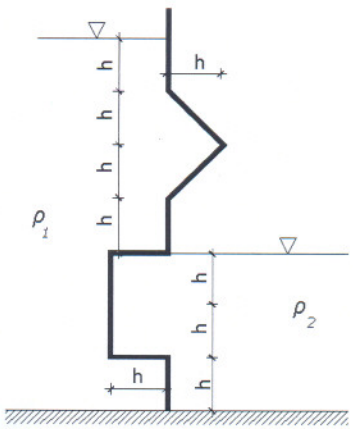
MEHANIKA TEKUĆINA / HIDROMEHANIKA 10.6.2010.

1) Različite tekućine se nalaze s lijeve i desne strane profiliranog lima kao na slici. Potrebno je odrediti reakcije u upetom ležaju u kojem je lim pričvršćen za pologu. Nacrtati horizontalne i vertikalne komponente dijagrama tlaka posebno s lijeve posebno s desne strane profiliranog lima.

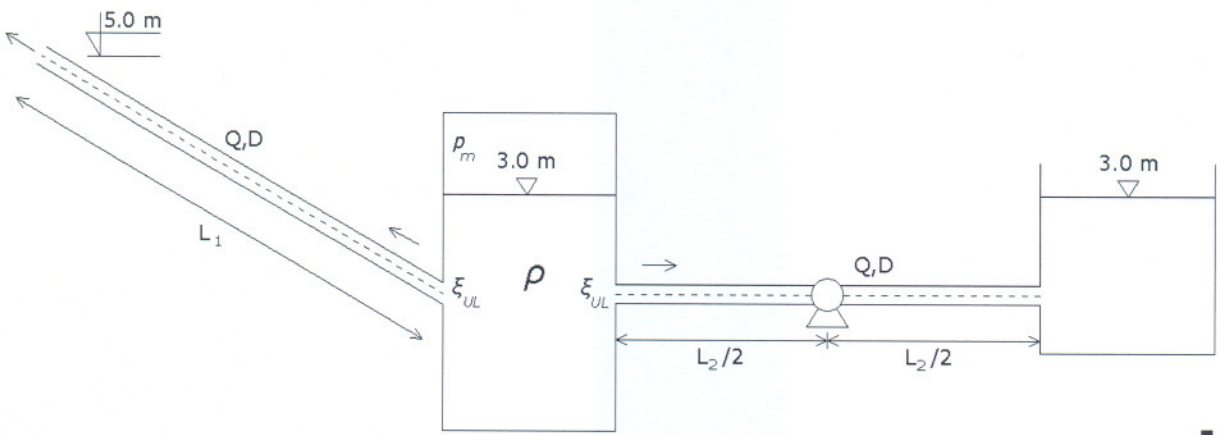
Zadano: $\rho_1 = 1000$ kg/m^3 ; $\rho_2 = 700$ kg/m^3 ; $h = 0.8$m

(20 bodova)

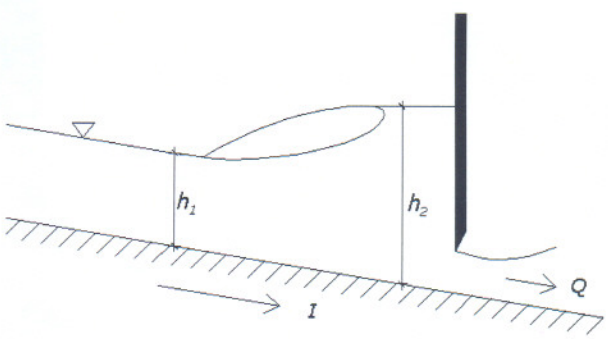


2) Na komoru pod tlakom priključene su dvije grane cjevovoda istih hidrauličkih karakteristika (relativne hrapavosti i promjera) ali različitih duljina L_1 i L_2. Potrebno je odrediti potrebnu visinu dizanja pumpe H_{pumpe} kojom će se omogućiti da se kroz «desnu» granu cjevovoda ostvaruje isti protok realne tekućine kao i kroz «lijevu» granu cjevovoda. Nacrtati energetsku i pijezometarsku liniju.

Zadano je: $D = 0{,}2$m ; $\rho = 1000$ kg/m^3 ; $p_m = 49{,}05$kPa ; $\lambda = 0{,}02$; $\xi_{UL} = 0{,}5$; $L_1 = 100$m ; $L_2 = 1000$m (25 bodova)



3) Izračunajte normalnu dubinu vode u pravokutnom kanalu širine B = 6m kao na slici ako je nizvodno od ustave izmjeren protok Q = 10 m^3/s. Potrebno je odrediti drugu spregnutu dubinu vodnog skoka uz pretpostavku da je prva spregnuta dubina jednaka normalnoj dubini. $I = 0.05$; $n = 0.035$.

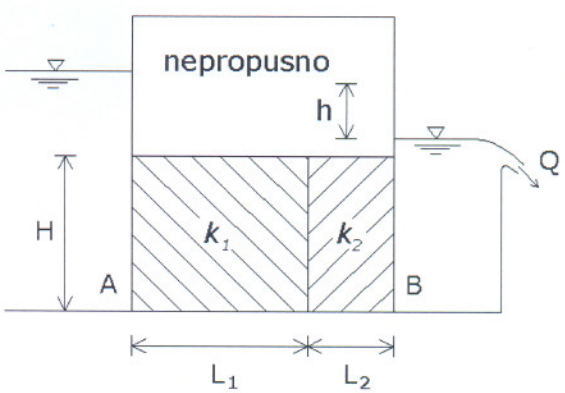


4) Za stacionarni slučaj strujanja kroz poroznu sredinu širine B = 3m sa koeficijentima propusnosti k_1=10^{-3} m/s, k_2=10^{-2} m/s izmjeren je protok Q =0,005 m^3/s. Potrebno je odrediti razliku razina h u posudi A i B koja omogućuje protjecanje zadanog Q te nacrtati pijezometarsku liniju.

Zadano je: $H = 5$m ; $L_1 = 6$m ; $L_2 = 3$m

Obavezno riješiti 1. i 2. zadatak

Pitanja iz teorije se nalaze na poleđini papira

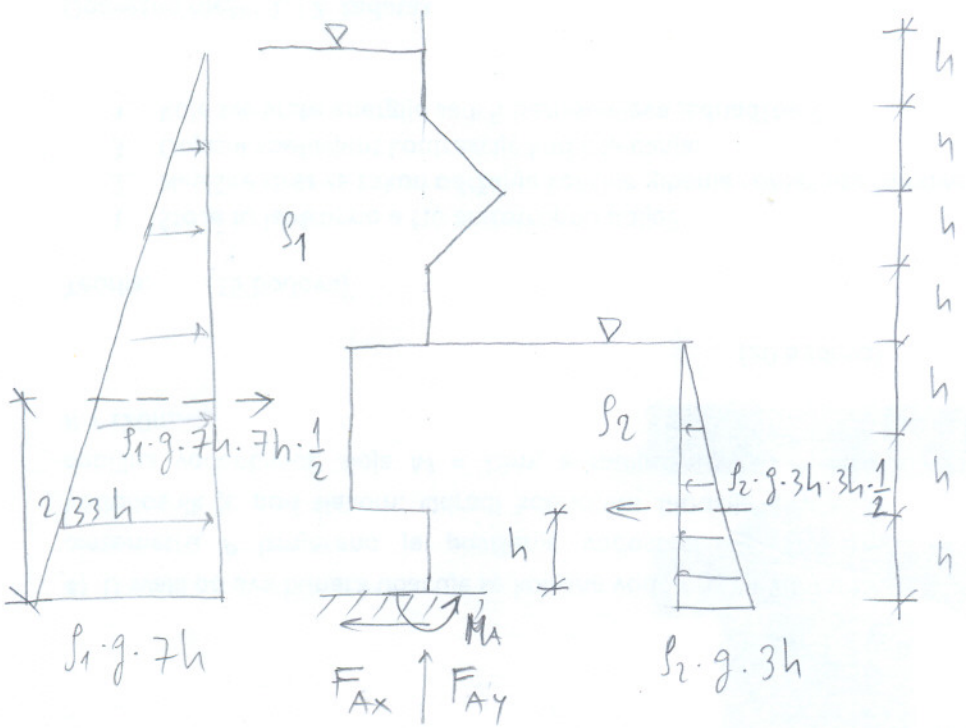


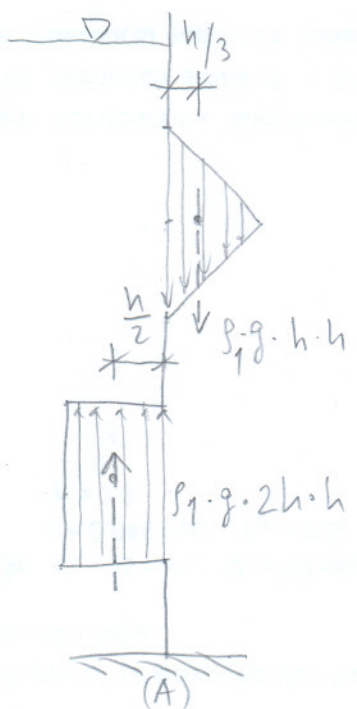
①

$h = 0{,}8\ m$

$\rho_1 = 1000\ kg/m^3$

$\rho_2 = 700\ kg/m^3$



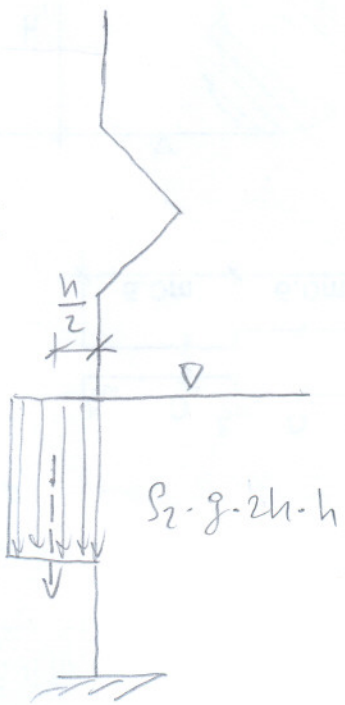


$$F_{Ax} = \rho_1 \cdot g \cdot 7h \cdot 7h \cdot \frac{1}{2} - \rho_2 \cdot g \cdot 3h \cdot 3h \cdot \frac{1}{2}$$

$$= 134{,}04\ kN$$

$$F_{Ay} = \rho_1 \cdot g \cdot h \cdot h - \rho_1 \cdot g \cdot 2h \cdot h + \rho_2 \cdot g \cdot 2h \cdot h$$

$$= 2{,}51\ kN$$



$$\Sigma M_{(A)} = 0$$

$$\left(\rho_1 \cdot g \cdot 7h \cdot 7h \cdot \tfrac{1}{2}\right) \cdot 2{,}33h - \left(\rho_2 \cdot g \cdot 3h \cdot 3h \cdot \tfrac{1}{2}\right) \cdot h + \left(\rho_1 \cdot g \cdot h \cdot h\right) \cdot \tfrac{h}{3} + \left(\rho_1 \cdot g \cdot 2h \cdot h\right) \cdot \tfrac{h}{2} - \left(\rho_2 \cdot g \cdot 2h \cdot h\right) \cdot \tfrac{h}{2} - M_A = 0$$

$$286{,}72 - 15{,}82 + 1{,}67 + 5{,}02 - 3{,}52 = M_A$$

$$M_A = 274{,}07\ kNm$$

(2)

1) $3 + \frac{p_m}{\rho g} = 5 + \frac{v^2}{2g}\left(\zeta_{ul} + \lambda \frac{L_1}{D}\right) + \frac{v^2}{2g}$

$8 = 5 + \frac{v^2}{2g}\left(0{,}5 + 0{,}02 \cdot \frac{100}{0{,}2} + 1\right)$

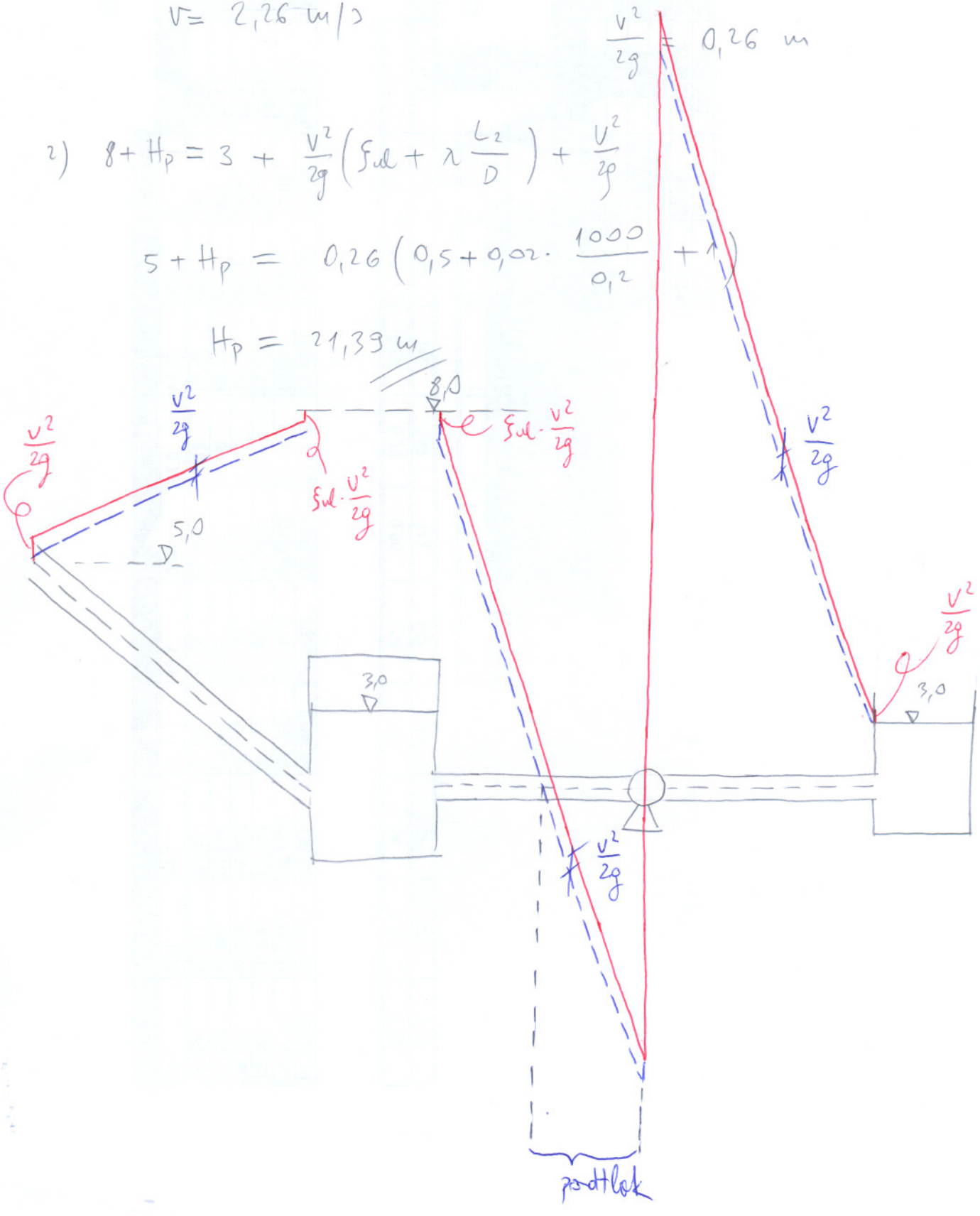
$v = 2{,}26 \text{ m/s}$

$\frac{v^2}{2g} = 0{,}26 \text{ m}$

2) $8 + H_p = 3 + \frac{v^2}{2g}\left(\zeta_{ul} + \lambda \frac{L_2}{D}\right) + \frac{v^2}{2g}$

$5 + H_p = 0{,}26\left(0{,}5 + 0{,}02 \cdot \frac{1000}{0{,}2} + 1\right)$

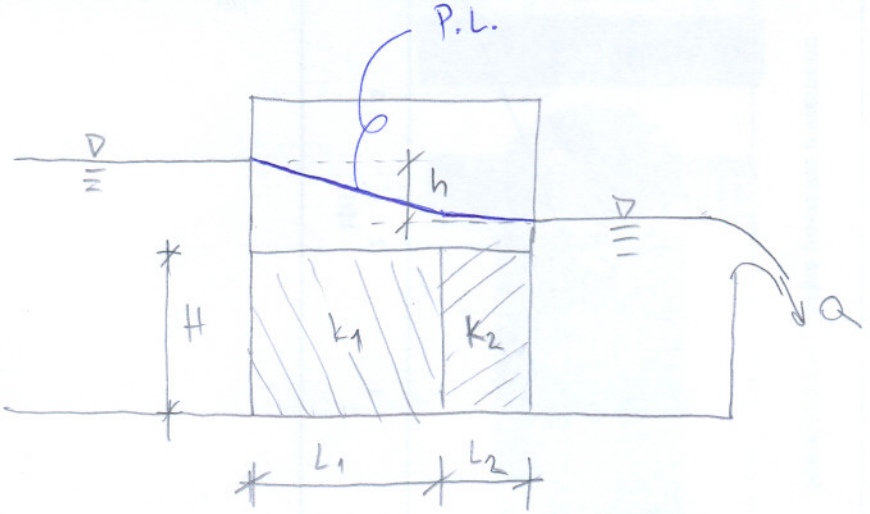
$H_p = 21{,}39 \text{ m}$



(3)

IDENTIČAN KAO 3. ~~ZADATAK~~ S ROKA OD 13.5.2010.

(4)



$k_1 = 10^{-3}$ m/s

$k_2 = 10^{-2}$ m/s

$Q = 0{,}005\ m^3/s$

$H = 5$ m ; $B = 3$ m

$L_1 = 6$ m

$L_2 = 3$ m

$$v = \frac{Q}{H \cdot B} = \frac{0{,}005}{5 \cdot 3} = 0{,}00033\ m/s$$

$$v = k \cdot J = k \cdot \frac{\Delta h}{\Delta L}$$

$$v = k_1 \cdot \frac{\Delta h_1}{L_1} \rightarrow \Delta h_1 = \frac{v \cdot L_1}{k_1} = \frac{0{,}33 \cdot \cancel{10^{-3}} \cdot 6}{\cancel{10^{-3}}} = 1{,}98\ m$$

$$\Delta h_2 = \frac{v \cdot L_2}{k_2} = \frac{0{,}03 \cdot \cancel{10^{-2}} \cdot 3}{\cancel{10^{-2}}} = 0{,}09\ m$$

$$h = \Delta h_1 + \Delta h_2$$

$$h = 2{,}07\ m$$