

2.136

2.136 A river barge, whose cross section is approximately rectangular, carries a load of grain. The barge is 28 ft wide and 90 ft long. When unloaded its draft (depth of submergence) is 5 ft, and with the load of grain the draft is 7 ft. Determine: (a) the unloaded weight of the barge, and (b) the weight of the grain.

(a) For equilibrium,

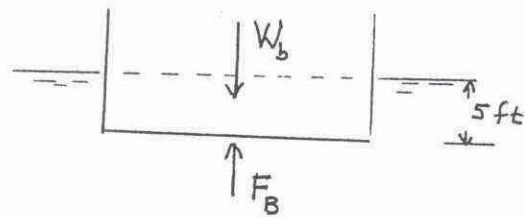
$$\sum F_{\text{vertical}} = 0$$

so that

$$W_b = F_B = \gamma_{\text{H}_2\text{O}} \times (\text{submerged volume})$$

$$= (62.4 \frac{\text{lb}}{\text{ft}^3}) (5 \text{ ft} \times 28 \text{ ft} \times 90 \text{ ft})$$

$$= \underline{\underline{786,000 \text{ lb}}}$$



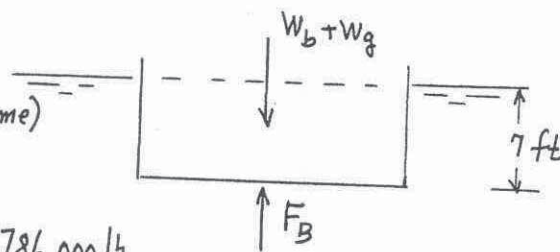
$W_b \sim$ weight of barge (unloaded)

(b) $\sum F_{\text{vertical}} = 0$

$$W_b + W_g = F_B = \gamma_{\text{H}_2\text{O}} \times (\text{submerged volume})$$

$$W_g = (62.4 \frac{\text{lb}}{\text{ft}^3}) (7 \text{ ft} \times 28 \text{ ft} \times 90 \text{ ft}) - 786,000 \text{ lb}$$

$$= \underline{\underline{315,000 \text{ lb}}}$$



$W_g \sim$ weight of grain