



Analysis of Redi Rock wall

Input data

Project

Task : Redi-Rock Wall - Preliminary Calculation
Part : Shopping center - Black Rose
Description : H=5,94 m
Customer : RRI - Preliminary Design Charts
Author : JWB
Date : 04.05.2017
Project ID : 156
Project number : 16569

Settings

(input for current task)

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Allowable eccentricity : 0,333
Internal stability : Standard - straight slip surface
Reduction coeff. of contact first block - base : 1,00
Verification methodology : according to LRFD

Blocks

No.	Description	Height h [mm]	Width w [mm]	Unit weight γ [kN/m ³]
1	Top block 24 straight	457,2	609,6	16,97
2	Block 28 PC	457,2	711,2	18,85
3	Block 41 PC	457,2	1028,7	18,85
4	Top block 28	457,2	711,2	18,85
5	Top block 41	457,2	1028,7	18,85
6	Top block 24 straight garden	457,2	609,6	12,57

No.	Description	Min. shear strength F_{min} [kN/m]	Max. shear strength F_{max} [kN/m]	Friction f [°]
1	Top block 24 straight	88,45	164,56	44,00
2	Block 28 PC	88,45	164,56	44,00
3	Block 41 PC	88,45	164,56	44,00
4	Top block 28	88,45	164,56	44,00
5	Top block 41	88,45	164,56	44,00
6	Top block 24 straight garden	88,45	164,56	44,00

Setbacks

No.	Setback s [mm]
1	0,254
2	9,525
3	41,275
4	238,125
5	422,275



Geometry

No. group	Description	Count	Setback s [mm]
1	Block 28 PC	12	41,3
2	Top block 28	1	41,3

Base

Geometry

Upper setback $a_1 = 0,50$ m

Lower setback $a_2 = 0,50$ m

Height $h = 0,50$ m

Width $b = 2,00$ m

Material

Concrete self-weight $\gamma = 25,00$ kN/m³

Shear cub (key) capacity = 0,00 kN/m

Friction angle concrete-concrete = 30,00 °

Types of reinforcements

No.	Name	Type of reinforcement	Line type	Tensile strength		
				T_{ult} [kN/m]	R_t [kN/m]	R_{con} [kN/m]
1	Miragrid 5XT	Miragrid 5XT	-----	68,59	30,20	31,73
2	Miragrid 8XT	Miragrid 8XT	-----	107,99	49,53	49,96
3	Miragrid 10XT	Miragrid 10XT	-----	138,64	63,59	62,57
4	Miragrid 20XT	Miragrid 20XT	~~~~~	200,01	95,72	88,00
5	Miragrid 24XT	Miragrid 24XT	~~~~~	400,09	200,18	154,12

Reinforcement details

1. Miragrid 5XT

Short-term strength	$T_{ult} = 68,59$ kN/m
Creep red. factor	$RF_{CR} = 1,58$
Durability red. factor	$RF_D = 1,15$
Installation damage red. factor	$RF_{ID} = 1,25$
Long-term strength	$R_t = 30,20$ kN/m
Coeff. of direct slip along reinforcement	$C_{ds} = 0,67$
Coeff. of interaction of soil and geo-reinforcement	$\alpha = 0,67$
Scale correction factor	$RF_D = 0,8$
Long-term strength reduction factor	$CR_{cr} = 0,532$
Design connection strength	$R_{con} = 31,73$ kN/m

2. Miragrid 8XT

Short-term strength	$T_{ult} = 107,99$ kN/m
Creep red. factor	$RF_{CR} = 1,58$
Durability red. factor	$RF_D = 1,15$
Installation damage red. factor	$RF_{ID} = 1,20$
Long-term strength	$R_t = 49,53$ kN/m
Coeff. of direct slip along reinforcement	$C_{ds} = 0,67$
Coeff. of interaction of soil and geo-reinforcement	$\alpha = 0,67$
Scale correction factor	$RF_D = 0,8$
Long-term strength reduction factor	$CR_{cr} = 0,532$



Design connection strength $R_{con} = 49,96 \text{ kN/m}$

3. Miragrid 10XT

Short-term strength $T_{ult} = 138,64 \text{ kN/m}$
 Creep red. factor $RF_{CR} = 1,58$
 Durability red. factor $RF_D = 1,15$
 Instalation damage red. factor $RF_{ID} = 1,20$
 Long-term strength $R_t = 63,59 \text{ kN/m}$
 Coeff. of direct slip along reinforcement $C_{ds} = 0,67$
 Coeff. of interaction of soil and geo-reinforcement $\alpha = 0,67$
 Scale correction factor $RF_D = 0,8$
 Long-term strength reduction factor $CR_{cr} = 0,519$
 Design connection strength $R_{con} = 62,57 \text{ kN/m}$

4. Miragrid 20XT

Short-term strength $T_{ult} = 200,01 \text{ kN/m}$
 Creep red. factor $RF_{CR} = 1,58$
 Durability red. factor $RF_D = 1,15$
 Instalation damage red. factor $RF_{ID} = 1,15$
 Long-term strength $R_t = 95,72 \text{ kN/m}$
 Coeff. of direct slip along reinforcement $C_{ds} = 0,67$
 Coeff. of interaction of soil and geo-reinforcement $\alpha = 0,67$
 Scale correction factor $RF_D = 0,8$
 Long-term strength reduction factor $CR_{cr} = 0,506$
 Design connection strength $R_{con} = 88,00 \text{ kN/m}$

5. Miragrid 24XT

Short-term strength $T_{ult} = 400,09 \text{ kN/m}$
 Creep red. factor $RF_{CR} = 1,58$
 Durability red. factor $RF_D = 1,15$
 Instalation damage red. factor $RF_{ID} = 1,10$
 Long-term strength $R_t = 200,18 \text{ kN/m}$
 Coeff. of direct slip along reinforcement $C_{ds} = 0,67$
 Coeff. of interaction of soil and geo-reinforcement $\alpha = 0,67$
 Scale correction factor $RF_D = 0,8$
 Long-term strength reduction factor $CR_{cr} = 0,443$
 Design connection strength $R_{con} = 154,12 \text{ kN/m}$

Reinforcements

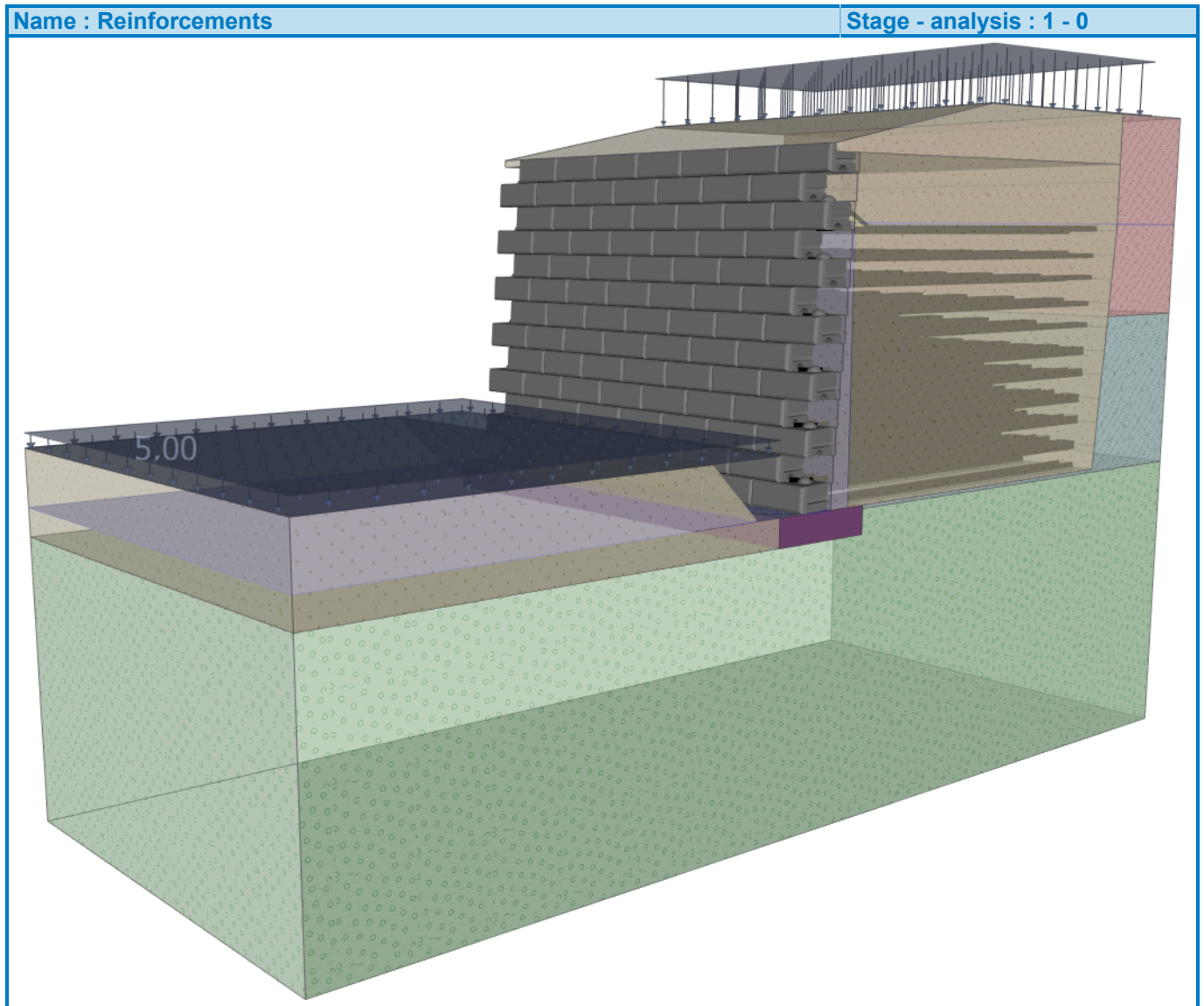
Input mode : 2 reinforcement type
 Reinf. installation : in every row of blocks (50%)
 Type of upper reinforcement : Miragrid 20XT, till the row No. 11
 Type of bottom reinforcement : Miragrid 24XT, till the row No. 5
 Top reinforcement : anchored tail
 Reinforcement geometry : identical length of reinforcements
 Length of reinforcement $l = 7,50 \text{ m}$
 Reinforced soil - S1

Reinforcements

No.	Consider	Name	Length of reinforcement $l \text{ [m]}$	End pt. coordinate $l_k \text{ [m]}$
1	Yes	Miragrid 24XT	7,50	
2	Yes	Miragrid 24XT	7,50	
3	Yes	Miragrid 24XT	7,50	
4	Yes	Miragrid 24XT	7,50	
5	Yes	Miragrid 24XT	7,50	
6	Yes	Miragrid 20XT	7,50	



No.	Consider	Name	Length of reinforcement l [m]	End pt. coordinate l _k [m]
7	Yes	Miragrid 20XT	7,50	
8	Yes	Miragrid 20XT	7,50	
9	Yes	Miragrid 20XT	7,50	
10	Yes	Miragrid 20XT	7,50	
11	Yes	Miragrid 20XT	7,50	
12	No			
13	No			



Basic soil parameters

No.	Name	Pattern	Φ_{ef} [°]	C_{ef} [kPa]	γ [kN/m ³]	γ_{su} [kN/m ³]	δ [°]
1	F1		25,00	8,00	19,00	9,00	15,00



No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]	γ_{su} [kN/m ³]	δ [°]
2	F5		21,00	6,00	20,00	10,00	10,00
3	G2		30,00	0,00	20,00	10,00	20,00
4	S1		36,50	0,00	20,00	10,00	20,00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

F1

Unit weight : $\gamma = 19,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 25,00^\circ$
 Cohesion of soil : $c_{ef} = 8,00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 15,00^\circ$
 Saturated unit weight : $\gamma_{sat} = 19,00 \text{ kN/m}^3$

F5

Unit weight : $\gamma = 20,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 21,00^\circ$
 Cohesion of soil : $c_{ef} = 6,00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 10,00^\circ$
 Saturated unit weight : $\gamma_{sat} = 20,00 \text{ kN/m}^3$

G2

Unit weight : $\gamma = 20,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 30,00^\circ$
 Cohesion of soil : $c_{ef} = 0,00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20,00^\circ$
 Saturated unit weight : $\gamma_{sat} = 20,00 \text{ kN/m}^3$

S1

Unit weight : $\gamma = 20,00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 36,50^\circ$
 Cohesion of soil : $c_{ef} = 0,00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20,00^\circ$
 Saturated unit weight : $\gamma_{sat} = 20,00 \text{ kN/m}^3$

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	3,00	F5	
2	3,00	F1	



No.	Layer [m]	Assigned soil	Pattern
3	-	G2	

Terrain profile

Terrain behind construction has the slope 1: 5,00 (slope angle is 11,31 °).
Embankment height is 0,80 m, embankment length is 4,00 m.

Water influence

GWT behind the structure lies at a depth of 1,25 m
Uplift in foot. bottom due to different pressures is not considered.

Input surface surcharges

No.	Surcharge new	Surcharge change	Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
1	Yes		permanent	30,00		4,00	5,00	on terrain

No.	Name
1	surcharge No. 1

Resistance on front face of the structure

Resistance on front face of the structure: at rest
Soil on front face of the structure - S1
Soil thickness in front of structure
Terrain surcharge

$$h = 0,50 \text{ m}$$

$$f = 5,00 \text{ kN/m}^2$$

Terrain shape in front of structure

No.	Coordinate x[m]	Depth z[m]
1	0,00	0,00
2	0,00	-0,50
3	-1,00	-0,50
4	-2,00	-1,50
5	-3,00	-1,50

Origin [0,0] is located in bottom left edge of construction.
Positive coordinate +z has downward direction.

Settings of the stage of construction

Design situation : Strength I

No. 1

Forces acting on construction

Name	F _{hor} [kN/m]	App.Pt. z [m]	F _{vert} [kN/m]	App.Pt. x [m]	Coeff. overturn.	Coeff. sliding	Coeff. stress
Weight - reinforced soil	0,00	-3,82	636,84	4,85	0,900	0,900	1,250
Active pressure	60,17	-2,29	26,27	8,62	1,500	1,500	1,500
Water pressure	0,00	-6,74	0,00	8,62	1,000	1,000	1,000
surcharge No. 1	12,42	-5,98	5,70	8,62	1,500	1,500	0,750
Weight - wall	0,00	-2,92	78,28	0,60	0,900	0,900	1,250

Verification of complete wall

Place of verification : bottom of blocks



Check for overturning stability

Resisting moment $M_{res} = 2912,26$ kNm/m

Overturning moment $M_{ovr} = 317,91$ kNm/m

Wall for overturning is SATISFACTORY

Check for slip

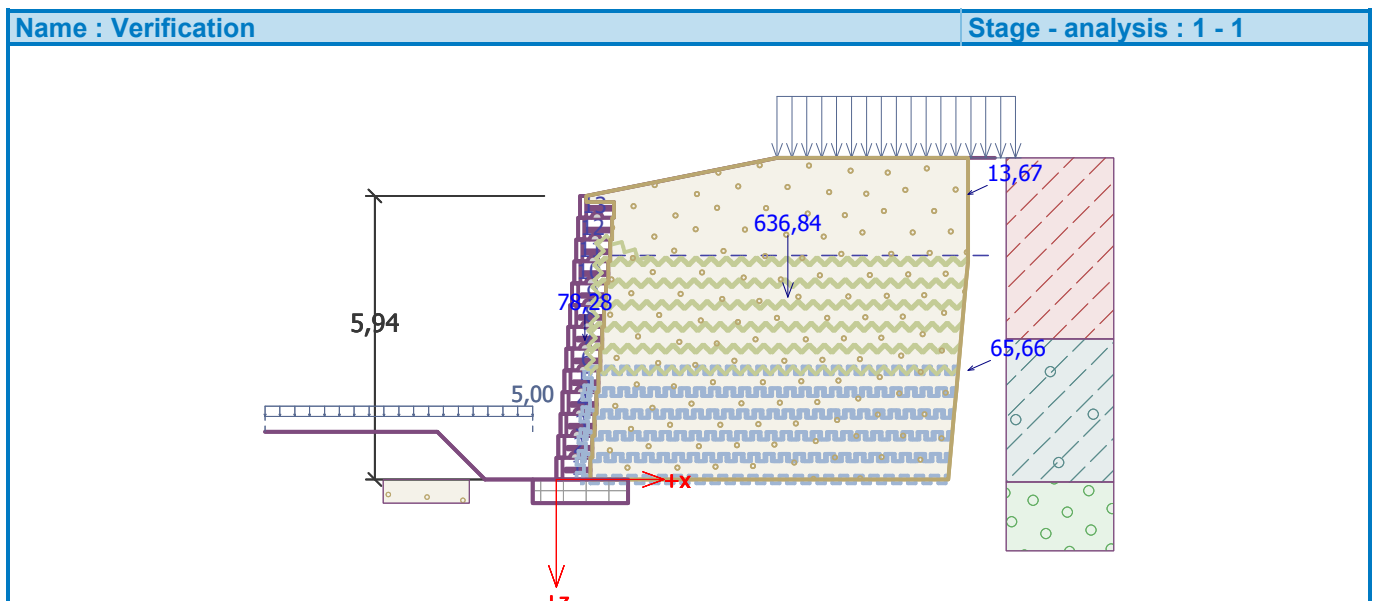
Resisting horizontal force $H_{res} = 310,54$ kN/m

Active horizontal force $H_{act} = 108,89$ kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 114,18 kPa



No. 2

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overturn.	Coeff. sliding	Coeff. stress
FF resistance	-0,51	-0,17	0,00	0,00	0,900	0,900	0,900
Resistance on front face	-1,01	-0,25	0,00	0,00	0,750	0,750	0,750
Weight - reinforced soil	0,00	-4,26	646,84	5,28	0,900	0,900	1,250
Active pressure	70,26	-2,42	31,98	9,12	0,900	1,500	1,500
Water pressure	0,00	-7,24	0,00	9,12	1,000	1,000	1,000
surcharge No. 1	12,42	-6,48	5,70	9,12	1,500	1,500	0,750
Weight - wall	0,00	-3,42	78,28	1,10	0,900	0,900	1,250

Verification of complete wall

Place of verification : bottom of leveling pad

Check for overturning stability

Resisting moment $M_{res} = 3144,36$ kNm/m

Overturning moment $M_{ovr} = 273,62$ kNm/m

Wall for overturning is SATISFACTORY



Check for slip

Resisting horizontal force $H_{res} = 277,34$ kN/m

Active horizontal force $H_{act} = 122,80$ kN/m

Wall for slip is **SATISFACTORY**

Overall check - WALL is **SATISFACTORY**

Maximum stress in footing bottom : 479,33 kPa

No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0,00	-0,41	11,54	0,37	0,900	0,900	1,250
Weight - earth wedge	0,00	-0,88	1,94	0,46	1,000	1,000	1,350
Active pressure	2,55	-0,34	1,13	0,72	1,500	1,500	0,900
Water pressure	0,00	-0,91	0,00	0,66	1,000	1,000	1,000
surcharge No. 1	0,00	-1,01	0,00	0,66	0,750	0,750	0,750

Verification of most stressed block No. 12

Place of verification : bottom of blocks

Check for overturning stability

Resisting moment $M_{res} = 5,33$ kNm/m

Overturning moment $M_{ovr} = 1,32$ kNm/m

Joint for overturning stability is **SATISFACTORY**

Check for slip

Resisting horizontal force $H_{res} = 81,59$ kN/m

Active horizontal force $H_{act} = 3,83$ kN/m

Joint for verification is **SATISFACTORY**

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	-184,88	937,59	99,57	0,000	114,18
2	-78,62	691,57	108,89	0,000	84,22
3	-185,36	937,59	97,37	0,000	114,18
4	-78,87	691,58	107,67	0,000	84,22

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-144,44	745,67	69,49
2	-112,35	675,59	72,59
3	-144,76	745,68	68,02
4	-112,61	675,59	71,38

Verification of foundation soil

Place of verification : bottom of blocks

Stress in the footing bottom : rectangle



Eccentricity verification

Max. eccentricity of normal force $e = 0,000$

Maximum allowable eccentricity $e_{alw} = 0,333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Bearing capacity of foundation soil $R = 280,00 \text{ kPa}$

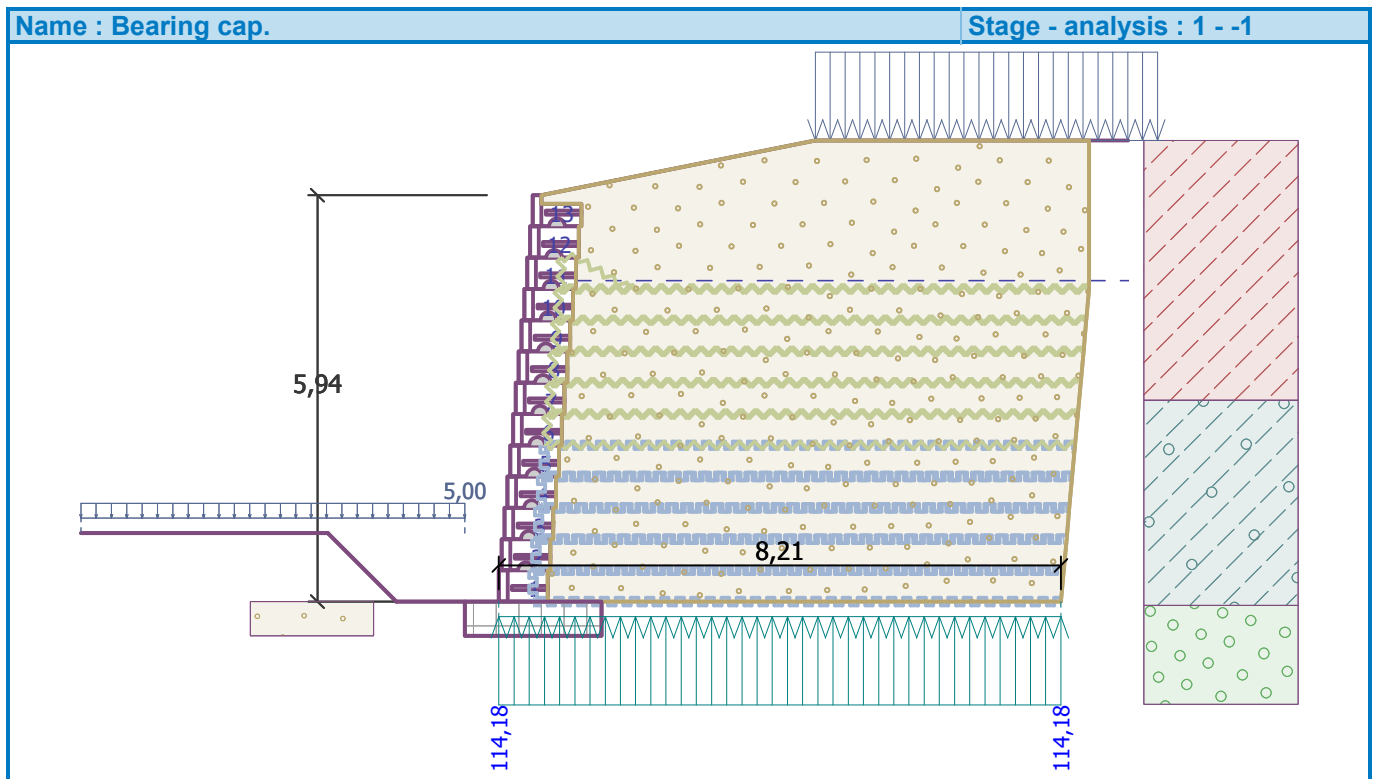
Partial factor on bearing capacity $\gamma_{Rv} = 0,55$

Max. stress at footing bottom $\sigma = 114,18 \text{ kPa}$

Bearing capacity of foundation soil $R_d = 154,00 \text{ kPa}$

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY



Verification of slip on georeinforcement No. 1

Forces acting on construction (verification of reinforcement No.: 1)

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-2,92	83,17	-0,11	0,900
Active pressure	47,72	-2,27	22,49	7,50	1,500
surcharge No. 1	12,30	-5,70	5,35	7,50	1,500
Weight - reinforced soil	0,00	-3,77	608,29	3,99	0,900
surcharge No. 1	0,00	-6,74	107,67	5,71	0,650

Verification against slip along geotextile No.: 1

Inclination of slip surface = $90,00^\circ$

Overall normal force acting on reinforcement = $659,20 \text{ kN/m}$

Coefficient of reduction of slip along
geo-textile = $0,83$

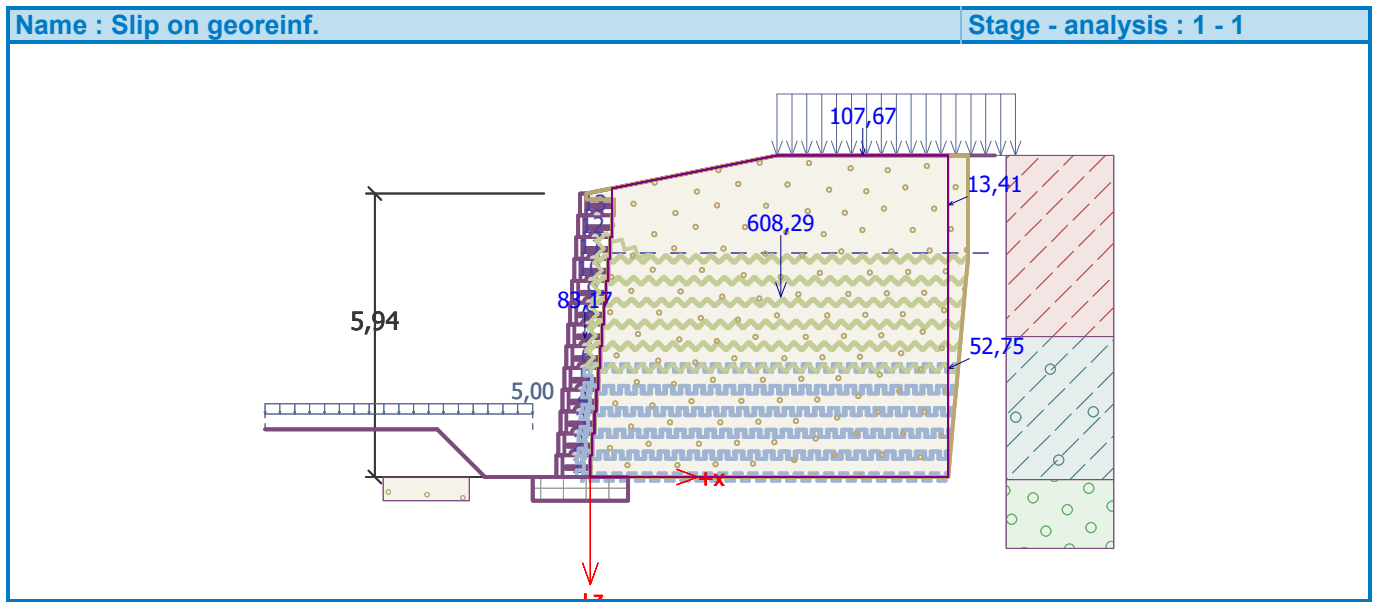


Resistance along geo-reinforcement = 256,67 kN/m
Wall resistance = 55,11 kN/m
Overall bearing capacity of reinforcements = 0,00 kN/m

Check for slip:

Resisting horizontal force $H_{res} = 311,78$ kN/m
Active horiz. force $H_{act} = 90,03$ kN/m

Slip along geotextile is SATISFACTORY



Calculation of internal stability No. 1

Calculated forces and strength of reinforcements

No.	Name	F_x [kN/m]	Depth z[m]	R_t [kN/m]	Utiliz. [%]	T_p [kN/m]	Utiliz. [%]	R_{con} [kN/m]	Utiliz. [%]
1	Miragrid 24XT	-18,23	5,94	45,04	40,49	649,15	2,81	34,68	52,58
2	Miragrid 24XT	-33,92	5,49	90,08	37,66	601,78	5,64	69,36	48,91
3	Miragrid 24XT	-30,78	5,03	90,08	34,17	552,26	5,57	69,36	44,37
4	Miragrid 24XT	-28,20	4,57	90,08	31,30	504,35	5,59	69,36	40,66
5	Miragrid 24XT	-25,62	4,11	90,08	28,44	458,39	5,59	69,36	36,94
6	Miragrid 24XT/ Miragrid 20XT	-23,05	3,66	66,58	34,61	414,39	5,56	54,48	42,30
7	Miragrid 20XT	-20,47	3,20	43,07	47,52	372,34	5,50	39,60	51,68
8	Miragrid 20XT	-13,36	2,74	43,07	31,02	332,24	4,02	39,60	33,74
9	Miragrid 20XT	-10,55	2,29	43,07	24,50	294,11	3,59	39,60	26,65
10	Miragrid 20XT	-7,87	1,83	43,07	18,26	257,92	3,05	39,60	19,86
11	Miragrid 20XT	-11,94	1,37	43,07	27,72	223,70	5,34	19,80	60,30

Check for tensile strength (reinforcement No.7)

Tension strength $R_t = 43,07$ kN/m
Force in reinforcement $F_x = 20,47$ kN/m

Reinforcement for tensile strength is SATISFACTORY

Check for pull out resistance (reinforcement No.2)

Pull out resistance $T_p = 601,78$ kN/m
Force in reinforcement $F_x = 33,92$ kN/m

Reinforcement for pull out resistance is SATISFACTORY



Verification of connection strength (reinforcement No.1)

Connection strength $R_{con} = 34,68 \text{ kN/m}$

Force in reinforcement $F_x = 18,23 \text{ kN/m}$

Connection strength is SATISFACTORY

Overall verification - reinforcement is SATISFACTORY

