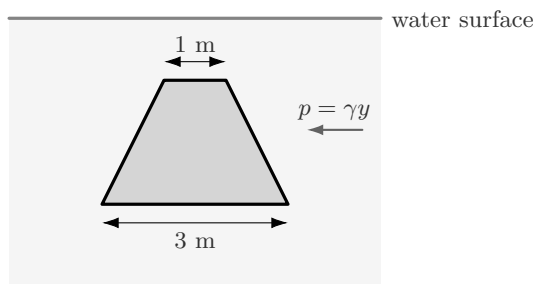
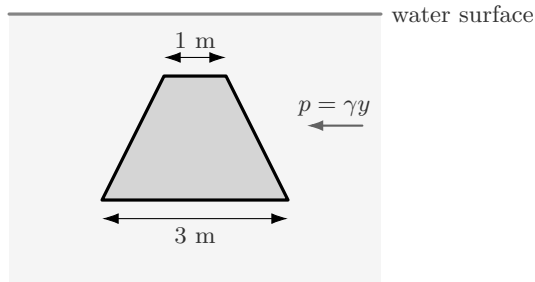


Question 4

Oil has weight density 8000 N/m^3 . A trapezoidal plate is (1) m wide at its top, (3) m wide at its bottom, (2) m high, with top depth (1) m. Find the force.



Question 4 – Solution



Step 1: Choose the depth variable. Let y be depth below the oil surface. The plate begins at $y = 1$ and ends at $y = 3$ m.

Step 2: Find the width at depth y . The width grows linearly from 1 m at $y = 1$ to 3 m at $y = 3$. The slope is

$$\frac{3 - 1}{3 - 1} = 1,$$

so the linear width function is

$$w(y) = y, \quad 1 \leq y \leq 3.$$

Step 3: Write the force on a horizontal strip.

$$p(y) = 8000y, \quad dA = w(y) dy = y dy.$$

Hence

$$dF = p(y) dA = 8000y^2 dy.$$

Step 4: Integrate and evaluate.

$$\begin{aligned} F &= 8000 \int_1^3 y^2 dy = 8000 \left[\frac{y^3}{3} \right]_1^3 \\ &= \frac{8000}{3} (27 - 1) = \frac{208000}{3} \text{ N}. \end{aligned}$$

$$F = \frac{208000}{3} \text{ N} \approx 69,333.3 \text{ N}$$