

$$\text{Pressure} = \frac{F}{A} ; P = \rho g h$$

$$F = P \times A$$

$$\begin{aligned} dF &= P \times dA \\ &= \rho g h \times b \times dh \end{aligned}$$

$$\begin{aligned} \text{Total pressure} &= \int dF \\ &= \int \rho g h \times b \times dh \\ &= \rho g \int h \times b \, dh \\ &= \rho g \int h \, dA \\ &= \rho g A \bar{h} \end{aligned}$$

$$= 1 \times 9.81 \times 21 \times \frac{7}{2} \times 10^3$$

$$= 721035 \text{ N}$$

$$\text{Total pressure force} = \underline{721.035 \text{ kN}}$$

The centre of pressure is given by $\bar{h} + \frac{I_G}{A\bar{h}}$

Where I_G = moment of inertia of the plate

$$I_G = \frac{bd^3}{12} = \frac{3 \times 7^3}{12} = 85.75$$

$$\text{so } h^* = \frac{7}{2} + \frac{85.75}{21 \times \frac{7}{2}} = \frac{14}{3} = \underline{\underline{4.667 \text{ m}}}$$

ii) The total Pressure force on the gate at angle of 65 degrees

$$F = \rho g A h \sin \theta$$

$$= 1000 \times 9.81 \times 21 \times \frac{7 \sin 65^\circ}{2}$$

$$= 653.4796 \text{ kN}$$

$$= \underline{\underline{653.48 \text{ kN}}}$$