SECTION - 3

Q1 Given that

$$D = 1.5$$

Gauge pressure (P) = 2MPa = 2×10^6 Pa

$$V = 4/3 \pi r^3 \Rightarrow \frac{4}{3} \times \frac{22}{7} \times \left(\frac{1.5}{2}\right)^3$$

$$V = 1.77 m^3$$

Total water escape = 4 ltr.

Bulk modulus (B) = 2 Gpa

$= 2 \times 10^9$ Pa

Young's modulus Vessel = 200 Gpa

$= 200 \times 10^9$ Pa

Poision ratio $\mu = 0.3$

To find t (thickness of material)

Contraction of vessel

$$\Delta V_1 \frac{3Pd}{4tE} (1-\mu)V$$

$$= \frac{3 \times 2 \times 10^6 \times 1.5 \times 0.7 \times 1.77}{4t \times 200 \times 10^9}$$

$$= \frac{0.0315 \times 1.77}{10^3 t}$$

Expansion of water $= \Delta V_2 = \frac{PV}{B}$

$\Delta V_1 + \Delta V_2$ = volume of water escape

$$\Rightarrow \frac{1.77}{108}\left(\frac{0.0315}{t} + 1\right) = 4 \times 10^{-3}\ m^3$$

$$\Rightarrow \frac{0.0315}{t} = \frac{4}{1.77} - 1$$

$$\Rightarrow t = 0.025\ mt$$

$$t = 2.5\ cm$$

$\therefore$ thickness of plates is 2.5 cm.