Gravity wall analysis

Input data

Project

Date : 24.3.2020

Settings

Slovenia - EN 1997

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard
Masonry (stone) wall : EN 1996-1-1 (EC6)

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Allowable eccentricity : 0,333
Verification methodology : according to EN 1997
Design approach : 2 - reduction of actions and resistances

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

Partial factors for resistances (R)			
Permanent design situation			
Partial factor on 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

Masonry : Category II
Mortar origin : Prescribed mortar

Masonry strength f_b = 20,00 MPa
Mortar strength f_m = 20,00 MPa

Parameters

Compressive strength f_k = 9,00 MPa
Shear strength f_{vko} = 0,10 MPa
Flexural tensile strength f_{xk} = 0,10 MPa
Partial factor γ_M = 2,50

[GEO5 - Gravity Wall | version 5.2020.27.0 | hardware key 9398 / 1 | BLAN d.o.o. | Copyright © 2020 Fine spol. s r.o. All Rights Reserved | www.finesoftware.eu]
[Geoportal d.o.o. | | info@geoportal.si| http://www.geoportal.si]

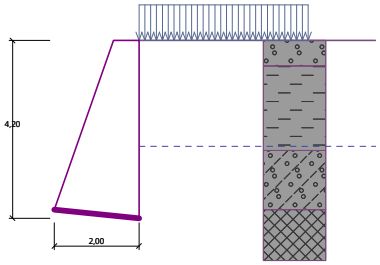
Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0,00	0,00
2	0,00	4,20
3	-2,00	4,00
4	-0,60	0,00

The origin [0,0] is located at the most upper right point of the wall.
Wall section area = 5,40 m^2.

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

Description : 1



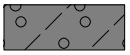
Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]	γ_{su} [kN/m^3]	δ [°]
1	Kamnito nasutje		35,00	1,00	20,00	11,00	30,00
2	Melj-glina		27,00	4,00	19,00	10,00	22,00
3	Trdna podlaga		40,00	100,00	23,00	13,00	35,00
4	Melj-glina-grušč		35,00	10,00	20,00	11,00	30,00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	φ_{ef} [°]	ν [–]	OCR [–]	K_r [–]
1	Kamnito nasutje		cohesionless	35,00	-	-	-
2	Melj-glina		cohesive	-	0,30	-	-
3	Trdna podlaga		cohesive	-	0,20	-	-

[GEO5 - Gravity Wall | version 5.2020.27.0 | hardware key 9398 / 1 | BLAN d.o.o. | Copyright © 2020 Fine spol. s r.o. All Rights Reserved | www.finesoftware.eu]
[Geoportal d.o.o. | | info@geoportal.si| http://www.geoportal.si]

No.	Name	Pattern	Type calculation	φ_{ef} [°]	ν [–]	OCR [–]	K_r [–]
4	Melj-glina-grušč		cohesive	-	0,30	-	-

Soil parameters

Kamnito nasutje

Unit weight :	γ =	20,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	35,00 °
Cohesion of soil :	c_{ef} =	1,00 kPa
Angle of friction struc.-soil :	δ =	30,00 °
Soil :		cohesionless
Saturated unit weight :	γ_{sat} =	21,00 kN/m^3

Melj-glina

Unit weight :	γ =	19,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	27,00 °
Cohesion of soil :	c_{ef} =	4,00 kPa
Angle of friction struc.-soil :	δ =	22,00 °
Soil :		cohesive
Poisson's ratio :	ν =	0,30
Saturated unit weight :	γ_{sat} =	20,00 kN/m^3

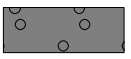
Trdna podlaga

Unit weight :	γ =	23,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	40,00 °
Cohesion of soil :	c_{ef} =	100,00 kPa
Angle of friction struc.-soil :	δ =	35,00 °
Soil :		cohesive
Poisson's ratio :	ν =	0,20
Saturated unit weight :	γ_{sat} =	23,00 kN/m^3

Melj-glina-grušč

Unit weight :	γ =	20,00 kN/m^3
Stress-state :		effective
Angle of internal friction :	φ_{ef} =	35,00 °
Cohesion of soil :	c_{ef} =	10,00 kPa
Angle of friction struc.-soil :	δ =	30,00 °
Soil :		cohesive
Poisson's ratio :	ν =	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	0,60	0,00 .. 0,60	Kamnito nasutje	
2	2,00	0,60 .. 2,60	Melj-glina	

[GEO5 - Gravity Wall | version 5.2020.27.0 | hardware key 9398 / 1 | BLAN d.o.o. | Copyright © 2020 Fine spol. s r.o. All Rights Reserved | www.finesoftware.eu]
[Geoportal d.o.o. | | info@geoportal.si| http://www.geoportal.si]

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
3	1,40	2,60 .. 4,00	Melj-glina-grušč	
4	-	4,00 .. ∞	Trdna podlaga	

Foundation

Type of foundation : soil from geological profile

Terrain profile

Terrain behind the structure is flat.

Water influence

GWT behind the structure lies at a depth of 2,50 m
Uplift in foot. bottom due to different pressures is not considered.

Input surface surcharges

No.	Surcharge new	Surcharge change	Action	Mag.1 [kN/m^2]	Mag.2 [kN/m^2]	Ord.x x [m]	Length l [m]	Depth z [m]
1	Yes		variable	9,00		0,00	4,00	on terrain

No.	Name
1	Promet

Resistance on front face of the structure

Resistance on front face of the structure is not considered.

Settings of the stage of construction

Design situation : permanent

Verification No. 1

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	-1,58	124,20	1,29	1,000	1,000	1,350
Active pressure	18,40	-1,58	8,63	2,00	1,350	1,350	1,350
Water pressure	14,45	-0,37	0,00	2,00	1,350	1,350	1,350
Uplift pressure	0,00	-4,00	0,00	2,00	1,000	1,000	1,350
Promet	9,18	-2,06	4,54	2,00	1,500	1,500	1,500

Verification of complete wall

Check for overturning stability
Resisting moment M_{res} = 140,71 kNm/m
Overturning moment M_{ovr} = 74,75 kNm/m

Wall for overturning is SATISFACTORY

Check for slip
Resisting horizontal force H_{res} = 263,15 kN/m
Active horizontal force H_{act} = 43,64 kN/m

Wall for slip is SATISFACTORY

[GEO5 - Gravity Wall | version 5.2020.27.0 | hardware key 9398 / 1 | BLAN d.o.o. | Copyright © 2020 Fine spol. s r.o. All Rights Reserved | www.finesoftware.eu]
[Geoportal d.o.o. | | info@geoportal.si| http://www.geoportal.si]

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 102,30 kPa

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	13,66	190,99	38,83	0,036	102,30
2	26,22	147,73	43,13	0,089	89,27

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	8,43	140,87	27,81

Verification of foundation soil

Stress in the footing bottom : trapezoid

Eccentricity verification

Max. eccentricity of normal force $e = 0,089$
Maximum allowable eccentricity $e_{alw} = 0,333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Bearing capacity of foundation soil $R = 1000,00$ kPa
Partial factor on bearing capacity $\gamma_{Rv} = 1,40$
Max. stress at footing bottom $\sigma = 115,99$ kPa
Bearing capacity of foundation soil $R_d = 714,29$ kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1

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	-1,64	119,49	1,29	1,000	1,000	1,000
Active pressure	18,38	-1,58	8,62	2,00	1,350	1,350	1,350
Water pressure	11,21	-0,50	0,00	2,00	1,350	1,350	1,350
Uplift pressure	0,00	-4,00	0,00	2,00	1,000	1,000	1,000
Promet	9,18	-2,05	4,37	2,00	1,500	1,500	1,500

Wall check at the construction joint 4,00 m from the wall crest

Cross-section depth h = 2,00 m

Ultimate shear force $V_{Rd} = 101,99$ kN/m $> 53,72$ kN/m $= V_{Ed}$
Ultimate compressive force $N_{Rd} = 6016,31$ kN/m $> 137,68$ kN/m $= N_{Ed}$
Ultimate moment $M_{Rd} = 134,99$ kNm/m $> 22,58$ kNm/m $= M_{Ed}$

Cross-section bearing capacity is SATISFACTORY

[GEO5 - Gravity Wall | version 5.2020.27.0 | hardware key 9398 / 1 | BLAN d.o.o. | Copyright © 2020 Fine spol. s r.o. All Rights Reserved | www.finesoftware.eu]
[Geoportal d.o.o. | | info@geoportal.si| http://www.geoportal.si]