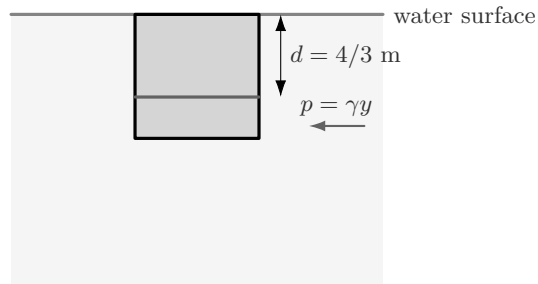
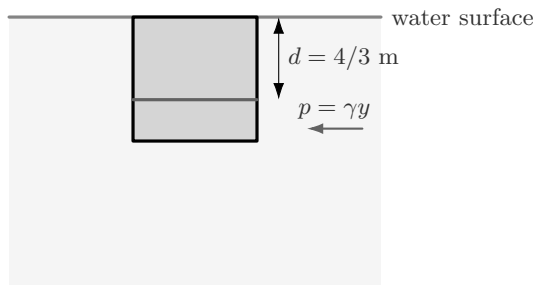


Question 6

A 2×2 m square gate has its top at the surface. Find the depth d of the center of pressure, where $d = M/F$.



Question 6 – Solution



Step 1: Set up the hydrostatic force. Let y be depth below the surface. The gate has constant width 2 m and extends from $y = 0$ to $y = 2$. Thus

$$dF = (9800y)(2 dy).$$

Therefore,

$$\begin{aligned} F &= 9800 \int_0^2 2y dy = 19600 \left[\frac{y^2}{2} \right]_0^2 \\ &= 39,200 \text{ N.} \end{aligned}$$

Step 2: Find the moment of the pressure force about the surface. The moment arm of the strip force is y , so

$$\begin{aligned} M &= \int_0^2 y dF = 9800 \int_0^2 2y^2 dy \\ &= 19600 \left[\frac{y^3}{3} \right]_0^2 = \frac{156,800}{3} \text{ N m.} \end{aligned}$$

Step 3: Divide moment by total force.

$$d = \frac{M}{F} = \frac{\frac{156800}{3}}{39200} = \frac{4}{3} \text{ m.}$$

$$d = \frac{4}{3} \text{ m below the surface}$$

The center of pressure lies below the geometric center at depth 1 m because pressure increases with depth.