

Slope stability analysis

Input data (Construction stage 1)

Project

Task : Yard extension stability assessment
 Part : Long term conditions - DA1
 Description : Section A-A'
 Customer : Bryn Aggregates Ltd
 Author : JPCE Ltd
 Date : 07/10/2023

Settings

Standard - EN 1997 - DA2 (2)

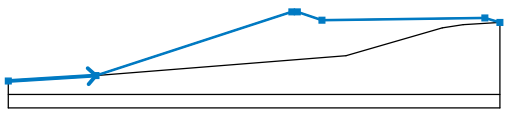
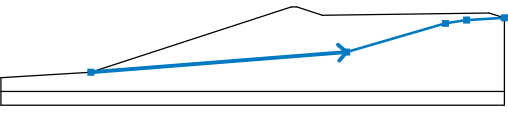
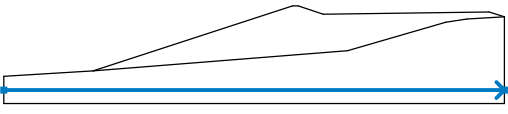
Stability analysis

Verification methodology : according to EN 1997
 Earthquake analysis : Standard
 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		0.00	0.00	32.72	2.02	105.67	25.82
		107.77	25.82	116.94	22.72	177.69	23.54
		183.30	21.85				
2		32.72	2.02	125.88	9.40	161.86	19.80
		169.57	21.03	183.30	21.85		
3		0.00	-5.00	183.30	-5.00		



Soil parameters - effective stress state

No.	Name	Pattern	Φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
1	Imported mixed soils		30.00	0.00	19.00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Imported mixed soils		20.00		

Soil parameters - total stress state

No.	Name	Pattern	c_u [kPa]	γ [kN/m ³]
1	In-situ clay soils		150.00	21.00
2	Sandstone bedrock		300.00	20.00

Soil parameters**In-situ clay soils**

Unit weight : $\gamma = 21.00 \text{ kN/m}^3$
 Stress-state : total
 Shear strength : Mohr-Coulomb
 Cohesion of soil : $c_u = 150.00 \text{ kPa}$

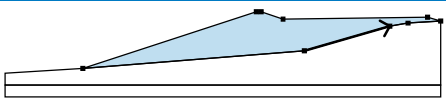
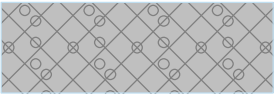
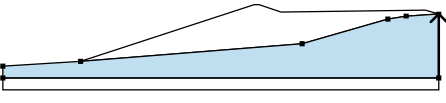
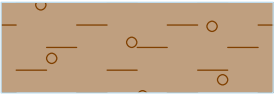
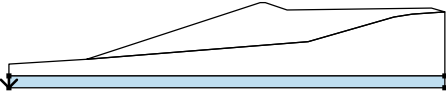

Imported mixed soils

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

Sandstone bedrock

Unit weight : $\gamma = 20.00 \text{ kN/m}^3$
 Stress-state : total
 Shear strength : Mohr-Coulomb
 Cohesion of soil : $c_u = 300.00 \text{ kPa}$

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		125.88	9.40	161.86	19.80	Imported mixed soils 
		169.57	21.03	183.30	21.85	
		177.69	23.54	116.94	22.72	
		107.77	25.82	105.67	25.82	
		32.72	2.02			
2		183.30	-5.00	183.30	21.85	In-situ clay soils 
		169.57	21.03	161.86	19.80	
		125.88	9.40	32.72	2.02	
		0.00	0.00	0.00	-5.00	
3		0.00	-5.00	0.00	-10.00	Sandstone bedrock 
		183.30	-10.00	183.30	-5.00	

Surcharge

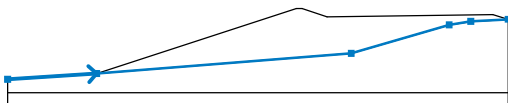
No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude		
								q, q ₁ , f, F, x	q ₂ , z	unit
1	strip	permanent	on terrain	x = 117.00	l = 60.00		0.00	100.00		kN/m ²

Surcharges

No.	Name
1	Working loads

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [m]					
		x	z	x	z	x	z
1		0.00	-0.14	32.63	1.97	125.80	9.40
		161.68	19.84	169.58	21.11	183.30	21.84

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Construction stage 1)**Analysis 1****Circular slip surface**

Slip surface parameters					
Center :	x =	74.89 [m]	Angles :	$\alpha_1 =$	-33.26 [°]
	z =	55.56 [m]		$\alpha_2 =$	57.28 [°]
Radius :	R =	60.53 [m]			
Slip surface after grid search.					

Total weight of soil above the slip surface: 26693.50 kN/m

Slope stability verification (Bishop)**Combination 1**Sum of active forces : $F_a = 7992.09$ kN/mSum of passive forces : $F_p = 13141.14$ kN/mSliding moment : $M_a = 467776.79$ kNm/mResisting moment : $M_p = 769150.75$ kNm/m

Utilization : 60.8 %

Slope stability ACCEPTABLE**Combination 2**Sum of active forces : $F_a = 5588.41$ kN/mSum of passive forces : $F_p = 9332.62$ kN/mSliding moment : $M_a = 338266.23$ kNm/mResisting moment : $M_p = 564903.78$ kNm/m

Utilization : 59.9 %

Slope stability ACCEPTABLE