

Slope stability analysis

Input data

Project

Task : IGHG podrobný průzkum: Bytová výstavba Kamenný vrch II - I. etapa
Part : ŘEZ D-D (reziduální parametry)
Author : I. POUL
Date : 13.02.2020

Settings

(input for current task)

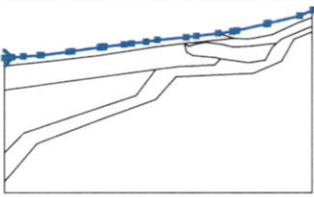
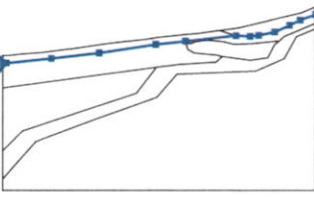
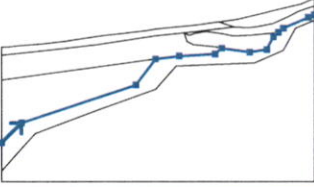
Stability analysis

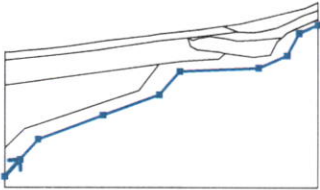
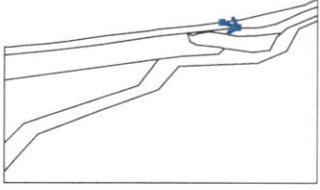
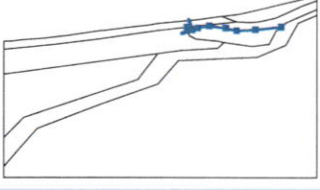
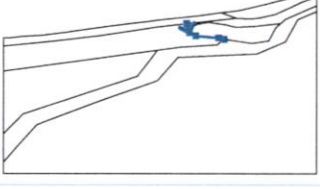
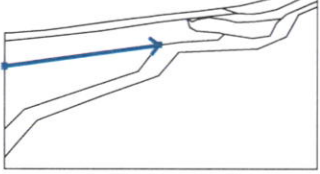
Earthquake analysis : Standard
Verification methodology : according to EN 1997
Design approach : 3 - reduction of actions (GEO, STR) and soil parameters

Partial factors on actions (A)					
Permanent design situation					
		State STR		State GEO	
		Unfavourable	Favourable	Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1,35 [-]	1,00 [-]	1,00 [-]	1,00 [-]
Variable actions :	$\gamma_Q =$	1,50 [-]	0,00 [-]	1,30 [-]	0,00 [-]
Water load :	$\gamma_w =$			1,00 [-]	


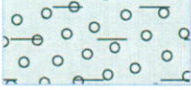


Partial factors for soil parameters (M)			
Permanent design situation			
Partial factor on internal friction :	$\gamma_\phi =$	1,25 [-]	
Partial factor on effective cohesion :	$\gamma_c =$	1,25 [-]	
Partial factor on undrained shear strength :	$\gamma_{cu} =$	1,40 [-]	



Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		0,00	33,90	3,62	34,15	8,54	34,63
		16,19	35,13	17,03	35,17	29,28	36,73
		30,93	36,94	43,51	38,77	44,67	38,90
		45,45	39,01	54,49	40,07	57,83	40,50
		64,38	41,28	69,47	42,08	82,77	43,39
		87,29	43,89	97,34	45,16	103,81	45,98
		105,75	46,35	119,16	49,51	120,00	49,71
		134,24	53,15	140,15	55,76		
2		0,00	30,43	1,77	30,55	21,94	32,56
		43,26	35,06	68,62	38,90	81,98	40,36
		104,54	42,85	110,84	42,58	114,71	43,02
		121,81	44,56	128,52	47,52	133,23	49,82
		140,15	52,34				
3		0,00	-8,98	8,97	0,00	60,16	16,92
		69,06	28,67	79,66	30,01	95,81	30,87
		98,70	33,48	111,28	31,78	118,94	32,88
		121,86	38,58	124,07	40,53	126,29	42,48
		137,42	47,21	140,15	48,31		

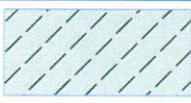
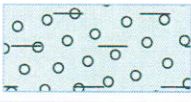
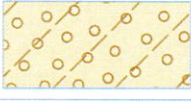



No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
4		0,00	-21,67	6,82	-13,98	14,92	-4,85
		44,03	6,06	69,15	15,06	78,28	25,42
		113,56	27,00	126,26	32,49	131,68	42,31
		140,15	45,88				
5		97,34	45,16	104,54	42,85		
6		81,98	40,36	84,28	39,19	86,78	40,06
		91,84	41,00	99,32	39,98	104,15	38,92
		112,52	39,29	124,07	40,53		
7		81,98	40,36	83,22	36,50	86,12	35,05
		96,31	34,15	98,70	33,48		
8		0,00	19,31	69,06	28,67		

Soil parameters - effective stress state

No.	Name	Pattern	Φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]
1	SVAHOVINA - prach		30,00	0,00	18,00
2	SVAHOVINA - sut'		35,00	5,00	18,00
3	PROLUVIUM 1		15,00	9,00	19,00
4	PROLUVIUM 2		18,00	21,00	20,50

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
5	SKÁLA 1		38,00	5,00	21,00
6	SKÁLA 2		45,00	10,00	21,00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	SVAHOVINA - prach		19,00		
2	SVAHOVINA - sut'		19,00		
3	PROLUVIUM 1		20,00		
4	PROLUVIUM 2		21,00		
5	SKÁLA 1		22,00		
6	SKÁLA 2		22,00		

Soil parameters

SVAHOVINA - prach

Unit weight : $\gamma = 18,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 30,00^\circ$
 Cohesion of soil : $c_{ef} = 0,00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 19,00 \text{ kN/m}^3$

SVAHOVINA - sut'

Unit weight : $\gamma = 18,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 35,00^\circ$
 Cohesion of soil : $c_{ef} = 5,00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 19,00 \text{ kN/m}^3$

PROLUVIUM 1

Unit weight : $\gamma = 19,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 15,00^\circ$
 Cohesion of soil : $c_{ef} = 9,00 \text{ kPa}$

Saturated unit weight : $\gamma_{\text{sat}} = 20,00 \text{ kN/m}^3$

PROLUVIUM 2

Unit weight : $\gamma = 20,50 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{\text{ef}} = 18,00^\circ$
 Cohesion of soil : $c_{\text{ef}} = 21,00 \text{ kPa}$
 Saturated unit weight : $\gamma_{\text{sat}} = 21,00 \text{ kN/m}^3$

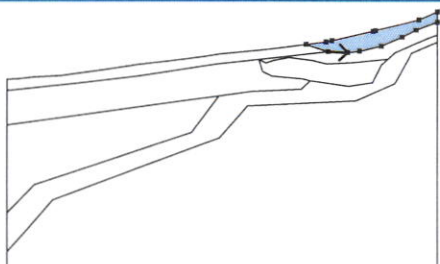
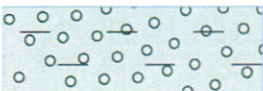
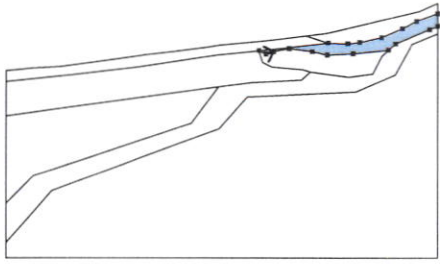

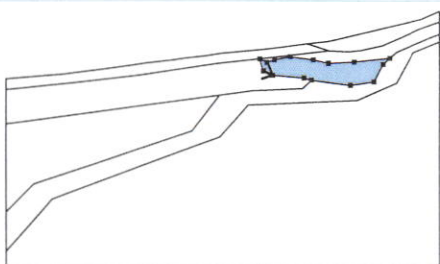
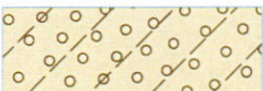
SKÁLA 1

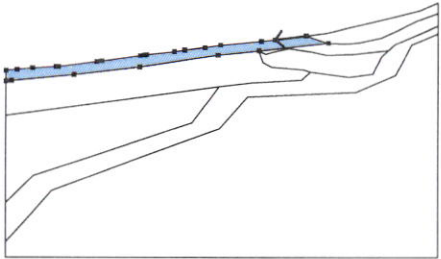

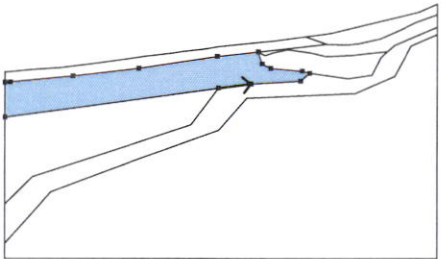

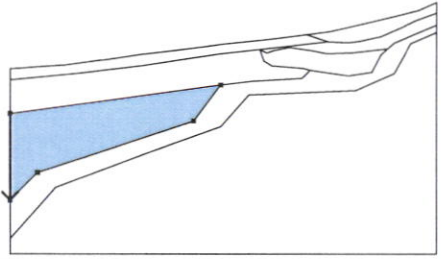

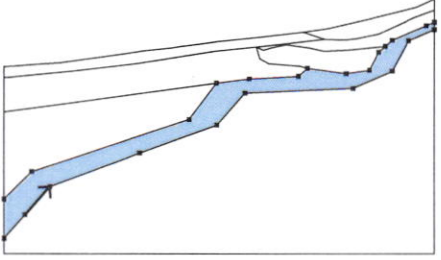

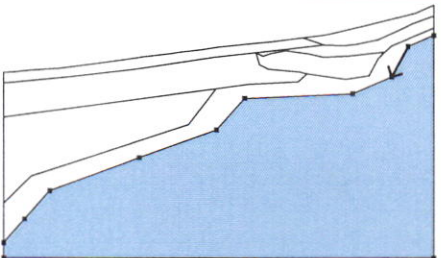

Unit weight : $\gamma = 21,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{\text{ef}} = 38,00^\circ$
 Cohesion of soil : $c_{\text{ef}} = 5,00 \text{ kPa}$
 Saturated unit weight : $\gamma_{\text{sat}} = 22,00 \text{ kN/m}^3$

SKÁLA 2

Unit weight : $\gamma = 21,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{\text{ef}} = 45,00^\circ$
 Cohesion of soil : $c_{\text{ef}} = 10,00 \text{ kPa}$
 Saturated unit weight : $\gamma_{\text{sat}} = 22,00 \text{ kN/m}^3$

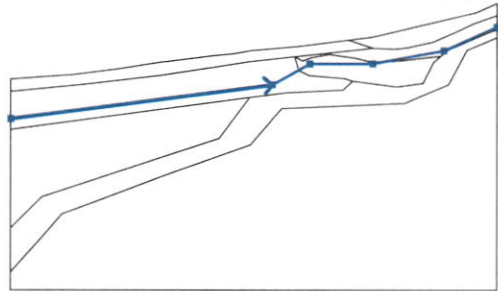
Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		104,54	42,85	110,84	42,58	SVAHOVINA - sut' 
		114,71	43,02	121,81	44,56	
		128,52	47,52	133,23	49,82	
		140,15	52,34	140,15	55,76	
		134,24	53,15	120,00	49,71	
		119,16	49,51	105,75	46,35	
		103,81	45,98	97,34	45,16	
2		84,28	39,19	86,78	40,06	PROLUVIUM 1 
		91,84	41,00	99,32	39,98	
		104,15	38,92	112,52	39,29	
		124,07	40,53	126,29	42,48	
		137,42	47,21	140,15	48,31	
		140,15	52,34	133,23	49,82	
		128,52	47,52	121,81	44,56	
		114,71	43,02	110,84	42,58	
3		104,54	42,85	81,98	40,36	PROLUVIUM 2 
		83,22	36,50	86,12	35,05	
		96,31	34,15	98,70	33,48	
		111,28	31,78	118,94	32,88	
		121,86	38,58	124,07	40,53	
		112,52	39,29	104,15	38,92	
		99,32	39,98	91,84	41,00	
		86,78	40,06	84,28	39,19	

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
4		97,34	45,16	87,29	43,89	SVAHOVINA - prach 
		82,77	43,39	69,47	42,08	
		64,38	41,28	57,83	40,50	
		54,49	40,07	45,45	39,01	
		44,67	38,90	43,51	38,77	
		30,93	36,94	29,28	36,73	
		17,03	35,17	16,19	35,13	
		8,54	34,63	3,62	34,15	
		0,00	33,90	0,00	30,43	
		1,77	30,55	21,94	32,56	
		43,26	35,06	68,62	38,90	
		81,98	40,36	104,54	42,85	
5		69,06	28,67	79,66	30,01	PROLUVIUM 1 
		95,81	30,87	98,70	33,48	
		96,31	34,15	86,12	35,05	
		83,22	36,50	81,98	40,36	
		68,62	38,90	43,26	35,06	
		21,94	32,56	1,77	30,55	
		0,00	30,43	0,00	19,31	
6		0,00	19,31	0,00	-8,98	PROLUVIUM 2 
		8,97	0,00	60,16	16,92	
		69,06	28,67			
7		6,82	-13,98	14,92	-4,85	SKÁLA 1 
		44,03	6,06	69,15	15,06	
		78,28	25,42	113,56	27,00	
		126,26	32,49	131,68	42,31	
		140,15	45,88	140,15	48,31	
		137,42	47,21	126,29	42,48	
		124,07	40,53	121,86	38,58	
		118,94	32,88	111,28	31,78	
		98,70	33,48	95,81	30,87	
		79,66	30,01	69,06	28,67	
		60,16	16,92	8,97	0,00	
		0,00	-8,98	0,00	-21,67	
8		131,68	42,31	126,26	32,49	SKÁLA 2 
		113,56	27,00	78,28	25,42	
		69,15	15,06	44,03	6,06	
		14,92	-4,85	6,82	-13,98	
		0,00	-21,67	0,00	-26,67	
		140,15	-26,67	140,15	45,88	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [m]					
		x	z	x	z	x	z
1		0,00	22,47	75,46	32,42	86,24	38,33
		104,36	38,39	124,89	42,10	140,15	48,96

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1 (stage 1)

Polygonal slip surface

Coordinates of slip surface points [m]									
x	z	x	z	x	z	x	z	x	z
12,16	34,87	12,45	34,69	23,78	27,75	60,57	32,56	78,76	37,43
90,84	44,23	91,09	44,37						

Analysis of the slip surface without optimization.

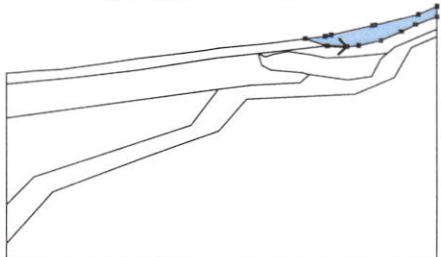
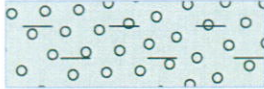
Slope stability verification (Sarma)

Utilization : 38,0 %

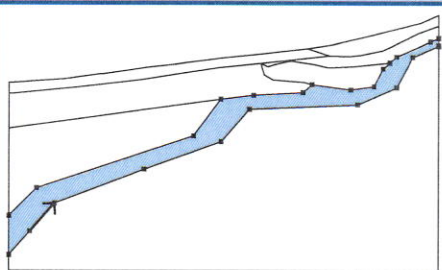

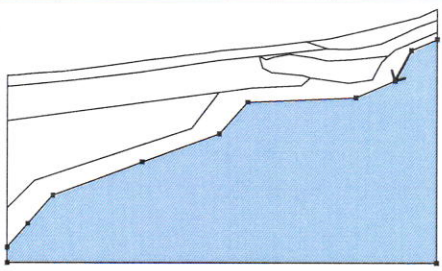
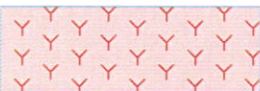
Slope stability ACCEPTABLE

Input data (Stage of construction 2)

Assigning and surfaces

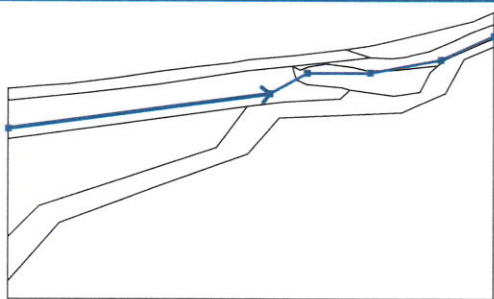
No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		104,54	42,85	110,84	42,58	SVAHOVINA - sut' 
		114,71	43,02	121,81	44,56	
		128,52	47,52	133,23	49,82	
		140,15	52,34	140,15	55,76	
		134,24	53,15	120,00	49,71	
		119,16	49,51	105,75	46,35	
		103,81	45,98	97,34	45,16	

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
2		84,28	39,19	86,78	40,06	PROLUVIUM 1
		91,84	41,00	99,32	39,98	
		104,15	38,92	112,52	39,29	
		124,07	40,53	126,29	42,48	
		137,42	47,21	140,15	48,31	
		140,15	52,34	133,23	49,82	
		128,52	47,52	121,81	44,56	
		114,71	43,02	110,84	42,58	
		104,54	42,85	81,98	40,36	
3		83,22	36,50	86,12	35,05	PROLUVIUM 2
		96,31	34,15	98,70	33,48	
		111,28	31,78	118,94	32,88	
		121,86	38,58	124,07	40,53	
		112,52	39,29	104,15	38,92	
		99,32	39,98	91,84	41,00	
		86,78	40,06	84,28	39,19	
		81,98	40,36			
4		97,34	45,16	87,29	43,89	SVAHOVINA - prach
		82,77	43,39	69,47	42,08	
		64,38	41,28	57,83	40,50	
		54,49	40,07	45,45	39,01	
		44,67	38,90	43,51	38,77	
		30,93	36,94	29,28	36,73	
		17,03	35,17	16,19	35,13	
		8,54	34,63	3,62	34,15	
		0,00	33,90	0,00	30,43	
		1,77	30,55	21,94	32,56	
		43,26	35,06	68,62	38,90	
		81,98	40,36	104,54	42,85	
5		69,06	28,67	79,66	30,01	PROLUVIUM 1
		95,81	30,87	98,70	33,48	
		96,31	34,15	86,12	35,05	
		83,22	36,50	81,98	40,36	
		68,62	38,90	43,26	35,06	
		21,94	32,56	1,77	30,55	
		0,00	30,43	0,00	19,31	
6		0,00	19,31	0,00	-8,98	PROLUVIUM 2
		8,97	0,00	60,16	16,92	
		69,06	28,67			

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
7		6,82	-13,98	14,92	-4,85	SKÁLA 1 
		44,03	6,06	69,15	15,06	
		78,28	25,42	113,56	27,00	
		126,26	32,49	131,68	42,31	
		140,15	45,88	140,15	48,31	
		137,42	47,21	126,29	42,48	
		124,07	40,53	121,86	38,58	
		118,94	32,88	111,28	31,78	
		98,70	33,48	95,81	30,87	
		79,66	30,01	69,06	28,67	
		60,16	16,92	8,97	0,00	
		0,00	-8,98	0,00	-21,67	
8		131,68	42,31	126,26	32,49	SKÁLA 2 
		113,56	27,00	78,28	25,42	
		69,15	15,06	44,03	6,06	
		14,92	-4,85	6,82	-13,98	
		0,00	-21,67	0,00	-26,67	
		140,15	-26,67	140,15	45,88	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [m]					
		x	z	x	z	x	z
1		0,00	22,47	75,46	32,42	86,24	38,33
		104,36	38,39	124,89	42,10	140,15	48,96

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 2)

Analysis 1 (stage 2)

Polygonal slip surface

Coordinates of slip surface points [m]									
x	z	x	z	x	z	x	z	x	z
73,28	42,46	73,54	42,44	94,61	41,14	110,95	41,62	124,47	45,05
Analysis of the slip surface without optimization.									

Coordinates of slip surface points [m]							
x	z	x	z	x	z	x	z
134,63	53,08	135,32	53,63				
Analysis of the slip surface without optimization.							

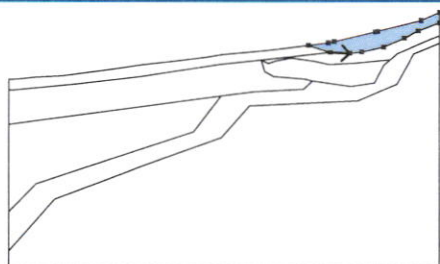
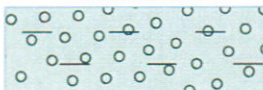
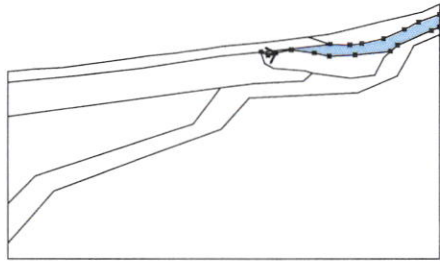

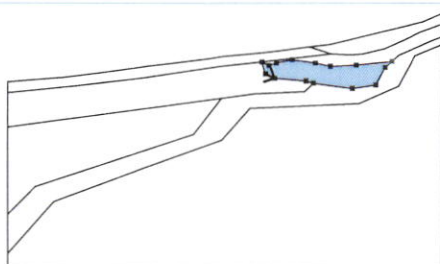

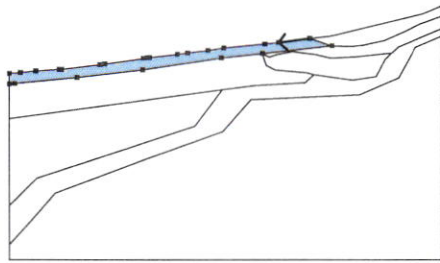

Slope stability verification (Sarma)

Utilization : 47,4 %

Slope stability ACCEPTABLE

Input data (Stage of construction 3)

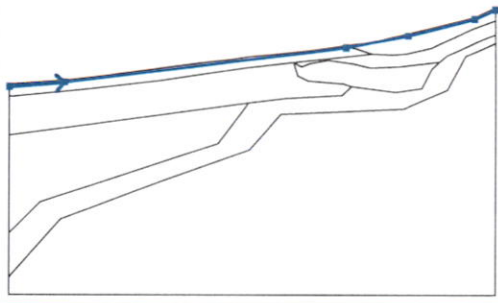
Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		104,54	42,85	110,84	42,58	SVAHOVINA - suť 
		114,71	43,02	121,81	44,56	
		128,52	47,52	133,23	49,82	
		140,15	52,34	140,15	55,76	
		134,24	53,15	120,00	49,71	
		119,16	49,51	105,75	46,35	
		103,81	45,98	97,34	45,16	
2		84,28	39,19	86,78	40,06	PROLUVIUM 1 
		91,84	41,00	99,32	39,98	
		104,15	38,92	112,52	39,29	
		124,07	40,53	126,29	42,48	
		137,42	47,21	140,15	48,31	
		140,15	52,34	133,23	49,82	
		128,52	47,52	121,81	44,56	
3		114,71	43,02	110,84	42,58	PROLUVIUM 2 
		104,54	42,85	81,98	40,36	
		83,22	36,50	86,12	35,05	
		96,31	34,15	98,70	33,48	
		111,28	31,78	118,94	32,88	
		121,86	38,58	124,07	40,53	
		112,52	39,29	104,15	38,92	
4		99,32	39,98	91,84	41,00	SVAHOVINA - prach 
		86,78	40,06	84,28	39,19	
		81,98	40,36			
		97,34	45,16	87,29	43,89	
		82,77	43,39	69,47	42,08	
		64,38	41,28	57,83	40,50	
		54,49	40,07	45,45	39,01	
		44,67	38,90	43,51	38,77	
		30,93	36,94	29,28	36,73	
		17,03	35,17	16,19	35,13	
		8,54	34,63	3,62	34,15	
		0,00	33,90	0,00	30,43	

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
5		69,06	28,67	79,66	30,01	PROLUVIUM 1
		95,81	30,87	98,70	33,48	
		96,31	34,15	86,12	35,05	
		83,22	36,50	81,98	40,36	
		68,62	38,90	43,26	35,06	
		21,94	32,56	1,77	30,55	
		0,00	30,43	0,00	19,31	
6		0,00	19,31	0,00	-8,98	PROLUVIUM 2
		8,97	0,00	60,16	16,92	
		69,06	28,67			
7		6,82	-13,98	14,92	-4,85	SKÁLA 1
		44,03	6,06	69,15	15,06	
		78,28	25,42	113,56	27,00	
		126,26	32,49	131,68	42,31	
		140,15	45,88	140,15	48,31	
		137,42	47,21	126,29	42,48	
		124,07	40,53	121,86	38,58	
		118,94	32,88	111,28	31,78	
		98,70	33,48	95,81	30,87	
		79,66	30,01	69,06	28,67	
		60,16	16,92	8,97	0,00	
8		0,00	-8,98	0,00	-21,67	SKÁLA 2
		131,68	42,31	126,26	32,49	
		113,56	27,00	78,28	25,42	
		69,15	15,06	44,03	6,06	
		14,92	-4,85	6,82	-13,98	
		0,00	-21,67	0,00	-26,67	
		140,15	-26,67	140,15	45,88	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [m]					
		x	z	x	z	x	z
1		0,00	33,25	15,88	34,62	97,09	44,64
		115,00	47,93	134,15	52,67	140,15	55,28

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 3)

Analysis 1 (stage 3)

Polygonal slip surface

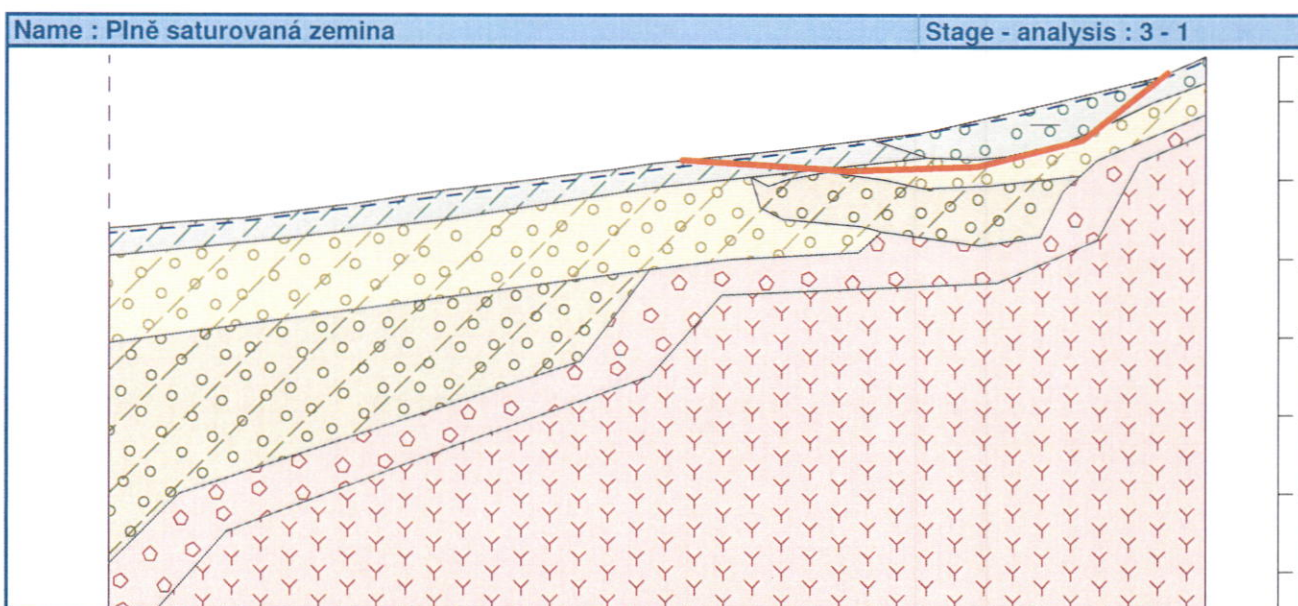
Coordinates of slip surface points [m]									
x	z	x	z	x	z	x	z	x	z
73,28	42,46	73,54	42,44	94,61	41,14	110,95	41,62	124,47	45,05
134,63	53,08	135,32	53,63						

Analysis of the slip surface without optimization.

Slope stability verification (Sarima)

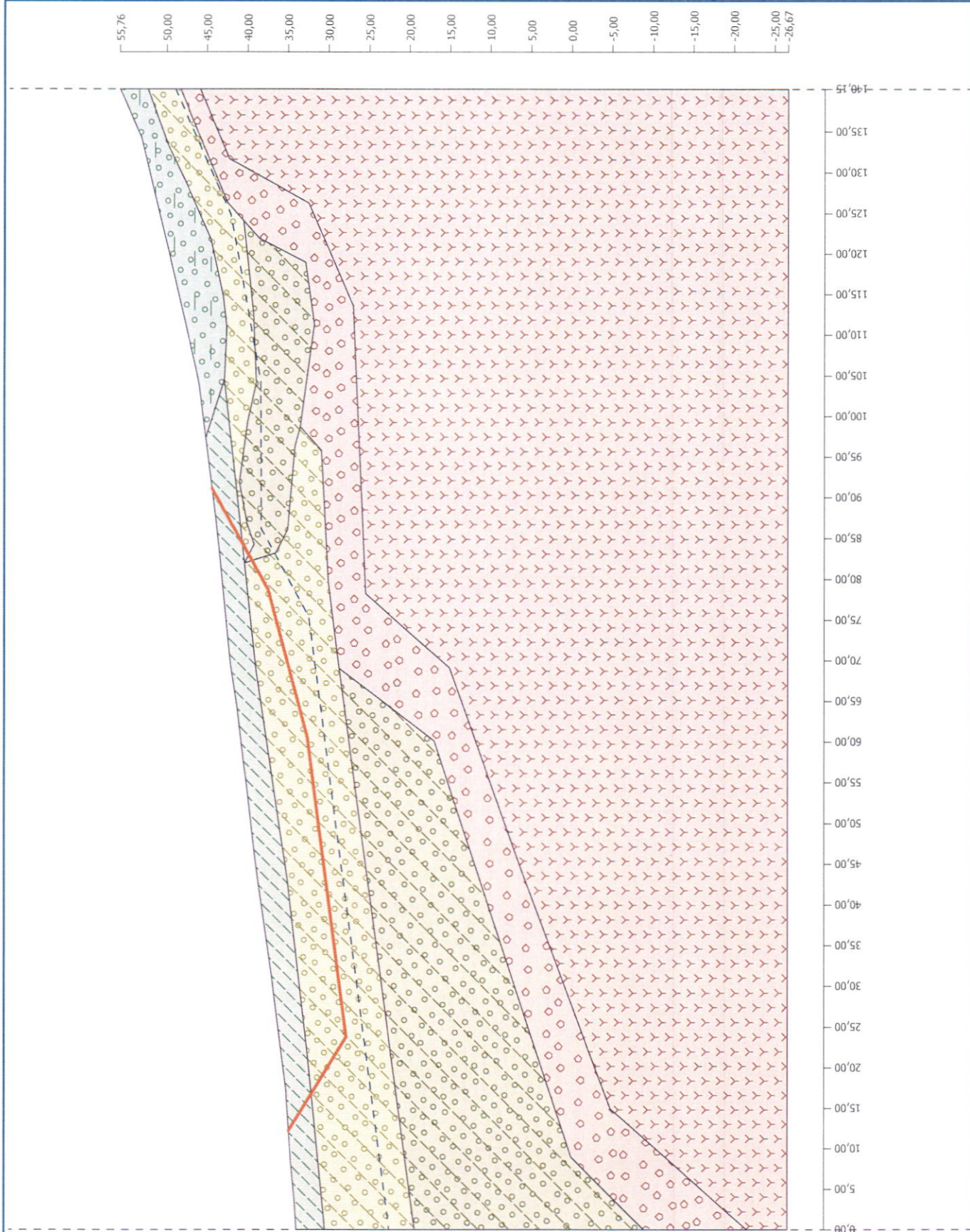
Utilization : 74,7 %

Slope stability ACCEPTABLE



Name :

Stage - analysis : 1 - 1



Analysis of the slip surface without optimization.

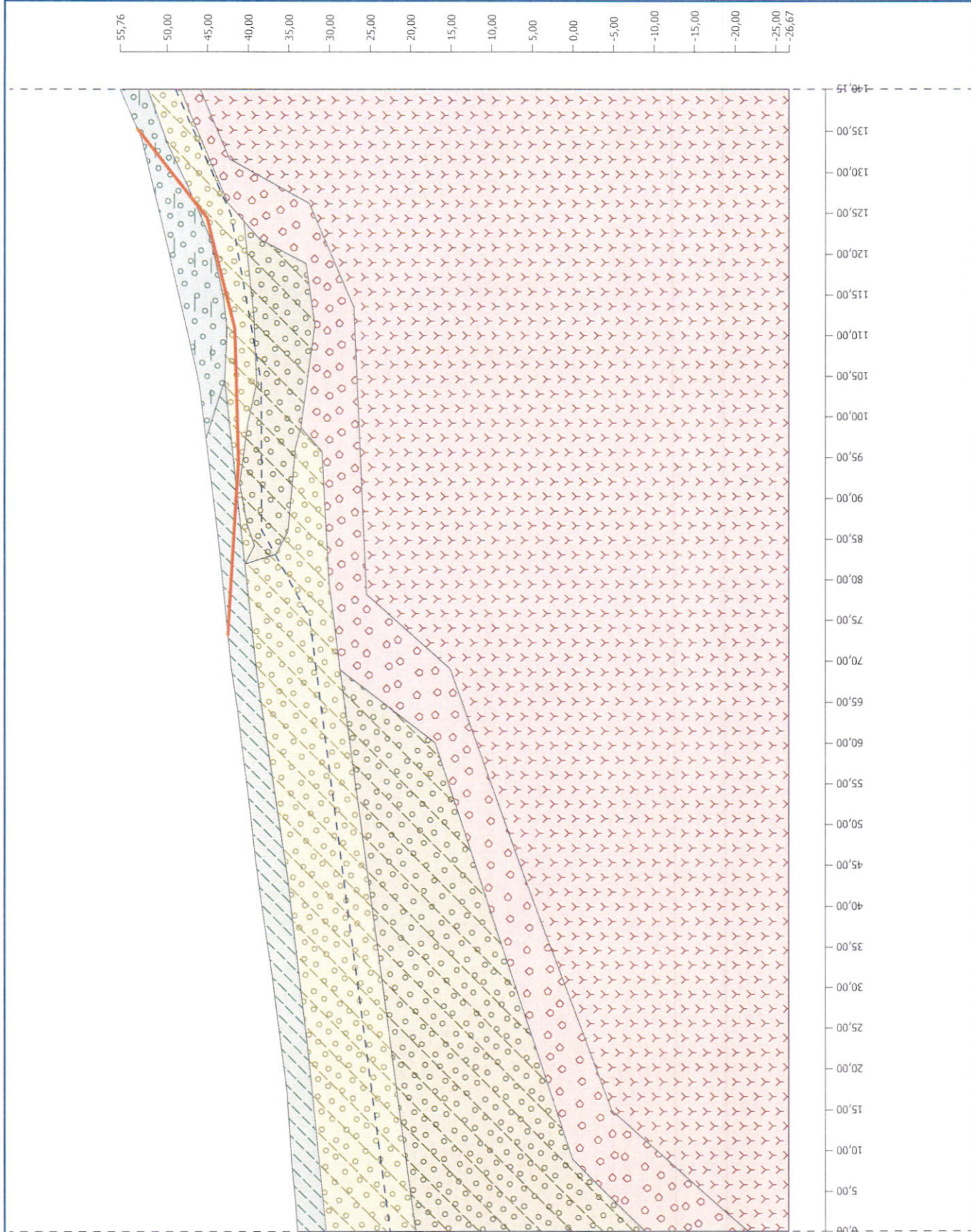
Slope stability verification (Sarma)

Utilization : 38,0 %

Slope stability ACCEPTABLE

Name :

Stage - analysis : 2 - 1



Analysis of the slip surface without optimization.

Slope stability verification (Sarma)

Utilization : 47,4 %

Slope stability **ACCEPTABLE**