

Slope stability analysis

Input data

Project

Task : Cheping Gardens southampton
 Part : Section 1-1
 Description : 25-3061
 Customer : TOBERMORE
 Author : NPC
 Date : 07/07/2025
 Project number : 25-3061

Settings

Standard - EN 1997 - DA1 (With additional slope stability methods)

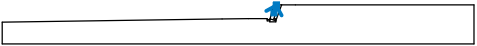
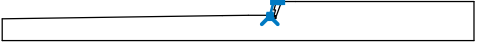
Stability analysis

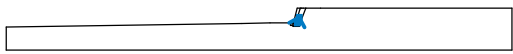
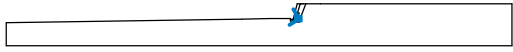
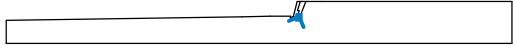
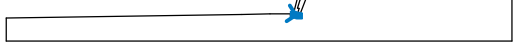
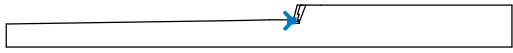
Earthquake analysis : Standard
 Verification methodology : according to EN 1997
 Design approach : 1 - reduction of actions and soil parameters

Partial factors on actions (A)						
Permanent design situation						
		Combination 1			Combination 2	
		Unfavourable	Favourable		Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.35 [-]	1.00 [-]		1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.50 [-]	0.00 [-]		1.30 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.35 [-]			1.00 [-]	

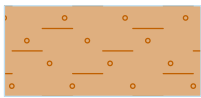
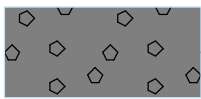
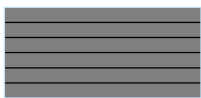
Partial factors for soil parameters (M)						
Permanent design situation						
		Combination 1			Combination 2	
Partial factor on internal friction :	$\gamma_\phi =$	1.00 [-]			1.25 [-]	
Partial factor on effective cohesion :	$\gamma_c =$	1.00 [-]			1.25 [-]	
Partial factor on undrained shear strength :	$\gamma_{cu} =$	1.00 [-]			1.40 [-]	

Interface

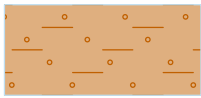
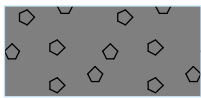
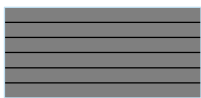
No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		1.12	1.69	1.63	3.44	1.68	3.59
2		0.15	-0.11	0.15	0.19	0.18	0.29
		0.20	0.38	1.03	3.59	1.68	3.59
		2.00	3.59	2.04	3.59	2.42	3.59
		2.89	3.59				
3		-61.71	-0.45	-10.92	0.30	-4.85	0.39
		-0.45	0.39	-0.45	0.19	-0.45	-0.11
		0.15	-0.11	0.15	-0.33	1.53	-0.33
		1.53	-0.03	2.89	3.59	6.05	3.59
		47.32	3.57				
4		1.12	1.69	1.46	1.61		

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
5		1.11	0.42	1.46	1.61		
6		1.11	0.42	1.45	0.34		
7		1.32	0.02	1.45	0.34		
8		0.18	0.29	0.77	0.16	1.02	0.10
		1.32	0.02	1.53	-0.03		
9		-0.45	0.19	0.15	0.19		

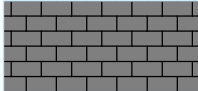
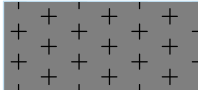
Soil parameters - effective stress state

No.	Name	Pattern	Φ_{ef} [°]	C_{ef} [kPa]	γ [kN/m ³]
1	Class 6l/J		35.00	0.00	20.00
2	Original, undisturbed Wittering Formation of sand, silt, and clay		30.00	0.00	19.00
3	ST4 CONCRETE		35.00	2.90	24.00
4	CRIB WALL [Crushed stone]		35.00	0.00	20.00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Class 6l/J		21.00		
2	Original, undisturbed Wittering Formation of sand, silt, and clay		20.00		
3	ST4 CONCRETE		24.00		
4	CRIB WALL [Crushed stone]		20.00		

Soil parameters - total stress state

No.	Name	Pattern	c_u [kPa]	γ [kN/m ³]
1	Secura Facing		10000.00	23.00
2	Concrete C20/25		10000.00	24.00

Soil parameters**Class 6I/J**

Unit weight : $\gamma = 20.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 35.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 21.00 \text{ kN/m}^3$

Original, undisturbed Wittering Formation of sand, silt, and clay

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 30.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

ST4 CONCRETE

Unit weight : $\gamma = 24.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 35.00^\circ$
 Cohesion of soil : $c_{ef} = 2.90 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 24.00 \text{ kN/m}^3$

Secura Facing

Unit weight : $\gamma = 23.00 \text{ kN/m}^3$
 Stress-state : total
 Cohesion of soil : $c_u = 10000.00 \text{ kPa}$

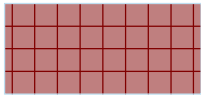
Concrete C20/25

Unit weight : $\gamma = 24.00 \text{ kN/m}^3$
 Stress-state : total
 Cohesion of soil : $c_u = 10000.00 \text{ kPa}$

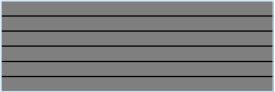
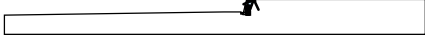
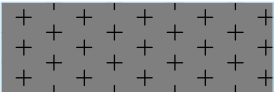
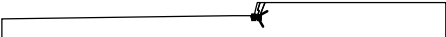
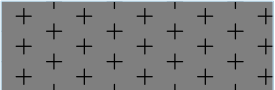
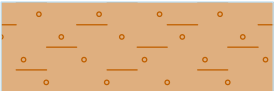
CRIB WALL [Crushed stone]

Unit weight : $\gamma = 20.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 35.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Rigid Bodies

No.	Name	Sample	Y [kN/m ³]
1	Concrete & facing		24.00

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		0.77	0.16	1.02	0.10	CRIB WALL [Crushed stone] 
		1.32	0.02	1.45	0.34	
		1.11	0.42	1.46	1.61	
		1.12	1.69	1.63	3.44	
		1.68	3.59	1.03	3.59	
		0.20	0.38	0.18	0.29	
2		1.53	-0.03	2.89	3.59	Class 6I/J 
		2.42	3.59	2.04	3.59	
		2.00	3.59	1.68	3.59	
		1.63	3.44	1.12	1.69	
		1.46	1.61	1.11	0.42	
		1.45	0.34	1.32	0.02	
3		-0.45	0.19	-0.45	-0.11	Concrete C20/25 
		0.15	-0.11	0.15	0.19	
4		1.32	0.02	1.02	0.10	Concrete C20/25 
		0.77	0.16	0.18	0.29	
		0.15	0.19	0.15	-0.11	
		0.15	-0.33	1.53	-0.33	
		1.53	-0.03			
5		6.05	3.59	2.89	3.59	Original, undisturbed Wittering Formation of sand, silt and clay 
		1.53	-0.03	1.53	-0.33	
		0.15	-0.33	0.15	-0.11	
		-0.45	-0.11	-0.45	0.19	
		-0.45	0.39	-4.85	0.39	
		-10.92	0.30	-61.71	-0.45	
		-61.71	-5.45	47.32	-5.45	
		47.32	3.57			

Nails

No.	Start pt.		Length l [m]	inclination α [°]	Spacing b [m]	Tension strength	Pull out resistance	Nail head strength
	x [m]	z [m]						
1	0.21	0.40	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
2	0.38	1.08	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
3	0.52	1.60	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$

No.	Start pt.		Length	inclination	Spacing	Tension strength	Pull out resistance	Nail head strength
	x [m]	z [m]	l [m]	α [°]	b [m]			
4	0.67	2.18	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}$, $f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
5	0.82	2.78	3.01	7.00	1.00	$d_s = 8.0 \text{ mm}$, $f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$

Water

Water type : No water

Tensile crack

Tensile crack not input.

Earthquake

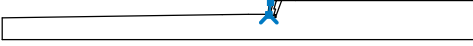
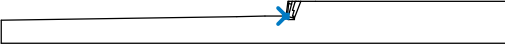
Earthquake not included.

Settings of the stage of construction

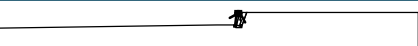
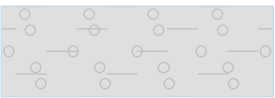
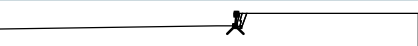
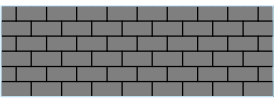
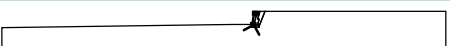
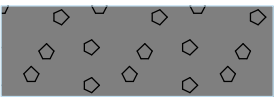
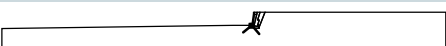
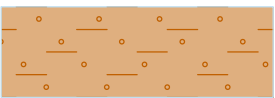
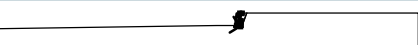
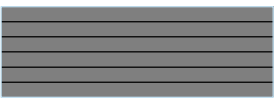
Design situation : permanent

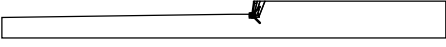
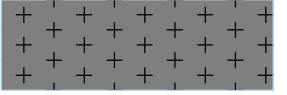
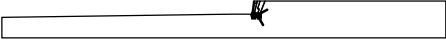
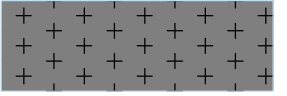
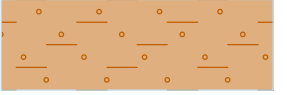
Input data (Stage of construction 2)

Embankment interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-0.30	0.19	-0.28	0.39	0.05	3.18
		0.10	3.59	0.33	3.59	1.03	3.59
2		-0.07	0.19	-0.07	0.36	-0.05	0.36
		0.28	3.12	0.33	3.59		
3		0.28	3.12	0.85	2.95		
4		-0.45	0.39	-0.28	0.39		

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		0.85	2.95	1.03	3.59	Class 6I/J 
		0.33	3.59	0.28	3.12	
2		-0.07	0.19	-0.07	0.36	Secura Facing 
		-0.05	0.36	0.28	3.12	
		0.33	3.59	0.10	3.59	
		0.05	3.18	-0.28	0.39	
		-0.30	0.19			
3		0.15	0.19	0.18	0.29	ST4 CONCRETE 
		0.20	0.38	0.85	2.95	
		0.28	3.12	-0.05	0.36	
		-0.07	0.36	-0.07	0.19	
4		-0.30	0.19	-0.28	0.39	Original, undisturbed Wittering Formation of sand, silt and clay 
		-0.45	0.39	-0.45	0.19	
5		0.77	0.16	1.02	0.10	CRIB WALL [Crushed stone] 
		1.32	0.02	1.45	0.34	
		1.11	0.42	1.46	1.61	
		1.12	1.69	1.63	3.44	
		1.68	3.59	1.03	3.59	
		0.85	2.95	0.20	0.38	
		0.18	0.29			
6		1.53	-0.03	2.89	3.59	Class 6I/J 
		2.42	3.59	2.04	3.59	
		2.00	3.59	1.68	3.59	
		1.63	3.44	1.12	1.69	
		1.46	1.61	1.11	0.42	
		1.45	0.34	1.32	0.02	

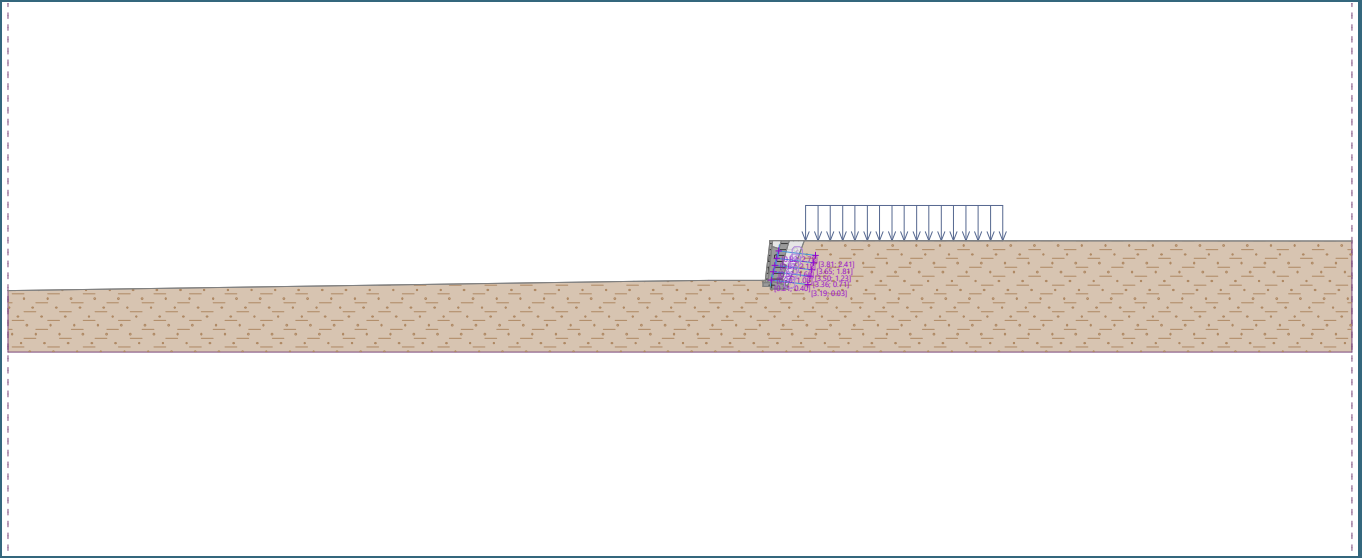
No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
7		-0.07	0.19	-0.30	0.19	Concrete C20/25 
		-0.45	0.19	-0.45	-0.11	
		0.15	-0.11	0.15	0.19	
8		1.32	0.02	1.02	0.10	Concrete C20/25 
		0.77	0.16	0.18	0.29	
		0.15	0.19	0.15	-0.11	
		0.15	-0.33	1.53	-0.33	
		1.53	-0.03			
9		6.05	3.59	2.89	3.59	Original, undisturbed Wittering Formation of sand, silt and clay 
		1.53	-0.03	1.53	-0.33	
		0.15	-0.33	0.15	-0.11	
		-0.45	-0.11	-0.45	0.19	
		-0.45	0.39	-4.85	0.39	
		-10.92	0.30	-61.71	-0.45	
		-61.71	-5.45	47.32	-5.45	
		47.32	3.57			

Nails

No.	Nail new	Start pt.		Length l [m]	Inclination α [°]	Spacing b [m]	Tension strength	Pull out resistance	Nail head strength
		x [m]	z [m]						
1	No	0.21	0.40	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
2	No	0.38	1.08	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
3	No	0.52	1.60	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
4	No	0.67	2.18	3.00	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$
5	No	0.82	2.78	3.01	7.00	1.00	$d_s = 8.0 \text{ mm}, f_y = 500.00 \text{ MPa}$	$T_p = 1.66 \text{ kN/m}$	$R_f = 10.00 \text{ kN}$

Name : Nails

Stage : 2



Surcharge

No.	Surcharge		Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude		
	new	change								q, q_1, q_2, z	f, F, x	unit
1	Yes		strip	permanent	on terrain	x = 3.00	l = 16.00		0.00	5.00		kN/m ²

Surcharges

No.	Name
1	5kPa

Water

Water type : No water

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 2)

Analysis 1 (stage 2)

Circular slip surface

Slip surface parameters					
Center :	x =	-1.26 [m]	Angles :	$\alpha_1 =$	-39.28 [°]
	z =	5.23 [m]		$\alpha_2 =$	74.81 [°]
Radius :	R =	6.26 [m]			
The slip surface after broken analysis.					

Author: NPC

Nails bearing capacity

Combination 1

Nail Bearing capacity [kN/m]	
1	1.23
2	0.22
3	0.00
4	0.00
5	0.00

Combination 2

Nail Bearing capacity [kN/m]	
1	1.37
2	0.44
3	0.00
4	0.00
5	0.00

Slope stability verification (Bishop)

Combination 1

Sum of active forces :	$F_a = 155.48 \text{ kN/m}$
Sum of passive forces :	$F_p = 245.02 \text{ kN/m}$
Sliding moment :	$M_a = 814.70 \text{ kNm/m}$
Resisting moment :	$M_p = 1283.89 \text{ kNm/m}$
Utilization :	63.5 %

Slope stability ACCEPTABLE

Combination 2

Sum of active forces :	$F_a = 140.80 \text{ kN/m}$
Sum of passive forces :	$F_p = 203.22 \text{ kN/m}$
Sliding moment :	$M_a = 881.40 \text{ kNm/m}$
Resisting moment :	$M_p = 1272.16 \text{ kNm/m}$
Utilization :	69.3 %

Slope stability ACCEPTABLE

Optimized slip surface for : Combination 2

