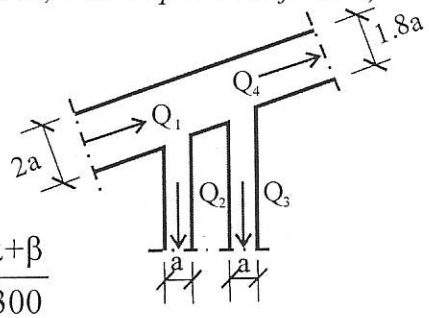
JEDNOSTAVNI ZADACI

ZADATAK 4.1

(Napomena: slike kotirati u metrima, a ne u opštim brojevima)

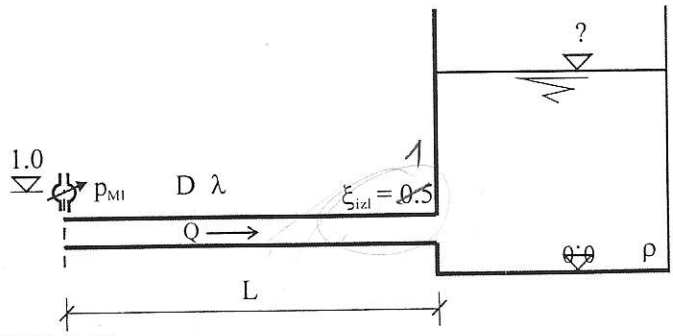
Kroz račvu prikazanu na skici protiče voda (ρ=1000 kg/m^3). Ukoliko je poznata brzina $V_1 = \alpha/8$ m/s i sledeći odnosi: $Q_1/Q_2 = 2$ i $Q_1/Q_4 = 0.9$, odrediti protoke Q_1, Q_2, Q_3 i Q_4 kao i odgovorajuće brzine vode u cevima.



$$a = \frac{\alpha+\beta}{300}$$

ZADATAK 4.2

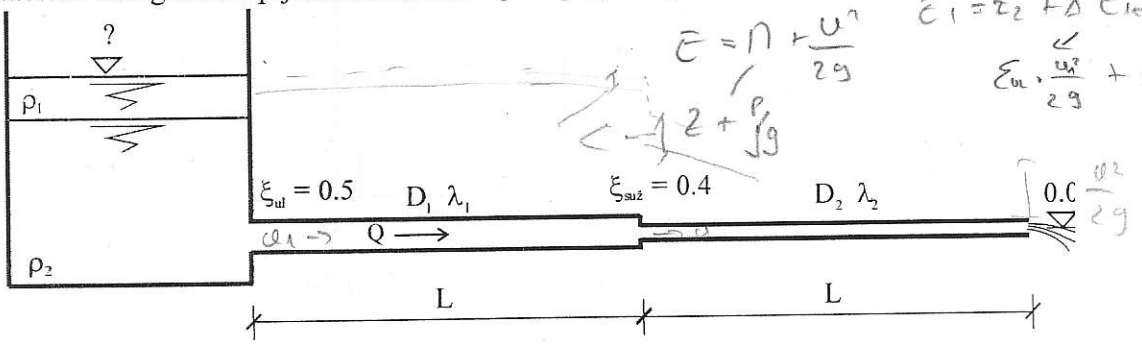
U rezervoara prikazan na skici dotiče voda protokom Q=β L/s kroz cev prečnika D=50+α mm koja ima koeficijent linijskog gubitka od λ=0.025. Na osnovu čitanja na manometru p_{M1}=0.2 bara, odrediti nivo vode u rezervoaru Skicirati pijezometarsku i energetsku liniju na potezu između manometra i rezervoara u pogodnoj razmeri.



SLOŽENI ZADACI

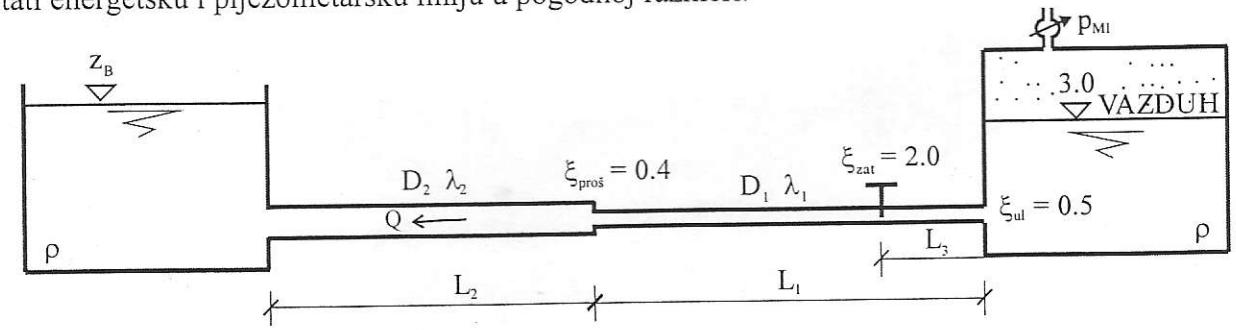
ZADATAK 4.3

Iz rezervoara prikazanog na slici, ističe voda protokom od Q=5β L/s. Odrediti pijezometarske kote oba fluida (ρ_1 = 900 kg/m^3 i ρ_2 = 1100 kg/m^3) u rezervoaru, ako su prečnici segmenata cevi D_1=100+10β mm i D_2=50+5β mm, dužine segmentata L=5β m i koeficijenti linijskih gubitaka segmenata λ_1=0.025 i λ_2=0.030. Nacrtati energetsku i pijezometarsku liniju u pogodnoj razmeri.

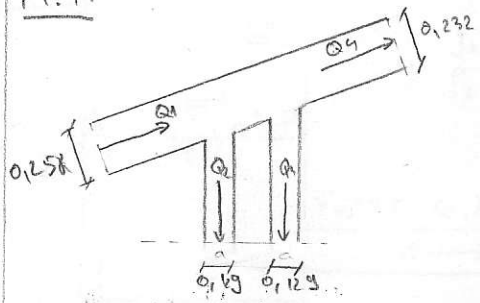


ZADATAK 4.4

Kroz horizontalnu cev prikazanu na slici iz rezervoara A teče fluid gustine ρ = 1000 kg/m^3 ka rezervoaru B. Odrediti protok kroz cevovod ukoliko ukoliko su prečnici segmenata cevi D_1=150+10β mm i D_2=50+5β mm, dužine segmentata L_1=150 m i L_2=200m a koeficijenti linijskih gubitaka segmenata λ_1=0.025 i λ_2=0.030. Nivo vode u rezervoaru B iznosi z_B=α m, dok je čitanje na manometru p_{M1}= (α+2)/10 bara. Nacrtati energetsku i pijezometarsku liniju u pogodnoj razmeri.



4.1



$q = \frac{32,4 + 6}{300} = 0,12g$

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

$v_1 = 0,45\ m/s$

$Q_1 = Q_4 + Q_2 + Q_3$

$Q_2 = Q_3$

$\frac{Q_1}{Q_2} = 2 \Rightarrow Q_2 = \frac{Q_1}{2}$

$\frac{Q_1}{Q_4} = 0,9 \Rightarrow Q_4 = \frac{Q_1}{0,9}$

$2Q_2 = 0,9\,Q_4$

$Q_4 = \frac{2Q_2}{0,9}$

$A_1 = \frac{0,258^2 \pi}{4} = 0,052\ m^2$

$A_2 = A_3 = \frac{0,12g^2 \pi}{4} = 0,013\ m^2$

$A_4 = \frac{0,232^2 \pi}{4} = 0,042\ m^2$

$Q_1 = v_1 \cdot A_1 = 0,039\ \frac{m^3}{s}$

$Q_2 = \frac{Q_1}{2} = 0,0195\ \frac{m^3}{s}$

$Q_3 = Q_1 - Q_4 - Q_2 = -0,0235$

$Q_4 = \frac{2 \cdot Q_2}{0,9} = 0,043\ \frac{m^3}{s}$

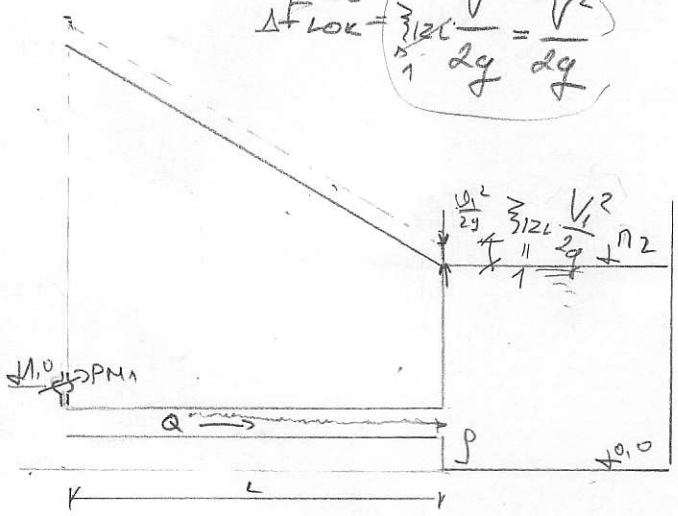
$v_2 = \frac{Q_2}{A_2} \Rightarrow v_2 = 1,5\ m/s$

$v_3 = \frac{Q_3}{A_3} \Rightarrow v_3 = -1,808\ m/s$

$v_4 = \frac{Q_4}{A_4} \Rightarrow v_4 = 1,02\ m/s$

4.2

$\Delta F_{LOK}^{12L} = \zeta_{12L} \frac{V^2}{2g} = \frac{V^2}{2g}$



$Q_1 = 3,24\ l/s = 0,00324\ \frac{m^3}{s}$

$D = 56\ mm = 0,056\ m$

$\lambda = 0,025$ $\quad \rho = 1000\ kg/m^3$

$p_{M1} = 20000\ Pa$ $\quad \zeta_{12L} = 1$

$L = 32,4\ m$

$A_1 = \frac{D^2 \pi}{4} = 0,00246\ m^2$

$\Pi_1 = \frac{p_{M1}}{\rho g} + z_{p_{M1}} \Rightarrow \Pi_1 = 3,0387\ m$

$v_1 = \frac{Q_1}{A_1} \Rightarrow v_1 = 1,329\ m/s$

$E_1 = \Pi_1 + \frac{v_1^2}{2g} = 3,129\ m$

$E_2 = \Pi_2 + \frac{v_2^2}{2g} \Rightarrow E_2 = \Pi_2$

$\Delta E_{1-2} = \lambda \cdot \frac{L}{D} \cdot \frac{v_1^2}{2g} + \zeta_{12L} \frac{v_1^2}{2g}$

$\Delta E_{1-2} = 1,404\ m$

$E_1 = E_2 + \Delta E_{1-2} \Rightarrow E_1 = \Pi_2 + \Delta E_{1-2}$

$3,129 = \Pi_2 + 1,404 \Rightarrow \boxed{\Pi_2 = 1,725\ m}$

$\Pi_1 + \frac{v_1^2}{2g} = \Pi_2 + \lambda \frac{L}{D} \cdot \frac{v_1^2}{2g} + \zeta_{12L} \cdot \frac{v_1^2}{2g}$

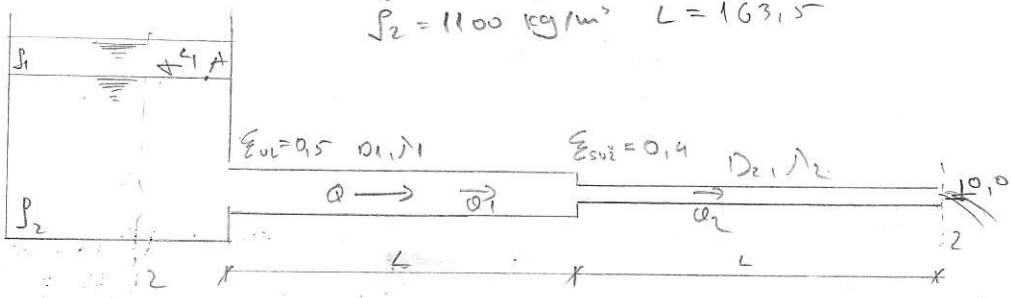
$3,024 = \Pi_2 + 1,314$

14.3

$Q = 0{,}1635\ L/s$ $D_1 = 0{,}427\ m$ $\lambda_1 = 0{,}025$

$\rho_1 = 900\ kg/m^3$ $D_2 = 0{,}2135\ m$ $\lambda_2 = 0{,}03$

$\rho_2 = 1100\ kg/m^3$ $L = 163{,}5$



$A_2 = 0{,}0358\ m^2$

$E_1 = E_2 + \Delta E_{1-2}$

$E_1 = \Pi_2$ $E_2 = \frac{v_2^2}{2g}$ $v_2 = Q/A_2 = \frac{Q}{\frac{D_2^2 \pi}{4}} \Rightarrow v_2 = 4{,}588\ m/s$, $A_1 = \frac{D_1^2 \pi}{4} = A_1 = 0{,}143\ m^2$

$\Pi_2 = \frac{v_1^2}{2g} + \left(\xi_{vol} \cdot \frac{v_1^2}{2g} + \lambda_1 \cdot \frac{L}{D_1} \frac{v_1^2}{2g} + \xi_{sud} \cdot \frac{v_2^2}{2g} + \lambda_2 \frac{L}{D_2} \frac{v_2^2}{2g} \right)$

$A_1 v_1 = A_2 v_2$

$\Downarrow$

$v_1 = 1{,}149\ m/s$

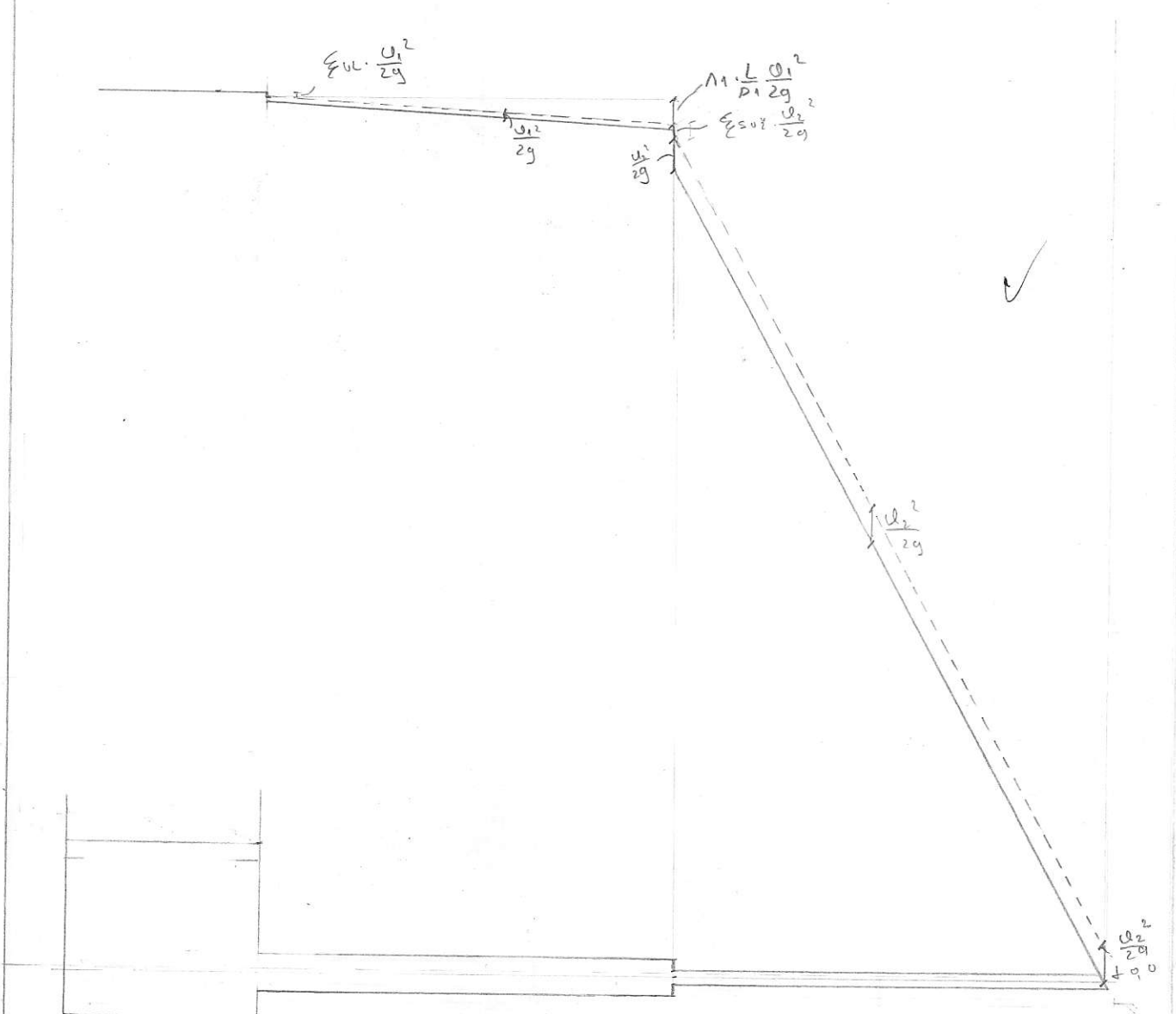
$\Pi_2 = 1{,}074 + (0{,}0336 + 0{,}644 + 0{,}429 + 24{,}648)$

$\Pi_2 = 27{,}131\ m$

$\frac{p_A}{\rho_2 g} + z_A = \Pi_2 \Rightarrow p_A = 249606{,}621\ Pa$

$\frac{p_A}{\rho_1 g} + z_A = \Pi_1 \Rightarrow \Pi_1 = 32{,}274\ m$

1:200



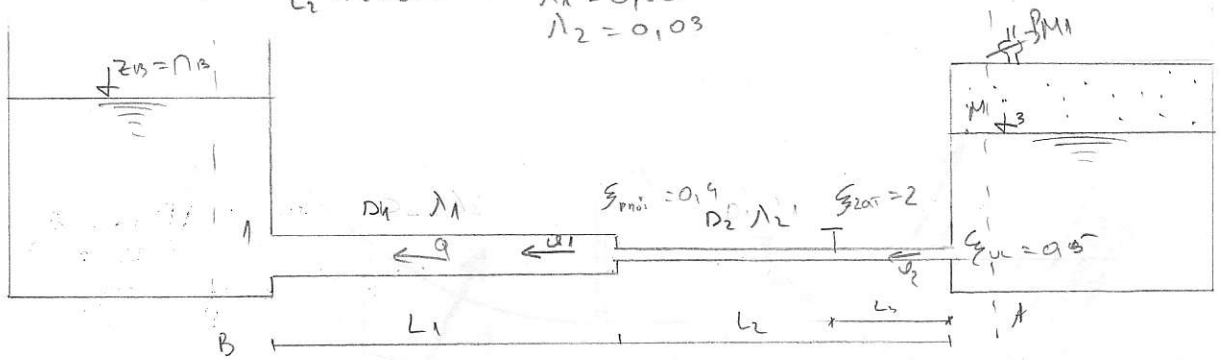
4.4

$\rho = 1000\ kg/m^3$ $D_1 = 0{,}447\ m$ $z_{M3} = 6\ m$

$L_1 = 150\ m$ $D_2 = 0{,}2135\ m$ $p_{M1} = 80000\ Pa$

$L_2 = 200\ m$ $\lambda_1 = 0{,}025$

$\lambda_2 = 0{,}03$



$\Pi_A = \frac{p_M}{\rho g} + z_M \Rightarrow \Pi_A = 11{,}155\ m$ $\Pi_{M3} = 6\ m$ $E_A = \Pi_A$ $E_B = \Pi_B$

$A_1 v_1 = A_2 v_2 \Rightarrow v_1 = v_2 \left(\frac{D_2}{D_1}\right)^2$

$E_A = E_B + \Delta E_{A\,B}$

$$\Pi_A = \Pi_B + \xi_{UL}\cdot\frac{v_2^2}{2g} + \xi_{zat}\frac{v_2^2}{2g} + \lambda_2\frac{L_2}{D_2}\frac{v_2^2}{2g} + \xi_{prot}\cdot\frac{v_1^2}{2g} + \lambda_1\frac{L_1 v_1^2}{D_1 2g} + \xi_{izl}\cdot\frac{v_1^2}{2g}$$

$$\Pi_A - \Pi_B = \frac{v_2^2}{2g}\left(\xi_{UL} + \xi_{zat} + \lambda_2\frac{L_2}{D_2} + \xi_{prot}\cdot\left(\frac{D_2}{D_1}\right)^4 + \lambda_1\frac{L_1}{D_1}\cdot\left(\frac{D_2}{D_1}\right)^4 + \xi_{izl}\cdot\left(\frac{D_2}{D_1}\right)^4\right)$$

$$v_2^2 = \frac{(\Pi_A - \Pi_B)\,2g}{\xi_{UL} + \xi_{zat} + \lambda_2\frac{L_2}{D_2} + \xi_{prot}\left(\frac{D_2}{D_1}\right)^4 + \lambda_1\frac{L_1}{D_1}\left(\frac{D_2}{D_1}\right)^4 + \xi_{izl}\left(\frac{D_2}{D_1}\right)^4}$$

$v_2 = 1{,}807\ m/s$ $v_1 = 0{,}362\ m/s$ $Q = 0{,}0644\ m^3/s$

1:100