

Sheeting structure verification

Input data (Stage of construction 1)

Settings

(input for current task)

Materials and standards

Concrete structures :	EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 :	standard
Circle pile shear :	simplified method
Steel structures :	EN 1993-1-1 (EC3)
Partial factor on bearing capacity of steel cross section :	$\gamma_{M0} = 1,00$
Timber structures :	EN 1995-1-1 (EC5)
Partial factor for timber property :	$\gamma_M = 1,30$
Modif. factor of load duration and moisture content :	$k_{mod} = 0,50$
Coeff. of effective width for shear stress :	$k_{cr} = 0,67$

Pressure analysis

Verification methodology :	according to EN 1997
Active earth pressure calculation :	Coulomb
Passive earth pressure calculation :	Caquot-Kerisel
Analysis method :	dependent pressures
Earthquake analysis :	Mononobe-Okabe
Modulus of subsoil reaction :	standard
Consider reduction of the modulus of subsoil reaction for a braced sheeting	
Design approach :	2 - reduction of actions and resistances

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

Partial factors for resistances (R)			
Permanent design situation			
Reduction coeff. of internal stability of anchors :	$\gamma_{Ris} =$	1,30 [-]	
Partial factor on earth resistance :	$\gamma_{Re} =$	1,40 [-]	

Partial factors for variable actions			
Permanent design situation			
Factor for combination value :	$\psi_0 =$	0,70 [-]	
Factor for frequent value :	$\psi_1 =$	0,50 [-]	
Factor for quasi-permanent value :	$\psi_2 =$	0,30 [-]	

Anchors

Verification methodology : Limit states (LSD)

Reduction coefficients			
Reduction. coeff of steel strength :	$\gamma_s =$	1,10 [-]	
Reduction coefficient of pull out resistance (soil) :	$\gamma_e =$	1,35 [-]	
Reduction coefficient of pull out resistance (grouting) :	$\gamma_c =$	1,35 [-]	

Geometry of structure

Structure length = 12,00 m

Cross-section name : Sheet pile : LARSEN 604 n

Area of cross-section $A = 1,57E-02 \text{ m}^2/\text{m}$

Moment of inertia $I = 3,04E-04 \text{ m}^4/\text{m}$

Sectional modulus $W = 1,600E-03 \text{ m}^3/\text{m}$

Plastic sectional modulus $W_{pl} = 1,862E-03 \text{ m}^3/\text{m}$

Material of structure

Structural steel: EN 10248-1 : S 240 GP

Yield strength $f_y = 240,00 \text{ MPa}$


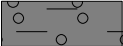

Elasticity modulus $E = 210000,00 \text{ MPa}$

Shear modulus $G = 81000,00 \text{ MPa}$


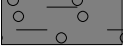
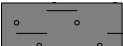
Modulus of reaction

Modulus of subsoil reaction is computed by method Schmitt.


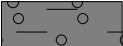

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]	γ_{su} [kN/m ³]	δ [°]
1	Glina		16,20	2,80	18,00	10,00	11,00
2	Zameljen prod		34,00	1,00	19,00	11,00	22,50
3	Siva zbita peščena		30,00	8,00	19,00	11,00	20,00

Soil parameters to compute pressure at rest

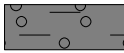
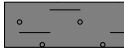
No.	Name	Pattern	Type calculation	φ_{ef} [°]	ν [-]	OCR [-]	K_r [-]
1	Glina		cohesive	-	0,30	-	-
2	Zameljen prod		cohesionless	34,00	-	-	-
3	Siva zbita peščena		cohesive	-	0,30	-	-

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

No.	Name	Pattern	ν [-]	E_{oed} [MPa]	E_{def} [MPa]
1	Glina		0,30	-	5,00
2	Zameljen prod		0,30	-	15,00
3	Siva zbita peščena		0,30	-	18,00

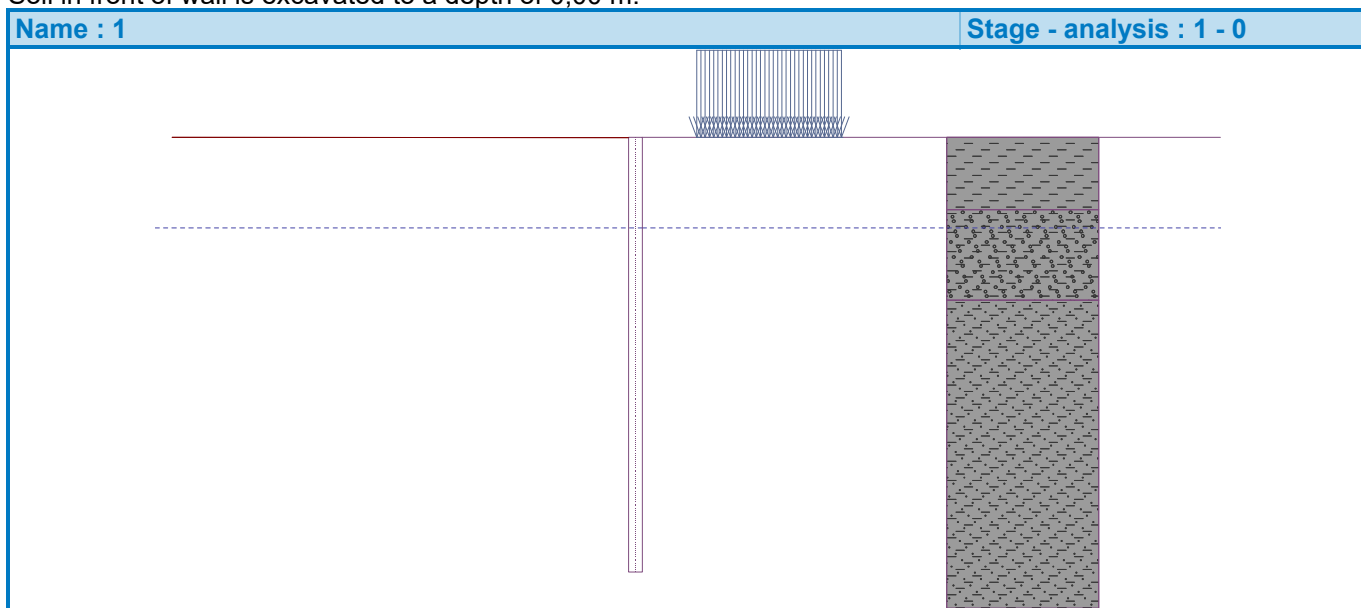
Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2,00	0,00 .. 2,00	Glina	

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
2	2,50	2,00 .. 4,50	Zameljen prod	
3	-	4,50 .. ∞	Siva zbita peščena	

Excavation

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



Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m

GWT in front of the structure lies at a depth of 2,50 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,00

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		variable	20,00		1,50	4,00	on terrain

No.	Name
1	Prometna obtežba

Global settings

Number of FEs to discretize wall = 100

Analysis of depending pressures : reduce according to analysis settings

Minimum pressure is considered as $\sigma_{a,min} = 0,20\sigma_z$

Settings of the stage of construction

Design situation : permanent

Analysis results (Stage of construction 1)

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
0.01	0.00	0.00	-5.90	0.04	0.19	6.18
0.40	0.00	-3.04	-17.13	1.45	7.68	17.41
0.41	0.00	-3.12	-17.41	1.49	7.87	17.70
0.44	-0.21	-3.28	-18.03	1.57	8.29	18.32
0.44	-0.21	-3.28	-18.03	15.13	15.13	18.32
0.48	-0.64	-3.63	-19.29	15.62	15.62	19.58
0.96	-5.29	-7.33	-32.97	20.92	20.92	33.26
1.44	-9.93	-11.03	-46.65	26.22	26.22	46.93
1.92	-14.58	-14.73	-60.33	31.52	31.52	60.61
2.00	-15.35	-15.35	-62.61	32.40	32.40	62.89
2.00	-10.23	-15.79	-184.95	16.46	24.69	185.86
2.40	-12.64	-19.14	-223.41	18.73	27.92	224.32
2.50	-13.25	-19.98	-233.03	19.30	28.56	233.94
2.50	-13.25	-19.98	-233.03	19.30	28.56	233.94
2.88	-14.57	-21.82	-254.18	20.49	29.63	255.10
3.36	-16.25	-24.15	-280.91	22.00	30.97	281.82
3.84	-17.92	-26.47	-307.63	23.50	32.39	308.54
4.32	-19.60	-28.80	-334.35	25.01	33.91	335.26
4.50	-20.22	-29.68	-344.37	25.57	34.51	345.29
4.50	-15.44	-28.85	-272.58	21.79	33.68	273.24
4.80	-16.68	-30.27	-284.71	22.90	34.67	285.37
5.28	-18.67	-32.53	-304.12	24.68	36.33	304.78
5.76	-20.67	-34.79	-323.53	26.45	38.08	324.19
6.24	-22.66	-37.05	-342.93	28.23	39.90	343.60
6.72	-24.65	-39.32	-362.34	30.00	41.80	363.00
7.20	-26.64	-41.58	-381.75	31.78	43.75	382.41
7.68	-28.63	-43.84	-401.16	33.55	45.75	401.82
7.96	-29.78	-45.15	-412.33	34.57	46.92	413.00
7.96	-29.78	-45.15	-412.33	29.85	46.92	413.00
8.16	-30.62	-46.11	-420.57	30.69	47.78	421.23
8.64	-32.61	-48.37	-439.97	32.68	49.85	440.63
9.12	-34.61	-50.63	-459.38	34.67	51.95	460.04
9.60	-36.60	-52.89	-478.79	36.66	54.07	479.45
10.08	-38.59	-55.16	-498.20	38.66	56.21	498.86
10.56	-40.58	-57.42	-517.60	40.65	58.37	518.27
11.04	-42.57	-59.68	-537.01	42.64	60.54	537.67
11.52	-44.56	-61.95	-556.42	44.63	62.73	557.08
12.00	-46.55	-64.21	-575.83	46.62	64.92	576.49

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	-1.17	0.00	0.00	-0.00
0.01	0.00	0.00	-1.17	-5.96	0.02	-0.00

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
0.60	6.68	0.00	-0.98	5.83	2.28	-1.15
1.20	6.68	0.00	-0.79	9.12	-2.20	-1.27
1.80	6.68	0.00	-0.59	12.46	-8.67	1.89
2.40	28.89	0.00	-0.40	-11.97	-5.43	7.04
3.00	28.89	28.89	-0.25	-6.88	0.48	8.36
3.60	28.89	28.89	-0.15	-2.05	3.03	7.16
4.20	28.89	28.89	-0.08	0.60	3.38	5.16
4.80	36.84	36.84	-0.05	0.97	2.88	3.28
5.40	36.84	36.84	-0.03	1.43	2.12	1.77
6.00	36.84	36.84	-0.02	1.27	1.29	0.75
6.60	36.84	36.84	-0.02	0.89	0.64	0.18
7.20	36.84	36.84	-0.02	0.51	0.22	-0.06
7.80	36.84	36.84	-0.02	0.23	0.01	-0.12
8.40	36.84	36.84	-0.02	0.06	-0.08	-0.10
9.00	36.84	36.84	-0.02	-0.03	-0.08	-0.05
9.60	36.84	36.84	-0.02	-0.06	-0.05	-0.01
10.20	36.84	36.84	-0.01	-0.05	-0.02	0.01
10.80	36.84	36.84	-0.01	-0.03	0.01	0.02
11.40	36.84	36.84	-0.01	0.01	0.02	0.01
12.00	36.84	36.84	-0.01	0.05	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 10,21 kN/m
Maximum moment = 8,36 kNm/m
Maximum displacement = 1,2 mm

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 0,3$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	0,6
2	0,86	0,6
3	1,72	0,7
4	2,58	0,6
5	3,44	0,6
6	4,30	0,6
7	5,16	0,5
8	6,02	0,4
9	6,88	0,3
10	7,74	0,2
11	8,60	0,0
12	8,60	0,0

Dimensioning No. 1 (Stage of construction 1)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 203,40$ kPa
Unfavourable water pressure $u_{\text{dst}} = 0,00$ kPa

Verification of failure by heave is SATISFACTORY

Verification of failure by piping




Critical hydraulic gradient $i_c = 0,67$

Hydraulic gradient $i = 0,00$

Verification of failure by piping is **SATISFACTORY**

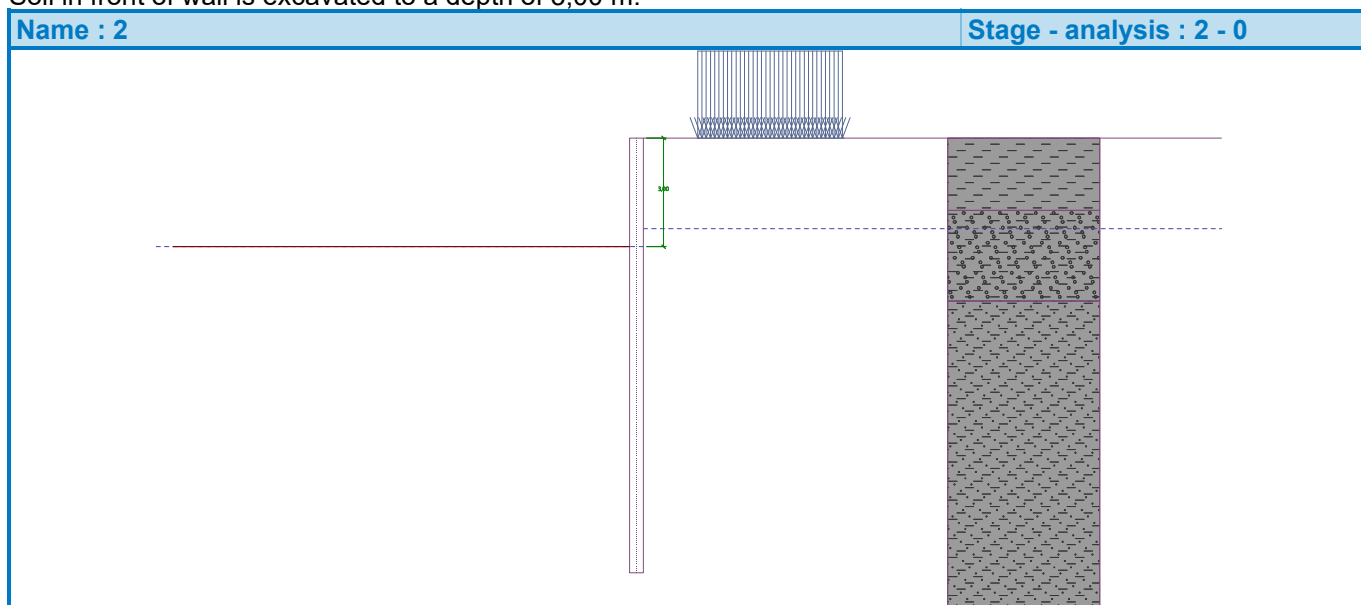
Input data (Stage of construction 2)

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2,00	0,00 .. 2,00	Glina	
2	2,50	2,00 .. 4,50	Zameljen prod	
3	-	4,50 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 3,00 m.



Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m

GWT in front of the structure lies at a depth of 3,00 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,03

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	No	No	variable	20,00		1,50	4,00	on terrain

No.	Name
1	Prometna obtežba

Settings of the stage of construction

Design situation : permanent

Analysis results (Stage of construction 2)

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	5.90
0.00	0.00	0.00	0.00	0.00	0.00	5.90
0.40	0.00	0.00	0.00	1.45	7.65	17.41
0.44	0.00	0.00	0.00	1.57	8.25	18.32
0.44	0.00	0.00	0.00	15.13	15.13	18.32
0.50	0.00	0.00	0.00	15.84	15.84	20.15
1.00	0.00	0.00	0.00	21.36	21.36	34.40
1.50	0.00	0.00	0.00	26.88	26.88	48.64
2.00	0.00	0.00	0.00	32.40	32.40	62.89
2.00	0.00	0.00	0.00	16.46	24.69	185.86
2.50	0.00	0.00	0.00	19.30	28.56	233.94
2.50	0.00	0.00	0.00	19.30	28.56	233.94
3.00	0.00	0.00	0.00	27.66	35.02	266.03
3.00	0.00	-0.00	-3.66	27.66	35.02	266.04
3.33	0.00	-1.57	-21.65	28.48	35.81	284.80
3.50	-0.57	-2.36	-30.81	28.90	36.22	294.35
4.00	-2.28	-4.73	-57.96	30.13	37.51	322.68
4.50	-3.98	-7.09	-85.11	31.37	38.91	351.00
4.50	0.00	-6.90	-84.29	27.62	38.08	278.21
5.00	0.00	-9.20	-104.01	29.15	39.53	298.72
5.46	0.00	-11.31	-122.13	30.55	40.95	317.57
5.50	-0.16	-11.50	-123.73	30.67	41.08	319.23
6.00	-2.19	-13.80	-143.45	32.20	42.72	339.75
6.50	-4.21	-16.09	-163.17	33.72	44.44	360.26
7.00	-6.23	-18.39	-182.89	35.25	46.23	380.78
7.50	-8.26	-20.69	-202.61	36.77	48.07	401.29
7.96	-10.11	-22.80	-220.67	38.17	49.80	420.09
7.96	-10.11	-22.80	-220.67	33.44	49.80	420.09
8.00	-10.28	-22.99	-222.33	33.59	49.96	421.81
8.50	-12.30	-25.29	-242.05	35.34	51.89	442.32
9.00	-14.33	-27.59	-261.77	37.09	53.84	462.84
9.50	-16.35	-29.89	-281.49	38.84	55.83	483.35
10.00	-18.38	-32.19	-301.21	40.59	57.84	503.87
10.50	-20.40	-34.49	-320.93	42.34	59.86	524.38
11.00	-22.42	-36.79	-340.65	44.09	61.90	544.90
11.50	-24.45	-39.09	-360.37	45.84	63.95	565.41
12.00	-26.47	-41.39	-380.09	47.59	66.02	585.93

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

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
0.00	0.00	0.00	-46.15	0.00	-0.00	0.00
0.60	0.00	0.00	-40.42	16.94	-3.20	0.37
1.20	0.00	0.00	-34.70	23.57	-15.35	5.73
1.80	0.00	0.00	-29.02	30.19	-31.48	19.58

Depth [m]	kh,p [MN/m³]	kh,z [MN/m³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
2.40	0.00	0.00	-23.45	18.73	-44.45	42.83
3.00	0.00	0.00	-18.15	27.59	-57.99	73.08
3.00	0.00	0.00	-18.09	23.80	-58.20	73.55
3.60	0.00	0.00	-13.21	-7.10	-63.18	110.63
4.20	0.00	0.00	-8.93	-38.20	-49.59	145.39
4.80	0.00	0.00	-5.45	-67.58	-17.19	166.35
5.40	36.84	0.00	-2.91	-87.76	30.28	162.97
6.00	36.84	0.00	-1.27	-28.26	63.53	133.04
6.60	36.84	0.00	-0.37	3.77	69.71	92.11
7.20	36.84	1.84	0.00	27.74	57.06	53.50
7.80	36.84	1.84	0.07	29.83	39.38	24.51
8.40	36.84	36.84	-0.01	26.21	21.94	6.22
9.00	36.84	36.84	-0.12	17.28	8.87	-2.75
9.60	36.84	36.84	-0.22	9.30	0.99	-5.47
10.20	36.84	36.84	-0.30	3.50	-2.74	-4.77
10.80	36.84	36.84	-0.35	-0.36	-3.60	-2.75
11.40	36.84	36.84	-0.38	-3.06	-2.54	-0.83
12.00	36.84	36.84	-0.41	-5.38	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 69,89 kN/m
Maximum moment = 168,45 kNm/m
Maximum displacement = 46,2 mm

Terrain settlement behind the structure

Terrain settlement δ_{\max} = 15,6 mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	23,3
2	0,86	26,6
3	1,72	28,6
4	2,58	29,4
5	3,44	28,9
6	4,30	27,2
7	5,16	24,3
8	6,02	20,1
9	6,88	14,6
10	7,74	7,9
11	8,60	0,0
12	8,60	0,0

Dimensioning No. 1 (Stage of construction 2)

Failure by heave

Favourable weight of soil σ_{stb} = 153,90 kPa
Unfavourable water pressure u_{dst} = 6,75 kPa

Verification of failure by heave is **SATISFACTORY**


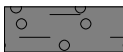

Verification of failure by piping

Critical hydraulic gradient i_c = 0,73
Hydraulic gradient i = 0,03

Verification of failure by piping is SATISFACTORY

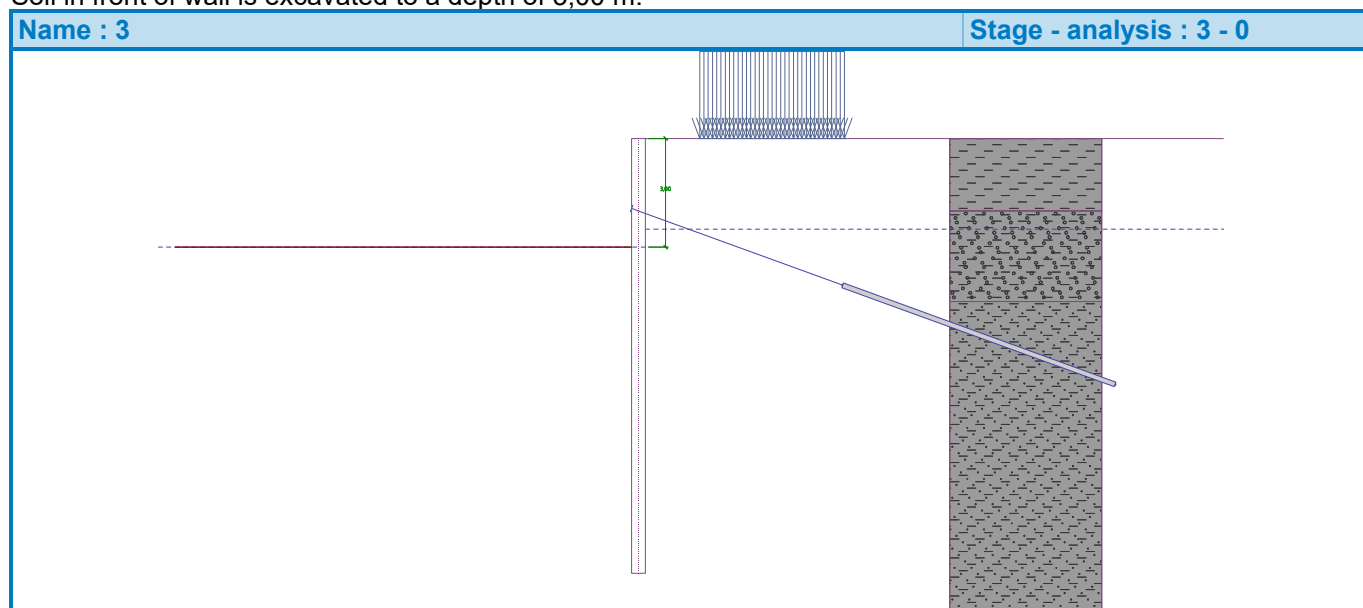
Input data (Stage of construction 3)

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2,00	0,00 .. 2,00	Glina	
2	2,50	2,00 .. 4,50	Zameljen prod	
3	-	4,50 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 3,00 m.



Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m

GWT in front of the structure lies at a depth of 3,00 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,03

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	No	No	variable	20,00		1,50	4,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	Yes	2,00	Anchor No. : 1 (user-defined)		30,00

List of the new anchors

Anchor No. : 1 (user-defined)

Anchor type : prestressed bar

Production set : user-defined

Depth : $z = 2,00$ m

Free length : $l = 6,00$ m

Root length : $l_k = 8,00$ m

Slope : $\alpha = 20,00^\circ$

Spacing : $b = 1,20$ m

Area of cross-section : $A = 791,00$ mm²

Elasticity modulus : $E = 210000,00$ MPa

Pre-stressing force : $F = 30,00$ kN

Tension strength : $R_t = 500,00$ kN

Pull out resistance (soil) : calculate from bond strength

Diameter of root : $d = 140,0$ mm

Bond strength : $f = 150,00$ kPa

Pull out resistance (grouting) : calculate from concrete strength

Standard for concrete structures : EN 1992-1-1 (EC2)

Concrete strength in compression : $f_{ck} = 20,00$ MPa

Coefficient of cohesion : $\eta_1 = 1,00$

Settings of the stage of construction

Design situation : permanent

Analysis results (Stage of construction 3)

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	5.90
0.00	0.00	0.00	0.00	0.00	0.00	5.90
0.40	0.00	0.00	0.00	1.45	7.65	17.41
0.44	0.00	0.00	0.00	1.57	8.25	18.32
0.44	0.00	0.00	0.00	15.13	15.13	18.32
0.50	0.00	0.00	0.00	15.84	15.84	20.15
1.00	0.00	0.00	0.00	21.36	21.36	34.40
1.50	0.00	0.00	0.00	26.88	26.88	48.64
2.00	0.00	0.00	0.00	32.40	32.40	62.89
2.00	0.00	0.00	0.00	16.46	24.69	185.86
2.50	0.00	0.00	0.00	19.30	28.56	233.94
2.50	0.00	0.00	0.00	19.30	28.56	233.94
3.00	0.00	0.00	0.00	27.66	35.02	266.03
3.00	0.00	-0.00	-3.66	27.66	35.02	266.04
3.33	0.00	-1.57	-21.65	28.48	35.81	284.80
3.50	-0.57	-2.36	-30.81	28.90	36.22	294.35
4.00	-2.28	-4.73	-57.96	30.13	37.51	322.68
4.50	-3.98	-7.09	-85.11	31.37	38.91	351.00
4.50	0.00	-6.90	-84.29	27.62	38.08	278.21
5.00	0.00	-9.20	-104.01	29.15	39.53	298.72
5.46	0.00	-11.31	-122.13	30.55	40.95	317.57
5.50	-0.16	-11.50	-123.73	30.67	41.08	319.23
6.00	-2.19	-13.80	-143.45	32.20	42.72	339.75
6.50	-4.21	-16.09	-163.17	33.72	44.44	360.26
7.00	-6.23	-18.39	-182.89	35.25	46.23	380.78

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
7.50	-8.26	-20.69	-202.61	36.77	48.07	401.29
7.96	-10.11	-22.80	-220.67	38.17	49.80	420.09
7.96	-10.11	-22.80	-220.67	33.44	49.80	420.09
8.00	-10.28	-22.99	-222.33	33.59	49.96	421.81
8.50	-12.30	-25.29	-242.05	35.34	51.89	442.32
9.00	-14.33	-27.59	-261.77	37.09	53.84	462.84
9.50	-16.35	-29.89	-281.49	38.84	55.83	483.35
10.00	-18.38	-32.19	-301.21	40.59	57.84	503.87
10.50	-20.40	-34.49	-320.93	42.34	59.86	524.38
11.00	-22.42	-36.79	-340.65	44.09	61.90	544.90
11.50	-24.45	-39.09	-360.37	45.84	63.95	565.41
12.00	-26.47	-41.39	-380.09	47.59	66.02	585.93

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

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
0.00	0.00	0.00	-45.72	5.90	-0.00	0.00
0.60	0.00	0.00	-39.99	23.00	-5.43	0.89
1.20	0.00	6.68	-34.28	26.41	-21.92	8.65
1.80	0.00	6.68	-28.62	32.87	-39.71	26.97
2.00	0.00	21.49	-26.76	29.85	-45.86	35.25
2.00	0.00	21.49	-26.76	29.85	-22.36	35.25
2.40	0.00	28.89	-23.11	28.48	-33.51	46.41
3.00	0.00	28.89	-17.91	34.77	-52.13	71.81
3.00	0.00	28.89	-17.84	30.94	-52.40	72.23
3.60	0.00	28.89	-13.05	-2.46	-60.90	107.08
4.20	0.00	28.89	-8.84	-35.59	-49.49	141.29
4.80	0.00	36.84	-5.41	-66.08	-18.21	162.53
5.40	36.84	36.84	-2.89	-86.89	28.61	160.05
6.00	36.84	0.00	-1.27	-28.31	61.33	131.37
6.60	36.84	0.00	-0.38	3.58	67.58	91.75
7.20	36.84	36.84	-0.00	27.34	57.69	53.37
7.80	36.84	36.84	0.06	31.78	39.17	24.18
8.40	36.84	36.84	-0.01	25.81	21.60	6.13
9.00	36.84	36.84	-0.13	17.02	8.74	-2.71
9.60	36.84	36.84	-0.23	9.16	0.98	-5.38
10.20	36.84	36.84	-0.30	3.44	-2.70	-4.70
10.80	36.84	36.84	-0.35	-0.35	-3.54	-2.71
11.40	36.84	36.84	-0.38	-3.01	-2.50	-0.82
12.00	36.84	36.84	-0.41	-5.30	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 67,75 kN/m
 Maximum moment = 164,95 kNm/m
 Maximum displacement = 45,7 mm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,00	-26,8	30,00

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 15,4$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	23,1
2	0,86	26,3
3	1,72	28,3
4	2,58	29,1
5	3,44	28,6
6	4,30	26,9
7	5,16	24,0
8	6,02	19,8
9	6,88	14,4
10	7,74	7,8
11	8,60	0,0
12	8,60	0,0

Dimensioning No. 1 (Stage of construction 3)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 153,90$ kPa

Unfavourable water pressure $u_{\text{dst}} = 6,75$ kPa

Verification of failure by heave is **SATISFACTORY**

Verification of failure by piping


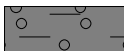

Critical hydraulic gradient $i_c = 0,73$

Hydraulic gradient $i = 0,03$

Verification of failure by piping is **SATISFACTORY**

Input data (Stage of construction 4)

Geological profile and assigned soils

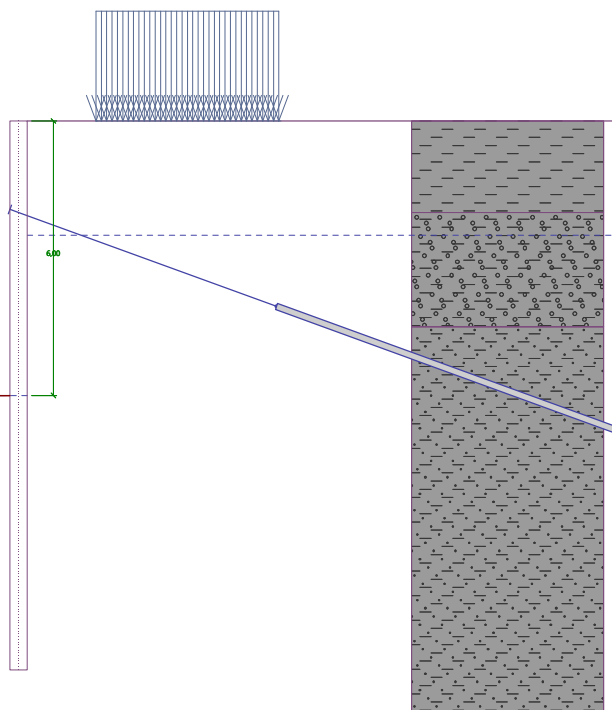
No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2,00	0,00 .. 2,00	Glina	
2	2,50	2,00 .. 4,50	Zameljen prod	
3	-	4,50 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 6,00 m.

Name : 4

Stage - analysis : 4 - 0



Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m

GWT in front of the structure lies at a depth of 6,00 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,23

Input surface surcharges

No.	Surcharge new	change	Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
1	No	No	variable	20,00		1,50	4,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	No	2,00	Anchor No. : 1 (user-defined)		220,40

Settings of the stage of construction

Design situation : permanent

Analysis results (Stage of construction 4)

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	5.90
0.00	0.00	0.00	0.00	0.00	0.00	5.90
0.40	0.00	0.00	0.00	1.45	7.65	17.41

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
0.44	0.00	0.00	0.00	1.57	8.25	18.32
0.44	0.00	0.00	0.00	15.13	15.13	18.32
0.50	0.00	0.00	0.00	15.84	15.84	20.15
1.00	0.00	0.00	0.00	21.36	21.36	34.40
1.50	0.00	0.00	0.00	26.88	26.88	48.64
2.00	0.00	0.00	0.00	32.40	32.40	62.89
2.00	0.00	0.00	0.00	16.46	24.69	185.86
2.50	0.00	0.00	0.00	19.30	28.56	233.94
2.50	0.00	0.00	0.00	19.30	28.56	233.94
3.00	0.00	0.00	0.00	27.97	35.46	271.06
3.50	0.00	0.00	0.00	36.65	42.37	308.18
4.00	0.00	0.00	0.00	45.33	49.38	345.31
4.50	0.00	0.00	0.00	54.00	56.50	382.43
4.50	0.00	0.00	0.00	50.49	55.62	304.13
5.00	0.00	0.00	0.00	59.52	62.77	332.07
5.50	0.00	0.00	0.00	68.55	70.02	360.00
6.00	0.00	0.00	0.00	77.58	77.58	387.94
6.00	0.00	-0.00	-25.13	77.59	77.59	387.95
6.50	0.00	-1.87	-41.20	75.92	76.88	410.22
7.00	0.00	-3.75	-57.26	74.26	76.45	432.51
7.50	0.00	-5.62	-73.33	72.60	76.08	454.79
7.99	0.00	-7.46	-89.12	70.96	75.76	476.69
8.00	0.00	-7.49	-89.40	66.21	75.76	477.07
8.50	0.00	-9.37	-105.46	64.77	75.47	499.36
9.00	0.00	-11.24	-121.53	63.34	75.21	521.64
9.02	0.00	-11.31	-122.13	63.28	75.21	522.48
9.50	-1.59	-13.11	-137.60	61.90	74.99	543.92
10.00	-3.24	-14.99	-153.66	60.46	74.78	566.21
10.50	-4.88	-16.86	-169.73	59.02	74.59	588.49
11.00	-6.53	-18.73	-185.80	57.59	74.42	610.77
11.50	-8.18	-20.61	-201.86	56.15	74.26	633.06
12.00	-9.83	-22.48	-217.93	54.71	74.11	655.34

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	-29.47	5.90	0.00	-0.00
0.60	0.00	0.00	-30.67	23.00	-8.67	2.09
1.20	0.00	0.00	-31.88	40.09	-27.60	12.45
1.80	0.00	0.00	-33.17	30.19	-45.87	34.78
2.00	0.00	0.00	-33.63	21.63	-51.70	44.56
2.00	0.00	0.00	-33.63	21.63	120.89	44.56
2.40	0.00	0.00	-34.63	18.73	113.75	-2.38
3.00	0.00	0.00	-36.08	27.97	100.02	-66.81
3.60	0.00	0.00	-37.15	38.39	80.11	-121.16
4.20	0.00	0.00	-37.55	48.80	53.96	-161.69
4.80	0.00	0.00	-37.05	55.91	22.57	-184.81

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
5.40	0.00	0.00	-35.51	66.74	-14.22	-187.64
6.00	0.00	0.00	-32.94	77.51	-57.21	-166.68
6.00	0.00	0.00	-32.90	52.31	-57.73	-166.22
6.60	0.00	0.00	-29.41	31.18	-82.61	-123.77
7.20	0.00	0.00	-25.21	9.90	-94.93	-69.87
7.80	0.00	0.00	-20.61	-11.37	-94.49	-12.41
8.40	0.00	0.00	-15.94	-37.19	-79.34	40.55
9.00	0.00	0.00	-11.49	-58.19	-50.72	80.20
9.60	0.00	0.00	-7.49	-79.20	-9.51	98.90
10.20	0.00	0.00	-4.03	-100.20	44.31	89.09
10.80	36.84	0.00	-1.05	1.41	74.86	49.82
11.40	0.00	1.84	1.64	69.46	42.47	12.82
12.00	0.00	1.84	4.25	72.10	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 120,89 kN/m
Maximum moment = 189,18 kNm/m
Maximum displacement = 37,6 mm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,00	-33,6	220,40

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 49,0$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	12,6
2	0,86	29,0
3	1,72	41,5
4	2,58	50,0
5	3,44	54,6
6	4,30	55,3
7	5,16	52,1
8	6,02	45,0
9	6,88	33,9
10	7,74	18,9
11	8,60	0,0
12	8,60	0,0

Dimensioning No. 1 (Stage of construction 4)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 102,60$ kPa
Unfavourable water pressure $u_{\text{dst}} = 47,25$ kPa

Verification of failure by heave is **SATISFACTORY**


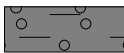
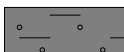
Verification of failure by piping

Critical hydraulic gradient $i_c = 0,73$
Hydraulic gradient $i = 0,23$

Verification of failure by piping is SATISFACTORY

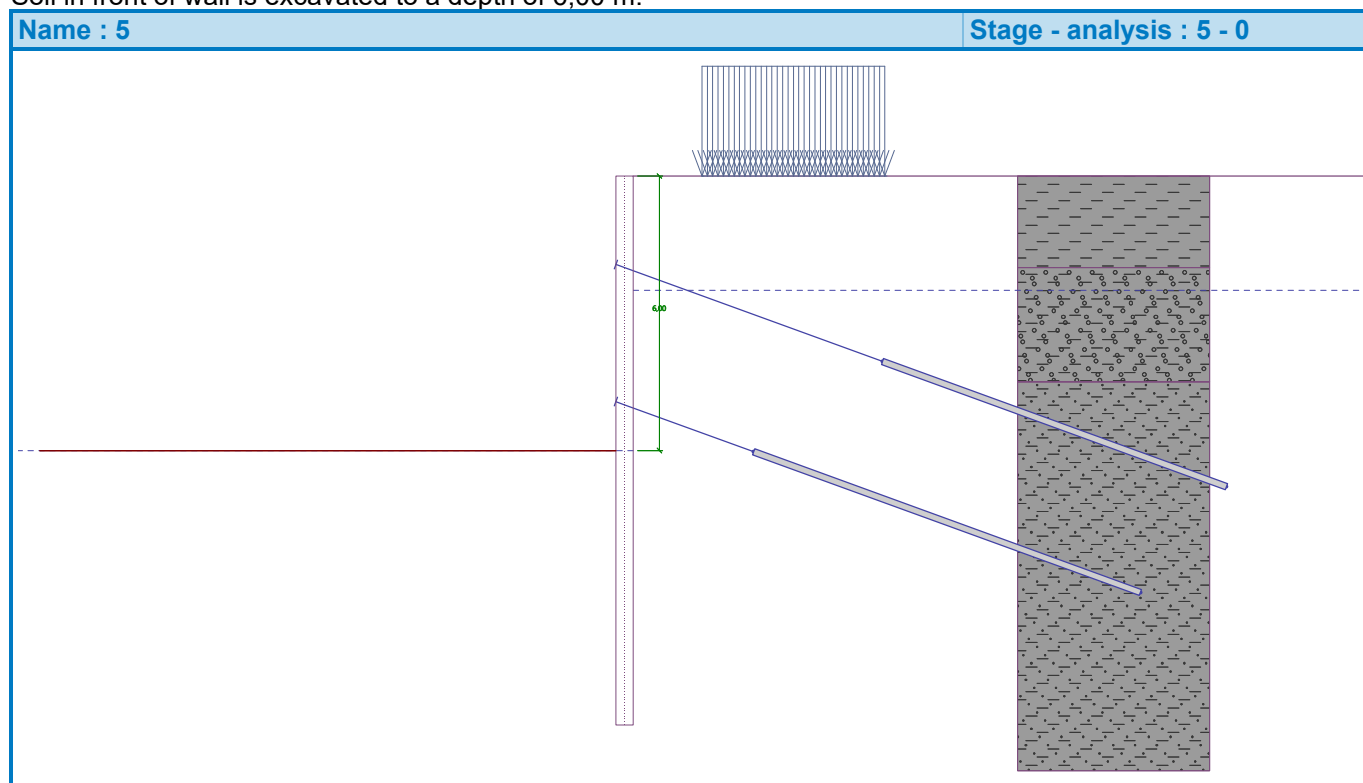
Input data (Stage of construction 5)

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2,00	0,00 .. 2,00	Glina	
2	2,50	2,00 .. 4,50	Zameljen prod	
3	-	4,50 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 6,00 m.



Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m

GWT in front of the structure lies at a depth of 6,00 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,23

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		variable	20,00		1,50	4,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	No	2,00	Anchor No. : 1 (user-defined)		221,83
2	Yes	5,00	Anchor No. : 2 (user-defined)		30,00

List of the new anchors

Anchor No. : 2 (user-defined)

Anchor type : prestressed bar

Production set : user-defined

Depth : $z = 5,00$ m

Free length : $l = 3,00$ m

Root length : $l_k = 9,00$ m

Slope : $\alpha = 20,00^\circ$

Spacing : $b = 1,20$ m

Area of cross-section : $A = 791,00$ mm²

Elasticity modulus : $E = 210000,00$ MPa

Pre-stressing force : $F = 30,00$ kN

Tension strength : $R_t = 500,00$ kN

Pull out resistance (soil) : calculate from bond strength

Diameter of root : $d = 140,0$ mm

Bond strength : $f = 150,00$ kPa

Pull out resistance (grouting) : calculate from concrete strength

Standard for concrete structures : EN 1992-1-1 (EC2)

Concrete strength in compression : $f_{ck} = 20,00$ MPa

Coefficient of cohesion : $\eta_1 = 1,00$

Settings of the stage of construction

Design situation : permanent

Analysis results (Stage of construction 5)

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	5.90
0.00	0.00	0.00	0.00	0.00	0.00	5.90
0.40	0.00	0.00	0.00	1.45	7.65	17.41
0.44	0.00	0.00	0.00	1.57	8.25	18.32
0.44	0.00	0.00	0.00	15.13	15.13	18.32
0.50	0.00	0.00	0.00	15.84	15.84	20.15
1.00	0.00	0.00	0.00	21.36	21.36	34.40
1.50	0.00	0.00	0.00	26.88	26.88	48.64
2.00	0.00	0.00	0.00	32.40	32.40	62.89
2.00	0.00	0.00	0.00	16.46	24.69	185.86
2.50	0.00	0.00	0.00	19.30	28.56	233.94
2.50	0.00	0.00	0.00	19.30	28.56	233.94
3.00	0.00	0.00	0.00	27.97	35.46	271.06
3.50	0.00	0.00	0.00	36.65	42.37	308.18
4.00	0.00	0.00	0.00	45.33	49.38	345.31
4.50	0.00	0.00	0.00	54.00	56.50	382.43
4.50	0.00	0.00	0.00	50.49	55.62	304.13
5.00	0.00	0.00	0.00	59.52	62.77	332.07
5.50	0.00	0.00	0.00	68.55	70.02	360.00
6.00	0.00	0.00	0.00	77.58	77.58	387.94

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
6.00	0.00	-0.00	-25.13	77.59	77.59	387.95
6.50	0.00	-1.87	-41.20	75.92	76.88	410.22
7.00	0.00	-3.75	-57.26	74.26	76.45	432.51
7.50	0.00	-5.62	-73.33	72.60	76.08	454.79
7.99	0.00	-7.46	-89.12	70.96	75.76	476.69
8.00	0.00	-7.49	-89.40	66.21	75.76	477.07
8.50	0.00	-9.37	-105.46	64.77	75.47	499.36
9.00	0.00	-11.24	-121.53	63.34	75.21	521.64
9.02	0.00	-11.31	-122.13	63.28	75.21	522.48
9.50	-1.59	-13.11	-137.60	61.90	74.99	543.92
10.00	-3.24	-14.99	-153.66	60.46	74.78	566.21
10.50	-4.88	-16.86	-169.73	59.02	74.59	588.49
11.00	-6.53	-18.73	-185.80	57.59	74.42	610.77
11.50	-8.18	-20.61	-201.86	56.15	74.26	633.06
12.00	-9.83	-22.48	-217.93	54.71	74.11	655.34

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	-29.72	5.90	0.00	0.00
0.60	0.00	0.00	-30.86	23.00	-8.67	2.09
1.20	0.00	0.33	-32.01	24.47	-26.66	12.41
1.80	0.00	0.00	-33.24	30.19	-42.89	33.11
2.00	0.00	0.96	-33.69	26.85	-48.94	42.28
2.00	0.00	0.96	-33.69	26.85	124.77	42.28
2.40	0.00	1.44	-34.63	27.33	114.41	-5.59
3.00	0.00	1.44	-35.99	35.20	95.81	-68.91
3.60	0.00	1.44	-36.97	43.76	72.12	-119.55
4.20	0.00	1.44	-37.29	52.43	43.27	-154.43
4.80	0.00	1.84	-36.74	60.27	9.47	-170.51
5.00	0.00	1.84	-36.35	63.17	-2.87	-171.18
5.00	0.00	1.84	-36.35	63.17	20.62	-171.18
5.40	0.00	1.84	-35.24	68.98	-5.81	-174.22
6.00	0.00	1.84	-32.79	77.81	-49.54	-157.99
6.00	0.00	1.84	-32.75	52.61	-50.11	-157.59
6.60	0.00	1.84	-29.42	32.31	-75.41	-119.57
7.20	0.00	1.84	-25.40	12.12	-88.73	-69.71
7.80	0.00	1.84	-20.99	-8.00	-89.97	-15.48
8.40	0.00	1.84	-16.49	-28.26	-79.05	35.85
9.00	0.00	1.84	-12.19	-48.19	-56.12	77.02
9.60	0.00	1.84	-8.31	-68.05	-21.24	100.84
10.20	0.00	1.84	-4.99	-87.91	25.54	100.16
10.80	36.84	0.00	-2.23	-41.84	73.42	68.61
11.40	0.00	36.84	0.16	72.42	67.74	22.74
12.00	0.00	36.84	2.41	153.11	0.00	-0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 124,77 kN/m

Maximum moment = 174,42 kNm/m
Maximum displacement = 37,3 mm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,00	-33,7	221,83
2	5,00	-36,3	30,00

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 49,4$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	13,7
2	0,86	30,1
3	1,72	42,6
4	2,58	51,1
5	3,44	55,7
6	4,30	56,3
7	5,16	52,9
8	6,02	45,6
9	6,88	34,4
10	7,74	19,2
11	8,60	0,0
12	8,60	0,0

Dimensioning No. 1 (Stage of construction 5)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 102,60$ kPa

Unfavourable water pressure $u_{\text{dst}} = 47,25$ kPa

Verification of failure by heave is SATISFACTORY

Verification of failure by piping



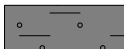
Critical hydraulic gradient $i_c = 0,73$

Hydraulic gradient $i = 0,23$

Verification of failure by piping is SATISFACTORY

Input data (Stage of construction 6)

Geological profile and assigned soils

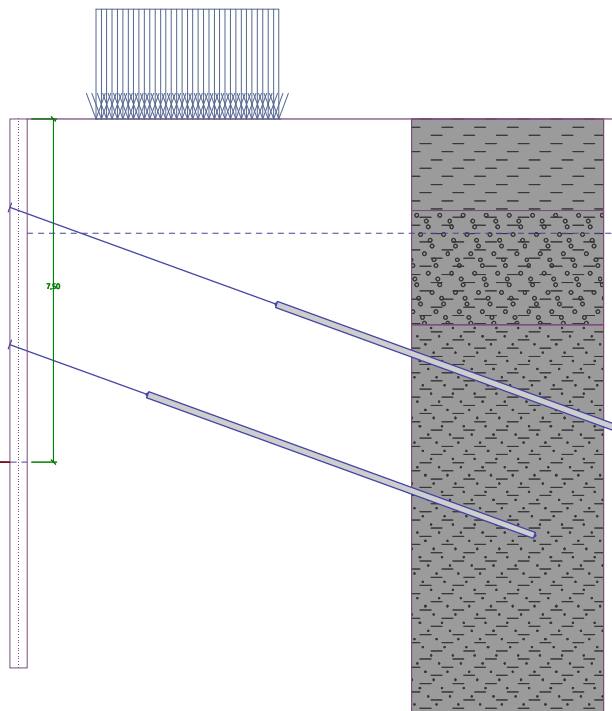
No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	2,00	0,00 .. 2,00	Glina	
2	2,50	2,00 .. 4,50	Zameljen prod	
3	-	4,50 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 7,50 m.

Name : 6

Stage - analysis : 6 - 0



Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m

GWT in front of the structure lies at a depth of 7,50 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,36

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	No	No	variable	20,00		1,50	4,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	No	2,00	Anchor No. : 1 (user-defined)		118,83
2	No	5,00	Anchor No. : 2 (user-defined)		389,66

Settings of the stage of construction

Design situation : permanent

Analysis results (Stage of construction 6)

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	5.90
0.00	0.00	0.00	0.00	0.00	0.00	5.90

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
0.40	0.00	0.00	0.00	1.45	7.65	17.41
0.44	0.00	0.00	0.00	1.57	8.25	18.32
0.44	0.00	0.00	0.00	15.13	15.13	18.32
0.50	0.00	0.00	0.00	15.84	15.84	20.15
1.00	0.00	0.00	0.00	21.36	21.36	34.40
1.50	0.00	0.00	0.00	26.88	26.88	48.64
2.00	0.00	0.00	0.00	32.40	32.40	62.89
2.00	0.00	0.00	0.00	16.46	24.69	185.86
2.50	0.00	0.00	0.00	19.30	28.56	233.94
2.50	0.00	0.00	0.00	19.30	28.56	233.94
3.00	0.00	0.00	0.00	28.18	35.75	274.39
3.50	0.00	0.00	0.00	37.07	42.95	314.83
4.00	0.00	0.00	0.00	45.95	50.25	355.28
4.50	0.00	0.00	0.00	54.83	57.66	395.72
4.50	0.00	0.00	0.00	51.48	56.74	313.78
5.00	0.00	0.00	0.00	60.76	64.17	344.13
5.50	0.00	0.00	0.00	70.03	71.71	374.49
6.00	0.00	0.00	0.00	79.31	79.34	404.84
6.50	0.00	0.00	0.00	88.58	88.58	435.19
7.00	0.00	0.00	0.00	97.86	97.86	465.54
7.50	0.00	0.00	0.00	107.13	107.13	495.89
7.50	0.00	-0.00	-25.13	107.13	107.13	495.90
7.99	0.00	-1.56	-38.54	102.25	102.25	518.29
8.00	0.00	-1.59	-38.78	97.44	99.96	518.70
8.50	0.00	-3.18	-52.44	92.68	97.32	541.52
9.00	0.00	-4.78	-66.09	87.93	94.71	564.33
9.50	0.00	-6.37	-79.74	83.18	92.12	587.14
10.00	0.00	-7.96	-93.39	78.43	89.56	609.95
10.50	0.00	-9.55	-107.05	73.67	87.01	632.76
11.00	0.00	-11.14	-120.70	68.92	84.48	655.58
11.05	0.00	-11.31	-122.13	68.42	84.22	657.97
11.50	-1.25	-12.73	-134.35	64.17	81.97	678.39
12.00	-2.65	-14.33	-148.01	59.42	79.46	701.20

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

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
0.00	0.00	0.00	-23.37	5.90	0.00	0.00
0.60	0.00	0.00	-25.30	23.00	-8.67	2.09
1.20	0.00	0.00	-27.24	40.09	-27.60	12.45
1.80	0.00	0.33	-29.26	31.52	-45.55	34.44
2.00	0.00	1.07	-29.97	30.85	-51.97	44.18
2.00	0.00	1.07	-29.97	30.85	41.09	44.18
2.40	0.00	1.44	-31.46	31.92	28.74	30.18
3.00	0.00	1.44	-33.83	38.61	7.73	19.02
3.60	0.00	1.44	-36.33	45.33	-17.50	21.74
4.20	0.00	0.00	-38.95	49.50	-45.04	40.50

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
4.80	0.00	0.00	-41.81	57.05	-76.97	76.93
5.00	0.00	0.00	-42.84	60.76	-88.75	93.49
5.00	0.00	0.00	-42.84	60.76	216.38	93.49
5.40	0.00	0.00	-45.06	68.18	190.59	11.99
6.00	0.00	0.00	-48.38	79.31	146.35	-89.42
6.60	0.00	0.00	-51.21	90.44	95.42	-162.29
7.20	0.00	0.00	-53.15	101.57	37.82	-202.59
7.50	0.00	0.00	-53.69	107.06	6.94	-209.26
7.50	0.00	0.00	-53.70	81.85	6.19	-209.31
7.80	0.00	0.00	-53.95	70.82	-16.41	-207.72
8.40	0.00	0.00	-53.60	43.93	-50.25	-186.88
9.00	0.00	0.00	-52.20	21.84	-69.98	-150.15
9.60	0.00	0.00	-49.96	-0.24	-76.46	-105.55
10.20	0.00	0.00	-47.13	-22.33	-69.69	-61.05
10.80	0.00	0.00	-43.94	-44.42	-49.66	-24.58
11.40	0.00	0.00	-40.61	-66.50	-16.39	-4.10
12.00	1.84	0.00	-37.25	-23.52	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 216,38 kN/m
Maximum moment = 209,53 kNm/m
Maximum displacement = 54,0 mm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,00	-30,0	118,83
2	5,00	-42,8	389,66

Dimensioning No. 1 (Stage of construction 6)

Failure by heave

Favourable weight of soil $\sigma_{stb} = 76,95$ kPa
Unfavourable water pressure $u_{dst} = 67,50$ kPa

Verification of failure by heave is **SATISFACTORY**

Verification of failure by piping

Critical hydraulic gradient $i_c = 0,73$
Hydraulic gradient $i = 0,36$

Verification of failure by piping is **SATISFACTORY**

Dimensioning No. 1

Distribution of forces on construction

	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	-46.15	-1.17	-0.00	0.00	-0.00	0.00
0.01	-46.09	-1.17	-0.05	-0.00	-0.03	0.00
0.01	-46.02	-1.17	-0.11	0.02	-0.06	0.01
0.60	-40.42	-0.98	-8.67	2.28	-1.15	2.09
1.20	-34.70	-0.79	-27.60	-2.20	-1.27	12.45
1.80	-33.24	-0.59	-45.87	-8.67	1.89	34.78

	Disp. min [mm]	Disp. max [mm]	Shear force min. [kN/m]	Shear force max [kN/m]	Moment min. [kNm/m]	Moment max. [kNm/m]
2.00	-33.69	-0.52	-51.97	-10.15	3.85	44.56
2.00	-33.69	-0.52	-37.11	124.77	3.85	44.56
2.40	-34.63	-0.40	-44.45	114.41	-5.59	46.41
3.00	-36.07	-0.25	-57.99	100.13	-68.52	73.08
3.00	-36.08	-0.25	-58.10	100.02	-68.91	73.31
3.00	-36.08	-0.25	-58.20	99.90	-69.28	73.55
3.00	-36.08	-0.25	-58.20	99.90	-69.28	73.55
3.60	-37.15	-0.15	-63.18	80.11	-121.16	110.63
4.20	-38.95	-0.08	-49.59	53.96	-161.69	145.39
4.80	-41.81	-0.05	-76.97	22.57	-184.81	166.35
5.00	-42.84	-0.04	-88.75	11.00	-188.09	168.27
5.00	-42.84	-0.04	-4.19	216.38	-188.09	168.27
5.40	-45.06	-0.03	-14.22	190.59	-187.64	162.97
6.00	-48.36	-0.02	-57.21	146.66	-166.68	133.29
6.00	-48.36	-0.02	-57.21	146.66	-166.68	133.29
6.00	-48.38	-0.02	-57.47	146.35	-166.45	133.04
6.00	-48.40	-0.02	-57.73	146.02	-166.22	132.78
6.00	-48.40	-0.02	-57.73	146.02	-166.22	132.78
6.60	-51.21	-0.02	-82.61	95.42	-162.29	92.11
7.20	-53.15	0.00	-94.93	57.69	-202.59	53.50
7.50	-53.69	0.06	-96.25	48.86	-209.26	37.92
7.50	-53.70	0.06	-96.24	48.61	-209.31	37.53
7.50	-53.70	0.06	-96.24	48.61	-209.31	37.53
7.80	-53.95	0.07	-94.49	39.38	-207.72	24.51
8.40	-53.60	-0.01	-79.34	21.94	-186.88	40.55
9.00	-52.20	-0.02	-69.98	8.87	-150.15	80.20
9.60	-49.96	-0.02	-76.46	0.99	-105.55	100.84
10.20	-47.13	-0.01	-69.69	44.31	-61.05	100.16
10.80	-43.94	-0.01	-49.66	74.86	-24.58	68.61
11.40	-40.61	1.64	-16.39	67.74	-4.10	22.74
12.00	-37.25	4.25	-0.00	0.00	-0.00	0.00

Maximum values of internal forces

Maximum displacement = -54,0 mm
 Minimum displacement = 4,2 mm
 Maximum bending moment = 168,45 kNm/m
 Minimum bending moment = -209,53 kNm/m
 Maximum shear force = 216,38 kN/m

Verification of steel section according to EN 1993-1-1

All construction stages are taken into the analysis.
 Partial factor on load = 1,00

Internal forces per 1 m of wall

$M_{\max} = 209,53 \text{ kNm/m}; \quad Q = 1,66 \text{ kN/m}$
 $Q_{\max} = 216,38 \text{ kN/m}; \quad M = 93,49 \text{ kNm/m}$

Verification of max. moment $M_{\max} + Q$:

Verification of bending:

$M_{\max}/M_{c,Rd} = 0,546 \leq 1$ **Is satisfactory**

Verification of shear:

$Q/V_{c,Rd} = 0,002 \leq 1$ **Is satisfactory**

Verification of plane state of stress:

Normal stress $\sigma_{x,Ed} = 124,06$ MPa

Shear stress $\tau_{Ed} = 0,22$ MPa

Verification: $(\sigma_{x,Ed}/(f_y/\gamma_{M0}))^2 + 3*(\tau_{Ed}/(f_y/\gamma_{M0}))^2 = 0,267 \leq 1$ **Is satisfactory**

Verification of max. shear force $Q_{max} + M$:

Verification of bending:

$M/M_{c,Rd} = 0,243 \leq 1$ **Is satisfactory**

Verification of shear:

$Q_{max}/V_{c,Rd} = 0,291 \leq 1$ **Is satisfactory**

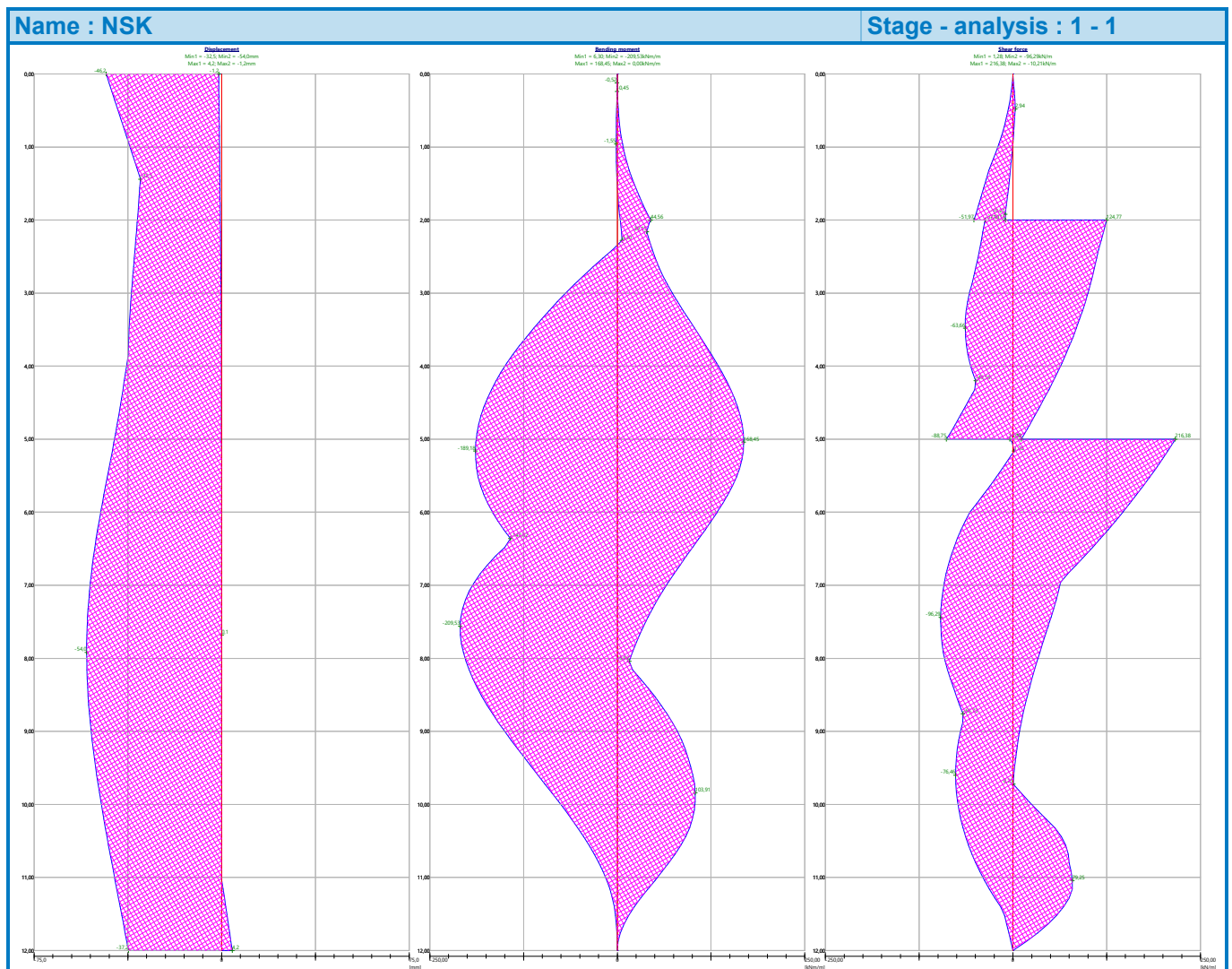
Verification of plane state of stress:

Normal stress $\sigma_{x,Ed} = 55,35$ MPa

Shear stress $\tau_{Ed} = 28,19$ MPa

Verification: $(\sigma_{x,Ed}/(f_y/\gamma_{M0}))^2 + 3*(\tau_{Ed}/(f_y/\gamma_{M0}))^2 = 0,095 \leq 1$ **Is satisfactory**

Cross section is SATISFACTORY



Verification of anchors

Anchor	Stage	Depth z [m]	Max. force F [kN]	Anchor strength R _t [kN]	Pull-out res. (soil) R _e [kN]	Pull-out res. (grouting) R _c [kN]	Verification
1	5	2,00	221,83	454,55	390,95	731,33	is satisfactory (56,74 %)
2	6	5,00	389,66	454,55	439,82	822,74	is satisfactory (88,59 %)
1	6	2,00	118,83	454,55	390,95	731,33	is satisfactory (30,40 %)

Anchor with max. utilization - Nr. 2. (Stage 6; z = 5,00 m)
Utilization is 88,59 %

Anchors bearing capacity is SATISFACTORY