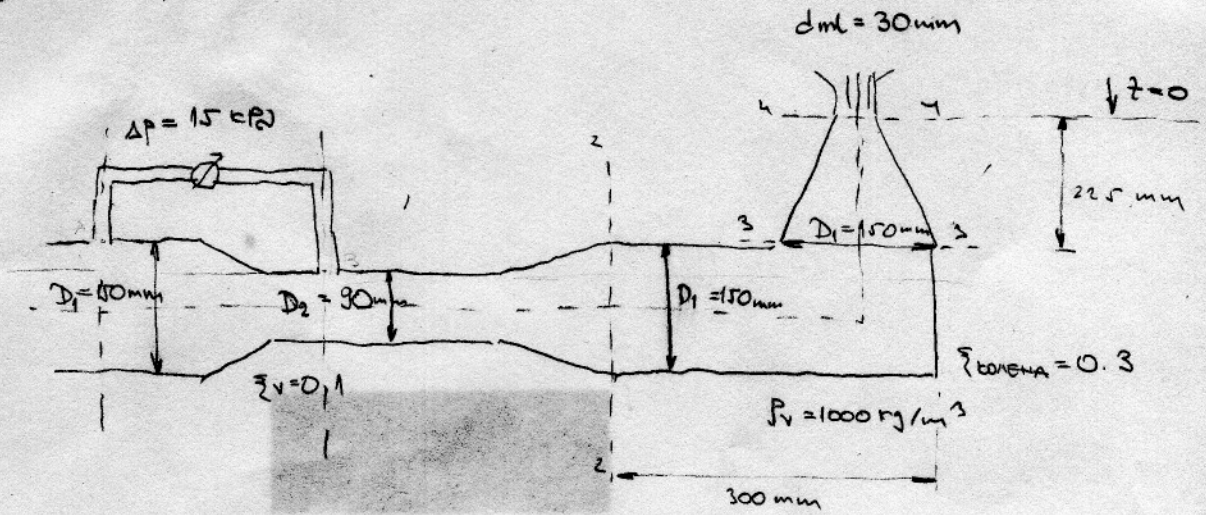


1.

$$G_c = 300 \text{ N/m}$$



0) $\Delta P = 15 \text{ kPa}$
 $Q = ?$

$$E_A = E_B + E_{A-B}$$

$$P_A + \frac{\rho v_1^2}{2g} = P_B + \frac{\rho v_2^2}{2g} + \zeta v \cdot \frac{\rho v_2^2}{2g}$$

$$Q_1 = Q_2$$

$$V_1 \cdot A_1 = V_2 \cdot A_2$$

$$V_1 \cdot \frac{D_1^2}{4} = V_2 \cdot \frac{D_2^2}{4}$$

$$V_1 \cdot 22500 = V_2 \cdot 8100$$

$$V_1 = V_2 \cdot 0,36 \checkmark$$

$$P_A - P_B = \frac{\rho v_2^2}{2g} (1 + \zeta v) - \frac{\rho v_1^2}{2g}$$

$$\frac{P_A}{\rho \cdot g} + z - \frac{P_B}{\rho \cdot g} - z = \frac{\rho v_2^2}{2g} (1 + \zeta v) - \frac{(0,36 \cdot v_2)^2}{2g}$$

$$\frac{P_A - P_B}{\rho \cdot g} = \frac{\rho v_2^2}{2g} (1 + \zeta v - 0,1296)$$

$$\frac{\Delta P}{\rho} = \frac{\rho v_2^2}{2} (1 + 0,1 - 0,1296)$$

$$v_2^2 = \frac{\Delta P}{\rho \cdot 0,4852} = \frac{15 \cdot 10^3}{1000 \cdot 0,4852} = 30,9151$$

$$v_2 = 5,56 \frac{\text{m}}{\text{s}} \checkmark$$

$$v_1 = 2,002 \frac{\text{m}}{\text{s}} \checkmark$$

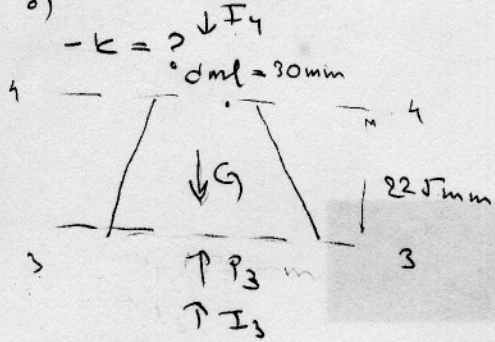
①

a) $Q = A_1 \cdot V_1$

$$Q = \frac{D_1^2 \cdot \bar{u}}{4} \cdot 2,002 = 0,03538 \text{ m}^3/\text{s}$$

$$Q = 35,38 \text{ L/s} \checkmark$$

b)



$$-\vec{k} = \vec{I}_3 + \vec{P}_3 + \vec{I}_4 + \vec{G}$$

$$P_3 = \rho \cdot g \cdot A_3 \cdot z_3$$

$$\vec{I}_3 = \rho \cdot Q \cdot \vec{V}_1$$

$$\vec{I}_4 = \rho \cdot Q \cdot \vec{V}_2$$

$$V_3 = V_2 = 2,002 \text{ m/s}$$

$$E_3 = E_4 + \Delta E_{3-4}$$

$$\rho_3 + \frac{V_3^2}{2g} = \rho_4 + \frac{V_4^2}{2g} + 0,05 \cdot \frac{V_4^2}{2g}$$

$$V_4 = \frac{Q}{A_4} = \frac{Q}{\frac{d^2 \bar{u}}{4}} = \frac{4 \cdot 0,03538}{2,827 \cdot 10^{-5}} = 50,06 \text{ m/s}$$

$$\rho_3 = \frac{V_4^2}{2g} + 0,05 \cdot \frac{V_4^2}{2g} - \frac{V_3^2}{2g} = \frac{50,06^2}{2 \cdot 9,81} + 0,05 \cdot \frac{50,06^2}{2 \cdot 9,81} - \frac{2,002^2}{2 \cdot 9,81}$$

$$\rho_3 = 134,1133 - 0,2043$$

$$\rho_3 = 133,909 \text{ m} \checkmark$$

$$P_3 = \rho g (\rho_3 - z_3) = \rho \cdot g (133,909 + 0,225) = 1315,855 \text{ kPa} = 1,3 \text{ MPa}$$

$$P_3 = \rho_3 \cdot A_3 = 1315,855 \cdot \frac{0,15^2 \cdot \bar{u}}{4} = 23,253 \text{ kN} \checkmark$$

$$\vec{I}_3 = \rho \cdot Q \cdot \vec{V}_3 = 1000 \cdot 0,03538 \cdot 2,002 = 70,831 \text{ N} = 0,071 \text{ kN} \checkmark$$

$$\vec{I}_4 = \rho \cdot Q \cdot \vec{V}_4 = 1000 \cdot 0,03538 \cdot 50,06 = 1771,122 \text{ N} = 1,771 \text{ kN} \checkmark$$

$$G = \rho g V \quad V = \frac{\pi}{3} (B_1 + \sqrt{B_1 \cdot B_2} + B_2) = \frac{0,225}{3} (0,018 + \sqrt{0,018 \cdot 0,10} + 0,10)$$

$$G = 1000 \cdot 9,81 \cdot 1,67 \cdot 10^{-3}$$

$$V = 0,075 \cdot 0,022 = 1,67 \cdot 10^{-3} \text{ m}^3$$

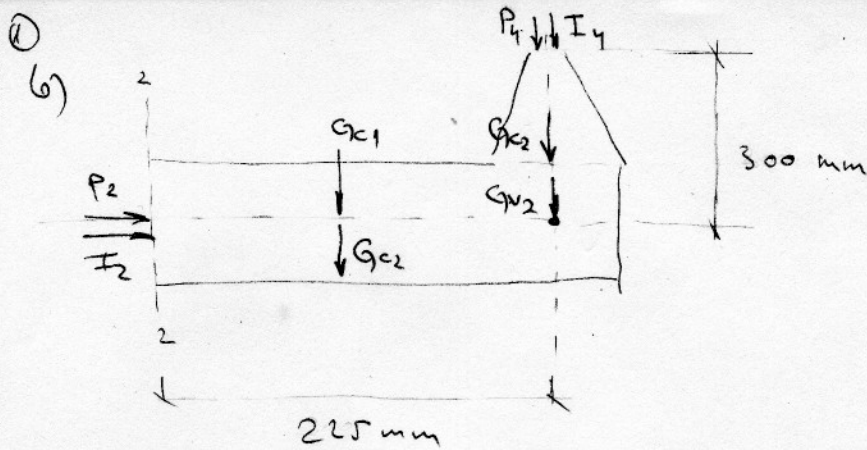
$$G = 16,388 \text{ N} = 0,0164 \text{ kN} \checkmark$$

$$-\vec{k} = \vec{I}_3 + \vec{P}_3 + \vec{I}_4 + \vec{G} = 0,071 + 23,253 - 1,771 - 0,0164 \text{ kN}$$

$$-\vec{k} = 21,5366 \text{ kN} \checkmark$$

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$$E_2 = E_3 + \Delta E_{2-3}$$

$$P_2 + \frac{V_2^2}{2g} = P_3 + \frac{V_3^2}{2g} + 0,3 \cdot \frac{V_3^2}{2g} \quad V_2 = V_3$$

$$P_2 = P_3 + 0,3 \cdot \frac{V_3^2}{2g}$$

$$P_2 = 133,909 + 0,3 \cdot \frac{2,002^2}{2 \cdot 9,81} = 133,970 \text{ m} \checkmark$$

$$P_2 = \rho \cdot g (P_2 - \frac{I_2}{g}) = 1000 \cdot 9,81 \cdot (133,970 + 0,13) =$$

$$P_2 = 1317,19 \text{ kPa} = 1,32 \text{ MPa} \quad P_2 = p_{t2} \cdot A_2 = 1317,19 \cdot \frac{0,15^2 \cdot \pi}{4}$$

$$I_2 = \rho \cdot Q \cdot V_2 = 1000 \cdot 0,03538 \cdot 2,002 = 70,831 \text{ kN} = 0,071 \text{ kN} \checkmark$$

$$P_4 = 0 \quad I_4 = 1,771 \text{ kN} \checkmark$$

$$G_{c1} = L_1 \cdot g_c = 0,225 \cdot 300 = 67,5 \text{ N} \checkmark$$

$$G_{c2} = L_2 \cdot g_c = 0,13 \cdot 300 = 39 \text{ N} \checkmark$$

$$G_{v1} = \rho \cdot g \cdot V_1 = 1000 \cdot 9,81 \cdot 0,225 \cdot \frac{0,15^2 \pi}{4} = 39,005 \text{ N} \checkmark$$

$$G_{v2} = \rho \cdot g \cdot V_2 = 1000 \cdot 9,81 \cdot 0,13 \cdot \frac{0,15^2 \pi}{4} = 52,007 \text{ N} \checkmark$$

$$N = P_2 + I_2 = 23,348 \text{ kN} \checkmark$$

$$T = G_{c1} + G_{c2} + G_{v1} + G_{v2} + I_4 + P_4 = 2019,634 \text{ N} \checkmark$$

$$M = (G_{c1} + G_{v1}) \cdot \frac{0,225}{2} + (G_{c2} + G_{v2} + I_4) \cdot 0,225 =$$

$$= 11,92 + 430,454 = 442,37 \text{ N} \checkmark$$

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Σ 100