI DI NEWTON APPLICATE A $\sim 6 \times 10^{23}$ OGGETTI)~~

- **DESCRIZIONE MACROSCOPICA**

QUANTITÀ MACROSC. MISURABILI DIRETTAMENTE

VARIABILI TERMODINAMICHE

→ PROPRIETÀ "MEDIE" DEI SISTEMI

MECCANICA STATISTICA

VARIABILI TERMODINAMICHE

ESEMPIO

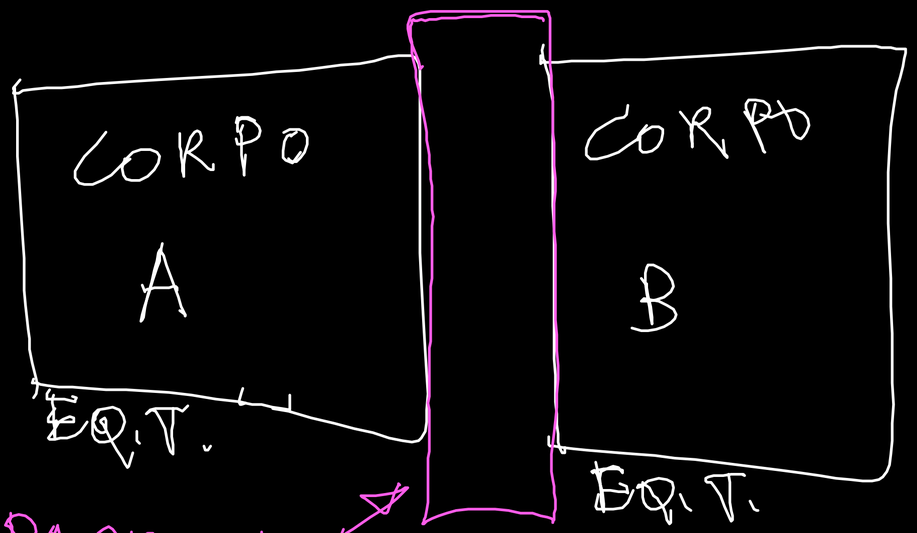
Coordinate termodinamiche

(*) → le stesse in ogni punto del sistema

- volume → V
- pressione → P (*)
- quantità di sostanza → n (Numero di moli)
  1 mole contiene $N_A = 6{,}023 \times 10^{23}$ oggetti elementari
- temperatura (*) → T
- entropia → S
- energia interna → U

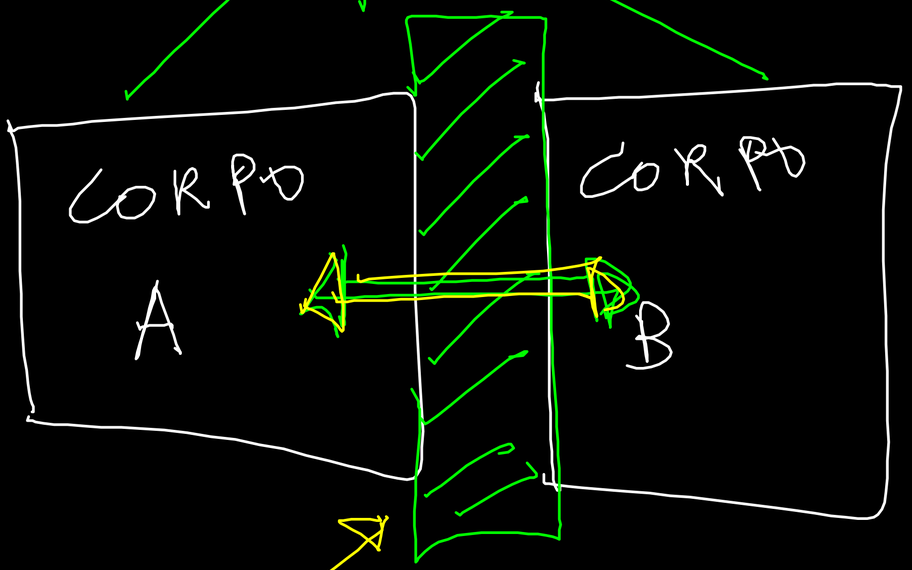
EQUILIBRIO TERMICO

→ Le coordinate termodinamiche NON variano nel tempo



PARETE ISOLANTE O ADIABATICA → NO SCAMBI TERMICI ⇒ A E B RIMANGONO NEL LORO STATO DI EQ.

A e B evolvono verso un eq. termico comune



PARETE DIATERMICA ↳ SCAMBI TERMICI PERMESSI