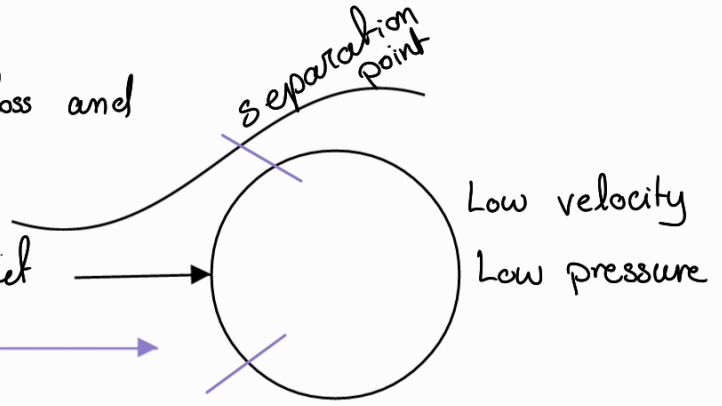
Experiment 7
Drag measurement on cylindrical Bodies

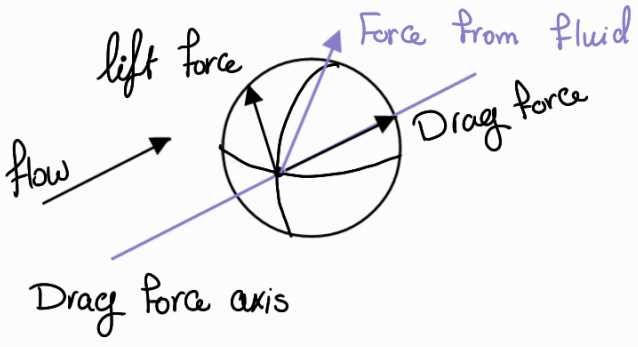
Drag force: It is the resistance of a body as it moves through a fluid
Generated by the solid body

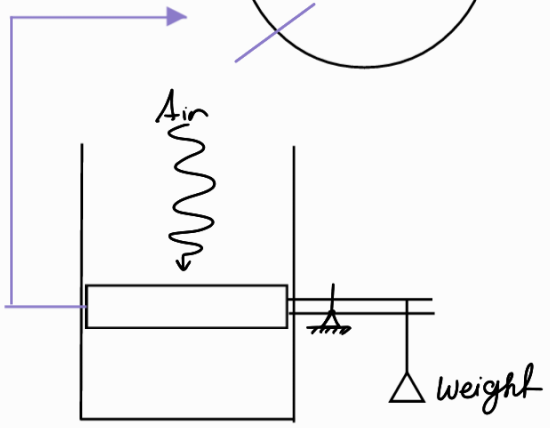
Direction: Same as fluid direction

Drag force: considered to be a flow loss and the body needs to overcome it

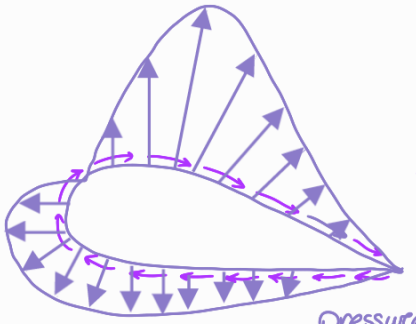
Lift force: provides the useful job and it opposites the weigh of the body.





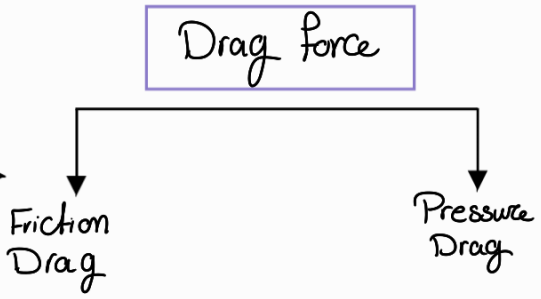


Why is the drag force generated?

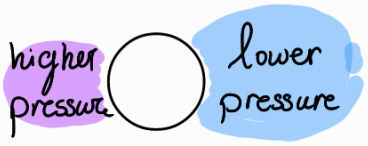


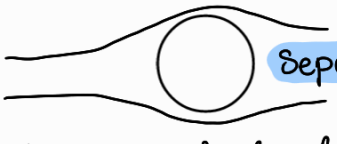
Shear Stress caused by friction forces

Pressure Stress caused by pressure distribution



Pressure drag: Caused by difference of pressure between front and rear of the object





Separation area: low pressure large drag force

Vortex are introduced causing vibrations and unstability

Drag depends on: Velocity (Reynolds), Roughness, Shape of the object and Angle of attack

Methods of measuring the drag:

1. Direct method (Weighing)
2. Pressure distribution around the Surface

Calculations

1. Direct method

$$C_D = \frac{D}{\frac{1}{2}\rho U^2 dL}$$

D → Drag force = mg → $\times 10^{-3}$

ρ → Speed of flow

dL → A

Dynamic pressure

$$P_d = \frac{1}{2}\rho U^2 = P_{total} - P_{in}$$

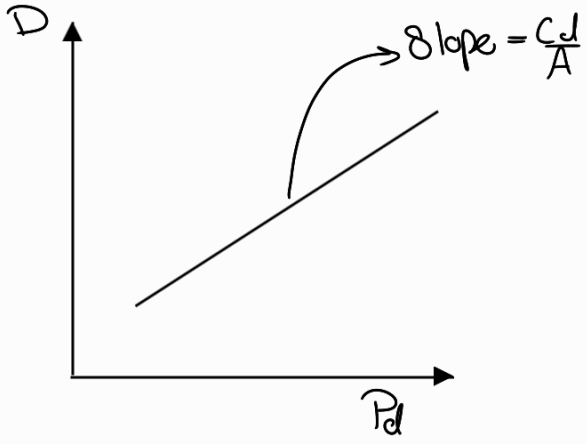
P_{total} → Airbox pressure

P_{in} → inlet pressure

$$U = \sqrt{\frac{2P_d}{\rho}}$$

$$Re = \frac{\rho U d}{\mu}$$

critical is 5×10^5

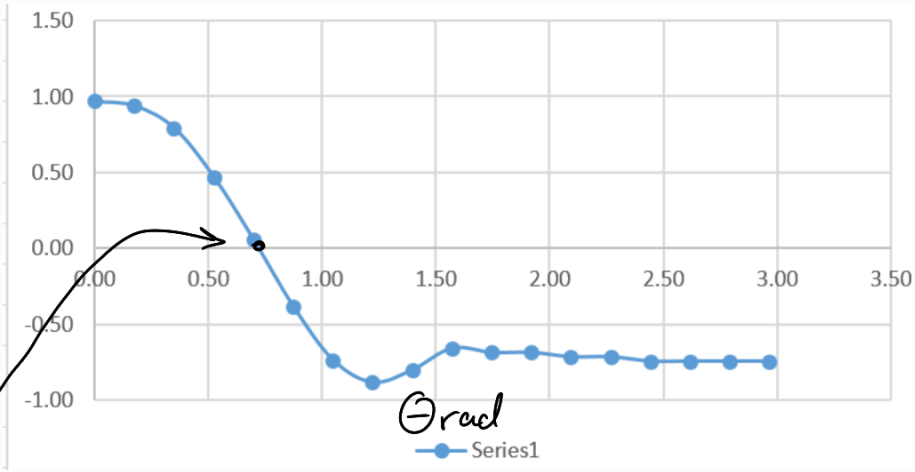


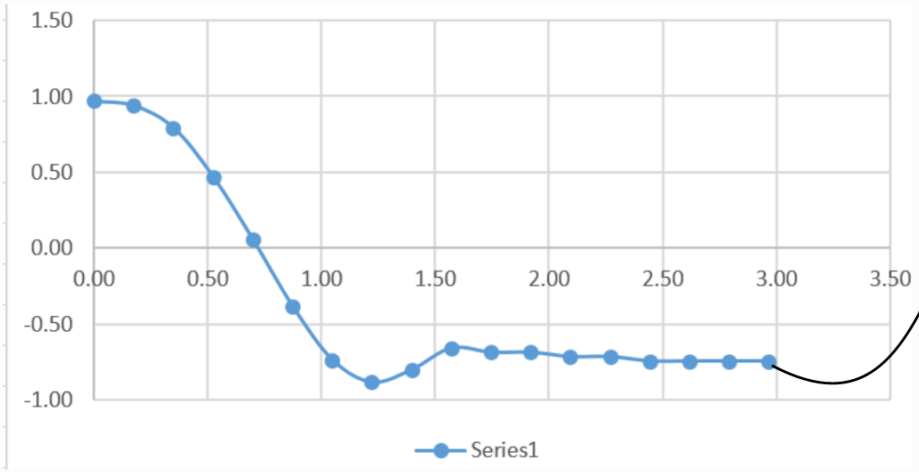
- D increases as Velocity increases

2. $C_p = \frac{P_{tube} - P_{in}}{\frac{1}{2}\rho U^2}$ → measured

$$C_D = \int_0^{\pi} C_p \cos(\theta)\, d\theta$$

- flow separates at this angle
Stagnation point





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$C_p \cos\theta$