Answer on Question#56544 - Physics - Mechanics - Relativity

A swimming pool is 5m long, 4m wide and 3m deep. Compute the force exerted by the water against the bottom and either end. Do not include the force due to air pressure.

Solution:

The pressure at the bottom of the pool:

$$P_b = \rho g h,$$

Where $h = 3\text{m}$ – is the depth of the pool, $g = 9.8\frac{\text{m}}{\text{s}^2}$ – acceleration due to gravity, $\rho = 1000\frac{\text{kg}}{\text{m}^3}$ – water density.

The area of the bottom is

$$A = l \cdot w,$$

Where $l = 5\text{m}$ – length, $w = 4\text{m}$ – width.

The force exerted against the bottom:

$$F_b = P_b A = \rho g h l w = 1000\frac{\text{kg}}{\text{m}^3} \cdot 9.8\frac{\text{m}}{\text{s}^2} \cdot 3\text{m} \cdot 5\text{m} \cdot 4\text{m} = 588\text{ kN}$$

Force exerted against the end of the pool with side l:

$$F_l = \int_0^h \rho g s l ds = \frac{1}{2}\rho g h^2 l = \frac{1}{2}1000\frac{\text{kg}}{\text{m}^3} \cdot 9.8\frac{\text{m}}{\text{s}^2} \cdot (3\text{m})^2 \cdot 5\text{m} = 220.5\text{ kN}$$

Force exerted against the end of the pool with side w:

$$F_w = \int_0^h \rho g s w ds = \frac{1}{2}\rho g h^2 w = \frac{1}{2}1000\frac{\text{kg}}{\text{m}^3} \cdot 9.8\frac{\text{m}}{\text{s}^2} \cdot (3\text{m})^2 \cdot 4\text{m} = 294\text{ kN}$$

Answer: $F_b = 588\text{ kN}$, $F_l = 220.5\text{ kN}$, $F_w = 294\text{ kN}$.