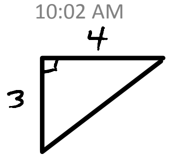
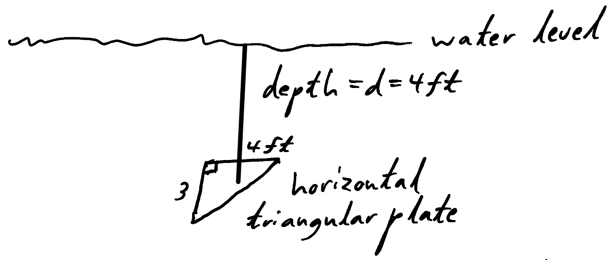
9.3 Force Due to Fluid Pressure.

Thursday, September 29, 2011
10:02 AM





Weight density of water is $\delta = 62.5 \ \text{lb}/\text{ft}^3$

$$\delta = 9800 \ \text{kg}/\text{m}^2\text{sec}^2 = 9800 \ \frac{N}{m^3}$$

$$1N = 1 \ \frac{\text{kg-m}}{\text{sec}^2}$$

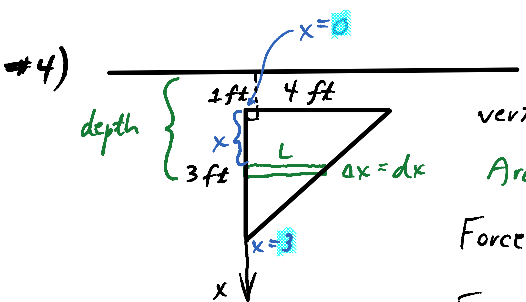
Force = (weight density)(depth)(area of plate).

$$= \delta \cdot d \cdot A$$

$$= 62.5 \cdot 4 \cdot \left(\tfrac{1}{2} \cdot 3 \cdot 4\right)$$

$$= 1500 \ \text{lb}.$$

#4)



vertical plate

For Riemann Sum ↓   For integral ↓

Area of the thin slice $= L \cdot \Delta x = L \cdot dx$

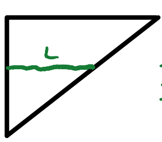
Force on thin slice $\cong \underset{(\text{density})}{\delta} \cdot \underset{(\text{depth})}{(x_i + 1)} \cdot \underset{(\text{area})}{L \cdot \Delta x_i}$

Force on entire plate $\approx \sum_{i=1}^{n} \delta (x_i + 1) \cdot L \cdot \Delta x$

use $\lim_{n \to \infty}$

$$F = \int_0^3 \overset{\delta}{62.5} \, \overset{d}{(x+1)} \, \overset{A}{(L \cdot dx)}$$ — area of the thin slice.

similar triangles



$$\frac{L}{3-x} = \frac{4}{3}$$

$$= \int_0^3 (62.5)(x+1) \cdot \frac{4}{3}(3-x)\, dx = 62.5 \cdot \frac{4}{3} \int_0^3 (3x - x^2 + 3 - x)\, dx$$

$$= \frac{250}{3}\left[-\frac{x^3}{3} + x^2 + 3x\right]_0^3 = \frac{250}{3}\left[-9 + 9 + 9\right] = 750 \text{ pounds.}$$

center of mass