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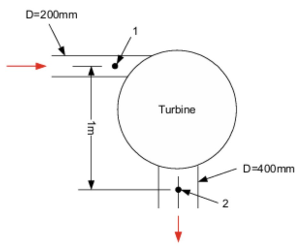
//NUCL521
//Assessment 02
//Date 15/08/2025

//QUESTION 1



{Water flows at 0.25 m3/s through the turbine shown below. The pressure at point 1 is 250kPa gage, and at point 2 its 30kPa gage. If we neglect friction and heat transfer, what is the power delivered to the turbine from the water? Assume
1000 , 9.81}

//Given

rho=1000 [kg/m^3]
q_dot=0,25 [m^3/s] //The flow rate is const cause the density is const
m_dot=rho*q_dot
g=9,81 [m/s^2]

//Point1

P_1=250 [kPa]***convert**(kPa;Pa)
D_1=200 [mm]***convert**(mm;m)
A_1=(pi*(D_1)^2)/4
z_1=1[m] //I am making state two a datum
V_1=q_dot/A_1

//State2
P_2=30 [kPa]***convert**(kPa;Pa)
D_2=400 [mm]***convert**(mm;m)
A_2=(pi*(D_2)^2)/4
z_2=0[m]
V_2=q_dot/A_2

//Assuming steady state operation by compressor, dE/dt =0
//No Heat Q_in=Qout=0
//Wout=0 only work to the system by Compressor
Q_dot_in=0[W]
Q_dot_out=0[W]
W_dot_out=0[W]
Q_dot_in - Q_dot_out + W_dot_in - W_dot_out + m_dot*((V_2^2)/2 + P_2/rho + g*z_2) - m_dot*((V_1^2)/2 + P_1/rho + g*z_1) = 0

$\rho = 1000$ [kg/m^3]

$\dot{q} = 0,25$ [m^3/s]

$\dot{m} = \rho \cdot \dot{q}$

$g = 9,81$ [m/s^2]

$P_1 = 250$ [kPa] $\cdot \left| 1000 \cdot \frac{Pa}{kPa} \right|$

$D_1 = 200$ [mm] $\cdot \left| 0,001 \cdot \frac{m}{mm} \right|$

$$A_1 = \frac{\pi \cdot D_1^{\;2}}{4}$$

$z_1 = 1$ [m]

$$V_1 = \frac{\dot{q}}{A_1}$$

$P_2 = 30$ [kPa] $\cdot \left| 1000 \cdot \frac{Pa}{kPa} \right|$

$D_2 = 400$ [mm] $\cdot \left| 0,001 \cdot \frac{m}{mm} \right|$

$$A_2 = \frac{\pi \cdot D_2^{\;2}}{4}$$

$z_2 = 0$ [m]

$$V_2 = \frac{\dot{q}}{A_2}$$

$\dot{Q}_{in} = 0$ [W]

$\dot{Q}_{out} = 0$ [W]

$\dot{W}_{out} = 0$ [W]

$$\dot{Q}_{in} - \dot{Q}_{out} + \dot{W}_{in} - \dot{W}_{out} + \dot{m} \cdot \left[\frac{V_2^{\;2}}{2} + \frac{P_2}{\rho} + g \cdot z_2 \right] - \dot{m} \cdot \left[\frac{V_1^{\;2}}{2} + \frac{P_1}{\rho} + g \cdot z_1 \right] = 0$$

SOLUTION

Unit Settings: SI C kPa kJ mass deg

A_1 = 0,03142 [m^2]	A_2 = 0,1257 [m^2]	D_1 = 0,2 [m]	D_2 = 0,4 [m]
g = 9,81 [m/s^2]	$\dot{m}$ = 250 [kg/s]	P_1 = 250000 [Pa]	P_2 = 30000 [Pa]
$\dot{q}$ = 0,25 [m^3/s]	$\dot{Q}_{in}$ = 0 [W]	$\dot{Q}_{out}$ = 0 [W]	ρ = 1000 [kg/m^3]
V_1 = 7,958 [m/s]	V_2 = 1,989 [m/s]	$\dot{W}_{in}$ = 64873 [W]	$\dot{W}_{out}$ = 0 [W]
z_1 = 1 [m]	z_2 = 0 [m]		

No unit problems were detected.