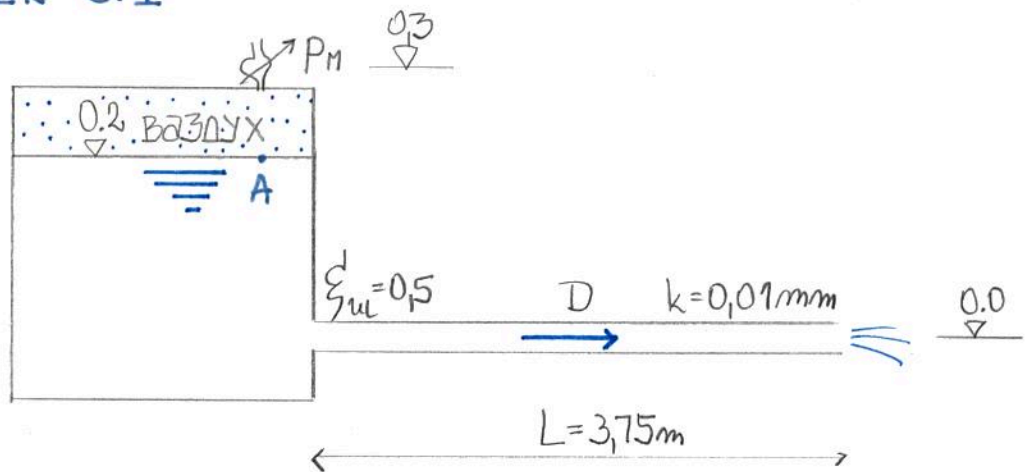


Задаток 02 - среда

Задаток 8.1



$$\rho = 1 \text{ kg/dm}^3 = 1000 \text{ kg/m}^3 \quad \nu = 10^{-6} \text{ m}^2/\text{s} \quad D = 3 + \frac{5}{10} = 3.5 \text{ mm}$$

а) $P_M^{\max} = ?$ $Q = ?$ УСЛОВ: Течение у цели ЛАМИНАРНО
 $Re_{\text{CRIT}} = 2500$

$$Re_{\text{CRIT}} = \frac{v_{\text{CRIT}} \cdot D}{\nu}$$

$$v_{\text{CRIT}} = \frac{\nu Re_{\text{CRIT}}}{D}$$

$$v_{\text{CRIT}} = \frac{10^{-6} \text{ m}^2/\text{s} \cdot 2500}{3.5 \cdot 10^{-3} \text{ m}} = \underline{\underline{0.714 \text{ m/s}}}$$

$$P_A = \cancel{P_{12L}}^{Z_{12L}=0} + \frac{v_{\text{CRIT}}^2}{2g} + \lambda \frac{L}{D} \frac{v_{\text{CRIT}}^2}{2g} + \xi_{wl} \frac{v_{\text{CRIT}}^2}{2g}$$

$\lambda = ?$

λ -одређујемо из услова да је течење у цеви ламинарно

$$\lambda = \frac{64}{Re} = \frac{64}{2500}$$

$$\lambda = 0,0256$$

$$P_A = 0 + \frac{(0,714 \text{ m/s})^2}{2 \cdot 9,81 \text{ m/s}^2} + 0,0256 \cdot \frac{(0,714 \text{ m/s})^2}{2 \cdot 9,81 \text{ m/s}^2} + 0,5 \cdot \frac{(0,714 \text{ m/s})^2}{2 \cdot 9,81 \text{ m/s}^2}$$

$$\underline{\underline{P_A = 0,752 \text{ m}}}$$

$$p_A = \rho g (P_A - \underset{0,2 \text{ m}}{z_A}) = 1000 \text{ kg/m}^3 \cdot 9,81 \text{ m/s}^2 (0,752 - 0,2) \text{ m}$$

$$\underline{\underline{p_A = 5417,74 \text{ Pa} = 5,42 \text{ kPa}}}$$

$$Q = v_{\text{срн}} \cdot A = 0,714 \text{ m/s} \cdot \frac{(3,5 \times 10^{-3} \text{ m})^2 \cdot \pi}{4}$$

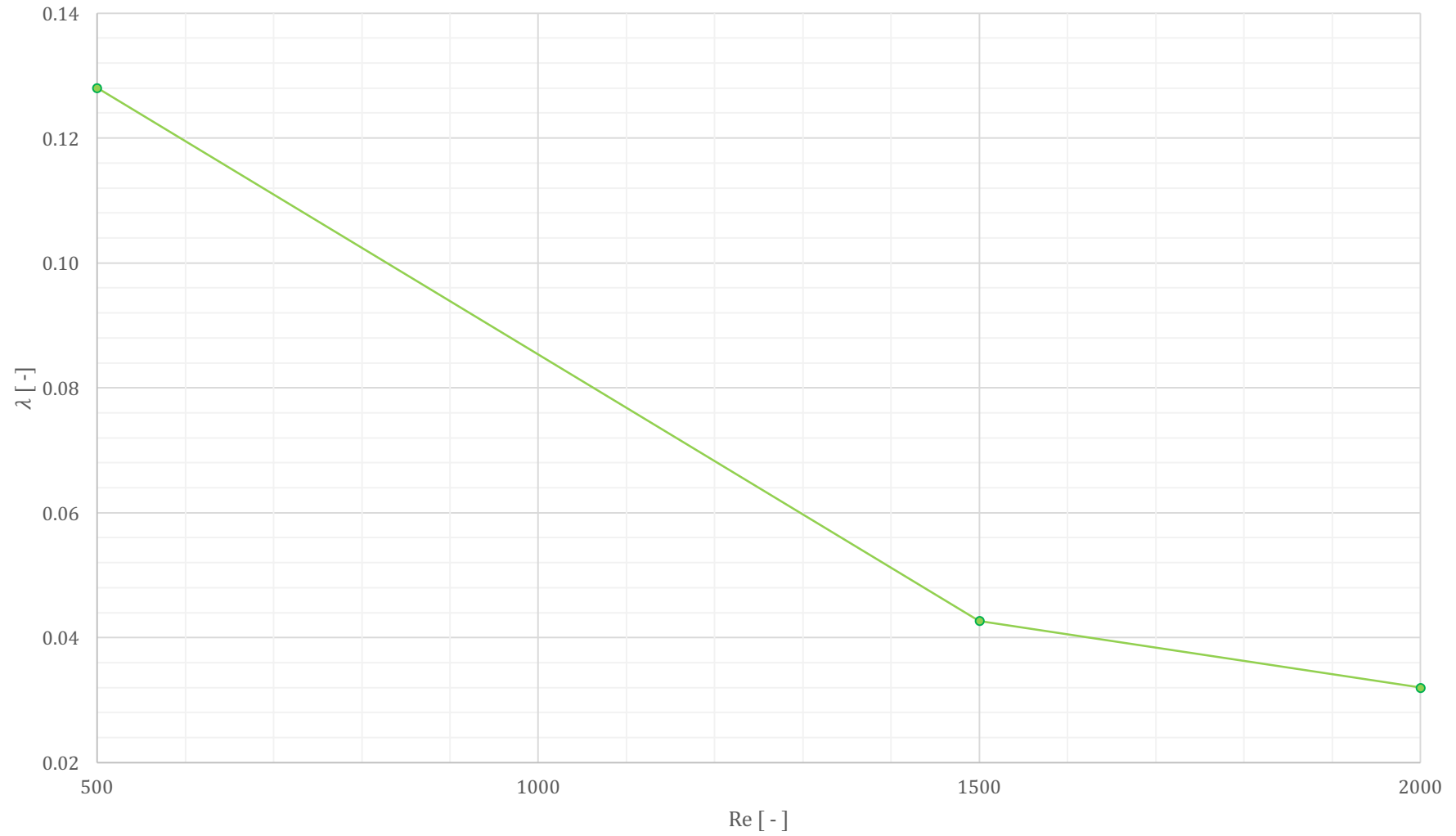
$$\underline{\underline{Q = 0,0069 \text{ L/s}}}$$

c) Зависност коефицијента линијског губитка, λ , од REYNOLDS-ОВОГ БРОЈА

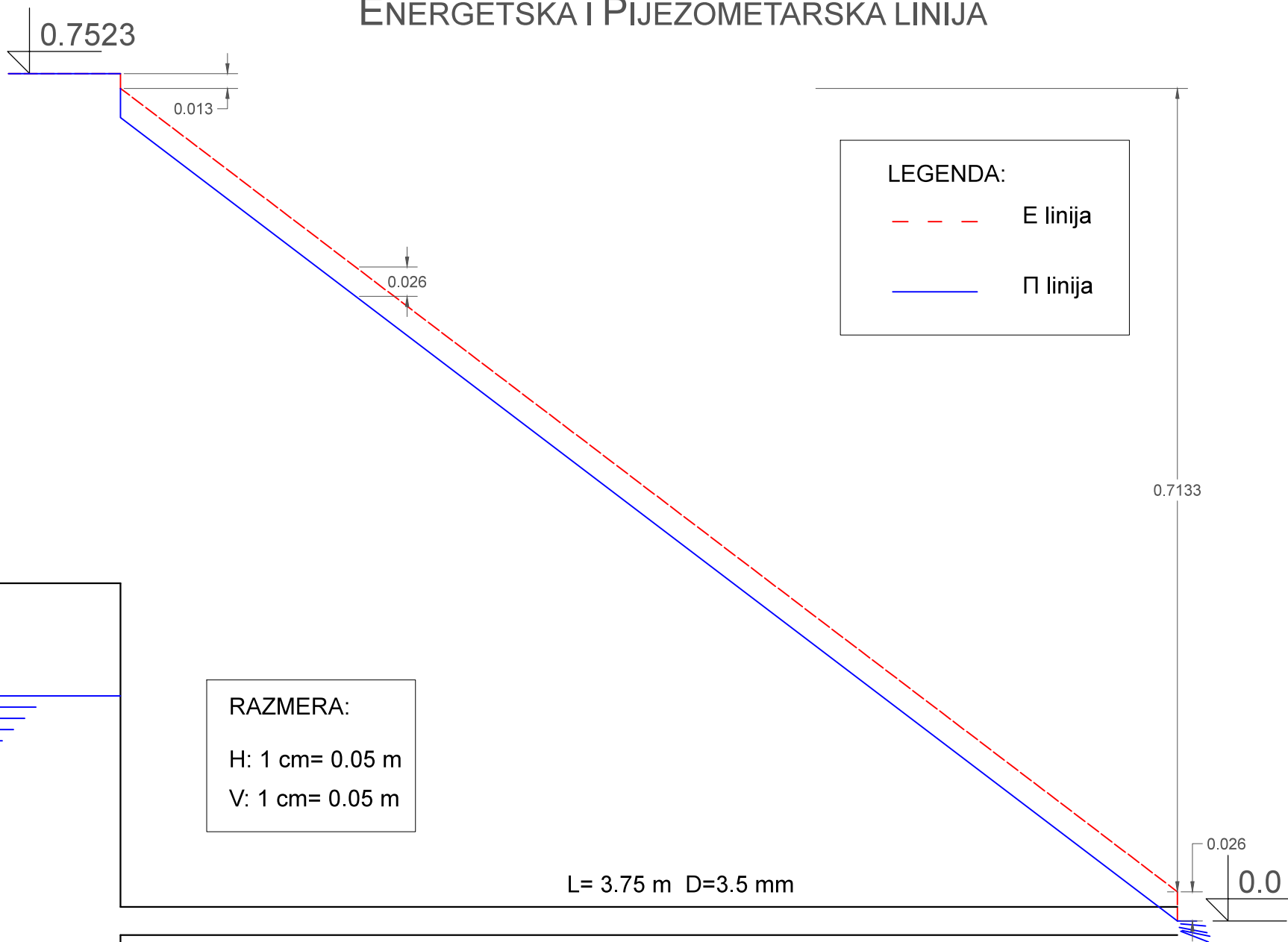
Re	λ
500	0,128
1500	0,043
2000	0,032

$$\lambda = \frac{64}{Re}$$

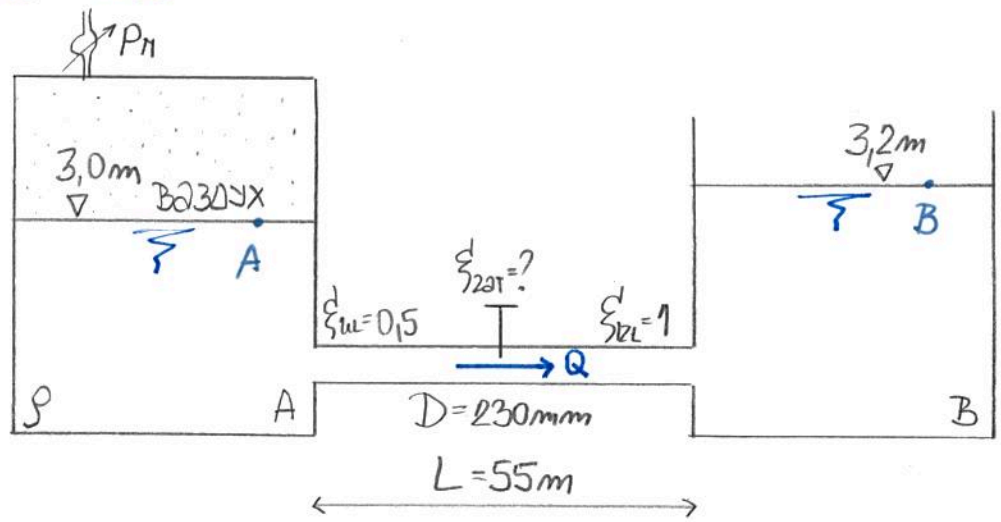
ZAVISNOST KOEFICIJENTA LINIJSKOG GUBITKA OD REYNOLDSOVOG BROJA



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Задаток 8.2



$$L = 50 + 5 \text{ m} = 55 \text{ m} \quad D = 200 + 30 = 230 \text{ mm}$$

$$Q = 3.5 \frac{\text{л}}{\text{с}} = 15 \frac{\text{л}}{\text{с}} = 0.015 \frac{\text{м}^3}{\text{с}} \quad Z_A = 3.0 \text{ m}$$

$$p_H = 0.12 + \frac{5}{20} = 0.37 \text{ бара} = 37 \times 10^3 \text{ Па}$$

$$Z_B = 3.2 \text{ m} \quad k = \frac{1}{5} = 0.2 \text{ mm}$$

а) $\xi_{220T} = ?$ ГИДРАВЛИЧКИ ГЛАТКА ЦЕВ $\lambda = \lambda(Re)$

$$\lambda = 0.115 \left(\frac{60}{Re} \right)^{1/4}$$

ЗА ПРОРАЧУН λ
МОГУЋЕ КОРИСТИТИ
И ДРУГЕ ФОРМУЛЕ
КНИГА СТР. 237-239.

$$Re = ? \quad Re = \frac{vD}{\nu}$$

$$v = ? \quad v = \frac{Q}{A} = \frac{0.015 \frac{\text{м}^3}{\text{с}}}{\frac{0.23^2 \pi \text{ м}^2}{4}} \Rightarrow \underline{\underline{v = 0.361 \frac{\text{м}}{\text{с}}}}$$

$$Re = \frac{0.361 \frac{\text{м}}{\text{с}} \cdot 0.23 \text{ м}}{10^{-6} \frac{\text{м}^2}{\text{с}}} = 83\,037.36$$

В) $\sum_{2\alpha T} = ?$ ГИДРАВЛИЧКИ ХРАТЪВЪ ЦЕВ $\lambda = \lambda(k/D)$

$$\lambda = 0,115 \left(\frac{k}{D} \right)^{1/4}$$

$$\lambda = 0,115 \left(\frac{0,2}{230} \right)^{1/4}$$

$$\underline{\underline{\lambda = 0,02}}$$

$$\begin{aligned} \Pi_a = & \underbrace{\sum_{\mu} \frac{v^2}{2g}}_{3,321 \times 10^{-3}} + \lambda \underbrace{\frac{L/2}{D} \cdot \frac{v^2}{2g}}_{0,0159} + \underbrace{\sum_{2\alpha T} \frac{v^2}{2g}}_{3,528} + \\ & + \lambda \underbrace{\frac{L/2}{D} \cdot \frac{v^2}{2g}}_{0,0159} + \underbrace{\sum_{12L} \frac{v^2}{2g}}_{6,642 \times 10^{-3}} + \Pi_B \end{aligned}$$

$$\begin{aligned} 6,77 = 3,2 + \frac{0,361^2}{19,62} \left(0,5 + 0,02 \cdot \frac{27,5}{0,23} + \sum_{2\alpha T} + \right. \\ \left. + 0,02 \frac{27,5}{0,23} + 1 \right) \end{aligned}$$

$$\sum_{2\alpha T} = 531,19$$

$$\lambda = 0,115 \left(\frac{60}{83037} \right)^{1/4}$$

$$\underline{\underline{\lambda = 0,019}}$$

ЕНЕРГЕТСКА ЈЕДНАЧИНА А-В

$$P_A = \underbrace{\sum_{\text{ш}} \frac{v^2}{2g}}_{3,32 \times 10^{-3}} + \lambda \underbrace{\frac{L/2}{D} \cdot \frac{v^2}{2g}}_{0,0151} + \underbrace{\sum_{2\alpha\Gamma} \frac{v^2}{2g}}_{3,53}$$

$$+ \lambda \underbrace{\frac{L/2}{D} \cdot \frac{v^2}{2g}}_{0,0151} + \underbrace{\sum_{12L} \frac{v^2}{2g}}_{6,642 \times 10^{-3}} + P_B$$

$$P_A = ?$$

$$p_A = \rho g (P_A - Z_A) \Rightarrow P_A = \frac{p_A}{\rho g} + Z_A = \frac{37 \times 10^3}{1000 \cdot 9,81} + 3$$

$$P_A = 6,77 \text{ м}$$

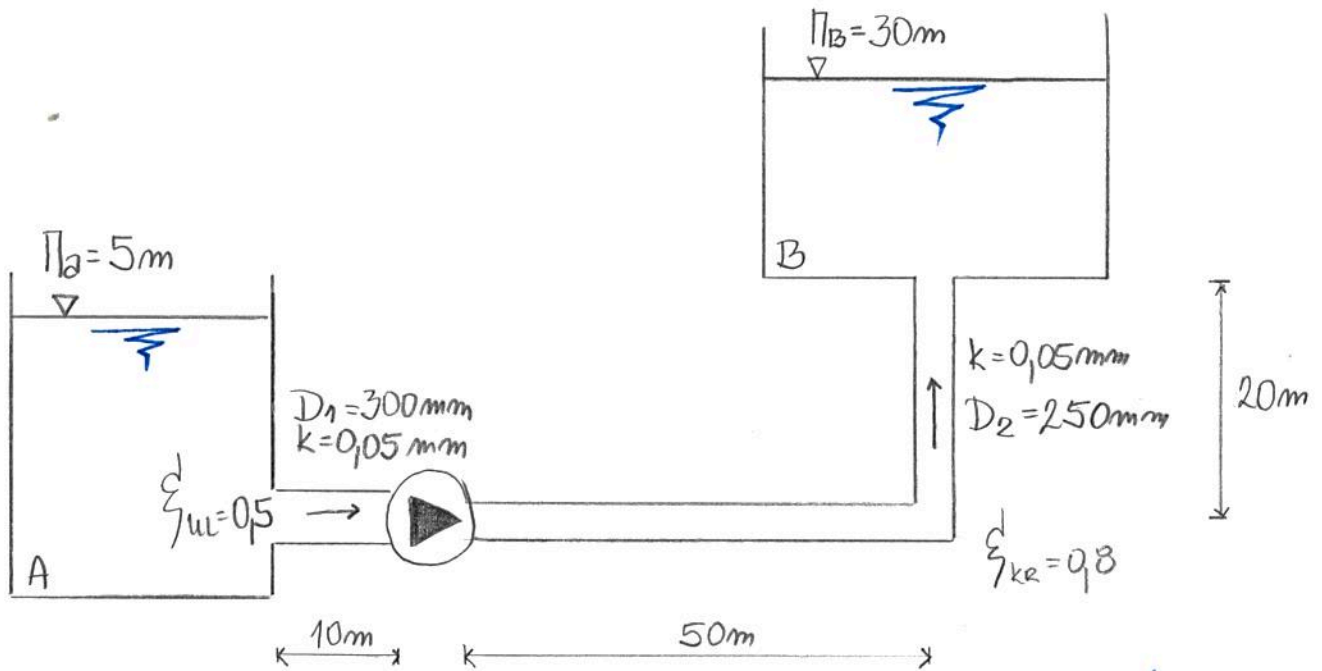
P_B - СЛОБОДНА ПОВРШИНА

$$P_B = Z_B = 3,2 \text{ м}$$

$$6,77 = 3,2 + \frac{0,361^2}{19,62} \left(0,5 + 0,019 \cdot \frac{27,5}{0,23} + \sum_{2\alpha\Gamma} + 0,019 \frac{27,5}{0,23} + 1 \right)$$

$$\sum_{2\alpha\Gamma} = 531,42$$

Задатак 8.3



$$D_1 = 300 \text{ mm} \quad D_2 = 250 \text{ mm} \quad L_1 = 10 \text{ m} \quad L_2 = 50 \text{ m} \quad L_3 = 20 \text{ m}$$

$$k = 0.05 \text{ mm} \quad \Pi_A = 5 \text{ m} \quad \Pi_B = 30 \text{ m} \quad H_p = 30 \text{ m}$$

ОДРЕДИТИ ПРОТОК УЗ ПРЕТПОСТАВКУ ДА ЈЕ ОСТВАРЕНО ТЕЧЕЊЕ У ЦЕВИ ТЕЧЕЊЕ У ХИДРАВЛИЧКИ ХРПАВОЈ ЦЕВИ.

$$\lambda = 0.115 \left(\frac{k}{D} \right)^{1/4}$$

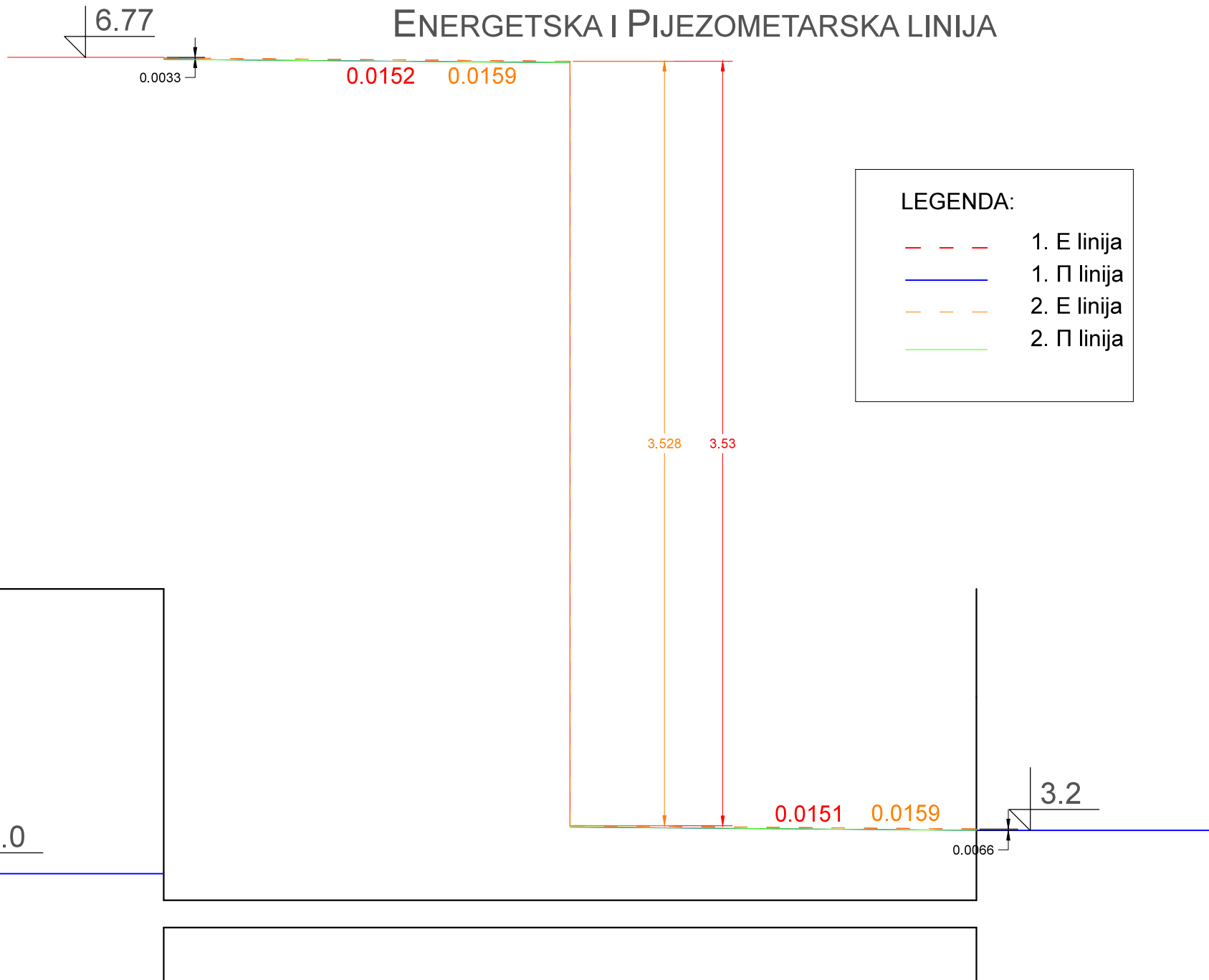
$$\lambda_1 = 0.115 \left(\frac{0.05}{300} \right)^{1/4}$$

$$\underline{\underline{\lambda_1 = 0.013}}$$

$$\lambda_2 = 0.115 \left(\frac{0.05}{250} \right)^{1/4}$$

$$\underline{\underline{\lambda_2 = 0.014}}$$

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ЕНЕРГЕТСКА ЈЕДНАЧИНА Д-В

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

$$\begin{aligned} \Pi_A = \Pi_B + \sum_{\text{ш}}^d \frac{v_1^2}{2g} + \lambda_1 \frac{L_1}{D_1} \cdot \frac{v_1^2}{2g} - H_p + \lambda_2 \frac{L_2}{D_2} \frac{v_2^2}{2g} + \\ + \sum_{\text{кр}}^d \frac{v_2^2}{2g} + \lambda_2 \cdot \frac{L_3}{D_2} \cdot \frac{v_2^2}{2g} + \sum_{\text{изл}}^d \frac{v_2^2}{2g} \end{aligned}$$

$$v_1 v_2 = ?$$

$$v_1 = \frac{Q}{A_1} = \frac{Q}{\frac{D_1^2 \pi}{4}} = \frac{Q}{0,0707 \text{ m}^2}$$

$$v_2 = \frac{Q}{A_2} = \frac{Q}{\frac{D_2^2 \pi}{4}} = \frac{Q}{0,0491 \text{ m}^2}$$

$$\begin{aligned} \Pi_A = \Pi_B + \sum_{\text{ш}}^d \frac{Q^2}{A_1^2 \cdot 2g} + \lambda_1 \frac{L_1}{D_1} \frac{Q^2}{A_1^2 \cdot 2g} - H_p + \lambda_2 \frac{L_2}{D_2} \frac{Q^2}{A_2^2 \cdot 2g} + \\ + \sum_{\text{кр}}^d \frac{Q^2}{A_2^2 \cdot 2g} + \lambda_2 \frac{L_3}{D_2} \cdot \frac{Q^2}{A_2^2 \cdot 2g} + \sum_{\text{изл}}^d \frac{Q^2}{A_2^2 \cdot 2g} \end{aligned}$$

$$5 = \cancel{30} + 95 \cdot \frac{Q^2}{0,098} + 0,013 \cdot \frac{10}{0,3} \frac{Q^2}{0,098} - \cancel{30} +$$

$$+ 0,014 \cdot \frac{50}{0,25} \cdot \frac{Q^2}{0,0473} + 0,8 \cdot \frac{Q^2}{0,0473} +$$

$$+ 0,014 \cdot \frac{20}{0,25} \cdot \frac{Q^2}{0,0473} + 1 \cdot \frac{Q^2}{0,0473}$$

$$5 = 5,102 Q^2 + 4,422 Q^2 + 59,197 Q^2 + \\ + 16,913 Q^2 + 23,679 Q^2 + 21,142 Q^2$$

$$5 = 130,455 Q^2$$

$$\underline{Q = 0,196 \frac{m^3}{s} = 195,774 \frac{l}{s}}$$

Провера режима течења

$$Re_1 = \frac{v_1 D_1}{\nu} = \frac{Q \cdot D_1}{\nu A_1} = \frac{0,196 \cdot 0,3 \frac{m^3}{s}}{10^{-6} \cdot 0,0707 \frac{m^4}{s}}$$

$$Re_1 = 830\,723,5$$

КЉИГА СТР. 236 - СЛИКА 6.13 (ЗАВИСНОСТ
ДАРСИЗЕВОГ КОЕФИЦИЈЕНТА ТРЕЊА ОД РЕЖНО-
ЛДСОВОГ БРОЈА

→ ПРЕЛАЗ ИЗ ХИДРАВЛИЧКИ ГЛАТКЕ У ХРАПАВУ
ЦЕВ - ОБЛАСТ IV

$$Re_2 = \frac{v_2 D_2}{\nu} = \frac{Q D_2}{\nu A_2} = \frac{0,196 \cdot 0,25 \frac{m^3}{s}}{10^{-6} \cdot 0,0491 \frac{m^4}{s}}$$

$$Re_2 = 996\,609$$

→ ПРЕЛАЗ ИЗ ХИДРАВЛИЧКИ ГЛАТКЕ У ХРАПАВУ
ЦЕВ - ОБЛАСТ IV

$$\lambda = \lambda \left(Re, \frac{k}{D} \right)$$

$$\lambda = 0,115 \left(\frac{k}{D} + \frac{60}{Re} \right)^{1/4}$$

$$\lambda_1 = 0,115 \left(\frac{0,05}{300} + \frac{60}{830\,123,5} \right)^{0,25} \quad \lambda_1 = 0,0143$$

$$\lambda_2 = 0,115 \left(\frac{0,05}{250} + \frac{60}{996\,609} \right)^{0,25} \quad \lambda_2 = 0,0145$$

$$\frac{v_1^2}{2g} = 0,391$$

$$\frac{v_2^2}{2g} = 0,81$$

A-B

$$5 = 30 + 0,5 \cdot 0,391 + 0,0143 \cdot \frac{10}{0,3} \cdot 0,391 - 30 + 0,0145 \cdot \frac{50}{0,25} \cdot 0,81 + 0,8 \cdot 0,81 + 0,0145 \cdot \frac{20}{0,25} \cdot 0,81 + 0,81$$

$$5 = 30 + 0,1955 + 0,186 - 30 + 2,349 + 0,648 + 0,9396 + 0,81$$

ENERGETSKA I PIJEZOMETARSKA LINIJA

LEGENDA:

--- E linija

— П linija

