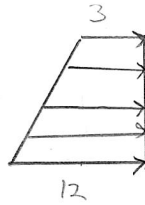
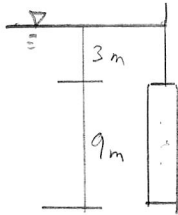


2 pts

A 9 m x 9 m vertical gate is submerged 3 m. Determine the resultant force (magnitude & location) using both methods (avg. pressure & inclined plane).



pressure distribution is trapezoidal

2pt Avg. Pressure Method

$$|F| = (\text{Avg. Pressure})(A_{\text{rect}}) = (\text{Avg. } \bar{h}) \cdot \gamma \cdot A_{\text{rect}}$$

$$|F| = \left(\frac{3+12}{2}\right) \left(9.81 \frac{\text{kN}}{\text{m}^3}\right) (81 \text{ m}^2)$$

$$|F| = 6000 \text{ kN}$$

location occurs @ centroid of trapezoid

$$\frac{h(2B+b)}{3(B+b)}$$

$$= \frac{(9)[(2)(12)+3]}{3(12+3)} = \frac{243}{45}$$

$$= 5.4 \text{ m (measured from top of gate)}$$

$$= 8.4 \text{ m (from top of water surface)}$$

2pt Inclined plane method

$$|F| = \bar{h} \cdot \gamma \cdot A = (7.5)(9.81 \frac{\text{kN}}{\text{m}^3})(81 \text{ m}^2)$$

$$|F| = 6000 \text{ kN}$$

$$y_{cp} = \bar{y} + \frac{\bar{I}}{\bar{y}A} = 7.5 + \frac{547}{(7.5)(81)}$$

$$y_{cp} = 8.4 \text{ m (from top of water surface)}$$

Moment of Inertia of Rect Gate

$$I = \frac{bh^3}{12}$$

$$I = \frac{(9)(9)^3}{12}$$

$$I = 547 \text{ m}^4$$