Chap 14 Fluid Mechanics

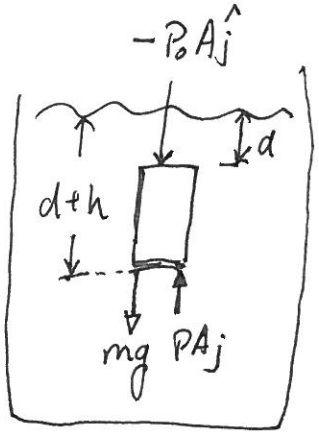
fluid: A collection of molecules that are held together by weak cohesive force

1. Pressure.

$$P \equiv \frac{F}{A} \qquad F = \text{force}, \quad A = \text{Area}$$

$$dF = P\,dA$$

2. Pressure in a fluid



If the cylinder is in equilibrium

$$\Sigma F = 0$$

$$\Sigma F = PA\hat{j} - P_0A\hat{j} - Mg\hat{j} = 0$$

$$PA - P_0A - \rho Ahg = 0$$

$$PA - P_0A = \rho Ahg$$

$$P = P_0 + \rho gh$$

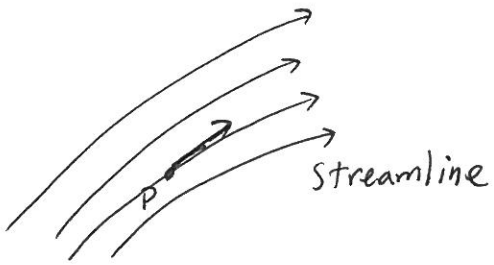
for a depth h, the pressure difference is ρgh

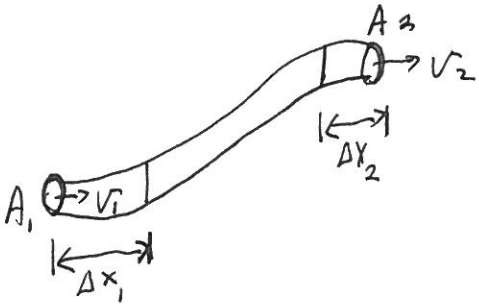
Pascal's law: A change in the pressure applied to a fluid is transmitted undiminished to every point of the fluid and to the walls of the container.

14.5 Fluid dynamics

Ideal fluid flow

1) fluid is non viscous, internal friction is neglected
2) the flow is steady
3) fluid is incompressible
4) fluid is irrotational





$m_1 = \rho A_1 \Delta x_1 = m_2 = \rho A_2 \Delta x_2$

$v_1 \Delta t \qquad v_2 \Delta t$

$\therefore \quad A_1 v_1 = A_2 v_2 = \text{Constant}$

— Equation for Continuity for fluid

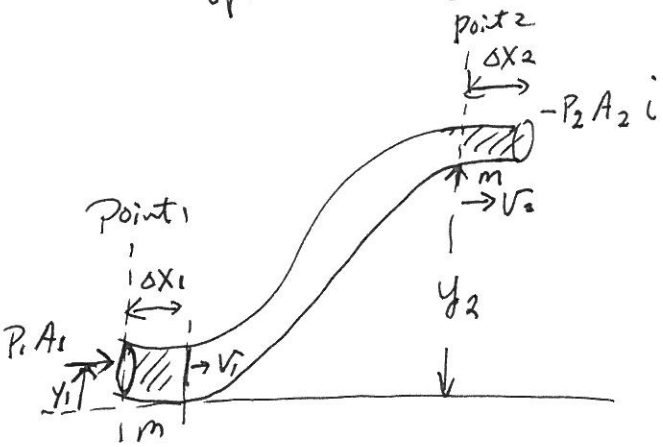
14.6 Bernoulli's Equation.

The net work done

$W = (P_1 - P_2) V$

$\Delta K = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$

$\Delta U = mg y_2 - mg y_1$



$\therefore W = (P_1 - P_2) V = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2 + mg y_2 - mg y_1 \quad , \rho = \frac{m}{V}$

$P_1 - P_2 = \frac{1}{2} \rho v_2^2 - \frac{1}{2} \rho v_1^2 + \rho g y_2 - \rho g y_1$

$P_1 + \frac{1}{2} \rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g y_2$

Thus: $P + \frac{1}{2} \rho v^2 + \rho g y = \text{Constant}$

— Bernoulli's equation