Cantilever wall analysis

Input data

Project : Plaz Gavce 26c
Part : Oporni zid nad gredo
Author : BLAN d.o.o.
Project number : GM - 212/2024

Settings

Slovenia - EN 1997

Materials and standards

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

Wall analysis

Verification methodology : according to EN 1997
Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Base key : The base key is considered as inclined footing bottom
Allowable eccentricity : 0,333
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 overturning :	γ_{Rv} =	1,40	[–]
Partial factor on sliding resistance :	γ_{Rh} =	1,10	[–]
Partial factor on bearing capacity :	γ_{Re} =	1,40	[–]

Partial factors for variable actions			
Permanent design situation			
Factor for combination value :	ψ_0 =	0,70	[–]
Factor for frequent value :	ψ_1 =	0,50	[–]
Factor for quasi-permanent value :	ψ_2 =	0,30	[–]

Material of structure

Unit weight γ = 23,00 kN/m^3
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	MPa
Tensile strength	f_{ctm} =	2,60	MPa
Elasticity modulus	E_{cm} =	31000,00	MPa

Longitudinal reinforcement: B500B

Yield strength	f_{yk} =	500,00	MPa

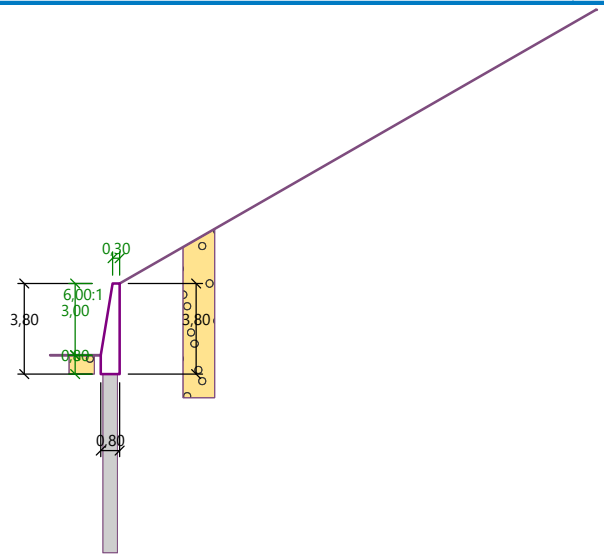
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Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0,00	0,00
2	0,00	3,00
3	0,00	3,80
4	-0,80	3,80
5	-0,80	3,00
6	-0,30	0,00

The origin [0,0] is located at the most upper right point of the wall.
Wall section area = 2,29 m^2.

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



Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]	γ_{su} [kN/m^3]	δ [°]
1	Peščena glina		22,00	5,00	19,00	9,00	15,00
2	Pobočni grušč		33,00	0,00	21,00	11,00	22,00
3	Apnenec		0,00	500,00	23,00	13,00	0,00
4	Kamnito nasutje (cesta)		38,00	1,00	21,00	11,00	26,00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	φ_{ef} [°]	ν [–]	OCR [–]	K_r [–]
1	Peščena glina		cohesive	-	0,30	-	-
2	Pobočni grušč		cohesive	-	0,30	-	-
3	Apnenec		cohesive	-	0,10	-	-

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No.	Name	Pattern	Type calculation	φ_{ef} [°]	v [–]	OCR [–]	K_r [–]
4	Kamnito nasutje (cesta)		cohesive	-	0,30	-	-

Soil parameters

Peščena glina

Unit weight :	γ =	19,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	22,00 °
Cohesion of soil :	c_{ef} =	5,00 kPa
Angle of friction struc.-soil :	δ =	15,00 °
Soil :		cohesive
Poisson's ratio :	v =	0,30
Saturated unit weight :	γ_{sat} =	19,00 kN/m^3

Pobočni grušč

Unit weight :	γ =	21,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	33,00 °
Cohesion of soil :	c_{ef} =	0,00 kPa
Angle of friction struc.-soil :	δ =	22,00 °
Soil :		cohesive
Poisson's ratio :	v =	0,30
Saturated unit weight :	γ_{sat} =	21,00 kN/m^3

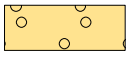
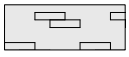
Apnenec

Unit weight :	γ =	23,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	0,00 °
Cohesion of soil :	c_{ef} =	500,00 kPa
Angle of friction struc.-soil :	δ =	0,00 °
Soil :		cohesive
Poisson's ratio :	v =	0,10
Saturated unit weight :	γ_{sat} =	23,00 kN/m^3

Kamnito nasutje (cesta)

Unit weight :	γ =	21,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	38,00 °
Cohesion of soil :	c_{ef} =	1,00 kPa
Angle of friction struc.-soil :	δ =	26,00 °
Soil :		cohesive
Poisson's ratio :	v =	0,30
Saturated unit weight :	γ_{sat} =	21,00 kN/m^3

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	7,50	0,00 .. 7,50	Peščena glina	
2	-	7,50 .. ∞	Apnenec	

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Foundation

Type of foundation : pile foundation
Unit weight γ = 25,00 kN/m3
Geometry
Length l = 7,50 m
Diameter d = 0,60 m
Offset x = 0,10 m

Terrain profile

No.	Coordinates x [m]	Depth z [m]
1	0,00	0,00
2	20,00	-11,50
3	21,00	-11,50

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.

Resistance on front face of the structure

Resistance on front face of the structure: not considered
Soil on front face of the structure - Peščena glina
Soil thickness in front of structure h = 0,80 m
Soil slope in front of structure β = 0,00 °

Settings of the stage of construction

Design situation : permanent
The wall is free to move. Active earth pressure is therefore assumed.
Reduction of soil/soil friction angle : do not reduce

Verification No. 1

Active pressure behind the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m3]	δ_d [°]	K_a	Comment
1	0,29	0,00	22,00	5,00	19,00	15,00	1,260	
2	2,71	0,00	22,00	5,00	19,00	15,00	1,260	
3	0,80	0,00	22,00	5,00	19,00	15,00	1,260	

Active pressure distribution behind the structure (without surcharge)

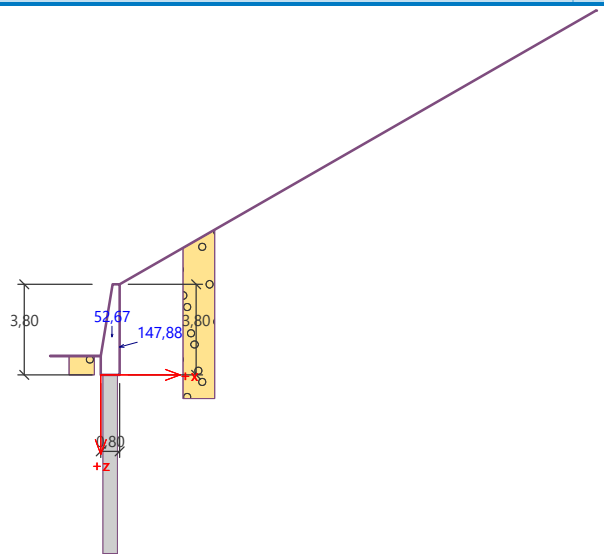
Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0,00	0,00	0,00	0,00	0,00	0,00
	0,29	5,42	0,00	0,00	0,00	0,00
2	0,29	5,42	0,00	0,00	0,00	0,00
	3,00	57,00	0,00	65,00	62,78	16,82
3	3,00	57,00	0,00	65,00	62,78	16,82
	3,80	72,20	0,00	84,15	81,28	21,78

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0,00	-1,61	52,67	0,48	1,000	1,000	1,350
Weight - soil	0,00	-0,80	0,00	0,00	1,000	1,000	1,350
Active pressure	142,84	-1,17	38,27	0,80	1,350	1,350	1,350

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Name : Verification	Stage - analysis : 1 - 1



Bearing capacity of foundation soil

Design load acting at the pile head

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	199,82	122,77	192,84	2,034	10000,00
2	201,23	104,34	192,84	2,411	10000,00

Service load acting at the pile head

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	148,02	90,94	142,84

Dimensioning No. 1

Wall stem check - front reinf.

Pressure at rest behind the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m³]	K_r	Comment
1	3,00	0,00	22,00	5,00	19,00	0,635	

Pressure at rest distribution behind the structure (without surcharge)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0,00	0,00	0,00	0,00	0,00	0,00
	3,00	56,98	0,00	51,52	51,52	0,00

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. moment	Coeff. norm.force	Coeff. shear for.
Weight - wall	0,00	-1,27	37,93	0,51	1,000	1,350	1,000
Pressure at rest	77,25	-1,00	0,00	0,80	1,350	1,000	1,350

Wall stem check - front reinf.

Front reinforcement is not required.

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Wall stem check - back reinf.

Pressure at rest behind the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m³]	K_r	Comment
1	3,00	0,00	22,00	5,00	19,00	0,635	

Pressure at rest distribution behind the structure (without surcharge)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0,00	0,00	0,00	0,00	0,00	0,00
	3,00	56,98	0,00	51,52	51,52	0,00

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. moment	Coeff. norm.force	Coeff. shear for.
Weight - wall	0,00	-1,27	37,93	0,51	1,000	1,350	1,000
Pressure at rest	77,25	-1,00	0,00	0,80	1,350	1,000	1,350

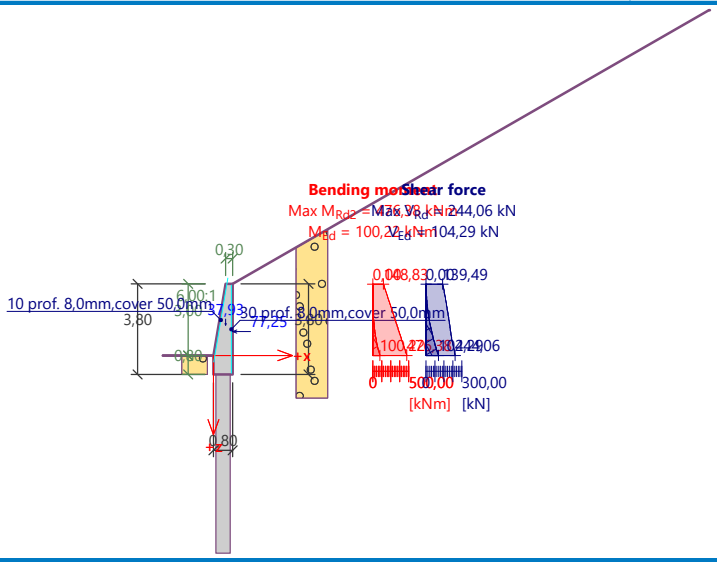
Wall stem check - back reinf.

Wall check at the construction joint 3,00 m from the wall crest
Reinforcement and dimensions of the cross-section
30 prof. 8,0 mm, cover 50,0 mm

Inputted reinforcement area		=	1508,0	mm²				
Required reinforcement area		=	1008,3	mm²				
Cross-section width		=	1,00	m				
Cross-section height		=	0,80	m				
Reinforcement ratio	ρ	=	0,20	%	>	0,14	%	= ρ_{min}
Position of neutral axis	x	=	0,05	m	<	0,46	m	= x_{max}
Ultimate shear force	V_{Rd}	=	244,06	kN	>	104,29	kN	= V_{Ed}
Ultimate moment	M_{Rd}	=	476,38	kNm	>	100,22	kNm	= M_{Ed}

Cross-section is SATISFACTORY.

Name : Dimensioning	Stage - analysis : 1 - 1



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