FAKULTET ZA POMORSTVO – KOTOR
BRODOMAŠINSTVO

ZADACI

ZA PRIPREMU 3. KOLOKVIJUMA

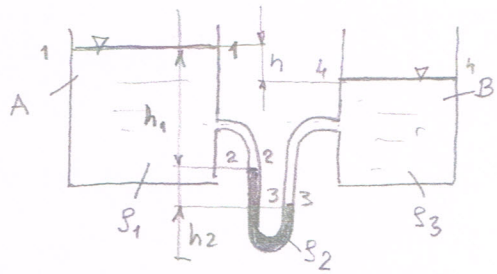
IZ

TEHNIČKE MEHANIKE I HIDROMEHANIKE

2.12.2015 g.

RJEŠENJA
ZADATAKA IZ SKRIPTE
HIDROSTATIKA

1z)



Poznato:
$\rho_1 = 1000\ kg/m^3$ (VODA)
$\rho_3 = 1800\ kg/m^3$
$\rho_2 = 1600\ kg/m^3$
$h_1 = 6\ m$
$h_2 = 0{,}5\ m$
$h = ?$

1-1 — 2-2: $p_a + \rho_1 g h_1 = p_2$

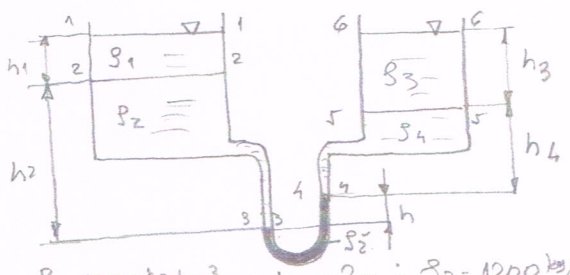
2-2 — 3-3: $p_2 + \rho_2 g h_2 = p_3$

3-3 — 4-4: $p_a + \rho_3 g (h_1 + h_2 - h) = p_3$

$\Rightarrow p_a + \rho_1 g h_1 + \rho_2 g h_2 = p_a + \rho_3 g (h_1 + h_2 - h)$

$$h = \frac{(\rho_3 - \rho_1) h_1 + (\rho_3 - \rho_2) h_2}{\rho_3} = \frac{(1800-1000)6 + (1800-1600)\cdot 0{,}5}{1800} = 2{,}72\ m$$

3z)



Poznato: $\rho_1 = 1000\ kg/m^3$; $h_1 = 2\ m$; $\rho_2 = 1200\ kg/m^3$
$h_2 = 4\ m$; $\rho_3 = 800\ kg/m^3$; $h_3 = 2\ m$; $\rho_4 = 1000\ kg/m^3$
$h_4 = 2\ m$
$\rho' = 13600\ kg/m^3$

1-1 — 2-2: $p_a + \rho_1 g h_1 = p_2$

2-2 — 3-3: $p_2 + \rho_2 g h_2 = p_3$

$\Rightarrow p_a + \rho_1 g h_1 + \rho_2 g h_2 = p_3 \quad \cdots (1)$

3-3 — 4-4: $p_4 + \rho' g h = p_3 \quad \cdots (2)$

5-5 — 4-4: $p_5 + \rho_4 g h_4 = p_4$

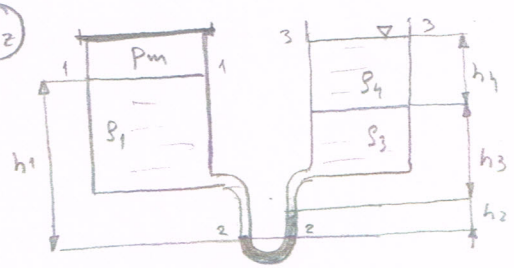
6-6 — 5-5: $p_a + \rho_3 g h_3 = p_5$

$\Rightarrow p_a + \rho_3 g h_3 + \rho_4 g h_4 = p_4 \quad \cdots (3)$

(1), (2), (3) $\Rightarrow h = \dfrac{p_3 - p_4}{\rho' \cdot g}$

$$h = \frac{p_a + \rho_1 g h_1 + \rho_2 g h_2 - (p_a + \rho_3 g h_3 + \rho_4 g h_4)}{\rho' g} = \frac{1000\cdot 2 + 1200\cdot 4 + 800\cdot 2 - 1000\cdot 2}{13600} = 0{,}235\ m$$

4z)



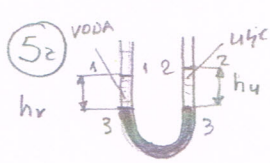
1-1 — 2-2: $p_m + \rho_1 g h_1 = p_2$

3-3 — 2-2: $p_a + \rho_4 g h_4 + \rho_3 g h_3 + \rho_2 g h_2 = p_2$

$\Rightarrow p_m = (\rho_4 h_4 + \rho_3 h_3 + \rho_2 h_2 - \rho_1 h_1) g$

Poznato: $\rho_1, \rho_2, \rho_3, \rho_4, h_1, h_2, h_3, h_4$
$p_m = ?$

5z)

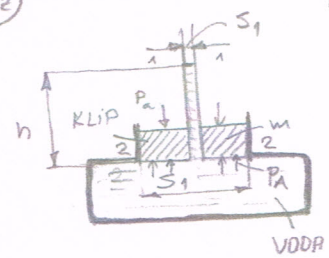


$p_a + \rho_v g h_v = p_3 = p_a + \rho_u g h_u \Rightarrow h_v = \dfrac{\rho_u \cdot h_u}{\rho_v} =$

Poznato: $\rho_u = 900\ kg/m^3$; $h_u = 20\ cm$

$$h_v = \frac{900\cdot 20}{1000} = 18\ cm$$

6z



POZNATO:
$S_1 = 314\,cm^2$
$S_2 = 78{,}5\,cm^2$
$h = 85\,cm$
$p_a = 100\,kPa$
a) $p_A = ?$
b) $F = ?$
c) $m = ?$

a) 1-1 – 2-2 : $p_a + \rho g h = p_A$

$p_A = p_a + \rho g h = 100000 + 1000 \cdot 9{,}81 \cdot 0{,}85 = 108338{,}5\ Pa$

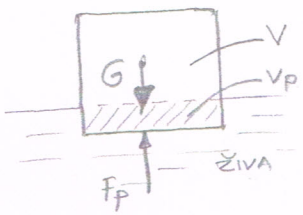
$p_a = 108{,}34\ kPa$

b) $F_A = (p_A - p_a)(S_2 - S_1)$

$F_A = (108338{,}5 - 100000)(314 - 78{,}5) \cdot 10^{-4} = 196{,}4\ N$

c) $F_A = m \cdot g \Rightarrow m = \frac{196{,}4}{9{,}81} \approx 20\ kg$

10z



V – ZAPREMINA KOCKE $V = a^3$ a – STRANICA KOCKE

V_p POTOPLJENI DIO ZAPREMINE KOCKE $V_1 = \frac{V}{5} = \frac{a^3}{5}$

$\rho_{\check{z}} = 13600\ kg/m^3$

$\rho = ?$ – GUSTINA KOCKE

F_p – SILA POTISKA

G – SILA TEŽINE

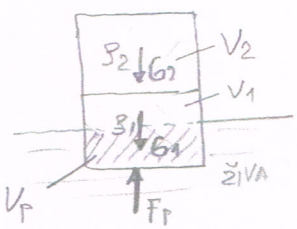
ρ – GUSTINA KOCKE

$G = mg = \rho \cdot V \cdot g = \rho a^3 g$

$F_p = \rho_{\check{z}} V_p g = \rho_{\check{z}} \cdot \frac{a^3}{5} \cdot g$

$F_p = G \Rightarrow \rho_{\check{z}} \frac{a^3}{5} \cdot g = \rho \cdot a^3 \cdot g \Rightarrow \rho = \frac{\rho_{\check{z}}}{5} = 2720\ kg/m^3$

11z



V_2 – ZAPREMINA DONJE KOCKE $V_2 = a^3$

V_1 – ZAPREMINA PRVE KOCKE $V_1 = a^3$

V_p – POTOPLJENA ZAPREMINA $V_p = \frac{V_1}{2} = \frac{a^3}{2}$

$\rho_{\check{z}} = 13600\ kg/m^3$

$\rho_2 = ?$ ρ_2 – GUSTINA DONJE KOCKE

$\rho_1 = \frac{\rho_{\check{z}}}{5}$ – POZNATO IZ 10z.

$F_p = G_1 + G_2$

$\frac{a^3}{2} \cdot \rho_{\check{z}} \cdot g = \frac{\rho_{\check{z}} \cdot g \cdot a^3}{5} + \rho_2 g \cdot a^3$

$\rho_2 = \frac{\rho_{\check{z}}}{2} - \frac{\rho_2}{5} = \frac{3}{10} \rho_{\check{z}} = 4080\ kg/m^3$

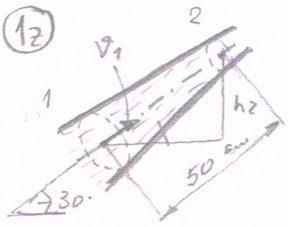
$G_1 = \rho_1 \cdot g \cdot a^3 = \frac{\rho_{\check{z}} \cdot g \cdot a^3}{5}$

$G_2 = \rho_2 \cdot g \cdot a^3$

$F_p = V_p \rho_{\check{z}} \cdot g \quad ; V_p = \frac{V_1}{2} = \frac{a^3}{2}$

HIDRODINAMIKA

1z



$\rho = 800\ kg/m^3$
$A_1 = 5\ cm^2$
$A_2 = 2\ cm^2$
$v_1 = 2\ m/s$
$\Delta p = ?$
$g \approx 10\ m/s^2$

1-1 — 2-2

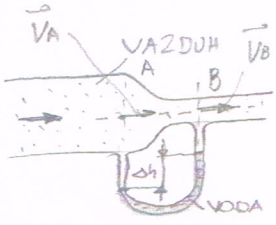
$$\frac{\rho v_1^2}{2} + \rho g h_1 + p_1 = \frac{\rho v_2^2}{2} + \rho g h_2 + p_2 \quad \dots (1)$$

$h_1 = 0$, $h_2 = 50 \cdot \sin 30 = 25\ cm$

$v_1 A_1 = v_2 A_2 \qquad v_2 = v_1 \frac{A_1}{A_2} = 2{,}5 v_1 = 5\ m/s$

$$(1) \Rightarrow \Delta p = p_1 - p_2 = \frac{\rho v_2^2}{2} - \frac{\rho v_1^2}{2} + \rho g h_2 = \frac{800}{2} \cdot 25 - \frac{800 \cdot 4}{2} + 800 \cdot 10 \cdot 0{,}25 = 10400\ Pa$$

2z



$Q = 15\ l/min$
$A_A = 2\ cm^2$
$A_B = 0{,}5\ cm^2$
$\Delta h = ?$
$\rho_{VAZ} = 1{,}32\ kg/m^3$

$$\frac{\rho_{VAZ} v_A^2}{2} + \rho_{VAZ} g h_A + p_A = \frac{\rho_{VAZ} v_B^2}{2} + \rho_{VAZ} g h_B + p_B$$

$h_A = h_B = 0$

$$p_A - p_B = \frac{\rho_{VAZ}}{2}\left(v_B^2 - v_A^2\right)$$

$$Q = 15\ l/min = 15\ dm^3 \cdot \frac{15}{60} \cdot 10^{-3}\ m^3 = 0{,}25\,10^{-3}\ m^3/s$$

$$Q = v_A A_A \Rightarrow v_A = \frac{Q}{A_A} = \frac{0{,}25 \cdot 10^{-3}}{2 \cdot 10^{-4}} = 1{,}25\ m/s$$

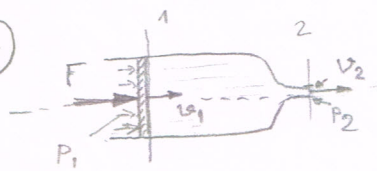
$$v_B = v_A \cdot \frac{A_A}{A_B} = 1{,}25 \cdot 4 = 5\ m/s$$

$$p_A - p_B = \Delta p = \frac{1{,}32}{2}\left(5^2 - 1{,}25^2\right) = 15{,}47\ \frac{N}{m^2}$$

$$\rho g \Delta h = p_A - p_B$$

$$\Delta h = (p_A - p_B)/\rho g = \frac{15{,}47}{1000 \cdot 10} = 0{,}00155\ m = 1{,}55\ mm$$

3z



$D_1 = 2\ cm$
$D_2 = 1\ mm = 0{,}1\ cm$
$v_2 = ?$
$F = 10\ N$

$h_1 = 0$, $h_2 = 0$

$$\frac{\rho v_1^2}{2} + \rho g h_1 + p_1 = \frac{\rho v_2^2}{2} + \rho g h_2 + p_2$$

$$p_1 = \frac{F}{A_1} + p_a \quad ; \quad p_2 = p_a$$

$v_1 \approx 0$ – KAO I PRI ISTICANJU VODE IZ ŠIROKOG REZERVOARA

$v_1 A_1 = v_2 A_2$

$v_1 = v_2 \frac{A_2}{A_1}$

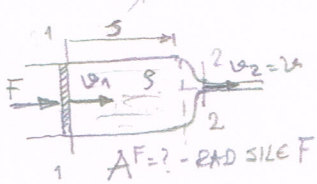
$$\frac{A_2}{A_1} = \frac{\frac{D_2^2 \pi}{4}}{\frac{D_1^2 \pi}{4}} = \left(\frac{D_2}{D_1}\right)^2 = \left(\frac{0{,}1}{2}\right)^2 = \frac{1}{400} \Rightarrow v_1 = \frac{v_2}{400}$$

$$\frac{\rho v_2^2}{2} = p_1 - p_2 = \frac{F}{A_1} + p_a - p_a = \frac{F}{A_1}$$

$$v_2 = \sqrt{\frac{2F}{\rho A}} = \sqrt{\frac{2 \cdot F \cdot 4}{\rho \cdot D_1^2 \pi}} = \sqrt{\frac{8 \cdot 10}{1000\,(0{,}02)^2 \pi}}$$

$v_2 = 7{,}98 \approx 8\ m/s$

4z



$A^F = ?$ – RAD SILE F

A_1 – POVRŠINA POPREČNOG PRESJEKA 1-1

$A_2 = S$ – POVRŠINA POPREČNOG PRESJEKA 2-2

$A_2 \ll A_1$

F – SILA

t – VRIJEME

V – ZAPREMINA ŠPRIKA

Poznato: ρ, V, t, S

$$\frac{\rho v^2}{2} = p_1 - p_2 = p_a + \frac{F}{A_1} - p_a = \frac{F}{A_1}$$

$$F = \frac{\rho v^2}{2} \cdot A_1$$

$$A^F = F \cdot s = \frac{\rho v^2}{2} \cdot A_1 \cdot s = \frac{\rho v^2}{2} \cdot V =$$

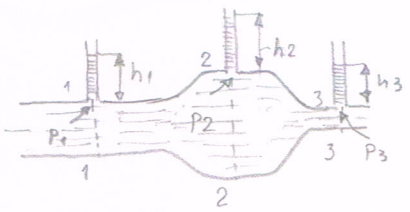
$$= \frac{\rho}{2}\left(\frac{V}{t \cdot S}\right)^2 V \Rightarrow A^F = \frac{\rho V^3}{2 t S}$$

$v_1 A_1 = v_2 A_2 = v \cdot S$

$v = v_1 \frac{A_1}{S} = \frac{s}{t} \cdot \frac{A_1}{S}$

$v = \frac{V}{t \cdot S}$

5z



$A_1 = 60cm^2$ $A_2 = 90cm^2$ $A_3 = 40cm^2$ $Q = 6\ell/s$ $P_1 = 102kPa$ $P_a = 100kPa$ $h_1 = ?$ $h_2 = ?$ $h_3 = ?$

$Q = 6\ell/s = 6dm^3/s = 6 \cdot 10^{-3} m^3/s$

$P_1 = \rho g h_1 + P_a \Rightarrow \rho g h_1 = P_1 - P_a = 102 - 100 = 2kPa = 2 \cdot 10^3 Pa$

$1000 \cdot 10 \cdot h_1 = 2 \cdot 10^3 \Rightarrow h_1 = 0,2m = 20cm$

$v_1 = \frac{Q}{A_1} = \frac{6 \cdot 10^{-3}}{60 \cdot 10^{-4}} = 1m/s$; $v_2 = \frac{v_1 A_1}{A_2} = 1 \cdot \frac{60}{90} = 0,677 m/s$ $v_3 = \frac{v_1 A_1}{A_3} = 1 \cdot \frac{60}{40} = 1,5 m/s$

1-1 ; 2-2 $\frac{\rho v_1^2}{2} + P_1 = \frac{\rho v_2^2}{2} + P_2$ $P_2 = \frac{\rho v_1^2}{2} - \frac{\rho v_2^2}{2} + P_1 = \frac{1000 \cdot 1^2}{2} - \frac{1000 \cdot 0,677^2}{2} + 102 \cdot 10^3 =$

$P_2 = 102,278 kPa$

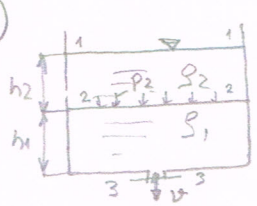
$P_2 = \rho g h_2 + P_a \Rightarrow \rho g h_2 = P_2 - P_a \Rightarrow h_2 = \frac{P_2 - P_a}{\rho g} = \frac{(102,28 - 100) 10^3}{1000 \cdot 10} = 22,8cm$

1-1 ; 3-3 $\frac{\rho v_1^2}{2} + P_1 = \frac{\rho v_3^2}{2} + P_3$ $P_3 = \frac{\rho v_1^2}{2} - \frac{\rho v_3^2}{2} + P_1 = \frac{1000 \cdot 1^2}{2} - \frac{1000 \cdot 1,5^2}{2} + 102 \cdot 10^3 =$

$P_3 = 101,37 kPa$

$h_3 = \frac{P_3 - P_a}{\rho g} = \frac{(101,37 - 100) 10^3}{1000 \cdot 10} = 13,7cm$

6z



ρ_1, ρ_2, h_1, h_2 $v = ?$

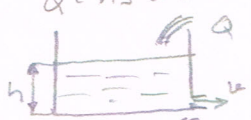
$P_2 = P_a + \rho g h_2$ 2-2 — 3-3

$\frac{\rho_1 v_2^2}{2} + \rho g h_1 + P_2 = \frac{\rho_1 v^2}{2} + P_a$

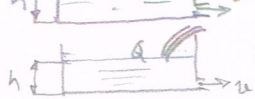
$\Rightarrow v = \sqrt{\frac{2g(\rho_1 h_1 + \rho_2 h_2)}{\rho_1}}$

7z $Q = 0,12\ell = 0,2 \cdot 10^{-3} m^3/s$ $d = ?$ $h = 8,3cm$ $v = \sqrt{2gh} = \sqrt{2 \cdot 10 \cdot 0,083} = 1,3 m/s$

$Q = A_s \cdot v = k \cdot A \cdot v \Rightarrow \frac{d^2 \pi}{4} = \frac{Q}{k \cdot v} \Rightarrow d = \sqrt{\frac{4Q}{\pi \cdot k \cdot v}} = \sqrt{\frac{4 \cdot 0,2 \cdot 10^{-3}}{3,14 \cdot 0,8 \cdot 1,3}} = 0,0156m = 16cm$



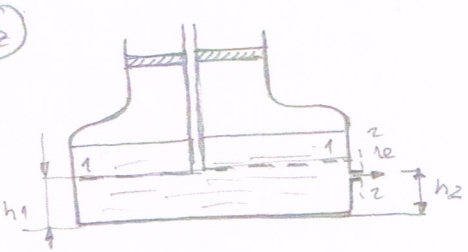
8z



$h = ?$ $Q = 15\ell/s = 15 \cdot 10^{-3} m^3/s$; $A = 20cm^2$ $h = ?$

$v = \sqrt{2gh} \Rightarrow h = \frac{v^2}{2g} = \frac{7,5^2}{2 \cdot 10} = 2,8m$ $Q = v \cdot A$ $v = \frac{Q}{A} = \frac{15 \cdot 10^{-3}}{20 \cdot 10^{-4}} = 7,5 m/s$

9z



$h_1 = 7,5cm$ $h_2 = 2cm$ $v = ?$ $P_1 = P_a$

1-1 — 2-2

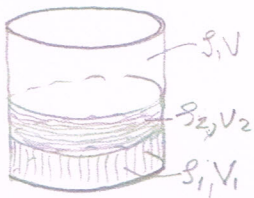
$\frac{\rho v_1^2}{2} + \rho g (h_1 - h_2) + P_a = \frac{\rho v^2}{2} + P_a$

$v = \sqrt{2g(h_1 - h_2)} = \sqrt{2 \cdot 10 (7,5 - 2) 10^{-2}}$

$v = 1,05 m/s$

3. KOLOKVIJUM (24.12.2014.)

(12) U BURETU ZAPREMINE V I GUSTINE ρ NALAZI SE PIJESAK GUSTINE ρ_1 I ZAPREMINE V_1 I ZEMLJA GUSTINE ρ_2 I ZAPREMINE V_2.
AKO JE $\rho_1 = 1200\ kg/m^3$, $\rho_2 = 1400\ kg/m^3$
V_1 20% ZAPREMINE BURETA I
V_2 30% ZAPREMINE BURETA I
AKO JE 80% ZAPREMINE BURETA POTOPLJENO U VODI ODREDITI GUSTINU BURETA. (SREDNJA GUSTINA)



$\rho_1 = 1200\ kg/m^3$
$\rho_2 = 1400\ kg/m^3$
$V_1 = 0{,}2V$
$V_2 = 0{,}3V$
$V_p = 0{,}8V$
$\rho_v = 1000\ kg/m^3$

$G = \rho V g$
$G_1 = \rho_1 V_1 g$
$G_2 = \rho_2 V_2 g$
F_p

$G + G_1 + G_2 = F_p$

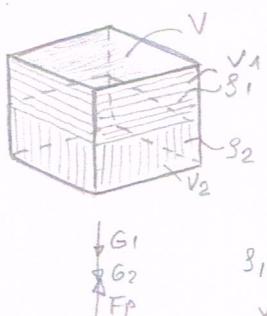
$\rho V g + \rho_1 V_1 g + \rho_2 V_2 g = \rho_v V_p g$

$\rho V + 1200 \cdot 0{,}2V + 1400 \cdot 0{,}3V = 1000 \cdot 0{,}8V$

$\rho = 1000 \cdot 0{,}8 - 1200 \cdot 0{,}2 - 1400 \cdot 0{,}3$

$\rho = 140\ kg/m^3$

(12.) KOJI DIO KOCKE U % JE NAPRAVLJEN OD MATERIJALA GUSTINE $1800\ kg/m^3$ AKO JE PREOSTALI DIO KOCKE NAPRAVLJEN OD MATERIJALA GUSTINE $800\ kg/m^3$, A KOCKA PLIVA POTPUNO POTOPLJENA U VODI.



$V_p = V$
$V_1 = X \cdot V$
$V_2 = (1 - X)V$

$G_1 + G_2 = F_p$

$\rho_1 V_1 g + \rho_2 V_2 g = \rho_v \cdot V_p \cdot g$

$\rho_1 X V + \rho_2 (1 - X) V = \rho_v \cdot V$

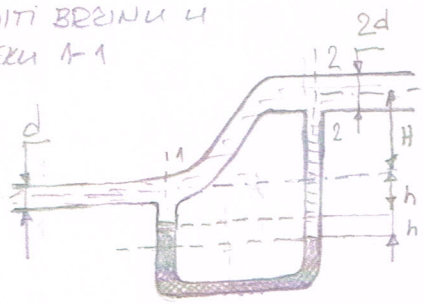
$X(\rho_1 - \rho_2) = \rho_v - \rho_2$

$X = \frac{\rho_v - \rho_2}{\rho_1 - \rho_2} = \frac{1000 - 800}{1800 - 800}$

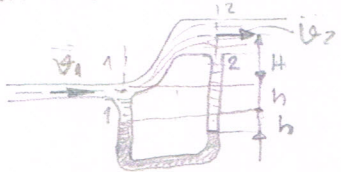
$X = \frac{200}{1000} = 0{,}2$

$V_1 = 0{,}2V \Rightarrow V_1 = 20\%\ V$
$V_2 = 80\%\ V$

(27) ODREDITI BRZINU U PRESJEKU 1-1



POZNATO JE $H = 1\ m$, $h = 10\ cm$



1-1, 2-2 $\frac{\rho v_1^2}{2} + \rho g h_1 + p_1 = \frac{\rho v_2^2}{2} + \rho g H + p_2 \quad \ldots (1)$

$p_1 + \rho g h + \rho_ž g \cdot h = p_2 + \rho g (H + h + h)$

$p_2 - p_1 = \rho g h + \rho_ž g \cdot h - \rho g (H + 2h) =$

$p_2 - p_1 = \rho_ž g h - \rho g (H + h)$

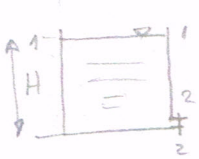
$p_2 - p_1 = 13600 \cdot 10 \cdot 0{,}1 - 1000 \cdot 10 \cdot 1{,}1 = 2600\ Pa$

$v_1 \cdot A_1 = v_2 \cdot A_2 \Rightarrow v_2 = v_1 \cdot \frac{d^2\pi}{4} : \frac{4d^2\pi}{4} = \frac{v_1}{4}$

(1) $\frac{\rho v_1^2}{2} - \frac{\rho v_1^2}{2 \cdot 16} = \rho g H + p_2 - p_1$

$v_1 = \sqrt{\frac{\rho g H + (p_1 - p_2)}{\frac{\rho}{2}\left(1 - \frac{1}{16}\right)}} = \sqrt{\frac{1000 \cdot 10 \cdot 1 + 2600}{\frac{1000}{2}\left(1 - \frac{1}{16}\right)}} = 5{,}18\ m/s$

(27) U ŠIROKOM REZERVOARU SE NALAZI VODA, A NA DNU REZERVOARA ZATVORENA SLAVINA.
AKO JE PROTOK VODE KROZ SLAVINU $1{,}256\ l/s$, A PREČNIK SLAVINE 2cm ODREDITI PRITISAK U SLAVINI KADA JE SLAVINA ZATVORENA.



$Q = 1{,}256\ l/s = 1{,}256 \cdot 10^{-3}\ \frac{m^3}{s}$

$v = \frac{Q}{A} = \frac{Q \cdot 4}{d^2\pi} = \frac{4 \cdot 1{,}256 \cdot 10^{-3}}{0{,}02^2 \cdot 3{,}14}$

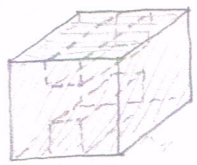
$v = 4\ m/s$

$v^2 = 2gH \Rightarrow H = \frac{v^2}{2g} = \frac{16}{2 \cdot 10} = 0{,}8\ m$

$p_{2\text{-}2} = \rho g H = 1000 \cdot 10 \cdot 0{,}8 = 8000\ Pa$

3. KOLOKVIJUM (17.12.2014.)

1z POTPUNO ZATVORENA KOCKA SA ŠUPLJINAMA KAO NA SLICI PLIVA POTPUNO POTOPLJENA U VODI. ODREDITI GUSTINU I TEŽINU TIJELA



$a = 2m$
$\rho = 1000 kg/m^3$
$g \approx 10 m/s^2$

$V_k = (3a \cdot 3a \cdot 3a) - 2a \cdot a \cdot 3a = 21a^3$

$V_p = V = 27a^3$

$G = F_p$

$G = \rho_k \cdot V_k \cdot g = \rho_k \cdot 21a^3 \cdot g$

$F_p = \rho_v \cdot V \cdot g = \rho_v \cdot 27a^3 \cdot g$

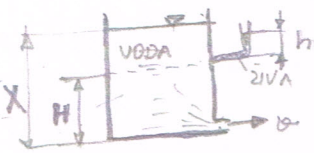
$\rho_k \cdot 21a^3 \cdot g = \rho_v \cdot 27a^3 \cdot g$

$\rho_k = \rho_v \cdot \frac{27}{21} = 1000 \cdot \frac{27}{21} = 1286 kg/m^3$

$G_k = \rho_k \cdot g \cdot V_k = 1286 \cdot 10 \cdot 21 \cdot 2^3$

$G_k = 480,480,00\ N = 480 kN$

2z ŠIROKI REZERVOAR NAPUNJEN VODOM IMA NA DNU MALI OTVOR KROZ KOJI ISTIČE VODA. VODA SE NALAZI U REZERVOARU DO VISINE X. NA VISINI H OD DNA REZERVOARA NALAZI SE ŽIVIN MANOMETAR (CIJEVČICA), PRI ČEMU h ODREĐUJE VISINU ŽIVE U MANOMETRU. NA BAZI POZNATIH VELIČINA ODREDITI TRAŽENE VELIČINE



$\rho_ž = 13600 \frac{kg}{m^3}$ $H = 4m$ $h = ?$

$\rho_v = 1000 kg/m^3$ $v = 10,95 m/s$

$v = \sqrt{2g \cdot X} \Rightarrow X = \frac{v^2}{2g} = \frac{10,95^2}{2 \cdot 10} = 6m$

ρg

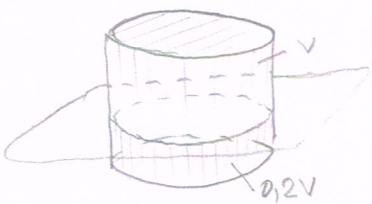
$\rho_v g (X - H) = \rho_ž g h$

$h = \frac{\rho_v (X - H)}{\rho_ž} = \frac{1000(6-4)}{13600} =$

$h = 0,147m = 14,7cm$

HE 2016.

1z PRAZNO BURE OD PLASTIKE PLIVA 20% POTOPLJENE ZAPREMINE U VODI. AKO SE U BURE USPE VODA DO TREĆINE ZAPREMINE BURETA, KOJI DIO ZAPREMINE BURETA U % ĆE BITI POTOPLJEN U VODI



prazno bure

$G_b = F_p = 0,2 V \rho_v g$

bure sa vodom

$G_b + G_{vode} = F_p$

$G_b + \frac{V}{3} \cdot \rho_v \cdot g = X \cdot V \rho_v g$

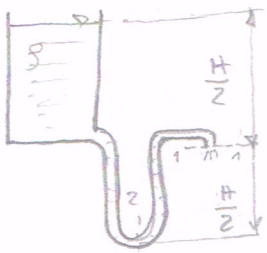
G_b, G_v, F_p

$\frac{1}{5} V \rho_v g + \frac{V}{3} \rho_v g = X V \rho_v g$

$X = \frac{8}{15} = 0,53$

potopljeno je 53% zapremine bureta

2z IZ ŠIROKOG REZERVOARA ISTIČE VODA KROZ SLAVINU (PRESJEK 1-1) PREČNIKA d_1. KOLIKA JE RAZLIKA PRITISAKA U PRESJEKU 2-2 KADA SE SLAVINA OTVORI I KADA SE SLAVINA ZATVORI. PREČNIK CIJEVI U PRESJEKU 2-2 JE d_2



$H = 10m$; $\rho = 1000 kg/m^3$ $d_2 = 2d_1$ i $d_1 = 1cm$

zatvorena slavina (voda miruje)

$p_2' = p_a + \rho g (H/2 + H/2) = p_a + \rho g H$ $g \approx 10 m/s^2$

$p_2' = p_a + 1000 \cdot 10 \cdot 10 = p_a + 100 kPa$

otvorena slavina

$v_1 = \sqrt{2g H/2} = \sqrt{2 \cdot 10 \cdot 5} = 10 m/s$

$v_2 = \frac{A_1}{A_2} \cdot v_1 = \frac{d_1^2 \pi / 4}{d_2^2 \pi / 4} \cdot v_1 = \frac{d_1^2}{4 d_1^2} \cdot v_1 = \frac{v_1}{4}$

$v_2 = 2,5 m/s$

2-2 : 1-1 $\frac{\rho v_2^2}{2} + p'' = \frac{\rho v_1^2}{2} + \rho g \frac{H}{2} + p_a \Rightarrow p_2'' = \frac{\rho v_1^2}{2} - \frac{\rho v_2^2}{2} + \rho g \frac{H}{2} + p_a$

$p_2'' = p_a + \frac{\rho}{2}(v_1^2 - v_2^2 + gH) = p_a + 500(10^2 - 2,5^2 + 10 \cdot 10) = p_a + 96,875,00\ Pa = p_a + 96,875 kPa$

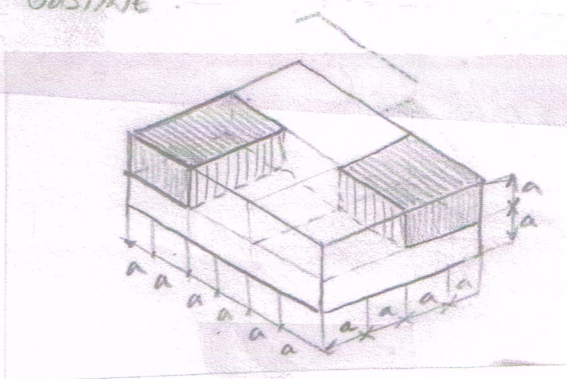
$p_2' - p_2'' = 100 - 96,87) = 3,125 kPa = 3125 Pa$

FAKULTET ZA POMORSTVO
BRODOMAŠINSTVO

IME I PREZIME _____ BR INDEKSA _____

3. KOLOKVIJUM IZ TEHNIČKE MEHANIKE I HIDROMEHANIKE (18.12.2013.)

(1z) PUNI KVADAR PRIKAZAN NA SLICI PLIVA POTPUNO POTOPLJEN U TEČNOSTI GUSTINE ρ. KOLIKI PRO-CENAT PRVOBITNE ZAPREMINE KVADRA ĆE BITI ISPOD POVRŠINE TEČNOSTI AKO SE OD KVADRA OSTRANI OZNA-ČENI - OSJENČENI DIO, A KVADAR PLIVA U TEČNOSTI DUPLO VEĆE GUSTINE?



$\rho_k = \rho$ $\quad V_k = 6a \cdot 4a \cdot 2a = 48a^3$

$G_k = \rho_k \cdot (48a^3 - 2 \cdot 4 \cdot a^3) g = \rho \cdot 40a^3 g$

$F_p = 2\rho \cdot x \cdot 24a^2 \cdot g$ $\quad F_p = G_k$

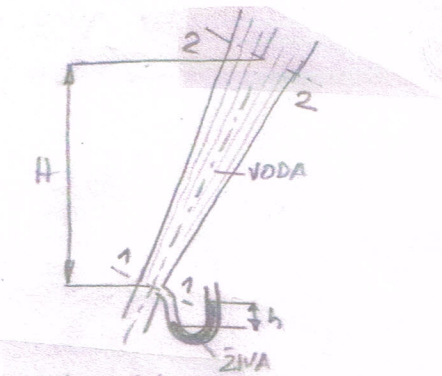
$40\rho a^3 g = 48\rho a^2 x g \rightarrow x = \frac{40}{48} a = \frac{5}{6} a$

Potopljena zapremina kvadra

$V_1 = 6a \cdot 4a \cdot x = 6a \cdot 4a \cdot \frac{5}{6} a = 20a^3$

Procenat: $\frac{V_1}{V_k} = \frac{20a^3}{48a^3} = 41{,}67\%$.

(2z) KROZ CIJEV PROMJENJIVOG POPREČNOG PRESJEKA (PRIKAZANA NA SLICI) PROTIČE VODA. PROTOK VODE KROZ PRESJEK 2-2 POVRŠINE $5\,dm^2$ JE 10 L/s. AKO JE: PREČNIK POPREČNOG PRESJEKA 1-1 $d_1 = 1{,}1285\,dm$, VISINSKA RAZLIKA PRESJEKA $H = 2m$, VISINSKA RAZLIKA NIVOA ŽIVE U "U" CIJEVI $h = 20\,cm$, GUSTINA VODE $1000\,kg/m^3$ A ŽIVE $13600\,kg/m^3$



ODREDITI PRITISAK U PRESJEKU 2-2

$1\ell = 1\,dm^3 = 10^{-3}\,m^3$

$Q = 10\frac{\ell}{s} = V_2 \cdot A_2 = V_1 \cdot A_1$ $\quad A_2 = 5\,dm^2$

$V_2 = \frac{Q}{A_2} = \frac{10\,dm^3/s}{5\,dm^2} = 2\frac{dm}{s} = 0{,}2\,m/s$

$A_1 = \frac{d_1^2 \pi}{4} = \frac{(1{,}1285)^2 \pi}{4} = 1\,dm^2$

$V_1 = \frac{Q}{A_1} = \frac{10}{1} = 10\frac{dm}{s} = 1\,m/s$

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

$v_1 = 1\,m/s$

$v_2 = 0{,}2\,m/s$

$H = 2m$; $h = 20\,cm = 0{,}2m$

$P_1 + \rho g h = \rho_2 g h$

$P_1 = (\rho_2 - \rho) g h$

$P_1 = (13600 - 1000) \cdot 9{,}81 \cdot 0{,}2$

$P_1 = 24721{,}2\,Pa = 24{,}72\,kPa$

P_1 - relativni pritisak

Bernulijeva jednačina za 1-1 i 2-2

$P_1 + \rho\frac{v_1^2}{2} = P_2 + \frac{\rho v_2^2}{2} + Hg\rho \rightarrow P_2 = P_1 + \frac{\rho}{2}(v_1^2 - v_2^2) - H\rho g$

$P_2 = 24721{,}2 + \frac{1000}{2}(1^2 - 0{,}2^2) - 2 \cdot 9{,}81 \cdot 1000 = 5581{,}2\,Pa = 5{,}58\,kPa$

BRODOMAŠINSKO
KOTOR – BAR

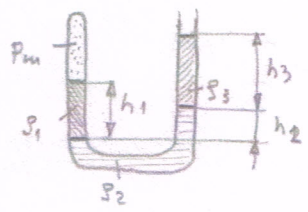
IME I PREZIME

BR. INDEKSA

3. KOLOKVIJUM IZ TEHNIČKE MEHANIKE I HIDROMEHANIKE

POPRAVNI 9.01.2013.g.

(12) U "U" CIJEVI SU USUTE TRI TEČNOSTI RAZLIČITIH GUSTINA. JEDAN KRAK "U" CIJEVI JE ZATVOREN. NIVOI POJEDINIH TEČNOSTI, KOJE SE NE MIJEŠAJU, SU PRIKAZANE NA SLICI

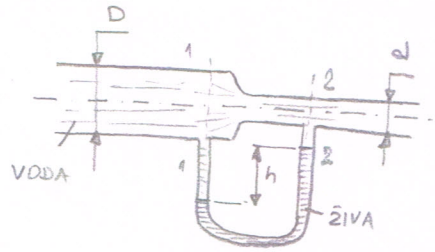


ODREDITI NADPRITISAK p_m U ZATVORENOM DIJELU "U" CIJEVI AKO SU GUSTINE ρ_1, ρ_2 i ρ_3 POZNATE, AKO SU POZNATE VISINE: h_1, h_2 i h_3

$$p_m + \rho_1 g h_1 = \rho_2 g h_2 + \rho_3 g h_3$$

$$p_m = (\rho_2 h_2 + \rho_3 h_3 - \rho_1 h_1) g$$

(27) VODA STRUJI KROZ ZATVORENU CIJEV KAO NA SLICI.



$\rho_ž = 13600 \frac{kg}{m^3}$

$\rho_v = 1000 \frac{kg}{m^3}$

AKO JE RAZLIKA NIVOA ŽIVE U "U" CIJEVI $h = 2cm$ i AKO JE $D = 0{,}1m$ $d = 0{,}05m$ ODREDITI PROTOK VODE KROZ CIJEV.

$$A_1 = \frac{D^2\pi}{4} = \frac{0{,}1^2 \cdot \pi}{4} = 7{,}85 \cdot 10^{-3} m^2; \quad A_2 = \frac{0{,}05^2\pi}{4} = 1{,}96 \cdot 10^{-3} m^2$$

Bernulijeva jednačina za 1-1 i 2-2

$$\rho \frac{v_1^2}{2} + p_1 = \rho \frac{v_2^2}{2} + p_2 \qquad v_1 A_1 = Q \rightarrow v_1^2 = \frac{Q^2}{A_1^2}$$

$$p_1 - p_2 = \frac{\rho}{2}(v_2^2 - v_1^2) \qquad v_2^2 = \frac{Q^2}{A_2^2}$$

$$p_1 + \rho_v g h = p_2 + \rho_ž g h \rightarrow p_1 - p_2 = (\rho_ž - \rho_v) g h$$

$$p_1 - p_2 = (13600 - 1000) 9{,}81 \cdot 0{,}02 = 2{,}47 kPa$$

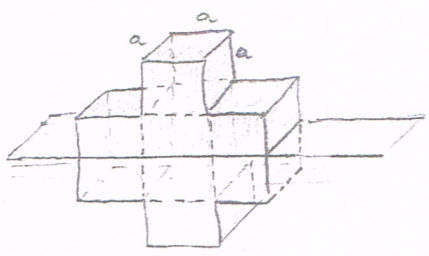
$$\frac{2(p_1 - p_2)}{\rho_v} = \frac{Q^2}{A_2^2} - \frac{Q^2}{A_1^2} = Q^2 \left(\frac{A_1^2 - A_2^2}{A_1^2 A_2^2} \right)$$

$$Q = \sqrt{\frac{2(p_1 - p_2) \cdot A_1^2 A_2^2}{\rho_v \cdot (A_1^2 - A_2^2)}} = \sqrt{\frac{2 \cdot 2{,}47 \cdot 10^3 \cdot 7{,}85^2 \cdot 10^{-6} \cdot 1{,}96^2 \cdot 10^{-6}}{1000 (7{,}85^2 \cdot 10^{-6} - 1{,}96^2 \cdot 10^{-6})}}$$

$Q = 4{,}5 m^3/s$

3. KOLOKVIJUM IZ TEHNIČKE MEHANIKE I HIDROMEHANIKE – 30.01.2014.g.

(2) TIJELO KOJE SE SASTOJI OD 8 KOCKI STRANICE $a = 0{,}25m$ PLIVA DO POLOVINE POTOPLJENO U VODI. KOLIKA JE GUSTINA TIJELA?



$G = F_p$

$G = a^3 \cdot 8 \cdot g \cdot \rho_T = 8 a^3 g \rho_T$

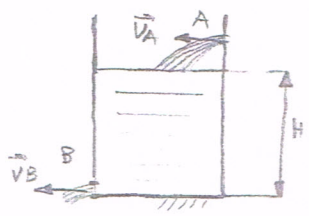
$F_p = 4a^3 g \rho_v$

$8 a^3 g \rho_T = 4 a^3 g \rho_v$

$\rho_T = \frac{\rho_v}{2} = 500 kg/m^3$

(27) U ŠIROKI REZERVOAR KROZ OTVOR A SE ULIVA 20 l/s VODE. KROZ OTVOR B VODA ISTIČE. AKO JE POVRŠINA OTVORA DVA PUTA VEĆA OD POVRŠINE OTVORA A I IZNOSI $0{,}4 dm^2$ ODREDITI NA KOJOJ VISINI ĆE SE NIVO VODE U REZERVOARU STABILIZOVATI?

KOLIKA JE BRZINA VODE U PRESJECIMA A i B?



$Q = 20 l/s = 20 dm^3/s$

$A_B = 2 A_A$

$v_B \cdot A_B = v_A A_A$

$v_B \cdot 2 A_A = v_A A_A$

$v_B = \frac{v_A}{2}$; $v_A = 2 v_B$

$Q = v_B \cdot A_B$

$v_B = \frac{20 dm^3}{0{,}4 dm^2} = 50 dm/s = 5 m/s$

$v_A = 10 m/s$