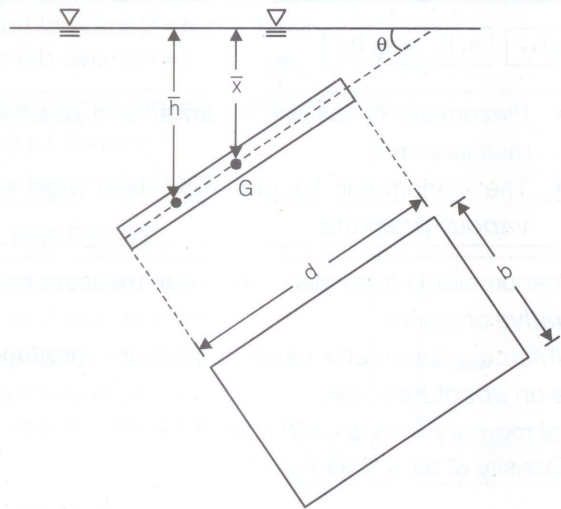


3.

HYDROSTATIC FORCES

HYDROSTATIC FORCES ON SUBMERGED SURFACE

Case	Force	Center of pressure (h)
Horizontal Position	$wA\bar{x}$	$h = \bar{x}$
Vertical Position	$wA\bar{x}$	$h = \bar{x} + \frac{I_G}{A\bar{x}}$
Inclined Position	$wA\bar{x}$	$h = \bar{x} + \frac{I_G}{A\bar{x}} \sin^2 \theta$



$$I_G = \frac{bd^3}{12}$$

(For rectangular plate)

$$I_G = \frac{\pi}{64} (\text{diameter})^4$$

(For circular plate)

Here,

A = Area of surface touching fluid

I_G = Area moment of inertia about centroidal axis and parallel to free axis.

\bar{x} = Vertical distance of C.O.G. of body from free surface.

w = Specific weight

θ = Angle at which the surface is inclined with horizontal

HYDROSTATIC FORCES ON CURVED SURFACE

• Horizontal Force (F_H)

Horizontal component of the resultant hydrostatic force ' F_x ' of curved surface may be computed by projecting the surface upon a vertical plane and multiplying the projected area by the pressure at its own centre of area.

• Vertical Force (F_V)

Vertical component of force ' F_y ' is equal to the weight of the liquid block lying above the curved surface upto free surface.

• Resultant Force (F)

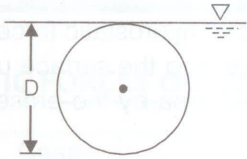
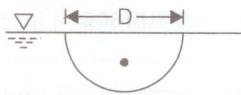
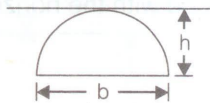
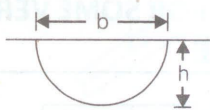
$$F = \sqrt{(F_H)^2 + (F_V)^2}$$

Angle of line of action of resultant force with the horizontal is given by

$$\tan \theta = \frac{F_y}{F_x}$$

DEPTH OF CENTER OF PRESSURE FOR SOME VERTICAL PLANE SURFACES FROM LIQUID SURFACE

SURFACE	C.G. (\bar{x})	C.P. (\bar{h})
Rectangle 	$\frac{h}{2}$	$\frac{2h}{3}$
Trapezium 	$\frac{a+2b}{a+b} \cdot \frac{h}{3}$	$\frac{a+3b}{a+2b} \cdot \frac{h}{2}$
Triangle (a) (b)	$\frac{2h}{3}$	$\frac{3h}{4}$
	$\frac{h}{3}$	$\frac{h}{2}$

<p>Circle</p> 	$\frac{D}{2}$	$\frac{5D}{8}$
<p>Semi Circle</p> 	$\frac{2D}{3\pi}$	$\frac{3\pi D}{32}$
<p>Parabola</p> <p>(a)</p>  <p>(b)</p> 	$\frac{3h}{5}$ $\frac{2h}{5}$	$\frac{5h}{7}$ $\frac{4h}{7}$



In case of vertical surface, when depth of immersion (\bar{x}) is very large then
centre of pressure = centre of gravity

