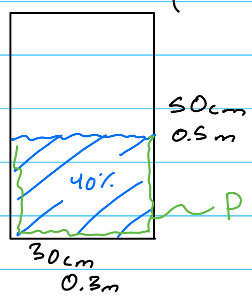
Trevor Swan **ECHE225: QUIZ #8 // 10.31.24**

1. This question is not related to this week's homework



- $A_c = 0.3m \cdot 0.4(.5m)$ $= 0.06\ m^2$ $0.4\times0.5=0.2$
- $P = (0.3) + 2(0.2m)$ $= 0.7$ wetted perimeter
- Steady-state, laminar flow desired
- $SG = 0.85$, $V_{Avg} = 2\ m/s$

$Re_{crit} = 2300$ (laminar flow)

$Re = \dfrac{\rho V_{Avg} D_h}{\mu}$

$\rightarrow \mu = \dfrac{\rho V_{Avg} D_h}{Re}$

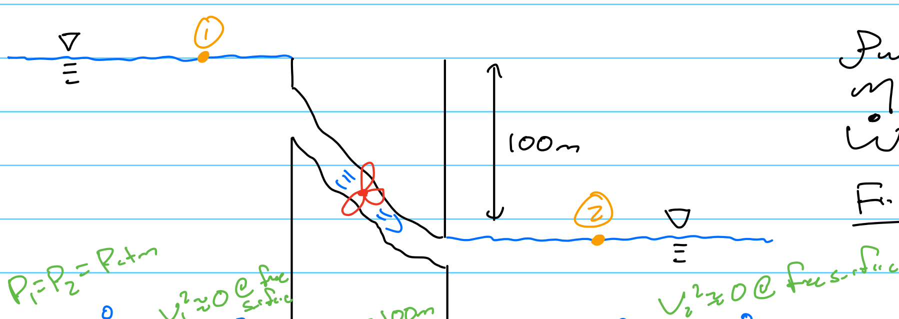
$D_h = \dfrac{4A_c}{P}$ $\rho = SG \cdot \rho_{water}$

$$\left.\begin{aligned} \rho &= 0.85 \cdot 1000\ kg/m^3 = 850\ kg/m^3 \\ D_h &= \frac{4(0.06m^2)}{0.7m} = 0.3429m \end{aligned}\right\}$$

$$\mu = \frac{850\ kg/m^3 \cdot 2m/s \cdot 0.3429m}{2300} = 0.2534\ kg/m\cdot s$$

$$\boxed{\mu = 0.25\ \frac{kg}{m \cdot s}}$$

2.



$\rho_w = 1000\ kg/m^3$

$\eta_{turbine} = 0.85 = \dfrac{\dot{W}_{turbine}}{\dot{W}_{turbine,e}}$

$\dot{W}_{turbine} = 100kW$

Find $\dot{m}$

$P_1 = P_2 = P_{atm}$ $V_1^2 \approx 0$ @ free surface $z_1 - z_2 = 100m$ $V_2^2 \approx 0$ @ free surface Given

$$\cancel{\frac{P_1}{\rho g}}^{0} + \cancel{\frac{V_1^2}{2g}}^{0} + z_1 + \cancel{h_{pump,u}}^{0} = \cancel{\frac{P_2}{\rho g}}^{0} + \cancel{\frac{V_2^2}{2g}}^{0} + \cancel{z_2} + h_{turbine,e} + \cancel{h_L}^{0}$$

$$h_{turbine,e} = 100\ m$$

$$\dot{W}_{turbine,e} = \frac{\dot{W}_{turbine}}{\eta_{turbine}} = \frac{100kW}{0.85} = 117.647\ kW = 117{,}647 W \ \left\{\frac{kg \cdot m^2}{s^3}\right\}$$

$$h_{turbine,e} = \frac{\dot{W}_{turbine,e}}{\dot{m} g} \rightarrow \dot{m} = \frac{\dot{W}_{turbine,e}}{g \cdot h_{turbine}} = \frac{117{,}647\ W}{(9.81 m/s^2)(100m)} = 119.93\ kg/s$$

$$\boxed{\dot{m} = 119.93\ kg/s}$$