ZADACI ZA OVERU PRISUSTVA NA VEŽBAMA

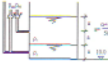
ZADATAK 1.1

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

Rezervoar kao na slici je napanjen vodom gustine $\rho=3\alpha/4$ kg/dm^3. Iznad slobodne površine fluida nalazi se vazduh pod pritiskom od $p_{VM}=\beta+5$ kPa. Izračunati pijezometarsku kota fluida i hidrostatičke i apsolutne pritiske u naznačenim tačkama A, B, C i D. Gustina vazduha se zanemaruje.

ZADATAK 1.2

Dva fluida gustina $\rho_2=1.2$ kg/dm^3 i $\rho_1=a$ kg/dm^3 nalaze se u otvorenom rezervoaru prikazanom na slici. Izračunati pijezometarske kote fluida, naznačiti nivo u pijezometru i izračunati pritiske koje pokazuju manometri.



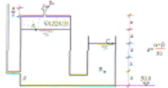
ZADACI KOJI SE OCENJUJU NA NAREDNOM ČASU

ZADATAK 1.3

U rezervoaru kao na slici se nalazi fluid gustine $\rho=2.5a$ kg/dm^3. Izračunati:

a) Pijezometarsku kota fluida,
b) hidrostatičke pritiske u tačkama A, B i C,
c) pritisak koji pokazuje manometar p_M i naznačiti nivo u pijezometru.

Napomena: Zanemariti gustinu vazduha.

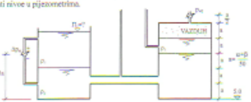


ZADATAK 1.4

U instalaciji kao na slici, nalaze se tri fluida i vazduh pod pritiskom. Gustine fluida su $\rho_1=1-\beta/200$ kg/dm^3, $\rho_2=1.2$ kg/dm^3 i $\rho_3=3\alpha/5$ kg/dm^3 dok se gustina vazduha zanemaruje. Ako je poznata pijezometarska kota fluida sa gustinom ρ_3, $\Pi_3=8$m, izračunati:

a) Pijezometarske kote fluida,
b) pritisak koji pokazuje manometar p_{M1} i
c) pritisak koji pokazuje manometar Δp_M.

Na crtežu ucrtati nivoe u pijezometrima.



Zadatak 1.1

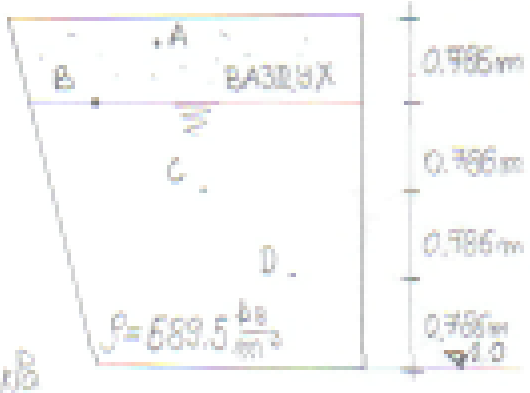
$\Delta\Pi = 8.981\,m$

$a = \frac{6+33.3}{50} = 0.786$

$f = \frac{30}{4}\,\frac{3 \cdot 0.786}{4} = 0.5895\,\frac{kg}{dm^3}$

$\rho = 589.5\,\frac{kg}{m^3}$

$P_{vak} = 33.3\,kPa + 5\,kPa = 38.3\,kPa$



$P_A = P_{vak} = 38.3\,kPa \qquad P_{atm} = 100\,kPa$

$P_{A,aps} = P_{atm} + P_A = 100\,kPa + 38.3\,kPa = 138.3\,kPa$

$P_B = P_A = 38.3\,kPa$

$P_{B,aps} = P_{atm} + P_B = 138.3\,kPa$

$\frac{P_B}{\rho g} + Z_B = \Pi$

$Z_B = 3 \cdot a = 3 \cdot 0.786\,m = 2.358\,m$

$\Pi = \frac{38300\,Pa}{589.5\,\frac{kg}{m^3} \cdot 9.81\,\frac{m}{s^2}} + 2.358\,m = 6.623\,m + 2.358\,m = 8.981\,m$

$\frac{P_C}{\rho g} + Z_C = \Pi \qquad P_C = (\Pi - Z_C) \cdot \rho g = (8.981\,m - 1.572\,m) \cdot 589.5\,\frac{kg}{m^3} \cdot 9.81$

$Z_C = 2a = 1.572\,m \qquad P_C = 42846.209\,Pa = 42.85\,kPa$

$P_{C,aps} = 100\,kPa + 42.85\,kPa = 142.85\,kPa$

$\frac{P_D}{\rho g} + Z_D = \Pi \qquad P_D = (\Pi - Z_D) \cdot \rho g = (8.981\,m - 0.786\,m) \cdot 589.5 \cdot 9.81$

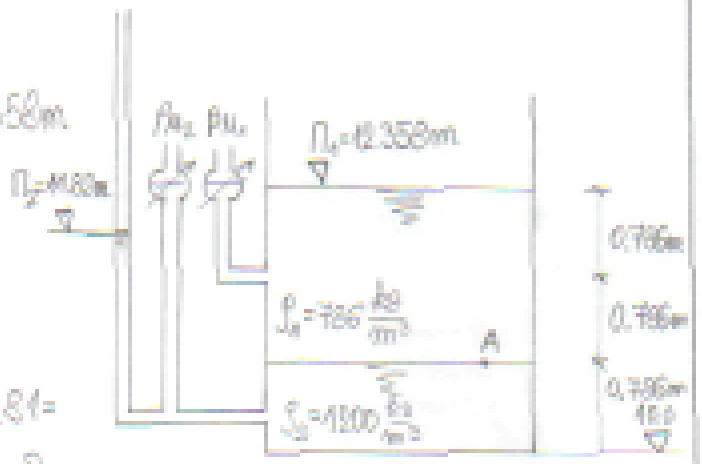
$P_D = 47391.64\,Pa = 47.39\,kPa$

$P_{D,atm} = 147.39\,kPa$

Задатак 1.2

$\rho_1 = 786 \frac{kg}{m^3}$

$\rho_2 = 1200 \frac{kg}{m^3}$



$\Pi_1 = 10m + 3 \cdot 0.786m = 12.358m$

$\frac{p_A}{\rho_1 g} + z_A = \Pi_1$

$p_A = (\Pi_1 - z_A) \rho_1 g$

$p_A = (12.358 - 10.786) \cdot 786 \cdot 9.81 =$

$= 12121.157 Pa \approx 12.12 kPa$

$\frac{p_A}{\rho_2 g} + z_A = \Pi_2 \quad \Pi_2 = \frac{12121.157}{1200 \cdot 9.81} + 10.786 = 1.036 + 10.786 = 11.82 m$

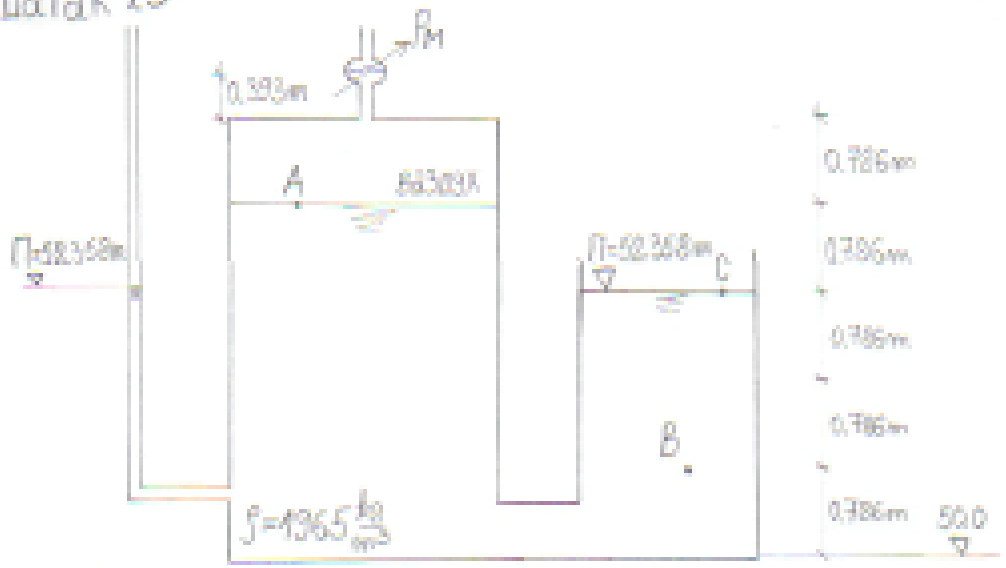
$\frac{p_{M_1}}{\rho_1 g} + z_{M_1} = \Pi_1 \quad p_{M_1} = (\Pi_1 - z_{M_1}) \rho_1 g$

$p_{M_1} = (12.358 - 12.358) \cdot 786 \cdot 9.81 = 0 kPa$

$\frac{p_{M_2}}{\rho_2 g} + z_{M_2} = \Pi_2 \quad p_{M_2} = (\Pi_2 - z_{M_2}) \rho_2 g$

$p_{M_2} = (11.82m - 12.358m) \cdot 1200 \cdot 9.81 = -6.33 kPa$

Задатак 13



$f = 1965 \frac{kg}{cm^2} = 1965 \frac{kg}{cm^2}$

a) $\Pi = 50 + 3 \cdot 0.786 = 52.358\,m$

b) $p_t = 0\,kPa$

$\frac{p_B}{\rho g} + z_B = \Pi$

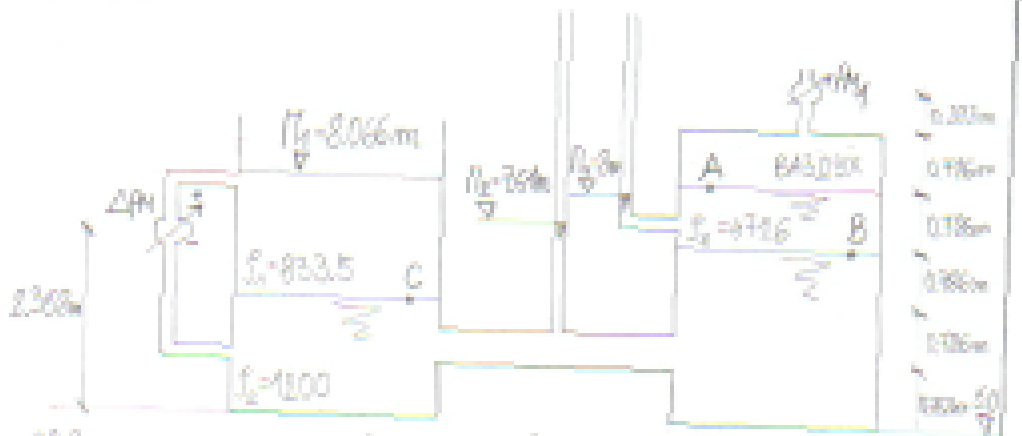
$p_B = (52.358 - 50.786) \cdot 1965 \cdot 9.81 = 30302.89\,Pa = 30.3\,kPa$

$\frac{p_A}{\rho g} + z_A = \Pi$

$p_A = (52.358 - 53.144) \cdot 1965 \cdot 9.81 = -15151.45\,Pa = -15.15\,kPa$

c) $p_M = p_A = -15.15\,kPa$

Задача 1.4



$\rho_1 = 1 - \frac{33.3}{100} = 1 - 0.1665 = 0.8335 \frac{kg}{dm^3} = 833.5 \frac{kg}{m^3}$

$\rho_2 = 1200 \frac{kg}{m^3}$ $\rho_3 = \frac{3 \cdot 9.786}{5} = 0.4716 \frac{kg}{dm^3} = 471.6 \frac{kg}{m^3}$

a) $\Pi_3 = 8m$

$\frac{p_A}{\rho_3 g} + z_A = \Pi_3$; $z_A = 8.144m$

$p_A = (\Pi_3 - z_A)\rho_3 g = (8 - 8.144) \cdot 471.6 \cdot 9.81 = -666.2 Pa = -0.67 kPa$

$\frac{p_B}{\rho_3 g} + z_B = \Pi_3$ $z_B = 7.358m$

$p_B = (\Pi_3 - z_B)\rho_3 g = (8 - 7.358) \cdot 471.6 \cdot 9.81 = 2970 Pa = 2.97 kPa$

$\frac{p_B}{\rho_2 g} + z_B = \Pi_2$ $\Pi_2 = \frac{2970}{1200 \cdot 9.81} + 7.358 = 0.252 + 7.358 = 7.61m$

$\frac{p_C}{\rho_2 g} + z_C = \Pi_2$ $z_C = 6.572m$ $p_C = (7.61 - 6.572) 1200 \cdot 9.81 = 12219 Pa = 12.22 kPa$

$\frac{p_C}{\rho_1 g} + z_C = \Pi_1$ $\Pi_1 = \frac{12219}{833.5 \cdot 9.81} + 6.572 = 1.494 + 6.572 = 8.066m$

b) $p_{M3} = p_{H2C} = p_A = -0.67 kPa$

c) $\Delta p_M = p_M^+ - p_M^-$ $z_M = 7.358m$

$p_M^+ = \rho_1 g (\Pi_1 - z_M) = 833.5 \cdot 9.81 (8.066 - 7.358) = 5789.06 Pa$

$p_M^- = \rho_2 g (\Pi_2 - z_M) = 1200 \cdot 9.81 (7.61 - 7.358) = 2966.54 Pa$

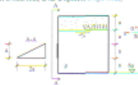
$\Delta p_M = 5789.06 - 2966.54 = 2822.52 Pa = 2.82 kPa$

ZADACI ZA OVERU PRISUSTVA NA VEŽBAMA

ZADATAK 2.1

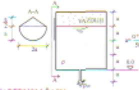
(Napomena: slike kotirati u metrima, a ne u opštim brojevima)

U rezervoaru prikazanom na slici nalazi se tečnost gustine ρ=1.2 kg/dm^3. Vazduh iznad slobodne površine tečnosti je pod pritiskom p_{Vm} =-β kPa. Gustina vazduha se zanemaruje. Izračunati horizontalnu komponentu hidrostatičke sile (intenzitet i mesto delovanja) na poklopac u obliku trougla koji je prikazan na slici (ucrtati sila na skici).



ZADATAK 2.2

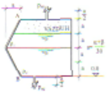
U rezervoara prikazanom na slici nalazi se fluid gustine ρ=β/20 kg/dm^3. Manometar prikazan na slici pokazuje pritisak od p_{M}= (2α+β) kPa. Gustina vazduha se zanemaruje. Izračunati horizontalnu komponentu hidrostatičke sile (intenzitet i mesto delovanja) na poklopac složene geometrije koji je prikazan na slici (ucrtati sila na skici).



ZADACI KOJI SE OCENJUJU NA NAREDNOM ČASU

ZADATAK 2.3

U zatvorenom rezervoaru prikazanom na slici nalaze se dva fluida gustina ρ_2=1 kg/dm^3 i $\rho_1 = 1 - \frac{\alpha+\beta}{100}$ kg/dm^3 i vazduh pod pritiskom. Gustina vazduha se zanemaruje. Ukoliko je pokazivanje na manometra p_{M2}=β/2 kPa, nacrtati dijagram visine pritiska i izračunati horizontalnu komponentu hidrostatičke sile na zid A-B (intenzitet i mesto delovanja), ravanskim postupkom (ucrtati silu na skici). Širina rezervoara je 1m. Takođe, odrediti čitanje na manometru p_{M1}.



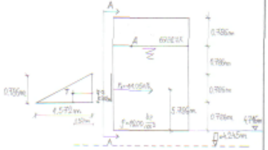
ZADATAK 2.4

Tri fluida gustina ρ_1=α kg/dm^3, ρ_2=1.4 kg/dm^3 i ρ_3 deli zid širine 1m'. Izračunati horizontalnu komponentu hidrostatičke sile (intenzitet i mesto delovanja) na zid A-B ravanskim postupkom (ucrtati silu na skici) od strane fluida ρ_1 i ρ_2 sa leve strane. Odrediti potrebnu gustinu fluida ρ_3 tako da skupna horizontalna sila na zid (od strane sva tri fluida) bude nula.

Задатак 2.1

$\rho = 1200 \frac{kg}{m^3}$

$P_{MAN} = -33.3\,kPa$



$p_A = p_{MAN} = -33.3\,kPa \qquad Z_A = 4.716m + 3\cdot 0.786m = 7.074m$

$\frac{p_A}{\rho g} + Z_A = \Pi \qquad \Pi = \frac{-33300}{1200\cdot 9.81} + 7.074 = -2.829m + 7.074m = 4.245m$

$Z_T = 4.716 + 0.786 + 0.262 = 5.764m$

$\frac{p_T}{\rho g} + Z_T = \Pi \qquad p_T = (4.245 - 5.764)\cdot 1200\cdot 9.81 = -17881.67\,Pa \approx -17.88\,kPa$

$A_x = \frac{1.572\cdot 0.786}{2} = 0.617796m^2 \approx 0.6178m^2$

$P_x = p_T\cdot A_x = -17881.67\cdot 0.6178 = -11047.22\,N = -11.05\,kN$

$e = -\frac{\rho g I_{yy}}{P_x}$

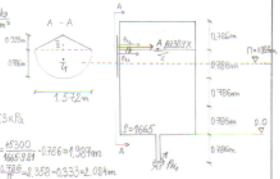
$I_{yy} = \frac{b h^3}{36} = \frac{1.572\cdot 0.786^3}{36} = 0.021m^4$

$e = \frac{-1200\cdot 9.81\cdot 0.021}{-11047} = 0.0223m$

$Z_x = Z_T + e = 5.764 + 0.0223 = 5.7863m$

Задатак 2.2

$\rho = \frac{33.3}{20}\frac{kg}{dm^3} = 1665\frac{kg}{m^3}$



$P_{M_1} = 2 \cdot 6 + 33.3 = 45.3\,kPa$

$Z_{M_1} = -0.786\,m$

$\frac{P_{M_1}}{\rho g} + Z_{M_1} = \Pi \quad \Pi = \frac{45300}{1665 \cdot 9.81} - 0.786 = 1.987\,m$

$Z_{T_1} = 3 \cdot 0.786 - \frac{4}{3} \cdot \frac{0.786}{\pi} = 2.358 - 0.333 = 2.084\,m$

$\frac{P_{T_1}}{\rho g} + Z_{T_1} = \Pi \quad P_{T_1} = (1.987 - 2.084) \cdot 1665 \cdot 9.81 = -604.34\,Pa$

$A_{x_1} = \frac{1}{2} \cdot 0.786^2 \cdot \pi = 0.97\,m^2$

$P_{x_1} = P_{T_1} \cdot A_{x_1} = -604.34 \cdot 0.97 = 586.21\,N$

$e_1 = \frac{-\rho g I_{yy}}{P_{x_1}}$

$I_{yy} = I_{y_0} - h_T^2 \cdot A_{x_1} \quad h_T = 0.333\,m$ ✓

$I_{yy} = \frac{\pi d^4}{128} - h_T^2 \cdot A_{x_1} = \frac{1.572^4 \cdot \pi}{128} - 0.333^2 \cdot 0.97 = 0.1499 - 0.1076 = 0.0423$

$e_1 = \frac{-1665 \cdot 9.81 \cdot 0.0423}{-586.21} = 0.11\,m$

$Z_{x_1} = Z_{T_1} + e_1 = 2.084 + 0.11 = 2.194\,m$

$\frac{P_A}{\rho g} + Z_A = \Pi, \quad P_A = (1.987 - 2.358) \cdot 1665 \cdot 9.81 = -6059.78\,Pa = -6.1\,kPa$

$P_{T_2} = -6.1\,kPa = P_A$ ✓

$Z_{T_2} = 2.358 + \frac{1}{3} \cdot 0.393 = 2.489\,m = Z_{x_2}$

$A_{x_2} = \frac{1.572 \cdot 0.393}{2} = 0.3089\,m^2 \quad P_{x_2} = P_{T_2} \cdot A_{x_2} = -6059.78 \cdot 0.3089 = -1871.85\,N$

$P_x = P_{x_1} + P_{x_2} = -586.21\,N - 1871.85\,N = -2458.06\,N = -2.46\,kN$

$Z_{x_1} P_{x_1} + Z_{x_2} P_{x_2} = P_x \cdot Z_x$

$Z_x = \frac{Z_{x_1} P_{x_1} + Z_{x_2} P_{x_2}}{P_x} = \frac{-2.134 \cdot 586.21 - 1871.85 \cdot 2.489}{-2458.06} = \frac{-1250.97 - 4659.03}{-2458.06} =$

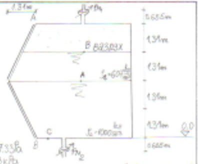
$Z_x = 2.404\,m$

Задатак 2.3

$a = \frac{33.3+6}{30} = 1.31$

$\rho_1 = 1 - \frac{33.3+6}{100} = 607 \frac{kg}{m^3}$

$p_{M_2} = 16.5\,kPa \qquad L = 1\,m$



$\frac{p_{M_2}}{\rho_2 g} + Z_{M_2} = \Pi_2$

$\Pi_2 = \frac{16500}{1000 \cdot 9.81} - 0.655 = 1.027\,m$

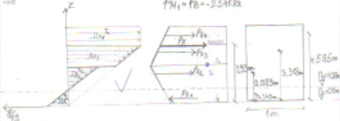
$\frac{p_A}{\rho_2 g} + Z_A = \Pi_2 \qquad Z_A = 2.62\,m$

$p_A = (1.027 - 2.62) \cdot 1000 \cdot 9.81 = -15627.33\,Pa = -15.63\,kPa$

$\frac{p_A}{\rho_1 g} + Z_A = \Pi_1 \qquad \Pi_1 = \frac{-15627.33}{607 \cdot 9.81} + 2.62 = 0.004\,m \approx 0.0\,m \qquad Z_C = 0 \quad p_C = \Pi_2 \rho_2 g = 10074.87$

$\frac{p_B}{\rho_1 g} + Z_B = \Pi_1 \qquad Z_B = 3.93\,m \qquad p_B = -3.93 \cdot 607 \cdot 9.81 = -23401.85\,Pa \approx -23.4\,kPa$

$p_{M_1} = p_B = -23.4\,kPa$



$\Omega_{x_1} = \frac{1.027 \cdot 1.027}{2} = 0.527\,m^2 \qquad Z_{T_1} = \frac{1}{3}\Pi_2 = 0.342\,m$

$\Omega_{x_2} = \frac{(Z_A - \Pi_2)\frac{p_A}{\rho g}}{2} = \frac{(1.593 \cdot (-1.593))}{2} = |-1.269|\,m^2 \qquad Z_{T_2} = Z_A - \frac{1}{3}(Z_A - \Pi_2) = 2.62 - \frac{1}{3}(2.62 - 1.027) = 2.089\,m$

$\Omega_{x_3} = \frac{\frac{p_A}{\rho g} + \frac{p_B}{\rho g}}{2} \cdot (Z_B - Z_A) = \left|\frac{-2.624 - 3.93}{2}\right| \cdot 1.31 = |-4.2837\,m^2| \qquad Z_{T_4} = 3.93 + \frac{1.31}{2} = 4.585\,m$

$\Omega_{x_4} = \frac{p_B}{\rho g} \cdot 1.31 = |-5.148|\,m^2 \qquad Z_{T_3} = \frac{0.655 \cdot 3.4374 + 0.873 \cdot 0.8594}{4.2837} + 2.62 = 3.318\,m$

$P_x = \rho g L \Omega_x$

$P_{x_1} = 1000 \cdot 9.81 \cdot 1 \cdot 0.527 = 5169.87 = 5.17\,kN$

$P_{x_2} = 1000 \cdot 9.81 \cdot 1 \cdot |1.269| = 12448.89\,N = 12.45\,kN$

$P_{x_3} = 607 \cdot 9.81 \cdot 1 \cdot |4.2837| = 25508\,N = 25.5\,kN$

$P_{x_4} = 607 \cdot 9.81 \cdot 1 \cdot |5.148| = 30654.6\,N = 30.65\,kN$

$P_x = P_{x_1} + P_{x_3} + P_{x_4} - P_{x_2} = 63441.62\,N$

$P_x = 63.44\,kN$

$Z_x = \frac{P_{x_1} Z_{T_1} + P_{x_2} Z_{T_2} + P_{x_3} Z_{T_3} + P_{x_4} Z_{T_4}}{P_x} = 3.93\,m$

Задатак 2.4

$a = \frac{22.5+6}{30} = 0.786$

$\rho_1 = 786 \frac{kg}{m^3}$ $\rho_2 = 1400 \frac{kg}{m^3}$ $L = 1m$

$\frac{p_B}{\rho_1 g} + Z_B = \Pi_1$ $Z_B = 1.179m$

$p_B = (3.144 - 1.179) \cdot 786 \cdot 9.81 = 15151.45 Pa$

$\frac{p_B}{\rho_2 g} + Z_B = \Pi_2$ $\Pi_2 = 2.288m$

$p_C = (\Pi_2 - Z_C)\rho_2 g = 31340.9 Pa$

$\Omega x_1 = \frac{\Pi_2 + \frac{p_B}{\rho_2 g}}{2} Z_B = \frac{2.288 + 1.103}{2} \cdot 1.179 = 1.9955 m^2$ $Z_{T11} = \frac{1}{3} Z_B = 0.393m$

$Z_{T12} = \frac{1}{2} Z_B = 0.5895$

$\Omega x_2 = \frac{\frac{p_B}{\rho_1 g} \cdot (\Pi_1 - Z_B)}{2} = \frac{1.965 \cdot 1.965}{2} = 1.9306 m^2$

$Z_{T1} = \frac{0.393 \cdot 0.695 + 0.5895 \cdot 1.3300}{1.9955} = 0.524m$ $Z_{T2} = Z_B + \frac{1}{3}(\Pi_1 - Z_B) = 1.834m$

$P_{x1} = \rho_2 g L \Omega x_1 = 27406.2 N$ $P_{x2} = \rho_1 g L \Omega x_2 = 14886.2 N$

$P_x = P_{x1} + P_{x2} = 42292.4 N$ $Z_x = \frac{P_{x1} Z_{T1} + P_{x2} Z_{T2}}{P_x} = \frac{14278.63 + 27301.29}{42292.4} = 0.983m$

$\Omega x_3 = \frac{\Pi_3^2}{2} = \frac{2.358^2}{2} = 2.780 m^2$

$P_x = \rho_3 g L \Omega x_3$

$\rho_3 = \frac{P_x}{g \Omega x_3} = \frac{42292.4}{9.81 \cdot 2.780} = 1550 \frac{kg}{m^3}$

ZADACI ZA OVERU PRISUSTVA NA VEŽBAMA

(Napomena: slike kontrati a matrima, a ne u opisim brojevima)

ZADATAK 3.1

U sudu pod pritiskom, nalaze se tečnost gustine $\rho=(1000+5\beta)$ kg/m^3 i vazduh pod pritiskom od (3β) kPa.
Potrebno je odrediti:

1. pijezometarsku kotu tečnosti,
2. vertikalnu komponentu hidrostatičke sile (intenzitet, smer i mesto delovanja) na zid AB širine 1m'.

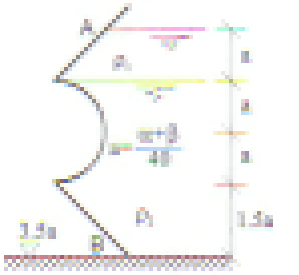
Ucrtati silu na skici.

ZADATAK 3.2

Zid se sastoji od dva kosa (45^0) i jednog polukružnog segmenta. Zid je u kontaktu sa dva fluida gustina $\rho_1=(1000-5\beta)$ kg/m^3 i $\rho_2=1000$ kg/m^3 i ima poprečnu širinu od (5a) m. Potrebno je odrediti:

1. pijezometarske kote oba fluida,
2. vertikalnu komponentu hidrostatičke sile (intenzitet, smer i mesto delovanja) na zid AB.

Ucrtati silu. Sve potrebne dimenzije date su na skici.

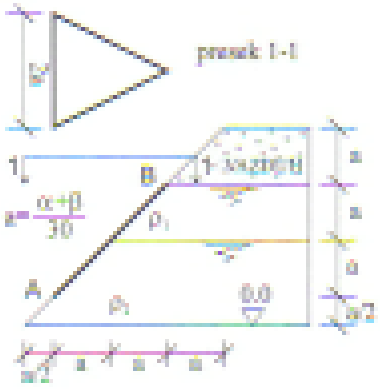


ZADACI KOJI SE OCENJUJU NA NAREDNOM ČASU

ZADATAK 3.3

U zatvorenom sudu nalazi se vazduh i dve tečnosti gustina: $\rho_1=(1+\alpha/10)$ kg/dm^3 i $\rho_2=(1+\alpha/10)$ kg/dm^3. Na levom zidu rezervoara nalazi se trougaoni poklopac AB čija je projekcija prikazana presekom 1-1 na skici. Poklopac je u kontaktu sa obe tečnosti, ali ne i sa vazduhom. Ukoliko je pijezometarska kota fluida ρ_2, $\Pi_2=(2a)$ m, odrediti:

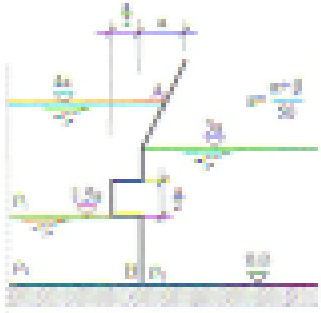
1. pijezometarsku kotu fluida gustine ρ_1 i pritisak u vazduhu
2. vertikalnu komponentu hidrostatičke sile (intenzitet, smer i mesto delovanja) na poklopac AB i ucrtati je
3. horizontalnu komponentu hidrostatičke sile (intenzitet, smer i mesto delovanja) na poklopac AB i ucrtati je
4. odrediti i ucrtati ukupnu hidrostatičku silu na poklopac AB



ZADATAK 3.4

Na skici je prostorna dispozicija iz zadatka 2.4. Tri fluida gustina $\rho_1=\alpha$ kg/dm^3, $\rho_2=1.4$ kg/dm^3 i $\rho_3=1.2$ kg/dm^3 dele zid širine 1m'. Izračunati:

1. vertikalnu komponentu hidrostatičke sile na zid AB,
2. ukupnu hidrostatičku silu (intenzitet, pravac, smer i mesto delovanja) na zid AB.
3. presečne sile (N,T,M) u preseku B

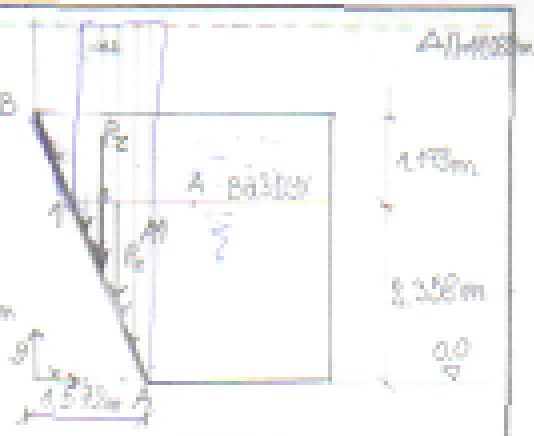


Задатак 3.1

a=0,786m

$\rho = (1000 + 166.5) = 1166.5 \frac{kg}{m^3}$

$p_{ISZ} = 99.9 kPa$

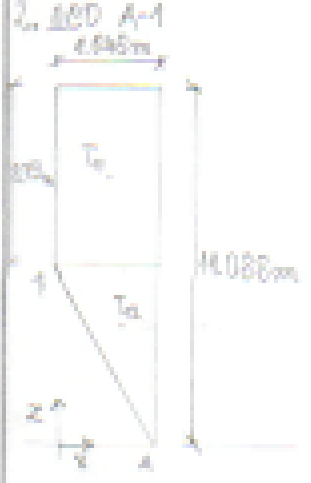


1. $p_A = p_{ISZ} = 99.9 kPa$ $z_A = 2.358m$

$\frac{p_A}{\rho g} + z_A = \Pi$ $\Pi = \frac{99900}{1166.5 \cdot 9.81} + 2.358 = 11.088m$

$L = 1m$

2. ΔCD A-1



3.537 : 1.572 = 2.358 : c $c = \frac{1.572 \cdot 2.358}{3.537} = 1.048m$

$P_{\square} = \frac{11088 + 873}{2} \cdot 4.048 = 40.3846m$

$V_1 = P_{\square} \cdot L = 40.3846 m^3$

$P_z^{A1} = \rho g V_1 = 118831 N = 118.8 kN$

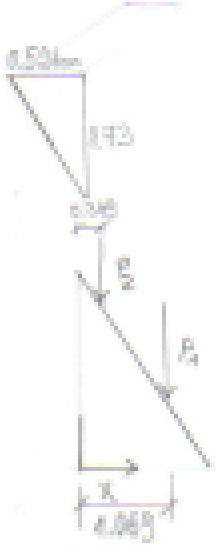
$x_{T_{\square}} = 0.524m$ $x_{T_{\Delta}} = 0.699m$

$A_{K_1} = 9.14304m^2$ $A_{K_2} = 1.235592m^2$

$x_{T_1} = \frac{x_{T_{\square}} A_{K_1} + x_{T_{\Delta}} A_{K_2}}{A_{K_1} + A_{K_2}} = \frac{0.524 \cdot 9.14304 + 0.699 \cdot 1.235592}{40.3846} =$

$= \frac{4.734 + 0.8637}{40.3846} = 0.545m$

ΔCD 1-B



$A_{ISZ} = 0.534m^2$ $P_{ISZ} = 99 kPa$

$P_z^{1B} = A_{ISZ} \cdot P_{ISZ} = 52.35 kN$ $x_{T_2} = \frac{2}{3} 0.524 = 0.349m$

$P_z = P_z^{A1} + P_z^{1B} = 171.15 kN$

$x_T = \frac{x_{T_1}' P_z^{A1} + x_{T_2} P_z^{1B}}{P_z} = \frac{4.068 \cdot 118800 + 0.349 \cdot 52350}{171150} =$

$= \frac{186997.2 + 18270.15}{171150} = 0.94m$

Завдання 3.2

$\rho_A = 833.5 \frac{kg}{m^3}$

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

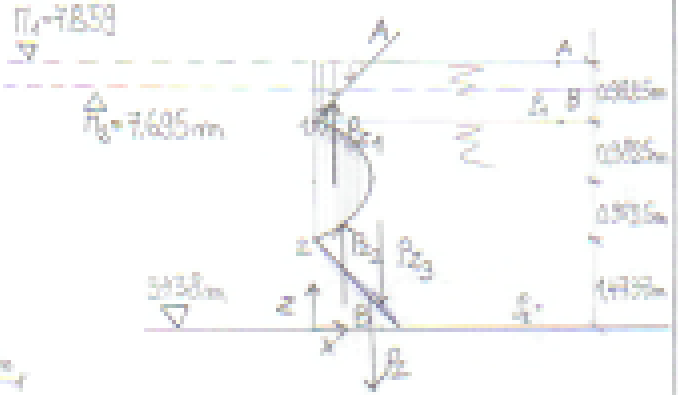
$L = 4.9125 m$

1. $\Pi_1 = Z_A = 7.859 m$

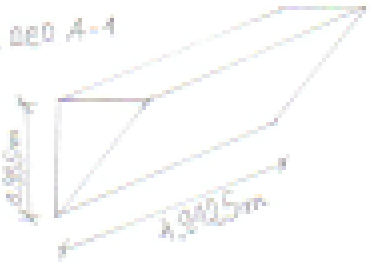
$\frac{P_B}{\rho_B g} + Z_B = \Pi_1$, $Z_B = 6.8767 m$

$P_B = 8031.3 P_A$

$\frac{P_B}{\rho_B g} + Z_B = \Pi_2 = 7.695 m$



2. дно A-1

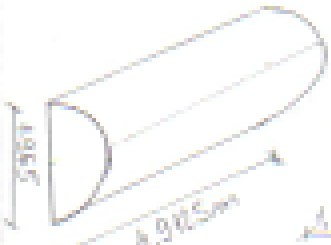


$V_1 = 0.985 \cdot 0.985 \cdot 4.9125 \cdot \frac{1}{2} = 2.383 m^3$

$P_1^{AA} = \rho_B g V_1 = 19484.9 N$

$X_{T_1} = \frac{1}{3} \cdot 0.985 = 0.328 m$

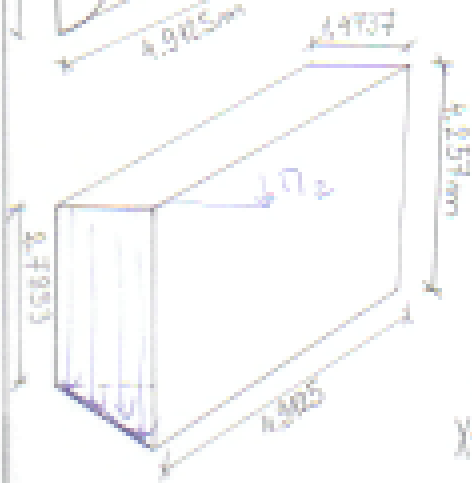
дно 1-2



$V_{12} = 0.985^2 \cdot \pi \cdot \frac{1}{2} \cdot 4.9125 = 7.449 m^3$

$P_2^{1-2} = \rho_B g V_{12} = 73072.9 N$

$X_{T_2} = \frac{4}{3} \cdot \frac{0.985}{\pi} = 0.417 m$



$V_3 = \frac{2.7833 + 4.257}{2} \cdot 4.4737 \cdot 4.9125 = 25.48 m^3$

$P_3^{2-6} = \rho_B g V_3 = 249958 N$

$X_{T_3} = \frac{0.736685 \cdot 3.1378 + 0.368 \cdot 1.0855}{4.2233}$

$X_{T_3} = \frac{2.312 + 1.0659}{4.2233} = 0.8 m$

$P_x = P_{z_3} - P_{z_2} - P_{z_1} = 157400 N$

$X_T = \frac{-6391 - 30471.3 + 199366}{157400} = 1.04 m$

Задача 3.3

$\rho_1 = 1000 \frac{kg}{m^3}$

$\rho_2 = 1600 \frac{kg}{m^3}$

$\Pi_2 = 2.62 m$

1. $\frac{p_A}{\rho_2 g} + Z_A = \Pi_2$, $Z_A = 1.965 m$

$p_A = (2.62 - 1.965) \cdot 1600 \cdot 9.81 = 10280.88 Pa$

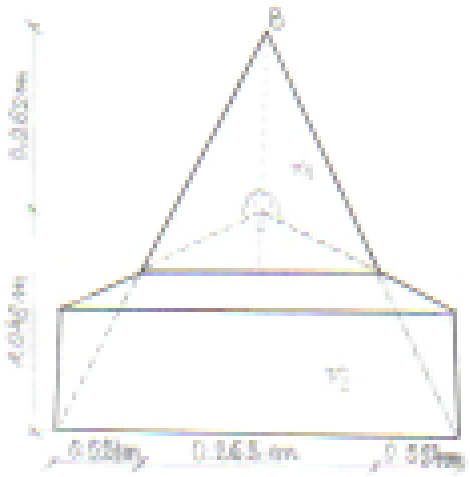
$\frac{p_A}{\rho_1 g} + Z_A = \Pi_1$, $\Pi_1 = 3.013 m$

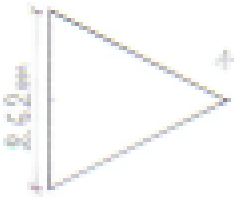
$\frac{p_B}{\rho_1 g} + Z_B = \Pi_1$, $Z_B = 3.275 m$

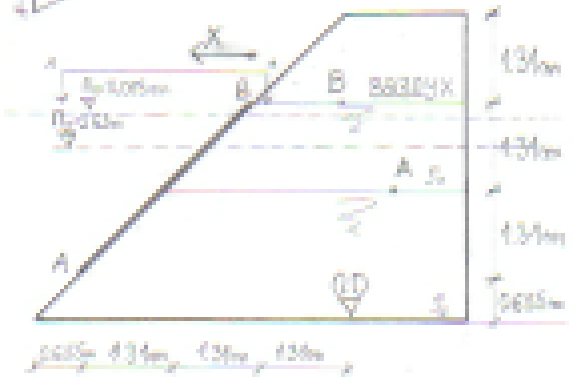
$p_B = -2570.2 Pa$

$p_{vak} = p_B = -2.57 kPa$

2. $P_z = ?$ фигура S_1







$V_1 = \frac{0.262 \cdot 0.262 \cdot 0.262}{6} = 0.003 m^3$

$P_{z_1} = \rho_1 g V_1 = 29.4 N$

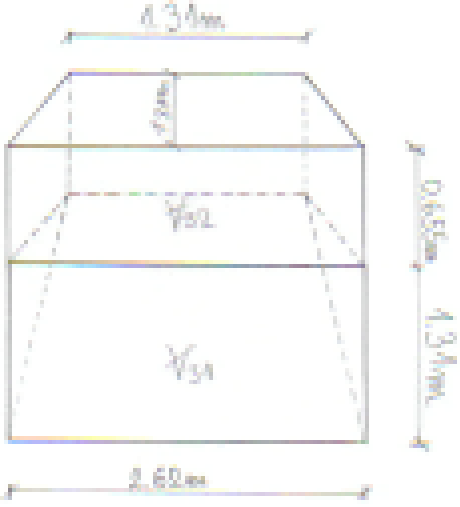
$x_{T_1} = \frac{1}{3} \cdot 0.262 m = 0.087 m$

$V_2 = \frac{1}{6}(3.14 \cdot 1 + 0.262) \cdot 1.048 \cdot 1.048 =$

$= 0.527 m^3$

$P_{z_2} = \rho_1 g V_2 = 5175 N$

$x_{T_2} = 0.262 + \frac{2}{3} \cdot 1.048 = 0.961 m$



$V_{31}=\frac{1}{2}(2.62+1.31)\cdot 1.31\cdot 1.31=1.873m^3$

$V_{32}=\frac{2.62+1.31}{2}\cdot 1.31\cdot 0.655=1.686m^3$

$V_3=V_{31}+V_{32}=3.559m^3$

$P_{z3}=\gamma_{28}V_3=55862.7N$

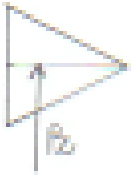
$x_{T3}=\frac{x_{T31}A_{31}+x_{T32}A_{32}}{A_{31}+A_{32}}=$

$=\frac{1.686+1.873}{1.7464}=2.079m$

$x_{T31}=1.365m$ $A_{31}=0.85805$

$x_{T32}=2.123m$ $A_{32}=0.85806$

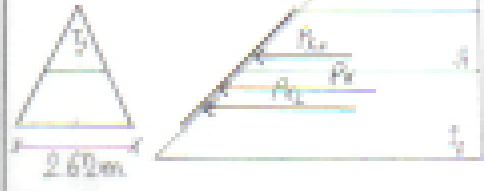
(b=1.31)



$P_z=P_{z1}+P_{z2}+P_{z3}=61007.6N$

$x_T=\frac{-P_{z1}x_{T1}+P_{z2}x_{T2}+P_{z3}x_{T3}}{P_z}=\frac{-2.6+8732+115857.8}{61007.6}=1.98m$

3. Хоризонтална сила



$z_{T1}=1.365+\frac{1}{3}1.31=2.402m$

$\frac{P_{x1}}{\rho g}+z_{T1}=\Pi_1$ $P_{x1}=5939.9Pa$

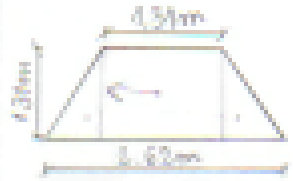
$A_{x1}=\frac{1.31^2}{2}=0.85805m^2$

$P_{x1}=P_{x1}A_{x1}=5143N$

$e=\frac{-\rho g I_{xy}}{P_{x1}}=\frac{-1000\cdot 9.81\cdot 0.082}{5143}=-0.156m$

$I_{xy}=\frac{1.31\cdot 1.31^3}{36}=0.082$

$z_{x1}=2.402-0.156=2.246m$



$Z_1 = 0.437 \quad A_{x_{21}} = 0.483$

$Z_2 = 0.655 \quad A_{x_{22}} = 1.716$

$Z_3 = 0.437 \quad A_{x_{23}} = 0.483$

$Z = 0.582$

$$Z_{T_2} = 0.655 + \frac{0.187 + 1.124 + 0.127}{2.574} = 1.237\,m$$

$$\frac{P_{T_2}}{\rho g} + Z_{T_2} = \Pi_2 \qquad P_{T_2} = 21707.6\,Pa$$

$$A_{x_2} = \frac{2.62 + 1.31}{2} \cdot 1.31 = 2.574\,15\,m^2$$

$$P_{x_2} = P_{T_2} \cdot A_{x_2} = 55878.6\,N$$

$$e = \frac{-\rho g I_{yy}}{P_{x_2}}$$

$$I_{yy} = \sum (I_{oT} + \ell^2 A_i) = \frac{1}{36} \cdot 0.655 \cdot 1.31^3 + (0.582 - 0.437)^2 \cdot 0.483 + \frac{1}{12} \cdot 1.31^3 \cdot$$

$$+ (0.582 - 0.655)^2 \cdot 1.716 + \frac{1}{36} \cdot 0.655 \cdot 1.31^3 + (0.582 - 0.437)^2 \cdot 0.483$$

$$= 0.04 + 0.009 + 0.245 + 0.009 + 0.04 + 0.009 = 0.352$$

$$e = \frac{-1600 \cdot 9.81 \cdot 0.352}{558786} = -0.099\,m$$

$$Z_{T_2}' = 1.237 - 0.099 = 1.138\,m$$

$$P_x = P_{x_1} + P_{x_2} = 5143 + 558786 = 610021.6\,N$$

$$Z_x = \frac{P_{x_1} Z_{x_1} + P_{x_2} Z_{x_2}}{P_x} = \frac{115512 + 635898}{610021.6} = 1.231\,m$$

4

P_z: $x_2 = 1.32\,m$; $x_1 = 1.250\,m$, $Z_1 = 1.250\,m$

P_x: $Z_x = 1.231\,m$; $Z_2 = 1.231\,m$, $x_2 = 1.231\,m$

$$P = \sqrt{P_x^2 + P_z^2} = \sqrt{372\,193\,272.58 + 372\,363\,966.7}$$

$$= 862\,87.71$$

$$\alpha = \operatorname{arctg} \frac{P_z}{P_x} = \operatorname{arctg}(0.9997) = 44.99^\circ \approx 45^\circ$$

Задатак 3.4

$\rho_1 = 786 \frac{kg}{m^3}$ $\Pi_1 = 3.144 m$

$\rho_2 = 900 \frac{kg}{m^3}$ $\Pi_2 = 2.358 m$

$\rho_3 = 1500 \frac{kg}{m^3}$

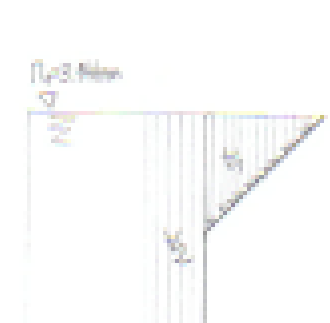
$L = 4m^2$

$\frac{p_A}{\rho_1 g} + z_A = \Pi_1$, $z_A = 1.179 m$

$p_A = 15151.4 Pa$

$\frac{p_A}{\rho_2 g} + z_A = \Pi_2$, $\Pi_2 = 2.28 m$

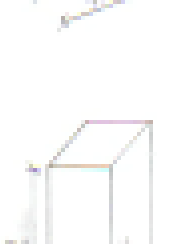
1. Вертикална сила од флуида ρ_1



$V_{t1} = \frac{0.786^2}{2} \cdot 4 = 1.236 m^3$

$F_{z1} = \rho_1 g V_1 = 9.384 N$

$x_{T1} = 0.524 m$



$V_2 = 0.393 \cdot 1.572 = 0.618 m^3$

$F_{z2} = \rho_1 g V_2 = 4763.6 N$

$x_{T2} = 0.786 + \frac{0.393}{2} = 0.9825 m$

Вертикална сила од флуида ρ_2

$V_3 = 0.393 \cdot 1.101 = 0.433 m^3$

$F_{z3} = \rho_2 g V_3 = 5342.6 N$

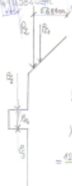
$x_{T3} = 0.9825 m$

Вертикална сила од флуид ρ_3

$V_4 = 0.393^2 = 0.154 m^3$

$P_{z4} = \rho_3 g V_4 = 1848 N$

$X_{T4} = 0.9825 m$



$P_Z = P_{Z1} + P_{Z2} - P_{Z3} + P_{Z4} = 2381 + 4763.6 - 5942.6 + 1848 = 3020 N$

$X_T = \frac{P_{Z1} X_{T1} + P_{Z2} X_{T2} - P_{Z3} X_{T3} + P_{Z4} X_{T4}}{P_Z} =$

$= \frac{1247.644 + 4680.1 - 5838.6 + 1786.2}{3020} = 0.621 m$

2. Хоризонтални сили

$\Omega x_1 = \frac{\frac{P_0}{\rho g} + (\Pi_1 - Z_N)}{2} = \frac{1.966 + 1.965}{2} \cdot 1.931 m^2$

$Z_{T1} = 1.179 + \frac{\Pi_1 - Z_N}{3} = 1.831 m$

$P_{x1} = \rho_1 g L \Omega x_1 = 14889.3 N$

$\Omega x_3 = \frac{\Pi_3^2}{2} = 2.78 m^2$

$Z_{T3} = \frac{\Pi_3}{3} = 0.786 m$

$P_{x3} = \rho_3 g L \Omega x_3 = 32726.16 N$

$\Omega x_2 = \frac{2.28 + 1.101}{2} \cdot 1.179 = 1.993 m^2$

$Z_{T2} = \frac{0.695 \cdot 0.5895 + 1.3 \cdot 0.393}{1.993} = 0.622 m$

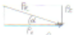
$P_{x2} = \rho_2 g L \Omega x_2 = 27317.8 N$

$P_X = P_{x1} + P_{x2} - P_{x3} = 9480.94 N$

$Z_T = \frac{P_{x1} Z_{T1} + P_{x2} Z_{T2} - P_{x3} Z_{T3}}{P_X} = \frac{27306.58 + 44860 - 25722.76}{9480.94}$

$Z_T = 1.67 m$

$R = \sqrt{P_z^2 + P_x^2} = \sqrt{3020^2 + 9480.94^2} = \sqrt{9120400 + 89888123.3} = 9950\ N$



$tg\alpha = \frac{P_z}{P_x}$

$\alpha = arctg \frac{P_z}{P_x} = arctg \frac{3020}{9481} = 17.6°$

P_x: $Z_x = 1.67 m$ $X_x = 0.786 m$

P_z: $Z_z = 2.688 m$ $X_z = 0.624 m$

$Z = \frac{Z_x P_x - Z_z P_z}{R_R} = \frac{15833.4 - 8117.76}{9950} = 2.054 m$

$X = \frac{X_x P_x - X_z P_z}{R_R} = \frac{5373.72 + 2887.66}{9950} = 0.830 m$

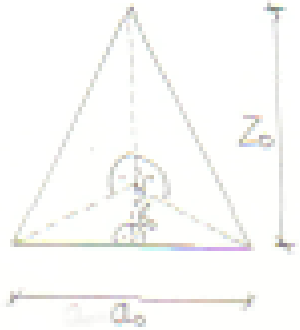
3. $N = \sum P_z = 2381 + 4763.6 - 5948.6 + 1818 = 3020\ N$

$T = \sum P_x = 9480.94\ N$

$M = P_{z_1} \cdot X_{T_1}' - P_{z_2} X_{T_2}' + P_{z_3} X_{T_3}' - P_{z_4} X_{T_4} + P_{x_2} \cdot Z_{T_2} + P_{x_4} \cdot Z_{T_2} - P_{x_3} Z_{T_3} =$

$= 392.9 - 93.6 + 1167.8 - 357 + 27306.9 + 14259.9 - 25722.76 = 16111\ Nm$

$= 16.1\ kNm$

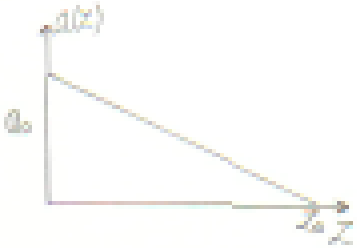


$$A_0 = \frac{a_0 b_0}{2}$$

$$A(z) = \frac{a(z) \cdot b(z)}{2}$$

$$dV = A(z)\,dz$$

$$V = \int_0^z A(z)\,dz$$



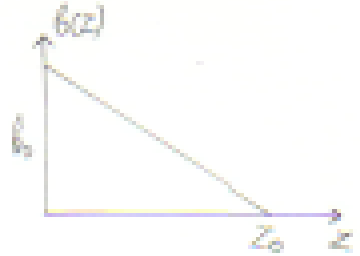
$a = a(z) \quad a \in (a_0, 0) \mid z \in (0, Z_0)$

$a(z) = kz + n$

$n = a_0$

$0 = kZ_0 + a_0 \quad a(z) = -\frac{a_0}{Z_0} z + a_0$

$k = -\frac{a_0}{Z_0}$



$b = b(z) \quad b \in (b_0, 0) \mid z \in (0, Z_0)$

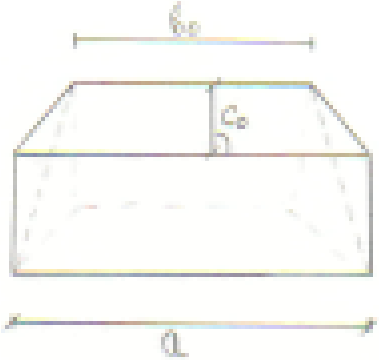
$b(z) = -\frac{b_0}{Z_0} z + b_0$

$$A(z) = \frac{1}{2} \cdot \left(-\frac{a_0}{Z_0} z + a_0\right)\left(-\frac{b_0}{Z_0} z + b_0\right) = \frac{1}{2}\left(\frac{a_0 b_0}{Z_0^2} z^2 - \frac{a_0 b_0}{Z_0} z - \frac{a_0 b_0}{Z_0} z + a_0 b_0\right) =$$

$$= \frac{1}{2}\left(\frac{a_0 b_0}{Z_0^2} z^2 - \frac{2 a_0 b_0}{Z_0} z + a_0 b_0\right) = \frac{1}{2} a_0 b_0 \left(\frac{z^2}{Z_0^2} - \frac{2z}{Z_0} + 1\right)$$

$$V = \int_0^{Z_0} \frac{1}{2} a_0 b_0 \left(\frac{z^2}{Z_0^2} - \frac{2z}{Z_0} + 1\right) = \frac{1}{2} a_0 b_0 \left(\frac{1}{Z_0^2} \cdot \frac{z^3}{3} - \frac{2}{Z_0} \cdot \frac{Z_0^2}{2} + Z_0\right) =$$

$$= \frac{1}{2} a_0 b_0 \left(\frac{Z_0}{3} - Z_0 + Z_0\right) = \boxed{\frac{1}{6} a_0 b_0 Z_0}$$

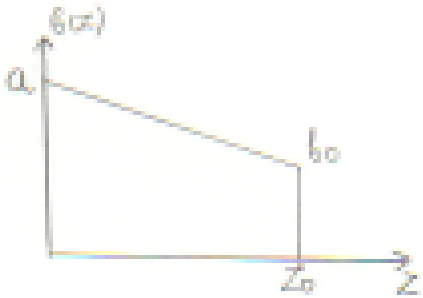


$A(z=z_0)=\frac{a+b_0}{2}\cdot c_0$

$A(z=0)=0$

$dV=A(z)dz \qquad A(z)=\frac{a+b(z)}{2}\cdot c(z)$

$V=\int_0^{z_0} A(z)dz$



$b=b(z) \quad b\in(a,b_0)\,|\,z\in(0,z_0)$

$b(z=0)=a$

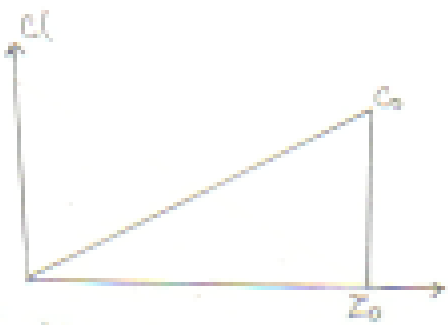
$b(z)=kz+m$

$m=a$

$b_0=kz_0+a \qquad b(z)=\frac{b_0-a}{z_0}z+a$

$kz_0=b_0-a$

$k=\frac{b_0-a}{z_0}$



$c=c(z) \quad c\in(0,c_0)\,|\,z\in(0,z_0)$

$c(z)=\frac{c_0}{z_0}z$

$A(z)=\frac{a+\frac{b_0-a}{z_0}z+a}{2}\cdot\frac{c_0}{z_0}z=\frac{2az_0+(b_0-a)z}{2z_0}\cdot\frac{c_0}{z_0}z=$

$=\frac{2az_0c_0z+c_0(b_0-a)z^2}{2z_0^2}=\frac{2az_0c_0z}{2z_0^2}+\frac{c_0(b_0-a)z^2}{2z_0^2}=\frac{ac_0}{z_0}z+\frac{c_0(b_0-a)}{2z_0^2}z^2$

$V=\int_0^{z_0}\left(\frac{ac_0}{z_0}z+\frac{c_0(b_0-a)}{2z_0^2}z^2\right)dz=\frac{ac_0}{z_0}\int_0^{z_0}z\,dz+\frac{c_0(b_0-a)}{2z_0^2}\int_0^{z_0}z^2dz=$

$=\frac{ac_0}{z_0}\cdot\frac{z_0^2}{2}+\frac{c_0(b_0-a)}{2z_0^2}\cdot\frac{z_0^3}{3}=\frac{ac_0z_0}{2}+\frac{c_0z_0(b_0-a)}{6}=\frac{ac_0z_0}{2}+\frac{b_0c_0z_0}{6}-\frac{ac_0z_0}{6}=$

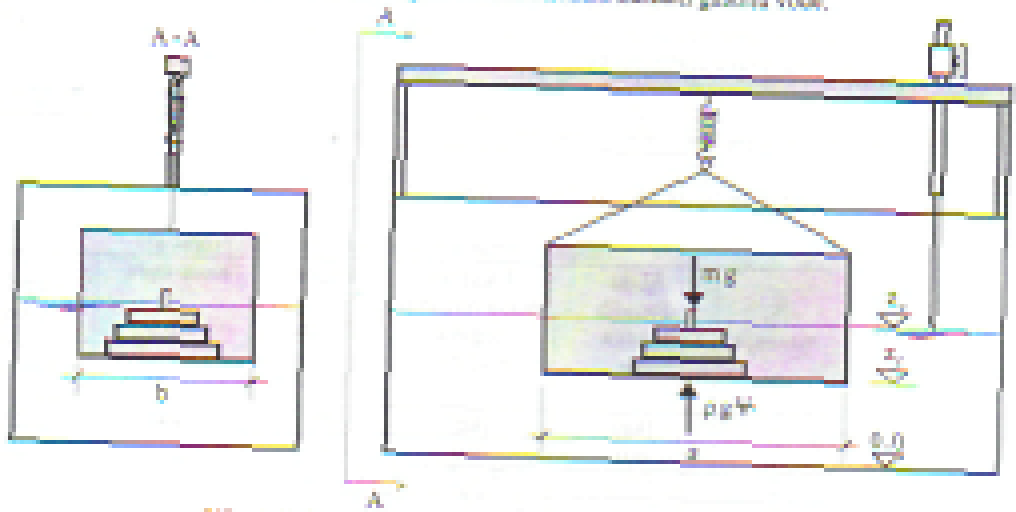
$=\frac{3ac_0z_0-ac_0z_0}{6}+\frac{b_0c_0z_0}{6}=\frac{2ac_0z_0}{6}+\frac{b_0c_0z_0}{6}=\boxed{\frac{1}{6}c_0z_0(2a+b_0)}$

Student: _____

MEHANIKA FLUIDA ..... HIDROSTATIKA

Laboratorijska vežba 1

ZADATAK: Merenjem sile uzgona na figuru u obliku kvadra odrediti gustinu vode.



Slika 1: Laboratorijska instalacija za određivanje gustine vode

Instalacija se sastoji od rezervoara, nosača, opruge i figure u obliku kvadra. Dok je rezervoar prazan okačiti figuru za za to predviđeno mesto. Pomoću nivoja podesiti položaj figure tako da joj se donja ivica dovede na unapred predviđeno mesto (vertikalno na zidu rezervoara). Pažljivo dodati vodu u rezervoar dok se nivo ne poklopi sa donjom ivicom figure (pri tome odstraniti gumirove vazdušne). Zatim pomoću merne igle odrediti kota donje ivice kota donje ivice $z_1 =$ _____ dm. Merenje sprovesti u više iteracija koje se sastoje iz sledećih koraka:

1. Dodavanjem tegova opteretiti figuru tako da sila teže prevazide silu uzgona. Primetiti da se figura pomerila iz prvobitnog položaja
2. Otvaranjem zatvarača dodati vodu u rezervoar i povećanjem sile uzgona vratiti figuru u prvobitni položaj
3. Merenom iglom odrediti kotu nivoa vode u rezervoaru z_2

Sila uzgona je jednaka vertikalnoj komponenti hidrostatičke sile, odnosno težini zapremine tečnosti koju istiskuje figura:

$$F_u = \rho g (z_1 - z_2) a \times b$$

Sa druge strane, ta sila je jednaka težini tegova kojima je opterećena figura:

$$F_t = mg$$

Izjednačavajući te dve sile, dobija se obrazac iz koga je moguće odrediti gustina vode:

$$\rho = \frac{m}{(z_1 - z_2) a \times b}$$

odnosno, napisano u obliku gde je gustina vode data kao razlika između zapremine i mase:

$$m = \rho (z_1 - z_2) a \times b$$

gde su: m- masa tegova dodatih u figuru da bi se vratio u početni položaj, g- ubrzanje zemljine teže, a,b- dimenzije figure, z_v- kota nivoa vode, z_f- kota donje ivice figure u početnom položaju, ρ- gustina vode.

Obzirom da se pri merenju javljaju slučajne greške, njihov uticaj je moguće smanjiti ponavljanjem merenja više puta (u našem slučaju 4-5 puta). Nakon svakog merenja rezultate upisati u za to predviđenu tabelu (Tabela 1) i ucrtati u za to predviđen dijagram. Gustina vode izračunati na osnovu nagiba prave koja se najbolje slaže sa dobijenim rezultatima (pravu ucrtati ručno).

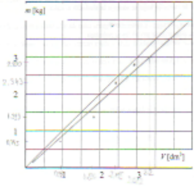
Dimenzije figure: $a=$ 2 dm, $b=$ 1.5 dm

Kota donje ivice figure $z_f=$ 0.762 dm

Tabela1: Izmerene vrednosti i rezultati proračuna

N. merenja	Masa dodatih tegova Δm	Ukupna masa dodatih tegova $m=\Sigma\Delta m$	Uzgon $P_z=mg$	Kota vode z_v	Zapremina zaronjenog dela $V=(z_v-z_f)ab$
	[kg]	[kg]	[N]	[dm]	[dm^3]
1	0.0	0.0	0.0	0.769	0.0
2	0.743	0.745	7.308	1.098	0.345
3	0.648	1.388	13.62	1.363	1.803
4	0.85	2.338	19.54	1.529	2.445
5	[illegible]	[illegible]	28.351	1.756	[illegible]

Očitana gustina vode sa dijagrama (nagib prave): $\rho=$ 0.969 kg/dm^3 [illegible]



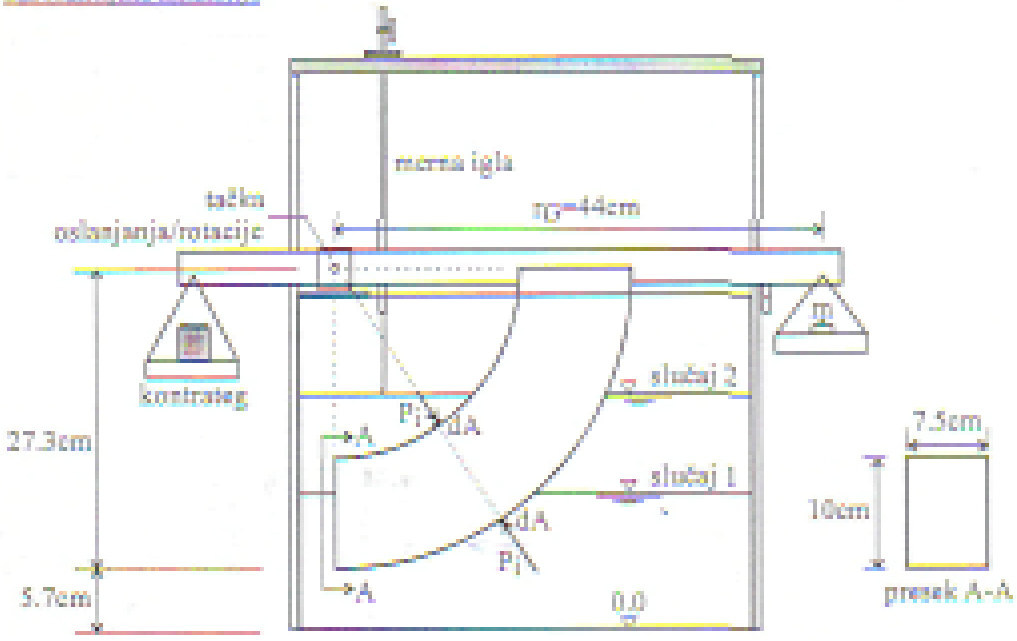
Student: _____

MEHANIKA FLUIDA.....HIDROSTATIKA

Laboratorijska vežba 2

ZADATAK: Određivanje hidrostatičke sile na potopljenu površinu i proračun momenata

Laboratorijska instalacija



Slika 1. Laboratorijska instalacija za određivanje hidrostatičke sile

Postupak izrade zadatka

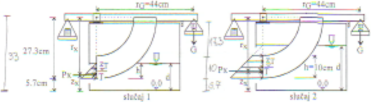
a) Pomoću tegova dovesti instalaciju u ravnotežni položaj (noseća greda je horizontalna i paralelna sa gornjom ivicom rezervoara), kada je nivo vode ispod donje ivice zakrivljenog elementa.
b) U korpu okačenu sa desne strane noseće grede staviti teg poznate težine, koji će stvoriti momenat oko tačke oslanjanja/rotacije grede.
c) Puniti rezervoar sa vodom sve dok se instalacija ne vrati u ravnotežni položaj. Tada je momenat od hidrostatičke sile na ravni kraj zakrivljenog elementa M_c jednak momentu od tega poznate težine M_G.
d) Pomoću merne igle odrediti kotu dna rezervoara z_d i kotu površine vode z. Dubina vode je razlika izmerenih kota.
e) Na osnovu izmerene dubine izračunati intenzitet i mesto delovanja hidrostatičke sile na ravni kraj zakrivljenog elementa. Pri proračunu voditi računa o položaju pijezometarske kote u odnosu na elemenat (slika 2).
f) Izračunati momente koje stvaraju teg poznate težine i hidrostatička sila oko tačke oslanjanja/rotacije noseće grede.
g) Izračunati relativnu grešku merenja momenta.
h) Postupak b) – f) ponoviti za 6 zadatih težina.
i) Na priloženom dijagramu nacrtati zavisnost stvarne i računske hidrostatičke sile i prokomentarisati rezultate.

Proračun

Kota dna rezervoara: z_0 = 3.16 cm

Dubina vode: $d = z - z_0$

Sila težine: $G = m \cdot g$



Relativna greška merenja momenta: $\varepsilon = \frac{M_x - M_G}{M_G} \cdot 100$

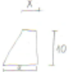
$\Omega x = \frac{h^2}{2}$

Slika 2. Mogući slučajevi raspodele pritiska u zavisnosti od dubine vode

Tabela 1. Izmerene vrednosti i rezultati proračuna

h_{T} (cm)	R.br.	m [gr]	Ω [cm²]	d [cm]	h [cm]	Px [N]	r_x [cm]	Mx [N cm]	G [N]	M_G [N cm]	ε [%]
3.94	1	50	13.69	10.51	4.84	0.834	15.4	[illegible]	0.4905	21.582	1.39
3.96	2	80	14.8	11.64	5.84	1.298	16.52	32.84	0.7848	34.5312	4.8
5.6	3	150	43.5	16.09	8.39	2.59	24.51	63.47	1.4715	64.746	1.97
6.46	4	300	91.05	17.829	10	5.29	23.46	124.103	2.943	129.492	4.1
5.98	5	350	102.38	18.12	10	6.17	23.82	145.97	3.4335	151.074	3.4
5.85	6	400	93.85	20.43	10	7.05	23.153	166.44	3.924	172.656	3.5

A=[illegible] L=7.5cm



$x = d - 5.7 - 10$

$y = d - 5.7$

$h_T = \frac{50x + 333.5}{10x + 50}$

$P = \frac{x+y}{2} \cdot 10$

	x	y
[illegible]	2.19	12.49
[illegible]	5.52	15.52
[illegible]	4.79	14.79