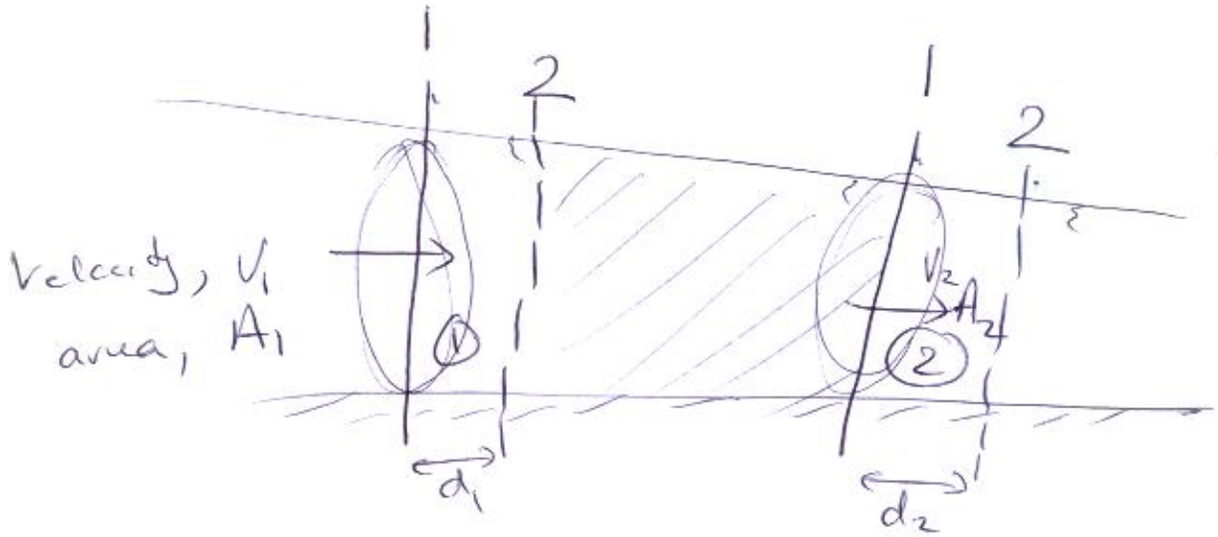
3.2 Continouity Equatron

It is based on the concept of mass conservatron.



$t_1 \rightarrow t_2$

mass ① = mass ②

$\text{area}_1 \times \text{dis}_1 \times \rho = \text{area}_2 \times \text{dis}_2 \times \rho$

$\text{dis}_1 \rightarrow V_{el_1} \times t$

$\text{dis}_2 \rightarrow V_{d_2} \times t$

$$\boxed{V_1 A_1 = V_2 A_2} \quad \text{-----}$$

2) Value of (VA) is named discharge @

where : $V \rightarrow$ Length / time

$A \rightarrow$ length^2

$\Rightarrow (VA)$: length^3 / time

Quantity / time

$\Rightarrow$ discharge

is m^3/s or ---

Then $Q_1 = Q_2 = ---$

Pipes, rivers ---

(closed conduit, open channel)

use this term .

So,

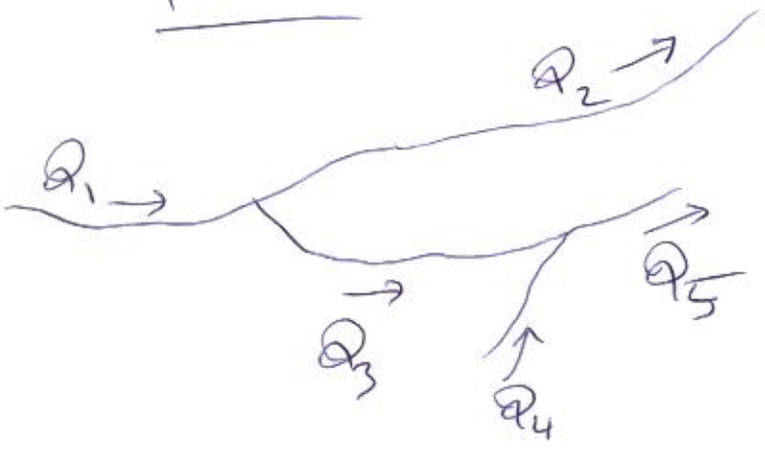
$VA = Q =$ Volume / time

Four characteristics of flow are related.

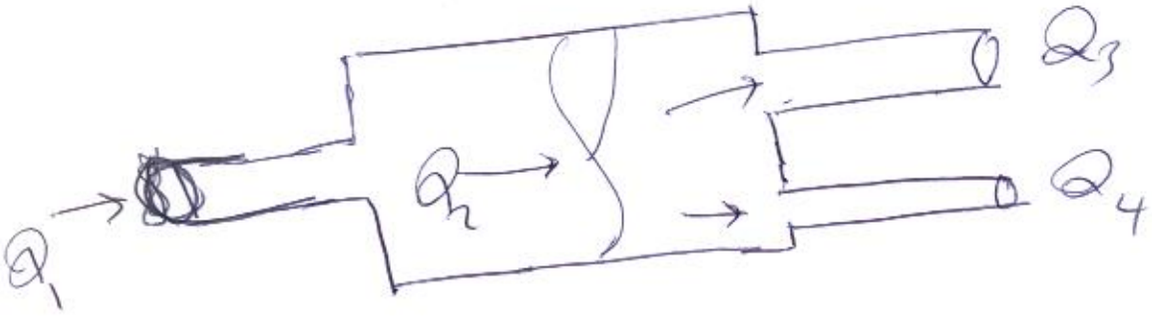
3)

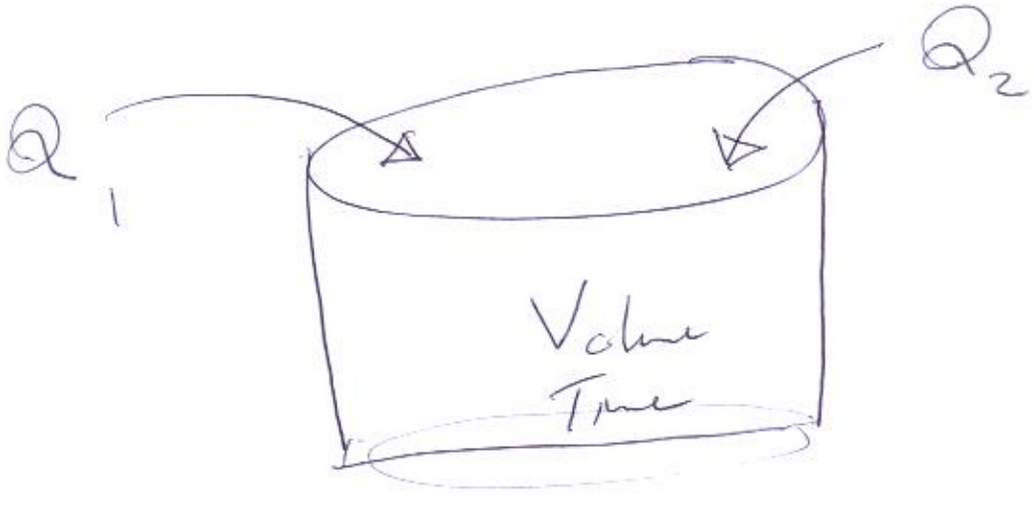
Application

Plan view



Q_1 ----

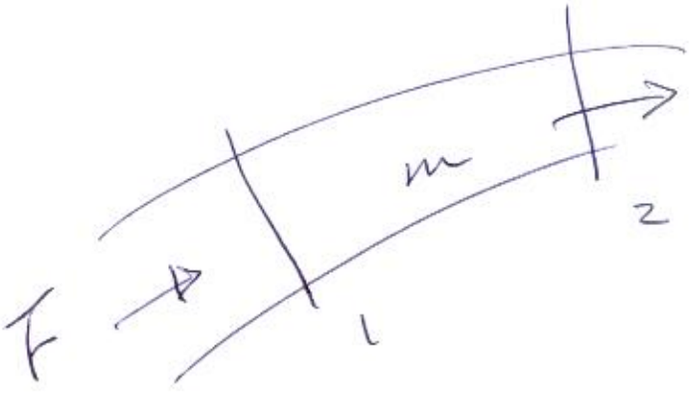




4)

3.3 Momentum Equation

It is based on Newton law of motion, $F = ma$



$$F = ma \rightarrow dv/dt$$

$$\downarrow$$

Sol.

$$\downarrow$$

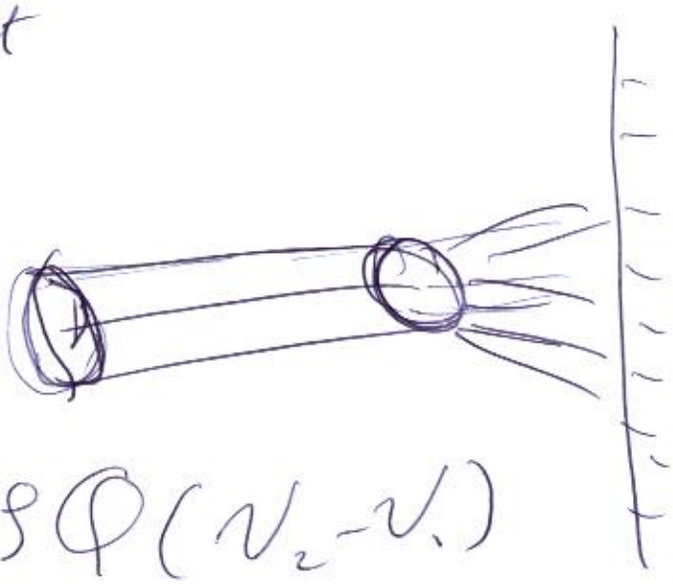
$$F_{\substack{x \\ y}} = \rho Q (V_2 - V_1)_{\substack{x \\ y}}$$

Force exerted by a moving fluid.

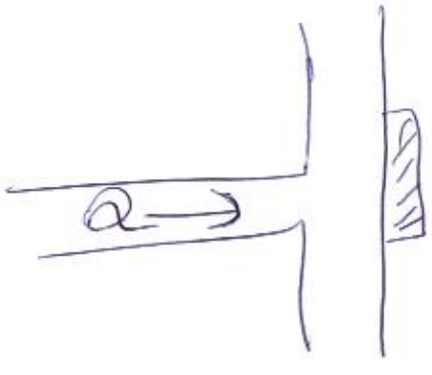
5)

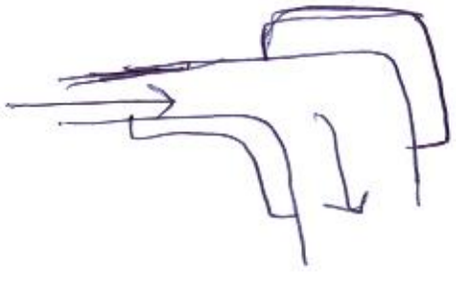
Applications:

Water jet



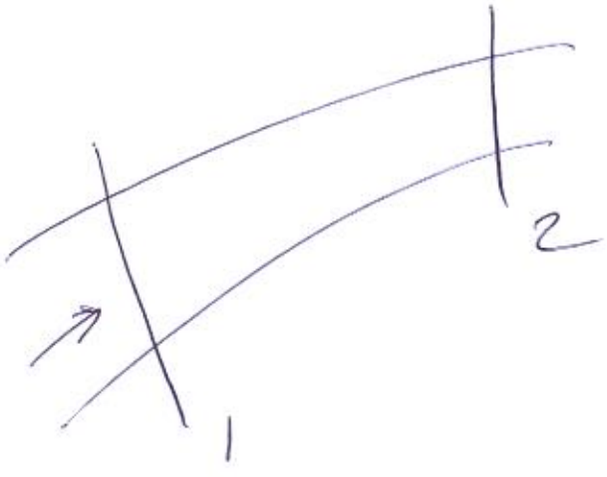
$$F = \rho Q (V_2 - V_1)$$





6) 3.4 Energy (Bernoulli) Equation

It is based on the concept of energy conservation



Energy as force x distance used to derive. Energy at any point in a fluid moving is given as three parts of energy:

$\frac{P}{\gamma}$: pressure energy

$\frac{V^2}{2g}$: Velocity "

Z : Potential " (from given datum) horizontal.

7) Then $E_1 = E_2$

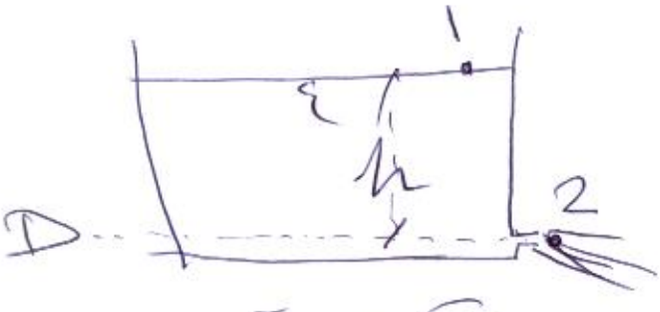
$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2$$

$\frac{P_1}{\gamma} = 0$ for open channel

$\frac{V_1}{2g} \cong 0$ ~ small velocities

$z = 0$ ~ a point on the datum

Application



$E_1 = E_2$

$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 = V_2/2g + \frac{P_2}{\gamma} + z_2$$

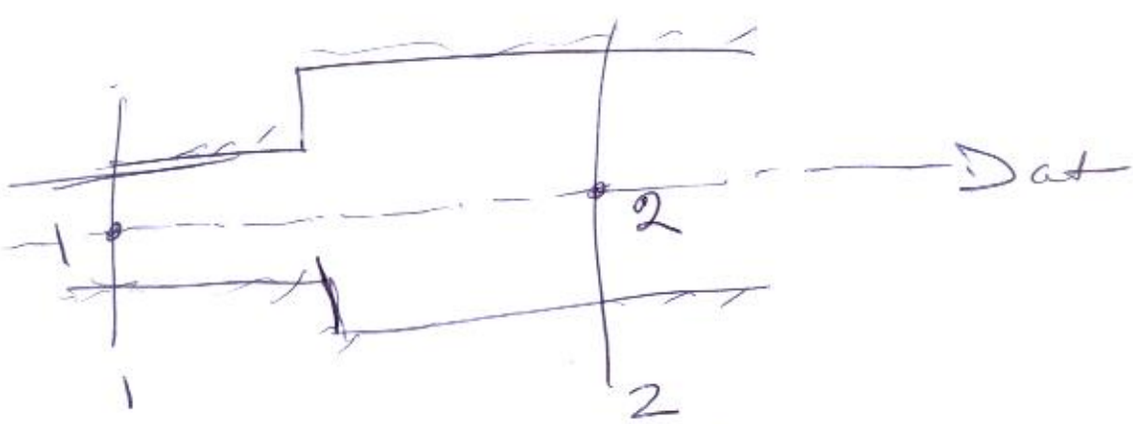
$$0 + 0 + h = \frac{V_2^2}{2g} + 0 + 0$$

$$\therefore V^2 = 2gh \text{ or } V = \sqrt{2gh}$$

8) Water bed channel drop

$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + h = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z$$

Pipes:



$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2$$

z_1 ↓ 0 ; z_2 ↓ 0

9) In case of losses,

(due to friction, entrance, ...)

or gain (due to pump),

then

$$E_1 + E_p - E_f = E_2$$

Generally $E_1 + E_{add} - E_{Loss} = E_2$