Project Name and Location:

Allenton, Derby

Ecocrib retaining wall with a maximum retained height of 4.1m and a maximum 1V:3H (18°) crest slope. 50m long.

Year of construction:

2020

Designer name (Company):

William Morrow (Geoman Ltd.)
Installer/ material supplier: PC Construction

Used software (GEO5):

Prefab Wall
Slope Stability

Project description:

100% recycled mixed polymer retaining crib wall system.

The system is manufactured using recycled waste polymers. Plastics such as bags, packaging, car bumpers and bottle tops are selected and processed into the profiles used in the construction of the wall system, the material is 100% recyclable at the end of its required life cycle.

Founded on original, undisturbed firm to stiff sandy CLAY.

Several protected mature trees present beyond the site boundary. Temporary excavations made in short lengths to prevent destabilising existing trees.

Ecocrib was used to allow for a reduced dig and Geo5 allowed the system to be economically designed to the skinniest section.

CASE

McDermott
CASE

CASE

Prefab wall analysis

Input data

Project

Task : MOORWAYS
Part : SECTION 1-1
Author : WM
Date : 24/04/2020
Project number : 20-5161

Settings

Standard - EN 1997 - DA1 (2)

Materials and standards

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

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 : 1 - reduction of actions and soil parameters

Partial factors on actions (A)								
Permanent design situation								
		Combination 1				Combination 2		
		Unfavourable		Favourable		Unfavourable		Favourable	
Permanent actions :	γ_G =	1.35	[–]	1.00	[–]	1.00	[–]	1.00	[–]
Variable actions :	γ_Q =	1.50	[–]	0.00	[–]	1.30	[–]	0.00	[–]
Water load :	γ_w =	1.35	[–]			1.00	[–]		

Partial factors for soil parameters (M)					
Permanent design situation					
		Combination 1		Combination 2	
Partial factor on internal friction :	γ_ϕ =	1.00	[–]	1.25	[–]
Partial factor on effective cohesion :	γ_c =	1.00	[–]	1.25	[–]
Partial factor on undrained shear strength :	γ_{cu} =	1.00	[–]	1.40	[–]
Partial factor on Poisson's ratio :	γ_v =	1.00	[–]	1.00	[–]

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	[–]

Geometry of structure

Slope of wall = 14.00 °

No.	Width b [m]	Height h [m]	Offset k [m]	Offs.(L) o_1 [m]	Offs.(R) o_2 [m]	Self w. [kN/m³]	Friction [–]	Cohesion [kPa]	Shear bear.cap. R_s [kN/m]
3	0.89	2.25	0.50	0.00	0.00	18.00	0.533	0.00	0.00
2	1.39	2.54	0.28	0.00	0.00	18.00	0.533	0.00	0.00

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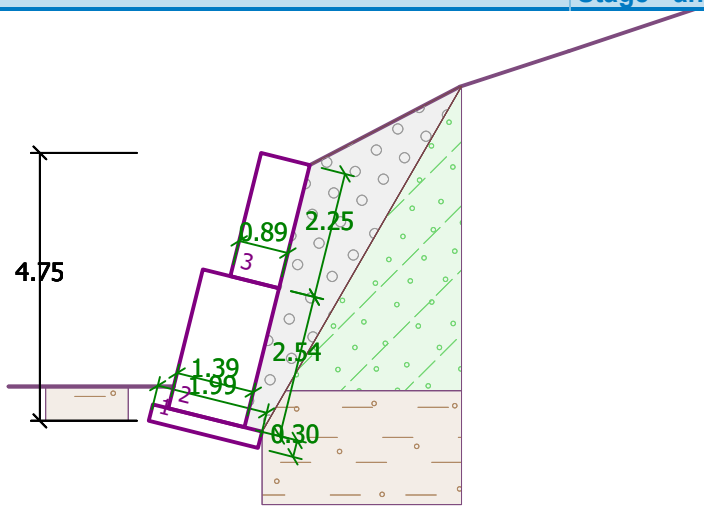
No.	Width b [m]	Height h [m]	Offset k [m]	Offs.(L) o_1 [m]	Offs.(R) o_2 [m]	Self w. [kN/m³]	Friction [–]	Cohesion [kPa]	Shear bear.cap. R_s [kN/m]
1	1.99	0.30	0.00	0.00	0.00	24.00	-	-	-

Note: Blocks are ordered from bottom to the top

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



Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Firm-stiff sandy CLAY		28.50	0.00	20.00	11.00	19.00
2	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)		28.50	0.00	20.00	11.00	19.00
3	CLASS 6N		35.00	0.00	18.00	9.00	23.33

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

Soil parameters

Firm-stiff sandy CLAY

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Angle of friction struc.-soil : δ = 19.00 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 21.00 kN/m³

Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Angle of friction struc.-soil : δ = 19.00 °
Soil : cohesionless

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Saturated unit weight : γ_{sat} = 21.00 kN/m^3

CLASS 6N

Unit weight : γ = 18.00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 35.00 °
Cohesion of soil : c_{ef} = 0.00 kPa
Angle of friction struc.-soil : δ = 23.33 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 19.00 kN/m^3

Backfill

Soil on front face of the structure - CLASS 6N

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	4.00	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)	
2	-	Firm-stiff sandy CLAY	

Foundation

Type of foundation : soil from geological profile

Terrain profile

No.	Coordinate x [m]	Depth z [m]
1	0.00	0.00
2	2.66	-1.39
3	4.59	-2.02
4	15.45	-5.65
5	16.45	-5.65

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.

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	5.00		0.30	20.00	on terrain

No.	Name
1	5kPa

Resistance on front face of the structure

Resistance on front face of the structure: not considered
Soil on front face of the structure - Firm-stiff sandy CLAY
Soil thickness in front of structure h = 0.61 m

Terrain in front of structure is flat.

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Settings of the stage of construction

Design situation : permanent

Verification No. 1

Forces acting on construction - combination 1

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	-1.83	113.92	1.55	1.000	1.000	1.350
Weight - earth wedge	0.00	-0.05	1.70	1.84	1.000	1.000	1.350
Active pressure	59.26	-1.07	29.63	1.97	1.350	1.350	1.350
5kPa	6.96	-2.08	1.80	2.15	1.500	1.500	1.500

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 263.85 kNm/m
Overturning moment M_{ovr} = 107.75 kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 95.29 kN/m
Active horizontal force H_{act} = 49.46 kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 107.92 kPa

Forces acting on construction - combination 2

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	-1.83	113.92	1.55	1.000	1.000	1.000
Weight - earth wedge	0.00	-0.05	1.70	1.84	1.000	1.000	1.000
Active pressure	85.47	-1.14	30.81	1.97	1.000	1.000	1.000
5kPa	9.64	-2.11	1.69	2.12	1.300	1.300	1.300

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 244.41 kNm/m
Overturning moment M_{ovr} = 124.12 kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 72.94 kN/m
Active horizontal force H_{act} = 59.14 kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 117.23 kPa

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

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No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	46.81	167.93	54.47	0.144	117.23
2	18.52	175.50	45.30	0.055	98.66
3	-5.12	214.77	35.80	0.000	107.92

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-5.35	158.71	25.86

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification
Max. eccentricity of normal force e = 0.144
Maximum allowable eccentricity e_{alw} = 0.333

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity
Max. stress at footing bottom σ = 117.23 kPa
Bearing capacity of foundation soil R_d = 120.00 kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1

Forces acting on construction - combination 1

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	-1.88	99.60	1.28	1.000	1.000	1.350
Active pressure	43.69	-1.26	7.18	1.75	1.350	1.350	1.350
5kPa	6.72	-1.96	1.10	1.92	1.500	1.500	1.500

Verification of the most stressed construction joint - above the block No. 1

Check for overturning stability
Resisting moment M_{res} = 147.49 kNm/m
Overturning moment M_{ovr} = 93.86 kNm/m

Joint for overturning stability is SATISFACTORY

Check for slip
Resisting horizontal force H_{res} = 66.28 kN/m
Active horizontal force H_{act} = 40.18 kN/m

Joint for slip is SATISFACTORY

Forces acting on construction - combination 2

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	-1.88	99.60	1.28	1.000	1.000	1.000
Active pressure	65.42	-1.30	6.30	1.76	1.000	1.000	1.000
5kPa	9.31	-1.99	0.90	1.93	1.300	1.300	1.300

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Verification of the most stressed construction joint - above the block No. 1

Check for overturning stability

Resisting moment M_{res} = 140.70 kNm/m

Overturning moment M_{ovr} = 108.87 kNm/m

Joint for overturning stability is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 65.37 kN/m

Active horizontal force H_{act} = 49.32 kN/m

Joint for slip is SATISFACTORY

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Slope stability analysis

Input data

Project

Settings

Standard - EN 1997 - DA1 (2)

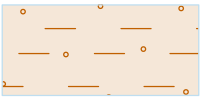
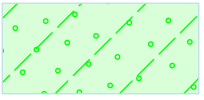
Stability analysis

Earthquake analysis : Standard
Verification methodology : according to EN 1997
Design approach : 1 - reduction of actions and soil parameters

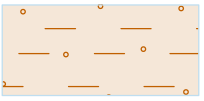
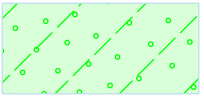
Partial factors on actions (A)								
Permanent design situation								
		Combination 1				Combination 2			
		Unfavourable		Favourable		Unfavourable		Favourable	
Permanent actions :	γ_G =	1.35	[–]	1.00	[–]	1.00	[–]	1.00	[–]
Variable actions :	γ_Q =	1.50	[–]	0.00	[–]	1.30	[–]	0.00	[–]
Water load :	γ_w =	1.35	[–]			1.00	[–]		

Partial factors for soil parameters (M)					
Permanent design situation					
		Combination 1		Combination 2	
Partial factor on internal friction :	γ_ϕ =	1.00	[–]	1.25	[–]
Partial factor on effective cohesion :	γ_c =	1.00	[–]	1.25	[–]
Partial factor on undrained shear strength :	γ_{cu} =	1.00	[–]	1.40	[–]

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]
1	Firm-stiff sandy CLAY		28.50	0.00	20.00
2	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)		28.50	0.00	20.00
3	CLASS 6N		35.00	0.00	18.00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [–]
1	Firm-stiff sandy CLAY		21.00		
2	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)		21.00		

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No.	Name	Pattern	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [–]
3	CLASS 6N		19.00		

Soil parameters

Firm-stiff sandy CLAY

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Saturated unit weight : γ_{sat} = 21.00 kN/m³

Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Saturated unit weight : γ_{sat} = 21.00 kN/m³

CLASS 6N

Unit weight : γ = 18.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 35.00 °
Cohesion of soil : c_{ef} = 0.00 kPa
Saturated unit weight : γ_{sat} = 19.00 kN/m³

Rigid bodies

No.	Name	Sample	γ [kN/m³]
1	Wall material		24.00
2	ECOCRIB		18.00

Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude q, q_1, f, F	q_2	unit
1	strip	variable	on terrain	x = 0.30	l = 20.00		0.00	5.00		kN/m²

Surcharges

No.	Name
1	5kPa

Water

Water type : No water

Tensile crack

Tensile crack not input.

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Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters							
Center :	x =	-2.67	[m]	Angles :	α_1 =	-27.68	[°]
	z =	5.60	[m]		α_2 =	76.48	[°]
Radius :	R =	10.75	[m]				
The slip surface after optimization.							

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 414.60 kN/m
Sum of passive forces : F_p = 482.39 kN/m

Sliding moment : M_a = 3781.17 kNm/m
Resisting moment : M_p = 4399.43 kNm/m
Utilization : 85.9 %

Slope stability ACCEPTABLE

Combination 2

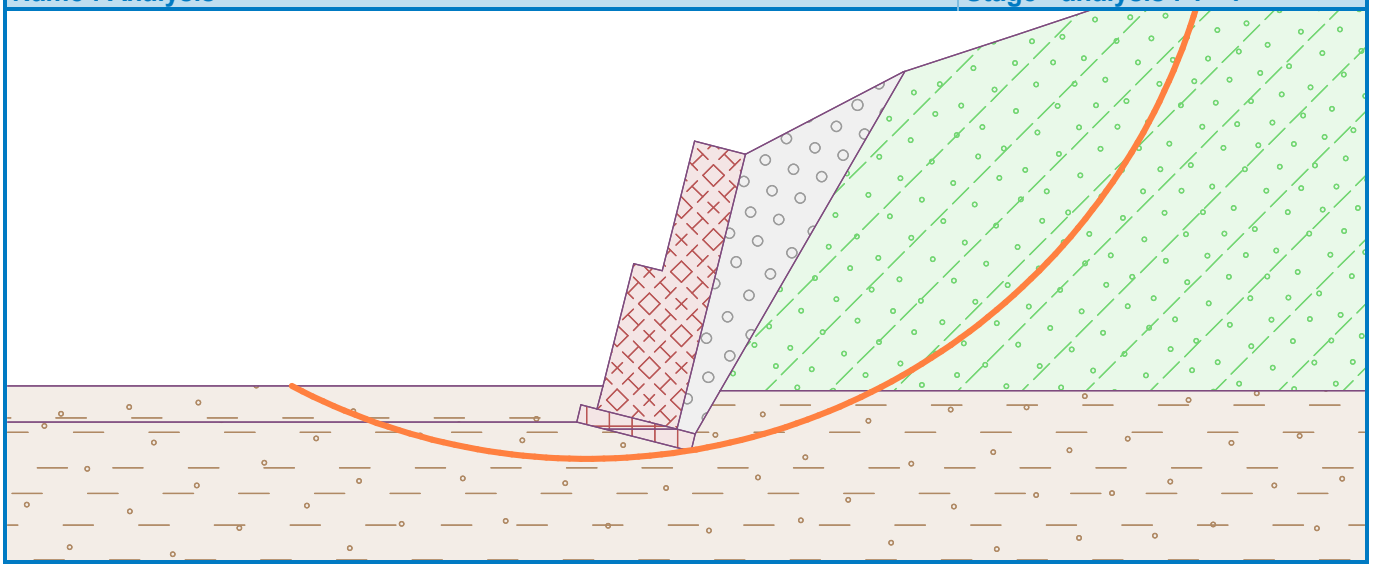
Sum of active forces : F_a = 385.03 kN/m
Sum of passive forces : F_p = 398.41 kN/m

Sliding moment : M_a = 4139.05 kNm/m
Resisting moment : M_p = 4282.89 kNm/m
Utilization : 96.6 %

Slope stability ACCEPTABLE

Optimized slip surface for : Combination 2

Name : Analysis	Stage - analysis : 1 - 1



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Prefab wall analysis

Input data

Project

Task : MOORWAYS
Part : SECTION 2-2
Author : WM
Date : 24/04/2020
Project number : 20-5161

Settings

Standard - EN 1997 - DA1 (2)

Materials and standards

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

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 : 1 - reduction of actions and soil parameters

Partial factors on actions (A)								
Permanent design situation								
		Combination 1				Combination 2		
		Unfavourable		Favourable		Unfavourable		Favourable	
Permanent actions :	γ_G =	1.35	[–]	1.00	[–]	1.00	[–]	1.00	[–]
Variable actions :	γ_Q =	1.50	[–]	0.00	[–]	1.30	[–]	0.00	[–]
Water load :	γ_w =	1.35	[–]			1.00	[–]		

Partial factors for soil parameters (M)					
Permanent design situation					
		Combination 1		Combination 2	
Partial factor on internal friction :	γ_ϕ =	1.00	[–]	1.25	[–]
Partial factor on effective cohesion :	γ_c =	1.00	[–]	1.25	[–]
Partial factor on undrained shear strength :	γ_{cu} =	1.00	[–]	1.40	[–]
Partial factor on Poisson's ratio :	γ_v =	1.00	[–]	1.00	[–]

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	[–]

Geometry of structure

Slope of wall = 14.00 °

No.	Width b [m]	Height h [m]	Offset k [m]	Offs.(L) o_1 [m]	Offs.(R) o_2 [m]	Self w. [kN/m³]	Friction [–]	Cohesion [kPa]	Shear bear.cap. R_s [kN/m]
3	0.64	1.80	0.25	0.00	0.00	18.00	0.533	0.00	0.00
2	0.89	1.19	0.28	0.00	0.00	18.00	0.533	0.00	0.00

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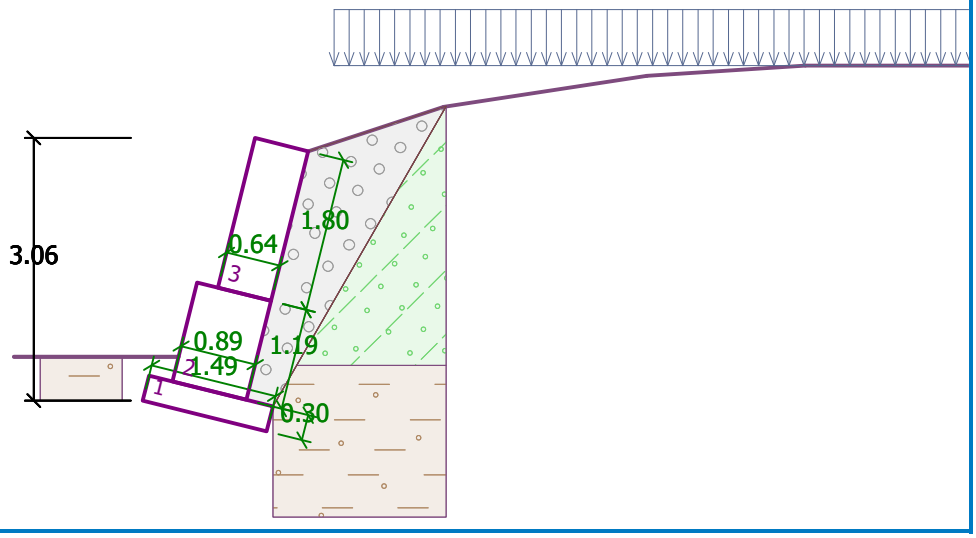
No.	Width b [m]	Height h [m]	Offset k [m]	Offs.(L) o_1 [m]	Offs.(R) o_2 [m]	Self w. [kN/m³]	Friction [–]	Cohesion [kPa]	Shear bear.cap. R_s [kN/m]
1	1.49	0.30	0.00	0.00	0.00	24.00	-	-	-

Note: Blocks are ordered from bottom to the top

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



Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Firm-stiff sandy CLAY		28.50	0.00	20.00	11.00	19.00
2	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)		28.50	0.00	20.00	11.00	19.00
3	CLASS 6N		35.00	0.00	18.00	9.00	23.33

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

Soil parameters

Firm-stiff sandy CLAY

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Angle of friction struc.-soil : δ = 19.00 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 21.00 kN/m³

Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Angle of friction struc.-soil : δ = 19.00 °
Soil : cohesionless

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Saturated unit weight : γ_{sat} = 21.00 kN/m^3

CLASS 6N

Unit weight : γ = 18.00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 35.00 °
Cohesion of soil : c_{ef} = 0.00 kPa
Angle of friction struc.-soil : δ = 23.33 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 19.00 kN/m^3

Backfill

Soil on front face of the structure - CLASS 6N

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	2.50	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)	
2	-	Firm-stiff sandy CLAY	

Foundation

Type of foundation : soil from geological profile

Terrain profile

No.	Coordinate x [m]	Depth z [m]
1	0.00	0.00
2	1.58	-0.52
3	3.95	-0.88
4	5.80	-1.00
5	6.80	-1.00

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.

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	5.00		0.30	20.00	on terrain

No.	Name
1	5kPa

Resistance on front face of the structure

Resistance on front face of the structure: not considered
Soil on front face of the structure - Firm-stiff sandy CLAY
Soil thickness in front of structure h = 0.51 m

Terrain in front of structure is flat.

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Settings of the stage of construction

Design situation : permanent

Verification No. 1

Forces acting on construction - combination 1

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	-1.12	50.53	1.08	1.000	1.000	1.350
Weight - earth wedge	0.00	-0.13	1.36	1.35	1.000	1.000	1.350
Active pressure	22.11	-0.64	14.83	1.44	1.350	1.350	1.350
5kPa	3.56	-1.29	1.08	1.51	1.500	1.500	1.500

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 87.80 kNm/m
Overturning moment M_{ovr} = 26.10 kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 43.35 kN/m
Active horizontal force H_{act} = 16.35 kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 65.41 kPa

Forces acting on construction - combination 2

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	-1.12	50.53	1.08	1.000	1.000	1.000
Weight - earth wedge	0.00	-0.13	1.36	1.35	1.000	1.000	1.000
Active pressure	30.29	-0.67	14.92	1.43	1.000	1.000	1.000
5kPa	4.97	-1.32	1.06	1.49	1.300	1.300	1.300

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 80.07 kNm/m
Overturning moment M_{ovr} = 28.88 kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 32.60 kN/m
Active horizontal force H_{act} = 19.17 kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 55.02 kPa

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

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No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	-8.90	97.47	10.56	0.000	65.41
2	-2.21	79.85	14.82	0.000	53.59
3	4.72	75.05	17.51	0.044	55.02
4	4.72	75.05	17.51	0.044	55.02

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-7.08	71.99	7.49

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification
Max. eccentricity of normal force e = 0.000
Maximum allowable eccentricity e_{alw} = 0.333

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity
Max. stress at footing bottom σ = 65.41 kPa
Bearing capacity of foundation soil R_d = 120.00 kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1

Forces acting on construction - combination 1

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	-1.21	39.80	0.83	1.000	1.000	1.350
Active pressure	14.41	-0.76	2.37	1.11	1.350	1.350	1.350
5kPa	3.37	-1.18	0.55	1.21	1.500	1.500	1.500

Verification of the most stressed construction joint - above the block No. 1

Check for overturning stability
Resisting moment M_{res} = 37.47 kNm/m
Overturning moment M_{ovr} = 20.73 kNm/m

Joint for overturning stability is SATISFACTORY

Check for slip
Resisting horizontal force H_{res} = 25.83 kN/m
Active horizontal force H_{act} = 13.18 kN/m

Joint for slip is SATISFACTORY

Forces acting on construction - combination 2

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	-1.21	39.80	0.83	1.000	1.000	1.000
Active pressure	20.63	-0.77	1.99	1.11	1.000	1.000	1.000

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Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
5kPa	4.71	-1.21	0.45	1.22	1.300	1.300	1.300

Verification of the most stressed construction joint - above the block No. 1

Check for overturning stability

Resisting moment M_{res} = 35.85 kNm/m

Overturning moment M_{ovr} = 23.27 kNm/m

Joint for overturning stability is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 25.37 kN/m

Active horizontal force H_{act} = 15.71 kN/m

Joint for slip is SATISFACTORY

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Slope stability analysis

Input data

Project

Settings

Standard - EN 1997 - DA1 (2)

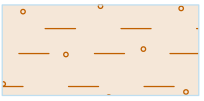
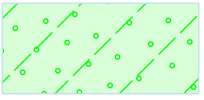
Stability analysis

Earthquake analysis : Standard
Verification methodology : according to EN 1997
Design approach : 1 - reduction of actions and soil parameters

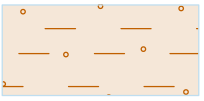
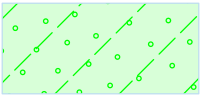
Partial factors on actions (A)								
Permanent design situation								
		Combination 1				Combination 2			
		Unfavourable		Favourable		Unfavourable		Favourable	
Permanent actions :	γ_G =	1.35	[–]	1.00	[–]	1.00	[–]	1.00	[–]
Variable actions :	γ_Q =	1.50	[–]	0.00	[–]	1.30	[–]	0.00	[–]
Water load :	γ_w =	1.35	[–]			1.00	[–]		

Partial factors for soil parameters (M)					
Permanent design situation					
		Combination 1		Combination 2	
Partial factor on internal friction :	γ_ϕ =	1.00	[–]	1.25	[–]
Partial factor on effective cohesion :	γ_c =	1.00	[–]	1.25	[–]
Partial factor on undrained shear strength :	γ_{cu} =	1.00	[–]	1.40	[–]

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]
1	Firm-stiff sandy CLAY		28.50	0.00	20.00
2	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)		28.50	0.00	20.00
3	CLASS 6N		35.00	0.00	18.00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [–]
1	Firm-stiff sandy CLAY		21.00		
2	Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)		21.00		

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No.	Name	Pattern	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [–]
3	CLASS 6N		19.00		

Soil parameters

Firm-stiff sandy CLAY

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Saturated unit weight : γ_{sat} = 21.00 kN/m³

Firm-stiff sandy CLAY/ loose to medium-dense silty SAND (MADE GROUND)

Unit weight : γ = 20.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.50 °
Cohesion of soil : c_{ef} = 0.00 kPa
Saturated unit weight : γ_{sat} = 21.00 kN/m³

CLASS 6N

Unit weight : γ = 18.00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 35.00 °
Cohesion of soil : c_{ef} = 0.00 kPa
Saturated unit weight : γ_{sat} = 19.00 kN/m³

Rigid bodies

No.	Name	Sample	γ [kN/m³]
1	Wall material		24.00
2	ECOCRIB		18.00

Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude q, q_1, f, F	Magnitude q_2	Magnitude unit
1	strip	variable	on terrain	x = 0.30	l = 20.00		0.00	5.00		kN/m²

Surcharges

No.	Name
1	5kPa

Water

Water type : No water

Tensile crack

Tensile crack not input.

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Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters							
Center :	x =	-1.65	[m]	Angles :	α_1 =	-35.38	[°]
	z =	1.97	[m]		α_2 =	77.65	[°]
Radius :	R =	5.36	[m]				
The slip surface after optimization.							

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 136.54 kN/m
Sum of passive forces : F_p = 181.02 kN/m

Sliding moment : M_a = 688.17 kNm/m
Resisting moment : M_p = 912.32 kNm/m
Utilization : 75.4 %

Slope stability ACCEPTABLE

Combination 2

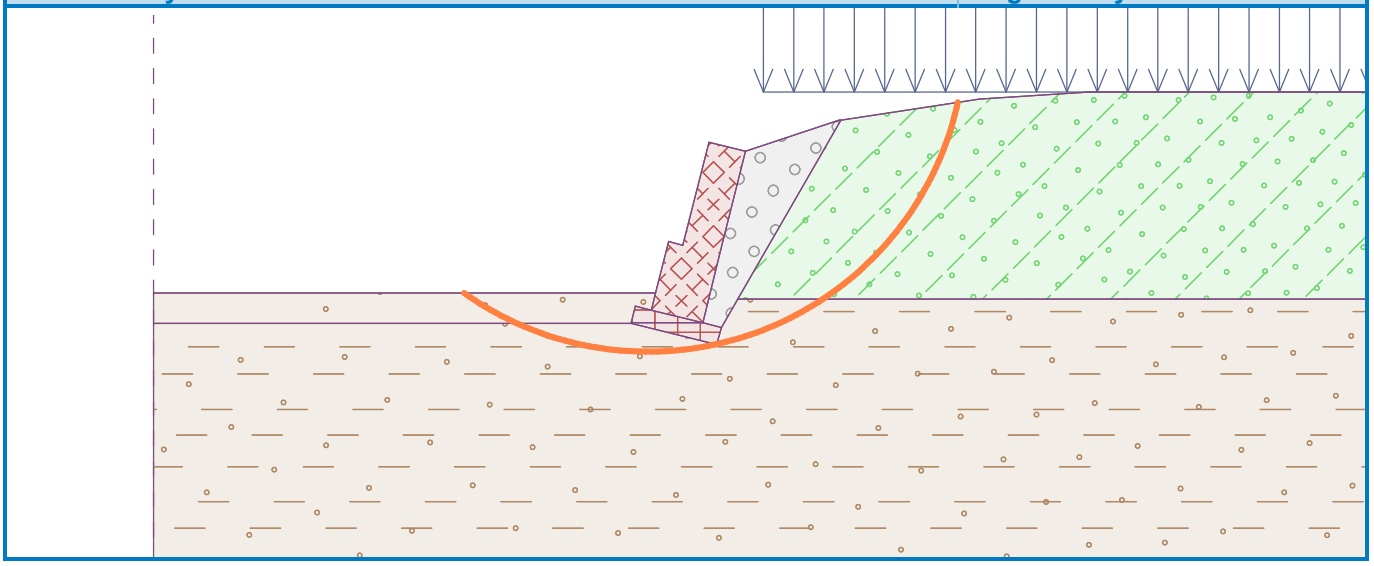
Sum of active forces : F_a = 114.51 kN/m
Sum of passive forces : F_p = 134.95 kN/m

Sliding moment : M_a = 613.76 kNm/m
Resisting moment : M_p = 723.34 kNm/m
Utilization : 84.9 %

Slope stability ACCEPTABLE

Optimized slip surface for : Combination 2

Name : Analysis	Stage - analysis : 1 - 1



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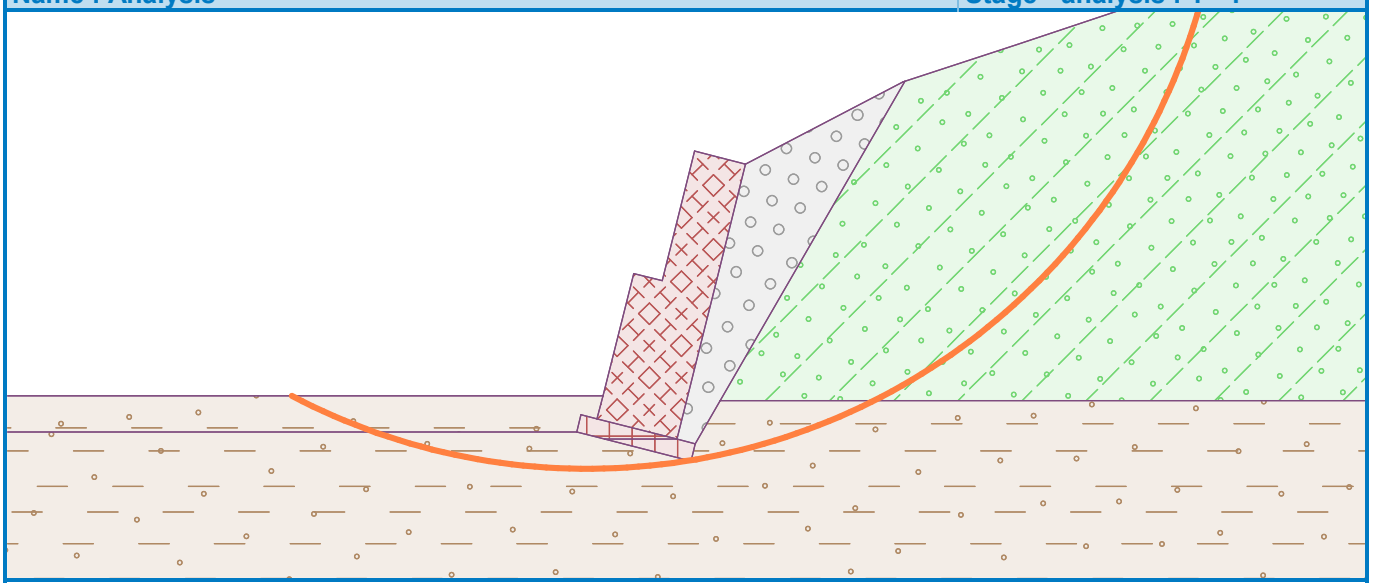
WM

MOORWAYS
SECTION 1-1

Name : Analysis | **Stage - analysis : 1 - 1**



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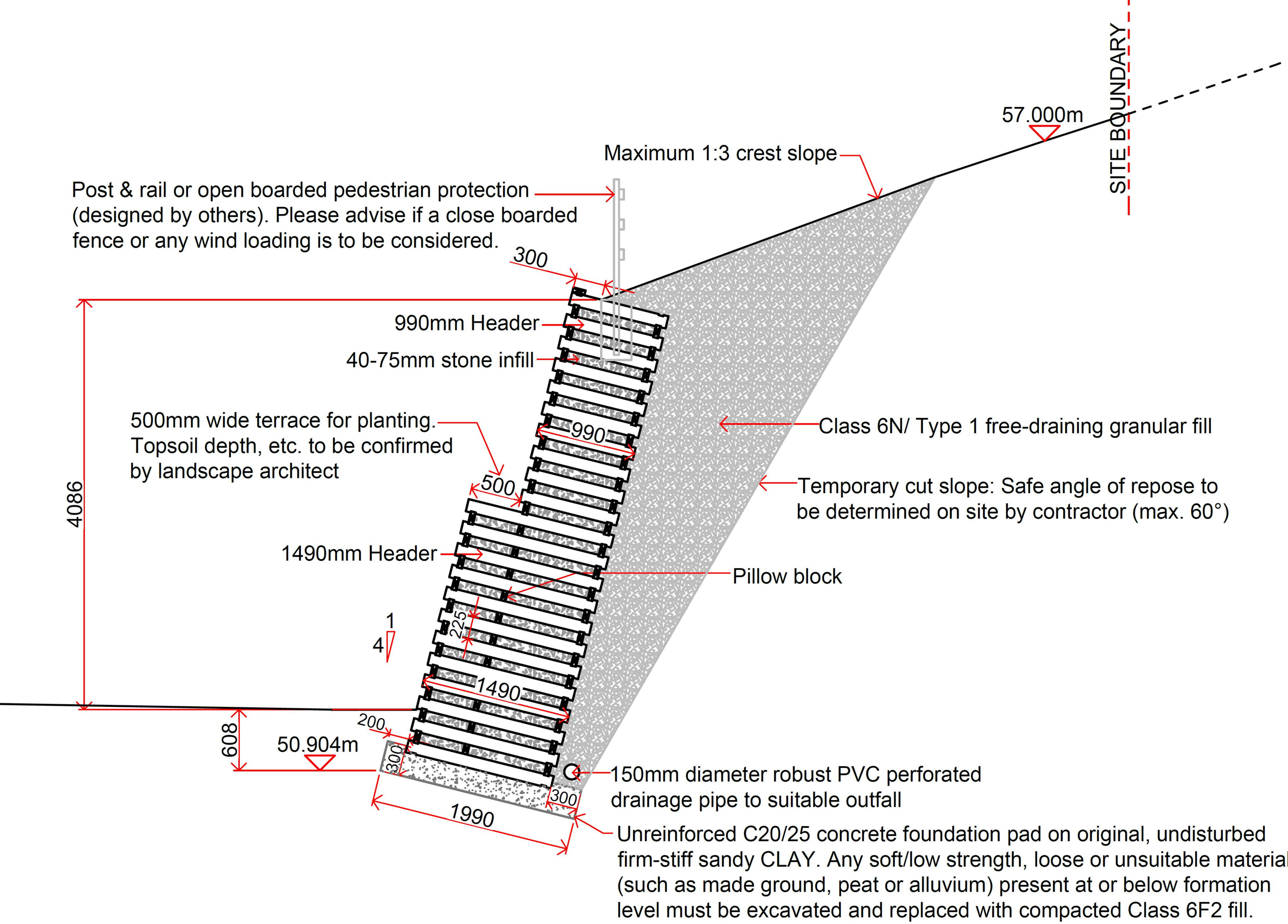
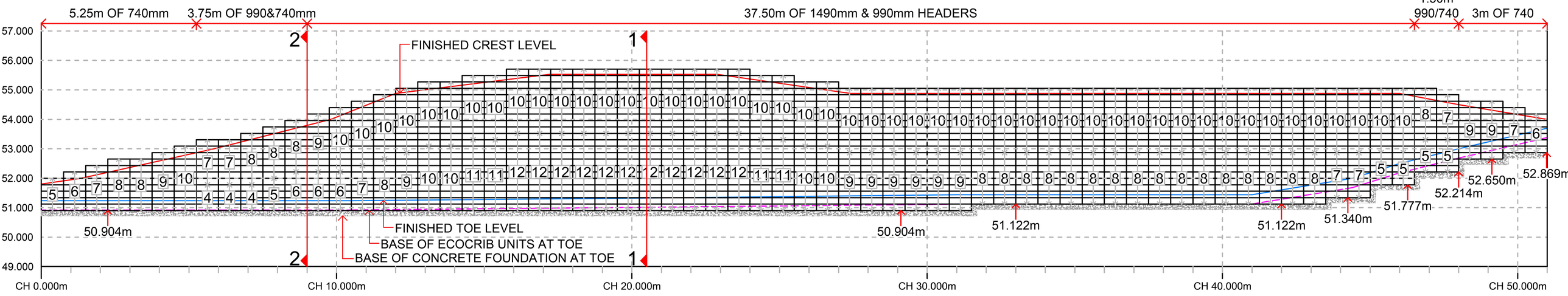

SITE BOUNDARY
57.000m
Maximum 1:3 crest slope
Post & rail or open boarded pedestrian protection (designed by others). Please advise if a close boarded fence or any wind loading is to be considered.
300
990mm Header
40-75mm stone infill
500mm wide terrace for planting. Topsoil depth, etc. to be confirmed by landscape architect
990
500
Class 6N/ Type 1 free-draining granular fill
Temporary cut slope: Safe angle of repose to be determined on site by contractor (max. 60°)
4086
1490mm Header
Pillow block
1
4
225
1490
200
608
50.904m
300
300
1990
150mm diameter robust PVC perforated drainage pipe to suitable outfall
Unreinforced C20/25 concrete foundation pad on original, undisturbed firm-stiff sandy CLAY. Any soft/low strength, loose or unsuitable material (such as made ground, peat or alluvium) present at or below formation level must be excavated and replaced with compacted Class 6F2 fill.


5.25m OF 740mm
3.75m OF 990&740mm
37.50m OF 1490mm & 990mm HEADERS
990/740
3m OF 740
FINISHED CREST LEVEL
FINISHED TOE LEVEL
BASE OF ECOCRIB UNITS AT TOE
BASE OF CONCRETE FOUNDATION AT TOE
50.904m
50.904m
51.122m
51.122m
51.340m
51.777m
52.214m
52.650m
52.869m
57.000
56.000
55.000
54.000
53.000
52.000
51.000
50.000
49.000
CH 0.000m
CH 10.000m
CH 20.000m
CH 30.000m
CH 40.000m
CH 50.000m