HYDRAULICS ENGINEERING

MODULE# 01a

Introduction:-

* "Hydraulic Engineering is the branch of Civil Engineering is basically concerned with the conveyance of fluids, especially water and sewage"-

* In Hydraulic Egineering gravity is the motive force which cause the morement of fluids.

* Hydraulic Engineering is Basically studied to further design bridges, dams, channels etc.

* According to Prasuhn, Alan L :-

"Hydraulic Engineering is the application of fluid mechanics principles for problems dealing with collection, storage, control, transport, use and Measurement of water"

* Hydraulics is branch of Engineering which deals with mechanical properties of liquids.

* There is actually no difference in hydraulics and fluid Mechanics These are two sides of one coin.

* Fluid Mechanics basically provide the theoretical background or foundation for hydraulic Engineering.

Types of flow:-

① Steady and Unsteady flow:-

"The flow in which depth of flow doesnot changes with respect to time is called Steady flow".

"The flow in which depth of flow changes with time is called unsteady flow".

Suppose in a flowing channel at a specific or particular point (A) flow depth or depth of water is "y" and velocity is "V"

Now if at point (A) depth of water flowing donot changes with time (t) it is known as steady flow.

$$\frac{dy}{dt} = 0 \quad \text{(steady flow)}.$$

While unsteady flow, flow depth of water "y" do change with time (t) at point A

$$\frac{dy}{dt} \neq 0 \quad \text{(Unsteady flow)}.$$

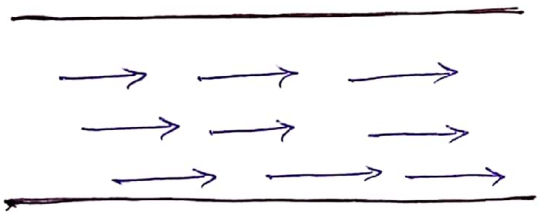
(2) Laminar - Turbulent Flow:-

Laminar flow occurs when a fluid flows in parallel layers, with no disruption between the layers. At low velocities the fluids tends to flow with out lateral mixing.

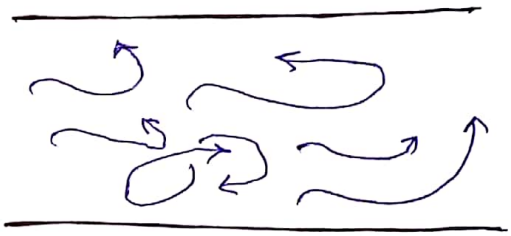
OR:- The flow of a fluid in which each particle of fluid flows in smooth path, path which never interfere with one another.

In laminar flow the velocity of the fluid is constant at any point of fluid.

* Laminar flow is also known as stream line flow.
* Turbulent flow is opposite of laminar flow.



Laminar flow



Turbulent flow.

③ Uniform - Non Uniform flow :-

* Uniform flow is a flow of fluid in which flow depth doesnot changes with horizontal distance.

* Non - Uniform flow is a flow in which flow depth change with horizontal distance.

Suppose in a flowing channel at a specific or particular point (A), flow depth "y" and velocity "V" and horizontal distance is "x"

When the flow in which flow depth "y" doesnot changes with horizontal distance "x", then it is uniform flow.

$$\frac{dy}{dx} = 0 \quad \text{(Uniform flow)}.$$

While the flow in which flow depth "y" changes with horizontal distance "x" then it is non uniform flow.

$$\frac{dy}{dx} \neq 0 \quad \text{(Non uniform flow)}.$$

④ Rapidly and Gradually Varied Flow:-

- Rapidly varied flow is the flow in which depth of flow changes rapidly over a short distance and time is known as rapid varried flow.

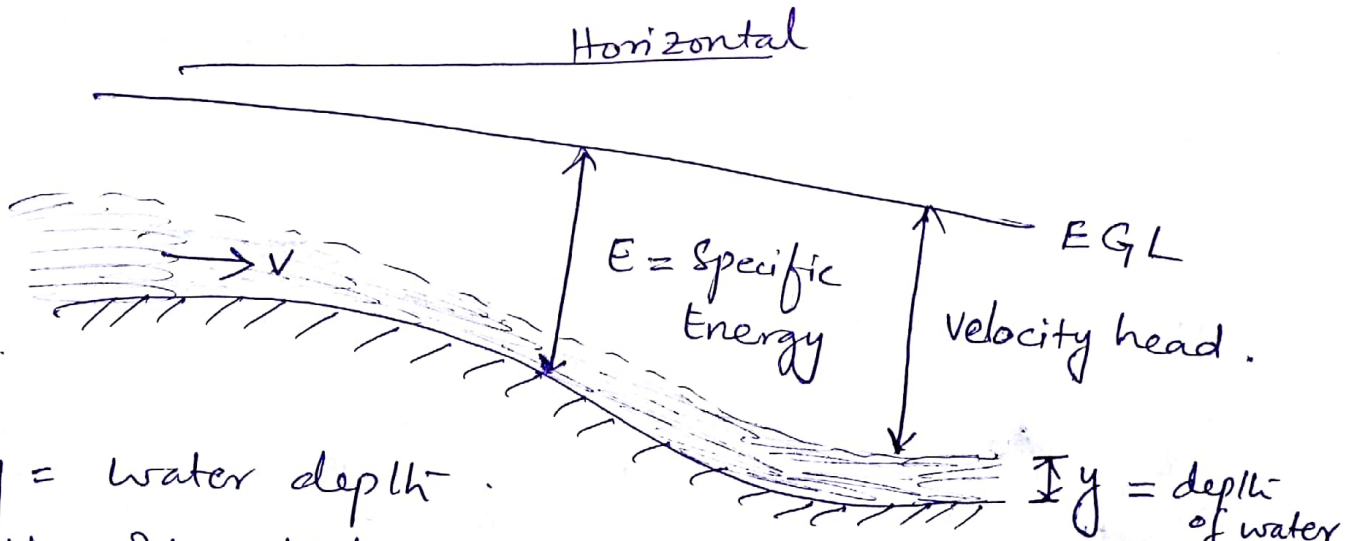
* flow due to hydraulic pump.

Gradually varied flow is the flow in which depth of fluid changes very slowly with respect to horizontal distance and time.

Flow of water from reservoir behind a dam.

Specific Energy & Critical depth

The parameter, specific energy can be used to clarify the meaning of Super critical, Subcritical and Critical flow in Open channel.



V = Flow Velocity.

EGL = Energy grade line (Energy line)

E = Specific Energy.

Specific energy at any cross sectional in an open channel is the sum of kinetic energy due to velocity and depth of water.

Specific energy = Depth of water + K.E

$$E = y + \frac{v^2}{2g} \longrightarrow (1)$$

As we know that $Q = AV$.

$$V = \frac{Q}{A}$$

$$v^2 = \frac{Q^2}{A^2}$$

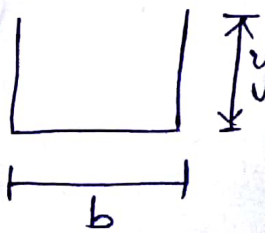
put v^2 in in eq (1).

$$E = y + \frac{Q^2}{A^2 2g} \longrightarrow (2)$$

let Suppose the channel is rectangular

So then $A = y \times b \longrightarrow (x)$

Also $Q = q\,b$



∴ "Q" Total discharge

q is discharge at Specific Area

b = width of channel.

$$Q = qb$$

$$q = \frac{Q}{b} \longrightarrow (9).$$

putting eq (x) and (9) in eq (2).

$$E = y + \frac{Q^2}{A^2 2g} \longrightarrow \text{eq (2)}.$$

$$E = y + \frac{Q^2}{y^2 \times b^2 \times 2g} \longrightarrow (x) \text{ — put}$$

$$E = y + \frac{q^2}{y^2 \times 2g} \text{ — (9) — put.}$$

$$E = y + \frac{q^2}{2gy^2}$$

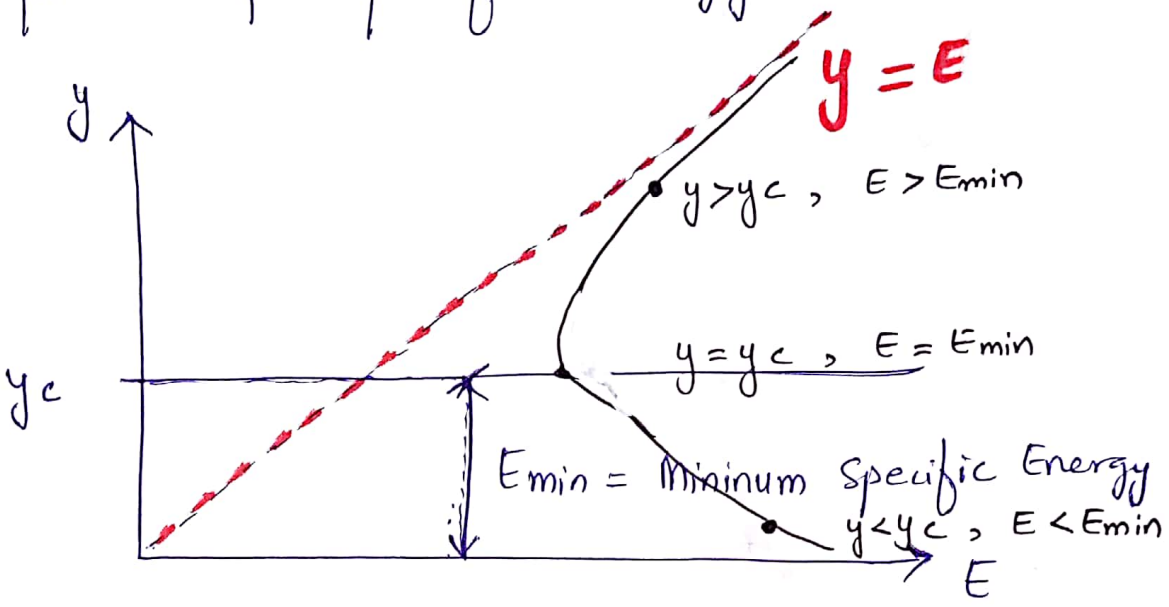
$$E - y = \frac{q^2}{2gy^2}$$

$$(E-y)\, y^2 = \frac{q^2}{2g}$$

$$\boxed{(E-y)\, y^2 = \text{Constant}} \longrightarrow (3)$$

As q, 2g are Constant.

Equation (3) can be used to prepare a plot of specific energy "E".



Critical depth :-

Critical depth is flow depth corresponding to minimum Specific Energy.

∴ $y > y_c$ — Sub critical flow.

$y = y_c$ — Critical flow.

$y < y_c$ — Super Critical flow.

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