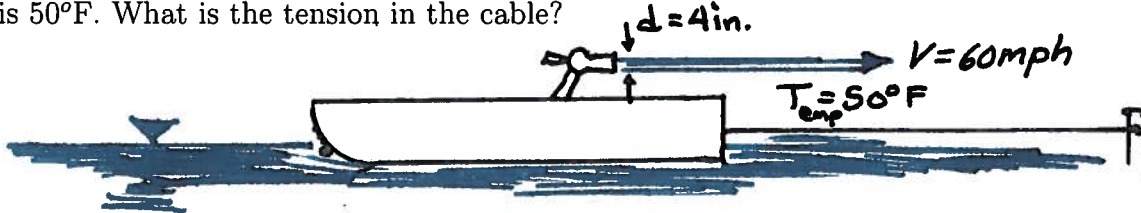


## CE 3305 Water Systems Design

## Quiz 14

Spring 2014

A firehose on a boat is producing a 4-in. -diameter, horizontal, water jet with a speed of  $V = 60$  mph. The boat is held stationary by a cable attached to a pier. The water temperature is  $50^\circ\text{F}$ . What is the tension in the cable?

KNOWN

$$d = 4 \text{ in.}$$

$$A_j = \frac{\pi (4/2)^2}{4} = 0.08726 \text{ ft}^2$$

$$V_j = \frac{60 \text{ miles}}{\text{hr}} \cdot \frac{1 \text{ hr}}{3600 \text{ s}} \cdot \frac{5280 \text{ ft}}{1 \text{ mile}} = 88 \text{ ft/s}$$

$$T_{\text{emp}} = 50^\circ \text{F}$$

$$\gamma_w g = 62.4 \frac{\text{lb}_f}{\text{ft}^3}$$

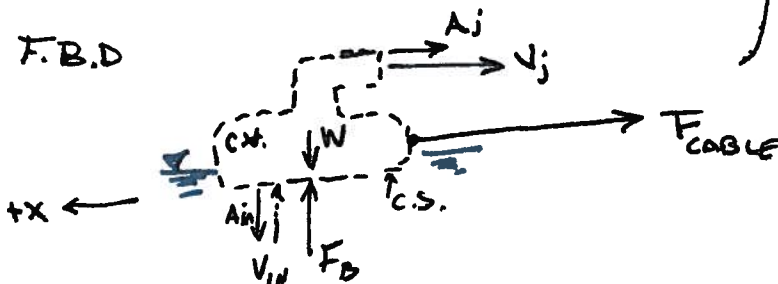
GOVERNING EQUATION(S)

$$\ast \Sigma F = m a$$

CONTINUITY

 $\ast$  MOMENTUMSOLUTION

F.B.D

MOMENTUM

$$\Sigma F = \frac{d}{dt} \left( \int_{C.V.} \rho \underline{V} dV \right) + \int_{C.S.} \rho \underline{V} (\underline{V} \cdot d\underline{A})$$

$= 0 \quad \frac{d}{dt} = 0 \text{ steady flow}$

$$-F_{\text{CABLE}} = \gamma_w V_j V_j A_j$$

$$= \left( \frac{62.4 \text{ lb}_f}{\text{ft}^3} \right) \left( \frac{\text{slug}}{32.2 \text{ ft/s}^2} \right) (88 \text{ ft/s})^2 (0.08726 \text{ ft}^2)$$

$$= 1309 \text{ lb}_f$$