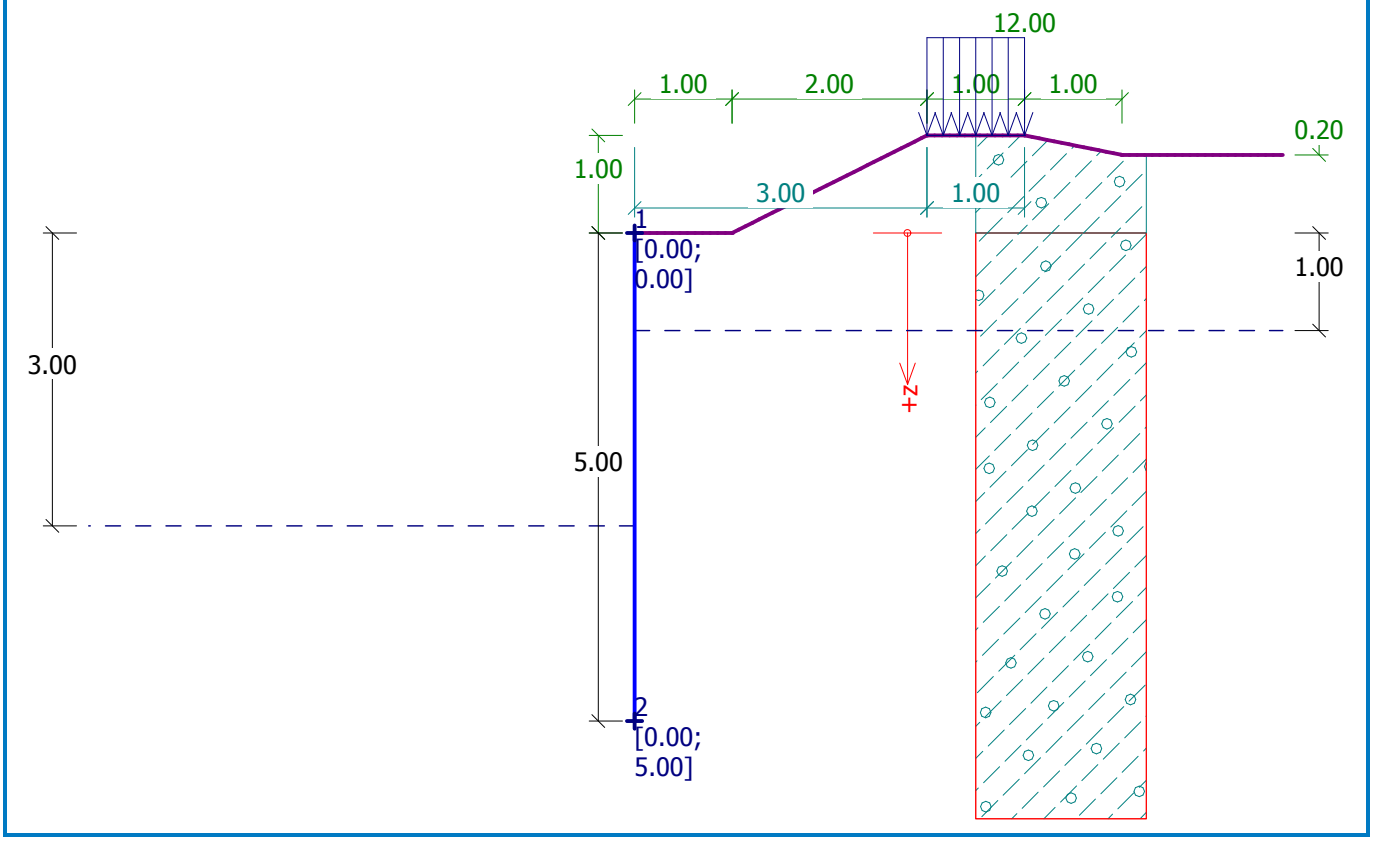
Earth pressure on structure analysis

Input data

Project

Date : 11/4/2005

Name : Project **Stage : 1**



Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0.00	0.00
2	0.00	5.00
3	0.00	0.00

The origin [0,0] is located at the most upper point of the structure.

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]	γ_{su} [kN/m^3]	δ [°]
1	Soil No. 1		29.00	8.00	19.00	9.00	12.00

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

Soil parameters

Soil No. 1

Unit weight : γ = 19.00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 29.00 °
Cohesion of soil : c_{ef} = 8.00 kPa
Angle of friction struc.-soil : δ = 12.00 °

Soil : cohesionless
Saturated unit weight : γ_{sat} = 19.00 kN/m^3

Geological profile and assigned soils

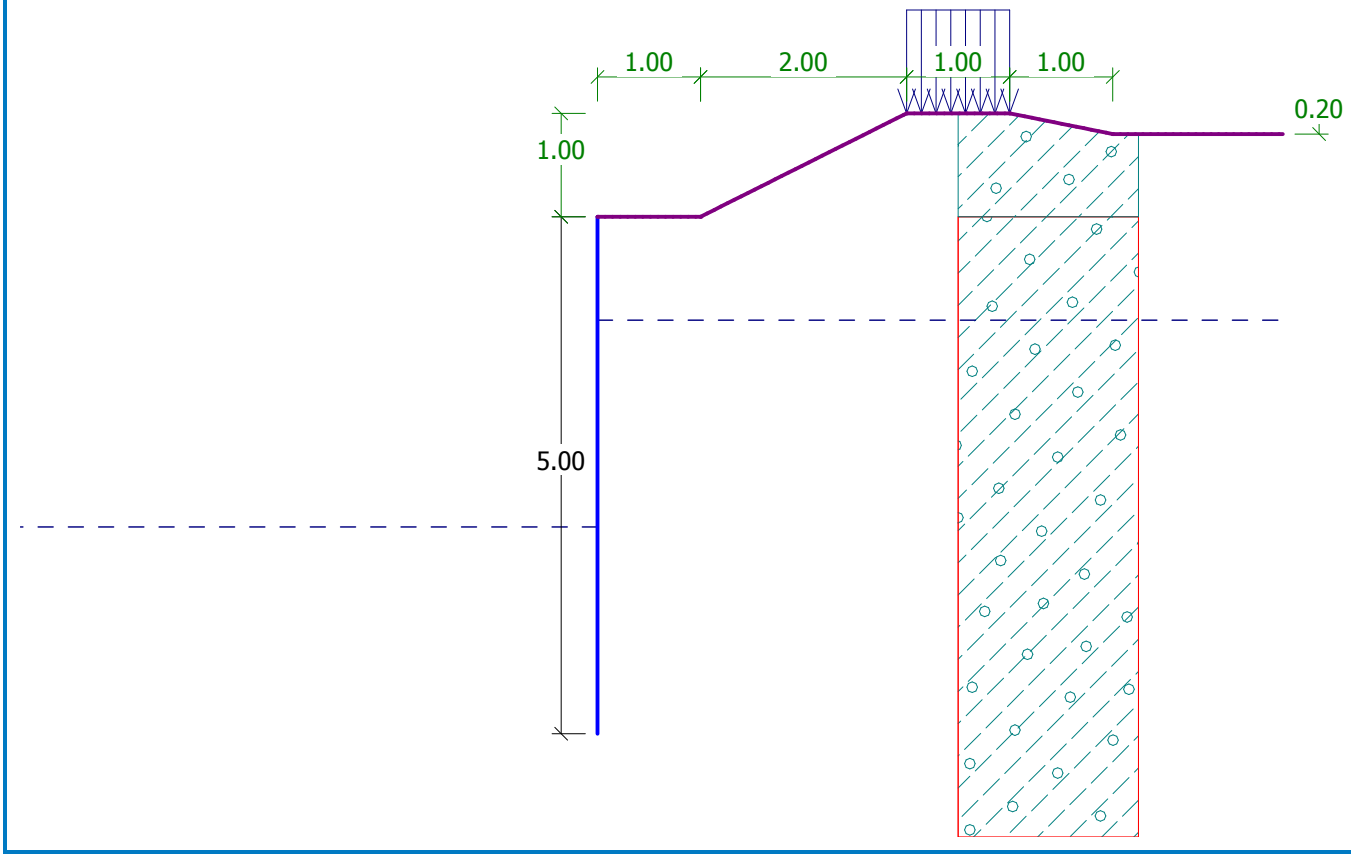
No.	Layer [m]	Assigned soil	Pattern
1	-	Soil No. 1	

Terrain profile

No.	Coordinate X [m]	Depth Z [m]
1	0.00	0.00
2	1.00	0.00
3	3.00	-1.00
4	4.00	-1.00
5	5.00	-0.80
6	6.00	-0.80

Origin [0,0] is located in upper right edge of construction.
Positive coordinate +z has downward direction.

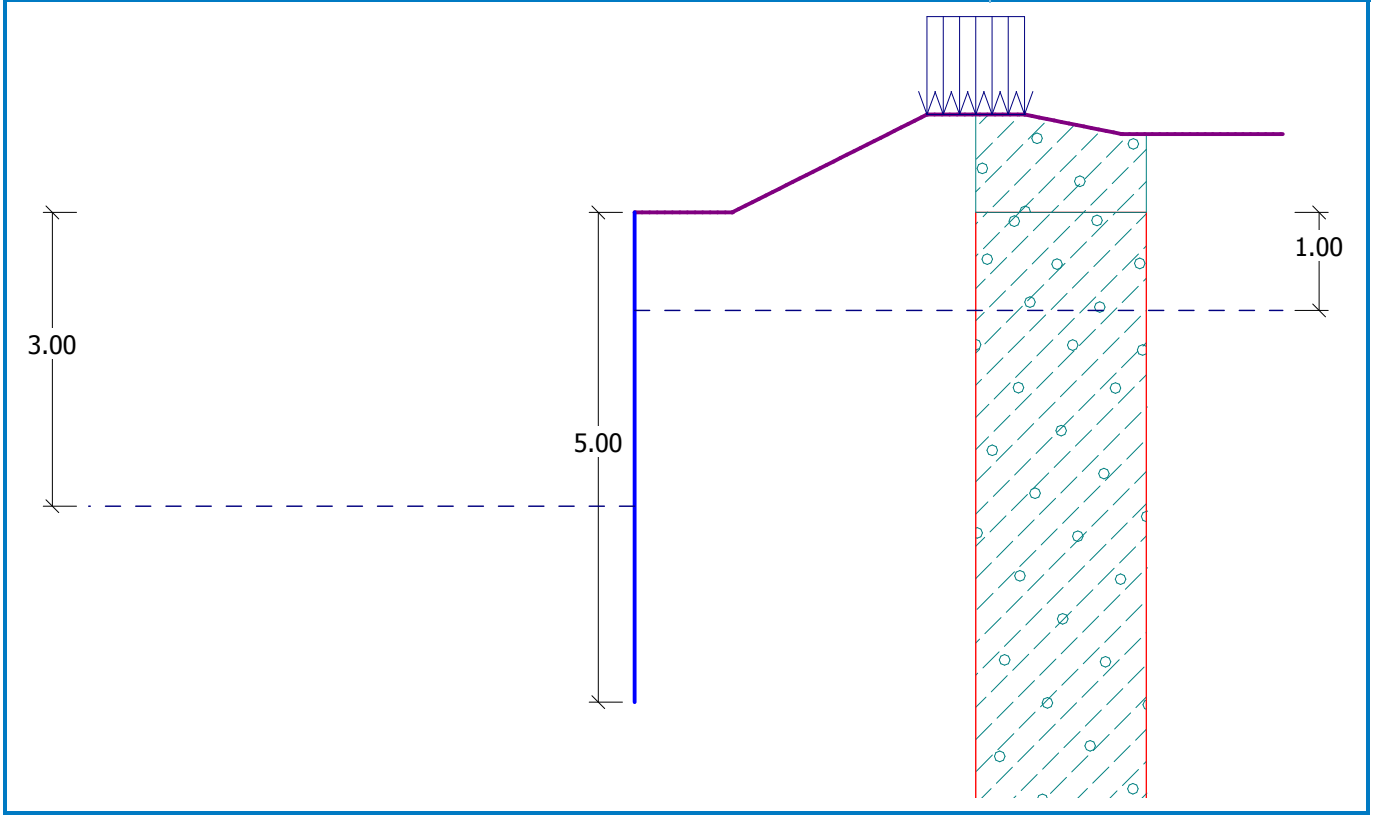
Name : Terrain **Stage : 1**



Water influence

GWT behind the structure lies at a depth of 1.00 m
GWT in front of the structure lies at a depth of 3.00 m
Subgrade at the heel is not permeable.

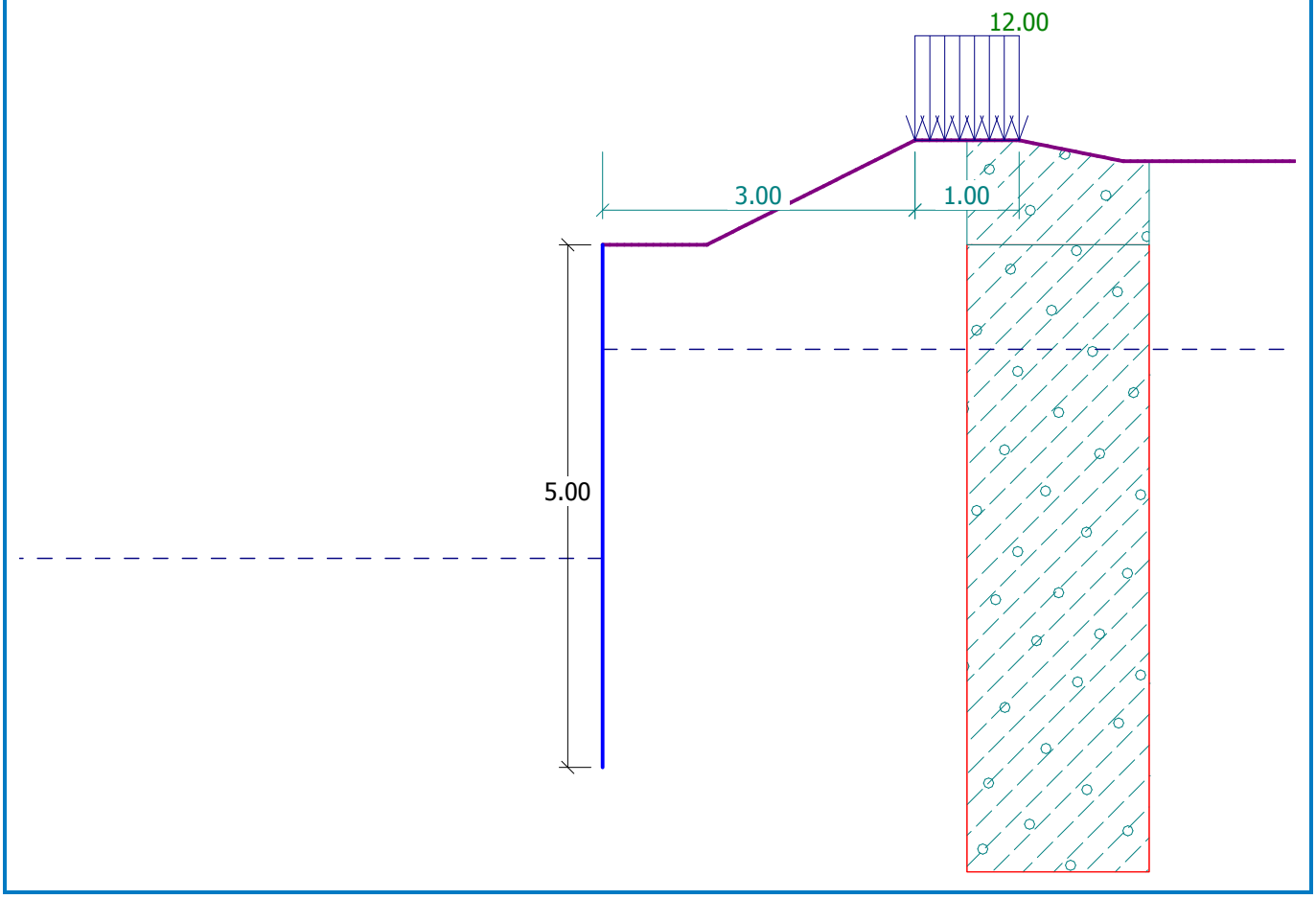
Name : Water **Stage : 1**



Inserted surface loads

No.	Surcharge new	Surcharge change	Name	Action	Mag.1 [kN/m2]	Mag.2 [kN/m2]	Ord.x x [m]	Length l [m]	Depth z [m]
1	YES		Surcharge No. 1	permanent	12.00		3.00	1.00	on terrain

Name : Surcharge | **Stage : 1**



Global settings

Verification methodology : Classical way
Active earth pressure calculation - Coulomb
Passive earth pressure calculation - Caqout-Kerisel

Settings of the stage of construction

Analysis carried out without reduction of input data.

Analysis No. 1

Active pressure behind the structure - partial results

Layer No.	Thickness [m]	α [°]	ϕ_d [°]	c_d [kPa]	γ [kN/m^3]	δ_d [°]	K_a	Comment
1	0.50	0.00	29.00	8.00	19.00	12.00	0.317	
2	0.50	0.00	29.00	8.00	19.00	12.00	0.317	
3	0.61	0.00	29.00	8.00	9.00	12.00	0.317	
4	0.23	0.00	29.00	8.00	9.00	12.00	0.317	
5	0.17	0.00	29.00	8.00	9.00	12.00	0.317	
6	0.99	0.00	29.00	8.00	9.00	12.00	0.563	
7	1.74	0.00	29.00	8.00	9.00	12.00	0.317	
8	0.26	0.00	29.00	8.00	9.00	12.00	0.317	

Active pressure distribution behind the structure (without surcharge)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00	0.00	0.00	0.00
	0.50	9.50	0.00	0.00	0.00	0.00
2	0.50	9.50	0.00	0.00	0.00	0.00
	1.00	19.00	0.00	0.00	0.00	0.00
3	1.00	19.00	0.00	0.00	0.00	0.00
	1.61	24.53	6.14	0.00	0.00	0.00
4	1.61	24.53	6.14	0.00	0.00	0.00
	1.85	26.64	8.49	0.00	0.00	0.00
5	1.85	26.64	8.49	0.00	0.00	0.00
	2.01	28.13	10.15	0.47	0.46	0.10
6	2.01	28.13	10.15	0.47	0.46	0.10
	3.00	37.00	20.00	5.47	5.35	1.14
7	3.00	37.00	20.00	5.47	5.35	1.14
	4.74	52.64	20.00	14.27	13.96	2.97
8	4.74	52.64	20.00	14.27	13.96	2.97
	5.00	55.00	20.00	15.02	14.69	3.12

Water pressure distribution

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00
2	0.50	0.00	0.00
3	1.00	0.00	0.00
4	1.61	6.14	0.00
5	1.85	8.49	0.00
6	2.01	10.15	0.00
7	3.00	20.00	0.00
8	4.74	20.00	0.00
9	5.00	20.00	0.00

Pressure profile due to surcharge - Surcharge No. 1

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00
2	0.00	0.00	0.00
3	0.50	0.00	0.00
4	0.66	0.00	0.00
5	0.66	2.11	0.45
6	1.00	1.99	0.42
7	1.61	1.78	0.38
8	1.85	1.70	0.36
9	2.01	1.64	0.35
10	3.00	1.29	0.27
11	4.74	0.65	0.14
12	5.00	0.55	0.12

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Active pressure	23.43	3.97	4.98	0.00	1.000

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Water pressure	60.00	3.44	0.00	0.00	1.000
Surcharge No. 1	4.16	2.94	1.24	0.00	1.000

Overall pressure acting on the structure

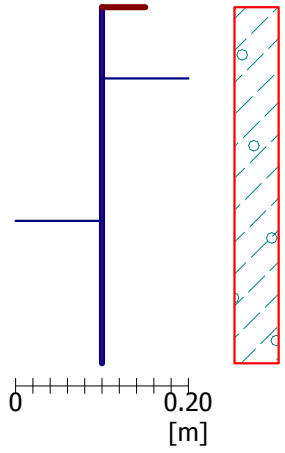
Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00
2	0.00	0.00	0.00
3	0.50	0.00	0.00
4	0.66	0.00	0.00
5	0.66	0.00	0.45
6	1.00	0.00	0.42
7	1.15	1.53	0.41
8	1.61	7.27	0.38
9	1.85	10.19	0.36
10	2.01	12.25	0.45
11	3.00	26.64	1.41
12	4.74	34.61	3.11
13	5.00	35.25	3.24

Resultant forces

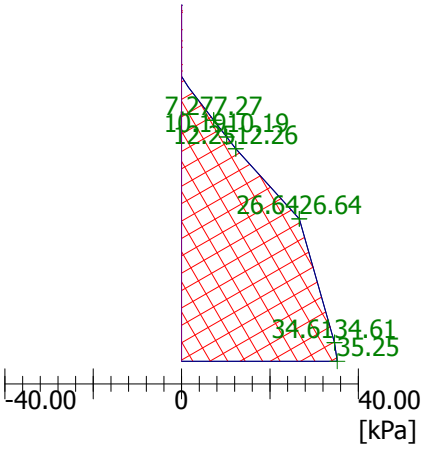
Total horizontal pressure acting on construction = 87.59 kN/m
Application point of horiz. comp. lies in depth = 3.56 m
Total vertical pressure acting on construction = 6.22 kN/m
Dist. of vertical comp. from top of constr. = 0.00 m

Name : Analysis | **Stage : 1; Analysis : 1**

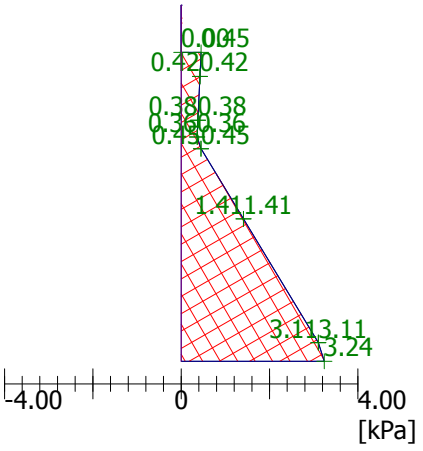
Geometry of structure
Length of structure = 5.00m



Horizontal component
Overall force = 87.59kN/m
Depth of centroid =3.56m

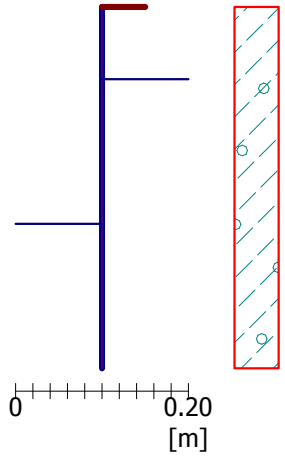


Vertical component
Overall force = 6.22kN/m
Shift of centroid =0.00m

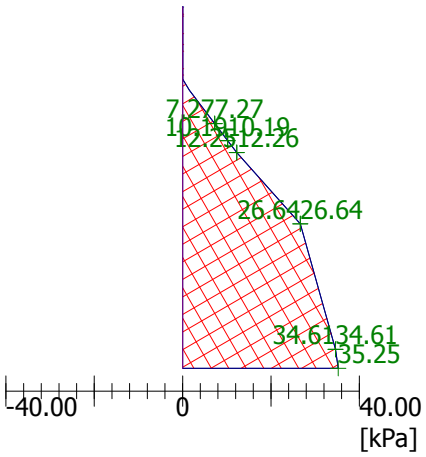


Name : Analysis | **Stage : 1; Analysis : 1**

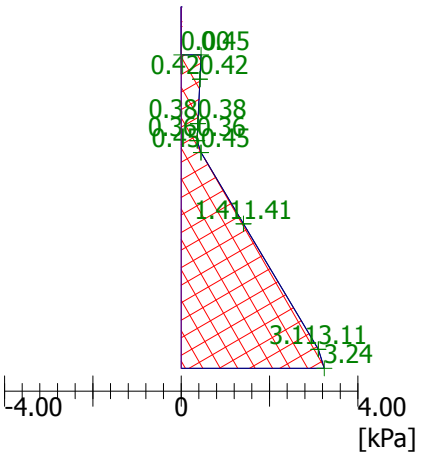
Geometry of structure
Length of structure = 5.00m



Horizontal component
Overall force = 87.59kN/m
Depth of centroid =3.56m



Vertical component
Overall force = 6.22kN/m
Shift of centroid =0.00m



Analysis No. 2

Pressure at rest behind the structure - partial results

Layer No.	Thickness [m]	α [°]	ϕ_d [°]	c_d [kPa]	γ [kN/m³]	K_r	Comment
1	0.50	0.00	29.00	8.00	19.00	0.515	
2	0.50	0.00	29.00	8.00	19.00	0.515	
3	0.96	0.00	29.00	8.00	9.00	0.515	
4	1.04	0.00	29.00	8.00	9.00	0.784	
5	2.00	0.00	29.00	8.00	9.00	0.784	

Pressure at rest distribution behind the structure (without surcharge)

Layer No.	Start [m] / End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00	0.00	0.00	0.00
	0.50	9.50	0.00	4.89	4.89	0.00
2	0.50	9.50	0.00	4.89	4.89	0.00
	1.00	19.00	0.00	9.79	9.79	0.00
3	1.00	19.00	0.00	9.79	9.79	0.00
	1.96	27.68	9.65	14.26	14.26	0.00
4	1.96	27.68	9.65	14.26	14.26	0.00
	3.00	37.00	20.00	21.57	21.57	0.00
5	3.00	37.00	20.00	21.57	21.57	0.00
	5.00	55.00	20.00	35.69	35.69	0.00

Water pressure distribution

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00
2	0.50	0.00	0.00
3	1.00	0.00	0.00
4	1.96	9.65	0.00
5	3.00	20.00	0.00
6	5.00	20.00	0.00

Pressure profile due to surcharge - Surcharge No. 1

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	1.08	0.00
2	0.20	1.21	0.00
3	0.40	1.31	0.00
4	0.50	1.35	0.00
5	0.60	1.37	0.00
6	0.80	1.41	0.00
7	1.00	1.42	0.00
8	1.20	1.41	0.00
9	1.40	1.38	0.00
10	1.60	1.34	0.00
11	1.80	1.29	0.00
12	1.96	1.25	0.00
13	2.00	1.24	0.00
14	2.20	1.18	0.00
15	2.40	1.12	0.00
16	2.60	1.05	0.00
17	2.80	0.99	0.00
18	3.00	0.93	0.00
19	3.20	0.87	0.00
20	3.40	0.82	0.00
21	3.60	0.77	0.00
22	3.80	0.72	0.00
23	4.00	0.67	0.00
24	4.20	0.63	0.00
25	4.40	0.59	0.00
26	4.60	0.55	0.00
27	4.80	0.51	0.00
28	5.00	0.48	0.00

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. Z [m]	F_{vert} [kN/m]	App.Pt. X [m]	Design coefficient
Pressure at rest	92.30	3.26	0.00	0.00	1.000
Water pressure	60.00	3.44	0.00	0.00	1.000
Surcharge No. 1	5.11	2.09	0.00	0.00	1.000

Overall pressure acting on the structure

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	1.08	0.00
2	0.20	3.17	0.00
3	0.40	5.22	0.00
4	0.50	6.24	0.00
5	0.60	7.25	0.00
6	0.80	9.24	0.00
7	1.00	11.21	0.00
8	1.20	14.13	0.00
9	1.40	17.03	0.00
10	1.60	19.91	0.00

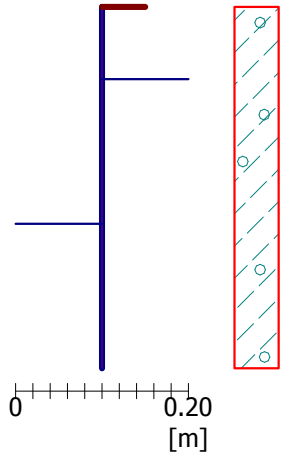
Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
11	1.80	22.79	0.00
12	1.96	25.15	0.00
13	2.00	25.75	0.00
14	2.20	29.10	0.00
15	2.40	32.45	0.00
16	2.60	35.80	0.00
17	2.80	39.15	0.00
18	3.00	42.50	0.00
19	3.20	43.86	0.00
20	3.40	45.21	0.00
21	3.60	46.57	0.00
22	3.80	47.93	0.00
23	4.00	49.30	0.00
24	4.20	50.67	0.00
25	4.40	52.04	0.00
26	4.60	53.41	0.00
27	4.80	54.79	0.00
28	5.00	56.17	0.00

Resultant forces

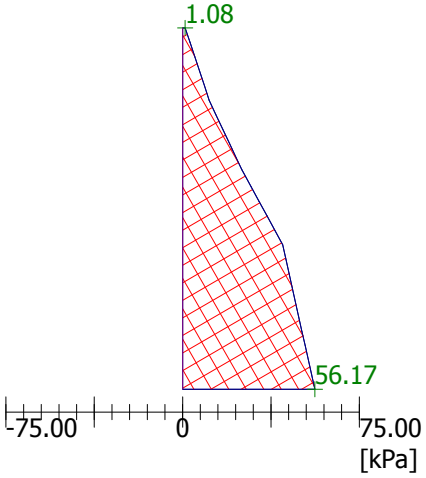
Total horizontal pressure acting on construction = 157.41 kN/m
Application point of horiz. comp. lies in depth = 3.29 m
Total vertical pressure acting on construction = 0.00 kN/m
Dist. of vertical comp. from top of constr. = 0.00 m

Name : Analysis | **Stage : 1; Analysis : 2**

Geometry of structure
Length of structure = 5.00m



Horizontal component
Overall force = 157.41kN/m
Depth of centroid =3.29m



Vertical component
Overall force = 0.00kN/m
Shift of centroid =0.00m