2.76 Find the weight W needed to hold the wall shown in Fig. P2.76 upright. The wall is 10 m wide.

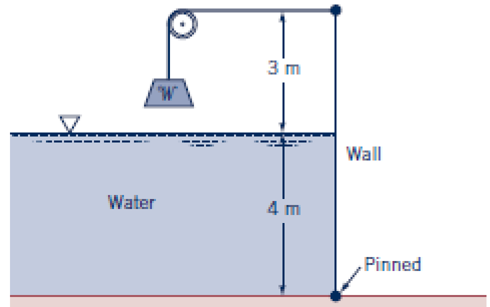
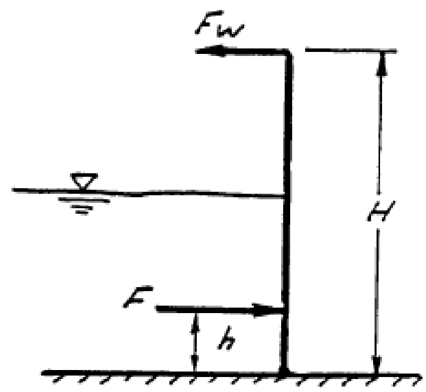


Figure P2.76

SOLUTION:

The hydrostatic force F on the wall is found from



$$F = \rho g h_c A$$
$$= \left(1000\frac{kg}{m^3}\right)\left(9.81\frac{m}{s^2}\right)(2m)\left(4\times 10m^2\right)$$
$$= 78500\left(\frac{kg\cdot m}{s^2}\right)\left(\frac{kN}{1000N}\right)$$
$$= 785\,kN$$

The force F is located one-third of the water depth from the bottom of the water.

$$h = \frac{1}{3}(4m) = 1.33m$$

Summing moments about the pinned joint,

$$F_W = \frac{h}{H}F = \frac{(1.33m)}{(7m)}(785kN) = 149\,kN$$

Assuming no friction between the rope and the pulley,

$$W = F_W \quad \rightarrow \quad \boxed{W = 149 \text{ kN}}$$

DISCUSSION

Note that the atmospheric pressure acts on both sides of the wall.

Therefore, the forces due to atmospheric pressure are equal and opposite, and cancel.