2.HYDROSTATICS

Fluid statics or **hydrostatics** is the branch of fluid mechanics that studies "fluids at rest and the pressure in a fluid or exerted by a fluid on an immersed body"

The **pressure** exerted by a fluid at equilibrium at a given point within the fluid, due to the force of gravity. **Hydrostatic pressure** increases in proportion to depth measured from the surface because of the increasing weight of fluid exerting downward force from above.

Total Pressure on a Vertically Immersed Surface.

Consider a plane vertical surface immersed in a liquid

Total area of the immersed surface

= Depth of the center of gravity of the

immersed surface from the liquid surface.

w=Sp.wt of the liquid.

A=Total area of the immersed surface.

x= Depth of Centre gravity of the immersed surface from the liquid surface.

Consider a strip of thickness dx, width b at a depth x from the free surface of liquid.

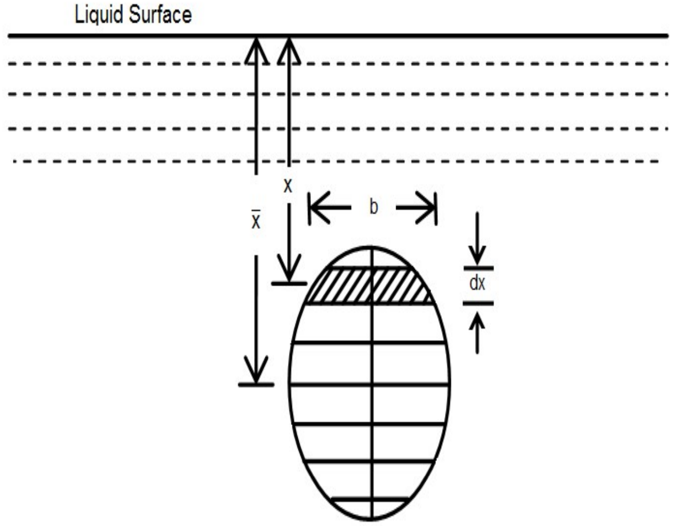


Fig 2 : Vertically immersed surface

- Area of strip =bdx.
- The intensity of pressure on the strip=wx
- Pressure on the Strip=Intensity of pressue x Area of strip.=wx.bdx.
- Hence total pressure on the Strip=P=∫ w x.bdx.= w∫ x.bdx
- But, ∫ x.bdx =Momemt of the surface area about the liquid level.=A X
- P=wAX

$\int wlsin\theta\, bdx$

- **Total Pressure on a Vertically Inclined Immersed Surface.**

Consider a plane l **surface immersed**

in a liquid inclined at angle θ

Total area of the **immersed surface**.

= Depth of the center of gravity of the

immersed surface from the liquid

surface.

Consider a strip of thickness dx,width b

at a distance x from the surface of

liquid at an angle θ.

The intensity of pressure on the strip

=wlSinθ

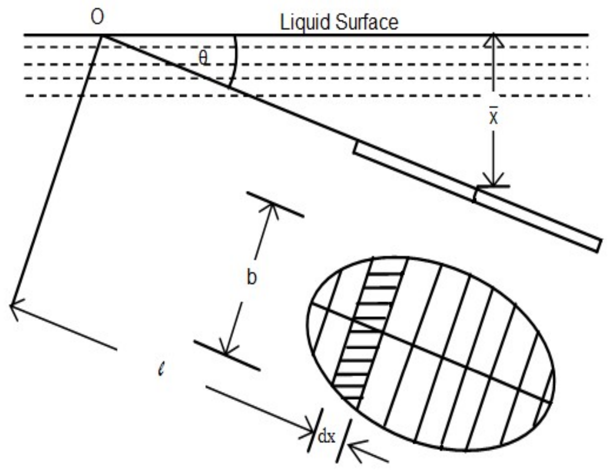


Fig 3 : Inclined immersed surface

- Area of strip =**bdx**
- Pressure on the Strip=Intensity of pressure x Area of strip = wlSinθ bdx
- Hence total pressure on the body=P= ∫ wlSinθ bdx= wSinθ ∫ lbdx
- But ∫ lbdx is the Moment of surface area about O.= **A X/**Sinθ=wAX

CENTRE OF PRESSURE

Divide the whole immersed the surface into small number of parallel strips .

Let **w=**Sp.wt of the liquid.

A=Total area of the immersed surface.

$\bar{x}$= Depth of Centre gravity of the immersed surface from the liquid surface.

- Consider a strip of thickness dx,width b at a depth x from the free surface of liquid.

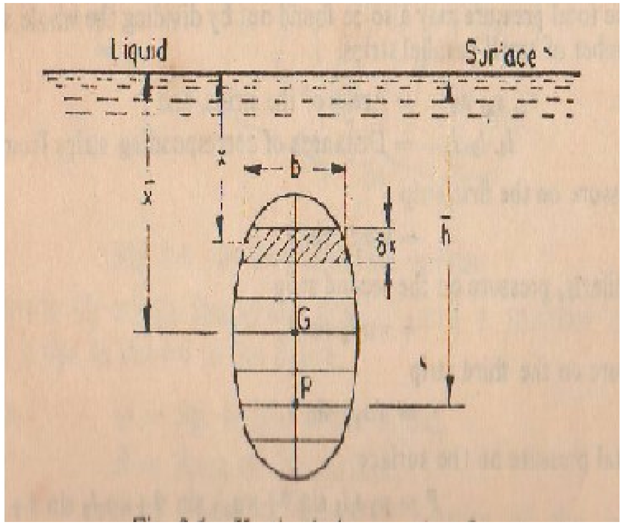
A=Total area of the immersed surface.

The intensity of pressure on the strip= **wx** & Area of strip **=bdx.**

Pressure of the Strip(**P**)= Intensity of pressure x Area= **wx.bdx.**

Moment of this pressure about the liquid surface

=(wx.bdx.).x=wx^2bdx.



Now sum of all moments about the liquid surface,

M=∫ wx^2bdx.

But ∫ x^2bdx=$I_{0=}$(Moment of Inertia of the surface liquid level, or second Moment of area).

Hence, **M=w I_0**.

We know, that sum of moments of the pressure is also equal to **P .h**

(Where h-depth of centre of Pressure from the liquid surface total pressure on the surface).

APPLICATION OF HYDROSTATICS

PRESSURE DIADRAM

A pressure Diagram may be defined as a graphical representation of the variation in the intensity of pressure over a surface. Such diagrams are very useful to find out total pressure and the centre of pressure of a liquid on vertical surface.

Pressure due to one kind of liquid on the one side.

Consider a vertical wall subjected to pressure due to one kind of liquid, on one of its sides as shown in Fig.

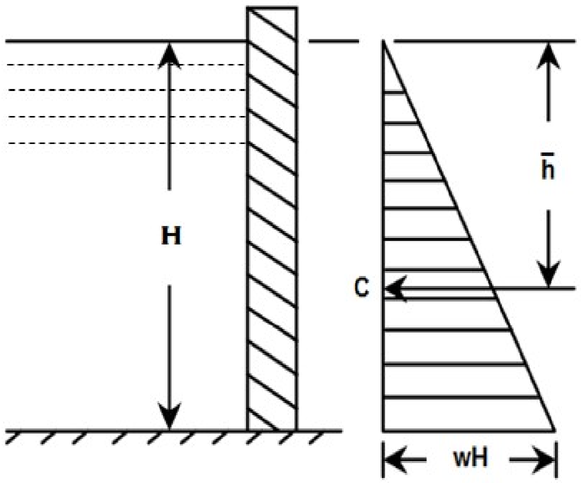


Fig : Masonry Wall

Let **H**=Height of liquid,

w=Specific weight of the liquid, and

P=Total pressure on the wall per unit length.

Pressure on the wall zero at the liquid surface, and will increase by a straight line law to wH at the bottom. Therefore the pressure diagram will be a triangle ABC as shown in Fig. The total pressure on the wall on per unit length,

P=(Area of Triangle ABC)= ½ .H .wH =½ wH^2

This Pressure will acts at the C.G of the triangle ,i.e.at a depth of 2H/3 from the liquid surface.