Analysis of reinforced slopes

Input data

Project

Date : 28.10.2015

Settings

Standard - safety factors

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

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
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for overturning :	SF_o =	1,50	[–]
Safety factor for sliding resistance :	SF_s =	1,50	[–]
Safety factor for bearing capacity :	SF_b =	1,50	[–]
Safety factor for sliding along geo-reinforcement :	SF_{sr} =	1,50	[–]
Safety factor for geo-reinforcement strength :	SF_{st} =	1,50	[–]
Safety factor for pull out resistance of geo-reinf. :	SF_{po} =	1,50	[–]
Safety factor for connection strength :	SF_{con} =	1,50	[–]

Stability analysis

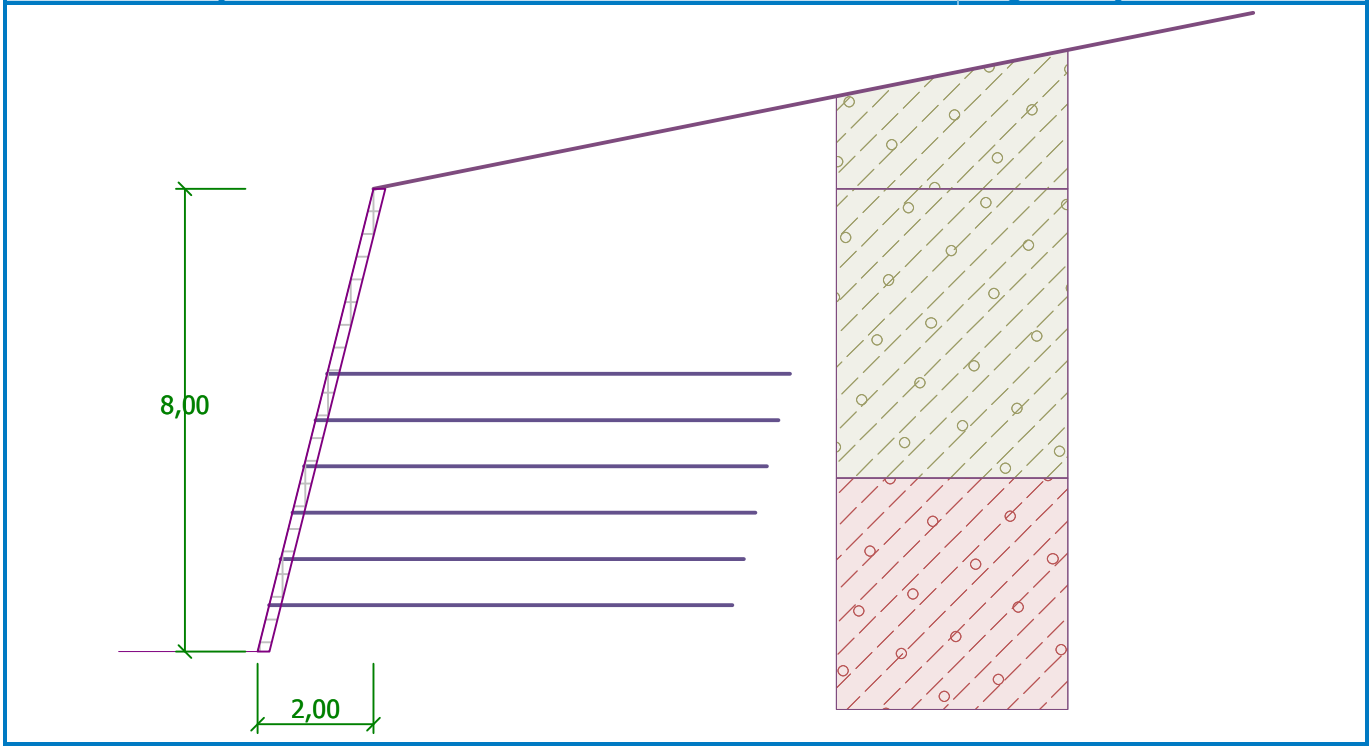
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1,50	[–]

Geometry of structure

Embankment height h_n = 8,00 m
Embankment length l_n = 2,00 m
Cover thickness t_c = 0,20 m

Name : Geometry | **Stage - analysis : 1 - 0**



Material

Reinforced soil is not defined!
Correct the input of material!

Cover material

Unit weight γ = 23,00 kN/m^3
Shear resistance R_s = 0,00 kPa

Types of reinforcements

No.	Name	Type of reinforcement	Line type	Reinforcement strength		Coefficient	
				T_{ult}[kN/m]	R_t[kN/m]	C_{ds}[–]	C_i[–]
1	Fortrac R 400/50-30	Fortrac R 400/50-30	————	400,00	120,59	0,60	0,70

Reinforcement details

1. Fortrac R 400/50-30

Short-term char. strength T_{ult} = 400,00 kN/m
Long-term design strength R_t = 120,59 kN/m
Overall coeff. of model uncertainty FS_{UNC} = 1,50

Calculate reduction factors
Life time : 120 years
Creep red. factor RF_{CR} = 1,83
Chemistry : pH 4.0-9.0
Durability red. factor RF_D = 1,14
Partical size : $D_{90} \leq 40$ mm
Installation damage red. factor RF_{ID} = 1,06

Reinforcement

No.	Number of reinforcement	Type of reinforcement	Spacing of reinforcement h_r[m]	Height of first reinforcement h[m]	Reinforcements geometry
1	6	Fortrac R 400/50-30	0,80	0,80	identical length of reinforcements

Reinforcement details

Reinforcement No. 1
Reinforcement type : Fortrac R 400/50-30
Number of reinforcements 6
Reinforcement geometry : identical length of reinforcements
Reinforcement length : 8,00 m

Reinforcement No.	Origin l_1[m]	End l_2[m]	Height from bottom h[m]	Length l[m]
1	-1,80	6,20	0,80	8,00
2	-1,60	6,40	1,60	8,00
3	-1,40	6,60	2,40	8,00
4	-1,20	6,80	3,20	8,00
5	-1,00	7,00	4,00	8,00
6	-0,80	7,20	4,80	8,00

Soil parameters

Soil No. 1

Unit weight :	γ	=	19,00 kN/m^3
Angle of internal friction :	φ_{ef}	=	29,00 °
Cohesion of soil :	c_{ef}	=	8,00 kPa
Angle of friction struc.-soil :	δ	=	10,00 °
Saturated unit weight :	γ_{sat}	=	19,00 kN/m^3

Soil No. 2

Unit weight :	γ	=	21,00 kN/m^3
Angle of internal friction :	φ_{ef}	=	30,00 °
Cohesion of soil :	c_{ef}	=	12,00 kPa
Angle of friction struc.-soil :	δ	=	12,00 °
Saturated unit weight :	γ_{sat}	=	21,50 kN/m^3

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	5,00	Soil No. 1	
2	-	Soil No. 2	

Terrain profile

Terrain behind construction has the slope 1: 5,00 (slope angle is 11,31 °).

Water influence

Ground water table is not considered.

Resistance on front face of the structure

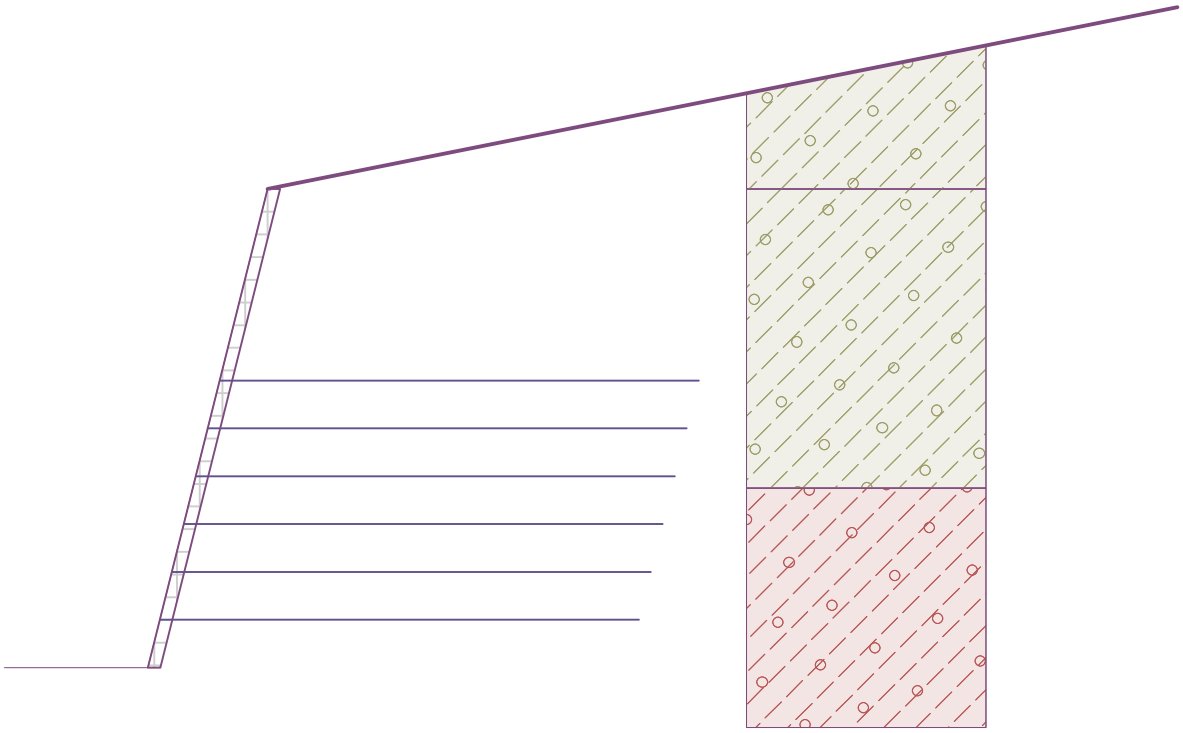
Resistance on front face of the structure is not considered.

Settings of the stage of construction

Design situation : permanent

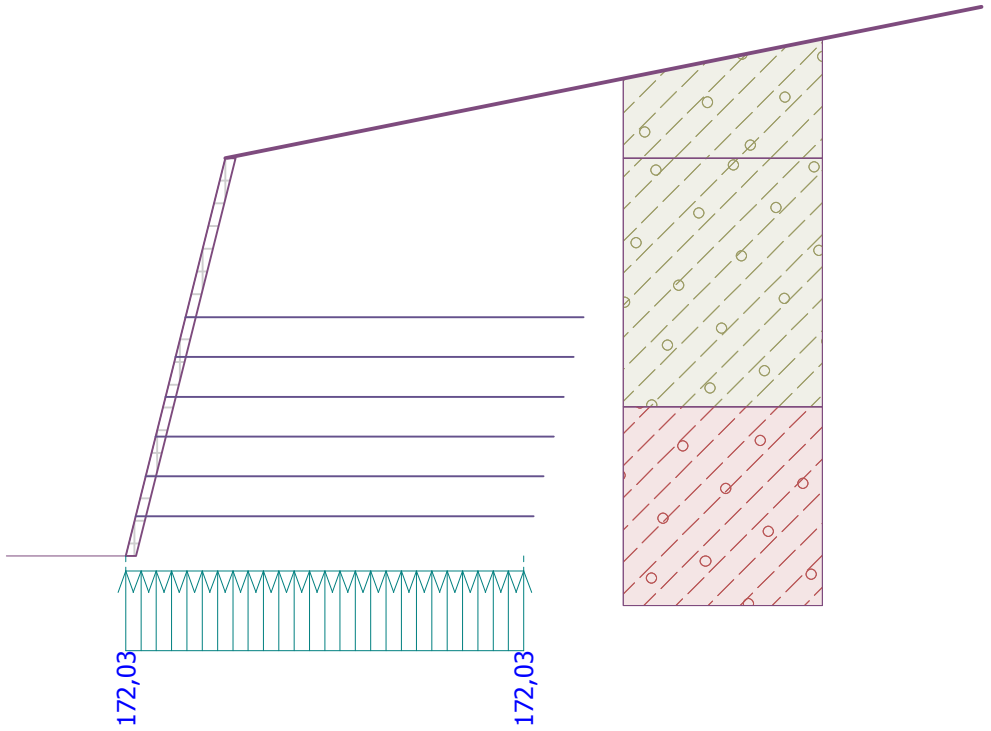
Verification No. 1

Name : Verification	Stage - analysis : 1 - 1



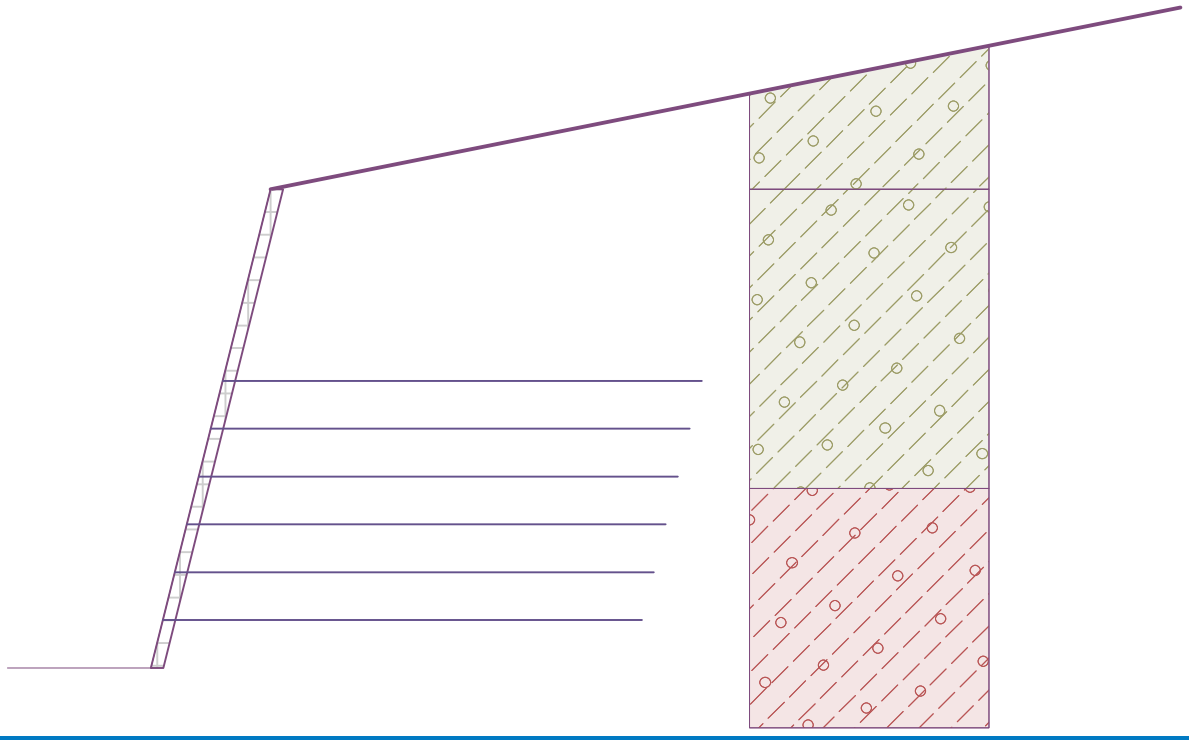
Bearing capacity of foundation soil

Name : Bearing cap.	Stage - analysis : 1 - -1



Verification of slip on georeinforcement No. 1

Name : Slip on georeinf.	Stage - analysis : 1 - 1



Calculation of internal stability No. 1

Calculated forces and strength of geo-reinforcements

No.	Name	F_x [kN/m]	Depth z[m]	R_t [kN/m]	Utilization [%]	T_p [kN/m]	Utilization [%]
1	Fortrac R 400/50-30	-26,50	7,21	120,59	32,96	926,29	4,29
2	Fortrac R 400/50-30	-14,32	6,41	120,59	17,82	787,60	2,73
3	Fortrac R 400/50-30	-11,36	5,60	120,59	14,13	657,22	2,59
4	Fortrac R 400/50-30	-11,76	4,80	120,59	14,63	519,29	3,40
5	Fortrac R 400/50-30	-10,13	4,00	120,59	12,60	422,71	3,60
6	Fortrac R 400/50-30	-21,41	3,20	120,59	26,63	334,82	9,59

Check for tensile strength (georeinforcement No.1)
Tensile strength R_t = 120,59 kN/m
Geo-reinforcement force F_x = 26,50 kN/m

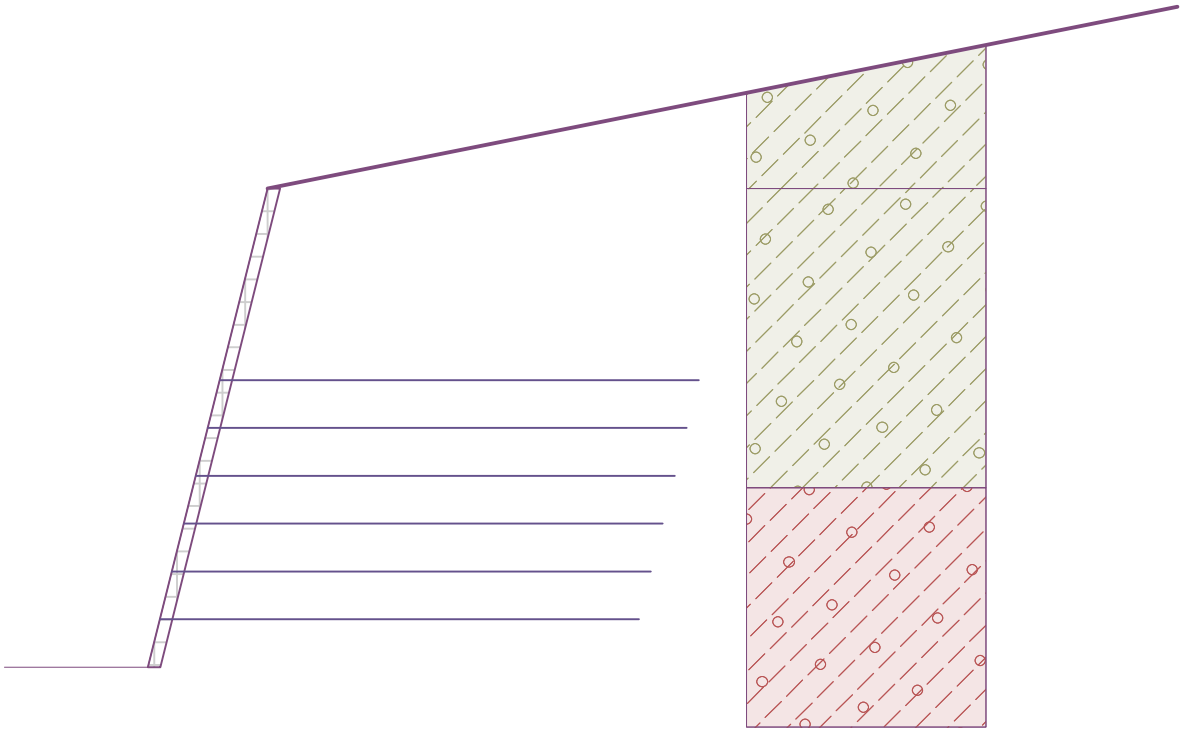
Factor of safety = 4,55 > 1,50
Geo-reinforcement for tensile strength is SATISFACTORY

Check for pull out resistance (georeinforcement No.6)
Pull out resistance T_p = 334,82 kN/m
Geo-reinforcement force F_x = 21,41 kN/m

Factor of safety = 15,64 > 1,50
Geo-reinforcement for pull out resistance is SATISFACTORY

Overall verification - geo-reinforcement is SATISFACTORY

Name : Internal stability | **Stage - analysis : 1 - 1**



Global stability analysis No. 1

Name : Global stability | **Stage - analysis : 1 - 1**