



REPUBLIKA E SHQIPERISE
BASHKIA FUSHE-ARREZ

RELACION TEKNIK

OBJEKTI:

***"STUDIM PROJEKTIM RINDERTIMI I MUREVE MBAJTES TE
SHESHEVE TE PALLATEVE NE QYTETIN FUSHE ARREZ"***



ARABEL – STUDIO

Adresa:Rruga "Frosina Plaku",
Tirane,Shqiperi



HMK-Consulting

Adresa:Rruga "Osman Myderizi", Adresa:Komuna e Parisit
"Komuna e Parisit"
Tirane,Shqiperi



TRANSPORT HIGHWAY CONSULTING

STUDIMI GJEOLOGJIK

Per hartimin e projektit te Rindertimi i mureve mbajtes te shesheve te pallateve ne qytetin fushe arrez, grupi yne i studimit kreu studimin gjeologo-inxhinerik per fazen e projek-zbatimit te shesheve te pallateve te Fushe Arrezit. .

Qellimi i studimit gjeologo-inxhinerik per fazen e projek-zbatimit, eshte:

- te sqaroje ndertimin gjeologo-litologjik te formacioneve
- Te vrojtohen fenomenet fiziko-gjeologjike negative si (rreshqitje,shembje, permbysje).

Per realizimin e studimit te kushteve gjeologo-inxhinerike per fazen e projekt- zbatimit, nga ana e jone u studiuuan materialet arshivale mbi te dhenat gjeologjike te zones .

Ndertimi gjeologjik i zones dhe kushtet gjeologo-inxhinerike .

Mbeshtetur ne rikonjucionin e kryer nga ne dhe ne harten gjeologjike te Shqiperise ne shkallen 1:200000, zona e fushearrezit ,eshte ndertuar nga depozitimet e Jurasikut te mesem.

Keto shtresa jane mbuluar nga masivet ofiolitike me perhapje madheshtore ne zonen e Mirdites. Mes vullkaniteve te ofioliteve takohen ndershtresa dhe thjerrza silicoresh radiolaritike si ne Fushe Arez. Ne baze te shoqerimeve te shumta te radiolarieve, mosha e tyre rezulton e Jurasikut te mesem me gelqerore me veti te mira fiziko-mekanike.

Llogaritjet e mureve mbajtese ne baze te krakteristikave te formacionit ku mbeshteten jane si me poshte

Cantilever wall analysis

Input data

Project

Date : 9/11/2020

Settings

Standard - EN 1997 - DA2

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

Base key : The base key is considered as inclined footing bottom

Allowable eccentricity : 0.333

Verification methodology : according to EN 1997

Design approach : 2 - reduction of actions and resistances

Partial factors on actions (A)			
Seismic design situation			
		Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.00 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]	

Partial factors for resistances (R)			
Seismic design situation			
Partial factor on overturning :		$\gamma_{Re} =$	1.00 [-]
Partial factor on sliding resistance :		$\gamma_{Rh} =$	1.00 [-]
Partial factor on bearing capacity :		$\gamma_{Rv} =$	1.00 [-]

Material of structure

Unit weight $\gamma = 23.56 \text{ kN/m}^3$

Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

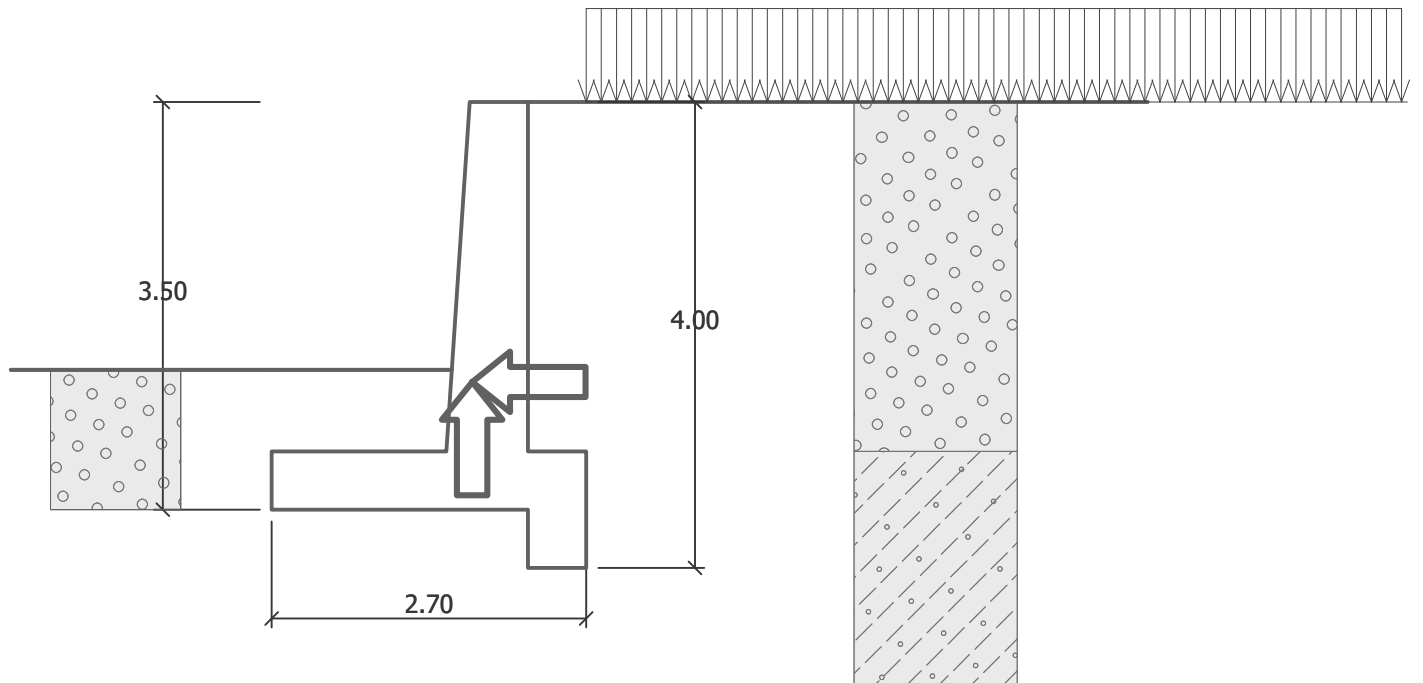
Concrete : C 25/30

Cylinder compressive strength $f_{ck} = 25.00 \text{ MPa}$

Tensile strength $f_{ctm} = 2.60 \text{ MPa}$

Longitudinal steel : B420

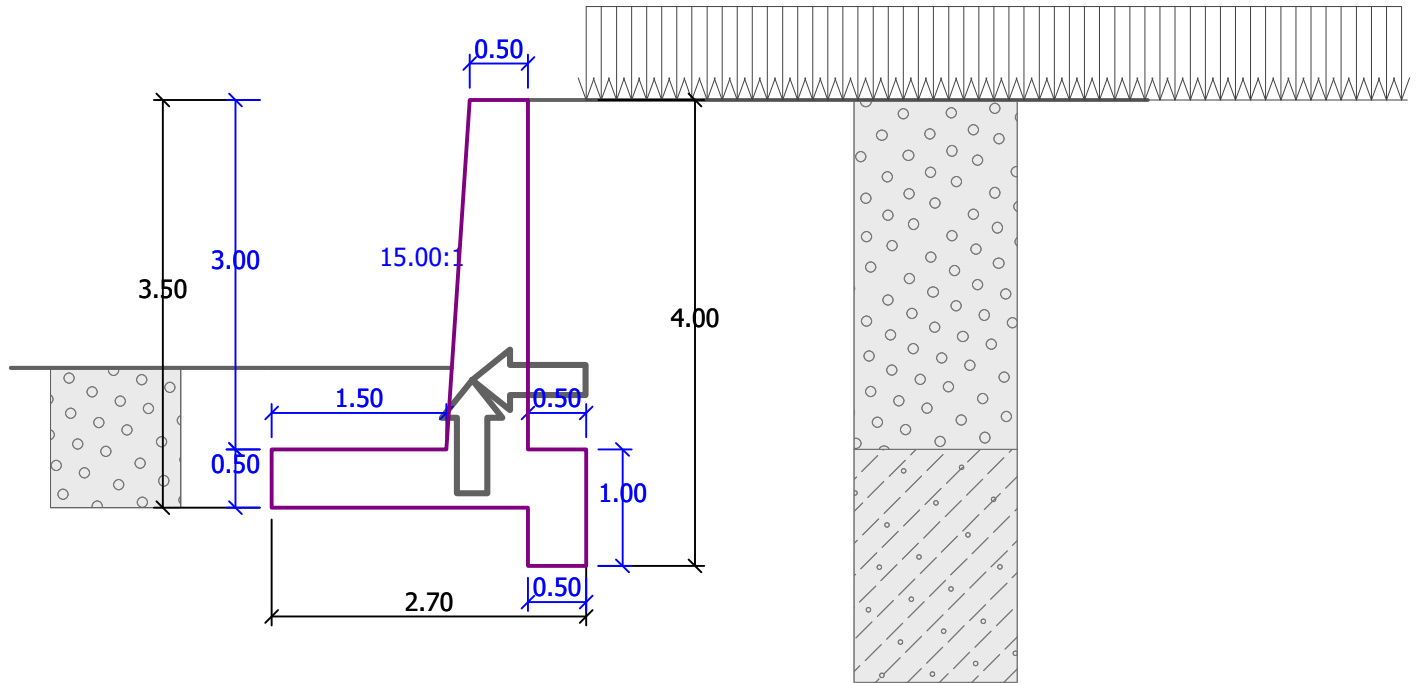
Yield strength $f_{yk} = 420.00 \text{ MPa}$



Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0.00	0.00
2	0.00	3.00
3	0.50	3.00
4	0.50	3.50
5	0.50	4.00
6	0.00	4.00
7	0.00	3.50
8	-2.20	3.50
9	-2.20	3.00
10	-0.70	3.00
11	-0.50	0.00

The origin [0,0] is located at the most upper right point of the wall.
Wall section area = 3.40 m².



Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]	γ_{su} [kN/m ³]	δ [°]
1	Gravel		35.00	0.00	20.00	10.00	20.00
2	Silty clay		22.00	18.00	19.30	10.00	17.00
3	Rock		22.00	35.00	19.60	10.00	20.00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	φ_{ef} [°]	ν [-]	OCR [-]	K_r [-]
1	Gravel		cohesionless	35.00	-	-	-
2	Silty clay		cohesive	-	0.40	-	-
3	Rock		cohesive	-	0.25	-	-

Soil parameters

GravelUnit weight : $\gamma = 20.00$ kN/m³

Stress-state : effective

Angle of internal friction : $\varphi_{ef} = 35.00$ °

Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20.00^\circ$
 Soil : cohesionless
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$



Silty clay

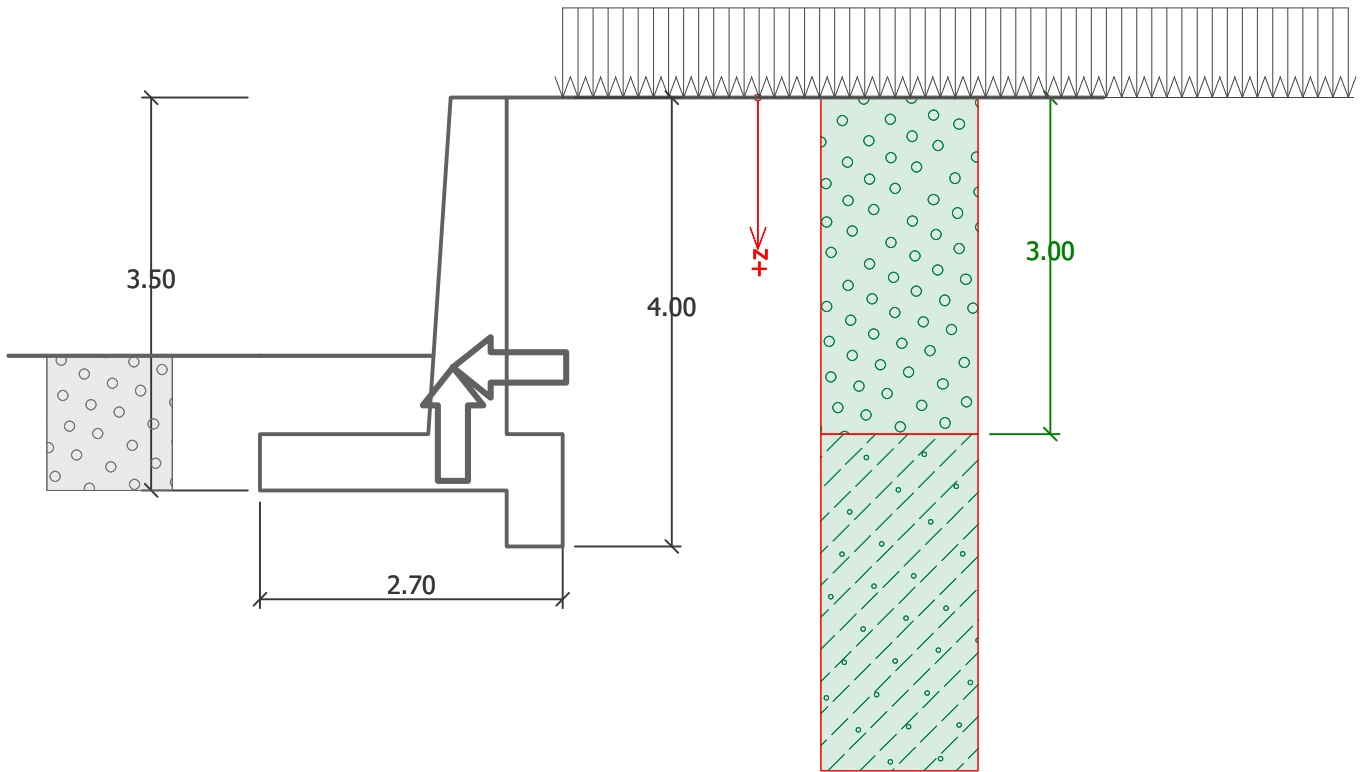
Unit weight : $\gamma = 19.30 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 18.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 17.00^\circ$
 Soil : cohesive
 Poisson's ratio : $\nu = 0.40$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Rock

Unit weight : $\gamma = 19.60 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 35.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20.00^\circ$
 Soil : cohesive
 Poisson's ratio : $\nu = 0.25$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	3.00	Gravel	
2	-	Silty clay	



Foundation

Type of foundation : soil from geological profile

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/m²]	Mag.2 [kN/m²]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	YES		variable	20.00		0.50	7.00	on terrain

No.	Name
1	TL

Resistance on front face of the structure

Resistance on front face of the structure: passive

Soil on front face of the structure - Gravel

Angle of friction struc.-soil $\delta = 15.00^\circ$

Soil thickness in front of structure $h = 1.20 \text{ m}$

Terrain in front of structure is flat.

Earthquake

Factor of horizontal acceleration $K_h = 0.3000$

Factor of vertical acceleration $K_v = 0.1500$

Water below the GWT is restricted.

Settings of the stage of construction

Design situation : seismic

Active pressure acts on the wall and stem.

Verification No. 1

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.70	3.81	35.00	0.00	20.00	-15.00	5.718	
2	0.00	89.95(30.00)	35.00	0.00	20.00	-15.00	2.341	MODIFIED
3	0.30	0.00	35.00	0.00	20.00	-15.00	6.368	
4	0.20	0.00	35.00	0.00	20.00	-15.00	6.368	

Passive pressure distribution on front face of the structure

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
	0.70	14.00	0.00	80.05	78.53	-15.53
2	0.70	14.00	0.00	32.78	8.51	31.65
	0.70	14.03	0.00	32.84	8.53	31.71
3	0.70	14.03	0.00	89.32	86.28	-23.12
	1.00	20.00	0.00	127.35	123.01	-32.96
4	1.00	20.00	0.00	127.35	123.01	-32.96
	1.20	24.00	0.00	152.83	147.62	-39.55

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.70	35.00	0.00	19.44	3.381	2.736	-0.646	
2	0.00	35.00	0.00	19.44	2.392	2.193	-0.198	
3	0.30	35.00	0.00	19.44	3.690	2.937	-0.753	
4	0.20	35.00	0.00	19.44	3.690	2.937	-0.753	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	20.40	-13.17	-12.92	2.56
	0.70	11.90	8.50	-5.49	-5.38	1.06
2	0.70	11.90	8.50	-1.69	-0.44	-1.63
	0.70	11.92	8.48	-1.68	-0.44	-1.62
3	0.70	11.92	8.48	-6.38	-6.16	1.65
	1.00	17.00	3.40	-2.56	-2.47	0.66
4	1.00	17.00	3.40	-2.56	-2.47	0.66
	1.20	20.40	0.00	0.00	0.00	0.00



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	2.04	0.00	35.00	0.00	20.00	20.00	0.245	
2	0.96	27.50	35.00	0.00	20.00	35.00	0.587	
3	0.50	0.00	22.00	18.00	19.30	17.00	0.401	
4	0.50	0.00	22.00	18.00	19.30	17.00	0.401	

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
	2.04	40.79	0.00	10.00	9.39	3.42
2	2.04	40.79	0.00	23.94	11.05	21.23
	3.00	60.00	0.00	35.21	16.26	31.23
3	3.00	60.00	0.00	3.60	3.44	1.05
	3.50	69.65	0.00	7.47	7.14	2.18
4	3.50	69.65	0.00	7.47	7.14	2.18
	4.00	79.30	0.00	11.34	10.85	3.32

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	2.04	35.00	0.00	19.44	0.245	0.542	0.297	
2	0.96	35.00	0.00	19.44	0.587	1.566	0.979	
3	0.50	22.00	0.00	19.44	0.401	0.934	0.532	
4	0.50	22.00	0.00	19.44	0.401	0.934	0.532	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	67.41	20.01	18.81	6.85
	2.04	34.67	32.73	9.72	9.13	3.32
2	2.04	34.67	32.73	32.05	14.80	28.43
	3.00	51.00	16.41	16.07	7.42	14.25
3	3.00	51.00	16.41	8.73	8.35	2.55
	3.50	59.20	8.20	4.37	4.18	1.28
4	3.50	59.20	8.20	4.37	4.18	1.28
	4.00	67.41	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	2.04	4.63	1.69

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
6	2.04	2.25	4.33
7	3.00	2.23	4.29
8	3.00	7.57	2.31
9	3.50	7.52	2.30
10	3.50	7.54	2.30
11	4.00	7.49	2.29

Forces acting on construction

Name	F _{hor} [kN/m]	App.Pt. z [m]	F _{vert} [kN/m]	App.Pt. x [m]	Coeff. overturn.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-1.10	80.11	1.72	1.000	1.000	1.000
Earthq.- constr.	24.03	-1.10	-12.02	1.72	1.000	1.000	1.000
FF resistance	-85.81	-0.39	-21.02	0.39	1.000	1.000	1.000
Earthq.- face	7.94	-0.79	1.68	1.15	1.000	1.000	1.000
Weight - earth wedge	0.00	-0.82	4.80	2.37	1.000	1.000	1.000
Earthquake - soil wedge	1.44	-0.82	-0.72	2.37	1.000	1.000	1.000
Active pressure	29.84	-1.08	30.87	2.45	1.000	1.000	1.000
Earthq.- act.pressure	43.34	-1.98	32.15	2.36	1.000	1.000	1.000
TL	17.58	-1.16	9.32	2.43	0.700	0.700	0.700

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 288.04$ kNm/m

Overtuning moment $M_{ovr} = 132.67$ kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 95.32$ kN/m

Active horizontal force $H_{act} = 10.26$ kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 51.38 kPa

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	9.83	126.35	9.53	0.053	51.38

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	9.83	126.35	9.53

Verification of foundation soil

Eccentricity verification

Max. eccentricity of normal force $e = 0.053$
 Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Max. stress at footing bottom $\sigma = 51.38$ kPa
 Bearing capacity of foundation soil $R_d = 300.00$ kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.70	3.81	35.00	0.00	20.00	-15.00	5.718	

Passive pressure distribution on front face of the structure

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
	0.70	13.98	0.00	79.91	78.39	-15.50

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.70	35.00	0.00	19.44	3.381	2.736	-0.646	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	11.88	-7.67	-7.52	1.49
	0.70	11.88	0.00	0.00	0.00	0.00

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	3.00	0.00	35.00	0.00	20.00	20.00	0.245	

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
	3.00	59.98	0.00	14.70	13.81	5.03

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	3.00	35.00	0.00	19.44	0.245	0.542	0.297	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	50.98	15.14	14.22	5.18
	3.00	50.98	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	3.00	4.59	1.67

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. moment	Coeff. norm.force	Coeff. shear for.
Weight - wall	0.00	-1.42	42.39	0.40	1.000	1.000	1.000
Earthq.- constr.	12.72	-1.42	-6.36	0.40	1.000	1.000	1.000
FF resistance	-27.39	-0.23	-5.42	0.02	1.000	1.000	1.000
Earthq.- face	2.63	-0.47	0.52	0.03	1.000	1.000	1.000
Active pressure	20.71	-1.00	7.54	0.70	1.000	1.000	1.000
Earthq.- act.pressure	21.33	-2.00	7.76	0.70	1.000	1.000	1.000
TL	12.32	-1.33	4.48	0.70	0.700	0.700	0.700

Wall stem check

Reinforcement and dimensions of the cross-section

Bar diameter = 20.0 mm

Number of bars = 5

Reinforcement cover = 30.0 mm

Cross-section width = 1.00 m

Cross-section depth = 0.70 m

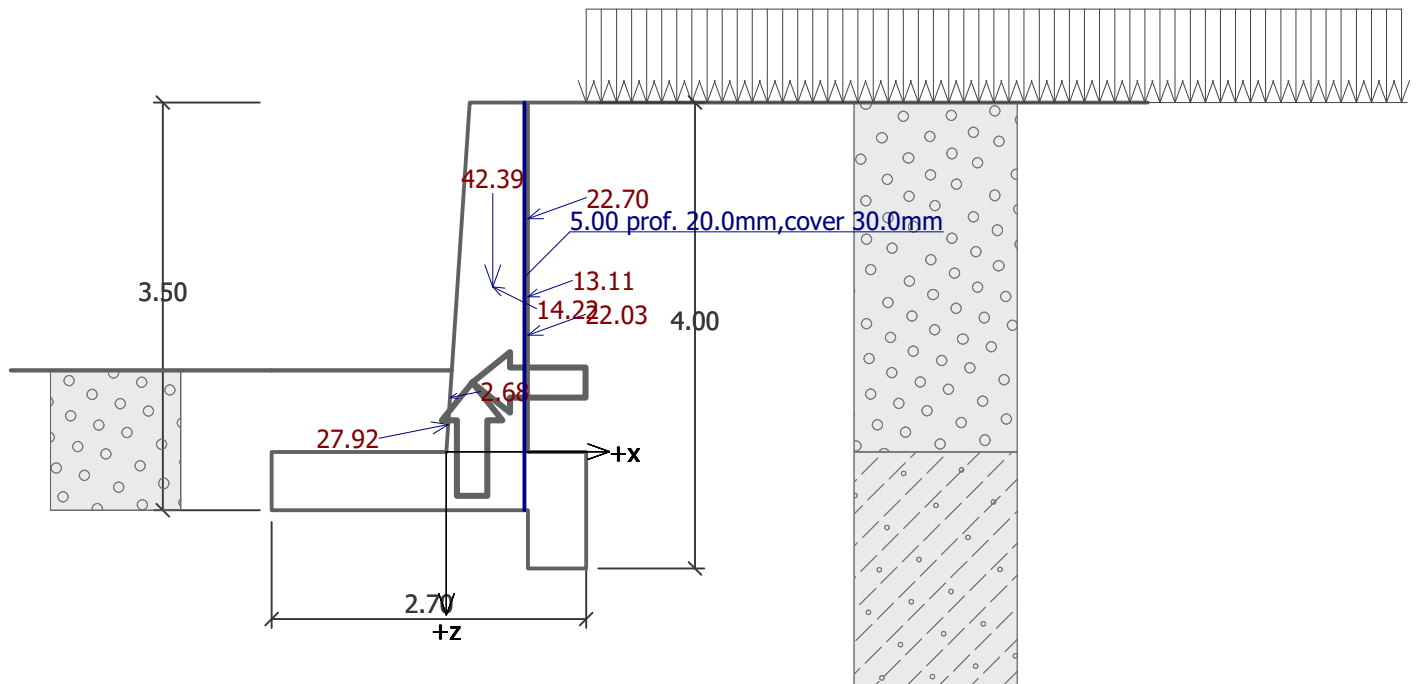
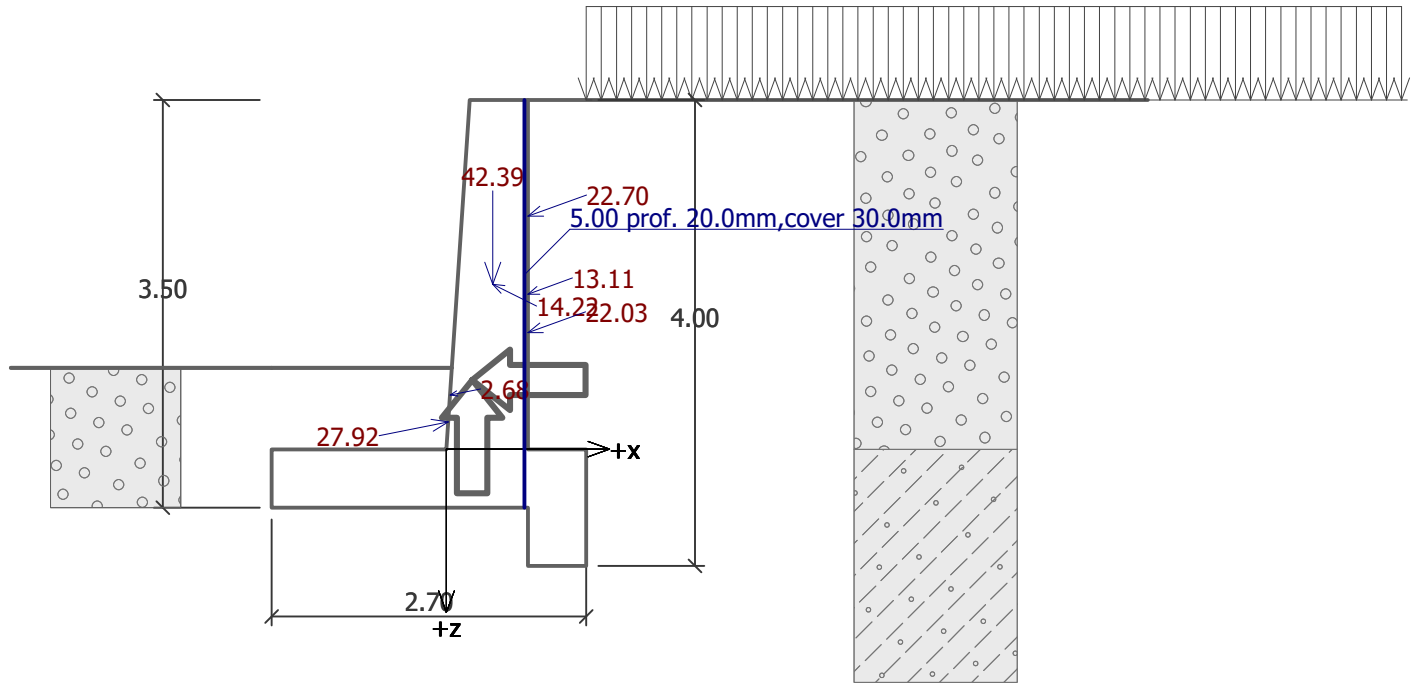
Reinforcement ratio $\rho = 0.24 \% > 0.16 \% = \rho_{min}$

Position of neutral axis $x = 0.04 \text{ m} < 0.43 \text{ m} = x_{max}$

Ultimate shear force $V_{Rd} = 226.46 \text{ kN} > 38.62 \text{ kN} = V_{Ed}$

Ultimate moment $M_{Rd} = 368.71 \text{ kNm} > 77.86 \text{ kNm} = M_{Ed}$

Cross-section is SATISFACTORY.



Dimensioning No. 2

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.70	3.81	35.00	0.00	20.00	-15.00	5.718	
2	0.00	89.95(30.00)	35.00	0.00	20.00	-15.00	2.341	MODIFIED
3	0.30	0.00	35.00	0.00	20.00	-15.00	6.368	
4	0.20	0.00	35.00	0.00	20.00	-15.00	6.368	

Passive pressure distribution on front face of the structure

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
	0.70	14.00	0.00	80.05	78.53	-15.53
2	0.70	14.00	0.00	32.78	8.51	31.65
	0.70	14.03	0.00	32.84	8.53	31.71
3	0.70	14.03	0.00	89.32	86.28	-23.12
	1.00	20.00	0.00	127.35	123.01	-32.96
4	1.00	20.00	0.00	127.35	123.01	-32.96
	1.20	24.00	0.00	152.83	147.62	-39.55

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.70	35.00	0.00	19.44	3.381	2.736	-0.646	
2	0.00	35.00	0.00	19.44	2.392	2.193	-0.198	
3	0.30	35.00	0.00	19.44	3.690	2.937	-0.753	
4	0.20	35.00	0.00	19.44	3.690	2.937	-0.753	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	20.40	-13.17	-12.92	2.56
	0.70	11.90	8.50	-5.49	-5.38	1.06
2	0.70	11.90	8.50	-1.69	-0.44	-1.63
	0.70	11.92	8.48	-1.68	-0.44	-1.62
3	0.70	11.92	8.48	-6.38	-6.16	1.65
	1.00	17.00	3.40	-2.56	-2.47	0.66
4	1.00	17.00	3.40	-2.56	-2.47	0.66
	1.20	20.40	0.00	0.00	0.00	0.00

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	2.04	0.00	35.00	0.00	20.00	20.00	0.245	
2	0.96	27.50	35.00	0.00	20.00	35.00	0.587	
3	0.50	0.00	22.00	18.00	19.30	17.00	0.401	

--	--	--	--	--	--	--	--	--

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_a	Comment
4	0.50	0.00	22.00	18.00	19.30	17.00	0.401	

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
	2.04	40.79	0.00	10.00	9.39	3.42
2	2.04	40.79	0.00	23.94	11.05	21.23
	3.00	60.00	0.00	35.21	16.26	31.23
3	3.00	60.00	0.00	3.60	3.44	1.05
	3.50	69.65	0.00	7.47	7.14	2.18
4	3.50	69.65	0.00	7.47	7.14	2.18
	4.00	79.30	0.00	11.34	10.85	3.32

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	2.04	35.00	0.00	19.44	0.245	0.542	0.297	
2	0.96	35.00	0.00	19.44	0.587	1.566	0.979	
3	0.50	22.00	0.00	19.44	0.401	0.934	0.532	
4	0.50	22.00	0.00	19.44	0.401	0.934	0.532	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	67.41	20.01	18.81	6.85
	2.04	34.67	32.73	9.72	9.13	3.32
2	2.04	34.67	32.73	32.05	14.80	28.43
	3.00	51.00	16.41	16.07	7.42	14.25
3	3.00	51.00	16.41	8.73	8.35	2.55
	3.50	59.20	8.20	4.37	4.18	1.28
4	3.50	59.20	8.20	4.37	4.18	1.28
	4.00	67.41	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	2.04	4.63	1.69
6	2.04	2.25	4.33
7	3.00	2.23	4.29
8	3.00	7.57	2.31
9	3.50	7.52	2.30

--	--	--	--	--	--

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
10	3.50	7.54	2.30
11	4.00	7.49	2.29

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	-1.10	80.11	1.72	1.000
Earthq.- constr.	24.03	-1.10	-12.02	1.72	1.000
FF resistance	-85.81	-0.39	-21.02	0.39	1.000
Earthq.- face	7.94	-0.79	1.68	1.15	1.000
Weight - earth wedge	0.00	-0.82	4.80	2.37	1.000
Earthquake - soil wedge	1.44	-0.82	-0.72	2.37	1.000
Active pressure	29.84	-1.08	30.87	2.45	1.000
Earthq.- act.pressure	43.34	-1.98	32.15	2.36	1.000
TL	17.58	-1.16	9.32	2.43	0.700

Front wall jump check

Reinforcement and dimensions of the cross-section

Bar diameter = 16.0 mm

Number of bars = 5

Reinforcement cover = 30.0 mm

Cross-section width = 1.00 m

Cross-section depth = 0.50 m

Reinforcement ratio $\rho = 0.22 \% > 0.16 \% = \rho_{min}$

Position of neutral axis $x = 0.03 \text{ m} < 0.30 \text{ m} = x_{max}$

Ultimate shear force $V_{Rd} = 172.60 \text{ kN} > 80.13 \text{ kN} = V_{Ed}$

Ultimate moment $M_{Rd} = 165.58 \text{ kNm} > 63.20 \text{ kNm} = M_{Ed}$

Cross-section is SATISFACTORY.

Dimensioning No. 3

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.70	3.81	35.00	0.00	20.00	-15.00	5.718	
2	0.00	89.95(30.00)	35.00	0.00	20.00	-15.00	2.341	MODIFIED
3	0.30	0.00	35.00	0.00	20.00	-15.00	6.368	
4	0.20	0.00	35.00	0.00	20.00	-15.00	6.368	

Passive pressure distribution on front face of the structure

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
	0.70	14.00	0.00	80.05	78.53	-15.53
2	0.70	14.00	0.00	32.78	8.51	31.65
	0.70	14.03	0.00	32.84	8.53	31.71

--

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
3	0.70	14.03	0.00	89.32	86.28	-23.12
	1.00	20.00	0.00	127.35	123.01	-32.96
4	1.00	20.00	0.00	127.35	123.01	-32.96
	1.20	24.00	0.00	152.83	147.62	-39.55

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.70	35.00	0.00	19.44	3.381	2.736	-0.646	
2	0.00	35.00	0.00	19.44	2.392	2.193	-0.198	
3	0.30	35.00	0.00	19.44	3.690	2.937	-0.753	
4	0.20	35.00	0.00	19.44	3.690	2.937	-0.753	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	20.40	-13.17	-12.92	2.56
	0.70	11.90	8.50	-5.49	-5.38	1.06
2	0.70	11.90	8.50	-1.69	-0.44	-1.63
	0.70	11.92	8.48	-1.68	-0.44	-1.62
3	0.70	11.92	8.48	-6.38	-6.16	1.65
	1.00	17.00	3.40	-2.56	-2.47	0.66
4	1.00	17.00	3.40	-2.56	-2.47	0.66
	1.20	20.40	0.00	0.00	0.00	0.00

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	2.04	0.00	35.00	0.00	20.00	20.00	0.245	
2	0.96	27.50	35.00	0.00	20.00	35.00	0.587	
3	0.50	0.00	22.00	18.00	19.30	17.00	0.401	
4	0.50	0.00	22.00	18.00	19.30	17.00	0.401	

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
	2.04	40.79	0.00	10.00	9.39	3.42
2	2.04	40.79	0.00	23.94	11.05	21.23
	3.00	60.00	0.00	35.21	16.26	31.23
3	3.00	60.00	0.00	3.60	3.44	1.05
	3.50	69.65	0.00	7.47	7.14	2.18
4	3.50	69.65	0.00	7.47	7.14	2.18
	4.00	79.30	0.00	11.34	10.85	3.32

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	2.04	35.00	0.00	19.44	0.245	0.542	0.297	
2	0.96	35.00	0.00	19.44	0.587	1.566	0.979	
3	0.50	22.00	0.00	19.44	0.401	0.934	0.532	
4	0.50	22.00	0.00	19.44	0.401	0.934	0.532	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	67.41	20.01	18.81	6.85
	2.04	34.67	32.73	9.72	9.13	3.32
2	2.04	34.67	32.73	32.05	14.80	28.43
	3.00	51.00	16.41	16.07	7.42	14.25
3	3.00	51.00	16.41	8.73	8.35	2.55
	3.50	59.20	8.20	4.37	4.18	1.28
4	3.50	59.20	8.20	4.37	4.18	1.28
	4.00	67.41	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	2.04	4.63	1.69
6	2.04	2.25	4.33
7	3.00	2.23	4.29
8	3.00	7.57	2.31
9	3.50	7.52	2.30
10	3.50	7.54	2.30
11	4.00	7.49	2.29

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	-0.25	5.89	2.45	1.000
Weight - earth wedge	0.00	-0.82	4.80	2.37	1.000
Active pressure	29.84	-1.08	30.87	2.45	1.000
TL	17.58	-1.16	9.32	2.43	0.700
Contact stress	0.00	0.00	-17.33	2.44	1.000

Back wall jump check

Reinforcement and dimensions of the cross-section

Bar diameter = 14.0 mm

Number of bars = 5

Reinforcement cover = 30.0 mm

Cross-section width = 1.00 m
 Cross-section depth = 0.50 m
 Reinforcement ratio $\rho = 0.17\% > 0.16\% = \rho_{min}$
 Position of neutral axis $x = 0.02\text{ m} < 0.30\text{ m} = x_{max}$
 Ultimate shear force $V_{Rd} = 172.86\text{ kN} > 30.75\text{ kN} = V_{Ed}$
 Ultimate moment $M_{Rd} = 127.78\text{ kNm} > 7.38\text{ kNm} = M_{Ed}$

Cross-section is SATISFACTORY.

Slope stability analysis

Input data

Project

Settings

Standard - EN 1997 - DA2

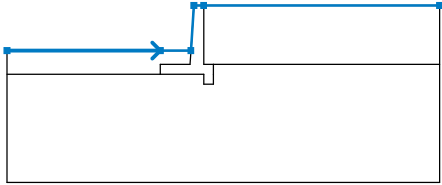
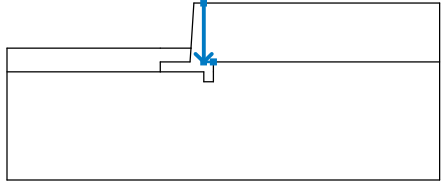
Stability analysis

Earthquake analysis : Standard
 Verification methodology : according to EN 1997
 Design approach : 2 - reduction of actions and resistances

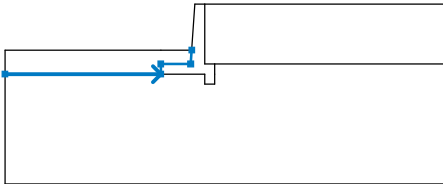
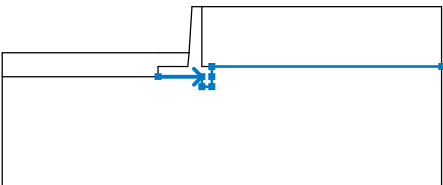
Partial factors on actions (A)			
Seismic design situation			
		Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.00 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]	

Partial factors for resistances (R)			
Seismic design situation			
Partial factor on sliding resistance (on slip surface) :	$\gamma_{Rs} =$	1.00 [-]	

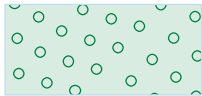


Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-10.00	-2.30	-2.20	-2.30	-0.65	-2.30
		-0.50	0.00	0.00	0.00	12.00	0.00
2		0.00	0.00	0.00	-3.00	0.50	-3.00

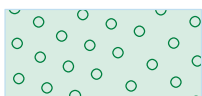




No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
3		-10.00	-3.50	-2.20	-3.50	-2.20	-3.00
		-0.70	-3.00	-0.65	-2.30		
4		-2.20	-3.50	0.00	-3.50	0.00	-4.00
		0.50	-4.00	0.50	-3.50	0.50	-3.00
		12.00	-3.00				

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
1	Gravel		35.00	0.00	20.00
2	Silty clay		22.00	18.00	19.30
3	Rock		22.00	35.00	19.60

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Gravel		20.00		
2	Silty clay		20.00		
3	Rock		20.00		

Soil parameters

Gravel

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


Silty clay

Unit weight : $\gamma = 19.30 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 18.00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

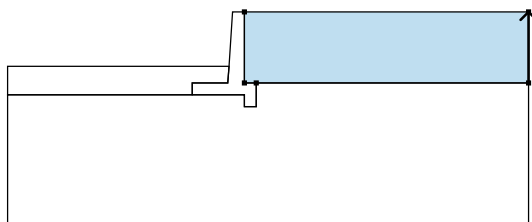
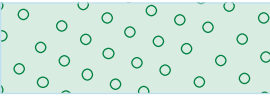
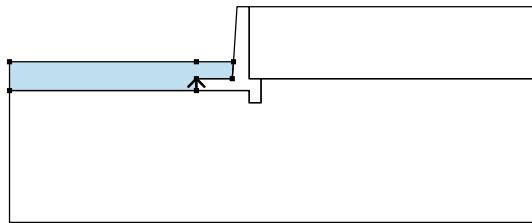

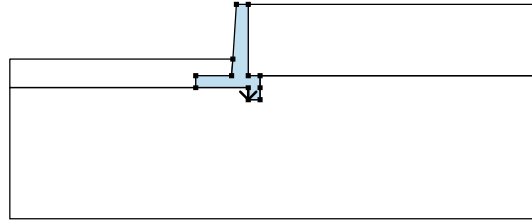
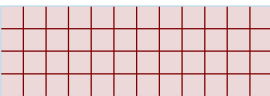
Rock

Unit weight : $\gamma = 19.60 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 35.00 \text{ kPa}$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Rigid bodies

No.	Name	Sample	γ [kN/m ³]
1	Wall material		23.56

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		12.00	-3.00	12.00	0.00	Gravel 
		0.00	0.00	0.00	-3.00	
		0.50	-3.00			
2		-2.20	-3.50	-2.20	-3.00	Gravel 
		-0.70	-3.00	-0.65	-2.30	
		-2.20	-2.30	-10.00	-2.30	
		-10.00	-3.50			
3		0.00	-3.50	0.00	-4.00	Wall material 
		0.50	-4.00	0.50	-3.50	
		0.50	-3.00	0.00	-3.00	
		0.00	0.00	-0.50	0.00	
		-0.65	-2.30	-0.70	-3.00	
		-2.20	-3.00	-2.20	-3.50	



No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
4		0.50	-3.00	0.50	-3.50	Silty clay
		0.50	-4.00	0.00	-4.00	
		0.00	-3.50	-2.20	-3.50	
		-10.00	-3.50	-10.00	-9.00	
		12.00	-9.00	12.00	-3.00	

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 = 0.50	l = 7.00		0.00	20.00	kN/m ²

Surcharges

No.	Name
1	TL

Water

Water type : No water

Tensile crack

Tensile crack not inputted.

Earthquake

Horizontal seismic coefficient : $K_h = 0.30$

Vertical seismic coefficient : $K_v = 0.15$

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters						
Center :	x =	-0.49	[m]	Angles :	$\alpha_1 =$	-36.44 [°]
	z =	4.94	[m]		$\alpha_2 =$	56.71 [°]
Radius :	R =	9.00	[m]			

The slip surface after optimization.

Slope stability verification (Bishop)

Sum of active forces : $F_a = 286.99$ kN/m

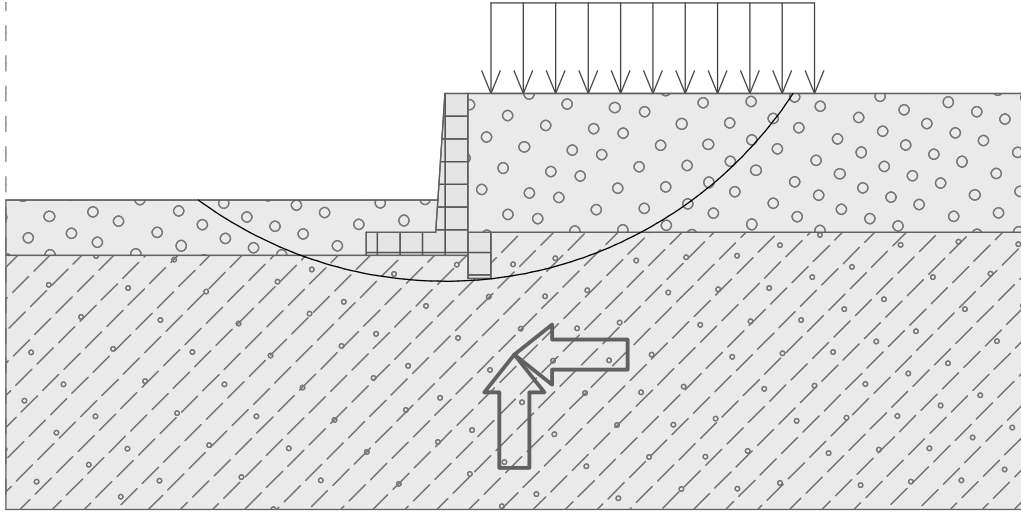
Sum of passive forces : $F_p = 439.52$ kN/m

Sliding moment : $M_a = 2582.94$ kNm/m

Resisting moment : $M_p = 3955.66$ kNm/m

Utilization : 65.3 %

Slope stability ACCEPTABLE



Cantilever wall analysis

Input data

Project

Date : 9/11/2020

Settings

Standard - EN 1997 - DA2

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

Base key : The base key is considered as inclined footing bottom

Allowable eccentricity : 0.333

Verification methodology : according to EN 1997

Design approach : 2 - reduction of actions and resistances

Partial factors on actions (A)			
Seismic design situation			
		Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.00 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]	

Partial factors for resistances (R)			
Seismic design situation			
Partial factor on overturning :		$\gamma_{Re} =$	1.00 [-]
Partial factor on sliding resistance :		$\gamma_{Rh} =$	1.00 [-]
Partial factor on bearing capacity :		$\gamma_{Rv} =$	1.00 [-]

Material of structure

Unit weight $\gamma = 23.56 \text{ kN/m}^3$

Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

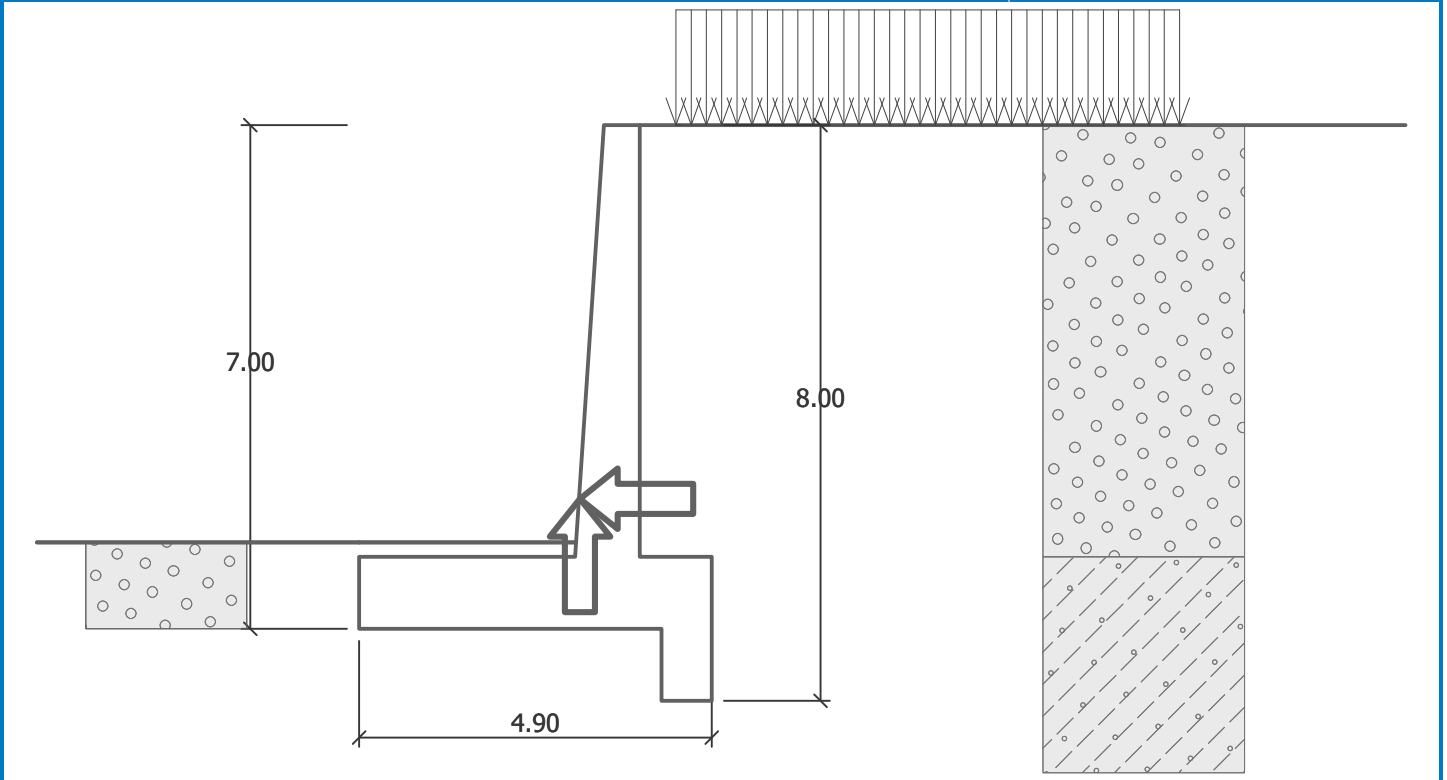
Concrete : C 25/30

Cylinder compressive strength $f_{ck} = 25.00 \text{ MPa}$

Tensile strength $f_{ctm} = 2.60 \text{ MPa}$

Longitudinal steel : B420

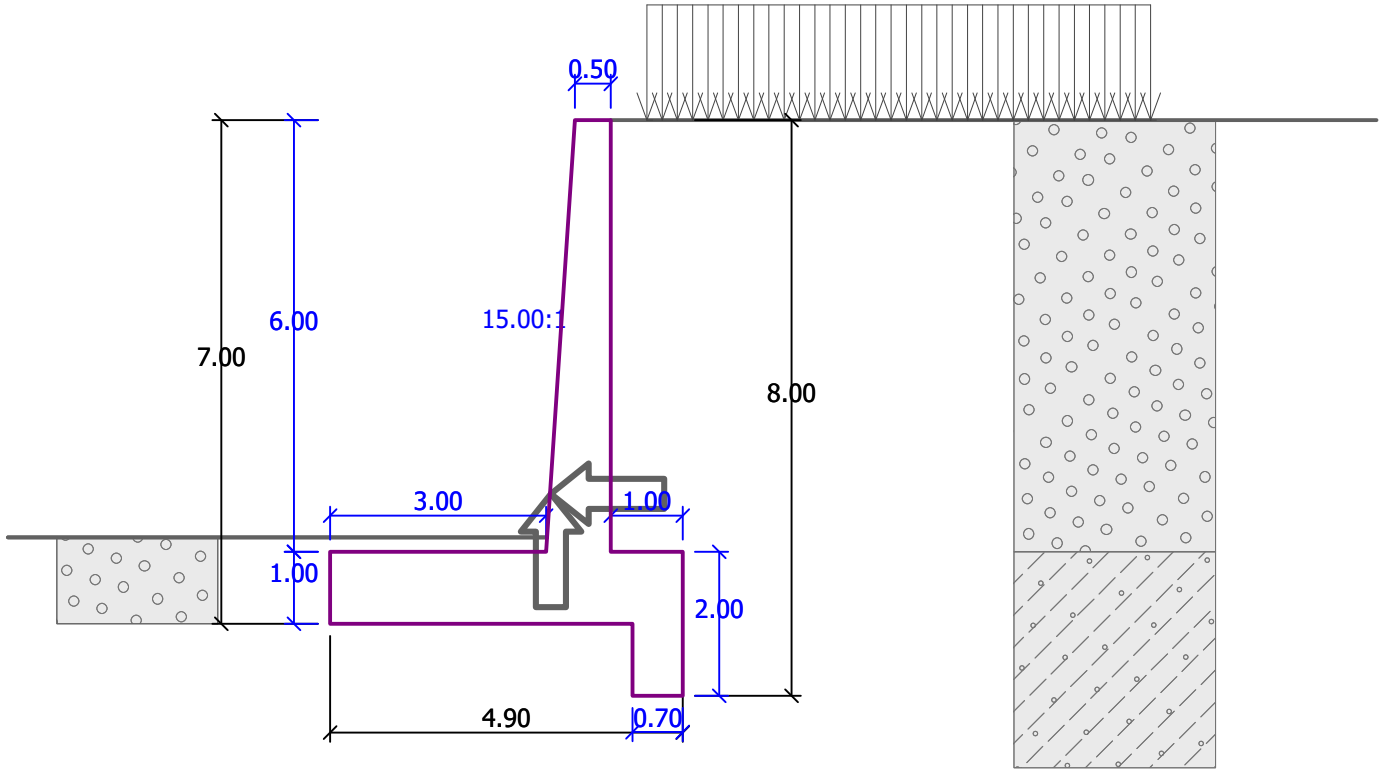
Yield strength $f_{yk} = 420.00 \text{ MPa}$



Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0.00	0.00
2	0.00	6.00
3	1.00	6.00
4	1.00	7.00
5	1.00	8.00
6	0.30	8.00
7	0.30	7.00
8	-3.90	7.00
9	-3.90	6.00
10	-0.90	6.00
11	-0.50	0.00

The origin [0,0] is located at the most upper right point of the wall.
 Wall section area = 9.80 m².



Basic soil parameters

No.	Name	Pattern	ϕ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]	γ_{su} [kN/m ³]	δ [°]
1	Gravel		35.00	0.00	20.00	10.00	20.00
2	Silty clay		22.00	18.00	19.30	10.00	17.00
3	Rock		22.00	35.00	19.60	10.00	20.00

Soil parameters to compute pressure at rest

No.	Name	Pattern	Type calculation	ϕ_{ef} [°]	ν [-]	OCR [-]	K_r [-]
1	Gravel		cohesionless	35.00	-	-	-
2	Silty clay		cohesive	-	0.40	-	-
3	Rock		cohesive	-	0.25	-	-

Soil parameters

Gravel

Unit weight : $\gamma = 20.00$ kN/m³
 Stress-state : effective

Angle of internal friction : $\varphi_{ef} = 35.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20.00^\circ$
 Soil : cohesionless
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$



Silty clay

Unit weight : $\gamma = 19.30 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 18.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 17.00^\circ$
 Soil : cohesive
 Poisson's ratio : $\nu = 0.40$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Rock

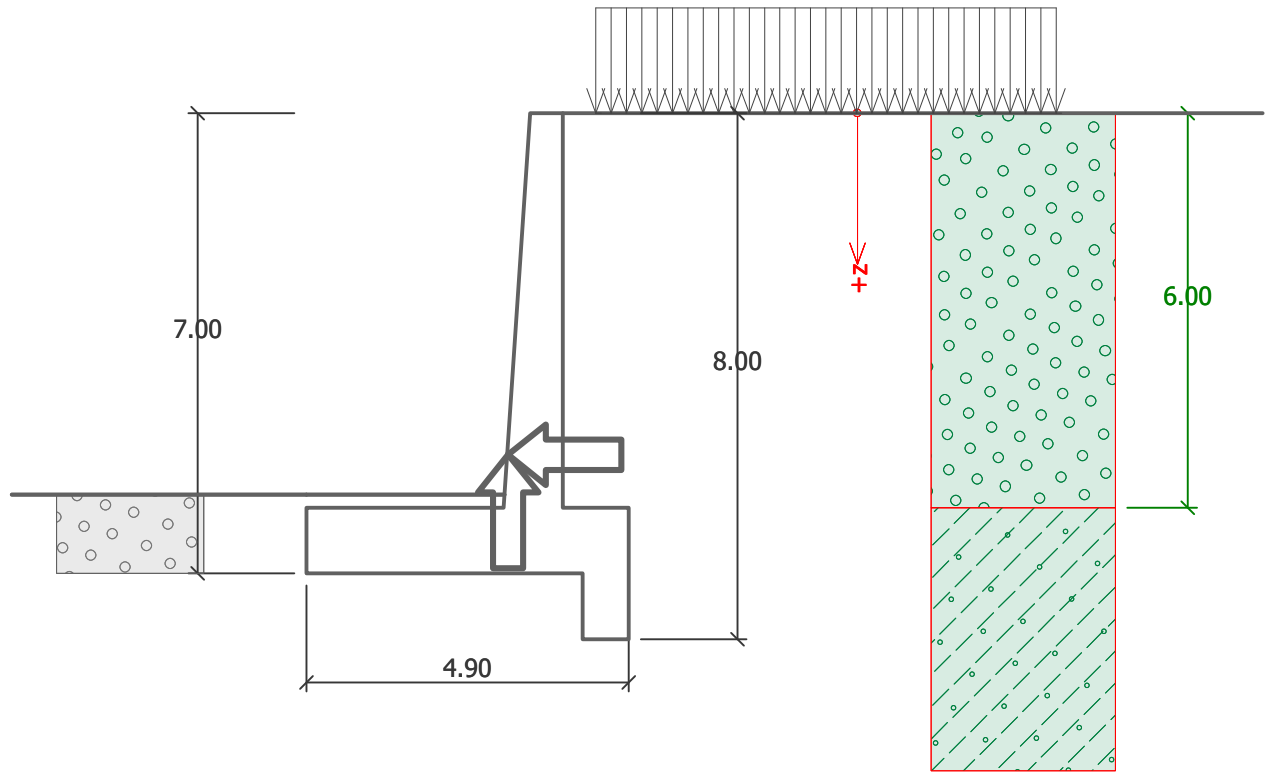
Unit weight : $\gamma = 19.60 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 35.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20.00^\circ$
 Soil : cohesive
 Poisson's ratio : $\nu = 0.25$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	6.00	Gravel	
2	-	Silty clay	

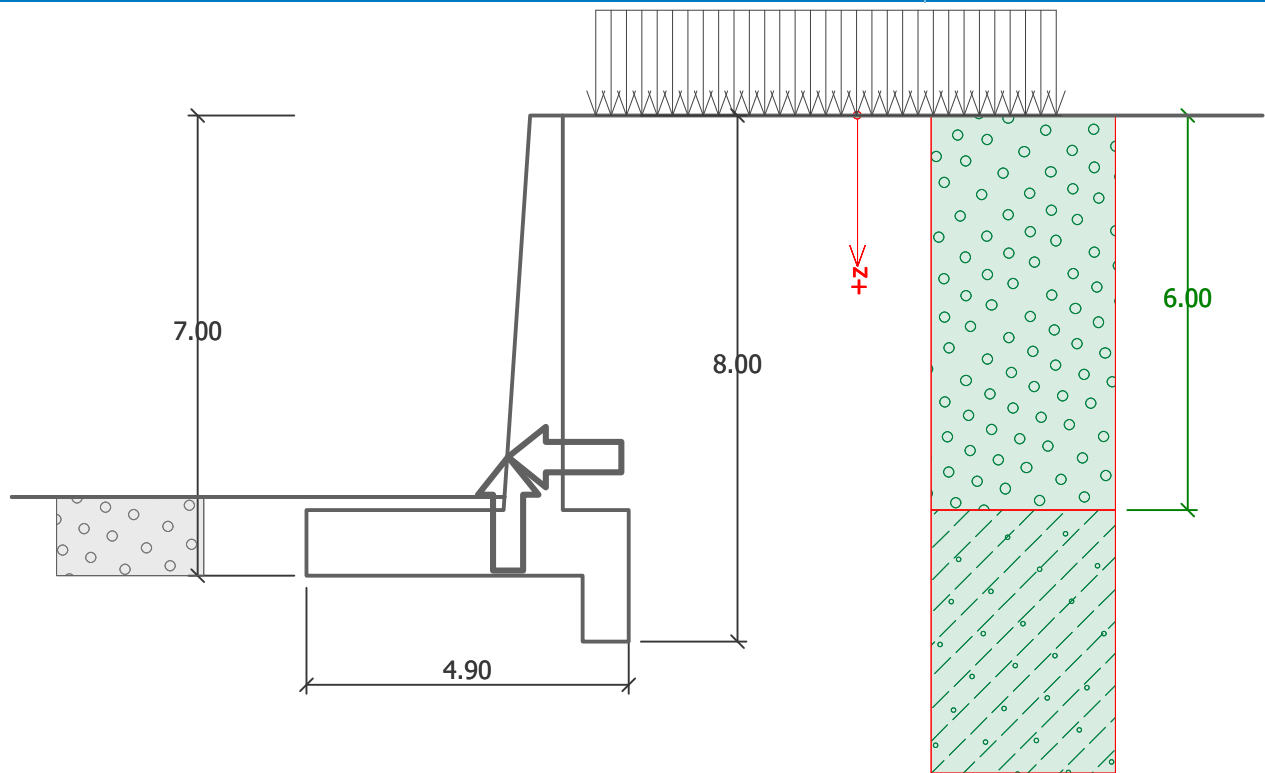
Name : Profile and assignment

Stage - analysis : 1 - 0



Name : Profile and assignment

Stage - analysis : 1 - 0



Foundation

Type of foundation : soil from geological profile

Terrain profile

Terrain behind the structure is flat.

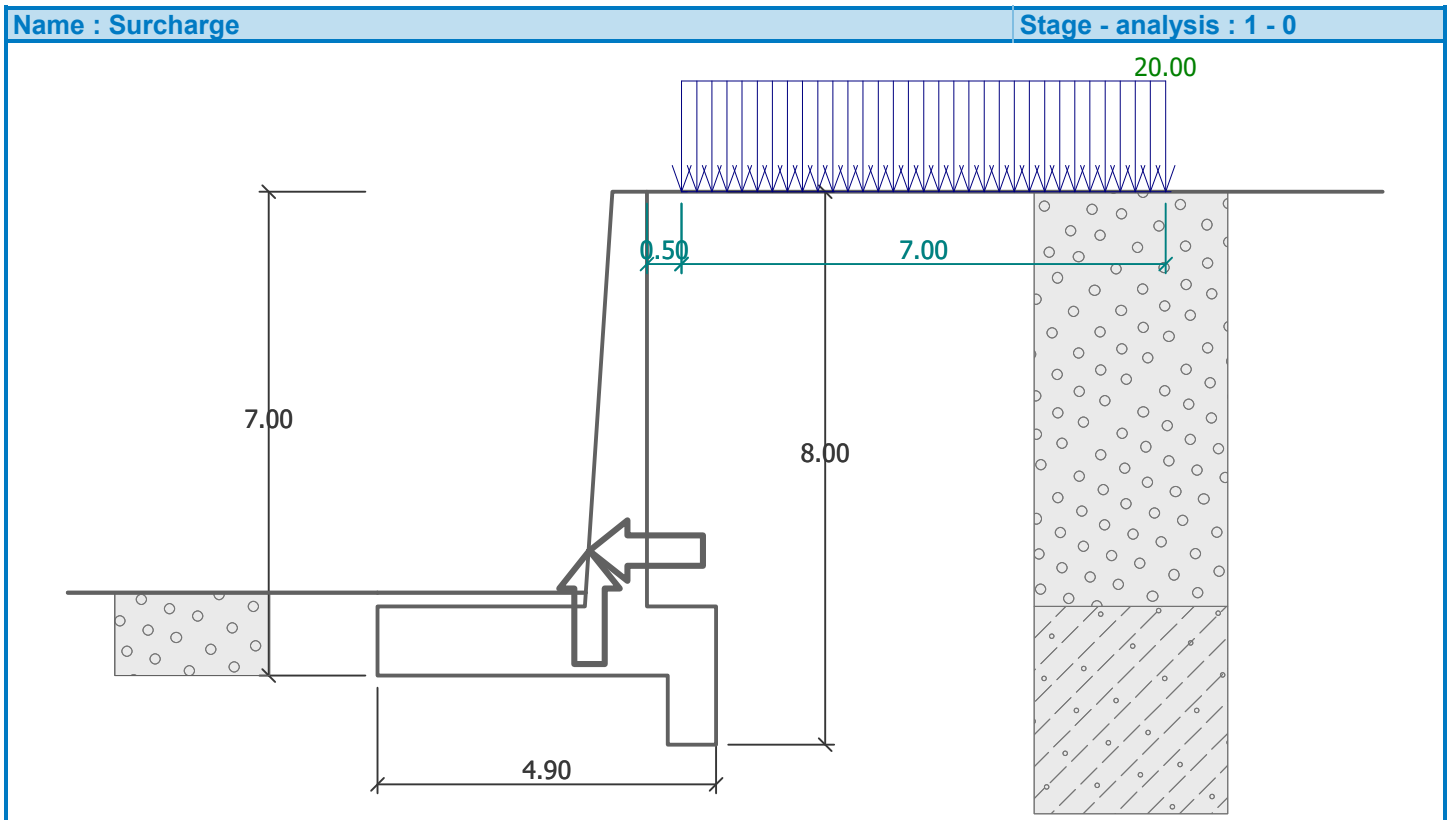
Water influence

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		variable	20.00		0.50	7.00	on terrain

No.	Name
1	TL



Resistance on front face of the structure

Resistance on front face of the structure: passive

Soil on front face of the structure - Gravel

Angle of friction struc.-soil

$$\delta = 15.00^\circ$$

Soil thickness in front of structure

$$h = 1.20 \text{ m}$$

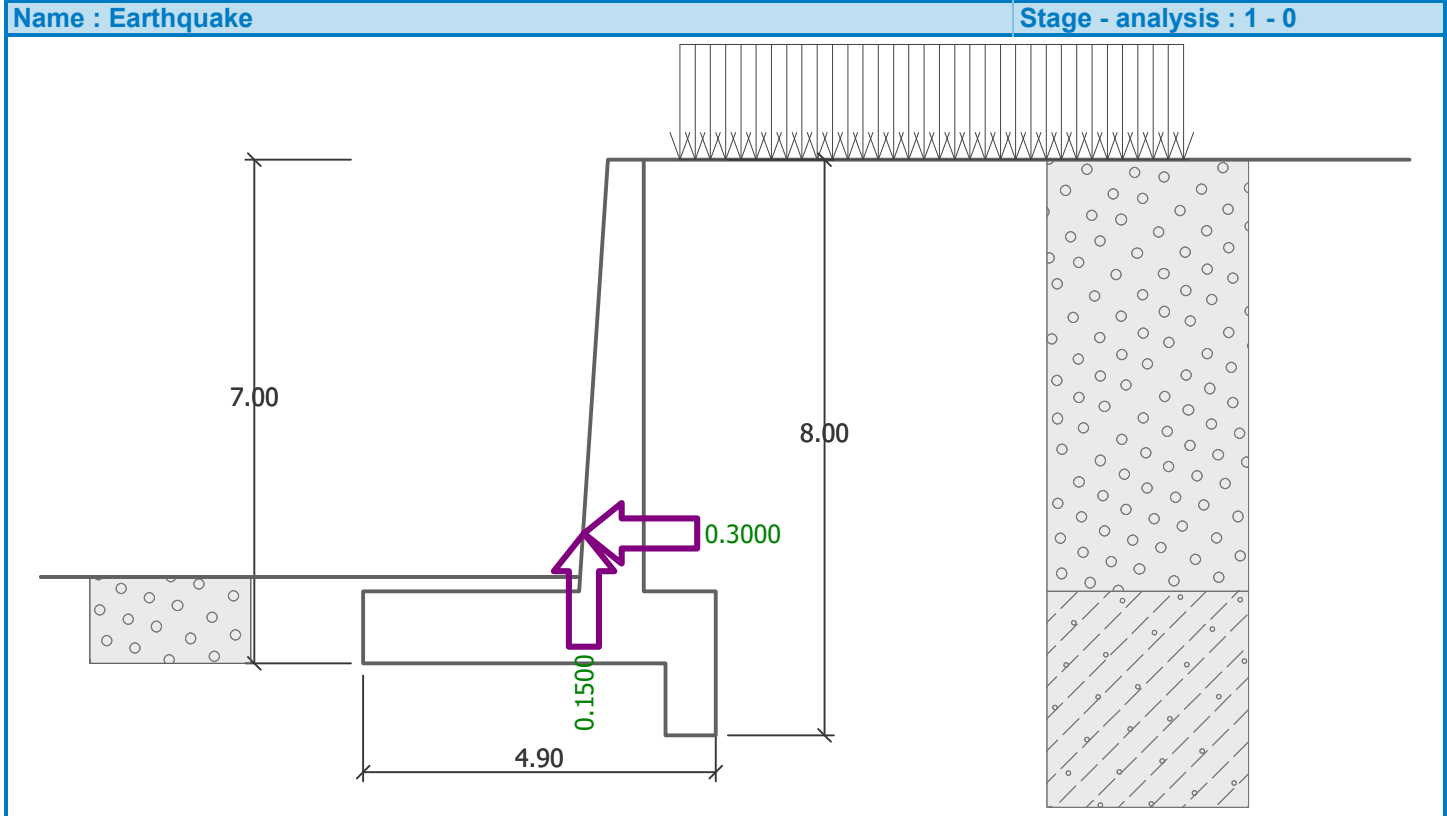
Terrain in front of structure is flat.

Earthquake

Factor of horizontal acceleration $K_h = 0.3000$

Factor of vertical acceleration $K_v = 0.1500$

Water below the GWT is restricted.



Settings of the stage of construction

Design situation : seismic

Active pressure acts on the wall and stem.

Verification No. 1

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.20	3.81	35.00	0.00	20.00	-15.00	5.718	
2	0.00	89.97(30.00)	35.00	0.00	20.00	-15.00	2.341	MODIFIED
3	0.80	0.00	35.00	0.00	20.00	-15.00	6.368	
4	0.20	0.00	35.00	0.00	20.00	-15.00	6.368	

Passive pressure distribution on front face of the structure

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
	0.20	4.00	0.00	22.87	22.44	-4.44

--

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
2	0.20	4.00	0.00	9.36	2.43	9.04
	0.20	4.03	0.00	9.43	2.44	9.11
3	0.20	4.03	0.00	25.64	24.77	-6.64
	1.00	20.00	0.00	127.35	123.01	-32.96
4	1.00	20.00	0.00	127.35	123.01	-32.96
	1.20	24.00	0.00	152.83	147.62	-39.55

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.20	35.00	0.00	19.44	3.381	2.736	-0.646	
2	0.00	35.00	0.00	19.44	2.392	2.193	-0.198	
3	0.80	35.00	0.00	19.44	3.690	2.937	-0.753	
4	0.20	35.00	0.00	19.44	3.690	2.937	-0.753	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	20.40	-13.17	-12.92	2.56
	0.20	3.40	17.00	-10.98	-10.77	2.13
2	0.20	3.40	17.00	-3.37	-0.87	-3.26
	0.20	3.42	16.98	-3.37	-0.87	-3.25
3	0.20	3.42	16.98	-12.78	-12.34	3.31
	1.00	17.00	3.40	-2.56	-2.47	0.66
4	1.00	17.00	3.40	-2.56	-2.47	0.66
	1.20	20.40	0.00	0.00	0.00	0.00

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	4.08	0.00	35.00	0.00	20.00	20.00	0.245	
2	1.92	27.50	35.00	0.00	20.00	35.00	0.587	
3	1.00	0.00	22.00	18.00	19.30	17.00	0.401	
4	1.00	0.00	22.00	18.00	19.30	17.00	0.401	

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
	4.08	81.58	0.00	19.99	18.78	6.84
2	4.08	81.58	0.00	47.88	22.11	42.47
	6.00	120.00	0.00	70.42	32.52	62.47
3	6.00	120.00	0.00	27.68	26.47	8.09
	7.00	139.30	0.00	35.43	33.88	10.36

--	--	--	--	--	--	--

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
4	7.00	139.30	0.00	35.43	33.88	10.36
	8.00	158.60	0.00	43.18	41.29	12.62

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	4.08	35.00	0.00	19.44	0.245	0.542	0.297	
2	1.92	35.00	0.00	19.44	0.587	1.566	0.979	
3	1.00	22.00	0.00	19.44	0.401	0.934	0.532	
4	1.00	22.00	0.00	19.44	0.401	0.934	0.532	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	134.81	40.03	37.61	13.69
	4.08	69.35	65.46	19.44	18.27	6.65
2	4.08	69.35	65.46	64.11	29.60	56.87
	6.00	102.00	32.81	32.13	14.84	28.50
3	6.00	102.00	32.81	17.47	16.71	5.11
	7.00	118.41	16.41	8.73	8.35	2.55
4	7.00	118.41	16.41	8.73	8.35	2.55
	8.00	134.81	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	4.08	4.54	1.65
6	4.08	2.21	4.24
7	6.00	2.17	4.16
8	6.00	7.40	2.26
9	7.00	7.30	2.23
10	7.00	7.30	2.23
11	8.00	7.20	2.20

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overturn.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-1.81	230.92	3.07	1.000	1.000	1.000
Earthq.- constr.	69.28	-1.81	-34.64	3.07	1.000	1.000	1.000
FF resistance	-88.32	-0.40	-23.50	0.06	1.000	1.000	1.000
Earthq.- face	8.53	-0.79	2.12	0.66	1.000	1.000	1.000
Weight - earth wedge	0.00	-1.64	19.21	4.23	1.000	1.000	1.000

--

Name	F _{hor} [kN/m]	App.Pt. z [m]	F _{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Earthquake - soil wedge	5.76	-1.64	-2.88	4.23	1.000	1.000	1.000
Active pressure	158.54	-1.63	135.45	4.45	1.000	1.000	1.000
Earthq.- act.pressure	173.36	-3.96	128.58	4.22	1.000	1.000	1.000
TL	36.05	-2.53	18.81	4.35	0.700	0.700	0.700

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 1874.13$ kNm/m

Overturning moment $M_{ovr} = 1114.53$ kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 265.55$ kN/m

Active horizontal force $H_{act} = 251.59$ kN/m

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 184.50 kPa

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	388.03	529.42	239.39	0.217	184.50

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	388.03	529.42	239.39

Verification of foundation soil

Eccentricity verification

Max. eccentricity of normal force $e = 0.217$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Max. stress at footing bottom $\sigma = 184.50$ kPa

Bearing capacity of foundation soil $R_d = 300.00$ kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.20	3.81	35.00	0.00	20.00	-15.00	5.718	

Passive pressure distribution on front face of the structure

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
	0.20	3.98	0.00	22.73	22.30	-4.41

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.20	35.00	0.00	19.44	3.381	2.736	-0.646	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	3.38	-2.18	-2.14	0.42
	0.20	3.38	0.00	0.00	0.00	0.00

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	6.00	0.00	35.00	0.00	20.00	20.00	0.245	

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
	6.00	119.98	0.00	29.40	27.62	10.05

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	6.00	35.00	0.00	19.44	0.245	0.542	0.297	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	101.98	30.28	28.45	10.36
	6.00	101.98	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
1	0.00	0.00	0.00

--	--	--	--

Point No.	Depth [m]	Hor. comp. [kPa]	Vert. comp. [kPa]
2	0.00	0.00	0.00
3	0.35	0.00	0.00
4	0.35	4.71	1.72
5	6.00	4.44	1.62

Forces acting on construction

Name	F _{hor} [kN/m]	App.Pt. z [m]	F _{vert} [kN/m]	App.Pt. x [m]	Coeff. moment	Coeff. norm.force	Coeff. shear for.
Weight - wall	0.00	-2.71	98.94	0.54	1.000	1.000	1.000
Earthq.- constr.	29.68	-2.71	-14.84	0.54	1.000	1.000	1.000
FF resistance	-2.22	-0.07	-0.44	0.00	1.000	1.000	1.000
Earthq.- face	0.21	-0.13	0.04	0.01	1.000	1.000	1.000
Active pressure	82.86	-2.00	30.16	0.90	1.000	1.000	1.000
Earthq.- act.pressure	85.34	-4.00	31.06	0.90	1.000	1.000	1.000
TL	25.87	-2.85	9.42	0.90	0.700	0.700	0.700

Wall stem check

Reinforcement and dimensions of the cross-section

Bar diameter = 25.0 mm

Number of bars = 7

Reinforcement cover = 30.0 mm

Cross-section width = 1.00 m

Cross-section depth = 0.90 m

Reinforcement ratio $\rho = 0.40\% > 0.16\% = \rho_{min}$

Position of neutral axis $x = 0.09\text{ m} < 0.56\text{ m} = x_{max}$

Ultimate shear force $V_{Rd} = 328.94\text{ kN} > 213.99\text{ kN} = V_{Ed}$

Ultimate moment $M_{Rd} = 1028.75\text{ kNm} > 600.77\text{ kNm} = M_{Ed}$

Cross-section is SATISFACTORY.

Dimensioning No. 2

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.20	3.81	35.00	0.00	20.00	-15.00	5.718	
2	0.00	89.97(30.00)	35.00	0.00	20.00	-15.00	2.341	MODIFIED
3	0.80	0.00	35.00	0.00	20.00	-15.00	6.368	
4	0.20	0.00	35.00	0.00	20.00	-15.00	6.368	

Passive pressure distribution on front face of the structure

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
	0.20	4.00	0.00	22.87	22.44	-4.44
2	0.20	4.00	0.00	9.36	2.43	9.04
	0.20	4.03	0.00	9.43	2.44	9.11

--	--	--	--	--	--	--

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_w [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vert. comp. [kPa]
3	0.20	4.03	0.00	25.64	24.77	-6.64
	1.00	20.00	0.00	127.35	123.01	-32.96
4	1.00	20.00	0.00	127.35	123.01	-32.96
	1.20	24.00	0.00	152.83	147.62	-39.55

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.20	35.00	0.00	19.44	3.381	2.736	-0.646	
2	0.00	35.00	0.00	19.44	2.392	2.193	-0.198	
3	0.80	35.00	0.00	19.44	3.690	2.937	-0.753	
4	0.20	35.00	0.00	19.44	3.690	2.937	-0.753	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	20.40	-13.17	-12.92	2.56
	0.20	3.40	17.00	-10.98	-10.77	2.13
2	0.20	3.40	17.00	-3.37	-0.87	-3.26
	0.20	3.42	16.98	-3.37	-0.87	-3.25
3	0.20	3.42	16.98	-12.78	-12.34	3.31
	1.00	17.00	3.40	-2.56	-2.47	0.66
4	1.00	17.00	3.40	-2.56	-2.47	0.66
	1.20	20.40	0.00	0.00	0.00	0.00

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	4.08	0.00	35.00	0.00	20.00	20.00	0.245	
2	1.92	27.50	35.00	0.00	20.00	35.00	0.587	
3	1.00	0.00	22.00	18.00	19.30	17.00	0.401	
4	1.00	0.00	22.00	18.00	19.30	17.00	0.401	

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
	4.08	81.58	0.00	19.99	18.78	6.84
2	4.08	81.58	0.00	47.88	22.11	42.47
	6.00	120.00	0.00	70.42	32.52	62.47
3	6.00	120.00	0.00	27.68	26.47	8.09
	7.00	139.30	0.00	35.43	33.88	10.36
4	7.00	139.30	0.00	35.43	33.88	10.36
	8.00	158.60	0.00	43.18	41.29	12.62

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	4.08	35.00	0.00	19.44	0.245	0.542	0.297	
2	1.92	35.00	0.00	19.44	0.587	1.566	0.979	
3	1.00	22.00	0.00	19.44	0.401	0.934	0.532	
4	1.00	22.00	0.00	19.44	0.401	0.934	0.532	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	134.81	40.03	37.61	13.69
	4.08	69.35	65.46	19.44	18.27	6.65
2	4.08	69.35	65.46	64.11	29.60	56.87
	6.00	102.00	32.81	32.13	14.84	28.50
3	6.00	102.00	32.81	17.47	16.71	5.11
	7.00	118.41	16.41	8.73	8.35	2.55
4	7.00	118.41	16.41	8.73	8.35	2.55
	8.00	134.81	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	4.08	4.54	1.65
6	4.08	2.21	4.24
7	6.00	2.17	4.16
8	6.00	7.40	2.26
9	7.00	7.30	2.23
10	7.00	7.30	2.23
11	8.00	7.20	2.20

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	-0.50	23.56	4.40	1.000
Weight - earth wedge	0.00	-1.64	19.21	4.23	1.000
Active pressure	158.54	-1.63	135.45	4.45	1.000
TL	36.05	-2.53	18.81	4.35	0.700
Contact stress	0.00	0.00	-1.96	3.98	1.000

Back wall jump check

Reinforcement and dimensions of the cross-section

Bar diameter = 18.0 mm

Number of bars = 7

Reinforcement cover = 30.0 mm

Cross-section width = 1.00 m
 Cross-section depth = 1.00 m

Reinforcement ratio $\rho = 0.19\% > 0.16\% = \rho_{min}$
 Position of neutral axis $x = 0.05\text{ m} < 0.63\text{ m} = x_{max}$
 Ultimate shear force $V_{Rd} = 323.56\text{ kN} > 189.42\text{ kN} = V_{Ed}$
 Ultimate moment $M_{Rd} = 612.49\text{ kNm} > 98.27\text{ kNm} = M_{Ed}$

Cross-section is SATISFACTORY.

Dimensioning No. 3

Passive pressure on front face of the structure - partial results

Layer No.	Thickness [m]	α [°]	φ_d [°]	c_d [kPa]	γ [kN/m ³]	δ_d [°]	K_p	Comment
1	0.20	3.81	35.00	0.00	20.00	-15.00	5.718	
2	0.00	89.97(30.00)	35.00	0.00	20.00	-15.00	2.341	MODIFIED
3	0.80	0.00	35.00	0.00	20.00	-15.00	6.368	
4	0.20	0.00	35.00	0.00	20.00	-15.00	6.368	

Passive pressure distribution on front face of the structure

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
	0.20	4.00	0.00	22.87	22.44	-4.44
2	0.20	4.00	0.00	9.36	2.43	9.04
	0.20	4.03	0.00	9.43	2.44	9.11
3	0.20	4.03	0.00	25.64	24.77	-6.64
	1.00	20.00	0.00	127.35	123.01	-32.96
4	1.00	20.00	0.00	127.35	123.01	-32.96
	1.20	24.00	0.00	152.83	147.62	-39.55

Earthquake effects (passive earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_p	K_{pe}	$K_{pe}-K_p$	Comment
1	0.20	35.00	0.00	19.44	3.381	2.736	-0.646	
2	0.00	35.00	0.00	19.44	2.392	2.193	-0.198	
3	0.80	35.00	0.00	19.44	3.690	2.937	-0.753	
4	0.20	35.00	0.00	19.44	3.690	2.937	-0.753	

Earthquake effects (passive earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	20.40	-13.17	-12.92	2.56
	0.20	3.40	17.00	-10.98	-10.77	2.13
2	0.20	3.40	17.00	-3.37	-0.87	-3.26
	0.20	3.42	16.98	-3.37	-0.87	-3.25
3	0.20	3.42	16.98	-12.78	-12.34	3.31
	1.00	17.00	3.40	-2.56	-2.47	0.66

--	--	--	--	--	--	--

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
4	1.00	17.00	3.40	-2.56	-2.47	0.66
	1.20	20.40	0.00	0.00	0.00	0.00

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	4.08	0.00	35.00	0.00	20.00	20.00	0.245	
2	1.92	27.50	35.00	0.00	20.00	35.00	0.587	
3	1.00	0.00	22.00	18.00	19.30	17.00	0.401	
4	1.00	0.00	22.00	18.00	19.30	17.00	0.401	

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
	4.08	81.58	0.00	19.99	18.78	6.84
2	4.08	81.58	0.00	47.88	22.11	42.47
	6.00	120.00	0.00	70.42	32.52	62.47
3	6.00	120.00	0.00	27.68	26.47	8.09
	7.00	139.30	0.00	35.43	33.88	10.36
4	7.00	139.30	0.00	35.43	33.88	10.36
	8.00	158.60	0.00	43.18	41.29	12.62

Earthquake effects (active earth pressure) - partial results

Layer No.	Thickness [m]	φ_d [°]	β [°]	ψ [°]	K_a	K_{ae}	$K_{ae}-K_a$	Comment
1	4.08	35.00	0.00	19.44	0.245	0.542	0.297	
2	1.92	35.00	0.00	19.44	0.587	1.566	0.979	
3	1.00	22.00	0.00	19.44	0.401	0.934	0.532	
4	1.00	22.00	0.00	19.44	0.401	0.934	0.532	

Earthquake effects (active earth pressure)

Layer No.	Start [m] End [m]	σ_z [kPa]	σ_D [kPa]	Pressure [kPa]	Hor. comp. [kPa]	Vertical comp. [kPa]
1	0.00	0.00	134.81	40.03	37.61	13.69
	4.08	69.35	65.46	19.44	18.27	6.65
2	4.08	69.35	65.46	64.11	29.60	56.87
	6.00	102.00	32.81	32.13	14.84	28.50
3	6.00	102.00	32.81	17.47	16.71	5.11
	7.00	118.41	16.41	8.73	8.35	2.55
4	7.00	118.41	16.41	8.73	8.35	2.55
	8.00	134.81	0.00	0.00	0.00	0.00

Pressure profile due to surcharge - TL

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	0.35	0.00	0.00
4	0.35	4.71	1.72
5	4.08	4.54	1.65
6	4.08	2.21	4.24
7	6.00	2.17	4.16
8	6.00	7.40	2.26
9	7.00	7.30	2.23
10	7.00	7.30	2.23
11	8.00	7.20	2.20

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	-1.81	230.92	3.07	1.000
Earthq.- constr.	69.28	-1.81	-34.64	3.07	1.000
FF resistance	-88.32	-0.40	-23.50	0.06	1.000
Earthq.- face	8.53	-0.79	2.12	0.66	1.000
Weight - earth wedge	0.00	-1.64	19.21	4.23	1.000
Earthquake - soil wedge	5.76	-1.64	-2.88	4.23	1.000
Active pressure	158.54	-1.63	135.45	4.45	1.000
Earthq.- act.pressure	173.36	-3.96	128.58	4.22	1.000
TL	36.05	-2.53	18.81	4.35	0.700

Front wall jump check

Reinforcement and dimensions of the cross-section

Bar diameter = 22.0 mm

Number of bars = 7

Reinforcement cover = 30.0 mm

Cross-section width = 1.00 m

Cross-section depth = 1.00 m

Reinforcement ratio $\rho = 0.28 \% > 0.16 \% = \rho_{min}$

Position of neutral axis $x = 0.07 \text{ m} < 0.63 \text{ m} = x_{max}$

Ultimate moment $M_{Rd} = 903.64 \text{ kNm} > 871.08 \text{ kNm} = M_{Ed}$

Cross-section must be reinforced by shear reinforcement with minimal area of 1550.1 mm².

Cross-section is SATISFACTORY.

Slope stability analysis

Input data

Project

Settings

Standard - EN 1997 - DA2

Stability analysis

Earthquake analysis : Standard
 Verification methodology : according to EN 1997
 Design approach : 2 - reduction of actions and resistances

Partial factors on actions (A)			
Seismic design situation			
		Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.00 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]	

Partial factors for resistances (R)			
Seismic design situation			
Partial factor on sliding resistance (on slip surface) :	$\gamma_{Rs} =$	1.00	[-]



Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-20.00	-5.80	-3.90	-5.80	-0.89	-5.80
		-0.50	0.00	0.00	0.00	24.00	0.00
2		0.00	0.00	0.00	-6.00	1.00	-6.00
3		-20.00	-7.00	-3.90	-7.00	-3.90	-6.00
		-0.90	-6.00	-0.89	-5.80		
4		-3.90	-7.00	0.30	-7.00	0.30	-8.00
		1.00	-8.00	1.00	-7.00	1.00	-6.00
		24.00	-6.00				

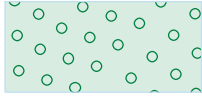


Soil parameters - effective stress state

No.	Name	Pattern	ϕ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
1	Gravel		35.00	0.00	20.00



No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
2	Silty clay		22.00	18.00	19.30
3	Rock		22.00	35.00	19.60

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Gravel		20.00		
2	Silty clay		20.00		
3	Rock		20.00		

Soil parameters

Gravel

Unit weight : $\gamma = 20.00$ kN/m³
Stress-state : effective
Angle of internal friction : $\varphi_{ef} = 35.00$ °
Cohesion of soil : $c_{ef} = 0.00$ kPa
Saturated unit weight : $\gamma_{sat} = 20.00$ kN/m³

Silty clay

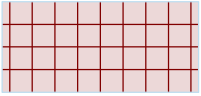
Unit weight : $\gamma = 19.30$ kN/m³
Stress-state : effective
Angle of internal friction : $\varphi_{ef} = 22.00$ °
Cohesion of soil : $c_{ef} = 18.00$ kPa
Saturated unit weight : $\gamma_{sat} = 20.00$ kN/m³

Rock

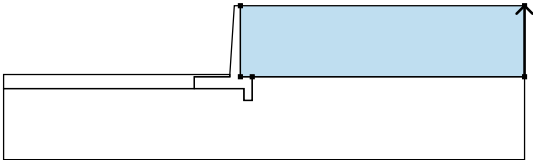
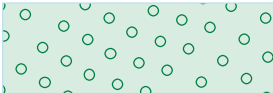
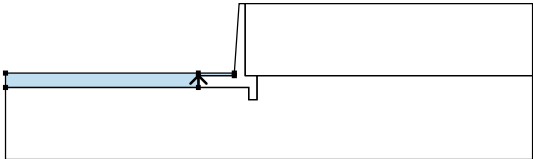
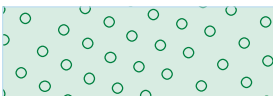
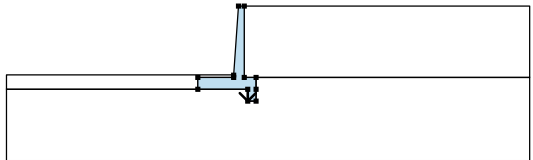
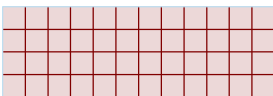
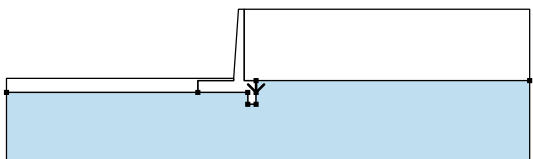
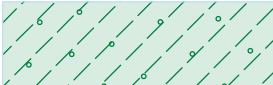
Unit weight : $\gamma = 19.60$ kN/m³
Stress-state : effective
Angle of internal friction : $\varphi_{ef} = 22.00$ °
Cohesion of soil : $c_{ef} = 35.00$ kPa
Saturated unit weight : $\gamma_{sat} = 20.00$ kN/m³



Rigid bodies

No.	Name	Sample	γ [kN/m ³]
1	Wall material		23.56

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		24.00	-6.00	24.00	0.00	Gravel 
		0.00	0.00	0.00	-6.00	
		1.00	-6.00			
2		-3.90	-7.00	-3.90	-6.00	Gravel 
		-0.90	-6.00	-0.89	-5.80	
		-3.90	-5.80	-20.00	-5.80	
		-20.00	-7.00			
3		0.30	-7.00	0.30	-8.00	Wall material 
		1.00	-8.00	1.00	-7.00	
		1.00	-6.00	0.00	-6.00	
		0.00	0.00	-0.50	0.00	
		-0.89	-5.80	-0.90	-6.00	
		-3.90	-6.00	-3.90	-7.00	
4		1.00	-6.00	1.00	-7.00	Silty clay 
		1.00	-8.00	0.30	-8.00	
		0.30	-7.00	-3.90	-7.00	
		-20.00	-7.00	-20.00	-13.00	
		24.00	-13.00	24.00	-6.00	

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 = 0.50	l = 7.00		0.00	20.00	kN/m ²

Surcharges

No.	Name
1	TL

Water

Water type : No water

Tensile crack

Tensile crack not inputted.

Earthquake

Horizontal seismic coefficient : $K_h = 0.30$

Vertical seismic coefficient : $K_v = 0.15$

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters						
Center :	x =	-1.48	[m]	Angles :	$\alpha_1 =$	-29.09 [°]
	z =	10.62	[m]		$\alpha_2 =$	55.58 [°]
Radius :	R =	18.79	[m]			
The slip surface after optimization.						

Slope stability verification (Bishop)

Sum of active forces : $F_a = 899.72$ kN/m

Sum of passive forces : $F_p = 1053.18$ kN/m

Sliding moment : $M_a = 16905.76$ kNm/m

Resisting moment : $M_p = 19789.29$ kNm/m

Utilization : 85.4 %

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
1	-1.53	0.68	9.04	80.7 %	ACCEPTABLE
2	-1.53	0.68	9.04	80.7 %	ACCEPTABLE
3	-1.53	0.68	9.04	80.7 %	ACCEPTABLE
4	-4.17	19.64	28.30	82.3 %	ACCEPTABLE
5	4.22	17.57	26.30	77.0 %	ACCEPTABLE
6	0.67	7.07	24.18	60.8 %	ACCEPTABLE
7	-8.19	6.65	17.02	10.8 %	ACCEPTABLE
8	-1.46	0.49	8.96	79.2 %	ACCEPTABLE
9	4.24	17.47	26.22	76.9 %	ACCEPTABLE
10	-180.22	761.36	786.29	4.3 %	ACCEPTABLE
11	-4.17	19.64	28.30	82.3 %	ACCEPTABLE
12	2.74	13.44	23.50	76.2 %	ACCEPTABLE
13	4.64	2.73	17.60	53.7 %	ACCEPTABLE
14	-3.38	29.46	38.90	80.2 %	ACCEPTABLE
15	1.64	19.64	28.30	80.8 %	ACCEPTABLE
16	-0.87	11.34	25.54	70.1 %	ACCEPTABLE
17	-2.17	4.36	13.30	81.6 %	ACCEPTABLE
18	-8.46	16.67	25.16	6.6 %	ACCEPTABLE
19	-5.98	3.76	16.80	65.9 %	ACCEPTABLE
20	-7.52	11.74	21.41	23.4 %	ACCEPTABLE
21	-2.44	5.33	13.90	84.1 %	ACCEPTABLE
22	-4.42	21.03	29.46	17.0 %	ACCEPTABLE
23	-3.08	13.47	23.53	79.9 %	ACCEPTABLE
24	3.37	5.33	13.90	7.2 %	ACCEPTABLE
25	-1.36	3.72	17.96	62.0 %	ACCEPTABLE
26	-8.25	5.33	13.90	2.3 %	ACCEPTABLE
27	-7.09	1.09	11.73	8.0 %	ACCEPTABLE
28	-4.17	19.62	28.29	82.4 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
29	3.64	4.36	13.30	8.8 %	ACCEPTABLE
30	-283.34	1900.22	1924.60	4.7 %	ACCEPTABLE
31	-2.44	5.33	13.90	84.1 %	ACCEPTABLE
32	2.46	1.59	11.92	61.2 %	ACCEPTABLE
33	-13.57	63.81	69.62	4.5 %	ACCEPTABLE
34	-6.33	33.68	39.48	5.6 %	ACCEPTABLE
35	-3.86	15.40	23.79	13.7 %	ACCEPTABLE
36	-2.94	10.86	20.35	80.9 %	ACCEPTABLE
37	1.44	5.33	13.90	76.5 %	ACCEPTABLE
38	-1.58	4.03	16.35	67.1 %	ACCEPTABLE
39	-9.33	16.33	22.76	2.9 %	ACCEPTABLE
40	-7.00	12.87	18.67	2.9 %	ACCEPTABLE
41	-6.32	5.33	13.90	5.9 %	ACCEPTABLE
42	-5.64	2.85	12.49	11.5 %	ACCEPTABLE
43	-3.61	14.17	22.82	83.3 %	ACCEPTABLE
44	1.36	5.61	14.08	77.4 %	ACCEPTABLE
45	-141.55	412.72	438.48	1.5 %	ACCEPTABLE
46	-137.68	412.72	438.48	3.1 %	ACCEPTABLE
47	-2.44	5.33	13.90	84.1 %	ACCEPTABLE
48	0.26	4.91	13.64	78.4 %	ACCEPTABLE
49	-6.76	26.96	33.42	1.6 %	ACCEPTABLE
50	-2.89	16.39	22.81	1.2 %	ACCEPTABLE
51	-3.43	11.84	20.24	15.8 %	ACCEPTABLE
52	1.49	0.40	11.49	58.4 %	ACCEPTABLE
53	-2.82	9.07	18.22	82.3 %	ACCEPTABLE
54	0.14	5.33	13.90	79.8 %	ACCEPTABLE
55	-1.78	4.33	15.38	72.3 %	ACCEPTABLE
56	-1.60	1.01	9.47	80.7 %	ACCEPTABLE
57	-6.76	11.68	18.68	1.3 %	ACCEPTABLE
58	-4.18	8.12	14.48	1.3 %	ACCEPTABLE
59	-5.02	5.33	13.90	8.6 %	ACCEPTABLE
60	-4.62	3.85	13.01	18.5 %	ACCEPTABLE
61	-1.58	0.95	9.44	80.3 %	ACCEPTABLE
62	-3.23	10.92	19.55	84.0 %	ACCEPTABLE
63	0.00	5.85	14.24	81.4 %	ACCEPTABLE
64	-149.30	470.64	496.17	1.8 %	ACCEPTABLE
65	-181.32	744.05	769.00	3.0 %	ACCEPTABLE
66	-146.71	470.64	496.17	2.8 %	ACCEPTABLE
67	-2.44	5.33	13.90	84.1 %	ACCEPTABLE
68	-0.83	5.73	14.16	82.4 %	ACCEPTABLE
69	-4.75	16.45	23.56	1.8 %	ACCEPTABLE
70	-2.33	11.21	18.29	3.7 %	ACCEPTABLE
71	-3.12	9.58	18.00	18.8 %	ACCEPTABLE
72	0.21	1.96	12.07	68.5 %	ACCEPTABLE
73	-2.72	7.86	16.79	82.9 %	ACCEPTABLE
74	-0.72	5.33	13.90	81.3 %	ACCEPTABLE
75	-1.95	4.58	14.79	75.9 %	ACCEPTABLE
76	-1.97	2.57	10.96	40.0 %	ACCEPTABLE
77	-5.25	9.29	16.74	2.1 %	ACCEPTABLE
78	-3.35	6.76	13.80	1.4 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
79	-4.16	5.33	13.90	10.5 %	ACCEPTABLE
80	-3.58	3.20	12.66	79.0 %	ACCEPTABLE
81	-1.64	1.55	10.43	78.6 %	ACCEPTABLE
82	-3.92	4.43	13.35	38.9 %	ACCEPTABLE
83	-1.88	2.28	10.80	82.4 %	ACCEPTABLE
84	-2.97	8.92	17.53	84.3 %	ACCEPTABLE
85	-1.43	9.70	18.10	84.2 %	ACCEPTABLE
86	-5.43	22.47	29.60	2.0 %	ACCEPTABLE
87	-3.02	16.44	23.55	3.8 %	ACCEPTABLE
88	-3.65	13.87	22.33	37.0 %	ACCEPTABLE
89	-0.28	4.81	14.92	74.1 %	ACCEPTABLE
90	-3.23	11.83	20.77	82.6 %	ACCEPTABLE
91	-1.25	8.92	17.53	83.2 %	ACCEPTABLE
92	-2.38	7.72	17.97	77.4 %	ACCEPTABLE
93	-2.57	5.81	14.21	25.8 %	ACCEPTABLE
94	-5.94	14.21	21.65	2.3 %	ACCEPTABLE
95	-4.05	11.21	18.29	1.7 %	ACCEPTABLE
96	-4.69	8.92	17.53	10.0 %	ACCEPTABLE
97	-2.52	2.93	13.25	74.3 %	ACCEPTABLE
98	-1.48	1.85	12.03	72.1 %	ACCEPTABLE
99	-4.11	6.45	15.88	80.9 %	ACCEPTABLE
100	-2.19	4.43	13.35	81.8 %	ACCEPTABLE
101	-3.53	3.99	14.49	75.3 %	ACCEPTABLE
102	-4.44	7.85	16.79	82.9 %	ACCEPTABLE
103	-2.44	5.33	13.90	84.1 %	ACCEPTABLE
104	-3.48	13.05	21.69	83.5 %	ACCEPTABLE
105	-1.40	9.57	18.00	84.1 %	ACCEPTABLE
106	-154.53	511.57	536.98	2.0 %	ACCEPTABLE
107	-175.90	693.85	718.87	2.9 %	ACCEPTABLE
108	-152.81	511.57	536.98	2.7 %	ACCEPTABLE
109	-2.97	8.92	17.53	84.3 %	ACCEPTABLE
110	-2.00	9.68	18.08	84.5 %	ACCEPTABLE
111	-1.06	10.56	18.74	84.9 %	ACCEPTABLE
112	-0.16	11.60	19.54	10.5 %	ACCEPTABLE
113	-2.76	19.71	26.92	9.8 %	ACCEPTABLE
114	-1.17	15.88	23.07	9.6 %	ACCEPTABLE
115	-1.58	14.23	22.28	10.1 %	ACCEPTABLE
116	0.84	7.35	16.46	77.9 %	ACCEPTABLE
117	-1.23	12.62	21.01	84.1 %	ACCEPTABLE
118	0.09	10.56	18.74	83.6 %	ACCEPTABLE
119	-0.54	9.41	18.66	80.5 %	ACCEPTABLE
120	-0.83	8.41	16.42	10.5 %	ACCEPTABLE
121	-3.13	14.49	21.89	10.7 %	ACCEPTABLE
122	-1.86	12.39	19.56	9.5 %	ACCEPTABLE
123	-2.21	10.56	18.74	11.9 %	ACCEPTABLE
124	-0.58	5.66	14.97	78.2 %	ACCEPTABLE
125	0.10	4.82	14.02	76.7 %	ACCEPTABLE
126	-1.79	8.77	17.43	83.2 %	ACCEPTABLE
127	-0.50	7.14	15.51	82.9 %	ACCEPTABLE
128	-1.25	6.49	15.91	79.0 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
129	-2.02	9.75	18.13	84.7 %	ACCEPTABLE
130	-0.69	7.87	16.03	84.4 %	ACCEPTABLE
131	-1.43	13.51	21.71	84.9 %	ACCEPTABLE
132	-0.06	11.19	19.22	38.6 %	ACCEPTABLE
133	-181.24	727.19	752.17	2.4 %	ACCEPTABLE
134	-195.82	868.49	893.31	3.0 %	ACCEPTABLE
135	-180.09	727.19	752.17	2.8 %	ACCEPTABLE
136	-1.06	10.56	18.74	84.9 %	ACCEPTABLE
137	-0.48	11.35	19.35	10.5 %	ACCEPTABLE
138	-2.11	16.11	23.64	9.5 %	ACCEPTABLE
139	-1.06	13.82	21.33	9.9 %	ACCEPTABLE
140	-1.41	12.98	21.07	12.0 %	ACCEPTABLE
141	0.22	8.36	17.14	80.7 %	ACCEPTABLE
142	-1.18	11.94	20.26	84.5 %	ACCEPTABLE
143	-0.29	10.56	18.74	84.1 %	ACCEPTABLE
144	-0.69	9.74	18.63	81.8 %	ACCEPTABLE
145	-0.91	9.14	17.20	12.2 %	ACCEPTABLE
146	-2.42	13.07	20.72	10.5 %	ACCEPTABLE
147	-1.55	11.67	19.17	9.8 %	ACCEPTABLE
148	-1.83	10.56	18.74	18.3 %	ACCEPTABLE
149	-0.70	7.08	16.01	80.8 %	ACCEPTABLE
150	-0.25	6.48	15.34	80.0 %	ACCEPTABLE
151	-1.56	9.44	17.91	84.0 %	ACCEPTABLE
152	-0.69	8.25	16.55	83.7 %	ACCEPTABLE
153	-1.15	7.68	16.68	81.1 %	ACCEPTABLE
154	-1.70	10.04	18.35	84.8 %	ACCEPTABLE
155	-0.81	8.74	16.90	84.7 %	ACCEPTABLE
156	-1.30	12.50	20.69	84.9 %	ACCEPTABLE
157	-0.73	13.37	21.38	10.3 %	ACCEPTABLE
158	-2.38	18.54	26.07	11.0 %	ACCEPTABLE
159	-1.34	16.11	23.63	9.8 %	ACCEPTABLE
160	-1.65	15.07	23.18	14.3 %	ACCEPTABLE
161	0.00	10.07	18.86	81.5 %	ACCEPTABLE
162	-1.42	13.96	22.28	84.5 %	ACCEPTABLE
163	-0.53	12.50	20.69	84.3 %	ACCEPTABLE
164	-0.91	11.53	20.42	82.3 %	ACCEPTABLE
165	-1.16	11.00	19.07	10.3 %	ACCEPTABLE
166	-2.69	15.32	22.97	11.1 %	ACCEPTABLE
167	-1.82	13.82	21.33	9.7 %	ACCEPTABLE
168	-2.07	12.50	20.69	18.1 %	ACCEPTABLE
169	-0.92	8.70	17.63	81.7 %	ACCEPTABLE
170	-0.47	8.06	16.93	81.1 %	ACCEPTABLE
171	-1.80	11.30	19.77	84.2 %	ACCEPTABLE
172	-0.93	10.03	18.34	84.2 %	ACCEPTABLE
173	-1.36	9.33	18.34	81.8 %	ACCEPTABLE
174	-1.94	11.94	20.25	84.8 %	ACCEPTABLE
175	-1.06	10.56	18.74	84.9 %	ACCEPTABLE
176	-1.54	14.56	22.76	84.8 %	ACCEPTABLE
177	-0.64	12.98	21.07	84.7 %	ACCEPTABLE
178	-181.44	750.47	775.42	3.4 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
179	-180.67	750.47	775.42	3.6 %	ACCEPTABLE
180	-1.30	12.50	20.69	84.9 %	ACCEPTABLE
181	-0.93	13.12	21.18	12.1 %	ACCEPTABLE
182	-1.98	16.30	24.05	11.4 %	ACCEPTABLE
183	-1.30	14.79	22.53	10.0 %	ACCEPTABLE
184	-1.54	14.20	22.33	24.6 %	ACCEPTABLE
185	-0.42	10.85	19.43	82.8 %	ACCEPTABLE
186	-1.38	13.48	21.75	84.6 %	ACCEPTABLE
187	-0.79	12.50	20.69	84.5 %	ACCEPTABLE
188	-1.03	11.82	20.48	83.2 %	ACCEPTABLE
189	-1.21	11.51	19.62	38.4 %	ACCEPTABLE
190	-2.22	14.32	22.15	10.7 %	ACCEPTABLE
191	-1.63	13.33	21.06	9.9 %	ACCEPTABLE
192	-1.81	12.50	20.69	38.0 %	ACCEPTABLE
193	-1.02	9.85	18.53	83.0 %	ACCEPTABLE
194	-0.72	9.40	18.04	82.7 %	ACCEPTABLE
195	-1.64	11.73	20.10	84.6 %	ACCEPTABLE
196	-1.06	10.84	19.11	84.5 %	ACCEPTABLE
197	-1.32	10.29	19.02	83.0 %	ACCEPTABLE
198	-1.73	12.13	20.41	84.8 %	ACCEPTABLE
199	-1.14	11.19	19.37	84.9 %	ACCEPTABLE
200	-0.77	11.78	19.82	11.3 %	ACCEPTABLE
201	-1.81	14.78	22.52	9.8 %	ACCEPTABLE
202	-1.12	13.33	21.06	10.1 %	ACCEPTABLE
203	-1.38	12.83	20.94	18.3 %	ACCEPTABLE
204	-0.27	9.64	18.22	82.4 %	ACCEPTABLE
205	-1.22	12.13	20.40	84.6 %	ACCEPTABLE
206	-0.63	11.19	19.37	84.4 %	ACCEPTABLE
207	-0.88	10.58	19.23	82.9 %	ACCEPTABLE
208	-1.05	10.23	18.33	24.9 %	ACCEPTABLE
209	-2.04	12.89	20.70	11.6 %	ACCEPTABLE
210	-1.46	11.93	19.65	10.0 %	ACCEPTABLE
211	-1.65	11.19	19.37	38.2 %	ACCEPTABLE
212	-0.87	8.69	17.37	82.6 %	ACCEPTABLE
213	-0.57	8.26	16.89	82.3 %	ACCEPTABLE
214	-1.48	10.46	18.81	84.6 %	ACCEPTABLE
215	-0.90	9.60	17.86	84.5 %	ACCEPTABLE
216	-1.17	9.12	17.84	82.7 %	ACCEPTABLE
217	-1.57	10.84	19.10	85.0 %	ACCEPTABLE
218	-1.19	11.40	19.53	85.2 %	ACCEPTABLE
219	-0.82	12.00	20.00	10.4 %	ACCEPTABLE
220	-1.87	15.06	22.75	11.4 %	ACCEPTABLE
221	-1.18	13.58	21.27	10.0 %	ACCEPTABLE
222	-1.43	13.06	21.13	10.2 %	ACCEPTABLE
223	-0.32	9.83	18.35	82.8 %	ACCEPTABLE
224	-1.27	12.35	20.57	84.9 %	ACCEPTABLE
225	-0.68	11.40	19.53	84.7 %	ACCEPTABLE
226	-0.92	10.77	19.37	83.3 %	ACCEPTABLE
227	-1.10	10.44	18.48	10.3 %	ACCEPTABLE
228	-2.10	13.13	20.90	11.5 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
229	-1.52	12.17	19.84	9.4 %	ACCEPTABLE
230	-1.70	11.40	19.53	14.5 %	ACCEPTABLE
231	-0.91	8.86	17.48	82.9 %	ACCEPTABLE
232	-0.61	8.43	17.01	82.5 %	ACCEPTABLE
233	-1.53	10.65	18.96	84.8 %	ACCEPTABLE
234	-0.94	9.79	18.00	84.7 %	ACCEPTABLE
235	-1.21	9.29	17.96	82.9 %	ACCEPTABLE
236	-1.62	11.04	19.26	85.2 %	ACCEPTABLE
237	-1.24	11.61	19.70	14.6 %	ACCEPTABLE
238	-2.28	14.59	22.37	11.4 %	ACCEPTABLE
239	-1.60	13.15	20.92	11.7 %	ACCEPTABLE
240	-1.85	12.66	20.82	24.6 %	ACCEPTABLE
241	-0.76	9.51	18.13	82.8 %	ACCEPTABLE
242	-1.70	11.98	20.29	84.7 %	ACCEPTABLE
243	-1.11	11.04	19.26	84.8 %	ACCEPTABLE
244	-1.36	10.45	19.14	83.1 %	ACCEPTABLE
245	-1.53	10.09	18.22	14.6 %	ACCEPTABLE
246	-2.52	12.71	20.57	11.4 %	ACCEPTABLE
247	-1.93	11.76	19.52	9.9 %	ACCEPTABLE
248	-2.13	11.04	19.26	24.6 %	ACCEPTABLE
249	-1.36	8.57	17.29	82.7 %	ACCEPTABLE
250	-1.06	8.14	16.81	82.7 %	ACCEPTABLE
251	-1.96	10.32	18.72	84.5 %	ACCEPTABLE
252	-1.38	9.47	17.76	84.7 %	ACCEPTABLE
253	-1.66	9.00	17.76	82.8 %	ACCEPTABLE
254	-2.05	10.70	19.00	85.0 %	ACCEPTABLE
255	-1.46	9.80	18.01	85.2 %	ACCEPTABLE
256	-1.78	12.34	20.56	85.1 %	ACCEPTABLE
257	-1.18	11.35	19.49	85.2 %	ACCEPTABLE
258	-193.46	860.23	885.05	3.3 %	ACCEPTABLE
259	-199.99	926.93	951.69	3.7 %	ACCEPTABLE
260	-192.95	860.23	885.05	3.8 %	ACCEPTABLE
261	-1.62	11.04	19.26	85.2 %	ACCEPTABLE
262	-1.37	11.44	19.57	24.9 %	ACCEPTABLE
263	-2.05	13.32	21.24	11.7 %	ACCEPTABLE
264	-1.59	12.40	20.32	10.1 %	ACCEPTABLE
265	-1.78	12.11	20.29	38.1 %	ACCEPTABLE
266	-1.04	10.01	18.49	83.8 %	ACCEPTABLE
267	-1.68	11.67	19.95	84.9 %	ACCEPTABLE
268	-1.28	11.04	19.26	85.0 %	ACCEPTABLE
269	-1.44	10.63	19.17	83.7 %	ACCEPTABLE
270	-1.56	10.41	18.57	24.9 %	ACCEPTABLE
271	-2.21	12.14	20.11	10.0 %	ACCEPTABLE
272	-1.82	11.50	19.42	10.1 %	ACCEPTABLE
273	-1.96	11.04	19.26	38.1 %	ACCEPTABLE
274	-1.44	9.34	17.89	83.6 %	ACCEPTABLE
275	-1.24	9.05	17.57	83.6 %	ACCEPTABLE
276	-1.85	10.57	18.91	84.8 %	ACCEPTABLE
277	-1.46	9.99	18.26	84.9 %	ACCEPTABLE
278	-1.64	9.64	18.22	83.6 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
279	-1.91	10.82	19.09	85.0 %	ACCEPTABLE
280	-1.51	10.20	18.42	85.2 %	ACCEPTABLE
281	-1.73	11.90	20.12	85.1 %	ACCEPTABLE
282	-1.33	11.25	19.42	85.3 %	ACCEPTABLE
283	-1.08	11.66	19.74	14.6 %	ACCEPTABLE
284	-1.76	13.57	21.44	10.0 %	ACCEPTABLE
285	-1.31	12.64	20.51	10.1 %	ACCEPTABLE
286	-1.49	12.34	20.47	24.8 %	ACCEPTABLE
287	-0.75	10.20	18.63	83.6 %	ACCEPTABLE
288	-1.39	11.88	20.11	85.0 %	ACCEPTABLE
289	-0.99	11.25	19.42	84.8 %	ACCEPTABLE
290	-1.15	10.83	19.31	83.9 %	ACCEPTABLE
291	-1.27	10.61	18.73	38.4 %	ACCEPTABLE
292	-1.93	12.37	20.29	11.7 %	ACCEPTABLE
293	-1.54	11.73	19.59	11.8 %	ACCEPTABLE
294	-1.67	11.25	19.42	38.2 %	ACCEPTABLE
295	-1.14	9.52	18.02	83.7 %	ACCEPTABLE
296	-0.94	9.23	17.70	83.6 %	ACCEPTABLE
297	-1.56	10.77	19.06	84.8 %	ACCEPTABLE
298	-1.17	10.18	18.40	84.9 %	ACCEPTABLE
299	-1.34	9.82	18.35	83.7 %	ACCEPTABLE
300	-1.62	11.02	19.24	85.2 %	ACCEPTABLE
301	-1.22	10.41	18.57	85.2 %	ACCEPTABLE
302	-1.44	12.12	20.29	85.2 %	ACCEPTABLE
303	-1.04	11.46	19.59	85.1 %	ACCEPTABLE
304	-188.12	807.18	832.05	3.2 %	ACCEPTABLE
305	-192.45	849.93	874.76	3.3 %	ACCEPTABLE
306	-1.33	11.25	19.42	85.3 %	ACCEPTABLE
307	-1.17	11.53	19.64	38.4 %	ACCEPTABLE
308	-1.61	12.76	20.73	10.1 %	ACCEPTABLE
309	-1.31	12.16	20.12	10.2 %	ACCEPTABLE
310	-1.44	11.97	20.11	24.8 %	ACCEPTABLE
311	-0.94	10.54	18.88	84.2 %	ACCEPTABLE
312	-1.37	11.67	19.88	85.1 %	ACCEPTABLE
313	-1.10	11.25	19.42	84.9 %	ACCEPTABLE
314	-1.21	10.96	19.34	84.2 %	ACCEPTABLE
315	-1.29	10.83	18.96	38.4 %	ACCEPTABLE
316	-1.73	11.99	19.99	11.9 %	ACCEPTABLE
317	-1.46	11.56	19.53	11.9 %	ACCEPTABLE
318	-1.56	11.25	19.42	85.3 %	ACCEPTABLE
319	-1.40	11.53	19.64	18.4 %	ACCEPTABLE
320	-1.84	12.76	20.73	11.8 %	ACCEPTABLE
321	-1.54	12.16	20.12	11.0 %	ACCEPTABLE
322	-1.67	11.97	20.11	14.5 %	ACCEPTABLE
323	-1.17	10.54	18.88	84.4 %	ACCEPTABLE
324	-1.60	11.67	19.88	85.2 %	ACCEPTABLE
325	-1.33	11.25	19.42	85.3 %	ACCEPTABLE
326	-1.44	10.96	19.34	84.4 %	ACCEPTABLE
327	-1.52	10.83	18.96	18.4 %	ACCEPTABLE
328	-1.96	11.99	19.99	11.8 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
329	-1.69	11.56	19.53	11.9 %	ACCEPTABLE
330	-1.79	11.25	19.42	24.7 %	ACCEPTABLE
331	-1.43	10.07	18.46	84.3 %	ACCEPTABLE
332	-1.30	9.87	18.24	84.4 %	ACCEPTABLE
333	-1.72	10.94	19.18	85.1 %	ACCEPTABLE
334	-1.45	10.54	18.74	85.2 %	ACCEPTABLE
335	-1.56	10.28	18.68	84.4 %	ACCEPTABLE
336	-1.75	11.10	19.30	38.2 %	ACCEPTABLE
337	-1.49	10.68	18.85	85.3 %	ACCEPTABLE
338	-1.63	11.83	20.00	38.2 %	ACCEPTABLE
339	-1.37	11.39	19.53	38.4 %	ACCEPTABLE
340	-1.56	11.25	19.42	85.3 %	ACCEPTABLE
341	-1.45	11.44	19.57	24.8 %	ACCEPTABLE
342	-1.75	12.24	20.28	11.0 %	ACCEPTABLE
343	-1.55	11.85	19.88	12.0 %	ACCEPTABLE
344	-1.63	11.73	19.88	24.8 %	ACCEPTABLE
345	-1.30	10.78	19.06	84.7 %	ACCEPTABLE
346	-1.59	11.53	19.73	85.2 %	ACCEPTABLE
347	-1.41	11.25	19.42	85.2 %	ACCEPTABLE
348	-1.48	11.06	19.36	84.8 %	ACCEPTABLE
349	-1.53	10.97	19.11	24.8 %	ACCEPTABLE
350	-1.82	11.74	19.80	11.1 %	ACCEPTABLE
351	-1.65	11.46	19.49	11.9 %	ACCEPTABLE
352	-1.71	11.25	19.42	24.8 %	ACCEPTABLE
353	-1.47	10.45	18.77	84.7 %	ACCEPTABLE
354	-1.38	10.32	18.62	84.7 %	ACCEPTABLE
355	-1.66	11.05	19.26	85.2 %	ACCEPTABLE
356	-1.49	10.77	18.96	85.2 %	ACCEPTABLE
357	-1.56	10.59	18.92	84.7 %	ACCEPTABLE
358	-1.69	11.15	19.34	38.2 %	ACCEPTABLE
359	-1.51	10.87	19.04	85.4 %	ACCEPTABLE
360	-1.40	11.06	19.18	18.4 %	ACCEPTABLE
361	-1.70	11.84	19.88	11.1 %	ACCEPTABLE
362	-1.50	11.45	19.49	10.2 %	ACCEPTABLE
363	-1.58	11.35	19.50	24.8 %	ACCEPTABLE
364	-1.25	10.41	18.69	84.7 %	ACCEPTABLE
365	-1.54	11.15	19.34	85.3 %	ACCEPTABLE
366	-1.36	10.87	19.04	85.2 %	ACCEPTABLE
367	-1.43	10.68	18.99	84.7 %	ACCEPTABLE
368	-1.48	10.59	18.74	24.9 %	ACCEPTABLE
369	-1.77	11.35	19.41	10.2 %	ACCEPTABLE
370	-1.60	11.07	19.10	12.0 %	ACCEPTABLE
371	-1.66	10.87	19.04	24.8 %	ACCEPTABLE
372	-1.42	10.09	18.40	84.7 %	ACCEPTABLE
373	-1.33	9.95	18.26	84.7 %	ACCEPTABLE
374	-1.61	10.67	18.89	85.2 %	ACCEPTABLE
375	-1.44	10.40	18.59	85.2 %	ACCEPTABLE
376	-1.51	10.22	18.55	84.7 %	ACCEPTABLE
377	-1.64	10.77	18.96	38.3 %	ACCEPTABLE
378	-1.46	10.50	18.66	38.4 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
379	-1.56	11.25	19.42	85.3 %	ACCEPTABLE
380	-1.38	10.97	19.11	38.4 %	ACCEPTABLE
381	-1.51	10.87	19.04	85.4 %	ACCEPTABLE
382	-1.44	11.00	19.14	24.9 %	ACCEPTABLE
383	-1.63	11.51	19.59	12.0 %	ACCEPTABLE
384	-1.50	11.26	19.34	10.3 %	ACCEPTABLE
385	-1.56	11.19	19.34	26.5 %	ACCEPTABLE
386	-1.34	10.56	18.80	85.0 %	ACCEPTABLE
387	-1.53	11.06	19.24	85.3 %	ACCEPTABLE
388	-1.41	10.87	19.04	85.4 %	ACCEPTABLE
389	-1.45	10.74	19.01	84.8 %	ACCEPTABLE
390	-1.49	10.68	18.84	26.6 %	ACCEPTABLE
391	-1.68	11.19	19.28	10.2 %	ACCEPTABLE
392	-1.57	11.00	19.08	12.0 %	ACCEPTABLE
393	-1.61	10.87	19.04	38.2 %	ACCEPTABLE
394	-1.45	10.34	18.61	84.9 %	ACCEPTABLE
395	-1.39	10.25	18.51	85.0 %	ACCEPTABLE
396	-1.58	10.74	18.94	85.2 %	ACCEPTABLE
397	-1.46	10.56	18.74	85.2 %	ACCEPTABLE
398	-1.51	10.44	18.71	84.9 %	ACCEPTABLE
399	-1.60	10.80	18.99	85.3 %	ACCEPTABLE
400	-1.48	10.62	18.79	85.4 %	ACCEPTABLE
401	-1.41	10.75	18.89	24.9 %	ACCEPTABLE
402	-1.60	11.25	19.34	12.0 %	ACCEPTABLE
403	-1.47	11.00	19.08	10.3 %	ACCEPTABLE
404	-1.53	10.93	19.09	38.3 %	ACCEPTABLE
405	-1.31	10.31	18.56	84.9 %	ACCEPTABLE
406	-1.50	10.80	18.99	85.2 %	ACCEPTABLE
407	-1.38	10.62	18.79	85.4 %	ACCEPTABLE
408	-1.43	10.50	18.76	85.0 %	ACCEPTABLE
409	-1.46	10.44	18.59	38.4 %	ACCEPTABLE
410	-1.65	10.93	19.03	9.8 %	ACCEPTABLE
411	-1.54	10.75	18.83	9.8 %	ACCEPTABLE
412	-1.58	10.62	18.79	38.3 %	ACCEPTABLE
413	-1.42	10.10	18.37	84.9 %	ACCEPTABLE
414	-1.36	10.01	18.27	85.0 %	ACCEPTABLE
415	-1.55	10.49	18.69	85.3 %	ACCEPTABLE
416	-1.43	10.31	18.49	85.2 %	ACCEPTABLE
417	-1.48	10.19	18.47	84.8 %	ACCEPTABLE
418	-1.57	10.56	18.74	38.3 %	ACCEPTABLE
419	-1.45	10.37	18.54	85.3 %	ACCEPTABLE
420	-1.51	10.87	19.04	85.4 %	ACCEPTABLE
421	-1.39	10.68	18.84	40.4 %	ACCEPTABLE
422	-187.49	803.63	828.51	3.3 %	ACCEPTABLE
423	-187.39	803.63	828.51	3.3 %	ACCEPTABLE
424	-1.48	10.62	18.79	85.4 %	ACCEPTABLE
425	-1.43	10.70	18.85	24.9 %	ACCEPTABLE
426	-1.56	11.04	19.15	13.1 %	ACCEPTABLE
427	-1.47	10.87	18.98	14.6 %	ACCEPTABLE
428	-1.51	10.83	18.99	38.3 %	ACCEPTABLE

No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
429	-1.36	10.42	18.63	85.1 %	ACCEPTABLE
430	-1.49	10.74	18.92	85.3 %	ACCEPTABLE
431	-1.41	10.62	18.79	85.4 %	ACCEPTABLE
432	-1.44	10.54	18.77	85.1 %	ACCEPTABLE
433	-1.47	10.50	18.66	38.4 %	ACCEPTABLE
434	-1.60	10.83	18.95	15.7 %	ACCEPTABLE
435	-1.52	10.70	18.81	14.6 %	ACCEPTABLE
436	-1.55	10.62	18.79	38.3 %	ACCEPTABLE
437	-1.44	10.27	18.51	85.1 %	ACCEPTABLE
438	-1.40	10.21	18.44	85.1 %	ACCEPTABLE
439	-1.53	10.53	18.72	85.2 %	ACCEPTABLE
440	-1.45	10.41	18.59	85.3 %	ACCEPTABLE
441	-1.48	10.33	18.57	85.1 %	ACCEPTABLE
442	-1.54	10.58	18.76	38.3 %	ACCEPTABLE
443	-1.46	10.45	18.62	40.4 %	ACCEPTABLE
444	-1.50	10.79	18.96	85.3 %	ACCEPTABLE
445	-1.42	10.66	18.82	38.4 %	ACCEPTABLE
446	-186.37	793.63	818.52	3.3 %	ACCEPTABLE
447	-187.22	801.91	826.79	3.3 %	ACCEPTABLE
448	-186.30	793.63	818.52	3.3 %	ACCEPTABLE
449	-1.48	10.62	18.79	85.4 %	ACCEPTABLE
450	-1.45	10.68	18.83	24.9 %	ACCEPTABLE
451	-1.53	10.90	19.03	18.4 %	ACCEPTABLE
452	-1.47	10.79	18.92	18.4 %	ACCEPTABLE
453	-1.50	10.76	18.92	26.6 %	ACCEPTABLE
454	-1.40	10.48	18.69	85.2 %	ACCEPTABLE
455	-1.49	10.70	18.88	85.3 %	ACCEPTABLE
456	-1.44	10.62	18.79	85.3 %	ACCEPTABLE
457	-1.46	10.56	18.78	85.2 %	ACCEPTABLE
458	-1.47	10.54	18.70	38.4 %	ACCEPTABLE
459	-1.56	10.76	18.90	18.4 %	ACCEPTABLE
460	-1.50	10.68	18.81	18.4 %	ACCEPTABLE
461	-1.52	10.62	18.79	38.4 %	ACCEPTABLE
462	-1.45	10.39	18.60	85.2 %	ACCEPTABLE
463	-1.43	10.35	18.56	85.2 %	ACCEPTABLE
464	-1.51	10.56	18.75	85.3 %	ACCEPTABLE
465	-1.46	10.48	18.66	85.2 %	ACCEPTABLE
466	-1.48	10.43	18.64	85.2 %	ACCEPTABLE
467	-1.52	10.59	18.77	38.3 %	ACCEPTABLE
468	-1.47	10.51	18.68	85.3 %	ACCEPTABLE
469	-1.49	10.73	18.90	40.3 %	ACCEPTABLE
470	-1.44	10.65	18.81	40.4 %	ACCEPTABLE
471	-186.51	795.00	819.89	3.3 %	ACCEPTABLE
472	-187.08	800.52	825.41	3.3 %	ACCEPTABLE
473	-186.47	795.00	819.89	3.3 %	ACCEPTABLE
474	-1.48	10.62	18.79	85.4 %	ACCEPTABLE
475	-1.46	10.66	18.82	38.4 %	ACCEPTABLE
476	-1.52	10.81	18.95	24.8 %	ACCEPTABLE
477	-1.48	10.73	18.87	19.8 %	ACCEPTABLE
478	-1.49	10.71	18.88	85.4 %	ACCEPTABLE



No.	Center		Radius R [m]	Utilization	Verification
	x [m]	z [m]			
479	-1.43	10.53	18.72	85.2 %	ACCEPTABLE
480	-1.49	10.67	18.85	85.3 %	ACCEPTABLE
481	-1.45	10.62	18.79	85.4 %	ACCEPTABLE
482	-1.46	10.58	18.78	85.2 %	ACCEPTABLE
483	-1.47	10.57	18.73	38.4 %	ACCEPTABLE
484	-1.53	10.71	18.86	18.4 %	ACCEPTABLE
485	-1.50	10.66	18.80	24.9 %	ACCEPTABLE
486	-1.51	10.62	18.79	38.3 %	ACCEPTABLE
487	-1.46	10.46	18.66	85.2 %	ACCEPTABLE
488	-1.44	10.44	18.63	85.2 %	ACCEPTABLE
489	-1.50	10.58	18.76	38.3 %	ACCEPTABLE
490	-1.47	10.53	18.70	85.4 %	ACCEPTABLE
491	-1.48	10.49	18.69	85.2 %	ACCEPTABLE
492	-1.51	10.60	18.78	38.4 %	ACCEPTABLE
493	-1.47	10.55	18.72	85.3 %	ACCEPTABLE
494	-1.49	10.69	18.86	85.4 %	ACCEPTABLE
495	-1.45	10.64	18.80	40.4 %	ACCEPTABLE
496	-186.61	795.92	820.81	3.3 %	ACCEPTABLE
497	-186.99	799.60	824.49	3.3 %	ACCEPTABLE
498	-186.58	795.92	820.81	3.3 %	ACCEPTABLE
499	-1.48	10.62	18.79	85.4 %	ACCEPTABLE

