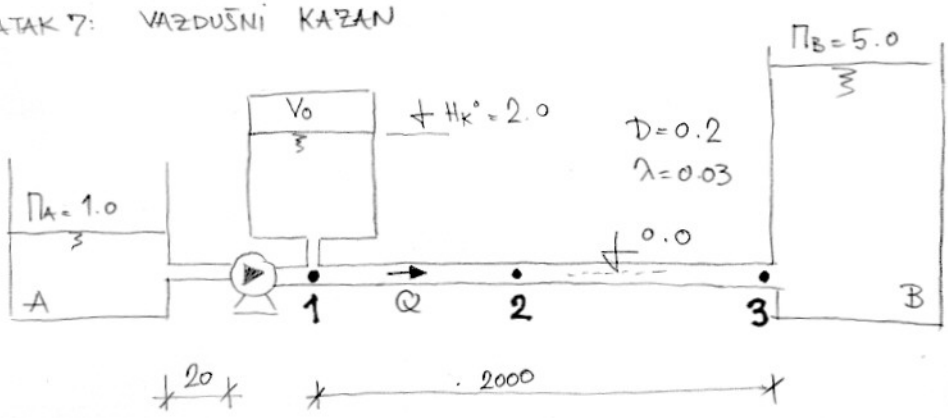
ZADATAK 7: VAZDUŠNI KAZAN



$Q_0 = 5\beta$ l/sec

izabrano $\beta = 11,6$

$Q_0 = 58$ l/sec

$V_0 = 0.2\ m^3$

$D_K = 1$ m (KAZAN)

$D_p = 0.05$ m (PRIGUŠIVAČ)

$\xi_p = 1,5$ $\left(\xi_p \cdot \frac{V_p^2}{2g}\right)$

MATEMATIČKI MODEL: HIDRAULIČKI UDAR

⊛ POTREBNO JE OPISATI SVAKI OD DELOVA SISTEMA:

A) CEV 1-2-3 tačka 2 je na polovini cevi

1) JEDNAČINA KONTINUITETA: $\frac{\partial \Pi}{\partial t} + \frac{a^2}{g}\frac{\partial V}{\partial x} = 0$

2) DINAMIČKA JEDNAČINA: $\frac{\partial V}{\partial t} + g\cdot\frac{\partial \Pi}{\partial x} + \frac{\lambda}{2D} V|V| = 0$

} SISTEM OD 2 PARCIJALNE DIFERENCIJALNE JEDNAČINE

STR. 128 - RAČUNSKA HIDRAULIKA, TEČENJE U CEVIMA - M. IVETIĆ

(POGLEDATI KAKO SE SISTEM 2 PARC. DIF. J. ZAMENJUJE SISTEMOM OD 4 OBIČNE DIF. JEDN.)

AKO SE OVAJ SISTEM REŠAVA METODOM KARAKTERISTIKA, ONDA JEDNAČINE IZGLEDAJU:

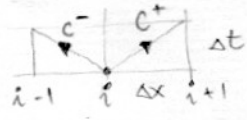
C^+: ① $\frac{g}{A}\frac{d\Pi}{dt} + \frac{1}{A}\frac{dQ}{dt} + \frac{\lambda}{2DA^2} Q|Q| = 0$

② $\frac{dx}{dt} = a$

C^-: ③ $-\frac{g}{A}\frac{d\Pi}{dt} + \frac{1}{A}\frac{dQ}{dt} + \frac{\lambda}{2DA^2} Q|Q| = 0$

④ $\frac{dx}{dt} = -a$

⊛ iz SVAKE TAČKE (UNUTAR GRANICA, ZNAČI IZMEĐU 1 i 3) POLAZE 2 KARAKTERISTIKE. ZA 1 i 3 POTREBNO JE DEFINISATI GRANIČNE USLOVE

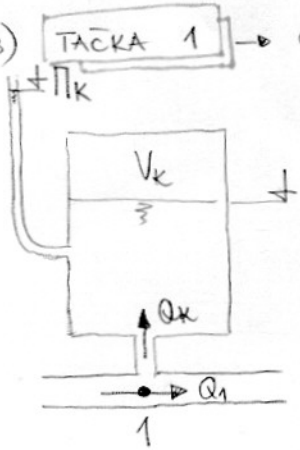


$g = 9,81\ m/sec^2$

A = površina poprečnog preseka cevi

D = prečnik cevi

B) TAČKA 1 → GRANIČNI USLOV: VAZDUŠNI KAZAN



NEKADA SE UMESTO VODOSTANA, ZA ZAŠTITU ELEMENATA CEVOVODA OD HIDR. UDARA KORISTI VAZDUŠNI KAZAN. TO JE ZATVORENA KOMORA U KOJOJ SE U GORNJEM DELU NALAZI VAZDUH POD PRITISKOM (PA SU DIMENZIJE KAZANA MANJE U ODNOSU NA VODOSTAN - VIŠINA MORALA DA BUDE VEĆA OD Π KOTE VODE U KAZANU). PRI EKSPLOATACIJI VAZDUŠNOG KAZANA - TREBA UVEK IMATI KOMPRESOR KOJI BI NADOKNAĐIVAO PRITISAK U VAZDUHU, KOJI VREMENOM OPADA ZBOG RASTVARANJA U VODI.

- Q_1 - PROTOK U CEVI NA MESTU TAČKE 1
- Q_K - PROTOK KA KAZANU
- H_K - NIVO VODE U KAZANU
- Π_K - Π-KOTA VODE U KAZANU
- V_K - ZAPREMINA VAZDUHA U KAZANU

1) BERNULIJEVA JEDNAČINA: TAČKA 1 (u cevi) DO PRESEKA U KAZANU
(ZANEMARENA BRZ. VISINA U CEVI I KAZANU)

$$\Pi_1 = \Pi_k + \zeta_p \cdot \frac{Q_k \cdot |Q_k|}{2g A_p^2}$$

ζ_p – koef. lok. gubitka na prigušivaču
A_p – površ. pop. preseka prigušivača

2) JEDNAČINE KONTINUITETA:

ČVOR 1: $Q_1 = -Q_k$

KAZAN – VODA: VODA KOJA ULAZI U KAZAN POVEĆAVA NIVO VODE U KAZANU

$$A_k \cdot \frac{dH_k}{dt} = +Q_k$$

A_k – povr. pop. preseka kazana
H_k – nivo vode u kazanu

KAZAN – VAZDUH: ZAPREMINA VODE KOJA UĐE U KAZAN JEDNAKA JE GUBITKU NA ZAPREMINI VAZDUHA (VAZDUH SE STIŠNE)

$$\frac{dV_k}{dt} = -Q_k$$

– NA RAČUN SMANJENJA ZAPREMINE – VAZDUHU SE POVEĆAVA PRITISAK

$$pV = nRT \quad \Longleftrightarrow \quad p_{abs}^{vaz} \left(V_k\right)^m = \text{const 1}$$

$m = 1$ IZOTERMSKI PROCES ($T = \text{const}$)
$m = 1{,}4$ ADIJABATSKI PROCES (bez razmene energije sa okolinom)
$m = 1{,}2 \rightarrow$ VRSTA POLITROPSKOG PROCESA KOJA BI ODGOVARALA PROCESU U VAZDUŠNOM KAZANU

$$p_{abs}^{vaz} \left(V_k\right)^{1.2} = \text{const 1.}$$

(const 1 nije unapred poznata, treba je odrediti iz početnih uslova)

– NA RAČUN POVEĆANJA PRITISKA U VAZDUHU – RASTE Π KOTA U KAZANU:

$$\Pi_k = H_k + \frac{p_{rel}^{vaz}}{\rho g} = H_k + \left(\frac{p_{abs}^{vaz}}{\rho g} - \frac{p_{atm}}{\rho g} \right) \circledast$$

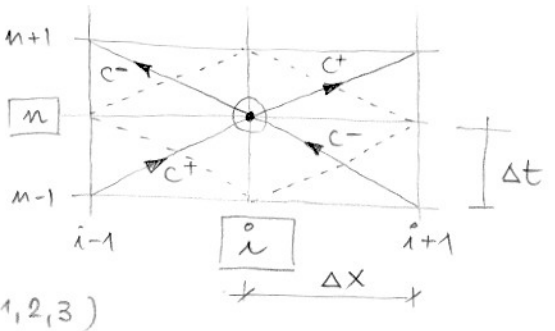
$\circledast$ $\Pi = z + \frac{p_{rel}}{\rho g}$ p_{rel} = relativni pritisak ρ = gustina vode
p_{abs} = apsolutni pritisak

$p_{abs} = p_{rel} + p_{atm}$ $\frac{p_{atm}}{\rho g} = 10\,m$
$p_{abs} \geq 0$!

c) TAČKA 3 – GRANIČNI USLOV: REZERVOAR VELIKOG POP. PRESEKA

$$\Pi_3 \simeq \Pi_B = 5.0\,m \quad (\text{const})$$

METODA KARAKTERISTIKA $\frac{\Delta x}{\Delta t} = \pm a$



a - brzina prostiranja poremećaja u cevi $a = 1000\ m/sec$

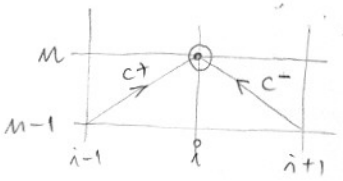
Δx - odabrani prostorni korak

$\Delta x = 1000\ m$ (JER RAČUNAMO U TAČKAMA 1, 2, 3)

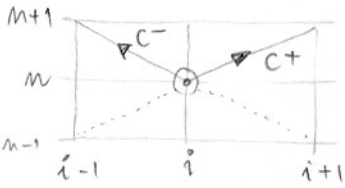
$$\Delta t = \frac{\Delta x}{a} = \frac{1000\ m}{1000\ m/sec} = 1\ sec$$

C^+: $\frac{\Delta x}{\Delta t} = +a$

C^-: $\frac{\Delta x}{\Delta t} = -a$



U TAČKU i U n-tom TRENUTKU (SADAŠNJOSTI) STIŽU 2 KARAKTERISTIKE: C^+ iz $i-1$ (PRETHODNE TAČKE) i C^- iz $i+1$ (NAREDNE TAČKE), OBE IZ PRETHODNOG TRENUTKA $(n-1)$. KOMBINACIJA OVE 2 KARAKTERISTIKE (INFORMACIJE) ČINI NOVO STANJE U TAČKI i.



U SLEDEĆEM TRENUTKU, $(n+1)$, TAČKA i EMITUJE 2 KARAKTERISTIKE C^+ (KA $i+1$) i C^- (KA $i-1$) i UTIČE NA NJIHOVA STANJA U $n+1$ TRENUTKU. ONA TO ČINI U SVAKOM TRENUTKU, PA TAKO I U $n-1$, PA JE MREŽA KARAKTERISTIKA NACRTANA NA GORNJOJ SLICI. (PUNE I ISPREKIDANE LINIJE SU TU ZBOG JASNOĆE)

SVAKA TAČKA U SVAKOM TRENUTKU UTIČE NA SVE TAČKE OKO SEBE. UTICAJI SE PRENOSE DUŽ KARAKTERISTIKA (IZOLOVANI UTICAJI BAŠ JEDNE TAČKE, NA BAŠ DRUGU TAČKU; BAŠ - TO SU ONE KOJE LEŽE NA ISTOJ KARAKTERISTICI)

$$B = \frac{a}{g \cdot A} \qquad M = \frac{\lambda \cdot a \cdot \Delta t}{2 g D A^2}$$

$a = 1000\ m/sec$

$g = 9.81\ m/sec^2$

D - prečnik cevi

A - površ. pop. pres cevi

OPŠTI OBLIK KARAKTERISTIKA:

C^+: $\Pi_i^{n+1} = CP - B \cdot Q_i^{n+1}$ $\quad CP = \Pi_{i-1}^n + B \cdot Q_{i-1}^n - M \cdot Q_{i-1}^n |Q_{i-1}^n|$

C^-: $\Pi_i^{n+1} = CM + B \cdot Q_i^{n+1}$ $\quad CM = \Pi_{i+1}^n - B \cdot Q_{i+1}^n + M \cdot Q_{i+1}^n |Q_{i+1}^n|$

(*) ZAPAMTITI NOTACIJU Q_{i-1}^{n+1}

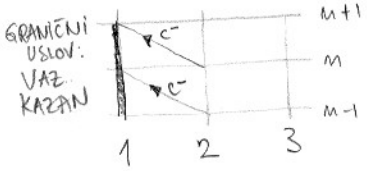
$i-1$: NA MESTU $i-1$, ODN. U PRETHODNOJ TAČKI

$n+1$: U TRENUTKU $n+1$, ODN U NAREDNOM TRENUTKU

i - TAČKA KOJA SE RAZMATRA

n - SADAŠNJI TRENUTAK

TAČKA 1



U TAČKI 1. STANJE SE FORMIRA KOMBINACIJOM C^- KARAKT. IZ TAČKE 2 I GRAN. USLOVA: VAZ. KAZAN.

$$C^-: \quad \Pi_1^{n+1} = CM_2 + B \cdot Q_1^{n+1} \qquad CM_2 = \Pi_2^n - B \cdot Q_2^n + M \cdot Q_2^n |Q_2^n|$$

ODN. ZBOG J.K. ZA ČVOR 1 $\quad Q_k = -Q_1$

$$\Pi_1^{n+1} = CM_2 - B \cdot Q_k^{n+1} \quad \ldots\ldots \quad (C^-)$$

B.J. 1-KAZAN $\quad \Pi_1^{n+1} = \Pi_k^{n+1} + R \cdot Q_k^{n+1} |Q_k^{n+1}| \qquad R = \frac{\sum \zeta_p}{2gA_p^2} \quad \ldots\ldots \quad (BJ)$

$C^- = BJ$:

$$CM_2 - B Q_k^{n+1} = \Pi_k^{n+1} + R Q_k^{n+1} |Q_k^{n+1}|$$

$$R Q_k^{n+1} \cdot |Q_k^{n+1}| + B \cdot Q_k^{n+1} - (CM_2 - \Pi_k^{n+1}) = 0$$

$$A \cdot x^2 + B \cdot x + C = 0$$

$$|Q_k^{n+1}| = \begin{cases} Q_k^{n+1}, & Q_k^{n+1} > 0 \\ -Q_k^{n+1}, & Q_k^{n+1} < 0 \end{cases}$$

a) $Q_k^{n+1} > 0$

$$R \cdot Q^2 + B \cdot Q - (CM_2 - \Pi_k) = 0$$

$$Q_k^{n+1} = \frac{-B + \sqrt{B^2 + 4R(CM_2 - \Pi_k^{n+1})}}{2R}$$

b) $Q_k^{n+1} < 0$

$$-R \cdot Q^2 + BQ - (CM_2 - \Pi_k) = 0$$

$$Q_k^{n+1} = \frac{B - \sqrt{B^2 - 4R(CM_2 - \Pi_k^{n+1})}}{2R}$$

$Q_k^{n+1} > 0 \iff CM_2 - \Pi_k > 0$ PA SE a i b MOGU OBJEDINITI:

⑤ $$Q_k^{n+1} = \frac{\operatorname{sgn}(CM_2 - \Pi_k^{n+1}) \cdot \left(-B + \sqrt{B^2 + 4R \cdot \operatorname{abs}(CM_2 - \Pi_k^{n+1})}\right)}{2R}$$

$\Pi_k = ?$ $\quad \Pi_k^{n+1} = H_k^{n+1} + \frac{p_{abs}^{n+1}}{\rho g} - 10 \quad [m]$ ④

$\frac{p_{abs}^{n+1}}{\rho g} = \frac{Const2}{(V_k^{n+1})^{1.2}}$ ③ $\leftarrow V_k^{n+1} = V_k^n - Q_k^n \cdot \Delta t$ ①

$H_k^{n+1} = H_k^n + \frac{Q_k^n \Delta t}{A_k}$ ②

① $V_k^{n+1} = V_k^n - Q_k^n \cdot \Delta t$

② $H_k^{n+1} = H_k^n + \dfrac{Q_k^n \Delta t}{A_k}$

③ $\dfrac{p_{abs}^{n+1}}{\rho g} = \dfrac{const\,2}{\left(V_k^{n+1}\right)^{1.2}}$

④ $\Pi_k^{n+1} = H_k^{n+1} + \dfrac{p_{abs}^{n+1}}{\rho g} - 10 \quad [m]$

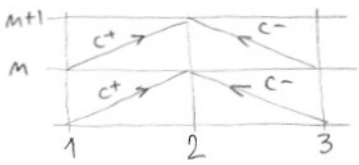
⑤ $Q_k^{n+1} = \dfrac{sgn\left(CM_2 - \Pi_k^{n+1}\right) \cdot \left(-B + \sqrt{B^2 + 4R\,abs\left(CM_2 - \Pi_k^{n+1}\right)}\right)}{2R}$

$CM_2 = \Pi_2^n - B\,Q_2^n + M \cdot Q_2^n \left|Q_2^n\right|$

⑥ $Q_1^{n+1} = -Q_k^{n+1}$

$\Pi_1^{n+1} = CM_2 + B \cdot Q_1^{n+1}$

TAČKA 2



U TAČKI 2. STANJE SE FORMIRA KOMBINACIJOM C^+ iz TAČKE 1 i C^- iz TAČKE 3.

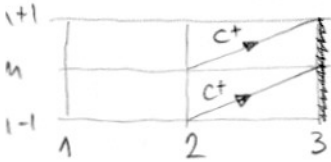
$C^+: \Pi_2^{n+1} = CP_1 - B\,Q_2^{n+1} \quad CP_1 = \Pi_1^n + B \cdot Q_1^n - M\,Q_1^n \left|Q_1^n\right|$

$C^-: \Pi_2^{n+1} = CM_3 - B\,Q_2^{n+1} \quad CM_3 = \Pi_3^n - B \cdot Q_3^n + M\,Q_3^n \left|Q_3^n\right|$

$\Pi_2^{n+1} = \frac{1}{2}\left(CP_1^n + CM_3^n\right)$

$Q_2^{n+1} = \frac{1}{B}\left(\Pi_2^{n+1} - CM_3^n\right)$

TAČKA 3



GRANIČNI USLOV: REZERVOAR

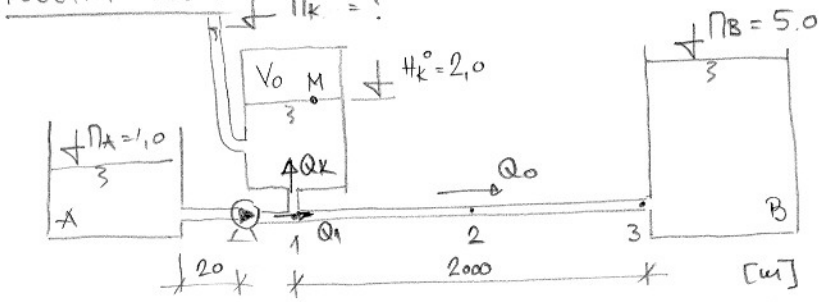
U TAČKI 3, STANJE SE FORMIRA KOMBINACIJOM C^+ iz TAČKE 2 i GRANIČNOG USLOVA: REZERVOAR

$\Pi_3^{n+1} = \Pi_B = 5.0\ m = const$

$C^+: \Pi_3^{n+1} = CP_2 - B \cdot Q_3^{n+1} \quad CP_2 = \Pi_2^n + B\,Q_2^n - M \cdot Q_2^n \left|Q_2^n\right|$

$Q_3^{n+1} = \frac{1}{B}\left(CP_2^n - \Pi_3^{n+1}\right)$

Početni uslovi $\Pi_k^\circ = ?$



$D = 0.2\,m$
$\lambda = 0.03$
$Q_0 = 58\ l/sec$
$D_K = 1\,m$
$D_p = 0.05\,m$
$\zeta_p = 1.5 \quad \left(\zeta_p \cdot \frac{v_p^2}{2g}\right)$
$V_0 = 0.2\,m^3$

B.J. A–B

$$\Pi_A = \Pi_B + \lambda \frac{L}{D} \cdot \frac{v^2}{2g} - H_p$$

$$1.0 = 5.0 + 0.03 \cdot \frac{2020}{0.2} \cdot \frac{0.058^2}{2.981} \cdot \frac{1}{\left(\frac{0.2^2\pi}{4}\right)^2} - H_p \Rightarrow H_p = 56.64\,m$$

$p_{vaz}^\circ \approx p_M$ pritisak u vazduhu ≈ pritisak u tački M.

$$p_{vaz}^\circ = \rho g \left(\Pi_k^\circ - 2.0\right) \qquad \Pi_k^\circ = \Pi_1^\circ$$

(JER U USTALJENOM NEMA DOTOKA U KAZAN $Q_K^\circ = 0$)

B.J. A–1.

$$\Pi_A = \Pi_1 + \lambda \cdot \frac{L_1}{D} \cdot \frac{v^2}{2g} - H_p$$

$$\boxed{\Pi_1^\circ} = 1.0 - 0.03 \cdot \frac{20}{0.2} \cdot \frac{0.058^2}{2 \cdot 9.81} \cdot \frac{1}{\left(\frac{0.2^2\pi}{4}\right)^2} + 56.64 = \boxed{57.12\,m}$$

$$p_{vaz}^\circ = 1000 \cdot 9.81 \cdot (57.12 - 2.0) = 540.7\ kPa \leftarrow p_{rel}$$

$$p_{abs}^{vaz\,\circ} = 540.7 + 100 = 640,7\ kPa \qquad p_{abs} = p_{rel} + p_{atm}$$

$$\frac{p_{abs}^\circ \left(V_k^\circ\right)^{1.2}}{\rho g} = Const\ 2$$

$$\boxed{Const\ 2} = \frac{640.7 \cdot 10^3 \cdot (0.2)^{1.2}}{1000 \cdot 9.81} = \boxed{9.4672\ m^{23/5}}$$

$$\boxed{\Pi_2^\circ} = 5.0 + 0.03\ \frac{1000}{0.2} \cdot \frac{0.058^2}{2.9.81} \cdot \frac{1}{\left(\frac{0.2^2\pi}{4}\right)^2} = \boxed{31.06\,m}$$

1) 0-ti TRENUTAK – USTALJENO STANJE

2) POČETAK PRVE SEKUNDE: PUMPA PRESTALA DA RADI → $Q_K^1 = Q_1^1$
ODN. KAZAN U POTPUNOSTI ZAMENJUJE ODSUSTVO PUMPE
$Q_K^1 = -58\ l/sec$, SVE OSTALE VELIČINE KAO U 0

3) POČETAK DRUGE SEKUNDE: POREMEĆAJ SE ŠIRI

TAČKA 1 → POČETAK 2. SEKUNDE (ili KRAJ PRVE SEKUNDE) → 1 sec POSLE PRESTANKA RADA PUMPE

$$V_k^2 = \underset{\text{"}V_k^\circ}{V_k^1} - Q_k^1 \cdot \Delta t = 0.2 - (-0.058 \cdot 1) = 0.258\ m^3$$

$$\frac{p_{abs}^2}{\rho g} = \frac{const\ 2}{(V_k^2)^{1.2}} = \frac{9.4672}{(0.258)^{1.2}} = 48.11\ m$$

$$H_k^2 = \underset{\text{"}H_k^\circ}{H_k^1} + \frac{Q_k^1 \cdot \Delta t}{A_k} = 2.0 + \frac{-0.058 \cdot 1}{0.785} = 1.93\ m$$

$$\Pi_k^2 = H_k^2 + \frac{p_{abs}^2}{\rho g} - 10 = 1.93 + 48.11 - 10 = 39.85\ m$$

[RAČUNATO SA 10.19 UMESTO 10, KAO PRITISAK $P_{atm} = 100\ kPa$ $\frac{P_{atm}}{\rho g} = 10.19$; može i 10,33, za $P_{atm} = 101\ kPa$ " 1 bar

$$CM_2^1 = \underset{=\Pi_2^\circ}{\Pi_2^1} - B \cdot \underset{=Q_2^\circ = Q^\circ}{Q_2^1} + M \cdot Q_2^1 \cdot |Q_2^1|$$

$$= 31.06 - 3244.75 \cdot 0.058 + 7746.27 \cdot 0.058^2 = -131.08$$

$$Q_k^2 = \frac{sgn\left(CM_2^1 - \Pi_k^2\right)\left(-B + \sqrt{B^2 + 4R\,abs\left(CM_2^1 - \Pi_k^2\right)}\right)}{2R}$$

$$Q_k^2 = \frac{sgn\left(-131.08 - 39.85\right)\left(-3244.75 + \sqrt{3244.75^2 + 4 \cdot 19830 \cdot |-131.08 - 39.85|}\right)}{2 \cdot 19830}$$

$$Q_k^2 = -0.042\ l/sec$$

$$Q_1^2 = 0.042\ l/sec \qquad \Pi_1^2 = CM_2^1 + B \cdot Q_1^2 = -131.08 + 3244.75 \cdot 0.042 = 4.98\ m$$

TAČKA 2.

$$CP_1^1 = \underset{=\Pi_1^\circ}{\Pi_1^1} + B \cdot \underset{=Q_1^\circ = Q^\circ}{Q_1^1} - M Q_1^1 |Q_1^1| = 57.12 + 3244.75 \cdot 0.058 - 7746.27 \cdot 0.058^2 = 219.25$$

$$CM_3^1 = \underset{\text{"}\Pi_3^\circ}{\Pi_3^1} - B \cdot \underset{\text{"}Q_3^\circ = Q^\circ}{Q_3^1} + M Q_3^1 |Q_3^1| = 5.0 - 3244.75 \cdot 0.058 + 7746.27 \cdot 0.058^2 = -157.14$$

$$\Pi_2^2 = \frac{1}{2}\left(CP_1^1 + CM_3^1\right) = \frac{1}{2}\left(219.25 - 157.14\right) = 31.06\ m$$

$$Q_2^2 = \frac{1}{B}\left(\Pi_2^2 - CM_3^1\right) = \frac{1}{3244.75}\left(31.06 - (-157.14)\right) = 0.058\ l/sec$$

(PRIMETITI DA POSLE 1sec od PRESTANKA RADA PUMPE, POREMEĆAJ JOŠ UVEK NIJE STIGAO, ODN. TEK STIŽE U TAČKU 2, STANJE NEPROMENJENO)

KA 3:

$$\Pi_3^2 = 5.0\ m\ (const)$$

$$CP_2^1 = \underset{\text{"}\Pi_2^\circ}{\Pi_2^1} + B \cdot \underset{\text{"}Q_2^\circ = Q^\circ}{Q_2^1} - M Q_2^1 |Q_2^1| = 31.06 + 3244.75 \cdot 0.058 - 7746.27 \cdot 0.058^2 = 193.20$$

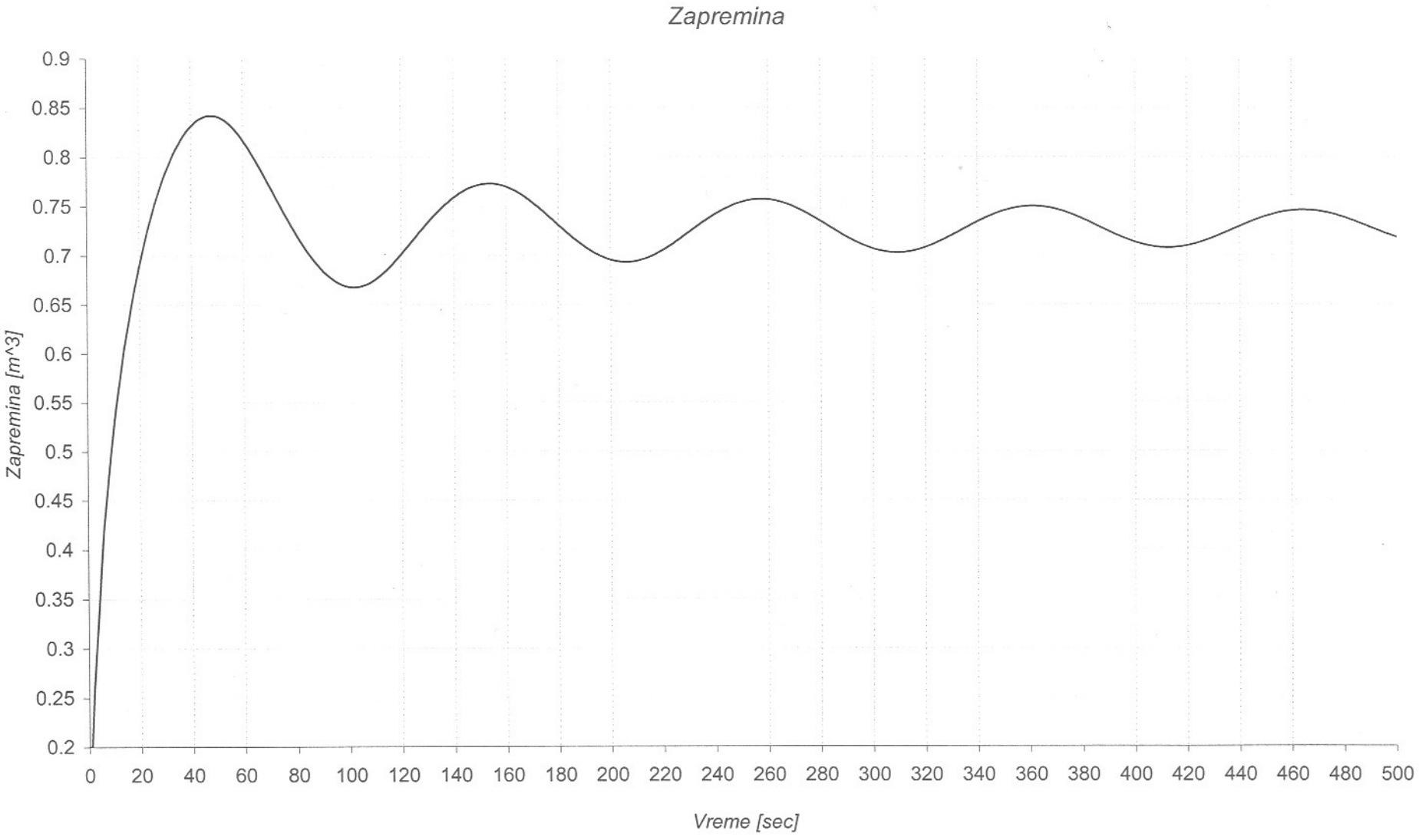
$$Q_3^2 = \frac{1}{B}\left(CP_2^1 - \Pi_3^2\right) = \frac{1}{\quad}\left(193.2 - 5.0\right) = 0.058\ l/sec$$ NEPROMENJENO!

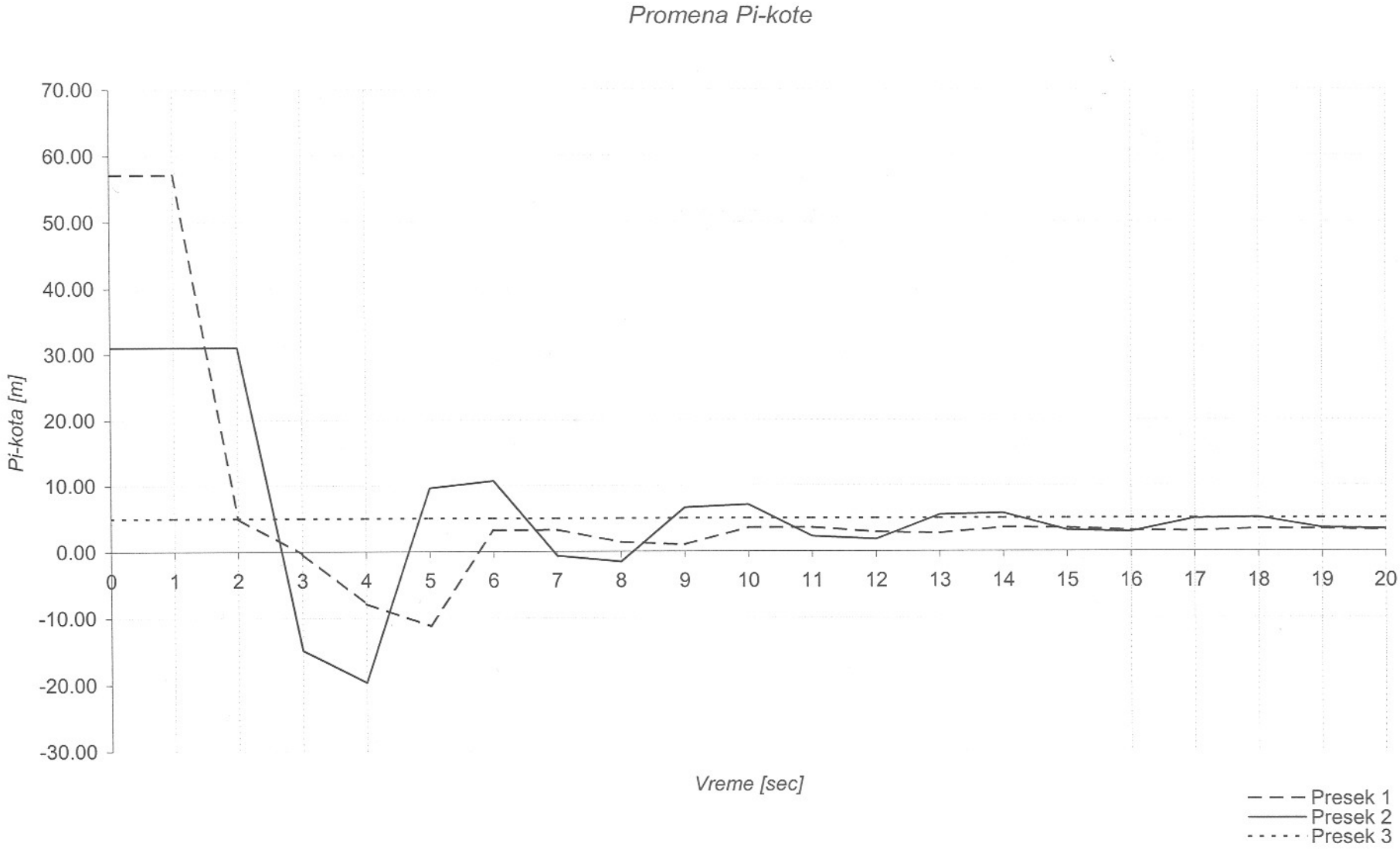
vežba 6: **Vazdušni kazan**

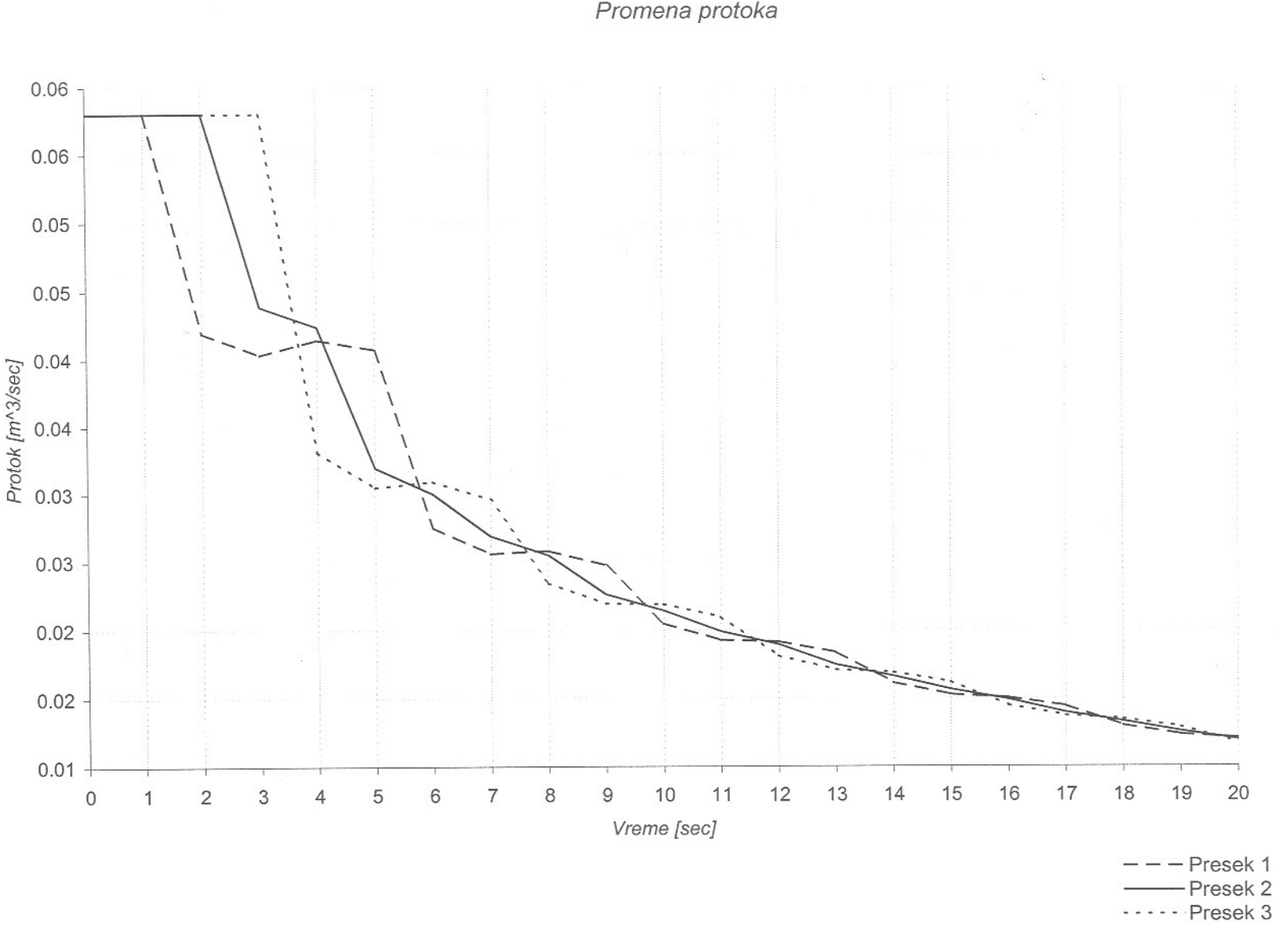
Ulazni podaci:

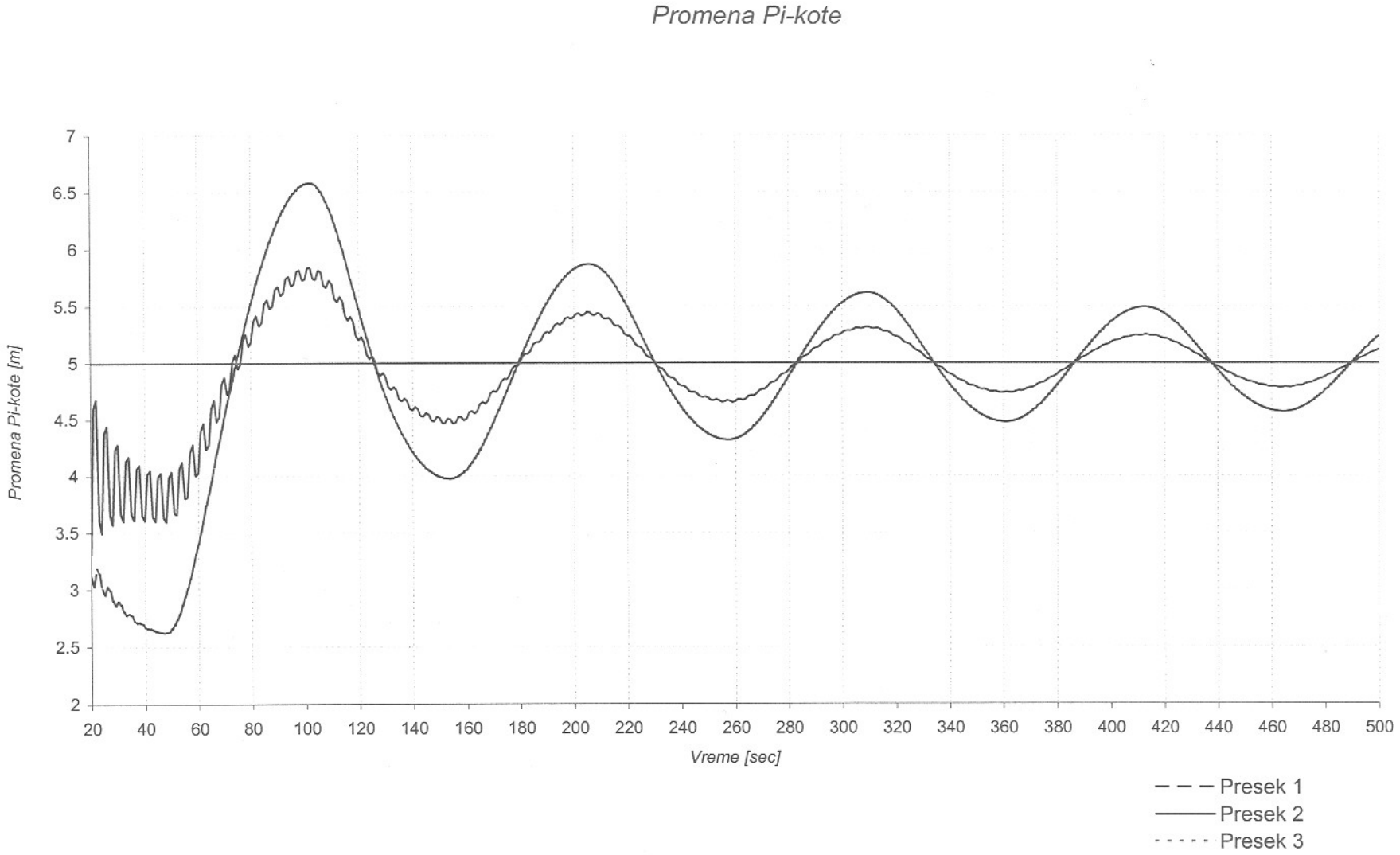
Πa[m]=	1.00	L[m]=	2000	Dk[m]=	1	p_o^{vaz}[kPa]=	540.697	R[sec^2/m^5]=	19830.4
Π_1^0[m]=	57.12	D[m]=	0.2	Dp[m]=	0.05	Const1[m$^{23/5}$]=	9.46715	B[sec/m^2]=	3244.75
Πb[m]=	5.00	λ[-]=	0.03	ξ_p=	1.5	A_{kaz}[m^2]=	0.7854	M[sec^2/m^5]=	7746.27
a[m/sec]=	1000.00	Q[L/sec]=	58	V_o[m^3]=	0.2	Acevi[m^2]=	0.03142		
		Δx[m]=	1000	Δt[sec]=	1	Aprig[m^2]=	0.00196		

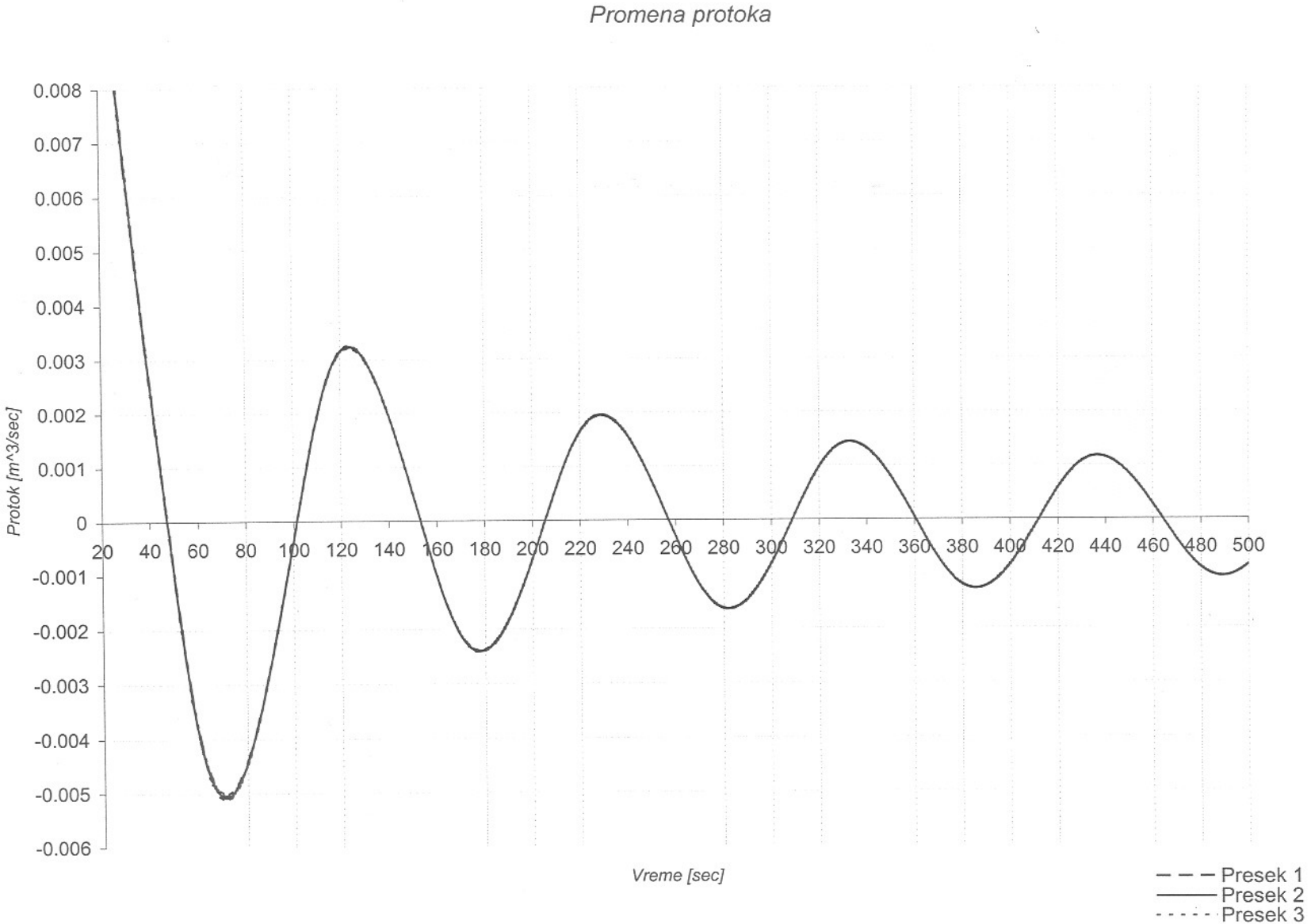
n [-]	t [sec]	Vk [m^3]	$p_{abs}/\rho g$ [m]	Hk [m]	Πk [m]	CM	Qk [m^3/sec]	Q1 [m^3/sec]	$\Pi 1$ [m]	CP	CM	$\Pi 2$ [m]	Q2 [m^3/sec]	CP	$\Pi 3$ [m]	Q3 [m^3/sec]
0	0	0.20	65.31	2.00	57.12		0.00	0.06	57.12			31.06	0.06		5.00	0.06
1	1	0.20	65.31	2.00	57.12	-131.08	-0.06	0.06	57.12	219.25	-157.14	31.06	0.06	193.20	5.00	0.06
2	2	0.26	48.11	1.93	39.85		-0.04	0.04	4.98			31.06	0.06		5.00	0.06
3	3	0.30	40.16	1.87	31.84	-131.08	-0.04	0.04	-0.35	127.42	-157.14	-14.86	0.04	193.20	5.00	0.06
4	4	0.34	34.52	1.82	26.15	-142.24	-0.04	0.04	-7.86	117.80	-157.14	-19.67	0.04	112.52	5.00	0.03
5	5	0.38	30.08	1.77	21.65	-143.23	-0.04	0.04	-11.19	113.23	-94.02	9.61	0.03	103.90	5.00	0.03
6	6	0.42	26.63	1.72	18.16	-86.12	-0.03	0.03	3.15	108.03	-86.70	10.66	0.03	105.33	5.00	0.03
7	7	0.45	24.69	1.68	16.18	-79.73	-0.03	0.03	3.22	86.55	-87.93	-0.69	0.03	101.05	5.00	0.03
8	8	0.48	23.11	1.65	14.56	-82.33	-0.03	0.03	1.37	81.11	-84.26	-1.58	0.03	80.95	5.00	0.02
9	9	0.50	21.69	1.62	13.11	-79.23	-0.02	0.02	0.99	79.91	-66.71	6.60	0.02	76.08	5.00	0.02
10	10	0.53	20.47	1.59	11.86	-62.75	-0.02	0.02	3.57	76.48	-62.36	7.06	0.02	75.96	5.00	0.02
11	11	0.55	19.55	1.56	10.92	-58.81	-0.02	0.02	3.59	66.67	-62.25	2.21	0.02	72.93	5.00	0.02
12	12	0.57	18.76	1.53	10.10	-59.19	-0.02	0.02	2.85	63.12	-59.54	1.79	0.02	63.61	5.00	0.02
13	13	0.58	18.03	1.51	9.34	-56.77	-0.02	0.02	2.68	62.06	-51.08	5.49	0.02	60.35	5.00	0.02
14	14	0.60	17.37	1.49	8.66	-48.73	-0.02	0.02	3.52	59.54	-48.10	5.72	0.02	59.71	5.00	0.02
15	15	0.62	16.83	1.47	8.10	-45.97	-0.02	0.02	3.49	53.76	-47.50	3.13	0.02	57.41	5.00	0.02
16	16	0.63	16.35	1.45	7.60	-45.62	-0.02	0.02	3.12	51.16	-45.38	2.89	0.01	51.88	5.00	0.01
17	17	0.65	15.89	1.43	7.13	-43.67	-0.01	0.01	3.02	50.12	-40.26	4.93	0.01	49.44	5.00	0.01
18	18	0.66	15.48	1.41	6.70	-38.76	-0.01	0.01	3.36	48.11	-37.99	5.06	0.01	48.62	5.00	0.01
19	19	0.68	15.12	1.39	6.32	-36.63	-0.01	0.01	3.32	44.16	-37.22	3.47	0.01	46.74	5.00	0.01
20	20	0.69	14.80	1.38	5.98	-36.00	-0.01	0.01	3.10	42.09	-35.46	3.31	0.01	42.94	5.00	0.01


Zapremina
Zapremina [m^3]
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
Vreme [sec]


Promena Pi-kote
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
Pi-kota [m]
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Vreme [sec]
Presek 1
Presek 2
Presek 3


Promena protoka
Protok [m^3/sec]
0.06
0.06
0.05
0.05
0.04
0.04
0.03
0.03
0.02
0.02
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Vreme [sec]
Presek 1
Presek 2
Presek 3


Promena Pi-kote
Promena Pi-kote [m]
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
Vreme [sec]
Presek 1
Presek 2
Presek 3


Promena protoka
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
-0.001
-0.002
-0.003
-0.004
-0.005
-0.006
Protok [m^3/sec]
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500
Vreme [sec]
Presek 1
Presek 2
Presek 3