

## S.1. NASLOVNA STRAN

Načrt in številčna oznaka načrta:

### 8 NAČRT IZKOPA IN OSNOVNE PODGRADNJE ZA PODZEMNE OBJEKTE

Naročnik: Stanovanjski sklad Republike Slovenije, javni sklad  
Poljanska cesta 31  
1000 Ljubljana

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Ime oz. firma in sedež naročnika:

Objekt:	<b>»STANOVANJSKA SOSESKA NOVO BRDO V OBMOČJU UREJANJA OPPN 252, FUNKCIONALNA ENOTA E3« Zaščita gradbene jame</b>
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Vrsta projektne dokumentacije: Projekt PZR  
Za gradnjo: NOVA GRADNJA

Odgovorni vodja projekta: Aljoša Dekleva, univ. dipl. inž. arh.  
IZS A-1117

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Izdelovalec: GEOEKSPERT  
PODJETJE ZA UPORABNO GEOTEHNIKO  
Igor Resanovič univ.dipl.inž.rud. in geotehnol. s.p.  
Ob Koprivnici 57, 3000 Celje

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Ob Koprivnici 57  
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Odgovorna oseba projektanta: Igor Resanovič univ.dipl.inž.rud. in geotehnol.  
IZS RG-0031

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Odgovorni projektant: Igor Resanovič univ.dipl.inž.rud. in geotehnol.  
IZS RG-0031

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Številka projekta: 118/16 – E3  
Številka načrta: 8/118/16 – E3  
Datum izdelave načrta: Celje, April 2018

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Številka, kraj in datum izdelave načrta:

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## S.2. KAZALO VSEBINE NAČRTA

Objekt: **»STANOVANJSKA SOSESKA NOVO BRDO V OBMOČJU UREJANJA OPPN 252, FUNKCIONALNA ENOTA E3 – Zaščita gradbene jame«**

Vrsta projektne dokumentacije: **Načrt izkopa in osnove podgradnje za podzemne objekte**

Št.:	Dokument:	Id. oznaka:
Št. mape:	118/16 – E3	
	Naslovna stran	S.1
	Kazalo vsebine načrta	S.2.
	Tehnično poročilo	T.
	Risbe	G
	Situacija	G.1
	Prečni prerez - jug	G.2
	Prečni prerez - zahod	G.3
	Prečni prerez - vzhod	G.4
	Geostatični izračuni	P.
	Geostatični izračuni	P.1.-P.6.

Objekt: **»STANOVANJSKA SOSESKA NOVO BRDO V OBMOČJU UREJANJA OPPN 252,  
FUNKCIONALNA ENOTA E3 – Zaščita gradbene jame«**

Vrsta projektne dokumentacije: **Načrt izkopa in osnovne podgradnje za podzemne objekte**

## **T. TEHNIČNO POROČILO**

## 1 UVOD

S strani naročnika smo dobili naročilo za izdelavo PZR projekta za zaščito gradbene jame na objektu v stanovanjski soseski Novo Brdo v območju urejanja OPPN 252, funkcionalne enote E3. Samo območje varovanja gradbene jame je z ene strani omejeno s cesto Pot Rdečega križa, z druge strani se dviguje brežina od 7,00 do 9,00 m visoka obstoječa brežina, drugače gre za gradbišče.

Položaj infrastrukture (komunalni vodi, kanalizacija itd.), je potrebno še enkrat preveriti na lokaciji terena glede na vrisane geotehnične ukrepe s strani pooblašene organizacije. Eventualna premestitev komunalnih vodov ni predmet tega projekta.

Geodetske osnove za izdelavo projekta zaščite gradbene jame je posredoval naročnik.

Ta projekt obravnava izvedbo zaščite gradbene jame funkcionalne enote E3, pri čemer se upošteva varnost po Eurocodu 7. Dane geološko geotehnični podatki so bili povzeti na podlagi Poročila o geološko – geomehanskih in hidroloških raziskavah (št. Načrta ic 209/17, 17.5.2017).



SLIKA 1: OBMOČJE ZAŠČITE GRADBENE JAME

## 2 OPIS OBSTOJEČEGA STANJA

Na lokaciji, kjer bo potekala izgradnja predvidenega novega objekta bo zaradi garažne hiše, potrebno izvesti izkop do cca 5,00 m globoko, zato bo potrebno narediti zaščito brežin gradbene jame pred porušitvijo.

Obravnavana lokacija se nahaja na območju opuščenega glinokopa. Na severni strani je območje omejeno s funkcionalno enoto E2, na vzhodni strani je teren porasel z grmičevjem, na zahodni strani je omejen s Potjo rdečega križa. Teren je v večini raven. Trenutno to območje ni v uporabi, služi večinoma kot odlagališče gradbenega materiala.

Za zaščito gradbene jame smo na podlagi geološko geomehanskih razmer predvideli izvedbo odprtega izkopa v naklonu 1:2, kjer to omogoča prostor kjer pa to ni mogoče bomo zaščito izvedli z zagatnicami in sicer na zahodnem delu samo zagatnice dolžine 10,00 m na vzhodni strani pa bo vsaka četrta zagatnica, dolžine 8,00 m še sidrana na globini -2,00m. Zaščita gradbene jame bo odmaknjena za 1,00 m od objekta, kjer je to mogoče ter bo potekala naokoli funkcionalne enote E3. Natančen potek zaščite gradbene jame je prikazan v risbi Situacija, G.1. Odmik zaščite od roba gradbene jame je podal naročnik.

## 3 GEOLOŠKO – GEOTEHNIČNE RAZMERE

Izdelano je bilo Poročila o geološko – geomehanskih in hidroloških raziskavah (št. Načrta ic 209/17, 17.5.2017). Same raziskave so obsegale 15 sondažnih vrtin v vrtinah so bili izvedeni tudi standardni penetracijski preizkusi (128 kom), izvedbo meritev z Menardovim presiometrom (30 kom), meritve dinamične oz. statične penetracije DP/CPT (5 kom), meritve nosilnosti tal CBR v razkopih (10 kom), geološko-geotehnična spremljava vrtalnih del in razkopov, preiskave vzorcev zemljin v geomehanskem laboratoriju, izdelavo treh piezometrov, izvedbo hidravličnih poskusov v piezometrih (3 × večstopenjski črpalni, 3 × daljši črpalni poskus, 2 × ponikovalni poskus) ter vgradnjo piezometrijskih sond za kontinuirano merjenje nivoja podzemne vode v obdobju 9 mesecev.

Karakteristične vrednosti geomehanskih parametrov posameznih plasti so podane v Geotehničnem poročilu in sicer so sledeče:

Geološka plast	Prostor. teža	Kohezija	Strižni kot
	$\gamma$	c	$\varphi$
	[ kN/m <sup>3</sup> ]	[ kN/m <sup>2</sup> ]	[ ° ]
Prodnat nasip	20	0	28-33
Meljno peščene zemljine	19	6,5	18,4
Prodno peščene zemljine	21	0	39

Za potrebe projektiranja smo privzeli konzervativne vrednosti.

IG0 = nasip glinastega in meljastega proda in grušča s plastmi gline

IG1 = sloj gline s prehodi v melje in meljaste peske

IG2 = peščene, meljaste in glinasti srednje do zelo gosti prodi

## 4 PROJEKTNE OSNOVE

Projekt novo gradnjo stanovanjske soseske Novo Brdo v območju urejene OPPN 252, funkcionalne enote E3 za vsebuje naslednje elemente:

- Projekt za zaščito gradbene jame za potrebe garažne hiše.

Glede na razpoložljive podatke menimo, da je potrebno zaščito gradbene jame izvesti tako, da bo zagotovljena varnost ter da bodo pomiki v skladu s projektiranjem po Eurocodu 7. Zato na podlagi geotehničnega poročila predvidimo za zaščito gradbene jame naslednje ukrepe:

- Južni del: odprti izkop v naklonu 1:2
- Vzhodni del: Zagatnice dolžine 8m, vsaka četrta zagatnica je sidrana s sidrom dolžine 12m (ob obstoječi brežini)
- Zahodni del: Zagatnice dolžine 10m
- Severni del: Odprti izkop v naklonu 1:3 (meja z nadaljevanjem gradnje sklopa E2)

## 5 FAZE IZVEDBE

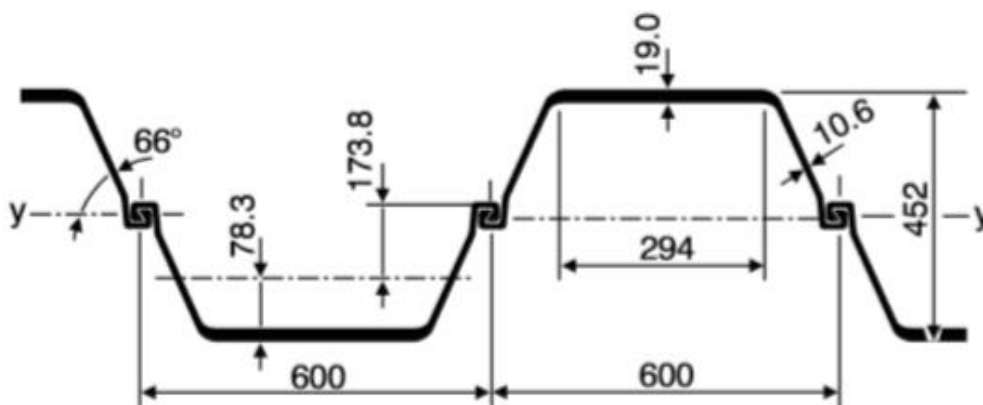
Celotno območje bo razdeljeno na tri dele i sicer bosta severni in južni izkop obsegala odprti izkop, medtem ko bo vzhodni del obsegal zagatnice in sidra, zahodni del pa samo zagatnice.

Dela pri zaščiti gradbene jame se izvajajo po naslednjem vrstnem redu:

- Izvede se geodetska zakoličba poteka osi zaščite gradbene jame (zakoličbo naj izvajalec potrdi z vpisom v gradbeni dnevnik).
- Izvajalec mora pred pričetkom izvedbe preveriti lokacijo in potek vseh komunalnih in energetskih vodov tako, da ustrezne pooblašene organizacije (upravljavci oziroma pogodbeni vzdrževalci) potrdijo potek le teh. Prestavitev le teh ni predmet tega projekta.

### 5.1 ZAGATNICE – ZAHODNI DEL

Izvajalec naj uporabi zagatnice Larssen tipa 607 n ali tip, ki ima vsaj enake nosilne karakteristike, vendar ga mora najprej odobriti geotehnični nadzor.



	W <sub>y</sub> cm <sup>2</sup>	W <sub>y</sub> cm <sup>2</sup>	kg/m	cm <sup>2</sup>	cm	m <sup>2</sup> /m	S <sub>y</sub> cm <sup>3</sup>	I <sub>y</sub> cm <sup>4</sup>	I <sub>y</sub> cm	Steel grades				
										S240GP	S270GP	S355GP	S390GP	S430GP
Wall	3200	3620	190	241.7	293	2.93	1810	72320	17.30	2	2	2	2	2
E	649	–	114	145.0	203	1.91	–	11280	8.73	–	–	–	–	–
D	3840	–	228	290.0	380	3.67	–	86790	17.30	–	–	–	–	–
Dr	4330	–	342	435.0	554	5.43	–	119400	16.55	–	–	–	–	–

Gradbeno jamo je potrebno predhodno zaščititi z zagatnicami tip 607 n dolžine 10 m, ki morajo biti zabite v tla do višine obstoječe površine oziroma vsaj 5 m pod nivo izkopa. Zagatnice se izvedejo pred začetkom izkopnih del. Izvajalec lahko vgradi tudi daljše zagatnice, vendar naj jih vgradi samo do

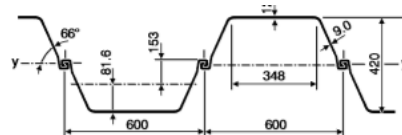
predvidene globine. Pred pričetkom izvedbe zagatne stene je potrebno izvesti poskusno zabijanje za določitev optimalnega načina zabijanja zagatnic.

Zagatnice je nujno izvesti po pravilu stroke oziroma jih pravilno zakleniti .

## 5.2 SIDRANE ZAGATNICE – VZHODNI DEL

Izvajalec naj uporabi zagatnice Larssen tipa 605 ali tip, ki ima vsaj enake nosilne karakteristike, vendar ga mora najprej odobriti geotehnični nadzor. Zagatnice so dolžine 8,00 m. Pri čemer je vsaka četrta zagatnica sidrana, kar pomeni na 2,40 m. Gre za IBO sidra nosilnosti 350 kN, dolžine 12 m, pod kotom 5° na globini -2,00 m.

### LARSEN 605



Wall	2020	2340	139.2	177.3	290	2.90	1170	42420	15.47	2	2	2	2	3
E	520	—	83.5	106.4	200	1.88	—	7910	8.62	—	—	—	—	—
D	2420	—	167.0	212.8	374	3.62	—	50900	15.47	—	—	—	—	—
Dr	2790	—	250.5	319.2	548	5.36	—	70510	14.86	—	—	—	—	—

Pred pričetkom izvedbe zagatne stene je potrebno izvesti poskusno zabijanje za določitev optimalnega načina zabijanja zagatnic.

Zagatnice je nujno izvesti po pravilu stroke oziroma jih pravilno zakleniti .

## 5.3 SEVERNI IN JUŽNI DEL – ODPRTI IZKOP

Južni del zaščite gradbene jame se izkoplje v naklonu 1:2, medtem ko se proti severnemu delu izvaja izkop v naklonu 1:3. Izkop je potrebno izvesti pod nadzorom in skladno z navodili geotehničnega nadzora. Predvidevamo da bo brežina med fazama E2 in E3 bila odprta daljši čas.

## 5.4 IZKOPI

Razen kjer je to določeno z projektom se lahko izkopi pri izvedbi začasne zaščite gradbene jame se izvajajo z uporabo težke gradbene mehanizacije. Izkop in odvažanje izkopenine je možno izvajati na več načinov, odvisen pa je od možnosti dostopa, razpoložljivega prostora, omejitev za gradbena dela na naseljenem območju ter drugih pogojev.

Pri izvedbi izkopa mora Izvajalec po celotnem obodu gradbene jame predvideti, da bo za vgradnjo zaščitnih elementov potreboval vsaj 10 m širok plato na nivoju vgradnje zaščitnih elementov. Plato se mora po končani izvedbi zaščitnih elementov odstraniti.

Izkop se lahko izvede samo takrat, ko je zagatna stena izdelana po celotnem obodu. Izkop naj se izvede najprej do globine 2 m, preostali izkop naj se izvede tako, da se v gradbeni jami izkop razporedi približno na četrtine, vsaka v dolžini 10 m in celotni širini. Najprej naj se izvede prva in tretja četrtina izkopa, nato pa naj se opazuje odziv zagatne stene oziroma njene pomike. Če so v mejah normale, bo s soglasjem geotehničnega nadzora dovoljen izkop do končne kote po celotni gradbeni jami.

Izkopi se bodo izvajali v zemljini II. In III. Zemeljske kategorije. Voda naj se iz gradbene jame črpa v kolikor se le ta pojavi.

## 6 GEOSTATIČNI IZRAČUN

Izvedeni so bili trije izračuni in sicer s programoma Slide in Larix:

1. Preverba situacije odprte izkopa v naklonu 1:2 in naklon 2:3. Ugotovili smo sledeče in sicer da pri izkopu 2:3 se nam pojavijo površinske porušnice, kar bi zahtevalo dodaten ukrep in sicer bi morali površje izkopa zaščititi s torketom. Če pa je naklon odprtega izkopa 1:2 ni potreben dodaten izkop in so tudi površinske porušnice zadovoljive.
2. Preverba če so potrebna sidra na strani kjer se dviguje obstoječa brežina 7,0 do 9,0 m. Ko smo predpostavili, da ne bi bila sidrana vsaka četrta zagatnica, smo dobili nezadovoljivo varnost, ki je zahtevana po Evrocode 7. Ko smo dodali IBO sidro na vsako četrto zagatnico, smo dobili varnost  $>1,0$  kot je to zahtevano.
3. Pri preverbi ali so 10.0 m dolge zagatnice zadovoljiva zaščita na zahodni strani, smo ugotovili, da je varnost primerna.

Vsi izračuni so razvidni iz prilog.

## 7 MONITORING

Med samo zaščito gradbene jame je potrebno spremljati pomike zagate stene. V ta namen se na zagatno steno pritrdijo repne točke za geodetsko opazovanje premikov. Skupno predvidevamo vgradnjo 5 reperjev.

Ničelno meritev na točkah na objektih je potrebno izvesti pred začetkom izkopa. Prav tako je potrebno pred pričetkom gradnje izvesti popis stanja vseh objektov, vključno z najbližjimi komunalnimi vodi. Na objektih je potrebno izvesti vsaj en do dva repera za določanje pomikov. Med izvajanjem izkopa je potrebno izvesti vsaj 6 meritev na bližnjih objektih, po potrebi pa več.

Geodetsko opazovanje repnih točk se mora izvajati redno. V nadaljevanju naj se meritve vršijo po enem tednu, po dveh tednih in nato enkrat mesečno. Meritve se naj izvajajo do zapiranja 2/3 gradbene jame. V primeru, da se opazijo oziroma evidentirajo premiki, je potrebno meritve zgostiti.

## 8 POSEBNI VARNOSTNI UKREPI

Razen običajnih varnostnih ukrepov pri izvajanju tovrstnih objektov je skladno z napredovanjem izkopov in izvedbi gradbenih del v gradbeni jami nujno upoštevati še:

- pri izkopu je nujno pregledovati površino brežine, da ne pride do lokalnih previsov, vsa brežina mora biti v naklonu =  $90^\circ$ , razen odprtega izkopa, ki je v nagibu 1:2
- na dnu gradbene jame morajo biti delavci ustrezno zaščiteni pred vsipom in padcem kosov zemljine (jeklene mreže, varovalni odri, osebna varovalna sredstva)
- vodstvo izvajanja del mora vsak dan pred pričetkom del pregledati brežine in odstraniti eventualne nevarne dele zemljine
- rob gradbene jame mora biti ustrezno zavarovan s predpisanimi ograjami in namestitvami ustreznih opozorilnih znakov, brez dodatnih obremenitev

## 9 VPLIV NA OKOLJE

Zaščita gradbene jame nima nobenega dejanskega učinka na okolje. Vpliv lahko sodi v normalno gradbeno delo, ker gradbena mehanizacija, ki delo izvaja ni nič drugačna od običajnih pri izvedbi gradbenih del, razen onesnaževanja, ki nastane pri gradbenih delih (gradbeni odpadki). Izvajalci so dolžni gradbene odpadke odstraniti skladno s slovensko zakonodajo.

## 10 NADZOR

Nadzor izvedbe mora obsegati pregled ustreznosti izvajanja zagatnic, sidranih zagatnic, zaščite gradbene jame ter izkopov (odprti izkop in izkop gradbene jame).

Pri izvedbi vkopov in ostalih zemeljskih delih pri predvideni izgradnji je obvezna prisotnost geotehnika (stalen geotehnični nadzor), ki bo dajal navodila za ustrezne posege in eventualne dodatne ukrepe pri izvedbi le teh.

V primeru večjih odstopanj od projekta, je potrebno obvestiti projektantski in geomehanski nadzor.

## 11 ZAKLJUČEK

Pred pričetkom izvedbe je potrebno ponovno preveriti mikrolokacijo obstoječih komunalnih in energetskih naprav in napeljav. Eventualna prestavitev obstoječe in predvidene komunalne infrastrukture ni predmet tega projekta.

Vsi detajli izvedbe, situativni nivoletni potek so razvidni iz grafičnih prilog.

Le ob kompleksnem upoštevanju vseh faktorjev, ki vplivajo na varnost in kakovost izvedbe del, določenih s tem projektom, lahko projektant in projektna organizacija odgovarjata za vsa opravljena dela pri projektiranju in končni izvedbi zaščite temeljnih tal.

Zaščita gradbene jame je začasna in omejena na 120 dni od časa izkopa le te.

Če se bo izvajalo v fazah, najprej Funkcionalna enota E3 in nato Funkcionalna enota E2, se med njimi izvede odprti izkop v nagibu 1:3.

Objekt: **»STANOVANJSKA SOSESKA NOVO BRDO V OBMOČJU UREJANJA OPPN 252,  
FUNKCIONALNA ENOTA E3 – Zaščita gradbene jame«**

Vrsta projektne dokumentacije: **Načrt izkopa in osnovne podgradnje za podzemne objekte**

## G. RISBE

		Risbe	G
		Situacija	G.1
		Prečni prerez - južni	G.2
		Prečni prerez - zahod	G.3
		Prečni prerez - vzhod	G.4

Objekt: **»STANOVANJSKA SOSESKA NOVO BRDO V OBMOČJU UREJANJA OPPN 252,  
FUNKCIONALNA ENOTA E3 – Zaščita gradbene jame«**

Vrsta projektne dokumentacije: **Načrt izkopa in osnovne podgradnje za podzemne objekte**

## **P. GEOSTATIČNI IZRAČUNI**

		<b>Geostatični izračuni</b>	<b>P.</b>
		Geostatični izračuni	P.1.-P.6.

106_Gradbena jama Brdo					Page 1	
Analiza zagatnic ob cesti (najbolj neugodna situacija)					12.01.18, 19:57	
I. Resanovic, Ob. Koprivnici 57, 3000 Celje					iva Larix-7 - Version 1.00	

### SYSTEM

#### Stages

Nb	Title
1	Final state

#### Excavation support walls

Wall type	Parameters		Top of wall		Inclination $\alpha$ [°]
	$\delta_a$	$\delta_p$	x [m]	y [m]	
Closed	0,67	-0,50	0	0	0

$\delta_a$  : Active wall friction angle as fraction of soil friction angle for determining the active earth pressure coefficients  
 $\delta_p$  : Passive wall friction angle as fraction of soil friction angle for determining the earth resistance coefficients

#### Wall system cross section: sheet pile wall

Description	Parameters Value	Unit
Profile	LARSEN 607 n	
Sheet pile steel	S240GP	
Statical action	Double plank	
Bending stiffness EI	151872	[kNm <sup>2</sup> /m]

#### Ground surface

Level y [m]	Variation	Description	Vertical surcharge Action	p [kN/m <sup>2</sup> ]	As e. pr.
0	Horizontal			0	No

As e. pr. : Earth pressure due to surcharge treated as usual earth pressure (redistribution, min. earth pressure, load factor)

#### Soil layers

Description	Level y [m]	Parameters			$c_p$ [kN/m <sup>2</sup> ]	k [m/s]	Further attributes			
		$\varphi$ [°]	$\gamma$ [kN/m <sup>3</sup> ]	$c_a$ [kN/m <sup>2</sup> ]			$\gamma'$ [kN/m <sup>3</sup> ]	$K_{ah}$ [-]	$K_{oh}$ [-]	$K_{ph}$ [-]
IG 0	0	28,00	20,00	0,00						
IG 1	-1,40	18,40	19,00	6,50						
IG 2	-6,40	39,00	21,00	0,00						

$c_a$  : Cohesion of soil layer to determine earth pressure  
 $c_p$  : Cohesion of soil layer to determine earth resistance  
k : Permeability of soil layer  
 $\gamma'$  : Quoyant unit weight of soil (without seepage force)

#### LOAD CASE PO: Prometna obte<sup>ba</sup> (Superimposed dead loads), Stage Final state

#### Concentrated loads on soil

Coordinates		Load values			As e. pr.
x [m]	y [m]	$P_x$ [kN/m]	$P_y$ [kN/m]	$M_z$ [kNm/m]	
0,95	0		-21,00		No
2,20	0		-21,00		No

As e. pr. : Excess earth pressure treated as usual earth pressure (redistribution, min. earth pressure, load factor)

#### Limit state values

#### Wall length

Stage	y [m]	t [m]	Base [m]	Values from
1	-9,39	4,39	-5,00	Stage 1, !Ultimate LS type 2, AC 1

y : Depth of bottom of wall  
t : Depth of embedment  
Base : Level of excavation base

					Nr.:
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106_Gradbena jama Brdo							Page 2	
Analiza zagatnic ob cesti (najbolj neugodna situacija)							12.01.18, 19:57	
I. Resanovic, Ob. Koprivnici 57, 3000 Celje							iva	Larix-7 - Version 1.00

Dimensioning of sheet pile wall

Verification		Dimensioning			Remarks	
aMax	St,LSS,AC	Profile	aMax	St,LSS,AC		
[-]			[-]			
1,47	1, 2, 1	LARSEN 607 n	1,47	1, 2, 1	Required profile inadequate!	
Verification		: Verification for selected section profile: LARSEN 607 n, Double plank				
aMax		: Maximum load factor (degree of exploitation), aMax <= 1.0 -> OK				
St,LSS,AC		: Stage, Limit state specification, Action combination				
		LSS 1 = !Serviceability LS occasional,				
		LSS 2 = !Ultimate LS type 2				

Axial force with corresponding components

y	Nd1 max			St,LSS,AC	Nd1 min			St,LSS,AC	
	Nd1	Vd1	Md1		Nd1	Vd1	Md1		
[m]	[kN/m]	[kN/m]	[kNm/m]	[kN/m]	[kN/m]	[kNm/m]	[kN/m]		
0	0	0,00	0,00	1, 2, 1	0	0,00	0,00	1, 2, 1	
-0,48	-0,57	-1,67	0,40	1, 2, 2	-1,09	-3,23	0,77	1, 2, 1	
-0,82	-1,86	-5,51	1,63	1, 2, 4	-3,37	-9,98	3,04	1, 2, 1	
-1,15	-3,16	-9,35	4,03	1, 2, 4	-5,68	-16,80	7,36	1, 2, 1	
-1,40	-4,68	-13,86	6,97	1, 2, 4	-8,36	-24,73	12,63	1, 2, 1	
-1,52	-5,09	-15,71	8,72	1, 2, 4	-9,06	-27,97	15,73	1, 2, 1	
-1,62	-5,44	-17,35	10,40	1, 2, 4	-9,68	-30,83	18,73	1, 2, 1	
-2,12	-6,56	-22,47	20,29	1, 2, 4	-11,71	-40,15	36,35	1, 2, 1	
-2,62	-8,00	-29,11	33,13	1, 2, 4	-14,37	-52,39	59,36	1, 2, 1	
-3,12	-9,77	-37,26	49,65	1, 2, 4	-17,67	-67,55	89,23	1, 2, 1	
-3,36	-10,74	-41,71	59,12	1, 2, 4	-19,47	-75,87	106,42	1, 2, 1	
-3,86	-12,50	-49,79	81,93	1, 2, 4	-22,87	-91,46	148,13	1, 2, 1	
-4,36	-14,58	-59,40	109,17	1, 2, 4	-26,89	-109,98	198,37	1, 2, 1	
-4,86	-17,00	-70,51	141,58	1, 2, 4	-31,55	-131,42	258,60	1, 2, 1	
-5,00	-17,74	-73,91	151,72	1, 2, 4	-32,98	-137,96	277,51	1, 2, 1	
-5,50	-19,98	-81,36	190,78	1, 2, 4	-35,22	-145,41	348,60	1, 2, 1	
-5,88	-21,12	-83,07	222,17	1, 2, 4	-36,36	-147,12	404,35	1, 2, 1	
-6,38	-21,89	-80,11	263,21	1, 2, 4	-37,13	-144,17	477,42	1, 2, 1	
-6,40	-21,90	-79,88	264,77	1, 2, 4	-37,14	-143,93	480,24	1, 2, 1	
-6,90	12,60	22,09	280,75	1, 2, 4	-2,64	-41,97	528,24	1, 2, 1	
-7,40	59,93	160,64	236,59	1, 2, 4	44,69	96,59	516,11	1, 2, 1	
-7,90	120,09	335,79	114,00	1, 2, 4	104,85	271,73	425,55	1, 2, 1	
-8,19	160,46	453,00	0,96	1, 2, 4	146,79	393,42	317,92	1, 2, 1	
-8,36	183,97	518,30	0,69	1, 2, 2	172,67	468,49	251,52	1, 2, 1	
-8,40	181,34	496,50	150,90	1, 2, 3	177,83	483,46	238,28	1, 2, 1	
-8,67	225,89	625,47	0,32	1, 2, 3	223,33	615,18	81,93	1, 2, 1	
-8,81	247,01	683,71	0,60	1, 2, 1	247,01	683,71	0,60	1, 2, 1	

St,LSS,AC : Stage, Limit state specification, Action combination

LSS 1 = !Serviceability LS occasional,

LSS 2 = !Ultimate LS type 2

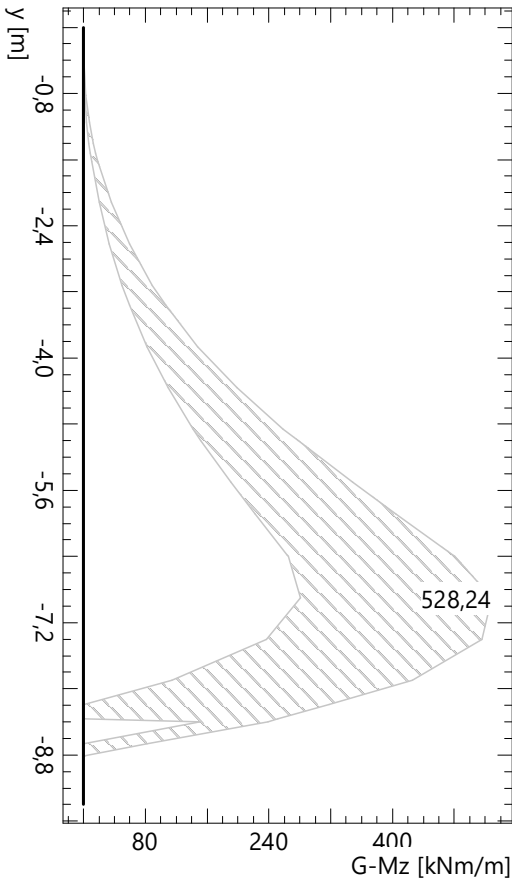
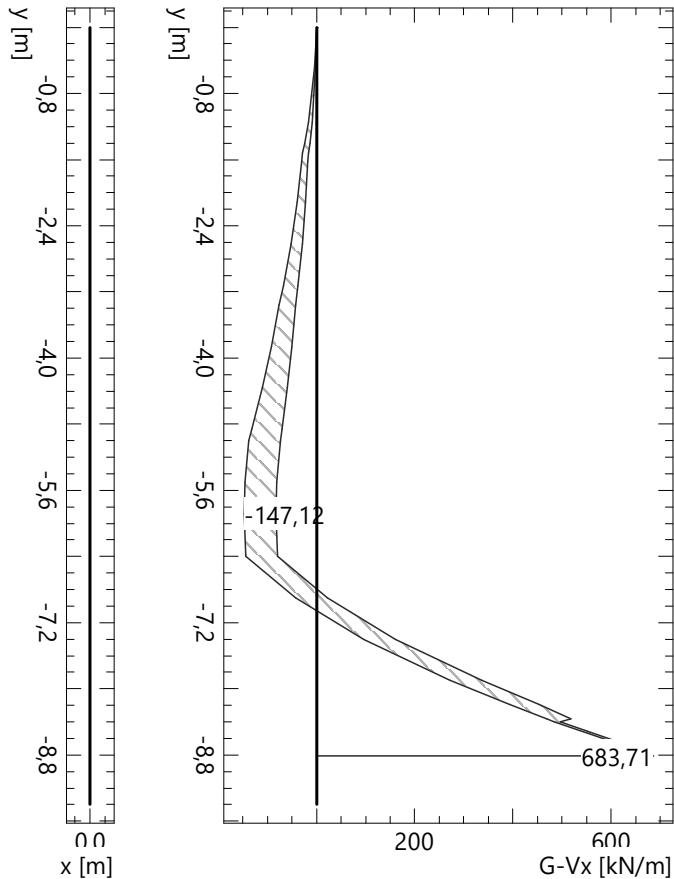
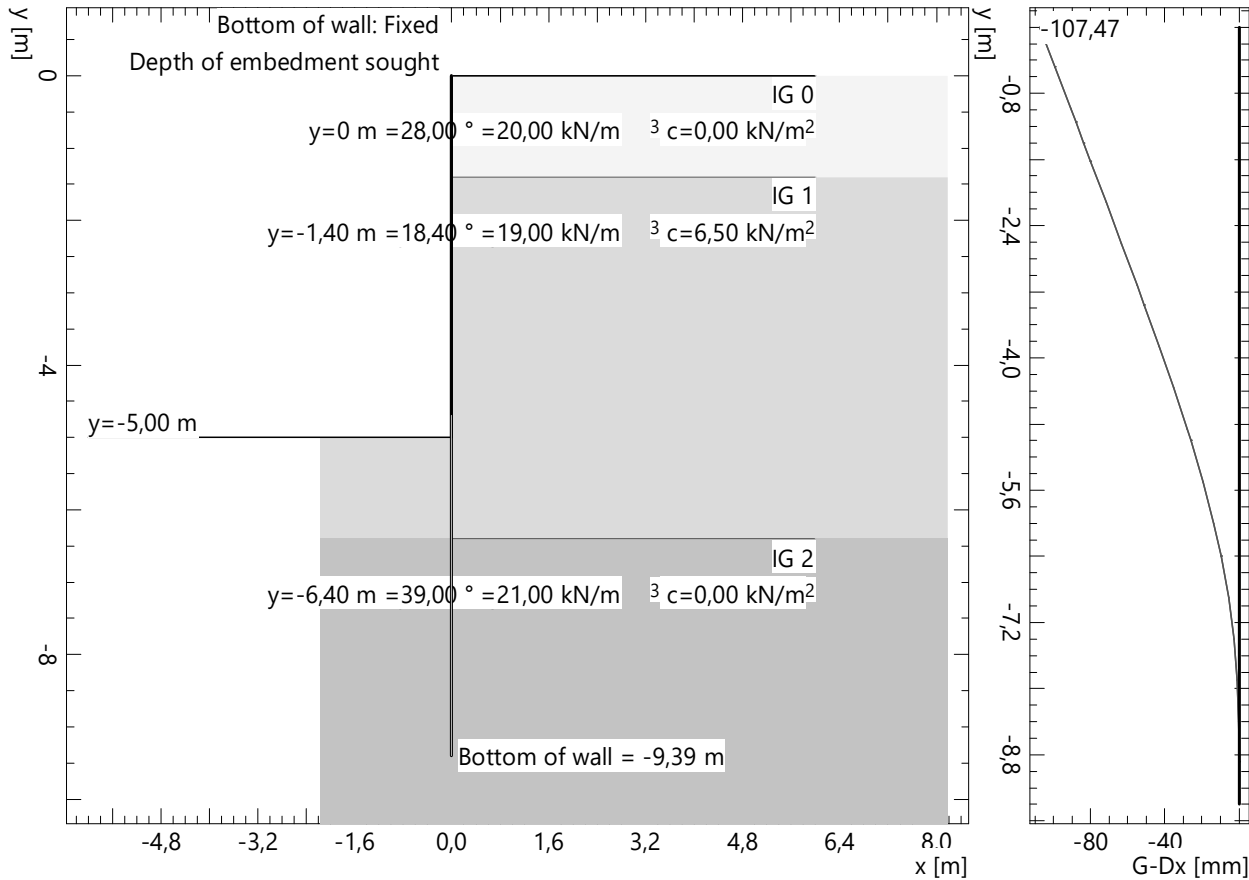
Shear force with corresponding components

y	Vd1 max			St,LSS,AC	Vd1 min			St,LSS,AC	
	Vd1	Nd1	Md1		Vd1	Nd1	Md1		
[m]	[kN/m]	[kN/m]	[kNm/m]	[kN/m]	[kN/m]	[kNm/m]	[kN/m]		
0	0,00	0	0,00	1, 2, 1	-0,00	0	-0,00	1, 2, 3	
-0,48	-1,67	-0,57	0,40	1, 2, 2	-3,23	-1,09	0,77	1, 2, 3	
-0,82	-5,51	-1,86	1,63	1, 2, 4	-9,98	-3,37	3,04	1, 2, 1	
-1,15	-9,35	-3,16	4,03	1, 2, 4	-16,80	-5,68	7,36	1, 2, 1	
-1,40	-13,86	-4,68	6,97	1, 2, 4	-24,73	-8,36	12,63	1, 2, 1	
-1,52	-15,71	-5,09	8,72	1, 2, 4	-27,97	-9,06	15,73	1, 2, 1	
-1,62	-17,35	-5,44	10,40	1, 2, 4	-30,83	-9,68	18,73	1, 2, 1	
-2,12	-22,47	-6,56	20,29	1, 2, 4	-40,15	-11,71	36,35	1, 2, 1	
-2,62	-29,11	-8,00	33,13	1, 2, 4	-52,39	-14,37	59,36	1, 2, 1	
-3,12	-37,26	-9,77	49,65	1, 2, 4	-67,55	-17,67	89,23	1, 2, 1	
-3,36	-41,71	-10,74	59,12	1, 2, 4	-75,87	-19,47	106,42	1, 2, 1	
-3,86	-49,79	-12,50	81,93	1, 2, 4	-91,46	-22,87	148,13	1, 2, 1	
-4,36	-59,40	-14,58	109,17	1, 2, 4	-109,98	-26,89	198,37	1, 2, 1	
-4,86	-70,51	-17,00	141,58	1, 2, 4	-131,42	-31,55	258,60	1, 2, 1	
-5,00	-73,91	-17,74	151,72	1, 2, 4	-137,96	-32,98	277,51	1, 2, 1	
-5,50	-81,36	-19,98	190,78	1, 2, 4	-145,41	-35,22	348,60	1, 2, 1	
-5,88	-83,07	-21,12	222,17	1, 2, 4	-147,12	-36,36	404,35	1, 2, 1	
-6,38	-80,11	-21,89	263,21	1, 2, 4	-144,17	-37,13	477,42	1, 2, 1	
-6,40	-79,88	-21,90	264,77	1, 2, 4	-143,93	-37,14	480,24	1, 2, 1	
-6,90	12,60	22,09	280,75	1, 2, 4	-41,97	-2,64	528,24	1, 2, 1	
-7,40	160,64	59,93	236,59	1, 2, 4	96,59	44,69	516,11	1, 2, 1	
-7,90	335,79	120,09	114,00	1, 2, 4	271,73	104,85	425,55	1, 2, 1	
-8,19	453,00	160,46	0,96	1, 2, 4	393,42	146,79	317,92	1, 2, 1	
-8,36	518,30	183,97	0,69	1, 2, 2	468,49	172,67	251,52	1, 2, 1	
-8,40	496,50	181,34	150,90	1, 2, 3	483,46	177,83	238,28	1, 2, 1	
-8,67	625,47	225,89	0,32	1, 2, 3	615,18	223,33	81,93	1, 2, 1	
-8,81	683,71	247,01	0,60	1, 2, 1	683,71	247,01	0,60	1, 2, 1	

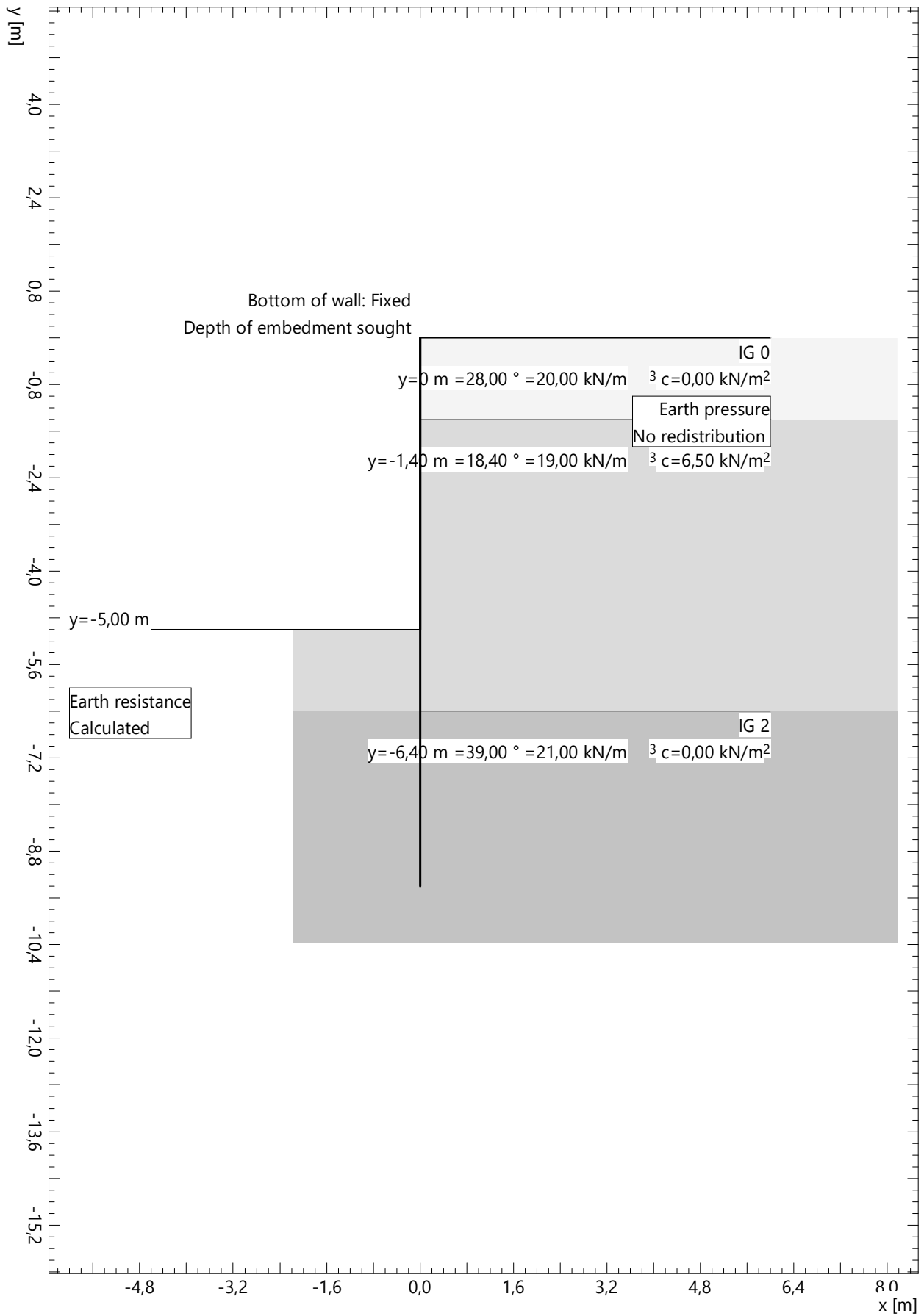
Nr.:

106_Gradbena jama Brdo								Page 3
Analiza zagatnic ob cesti (najbolj neugodna situacija)								12.01.18, 19:57
I. Resanovic, Ob. Koprivnici 57, 3000 Celje								Larix-7 - Version 1.00
St,LSS,AC : Stage, Limit state specification, Action combination LSS 1 = !Serviceability LS occasional, LSS 2 = !Ultimate LS type 2								
<b>Bending moment with corresponding components</b>								
y [m]	Md1 [kNm/m]	Nd1 [kN/m]	Vd1 [kN/m]	St,LSS,AC	Md1 [kNm/m]	Nd1 [kN/m]	Vd1 [kN/m]	St,LSS,AC
0	0,00	0	0,00	1, 2, 1	-0,00	0	-0,00	1, 2, 3
-0,48	0,77	-1,09	-3,23	1, 2, 1	0,40	-0,57	-1,67	1, 2, 4
-0,82	3,04	-3,37	-9,98	1, 2, 1	1,63	-1,86	-5,51	1, 2, 4
-1,15	7,36	-5,68	-16,80	1, 2, 1	4,03	-3,16	-9,35	1, 2, 4
-1,40	12,63	-8,36	-24,73	1, 2, 1	6,97	-4,68	-13,86	1, 2, 4
-1,52	15,73	-9,06	-27,97	1, 2, 1	8,72	-5,09	-15,71	1, 2, 4
-1,62	18,73	-9,68	-30,83	1, 2, 1	10,40	-5,44	-17,35	1, 2, 4
-2,12	36,35	-11,71	-40,15	1, 2, 1	20,29	-6,56	-22,47	1, 2, 4
-2,62	59,36	-14,37	-52,39	1, 2, 1	33,13	-8,00	-29,11	1, 2, 4
-3,12	89,23	-17,67	-67,55	1, 2, 1	49,65	-9,77	-37,26	1, 2, 4
-3,36	106,42	-19,47	-75,87	1, 2, 1	59,12	-10,74	-41,71	1, 2, 4
-3,86	148,13	-22,87	-91,46	1, 2, 1	81,93	-12,50	-49,79	1, 2, 4
-4,36	198,37	-26,89	-109,98	1, 2, 1	109,17	-14,58	-59,40	1, 2, 4
-4,86	258,60	-31,55	-131,42	1, 2, 1	141,58	-17,00	-70,51	1, 2, 4
-5,00	277,51	-32,98	-137,96	1, 2, 1	151,72	-17,74	-73,91	1, 2, 4
-5,50	348,60	-35,22	-145,41	1, 2, 1	190,78	-19,98	-81,36	1, 2, 4
-5,88	404,35	-36,36	-147,12	1, 2, 1	222,17	-21,12	-83,07	1, 2, 4
-6,38	477,42	-37,13	-144,17	1, 2, 1	263,21	-21,89	-80,11	1, 2, 4
-6,40	480,24	-37,14	-143,93	1, 2, 1	264,77	-21,90	-79,88	1, 2, 4
-6,90	528,24	-2,64	-41,97	1, 2, 1	280,75	12,60	22,09	1, 2, 4
-7,40	516,11	44,69	96,59	1, 2, 1	236,59	59,93	160,64	1, 2, 4
-7,90	425,55	104,85	271,73	1, 2, 1	114,00	120,09	335,79	1, 2, 4
-8,19	317,92	146,79	393,42	1, 2, 1	0,96	160,46	453,00	1, 2, 4
-8,36	251,52	172,67	468,49	1, 2, 1	0,69	183,97	518,30	1, 2, 2
-8,40	238,28	177,83	483,46	1, 2, 1	150,90	181,34	496,50	1, 2, 3
-8,67	81,93	223,33	615,18	1, 2, 1	0,32	225,89	625,47	1, 2, 3
-8,81	0,60	247,01	683,71	1, 2, 1	0,60	247,01	683,71	1, 2, 1
St,LSS,AC : Stage, Limit state specification, Action combination LSS 1 = !Serviceability LS occasional, LSS 2 = !Ultimate LS type 2								
<b>Deformations</b>								
y [m]	Dx [mm]	Dx max St,LSS,AC	Dx [mm]	Dx min St,LSS,AC				
0	-107,47	1, 1, 1	-107,47	1, 1, 1				
-0,48	-99,36	1, 1, 1	-99,36	1, 1, 1				
-0,48	-99,36	1, 1, 1	-99,36	1, 1, 1				
-0,98	-90,89	1, 1, 1	-90,89	1, 1, 1				
-1,15	-88,06	1, 1, 1	-88,06	1, 1, 1				
-1,15	-88,06	1, 1, 1	-88,06	1, 1, 1				
-1,40	-83,75	1, 1, 1	-83,75	1, 1, 1				
-1,40	-83,75	1, 1, 1	-83,75	1, 1, 1				
-1,62	-80,03	1, 1, 1	-80,03	1, 1, 1				
-1,62	-80,03	1, 1, 1	-80,03	1, 1, 1				
-2,12	-71,59	1, 1, 1	-71,59	1, 1, 1				
-2,62	-63,20	1, 1, 1	-63,20	1, 1, 1				
-3,12	-54,93	1, 1, 1	-54,93	1, 1, 1				
-3,36	-51,01	1, 1, 1	-51,01	1, 1, 1				
-3,36	-51,01	1, 1, 1	-51,01	1, 1, 1				
-3,86	-42,99	1, 1, 1	-42,99	1, 1, 1				
-4,36	-35,26	1, 1, 1	-35,26	1, 1, 1				
-4,86	-27,95	1, 1, 1	-27,95	1, 1, 1				
-5,00	-25,99	1, 1, 1	-25,99	1, 1, 1				
-5,00	-25,99	1, 1, 1	-25,99	1, 1, 1				
-5,50	-19,38	1, 1, 1	-19,38	1, 1, 1				
-6,00	-13,52	1, 1, 1	-13,52	1, 1, 1				
-6,40	-9,49	1, 1, 1	-9,49	1, 1, 1				
-6,40	-9,49	1, 1, 1	-9,49	1, 1, 1				
-6,90	-5,54	1, 1, 1	-5,54	1, 1, 1				
-7,40	-2,81	1, 1, 1	-2,81	1, 1, 1				
-7,90	-1,11	1, 1, 1	-1,11	1, 1, 1				
-8,40	-0,24	1, 1, 1	-0,24	1, 1, 1				
-8,88	0,00	1, 1, 1	0,00	1, 1, 1				
Dx : Displacements St,LSS,AC : Stage, Limit state specification, Action combination LSS 1 = !Serviceability LS occasional, LSS 2 = !Ultimate LS type 2								
								Nr.:

Limit state values graphic



Limit state values graphic



## GEOTECHNICAL MODEL

### Soil layer attributes

Id	Description	$\phi_k$ [°]	$\gamma_k$ [kN/m <sup>3</sup> ]	$c_k$ [kN/m <sup>2</sup> ]	
M1	IG 0	28,00	20,00	0,00	
M2	IG 1	18,40	19,00	6,50	
M3	IG 2	39,00	21,00	0,00	

### Shear resistances

Parameters			Geometry				
$W_1$ [kN/m]	$W_2$ [kN/m]	$L_E$ [m]	$x_1$ [m]	$y_1$ [m]	$x_2$ [m]	$y_2$ [m]	
1,00	1,00	5,00	0,00	0	0,00	-9,39	

$L_E$  : Length of transmission zone

### LOAD CASE PO: Prometna obteba (Superimposed dead loads)

#### Line loads

Coordinates		Load values			$M_{active}$	
$x$ [m]	$y$ [m]	$P_x$ [kN/m]	$P_y$ [kN/m]	$M_z$ [kNm/m]		
0,95	0	0	-21,00	0	Yes	
2,20	0	0	-21,00	0	Yes	

### Limit state values: Definition with centres and constraint line

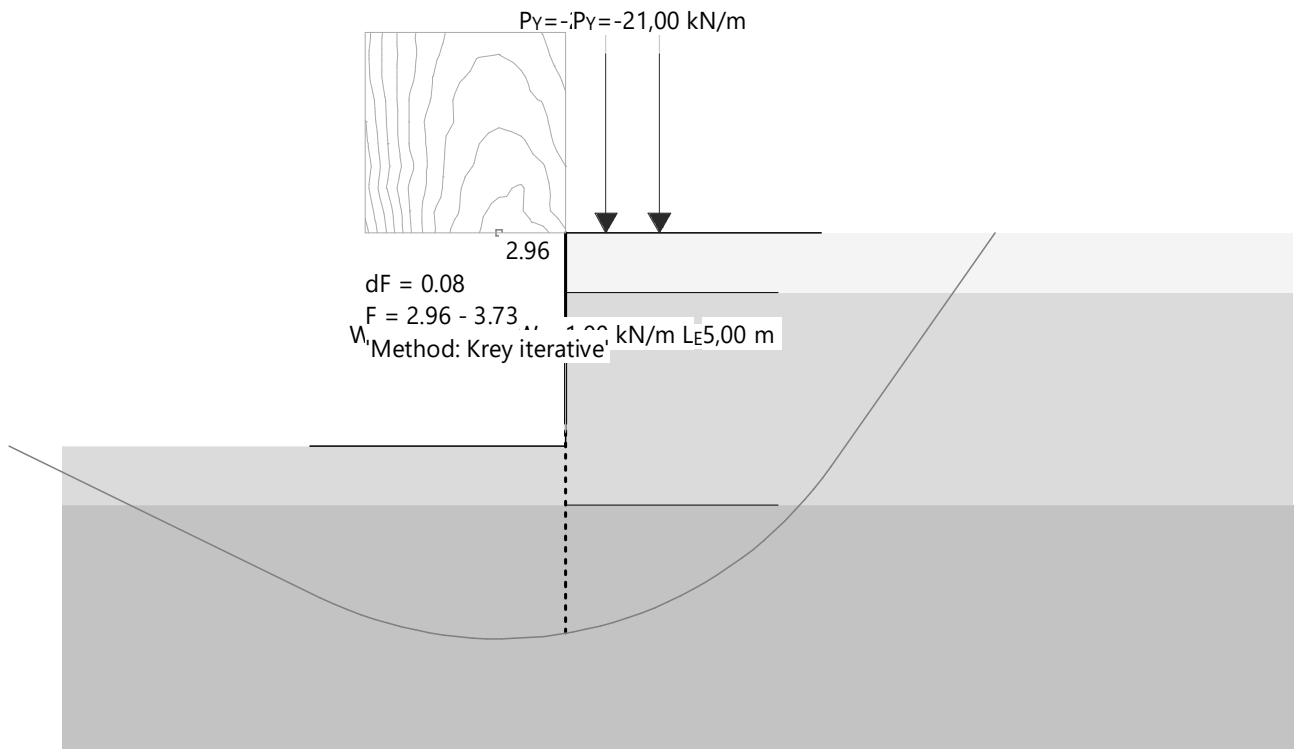
#### Slip circles with minimum safeties

LSS	AC	Circle No.	$x$ [m]	$y$ [m]	$R$ [m]	Anchor	$F_{ex}$ [-]	$L_{req}$ [m]	$L_{min}$ [m]	Remark see footnotes	
1	1	7	-1,57	0	9,53		2,96				
		9	-0,52	0	9,42		2,99				
		8	-1,04	0	9,46		2,99				
		17	-1,57	0,52	10,05		2,99				

LSS : Limit state specification  
AC : Action combinations  
 $F_{ex}$  : existing safety, required safety  $F_{req} = 1.00$   
 $L_{req}$  : calculated required free anchor length between  $L_{min}$  -  $L_{max}$   
 $L_{min}$  : input minimum free anchor length

Loading PO: Prometna obteba  
Limit state values: Critical slip surface, Definition with centres and constraint line

Scale 1 :177,6



# ***Phase2 Analysis Information***

## ***Project Summary***

---

File Name: SLIDE-Jama Brdo  
Last saved with Phase2 version: 8.005  
Analysis: Converted from Slide v7.009 with PHASE2 8.005

## ***General Settings***

---

Number of Stages: 5  
Analysis Type: Plane Strain  
Solver Type: Gaussian Elimination  
Units: Metric, stress as kPa

## ***Analysis Options***

---

Maximum Number of Iterations: 500  
Tolerance: 0.001  
Number of Load Steps: Automatic  
Convergence Type: Absolute Energy  
Tensile Failure: Reduces Shear Strength  
Joint tension reduces joint stiffness by a factor of 0.01

## ***Strength Reduction Settings***

---

Initial Estimate of SRF: 1  
Step Size: Automatic  
Tolerance (SRF): 0.01  
Limit SSR Search Area: No  
Apply SSR to Mohr-Coulomb Tensile Strength: Yes  
Convergence Parameters: Automatic

## ***Groundwater Analysis***

---

Method: Piezometric Lines  
Pore Fluid Unit Weight: 9.81 kN/m<sup>3</sup>  
Probability: None

## ***Field Stress***

---

Field stress: gravity  
Using actual ground surface  
Total stress ratio (horizontal/vertical in-plane): 1  
Total stress ratio (horizontal/vertical out-of-plane): 1  
Locked-in horizontal stress (in-plane): 0  
Locked-in horizontal stress (out-of-plane): 0

## ***Mesh***

---

Mesh type: graded  
Element type: 3 noded triangles

Number of elements on Osnovno: 1239  
Number of nodes on Osnovno: 671  
Number of elements on Zagatnica: 1239  
Number of nodes on Zagatnica: 671  
Number of elements on Izkop1: 1157  
Number of nodes on Izkop1: 630  
Number of elements on Izkop2: 1069  
Number of nodes on Izkop2: 586  
Number of elements on Izkop3: 981  
Number of nodes on Izkop3: 542

## ***Mesh Quality***

---

All elements are of good quality

### **Poor quality elements defined as:**

Side length ratio (maximum / minimum) > 30.00  
Minimum interior angle < 2.0 degrees  
Maximum interior angle > 175.0 degrees

## ***Reset Displacements***

---

Displacements reset after: Osnovno

## ***Areas of Excavated and Filled Elements***

---

### **Izkop1**

Material: IG0, Area Excavated: 12.037 m2

### **Izkop2**

Material: IG1, Area Excavated: 15.685 m2

### **Izkop3**

Material: IG1, Area Excavated: 15.269 m2

## ***Excavation Areas***

---

### **Original Un-deformed Areas**

External Boundary Area: 215.856 m2  
External Boundary Perimeter: 60.670 m

### **Osnovno**

External Boundary Area: 215.718 m2 (-0.138592 m2 change from original area)  
External Boundary Perimeter: 60.670 m (0.000892083 m change from original perimeter)

### **Zagatnica**

External Boundary Area: 215.718 m2 (-0.138592 m2 change from original area)  
External Boundary Perimeter: 60.670 m (0.000892083 m change from original perimeter)

### **Izkop1**

External Boundary Area: 215.718 m2 (-0.138592 m2 change from original area)  
External Boundary Perimeter: 60.670 m (0.000892083 m change from original perimeter)

Izkop2


External Boundary Area: 215.718 m2 (-0.138592 m2 change from original area)  
External Boundary Perimeter: 60.670 m (0.000892083 m change from original perimeter)

Izkop3


External Boundary Area: 215.718 m2 (-0.138592 m2 change from original area)  
External Boundary Perimeter: 60.670 m (0.000892083 m change from original perimeter)

Material Properties

Material: IG0


Color	
Initial element loading	field stress & body force
Unit weight	20 kN/m3
Elastic type	isotropic
Young's modulus	50000 kPa
Poisson's ratio	0.4
Failure criterion	Mohr-Coulomb
Peak tensile strength	0 kPa
Residual tensile strength	0 kPa
Peak friction angle	28 degrees
Peak cohesion	0 kPa
Material type	Plastic
Dilation Angle	0 degrees
Residual Friction Angle	28 degrees
Residual Cohesion	0 kPa
Piezo to use	None
Ru value	0

Material: IG1

Color	
Initial element loading	field stress & body force
Unit weight	19 kN/m3
Elastic type	isotropic
Young's modulus	50000 kPa
Poisson's ratio	0.4
Failure criterion	Mohr-Coulomb
Peak tensile strength	6.5 kPa
Residual tensile strength	0 kPa
Peak friction angle	18.4 degrees
Peak cohesion	6.5 kPa
Material type	Plastic
Dilation Angle	0 degrees
Residual Friction Angle	18.4 degrees
Residual Cohesion	6.5 kPa
Piezo to use	None
Ru value	0

Material: IG2

--	--

Color	
Initial element loading	field stress & body force
Unit weight	21 kN/m3
Elastic type	isotropic
Young's modulus	50000 kPa
Poisson's ratio	0.4
Failure criterion	Mohr-Coulomb
Peak tensile strength	0 kPa
Residual tensile strength	0 kPa
Peak friction angle	39 degrees
Peak cohesion	0 kPa
Material type	Plastic
Dilation Angle	0 degrees
Residual Friction Angle	39 degrees
Residual Cohesion	0 kPa
Piezo to use	None
Ru value	0

## Shear Strength Reduction - Material Properties

---

Strength Reduction Factor: 1

Maximum Total Displacement: 0.0228971 m

Converged: yes

Material	IG0
Peak friction angle	28 degrees
Peak cohesion	0 kPa
Residual Friction Angle	28 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	18.4 degrees
Peak cohesion	6.5 kPa
Residual Friction Angle	18.4 degrees
Residual Cohesion	6.5 kPa

Material	IG2
Peak friction angle	39 degrees
Peak cohesion	0 kPa
Residual Friction Angle	39 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.3

Maximum Total Displacement: 0.0500578 m

Converged: yes

Material	IG0
Peak friction angle	22.2449 degrees
Peak cohesion	0 kPa
Residual Friction Angle	22.2449 degrees
Residual Cohesion	0 kPa

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Material	IG1
Peak friction angle	14.3534 degrees
Peak cohesion	5 kPa
Residual Friction Angle	14.3534 degrees
Residual Cohesion	5 kPa

Material	IG2
Peak friction angle	31.9192 degrees
Peak cohesion	0 kPa
Residual Friction Angle	31.9192 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.5  
Maximum Total Displacement: 0.0765621 m  
Converged: yes

Material	IG0
Peak friction angle	19.518 degrees
Peak cohesion	0 kPa
Residual Friction Angle	19.518 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	12.5041 degrees
Peak cohesion	4.33333 kPa
Residual Friction Angle	12.5041 degrees
Residual Cohesion	4.33333 kPa

Material	IG2
Peak friction angle	28.3627 degrees
Peak cohesion	0 kPa
Residual Friction Angle	28.3627 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.7  
Maximum Total Displacement: 0.111927 m  
Converged: yes

Material	IG0
Peak friction angle	17.3681 degrees
Peak cohesion	0 kPa
Residual Friction Angle	17.3681 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	11.0717 degrees
Peak cohesion	3.82353 kPa
Residual Friction Angle	11.0717 degrees
Residual Cohesion	3.82353 kPa

--

Material	IG2
Peak friction angle	25.4705 degrees
Peak cohesion	0 kPa
Residual Friction Angle	25.4705 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.9  
Maximum Total Displacement: 0.172311 m  
Converged: yes

Material	IG0
Peak friction angle	15.6341 degrees
Peak cohesion	0 kPa
Residual Friction Angle	15.6341 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.9308 degrees
Peak cohesion	3.42105 kPa
Residual Friction Angle	9.9308 degrees
Residual Cohesion	3.42105 kPa

Material	IG2
Peak friction angle	23.0838 degrees
Peak cohesion	0 kPa
Residual Friction Angle	23.0838 degrees
Residual Cohesion	0 kPa

Critical Strength Reduction Factor: 2.1  
Maximum Total Displacement: 0.438824 m  
Converged: yes

Material	IG0
Peak friction angle	14.2084 degrees
Peak cohesion	0 kPa
Residual Friction Angle	14.2084 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.00129 degrees
Peak cohesion	3.09524 kPa
Residual Friction Angle	9.00129 degrees
Residual Cohesion	3.09524 kPa

Material	IG2
Peak friction angle	21.0872 degrees
Peak cohesion	0 kPa
Residual Friction Angle	21.0872 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2.11  
Maximum Total Displacement: 0.256165 m  
Converged: no

--

Material	IG0
Peak friction angle	14.1438 degrees
Peak cohesion	0 kPa
Residual Friction Angle	14.1438 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	8.95932 degrees
Peak cohesion	3.08057 kPa
Residual Friction Angle	8.95932 degrees
Residual Cohesion	3.08057 kPa

Material	IG2
Peak friction angle	20.996 degrees
Peak cohesion	0 kPa
Residual Friction Angle	20.996 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2.12  
Maximum Total Displacement: 0.263275 m  
Converged: no

Material	IG0
Peak friction angle	14.0797 degrees
Peak cohesion	0 kPa
Residual Friction Angle	14.0797 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	8.91774 degrees
Peak cohesion	3.06604 kPa
Residual Friction Angle	8.91774 degrees
Residual Cohesion	3.06604 kPa

Material	IG2
Peak friction angle	20.9055 degrees
Peak cohesion	0 kPa
Residual Friction Angle	20.9055 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2.15  
Maximum Total Displacement: 0.286267 m  
Converged: no

Material	IG0
Peak friction angle	13.8909 degrees
Peak cohesion	0 kPa
Residual Friction Angle	13.8909 degrees
Residual Cohesion	0 kPa

--

Material	IG1
Peak friction angle	8.79527 degrees
Peak cohesion	3.02326 kPa
Residual Friction Angle	8.79527 degrees
Residual Cohesion	3.02326 kPa

Material	IG2
Peak friction angle	20.6386 degrees
Peak cohesion	0 kPa
Residual Friction Angle	20.6386 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2.2  
Maximum Total Displacement: 0.330765 m  
Converged: no

Material	IG0
Peak friction angle	13.587 degrees
Peak cohesion	0 kPa
Residual Friction Angle	13.587 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	8.5984 degrees
Peak cohesion	2.95455 kPa
Residual Friction Angle	8.5984 degrees
Residual Cohesion	2.95455 kPa

Material	IG2
Peak friction angle	20.2078 degrees
Peak cohesion	0 kPa
Residual Friction Angle	20.2078 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2.3  
Maximum Total Displacement: 0.439283 m  
Converged: no

Material	IG0
Peak friction angle	13.0169 degrees
Peak cohesion	0 kPa
Residual Friction Angle	13.0169 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	8.22979 degrees
Peak cohesion	2.82609 kPa
Residual Friction Angle	8.22979 degrees
Residual Cohesion	2.82609 kPa


--

Material	IG2
Peak friction angle	19.3961 degrees
Peak cohesion	0 kPa
Residual Friction Angle	19.3961 degrees
Residual Cohesion	0 kPa

## Liner Properties

---

### Liner: Zagatnica Larssen 607 n

Color	
Liner Type	Standard Beam
Formulation	Timoshenko
Area	0.02417 m2
Moment of Inertia	0.0007232 m4

### Elastic Properties

Young's modulus	2.1e+008 kPa
Poisson's ratio	0.3

### Properties changed in Osnovno

Area: 0.0161939 m2 (factor = 0.67)

Moment of Inertia: 0.000484544 m4 (factor = 0.67)

## Displacements

---

Displacement data is not available for Osnovno until total displacement is viewed in a window  
Displacement data is not available for Zagatnica until total displacement is viewed in a window  
Displacement data is not available for Izkop1 until total displacement is viewed in a window  
Displacement data is not available for Izkop2 until total displacement is viewed in a window  
Displacement data is not available for Izkop3 until total displacement is viewed in a window

## Yielded Elements

---

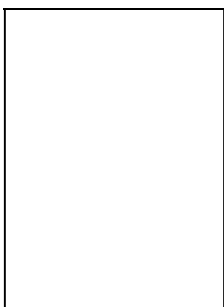
### Yielded Mesh Elements

Number of yielded mesh elements on Osnovno: 7  
Number of yielded mesh elements on Zagatnica: 7  
Number of yielded mesh elements on Izkop1: 38  
Number of yielded mesh elements on Izkop2: 177  
Number of yielded mesh elements on Izkop3: 264

## List of All Coordinates

---

### External boundary



X	Y
2579.18	3811.98
2579.18	3810.16
2579.18	3808.38
2579.18	3807.98
2579.18	3801.98
2598.12	3801.98
2598.12	3807.98
2598.12	3811.98
2598.12	3813.38
2587.78	3813.38
2579.18	3813.38

**Material boundary**

X	Y
2579.18	3811.98
2587.78	3811.98
2598.12	3811.98

**Material boundary**

X	Y
2579.18	3807.98
2587.78	3807.98
2598.12	3807.98

**Material boundary**

X	Y
2587.78	3803.38
2587.78	3807.98
2587.78	3808.38
2587.78	3810.16
2587.78	3811.98
2587.78	3813.38

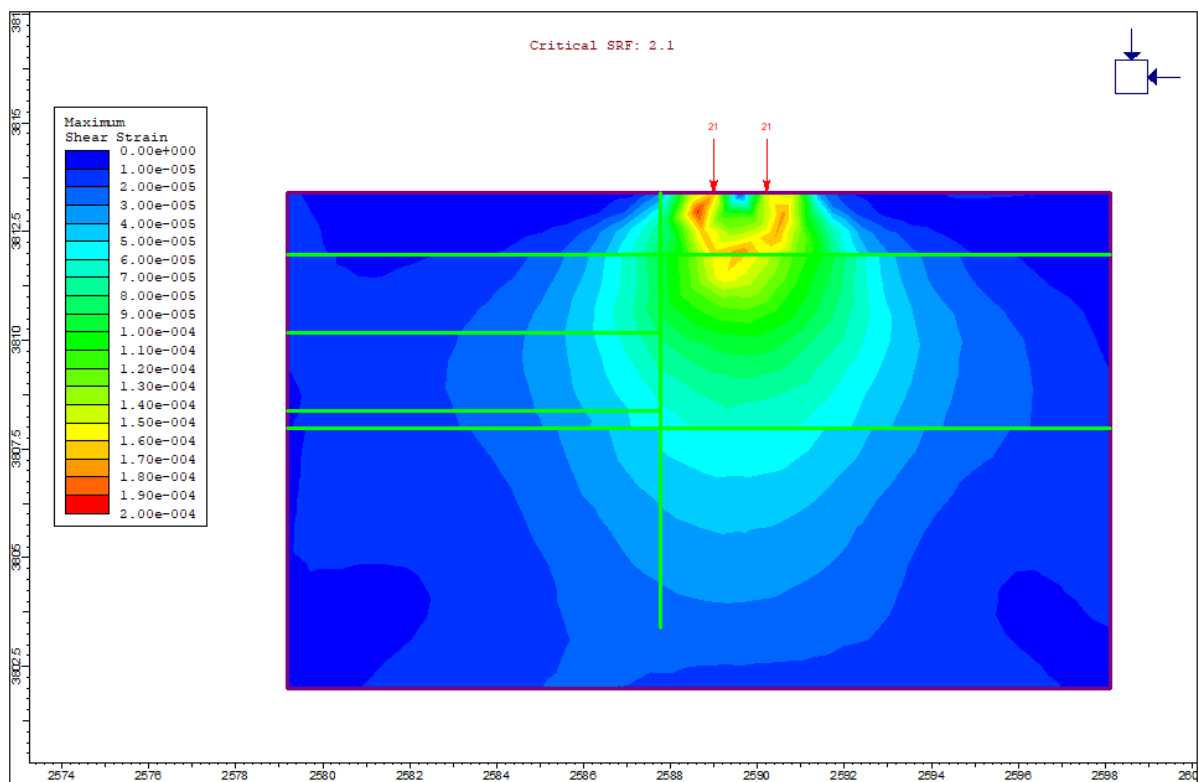
**Material boundary**

X	Y
2579.18	3808.38
2587.78	3808.38

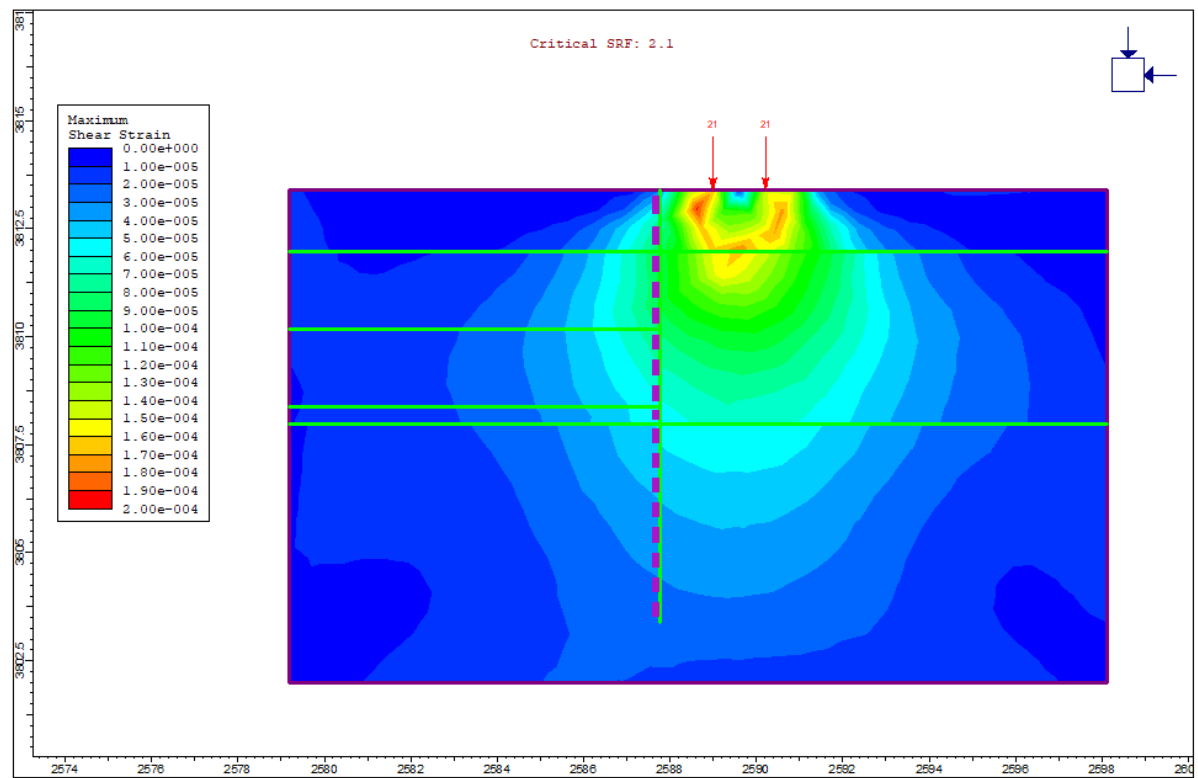
**Material boundary**

X	Y
2579.18	3810.16
2587.78	3810.16

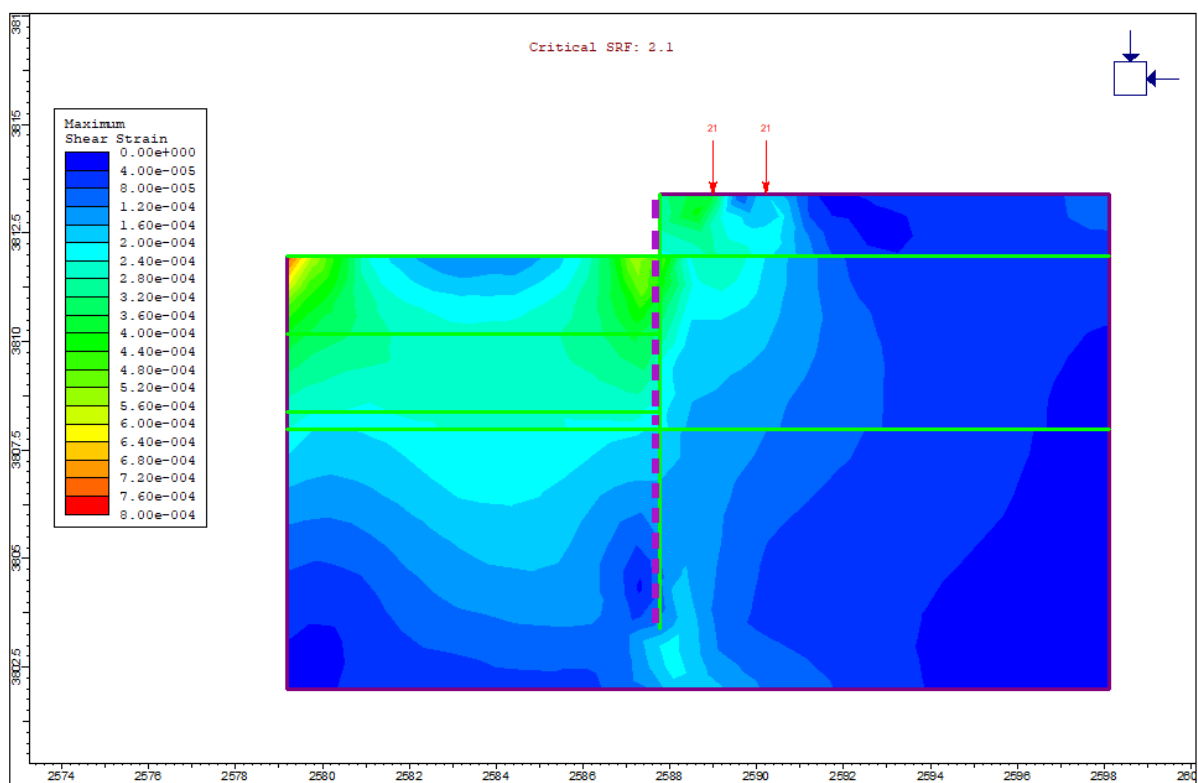
## 1.faza: Osnovno



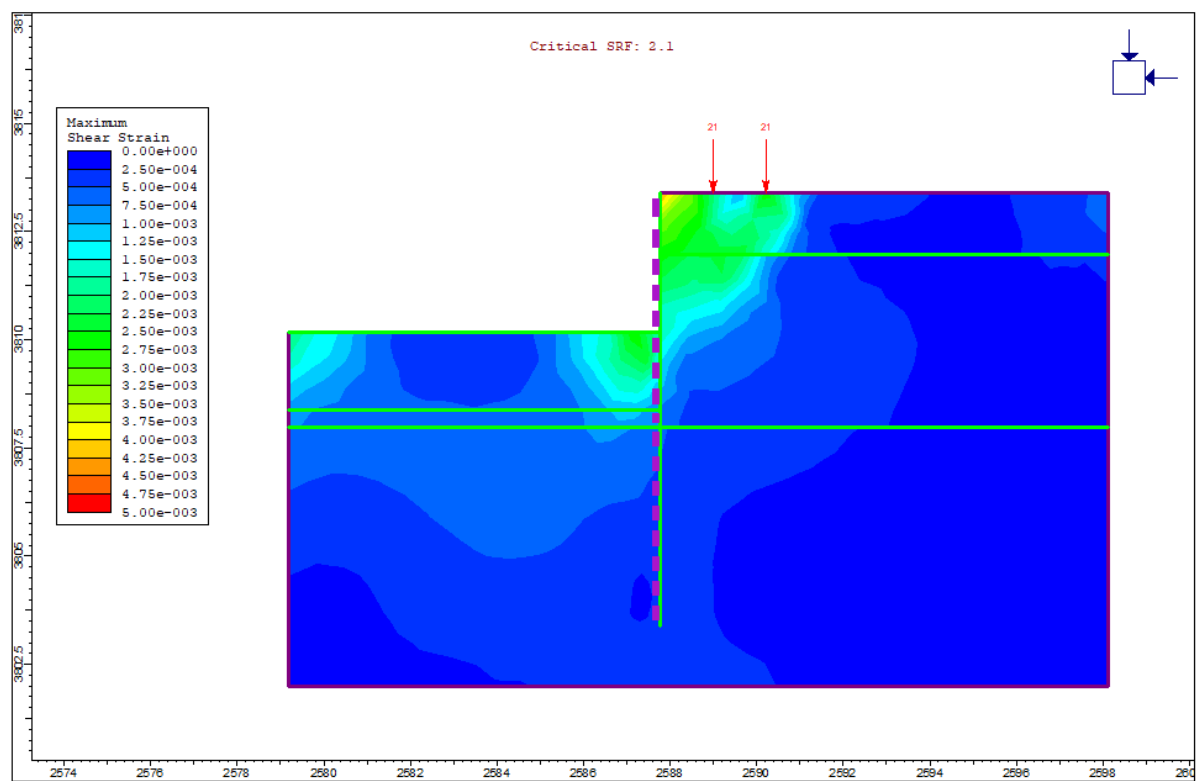
## 2.faza: Zagatnica



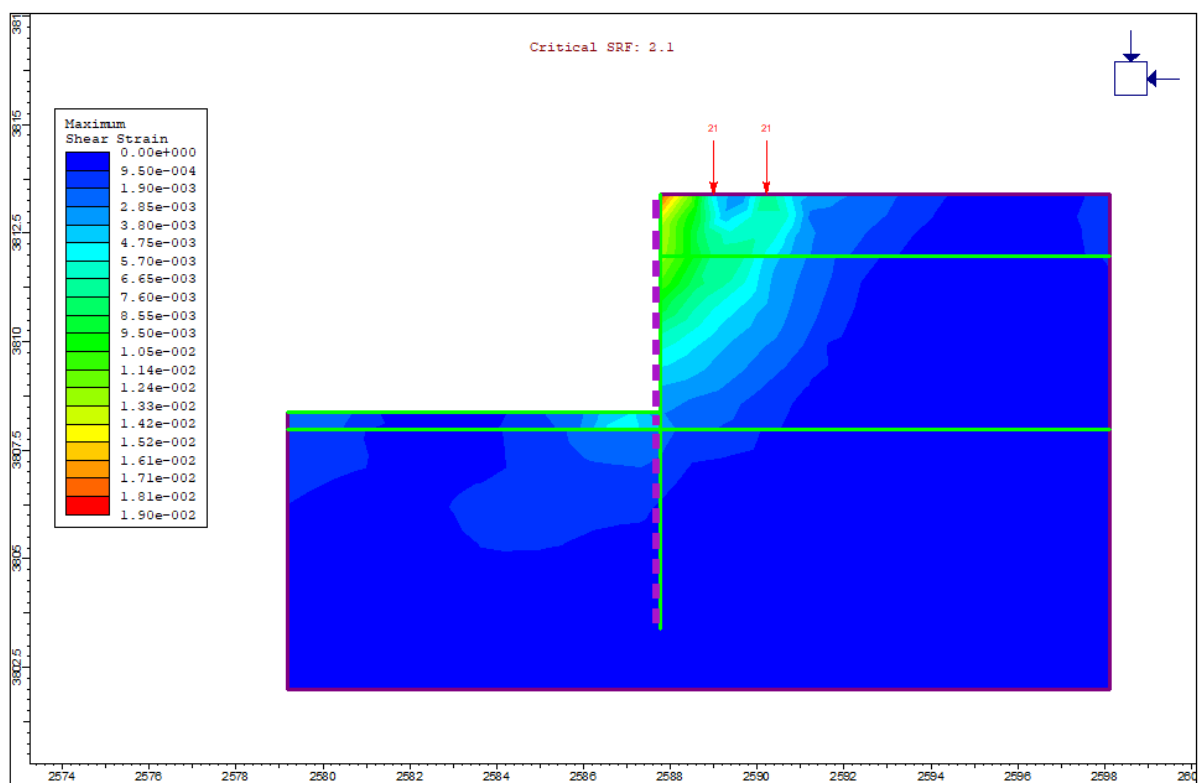
### 3.faza: Izkop1



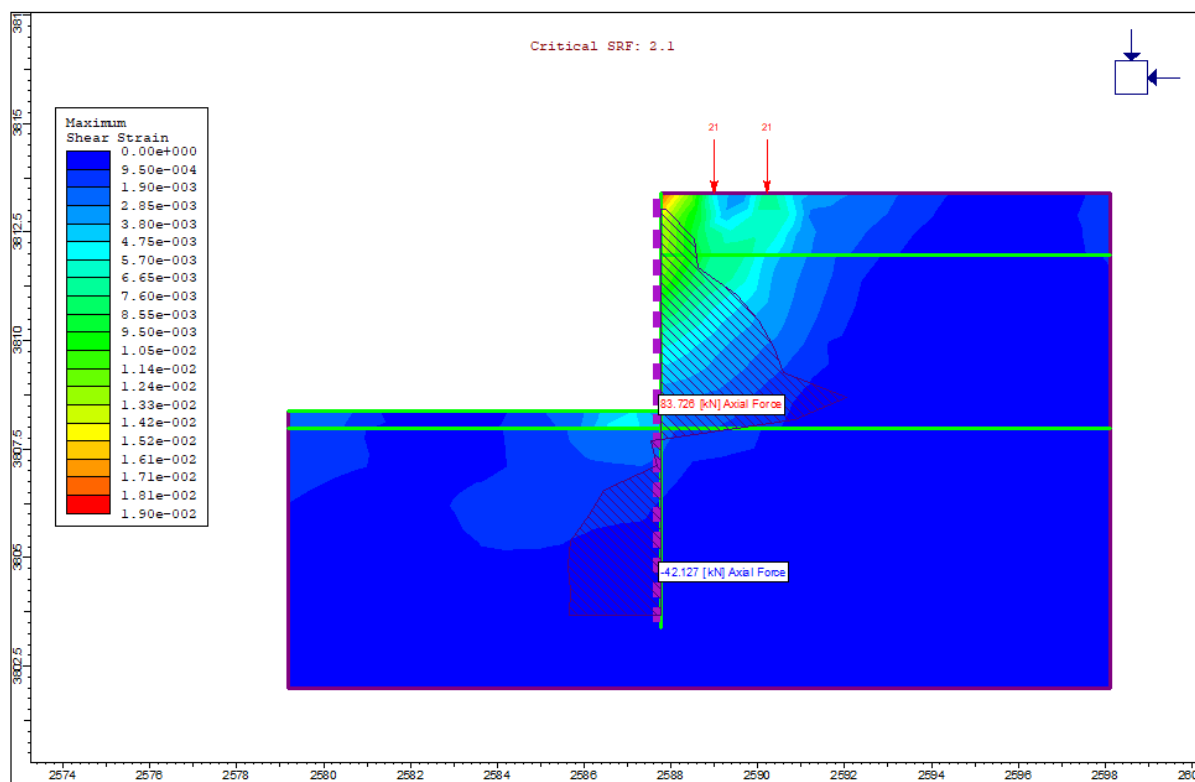
### 4.faza: Izkop2



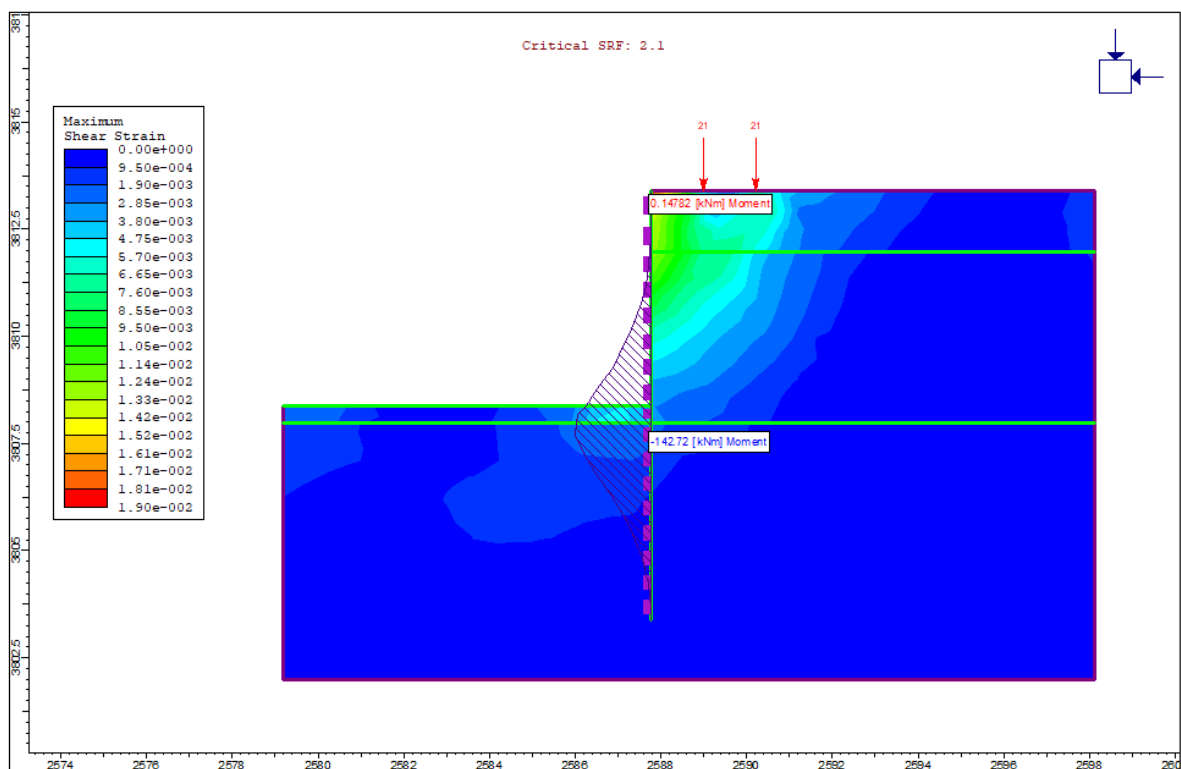
## 5.faza: Izkop3



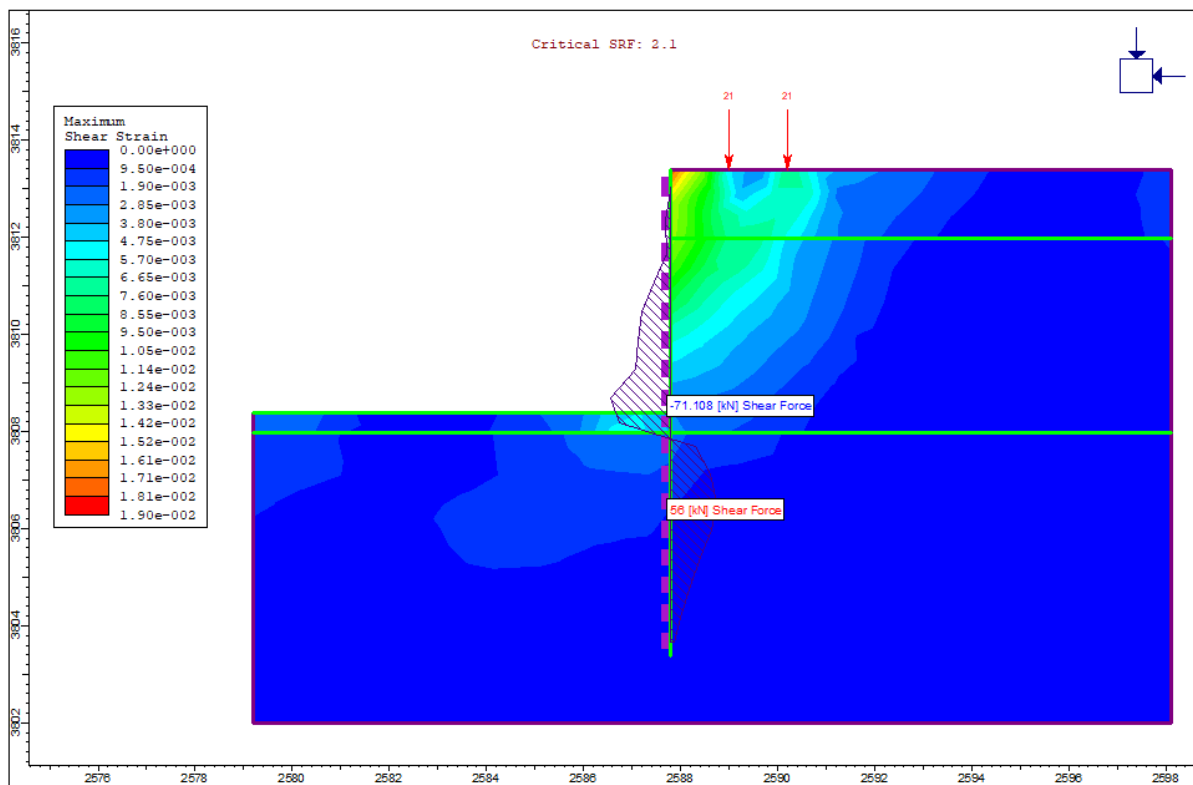
## Osne sile v zagatnici



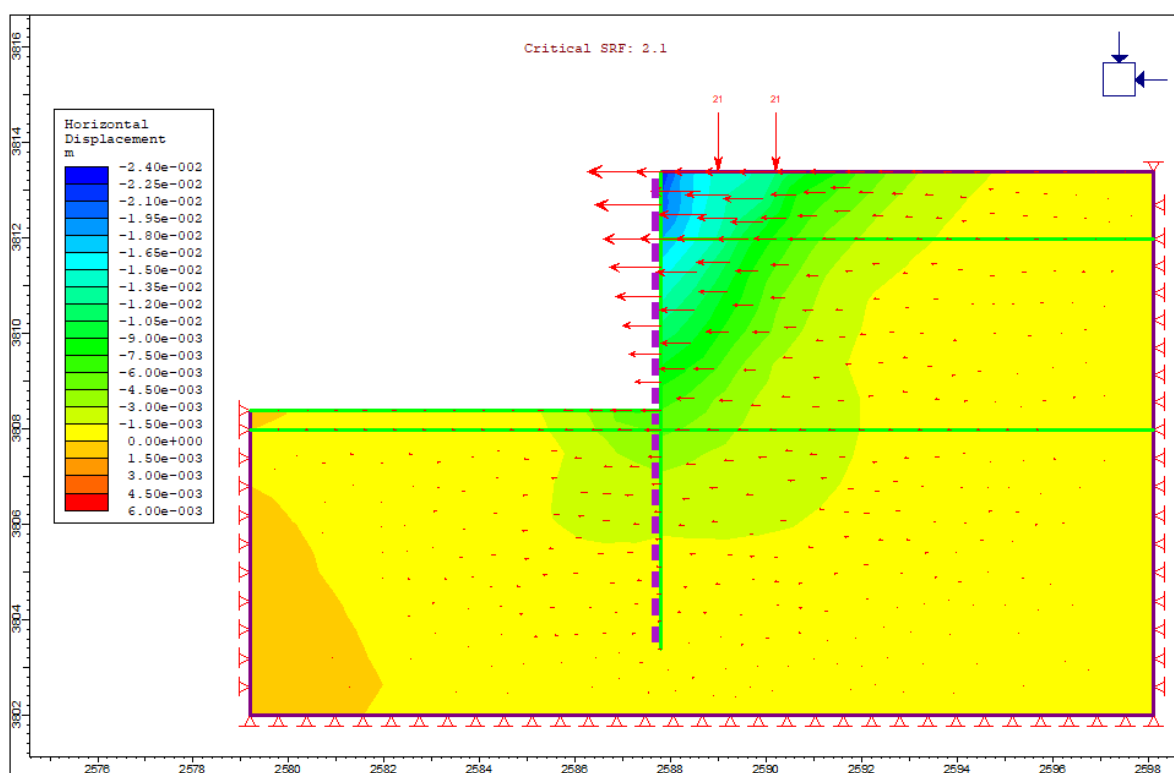
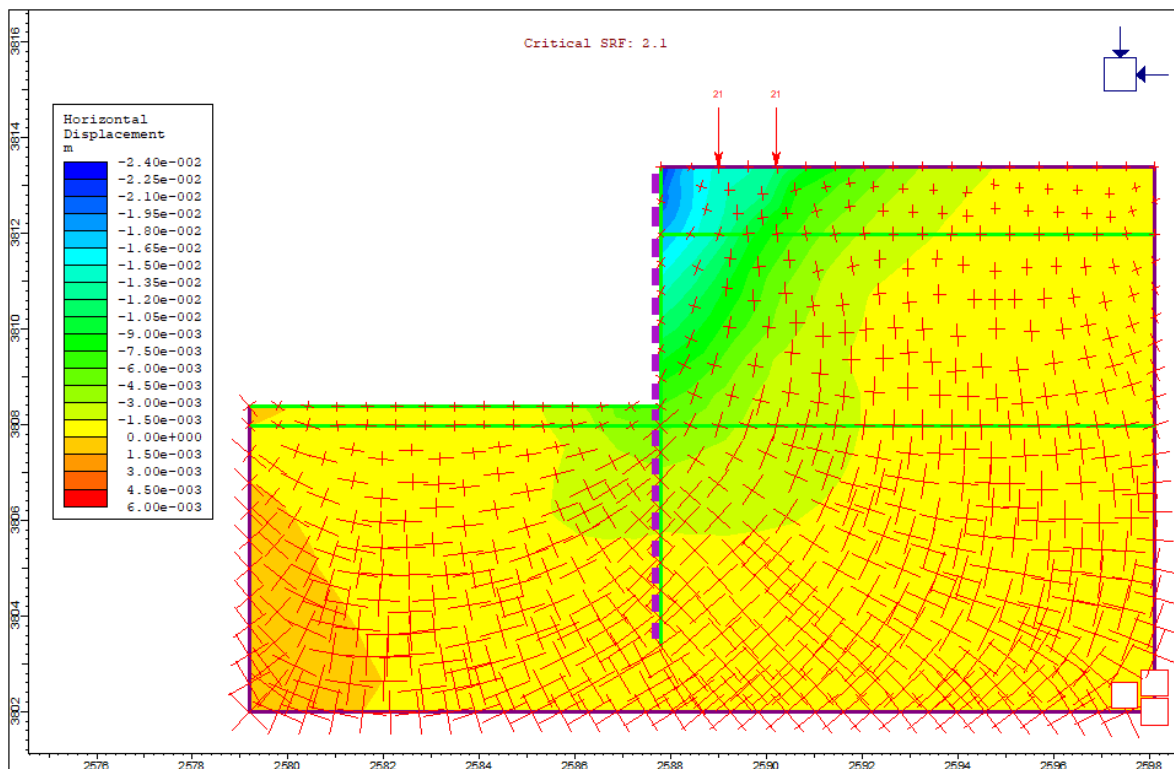
## Upogibni momenti



## Prečne sile



## Horizontalni premiki



106_Gradbena jama Brdo Analiza zagatnic					Page 1 12.01.18, 15:28	
I. Resanovic, Ob. Koprivnici 57, 3000 Celje					iva Larix-7 - Version 1.00	

### SYSTEM

#### Stages

Nb	Title
1	Final state

#### Excavation support walls

Wall type	Parameters		Top of wall		Inclination $\alpha$ [°]
	$\delta_a$	$\delta_p$	x [m]	y [m]	
Closed	0,67	-0,50	0	0	0

$\delta_a$  : Active wall friction angle as fraction of soil friction angle for determining the active earth pressure coefficients  
 $\delta_p$  : Passive wall friction angle as fraction of soil friction angle for determining the earth resistance coefficients

#### Wall system cross section: sheet pile wall

Description	Parameters Value	Unit
Profile	LARSEN 605	
Sheet pile steel	S240GP	
Statical action	Double plank	
Bending stiffness EI	88977	[kNm <sup>2</sup> /m]

#### Ground surface

Level y [m]	Variation	$\beta$ [°]	Description	Vertical surcharge Action	p [kN/m <sup>2</sup> ]	As e. pr.
0	Inclin.	25,00			0	No

As e. pr. : Earth pressure due to surcharge treated as usual earth pressure (redistribution, min. earth pressure, load factor)

#### Soil layers

Description	Level y [m]	$\varphi$ [°]	Parameters		$c_p$ [kN/m <sup>2</sup> ]	k [m/s]	Further attributes			
			$\gamma$ [kN/m <sup>3</sup> ]	$c_a$ [kN/m <sup>2</sup> ]			$\gamma'$ [kN/m <sup>3</sup> ]	$K_{ah}$ [-]	$K_{oh}$ [-]	$K_{ph}$ [-]
IG 0	0	28,00	20,00	0,00						
IG 1	-1,40	18,40	19,00	6,50						
IG 2	-6,40	39,00	21,00	0,00						

$c_a$  : Cohesion of soil layer to determine earth pressure  
 $c_p$  : Cohesion of soil layer to determine earth resistance  
k : Permeability of soil layer  
 $\gamma'$  : Quoyant unit weight of soil (without seepage force)

#### Props

Level y [m]	Inclination $\alpha$ [°]	dh [m]	Support	f [kN/m <sup>2</sup> ]	Support movement on activation dx [m]	Type
-2,00	-5,00	0	Rigid		Acc. to last stage	Anchor

dh : Support height above which the section forces are smoothed  
f : Spring constant

### STAGE 1: Final state

#### Excavation support walls

Top of wall Support	t	Bottom of wall Support
Free	sought	Simply supported

t : Depth of embedment relative to excavation base

#### Base of excavation

Level y [m]	Variation	Description	Vertical surcharge Action	p [kN/m <sup>2</sup> ]
-5,00	Horizontal			0

					Nr.:
--	--	--	--	--	------

**Props**

Prop No.	Level y [m]	Status	
1	-2,00	active	

**Earth resistance / earth pressure**

Earth resistance	Load factor	Earth pressure	Action
Calculate	(1) EXL	Redistribute None	Earth pressure permanent

(1) : Down to excavation level

**Final state, !Serviceability LS occasional, AC 1: Results****Deformations**

y [m]	Dx [mm]	Rz [‰]
0	5,50	-2,73
-0,50	4,13	-2,72
-1,00	2,77	-2,73
-1,40	1,67	-2,75
-1,40	1,67	-2,75
-1,90	0,28	-2,82
-2,00	-0,00	-2,84
-2,00	-0,00	-2,84
-2,50	-1,37	-2,61
-3,00	-2,58	-2,20
-3,50	-3,55	-1,61
-4,00	-4,17	-0,84
-4,50	-4,35	0,12
-5,00	-4,01	1,26
-5,00	-4,01	1,26
-5,50	-3,16	2,11
-6,00	-1,95	2,70
-6,40	-0,80	2,98
-6,40	-0,80	2,98
-6,67	-0,00	3,04
-6,67	-0,00	3,04
-6,91	0,73	3,04

Dx : Displacements

Rz : Rotations

**Wall pressures**

y [m]	De [kN/m <sup>2</sup> ]	Du [kN/m <sup>2</sup> ]	Do [kN/m <sup>2</sup> ]	Dw [kN/m <sup>2</sup> ]	Ew [kN/m <sup>2</sup> ]	Dr [kN/m <sup>2</sup> ]
0	0	0	0	0	0	0
-1,40	21,13	21,13	0	0	0	21,13
-1,40	27,26	27,26	0	0	0	27,26
-2,00	38,36	38,36	0	0	0	38,36
-5,00	93,85	93,85	0	0	0	93,85
-5,00	93,85	93,85	0	0	-20,05	73,80
-6,40	119,75	119,75	0	0	-83,35	36,40
-6,40	64,86	64,86	0	0	-266,50	-201,64
-6,67	67,82	67,82	0	0	-322,63	-254,81
-6,91	70,46	70,46	0	0	-372,86	-302,40

De : Active or increased active earth pressure including berm (charact. values)

Du : Redistributed earth pressure

Do : Non-redistributed earth pressure

Dw : Water pressure

Ew : Earth resistance

Dr : Resultant of wall pressure

**Wall friction angles and inclinations**

$\delta_a$	$\delta_p$	$\alpha$ [°]	$\beta_a$ [°]	$\beta_p$ [°]
0,667	-0,500	0	25,00	0

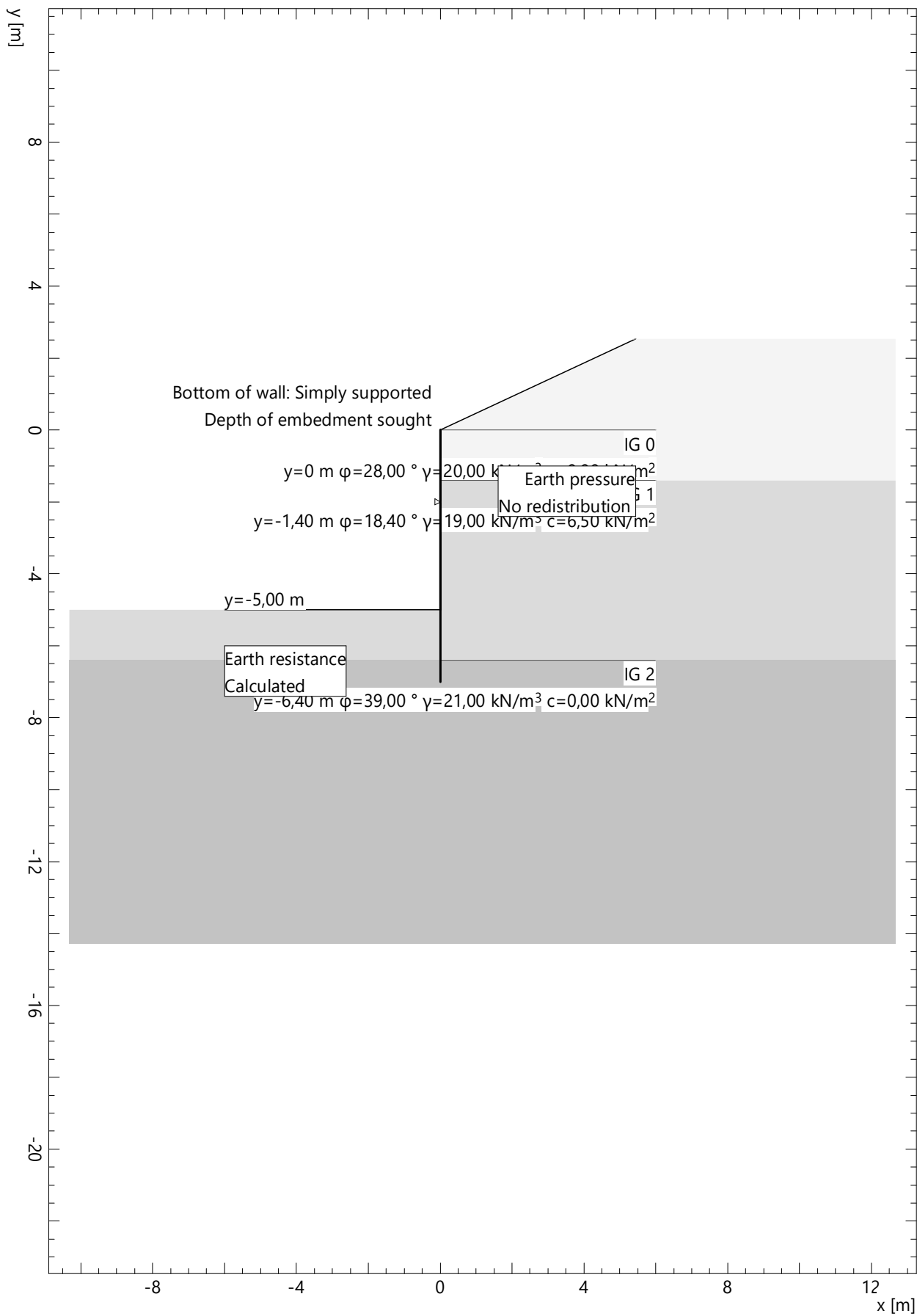
$\delta_a$  : Active wall friction angle as fraction of  $\varphi$   
 $\delta_p$  : Passive wall friction angle as fraction of  $\varphi$   
 $\alpha$  : Inclination of wall  
 $\beta_a$  : Inclination of ground surface  
 $\beta_p$  : Inclination of excavation base

#### Earth pressure coefficients of soil layers

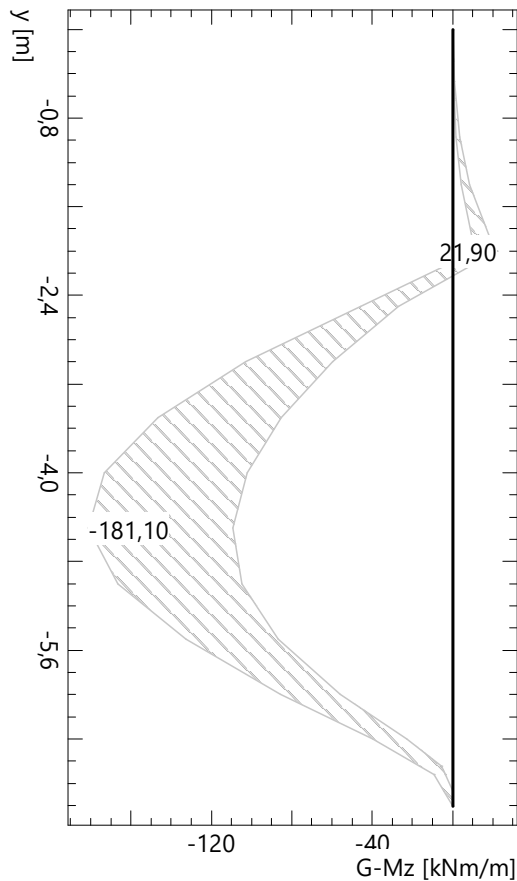
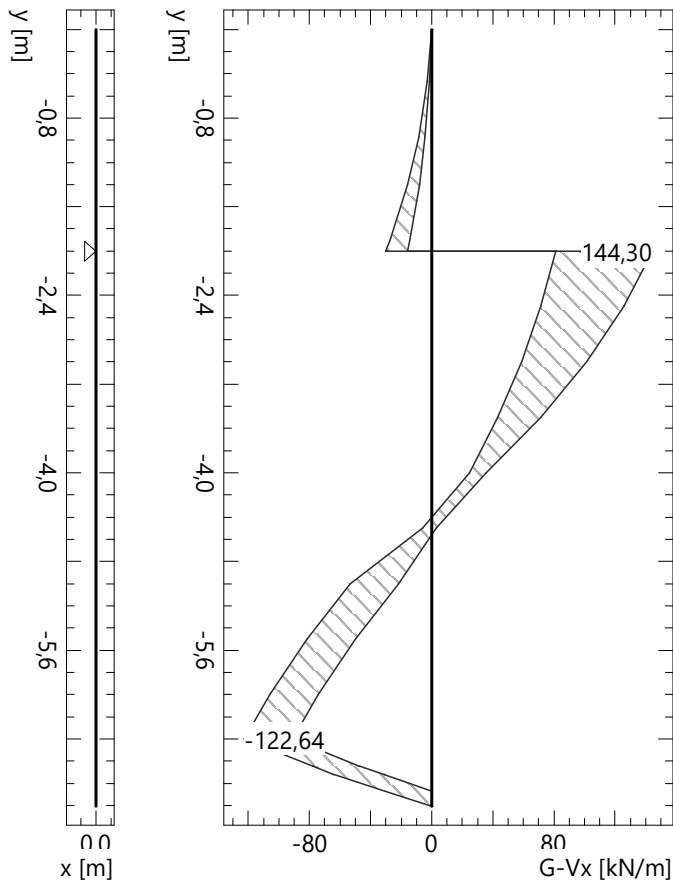
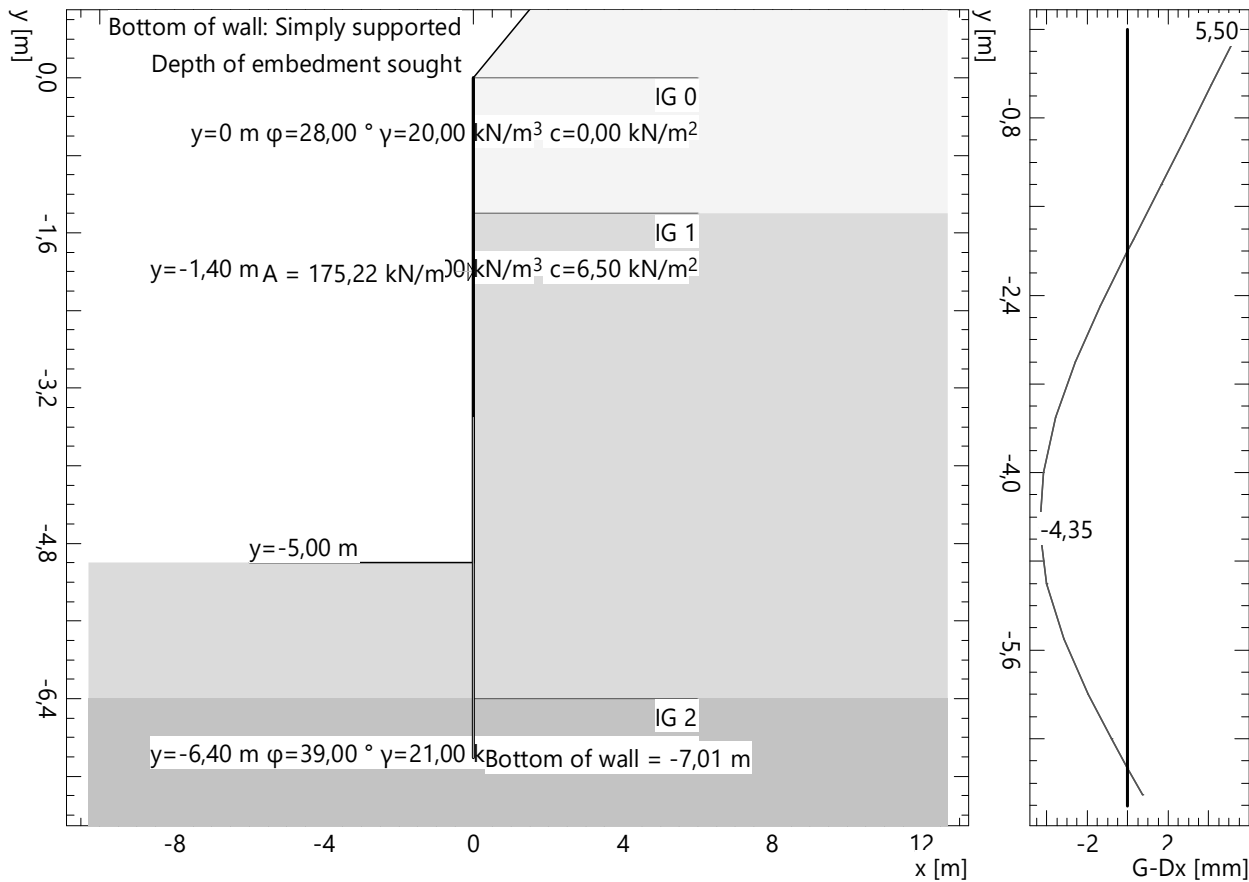
y [m]	$\gamma$ [kN/m <sup>3</sup> ]	$\varphi$ [°]	$c_a$ [kN/m <sup>2</sup> ]	$c_p$ [kN/m <sup>2</sup> ]	$K_{ah}$ [-]	$K_{0h}$ [-]	$K_{eh}$ [-]	$K_{ph}$ [-]	
0	20,00	28,00	0	0	0,5320	0,7547	0,7547	4,1967	
-1,40	19,00	18,40	6,50	6,50	0,9004	0,9736	0,9736	2,3797	
-6,40	21,00	39,00	0	0	0,2618	0,5273	0,5273	10,0188	

$K_{eh}$  : Increased active earth pressure coefficient ( $r = 1,00$ )

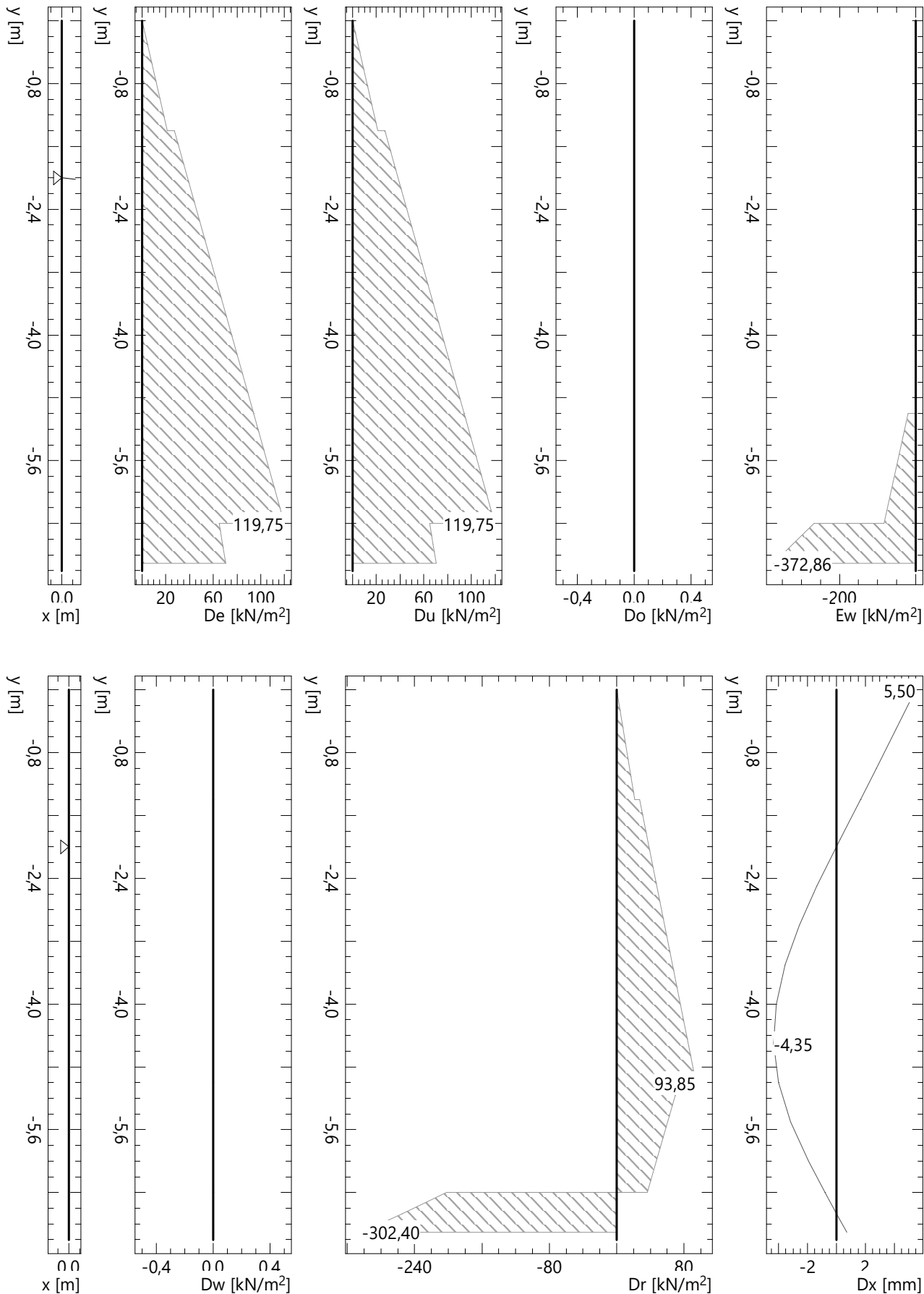
Final state, !Serviceability LS occasional, AC 1: Deformation graphic



Final state, !Serviceability LS occasional, AC 1: Deformation graphic



Final state, !Serviceability LS occasional, AC 1: Deformation graphic



**GEOTECHNICAL MODEL****Soil layer attributes**

Id	Description	$\varphi_k$ [°]	$\gamma_k$ [kN/m <sup>3</sup> ]	$c_k$ [kN/m <sup>2</sup> ]	
M1	IG 0	28,00	20,00	0,00	
M2	IG 1	18,40	19,00	6,50	
M3	IG 2	39,00	21,00	0,00	

**Prestressed anchor**

Anchor No.	Parameters			Geometry					
	$P_{pk}$ [kN/m]	$\gamma_0$	$\gamma_A$	x [m]	y [m]	$\alpha$ [°]	$l_{min}$ [m]	$l_{max}$ [m]	
1	350,00	0,600	1,000	0	-2,00	-5,00	12,00	10,00	

$P_{pk}$  : Ultimate tendon force  
 $\gamma_0$  : Factor to calculate the lock-off force  $P_0 = P_{pk} \cdot \gamma_0$   
 $\gamma_A$  : Anchor force factor  
 $l_{min}$  : Min. free anchor length  
 $l_{max}$  : Max. free anchor length

**Shear resistances**

Parameters			Geometry				
$W_1$ [kN/m]	$W_2$ [kN/m]	$L_E$ [m]	$x_1$ [m]	$y_1$ [m]	$x_2$ [m]	$y_2$ [m]	
1,00	1,00	0	0,00	0	0,00	-7,01	

$L_E$  : Length of transmission zone

**Limit state values: Definition with centres and constraint line****Slip circles with minimum safeties**

LSS	AC	Circle No.	x [m]	y [m]	R [m]	Anchor	$F_{ex}$ [-]	$L_{req}$ [m]	$L_{min}$ [m]	Remark see footnotes	
1	1	59	-0,39	1,95	8,97	w/o inc	1,22				
		79	-0,39	2,72	9,75	w/o inc	1,22				
		58	-0,78	1,95	9,00	w/o inc	1,22				
		78	-0,78	2,72	9,77	w/o inc	1,22				

LSS : Limit state specification  
AC : Action combinations  
 $F_{ex}$  : existing safety, required safety  $F_{req} = 1.00$   
 $L_{req}$  : calculated required free anchor length between  $L_{min}$  -  $L_{max}$   
 $L_{min}$  : input minimum free anchor length

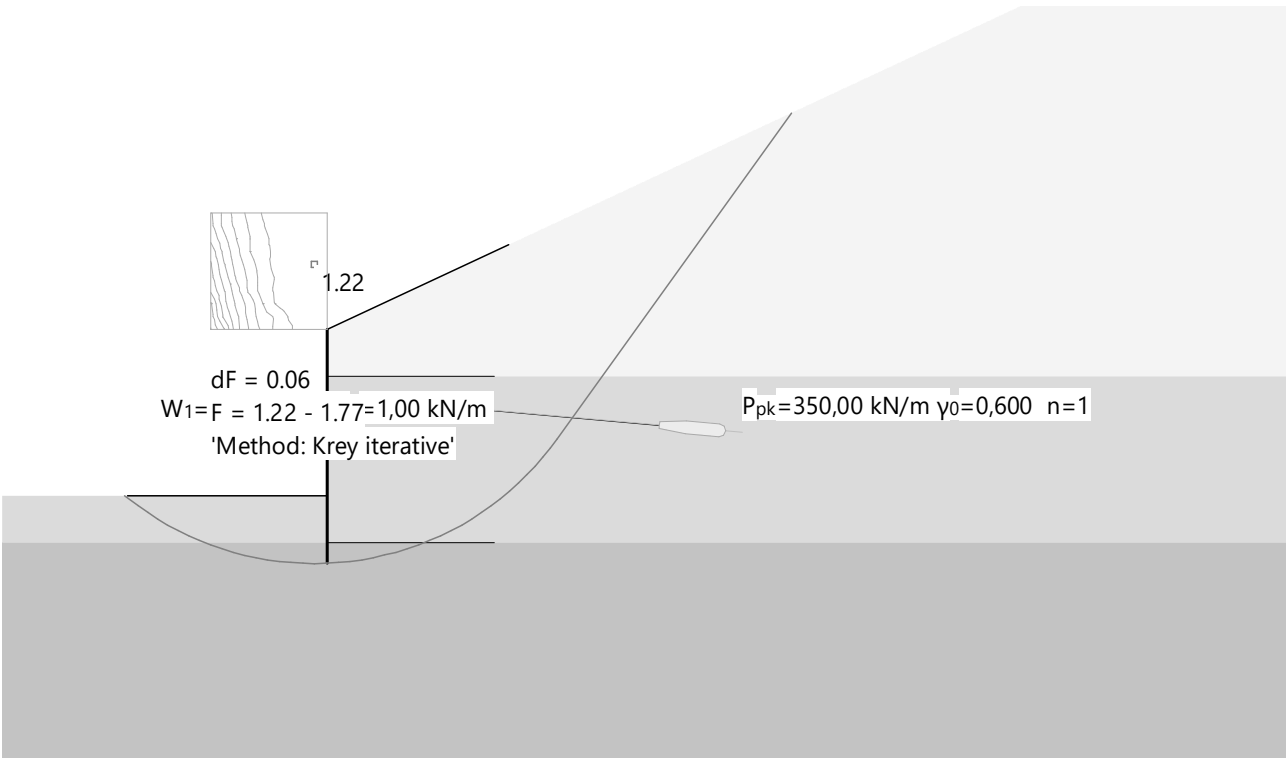
**Anchor**

Anchor No.	LSS	AC	$R_{d1}$ [kN]	$R_{d2}$ [kN]	$R_d$ [kN]	Circle No.	$L_{min}$ [m]	$L_{max}$ [m]	$L_{req}$ [m]	
1	1	1	259,26	210,00	210,00		10,00	10,00	10,00	

LSS : Limit state specification  
AC : Action combinations  
 $R_{d1}$  : Dimensioning value of ultimate resistance of ultimate force  $R_{d1} = P_{pk} / \gamma_M$   
 $R_{d2}$  : Dimensioning value of ultimate resistance of lock-off (initial) force  $R_{d2} = P_0 \cdot \gamma_A$   
 $R_d$  : In der Standsicherheitsberechnung verwendeter Bemessungswert des Tragwiderstandes (Minimum aus  $R_{d1}$  and  $R_{d2}$ )  
 $L_{min}$  : input minimum free anchor length  
 $L_{max}$  : input maximum free anchor length  
 $L_{req}$  : calculated required free anchor length between  $L_{min}$  -  $L_{max}$

Limit state values: Critical slip surface, Definition with centres and constraint line

Scale 1 :226,9



# ***Phase2 Analysis Information***

## ***Project Summary***

---

File Name: Gradbena jama Brdo\_sidra  
Last saved with Phase2 version: 8.005  
Analysis: Converted from Slide v7.009 with PHASE2 8.005

## ***General Settings***

---

Number of Stages: 4  
Analysis Type: Plane Strain  
Solver Type: Gaussian Elimination  
Units: Metric, stress as kPa

## ***Analysis Options***

---

Maximum Number of Iterations: 500  
Tolerance: 0.001  
Number of Load Steps: Automatic  
Convergence Type: Absolute Energy  
Tensile Failure: Reduces Shear Strength  
Joint tension reduces joint stiffness by a factor of 0.01

## ***Strength Reduction Settings***

---

Initial Estimate of SRF: 1  
Step Size: Automatic  
Tolerance (SRF): 0.01  
Limit SSR Search Area: No  
Apply SSR to Mohr-Coulomb Tensile Strength: Yes  
Convergence Parameters: Automatic

## ***Groundwater Analysis***

---

Method: Piezometric Lines  
Pore Fluid Unit Weight: 9.81 kN/m<sup>3</sup>  
Probability: None

## ***Field Stress***

---

Field stress: gravity  
Using actual ground surface  
Total stress ratio (horizontal/vertical in-plane): 1  
Total stress ratio (horizontal/vertical out-of-plane): 1  
Locked-in horizontal stress (in-plane): 0  
Locked-in horizontal stress (out-of-plane): 0

## ***Mesh***

---

Mesh type: graded  
Element type: 3 noded triangles

Number of elements on Osnovno: 218  
Number of nodes on Osnovno: 131  
Number of elements on Zagatnica: 218  
Number of nodes on Zagatnica: 131  
Number of elements on Izkop1: 210  
Number of nodes on Izkop1: 127  
Number of elements on Izkop2+ IBO: 194  
Number of nodes on Izkop2+ IBO: 119

## ***Mesh Quality***

---

All elements are of good quality

### **Poor quality elements defined as:**

Side length ratio (maximum / minimum) > 30.00  
Minimum interior angle < 2.0 degrees  
Maximum interior angle > 175.0 degrees

## ***Excavation Areas***

---

### **Original Un-deformed Areas**

External Boundary Area: 405.425 m<sup>2</sup>  
External Boundary Perimeter: 89.510 m

### **Osnovno**

Values not available until this stage is viewed in a window

### **Zagatnica**

Values not available until this stage is viewed in a window

### **Izkop1**

Values not available until this stage is viewed in a window

### **Izkop2+ IBO**


Values not available until this stage is viewed in a window

## ***Material Properties***


---

### **Material: IG0**




Color	
Initial element loading	field stress & body force
Unit weight	20 kN/m <sup>3</sup>
Elastic type	isotropic
Young's modulus	50000 kPa
Poisson's ratio	0.4
Failure criterion	Mohr-Coulomb
Peak tensile strength	0 kPa
Residual tensile strength	0 kPa
Peak friction angle	28 degrees
Peak cohesion	0 kPa
Material type	Plastic
Dilation Angle	0 degrees
Residual Friction Angle	28 degrees
Residual Cohesion	0 kPa
Piezo to use	None
Ru value	0

## Material: IG1

Color	
Initial element loading	field stress & body force
Unit weight	19 kN/m <sup>3</sup>
Elastic type	isotropic
Young's modulus	50000 kPa
Poisson's ratio	0.4
Failure criterion	Mohr-Coulomb
Peak tensile strength	6.5 kPa
Residual tensile strength	0 kPa
Peak friction angle	18.4 degrees
Peak cohesion	6.5 kPa
Material type	Plastic
Dilation Angle	0 degrees
Residual Friction Angle	18.4 degrees
Residual Cohesion	6.5 kPa
Piezo to use	None
Ru value	0

## Material: IG2

Color	
Initial element loading	field stress & body force
Unit weight	21 kN/m <sup>3</sup>
Elastic type	isotropic
Young's modulus	50000 kPa
Poisson's ratio	0.4
Failure criterion	Mohr-Coulomb
Peak tensile strength	0 kPa
Residual tensile strength	0 kPa
Peak friction angle	39 degrees
Peak cohesion	0 kPa
Material type	Plastic
Dilation Angle	0 degrees
Residual Friction Angle	39 degrees
Residual Cohesion	0 kPa
Piezo to use	None
Ru value	0

## Shear Strength Reduction - Material Properties

Strength Reduction Factor: 1  
Maximum Total Displacement: 0.0177112 m  
Converged: yes

Material	IG0
Peak friction angle	28 degrees
Peak cohesion	0 kPa
Residual Friction Angle	28 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	18.4 degrees
Peak cohesion	6.5 kPa
Residual Friction Angle	18.4 degrees
Residual Cohesion	6.5 kPa

Material	IG2
Peak friction angle	39 degrees
Peak cohesion	0 kPa
Residual Friction Angle	39 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.4  
Maximum Total Displacement: 0.0582582 m  
Converged: yes

Material	IG0
Peak friction angle	20.7964 degrees
Peak cohesion	0 kPa
Residual Friction Angle	20.7964 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	13.3663 degrees
Peak cohesion	4.64286 kPa
Residual Friction Angle	13.3663 degrees
Residual Cohesion	4.64286 kPa

Material	IG2
Peak friction angle	30.0458 degrees
Peak cohesion	0 kPa
Residual Friction Angle	30.0458 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.7  
Maximum Total Displacement: 0.15467 m  
Converged: yes

--

Material	IG0
Peak friction angle	17.3681 degrees
Peak cohesion	0 kPa
Residual Friction Angle	17.3681 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	11.0717 degrees
Peak cohesion	3.82353 kPa
Residual Friction Angle	11.0717 degrees
Residual Cohesion	3.82353 kPa

Material	IG2
Peak friction angle	25.4705 degrees
Peak cohesion	0 kPa
Residual Friction Angle	25.4705 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.9  
Maximum Total Displacement: 0.48824 m  
Converged: yes

Material	IG0
Peak friction angle	15.6341 degrees
Peak cohesion	0 kPa
Residual Friction Angle	15.6341 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.9308 degrees
Peak cohesion	3.42105 kPa
Residual Friction Angle	9.9308 degrees
Residual Cohesion	3.42105 kPa

Material	IG2
Peak friction angle	23.0838 degrees
Peak cohesion	0 kPa
Residual Friction Angle	23.0838 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.95  
Maximum Total Displacement: 0.615205 m  
Converged: yes

Material	IG0
Peak friction angle	15.2521 degrees
Peak cohesion	0 kPa
Residual Friction Angle	15.2521 degrees
Residual Cohesion	0 kPa

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Material	IG1
Peak friction angle	9.68105 degrees
Peak cohesion	3.33333 kPa
Residual Friction Angle	9.68105 degrees
Residual Cohesion	3.33333 kPa

Material	IG2
Peak friction angle	22.5518 degrees
Peak cohesion	0 kPa
Residual Friction Angle	22.5518 degrees
Residual Cohesion	0 kPa

Critical Strength Reduction Factor: 1.97  
Maximum Total Displacement: 0.682042 m  
Converged: yes

Material	IG0
Peak friction angle	15.1044 degrees
Peak cohesion	0 kPa
Residual Friction Angle	15.1044 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.58459 degrees
Peak cohesion	3.29949 kPa
Residual Friction Angle	9.58459 degrees
Residual Cohesion	3.29949 kPa

Material	IG2
Peak friction angle	22.3455 degrees
Peak cohesion	0 kPa
Residual Friction Angle	22.3455 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 1.98  
Maximum Total Displacement: 0.489028 m  
Converged: no

Material	IG0
Peak friction angle	15.0316 degrees
Peak cohesion	0 kPa
Residual Friction Angle	15.0316 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.53708 degrees
Peak cohesion	3.28283 kPa
Residual Friction Angle	9.53708 degrees
Residual Cohesion	3.28283 kPa

--

Material	IG2
Peak friction angle	22.2437 degrees
Peak cohesion	0 kPa
Residual Friction Angle	22.2437 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2  
Maximum Total Displacement: 0.515843 m  
Converged: no

Material	IG0
Peak friction angle	14.888 degrees
Peak cohesion	0 kPa
Residual Friction Angle	14.888 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.44343 degrees
Peak cohesion	3.25 kPa
Residual Friction Angle	9.44343 degrees
Residual Cohesion	3.25 kPa

Material	IG2
Peak friction angle	22.0426 degrees
Peak cohesion	0 kPa
Residual Friction Angle	22.0426 degrees
Residual Cohesion	0 kPa

Strength Reduction Factor: 2.1  
Maximum Total Displacement: 0.588011 m  
Converged: no

Material	IG0
Peak friction angle	14.2084 degrees
Peak cohesion	0 kPa
Residual Friction Angle	14.2084 degrees
Residual Cohesion	0 kPa

Material	IG1
Peak friction angle	9.00129 degrees
Peak cohesion	3.09524 kPa
Residual Friction Angle	9.00129 degrees
Residual Cohesion	3.09524 kPa


Material	IG2
Peak friction angle	21.0872 degrees
Peak cohesion	0 kPa
Residual Friction Angle	21.0872 degrees
Residual Cohesion	0 kPa

## Liner Properties

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Liner: Zagatnica Larssen 605

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Color	
Liner Type	Standard Beam
Formulation	Timoshenko
Area	0.01567 m2
Moment of Inertia	0.0004242 m4

### Elastic Properties

Young's modulus	2.1e+008 kPa
Poisson's ratio	0.3


### Properties changed in Osnovno

Area: 0.0104989 m2 (factor = 0.67)

Moment of Inertia: 0.000284214 m4 (factor = 0.67)

## Bolt Properties

---

Bolt name	IBO
Color	
Bolt Type	End anchored bolt
Diameter	28 mm
Young's modulus	1.6e+008 kPa
Tensile capacity	350 kN
Residual Tensile capacity	350 kN
Pre-tensioning	0 kN
Pre-tensioning force	Constant in install stage
Out-of-plane spacing	2.5 m

## Displacements

---

Displacement data is not available for Osnovno until total displacement is viewed in a window

Displacement data is not available for Zagatnica until total displacement is viewed in a window

Displacement data is not available for Izkop1 until total displacement is viewed in a window

Displacement data is not available for Izkop2+ IBO until total displacement is viewed in a window

## Yielded Elements

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### Yielded Mesh Elements

Number of yielded mesh elements is not available for Osnovno until the stage is viewed in a window

Number of yielded mesh elements is not available for Zagatnica until the stage is viewed in a window

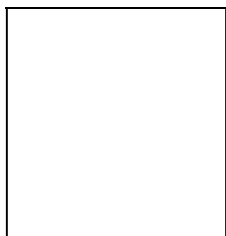
Number of yielded mesh elements is not available for Izkop1 until the stage is viewed in a window

Number of yielded mesh elements is not available for Izkop2+ IBO until the stage is viewed in a window

## List of All Coordinates

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### External boundary



X	Y
2607.53	3813.38
2607.53	3821.71
2587.78	3813.38
2579.18	3808.38
2579.18	3807.98
2579.18	3801.98
2607.53	3801.98
2607.53	3807.98
2607.53	3811.98

**Material boundary**

X	Y
2587.78	3811.98
2607.53	3811.98

**Material boundary**

X	Y
2579.18	3807.98
2587.78	3807.98
2607.53	3807.98

**Material boundary**

X	Y
2587.78	3805.38
2587.78	3807.98
2587.78	3808.38
2587.78	3811.38
2587.78	3811.98
2587.78	3813.38

**Material boundary**

X	Y
2579.18	3808.38
2587.78	3808.38

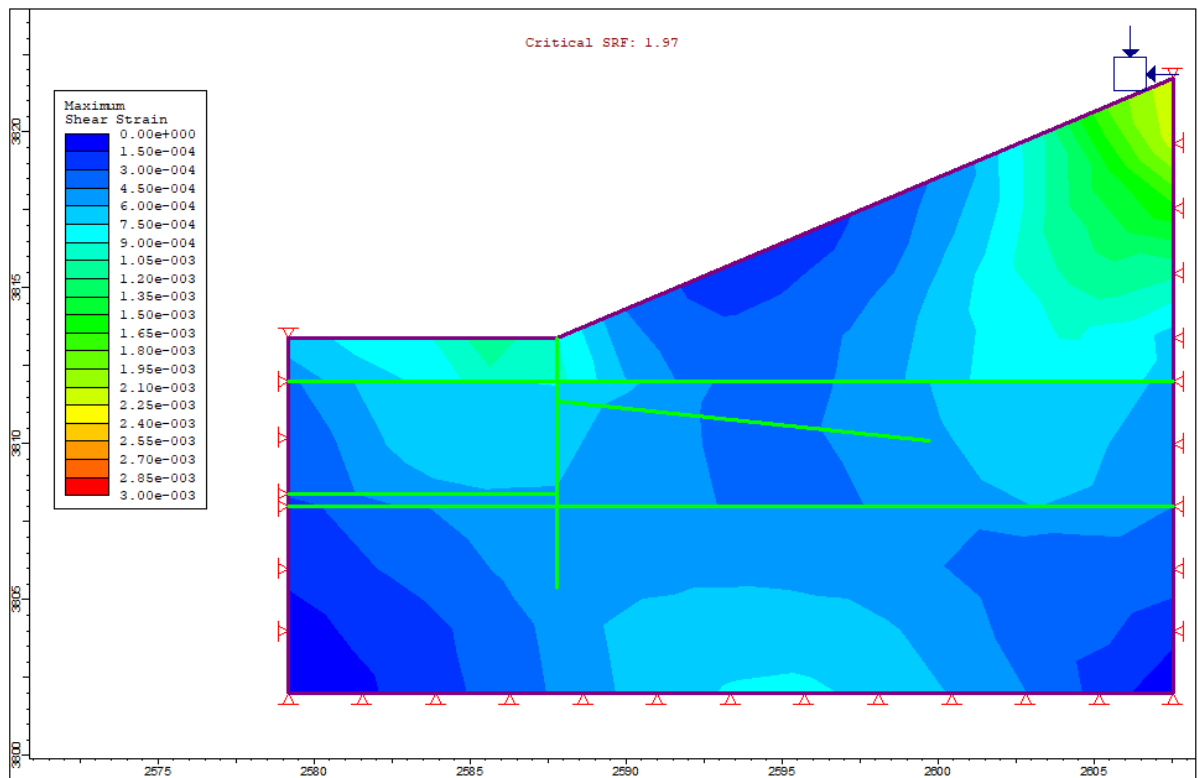
**Material boundary**

X	Y
2587.78	3811.38
2599.71	3810.12

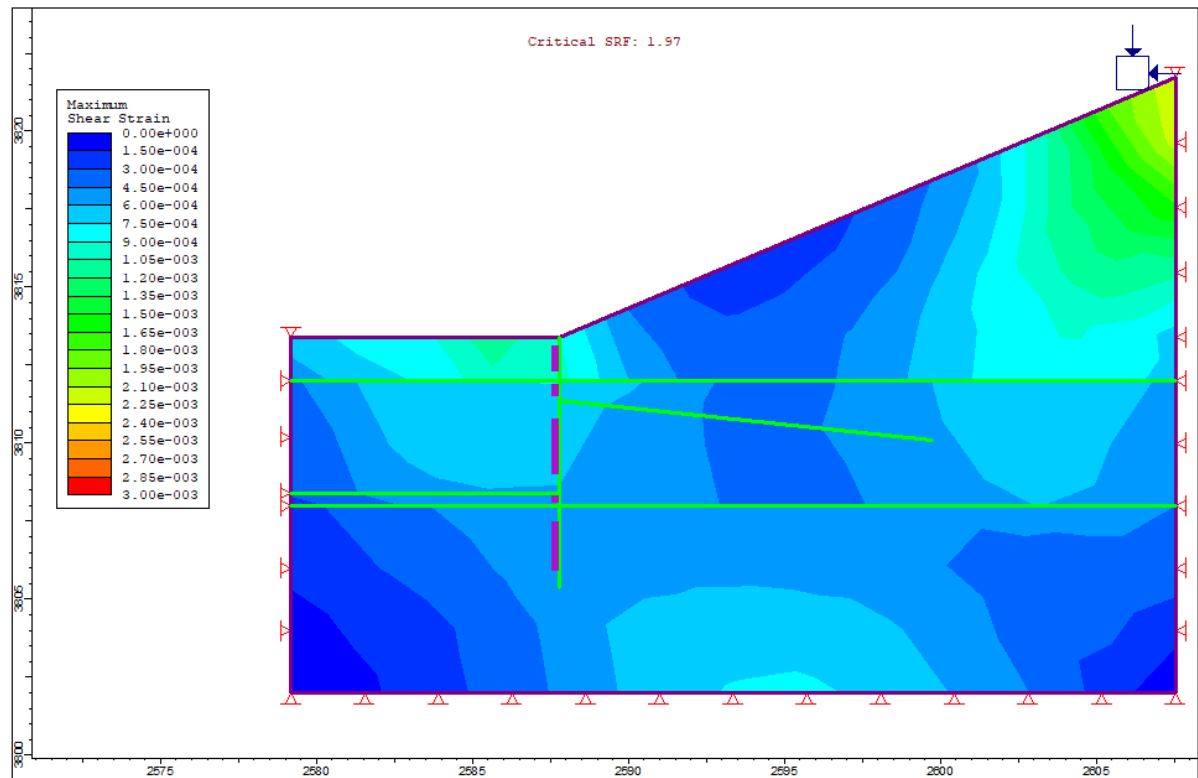
**Bolt**

X	Y
2587.78	3811.38
2599.71	3810.12

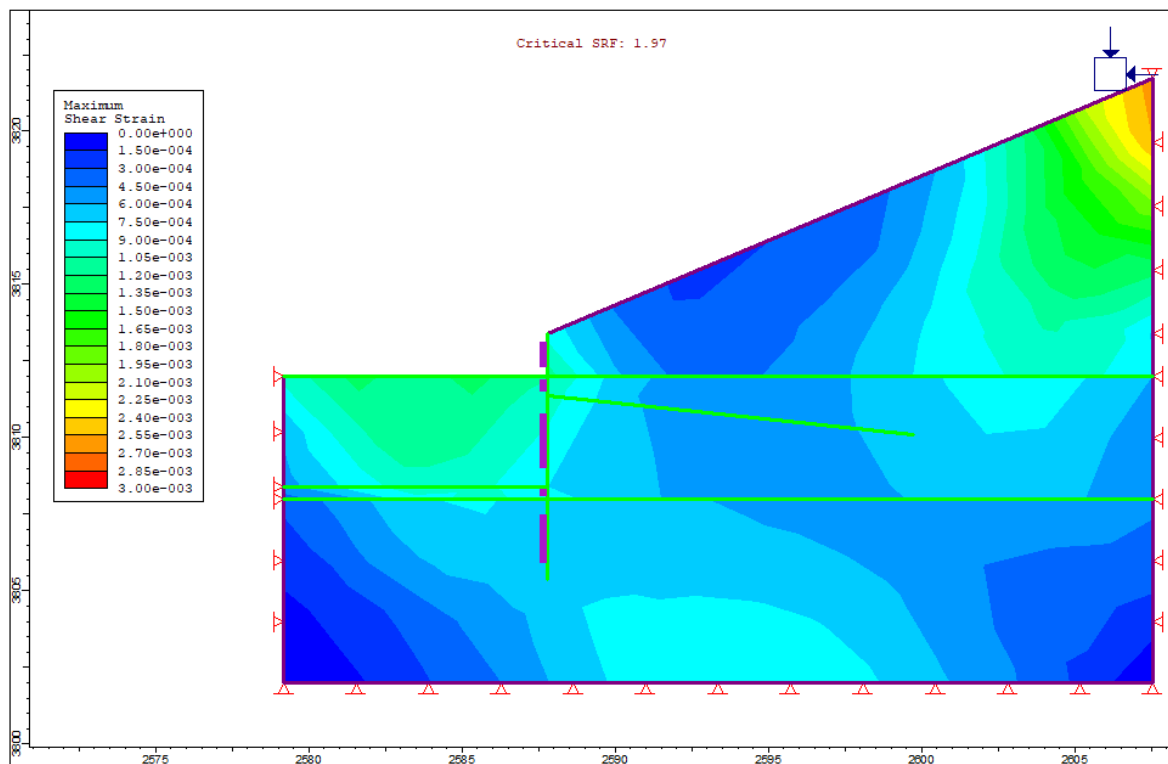
## 1. Faza: Osnova



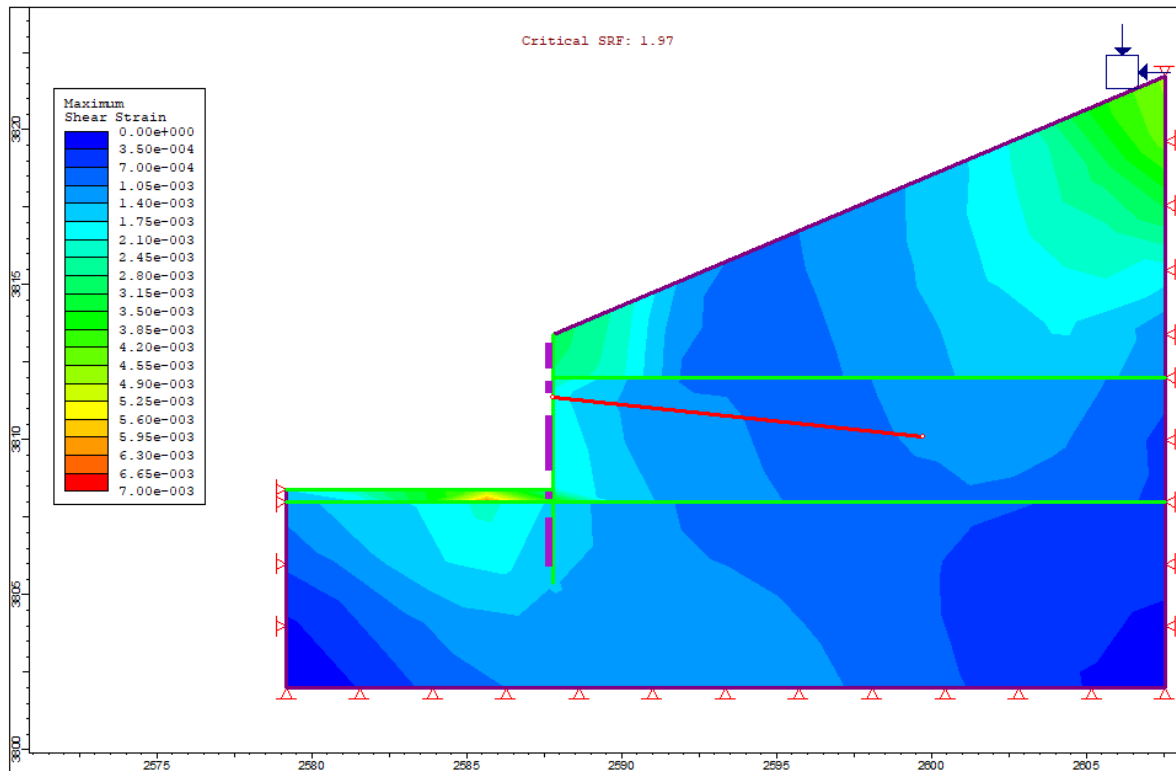
## 2. Faza: Zagatnica



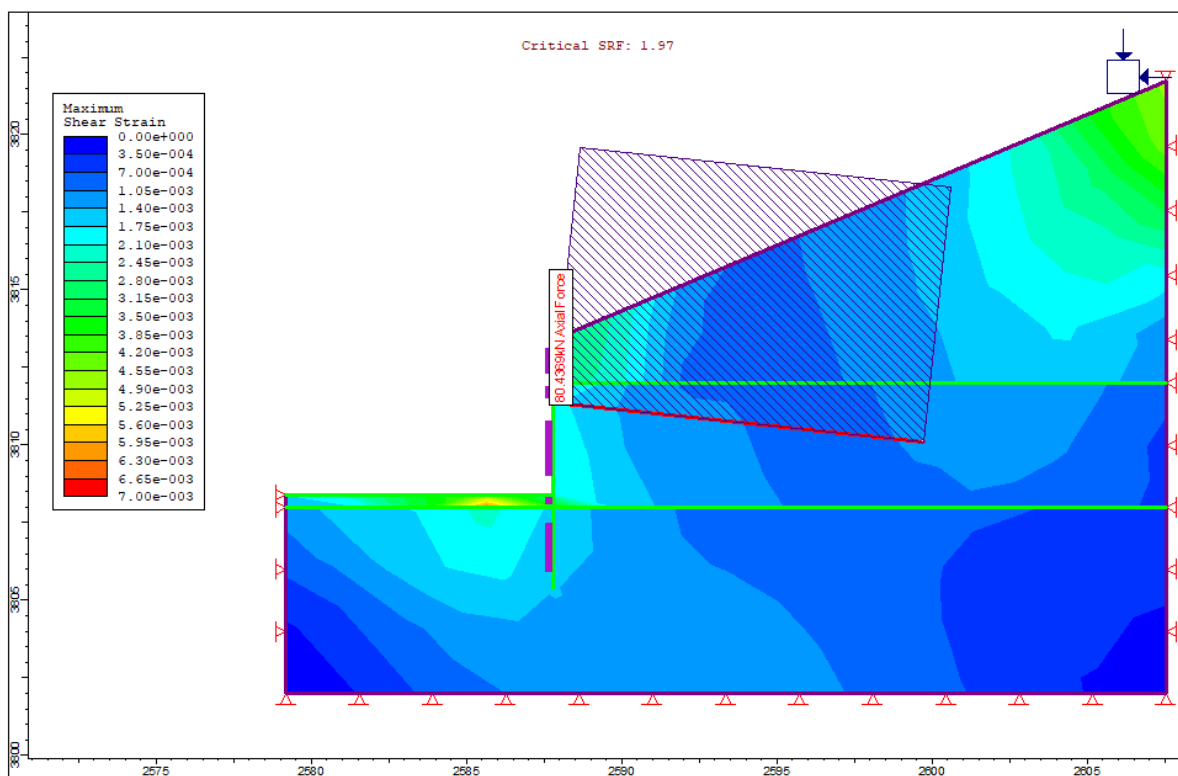
### 3. Faza: Izkop 1



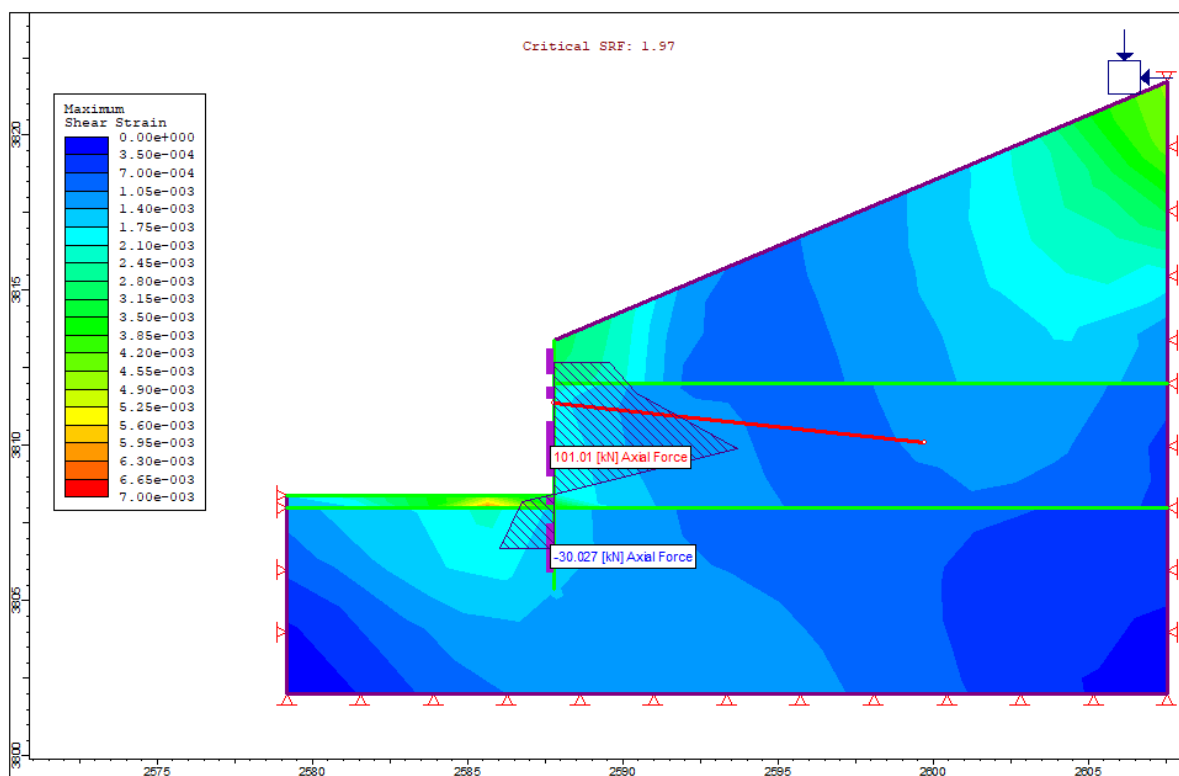
### 4. Faza: Izkop2 + IBO



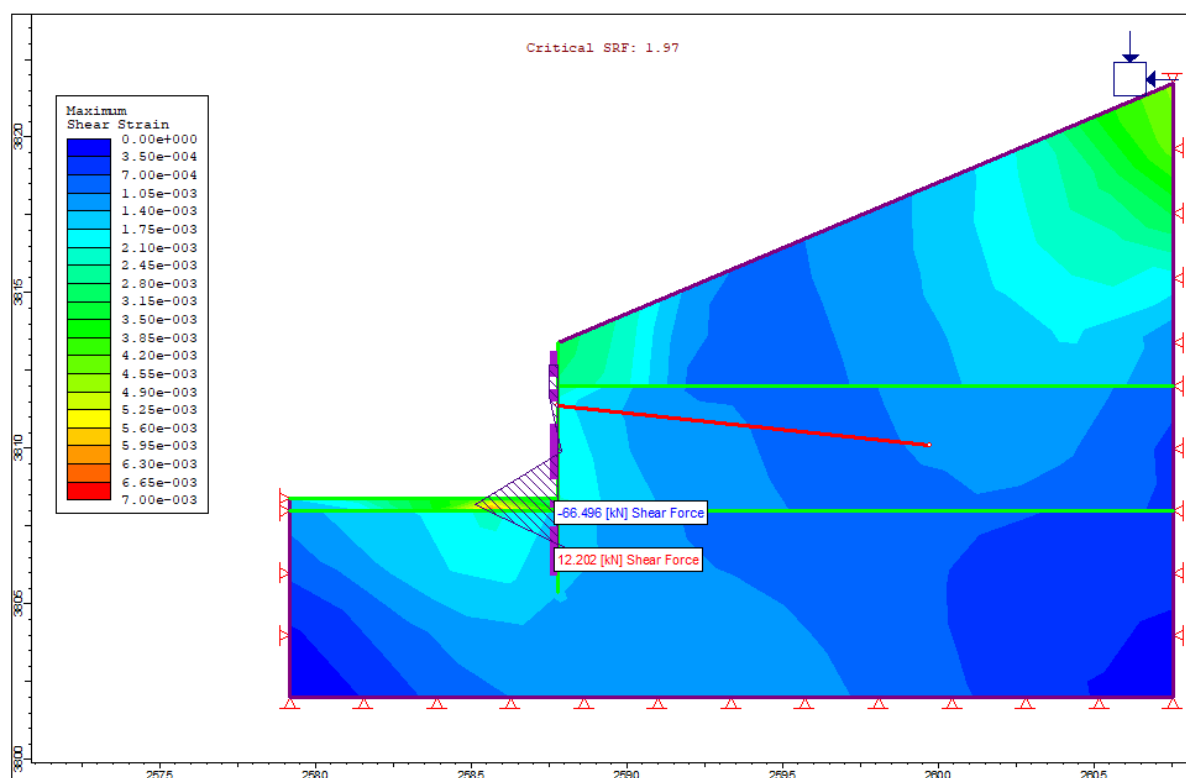
## Osna sila v IBO



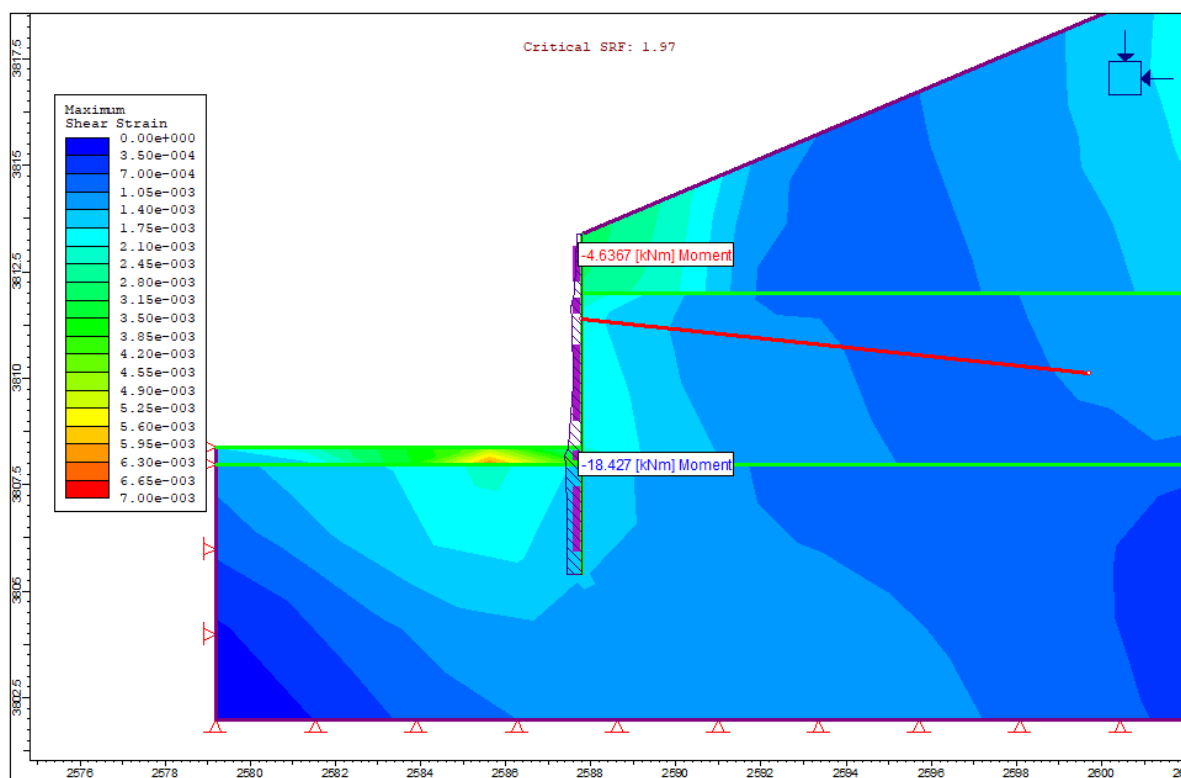
## Osna sila v zagatnici



## Prečne sile v zagatnici



## Momenti v zagatnici



## *Slide Analysis Information*

### *SLIDE - An Interactive Slope Stability Program*

#### *Project Summary*

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File Name: 1\_2  
 Slide Modeler Version: 7.009  
 Project Title: SLIDE - An Interactive Slope Stability Program  
 Date Created: 11. 12. 2017, 17:03:15

#### *General Settings*

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Units of Measurement: Metric Units  
 Time Units: days  
 Permeability Units: meters/second  
 Failure Direction: Right to Left  
 Data Output: Standard  
 Maximum Material Properties: 20  
 Maximum Support Properties: 20

#### *Analysis Options*

---

Slices Type: Vertical

##### **Analysis Methods Used**

Bishop simplified  
 Janbu simplified

Number of slices: 50  
 Tolerance: 0.005  
 Maximum number of iterations: 75  
 Check malpha < 0.2: Yes  
 Create Interslice boundaries at intersections with water tables and piezos: Yes  
 Initial trial value of FS: 1  
 Steffensen Iteration: Yes

#### *Groundwater Analysis*

---

Groundwater Method: Water Surfaces  
 Pore Fluid Unit Weight [kN/m3]: 9.81  
 Advanced Groundwater Method: None

#### *Random Numbers*

---

Pseudo-random Seed: 10116  
 Random Number Generation Method: Park and Miller v.3

#### *Surface Options*




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Surface Type: Circular  
 Search Method: Grid Search  
 Radius Increment: 10  
 Composite Surfaces: Disabled  
 Reverse Curvature: Invalid Surfaces  
 Minimum Elevation: Not Defined  
 Minimum Depth: Not Defined  
 Minimum Area: Not Defined  
 Minimum Weight: Not Defined

## Seismic

Advanced Seismic Analysis: No  
 Staged pseudostatic analysis: No

## Material Properties

Property	IG0	IG1	IG2
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [kN/m3]	20	19	21
Cohesion [kPa]	0	6.5	0
Friction Angle [deg]	28	18.4	39
Water Surface	None	None	None
Ru Value	0	0	0

## Global Minimums

### Method: bishop simplified

FS	1.064850
Center:	4222.237, 4639.516
Radius:	14.452
Left Slip Surface Endpoint:	4228.031, 4626.276
Right Slip Surface Endpoint:	4229.353, 4626.937
Resisting Moment:	.5614 kN-m
Driving Moment:	.40541 kN-m
Total Slice Area:	.0186231 m2

### Method: janbu simplified

FS	1.064120
Center:	4222.237, 4639.516
Radius:	14.452
Left Slip Surface Endpoint:	4228.031, 4626.276
Right Slip Surface Endpoint:	4229.353, 4626.937
Resisting Horizontal Force:	.158476 kN
Driving Horizontal Force:	.148928 kN
Total Slice Area:	.0186231 m2

## Valid / Invalid Surfaces

### Method: bishop simplified

Number of Valid Surfaces: 4730  
 Number of Invalid Surfaces: 122

#### Error Codes:

Error Code -108 reported for 38 surfaces

Error Code -112 reported for 84 surfaces

**Method: janbu simplified**

Number of Valid Surfaces: 4775

Number of Invalid Surfaces: 77

### Error Codes:

Error Code -108 reported for 43 surfaces

Error Code -112 reported for 34 surfaces

## Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-112 = The coefficient  $M\text{-Alpha} = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi)/F) < 0.2$  for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

### Slice Data

**Global Minimum Query (bishop simplified) - Safety Factor: 1.06485**

Slice Number	Width [m]	Weight [kN]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	0.0264388	0.00042785	23.6913	IG0	0	28	0.00662837	0.00705822	0.0132746	0	0.0132746
2	0.0264388	0.00126697	23.8058	IG0	0	28	0.0196091	0.0208808	0.039271	0	0.039271
3	0.0264388	0.00207268	23.9204	IG0	0	28	0.0320478	0.0341261	0.0641818	0	0.0641818
4	0.0264388	0.00284486	24.0351	IG0	0	28	0.0439441	0.0467939	0.0880065	0	0.0880065
5	0.0264388	0.00358351	24.1499	IG0	0	28	0.0552997	0.0588859	0.110748	0	0.110748
6	0.0264388	0.00428841	24.2649	IG0	0	28	0.0661125	0.0703999	0.132403	0	0.132403
7	0.0264388	0.00495967	24.3799	IG0	0	28	0.0763858	0.0813394	0.152977	0	0.152977
8	0.0264388	0.00559706	24.495	IG0	0	28	0.0861176	0.0917023	0.172467	0	0.172467
9	0.0264388	0.00620041	24.6103	IG0	0	28	0.0953064	0.101487	0.19087	0	0.19087
10	0.0264388	0.00676986	24.7256	IG0	0	28	0.103956	0.110698	0.208193	0	0.208193
11	0.0264388	0.00730511	24.8411	IG0	0	28	0.112065	0.119332	0.224431	0	0.224431
12	0.0264388	0.0078062	24.9566	IG0	0	28	0.119633	0.127391	0.239587	0	0.239587
13	0.0264388	0.0082729	25.0723	IG0	0	28	0.126659	0.134873	0.253659	0	0.253659
14	0.0264388	0.00870518	25.1881	IG0	0	28	0.133145	0.141779	0.266647	0	0.266647
15	0.0264388	0.00910301	25.3039	IG0	0	28	0.13909	0.14811	0.278554	0	0.278554
16	0.0264388	0.00946619	25.4199	IG0	0	28	0.144495	0.153865	0.289378	0	0.289378
17	0.0264388	0.00979465	25.536	IG0	0	28	0.149358	0.159044	0.299118	0	0.299118
18	0.0264388	0.0100883	25.6523	IG0	0	28	0.153682	0.163648	0.307777	0	0.307777
19	0.0264388	0.010347	25.7686	IG0	0	28	0.157464	0.167676	0.315353	0	0.315353
20	0.0264388	0.0105708	25.8851	IG0	0	28	0.160707	0.171129	0.321847	0	0.321847
21	0.0264388	0.0107594	26.0016	IG0	0	28	0.16341	0.174007	0.327259	0	0.327259
22	0.0264388	0.0109127	26.1183	IG0	0	28	0.16557	0.176307	0.331586	0	0.331586
23	0.0264388	0.0110308	26.2351	IG0	0	28	0.167192	0.178034	0.334834	0	0.334834
24	0.0264388	0.0111134	26.352	IG0	0	28	0.168273	0.179185	0.336998	0	0.336998
25	0.0264388	0.0111604	26.469	IG0	0	28	0.168813	0.179761	0.338082	0	0.338082
26	0.0264388	0.0111718	26.5862	IG0	0	28	0.168813	0.179761	0.338082	0	0.338082
27	0.0264388	0.0111475	26.7035	IG0	0	28	0.168273	0.179186	0.336999	0	0.336999
28	0.0264388	0.0110873	26.8208	IG0	0	28	0.167193	0.178035	0.334836	0	0.334836
29	0.0264388	0.0109911	26.9384	IG0	0	28	0.165573	0.17631	0.33159	0	0.33159
30	0.0264388	0.0108588	27.056	IG0	0	28	0.163412	0.174009	0.327263	0	0.327263
31	0.0264388	0.0106902	27.1738	IG0	0	28	0.160707	0.171129	0.321848	0	0.321848
32	0.0264388	0.0104854	27.2916	IG0	0	28	0.157465	0.167677	0.315355	0	0.315355
33	0.0264388	0.0102441	27.4097	IG0	0	28	0.153684	0.16365	0.30778	0	0.30778
34	0.0264388	0.00996627	27.5278	IG0	0	28	0.14936	0.159046	0.299122	0	0.299122
35	0.0264388	0.00965171	27.646	IG0	0	28	0.144495	0.153866	0.28938	0	0.28938
36	0.0264388	0.00930037	27.7644	IG0	0	28	0.139091	0.148111	0.278556	0	0.278556
37	0.0264388	0.0089122	27.883	IG0	0	28	0.133146	0.141781	0.26665	0	0.26665
38	0.0264388	0.00848688	28.0016	IG0	0	28	0.126659	0.134873	0.253659	0	0.253659
39	0.0264388	0.00802454	28.1204	IG0	0	28	0.119634	0.127392	0.239589	0	0.239589
40	0.0264388	0.00752475	28.2393	IG0	0	28	0.112065	0.119332	0.224431	0	0.224431
41	0.0264388	0.00698771	28.3583	IG0	0	28	0.103956	0.110698	0.208194	0	0.208194
42	0.0264388	0.00641305	28.4775	IG0	0	28	0.0953064	0.101487	0.19087	0	0.19087
43	0.0264388	0.00580084	28.5968	IG0	0	28	0.0861171	0.0917018	0.172466	0	0.172466
44	0.0264388	0.0051507	28.7163	IG0	0	28	0.0763842	0.0813377	0.152974	0	0.152974
45	0.0264388	0.00446279	28.8359	IG0	0	28	0.0661121	0.0703995	0.132402	0	0.132402
46	0.0264388	0.00373669	28.9556	IG0	0	28	0.0552967	0.0588827	0.110742	0	0.110742
47	0.0264388	0.00297248	29.0754	IG0	0	28	0.0439406	0.0467902	0.0879997	0	0.0879997
48	0.0264388	0.00216994	29.1954	IG0	0	28	0.0320428	0.0341208	0.0641718	0	0.0641718
49	0.0264388	0.00132896	29.3156	IG0	0	28	0.0196032	0.0208745	0.039259	0	0.039259
50	0.0264388	0.000449456	29.4359	IG0	0	28	0.00662269	0.00705217	0.0132632	0	0.0132632

Query 1 (bishop simplified) - Safety Factor: 1.06485

Slice Number	Width [m]	Weight [kN]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	0.0264388	0.00042785	23.6913	IG0	0	28	0.00662837	0.00705822	0.0132746	0	0.0132746
2	0.0264388	0.00126697	23.8058	IG0	0	28	0.0196091	0.0208808	0.039271	0	0.039271
3	0.0264388	0.00207268	23.9204	IG0	0	28	0.0320478	0.0341261	0.0641818	0	0.0641818
4	0.0264388	0.00284486	24.0351	IG0	0	28	0.0439441	0.0467939	0.0880065	0	0.0880065
5	0.0264388	0.00358351	24.1499	IG0	0	28	0.0552997	0.0588859	0.110748	0	0.110748
6	0.0264388	0.00428841	24.2649	IG0	0	28	0.0661125	0.0703999	0.132403	0	0.132403
7	0.0264388	0.00495967	24.3799	IG0	0	28	0.0763858	0.0813394	0.152977	0	0.152977
8	0.0264388	0.00559706	24.495	IG0	0	28	0.0861176	0.0917023	0.172467	0	0.172467
9	0.0264388	0.00620041	24.6103	IG0	0	28	0.0953064	0.101487	0.19087	0	0.19087
10	0.0264388	0.00676986	24.7256	IG0	0	28	0.103956	0.110698	0.208193	0	0.208193
11	0.0264388	0.00730511	24.8411	IG0	0	28	0.112065	0.119332	0.224431	0	0.224431
12	0.0264388	0.0078062	24.9566	IG0	0	28	0.119633	0.127391	0.239587	0	0.239587
13	0.0264388	0.0082729	25.0723	IG0	0	28	0.126659	0.134873	0.253659	0	0.253659
14	0.0264388	0.00870518	25.1881	IG0	0	28	0.133145	0.141779	0.266647	0	0.266647
15	0.0264388	0.00910301	25.3039	IG0	0	28	0.13909	0.14811	0.278554	0	0.278554
16	0.0264388	0.00946619	25.4199	IG0	0	28	0.144495	0.153865	0.289378	0	0.289378
17	0.0264388	0.00979465	25.536	IG0	0	28	0.149358	0.159044	0.299118	0	0.299118
18	0.0264388	0.0100883	25.6523	IG0	0	28	0.153682	0.163648	0.307777	0	0.307777
19	0.0264388	0.010347	25.7686	IG0	0	28	0.157464	0.167676	0.315353	0	0.315353
20	0.0264388	0.0105708	25.8851	IG0	0	28	0.160707	0.171129	0.321847	0	0.321847
21	0.0264388	0.0107594	26.0016	IG0	0	28	0.16341	0.174007	0.327259	0	0.327259
22	0.0264388	0.0109127	26.1183	IG0	0	28	0.16557	0.176307	0.331586	0	0.331586
23	0.0264388	0.0110308	26.2351	IG0	0	28	0.167192	0.178034	0.334834	0	0.334834
24	0.0264388	0.0111134	26.352	IG0	0	28	0.168273	0.179185	0.336998	0	0.336998
25	0.0264388	0.0111604	26.469	IG0	0	28	0.168813	0.179761	0.338082	0	0.338082
26	0.0264388	0.0111718	26.5862	IG0	0	28	0.168813	0.179761	0.338082	0	0.338082
27	0.0264388	0.0111475	26.7035	IG0	0	28	0.168273	0.179186	0.336999	0	0.336999
28	0.0264388	0.0110873	26.8208	IG0	0	28	0.167193	0.178035	0.334836	0	0.334836
29	0.0264388	0.0109911	26.9384	IG0	0	28	0.165573	0.17631	0.33159	0	0.33159
30	0.0264388	0.0108588	27.056	IG0	0	28	0.163412	0.174009	0.327263	0	0.327263
31	0.0264388	0.0106902	27.1738	IG0	0	28	0.160707	0.171129	0.321848	0	0.321848
32	0.0264388	0.0104854	27.2916	IG0	0	28	0.157465	0.167677	0.315355	0	0.315355
33	0.0264388	0.0102441	27.4097	IG0	0	28	0.153684	0.16365	0.30778	0	0.30778
34	0.0264388	0.00996627	27.5278	IG0	0	28	0.14936	0.159046	0.299122	0	0.299122
35	0.0264388	0.00965171	27.646	IG0	0	28	0.144495	0.153866	0.28938	0	0.28938
36	0.0264388	0.00930037	27.7644	IG0	0	28	0.139091	0.148111	0.278556	0	0.278556
37	0.0264388	0.0089122	27.883	IG0	0	28	0.133146	0.141781	0.26665	0	0.26665
38	0.0264388	0.00848688	28.0016	IG0	0	28	0.126659	0.134873	0.253659	0	0.253659
39	0.0264388	0.00802454	28.1204	IG0	0	28	0.119634	0.127392	0.239589	0	0.239589
40	0.0264388	0.00752475	28.2393	IG0	0	28	0.112065	0.119332	0.224431	0	0.224431
41	0.0264388	0.00698771	28.3583	IG0	0	28	0.103956	0.110698	0.208194	0	0.208194
42	0.0264388	0.00641305	28.4775	IG0	0	28	0.0953064	0.101487	0.19087	0	0.19087
43	0.0264388	0.00580084	28.5968	IG0	0	28	0.0861171	0.0917018	0.172466	0	0.172466
44	0.0264388	0.0051507	28.7163	IG0	0	28	0.0763842	0.0813377	0.152974	0	0.152974
45	0.0264388	0.00446279	28.8359	IG0	0	28	0.0661121	0.0703995	0.132402	0	0.132402
46	0.0264388	0.00373669	28.9556	IG0	0	28	0.0552967	0.0588827	0.110742	0	0.110742
47	0.0264388	0.00297248	29.0754	IG0	0	28	0.0439406	0.0467902	0.0879997	0	0.0879997
48	0.0264388	0.00216994	29.1954	IG0	0	28	0.0320428	0.0341208	0.0641718	0	0.0641718
49	0.0264388	0.00132896	29.3156	IG0	0	28	0.0196032	0.0208745	0.039259	0	0.039259
50	0.0264388	0.000449456	29.4359	IG0	0	28	0.00662269	0.00705217	0.0132632	0	0.0132632

Global Minimum Query (janbu simplified) - Safety Factor: 1.06412

Slice Number	Width [m]	Weight [kN]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	0.0264388	0.00042785	23.6913	IG0	0	28	0.00663198	0.00705722	0.0132727	0	0.0132727
2	0.0264388	0.00126697	23.8058	IG0	0	28	0.0196198	0.0208778	0.0392654	0	0.0392654
3	0.0264388	0.00207268	23.9204	IG0	0	28	0.0320652	0.0341212	0.0641728	0	0.0641728
4	0.0264388	0.00284486	24.0351	IG0	0	28	0.043968	0.0467872	0.087994	0	0.087994
5	0.0264388	0.00358351	24.1499	IG0	0	28	0.0553297	0.0588774	0.110732	0	0.110732
6	0.0264388	0.00428841	24.2649	IG0	0	28	0.0661483	0.0703897	0.132384	0	0.132384
7	0.0264388	0.00495967	24.3799	IG0	0	28	0.0764271	0.0813276	0.152955	0	0.152955
8	0.0264388	0.00559706	24.495	IG0	0	28	0.0861641	0.0916889	0.172442	0	0.172442
9	0.0264388	0.00620041	24.6103	IG0	0	28	0.0953577	0.101472	0.190842	0	0.190842
10	0.0264388	0.00676986	24.7256	IG0	0	28	0.104013	0.110682	0.208162	0	0.208162
11	0.0264388	0.00730511	24.8411	IG0	0	28	0.112125	0.119314	0.224398	0	0.224398
12	0.0264388	0.0078062	24.9566	IG0	0	28	0.119697	0.127372	0.239552	0	0.239552
13	0.0264388	0.0082729	25.0723	IG0	0	28	0.126727	0.134853	0.253621	0	0.253621
14	0.0264388	0.00870518	25.1881	IG0	0	28	0.133215	0.141757	0.266607	0	0.266607
15	0.0264388	0.00910301	25.3039	IG0	0	28	0.139165	0.148088	0.278512	0	0.278512
16	0.0264388	0.00946619	25.4199	IG0	0	28	0.144572	0.153842	0.289334	0	0.289334
17	0.0264388	0.00979465	25.536	IG0	0	28	0.149438	0.15902	0.299073	0	0.299073
18	0.0264388	0.0100883	25.6523	IG0	0	28	0.153764	0.163623	0.307731	0	0.307731
19	0.0264388	0.010347	25.7686	IG0	0	28	0.157548	0.16765	0.315305	0	0.315305
20	0.0264388	0.0105708	25.8851	IG0	0	28	0.160793	0.171103	0.321798	0	0.321798
21	0.0264388	0.0107594	26.0016	IG0	0	28	0.163497	0.17398	0.327208	0	0.327208
22	0.0264388	0.0109127	26.1183	IG0	0	28	0.165658	0.17628	0.331534	0	0.331534
23	0.0264388	0.0110308	26.2351	IG0	0	28	0.167281	0.178007	0.334782	0	0.334782
24	0.0264388	0.0111134	26.352	IG0	0	28	0.168362	0.179157	0.336946	0	0.336946
25	0.0264388	0.0111604	26.469	IG0	0	28	0.168903	0.179733	0.338028	0	0.338028
26	0.0264388	0.0111718	26.5862	IG0	0	28	0.168903	0.179733	0.338028	0	0.338028
27	0.0264388	0.0111475	26.7035	IG0	0	28	0.168362	0.179157	0.336946	0	0.336946
28	0.0264388	0.0110873	26.8208	IG0	0	28	0.167281	0.178007	0.334783	0	0.334783
29	0.0264388	0.0109911	26.9384	IG0	0	28	0.16566	0.176282	0.331537	0	0.331537
30	0.0264388	0.0108588	27.056	IG0	0	28	0.163498	0.173981	0.32721	0	0.32721
31	0.0264388	0.0106902	27.1738	IG0	0	28	0.160792	0.171102	0.321796	0	0.321796
32	0.0264388	0.0104854	27.2916	IG0	0	28	0.157548	0.16765	0.315304	0	0.315304
33	0.0264388	0.0102441	27.4097	IG0	0	28	0.153764	0.163623	0.307731	0	0.307731
34	0.0264388	0.00996627	27.5278	IG0	0	28	0.149438	0.15902	0.299074	0	0.299074
35	0.0264388	0.00965171	27.646	IG0	0	28	0.144571	0.153841	0.289333	0	0.289333
36	0.0264388	0.00930037	27.7644	IG0	0	28	0.139163	0.148086	0.27851	0	0.27851
37	0.0264388	0.0089122	27.883	IG0	0	28	0.133215	0.141757	0.266607	0	0.266607
38	0.0264388	0.00848688	28.0016	IG0	0	28	0.126725	0.134851	0.253617	0	0.253617
39	0.0264388	0.00802454	28.1204	IG0	0	28	0.119696	0.127371	0.239549	0	0.239549
40	0.0264388	0.00752475	28.2393	IG0	0	28	0.112123	0.119312	0.224393	0	0.224393
41	0.0264388	0.00698771	28.3583	IG0	0	28	0.104011	0.11068	0.208159	0	0.208159
42	0.0264388	0.00641305	28.4775	IG0	0	28	0.0953558	0.10147	0.190838	0	0.190838
43	0.0264388	0.00580084	28.5968	IG0	0	28	0.0861616	0.0916863	0.172437	0	0.172437
44	0.0264388	0.0051507	28.7163	IG0	0	28	0.0764237	0.081324	0.152948	0	0.152948
45	0.0264388	0.00446279	28.8359	IG0	0	28	0.0661463	0.0703876	0.13238	0	0.13238
46	0.0264388	0.00373669	28.9556	IG0	0	28	0.0553252	0.0588726	0.110723	0	0.110723
47	0.0264388	0.00297248	29.0754	IG0	0	28	0.0439633	0.0467822	0.0879845	0	0.0879845
48	0.0264388	0.00216994	29.1954	IG0	0	28	0.0320593	0.0341149	0.0641609	0	0.0641609
49	0.0264388	0.00132896	29.3156	IG0	0	28	0.0196133	0.0208709	0.0392524	0	0.0392524
50	0.0264388	0.000449456	29.4359	IG0	0	28	0.00662609	0.00705095	0.0132609	0	0.0132609

Query 1 (janbu simplified) - Safety Factor: 1.06412

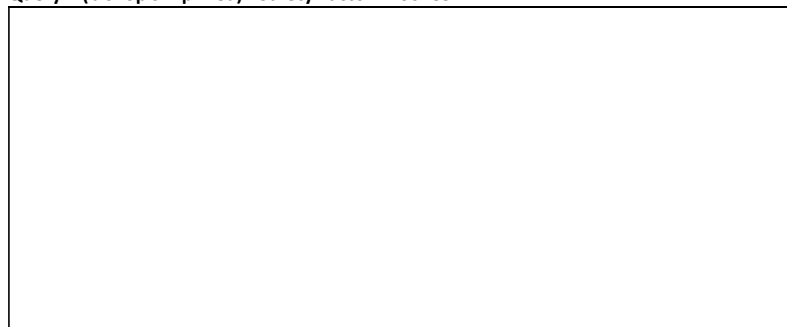
Slice Number	Width [m]	Weight [kN]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [kPa]	Base Friction Angle [degrees]	Shear Stress [kPa]	Shear Strength [kPa]	Base Normal Stress [kPa]	Pore Pressure [kPa]	Effective Normal Stress [kPa]
1	0.0264388	0.00042785	23.6913	IG0	0	28	0.00663198	0.00705722	0.0132727	0	0.0132727
2	0.0264388	0.00126697	23.8058	IG0	0	28	0.0196198	0.0208778	0.0392654	0	0.0392654
3	0.0264388	0.00207268	23.9204	IG0	0	28	0.0320652	0.0341212	0.0641728	0	0.0641728
4	0.0264388	0.00284486	24.0351	IG0	0	28	0.043968	0.0467872	0.087994	0	0.087994
5	0.0264388	0.00358351	24.1499	IG0	0	28	0.0553297	0.0588774	0.110732	0	0.110732
6	0.0264388	0.00428841	24.2649	IG0	0	28	0.0661483	0.0703897	0.132384	0	0.132384
7	0.0264388	0.00495967	24.3799	IG0	0	28	0.0764271	0.0813276	0.152955	0	0.152955
8	0.0264388	0.00559706	24.495	IG0	0	28	0.0861641	0.0916889	0.172442	0	0.172442
9	0.0264388	0.00620041	24.6103	IG0	0	28	0.0953577	0.101472	0.190842	0	0.190842
10	0.0264388	0.00676986	24.7256	IG0	0	28	0.104013	0.110682	0.208162	0	0.208162
11	0.0264388	0.00730511	24.8411	IG0	0	28	0.112125	0.119314	0.224398	0	0.224398
12	0.0264388	0.0078062	24.9566	IG0	0	28	0.119697	0.127372	0.239552	0	0.239552
13	0.0264388	0.0082729	25.0723	IG0	0	28	0.126727	0.134853	0.253621	0	0.253621
14	0.0264388	0.00870518	25.1881	IG0	0	28	0.133215	0.141757	0.266607	0	0.266607
15	0.0264388	0.00910301	25.3039	IG0	0	28	0.139165	0.148088	0.278512	0	0.278512
16	0.0264388	0.00946619	25.4199	IG0	0	28	0.144572	0.153842	0.289334	0	0.289334
17	0.0264388	0.00979465	25.536	IG0	0	28	0.149438	0.15902	0.299073	0	0.299073
18	0.0264388	0.0100883	25.6523	IG0	0	28	0.153764	0.163623	0.307731	0	0.307731
19	0.0264388	0.010347	25.7686	IG0	0	28	0.157548	0.16765	0.315305	0	0.315305
20	0.0264388	0.0105708	25.8851	IG0	0	28	0.160793	0.171103	0.321798	0	0.321798
21	0.0264388	0.0107594	26.0016	IG0	0	28	0.163497	0.17398	0.327208	0	0.327208
22	0.0264388	0.0109127	26.1183	IG0	0	28	0.165658	0.17628	0.331534	0	0.331534
23	0.0264388	0.0110308	26.2351	IG0	0	28	0.167281	0.178007	0.334782	0	0.334782
24	0.0264388	0.0111134	26.352	IG0	0	28	0.168362	0.179157	0.336946	0	0.336946
25	0.0264388	0.0111604	26.469	IG0	0	28	0.168903	0.179733	0.338028	0	0.338028
26	0.0264388	0.0111718	26.5862	IG0	0	28	0.168903	0.179733	0.338028	0	0.338028
27	0.0264388	0.0111475	26.7035	IG0	0	28	0.168362	0.179157	0.336946	0	0.336946
28	0.0264388	0.0110873	26.8208	IG0	0	28	0.167281	0.178007	0.334783	0	0.334783
29	0.0264388	0.0109911	26.9384	IG0	0	28	0.16566	0.176282	0.331537	0	0.331537
30	0.0264388	0.0108588	27.056	IG0	0	28	0.163498	0.173981	0.32721	0	0.32721
31	0.0264388	0.0106902	27.1738	IG0	0	28	0.160792	0.171102	0.321796	0	0.321796
32	0.0264388	0.0104854	27.2916	IG0	0	28	0.157548	0.16765	0.315304	0	0.315304
33	0.0264388	0.0102441	27.4097	IG0	0	28	0.153764	0.163623	0.307731	0	0.307731
34	0.0264388	0.00996627	27.5278	IG0	0	28	0.149438	0.15902	0.299074	0	0.299074
35	0.0264388	0.00965171	27.646	IG0	0	28	0.144571	0.153841	0.289333	0	0.289333
36	0.0264388	0.00930037	27.7644	IG0	0	28	0.139163	0.148086	0.27851	0	0.27851
37	0.0264388	0.0089122	27.883	IG0	0	28	0.133215	0.141757	0.266607	0	0.266607
38	0.0264388	0.00848688	28.0016	IG0	0	28	0.126725	0.134851	0.253617	0	0.253617
39	0.0264388	0.00802454	28.1204	IG0	0	28	0.119696	0.127371	0.239549	0	0.239549
40	0.0264388	0.00752475	28.2393	IG0	0	28	0.112123	0.119312	0.224393	0	0.224393
41	0.0264388	0.00698771	28.3583	IG0	0	28	0.104011	0.11068	0.208159	0	0.208159
42	0.0264388	0.00641305	28.4775	IG0	0	28	0.0953558	0.10147	0.190838	0	0.190838
43	0.0264388	0.00580084	28.5968	IG0	0	28	0.0861616	0.0916863	0.172437	0	0.172437
44	0.0264388	0.0051507	28.7163	IG0	0	28	0.0764237	0.081324	0.152948	0	0.152948
45	0.0264388	0.00446279	28.8359	IG0	0	28	0.0661463	0.0703876	0.13238	0	0.13238
46	0.0264388	0.00373669	28.9556	IG0	0	28	0.0553252	0.0588726	0.110723	0	0.110723
47	0.0264388	0.00297248	29.0754	IG0	0	28	0.0439633	0.0467822	0.0879845	0	0.0879845
48	0.0264388	0.00216994	29.1954	IG0	0	28	0.0320593	0.0341149	0.0641609	0	0.0641609
49	0.0264388	0.00132896	29.3156	IG0	0	28	0.0196133	0.0208709	0.0392524	0	0.0392524
50	0.0264388	0.000449456	29.4359	IG0	0	28	0.00662609	0.00705095	0.0132609	0	0.0132609

## Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.06485

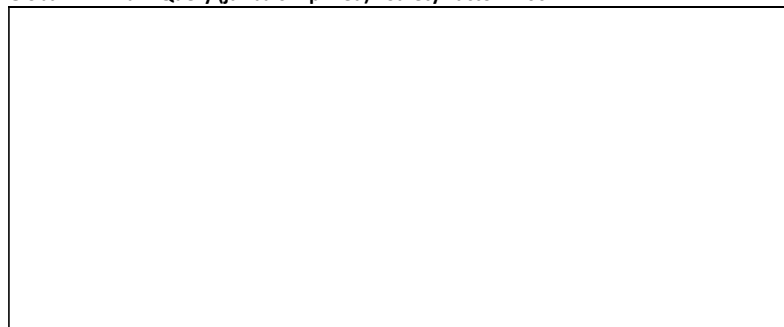
Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	4228.03	4626.28	0	0	0
2	4228.06	4626.29	2.12243e-005	0	0
3	4228.08	4626.3	8.15365e-005	0	0
4	4228.11	4626.31	0.000176048	0	0
5	4228.14	4626.32	0.000300063	0	0
6	4228.16	4626.33	0.000449083	0	0
7	4228.19	4626.35	0.0006188	0	0
8	4228.22	4626.36	0.000805111	0	0
9	4228.24	4626.37	0.0010041	0	0
10	4228.27	4626.38	0.00121206	0	0
11	4228.3	4626.4	0.00142548	0	0
12	4228.32	4626.41	0.00164103	0	0
13	4228.35	4626.42	0.00185562	0	0
14	4228.37	4626.43	0.00206632	0	0
15	4228.4	4626.44	0.00227043	0	0
16	4228.43	4626.46	0.00246544	0	0
17	4228.45	4626.47	0.00264907	0	0
18	4228.48	4626.48	0.00281921	0	0
19	4228.51	4626.49	0.00297398	0	0
20	4228.53	4626.51	0.00311171	0	0
21	4228.56	4626.52	0.00323093	0	0
22	4228.59	4626.53	0.00333039	0	0
23	4228.61	4626.55	0.00340903	0	0
24	4228.64	4626.56	0.00346605	0	0
25	4228.67	4626.57	0.00350081	0	0
26	4228.69	4626.59	0.00351292	0	0
27	4228.72	4626.6	0.0035022	0	0
28	4228.74	4626.61	0.00346869	0	0
29	4228.77	4626.63	0.00341264	0	0
30	4228.8	4626.64	0.00333454	0	0
31	4228.82	4626.65	0.00323508	0	0
32	4228.85	4626.67	0.00311519	0	0
33	4228.88	4626.68	0.00297602	0	0
34	4228.9	4626.69	0.00281895	0	0
35	4228.93	4626.71	0.00264559	0	0
36	4228.96	4626.72	0.00245777	0	0
37	4228.98	4626.74	0.00225756	0	0
38	4229.01	4626.75	0.00204726	0	0
39	4229.04	4626.76	0.00182941	0	0
40	4229.06	4626.78	0.00160679	0	0
41	4229.09	4626.79	0.0013824	0	0
42	4229.11	4626.81	0.00115949	0	0
43	4229.14	4626.82	0.000941556	0	0
44	4229.17	4626.83	0.000732335	0	0
45	4229.19	4626.85	0.00053581	0	0
46	4229.22	4626.86	0.000356204	0	0
47	4229.25	4626.88	0.000197998	0	0
48	4229.27	4626.89	6.59173e-005	0	0
49	4229.3	4626.91	-3.50569e-005	0	0
50	4229.33	4626.92	-9.96906e-005	0	0
51	4229.35	4626.94	0	0	0

Query 1 (bishop simplified) - Safety Factor: 1.06485



Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	4228.03	4626.28	0	0	0
2	4228.06	4626.29	2.12243e-005	0	0
3	4228.08	4626.3	8.15365e-005	0	0
4	4228.11	4626.31	0.000176048	0	0
5	4228.14	4626.32	0.000300063	0	0
6	4228.16	4626.33	0.000449083	0	0
7	4228.19	4626.35	0.0006188	0	0
8	4228.22	4626.36	0.000805111	0	0
9	4228.24	4626.37	0.0010041	0	0
10	4228.27	4626.38	0.00121206	0	0
11	4228.3	4626.4	0.00142548	0	0
12	4228.32	4626.41	0.00164103	0	0
13	4228.35	4626.42	0.00185562	0	0
14	4228.37	4626.43	0.00206632	0	0
15	4228.4	4626.44	0.00227043	0	0
16	4228.43	4626.46	0.00246544	0	0
17	4228.45	4626.47	0.00264907	0	0
18	4228.48	4626.48	0.00281921	0	0
19	4228.51	4626.49	0.00297398	0	0
20	4228.53	4626.51	0.00311171	0	0
21	4228.56	4626.52	0.00323093	0	0
22	4228.59	4626.53	0.00333039	0	0
23	4228.61	4626.55	0.00340903	0	0
24	4228.64	4626.56	0.00346605	0	0
25	4228.67	4626.57	0.00350081	0	0
26	4228.69	4626.59	0.00351292	0	0
27	4228.72	4626.6	0.0035022	0	0
28	4228.74	4626.61	0.00346869	0	0
29	4228.77	4626.63	0.00341264	0	0
30	4228.8	4626.64	0.00333454	0	0
31	4228.82	4626.65	0.00323508	0	0
32	4228.85	4626.67	0.00311519	0	0
33	4228.88	4626.68	0.00297602	0	0
34	4228.9	4626.69	0.00281895	0	0
35	4228.93	4626.71	0.00264559	0	0
36	4228.96	4626.72	0.00245777	0	0
37	4228.98	4626.74	0.00225756	0	0
38	4229.01	4626.75	0.00204726	0	0
39	4229.04	4626.76	0.00182941	0	0
40	4229.06	4626.78	0.00160679	0	0
41	4229.09	4626.79	0.0013824	0	0
42	4229.11	4626.81	0.00115949	0	0
43	4229.14	4626.82	0.000941556	0	0
44	4229.17	4626.83	0.000732335	0	0
45	4229.19	4626.85	0.00053581	0	0
46	4229.22	4626.86	0.000356204	0	0
47	4229.25	4626.88	0.000197998	0	0
48	4229.27	4626.89	6.59173e-005	0	0
49	4229.3	4626.91	-3.50569e-005	0	0
50	4229.33	4626.92	-9.96906e-005	0	0
51	4229.35	4626.94	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.06412



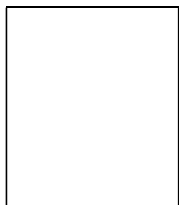
Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	4228.03	4626.28	0	0	0
2	4228.06	4626.29	2.13596e-005	0	0
3	4228.08	4626.3	8.20724e-005	0	0
4	4228.11	4626.31	0.000177239	0	0
5	4228.14	4626.32	0.000302153	0	0
6	4228.16	4626.33	0.000452305	0	0
7	4228.19	4626.35	0.000623378	0	0
8	4228.22	4626.36	0.000811256	0	0
9	4228.24	4626.37	0.00101202	0	0
10	4228.27	4626.38	0.00122193	0	0
11	4228.3	4626.4	0.00143749	0	0
12	4228.32	4626.41	0.00165535	0	0
13	4228.35	4626.42	0.0018724	0	0
14	4228.37	4626.43	0.00208571	0	0
15	4228.4	4626.44	0.00229257	0	0
16	4228.43	4626.46	0.00249046	0	0
17	4228.45	4626.47	0.00267707	0	0
18	4228.48	4626.48	0.0028503	0	0
19	4228.51	4626.49	0.00300825	0	0
20	4228.53	4626.51	0.00314925	0	0
21	4228.56	4626.52	0.0032718	0	0
22	4228.59	4626.53	0.00337465	0	0
23	4228.61	4626.55	0.00345674	0	0
24	4228.64	4626.56	0.00351723	0	0
25	4228.67	4626.57	0.0035555	0	0
26	4228.69	4626.59	0.00357113	0	0
27	4228.72	4626.6	0.00356394	0	0
28	4228.74	4626.61	0.00353395	0	0
29	4228.77	4626.63	0.0034814	0	0
30	4228.8	4626.64	0.00340676	0	0
31	4228.82	4626.65	0.00331073	0	0
32	4228.85	4626.67	0.00319421	0	0
33	4228.88	4626.68	0.00305835	0	0
34	4228.9	4626.69	0.00290451	0	0
35	4228.93	4626.71	0.00273429	0	0
36	4228.96	4626.72	0.00254952	0	0
37	4228.98	4626.74	0.00235224	0	0
38	4229.01	4626.75	0.00214476	0	0
39	4229.04	4626.76	0.00192959	0	0
40	4229.06	4626.78	0.0017095	0	0
41	4229.09	4626.79	0.00148748	0	0
42	4229.11	4626.81	0.00126678	0	0
43	4229.14	4626.82	0.00105087	0	0
44	4229.17	4626.83	0.000843485	0	0
45	4229.19	4626.85	0.000648587	0	0
46	4229.22	4626.86	0.00047039	0	0
47	4229.25	4626.88	0.000313365	0	0
48	4229.27	4626.89	0.000182225	0	0
49	4229.3	4626.91	8.19362e-005	0	0
50	4229.33	4626.92	1.77228e-005	0	0
51	4229.35	4626.94	0	0	0

Query 1 (janbu simplified) - Safety Factor: 1.06412

Slice Number	X coordinate [m]	Y coordinate - Bottom [m]	Interslice Normal Force [kN]	Interslice Shear Force [kN]	Interslice Force Angle [degrees]
1	4228.03	4626.28	0	0	0
2	4228.06	4626.29	2.13596e-005	0	0
3	4228.08	4626.3	8.20724e-005	0	0
4	4228.11	4626.31	0.000177239	0	0
5	4228.14	4626.32	0.000302153	0	0
6	4228.16	4626.33	0.000452305	0	0
7	4228.19	4626.35	0.000623378	0	0
8	4228.22	4626.36	0.000811256	0	0
9	4228.24	4626.37	0.00101202	0	0
10	4228.27	4626.38	0.00122193	0	0
11	4228.3	4626.4	0.00143749	0	0
12	4228.32	4626.41	0.00165535	0	0
13	4228.35	4626.42	0.0018724	0	0
14	4228.37	4626.43	0.00208571	0	0
15	4228.4	4626.44	0.00229257	0	0
16	4228.43	4626.46	0.00249046	0	0
17	4228.45	4626.47	0.00267707	0	0
18	4228.48	4626.48	0.0028503	0	0
19	4228.51	4626.49	0.00300825	0	0
20	4228.53	4626.51	0.00314925	0	0
21	4228.56	4626.52	0.0032718	0	0
22	4228.59	4626.53	0.00337465	0	0
23	4228.61	4626.55	0.00345674	0	0
24	4228.64	4626.56	0.00351723	0	0
25	4228.67	4626.57	0.0035555	0	0
26	4228.69	4626.59	0.00357113	0	0
27	4228.72	4626.6	0.00356394	0	0
28	4228.74	4626.61	0.00353395	0	0
29	4228.77	4626.63	0.0034814	0	0
30	4228.8	4626.64	0.00340676	0	0
31	4228.82	4626.65	0.00331073	0	0
32	4228.85	4626.67	0.00319421	0	0
33	4228.88	4626.68	0.00305835	0	0
34	4228.9	4626.69	0.00290451	0	0
35	4228.93	4626.71	0.00273429	0	0
36	4228.96	4626.72	0.00254952	0	0
37	4228.98	4626.74	0.00235224	0	0
38	4229.01	4626.75	0.00214476	0	0
39	4229.04	4626.76	0.00192959	0	0
40	4229.06	4626.78	0.0017095	0	0
41	4229.09	4626.79	0.00148748	0	0
42	4229.11	4626.81	0.00126678	0	0
43	4229.14	4626.82	0.00105087	0	0
44	4229.17	4626.83	0.000843485	0	0
45	4229.19	4626.85	0.000648587	0	0
46	4229.22	4626.86	0.00047039	0	0
47	4229.25	4626.88	0.000313365	0	0
48	4229.27	4626.89	0.000182225	0	0
49	4229.3	4626.91	8.19362e-005	0	0
50	4229.33	4626.92	1.77228e-005	0	0
51	4229.35	4626.94	0	0	0

## List Of Coordinates

### External Boundary



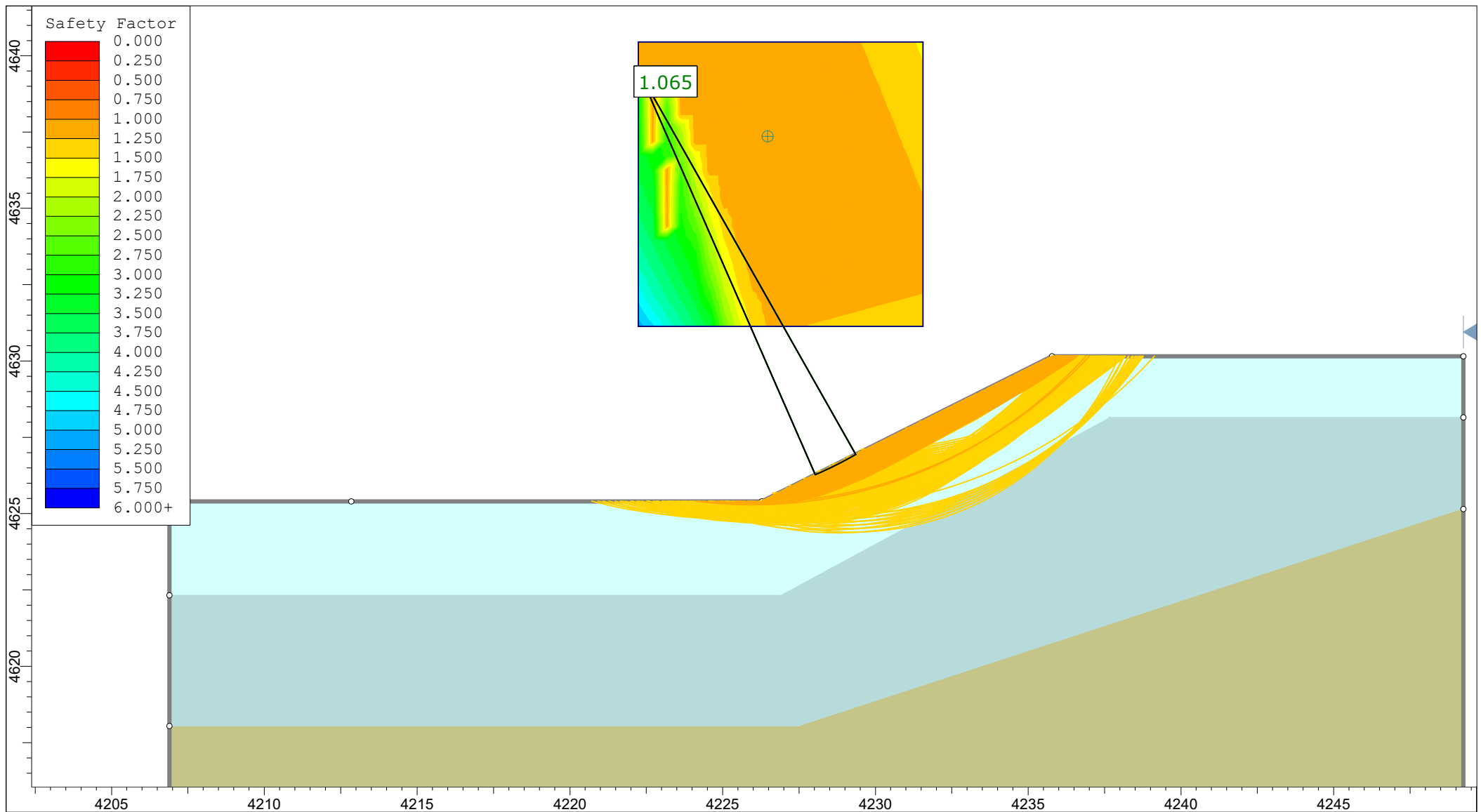
X	Y
4206.89	4625.4
4206.89	4622.32
4206.89	4618.04
4206.89	4605.03
4249.25	4605.03
4249.25	4625.15
4249.25	4628.15
4249.25	4630.15
4235.78	4630.15
4226.28	4625.4
4212.84	4625.4

### Material Boundary

X	Y
4206.89	4622.32
4226.86	4622.32
4237.64	4628.15
4249.25	4628.15

### Material Boundary

X	Y
4206.89	4618.04
4227.54	4618.04
4249.25	4625.15



SLIDEINTERPRET 7.009

Project

SLIDE - An Interactive Slope Stability Program

Analysis Description

Drawn By

Company

Date

11. 12. 2017, 17:03:15

File Name

1\_2.slim