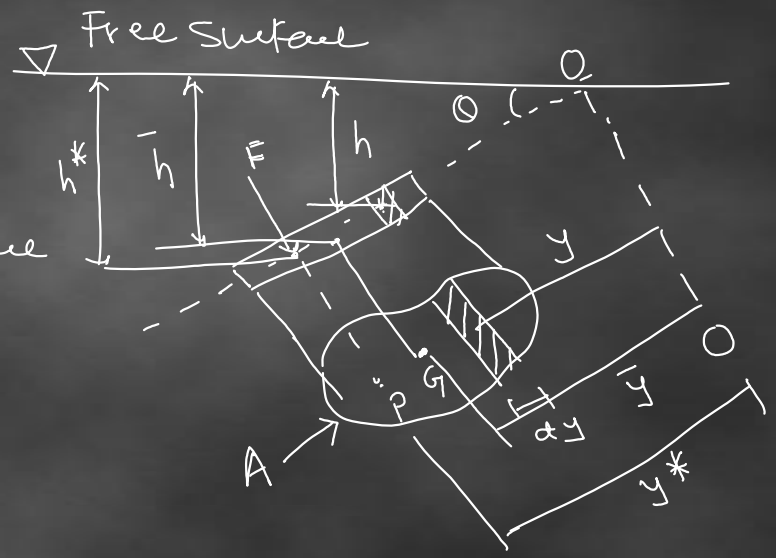
Case - III Inclined surface

$h = y \sin\theta$



let A = area of surface

θ = angle of inclination

O-O = axis Perpendicular to the Plane of surface

$\bar{y}$ = Distance of CG from O-O

y^* = " " CP " "

$\bar{h}$ = Dept of CG from free surface

h^* = " " CP " "

Total Pressure force

$$P = \rho g h$$

$$= \rho g y \sin\theta$$

Pressure force $dF = P \times dA$

$= \rho g y \sin\theta \, dA$

Total Pressure Force

$$F = \int dF$$

$$= \int \rho g y \sin\theta \, dA$$

$$= \rho g \sin\theta \int y \, dA$$

$$= \rho g \sin\theta \, A\bar{y}$$

$$\int y \, dA = A\bar{y}$$

first moment of area about O-O

$$F = \rho g A \sin\theta \, \bar{y}$$

$$\boxed{= \rho g A \bar{h}}$$

Centre of Pressure (h^*)

Moment of force about O-O = Sum of moment about O-O

$$F \times y^* = \int dF \times y$$

↳ moment of strip abt O-O

$$= \int \rho g\, y \sin\theta\, dA \cdot y$$

$$= \int \rho g \sin\theta\, y^2\, dA$$

$$= \rho g \sin\theta \int y^2\, dA$$

$$= \rho g \sin\theta\, I_o$$

$\int y^2 dA$ = Second moment of area

I_o = M.I abt O-O

$$F \times y^* = \rho g \sin\theta\, I_o$$

$$y^* = \frac{\rho g \sin\theta\, I_o}{F}$$

$$= \frac{\rho g \sin\theta\, I_o}{\rho g A \bar{h}}$$

$$y^* = \frac{\sin\theta\, I_o}{A\bar{h}}$$

$$y^* = \frac{\sin\theta\, I_o}{A\bar{h}}$$

$$\frac{h^*}{\sin\theta} = \frac{\sin\theta\, I_o}{A\bar{h}}$$

$$h^* = \frac{\sin^2\theta\, I_o}{A\bar{h}}$$

$$h^* = \frac{\sin^2\theta\,(I_G + A\bar{y}^2)}{A\bar{h}}$$

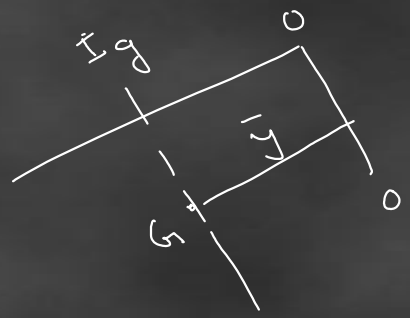
$$= \frac{\sin^2\theta}{A\bar{h}}\left[I_G + A\left(\frac{\bar{h}}{\sin\theta}\right)^2\right]$$

$$= \frac{I_G \sin^2\theta}{A\bar{h}} + \bar{h}$$

$$h^* = y^* \sin\theta$$

$$y^* = \frac{h^*}{\sin\theta}$$

$$I_o = I_G + A\bar{y}^2$$



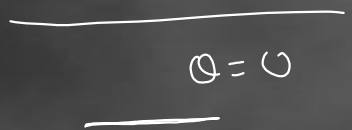
$$\bar{h} = \bar{y}\sin\theta$$

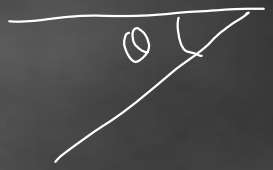
$$\bar{y} = \frac{\bar{h}}{\sin\theta}$$

$$\boxed{h^* = \frac{I_G \sin^2\theta}{A\bar{h}} + \bar{h}}$$

$\theta = 90 \quad \sin\theta = 1$

$\theta = 0 \quad \sin\theta = 0$





$\theta = 0$

$\sin\theta = 0$

$$h^* = \frac{I_G \sin^2\theta}{A\bar{h}} + \bar{h}$$

$$h^* = \frac{I_G \times 0}{A\bar{h}} + \bar{h}$$

$$h^* = \bar{h}$$

$CP = CG$

$\theta = 90$

$\sin 90 = 1$

$$h^* = \frac{I_G (1)^2}{A\bar{h}} + \bar{h}$$

$$\boxed{h^* = \frac{I_G}{A\bar{h}} + \bar{h}}$$