FAKULTET TEHNIČKIH NAUKA
DEPARTMAN ZA GRAĐEVINARSTVO I GEODEZIJU
LABORATORIJA ZA GEODEZIJU

INŽENJERSKA GEODEZIJA 1

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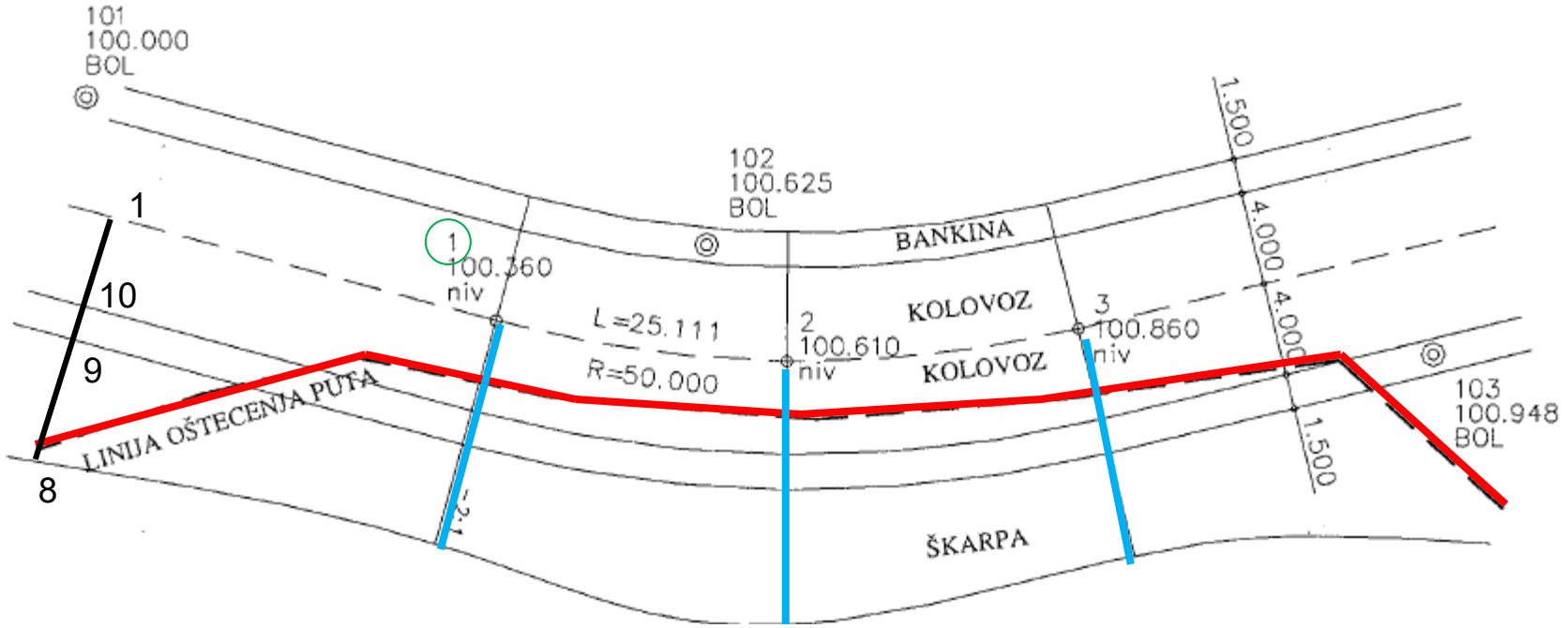
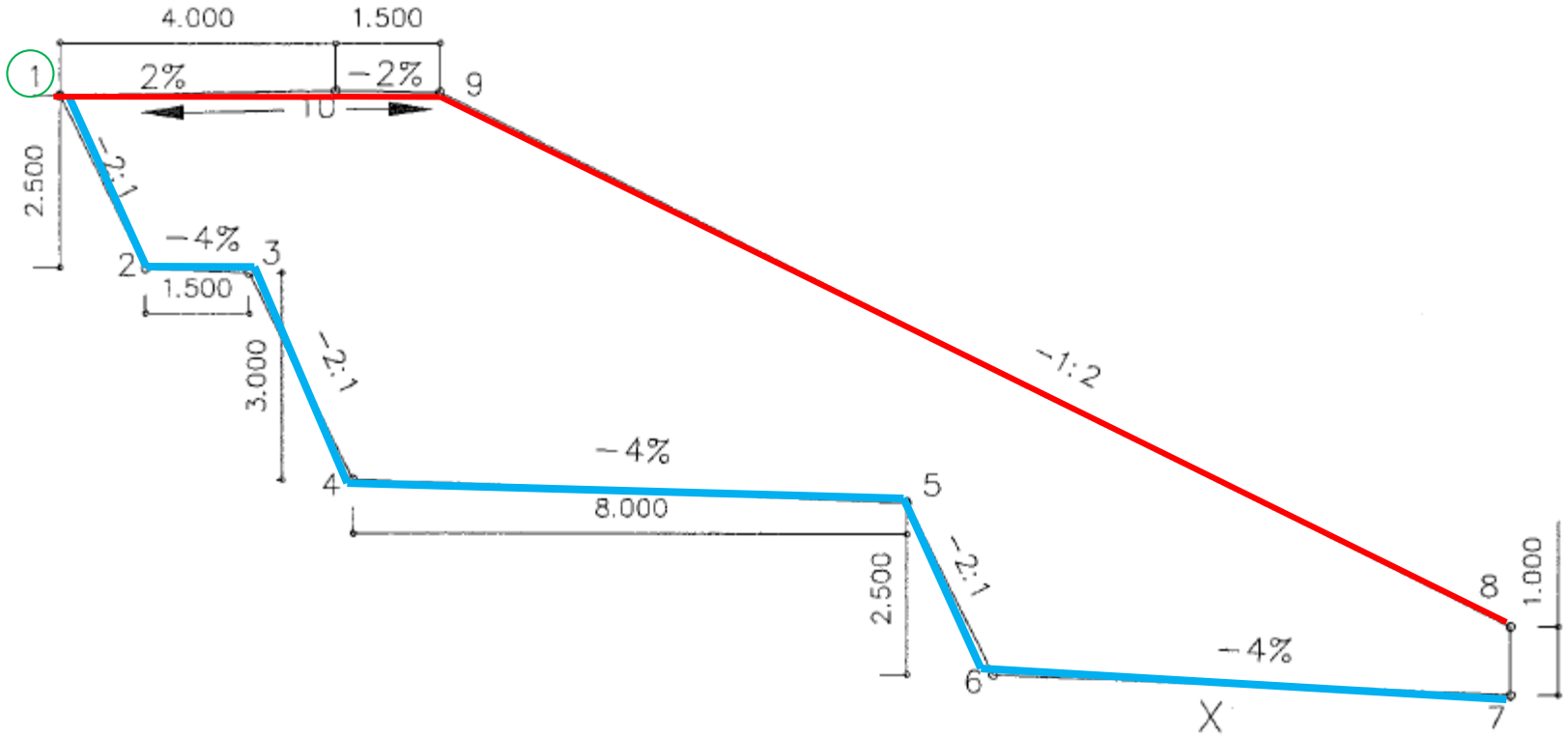
Asistent: Đuro Krnić, mast. inž. geodez. djuro.geo@uns.ac.rs

Vežba 5 Rekonstrukcija puta na nestabilnom terenu

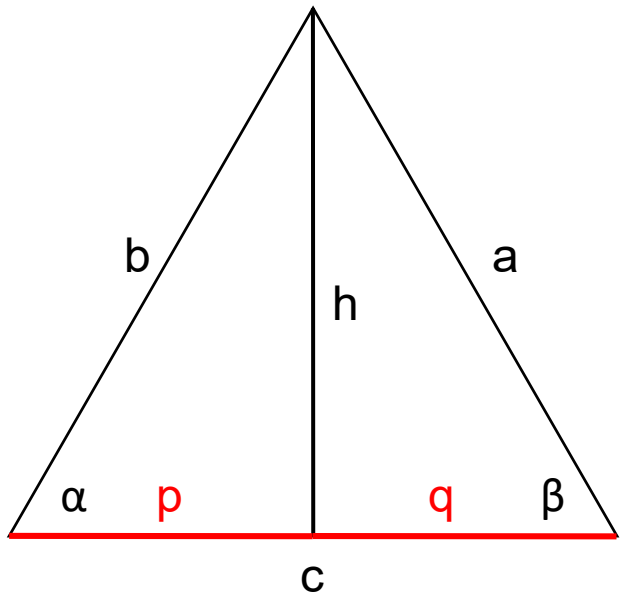
- Izračunati koordinate i kote tačaka na kaskadama
- Izračunati podatke za detaljno obeležavanje tačaka na kaskadama sa postojeće mreže
- Situacija:



Vežba 5


4.000
1.500
1
2%
−2%
9
10
2.500
−2:1
−4%
2
3
1.500
3.000
−2:1
−1:2
−4%
4
5
8.000
2.500
−2:1
8
1.000
−4%
6
X
7

Vežba 5



$$p+q=c$$

$$\frac{p+q}{2}=\frac{c}{2}$$

$$h^2=a^2-q^2$$

$$h^2=b^2-p^2$$

$$b^2-p^2=a^2-q^2$$

$$b^2-a^2=p^2-q^2$$

$$b^2-a^2=(p-q)(p+q)$$

$$\frac{b^2-a^2}{c}=p-q$$

$$\frac{p-q}{2}=\frac{b^2-a^2}{2c}$$

$$p=\frac{p+q}{2}+\frac{p-q}{2}$$

$$q=\frac{p+q}{2}-\frac{p-q}{2}$$

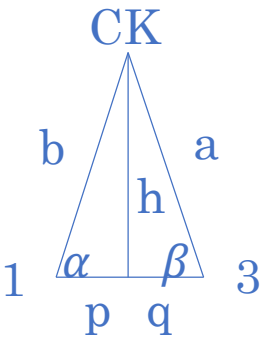
$$\alpha=\arccos\frac{p}{b}$$

$$\beta=\arccos\frac{q}{a}$$

ЛАБОРАТОРИЈА ЗА ГЕОДЕЗИЈУ

Vežba 5

❖ Lučni presek se primenjuje kada su u trouglu samo dužine poznate



$\nu_1^3 = 90° 37' 38''$

$d_{1-3} = 24.847m$

$R = a = b$

$\frac{p+q}{2} = \frac{d_{1-3}}{2} =$

$\frac{p-q}{2} = \frac{b^2 - a^2}{2 * d_{1-3}} =$

usvojićemo R = 50

$p = \frac{p+q}{2} + \frac{p-q}{2} =$

$\nu_1^{ck} = \nu_1^3 - \alpha =$

$q = \frac{p+q}{2} - \frac{p-q}{2} =$

$\nu_3^{ck} = \nu_3^1 + \beta =$

$\alpha = arccos\frac{p}{R} =$

$y_{ck}' = y_1 + R*sin\nu_1^{ck}$

$y_{ck}'' = y_3 + R*sin\nu_3^{ck}$

$x_{ck}' = x_1 + R*cos\nu_1^{ck}$

$x_{ck}'' = x_3 + R*cos\nu_3^{ck}$

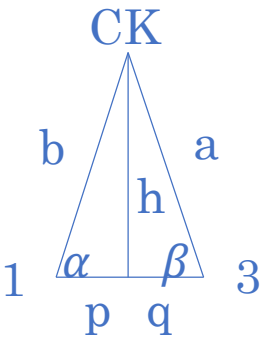
$\beta = arccos\frac{q}{R} =$

$y_{ck} =$

$x_{ck} =$

Vežba 5

❖ Lučni presek se primenjuje kada su u trouglu samo dužine poznate



$\nu_1^3 = 90° 37' 38"$

$d_{1-3} = 24.847m$

$R = a = b$

$\frac{p+q}{2} = \frac{d_{1-3}}{2} = 12.424\text{m}$

$\frac{p-q}{2} = \frac{b^2 - a^2}{2 * d_{1-3}} = 0$

usvojićemo R = 50m

$p = \frac{p+q}{2} + \frac{p-q}{2} = 12.424m$

$\nu_1^{ck} = \nu_1^3 - \alpha = 15° 00' 52"$

$\nu_3^{ck} = \nu_3^1 + \beta = 346° 14' 22"$

$q = \frac{p+q}{2} - \frac{p-q}{2} = 12.424m$

$\alpha = arccos\frac{p}{R} = 75° 36' 45"$

$\beta = arccos\frac{q}{R} = 75° 36' 45"$

$y_{ck}' = y_1 + \text{R}*sin\nu_1^{ck}$

$x_{ck}' = x_1 + \text{R}*\cos\nu_1^{ck}$

$y_{ck}'' = y_3 + \text{R}*sin\nu_3^{ck}$

$x_{ck}'' = y_3 + \text{R}*cos\nu_3^{ck}$

$y_{ck} = 5030.461\text{m}$

$x_{ck} = 3038.741\text{m}$

Vežba 5

Za računanje koordinata tačaka u profilima, usvojene su oznake:
1. profil (')
2. profil (")
3. profil ("')

1.1. a) **Računanje kota tačaka na profilu 1**

H_1=100,360 m

$$H_2' = H_1 - 2{,}500 =$$

$$H_3' = H_2' - \frac{1{,}500 \cdot 4}{100} =$$

$$H_4' = H_3' - 3{,}000 =$$

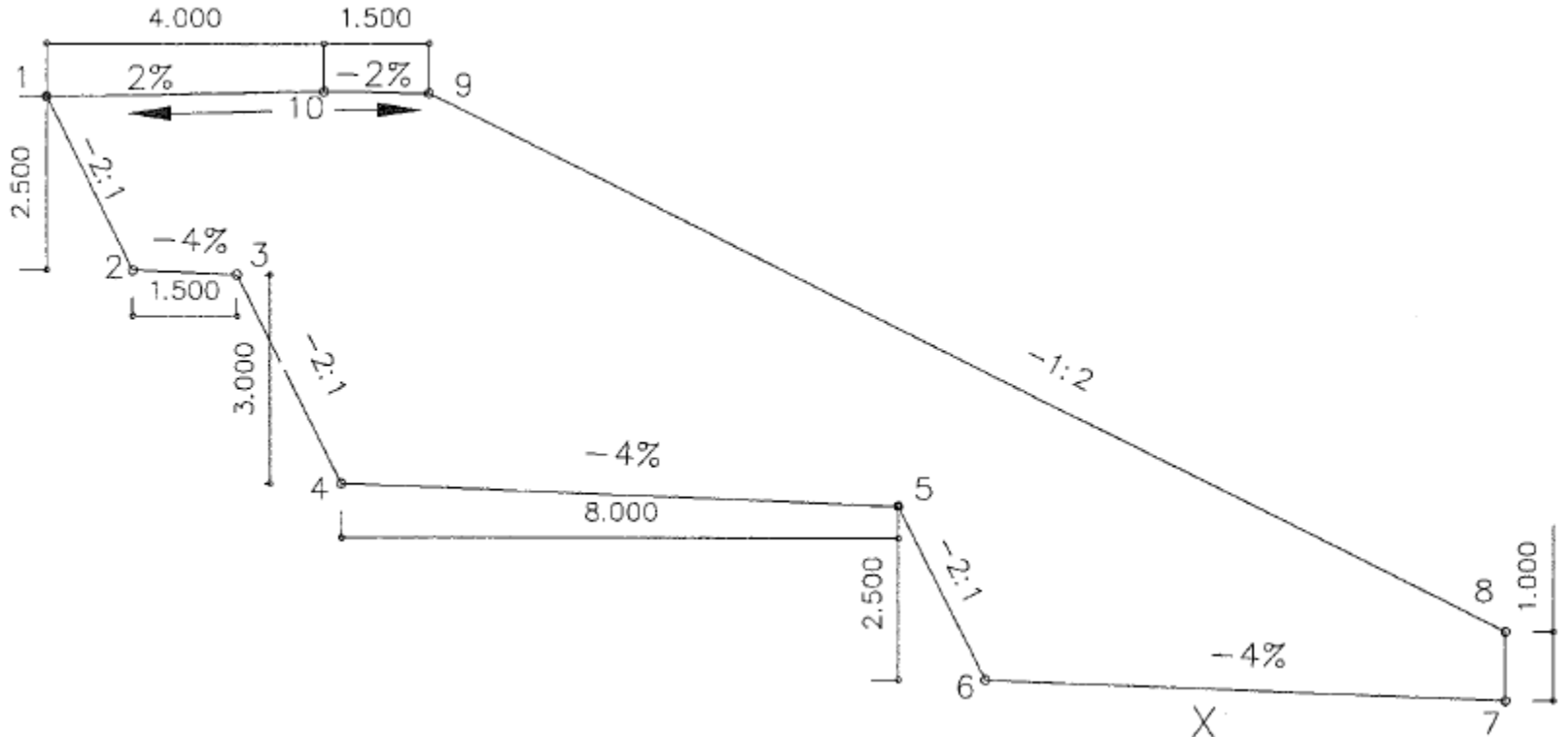
$$H_5' = H_4' - \frac{8{,}000 \cdot 4}{100} =$$

$$H_6' = H_5' - 2{,}500 =$$

$$H_7' = H_6' - \frac{x \cdot 4}{100}$$

$$H_8' = H_7' + 1{,}000$$

$$H_{10}' = H_1 + \frac{4{,}000 \cdot 2}{100} =$$



Vežba 5

Za računanje koordinata tačaka u profilima, usvojene su oznake:
1. profil (')
2. profil (")
3. profil ("')

1.1. a) **Računanje kota tačaka na profilu 1**

H_1=100,360 m

$H_2' = H_1 - 2{,}500 = 97{,}860$ m

$H_3' = H_2' - \frac{1{,}500 \cdot 4}{100} = 97{,}800$ m

$H_4' = H_3' - 3{,}000 = 94{,}800$ m

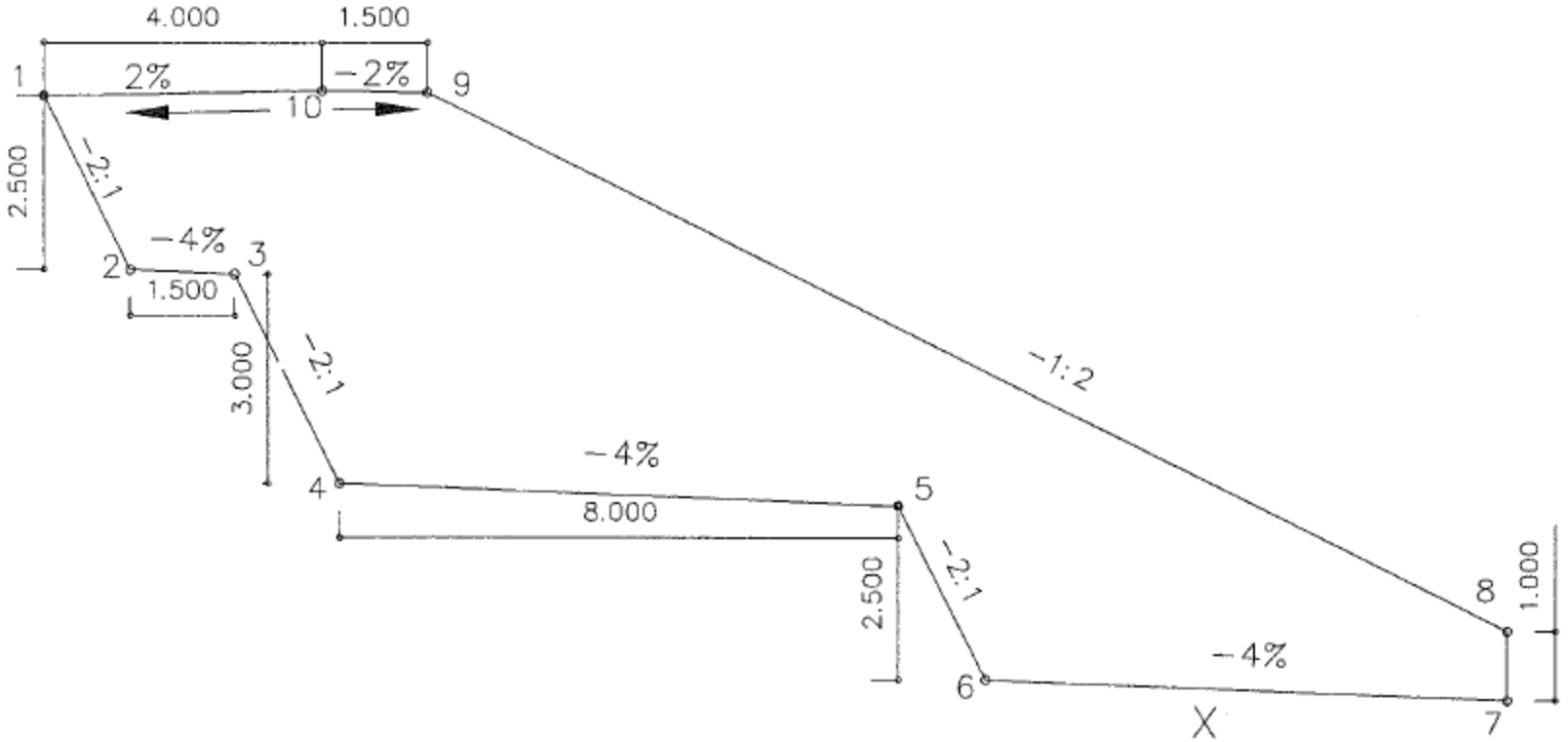
$H_5' = H_4' - \frac{8{,}000 \cdot 4}{100} = 94{,}480$ m

$H_6' = H_5' - 2{,}500 = 91{,}980$ m

$H_7' = H_6' - \frac{x \cdot 4}{100}$

$H_8' = H_7' + 1{,}000$

$H_{10}' = H_1 + \frac{4{,}000 \cdot 2}{100} = 100{,}440$



Vežba 5

$$H_9' = H_{10}' - \frac{1{,}500 \cdot 2}{100} =$$

Računanje nepoznate veličine x:

$$H_7' = H_9' - \frac{(1{,}25 + 1{,}50 + 1{,}50 + 8{,}00 + 1{,}25 + x - 4{,}00 - 1{,}50)}{2} - 1 = H_9' - \frac{8{,}000 + x}{2} - 1$$

$$H_7' = H_6' - \frac{x \cdot 4}{100}$$

$\Rightarrow$

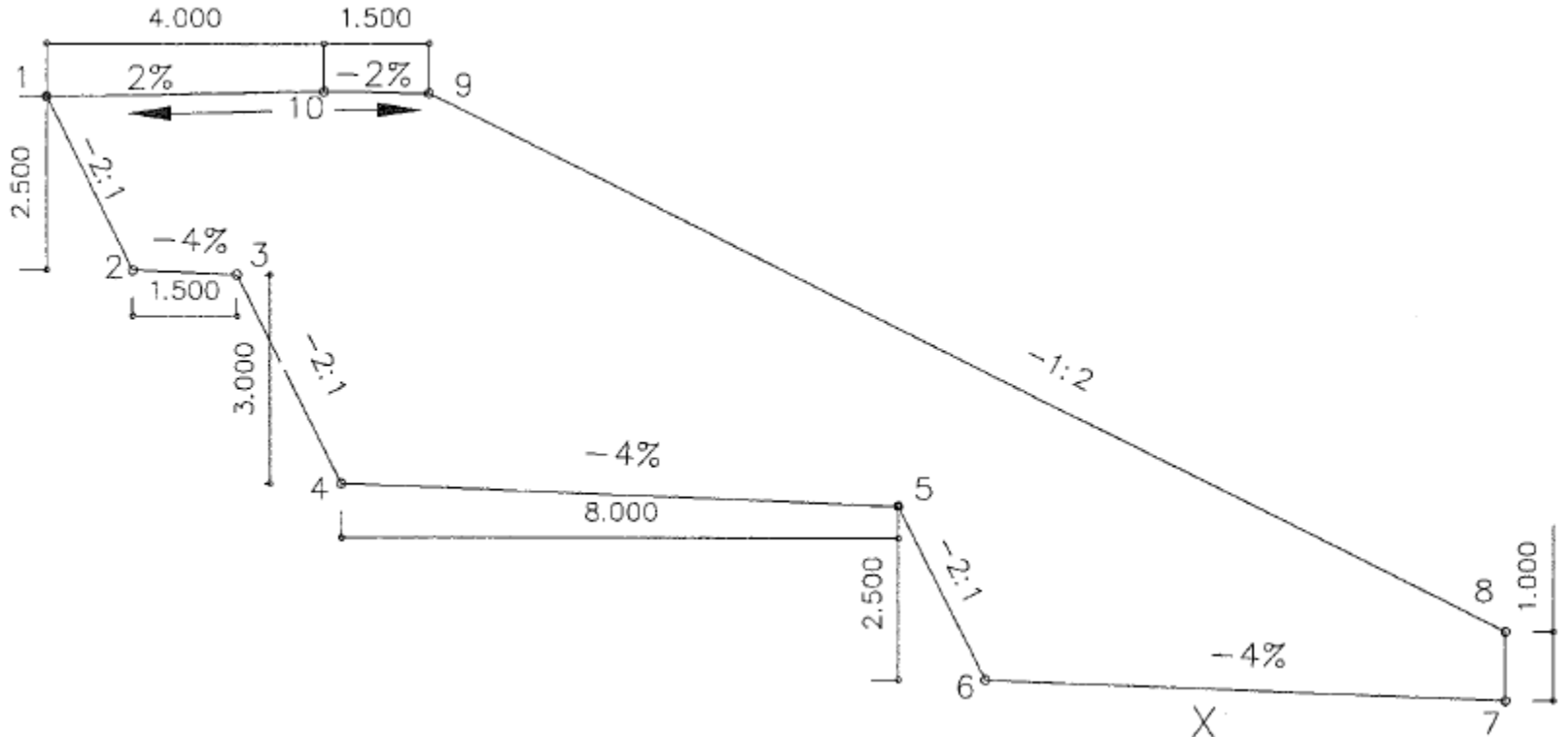
$\Rightarrow x =$

$\overline{H_7'} =$

$H_8' =$

$H_9' =$

$H_{10}' =$



Vežba 5

$$H_9' = H_{10}' - \frac{1{,}500 \cdot 2}{100} =$$

Računanje nepoznate veličine x:

$$H_7' = H_9' - \frac{(1{,}25 + 1{,}50 + 1{,}50 + 8{,}00 + 1{,}25 + x - 4{,}00 - 1{,}50)}{2} - 1 = H_9' - \frac{8{,}000 + x}{2} - 1$$

$$H_7' = H_6' - \frac{x \cdot 4}{100}$$

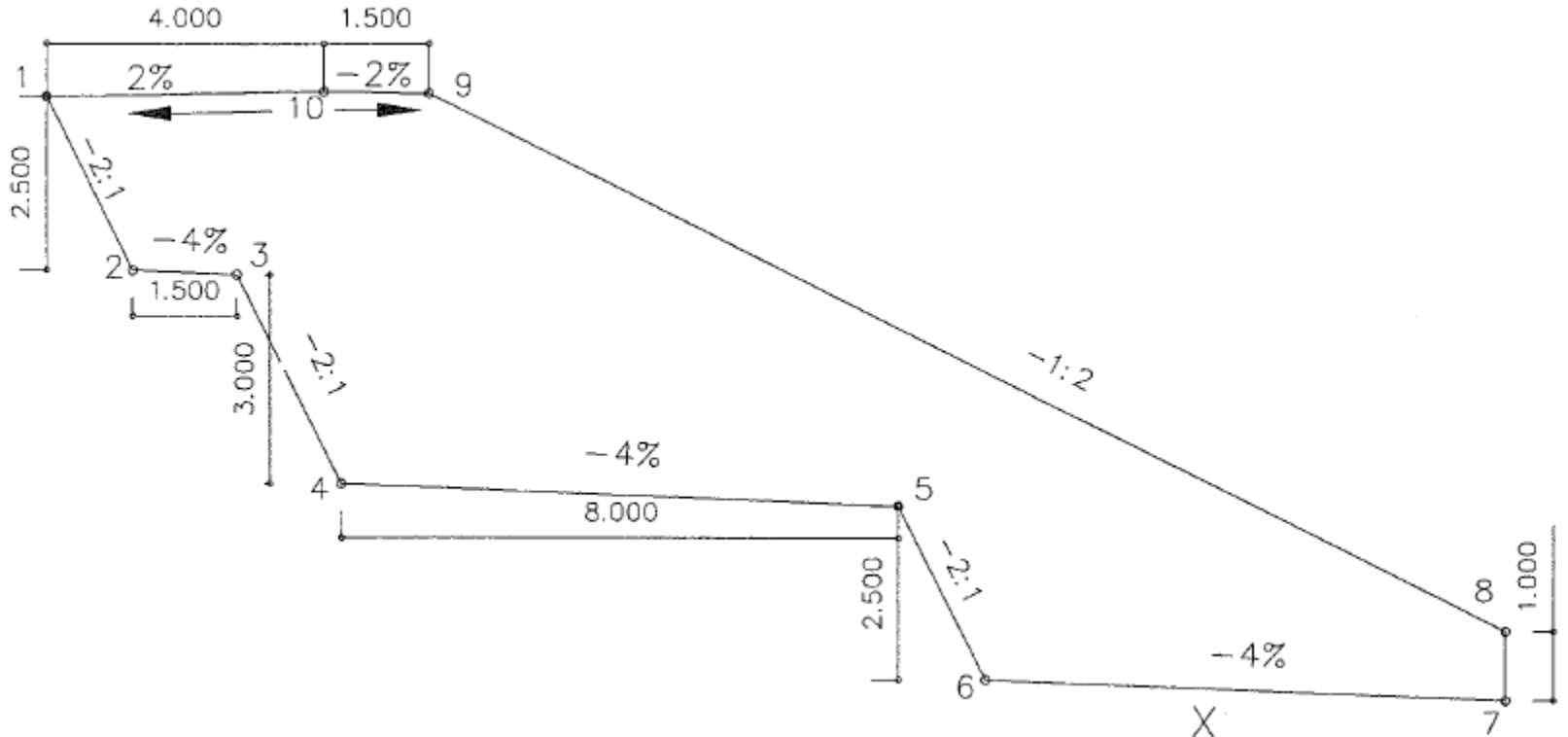
$$\Rightarrow x = \frac{100 \cdot H_9' - 500 - 100 \cdot H_6'}{46} = 7{,}457 \text{ m}$$

$H_7' = 91{,}682$ m

$H_8' = 92{,}682$ m

$H_9' = 100{,}410$ m

$H_{10}' = 100{,}440$ m



Vežba 5

1.1. b) **Računanje koordinata tačaka na profilu 1**

$$\nu_{C1}^{1} = arctg\left(\frac{Y_1 - Y_{C1}}{X_1 - X_{C1}}\right)$$

$$Y_2' = Y_1 + 1{,}250 \cdot \sin \nu_{C1}^{1}$$

$$X_2' = X_1 + 1{,}250 \cdot \cos \nu_{C1}^{1}$$

$$Y_3' = Y_1 + (1{,}250 + 1{,}500) \cdot \sin \nu_{C1}^{1}$$

$$X_3' = X_1 + (1{,}250 + 1{,}500) \cdot \cos \nu_{C1}^{1}$$

$$Y_4' = Y_1 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \sin \nu_{C1}^{1}$$

$$X_4' = X_1 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \cos \nu_{C1}^{1}$$

$$Y_5' = Y_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \sin \nu_{C1}^{1}$$

$$X_5' = X_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \cos \nu_{C1}^{1}$$

$$Y_6' = Y_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \sin \nu_{C1}^{1}$$

$$X_6' = X_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \cos \nu_{C1}^{1}$$

$$Y_7' = Y_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \sin \nu_{C1}^{1}$$

$$X_7' = X_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \cos \nu_{C1}^{1}$$

$$Y_8' = Y_7' \; ; \; X_8' = X_7'$$

$$Y_9' = Y_1 + (4{,}000 + 1{,}500) \cdot \sin \nu_{C1}^{1}$$

$$X_9' = X_1 + (4{,}000 + 1{,}500) \cdot \cos \nu_{C1}^{1}$$

$$Y_{10}' = Y_1 + 4{,}000 \cdot \sin \nu_{C1}^{1}$$

$$X_{10}' = X_1 + 4{,}000 \cdot \cos \nu_{C1}^{1}$$

Vežba 5

$$\nu_{C1}^{1} = arctg\left(\frac{Y_1 - Y_{C1}}{X_1 - X_{C1}}\right) = \quad 195^\circ\ 00'\ 52''$$

$$Y_2^{'} = Y_1 + 1{,}250 \cdot \sin \nu_{C1}^{1} = 5017{,}184 \text{ m}$$

$$X_2^{'} = X_1 + 1{,}250 \cdot \cos \nu_{C1}^{1} = 2989{,}241 \text{ m}$$

$$Y_3^{'} = Y_1 + (1{,}250 + 1{,}500) \cdot \sin \nu_{C1}^{1} = 5016{,}796 \text{ m}$$

$$X_3^{'} = X_1 + (1{,}250 + 1{,}500) \cdot \cos \nu_{C1}^{1} = 2987{,}792 \text{ m}$$

$$Y_4^{'} = Y_1 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \sin \nu_{C1}^{1} = 5016{,}407 \text{ m}$$

$$X_4^{'} = X_1 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \cos \nu_{C1}^{1} = 2986{,}343 \text{ m}$$

$$Y_5^{'} = Y_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \sin \nu_{C1}^{1} = 5014{,}335 \text{ m}$$

$$X_5^{'} = X_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \cos \nu_{C1}^{1} = 2978{,}616 \text{ m}$$

$$Y_6^{'} = Y_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \sin \nu_{C1}^{1} = 5014{,}011 \text{ m}$$

$$X_6^{'} = X_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \cos \nu_{C1}^{1} = 2977{,}409 \text{ m}$$

$$Y_7^{'} = Y_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \sin \nu_{C1}^{1} = 5012{,}079 \text{ m}$$

$$X_7^{'} = X_1 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \cos \nu_{C1}^{1} = 2970{,}206 \text{ m}$$

$$Y_8^{'} = Y_7^{'}\ ;\ X_8^{'} = X_7^{'}$$

$$Y_9^{'} = Y_1 + (4{,}000 + 1{,}500) \cdot \sin \nu_{C1}^{1} = 5016{,}083 \text{ m}$$

$$X_9^{'} = X_1 + (4{,}000 + 1{,}500) \cdot \cos \nu_{C1}^{1} = 2985{,}136 \text{ m}$$

$$Y_{10}^{'} = Y_1 + 4{,}000 \cdot \sin \nu_{C1}^{1} = 5016{,}472 \text{ m}$$

$$X_{10}^{'} = X_1 + 4{,}000 \cdot \cos \nu_{C1}^{1} = 2986{,}585 \text{ m}$$

Vežba 5

***1. 2. a)* Računanje kota tačaka na profilu 2**

Kote tačaka u profilu 2 se računaju na isti način kao i u profilu 1.

$x = 7{,}457\text{m}$

Kote su:

$H_1 = 100{,}610$ m *(kota tačke na osovini puta u profilu 2)*

Ostale kote su:

$H_2^{"} =$; $H_3^{"} =$; $H_4^{"} =$

$H_5^{"} =$; $H_6^{"} =$; $H_7^{"} =$

$H_8^{"} =$; $H_9^{"} =$; $H_{10}^{"} =$

***1.2. b)* Računanje koordinata tačaka na profilu 2**

$$\nu_{C1}^2 = arctg\left(\frac{Y_2 - Y_{C1}}{X_2 - X_{C1}}\right) =$$

$$Y_2^{"} = Y_2 + 1{,}250 \cdot \sin\nu_{C1}^2 =$$

$$X_2^{"} = X_2 + 1{,}250 \cdot \cos\nu_{C1}^2 =$$

$$Y_3^{"} = Y_2 + (1{,}250 + 1{,}500) \cdot \sin\nu_{C1}^2 =$$

$$X_3^{"} = X_2 + (1{,}250 + 1{,}500) \cdot \cos\nu_{C1}^2 =$$

$$Y_4^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \sin\nu_{C1}^2 =$$

$$X_4^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \cos\nu_{C1}^2 =$$

$$Y_5^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \sin\nu_{C1}^2 =$$

$$X_5^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \cos\nu_{C1}^2 =$$

$$Y_6^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \sin\nu_{C1}^2 =$$

$$X_6^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \cos\nu_{C1}^2 =$$

$$Y_7^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \sin\nu_{C1}^2 =$$

$$X_7^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \cos\nu_{C1}^2 =$$

$$Y_8^{"} = Y_7^{"} \quad ; \quad X_8^{"} = X_7^{"}$$

$$Y_9^{"} = Y_2 + (4{,}000 + 1{,}500) \cdot \sin\nu_{C1}^2 =$$

$$X_9^{"} = X_2 + (4{,}000 + 1{,}500) \cdot \cos\nu_{C1}^2 =$$

$$Y_{10}^{"} = Y_2 + 4{,}000 \cdot \sin\nu_{C1}^2 =$$

$$X_{10}^{"} = X_2 + 4{,}000 \cdot \cos\nu_{C1}^2 =$$

3I ISTI KAO DRUGI

SAMO SE KORISTI TACKA 3

Vežba 5

1. 2. a) Računanje kota tačaka na profilu 2

Kote tačaka u profilu 2 se računaju na isti način kao i u profilu 1.

$x = 7{,}457$m

Kote su:

$H_1 = 100{,}610$ m *(kota tačke na osovini puta u profilu 2)*

Ostale kote su:

$H_2^{"} = 98{,}110$ m ; $H_3^{"} = 98{,}050$ m ; $H_4^{"} = 95{,}050$ m

$H_5^{"} = 94{,}730$ m ; $H_6^{"} = 92{,}230$ m ; $H_7^{"} = 91{,}932$ m

$H_8^{"} = 92{,}932$ m ; $H_9^{"} = 100{,}660$ m ; $H_{10}^{"} = 100{,}690$ m

1.2. b) Računanje koordinata tačaka na profilu 2

$$\nu_{C1}^{2} = arctg\left(\frac{Y_2 - Y_{C1}}{X_2 - X_{C1}}\right) = 180°37'36"$$

$$Y_2^{"} = Y_2 + 1{,}250 \cdot \sin\nu_{C1}^{2} = 5029{,}900 \text{ m}$$

$$X_2^{"} = X_2 + 1{,}250 \cdot \cos\nu_{C1}^{2} = 2987{,}494 \text{ m}$$

$$Y_3^{"} = Y_2 + (1{,}250 + 1{,}500) \cdot \sin\nu_{C1}^{2} = 5029{,}884 \text{ m}$$

$$X_3^{"} = X_2 + (1{,}250 + 1{,}500) \cdot \cos\nu_{C1}^{2} = 2985{,}994 \text{ m}$$

$$Y_4^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \sin\nu_{C1}^{2} = 5029{,}868 \text{ m}$$

$$X_4^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500) \cdot \cos\nu_{C1}^{2} = 2984{,}494 \text{ m}$$

$$Y_5^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \sin\nu_{C1}^{2} = 5029{,}777 \text{ m}$$

$$X_5^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000) \cdot \cos\nu_{C1}^{2} = 2976{,}495 \text{ m}$$

$$Y_6^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \sin\nu_{C1}^{2} = 5029{,}766 \text{ m}$$

$$X_6^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250) \cdot \cos\nu_{C1}^{2} = 2975{,}245 \text{ m}$$

$$Y_7^{"} = Y_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \sin\nu_{C1}^{2} = 5029{,}685 \text{ m}$$

$$X_7^{"} = X_2 + (1{,}250 + 1{,}500 + 1{,}500 + 8{,}000 + 1{,}250 + x) \cdot \cos\nu_{C1}^{2} = 2967{,}788 \text{ m}$$

$$Y_8^{"} = Y_7^{"} \quad ; \quad X_8^{"} = X_7^{"}$$

$$Y_9^{"} = Y_2 + (4{,}000 + 1{,}500) \cdot \sin\nu_{C1}^{2} = 5029{,}845 \text{ m}$$

$$X_9^{"} = X_2 + (4{,}000 + 1{,}500) \cdot \cos\nu_{C1}^{2} = 2983{,}244 \text{ m}$$

$$Y_{10}^{"} = Y_2 + 4{,}000 \cdot \sin\nu_{C1}^{2} = 5029{,}870 \text{ m}$$

$$X_{10}^{"} = X_2 + 4{,}000 \cdot \cos\nu_{C1}^{2} = 2984{,}744 \text{ m}$$

3I ISTI KAO DRUGI
SAMO SE KORISTI TACKA 3

ЛАБОРАТОРИЈА ЗА ГЕОДЕЗИЈУ

Vežba 5

2) **Računanje podataka za detaljno obeležavanje tačaka na kaskadama**

Stanica	Vizura	Y [m]	X [m]	v	Dužina
102		5026,453	2993,725		
	101	5000,000	3000,000		
	103	5057,439	2989,073		
Profil 1					
	6'	5014,011	2977,409		
	5'	5014,335	2978,616		
	9'	5016,083	2985,136		
	4'	5016,407	2986,343		
	10'	5016,472	2986,585		
	3'	5016,796	2987,792		
	2'	5017,184	2989,241		
	1'	5017,508	2990,448		
	7'	5012,079	2970,206		
	8'	5012,079	2970,206		

Vežba 5

2) **Računanje podataka za detaljno obeležavanje tačaka na kaskadama**

Stanica	Vizura	Y [m]	X [m]	v	Dužina
102		5026,453	2993,725		
	101	5000,000	3000,000	283°20'40"	27,187
	103	5057,439	2989,073	98°32'17"	31,333
Profil 1					
	6'	5014,011	2977,409	217°19'40"	20,519
	5'	5014,335	2978,616	218°43'51"	19,368
	9'	5016,083	2985,136	230°21'59"	13,465
	4'	5016,407	2986,343	233°41'26"	12,467
	10'	5016,472	2986,585	234°25'17"	12,272
	3'	5016,796	2987,792	238°26'04"	11,334
	2'	5017,184	2989,241	244°11'02"	10,297
	1'	5017,508	2990,448	249°52'46"	9,526
	7'	5012,079	2970,206	211°25'54"	27,564
	8'	5012,079	2970,206	211°25'54"	27,564

ЛАБОРАТОРИЈА ЗА ГЕОДЕЗИЈУ