Section – 3

Ans-1 Given that

$D = 1.5\ m$

$R = d/2 = \frac{1.5}{2}\ m$

Gauge pressure $(P) = 2\ MPa = 2 \times 10^6\ Pa$

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

$V = 1.77\ m^3$

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

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

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

$$\Rightarrow t = 0.025\ mt.$$

$\therefore t = 2.5\ cm$

$\therefore$ thickness of plate is 2.5 cm.