

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 = 15,00 m

Cross-section name : Pile curtain d = 0,80 m, a = 1,40 m

Material of pile : concrete

Computed coefficient of pressure reduction below the ditch = 1,00

Area of cross-section $A = 3,59E-01 \text{ m}^2/\text{m}$

Moment of inertia $I = 1,44E-02 \text{ m}^4/\text{m}$

Material of structure

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

Concrete: C 25/30

Cylinder compressive strength $f_{ck} = 25,00 \text{ MPa}$

Tensile strength $f_{ctm} = 2,60 \text{ MPa}$

Elasticity modulus $E_{cm} = 31000,00 \text{ MPa}$

Shear modulus $G = 12917,00 \text{ MPa}$

Longitudinal reinforcement: B500B

Yield strength $f_{yk} = 500,00 \text{ MPa}$


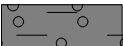

Transverse reinforcement: B500B

Yield strength $f_{yk} = 500,00 \text{ MPa}$



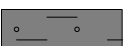
Modulus of reaction

Modulus of subsoil reaction is computed by method Schmitt.

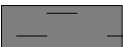

Basic soil parameters


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	16,20
2	Zameljen prod		34,00	1,00	19,00	11,00	34,00
3	Siva zbita peščena		30,00	8,00	19,00	11,00	30,00

Soil parameters to compute pressure at rest


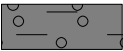
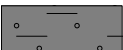
No.	Name	Pattern	Type calculation	Φ_{ef} [°]	ν [-]	OCR [-]	K_r [-]
1	Glina		cohesive	-	0,30	-	-
2	Zameljen prod		cohesionless	34,00	-	-	-
3	Siva zbita peščena		cohesive	-	0,30	-	-

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

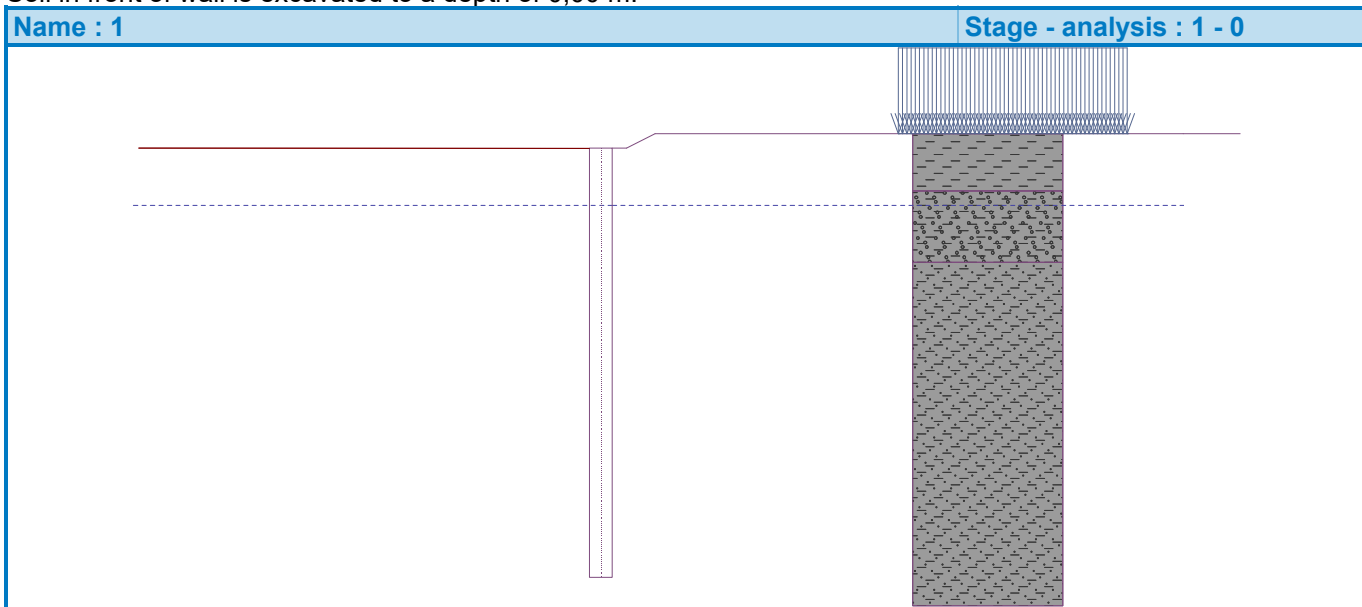
No.	Name	Pattern	ν [-]	E_{oed} [MPa]	E_{def} [MPa]
3	Siva zbita peščena		0,30	-	18,00

Geological profile and assigned soils

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

Excavation

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



Terrain profile

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

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

Water influence

GWT behind the structure lies at a depth of 2,00 m
GWT in front of the structure lies at a depth of 2,00 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		10,00	8,00	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]	T _{a,p} [kPa]	T _{k,p} [kPa]	T _{p,p} [kPa]	T _{a,z} [kPa]	T _{k,z} [kPa]	T _{p,z} [kPa]
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.01	0.00	-0.04	-6.08	0.05	0.70	6.38
0.15	0.00	-1.04	-9.92	0.52	1.85	10.22
0.15	0.00	-1.05	-9.95	0.53	1.86	10.24
0.22	0.00	-1.65	-12.24	0.81	2.54	12.54
0.23	0.00	-1.72	-12.52	0.84	2.63	12.81
0.26	0.00	-1.91	-13.23	1.07	2.84	13.53
0.33	0.00	-2.45	-15.28	1.75	4.14	15.58
0.38	0.00	-2.82	-16.71	3.60	5.05	17.00
0.40	0.00	-3.04	-17.54	4.44	5.59	17.84
0.57	-1.72	-4.30	-22.38	6.54	8.67	22.67
0.75	-3.63	-5.71	-27.74	8.88	10.42	28.04
0.99	-6.13	-7.55	-34.78	11.94	12.99	35.07
1.50	-11.49	-11.49	-49.84	18.51	18.51	52.46
1.50	-6.80	-11.82	-153.63	9.45	16.61	204.97
1.99	-9.50	-15.94	-205.92	12.16	22.61	257.26
2.00	-9.54	-16.01	-206.76	12.20	22.68	258.10
2.25	-10.34	-17.22	-222.14	13.00	24.11	273.48
3.00	-12.73	-20.86	-268.27	15.38	28.33	319.61
3.60	-14.64	-23.78	-305.29	17.30	31.63	356.63
3.60	-14.64	-23.78	-305.29	22.68	31.63	356.63
3.75	-15.11	-24.50	-314.41	23.12	32.44	365.75
4.00	-15.91	-25.71	-329.79	23.88	33.79	381.13
4.00	-11.58	-24.99	-256.69	21.15	32.96	293.14
4.50	-13.49	-27.35	-278.53	22.95	35.55	314.99
5.25	-16.36	-30.89	-311.29	25.65	39.34	347.75
6.00	-19.22	-34.42	-344.06	28.36	43.03	380.51
6.75	-22.09	-37.96	-376.82	31.06	46.64	413.28
7.50	-24.96	-41.49	-409.58	33.77	50.18	446.04
8.25	-27.82	-45.03	-442.35	36.47	53.66	478.80
9.00	-30.69	-48.57	-475.11	39.17	57.09	511.57
9.75	-33.56	-52.10	-507.87	41.88	60.49	544.33

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
10.50	-36.42	-55.64	-540.64	44.58	63.87	577.09
11.25	-39.29	-59.17	-573.40	47.28	67.22	609.86
12.00	-42.15	-62.71	-606.16	49.99	70.57	642.62
12.75	-45.02	-66.24	-638.93	52.69	73.91	675.38
13.50	-47.89	-69.78	-671.69	55.40	77.25	708.15
14.25	-50.75	-73.32	-704.46	58.10	80.60	740.91
15.00	-53.62	-76.85	-737.22	60.80	83.94	773.68

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	-0.36	0.00	0.00	0.00
0.01	3.50	0.00	-0.36	-1.23	0.00	-0.00
0.75	3.50	3.50	-0.33	2.37	-0.10	-0.19
1.50	15.12	0.00	-0.31	2.33	-2.85	0.82
2.25	15.12	15.12	-0.29	-1.79	-1.16	2.35
3.00	15.12	15.12	-0.27	-0.60	-0.27	2.82
3.75	15.12	15.12	-0.25	0.37	-0.19	2.95
4.50	19.28	19.28	-0.24	-0.98	0.36	2.97
5.25	19.28	19.28	-0.23	-0.38	0.86	2.48
6.00	19.28	19.28	-0.22	0.00	1.00	1.77
6.75	19.28	19.28	-0.22	0.21	0.91	1.04
7.50	19.28	19.28	-0.22	0.30	0.71	0.43
8.25	19.28	19.28	-0.22	0.31	0.49	-0.02
9.00	19.28	19.28	-0.21	0.27	0.27	-0.31
9.75	19.28	19.28	-0.21	0.20	0.10	-0.44
10.50	19.28	19.28	-0.21	0.14	-0.03	-0.46
11.25	19.28	19.28	-0.21	0.08	-0.11	-0.41
12.00	19.28	19.28	-0.20	0.02	-0.14	-0.31
12.75	19.28	19.28	-0.20	-0.02	-0.15	-0.20
13.50	19.28	19.28	-0.20	-0.05	-0.12	-0.10
14.25	19.28	19.28	-0.19	-0.08	-0.07	-0.03
15.00	19.28	19.28	-0.19	-0.10	-0.00	-0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 2,85 kN/m
Maximum moment = 3,03 kNm/m
Maximum displacement = 0,4 mm

Maximum internal forces on cross-section

Maximum shear force = 3,99 kN
Maximum moment = 4,24 kNm

Terrain settlement behind the structure

Terrain settlement δ_{\max} = 0,5 mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	0,3
2	1,01	0,4
3	2,02	0,5

	Coordinates x [m]	Settlement z [mm]
4	3,04	0,6
5	4,05	0,6
6	5,06	0,6
7	6,07	0,6
8	7,08	0,5
9	8,09	0,4
10	9,11	0,2
11	10,12	0,0
12	10,12	0,0

Dimensioning No. 1 (Stage of construction 1)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 255,15 \text{ kPa}$

Unfavourable water pressure $u_{\text{dst}} = 0,00 \text{ kPa}$

Verification of failure by heave is SATISFACTORY

Verification of failure by piping


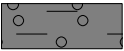
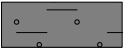
Critical hydraulic gradient $i_c = 0,67$

Hydraulic gradient $i = 0,00$

Verification of failure by piping is SATISFACTORY

Input data (Stage of construction 2)

Geological profile and assigned soils

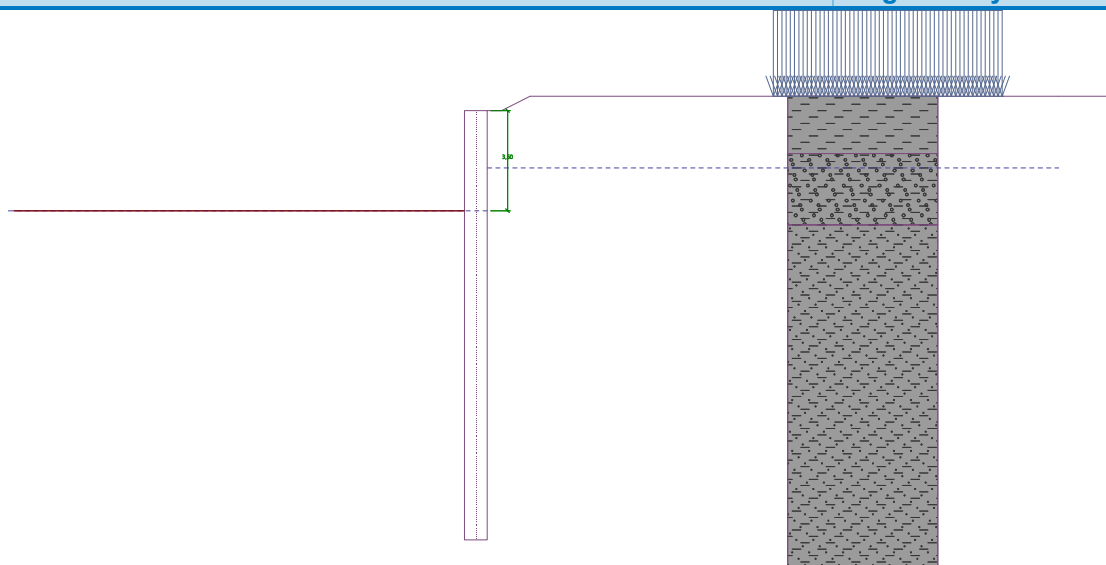
No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	1,50	0,00 .. 1,50	Glina	
2	2,50	1,50 .. 4,00	Zameljen prod	
3	-	4,00 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 3,50 m.

Name : 2

Stage - analysis : 2 - 0



Terrain profile

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

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

Water influence

GWT behind the structure lies at a depth of 2,00 m
GWT in front of the structure lies at a depth of 3,50 m
Subgrade at the heel is permeable.
Hydraulic gradient = 0,06

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		10,00	8,00	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	0.56	6.38
0.01	0.00	0.00	0.00	0.05	0.70	6.38
0.15	0.00	0.00	0.00	0.52	1.85	10.22
0.15	0.00	0.00	0.00	0.53	1.86	10.24
0.22	0.00	0.00	0.00	0.81	2.54	12.54

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
0.23	0.00	0.00	0.00	0.84	2.63	12.81
0.26	0.00	0.00	0.00	1.07	2.84	13.53
0.33	0.00	0.00	0.00	1.75	4.14	15.58
0.38	0.00	0.00	0.00	3.60	5.05	17.00
0.39	0.00	0.00	0.00	4.31	5.40	17.54
0.57	0.00	0.00	0.00	6.54	8.67	22.67
0.79	0.00	0.00	0.00	9.39	10.79	29.20
0.99	0.00	0.00	0.00	11.94	12.96	35.07
1.50	0.00	0.00	0.00	18.51	18.51	52.46
1.50	0.00	0.00	0.00	9.45	16.61	204.97
1.58	0.00	0.00	0.00	9.89	17.57	213.36
1.99	0.00	0.00	0.00	12.16	22.61	257.26
2.00	0.00	0.00	0.00	12.20	22.68	258.10
2.37	0.00	0.00	0.00	18.41	28.57	284.65
3.16	0.00	0.00	0.00	31.72	41.10	341.56
3.50	0.00	0.00	0.00	37.49	46.49	366.22
3.50	0.00	-0.00	-3.65	37.49	42.74	366.23
3.60	0.00	-0.47	-9.55	37.65	46.93	372.73
3.60	0.00	-0.47	-9.55	42.97	46.93	372.73
3.82	0.00	-1.47	-22.25	43.29	47.89	386.73
3.95	-0.38	-2.05	-29.63	43.47	48.45	394.86
4.00	-0.54	-2.29	-32.69	43.55	48.68	398.23
4.00	0.00	-2.23	-45.70	40.88	47.83	308.25
4.74	0.00	-5.51	-76.10	42.39	50.86	341.55
5.53	0.00	-9.02	-108.67	44.02	53.99	377.22
5.91	0.00	-10.71	-124.32	44.80	55.45	394.36
6.32	-1.48	-12.54	-141.24	45.65	57.02	412.89
7.11	-4.33	-16.05	-173.81	47.28	59.96	448.56
7.89	-7.18	-19.56	-206.38	48.90	62.83	484.24
8.68	-10.03	-23.08	-238.94	50.53	65.64	519.91
9.47	-12.88	-26.59	-271.51	52.16	68.41	555.58
10.26	-15.73	-30.11	-304.08	53.79	71.15	591.25
11.05	-18.58	-33.62	-336.65	55.41	73.86	626.92
11.84	-21.43	-37.14	-369.22	57.04	76.57	662.60
12.63	-24.27	-40.65	-401.79	58.67	79.26	698.27
13.42	-27.12	-44.17	-434.35	60.30	81.96	733.94
14.21	-29.97	-47.68	-466.92	61.92	84.65	769.61
15.00	-32.82	-51.20	-499.49	63.55	87.35	805.28

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	-15.51	0.00	-0.00	-0.00
0.75	0.00	0.00	-13.86	8.88	-2.77	0.56
1.50	0.00	0.00	-12.20	18.51	-13.04	6.04
2.25	0.00	0.00	-10.56	16.42	-22.73	19.37
3.00	0.00	0.00	-8.94	29.06	-39.79	42.23

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
3.50	0.00	0.00	-7.90	37.42	-56.28	65.88
3.50	0.00	0.00	-7.88	33.62	-56.56	66.33
3.75	0.00	0.00	-7.38	25.02	-63.52	81.14
4.50	0.00	0.00	-5.92	-24.42	-60.34	130.05
5.25	19.28	0.00	-4.62	-53.47	-30.85	165.42
6.00	19.28	0.00	-3.53	-34.23	1.77	175.42
6.75	19.28	0.00	-2.66	-19.23	21.56	165.98
7.50	19.28	0.00	-2.00	-8.25	31.62	145.52
8.25	19.28	0.00	-1.52	-0.82	34.82	120.26
9.00	19.28	0.00	-1.19	3.69	33.58	94.40
9.75	19.28	0.00	-0.99	5.90	29.86	70.50
10.50	19.28	0.00	-0.87	6.38	25.17	49.85
11.25	19.28	0.00	-0.81	5.63	20.60	32.72
12.00	19.28	19.28	-0.80	8.38	15.99	18.79
12.75	19.28	19.28	-0.81	7.15	10.12	9.06
13.50	19.28	19.28	-0.84	5.46	5.38	3.32
14.25	19.28	19.28	-0.86	3.59	1.98	0.65
15.00	19.28	19.28	-0.89	1.69	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 67,37 kN/m
 Maximum moment = 175,42 kNm/m
 Maximum displacement = 15,5 mm

Maximum internal forces on cross-section

Maximum shear force = 94,31 kN
 Maximum moment = 245,59 kNm

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 8,0$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	8,2
2	1,01	10,3
3	2,02	11,7
4	3,04	12,5
5	4,05	12,6
6	5,06	12,1
7	6,07	11,0
8	7,08	9,2
9	8,09	6,8
10	9,11	3,7
11	10,12	0,0
12	10,12	0,0

Dimensioning No. 1 (Stage of construction 2)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 196,65$ kPa
 Unfavourable water pressure $u_{\text{dst}} = 20,25$ kPa

Verification of failure by heave is SATISFACTORY

Verification of failure by piping




Critical hydraulic gradient $i_c = 0,73$

Hydraulic gradient $i = 0,06$

Verification of failure by piping is **SATISFACTORY**

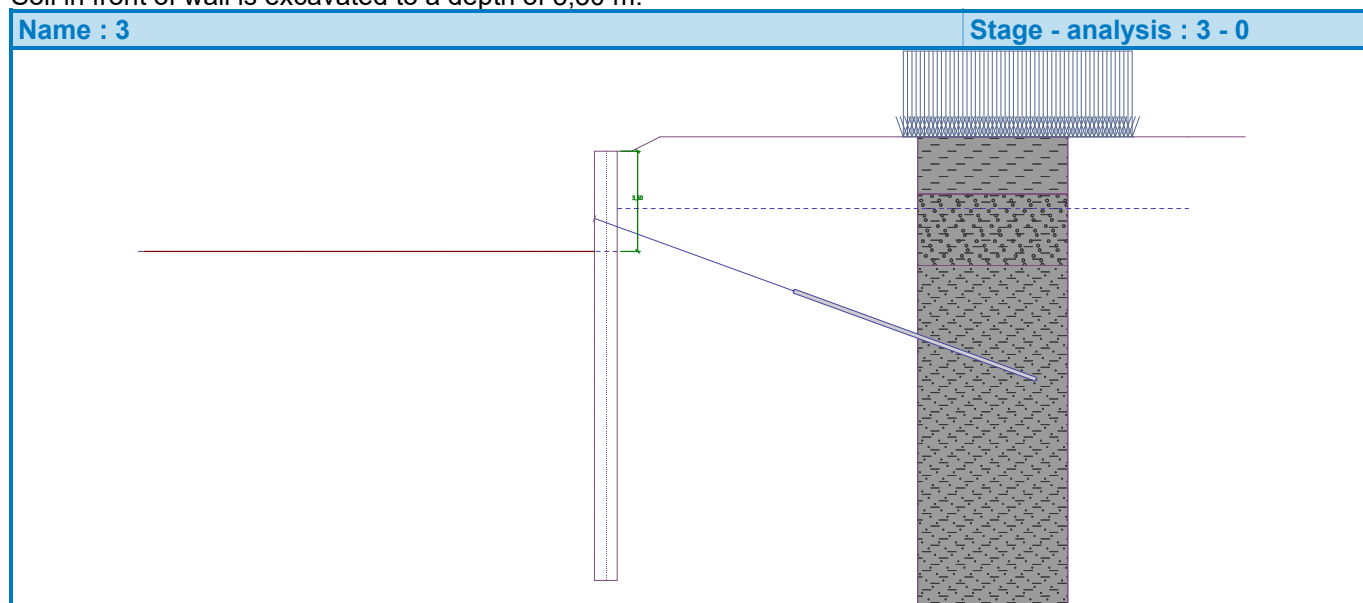
Input data (Stage of construction 3)

Geological profile and assigned soils

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

Excavation

Soil in front of wall is excavated to a depth of 3,50 m.



Terrain profile

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

Origin [0,0] is located in upper right edge of construction.

Positive coordinate +z has downward direction.

Water influence

GWT behind the structure lies at a depth of 2,00 m

GWT in front of the structure lies at a depth of 3,50 m

Subgrade at the heel is permeable.

Hydraulic gradient = 0,06

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		10,00	8,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	Yes	2,50	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 = 2,50 m

Free length : l = 7,00 m

Root length : l_k = 9,00 m

Slope : α = 20,00 °

Spacing : b = 1,40 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 : η₁ = 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	0.56	6.38
0.01	0.00	0.00	0.00	0.05	0.70	6.38
0.15	0.00	0.00	0.00	0.52	1.85	10.22
0.15	0.00	0.00	0.00	0.53	1.86	10.24
0.22	0.00	0.00	0.00	0.81	2.54	12.54
0.23	0.00	0.00	0.00	0.84	2.63	12.81
0.26	0.00	0.00	0.00	1.07	2.84	13.53
0.33	0.00	0.00	0.00	1.75	4.14	15.58
0.38	0.00	0.00	0.00	3.60	5.05	17.00
0.39	0.00	0.00	0.00	4.31	5.40	17.54
0.57	0.00	0.00	0.00	6.54	8.67	22.67
0.79	0.00	0.00	0.00	9.39	10.79	29.20
0.99	0.00	0.00	0.00	11.94	12.96	35.07
1.50	0.00	0.00	0.00	18.51	18.51	52.46

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
1.50	0.00	0.00	0.00	9.45	16.61	204.97
1.58	0.00	0.00	0.00	9.89	17.57	213.36
1.99	0.00	0.00	0.00	12.16	22.61	257.26
2.00	0.00	0.00	0.00	12.20	22.68	258.10
2.37	0.00	0.00	0.00	18.41	28.57	284.65
3.16	0.00	0.00	0.00	31.72	41.10	341.56
3.50	0.00	0.00	0.00	37.49	46.49	366.22
3.50	0.00	-0.00	-3.65	37.49	42.74	366.23
3.60	0.00	-0.47	-9.55	37.65	46.93	372.73
3.60	0.00	-0.47	-9.55	42.97	46.93	372.73
3.82	0.00	-1.47	-22.25	43.29	47.89	386.73
3.95	-0.38	-2.05	-29.63	43.47	48.45	394.86
4.00	-0.54	-2.29	-32.69	43.55	48.68	398.23
4.00	0.00	-2.23	-45.70	40.88	47.83	308.25
4.74	0.00	-5.51	-76.10	42.39	50.86	341.55
5.53	0.00	-9.02	-108.67	44.02	53.99	377.22
5.91	0.00	-10.71	-124.32	44.80	55.45	394.36
6.32	-1.48	-12.54	-141.24	45.65	57.02	412.89
7.11	-4.33	-16.05	-173.81	47.28	59.96	448.56
7.89	-7.18	-19.56	-206.38	48.90	62.83	484.24
8.68	-10.03	-23.08	-238.94	50.53	65.64	519.91
9.47	-12.88	-26.59	-271.51	52.16	68.41	555.58
10.26	-15.73	-30.11	-304.08	53.79	71.15	591.25
11.05	-18.58	-33.62	-336.65	55.41	73.86	626.92
11.84	-21.43	-37.14	-369.22	57.04	76.57	662.60
12.63	-24.27	-40.65	-401.79	58.67	79.26	698.27
13.42	-27.12	-44.17	-434.35	60.30	81.96	733.94
14.21	-29.97	-47.68	-466.92	61.92	84.65	769.61
15.00	-32.82	-51.20	-499.49	63.55	87.35	805.28

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	3.50	-14.97	1.90	0.00	0.00
0.75	0.00	3.50	-13.37	10.57	-4.11	1.07
1.50	0.00	15.12	-11.78	24.93	-15.80	7.62
2.25	0.00	15.12	-10.20	21.92	-29.98	24.78
2.50	0.00	15.12	-9.67	25.81	-35.94	33.00
2.50	0.00	15.12	-9.67	25.81	-15.81	33.00
3.00	0.00	15.12	-8.64	33.55	-30.65	44.46
3.50	0.00	15.12	-7.65	41.21	-49.19	64.11
3.50	0.00	15.12	-7.63	37.40	-49.51	64.50
3.75	0.00	15.12	-7.15	28.45	-57.35	77.70
4.50	0.00	19.28	-5.76	-21.34	-56.72	122.93
5.25	19.28	19.28	-4.52	-49.54	-29.28	156.40
6.00	19.28	19.28	-3.48	-32.11	1.10	166.17
6.75	19.28	19.28	-2.64	-18.49	19.82	157.71

Depth [m]	kh,p [MN/m ³]	kh,z [MN/m ³]	Displacement [mm]	Pressure [kPa]	Shear Force [kN/m]	Moment [kNm/m]
7.50	19.28	0.00	-2.00	-8.37	29.62	138.81
8.25	19.28	0.00	-1.54	-1.26	33.03	114.99
9.00	19.28	0.00	-1.23	3.06	32.20	90.32
9.75	19.28	0.00	-1.02	5.16	29.00	67.28
10.50	19.28	0.00	-0.91	5.63	24.87	47.06
11.25	19.28	19.28	-0.85	7.27	19.86	30.16
12.00	19.28	19.28	-0.83	7.21	14.36	17.33
12.75	19.28	19.28	-0.84	6.28	9.27	8.51
13.50	19.28	19.28	-0.85	4.91	5.06	3.21
14.25	19.28	19.28	-0.87	3.38	1.94	0.65
15.00	19.28	19.28	-0.89	1.80	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 62,19 kN/m
 Maximum moment = 166,17 kNm/m
 Maximum displacement = 15,0 mm

Maximum internal forces on cross-section

Maximum shear force = 87,06 kN
 Maximum moment = 232,64 kNm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,50	-9,7	30,00

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 7,9$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	7,9
2	1,01	10,0
3	2,02	11,4
4	3,04	12,1
5	4,05	12,3
6	5,06	11,8
7	6,07	10,7
8	7,08	9,0
9	8,09	6,6
10	9,11	3,6
11	10,12	0,0
12	10,12	0,0

Dimensioning No. 1 (Stage of construction 3)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 196,65$ kPa
 Unfavourable water pressure $u_{\text{dst}} = 20,25$ kPa

Verification of failure by heave is SATISFACTORY

Verification of failure by piping



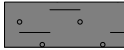
Critical hydraulic gradient $i_c = 0,73$

Hydraulic gradient $i = 0,06$

Verification of failure by piping is **SATISFACTORY**

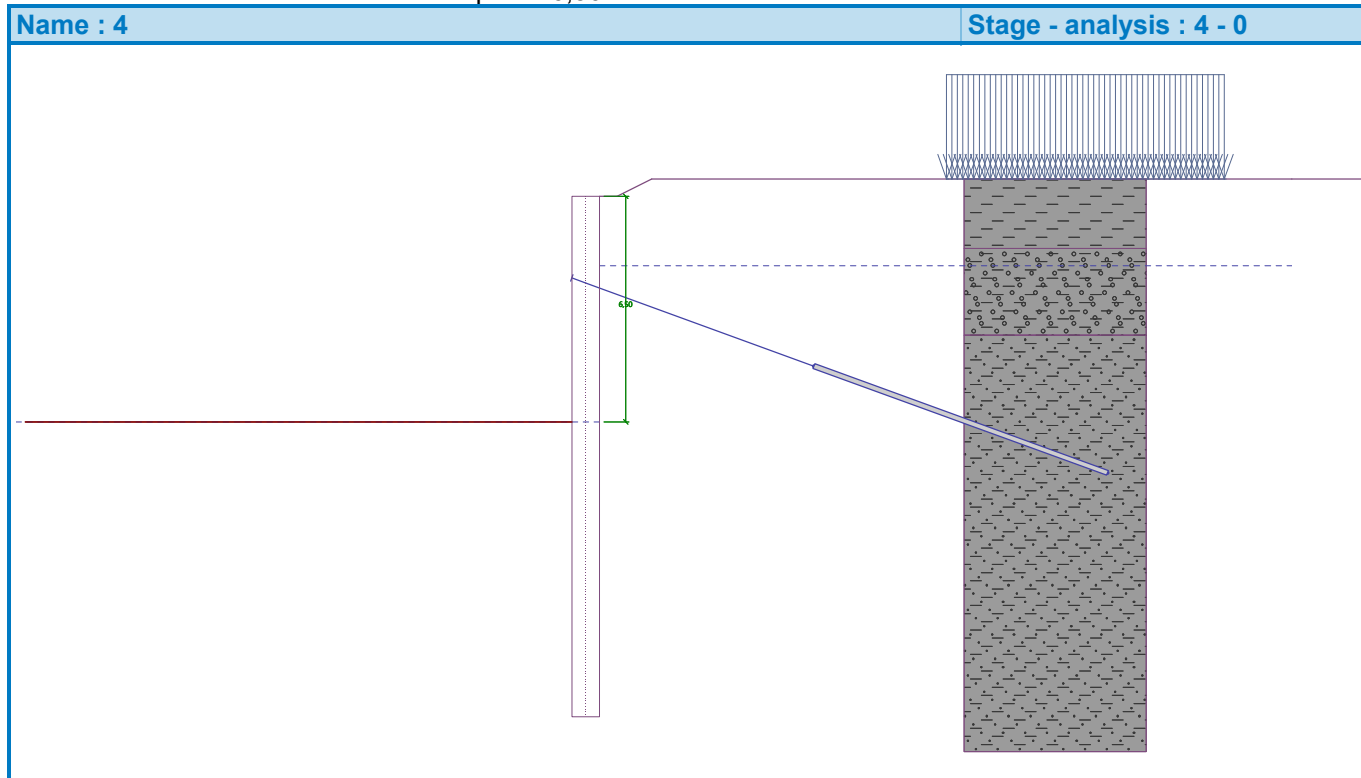
Input data (Stage of construction 4)

Geological profile and assigned soils

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

Excavation

Soil in front of wall is excavated to a depth of 6,50 m.



Terrain profile

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

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

Water influence

GWT behind the structure lies at a depth of 2,00 m
GWT in front of the structure lies at a depth of 6,50 m
Subgrade at the heel is permeable.

Hydraulic gradient = 0,21
Input surface surcharges

No.	Surchage		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		10,00	8,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	No	2,50	Anchor No. : 1 (user-defined)		287,14

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	0.56	6.38
0.01	0.00	0.00	0.00	0.05	0.70	6.38
0.15	0.00	0.00	0.00	0.52	1.85	10.22
0.15	0.00	0.00	0.00	0.53	1.86	10.24
0.22	0.00	0.00	0.00	0.81	2.54	12.54
0.23	0.00	0.00	0.00	0.84	2.63	12.81
0.26	0.00	0.00	0.00	1.07	2.84	13.53
0.33	0.00	0.00	0.00	1.75	4.14	15.58
0.38	0.00	0.00	0.00	3.60	5.05	17.00
0.39	0.00	0.00	0.00	4.31	5.40	17.54
0.57	0.00	0.00	0.00	6.54	8.67	22.67
0.79	0.00	0.00	0.00	9.39	10.79	29.20
0.99	0.00	0.00	0.00	11.94	12.96	35.07
1.50	0.00	0.00	0.00	18.51	18.51	52.46
1.50	0.00	0.00	0.00	9.45	16.61	204.97
1.58	0.00	0.00	0.00	9.89	17.57	213.36
1.99	0.00	0.00	0.00	12.16	22.61	257.26
2.00	0.00	0.00	0.00	12.20	22.68	258.10
2.37	0.00	0.00	0.00	18.57	28.81	287.70
3.16	0.00	0.00	0.00	32.22	41.85	351.15
3.60	0.00	0.00	0.00	39.89	49.12	386.82
3.60	0.00	0.00	0.00	45.21	49.12	386.82
3.95	0.00	0.00	0.00	51.13	54.78	414.60
4.00	0.00	0.00	0.00	52.03	55.63	418.83
4.00	0.00	0.00	0.00	49.52	54.76	324.05
4.74	0.00	0.00	0.00	62.67	66.58	367.63
5.53	0.00	0.00	0.00	76.76	79.14	414.32
6.32	0.00	0.00	0.00	90.85	91.59	461.01
6.50	0.00	0.00	0.00	94.13	94.49	471.90
6.50	0.00	-0.00	-25.08	94.15	94.49	471.91
7.11	0.00	-2.31	-46.49	92.45	94.70	501.09

Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
7.89	0.00	-5.32	-74.41	90.23	94.92	539.15
8.68	0.00	-8.34	-102.34	88.01	95.08	577.22
9.31	0.00	-10.71	-124.32	86.26	95.18	607.17
9.47	-0.52	-11.35	-130.26	85.79	95.20	615.28
10.26	-2.96	-14.37	-158.19	83.57	95.29	653.34
11.05	-5.41	-17.38	-186.12	81.35	95.36	691.41
11.84	-7.85	-20.39	-214.04	79.13	95.41	729.47
12.63	-10.29	-23.41	-241.97	76.91	95.46	767.54
13.42	-12.74	-26.42	-269.89	74.70	95.50	805.60
14.21	-15.18	-29.43	-297.82	72.48	95.55	843.67
15.00	-17.62	-32.45	-325.75	70.26	95.60	881.73

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	-20.81	0.00	-0.00	-0.00
0.75	0.00	0.00	-20.71	8.88	-2.77	0.56
1.50	0.00	0.00	-20.62	18.51	-13.04	6.04
2.25	0.00	0.00	-20.53	16.52	-22.75	19.38
2.50	0.00	0.00	-20.51	20.84	-27.42	25.62
2.50	0.00	0.00	-20.51	20.84	165.31	25.62
3.00	0.00	0.00	-20.46	29.49	152.72	-54.06
3.75	0.00	0.00	-20.33	47.75	125.35	-159.08
4.50	0.00	0.00	-19.99	58.45	85.94	-238.79
5.25	0.00	0.00	-19.36	71.83	37.09	-285.55
6.00	0.00	0.00	-18.37	85.21	-21.80	-291.91
6.50	0.00	0.00	-17.51	94.06	-66.26	-270.26
6.50	0.00	0.00	-17.50	68.92	-66.91	-269.72
6.75	0.00	0.00	-17.01	59.52	-82.71	-251.27
7.50	0.00	0.00	-15.35	30.89	-116.61	-175.18
8.25	0.00	0.00	-13.46	2.25	-129.04	-81.72
9.00	0.00	0.00	-11.47	-26.39	-119.98	13.00
9.75	0.00	0.00	-9.49	-55.03	-89.45	92.88
10.50	19.28	0.00	-7.63	-79.51	-37.50	141.39
11.25	19.28	0.00	-5.94	-51.94	11.57	149.83
12.00	19.28	0.00	-4.44	-27.97	41.32	128.87
12.75	19.28	0.00	-3.10	-7.11	54.31	92.04
13.50	19.28	0.00	-1.88	11.51	52.55	51.10
14.25	19.28	0.00	-0.72	28.87	37.36	16.57
15.00	19.28	0.96	0.41	71.54	-0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 165,31 kN/m
Maximum moment = 294,70 kNm/m
Maximum displacement = 20,8 mm

Maximum internal forces on cross-section

Maximum shear force = 231,43 kN
Maximum moment = 412,58 kNm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,50	-20,5	287,14

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 27,9$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	10,2
2	1,01	19,2
3	2,02	26,0
4	3,04	30,6
5	4,05	32,9
6	5,06	33,0
7	6,07	30,9
8	7,08	26,5
9	8,09	19,9
10	9,11	11,1
11	10,12	0,0
12	10,12	0,0

Dimensioning No. 1 (Stage of construction 4)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 145,35$ kPa

Unfavourable water pressure $u_{\text{dst}} = 60,75$ kPa

Verification of failure by heave is **SATISFACTORY**

Verification of failure by piping


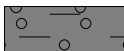

Critical hydraulic gradient $i_c = 0,73$

Hydraulic gradient $i = 0,21$

Verification of failure by piping is **SATISFACTORY**

Input data (Stage of construction 5)

Geological profile and assigned soils

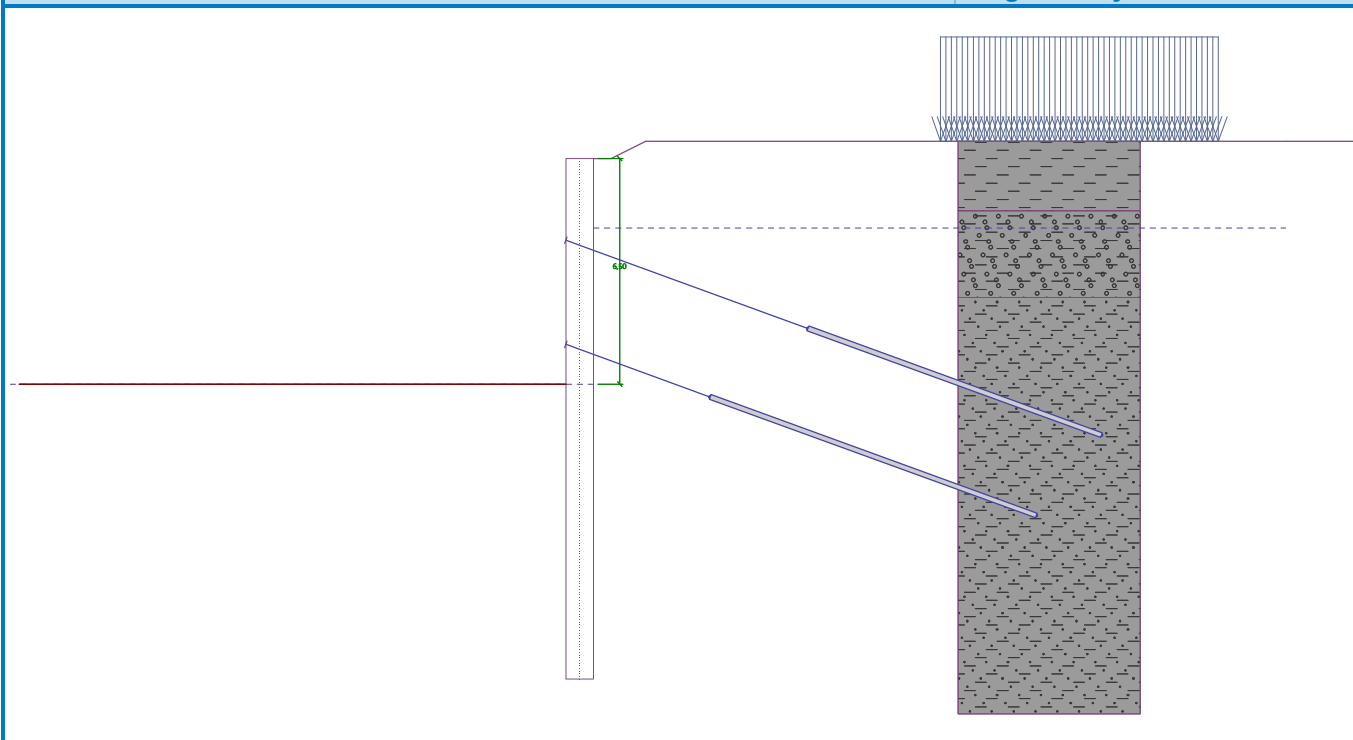
No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	1,50	0,00 .. 1,50	Glina	
2	2,50	1,50 .. 4,00	Zameljen prod	
3	-	4,00 .. ∞	Siva zbita peščena	

Excavation

Soil in front of wall is excavated to a depth of 6,50 m.

Name : 5

Stage - analysis : 5 - 0



Terrain profile

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

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

Water influence

GWT behind the structure lies at a depth of 2,00 m
GWT in front of the structure lies at a depth of 6,50 m
Subgrade at the heel is permeable.
Hydraulic gradient = 0,21

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		10,00	8,00	on terrain

No.	Name
1	Prometna obtežba

Input anchors

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	No	2,50	Anchor No. : 1 (user-defined)		284,84
2	Yes	5,50	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 : $z = 5,50 \text{ m}$
 Free length : $l = 4,00 \text{ m}$
 Root length : $l_k = 10,00 \text{ m}$
 Slope : $\alpha = 20,00^\circ$
 Spacing : $b = 1,40 \text{ m}$
 Area of cross-section : $A = 791,00 \text{ mm}^2$
 Elasticity modulus : $E = 210000,00 \text{ MPa}$
 Pre-stressing force : $F = 30,00 \text{ kN}$
 Tension strength : $R_t = 500,00 \text{ kN}$
 Pull out resistance (soil) : calculate from bond strength
 Diameter of root : $d = 140,0 \text{ mm}$
 Bond strength : $f = 150,00 \text{ kPa}$
 Pull out resistance (grouting) : calculate from concrete strength
 Standard for concrete structures : EN 1992-1-1 (EC2)
 Concrete strength in compression : $f_{ck} = 20,00 \text{ MPa}$
 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	0.56	6.38
0.01	0.00	0.00	0.00	0.05	0.70	6.38
0.15	0.00	0.00	0.00	0.52	1.85	10.22
0.15	0.00	0.00	0.00	0.53	1.86	10.24
0.22	0.00	0.00	0.00	0.81	2.54	12.54
0.23	0.00	0.00	0.00	0.84	2.63	12.81
0.26	0.00	0.00	0.00	1.07	2.84	13.53
0.33	0.00	0.00	0.00	1.75	4.14	15.58
0.38	0.00	0.00	0.00	3.60	5.05	17.00
0.39	0.00	0.00	0.00	4.31	5.40	17.54
0.57	0.00	0.00	0.00	6.54	8.67	22.67
0.79	0.00	0.00	0.00	9.39	10.79	29.20
0.99	0.00	0.00	0.00	11.94	12.96	35.07
1.50	0.00	0.00	0.00	18.51	18.51	52.46
1.50	0.00	0.00	0.00	9.45	16.61	204.97
1.58	0.00	0.00	0.00	9.89	17.57	213.36
1.99	0.00	0.00	0.00	12.16	22.61	257.26
2.00	0.00	0.00	0.00	12.20	22.68	258.10
2.37	0.00	0.00	0.00	18.57	28.81	287.70
3.16	0.00	0.00	0.00	32.22	41.85	351.15
3.60	0.00	0.00	0.00	39.89	49.12	386.82
3.60	0.00	0.00	0.00	45.21	49.12	386.82
3.95	0.00	0.00	0.00	51.13	54.78	414.60
4.00	0.00	0.00	0.00	52.03	55.63	418.83
4.00	0.00	0.00	0.00	49.52	54.76	324.05
4.74	0.00	0.00	0.00	62.67	66.58	367.63
5.53	0.00	0.00	0.00	76.76	79.14	414.32

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Depth [m]	Ta,p [kPa]	Tk,p [kPa]	Tp,p [kPa]	Ta,z [kPa]	Tk,z [kPa]	Tp,z [kPa]
6.32	0.00	0.00	0.00	90.85	91.59	461.01
6.50	0.00	0.00	0.00	94.13	94.49	471.90
6.50	0.00	-0.00	-25.08	94.15	94.49	471.91
7.11	0.00	-2.31	-46.49	92.45	94.70	501.09
7.89	0.00	-5.32	-74.41	90.23	94.92	539.15
8.68	0.00	-8.34	-102.34	88.01	95.08	577.22
9.31	0.00	-10.71	-124.32	86.26	95.18	607.17
9.47	-0.52	-11.35	-130.26	85.79	95.20	615.28
10.26	-2.96	-14.37	-158.19	83.57	95.29	653.34
11.05	-5.41	-17.38	-186.12	81.35	95.36	691.41
11.84	-7.85	-20.39	-214.04	79.13	95.41	729.47
12.63	-10.29	-23.41	-241.97	76.91	95.46	767.54
13.42	-12.74	-26.42	-269.89	74.70	95.50	805.60
14.21	-15.18	-29.43	-297.82	72.48	95.55	843.67
15.00	-17.62	-32.45	-325.75	70.26	95.60	881.73

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	-20.81	0.00	0.00	-0.00
0.75	0.00	0.00	-20.69	8.88	-2.77	0.56
1.50	0.00	0.76	-20.56	18.55	-13.04	5.99
2.25	0.00	15.12	-20.45	17.83	-23.02	18.54
2.50	0.00	15.12	-20.41	22.31	-28.04	24.90
2.50	0.00	15.12	-20.41	22.31	163.15	24.90
3.00	0.00	15.12	-20.35	31.25	149.76	-53.52
3.75	0.00	15.12	-20.18	49.95	120.90	-155.79
4.50	0.00	19.28	-19.82	61.70	79.37	-231.67
5.25	0.00	19.28	-19.18	75.34	27.98	-272.57
5.50	0.00	19.28	-18.89	79.82	8.59	-277.16
5.50	0.00	19.28	-18.89	79.82	28.73	-277.16
6.00	0.00	19.28	-18.19	88.66	-13.39	-281.17
6.50	0.00	19.28	-17.34	97.31	-59.51	-263.26
6.50	0.00	19.28	-17.33	72.16	-60.18	-262.79
6.75	0.00	19.28	-16.85	62.63	-76.76	-245.88
7.50	0.00	19.28	-15.21	33.50	-112.80	-173.37
8.25	0.00	19.28	-13.35	4.30	-126.97	-82.03
9.00	0.00	19.28	-11.39	-24.90	-119.24	11.73
9.75	0.00	19.28	-9.44	-54.08	-89.62	91.49
10.50	19.28	19.28	-7.61	-78.65	-38.22	140.40
11.25	19.28	0.00	-5.95	-52.02	10.34	149.90
12.00	19.28	0.00	-4.47	-28.55	40.33	129.81
12.75	19.28	0.00	-3.16	-8.21	53.94	93.51
13.50	19.28	0.00	-1.97	9.85	53.22	52.48
14.25	19.28	0.00	-0.84	26.63	39.49	16.94
15.00	19.28	19.28	0.27	73.43	0.00	-0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 163,15 kN/m
Maximum moment = 282,20 kNm/m
Maximum displacement = 20,8 mm

Maximum internal forces on cross-section

Maximum shear force = 228,41 kN
Maximum moment = 395,07 kNm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,50	-20,4	284,84
2	5,50	-18,9	30,00

Terrain settlement behind the structure

Terrain settlement $\delta_{\max} = 27,8$ mm

	Coordinates x [m]	Settlement z [mm]
1	0,00	10,3
2	1,01	19,2
3	2,02	26,0
4	3,04	30,5
5	4,05	32,8
6	5,06	32,9
7	6,07	30,8
8	7,08	26,4
9	8,09	19,8
10	9,11	11,0
11	10,12	0,0
12	10,12	0,0

Dimensioning No. 1 (Stage of construction 5)

Failure by heave

Favourable weight of soil $\sigma_{\text{stb}} = 145,35$ kPa
Unfavourable water pressure $u_{\text{dst}} = 60,75$ kPa

Verification of failure by heave is SATISFACTORY


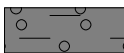
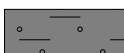
Verification of failure by piping

Critical hydraulic gradient $i_c = 0,73$
Hydraulic gradient $i = 0,21$

Verification of failure by piping is SATISFACTORY

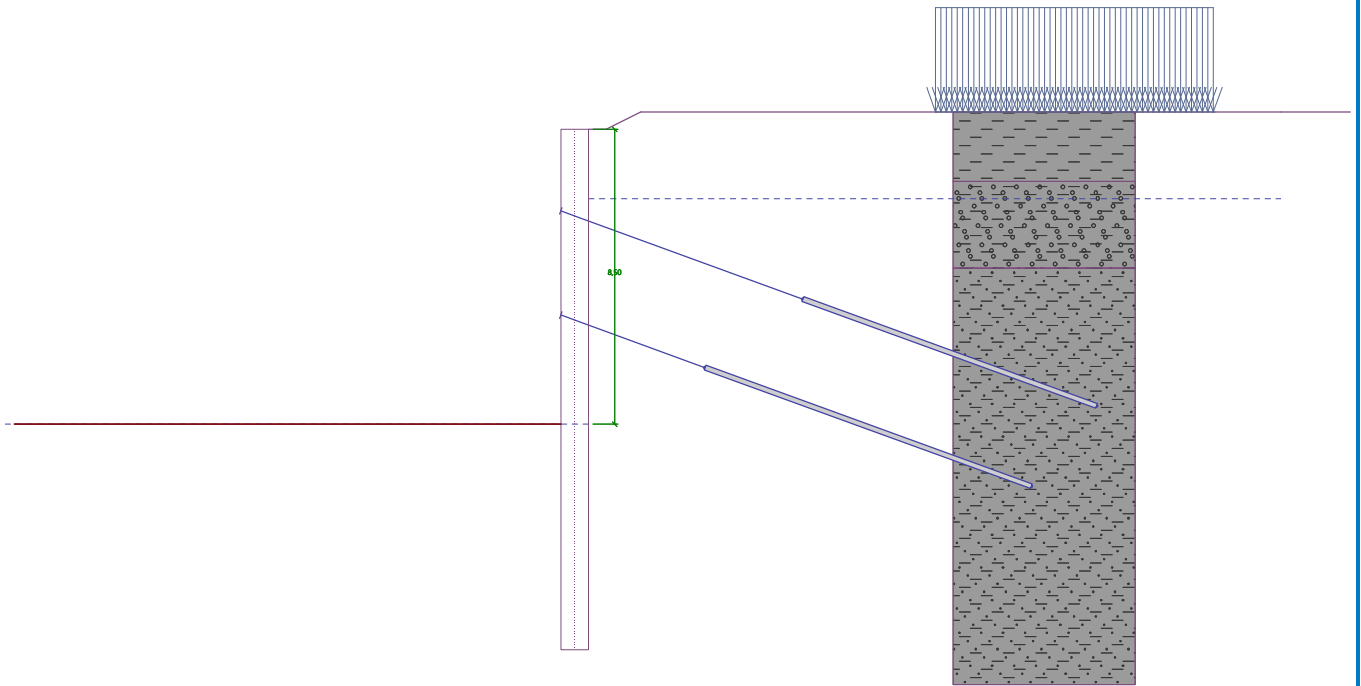
Input data (Stage of construction 6)

Geological profile and assigned soils

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

Soil in front of wall is excavated to a depth of 8,50 m.

Stage - analysis : 6 - 0



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

Water influence

Input surface surcharges

No.	Surcharge		Action	Mag.1	Mag.2	Ord.x	Length	Depth
	new	change		[kN/m ²]	[kN/m ²]	x [m]	l [m]	z [m]
1	No	No	variable	20,00		10,00	8,00	on terrain

No.	Name
1	Prometna obtežba

No.	New anchor	Depth z [m]	Name	Post-stressing	Force F [kN]
1	No	2,50	Anchor No. : 1 (user-defined)		306,11
2	No	5,50	Anchor No. : 2 (user-defined)		441,22

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	0.56	6.38
0.01	0.00	0.00	0.00	0.05	0.70	6.38
0.15	0.00	0.00	0.00	0.52	1.85	10.22
0.15	0.00	0.00	0.00	0.53	1.86	10.24
0.22	0.00	0.00	0.00	0.81	2.54	12.54
0.23	0.00	0.00	0.00	0.84	2.63	12.81
0.26	0.00	0.00	0.00	1.07	2.84	13.53
0.33	0.00	0.00	0.00	1.75	4.14	15.58
0.38	0.00	0.00	0.00	3.60	5.05	17.00
0.39	0.00	0.00	0.00	4.31	5.40	17.54
0.57	0.00	0.00	0.00	6.54	8.67	22.67
0.79	0.00	0.00	0.00	9.39	10.79	29.20
0.99	0.00	0.00	0.00	11.94	12.96	35.07
1.50	0.00	0.00	0.00	18.51	18.51	52.46
1.50	0.00	0.00	0.00	9.45	16.61	204.97
1.58	0.00	0.00	0.00	9.89	17.57	213.36
1.99	0.00	0.00	0.00	12.16	22.61	257.26
2.00	0.00	0.00	0.00	12.20	22.68	258.10
2.37	0.00	0.00	0.00	18.70	29.01	290.26
3.16	0.00	0.00	0.00	32.63	42.49	359.18
3.60	0.00	0.00	0.00	40.47	49.99	397.93
3.60	0.00	0.00	0.00	45.79	49.99	397.93
3.95	0.00	0.00	0.00	51.83	55.84	428.10
4.00	0.00	0.00	0.00	52.75	56.73	432.70
4.00	0.00	0.00	0.00	50.39	55.82	333.90
4.74	0.00	0.00	0.00	63.86	68.04	381.11
5.53	0.00	0.00	0.00	78.28	81.01	431.69
6.32	0.00	0.00	0.00	92.71	93.89	482.27
7.11	0.00	0.00	0.00	107.13	107.13	532.84
7.89	0.00	0.00	0.00	121.56	121.56	583.42
8.50	0.00	0.00	0.00	132.61	132.61	622.20
8.50	0.00	-0.00	-25.08	132.62	132.62	622.20
8.68	0.00	-0.61	-30.69	131.01	131.01	631.37
9.47	0.00	-3.20	-54.72	124.12	125.18	670.67
10.26	0.00	-5.79	-78.76	117.22	121.97	709.97
11.05	0.00	-8.39	-102.80	110.33	118.75	749.27
11.76	0.00	-10.71	-124.32	104.16	115.84	784.45
11.84	-0.22	-10.98	-126.83	103.43	115.50	788.57
12.63	-2.32	-13.58	-150.87	96.54	112.26	827.87
13.42	-4.43	-16.17	-174.91	89.65	109.01	867.17
14.21	-6.53	-18.76	-198.95	82.75	105.76	906.47
15.00	-8.63	-21.36	-222.98	75.86	102.51	945.77

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	-14.80	6.38	-0.00	-0.00
0.75	0.00	3.50	-16.74	22.78	-12.23	3.56
1.50	0.00	15.12	-18.68	47.91	-32.13	18.84
2.25	0.00	0.00	-20.64	16.61	-52.19	52.72
2.50	0.00	0.00	-21.31	21.02	-56.90	66.34
2.50	0.00	0.00	-21.31	21.02	148.57	66.34
3.00	0.00	0.00	-22.67	29.85	135.85	-4.95
3.75	0.00	0.00	-24.68	48.38	108.10	-97.18
4.50	0.00	0.00	-26.58	59.53	68.04	-163.74
5.25	0.00	0.00	-28.28	73.23	18.25	-196.74
5.50	0.00	0.00	-28.79	77.80	-0.62	-198.97
5.50	0.00	0.00	-28.79	77.80	295.52	-198.97
6.00	0.00	0.00	-29.71	86.94	254.34	-336.62
6.75	0.00	0.00	-30.73	100.64	184.00	-501.64
7.50	0.00	0.00	-31.12	114.34	103.38	-610.05
8.25	0.00	0.00	-30.74	128.05	12.49	-654.15
8.50	0.00	0.00	-30.44	132.54	-19.57	-653.30
8.50	0.00	0.00	-30.42	107.38	-20.53	-653.14
9.00	0.00	0.00	-29.54	87.95	-68.97	-630.54
9.75	0.00	0.00	-27.55	58.57	-123.91	-556.84
10.50	0.00	0.00	-24.87	29.18	-156.82	-450.18
11.25	0.00	0.00	-21.61	-0.20	-167.69	-327.12
12.00	0.00	0.00	-17.94	-29.59	-156.52	-204.16
12.75	0.00	0.00	-14.02	-58.97	-123.31	-97.85
13.50	0.00	0.00	-9.96	-88.36	-68.06	-24.71
14.25	19.28	0.00	-5.87	-49.68	-8.04	1.14
15.00	0.96	0.00	-1.78	52.79	0.00	0.00

Maximum values of internal forces acting on the structure

Maximum shear force = 295,52 kN/m
Maximum moment = 654,57 kNm/m
Maximum displacement = 31,1 mm

Maximum internal forces on cross-section

Maximum shear force = 413,73 kN
Maximum moment = 916,39 kNm

Anchors forces

No.	Depth [m]	Displacement [mm]	Anchor force [kN]
1	2,50	-21,3	306,11
2	5,50	-28,8	441,22

Dimensioning No. 1 (Stage of construction 6)

Failure by heave

Favourable weight of soil σ_{stb} = 111,15 kPa
Unfavourable water pressure u_{dst} = 87,75 kPa

Verification of failure by heave is SATISFACTORY

Verification of failure by piping

Critical hydraulic gradient $i_c = 0,73$

Hydraulic gradient $i = 0,33$

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	-20.81	-0.36	-0.00	0.00	-0.00	0.00
0.01	-20.81	-0.36	-0.05	-0.00	0.00	0.00
0.01	-20.81	-0.36	-0.12	0.00	-0.00	0.01
0.75	-20.71	-0.33	-12.23	-0.10	-0.19	3.56
1.50	-20.62	-0.31	-32.13	-2.85	0.82	18.84
2.25	-20.64	-0.29	-52.19	-1.16	2.35	52.72
2.50	-21.31	-0.28	-56.90	-0.77	2.58	66.34
2.50	-21.31	-0.28	-27.41	165.31	2.58	66.34
3.00	-22.67	-0.27	-39.79	152.72	-54.06	44.46
3.50	-24.01	-0.26	-56.28	135.93	-125.74	65.88
3.50	-24.01	-0.26	-56.28	135.93	-125.74	65.88
3.50	-24.03	-0.26	-56.56	135.62	-126.82	66.33
3.50	-24.03	-0.26	-56.56	135.62	-126.82	66.33
3.75	-24.68	-0.25	-63.52	125.35	-159.08	81.14
4.50	-26.58	-0.24	-60.34	85.94	-238.79	130.05
5.25	-28.28	-0.23	-30.85	37.09	-285.55	165.42
5.50	-28.79	-0.23	-18.42	18.53	-292.34	171.42
5.50	-28.79	-0.23	-18.42	295.52	-292.34	171.42
6.00	-29.71	-0.22	-21.80	254.34	-336.62	175.42
6.50	-30.44	-0.22	-66.26	208.93	-451.48	170.72
6.50	-30.44	-0.22	-66.26	208.93	-451.48	170.72
6.50	-30.45	-0.22	-66.91	208.16	-453.13	170.59
6.50	-30.45	-0.22	-66.91	208.16	-453.13	170.59
6.75	-30.73	-0.22	-82.71	184.00	-501.64	165.98
7.50	-31.12	-0.22	-116.61	103.38	-610.05	145.52
8.25	-30.74	-0.22	-129.04	34.82	-654.15	120.26
8.50	-30.44	-0.22	-128.34	34.78	-653.30	111.69
8.50	-30.42	-0.22	-128.29	34.78	-653.14	111.41
8.50	-30.42	-0.22	-128.29	34.78	-653.14	111.41
9.00	-29.54	-0.21	-119.98	33.58	-630.54	94.40
9.75	-27.55	-0.21	-123.91	29.86	-556.84	92.88
10.50	-24.87	-0.21	-156.82	25.17	-450.18	141.39
11.25	-21.61	-0.21	-167.69	20.60	-327.12	149.90
12.00	-17.94	-0.20	-156.52	41.32	-204.16	129.81
12.75	-14.02	-0.20	-123.31	54.31	-97.85	93.51
13.50	-9.96	-0.20	-68.06	53.22	-24.71	52.48
14.25	-5.87	-0.19	-8.04	39.49	-0.03	16.94
15.00	-1.78	0.41	-0.00	0.00	-0.00	0.00

Maximum values of internal forces

Maximum displacement = -31,1 mm

Minimum displacement = 0,4 mm
Maximum bending moment = 175,42 kNm/m
Minimum bending moment = -654,57 kNm/m
Maximum shear force = 295,52 kN/m

Verification of RC cross section (Pile curtain d = 0,80 m, a = 1,40 m)

All construction stages are taken into the analysis.

Partial factor on load = 1,00

Verification of cross section in bending:

Reinforcement - 18 pc bars 25,0 mm; cover 80,0 mm

Type of structure (reinforcement ratio) : beam

Reinforcement ratio $\rho = 0,879 \% > 0,135 \% = \rho_{\min}$

Load : $M_{Ed} = 916,39 \text{ kNm}$

Bearing capacity : $M_{Rd} = 1004,08 \text{ kNm}$

Designed pile reinforcement is SATISFACTORY

Verification of cross section in shear:

Shear reinf. - profile 10,0 mm; spacing 150,0 mm

$A_{sw} = 2 \times 523,6 = 1047,2 \text{ mm}^2$

$b_w = 0,70 \text{ m}$; $d = 0,64 \text{ m}$

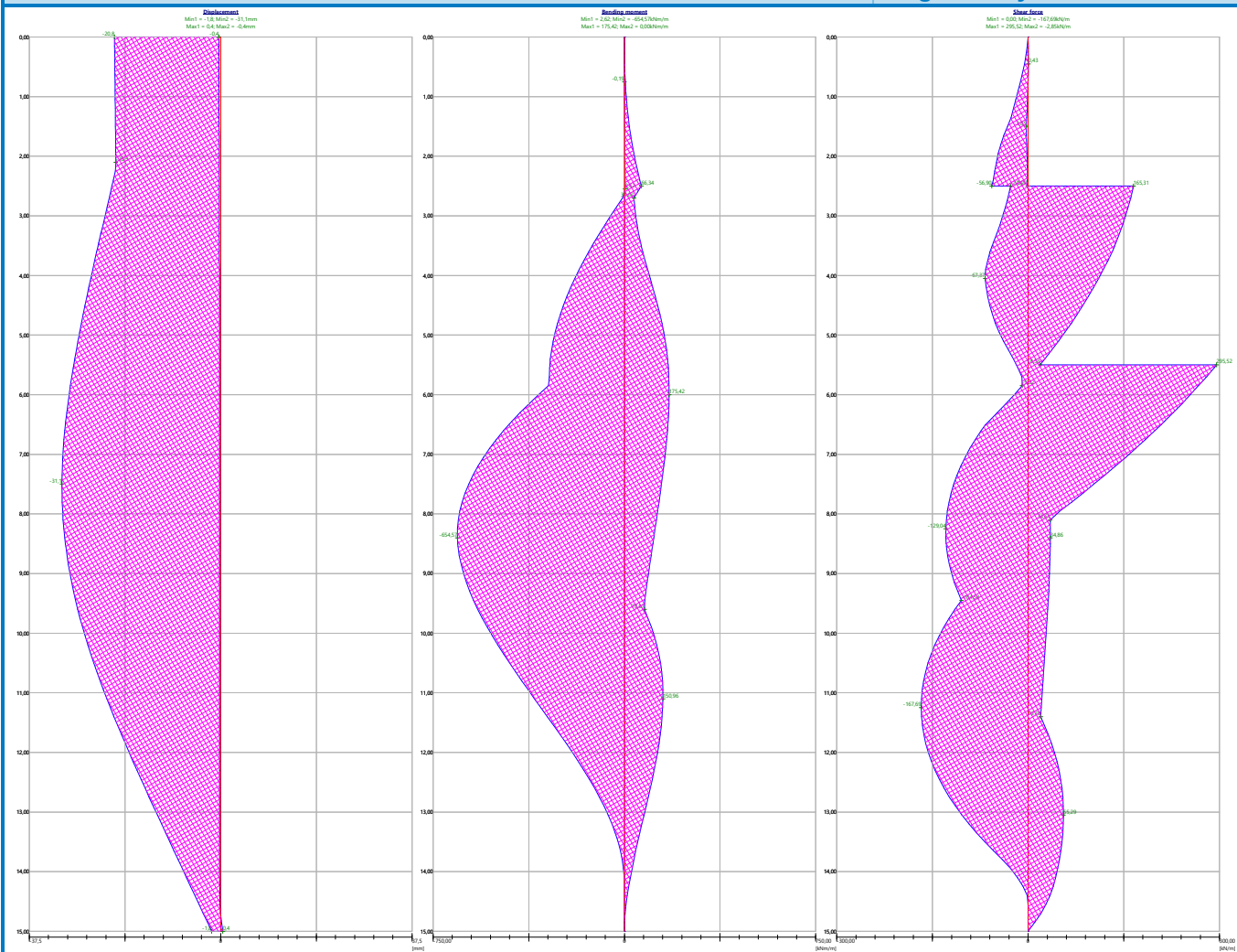
Ultimate shear force: $V_{Rd} = 655,64 \text{ kN} > 413,73 \text{ kN} = V_{Ed}$

Cross-section is SATISFACTORY.

Overall verification: Cross-section is SATISFACTORY

Name : NSK

Stage - analysis : 1 - 1



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	6	2,50	306,11	454,55	439,82	822,74	is satisfactory (69,60 %)
2	6	5,50	441,22	454,55	488,69	914,16	is satisfactory (97,07 %)

Anchor with max. utilization - Nr. 2. (Stage 6; z = 5,50 m)

Utilization is 97,07 %

Anchors bearing capacity is SATISFACTORY