Slope stability analysis

Input data

Project

Task : Sanacija plazu 2 na JP 948 321
Part : P -3
Description : Piloti
Customer : Občina Oplotnica
Author : GEOING d.o.o.
Date : 23.2.2023

Settings

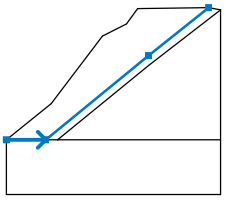
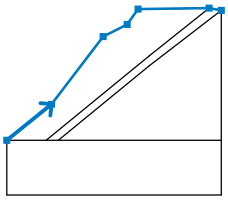
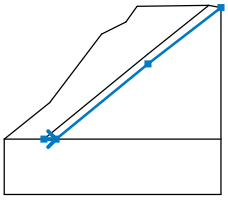
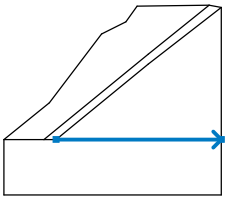
Slovenia - EN 1997 (38)

Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

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

Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		0,00	0,00	3,60	0,00	13,00	7,70
		18,50	12,10				
2		0,00	0,00	4,10	3,30	8,80	9,50
		11,00	10,60	12,00	12,00	18,50	12,10
		19,60	11,90				
3		3,60	0,00	4,70	0,00	13,00	6,80
		19,60	11,90				
4		4,70	0,00	19,60	0,00		

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Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]
1	Zaglinjeni grušč		30,00	5,00	19,00
2	Preperina		30,00	10,00	21,00
3	Hribina		34,00	30,00	23,00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m^3]	γ_s [kN/m^3]	n [–]
1	Zaglinjeni grušč		19,00		
2	Preperina		21,00		
3	Hribina		23,00		

Soil parameters

Zaglinjeni grušč

Unit weight : γ = 19,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 30,00 °
Cohesion of soil : c_{ef} = 5,00 kPa
Saturated unit weight : γ_{sat} = 19,00 kN/m^3

Preperina

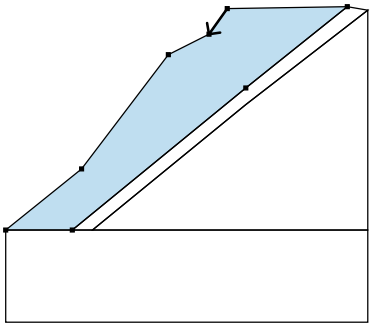
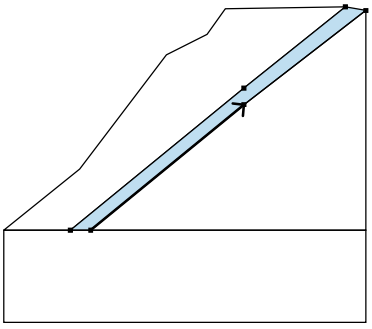
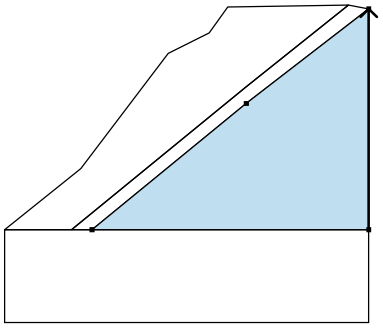
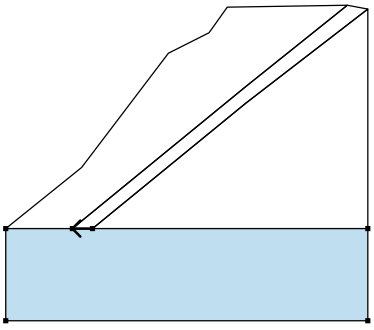
Unit weight : γ = 21,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 30,00 °
Cohesion of soil : c_{ef} = 10,00 kPa
Saturated unit weight : γ_{sat} = 21,00 kN/m^3

Hribina

Unit weight : γ = 23,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 34,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Saturated unit weight : γ_{sat} = 23,00 kN/m^3

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Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		12,00	12,00	11,00	10,60	Zaglinjeni gruščč
		8,80	9,50	4,10	3,30	
		0,00	0,00	3,60	0,00	
		13,00	7,70	18,50	12,10	
2		4,70	0,00	13,00	6,80	Preperina
		19,60	11,90	18,50	12,10	
		13,00	7,70	3,60	0,00	
3		19,60	0,00	19,60	11,90	Hribina
		13,00	6,80	4,70	0,00	
4		4,70	0,00	3,60	0,00	Hribina
		0,00	0,00	0,00	-5,00	
		19,60	-5,00	19,60	0,00	

Anti-Slide piles

No.	Point		Length	Pile spacing	Cross-section	Pile bearing capacity			
	x [m]	z [m]	l [m]	b [m]	[m]	Distribution along the pile	Max. bearing capacity V_u [kN]	Gradient K [–]	Passive force direction
1	16,00	12,08	6,93	1,20	d = 0,60	linear	150,00	0,50	perpendicular to pile

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Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude q, q_1, f, F	Magnitude q_2	Magnitude unit
1	strip	permanent	on terrain	x = 15,00	l = 3,00		0,00	16,67		kN/m^2

Water

Water type : No water

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters						
Center :	x =	-13,12	[m]	Angles :	α_1 =	21,80 [°]
	z =	45,22	[m]		α_2 =	43,21 [°]
Radius :	R =	45,45	[m]			
Analysis of the slip surface without optimization.						

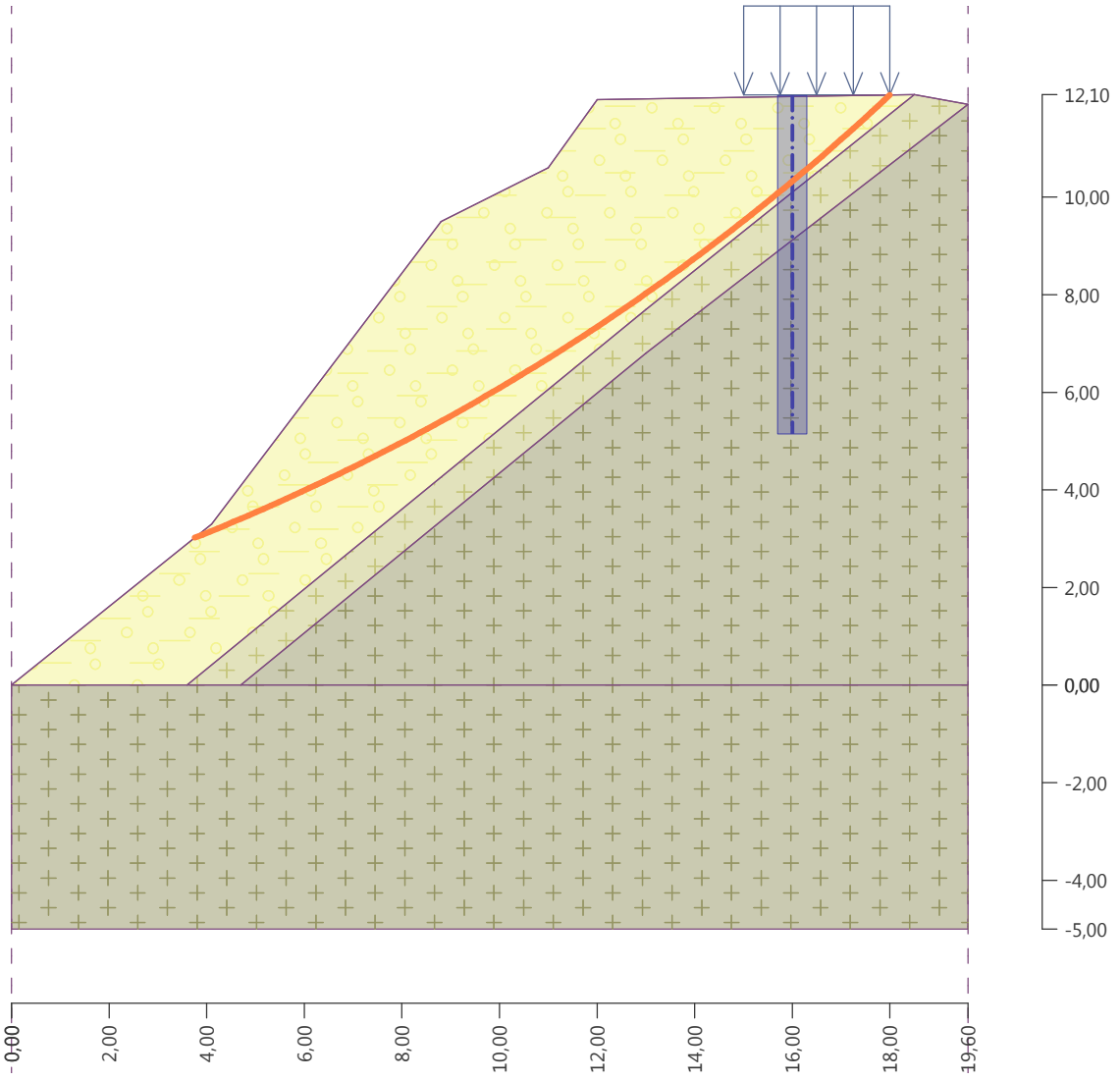
The forces acting on the pile

Anti-Slide Pile No. 1 (16,00; 12,08 [m])
Horizontal active force: 15,14 kN/m
Horizontal passive force: 0,00 kN/m The slope in front of anti-slide pile is not satisfactory.
Depth of slip surface: 1,73 m
The length of pile below terrain: 6,91 m

Slope stability verification (Morgenstern-Price)
Factor of safety = 1,56 > 1,50
Slope stability ACCEPTABLE

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Name : Analysis | **Stage - analysis : 1 - 1**
Description : Drsina



Piles verification 1

Anti-Slide pile : Anti-Slide Pile No. 1 (16,00; 12,08 [m])
Analysis : Calculation 1 (slip surface circular)
Method : Morgenstern-Price

Analysis of anti-slide pile

Input data

Settings

Slovenia - EN 1997 (38)

Materials and standards

Concrete structures :	EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 :	standard
Steel structures :	EN 1993-1-1 (EC3)
Partial factor on bearing capacity of steel cross section :	γ_{M0} = 1,00

Pressure analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel

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Earthquake analysis : Mononobe-Okabe
Modulus of subsoil reaction : standard
Consider reduction of the modulus of subsoil reaction for a braced sheeting
Verification methodology : according to EN 1997
Design approach : 2 - reduction of actions and resistances

Partial factors on actions (A)					
Permanent design situation					
		Unfavourable		Favourable	
Permanent actions :	γ_G =	1,35	[–]	1,00	[–]
Variable actions :	γ_Q =	1,50	[–]	0,00	[–]
Water load :	γ_w =	1,35	[–]		

Partial factors for resistances (R)			
Permanent design situation			
Partial factor on earth resistance :	γ_{Re} =	1,40	[–]

Anchors

Verification methodology : Limit states (LSD)

Reduction coefficients			
Reduction. coeff of steel strength :	γ_s =	1,35	[–]
Reduction coefficient of pull out resistance (soil) :	γ_e =	1,35	[–]
Reduction coefficient of pull out resistance (grouting) :	γ_c =	1,35	[–]

Geometry of structure

Structure length = 6,91 m

Cross-section name : Pile curtain d = 0,60 m; a = 1,20 m
Material of pile : concrete
Computed coefficient of pressure reduction below the ditch = 1,00
Area of cross-section A = 2,36E-01 m^2/m
Moment of inertia I = 5,30E-03 m^4/m
Elastic modulus E = 33000,00 MPa
Shear modulus G = 13750,00 MPa

Input pressure acting on structure

Depth of slip surface h_{s1} = 1,73 m

Active horizontal force T = 15,14 kN/m
Passive horizontal force P = 0,00 kN/m

Distribution of active force : triangle
Distribution of passive force : as active force

Material of structure

Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

Concrete : C 30/37
Cylinder compressive strength f_{ck} = 30,00 MPa
Tensile strength f_{ctm} = 2,90 MPa
Elasticity modulus E_{cm} = 33000,00 MPa
Shear modulus G = 13750,00 MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500

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Yield strength f_{yk} = 500,00 MPa

Modulus of reaction

Modulus of subsoil reaction is computed by method Schmitt.

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]	γ_{su} [kN/m^3]	δ [°]
1	Zaglinjeni grušč		30,00	5,00	19,00	9,00	30,00
2	Preperina		30,00	10,00	21,00	11,00	30,00
3	Hribina		34,00	30,00	23,00	13,00	34,00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	φ_{ef} [°]	ν [–]	OCR [–]	K_r [–]
1	Zaglinjeni grušč		cohesive	-	0,35	-	-
2	Preperina		cohesive	-	0,30	-	-
3	Hribina		cohesive	-	0,20	-	-

Parameters of soils to compute modulus of subsoil reaction (Schmitt)

No.	Name	Pattern	ν [–]	E_{oed} [MPa]	E_{def} [MPa]
1	Zaglinjeni grušč		0,35	5,00	-
2	Preperina		0,30	10,00	-
3	Hribina		0,20	30,00	-

Soil parameters

Zaglinjeni grušč

Unit weight : γ = 19,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 30,00 °
Cohesion of soil : c_{ef} = 5,00 kPa
Angle of friction struc.-soil : δ = 30,00 °
Soil : cohesive
Poisson's ratio : ν = 0,35
Oedometric modulus : E_{oed} = 5,00 MPa
Saturated unit weight : γ_{sat} = 19,00 kN/m^3

Preperina

Unit weight : γ = 21,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 30,00 °

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Cohesion of soil :	c_{ef}	=	10,00 kPa
Angle of friction struc.-soil :	δ	=	30,00 °
Soil :	cohesive		
Poisson's ratio :	ν	=	0,30
Oedometric modulus :	E_{oed}	=	10,00 MPa
Saturated unit weight :	γ_{sat}	=	21,00 kN/m^3

Hribina

Unit weight :	γ	=	23,00 kN/m^3
Stress-state :	effective		
Angle of internal friction :	φ_{ef}	=	34,00 °
Cohesion of soil :	c_{ef}	=	30,00 kPa
Angle of friction struc.-soil :	δ	=	34,00 °
Soil :	cohesive		
Poisson's ratio :	ν	=	0,20
Oedometric modulus :	E_{oed}	=	30,00 MPa
Saturated unit weight :	γ_{sat}	=	23,00 kN/m^3

Pile fixed into the rock

Length of wall in the rock l = 3,50 m
Bearing capacity of rock R = 3000,00 kPa

Geological profile and assigned soils

Position information
Terrain elevation = 12,06 m
Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Altitude [m]	Assigned soil	Pattern
1	1,73	0,00 .. 1,73	12,06 .. 10,33	Zaglinjeni grušč	
2	0,99	1,73 .. 2,72	10,33 .. 9,34	Preperina	
3	9,35	2,72 .. 12,07	9,34 .. -0,01	Hribina	
4	-	12,07 .. ∞	-0,01 .. -	Hribina	

Excavation

Soil in front of wall is excavated to a depth of 0,00 m.

Ditch bottom shape

No.	Coordinate x [m]	Depth z [m]
1	0,00	0,01
2	-3,70	0,06
3	-4,70	1,46
4	-6,90	2,56
5	-11,60	8,76
6	-15,70	12,06
7	-16,70	12,06

Origin [0,0] is located at the ditch bottom.
Positive coordinate +z has downward direction.

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Terrain profile

No.	Coordinate x [m]	Depth z [m]
1	0,00	0,00
2	0,10	-0,01
3	2,20	-0,04
4	3,30	0,16
5	4,30	0,16

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

Water influence

Ground water table is located below the structure.

Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m^2]	Mag.2 [kN/m^2]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	Yes		permanent	16,67		0,00	1,70	on terrain

Global settings

Number of FEs to discretize wall = 40
Analysis of depending pressures : reduce according to analysis settings
Minimum dimensioning pressure is considered as $\sigma_{a,min} = 0{,}20\sigma_z$

Settings of the stage of construction

Design situation : permanent

Analysis results

Pressure above the slip surface

Depth [m]	Passive pressure [kPa]	Active pressure [kPa]
0	0,00	0,00
0,00	0,00	0,00
0,00	0,00	0,00
1,73	0,00	17,47

Distribution of pressures acting on the structure (in front and behind the wall)

Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.00	0.00	0.00	0.24	0.24	0.24
0.05	0.00	0.00	0.00	0.50	0.50	0.50
0.06	0.00	0.00	0.00	0.57	0.57	0.57
0.16	0.00	0.00	0.00	1.61	1.61	1.61
0.35	0.00	0.00	0.00	3.48	3.48	3.48
0.37	0.00	0.00	0.00	3.77	3.77	3.77
0.57	0.00	0.00	0.00	5.74	5.74	5.74
0.58	0.00	0.00	0.00	5.82	5.82	5.82

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
0.69	0.00	0.00	0.00	6.96	6.96	6.96
0.72	0.00	0.00	0.00	7.26	7.26	7.26
0.75	0.00	0.00	0.00	7.60	7.60	7.60
0.78	0.00	0.00	0.00	7.83	7.83	7.83
0.78	0.00	0.00	0.00	7.86	7.86	7.86
0.82	0.00	0.00	0.00	8.23	8.23	8.23
0.84	0.00	0.00	0.00	8.43	8.43	8.43
1.04	0.00	0.00	0.00	10.44	10.44	10.44
1.08	0.00	0.00	0.00	10.89	10.89	10.89
1.32	0.00	0.00	0.00	13.34	13.34	13.34
1.33	0.00	0.00	0.00	13.41	13.41	13.41
1.38	0.00	0.00	0.00	13.92	13.92	13.92
1.45	0.00	0.00	0.00	14.61	14.61	14.61
1.73	0.00	0.00	0.00	17.40	17.40	17.40
1.73	-0.46	-13.93	-31.35	6.59	17.12	150.16
2.07	-2.91	-16.96	-31.35	8.97	19.33	178.42
2.27	-4.34	-18.73	-31.35	10.36	20.79	194.95
2.28	-4.42	-17.12	-31.35	10.44	20.87	195.87
2.42	-5.41	-17.71	-31.35	11.40	21.87	207.23
2.55	-6.36	-18.27	-31.35	12.32	22.90	218.20
2.72	-7.59	-19.00	-31.35	13.52	24.23	232.38
2.72	0.00	-12.72	-109.19	10.73	14.62	392.28
2.76	0.00	-12.85	-109.19	10.93	14.82	397.78
2.76	0.00	-12.86	-109.19	10.93	14.83	397.94
3.00	0.00	-13.61	-109.19	12.03	16.01	428.65
3.11	0.00	-13.94	-109.19	12.52	16.54	442.38
3.41	0.00	-14.89	-109.19	13.91	18.10	481.03
3.41	0.00	-14.89	-3639.60	13.91	18.10	4011.44
3.46	0.00	-14.70	-3640.94	13.73	13.73	4017.23
3.80	0.00	-13.23	-3651.18	12.35	12.35	4061.67
4.15	0.00	-11.76	-3661.42	10.98	10.98	4106.11
4.49	0.00	-10.29	-3671.66	9.61	9.61	4150.55
4.84	0.00	-8.82	-3681.90	8.24	8.24	4194.99
4.98	0.00	-8.21	-3686.12	7.67	7.67	4213.33
5.18	0.00	-7.35	-3692.14	6.86	6.86	4239.43
5.53	0.00	-5.88	-3702.38	5.49	5.49	4283.87
5.87	0.00	-4.41	-3712.62	4.12	4.12	4328.31
6.22	0.00	-2.94	-3722.86	2.75	2.75	4372.75
6.46	0.00	-1.92	-3729.96	1.79	1.79	4403.57
6.46	0.00	-1.92	-3729.99	1.79	1.79	4403.70
6.56	0.00	-1.47	-3733.10	1.37	1.37	4417.20
6.91	0.00	0.00	-3743.34	0.00	0.00	4461.64

Distributions of the modulus of subsoil reaction and internal forces on the structure

Depth [m]	kh,p [MN/m3]	kh,z [MN/m3]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
0.00	0.00	0.00	-1.59	0.00	0.00	-0.00

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Depth [m]	kh,p [MN/m3]	kh,z [MN/m3]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
0.02	0.00	0.00	-1.58	0.18	-0.00	0.00
0.17	0.00	0.00	-1.51	1.74	-0.15	0.01
0.35	0.00	0.00	-1.44	3.48	-0.60	0.07
0.52	0.00	0.00	-1.36	5.22	-1.35	0.23
0.69	0.00	0.00	-1.29	6.96	-2.40	0.55
0.86	0.00	0.00	-1.21	8.70	-3.76	1.08
1.04	0.00	0.00	-1.14	10.44	-5.41	1.87
1.21	0.00	0.00	-1.06	12.18	-7.37	2.97
1.38	0.00	0.00	-0.99	13.92	-9.62	4.43
1.55	0.00	0.00	-0.91	15.66	-12.18	6.31
1.73	0.00	0.00	-0.84	17.39	-15.01	8.63
1.74	8.09	8.09	-0.83	-10.30	-15.07	8.87
1.90	8.09	8.09	-0.77	-9.63	-13.49	11.13
2.07	8.09	8.09	-0.70	-8.92	-11.89	13.32
2.25	8.09	8.09	-0.63	-8.10	-10.42	15.25
2.42	8.09	8.09	-0.57	-5.00	-9.29	16.94
2.59	8.09	8.09	-0.50	-3.38	-8.57	18.48
2.76	35.00	0.00	-0.45	-17.51	-6.71	19.82
2.94	35.00	0.00	-0.39	-15.33	-3.88	20.73
3.11	35.00	0.00	-0.34	-13.27	-1.41	21.18
3.28	35.00	0.00	-0.29	-11.33	0.71	21.24
3.46	35.00	0.00	-0.25	-9.58	2.52	20.95
3.63	35.00	0.00	-0.20	-8.10	4.04	20.38
3.80	35.00	0.00	-0.17	-6.74	5.32	19.57
3.97	35.00	0.00	-0.13	-5.50	6.38	18.56
4.15	35.00	0.00	-0.10	-4.36	7.23	17.38
4.32	35.00	0.00	-0.07	-3.34	7.89	16.07
4.49	35.00	0.00	-0.05	-2.40	8.39	14.66
4.66	35.00	0.00	-0.03	-1.56	8.73	13.18
4.84	35.00	0.00	-0.01	-0.79	8.93	11.65
5.01	35.00	35.00	0.01	0.34	8.99	10.10
5.18	35.00	35.00	0.03	1.57	8.83	8.56
5.36	35.00	35.00	0.04	2.69	8.46	7.07
5.53	35.00	35.00	0.06	3.73	7.90	5.65
5.70	35.00	35.00	0.07	4.70	7.17	4.34
5.87	35.00	35.00	0.08	5.62	6.28	3.18
6.05	35.00	35.00	0.10	6.49	5.24	2.18
6.22	0.00	35.00	0.11	6.52	4.10	1.36
6.39	0.00	35.00	0.12	6.22	2.99	0.75
6.56	0.00	35.00	0.13	5.93	1.94	0.33
6.74	0.00	35.00	0.14	5.63	0.95	0.08
6.91	0.00	35.00	0.15	5.33	0.00	-0.00

Maximum shear force = 15,07 kN/m
Maximum moment = 21,24 kNm/m
Maximum displacement = 1,6 mm
Displacement in the depth of slip surface = 0,8 mm

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Verification of rock bearing capacity

Bearing capacity of rock	R	=	3000,00	kPa
Partial factor on rock bearing capacity	γ_{Rr}	=	1,40	
Max. stress	σ	=	19,16	kPa
Design bearing capacity of rock	R_d	=	2142,86	kPa

Bearing capacity of rock is SATISFACTORY

Terrain settlement behind the structure

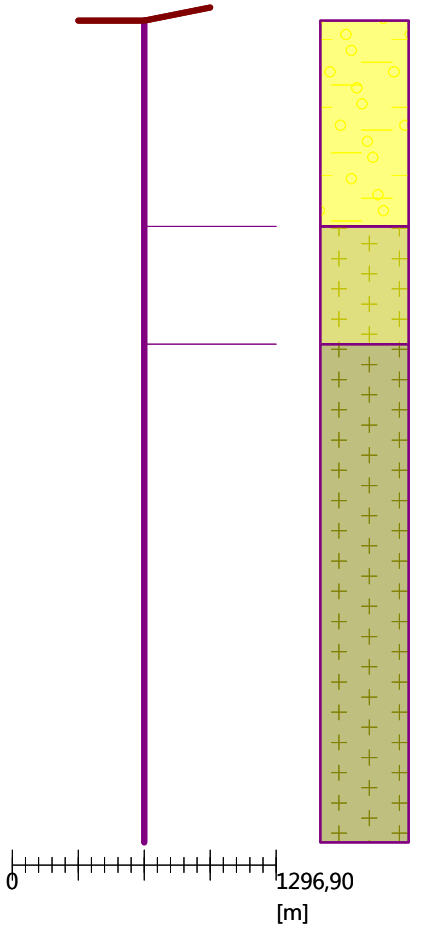
Terrain settlement δ_{max} = 0,8 mm

	Coordinate x [m]	Settlement z [mm]
1	0,00	0,7
2	0,48	0,9
3	0,96	1,1
4	1,43	1,2
5	1,91	1,2
6	2,39	1,1
7	2,87	1,0
8	3,35	0,9
9	3,83	0,6
10	4,30	0,4
11	4,78	0,0
12	4,78	0,0

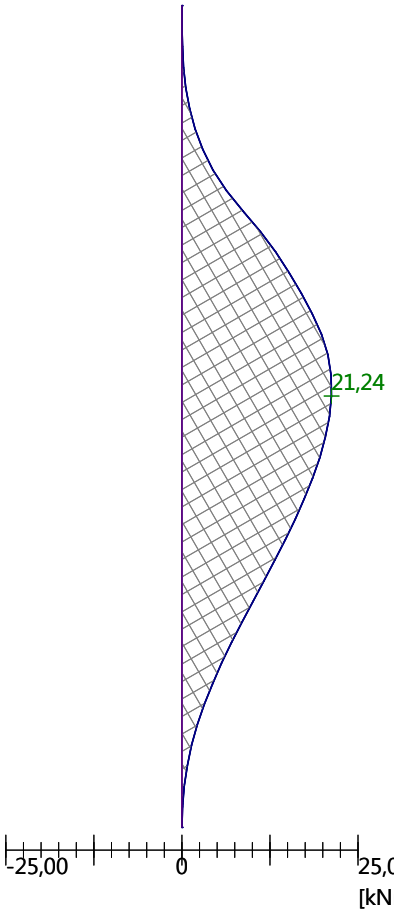
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Name : Analysis	Stage - analysis : 1 - -1

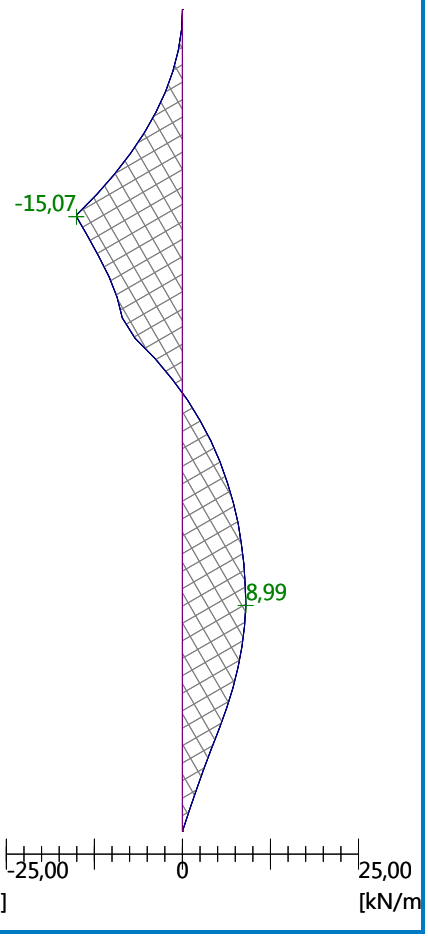
Geometry of structure
Length of structure = 6,91m



Bending moment
Max. M = 21,24 kNm/m

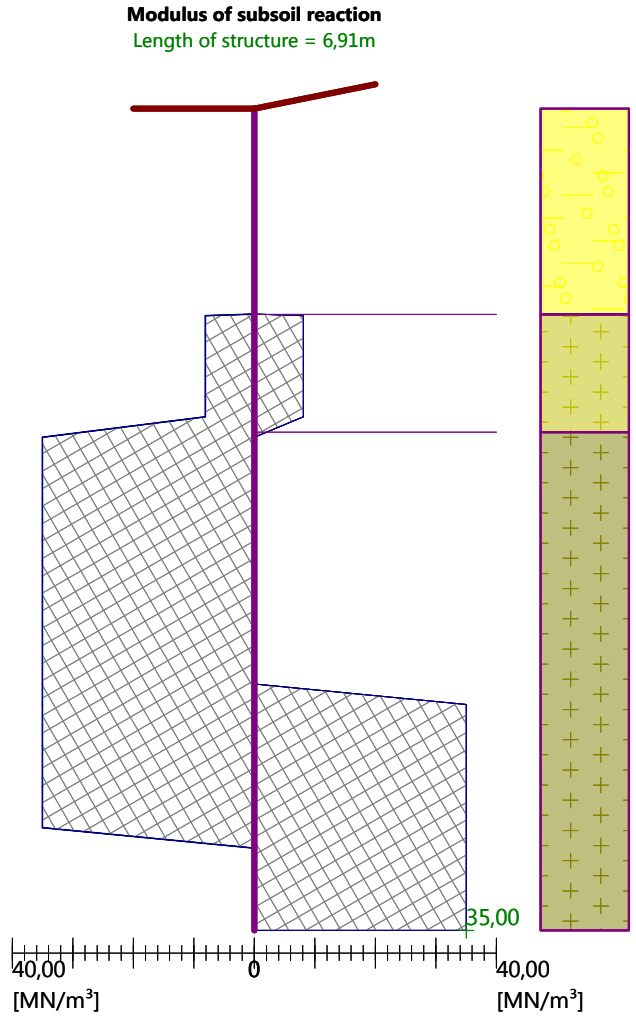


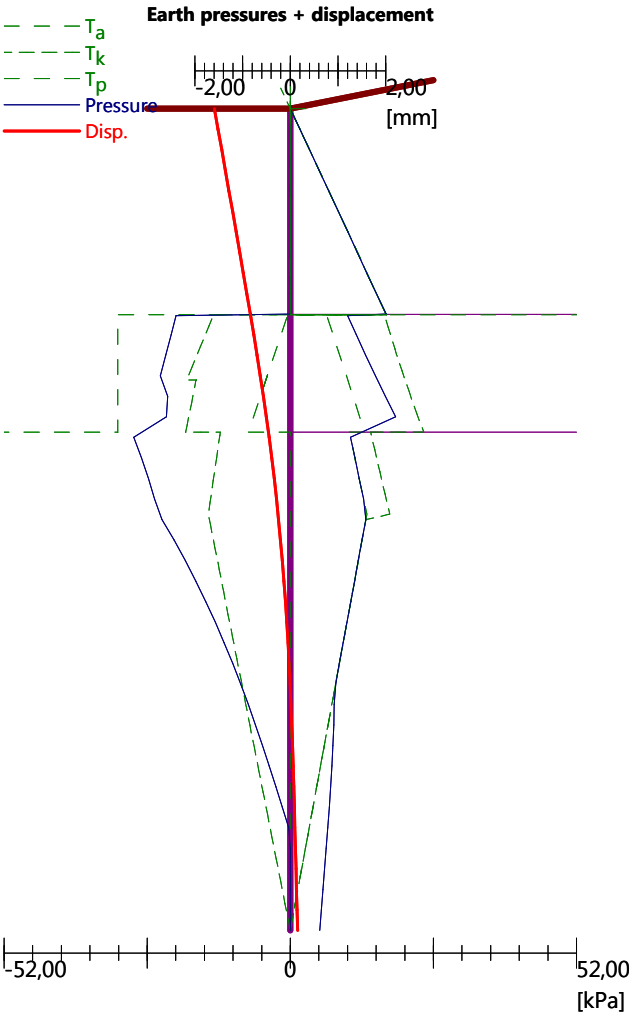
Shear force
Max. Q = 15,07 kN/m



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Name : Analysis | **Stage - analysis : 1 - -1**

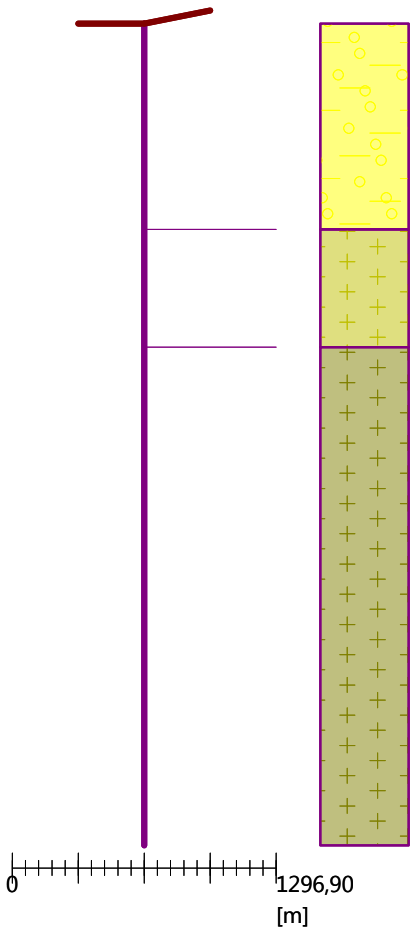




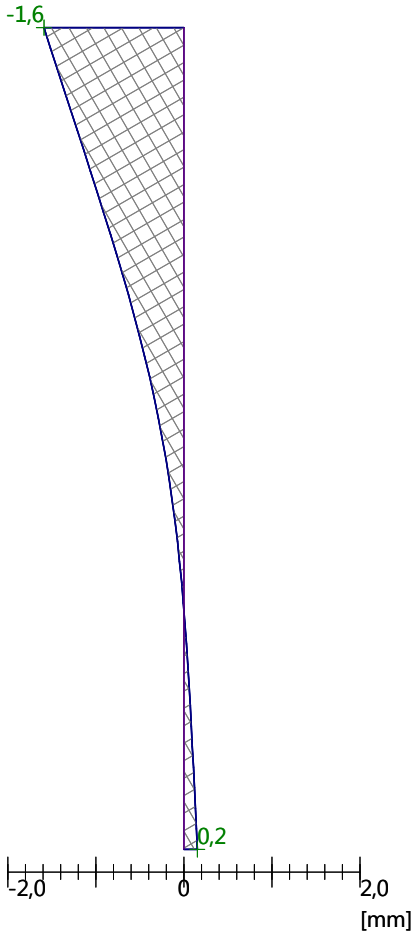
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Name : Analysis	Stage - analysis : 1 - -1

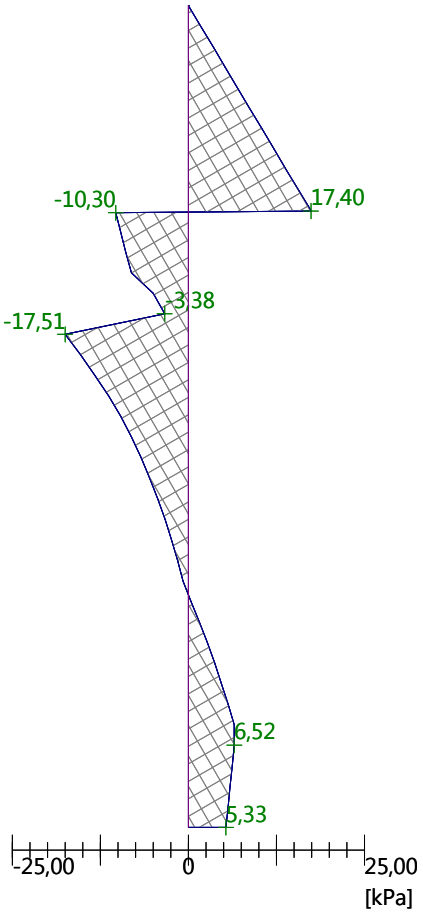
Geometry of structure
Length of structure = 6,91m



Displacement of structure
Max. disp. = 1,6 mm



Pressure acting on structure
Max. pressure = 17,51 kPa



Dimensioning No. 1

	Disp. min [mm]	Disp. max [mm]	Shear force min. [kN/m]	Shear force max [kN/m]	Moment min. [kNm/m]	Moment max. [kNm/m]
0.00	-1.59	-1.59	0.00	0.00	-0.00	-0.00
0.02	-1.58	-1.58	-0.00	-0.00	0.00	0.00
0.17	-1.51	-1.51	-0.15	-0.15	0.01	0.01
0.35	-1.44	-1.44	-0.60	-0.60	0.07	0.07
0.52	-1.36	-1.36	-1.35	-1.35	0.23	0.23
0.69	-1.29	-1.29	-2.40	-2.40	0.55	0.55
0.86	-1.21	-1.21	-3.76	-3.76	1.08	1.08
1.04	-1.14	-1.14	-5.41	-5.41	1.87	1.87
1.21	-1.06	-1.06	-7.37	-7.37	2.97	2.97
1.38	-0.99	-0.99	-9.62	-9.62	4.43	4.43
1.55	-0.91	-0.91	-12.18	-12.18	6.31	6.31
1.73	-0.84	-0.84	-15.01	-15.01	8.63	8.63
1.74	-0.83	-0.83	-15.07	-15.07	8.87	8.87
1.90	-0.77	-0.77	-13.49	-13.49	11.13	11.13
2.07	-0.70	-0.70	-11.89	-11.89	13.32	13.32

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	Disp. min [mm]	Disp. max [mm]	Shear force min. [kN/m]	Shear force max [kN/m]	Moment min. [kNm/m]	Moment max. [kNm/m]
2.25	-0.63	-0.63	-10.42	-10.42	15.25	15.25
2.42	-0.57	-0.57	-9.29	-9.29	16.94	16.94
2.59	-0.50	-0.50	-8.57	-8.57	18.48	18.48
2.76	-0.45	-0.45	-6.71	-6.71	19.82	19.82
2.94	-0.39	-0.39	-3.88	-3.88	20.73	20.73
3.11	-0.34	-0.34	-1.41	-1.41	21.18	21.18
3.28	-0.29	-0.29	0.71	0.71	21.24	21.24
3.46	-0.25	-0.25	2.52	2.52	20.95	20.95
3.63	-0.20	-0.20	4.04	4.04	20.38	20.38
3.80	-0.17	-0.17	5.32	5.32	19.57	19.57
3.97	-0.13	-0.13	6.38	6.38	18.56	18.56
4.15	-0.10	-0.10	7.23	7.23	17.38	17.38
4.32	-0.07	-0.07	7.89	7.89	16.07	16.07
4.49	-0.05	-0.05	8.39	8.39	14.66	14.66
4.66	-0.03	-0.03	8.73	8.73	13.18	13.18
4.84	-0.01	-0.01	8.93	8.93	11.65	11.65
5.01	0.01	0.01	8.99	8.99	10.10	10.10
5.18	0.03	0.03	8.83	8.83	8.56	8.56
5.36	0.04	0.04	8.46	8.46	7.07	7.07
5.53	0.06	0.06	7.90	7.90	5.65	5.65
5.70	0.07	0.07	7.17	7.17	4.34	4.34
5.87	0.08	0.08	6.28	6.28	3.18	3.18
6.05	0.10	0.10	5.24	5.24	2.18	2.18
6.22	0.11	0.11	4.10	4.10	1.36	1.36
6.39	0.12	0.12	2.99	2.99	0.75	0.75
6.56	0.13	0.13	1.94	1.94	0.33	0.33
6.74	0.14	0.14	0.95	0.95	0.08	0.08
6.91	0.15	0.15	0.00	0.00	-0.00	-0.00

Maximum values of internal forces

Maximum displacement = -1,6 mm
Minimum displacement = 0,2 mm
Maximum bending moment = 21,24 kNm/m
Minimum bending moment = 0,00 kNm/m
Maximum shear force = 8,99 kN/m

Verification of RC cross section (Pile curtain d = 0,60 m; a = 1,20 m)

All construction stages are taken into the analysis.
Reduct. coefficient of bearing capacity = 1,00

Verification of cross section in bending:

Reinforcement - 6 pc bars 16,0 mm; cover 60,0 mm
Type of structure (reinforcement ratio) : beam
Reinforcement ratio ρ = 0,213 % > 0,151 % = ρ_{min}
Load : M_{Ed} = 25,48 kNm
Bearing capacity : M_{Rd} = 128,33 kNm
Designed pile reinforcement is SATISFACTORY

Verification of cross section in shear:

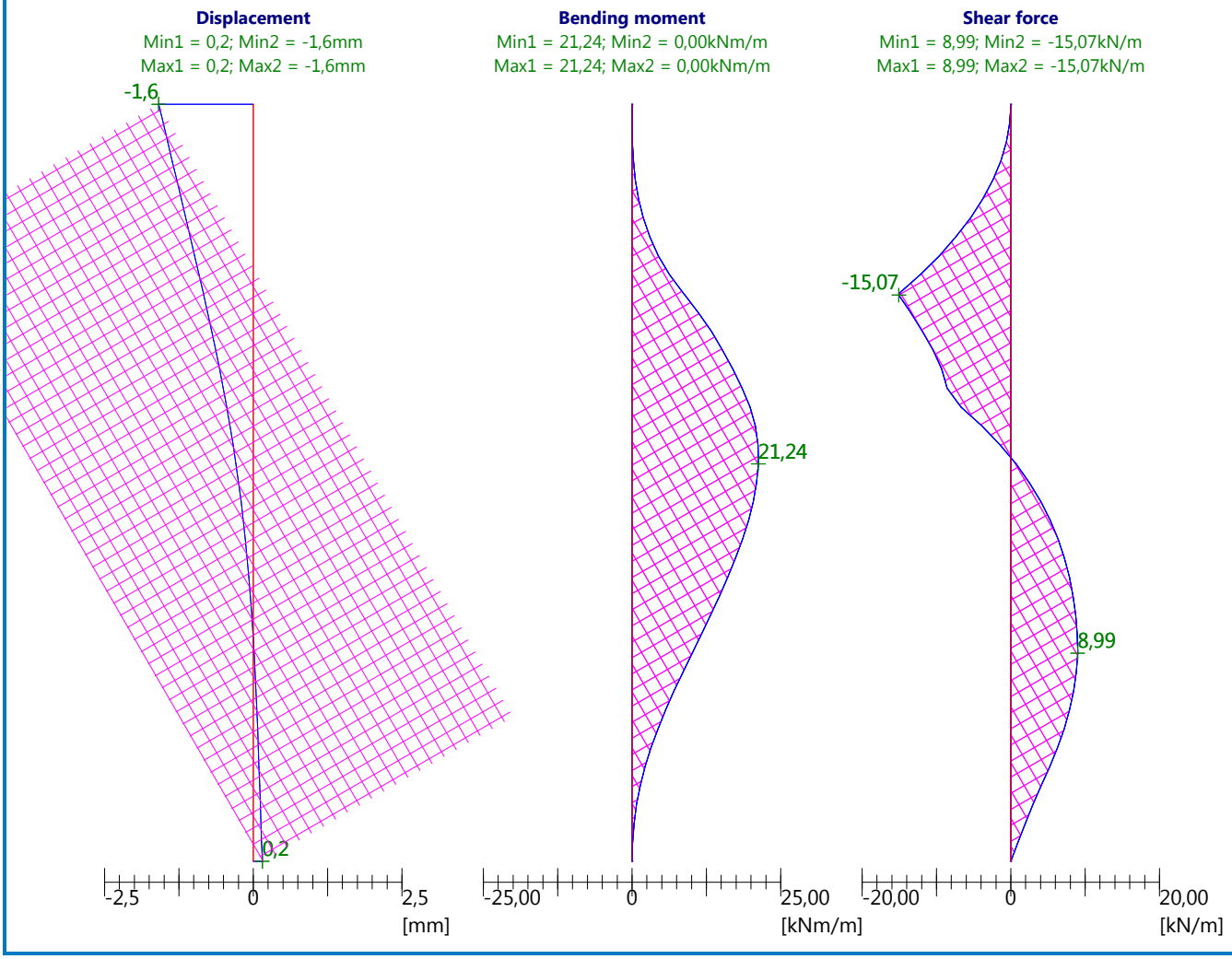
Shear reinf. - profile 10,0 mm; spacing 250,0 mm

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A_{sw} = 628,3 mm^2
Ultimate shear force: V_{Rd} = 295,04 kN > 18,08 kN = V_{Ed}
Cross-section is SATISFACTORY.
only minimal shear reinforcement

Overall verification: Cross-section is SATISFACTORY

Name : Dimensioning | **Stage - analysis : 1 - 1**



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