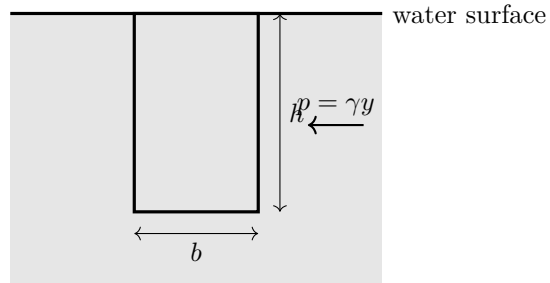
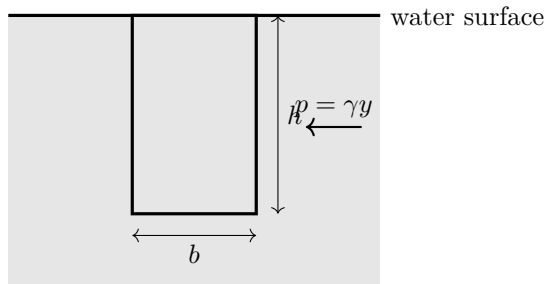


Question 7

A rectangular dam face is b meters wide and extends from the surface to depth h . Derive $F(h)$. If h doubles, by what factor does F change?



Question 7 – Solution



Step 1: Choose the depth variable. Let y measure depth below the surface. The dam face extends from $y = 0$ to $y = h$.

Step 2: Write the force on a horizontal strip. The pressure is $p(y) = \gamma y$, and a strip of width b and thickness dy has area $dA = b dy$. Therefore,

$$dF = p(y) dA = \gamma b y dy.$$

Step 3: Integrate from the surface to depth h .

$$\begin{aligned} F(h) &= \gamma b \int_0^h y dy \\ &= \gamma b \left[\frac{y^2}{2} \right]_0^h = \frac{1}{2} \gamma b h^2. \end{aligned}$$

$$F(h) = \frac{1}{2} \gamma b h^2$$

Step 4: Determine the effect of doubling the depth.

$$F(2h) = \frac{1}{2} \gamma b (2h)^2 = 4 \left(\frac{1}{2} \gamma b h^2 \right) = 4F(h).$$

Doubling h multiplies the force by 4.