Bijlage 4 Resultaat ontwerp Oostelijke waterkering, met damwand

Report for D-Sheet Piling 14.1

Design of Sheet Pilings
Developed by Deltares

Date of report:	8/13/2014
Time of report:	6:46:24 PM
Date of calculation:	8/13/2014
Time of calculation:	5:54:50 PM
Filename:	T:\..\hoogwaterveiligheid\Damwand waterkering oost 0
Project identification:	Zeesluis Terneuzen Waterkering oost Ontwerp damwand

Verification according to NEN-EN 9997+C1:2012

1 Table of Contents

1 Table of Contents 2
2 Summary 4
2.1 Overview per Stage and Test 4
2.2 Anchors and Struts 4
2.3 Overall Stability per Stage 4
3 Input Data for all Stages 5
3.1 General Input Data 5
3.2 Sheet Piling Properties 5
3.3 Calculation Options 5
4 Outline Stage 3: Eindsituatie 7
5 Step 6.3 Stage 3: Eindsituatie 8
5.1 Input Data Left 8
5.1.1 Calculation Method 8
5.1.2 Water Level 8
5.1.3 Surface 8
5.1.4 Soil Material Properties in Profile: bestaand links 8
5.1.5 Modulus of Subgrade Reaction (Secant) 8
5.2 Calculated Earth Pressure Coefficients Left 9
5.3 Calculated Force from a layer Left 9
5.4 Input Data Right 9
5.4.1 Calculation Method 9
5.4.2 Water Level 9
5.4.3 Surface 10
5.4.4 Soil Material Properties in Profile: bestaand links 10
5.4.5 Modulus of Subgrade Reaction (Secant) 10
5.4.6 Anchors 11
5.4.7 Surcharge Loads 11
5.5 Calculated Earth Pressure Coefficients Right 11
5.6 Calculated Force from a layer Right 12
5.7 Calculation Results 12
5.7.1 Charts of Moments, Forces and Displacements 12
5.7.2 Moments, Forces and Displacements 12
5.7.3 Stresses 13
5.7.4 Soil Collapse 14
5.7.5 Vertical Force Balance 14
5.7.6 Vertical Force Balance Contribution per Layer 15
5.7.7 Anchors/Struts 15
6 Step 6.4 Stage 3: Eindsituatie 16
6.1 Input Data Left 16
6.1.1 Calculation Method 16
6.1.2 Water Level 16
6.1.3 Surface 16
6.1.4 Soil Material Properties in Profile: bestaand links 16
6.1.5 Modulus of Subgrade Reaction (Secant) 16
6.2 Calculated Earth Pressure Coefficients Left 17
6.3 Calculated Force from a layer Left 17
6.4 Input Data Right 17
6.4.1 Calculation Method 17
6.4.2 Water Level 17
6.4.3 Surface 18
6.4.4 Soil Material Properties in Profile: bestaand links 18
6.4.5 Modulus of Subgrade Reaction (Secant) 18
6.4.6 Anchors 19
6.4.7 Surcharge Loads 19
6.5 Calculated Earth Pressure Coefficients Right 19
6.6 Calculated Force from a layer Right 20
6.7 Calculation Results 20
6.7.1 Charts of Moments, Forces and Displacements 20
6.7.2 Moments, Forces and Displacements 20
6.7.3 Stresses 21
6.7.4 Soil Collapse 22
6.7.5 Vertical Force Balance 22
6.7.6 Vertical Force Balance Contribution per Layer 23
6.7.7 Anchors/Struts 23

6.7.8 Rigid and Spring Supports 23
7 Step 6.5 Stage 3: Eindsituatie 24
7.1 Input Data Left 24
7.1.1 Calculation Method 24
7.1.2 Water Level 24
7.1.3 Surface 24
7.1.4 Soil Material Properties in Profile: bestaand links 24
7.1.5 Modulus of Subgrade Reaction (Secant) 24
7.2 Calculated Earth Pressure Coefficients Left 25
7.3 Calculated Force from a layer Left 25
7.4 Input Data Right 25
7.4.1 Calculation Method 25
7.4.2 Water Level 25
7.4.3 Surface 26
7.4.4 Soil Material Properties in Profile: bestaand links 26
7.4.5 Modulus of Subgrade Reaction (Secant) 26
7.4.6 Anchors 27
7.4.7 Surcharge Loads 27
7.5 Calculated Earth Pressure Coefficients Right 27
7.6 Calculated Force from a layer Right 27
7.7 Calculation Results 28
7.7.1 Charts of Moments, Forces and Displacements 28
7.7.2 Moments, Forces and Displacements 28
7.7.3 Stresses 29
7.7.4 Soil Collapse 30
7.7.5 Vertical Force Balance 30
7.7.6 Vertical Force Balance Contribution per Layer 31
7.7.7 Anchors/Struts 31

2 Summary

2.1 Overview per Stage and Test

Stage no.	Verification type	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
1	Not verified						
2	Not verified						
3	EC7(NL)-Step 6.3		**-567.1**	**-397.0**	68.7	74.7	---
3	EC7(NL)-Step 6.4		-544.4	-386.6	**71.5**	**77.3**	---
3	EC7(NL)-Step 6.5	**-39.6**	-341.8	-292.8	45.3	52.6	---
3	EC7(NL)-Step 6.5 * 1.20		-410.2	-351.4			
Max		**-39.6**	**-567.1**	**-397.0**	**71.5**	**77.3**	---

2.2 Anchors and Struts

Stage	Verification type	Anchor/strut leganker M72	
		Force [kN]	State
3	Step 6.3	**596.64**	Elastic
3	Step 6.4	578.69	Elastic
3	Step 6.5 * 1.20	534.29	Elastic
Max		**596.64**	

Due to multiplication of the representative value a Force bigger than Yield or Buckling Force may be present

2.3 Overall Stability per Stage

Stage name	Stability factor [-]
Eindsituatie	1.18

3 Input Data for all Stages

3.1 General Input Data

Verification according to NEN-EN 9997+C1:2012

Model	Sheet piling
Check vertical balance	Yes
Number of construction stages	3
Unit weight of water	10.25 kN/m³
Number of curves on spring characteristic	3
Unloading curve on spring characteristic	No

3.2 Sheet Piling Properties

Length	20.60 m
Level top side	4.60 m
Number of sections	1
Pr;max;point	0.00 MPa
Xi factor	0.72

Section name	From [m]	To [m]	Stiffness EI [kNm²/m']	Acting width [m]
AZ 36 -700*	-16.00	4.60	1.8845E+05	1.00

Section name	From [m]	To [m]	Max. char. moment [kNm/m']	Modification factor [-]	Material factor [-]	Red. factor max. moment [-]	Design moment [kNm/m']
AZ 36 -700*	-16.00	4.60	864.00	1.00	1.00	0.75	648.00

Section name	From [m]	To [m]	Red. factor EI [-]	Note to reduction factor	Corrected stiffness EI [kNm²]
AZ 36 -700*	-16.00	4.60	0.75		141300.00

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
AZ 36 -700*	-16.00	4.60	499.00	1.46	216.00

3.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL method B: Partial factors (design values) in verified stage only Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
Verification of stage	3: Eindsituatie
Multiplication factor for anchor stiffness	1.000
Used partial factor set	RC 3
Factors on loads	
- Permanent load, unfavourable	1.00
- Permanent load, favourable	1.00
- Variable load, unfavourable	1.25
- Variable load, favourable	0.00
Material factors	
- Cohesion	1.40

- Tangent phi	1.20
- Delta (wall friction angle)	1.20
- Modulus of subgrade reactions	1.30

Geometry modification

- Increase retaining height	10.00 %
- Maximum increase retaining height	0.50 m
- Reduction in phreatic line on passive side	0.25 m
- Raise in phreatic line on passive side	0.25 m
- Raise in phreatic line on active side	0.05 m

Overall stability factors

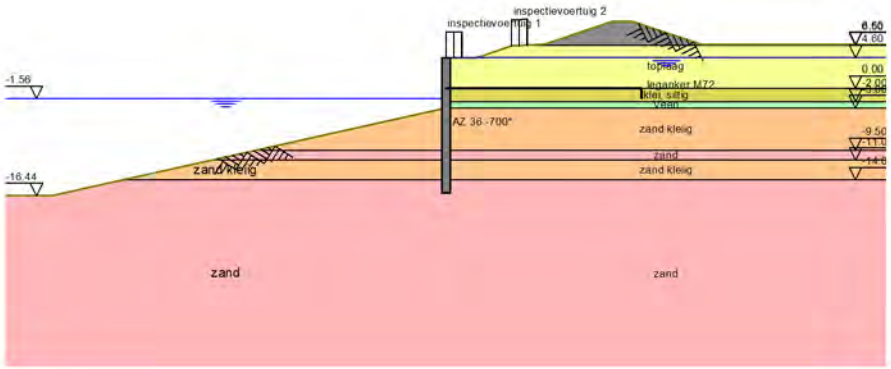
- Cohesion	1.60
- Tangent phi	1.30
- Factor on Unit weight soil	1.00

Vertical balance factors

- Gamma m:b4	1.20

4 Outline Stage 3: Eindsituatie

Outline - Stage 3: Eindsituatie



5 Step 6.3 Stage 3: Eindsituatie

5.1 Input Data Left

5.1.1 Calculation Method

Calculation method: C, phi, delta

5.1.2 Water Level

Water level: -1.81 [m]

5.1.3 Surface

X [m]	Y [m]
0.00	-3.30
60.48	-16.74

5.1.4 Soil Material Properties in Profile: bestaand links

Layer name	Level [m]	Unit weight Unsat [kN/m³]	Unit weight Sat [kN/m³]	Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
dijk	10.50	17.10	19.10	0.00	25.69	17.13
toplaag	6.50	17.00	18.20	0.00	23.01	15.34
klei, siltig	0.00	16.00	17.10	0.00	27.51	9.46
Veen	-2.00	12.00	12.00	1.79	12.59	0.00
zand kleiig	-3.00	16.00	17.10	0.00	27.51	18.91
zand	-9.50	17.10	19.10	0.00	32.13	16.60
zand kleiig	-11.00	16.00	17.10	0.00	27.51	18.91
zand	-14.00	17.10	19.10	0.00	32.13	16.60

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
dijk	10.50	1.00	1.00	Fine
toplaag	6.50	1.00	1.00	Fine
klei, siltig	0.00	1.00	1.00	Fine
Veen	-2.00	1.00	1.00	Fine
zand kleiig	-3.00	1.00	1.00	Fine
zand	-9.50	1.00	1.00	Fine
zand kleiig	-11.00	1.00	1.00	Fine
zand	-14.00	1.00	1.00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Earth pressure coefficients Neutral [-]	Earth pressure coefficients Passive [-]	Additional pore pressure Top [kN/m²]	Additional pore pressure Bottom [kN/m²]
dijk	10.50	n.a.	n.a.	n.a.	0.00	0.00
toplaag	6.50	n.a.	n.a.	n.a.	0.00	0.00
klei, siltig	0.00	n.a.	n.a.	n.a.	0.00	0.00
Veen	-2.00	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-3.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-9.50	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-11.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-14.00	n.a.	n.a.	n.a.	0.00	0.00

5.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
dijk	10.50	15384.62	15384.62	7692.31	7692.31
toplaag	6.50	15384.62	15384.62	7692.31	7692.31
klei, siltig	0.00	3076.92	3076.92	1538.46	1538.46
Veen	-2.00	1538.46	1538.46	615.38	615.38

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
zand kleiig	-3.00	15384.62	15384.62	7692.31	7692.31
zand	-9.50	30769.23	30769.23	15384.62	15384.62
zand kleiig	-11.00	15384.62	15384.62	7692.31	7692.31
zand	-14.00	30769.23	30769.23	15384.62	15384.62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
dijk	10.50	3846.15	3846.15
toplaag	6.50	3846.15	3846.15
klei, siltig	0.00	615.38	615.38
Veen	-2.00	384.62	384.62
zand kleiig	-3.00	3846.15	3846.15
zand	-9.50	7692.31	7692.31
zand kleiig	-11.00	3846.15	3846.15
zand	-14.00	7692.31	7692.31

5.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
1	-3.74	0.8	7.9	0.32	0.32	3.05
2	-4.63	2.4	23.7	0.31	0.31	3.03
3	-5.51	4.1	39.5	0.31	0.31	3.03
4	-6.40	5.7	55.3	0.31	0.31	3.03
5	-7.29	7.3	71.1	0.31	0.31	3.03
6	-8.17	9.0	86.9	0.31	0.31	3.03
7	-9.06	10.6	102.7	0.31	0.31	3.03
8	-9.88	10.4	171.3	0.26	0.26	4.34
9	-10.63	12.1	191.0	0.27	0.27	4.21
10	-11.50	16.1	150.8	0.31	0.31	2.94
11	-12.50	17.9	166.1	0.31	0.31	2.91
12	-13.50	19.8	176.3	0.31	0.32	2.80
13	-14.50	18.6	304.8	0.27	0.27	4.36
14	-15.50	20.8	323.3	0.27	0.28	4.15

5.3 Calculated Force from a layer Left

Name	Force
dijk	0.00
toplaag	0.00
klei, siltig	0.00
Veen	0.00
zand kleiig	342.70
zand	271.76
zand kleiig	425.42
zand	256.20

5.4 Input Data Right

5.4.1 Calculation Method

Calculation method: C, phi, delta

5.4.2 Water Level

Water level: 4.60 [m]

5.4.3 Surface

X [m]	Y [m]
0.00	4.60
4.65	4.60
10.05	6.40
15.05	6.65
25.55	10.15
28.55	10.15
39.05	6.65

5.4.4 Soil Material Properties in Profile: bestaand links

Layer name	Level [m]	Unit weight Unsat [kN/m³]	Unit weight Sat [kN/m³]	Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
dijk	10.50	17.10	19.10	0.00	25.69	17.13
toplaag	6.50	17.00	18.20	0.00	23.01	15.34
klei, siltig	0.00	16.00	17.10	0.00	27.51	9.46
Veen	-2.00	12.00	12.00	1.79	12.59	0.00
zand kleiig	-3.00	16.00	17.10	0.00	27.51	18.91
zand	-9.50	17.10	19.10	0.00	32.13	16.60
zand kleiig	-11.00	16.00	17.10	0.00	27.51	18.91
zand	-14.00	17.10	19.10	0.00	32.13	16.60

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
dijk	10.50	1.00	1.00	Fine
toplaag	6.50	1.00	1.00	Fine
klei, siltig	0.00	1.00	1.00	Fine
Veen	-2.00	1.00	1.00	Fine
zand kleiig	-3.00	1.00	1.00	Fine
zand	-9.50	1.00	1.00	Fine
zand kleiig	-11.00	1.00	1.00	Fine
zand	-14.00	1.00	1.00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Earth pressure coefficients Neutral [-]	Earth pressure coefficients Passive [-]	Additional pore pressure Top [kN/m²]	Additional pore pressure Bottom [kN/m²]
dijk	10.50	n.a.	n.a.	n.a.	0.00	0.00
toplaag	6.50	n.a.	n.a.	n.a.	0.00	0.00
klei, siltig	0.00	n.a.	n.a.	n.a.	0.00	0.00
Veen	-2.00	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-3.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-9.50	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-11.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-14.00	n.a.	n.a.	n.a.	0.00	0.00

5.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
dijk	10.50	15384.62	15384.62	7692.31	7692.31
toplaag	6.50	15384.62	15384.62	7692.31	7692.31
klei, siltig	0.00	3076.92	3076.92	1538.46	1538.46
Veen	-2.00	1538.46	1538.46	615.38	615.38
zand kleiig	-3.00	15384.62	15384.62	7692.31	7692.31
zand	-9.50	30769.23	30769.23	15384.62	15384.62
zand kleiig	-11.00	15384.62	15384.62	7692.31	7692.31
zand	-14.00	30769.23	30769.23	15384.62	15384.62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
dijk	10.50	3846.15	3846.15
toplaag	6.50	3846.15	3846.15
klei, siltig	0.00	615.38	615.38
Veen	-2.00	384.62	384.62
zand kleiig	-3.00	3846.15	3846.15
zand	-9.50	7692.31	7692.31
zand kleiig	-11.00	3846.15	3846.15
zand	-14.00	7692.31	7692.31

5.4.6 Anchors

Name	Level [m]	E-Modulus [kN/m²]	Cross section [m²/m']	Length [m]	Angle [deg]	Yield force [kN/m']	Pre-tension. force [kN/m']
leganker M72	0.00	2.100E+08	2.300E-03	30.00	0.00	653.00	n.a.

5.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
inspectievoertuig 1	0.00	16.63
	2.50	16.63
inspectievoertuig 2	10.05	16.63
	12.55	16.63

5.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
1	4.22	7.4	55.7	0.38	0.88	2.83
2	3.45	9.7	49.7	0.38	0.75	1.96
3	2.67	12.0	76.6	0.39	0.74	2.51
4	1.91	14.3	113.5	0.40	0.77	3.19
5	1.15	15.6	160.1	0.38	0.79	3.92
6	0.38	15.3	215.1	0.33	0.80	4.62
7	-0.39	13.9	274.7	0.27	0.75	5.25
8	-1.17	13.9	363.1	0.24	0.75	6.26
9	-1.69	14.6	438.8	0.24	0.74	7.09
10	-1.91	15.3	308.1	0.24	0.74	4.85
11	-2.50	39.5	190.3	0.60	0.92	2.90
12	-3.15	28.1	555.9	0.41	0.73	8.14
13	-3.74	29.6	657.5	0.40	0.71	9.00
14	-4.63	27.0	737.3	0.34	0.69	9.19
15	-5.51	31.8	801.5	0.36	0.68	9.16
16	-6.40	34.6	780.4	0.37	0.66	8.23
17	-7.29	36.2	598.8	0.35	0.64	5.87
18	-8.17	39.1	571.0	0.36	0.63	5.22
19	-9.06	41.1	613.1	0.35	0.62	5.26
20	-9.88	36.0	764.9	0.29	0.55	6.17
21	-10.63	38.0	800.8	0.29	0.54	6.09
22	-11.50	59.1	745.9	0.42	0.59	5.35
23	-12.50	61.1	835.5	0.41	0.58	5.67
24	-13.50	61.0	900.3	0.39	0.57	5.79
25	-14.50	50.4	1030.7	0.31	0.51	6.27
26	-15.50	57.1	1046.6	0.33	0.50	6.01

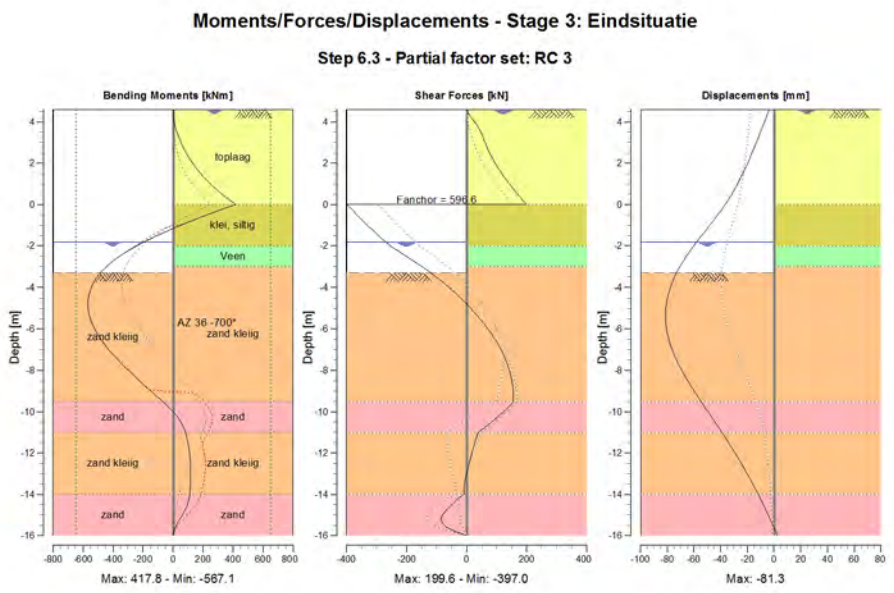
5.6 Calculated Force from a layer Right

Name	Force
dijk	0.00
toplaag	0.00
klei, siltig	28.29
Veen	39.51
zand kleiig	220.49
zand	55.50
zand kleiig	181.18
zand	135.12

5.7 Calculation Results

Number of iterations: 6

5.7.1 Charts of Moments, Forces and Displacements



5.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	4.60	0.0	0.1	-3.5
1	3.83	11.9	34.8	-8.2
2	3.83	11.9	34.9	-8.2
2	3.06	49.4	59.8	-12.9
3	3.06	49.4	59.6	-12.9
3	2.29	104.2	84.0	-17.9
4	2.29	104.2	84.0	-17.9
4	1.53	180.0	116.0	-23.2
5	1.53	180.0	116.0	-23.2
5	0.76	282.9	154.9	-29.3
6	0.76	282.9	154.9	-29.3
6	0.00	417.8	199.6	-36.6
7	0.00	417.8	**-397.0**	-36.6
7	-0.78	127.4	-346.2	-45.5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
8	-0.78	127.4	-346.3	-45.5
8	-1.56	-120.9	-289.3	-54.9
9	-1.56	-120.9	-289.3	-54.9
9	-1.81	-190.8	-269.5	-57.9
10	-1.81	-190.8	-269.5	-57.9
10	-2.00	-240.5	-254.1	-60.1
11	-2.00	-240.5	-254.1	-60.1
11	-3.00	-442.2	-148.9	-70.4
12	-3.00	-442.2	-148.9	-70.4
12	-3.30	-482.6	-120.8	-72.9
13	-3.30	-482.6	-120.7	-72.9
13	-4.19	-554.4	-43.3	-78.6
14	-4.19	-554.4	-43.4	-78.6
14	-5.07	**-564.9**	17.8	**-81.2**
15	-5.07	**-564.9**	17.8	**-81.2**
15	-5.96	-525.5	69.2	-80.6
16	-5.96	-525.5	69.2	-80.6
16	-6.84	-445.7	109.1	-77.2
17	-6.84	-445.7	109.0	-77.2
17	-7.73	-336.2	136.4	-71.3
18	-7.73	-336.2	136.2	-71.3
18	-8.61	-207.6	152.1	-63.6
19	-8.61	-207.6	152.1	-63.6
19	-9.50	-70.4	155.8	-54.7
20	-9.50	-70.4	155.8	-54.7
20	-10.25	28.0	103.6	-46.9
21	-10.25	28.0	103.6	-46.9
21	-11.00	82.3	38.1	-39.1
22	-11.00	82.3	38.1	-39.1
22	-12.00	109.8	17.3	-29.2
23	-12.00	109.8	17.3	-29.2
23	-13.00	118.1	-0.3	-20.2
24	-13.00	118.1	-0.4	-20.2
24	-14.00	111.6	-9.2	-11.9
25	-14.00	111.6	-9.3	-11.9
25	-15.00	62.5	-80.0	-4.4
26	-15.00	62.7	-81.4	-4.4
26	-16.00	0.0	-0.4	2.6
Max		**-564.9**	**-397.0**	**-81.2**
Max, minor nodes incl.		-567.1	-397.0	-81.3

5.7.3 Stresses

Node number	Level [m]	Left				Right			
		Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]
1	4.60	0.00	0.00	-		0.06	0.00	P	
1	3.83	0.00	0.00	-		42.22	7.89	2	66
2	3.83	0.00	0.00	-		34.29	7.89	2	77
2	3.06	0.00	0.00	-		10.70	15.79	A	
3	3.06	0.00	0.00	-		11.01	15.79	A	
3	2.29	0.00	0.00	-		12.99	23.68	A	
4	2.29	0.00	0.00	-		13.28	23.68	A	
4	1.53	0.00	0.00	-		15.34	31.50	A	
5	1.53	0.00	0.00	-		14.57	31.50	A	
5	0.76	0.00	0.00	-		16.67	39.33	A	
6	0.76	0.00	0.00	-		14.39	39.33	A	
6	0.00	0.00	0.00	-		16.34	47.15	A	
7	0.00	0.00	0.00	-		13.19	47.15	A	
7	-0.78	0.00	0.00	-		14.67	55.15	A	
8	-0.78	0.00	0.00	-		13.24	55.15	A	
8	-1.56	0.00	0.00	-		14.64	63.14	A	
9	-1.56	0.00	0.00	-		14.42	63.14	A	
9	-1.81	0.00	0.00	-		14.87	65.70	A	
10	-1.81	0.00	0.00	-		15.09	65.70	A	

Node number	Level [m]	Left				Right			
		Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]
10	-2.00	0.00	1.95	-		15.44	67.65	A	
11	-2.00	0.00	1.95	-		38.69	67.65	A	
11	-3.00	0.00	12.20	-		40.35	77.90	A	
12	-3.00	0.00	12.20	-		27.61	77.90	A	
12	-3.30	0.00	15.27	-		28.60	80.98	A	
13	-3.30	0.00	15.27	P		28.12	80.98	A	
13	-4.19	15.87	24.35	P		31.02	90.05	A	
14	-4.19	15.78	24.35	P		25.81	90.05	A	
14	-5.07	31.60	33.43	P		28.24	99.13	A	
15	-5.07	31.58	33.43	P		30.48	99.13	A	
15	-5.96	47.38	42.51	P		33.12	108.21	A	
16	-5.96	47.38	42.51	P		33.32	108.21	A	
16	-6.84	63.18	51.59	P		35.98	117.29	A	
17	-6.84	63.17	51.59	P		34.93	117.29	A	
17	-7.73	78.97	60.67	P		37.51	126.37	A	
18	-7.73	78.96	60.67	P		37.78	126.37	A	
18	-8.61	94.76	69.74	P		40.37	135.45	A	
19	-8.61	94.75	69.74	P		39.81	135.45	A	
19	-9.50	110.56	78.82	P		42.36	144.53	A	
20	-9.50	158.45	78.82	P		34.93	144.53	A	
20	-10.25	184.16	86.51	P		37.14	152.21	A	
21	-10.25	178.57	86.51	P		36.87	152.21	A	
21	-11.00	203.51	94.20	P		39.06	159.90	A	
22	-11.00	142.17	94.20	P		57.41	159.90	A	
22	-12.00	145.79	104.45	3	91	60.82	170.15	A	
23	-12.00	144.46	104.45	3	92	59.41	170.15	A	
23	-13.00	144.40	114.70	3	83	62.72	180.40	A	
24	-13.00	140.03	114.70	3	83	59.45	180.40	A	
24	-14.00	124.45	124.95	2	67	62.56	190.65	A	
25	-14.00	212.43	124.95	2	74	48.89	190.65	A	
25	-15.00	162.12	135.20	2	50	51.92	200.90	A	
26	-15.00	156.92	135.20	2	51	55.49	200.90	A	
26	-16.00	21.84	145.45	A		164.01	211.15	1	15

*

Stat	Status (A=active, P=passive, Number is branche, 0 is unloading)
Mob	Percentage passive mobilized

5.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	1296.1	751.3
Water	1032.0	2174.9
Total	2328.0	2926.1

Considered as passive side	Left
Maximum passive effective resistance	1735.81 kN
Mobilized passive effective resistance	1296.08 kN
Percentage mobilized resistance	74.7 %
Position single support	0.00 m
Maximum passive moment	20971.75 kNm
Mobilized passive moment	14414.92 kNm
Percentage mobilized moment	68.7 %

5.7.5 Vertical Force Balance

Xi factor	0.72
Partial material factor	1.20
Maximum point resistance	0.00 [MPa]

A maximum point resistance of zero results in a vertical toe capacity of zero

Vertical force balance unplugged	Force [kN]
Vertical force active	-239.89
Vertical force passive	464.12
Resulting vertical force (no dead weight)	224.23
Vertical toe capacity Ftoe;d	0.00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-239.89
Vertical force passive	464.12
Resulting vertical force (no dead weight)	224.23
Vertical toe capacity Ftoe;d	0.00
Resultant goes up	

5.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
-3.30	zand kleiig	117.41	4.60	toplaag	-25.01
-9.50	zand	103.44	0.00	klei, siltig	-4.71
-11.00	zand kleiig	145.75	-2.00	Veen	0.00
-14.00	zand	97.52	-3.00	zand kleiig	-75.54
			-9.50	zand	-21.13
			-11.00	zand kleiig	-62.07
			-14.00	zand	-51.43

5.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
leganker M72	0.00	2.100E+08	596.64	Elastic	Right	Anchor

6 Step 6.4 Stage 3: Eindsituatie

6.1 Input Data Left

6.1.1 Calculation Method

Calculation method: C, phi, delta

6.1.2 Water Level

Water level: -1.81 [m]

6.1.3 Surface

X [m]	Y [m]
0.00	-3.30
60.48	-16.74

6.1.4 Soil Material Properties in Profile: bestaand links

Layer name	Level [m]	Unit weight Unsat [kN/m³]	Unit weight Sat [kN/m³]	Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
dijk	10.50	17.10	19.10	0.00	25.69	17.13
toplaag	6.50	17.00	18.20	0.00	23.01	15.34
klei, siltig	0.00	16.00	17.10	0.00	27.51	9.46
Veen	-2.00	12.00	12.00	1.79	12.59	0.00
zand kleiig	-3.00	16.00	17.10	0.00	27.51	18.91
zand	-9.50	17.10	19.10	0.00	32.13	16.60
zand kleiig	-11.00	16.00	17.10	0.00	27.51	18.91
zand	-14.00	17.10	19.10	0.00	32.13	16.60

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
dijk	10.50	1.00	1.00	Fine
toplaag	6.50	1.00	1.00	Fine
klei, siltig	0.00	1.00	1.00	Fine
Veen	-2.00	1.00	1.00	Fine
zand kleiig	-3.00	1.00	1.00	Fine
zand	-9.50	1.00	1.00	Fine
zand kleiig	-11.00	1.00	1.00	Fine
zand	-14.00	1.00	1.00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Earth pressure coefficients Neutral [-]	Earth pressure coefficients Passive [-]	Additional pore pressure Top [kN/m²]	Additional pore pressure Bottom [kN/m²]
dijk	10.50	n.a.	n.a.	n.a.	0.00	0.00
toplaag	6.50	n.a.	n.a.	n.a.	0.00	0.00
klei, siltig	0.00	n.a.	n.a.	n.a.	0.00	0.00
Veen	-2.00	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-3.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-9.50	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-11.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-14.00	n.a.	n.a.	n.a.	0.00	0.00

6.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
dijk	10.50	45000.00	45000.00	22500.00	22500.00
toplaag	6.50	45000.00	45000.00	22500.00	22500.00
klei, siltig	0.00	9000.00	9000.00	4500.00	4500.00
Veen	-2.00	4500.00	4500.00	1800.00	1800.00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
zand kleiig	-3.00	45000.00	45000.00	22500.00	22500.00
zand	-9.50	90000.00	90000.00	45000.00	45000.00
zand kleiig	-11.00	45000.00	45000.00	22500.00	22500.00
zand	-14.00	90000.00	90000.00	45000.00	45000.00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
dijk	10.50	11250.00	11250.00
toplaag	6.50	11250.00	11250.00
klei, siltig	0.00	1800.00	1800.00
Veen	-2.00	1125.00	1125.00
zand kleiig	-3.00	11250.00	11250.00
zand	-9.50	22500.00	22500.00
zand kleiig	-11.00	11250.00	11250.00
zand	-14.00	22500.00	22500.00

6.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
1	-3.74	0.8	7.9	0.32	0.32	3.05
2	-4.63	2.4	23.7	0.31	0.31	3.03
3	-5.51	4.1	39.5	0.31	0.31	3.03
4	-6.40	5.7	55.3	0.31	0.31	3.03
5	-7.29	7.3	71.1	0.31	0.31	3.03
6	-8.17	9.0	86.9	0.31	0.31	3.03
7	-9.06	10.6	102.7	0.31	0.31	3.03
8	-9.88	10.4	171.3	0.26	0.26	4.34
9	-10.63	12.1	191.0	0.27	0.27	4.21
10	-11.50	16.1	150.8	0.31	0.31	2.94
11	-12.50	17.9	166.1	0.31	0.31	2.91
12	-13.50	19.8	176.3	0.31	0.32	2.80
13	-14.50	18.6	304.8	0.27	0.27	4.36
14	-15.50	20.8	323.3	0.27	0.28	4.15

6.3 Calculated Force from a layer Left

Name	Force
dijk	0.00
toplaag	0.00
klei, siltig	0.00
Veen	0.00
zand kleiig	342.70
zand	271.76
zand kleiig	464.59
zand	262.72

6.4 Input Data Right

6.4.1 Calculation Method

Calculation method: C, phi, delta

6.4.2 Water Level

Water level: 4.60 [m]

6.4.3 Surface

X [m]	Y [m]
0.00	4.60
4.65	4.60
10.05	6.40
15.05	6.65
25.55	10.15
28.55	10.15
39.05	6.65

6.4.4 Soil Material Properties in Profile: bestaand links

Layer name	Level [m]	Unit weight Unsat [kN/m³]	Unit weight Sat [kN/m³]	Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
dijk	10.50	17.10	19.10	0.00	25.69	17.13
toplaag	6.50	17.00	18.20	0.00	23.01	15.34
klei, siltig	0.00	16.00	17.10	0.00	27.51	9.46
Veen	-2.00	12.00	12.00	1.79	12.59	0.00
zand kleiig	-3.00	16.00	17.10	0.00	27.51	18.91
zand	-9.50	17.10	19.10	0.00	32.13	16.60
zand kleiig	-11.00	16.00	17.10	0.00	27.51	18.91
zand	-14.00	17.10	19.10	0.00	32.13	16.60

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
dijk	10.50	1.00	1.00	Fine
toplaag	6.50	1.00	1.00	Fine
klei, siltig	0.00	1.00	1.00	Fine
Veen	-2.00	1.00	1.00	Fine
zand kleiig	-3.00	1.00	1.00	Fine
zand	-9.50	1.00	1.00	Fine
zand kleiig	-11.00	1.00	1.00	Fine
zand	-14.00	1.00	1.00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Earth pressure coefficients Neutral [-]	Earth pressure coefficients Passive [-]	Additional pore pressure Top [kN/m²]	Additional pore pressure Bottom [kN/m²]
dijk	10.50	n.a.	n.a.	n.a.	0.00	0.00
toplaag	6.50	n.a.	n.a.	n.a.	0.00	0.00
klei, siltig	0.00	n.a.	n.a.	n.a.	0.00	0.00
Veen	-2.00	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-3.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-9.50	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-11.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-14.00	n.a.	n.a.	n.a.	0.00	0.00

6.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
dijk	10.50	45000.00	45000.00	22500.00	22500.00
toplaag	6.50	45000.00	45000.00	22500.00	22500.00
klei, siltig	0.00	9000.00	9000.00	4500.00	4500.00
Veen	-2.00	4500.00	4500.00	1800.00	1800.00
zand kleiig	-3.00	45000.00	45000.00	22500.00	22500.00
zand	-9.50	90000.00	90000.00	45000.00	45000.00
zand kleiig	-11.00	45000.00	45000.00	22500.00	22500.00
zand	-14.00	90000.00	90000.00	45000.00	45000.00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
dijk	10.50	11250.00	11250.00
toplaag	6.50	11250.00	11250.00
klei, siltig	0.00	1800.00	1800.00
Veen	-2.00	1125.00	1125.00
zand kleiig	-3.00	11250.00	11250.00
zand	-9.50	22500.00	22500.00
zand kleiig	-11.00	11250.00	11250.00
zand	-14.00	22500.00	22500.00

6.4.6 Anchors

Name	Level [m]	E-Modulus [kN/m²]	Cross section [m²/m']	Length [m]	Angle [deg]	Yield force [kN/m']	Pre-tension. force [kN/m']
leganker M72	0.00	2.100E+08	2.300E-03	30.00	0.00	653.00	n.a.

6.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
inspectievoertuig 1	0.00	16.63
	2.50	16.63
inspectievoertuig 2	10.05	16.63
	12.55	16.63

6.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
1	4.22	7.4	55.7	0.38	0.88	2.83
2	3.45	9.7	49.7	0.38	0.75	1.96
3	2.67	12.0	76.6	0.39	0.74	2.51
4	1.91	14.3	113.5	0.40	0.77	3.19
5	1.15	15.6	160.1	0.38	0.79	3.92
6	0.38	15.3	215.1	0.33	0.80	4.62
7	-0.39	13.9	274.7	0.27	0.75	5.25
8	-1.17	13.9	363.1	0.24	0.75	6.26
9	-1.69	14.6	438.8	0.24	0.74	7.09
10	-1.91	15.3	308.1	0.24	0.74	4.85
11	-2.50	39.5	190.3	0.60	0.92	2.90
12	-3.15	28.1	555.9	0.41	0.73	8.14
13	-3.74	29.6	657.5	0.40	0.71	9.00
14	-4.63	27.0	737.3	0.34	0.69	9.19
15	-5.51	31.8	801.5	0.36	0.68	9.16
16	-6.40	34.6	780.4	0.37	0.66	8.23
17	-7.29	36.2	598.8	0.35	0.64	5.87
18	-8.17	39.1	571.0	0.36	0.63	5.22
19	-9.06	41.1	613.1	0.35	0.62	5.26
20	-9.88	36.0	764.9	0.29	0.55	6.17
21	-10.63	38.0	800.8	0.29	0.54	6.09
22	-11.50	59.1	745.9	0.42	0.59	5.35
23	-12.50	61.1	835.5	0.41	0.58	5.67
24	-13.50	61.0	900.3	0.39	0.57	5.79
25	-14.50	50.4	1030.7	0.31	0.51	6.27
26	-15.50	57.1	1046.6	0.33	0.50	6.01

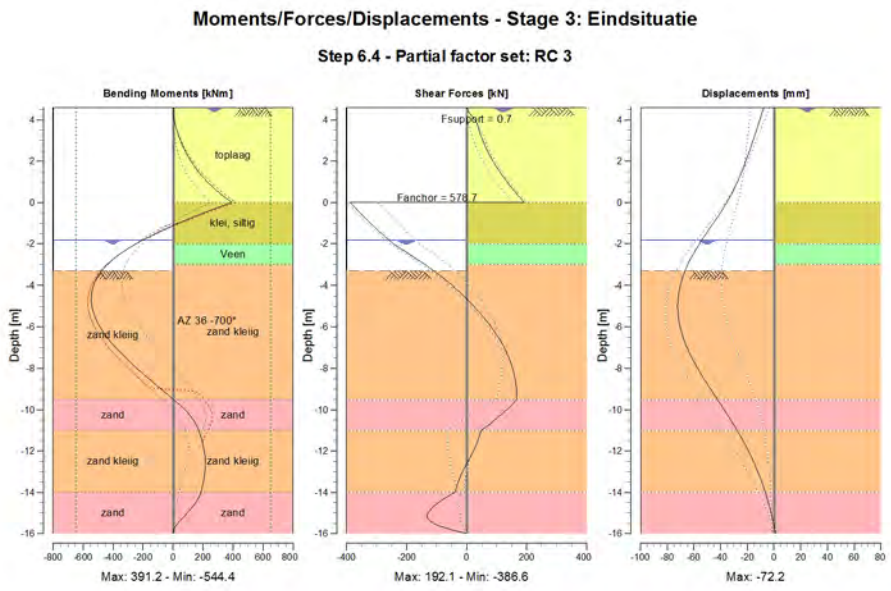
6.6 Calculated Force from a layer Right

Name	Force
dijk	0.00
toplaag	0.00
klei, siltig	28.29
Veen	39.51
zand kleiig	220.49
zand	55.50
zand kleiig	181.18
zand	171.49

6.7 Calculation Results

Number of iterations: 16

6.7.1 Charts of Moments, Forces and Displacements



6.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	4.60	0.0	0.2	-7.7
1	3.83	12.6	34.4	-11.5
2	3.83	12.7	34.4	-11.5
2	3.06	45.9	52.1	-15.5
3	3.06	45.9	52.1	-15.5
3	2.29	94.9	76.5	-19.6
4	2.29	94.9	76.5	-19.6
4	1.53	165.0	108.5	-24.0
5	1.53	165.0	108.5	-24.0
5	0.76	262.1	147.4	-29.2
6	0.76	262.1	147.4	-29.2
6	0.00	391.2	192.1	-35.4
7	0.00	391.2	**-386.6**	-35.4
7	-0.78	109.0	-335.8	-43.2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
8	-0.78	109.0	-335.8	-43.2
8	-1.56	-131.1	-278.8	-51.4
9	-1.56	-131.1	-278.8	-51.4
9	-1.81	-198.4	-259.0	-54.0
10	-1.81	-198.4	-259.0	-54.0
10	-2.00	-246.1	-243.7	-55.9
11	-2.00	-246.1	-243.7	-55.9
11	-3.00	-437.3	-138.5	-64.6
12	-3.00	-437.3	-138.5	-64.6
12	-3.30	-474.7	-110.3	-66.6
13	-3.30	-474.7	-110.3	-66.6
13	-4.19	-537.2	-32.9	-70.9
14	-4.19	-537.2	-32.9	-70.9
14	-5.07	**-538.4**	28.2	**-72.2**
15	-5.07	**-538.4**	28.2	**-72.2**
15	-5.96	-489.8	79.6	-70.5
16	-5.96	-489.8	79.6	-70.5
16	-6.84	-400.8	119.5	-66.1
17	-6.84	-400.7	119.5	-66.1
17	-7.73	-282.0	146.8	-59.6
18	-7.73	-282.0	146.7	-59.6
18	-8.61	-144.2	162.6	-51.4
19	-8.61	-144.2	162.6	-51.4
19	-9.50	2.3	166.2	-42.5
20	-9.50	2.3	166.2	-42.5
20	-10.25	108.6	114.1	-34.9
21	-10.25	108.6	114.1	-34.9
21	-11.00	170.6	48.6	-27.7
22	-11.00	170.6	48.6	-27.7
22	-12.00	207.3	22.5	-19.2
23	-12.00	207.3	22.4	-19.2
23	-13.00	211.8	-13.5	-12.2
24	-13.00	211.8	-13.6	-12.2
24	-14.00	184.9	-37.9	-6.6
25	-14.00	184.9	-38.7	-6.6
25	-15.00	94.7	-127.9	-2.3
26	-15.00	94.8	-130.0	-2.3
26	-16.00	-0.1	-0.5	1.4
Max		**-538.4**	**-386.6**	**-72.2**
Max, minor nodes incl.		-544.4	-386.6	-72.2

6.7.3 Stresses

Node number	Level	Left				Right			
	[m]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]
1	4.60	0.00	0.00	-		0.06	0.00	P	
1	3.83	0.00	0.00	-		27.10	7.89	1	42
2	3.83	0.00	0.00	-		22.74	7.89	2	51
2	3.06	0.00	0.00	-		10.70	15.79	A	
3	3.06	0.00	0.00	-		11.01	15.79	A	
3	2.29	0.00	0.00	-		12.99	23.68	A	
4	2.29	0.00	0.00	-		13.28	23.68	A	
4	1.53	0.00	0.00	-		15.34	31.50	A	
5	1.53	0.00	0.00	-		14.57	31.50	A	
5	0.76	0.00	0.00	-		16.67	39.33	A	
6	0.76	0.00	0.00	-		14.39	39.33	A	
6	0.00	0.00	0.00	-		16.34	47.15	A	
7	0.00	0.00	0.00	-		13.19	47.15	A	
7	-0.78	0.00	0.00	-		14.67	55.15	A	
8	-0.78	0.00	0.00	-		13.24	55.15	A	
8	-1.56	0.00	0.00	-		14.64	63.14	A	
9	-1.56	0.00	0.00	-		14.42	63.14	A	
9	-1.81	0.00	0.00	-		14.87	65.70	A	
10	-1.81	0.00	0.00	-		15.09	65.70	A	

Node number	Level [m]	Left				Right			
		Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]
10	-2.00	0.00	1.95	-		15.44	67.65	A	
11	-2.00	0.00	1.95	-		38.69	67.65	A	
11	-3.00	0.00	12.20	-		40.35	77.90	A	
12	-3.00	0.00	12.20	-		27.61	77.90	A	
12	-3.30	0.00	15.27	-		28.60	80.98	A	
13	-3.30	0.00	15.27	P		28.12	80.98	A	
13	-4.19	15.87	24.35	P		31.02	90.05	A	
14	-4.19	15.78	24.35	P		25.81	90.05	A	
14	-5.07	31.60	33.43	P		28.24	99.13	A	
15	-5.07	31.58	33.43	P		30.48	99.13	A	
15	-5.96	47.38	42.51	P		33.12	108.21	A	
16	-5.96	47.38	42.51	P		33.32	108.21	A	
16	-6.84	63.18	51.59	P		35.98	117.29	A	
17	-6.84	63.17	51.59	P		34.93	117.29	A	
17	-7.73	78.97	60.67	P		37.51	126.37	A	
18	-7.73	78.96	60.67	P		37.78	126.37	A	
18	-8.61	94.76	69.74	P		40.37	135.45	A	
19	-8.61	94.75	69.74	P		39.81	135.45	A	
19	-9.50	110.56	78.82	P		42.36	144.53	A	
20	-9.50	158.45	78.82	P		34.93	144.53	A	
20	-10.25	184.16	86.51	P		37.14	152.21	A	
21	-10.25	178.57	86.51	P		36.87	152.21	A	
21	-11.00	203.51	94.20	P		39.06	159.90	A	
22	-11.00	142.17	94.20	P		57.41	159.90	A	
22	-12.00	159.52	104.45	P		60.82	170.15	A	
23	-12.00	157.53	104.45	P		59.41	170.15	A	
23	-13.00	160.73	114.70	3	92	62.72	180.40	A	
24	-13.00	156.35	114.70	3	93	59.45	180.40	A	
24	-14.00	145.18	124.95	2	79	62.56	190.65	A	
25	-14.00	237.34	124.95	3	83	48.89	190.65	A	
25	-15.00	164.29	135.20	2	51	51.92	200.90	A	
26	-15.00	159.09	135.20	2	52	55.49	200.90	A	
26	-16.00	21.84	145.45	A		253.65	211.15	1	24

*

Stat	Status (A=active, P=passive, Number is branche, 0 is unloading)
Mob	Percentage passive mobilized

6.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	1341.8	780.0
Water	1032.0	2174.9
Total	2373.7	2954.9

Considered as passive side	Left
Maximum passive effective resistance	1735.81 kN
Mobilized passive effective resistance	1341.76 kN
Percentage mobilized resistance	77.3 %
Position single support	0.00 m
Maximum passive moment	20971.75 kNm
Mobilized passive moment	14997.92 kNm
Percentage mobilized moment	71.5 %

6.7.5 Vertical Force Balance

Xi factor	0.72
Partial material factor	1.20
Maximum point resistance	0.00 [MPa]

A maximum point resistance of zero results in a vertical toe capacity of zero

Vertical force balance unplugged	Force [kN]
Vertical force active	-251.65
Vertical force passive	480.02
Resulting vertical force (no dead weight)	228.37
Vertical toe capacity Ftoe;d	0.00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-251.65
Vertical force passive	480.02
Resulting vertical force (no dead weight)	228.37
Vertical toe capacity Ftoe;d	0.00
Resultant goes up	

6.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
-3.30	zand kleiig	117.41	4.60	toplaag	-22.92
-9.50	zand	103.44	0.00	klei, siltig	-4.71
-11.00	zand kleiig	159.16	-2.00	Veen	0.00
-14.00	zand	100.00	-3.00	zand kleiig	-75.54
			-9.50	zand	-21.13
			-11.00	zand kleiig	-62.07
			-14.00	zand	-65.28

6.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
leganker M72	0.00	2.100E+08	578.69	Elastic	Right	Anchor

6.7.8 Rigid and Spring Supports

Node number	Level [m]	Force [kN]	Moment [kNm]
2	3.83	0.68	0.05
3	3.06	0.02	-0.01

7 Step 6.5 Stage 3: Eindsituatie

7.1 Input Data Left

7.1.1 Calculation Method

Calculation method: C, phi, delta

7.1.2 Water Level

Water level: -1.56 [m]

7.1.3 Surface

X [m]	Y [m]
0.00	-3.00
60.48	-16.44

7.1.4 Soil Material Properties in Profile: bestaand links

Layer name	Level [m]	Unit weight Unsat [kN/m³]	Unit weight Sat [kN/m³]	Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
dijk	10.50	17.10	19.10	0.00	30.00	20.00
toplaag	6.50	17.00	18.20	0.00	27.00	18.00
klei, siltig	0.00	16.00	17.10	0.00	32.00	11.00
Veen	-2.00	12.00	12.00	2.50	15.00	0.00
zand kleiig	-3.00	16.00	17.10	0.00	32.00	16.60
zand	-9.50	17.10	19.10	0.00	37.00	17.20
zand kleiig	-11.00	16.00	17.10	0.00	32.00	16.60
zand	-14.00	17.10	19.10	0.00	37.00	17.20

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
dijk	10.50	1.00	1.00	Fine
toplaag	6.50	1.00	1.00	Fine
klei, siltig	0.00	1.00	1.00	Fine
Veen	-2.00	1.00	1.00	Fine
zand kleiig	-3.00	1.00	1.00	Fine
zand	-9.50	1.00	1.00	Fine
zand kleiig	-11.00	1.00	1.00	Fine
zand	-14.00	1.00	1.00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Earth pressure coefficients Neutral [-]	Earth pressure coefficients Passive [-]	Additional pore pressure Top [kN/m²]	Additional pore pressure Bottom [kN/m²]
dijk	10.50	n.a.	n.a.	n.a.	0.00	0.00
toplaag	6.50	n.a.	n.a.	n.a.	0.00	0.00
klei, siltig	0.00	n.a.	n.a.	n.a.	0.00	0.00
Veen	-2.00	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-3.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-9.50	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-11.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-14.00	n.a.	n.a.	n.a.	0.00	0.00

7.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
dijk	10.50	20000.00	20000.00	10000.00	10000.00
toplaag	6.50	20000.00	20000.00	10000.00	10000.00
klei, siltig	0.00	4000.00	4000.00	2000.00	2000.00
Veen	-2.00	2000.00	2000.00	800.00	800.00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
zand kleiig	-3.00	20000.00	20000.00	10000.00	10000.00
zand	-9.50	40000.00	40000.00	20000.00	20000.00
zand kleiig	-11.00	20000.00	20000.00	10000.00	10000.00
zand	-14.00	40000.00	40000.00	20000.00	20000.00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
dijk	10.50	5000.00	5000.00
toplaag	6.50	5000.00	5000.00
klei, siltig	0.00	800.00	800.00
Veen	-2.00	500.00	500.00
zand kleiig	-3.00	5000.00	5000.00
zand	-9.50	10000.00	10000.00
zand kleiig	-11.00	5000.00	5000.00
zand	-14.00	10000.00	10000.00

7.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
1	-3.46	0.7	9.8	0.28	0.28	3.61
2	-4.39	2.2	29.4	0.27	0.27	3.59
3	-5.32	3.7	49.0	0.27	0.27	3.59
4	-6.25	5.2	68.6	0.27	0.27	3.59
5	-7.18	6.7	88.2	0.27	0.27	3.59
6	-8.11	8.2	107.8	0.27	0.27	3.59
7	-9.04	9.7	127.5	0.27	0.27	3.59
8	-9.88	9.0	246.3	0.22	0.22	5.98
9	-10.63	10.4	271.5	0.22	0.22	5.76
10	-11.50	14.5	164.8	0.27	0.27	3.11
11	-12.50	16.1	185.9	0.27	0.27	3.15
12	-13.50	17.7	209.8	0.27	0.27	3.24
13	-14.50	15.8	429.7	0.22	0.22	5.99
14	-15.50	17.5	448.7	0.22	0.22	5.63

7.3 Calculated Force from a layer Left

Name	Force
dijk	0.00
toplaag	0.00
klei, siltig	0.00
Veen	0.00
zand kleiig	431.63
zand	302.75
zand kleiig	272.87
zand	189.06

7.4 Input Data Right

7.4.1 Calculation Method

Calculation method: C, phi, delta

7.4.2 Water Level

Water level: 4.60 [m]

7.4.3 Surface

X [m]	Y [m]
0.00	4.60
4.65	4.60
10.05	6.40
15.05	6.65
25.55	10.15
28.55	10.15
39.05	6.65

7.4.4 Soil Material Properties in Profile: bestaand links

Layer name	Level [m]	Unit weight Unsat [kN/m³]	Unit weight Sat [kN/m³]	Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
dijk	10.50	17.10	19.10	0.00	30.00	20.00
toplaag	6.50	17.00	18.20	0.00	27.00	18.00
klei, siltig	0.00	16.00	17.10	0.00	32.00	11.00
Veen	-2.00	12.00	12.00	2.50	15.00	0.00
zand kleiig	-3.00	16.00	17.10	0.00	32.00	16.60
zand	-9.50	17.10	19.10	0.00	37.00	17.20
zand kleiig	-11.00	16.00	17.10	0.00	32.00	16.60
zand	-14.00	17.10	19.10	0.00	37.00	17.20

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
dijk	10.50	1.00	1.00	Fine
toplaag	6.50	1.00	1.00	Fine
klei, siltig	0.00	1.00	1.00	Fine
Veen	-2.00	1.00	1.00	Fine
zand kleiig	-3.00	1.00	1.00	Fine
zand	-9.50	1.00	1.00	Fine
zand kleiig	-11.00	1.00	1.00	Fine
zand	-14.00	1.00	1.00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Earth pressure coefficients Neutral [-]	Earth pressure coefficients Passive [-]	Additional pore pressure Top [kN/m²]	Additional pore pressure Bottom [kN/m²]
dijk	10.50	n.a.	n.a.	n.a.	0.00	0.00
toplaag	6.50	n.a.	n.a.	n.a.	0.00	0.00
klei, siltig	0.00	n.a.	n.a.	n.a.	0.00	0.00
Veen	-2.00	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-3.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-9.50	n.a.	n.a.	n.a.	0.00	0.00
zand kleiig	-11.00	n.a.	n.a.	n.a.	0.00	0.00
zand	-14.00	n.a.	n.a.	n.a.	0.00	0.00

7.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
dijk	10.50	20000.00	20000.00	10000.00	10000.00
toplaag	6.50	20000.00	20000.00	10000.00	10000.00
klei, siltig	0.00	4000.00	4000.00	2000.00	2000.00
Veen	-2.00	2000.00	2000.00	800.00	800.00
zand kleiig	-3.00	20000.00	20000.00	10000.00	10000.00
zand	-9.50	40000.00	40000.00	20000.00	20000.00
zand kleiig	-11.00	20000.00	20000.00	10000.00	10000.00
zand	-14.00	40000.00	40000.00	20000.00	20000.00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
dijk	10.50	5000.00	5000.00
toplaag	6.50	5000.00	5000.00
klei, siltig	0.00	800.00	800.00
Veen	-2.00	500.00	500.00
zand kleiig	-3.00	5000.00	5000.00
zand	-9.50	10000.00	10000.00
zand kleiig	-11.00	5000.00	5000.00
zand	-14.00	10000.00	10000.00

7.4.6 Anchors

Name	Level [m]	E-Modulus [kN/m²]	Cross section [m²/m']	Length [m]	Angle [deg]	Yield force [kN/m']	Pre-tension. force [kN/m']
leganker M72	0.00	2.100E+08	2.300E-03	30.00	0.00	653.00	n.a.

7.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
inspectievoertuig 1	0.00	13.30
	2.50	13.30
inspectievoertuig 2	10.05	13.30
	12.55	13.30

7.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
1	4.22	5.2	59.8	0.32	0.88	3.65
2	3.45	7.1	60.9	0.32	0.76	2.75
3	2.67	9.1	104.5	0.33	0.75	3.79
4	1.91	11.0	169.3	0.34	0.77	5.14
5	1.15	12.7	254.6	0.33	0.78	6.61
6	0.38	12.8	363.3	0.29	0.79	8.18
7	-0.39	11.3	445.3	0.22	0.72	8.84
8	-1.17	11.7	403.3	0.21	0.71	7.17
9	-1.78	12.8	466.9	0.21	0.70	7.66
10	-2.50	28.5	319.2	0.44	0.91	4.98
11	-3.46	18.4	851.5	0.27	0.68	12.28
12	-4.39	23.5	1035.2	0.31	0.65	13.45
13	-5.32	24.7	872.4	0.29	0.63	10.31
14	-6.25	30.1	633.0	0.33	0.61	6.85
15	-7.18	32.0	660.6	0.32	0.60	6.60
16	-8.11	33.6	663.9	0.31	0.58	6.16
17	-9.04	34.9	713.2	0.30	0.57	6.18
18	-9.88	29.3	1007.4	0.24	0.50	8.19
19	-10.63	30.9	1058.7	0.24	0.49	8.11
20	-11.50	40.2	890.4	0.29	0.54	6.43
21	-12.50	42.2	1018.7	0.29	0.53	6.95
22	-13.50	44.5	1076.7	0.29	0.52	6.97
23	-14.50	42.2	1357.3	0.26	0.45	8.31
24	-15.50	42.3	1391.1	0.24	0.44	8.03

7.6 Calculated Force from a layer Right

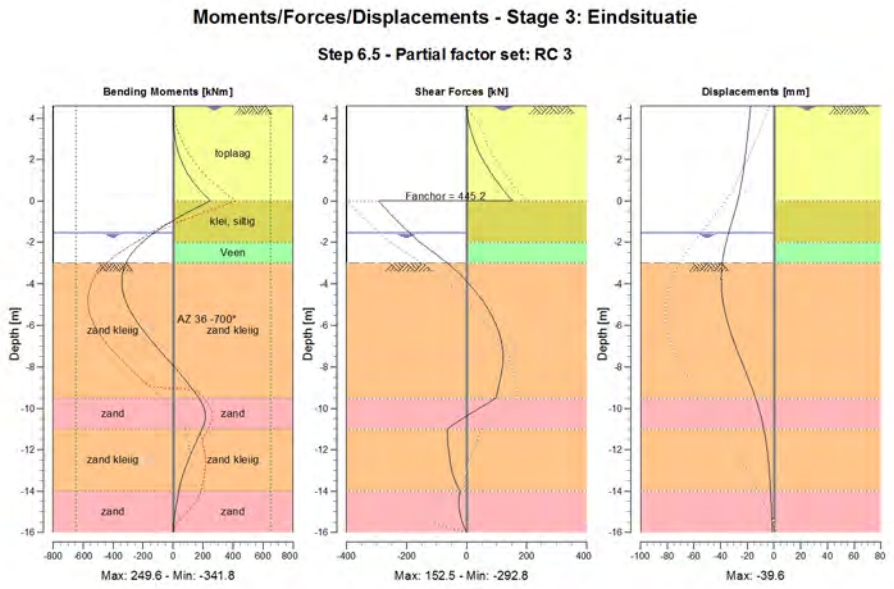
Name	Force
dijk	0.00
toplaag	0.00
klei, siltig	23.62
Veen	28.51
zand kleiig	183.08

Name	Force
zand	45.09
zand kleiig	126.81
zand	84.53

7.7 Calculation Results

Number of iterations: 6

7.7.1 Charts of Moments, Forces and Displacements



7.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	4.60	0.0	0.0	-17.4
1	3.83	2.0	6.7	-18.7
2	3.83	2.0	6.7	-18.7
2	3.06	12.3	21.3	-20.0
3	3.06	12.3	21.3	-20.0
3	2.29	36.8	43.5	-21.4
4	2.29	36.8	43.5	-21.4
4	1.53	80.8	73.0	-22.9
5	1.53	80.8	73.0	-22.9
5	0.76	150.0	109.7	-24.7
6	0.76	150.0	109.7	-24.7
6	0.00	249.6	152.5	-27.2
7	0.00	249.6	**-292.8**	-27.2
7	-0.78	39.8	-244.1	-30.5
8	-0.78	39.8	-244.1	-30.5
8	-1.56	-129.5	-188.8	-34.1
9	-1.56	-129.5	-188.8	-34.1
9	-2.00	-205.2	-155.4	-35.9
10	-2.00	-205.2	-155.4	-35.9
10	-3.00	-314.9	-63.7	-38.8
11	-3.00	-314.9	-63.7	-38.8
11	-3.93	**-341.8**	2.9	**-39.6**
12	-3.93	**-341.8**	2.9	**-39.6**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	-4.86	-313.2	56.1	-38.3
13	-4.86	-313.2	56.1	-38.3
13	-5.79	-243.1	92.2	-35.1
14	-5.79	-243.1	92.1	-35.1
14	-6.71	-145.7	115.0	-30.5
15	-6.71	-145.7	115.0	-30.5
15	-7.64	-34.8	121.4	-24.9
16	-7.64	-34.8	121.2	-24.9
16	-8.57	74.4	112.2	-19.2
17	-8.57	74.4	112.1	-19.2
17	-9.50	172.1	98.0	-13.9
18	-9.50	172.1	98.0	-13.9
18	-10.25	214.4	13.4	-10.3
19	-10.25	214.4	13.4	-10.3
19	-11.00	194.2	-65.0	-7.6
20	-11.00	194.2	-65.0	-7.6
20	-12.00	131.0	-59.9	-5.2
21	-12.00	131.0	-59.9	-5.2
21	-13.00	75.7	-49.5	-3.6
22	-13.00	75.7	-49.6	-3.6
22	-14.00	38.3	-21.8	-2.6
23	-14.00	38.3	-21.7	-2.6
23	-15.00	13.5	-22.9	-1.9
24	-15.00	13.6	-23.0	-1.9
24	-16.00	0.0	0.0	-1.3
Max		**-341.8**	**-292.8**	**-39.6**
Max, minor nodes incl.		-341.8	-292.8	-39.6

7.7.3 Stresses

Node number	Level [m]	Left				Right			
		Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]
1	4.60	0.00	0.00	-		0.01	0.00	A	
1	3.83	0.00	0.00	-		6.14	7.89	A	
2	3.83	0.00	0.00	-		6.23	7.89	A	
2	3.06	0.00	0.00	-		8.02	15.79	A	
3	3.06	0.00	0.00	-		8.21	15.79	A	
3	2.29	0.00	0.00	-		9.96	23.68	A	
4	2.29	0.00	0.00	-		10.12	23.68	A	
4	1.53	0.00	0.00	-		11.94	31.50	A	
5	1.53	0.00	0.00	-		11.75	31.50	A	
5	0.76	0.00	0.00	-		13.66	39.33	A	
6	0.76	0.00	0.00	-		11.89	39.33	A	
6	0.00	0.00	0.00	-		13.65	47.15	A	
7	0.00	0.00	0.00	-		10.70	47.15	A	
7	-0.78	0.00	0.00	-		11.98	55.15	A	
8	-0.78	0.00	0.00	-		11.08	55.15	A	
8	-1.56	0.00	0.00	-		12.32	63.14	A	
9	-1.56	0.00	0.00	-		12.48	63.14	A	
9	-2.00	0.00	4.51	-		13.21	67.65	A	
10	-2.00	0.00	4.51	-		27.87	67.65	A	
10	-3.00	0.00	14.76	-		29.16	77.90	A	
11	-3.00	0.00	14.76	P		17.38	77.90	A	
11	-3.93	19.69	24.28	P		19.39	87.42	A	
12	-3.93	19.59	24.28	P		22.38	87.42	A	
12	-4.86	39.23	33.80	P		24.72	96.94	A	
13	-4.86	39.21	33.80	P		23.62	96.94	A	
13	-5.79	58.83	43.31	P		25.86	106.45	A	
14	-5.79	58.82	43.31	P		28.84	106.45	A	
14	-6.71	78.44	52.83	P		31.34	115.97	A	
15	-6.71	78.43	52.83	P		30.73	115.97	A	
15	-7.64	98.05	62.35	P		33.19	125.49	A	
16	-7.64	98.03	62.35	P		32.39	125.49	A	
16	-8.57	111.16	71.87	3	94	34.78	135.01	A	

Node number	Level [m]	Left				Right			
		Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]	Effective stress [kN/m²]	Water stress [kN/m²]	Stat*	Mob* [%]
17	-8.57	111.15	71.87	3	94	33.70	135.01	A	
17	-9.50	115.53	81.39	3	84	36.00	144.53	A	
18	-9.50	199.43	81.39	3	87	28.36	144.53	A	
18	-10.25	211.30	89.07	3	80	30.17	152.21	A	
19	-10.25	204.88	89.07	3	81	29.96	152.21	A	
19	-11.00	191.11	96.76	2	66	31.75	159.90	A	
20	-11.00	101.92	96.76	2	65	39.01	159.90	A	
20	-12.00	95.58	107.01	2	55	41.36	170.15	A	
21	-12.00	96.54	107.01	2	55	40.99	170.15	A	
21	-13.00	89.48	117.26	1	46	43.30	180.40	A	
22	-13.00	89.48	117.26	1	45	43.33	180.40	A	
22	-14.00	71.34	127.51	1	33	45.62	190.65	A	
23	-14.00	120.47	127.51	1	30	40.92	190.65	A	
23	-15.00	93.82	137.76	1	21	43.48	200.90	A	
24	-15.00	93.88	137.76	1	22	41.13	200.90	A	
24	-16.00	71.34	148.01	1	15	43.53	211.15	A	

*

Stat	Status (A=active, P=passive, Number is branche, 0 is unloading)
Mob	Percentage passive mobilized

7.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	1196.3	535.7
Water	1068.6	2174.9
Total	2264.9	2710.5

Considered as passive side	Left
Maximum passive effective resistance	2273.27 kN
Mobilized passive effective resistance	1196.30 kN
Percentage mobilized resistance	52.6 %
Position single support	0.00 m
Maximum passive moment	27509.62 kNm
Mobilized passive moment	12451.12 kNm
Percentage mobilized moment	45.3 %

7.7.5 Vertical Force Balance

Xi factor	0.72
Partial material factor	1.20
Maximum point resistance	0.00 [MPa]

A maximum point resistance of zero results in a vertical toe capacity of zero

Vertical force balance unplugged	Force [kN]
Vertical force active	-201.81
Vertical force passive	503.60
Resulting vertical force (no dead weight)	301.79
Vertical toe capacity Ftoe;d	0.00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-201.81
Vertical force passive	503.60
Resulting vertical force (no dead weight)	301.79
Vertical toe capacity Ftoe;d	0.00
Resultant goes up	

7.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
-3.00	zand kleiig	174.39	4.60	toplaag	-14.30
-9.50	zand	134.79	0.00	klei, siltig	-4.59
-11.00	zand kleiig	110.25	-2.00	Veen	0.00
-14.00	zand	84.17	-3.00	zand kleiig	-73.97
			-9.50	zand	-20.08
			-11.00	zand kleiig	-51.24
			-14.00	zand	-37.64

7.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
leganker M72	0.00	2.100E+08	445.25	Elastic	Right	Anchor

End of Report