

Analysis of Redi Rock wall

Input data

Date : 17/05/2023

Settings

(input for current task)

Wall analysis

Verification methodology : Safety factors (ASD)
Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Mazindrani (Rankine)
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Allowable eccentricity : 0.333
Internal stability : Standard - straight slip surface
Reduction coeff. of contact first block - base : 0.70

Safety factors				
Permanent design situation				
Safety factor for overturning :	$SF_o =$	1.50	[-]	
Safety factor for sliding resistance :	$SF_s =$	1.50	[-]	
Safety factor for bearing capacity :	$SF_b =$	2.00	[-]	
Safety factor for sliding along geo-reinforcement :	$SF_{sr} =$	1.50	[-]	
Safety factor for geo-reinforcement strength :	$SF_{st} =$	1.50	[-]	
Safety factor for pull out resistance of geo-reinf. :	$SF_{po} =$	1.50	[-]	
Safety factor for connection strength :	$SF_{con} =$	1.50	[-]	

Blocks

No.	Description	Height h [mm]	Width w [mm]	Unit weight γ [kN/m³]
1	Block 28	457.2	711.2	18.85
2	Block 41	457.2	1028.7	18.85
3	Block 60	457.2	1524.0	20.42
4	Top block 24 straight	457.2	609.6	16.97
5	Planter 41	457.2	1028.7	18.85
6	Planter 60	457.2	1524.0	17.59
7	Top block 28	457.2	711.2	18.85
8	Top block 41	457.2	1028.7	18.85
9	Top block 24 straight garden	457.2	609.6	12.57
10	Block R-5236 HC	914.4	1320.8	17.28
11	Block R-7236 HC	914.4	1828.8	17.28
12	Block R-9636 HC	914.4	2438.4	17.28
13	Block R-41 HC	457.2	1028.7	17.28

No.	Description	Min. shear strength F_{min} [kN/m]	Max. shear strength F_{max} [kN/m]	Friction f [°]
1	Block 28	88.45	164.56	44.00
2	Block 41	88.45	164.56	44.00
3	Block 60	88.45	164.56	44.00
4	Top block 24 straight	88.45	164.56	44.00

No.	Description	Min. shear strength $F_{\min}$ [kN/m]	Max. shear strength $F_{\max}$ [kN/m]	Friction f [°]
5	Planter 41	88.45	164.56	44.00
6	Planter 60	88.45	164.56	44.00
7	Top block 28	88.45	164.56	44.00
8	Top block 41	88.45	164.56	44.00
9	Top block 24 straight garden	88.45	164.56	44.00
10	Block R-5236 HC	66.40	175.13	44.00
11	Block R-7236 HC	66.40	175.13	44.00
12	Block R-9636 HC	66.40	175.13	44.00
13	Block R-41 HC	78.19	188.35	37.00

Setbacks

No.	Setback s [mm]
1	0.254
2	9.525
3	41.275
4	238.125
5	422.275

Geometry

No. group	Description	Count	Setback s [mm]
1	Block 41	8	41.3
2	Top block 28	1	-

Base

Geometry

Upper setback $a_1 = 0.40$ m

Lower setback $a_2 = 0.40$ m

Height $h = 0.35$ m

Width $b = 2.00$ m

Material

Concrete footing

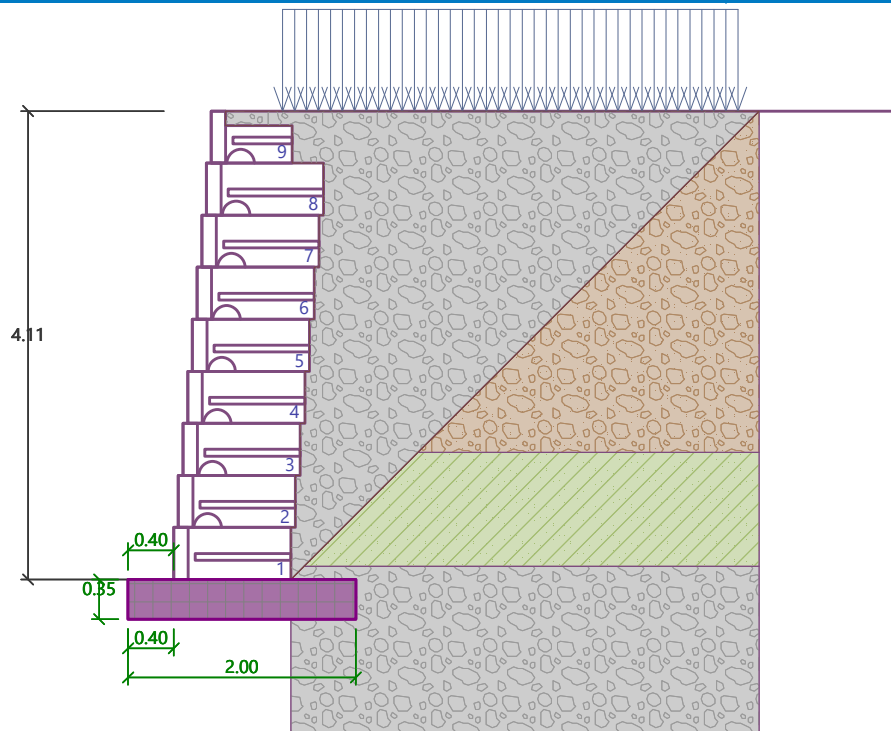
Concrete self-weight $\gamma = 25.13$ kN/m³

Shear cub (key) capacity = 0.00 kN/m

Friction angle concrete-concrete = 30.00 °

Name : Base

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	crushed stone		40.00	0.00	19.00	9.50	27.00
2	sandy clay		20.00	0.00	18.00	8.50	0.00
3	sandstone		40.00	0.00	20.00	10.00	0.00
4	gravely sand made ground		18.00	0.00	18.00	8.50	0.00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

crushed stone

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 40.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 27.00^\circ$
 Saturated unit weight : $\gamma_{sat} = 19.50 \text{ kN/m}^3$

sandy clay

Unit weight : $\gamma = 18.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 20.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 0.00^\circ$
 Saturated unit weight : $\gamma_{sat} = 18.50 \text{ kN/m}^3$

sandstone

Unit weight : $\gamma = 20.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 40.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 0.00^\circ$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

gravely sand made ground

Unit weight : $\gamma = 18.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 18.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 0.00^\circ$
 Saturated unit weight : $\gamma_{sat} = 18.50 \text{ kN/m}^3$

Backfill

Assigned soil : crushed stone
 Slope = 45.00°

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	3.00	0.00 .. 3.00	gravely sand made ground	
2	1.00	3.00 .. 4.00	sandy clay	
3	-	4.00 .. ∞	crushed stone	

Terrain profile

Terrain behind the structure is flat.

Water influence

Ground water table is located below the structure.

Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	Yes		permanent	1.50		0.50	4.00	on terrain

No.	Name
1	Garden load

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
 Reduction of soil/soil friction angle : do not reduce

Verification No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0.00	-1.91	93.31	1.05	1.000
Weight - earth wedge	0.00	-0.70	5.69	1.65	1.000
Weight - earth wedge	0.00	-4.29	2.88	1.35	1.000
Active pressure	34.83	-1.40	42.55	1.76	1.000
Garden load	1.00	-2.31	0.75	1.69	1.000
Garden load	0.00	-4.46	0.22	1.43	1.000

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 187.40$ kNm/m

Overturning moment $M_{ovr} = 50.96$ kNm/m

Safety factor = 3.68 > 1.50

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 122.00$ kN/m

Active horizontal force $H_{act} = 35.83$ kN/m

Safety factor = 3.40 > 1.50

Wall for slip is SATISFACTORY

Overall check - WALL 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]	Design coefficient
Weight - wall	0.00	-1.96	75.72	0.66	1.000
Weight - earth wedge	0.00	-3.94	2.88	0.95	1.000
Active pressure	25.48	-1.38	11.29	1.14	1.000
Garden load	1.06	-1.94	0.53	1.18	1.000
Garden load	0.00	-4.11	0.22	1.03	1.000

Verification of block No. 1

Check for overturning stability

Resisting moment $M_{res} = 66.52$ kNm/m

Overturning moment $M_{ovr} = 37.28$ kNm/m

Safety factor = 1.78 > 1.50

Joint for overturning stability is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 52.33$ kN/m

Active horizontal force $H_{act} = 26.54$ kN/m

Safety factor = 1.97 > 1.50

Joint for verification is SATISFACTORY

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	8.95	145.39	35.83	0.031	77.46

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	8.95	145.39	35.83

Verification of foundation soil

Stress in the footing bottom : trapezoid

Eccentricity verification

Max. eccentricity of normal force $e = 0.031$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Max. stress at footing bottom $\sigma = 86.12 \text{ kPa}$

Bearing capacity of foundation soil $R_d = 50.00 \text{ kPa}$

Safety factor = $0.58 < 2.00$

Bearing capacity of foundation soil is NOT SATISFACTORY

Overall verification - bearing capacity of found. soil is NOT SATISFACTORY

