Øving 4, Strømning, Vegard G. Jervell

Oppg 1)

$$R_E = \frac{\rho U L}{\mu} = \frac{UL}{\nu}$$

$R_E = 6 \cdot 10^4 > 2300 \rightarrow$ Turbulent

Oppg 2) $q = V_1 A_1 = V_2 A_2 = V_3 A_3$ ved inkompressibel strømning

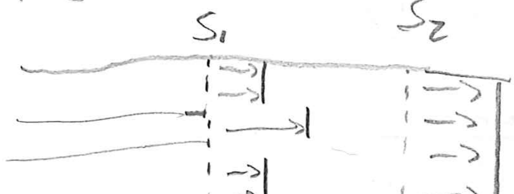
$q = 800\ dm^3/min$

$q = \frac{1}{75}\ m^3/s$

$D_1 = 50mm$, $D_2 = 60mm$, $D_3 = 100mm$

$V_1 = 6{,}8\ m/s$, $V_2 = 4{,}7\ m/s$, $V_3 = 1{,}7\ m/s$

Oppg 3)



$q_1 = q_2$, innkompressibel

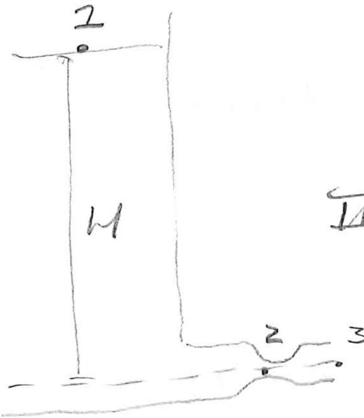
$$\int_{S_1} U\,dA = \int_{S_2} U\,dA$$

$$\int_{S_1} U\,dA = \int_{A_1} U\,dA + \int_{A_2} U\,dA = U_1 A_1 + U_2 A_2$$
$$= U_1\left(\frac{\pi}{4} D_1^2\right) + U_2\left(\frac{\pi}{4}(D_2^2 - D_1^2)\right)$$

$q_1 = 0{,}31\ m^3/s$

$q_1 = q_2 = U_3 A_3 \rightarrow U_3 = \frac{q_1}{A_3} = 6{,}31\ m/s$

Oppg: 4a) I $\left(\frac{P}{\rho}+\cancelto{0}{\frac{U_{AV}^2}{2\alpha}}+gz\right)_1 = \left(\frac{P}{\rho}+\frac{U_{AV}^2}{2\alpha}+\cancelto{0}{gz}\right)_2$



I $\quad gz_1 = \frac{P_2 - P_{atm}}{\rho} + \frac{1}{2}U_2^2$

II $\left(\frac{P}{\rho}+\frac{U^2}{2\alpha}+\cancelto{0}{gz}\right)_2 = \left(\frac{P}{\rho}+\frac{U^2}{2\alpha}+\cancelto{0}{gz}\right)_3$

II $\frac{P_2}{\rho}+\frac{1}{2}U_2^2 = \frac{P_3}{\rho}+\frac{1}{2}U_3^2$

II $\frac{P_2-P_{atm}}{\rho}+\frac{1}{2}U_2^2 = \frac{1}{2}U_3^2$

III $U_2A_2 = U_3A_3$

III $U_3 = \left(\frac{A_2}{A_3}\right)U_2$

III -> II) $\frac{P_2-P_{atm}}{\rho}+\frac{1}{2}U_2^2 = \frac{1}{2}\left(\left(\frac{A_2}{A_3}\right)U_2\right)^2$

$$\frac{P_2-P_{atm}}{\rho} = \frac{1}{2}U_2^2\left(\left(\frac{A_2}{A_3}\right)^2-1\right)$$

$$\frac{1}{2}U_2^2 = \frac{P_2-P_{atm}}{\rho\left(\left(\frac{A_2}{A_3}\right)^2-1\right)}$$

II -> I)

$$gz_1 = \frac{P_2-P_{atm}}{\rho} + \frac{P_2-P_{atm}}{\rho\left(\left(\frac{A_2}{A_3}\right)^2-1\right)}$$

$$\rho g z_1 = (P_2-P_{atm})\left(1+\left(\left(\frac{A_2}{A_3}\right)^2-1\right)^{-1}\right)$$

$$\rho g z_1\left(\left(\frac{D_2}{D_3}\right)^4-1\right) = (P_2-P_{atm})\left(1+\left(\frac{D_2}{D_3}\right)^4-1\right)$$

$$P_2 = \rho g z_1\left(\left(\frac{D_2}{D_3}\right)^4-1\right)\left(\frac{D_3}{D_2}\right)^4+P_{atm}$$

$$P_2 = \rho g z_1\left(1-\left(\frac{D_3}{D_2}\right)^4\right)+P_{atm}$$

$\underline{P_2 = 26\,kPa}$, $P_{atm} \approx 10^5\,Pa$

Løser for D_2 med $P_2 = P_{H_2O}(25°C) = 3\,kPa$

$D_2 = 9{,}6\cdot10^{-4}\,m$