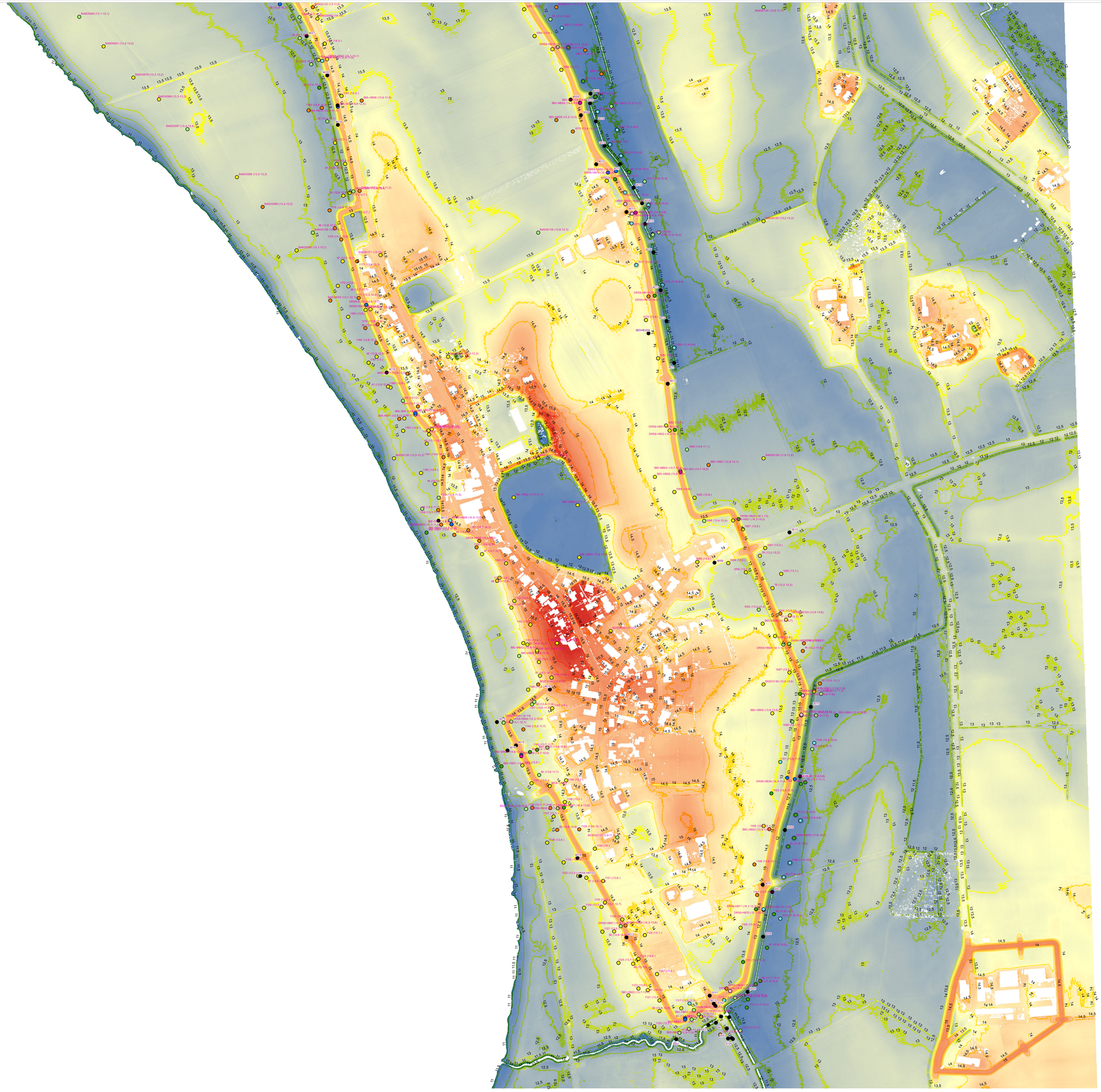
N

CONCEPT



Legenda

Kleidikte (m)

- 0,00 - 0,10
- 0,10 - 0,50
- 0,50 - 1,00
- 1,00 - 1,50
- 1,50 - 2,00
- 2,00 - 3,00
- 3,00 - 4,00
- > 4,00
- Overige punten
- Veen

AHN (mNAP)

High : 21,587

Low : 10,764

Titel
Geotechnisch onderzoek DR 59

Project
9x4447

Opdrachtgever
Waterschap Peel en Maasvallei

Datum	*Schaal*
19-9-2014	1:2000

Figuur
Pagina 2

Gecontroleerd door	*Volgnummer*
Thomas Viehofer	1

Royal HaskoningDHV
Enhancing Society Together

Betreft	:	Aanvullend grondonderzoek dijkring 59 te BERGEN
Opdrachtgever	:	HaskoningDHV Nederland BV T.a.v. Dhr. R. Hoevers Postbus 151 6500 AD NIJMEGEN NL
Behandeld door	:	ing. N.R. Okhuijzen Mulder (0492 535 455)
Kenmerk	:	R1403589-HE_1
Datum	:	4 december 2014

Inhoudsopgave

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2.3 Uitzetten en waterpassen 3

Bijlage A Boringen

Bijlage B Situatietekening

1. INLEIDING

In opdracht van Royal HaskoningDHV is door Mos Grondmechanica B.V. een grondonderzoek uitgevoerd ten behoeve van de versterking van de Maasdijk, dijkring 59 te Bergen.

2. UITGEVOERD GRONDONDERZOEK

2.1 Vrijgeven onderzoekslocaties op niet gesprongen explosieven

Bij het vooronderzoek is gebleken dat op de onderzoekslocaties een verhoogd risico aanwezig is op de aanwezigheid van niet gesprongen explosieven. Om veilig het grondonderzoek uit te kunnen voeren zijn door een OCE gecertificeerd bedrijf de onderzoekslocaties vrijgegeven. Indien bij de OCE metingen bleek dat locaties niet vrijgegeven konden worden zijn deze locaties enigszins verplaatst zodat deze wel vrijgegeven konden worden.

2.2 Boringen

In november 2014 zijn 15 handboringen uitgevoerd tot maximaal maaiveld -5 m. In verband met de grondslag (grind) konden niet alle boringen tot de gewenste diepte worden uitgevoerd.

De vrijgekomen grondslag is visueel geclassificeerd, conform NEN 5104, en tot boorprofiel verwerkt. De boorstaten zijn opgenomen onder bijlage A.

2.3 Uitzetten en waterpassen

De boorlocaties zijn door onze landmeetkundige afdeling in het terrein uitgezet en gewaterpast ten opzichte van NAP en ingemeten ten opzichte van de Rijks Driehoeks coordinaten. Voor de resultaten van de waterpassing en een situatietekening met de ligging van de onderzoekslocaties wordt verwezen naar bijlage B.

ing. N.R. Okhuijzen Mulder (0492 535 455)

Helmond, 4 december 2014

Mos Grondmechanica B.V.

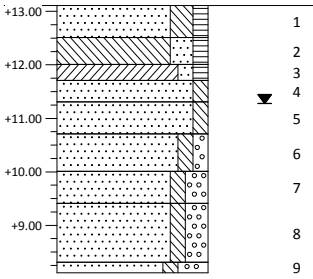
Contr. : d.s.

Bijlage A
Boringen

Opdracht : 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

BORING : W30-01

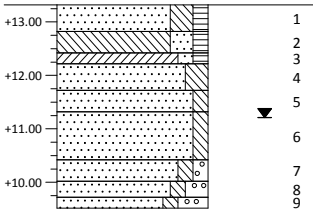
Datum	:	24-11-2014	X	:	200359.430	Boormeester	: ES
GWS	:	NAP +11.28 m	Y	:	400514.980	Beschrijver	: ES
Maaiveld	:	NAP +13.11 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.11	+12.51	Zand, matig fijn, matig siltig, zwak humeus	donkerbruin
2	+12.51	+12.01	Leem, matig zandig, zwak humeus	bruin
3	+12.01	+11.71	Klei, zwak zandig, zwak humeus, zwak oerhoudend	bruingrijs
4	+11.71	+11.31	Zand, matig grof, zwak siltig	geelgrijs
5	+11.31	+10.71	Zand, matig grof, zwak siltig	grijsgeel
6	+10.71	+10.01	Zand, matig grof, zwak siltig, zwak grindig	grijsgeel
7	+10.01	+9.41	Zand, matig grof, zwak siltig, matig grindig	grijsgeel
8	+9.41	+8.31	Zand, matig grof, zwak siltig, matig grindig	grijs
9	+8.31	+8.11	Zand, matig grof, zwak siltig, sterk grindig	grijs

BORING : W30-02

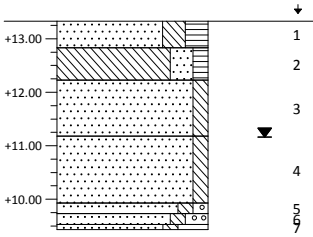
Datum	:	24-11-2014	X	:	200382.850	Boormeester	: ES
GWS	:	NAP +11.21 m	Y	:	400466.190	Beschrijver	: ES
Maaiveld	:	NAP +13.32 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.32	+12.82	Zand, matig fijn, matig siltig, zwak humeus	donkerbruin
2	+12.82	+12.42	Leem, matig zandig, zwak humeus	bruin
3	+12.42	+12.22	Klei, zwak zandig, zwak humeus	bruingrijs
4	+12.22	+11.72	Zand, matig fijn, matig siltig	bruingrijs
5	+11.72	+11.32	Zand, matig fijn, zwak siltig	bruin licht
6	+11.32	+10.42	Zand, matig fijn, zwak siltig	grijsbruin
7	+10.42	+10.02	Zand, matig grof, zwak siltig, zwak grindig, boring gestaakt ivm grind	grijs
8	+10.02	+9.72	Zand, matig grof, zwak siltig, matig grindig	grijs
9	+9.72	+9.52	Zand, matig grof, zwak siltig, sterk grindig	grijs

BORING : W30-03

Datum	:	24-11-2014	X	:	200399.510	Boormeester	: ES
GWS	:	NAP +11.16 m	Y	:	400431.150	Beschrijver	: ES
Maaiveld	:	NAP +13.33 m				Norm	: NEN5104
Opmerking	:						

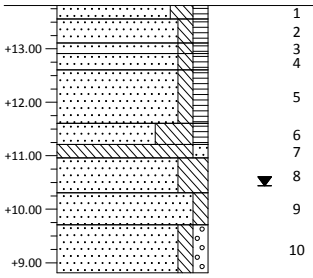


Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.33	+12.83	Zand, matig fijn, matig siltig, matig humeus	donkerbruin
2	+12.83	+12.23	Leem, matig zandig, zwak humeus	bruin
3	+12.23	+11.18	Zand, matig fijn, zwak siltig	bruingrijs
4	+11.18	+9.93	Zand, matig grof, zwak siltig	bruin licht
5	+9.93	+9.73	Zand, matig grof, zwak siltig, zwak grindig	bruin licht
6	+9.73	+9.53	Zand, matig grof, zwak siltig, matig grindig	grijsbruin
7	+9.53	+9.43	Zand, matig grof, zwak siltig, sterk grindig, boring gestaakt ivm grind	grijsbruin

Opdracht : 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

BORING : W30-04

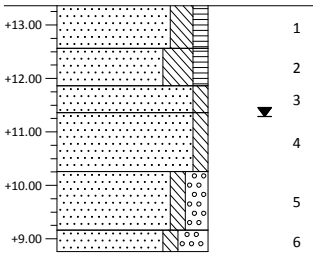
Datum	: 18-11-2014	X	:	200466.310	Boormeester	:	ES
GWS	: NAP +10.44 m	Y	:	400326.490	Beschrijver	:	ES
Maaiveld	: NAP +13.81 m				Norm	:	NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.81	+13.56	Zand, matig fijn, matig siltig, zwak humeus	zwartbruin
2	+13.56	+13.11	Zand, matig fijn, zwak siltig, zwak humeus, zwak kleihoudend	zwartbruin
3	+13.11	+12.91	Zand, matig fijn, zwak siltig, zwak humeus	bruin
4	+12.91	+12.61	Zand, matig fijn, zwak siltig, zwak humeus	bruin
5	+12.61	+11.61	Zand, matig fijn, zwak siltig, zwak humeus	bruin
6	+11.61	+11.21	Zand, matig fijn, uiterst siltig, zwak humeus, matig oerhoudend	bruingrijs
7	+11.21	+10.96	Leem, zwak zandig	grijsbruin
8	+10.96	+10.31	Zand, matig fijn, sterk siltig	geelgrijs
9	+10.31	+9.71	Zand, matig fijn, zwak siltig	grijs
10	+9.71	+8.81	Zand, matig grof, zwak siltig, zwak grindig	grijs

BORING : W30-05

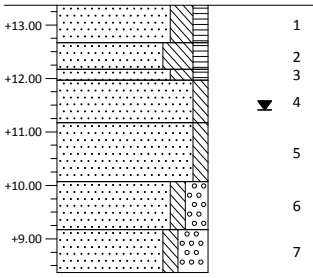
Datum	: 24-11-2014	X	:	200701.080	Boormeester	:	ES
GWS	: NAP +11.29 m	Y	:	399651.080	Beschrijver	:	ES
Maaiveld	: NAP +13.36 m				Norm	:	NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.36	+12.56	Zand, matig fijn, matig siltig, zwak humeus	donkerbruin
2	+12.56	+11.86	Zand, matig fijn, sterk siltig, zwak humeus, sterk oerhoudend	bruin
3	+11.86	+11.36	Zand, matig grof, zwak siltig	bruin licht
4	+11.36	+10.26	Zand, matig fijn, zwak siltig	grijs
5	+10.26	+9.16	Zand, matig grof, zwak siltig, matig grindig	grijsbruin
6	+9.16	+8.76	Zand, matig grof, zwak siltig, sterk grindig, boring gestaakt ivm grind	grijs

BORING : W30-06

Datum	: 19-11-2014	X	:	200696.190	Boormeester	:	ES
GWS	: NAP +11.41 m	Y	:	399610.080	Beschrijver	:	ES
Maaiveld	: NAP +13.37 m				Norm	:	NEN5104
Opmerking	:						

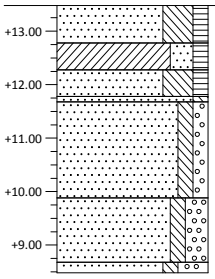


Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.37	+12.67	Zand, matig fijn, matig siltig, zwak humeus	donkerbruin
2	+12.67	+12.17	Zand, matig fijn, sterk siltig, zwak humeus, sterk oerhoudend	bruingrijs
3	+12.17	+11.97	Zand, matig fijn, matig siltig, zwak humeus, matig oerhoudend	grijsbruin
4	+11.97	+11.17	Zand, matig grof, zwak siltig	bruin licht
5	+11.17	+10.07	Zand, matig fijn, zwak siltig	grijsgeel
6	+10.07	+9.17	Zand, matig grof, zwak siltig, matig grindig	bruingrijs
7	+9.17	+8.37	Zand, matig grof, zwak siltig, sterk grindig	grijs

Opdracht : 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

BORING : W30-07

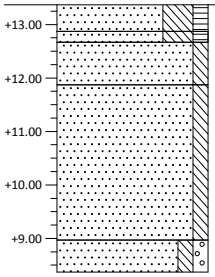
Datum	:	19-11-2014	X	:	200683.510	Boormeester	: ES
GWS	:	NAP +11.37 m	Y	:	399526.140	Beschrijver	: ES
Maaiveld	:	NAP +13.48 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.48	+12.78	Zand, matig fijn, sterk siltig, zwak humeus	donkerbruin
2	+12.78	+12.28	Klei, matig zandig, zwak humeus	bruingrijs
3	+12.28	+11.78	Zand, matig fijn, sterk siltig, zwak humeus, zwak kleihoudend, zwak oerhoudend	grijsbruin
4	+11.78	+11.68	Zand, matig grof, zwak siltig	bruin licht
5	+11.68	+9.88	Zand, matig fijn, zwak siltig, zwak grindig	grijsgeel
6	+9.88	+8.68	Zand, matig grof, zwak siltig, matig grindig	bruingrijs
7	+8.68	+8.48	Zand, matig grof, zwak siltig, sterk grindig	grijs

BORING : W30-08

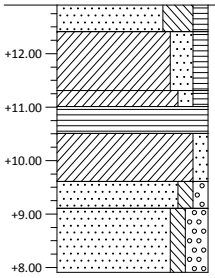
Datum	:	19-11-2014	X	:	200640.560	Boormeester	: ES
GWS	:	NAP +11.19 m	Y	:	399312.350	Beschrijver	: ES
Maaiveld	:	NAP +13.37 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.37	+12.87	Zand, matig fijn, sterk siltig, zwak humeus, zwak kleihoudend	donkerbruin
2	+12.87	+12.67	Zand, matig fijn, sterk siltig, zwak humeus, bevat resten van puin	donkerbruin
3	+12.67	+11.87	Zand, matig fijn, zwak siltig	bruingeel
4	+11.87	+8.97	Zand, matig fijn, zwak siltig	geelgrijs
5	+8.97	+8.37	Zand, matig grof, zwak siltig, zwak grindig	bruin licht

BORING : W30-09

Datum	:	18-11-2014	X	:	200619.080	Boormeester	: ES
GWS	:	NAP +10.53 m	Y	:	399233.290	Beschrijver	: ES
Maaiveld	:	NAP +12.91 m				Norm	: NEN5104
Opmerking	:						

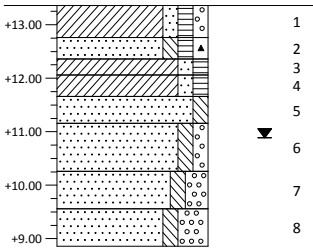


Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+12.91	+12.41	Zand, matig fijn, sterk siltig, zwak humeus, zwak kleihoudend	donkerbruin
2	+12.41	+11.31	Klei, matig zandig, zwak humeus	bruin
3	+11.31	+11.01	Klei, zwak zandig, zwak humeus	bruingrijs
4	+11.01	+10.51	Veen, mineraalarm	donkerbruin
5	+10.51	+9.61	Klei, zwak zandig	grijs
6	+9.61	+9.11	Zand, matig fijn, zwak siltig, zwak grindig	grijs
7	+9.11	+7.91	Zand, matig grof, zwak siltig, matig grindig	grijs

Opdracht : 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

BORING : W30-10

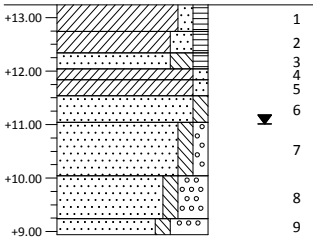
Datum	:	18-11-2014	X	:	200316.300	Boormeester	: ES
GWS	:	NAP +10.89 m	Y	:	399561.850	Beschrijver	: ES
Maaiveld	:	NAP +13.36 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.36	+12.76	Klei, zwak zandig, zwak humeus, zwak grindig	bruingrijs
2	+12.76	+12.36	Zand, matig fijn, zwak siltig, zwak humeus, zwak puinhoudend	zwartbruin
3	+12.36	+12.06	Klei, zwak zandig, zwak humeus	donkergrijs
4	+12.06	+11.66	Klei, zwak zandig, zwak humeus, zwak oerhoudend	bruingrijs
5	+11.66	+11.16	Zand, matig fijn, zwak siltig, matig kleihoudend, zwak roesthoudend	bruingrijs
6	+11.16	+10.26	Zand, matig fijn, zwak siltig, zwak grindig	grijs
7	+10.26	+9.56	Zand, matig grof, zwak siltig, matig grindig	bruin licht
8	+9.56	+8.86	Zand, matig grof, zwak siltig, sterk grindig, boring gestaakt ivm grind	bruin licht

BORING : W30-11

Datum	:	18-11-2014	X	:	200298.990	Boormeester	: ES
GWS	:	NAP +11.01 m	Y	:	399594.250	Beschrijver	: ES
Maaiveld	:	NAP +13.24 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.24	+12.74	Klei, zwak zandig, zwak humeus	donkerbruin
2	+12.74	+12.34	Klei, matig zandig, zwak humeus	bruingrijs
3	+12.34	+12.04	Zand, matig fijn, matig siltig, zwak humeus, matig kleihoudend	bruingrijs
4	+12.04	+11.84	Klei, zwak zandig	donkerbruin
5	+11.84	+11.54	Klei, zwak zandig	bruingrijs
6	+11.54	+11.04	Zand, matig fijn, zwak siltig	grijs
7	+11.04	+10.04	Zand, matig grof, zwak siltig, zwak grindig	grijs
8	+10.04	+9.24	Zand, matig grof, zwak siltig, sterk grindig	bruingrijs
9	+9.24	+8.94	Zand, matig grof, zwak siltig, uiterst grindig, boring gestaakt ivm grind	bruingrijs

Opdracht : 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

BORING : W30-12

Datum	:	26-11-2014	X	:	200072.240	Boormeester	: ES
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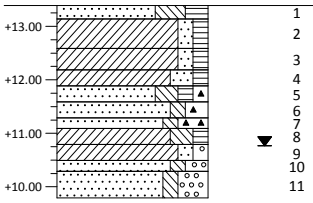
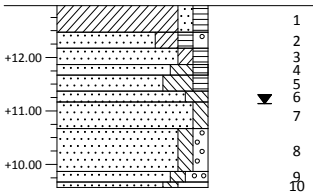
Maaiveld	:	NAP +13.39 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+13.39	+13.14	Zand, matig fijn, sterk siltig, matig humeus, zwak kleihoudend	zwartbruin
2	+13.14	+12.59	Klei, zwak zandig, zwak humeus	bruin
3	+12.59	+12.19	Klei, zwak zandig, zwak humeus, zwak oerhoudend	bruin
4	+12.19	+11.89	Klei, matig zandig, zwak humeus, zwak oerhoudend	bruinzwart
5	+11.89	+11.59	Zand, matig fijn, matig siltig, zwak humeus, zwak puinhoudend	bruinzwart
6	+11.59	+11.29	Zand, matig fijn, zwak siltig, matig puinhoudend	donkergrijs
7	+11.29	+11.09	Zand, matig fijn, zwak siltig, sterk puinhoudend	donkergrijs
8	+11.09	+10.79	Klei, matig siltig, zwak humeus	grijs
9	+10.79	+10.49	Klei, zwak zandig, zwak grindig	grijs
10	+10.49	+10.29	Zand, matig grof, zwak siltig, matig grindig	grijs
11	+10.29	+9.79	Zand, matig grof, zwak siltig, sterk grindig, boring gestaakt ivm grind	grijs

BORING : W30-13

Datum	:	26-11-2014	X	:	200056.260	Boormeester	: ES
GWS	:	NAP +11.14 m	Y	:	401389.430	Beschrijver	: ES
Maaiveld	:	NAP +12.97 m				Norm	: NEN5104
Opmerking	:						

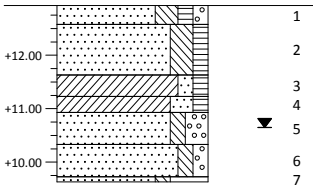


Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+12.97	+12.47	Klei, zwak zandig, zwak humeus	zwartbruin
2	+12.47	+12.17	Zand, matig fijn, matig kleïig, zwak humeus, zwak grindig	bruin
3	+12.17	+11.87	Zand, matig fijn, zwak kleïig, zwak humeus	bruin
4	+11.87	+11.67	Zand, matig fijn, matig siltig, zwak humeus, bevat resten van puin	bruinzwart
5	+11.67	+11.37	Zand, matig fijn, sterk siltig, zwak humeus	bruinzwart
6	+11.37	+11.17	Zand, matig fijn, matig siltig	donkergrijs
7	+11.17	+10.67	Zand, matig fijn, zwak siltig	donkergrijs
8	+10.67	+9.87	Zand, matig grof, zwak siltig, zwak grindig	grijs
9	+9.87	+9.67	Zand, matig grof, zwak siltig, matig grindig	grijs
10	+9.67	+9.57	Zand, matig grof, zwak siltig, sterk grindig, boring gestaakt ivm grind	grijs

Opdracht : 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

BORING : W30-14

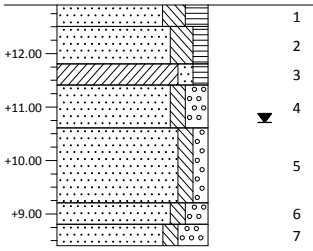
Datum	:	26-11-2014	X	:	200022.680	Boormeester	: ES
GWS	:	NAP +10.65 m	Y	:	401433.170	Beschrijver	: ES
Maaiveld	:	NAP +12.93 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+12.93	+12.58	Zand, matig fijn, matig siltig, zwak humeus, zwak grindig	zwartbruin
2	+12.58	+11.63	Zand, matig fijn, matig siltig, zwak humeus	bruin
3	+11.63	+11.23	Klei, zwak zandig, zwak humeus, zwak roesthoudend	bruingrijs
4	+11.23	+10.93	Klei, matig zandig, zwak humeus, zwak oerhoudend	bruingrijs
5	+10.93	+10.33	Zand, matig grof, zwak siltig, matig grindig	grijsgeel
6	+10.33	+9.73	Zand, matig fijn, zwak siltig, zwak grindig	grijsgeel
7	+9.73	+9.63	Zand, matig grof, zwak siltig, uiterst grindig, boring gestaakt ivm grind	grijsgeel

BORING : W30-15

Datum	:	26-11-2014	X	:	200007.240	Boormeester	: ES
GWS	:	NAP +10.71 m	Y	:	401468.940	Beschrijver	: ES
Maaiveld	:	NAP +12.91 m				Norm	: NEN5104
Opmerking	:						



Laag nr.	Diepte [m t.o.v. NAP] van	tot	Omschrijving grondlaag	Kleur
1	+12.91	+12.51	Zand, matig fijn, matig siltig, matig humeus, matig wortelhoudend	zwart
2	+12.51	+11.81	Zand, matig fijn, matig siltig, zwak humeus	bruin
3	+11.81	+11.41	Klei, zwak zandig, zwak humeus, zwak roesthoudend, zwak oerhoudend	bruingrijs
4	+11.41	+10.61	Zand, matig grof, zwak siltig, matig grindig	grijs
5	+10.61	+9.21	Zand, matig fijn, zwak siltig, zwak grindig	grijs
6	+9.21	+8.81	Zand, matig grof, zwak siltig, matig grindig	grijs
7	+8.81	+8.41	Zand, matig grof, zwak siltig, sterk grindig, boring gestaakt ivm grind	grijs

Bijlage B
Situatietekening

Opdracht: 1403589
Plaats : Bergen
Project : Aanvullend grondonderzoek dijkring 59

Betreft : Inmeetcoordinaten
Coordinaten tov : RD-stelsel
Ingemeten met : GPS-RTK
Datum : 17-11-2014
Ingemeten door : H. van Ham

Sonderingen	X [m]	Y [m]	Z [M] mv
nummer	Ingemeten	Ingemeten	TOV NAP
W30-01	200359,43	400514,98	13,11
W30-02	200382,85	400466,19	13,32
W30-03	200399,51	400431,15	13,33
W30-04	200466,31	400326,49	13,81
W30-05	200701,08	399651,08	13,36
W30-06	200696,19	399610,08	13,37
W30-07	200683,51	399526,14	13,48
W30-08	200640,56	399312,35	13,37
W30-09	200619,08	399233,29	12,91
W30-10	200316,30	399561,85	13,36
W30-11	200298,99	399594,25	13,24
W30-12	200072,24	401336,63	13,39
W30-13	200056,26	401389,43	12,97
W30-14	200022,68	401433,17	12,93
W30-15	200007,24	401468,94	12,91

MOS GRONDMECHANICA

DR59-HB93
DR59-HB26
DR59-HB25
DR59-HB58
DR59-HB57
DR59-HB24
DR59-HB23
DR59-HB06
DR59-HB56
DR59-HB55
DR59-HB89
DR59-HB94
DR59-HB13
DR59-HB22
DR59-HB98
DR59-HB97
DR59-HB96
DR59-HB100
DR59-HB95
DR59-HB54
DR59-HB53
DR59-HB101
DR59-HB78
DR59-HB32
DR59-HB31
DR59-HB07
DR59-SO05
DR59-HB10
DR59-HB79
DR59-HB80
DR59-HB81
DR59-HB90
DR59-HB40
DR59-HB41
W30-12
W30-13
W30-14
W30-15
DR59-HB60
DR59-HB59
DR59-HB46
DR59-HB47
DR59-HB89
DR59-HB14
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DR59-HB77
DR59-HB16
DR59-HB17
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W30-02
W30-03
DR59-HB72
DR59-HB50
DR59-HB05
DR59-HB42
DR59-HB29
DR59-HB74
DR59-HB64
DR59-HB43
DR59-HB30
DR59-HB75
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DR59-HB82
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DR59-HB88
DR59-HB86
DR59-HB84
DR59-HB73
DR59-HB63
DR59-SO02

DR59-HB16
DR59-HB17
DR59-HB72
DR59-HB50
DR59-HB05
DR59-SO01
DR59-HB04
W30-04
DR59-HB18
DR59-HB19
DR59-HB51
DR59-HB52
DR59-HB20
DR59-HB21
DR59-HB103
DR59-HB68
DR59-HB69
DR59-HB01
DR59-SO03
DR59-HB11
W30-05
W30-06
DR59-HB38
DR59-HB39
W30-07
DR59-HB76
W30-01
W30-02
W30-03
DR59-HB70
DR59-HB71
W30-08
W30-09
DR59-HB02
DR59-HB12
DR59-SO04
DR59-HB34
DR59-HB35
DR59-HB42
DR59-HB29
DR59-HB73
DR59-HB63
DR59-HB66
DR59-HB67
DR59-HB36
DR59-HB37
DR59-HB102
DR59-HB08
DR59-HB09
DR59-HB33
DR59-HB62
DR59-HB61
DR59-SO02
DR59-HB28
DR59-HB27
DR59-HB45
DR59-SO011
W30-10

Nog uit te voeren boringen

Al uitgevoerde boringen

Handboring

Sondering

Sondering met pl.wrijving

Boring

Peilbuis

onderdeel	SITUATIE GRONDONDERZOEK	projekt :	Grondonderzoek versterkingen Maasdijk te Mook - Aijen
uitvoeren verzorgd door	MOS GRONDMECHANICA		
schaal 1: 1500	maten in meters	gtf. g.h.	gkz.
datum 31-01-14	opdr.nr. : 1302640 / 1403589		
wijz. 04-12-14	Formaat : A0		

MOS GRONDMECHANICA
Postbus 801, 3160 AA Rhoon - Telefoon (010) 5030200 - Fax (010) 5013656

H:\Projecten\2014\1403589 - Bergen - Aanvullend grondonderzoek dijkring 59\5-1403589.dws 4-12-2014 14:57:20 DWG To PDF.pc3

BIJLAGE 3 Piping en kwelschermen

cohesive slope protection layer: uplift pressure and shear

Status	Uplift:	*Validated*
	Shear:	*Validated*
Version	1.3	

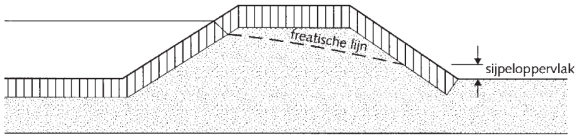
Input cell
Output/calculation cell

Project	Prioritaire dijkversterkingen 1
Projectcode	9Y3672-105-104
Subject	Uplift due to uplift pressure in dike core - Algmeen / basis STMI
Author	Albert Wiggers + Tom de Wit
Date	06-10-2014
file name	17-9-14_Spreadsheet_STMI_uplift pressure_shear_version1.3

1. Equilibrium cohesive slope protection layer due to uplift pressure in dike core

1.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 123 and 124



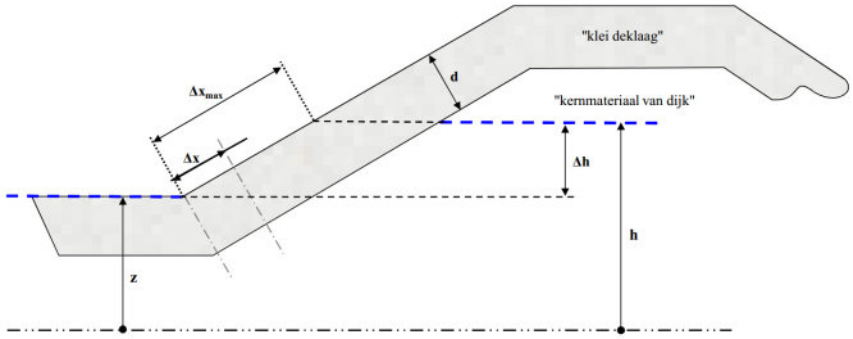
Formula 1: 1-dimentional exclusive friction in clay (in pressures)

$$\cos\alpha \geq \frac{\gamma_d\,\gamma_{m,\rho}\,\gamma_n\,\rho_w(h-z)}{\rho_g\,d}$$

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\frac{2cd}{\gamma_{m;c}} + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\cos\alpha + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\sin\alpha\frac{\tan\varphi}{\gamma_{m;\varphi}} \geq \gamma_n\gamma_d\left(\Delta h - \tfrac{1}{2}\Delta x\sin\alpha\right)\frac{\rho_g g}{\gamma_{m;\rho}}\Delta x$$

1.2 Input



Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,6	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1700	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,99	*m*

Partial factor	symbol	value	unit
volumetric mass of water	γm,ρ	1	-
volumetric mass of soil (clay)	γm,ρ	1	-
cohesion	γm,c	1,25	-
friction angle (effective)	γm,φ	1,1	-
overall load factor (product of schadefactor and modelfactor)	γd * γn	2	-

1.3 Output

Formula 1: exclusive friction in clay (in pressures)

	value	unit	
Resistance:	25,32	*kN/m2*	weight perpendicular to slope
Action:	39,04	*kN/m2*	uplift pressure perpendicular to slope
Resistance / Action	0,648398	-	no uplift if resistance/action >= 1

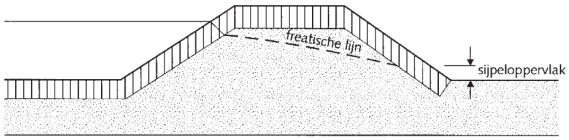
Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Δx_{max}	6,30	*m*	maximum width of the slice of clay
Δx	1,6	*m*	width of clay beloning to the lowest resistance/action value
Check if $\Delta x < \Delta x_{max}$	OK	-	check error in sheet
Resistance:	54,43	*kN/m*	resistance force beloning to the lowest resistance/action value
Action:	54,53	*kN/m*	action force beloning to the lowest resistance/action value
Resistance / Action	0,99817515	-	no uplift if resistance/action >= 1

2. Equilibrium cohesive slope protection layer due to shear

2.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 125



Formula 1: 1-dimentional exclusive friction in clay (in pressures)

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\gamma_n\gamma_d\left[\Delta h d\frac{\rho_g g}{\gamma_{m,\rho}}-\left[\frac{cd}{\gamma_{m,c}}+\frac{c\Delta h}{\gamma_{m,c}\sin\alpha}+\left[\frac{\Delta h}{\tan\alpha}d\frac{\rho_g g}{\gamma_{m,\rho}}-\tfrac{1}{2}\frac{\rho_w g\Delta h^2}{\gamma_{m,\rho}\sin\alpha}\right]\frac{\tan\phi}{\gamma_{m\phi}}\right]\right]\le\frac{cd}{\gamma_{m,c}\sin\alpha}+\tfrac{1}{2}\frac{d^2\rho_g g}{\sin\alpha\gamma_{m,\rho}}$$

2.2 Input

requires the same input parameters as shown in 1.2.
! CHANGE THE PARAMETERS IN 1.2 Input

Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,6	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1700	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,99	*m*

Partial factor	symbol	value	unit
volumetric mass of water	γm,ρ	1	-
volumetric mass of soil (clay)	γm,ρ	1	-
cohesion	γm,c	1,25	-
friction angle (effective)	γm,φ	1,1	-
load factor - schadefactor	γd	1,1	-
load factor - modelfactor	γn	1,1	

2.4 Output

Formula 1: exclusive friction in clay

Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Action:	-13,59	*kN/m2*	shear pressure perpendicular to slope
Resistance:	79,70	*kN/m2*	resistance clay
Resistance / Action	**OK**	-	no shear if resistance/action >= 1, or OK

cohesive slope protection layer: uplift pressure and shear

Status	Uplift:	*Validated*
	Shear:	*Validated*
Version	1.6	

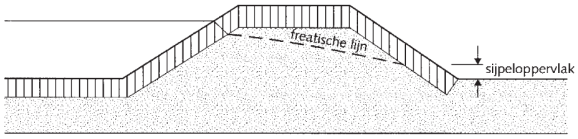
Input cell
Output/calculation cell

Project	Prioritaire dijkversterkingen 1
Projectcode	9X4447-116-104
Subject	Uplift due to uplift pressure in dike core DP59.058-060
Author	T.J. de Wit
Date	01-12-2014
file name	01-12-14-STMI_1.6

1. Equilibrium cohesive slope protection layer due to uplift pressure in dike core

1.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 123 and 124



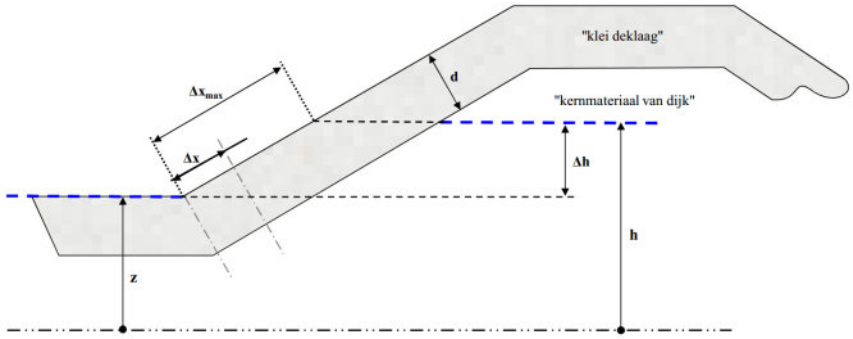
Formula 1: 1-dimentional exclusive friction in clay (in pressures)

$$\cos\alpha \geq \frac{\gamma_d\,\gamma_{m,\rho}\,\gamma_n\,\rho_w(h-z)}{\rho_g\,d}$$

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\frac{2cd}{\gamma_{m;c}} + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\cos\alpha + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\sin\alpha\frac{\tan\varphi}{\gamma_{m;\varphi}} \geq \gamma_n\gamma_d\left(\Delta h - \tfrac{1}{2}\Delta x\sin\alpha\right)\frac{\rho_g g}{\gamma_{m;\rho}}\Delta x$$

1.2 Input



Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,55	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1700	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,9	*m*

Partial factor	symbol	value	unit
volumetric mass of water	γm,ρ	1	-
volumetric mass of soil (clay)	γm,ρ	1	-
cohesion	γm,c	1,25	-
friction angle (effective)	γm,φ	1,1	-
overall load factor (product of schadefactor and modelfactor)	γd * γn	2	-

1.3 Output

Formula 1: exclusive friction in clay (in pressures)

	value	unit	
Resistance:	24,52	*kN/m2*	weight perpendicular to slope
Action:	37,28	*kN/m2*	uplift pressure perpendicular to slope
Resistance / Action	0,657889	-	no uplift if resistance/action >= 1

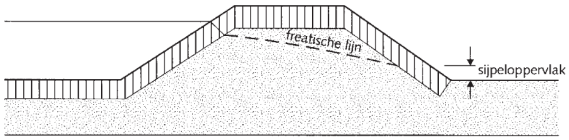
Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Δx_{max}	6,01	*m*	maximum width of the slice of clay
Δx	1,55	*m*	width of clay beloning to the lowest resistance/action value
Check if $\Delta x < \Delta x_{max}$	**OK**	-	check error in sheet
Resistance:	51,32	*kN/m*	resistance force beloning to the lowest resistance/action value
Action:	50,33	*kN/m*	action force beloning to the lowest resistance/action value
Resistance / Action	1,01956784	-	no uplift if resistance/action >= 1

2. Equilibrium cohesive slope protection layer due to shear

2.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 125



Formula 1: 1-dimentional exclusive friction in clay (in pressures)

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\gamma_n\gamma_d\left[\Delta h d\frac{\rho_g g}{\gamma_{m,\rho}}-\left[\frac{cd}{\gamma_{m,c}}+\frac{c\Delta h}{\gamma_{m,c}\sin\alpha}+\left[\frac{\Delta h}{\tan\alpha}d\frac{\rho_g g}{\gamma_{m,\rho}}-\tfrac{1}{2}\frac{\rho_w g\Delta h^2}{\gamma_{m,\rho}\sin\alpha}\right]\frac{\tan\phi}{\gamma_{m\phi}}\right]\right]\le\frac{cd}{\gamma_{m,c}\sin\alpha}+\tfrac{1}{2}\frac{d^2\rho_g g}{\sin\alpha\gamma_{m,\rho}}$$

2.2 Input

requires the same input parameters as shown in 1.2.
! CHANGE THE PARAMETERS IN 1.2 Input

Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,55	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1700	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,9	*m*

Partial factor	symbol	value	unit
volumetric mass of water	γm,ρ	1	-
volumetric mass of soil (clay)	γm,ρ	1	-
cohesion	γm,c	1,25	-
friction angle (effective)	γm,φ	1,1	-
load factor - schadefactor	γd	1,1	-
load factor - modelfactor	γn	1,1	

2.4 Output

Formula 1: exclusive friction in clay

Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Action:	-13,78	*kN/m2*	shear pressure perpendicular to slope
Resistance:	75,17	*kN/m2*	resistance clay
Resistance / Action	**OK**	-	no shear if resistance/action >= 1, or OK

cohesive slope protection layer: uplift pressure and shear

Status	Uplift:	*Validated*
	Shear:	*Validated*
Version	1.3	

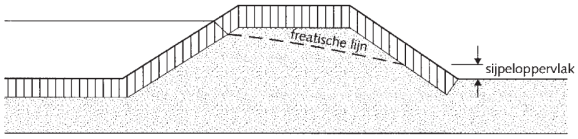
Input cell
Output/calculation cell

Project	Prioritaire dijkversterkingen 1
Projectcode	9X4447-116-104
Subject	Uplift due to uplift pressure in dike core DP59.063-065
Author	T.J. de Wit
Date	01-12-2014
file name	01-12-14_STMI_1,7

1. Equilibrium cohesive slope protection layer due to uplift pressure in dike core

1.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 123 and 124



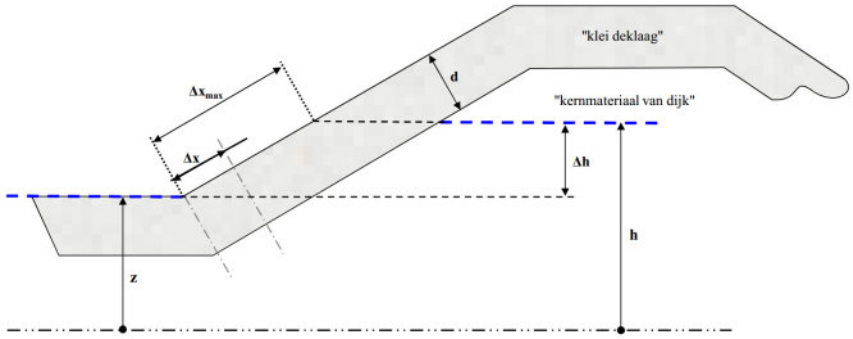
Formula 1: 1-dimentional exclusive friction in clay (in pressures)

$$\cos\alpha \geq \frac{\gamma_d\,\gamma_{m,\rho}\,\gamma_n\,\rho_w(h-z)}{\rho_g\,d}$$

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\frac{2cd}{\gamma_{m;c}} + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\cos\alpha + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\sin\alpha\frac{\tan\varphi}{\gamma_{m;\varphi}} \geq \gamma_n\gamma_d\left(\Delta h - \tfrac{1}{2}\Delta x\sin\alpha\right)\frac{\rho_g g}{\gamma_{m;\rho}}\Delta x$$

1.2 Input



Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,56	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1700	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,83	*m*

3,39

Partial factor	symbol	value	unit
volumetric mass of water	$\gamma_{m,\rho}$	1	-
volumetric mass of soil (clay)	$\gamma_{m,\rho}$	1	-
cohesion	$\gamma_{m,c}$	1,25	-
friction angle (effective)	$\gamma_{m,\varphi}$	1,1	-
overall load factor (product of schadefactor and modelfactor)	$\gamma_d * \gamma_n$	2	-

1.3 Output

Formula 1: exclusive friction in clay (in pressures)

	value	unit	
Resistance:	24,68	*kN/m2*	weight perpendicular to slope
Action:	35,90	*kN/m2*	uplift pressure perpendicular to slope
Resistance / Action	0,687461	-	no uplift if resistance/action >= 1

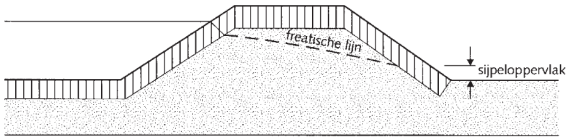
Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Δx_{max}	5,79	*m*	maximum width of the slice of clay
Δx	1,5	*m*	width of clay beloning to the lowest resistance/action value
Check if $\Delta x < \Delta x_{max}$	OK	-	check error in sheet
Resistance:	50,22	*kN/m*	resistance force beloning to the lowest resistance/action value
Action:	46,88	*kN/m*	action force beloning to the lowest resistance/action value
Resistance / Action	1,07130026	-	no uplift if resistance/action >= 1

2. Equilibrium cohesive slope protection layer due to shear

2.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 125



Formula 1: 1-dimentional exclusive friction in clay (in pressures)

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\gamma_n\gamma_d\left[\Delta h d\frac{\rho_g g}{\gamma_{m,\rho}}-\left[\frac{cd}{\gamma_{m,c}}+\frac{c\Delta h}{\gamma_{m,c}\sin\alpha}+\left[\frac{\Delta h}{\tan\alpha}d\frac{\rho_g g}{\gamma_{m,\rho}}-\tfrac{1}{2}\frac{\rho_w g\Delta h^2}{\gamma_{m,\rho}\sin\alpha}\right]\frac{\tan\phi}{\gamma_{m\phi}}\right]\right]\le\frac{cd}{\gamma_{m,c}\sin\alpha}+\tfrac{1}{2}\frac{d^2\rho_g g}{\sin\alpha\gamma_{m,\rho}}$$

2.2 Input

requires the same input parameters as shown in 1.2.
! CHANGE THE PARAMETERS IN 1.2 Input

Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,56	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1700	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,83	*m*

Partial factor	symbol	value	unit
volumetric mass of water	γm,ρ	1	-
volumetric mass of soil (clay)	γm,ρ	1	-
cohesion	γm,c	1,25	-
friction angle (effective)	γm,φ	1,1	-
load factor - schadefactor	γd	1,1	-
load factor - modelfactor	γn	1,1	

2.4 Output

Formula 1: exclusive friction in clay

Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Action:	-14,72	*kN/m2*	shear pressure perpendicular to slope
Resistance:	76,06	*kN/m2*	resistance clay
Resistance / Action	**OK**	-	no shear if resistance/action >= 1, or OK

BIJLAGE 4 Binnenwaartse macrostabiliteit

Critical Circle Bishop

Xm : 6,49 [m]
Ym : 2,07 [m]

Radius : 2,79 [m]
Safety : 1,99

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI basisberekening 01_1

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Annex	-	form.	A4

D-Geo Stability 10.1 : STBI_h1m_dkl 0m.sti

Critical Circle Bishop

Xm : 8,99 [m]
Ym : 7,07 [m]

Radius : 7,29 [m]
Safety : 1,50

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI basisberekening 01_2

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D-Geo Stability 10.1 : STBI_h2m_dkl 0m.sti

Critical Circle Bishop

Xm : 11,49 [m]
Ym : 11,07 [m]

Radius : 11,29 [m]
Safety : 1,27

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI basisberekening 01-3

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D-Geo Stability 10.1 : STBI_h3m_dkl 0m.sti

Critical Circle Bishop

Xm : 11,99 [m]
Ym : 12,07 [m]

Radius : 11,79 [m]
Safety : 1,12

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 01-4

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D-Geo Stability 10.1 : STBI_h4m_dkl 0m.sti

Critical Circle Bishop

Xm : 14,49 [m]
Ym : 16,07 [m]

Radius : 15,79 [m]
Safety : 1,01

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI basisberekening 01-5

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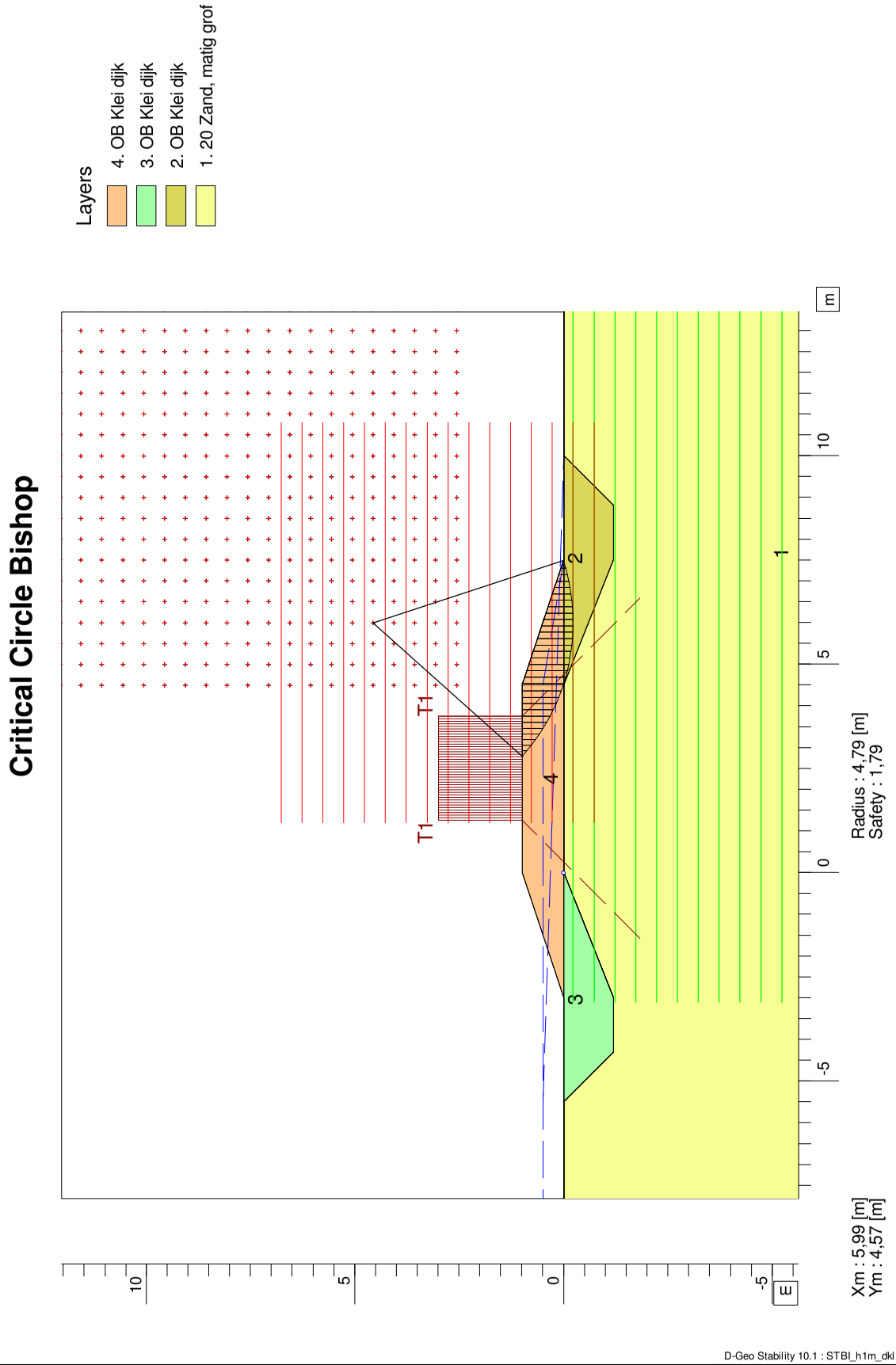
D-Geo Stability 10.1 : STBI_h5m_dkl 0m.sti



D-Geo Stability 10.1 : STBI_h1m_dkl 0m_bel.sti

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Prioritaire Dijkversterking
Waterschap Peel en Maasvallei

STBI (situatie 2 / h=1 m)

	ctr.
-	
Annex -	form. A4

Critical Circle Bishop

Xm : 8,49 [m]
Ym : 10,07 [m]

Radius : 10,29 [m]
Safety : 1,41

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (Situatie 2 / h=2m)

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D-Geo Stability 10.1 : STBI_h2m_dkl 0m_bel.sti

Critical Circle Bishop

Xm : 8,99 [m]
Ym : 11,07 [m]

Radius : 10,79 [m]
Safety : 1,24

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (Situatie 2 / h=3m)

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D-Geo Stability 10.1 : STBI_h3m_dkl 0m_bel.sti

Critical Circle Bishop

Xm : 11,49 [m]
Ym : 15,57 [m]

Radius : 15,29 [m]
Safety : 1,11

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (Situatie 2 / h=4m)

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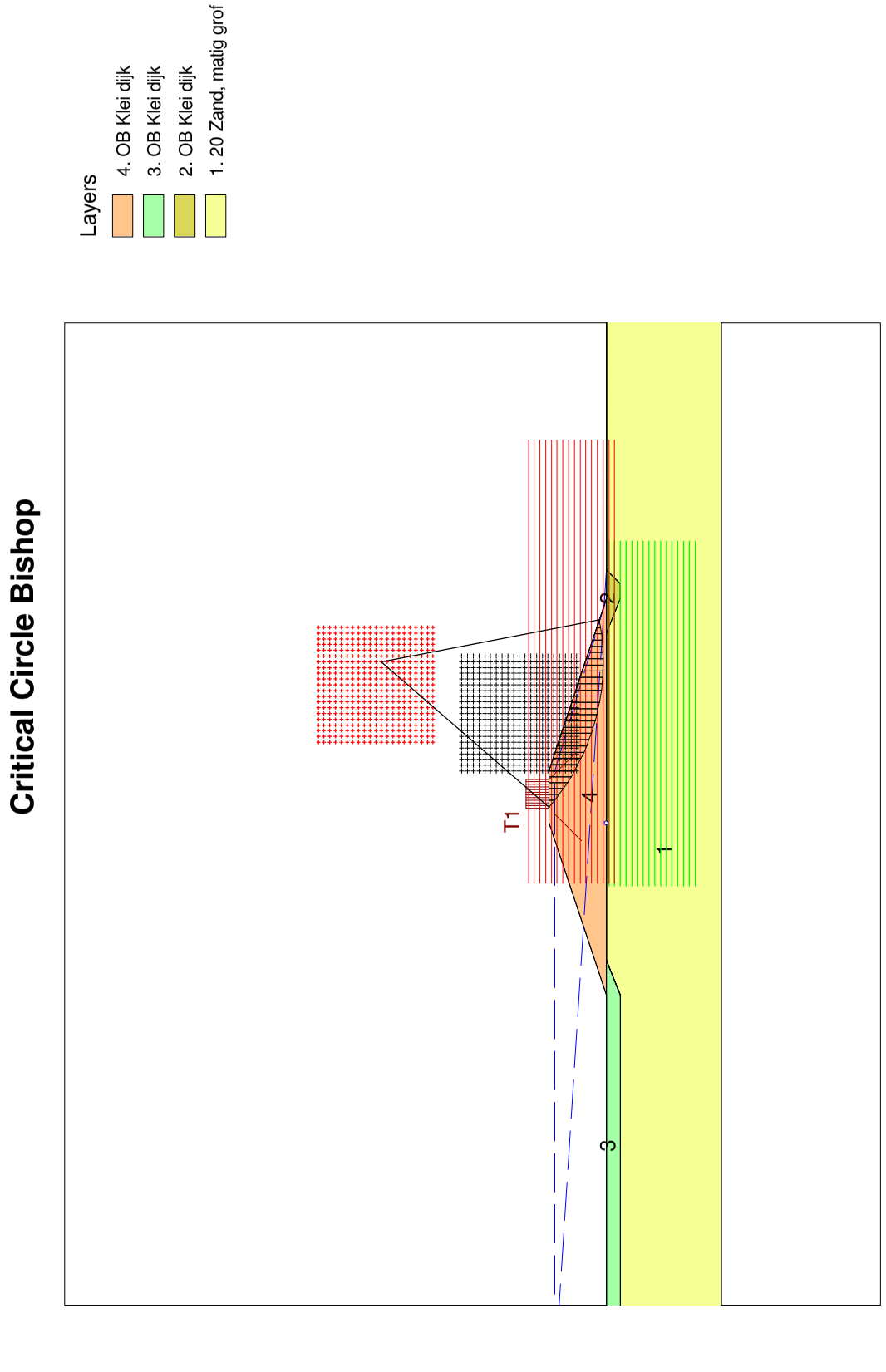
D-Geo Stability 10.1 : STBI_h4m_dkl 0m_bel.sti



D-Geo Stability 10.1 : STBI_h5m_dkl 0m_bel.sti

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Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei

STBI (situatie 2 / h=5m)

	ctr.
-	
Annex -	form. A4

Critical Circle Bishop

Xm : 6,49 [m]
Ym : 2,57 [m]

Radius : 3,29 [m]
Safety : 1,98

D-Geo Stability 10.1 : STBI_h1m_dkl 1m.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04-01

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Critical Circle Bishop

Xm : 8,49 [m]
Ym : 5,07 [m]

Radius : 5,79 [m]
Safety : 1,41

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04-02

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D-Geo Stability 10.1 : STBI_h2m_dkl 1m.sti

Critical Circle Bishop

Xm : 10,99 [m]
Ym : 10,07 [m]

Radius : 10,29 [m]
Safety : 1,19

D-Geo Stability 10.1 : STBI_h3m_dkl 1m.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04-3

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Critical Circle Bishop

Xm : 13,49 [m]
Ym : 14,07 [m]

Radius : 14,29 [m]
Safety : 1,06

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04-4

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D-Geo Stability 10.1 : STBI_h4m_dkl 1m.sti

Critical Circle Bishop

Xm : 15,99 [m]
Ym : 18,07 [m]

Radius : 18,29 [m]
Safety : 0,98

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04-5

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D-Geo Stability 10.1 : STBI_h5m_dkl 1m.sti

Critical Circle Bishop

Layers

- 8. OB Klei dijk
- 7. OB Klei dijk
- 6. OB Klei dijk
- 5. 19 Klei
- 4. OB Klei dijk (sterkte0)
- 3. OB Klei dijk
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 6,49 [m]
Ym : 2,57 [m]

Radius : 3,29 [m]
Safety : 1,75

D-Geo Stability 10.1 : STBI_h1m_dkl 1m_opb.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04b-1

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Critical Circle Bishop

Xm : 8,99 [m]
Ym : 5,57 [m]

Radius : 6,29 [m]
Safety : 1,31

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04b-2

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D-Geo Stability 10.1 : STBI_h2m_dkl 1m_opb.sti

Critical Circle Bishop

Xm : 11,99 [m]
Ym : 10,57 [m]

Radius : 11,29 [m]
Safety : 1,13

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 04b-3

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D-Geo Stability 10.1 : STBI_h3m_dkl 1m_opb.sti

Critical Circle Bishop

Layers

- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. OB Klei dijk
- 3. 19 Klei
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 5,49 [m]
Ym : 4,57 [m]

Radius : 5,29 [m]
Safety : 1,74

D-Geo Stability 10.1 : STBI_h1m_dkl 1m_bel.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 05-1

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Critical Circle Bishop

Layers

- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. OB Klei dijk
- 3. 19 Klei (y=19)
- 2. 19 Klei
- 1. 20 Zand, matig grof

Xm : 7,99 [m]
Ym : 8,57 [m]

Radius : 9,29 [m]
Safety : 1,41

D-Geo Stability 10.1 : STBI_h2m_dkl 1m_bel.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 05-2

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Critical Circle Bishop

Layers

- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. OB Klei dijk
- 3. 19 Klei (y=19)
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 9,99 [m]
Ym : 11,57 [m]

Radius : 12,29 [m]
Safety : 1,24

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 05-3

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D-Geo Stability 10.1 : STBI_h3m_dkl 1m_bel.sti

Critical Circle Bishop

Xm : 12,49 [m]
Ym : 17,57 [m]

Radius : 17,79 [m]
Safety : 1,13

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 05-4

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D-Geo Stability 10.1 : STBI_h4m_dkl 1m_bel.sti

Critical Circle Bishop

Xm : 6,49 [m]
Ym : 2,57 [m]

Radius : 3,29 [m]
Safety : 1,99

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 07-1

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D-Geo Stability 10.1 : STBI_h1m_dkl 3m.sti

Critical Circle Bishop

Xm : 8,49 [m]
Ym : 5,07 [m]

Radius : 5,79 [m]
Safety : 1,36

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 07-2

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Annex -

D-Geo Stability 10.1 : STBI_h2m_dkl 3m.sti

Critical Circle Bishop

Xm : 10,49 [m]
Ym : 7,57 [m]

Radius : 8,29 [m]
Safety : 1,15

D-Geo Stability 10.1 : STBI_h3m_dkl 3m.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 07-3

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ctr. -
form. A4
Annex -

Critical Circle Bishop

Xm : 12,99 [m]
Ym : 11,57 [m]

Radius : 12,29 [m]
Safety : 1,03

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 07-4

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Annex -

D-Geo Stability 10.1 : STBI_h4m_dkl 3m.sti

Critical Circle Bishop

Xm : 6,49 [m]
Ym : 2,07 [m]

Radius : 2,79 [m]
Safety : 1,83

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 07b-1

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D-Geo Stability 10.1 : STBI_h1m_dkl 3m_opd.sti

Critical Circle Bishop

Xm : 8,49 [m]
Ym : 4,57 [m]

Radius : 5,79 [m]
Safety : 1,16

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 07b-2

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dnw.	-

D-Geo Stability 10.1 : STBI_h2m_dkl 3m_opd.sti

Critical Circle Bishop

Xm : 13,99 [m]
Ym : 8,57 [m]

Radius : 11,79 [m]
Safety : 0,74

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei

STBI basisberekening 07b-3

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D-Geo Stability 10.1 : STBI_h3m_dkl 3m_opd.sti

Critical Circle Bishop

Layers

- 7. OB Klei dijk
- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. 19 Klei
- 3. 19 Klei (y=19)
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 5,49 [m]
Ym : 4,07 [m]

Radius : 5,29 [m]
Safety : 1,71

D-Geo Stability 10.1 : STBI_h1m_dki 3m_bei.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 08-1

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-	ctr.
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Critical Circle Bishop

Layers

- 7. OB Klei dijk
- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. 19 Klei (y=19)
- 3. 19 Klei
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 7,49 [m]
Ym : 7,07 [m]

Radius : 8,29 [m]
Safety : 1,36

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 08-2

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ctr. -
form. A4
Annex -

D-Geo Stability 10.1 : STBI_h2m_dkl 3m_bel.sti

Critical Circle Bishop

Layers

- 7. OB Klei dijk
- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. 19 Klei (y=19)
- 3. 19 Klei (y=19)
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 9,99 [m]
Ym : 11,57 [m]

Radius : 12,29 [m]
Safety : 1,19

D-Geo Stability 10.1 : STBI_h3m_dki 3m_bei.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI basisberekening 08-3

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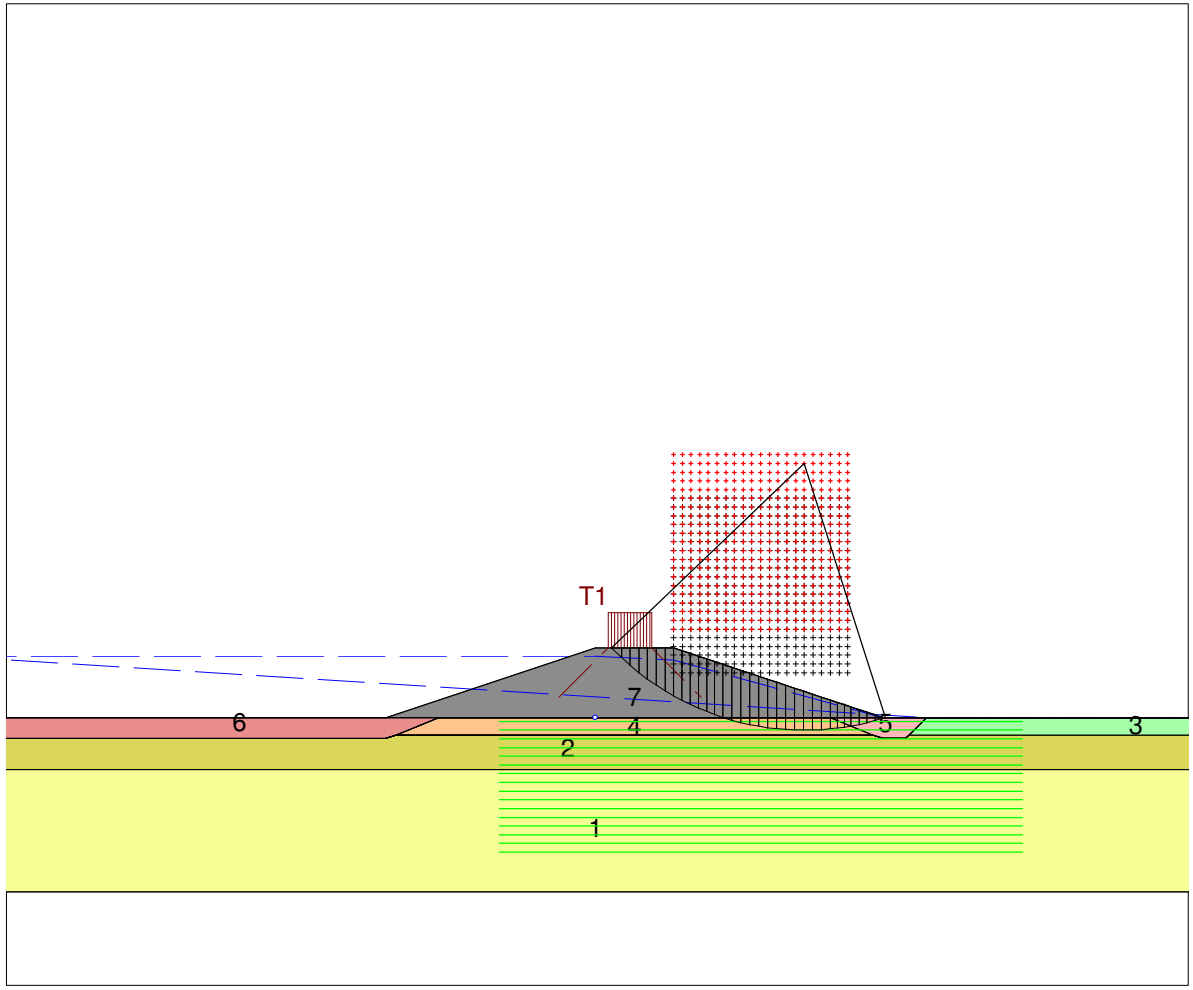
form. A4	ctr.		

Critical Circle Bishop



Layers

- 7. OB Klei dijk
- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. 19 Klei (y=19)
- 3. 19 Klei (y=19)
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : 11,99 [m]
Ym : 14,57 [m]

Radius : 15,29 [m]
Safety : 1,08

D-Geo Stability 10.1 : STBI_h4m_dkl 3m_bel.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei

STBI basisberekening 08-4

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date 1-12-2014
drw. -
ctr. -
form. A4

Annex -

Critical Circle Bishop

Xm : 11,49 [m]
Ym : 10,07 [m]

Radius : 10,29 [m]
Safety : 1,50

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (Situatie 10 / h=3 m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	dnw.	-
	-	dtr.	
Annex	-	form.	A4

D-Geo Stability 10.1 : STBI_h3m_dkl 0m_Z.sti

Critical Circle Bishop

Xm : 13,99 [m]
Ym : 13,57 [m]

Radius : 13,79 [m]
Safety : 1,37

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (Situatie 10 / h=4 m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	dnw.	-
	-	dtr.	
Annex	-	form.	A4

D-Geo Stability 10.1 : STBI_hkm_dkl 0m_Z.sti

Critical Circle Bishop

Xm : 17,49 [m]
Ym : 15,07 [m]

Radius : 14,79 [m]
Safety : 1,23

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (situatie 10 / h=5 m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	dnw.
12/1/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBI_h5m_dkl 0m_Z.sti

Critical Circle Bishop

Xm : 10,99 [m]
Ym : 7,57 [m]

Radius : 8,29 [m]
Safety : 1,44

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (situatie 11 / h=3m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date 12/1/2014
dnw. -
ctr. -
form. A4
Annex -

D-Geo Stability 10.1 : STBI_h3m_dkl 1m_Z.sti

Critical Circle Bishop

Xm : 13,49 [m]
Ym : 10,57 [m]

Radius : 11,29 [m]
Safety : 1,35

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (situatie 11 / h=4 m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	dnw.	-
	-	dtr.	
Annex	-	form.	A4

D-Geo Stability 10.1 : STBI_h4m_dkl 1m_Z.sti

Critical Circle Bishop

Xm : 15,99 [m]
Ym : 14,07 [m]

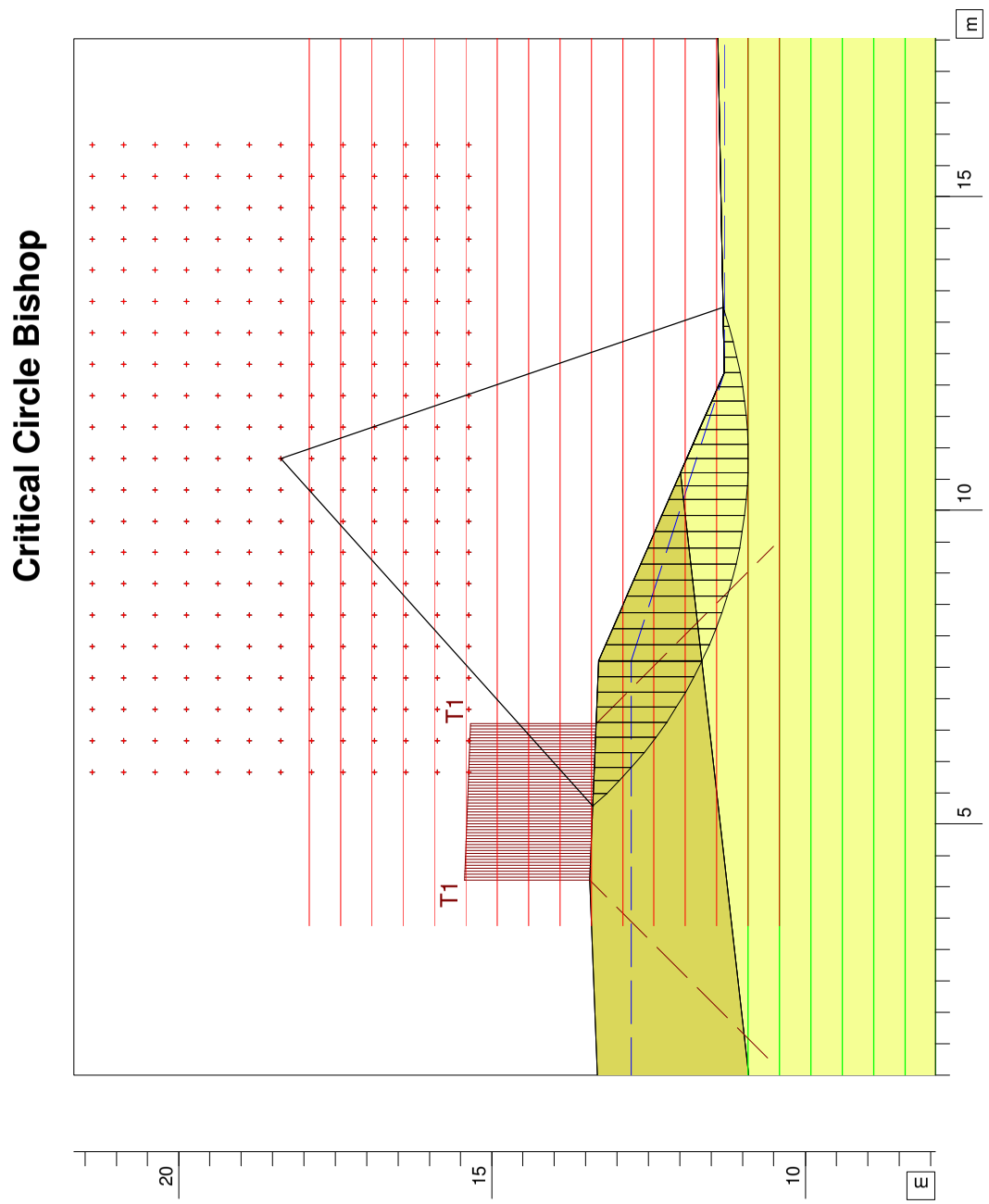
Radius : 14,79 [m]
Safety : 1,32

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBI (situatie 11 / h=5m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

Annex -	-	date 12/1/2014	dnw. -
form. A4	ctr.		

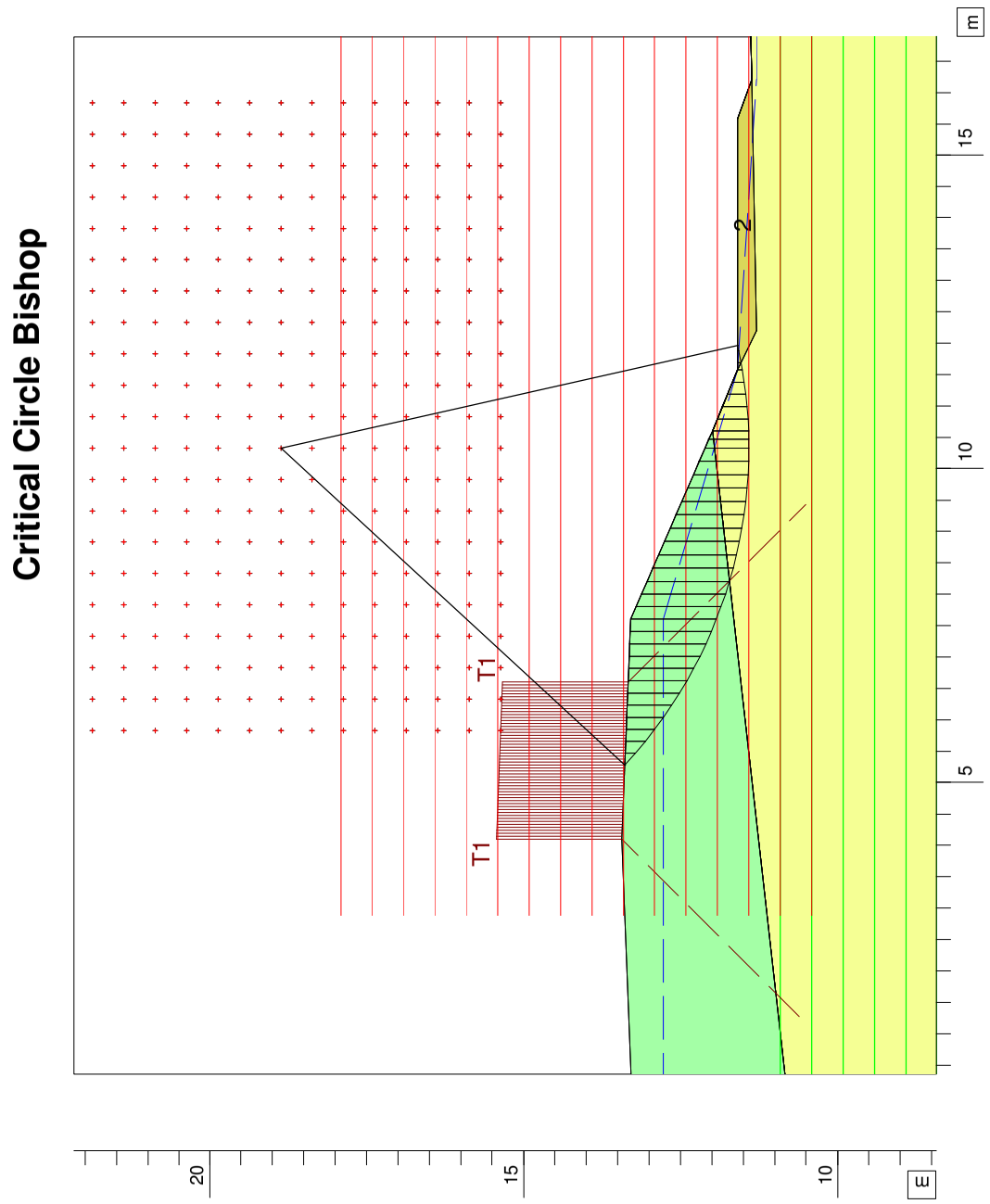
D-Geo Stability 10.1 : STBI_h5m_dkl 1m_Z.sti



D-Geo Stability 10.1 : STBI_54.170-172_huidig.sti

Royal HaskoningDHV
Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

	date 12/1/2014	drw. AHO
Prioritaire Dijkversterking Perceel 1 Waterschap Peel en Maasvallei	-	ctr.
STBI DP54.170-172 Huidig talud	Annex -	form. A4



D-Geo Stability 10.1 : STBI_54.170-172_weg verhoogd.sti

Royal HaskoningDHV
Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

	date 12/1/2014	drw. -
Prioritaire Dijkversterking Perceel 1 Waterschap Peel en Maasvallei	-	ctr.
STBI DP54.170-172 Weg 0,3 m verhoogd	Annex -	form. A4

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 11/7/2014
Time        : 11:14:40 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

Problem identification : Prioritaire Dijkversterking Perceel 1
: Waterschap Peel en Maasvallei

Calculation model : Bishop
Default shear strength : C phi

LAYER BOUNDARIES

Boundary no.	Co-ordinates [m]					
3 - X -	-43.10	-41.70	-37.90	-31.00	-14.70	-3.40
3 - Y -	8.30	8.30	9.60	9.60	11.30	11.60
3 - X -	0.00	4.10	7.60	10.60	11.57	15.57
3 - Y -	13.28	13.44	13.30	12.00	11.60	11.60
3 - X -	16.20	17.60	50.00			
3 - Y -	11.37	11.40	11.40			
2 - X -	-43.10	-15.00	0.00	10.60	11.57	15.57
2 - Y -	8.00	8.00	10.80	12.00	11.60	11.60
2 - X -	16.20	17.60	50.00			
2 - Y -	11.37	11.40	11.40			
1 - X -	-43.10	-15.00	0.00	10.60	11.57	12.20
1 - Y -	8.00	8.00	10.80	12.00	11.60	11.30
1 - X -	16.20	17.60	50.00			
1 - Y -	11.37	11.40	11.40			
0 - X -	-43.10	50.00				
0 - Y -	-10.00	-10.00				

PL LINES

PL line no.	Co-ordinates [m]					
1 - X -	-43.10	0.00	7.60	11.57	16.20	50.00
1 - Y -	12.78	12.78	12.78	11.60	11.30	11.30

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
3	OB Klei dijk
2	OA Zand dijk
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
3	18.50	18.50	1	1
2	18.00	20.00	1	1
1	18.00	20.00	1	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
3	2.40	23.00	-	-	-	-	-
2	0.00	25.70	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 5.83 [m]
X co-ordinate grid right : 15.83 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 15.37 [m]
Y co-ordinate grid top : 25.37 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 10.92 [m]
Y co-ordinate tangent biggest circle : 3.42 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	4.10	6.60	45.00	Temporary

TREE ON SLOPE

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS

==========

Layer number	Degree of consolidation
3	0
2	100
1	100

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
==========

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 5.83 [m]
X maximum = 15.83 [m]
Y minimum = 15.37 [m]
Y maximum = 25.37 [m]
tangent minimum = 10.42 [m]
tangent maximum = 17.92 [m]

Information on the critical circle : Fmin = 1.101
Calculation method used : Bishop - C phi
==========

X co-ordinate center point : 10.33 [m]
Y co-ordinate center point : 18.87 [m]
Radius of critical circle : 7.46 [m]

The center point of the critical circle is enclosed

Total driving moment : 277.99 [kNm/m]
Driving moment free water : 0.00 [kNm/m]
Driving moment external loads : 77.64 [kNm/m]
Iterated resisting moment : 277.99 [kNm/m]
Non-iterated resisting moment : 302.18 [kNm/m]

END OF D-Geo Stability OUTPUT
==========

Critical Circle Bishop

Xm : 12,27 [m]
Ym : 26,02 [m]

Radius : 13,65 [m]
Safety : 1,88

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI DP56.058 (Restprofiel Hengeland 7)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

Annex -	-	date 12/1/2014	dnw. -
form. A4	ctr.		

D-Geo Stability 10.1 : STBI_56.058.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 19-11-2014
Time        : 12:56:51

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   3  - X -  | -40.00   -10.80    -8.30     0.00     4.50     4.75
   3  - Y -  |  11.80    11.80    11.80    14.58    14.58    14.50
             |
   3  - X -  |   7.25     7.50    15.50    19.00    27.00    50.00
   3  - Y -  |  14.50    14.50    12.50    12.50    14.50    14.50
             |
   2  - X -  | -40.00   -10.80    -9.80    -8.30     0.00     4.50
   2  - Y -  |  11.30    11.30    11.30    11.80    14.58    14.58
             |
   2  - X -  |   4.75     7.25     7.50    15.50    19.00    27.00
   2  - Y -  |  14.50    14.50    14.50    12.50    12.50    14.50
             |
   2  - X -  |  50.00
   2  - Y -  |  14.50
             |
   1  - X -  | -40.00   -10.80   -10.80    -9.80     0.00     4.50
   1  - Y -  |  11.30    11.30    10.30    10.30    13.38    13.38
             |
   1  - X -  |   4.75     7.25     7.25     7.50    15.50    19.00
   1  - Y -  |  13.30    13.30    14.50    14.50    12.50    12.50
             |
   1  - X -  |  27.00    50.00
   1  - Y -  |  14.50    14.50
             |
   0  - X -  | -40.00    50.00
   0  - Y -  | -10.00   -10.00


               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   1  - X -  | -40.00     0.00     4.50    11.00    50.00
   1  - Y -  |  14.58    14.58    14.38    13.50    13.50
             |
   2  - X -  | -40.00   -10.80     7.25    50.00
   2  - Y -  |  14.58    14.58    13.50    13.50



 Unit weight of water used for calculation:     9.81 [kN/m3]
 The groundwater level is determined by PL-line number 1
```

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
3	20 Zand, matig grof
2	OB Klei dijk (sterkte0)
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
3	18.00	20.00	1	1
2	18.50	18.50	1	1
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
3	0.00	27.50	-	-	-	-	-
2	1.00	0.00	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 4.27 [m]
X co-ordinate grid right : 14.27 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 19.02 [m]
Y co-ordinate grid top : 29.02 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 12.87 [m]
Y co-ordinate tangent biggest circle : 5.37 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD

No uniform loads were input.

TREE ON SLOPE

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

Information on the critical circle : Fmin = 1.881
Calculation method used : Bishop - C phi

X co-ordinate center point	:	12.27 [m]
Y co-ordinate center point	:	26.02 [m]
Radius of critical circle	:	13.65 [m]

The center point of the critical circle is enclosed

Total driving moment	:	379.41 [kNm/m]
Driving moment free water	:	-70.58 [kNm/m]
Driving moment external loads	:	0.00 [kNm/m]
Iterated resisting moment	:	379.41 [kNm/m]
Non-iterated resisting moment	:	688.98 [kNm/m]

END OF D-Geo Stability OUTPUT
=============================

Critical Circle Bishop

Xm : 8,27 [m]
Ym : 19,02 [m]

Radius : 5,65 [m]
Safety : 1,55

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI DP59.006 (Restprofiel Aijenseweg 22)

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date	12/1/2014	dnw.	-
	-	ctr.	
Annex	-	form.	A4

D-Geo Stability 10.1 : STBI_59.006.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 18-11-2014
Time        : 15:07:55

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

Problem identification : Prioritaire Dijkversterking
: Waterschap Peel en Maasvallei

Calculation model : Bishop
Default shear strength : C phi

LAYER BOUNDARIES

Boundary no.	Co-ordinates [m]					
5 - X -	-26.00	-15.80	-7.60	0.00	4.50	9.70
5 - Y -	12.80	12.80	12.80	15.33	15.33	13.60
5 - X -	12.21	13.70	22.70	50.00		
5 - Y -	13.60	13.60	11.80	11.80		
4 - X -	-26.00	-15.80	-9.10	-7.60	0.00	4.50
4 - Y -	12.10	12.10	12.30	12.80	15.33	15.33
4 - X -	9.70	12.21	13.70	22.70	50.00	
4 - Y -	13.60	13.60	13.60	11.80	11.80	
3 - X -	-26.00	-15.80	-9.10	-7.60	-4.60	6.70
3 - Y -	12.10	12.10	12.30	12.80	12.80	13.60
3 - X -	9.70	12.21	13.70	22.70	50.00	
3 - Y -	13.60	13.60	13.60	11.80	11.80	
2 - X -	-26.00	-15.80	-15.80	-9.10	-4.60	6.70
2 - Y -	12.10	12.10	11.10	11.30	12.80	13.60
2 - X -	9.70	12.21	13.70	22.70	50.00	
2 - Y -	13.60	13.60	13.60	11.80	11.80	
1 - X -	-26.00	-15.80	-15.80	-9.10	-4.60	6.70
1 - Y -	12.10	12.10	11.10	11.30	12.80	13.60
1 - X -	9.70	12.20	12.21	13.70	22.70	50.00
1 - Y -	12.60	12.60	13.60	13.60	11.80	11.80
0 - X -	-26.00	50.00				
0 - Y -	-10.00	-10.00				

PL LINES

PL line no.	Co-ordinates [m]				
1 - X -	-26.00	0.00	4.50	9.70	50.00
1 - Y -	15.33	15.33	15.13	13.60	13.60
2 - X -	-26.00	-15.80	12.20	50.00	
2 - Y -	15.33	15.33	13.60	13.60	

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
5	20 Zand, matig grof
4	OB Klei dijk
3	OB Klei dijk
2	OB Klei dijk
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
5	18.00	20.00	1	1
4	18.50	18.50	1	1
3	18.50	18.50	1	1
2	18.50	18.50	1	1
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
5	0.00	27.50	-	-	-	-	-
4	2.40	23.00	-	-	-	-	-
3	2.40	23.00	-	-	-	-	-
2	2.40	23.00	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 4.27 [m]
X co-ordinate grid right : 14.27 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 19.02 [m]
Y co-ordinate grid top : 29.02 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 12.87 [m]
Y co-ordinate tangent biggest circle : 5.37 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD
============

No uniform loads were input.

TREE ON SLOPE
=============

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 4.27 [m]
X maximum = 14.27 [m]
Y minimum = 18.52 [m]
Y maximum = 28.52 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 4.27 [m]
X maximum = 14.27 [m]
Y minimum = 18.02 [m]
Y maximum = 28.02 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 4.27 [m]
X maximum = 14.27 [m]
Y minimum = 17.52 [m]
Y maximum = 27.52 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 4.27 [m]
X maximum = 14.27 [m]
Y minimum = 17.52 [m]
Y maximum = 27.52 [m]
tangent minimum = 12.37 [m]
tangent maximum = 19.87 [m]

Information on the critical circle : Fmin = 1.546
Calculation method used : Bishop - C phi
==========

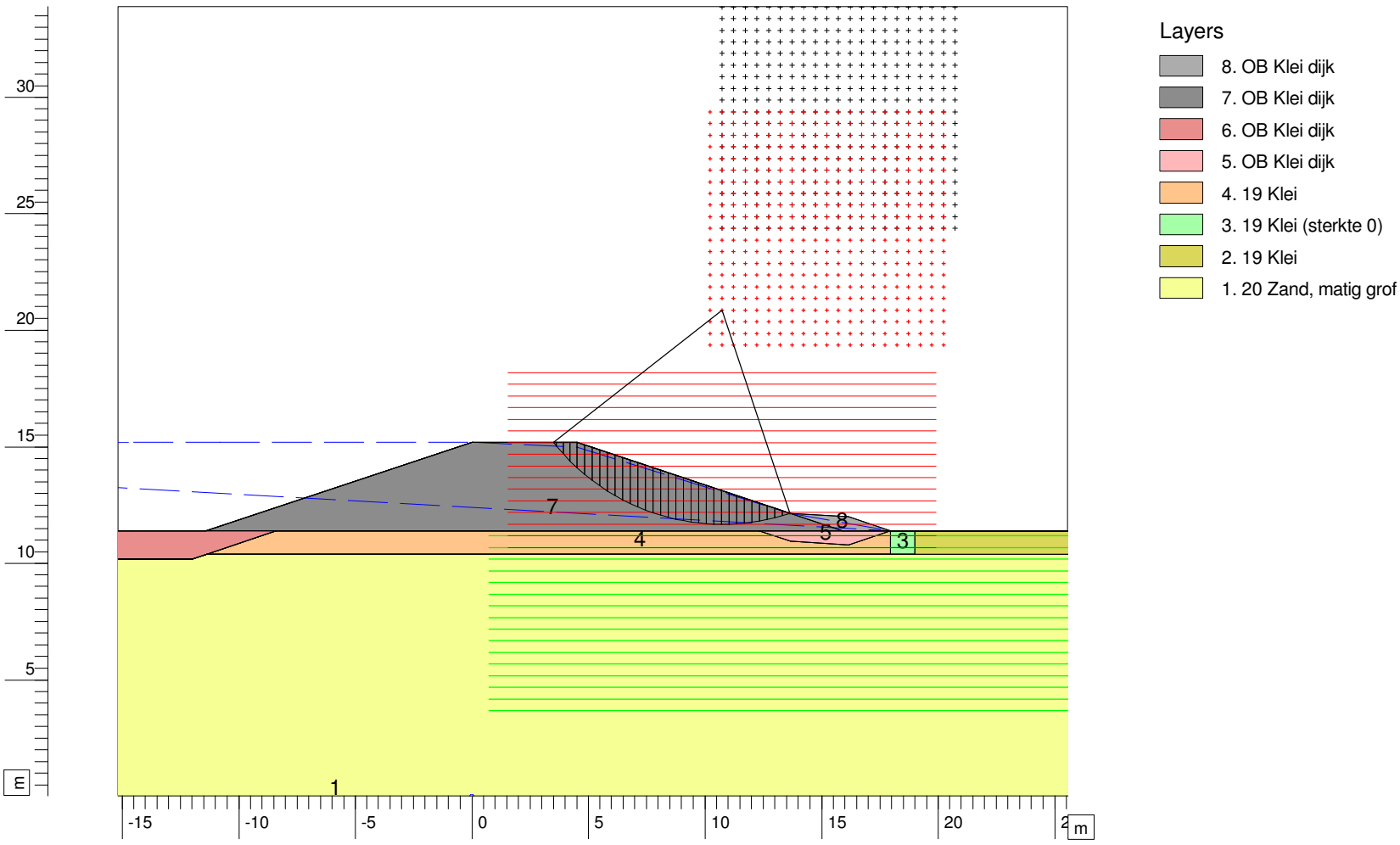
X co-ordinate center point : 8.27 [m]
Y co-ordinate center point : 19.02 [m]
Radius of critical circle : 5.65 [m]

The center point of the critical circle is enclosed

Total driving moment : 117.02 [kNm/m]
Driving moment free water : 0.00 [kNm/m]

```
Driving moment external loads   :          0.00 [kNm/m]
Iterated resisting moment       :        117.02 [kNm/m]
Non-iterated resisting moment   :        174.00 [kNm/m]


                          END OF D-Geo Stability OUTPUT
                          ============================
```

Critical Circle Bishop



Xm : 10,72 [m]
Ym : 20,87 [m]

Radius : 9,19 [m]
Safety : 1,15

D-Geo Stability 10.1 : STBI_59.018-021.sti

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI DP59.019

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date 1-12-2014
drw. -
ctr. -
form. A4

Annex -

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 1-12-2014
Time        : 13:48:49

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   8  - X -  | -50.00   -48.60   -14.50   -11.40     0.00     4.50
   8  - Y -  |  11.40    11.40    11.40    11.40    15.20    15.20
             |
   8  - X -  |  13.65    16.15    17.95    19.00    50.00
   8  - Y -  |  12.15    12.00    11.40    11.40    11.40
             |
   7  - X -  | -50.00   -48.60   -14.50   -11.40     0.00     4.50
   7  - Y -  |  11.40    11.40    11.40    11.40    15.20    15.20
             |
   7  - X -  |  13.65    15.90    17.95    19.00    50.00
   7  - Y -  |  12.15    11.40    11.40    11.40    11.40
             |
   6  - X -  | -50.00   -48.60   -14.50   -11.40    -8.40    12.30
   6  - Y -  |  11.40    11.40    11.40    11.40    11.40    11.40
             |
   6  - X -  |  15.90    17.95    19.00    50.00
   6  - Y -  |  11.40    11.40    11.40    11.40
             |
   5  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    -8.40
   5  - Y -  |  11.40    11.40    10.20    10.20    10.40    11.40
             |
   5  - X -  |  12.30    15.90    17.95    19.00    50.00
   5  - Y -  |  11.40    11.40    11.40    11.40    11.40
             |
   4  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    -8.40
   4  - Y -  |  11.40    11.40    10.20    10.20    10.40    11.40
             |
   4  - X -  |  12.30    13.65    16.15    17.95    19.00    50.00
   4  - Y -  |  11.40    10.95    10.80    11.40    11.40    11.40
             |
   3  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    17.95
   3  - Y -  |  11.40    11.40    10.20    10.20    10.40    10.40
             |
   3  - X -  |  17.95    19.00    50.00
   3  - Y -  |  11.40    11.40    11.40
             |
   2  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    17.95
   2  - Y -  |  11.40    11.40    10.20    10.20    10.40    10.40
             |
   2  - X -  |  19.00    19.00    50.00
   2  - Y -  |  10.40    11.40    11.40
             |
   1  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    17.95
   1  - Y -  |  11.40    11.40    10.20    10.20    10.40    10.40
             |
   1  - X -  |  19.00    50.00
   1  - Y -  |  10.40    10.40
             |
   0  - X -  | -50.00    50.00
```

0	- Y -	-10.00 -10.00

PL LINES

PL line no.	Co-ordinates [m]					
1	- X -	-50.00	-14.50	-10.80	0.00	4.50	13.65
1	- Y -	15.20	15.20	15.20	15.20	15.00	12.15
1	- X -	17.95	50.00				
1	- Y -	11.40	11.40				
2	- X -	-50.00	17.95	50.00			
2	- Y -	15.20	11.40	11.40			

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
8	OB Klei dijk
7	OB Klei dijk
6	OB Klei dijk
5	OB Klei dijk
4	19 Klei
3	19 Klei (sterkte 0)
2	19 Klei
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
8	18.50	18.50	1	1
7	18.50	18.50	1	1
6	18.50	18.50	1	1
5	18.50	18.50	1	99
4	18.00	18.00	99	2
3	18.00	18.00	1	2
2	18.00	18.00	1	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
8	2.40	23.00	-	-	-	-	-
7	2.40	23.00	-	-	-	-	-
6	2.40	23.00	-	-	-	-	-
5	2.40	23.00	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	0.00	0.00	-	-	-	-	-
2	2.40	21.20	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES
==========

X co-ordinate grid left : 10.72 [m]
X co-ordinate grid right : 20.72 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 24.37 [m]
Y co-ordinate grid top : 34.37 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 11.19 [m]
Y co-ordinate tangent biggest circle : 3.69 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS
==========

No line loads input.

UNIFORM LOAD
==========

No uniform loads were input.

TREE ON SLOPE
==========

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
==========

The center point of the critical circle lies on the edge of the grid.

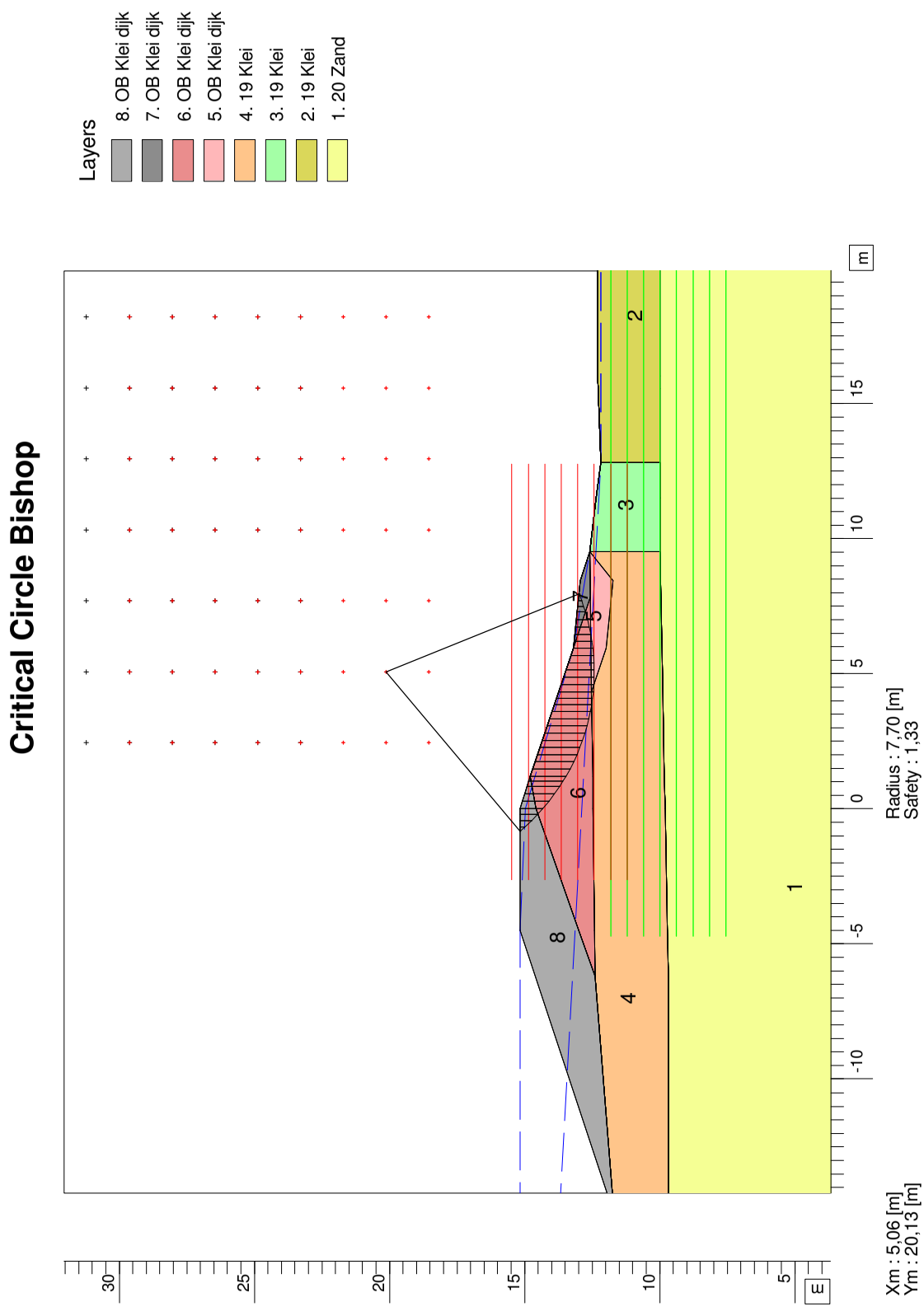
New grid with : X minimum = 10.72 [m]
X maximum = 20.72 [m]
Y minimum = 23.87 [m]
Y maximum = 33.87 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 10.72 [m]
X maximum = 20.72 [m]
Y minimum = 23.37 [m]
Y maximum = 33.37 [m]

```
The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.72 [m]
                 X maximum =   20.72 [m]
                 Y minimum =   22.87 [m]
                 Y maximum =   32.87 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.72 [m]
                 X maximum =   20.72 [m]
                 Y minimum =   22.37 [m]
                 Y maximum =   32.37 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.72 [m]
                 X maximum =   20.72 [m]
                 Y minimum =   21.87 [m]
                 Y maximum =   31.87 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.72 [m]
                 X maximum =   20.72 [m]
                 Y minimum =   21.37 [m]
                 Y maximum =   31.37 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.72 [m]
                 X maximum =   20.72 [m]
                 Y minimum =   20.87 [m]
                 Y maximum =   30.87 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.22 [m]
                 X maximum =   20.22 [m]
                 Y minimum =   20.37 [m]
                 Y maximum =   30.37 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.22 [m]
                 X maximum =   20.22 [m]
                 Y minimum =   19.87 [m]
                 Y maximum =   29.87 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.22 [m]
                 X maximum =   20.22 [m]
                 Y minimum =   19.37 [m]
                 Y maximum =   29.37 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =   10.22 [m]
                 X maximum =   20.22 [m]
                 Y minimum =   19.37 [m]
                 Y maximum =   29.37 [m]
           tangent minimum =   10.69 [m]
           tangent maximum =   18.19 [m]


Information on the critical circle  : Fmin =      1.146
Calculation method used             : Bishop - C phi
================================================================================
```

```
X co-ordinate center point      :        10.72 [m]
Y co-ordinate center point      :        20.87 [m]
Radius of critical circle       :         9.19 [m]

The center point of the critical circle is enclosed

Total driving moment            :       623.89 [kNm/m]
Driving moment free water       :         0.00 [kNm/m]
Driving moment external loads   :         0.00 [kNm/m]
Iterated resisting moment       :       623.89 [kNm/m]
Non-iterated resisting moment   :       705.49 [kNm/m]


                          END OF D-Geo Stability OUTPUT
                          ============================
```



D-Geo Stability 10.1 : STBI_DP59.033-035.sti

Royal Haskoning DHV
Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

	date 12/4/2014	drw. -
Prioritaire dijkversterking Waterschap Peel en Maasvallei	-	ctr.
STBI DR59.033-035	Annex -	form. A4

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 12/4/2014
Time        : 4:28:27 PM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   8  - X -  | -41.50   -21.80   -18.75   -15.00    -4.50     0.00
   8  - Y -  |  11.60    11.70    11.30    11.70    15.18    15.18
             |
   8  - X -  |   1.20     5.94     8.44     9.50    11.50    12.80
   8  - Y -  |  14.80    13.20    12.95    12.60    12.36    12.20
             |
   8  - X -  |  16.00    30.00
   8  - Y -  |  12.30    12.30
             |
   7  - X -  | -41.50   -21.80   -18.75   -15.00    -6.20    -4.50
   7  - Y -  |  11.60    11.70    11.30    11.70    12.40    13.00
             |
   7  - X -  |   0.00     1.20     5.94     8.44     9.50    11.50
   7  - Y -  |  14.60    14.80    13.20    12.95    12.60    12.36
             |
   7  - X -  |  12.80    16.00    30.00
   7  - Y -  |  12.20    12.30    12.30
             |
   6  - X -  | -41.50   -21.80   -18.75   -15.00    -6.20    -4.50
   6  - Y -  |  11.60    11.70    11.30    11.70    12.40    13.00
             |
   6  - X -  |   0.00     1.20     5.94     7.84     9.50    11.50
   6  - Y -  |  14.60    14.80    13.20    12.58    12.60    12.36
             |
   6  - X -  |  12.80    16.00    30.00
   6  - Y -  |  12.20    12.30    12.30
             |
   5  - X -  | -41.50   -21.80   -18.75   -15.00    -6.20    -4.50
   5  - Y -  |  11.60    11.70    11.30    11.70    12.40    12.42
             |
   5  - X -  |   0.00     1.20     4.32     7.84     9.50    11.50
   5  - Y -  |  12.48    12.49    12.54    12.58    12.60    12.36
             |
   5  - X -  |  12.80    16.00    30.00
   5  - Y -  |  12.20    12.30    12.30
             |
   4  - X -  | -41.50   -21.80   -18.75   -15.00    -6.20    -4.50
   4  - Y -  |  11.60    11.70    11.30    11.70    12.40    12.42
             |
   4  - X -  |   0.00     1.20     4.32     5.94     8.44     9.50
   4  - Y -  |  12.48    12.49    12.54    12.00    11.75    12.60
             |
   4  - X -  |  11.50    12.80    16.00    30.00
   4  - Y -  |  12.36    12.20    12.30    12.30
             |
   3  - X -  | -41.50   -21.80   -18.75   -15.00    -6.20    -4.50
   3  - Y -  |   9.70     9.70     9.70     9.70     9.70     9.73
             |
   3  - X -  |   0.00     1.20     4.80     9.50     9.50    11.50
```

3 - Y -	9.82	9.84	9.91	10.00	12.60	12.36
3 - X -	12.80	16.00	30.00			
3 - Y -	12.20	12.30	12.30			
2 - X -	-41.50	-21.80	-18.75	-15.00	-6.20	-4.50
2 - Y -	9.70	9.70	9.70	9.70	9.70	9.73
2 - X -	0.00	1.20	4.80	9.50	11.50	12.80
2 - Y -	9.82	9.84	9.91	10.00	10.00	10.00
2 - X -	12.80	16.00	30.00			
2 - Y -	12.20	12.30	12.30			
1 - X -	-41.50	-21.80	-18.75	-15.00	-6.20	-4.50
1 - Y -	9.70	9.70	9.70	9.70	9.70	9.73
1 - X -	0.00	1.20	4.80	9.50	11.50	12.80
1 - Y -	9.82	9.84	9.91	10.00	10.00	10.00
1 - X -	15.54	16.00	30.00			
1 - Y -	10.00	10.00	10.00			
0 - X -	-41.50	30.00				
0 - Y -	0.00	0.00				

PL LINES

PL line no.	Co-ordinates [m]					
1 - X -	-41.50	-4.50	0.00	5.94	9.50	12.80
1 - Y -	15.18	15.18	14.98	13.20	12.60	12.20
1 - X -	30.00					
1 - Y -	12.20					
2 - X -	-41.50	12.80	30.00			
2 - Y -	15.18	12.20	12.20			

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
8	OB Klei dijk
7	OB Klei dijk
6	OB Klei dijk
5	OB Klei dijk
4	19 Klei
3	19 Klei
2	19 Klei
1	20 Zand

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
8	18.00	18.00	1	1
7	18.00	18.00	1	1

6	18.00	18.00	1	1
5	18.00	18.00	1	1
4	18.00	18.00	1	2
3	18.00	18.00	1	2
2	18.00	18.00	1	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
8	2.40	21.20	-	-	-	-	-
7	2.40	21.20	-	-	-	-	-
6	2.40	21.20	-	-	-	-	-
5	2.40	21.20	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	2.40	21.20	-	-	-	-	-
2	2.40	21.20	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 2.43 [m]
X co-ordinate grid right : 20.81 [m]
Number of grid points in X - direction : 8

Y co-ordinate grid bottom : 23.30 [m]
Y co-ordinate grid top : 34.38 [m]
Number of grid points in Y - direction : 8

Y co-ordinate tangent smallest circle : 11.83 [m]
Y co-ordinate tangent biggest circle : 7.57 [m]
Number of circles per grid point : 8

No fixed points input.

Total number of center points in the grid: 64
Total number of slip circles in the grid : 512

LINE LOADS

No line loads input.

UNIFORM LOAD

No uniform loads were input.

TREE ON SLOPE

No tree on slope was input.

EARTHQUAKE

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********

****

RESULTS OF THE SLOPE STABILITY ANALYSIS
==========

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 23.30 [m]
Y maximum = 34.38 [m]
tangent minimum = 11.22 [m]
tangent maximum = 15.48 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 21.72 [m]
Y maximum = 32.80 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 20.13 [m]
Y maximum = 31.21 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 18.55 [m]
Y maximum = 29.63 [m]

Information on the critical circle : Fmin = 1.335
Calculation method used : Bishop - C phi
==========

X co-ordinate center point : 5.06 [m]
Y co-ordinate center point : 20.13 [m]
Radius of critical circle : 7.70 [m]

The center point of the critical circle is enclosed

Total driving moment : 302.97 [kNm/m]
Driving moment free water : 0.00 [kNm/m]
Driving moment external loads : 0.00 [kNm/m]
Iterated resisting moment : 302.97 [kNm/m]
Non-iterated resisting moment : 395.98 [kNm/m]

END OF D-Geo Stability OUTPUT
==========

Critical Circle Bishop

Xm : 5,06 [m]
Ym : 21,72 [m]

Radius : 9,28 [m]
Safety : 1,64

Prioritaire dijkversterking
Waterschap Peel en Maasvallei
STBI DP59.045-047

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	dnw.
4-12-2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBI_DP59.045-047.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 4-12-2014
Time        : 16:34:58

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-------------------------------------------------
             |
   8  - X -  | -30.00   -22.00   -15.90    -4.50     0.00     3.30
   8  - Y -  |  11.60    11.54    11.50    15.30    15.30    14.30
             |
   8  - X -  |   4.05     6.55     8.05    15.40    18.40    30.00
   8  - Y -  |  14.05    13.80    13.30    13.30    13.20    13.30
             |
   7  - X -  | -30.00   -22.00   -15.90   -11.50   -10.50    -8.00
   7  - Y -  |  11.60    11.54    11.50    11.50    11.00    11.00
             |
   7  - X -  |  -7.00    -6.00    -3.50     0.00     3.30     4.05
   7  - Y -  |  11.50    11.50    12.25    13.30    14.30    14.05
             |
   7  - X -  |   6.55     8.05    15.40    18.40    30.00
   7  - Y -  |  13.80    13.30    13.30    13.20    13.30
             |
   6  - X -  | -30.00   -22.00   -15.90   -11.50   -10.50    -8.00
   6  - Y -  |  11.60    11.54    11.50    11.50    11.00    11.00
             |
   6  - X -  |  -7.00    -6.00    -3.50     8.05     9.40    15.40
   6  - Y -  |  11.50    11.50    12.25    12.25    12.25    13.30
             |
   6  - X -  |  18.40    30.00
   6  - Y -  |  13.20    13.30
             |
   5  - X -  | -30.00   -22.00   -15.90   -11.50   -10.50    -8.00
   5  - Y -  |  11.60    11.54    11.50    11.50    11.00    11.00
             |
   5  - X -  |  -7.00    -6.00    -3.50     8.05     9.40    15.40
   5  - Y -  |  11.50    11.50    12.25    12.25    12.25    10.65
             |
   5  - X -  |  30.00
   5  - Y -  |  10.65
             |
   4  - X -  | -30.00   -11.50    -6.00     9.40    15.40    30.00
   4  - Y -  |  10.80    10.80     9.80     9.80    10.65    10.65
             |
   3  - X -  | -30.00   -11.50    -6.00     9.40    15.40    30.00
   3  - Y -  |  10.60    10.60     9.50     9.50    10.65    10.65
             |
   2  - X -  | -30.00   -11.50    -6.00     9.40    15.40    30.00
   2  - Y -  |  10.30    10.30     9.50     9.50    10.65    10.65
             |
   1  - X -  | -30.00    30.00
   1  - Y -  |   3.00     3.00
             |
   0  - X -  | -30.00    30.00
   0  - Y -  |   0.00     0.00
```

PL LINES

PL line no.	Co-ordinates [m]					
1 - X -	-30.00	-4.50	0.00	4.05	8.05	30.00
1 - Y -	15.30	15.30	15.10	14.05	13.30	13.30
2 - X -	-30.00	-22.00	8.05	30.00		
2 - Y -	15.30	15.30	13.30	13.30		

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
8	OB Klei dijk
7	OB Klei dijk
6	19A Klei, zandig
5	19 Klei
4	4 Veen
3	19 Klei
2	20 Zand
1	32 Grind

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
8	18.00	18.00	1	1
7	18.00	18.00	1	1
6	18.50	18.50	1	1
5	18.00	18.00	1	1
4	13.00	13.00	1	1
3	18.00	18.00	1	1
2	18.00	20.00	1	1
1	19.00	20.00	1	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
8	2.40	21.20	-	-	-	-	-
7	2.40	21.20	-	-	-	-	-
6	2.40	23.00	-	-	-	-	-
5	2.40	21.20	-	-	-	-	-
4	1.30	12.10	-	-	-	-	-
3	2.40	21.20	-	-	-	-	-
2	0.00	27.50	-	-	-	-	-
1	0.00	30.30	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 2.43 [m]
X co-ordinate grid right : 20.81 [m]
Number of grid points in X - direction : 8

```
Y co-ordinate grid bottom               :   23.30 [m]
Y co-ordinate grid top                  :   34.38 [m]
Number of grid points in Y - direction  :     8

Y co-ordinate tangent smallest circle   :   11.83 [m]
Y co-ordinate tangent biggest  circle   :    7.57 [m]
Number of circles per grid point        :     8

No fixed points input.

Total number of center points in the grid:    64
Total number of slip circles in the grid :   512



              LINE LOADS
              ==========

No line loads input.



              UNIFORM LOAD
              ============

No uniform loads were input.



              TREE ON SLOPE
              =============

No tree on slope was input.



              EARTHQUAKE
              ==========

No earth quake factors were input.


*******************************************************************************
***************  The input has been tested, and is correct.  ***************
*******************************************************************************
□

               RESULTS OF THE SLOPE STABILITY ANALYSIS
               =======================================



The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =    2.43 [m]
                 X maximum =   20.81 [m]
                 Y minimum =   21.72 [m]
                 Y maximum =   32.80 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =    2.43 [m]
                 X maximum =   20.81 [m]
                 Y minimum =   20.13 [m]
                 Y maximum =   31.21 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =    2.43 [m]
                 X maximum =   20.81 [m]
                 Y minimum =   18.55 [m]
                 Y maximum =   29.63 [m]


The center point of the critical circle lies on the edge of the grid.
```

```
New grid with  : X minimum =    2.43 [m]
                 X maximum =   20.81 [m]
                 Y minimum =   18.55 [m]
                 Y maximum =   29.63 [m]
           tangent minimum =   11.22 [m]
           tangent maximum =   15.48 [m]


Information on the critical circle  : Fmin =      1.637
Calculation method used             : Bishop - C phi
================================================================================

X co-ordinate center point      :         5.06 [m]
Y co-ordinate center point      :        21.72 [m]
Radius of critical circle       :         9.28 [m]

The center point of the critical circle is enclosed

Total driving moment            :       411.24 [kNm/m]
Driving moment free water       :         0.00 [kNm/m]
Driving moment external loads   :         0.00 [kNm/m]
Iterated resisting moment       :       411.24 [kNm/m]
Non-iterated resisting moment   :       657.65 [kNm/m]


                        END OF D-Geo Stability OUTPUT
                        ============================
```

Prioritaire dijkversterking
Waterschap Peel en Maasvallei
STBI DR59.054-055

Laan 1914 nr 35
3818 EX Amersfoort
Phone
Fax
+31 (0)6 46 37 14 07

date 12/4/2014
dnw. -
ctr. -
form. A4
Annex -

D-Geo Stability 10.1 : STBI_DP59.054-055.sti

Critical Circle Bishop

Xm : 2,43 [m]
Ym : 16,97 [m]

Radius : 3,31 [m]
Safety : 1,61

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 12/4/2014
Time        : 4:47:26 PM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

Problem identification : Prioritaire dijkversterking
: Waterschap Peel en Maasvallei

Calculation model : Bishop
Default shear strength : C phi

LAYER BOUNDARIES

Boundary no.	Co-ordinates [m]					
7 - X -	-30.00	-13.90	-6.15	-4.50	0.00	3.90
7 - Y -	12.10	12.20	14.90	15.41	15.41	14.10
7 - X -	6.40	7.75	30.00			
7 - Y -	13.85	13.40	13.60			
6 - X -	-30.00	-13.90	-6.15	-3.10	0.00	3.40
6 - Y -	12.10	12.20	14.90	14.90	13.90	13.20
6 - X -	7.75	30.00				
6 - Y -	13.40	13.60				
5 - X -	-30.00	-13.90	3.40	7.75	30.00	
5 - Y -	12.10	12.20	13.20	13.40	13.60	
4 - X -	-30.00	-13.90	-6.15	30.00		
4 - Y -	9.78	9.78	12.50	12.50		
3 - X -	-30.00	-13.90	-6.15	30.00		
3 - Y -	9.78	9.78	11.50	11.50		
2 - X -	-30.00	-13.90	-6.15	30.00		
2 - Y -	9.78	9.78	10.00	10.00		
1 - X -	-30.00	30.00				
1 - Y -	3.00	3.00				
0 - X -	-30.00	30.00				
0 - Y -	0.00	0.00				

PL LINES

PL line no.	Co-ordinates [m]					
1 - X -	-30.00	-4.50	0.00	3.90	7.75	30.00
1 - Y -	15.41	15.41	15.21	14.10	13.40	13.40
2 - X -	-30.00	-27.00	7.75	30.00		
2 - Y -	15.41	15.41	13.40	13.40		

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
7	OB Klei dijk
6	OB Klei dijk
5	19A Klei, zandig
4	19 Klei
3	20 Zand (los)
2	20 Zand
1	32 Grind

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
7	18.00	18.00	1	1
6	18.00	18.00	1	1
5	18.50	18.50	1	99
4	18.00	18.00	1	2
3	18.00	20.00	2	2
2	18.00	20.00	2	2
1	19.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
7	2.40	21.20	-	-	-	-	-
6	2.40	21.20	-	-	-	-	-
5	2.40	23.00	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	0.00	24.80	-	-	-	-	-
2	0.00	27.50	-	-	-	-	-
1	0.00	30.30	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 2.43 [m]
X co-ordinate grid right : 20.81 [m]
Number of grid points in X - direction : 8

Y co-ordinate grid bottom : 23.30 [m]
Y co-ordinate grid top : 34.38 [m]
Number of grid points in Y - direction : 8

Y co-ordinate tangent smallest circle : 11.83 [m]
Y co-ordinate tangent biggest circle : 7.57 [m]
Number of circles per grid point : 8

No fixed points input.

Total number of center points in the grid: 64
Total number of slip circles in the grid : 512

LINE LOADS

No line loads input.

UNIFORM LOAD
============

No uniform loads were input.

TREE ON SLOPE
=============

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 21.72 [m]
Y maximum = 32.80 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 20.13 [m]
Y maximum = 31.21 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 18.55 [m]
Y maximum = 29.63 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 18.55 [m]
Y maximum = 29.63 [m]
tangent minimum = 11.22 [m]
tangent maximum = 15.48 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -0.19 [m]
X maximum = 18.18 [m]
Y minimum = 16.97 [m]
Y maximum = 28.05 [m]

The center point of the critical circle lies on the edge of the grid.

```
New grid with  : X minimum =   -0.19 [m]
                 X maximum =   18.18 [m]
                 Y minimum =   15.38 [m]
                 Y maximum =   26.46 [m]


Information on the critical circle  : Fmin =      1.606
Calculation method used             : Bishop - C phi
================================================================================

X co-ordinate center point      :         2.43 [m]
Y co-ordinate center point      :        16.97 [m]
Radius of critical circle       :         3.31 [m]

The center point of the critical circle is enclosed

Total driving moment            :        52.15 [kNm/m]
Driving moment free water       :         0.00 [kNm/m]
Driving moment external loads   :         0.00 [kNm/m]
Iterated resisting moment       :        52.15 [kNm/m]
Non-iterated resisting moment   :        80.97 [kNm/m]


                          END OF D-Geo Stability OUTPUT
                          ============================
```

Shear Stress Bishop

Xm : 7,68 [m]
Ym : 23,30 [m]

Radius : 12,08 [m]
Safety : 1,22

Max. stress : 8,664 [kN/m2]
Min. stress : 0,000 [kN/m2]

Prioritaire dijkversterking
Waterschap Peel en Maasvallei
STBI DP59.058-059

Laan 1914 nr 35
3818 EX Amersfoort
Phone
Fax
+31 (0)6 46 37 14 07

Annex -	-	date 12/4/2014	dnw. -
form. A4	ctr.		

D-Geo Stability 10.1 : STBI_DP59.058-059.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 12/4/2014
Time        : 5:01:25 PM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-------------------------------------------------
             |
  14  - X -  | -33.00   -14.90    -6.10    -4.50     0.00     5.20
  14  - Y -  |  11.70    12.00    15.00    15.45    15.45    13.70
             |
  14  - X -  |   7.75     9.10    14.00    30.00
  14  - Y -  |  13.45    13.00    12.98    12.90
             |
  13  - X -  | -33.00   -14.90    -6.10    -3.00     0.00     3.10
  13  - Y -  |  11.70    12.00    15.00    14.90    14.00    13.10
             |
  13  - X -  |   9.10    14.00    30.00
  13  - Y -  |  13.00    12.98    12.90
             |
  12  - X -  | -33.00   -14.90     3.10     9.10    14.00    30.00
  12  - Y -  |  11.70    12.00    13.10    13.00    12.98    12.90
             |
  11  - X -  | -33.00   -14.90    -6.10    -3.00     3.10     9.10
  11  - Y -  |  11.00    11.00    12.30    12.30    12.00    12.00
             |
  11  - X -  |   9.10    14.00    30.00
  11  - Y -  |  13.00    12.98    12.90
             |
  10  - X -  | -33.00   -14.90    -6.10    -3.00     3.10     9.10
  10  - Y -  |  11.00    11.00    12.30    12.30    11.50    11.50
             |
  10  - X -  |   9.10     9.10    14.00    30.00
  10  - Y -  |  12.00    13.00    12.98    12.90
             |
   9  - X -  | -33.00   -14.90    -6.10    -3.00     3.10     9.10
   9  - Y -  |  11.00    11.00    12.30    12.30    10.95    10.95
             |
   9  - X -  |   9.10     9.10     9.10    14.00    30.00
   9  - Y -  |  11.50    12.00    13.00    12.98    12.90
             |
   8  - X -  | -33.00   -14.90    -6.10    -3.00     3.10     9.10
   8  - Y -  |  11.00    11.00    12.30    12.30    10.95    10.95
             |
   8  - X -  |   9.10     9.10    14.00    14.00    30.00
   8  - Y -  |  11.50    12.00    12.00    12.98    12.90
             |
   7  - X -  | -33.00   -14.90    -6.10    -3.00     3.10     9.10
   7  - Y -  |  11.00    11.00    12.30    12.30    10.95    10.95
             |
   7  - X -  |   9.10    14.00    14.00    14.00    30.00
   7  - Y -  |  11.50    11.50    12.00    12.98    12.90
             |
   6  - X -  | -33.00   -14.90    -6.10    -3.00     3.10     9.10
   6  - Y -  |  11.00    11.00    12.30    12.30    10.95    10.95
             |
   6  - X -  |  14.00    14.00    14.00    14.00    30.00
   6  - Y -  |  10.95    11.50    12.00    12.98    12.90
```

5 - X -	-33.00	-14.90	-6.10	-3.00	3.10	9.10
5 - Y -	11.00	11.00	12.30	12.30	10.95	10.95
5 - X -	14.00	14.00	14.00	30.00		
5 - Y -	10.95	11.50	12.00	12.00		
4 - X -	-33.00	-14.90	-6.10	-3.00	3.10	9.10
4 - Y -	11.00	11.00	12.30	12.30	10.95	10.95
4 - X -	14.00	14.00	30.00			
4 - Y -	10.95	11.50	11.50			
3 - X -	-33.00	-14.90	-6.10	-3.00	3.10	9.10
3 - Y -	11.00	11.00	12.30	12.30	10.95	10.95
3 - X -	14.00	30.00				
3 - Y -	10.95	10.95				
2 - X -	-33.00	30.00				
2 - Y -	6.00	6.00				
1 - X -	-33.00	30.00				
1 - Y -	4.80	4.80				
0 - X -	-33.00	30.00				
0 - Y -	0.00	0.00				

PL LINES

PL line no.	Co-ordinates [m]					
1 - X -	-33.00	-4.50	0.00	5.20	9.10	30.00
1 - Y -	15.45	15.45	15.25	13.70	13.00	12.90
2 - X -	-33.00	9.10	30.00			
2 - Y -	15.45	13.00	12.90			

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
14	OB Klei dijk
13	OB Klei dijk
12	19 Klei
11	20 Zand
10	19 Klei
9	19 Klei (sterkte 0)
8	20 Zand (sterkte 0)
7	19 Klei (sterkte 0)
6	19 Klei
5	20 Zand
4	19 Klei
3	20 Zand
2	32 Grind
1	20 Zand

Layer	Gam usat	Gam sat	PL-line	PL-line

number	[kN/m3]	[kN/m3]	top	bottom
14	18.00	18.00	1	1
13	18.00	18.00	1	1
12	18.00	18.00	1	1
11	18.00	20.00	1	1
10	18.00	18.00	1	1
9	18.00	18.00	1	1
8	18.00	20.00	1	1
7	18.00	18.00	1	1
6	18.00	18.00	1	1
5	18.00	20.00	1	1
4	18.00	18.00	1	1
3	18.00	20.00	1	1
2	19.00	20.00	1	1
1	18.00	20.00	1	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
14	2.40	21.20	-	-	-	-	-
13	2.40	21.20	-	-	-	-	-
12	2.40	21.20	-	-	-	-	-
11	0.00	27.50	-	-	-	-	-
10	2.40	21.20	-	-	-	-	-
9	0.00	0.00	-	-	-	-	-
8	0.00	0.00	-	-	-	-	-
7	0.00	0.00	-	-	-	-	-
6	2.40	21.20	-	-	-	-	-
5	0.00	27.50	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	0.00	27.50	-	-	-	-	-
2	0.00	30.30	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 2.43 [m]
X co-ordinate grid right : 20.81 [m]
Number of grid points in X - direction : 8

Y co-ordinate grid bottom : 23.30 [m]
Y co-ordinate grid top : 34.38 [m]
Number of grid points in Y - direction : 8

Y co-ordinate tangent smallest circle : 11.83 [m]
Y co-ordinate tangent biggest circle : 7.57 [m]
Number of circles per grid point : 8

No fixed points input.

Total number of center points in the grid: 64
Total number of slip circles in the grid : 512

LINE LOADS

No line loads input.

UNIFORM LOAD

No uniform loads were input.

TREE ON SLOPE

==========

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 2.43 [m]
X maximum = 20.81 [m]
Y minimum = 21.72 [m]
Y maximum = 32.80 [m]

Information on the critical circle : Fmin = 1.223
Calculation method used : Bishop - C phi
==========

X co-ordinate center point : 7.68 [m]
Y co-ordinate center point : 23.30 [m]
Radius of critical circle : 12.08 [m]

The center point of the critical circle is enclosed

Total driving moment : 943.97 [kNm/m]
Driving moment free water : 0.00 [kNm/m]
Driving moment external loads : 0.00 [kNm/m]
Iterated resisting moment : 943.97 [kNm/m]
Non-iterated resisting moment : 1130.97 [kNm/m]

END OF D-Geo Stability OUTPUT
=============================

Critical Circle Bishop

Xm : 8,27 [m]
Ym : 19,52 [m]

Radius : 6,15 [m]
Safety : 1,49

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI DP59.062 (Restprofiel Aijen 2)

Laan 1914 nr 35
3818 EX Amersfoort
Phone
Fax +31 (0)6 46 37 14 07

Annex -	-	date 12/1/2014	dnw. -
form. A4	ctr.		

D-Geo Stability 10.1 : STBI_59.062.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 12/1/2014
Time        : 11:13:53 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

Problem identification : Prioritaire Dijkversterking
: Waterschap Peel en Maasvallei

Calculation model : Bishop
Default shear strength : C phi

LAYER BOUNDARIES

Boundary no.	Co-ordinates [m]					
5 - X -	-40.00	-26.00	-6.90	0.00	4.50	10.50
5 - Y -	12.80	12.80	13.10	15.41	15.41	13.40
5 - X -	13.00	15.50	23.70	50.00		
5 - Y -	13.40	13.40	11.35	11.35		
4 - X -	-40.00	-26.00	-8.40	-6.90	0.00	4.50
4 - Y -	12.30	12.30	12.60	13.10	15.41	15.41
4 - X -	10.50	13.00	15.50	23.70	50.00	
4 - Y -	13.40	13.40	13.40	11.35	11.35	
3 - X -	-40.00	-26.00	-8.40	-6.90	-4.60	7.50
3 - Y -	12.30	12.30	12.60	13.10	13.10	13.40
3 - X -	10.50	13.00	15.50	23.70	50.00	
3 - Y -	13.40	13.40	13.40	11.35	11.35	
2 - X -	-40.00	-26.00	-26.00	-8.40	-4.60	7.50
2 - Y -	12.30	12.30	11.30	11.60	13.10	13.40
2 - X -	10.50	13.00	15.50	23.70	50.00	
2 - Y -	13.40	13.40	13.40	11.35	11.35	
1 - X -	-40.00	-26.00	-26.00	-8.40	-4.60	7.50
1 - Y -	12.30	12.30	11.30	11.60	13.10	13.40
1 - X -	10.50	13.00	13.00	15.50	23.70	50.00
1 - Y -	12.40	12.40	13.40	13.40	11.35	11.35
0 - X -	-40.00	50.00				
0 - Y -	-10.00	-10.00				

PL LINES

PL line no.	Co-ordinates [m]				
1 - X -	-40.00	0.00	4.50	10.50	50.00
1 - Y -	15.41	15.41	15.21	13.40	13.40
2 - X -	-40.00	-26.00	13.00	50.00	
2 - Y -	15.41	15.41	13.40	13.40	

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
5	20 Zand, matig grof
4	OB Klei dijk
3	OB Klei dijk
2	OB Klei dijk
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
5	18.00	20.00	1	1
4	18.50	18.50	1	1
3	18.50	18.50	1	1
2	18.50	18.50	1	1
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
5	0.00	27.50	-	-	-	-	-
4	2.40	23.00	-	-	-	-	-
3	2.40	23.00	-	-	-	-	-
2	2.40	23.00	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 4.27 [m]
X co-ordinate grid right : 14.27 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 19.02 [m]
Y co-ordinate grid top : 29.02 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 12.87 [m]
Y co-ordinate tangent biggest circle : 5.37 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD
============

No uniform loads were input.

TREE ON SLOPE
=============

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 4.27 [m]
X maximum = 14.27 [m]
Y minimum = 18.52 [m]
Y maximum = 28.52 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = 4.27 [m]
X maximum = 14.27 [m]
Y minimum = 18.52 [m]
Y maximum = 28.52 [m]
tangent minimum = 12.37 [m]
tangent maximum = 19.87 [m]

Information on the critical circle : Fmin = 1.485
Calculation method used : Bishop - C phi
==========

X co-ordinate center point : 8.27 [m]
Y co-ordinate center point : 19.52 [m]
Radius of critical circle : 6.15 [m]

The center point of the critical circle is enclosed

Total driving moment : 147.96 [kNm/m]
Driving moment free water : 0.00 [kNm/m]
Driving moment external loads : 0.00 [kNm/m]
Iterated resisting moment : 147.96 [kNm/m]
Non-iterated resisting moment : 212.21 [kNm/m]

END OF D-Geo Stability OUTPUT
=============================

Shear Stress Bishop

Xm : 5,77 [m]
Ym : 20,52 [m]

Radius : 8,65 [m]
Safety : 1,26

Max. stress : 6,364 [kN/m2]
Min. stress : 1,638 [kN/m2]

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBI DP59.063-064

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date 12/5/2014
dhw. -
ctr.
form. A4
Annex -
-

D-Geo Stability 10.1 : STBI_59.063-064.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 12/5/2014
Time        : 8:46:54 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-------------------------------------------------
             |
   6  - X -  | -40.00   -26.00   -15.60   -12.50   -10.50    -4.50
   6  - Y -  |  13.00    13.00    13.10    13.30    13.40    15.40
             |
   6  - X -  |   0.00     3.70     6.20     7.60    12.00    50.00
   6  - Y -  |  15.40    14.20    13.95    13.40    13.40    13.40
             |
   5  - X -  | -40.00   -13.00   -12.30   -10.50    -4.50     0.00
   5  - Y -  |  12.50    12.80    12.80    13.40    15.40    15.40
             |
   5  - X -  |   3.70     6.20     7.60    12.00    50.00
   5  - Y -  |  14.20    13.95    13.40    13.40    13.40
             |
   4  - X -  | -40.00   -13.00   -12.30   -10.50    -7.50     2.20
   4  - Y -  |  12.50    12.80    12.80    13.40    13.40    13.40
             |
   4  - X -  |   7.60    12.00    50.00
   4  - Y -  |  13.40    13.40    13.40
             |
   3  - X -  | -40.00   -13.00   -13.00   -12.30   -10.14    -7.50
   3  - Y -  |  12.50    12.80    11.80    11.80    12.52    13.40
             |
   3  - X -  |   2.20     7.60    12.00    50.00
   3  - Y -  |  13.40    13.40    13.40    13.40
             |
   2  - X -  | -40.00   -13.00   -13.00   -12.30   -10.14    -7.50
   2  - Y -  |  12.50    12.80    11.80    11.80    12.52    13.40
             |
   2  - X -  |   2.20     3.70     6.20     7.60    12.00    50.00
   2  - Y -  |  13.40    12.90    12.65    13.40    13.40    13.40
             |
   1  - X -  | -40.00   -13.00   -13.00   -12.30   -10.14    -4.50
   1  - Y -  |  12.50    12.80    11.80    11.80    12.52    12.50
             |
   1  - X -  |   0.00     3.10     7.60    12.00    50.00
   1  - Y -  |  12.50    12.00    12.00    12.00    12.00
             |
   0  - X -  | -40.00    50.00
   0  - Y -  | -10.00   -10.00



               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-------------------------------------------------
             |
   1  - X -  | -40.00    -4.50     0.00     3.70     7.60    50.00
   1  - Y -  |  15.41    15.40    15.20    14.20    13.40    13.40
             |
```

2	- X -	-40.00	-13.00	7.60	50.00	50.00
2	- Y -	15.41	15.41	14.50	13.65	13.40

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
6	20 Zand, matig grof
5	OB Klei dijk
4	OB Klei dijk
3	OB Klei dijk
2	19 Klei
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
6	18.00	20.00	1	1
5	18.50	18.50	1	1
4	18.50	18.50	1	2
3	18.50	18.50	1	1
2	18.00	18.00	1	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
6	0.00	27.50	-	-	-	-	-
5	2.40	23.00	-	-	-	-	-
4	2.40	23.00	-	-	-	-	-
3	2.40	23.00	-	-	-	-	-
2	2.40	21.20	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 4.27 [m]
X co-ordinate grid right : 14.27 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 19.02 [m]
Y co-ordinate grid top : 29.02 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 12.87 [m]
Y co-ordinate tangent biggest circle : 5.37 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS
==========

No line loads input.

UNIFORM LOAD
============

No uniform loads were input.

TREE ON SLOPE
=============

No tree on slope was input.

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

Information on the critical circle : Fmin = 1.263
Calculation method used : Bishop - C phi
==========

X co-ordinate center point : 5.77 [m]
Y co-ordinate center point : 20.52 [m]
Radius of critical circle : 8.65 [m]

The center point of the critical circle is enclosed

Total driving moment : 492.28 [kNm/m]
Driving moment free water : 0.00 [kNm/m]
Driving moment external loads : 0.00 [kNm/m]
Iterated resisting moment : 492.28 [kNm/m]
Non-iterated resisting moment : 610.95 [kNm/m]

END OF D-Geo Stability OUTPUT
=============================

BIJLAGE 5 Buitenwaartse macrostabiliteit

Critical Circle Bishop

Xm : -1,76 [m]
Ym : 5,86 [m]

Radius : 6,09 [m]
Safety : 1,60

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (situatie 1 / h=1m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	drw.
12/1/2014	AHO

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h1m_dkl 0m.sti

Critical Circle Bishop

Xm : -2,28 [m]
Ym : 7,67 [m]

Radius : 7,39 [m]
Safety : 1,30

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 1 / h=2m)

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date	drw.
12/1/2014	AHO

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h2m_dkl 0m.sti

Critical Circle Bishop

Xm : -4,38 [m]
Ym : 11,01 [m]

Radius : 10,74 [m]
Safety : 1,12

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 1 / h=3 m)

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date	drw.
12/1/2014	AHO

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h3m_dkl 0m.sti

Critical Circle Bishop

Xm : -6,89 [m]
Ym : 15,46 [m]

Radius : 15,19 [m]
Safety : 1,02

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 1 / h=4m)

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12/1/2014	AHO

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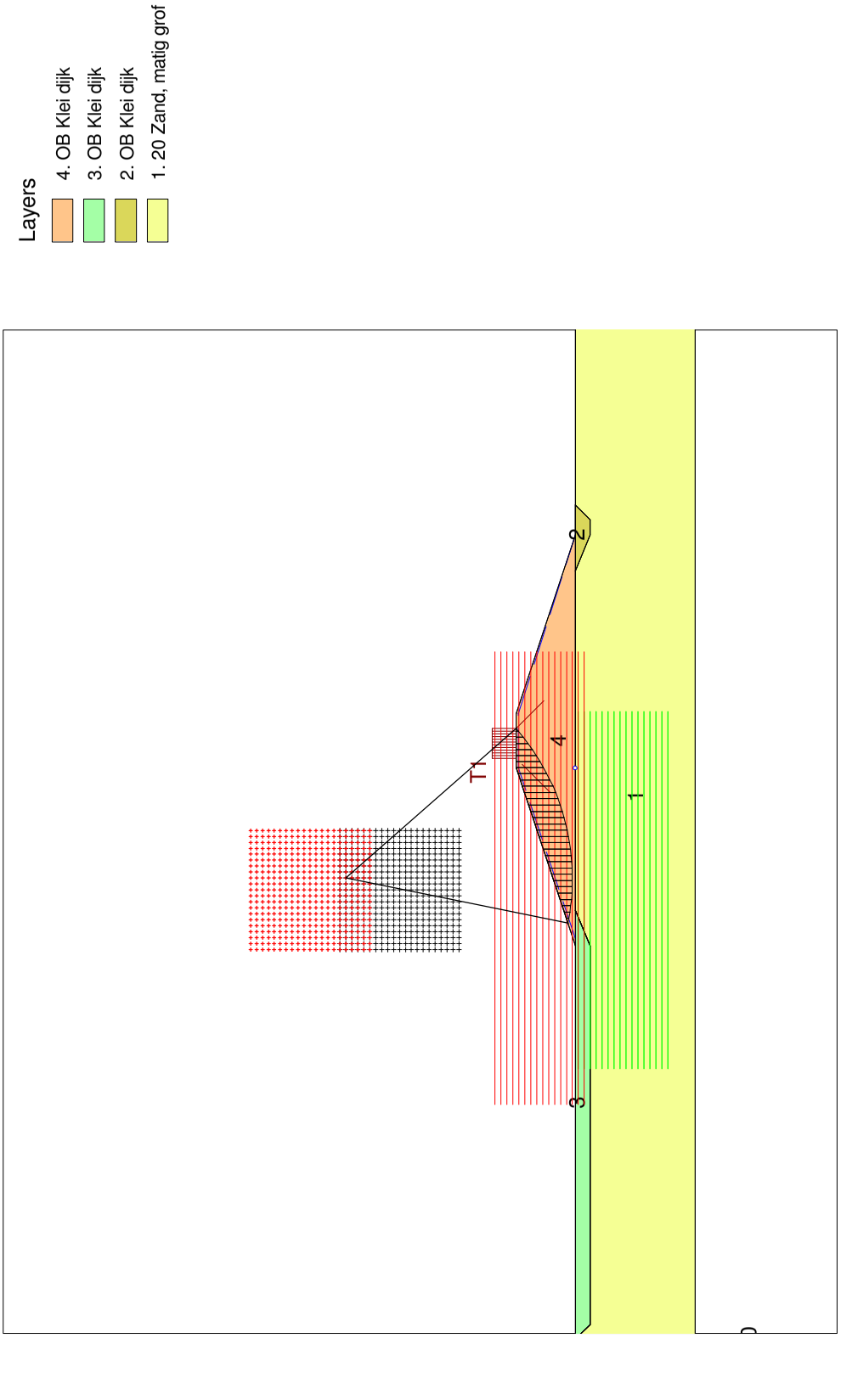
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h4m_dkl 0m.sti



D-Geo Stability 10.1 : STBU_h5m_dkl 0m.sti

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date	drw.
12/1/2014	AHO

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei

STBU (situatie 1 / h=5m)

-	ctr.
Annex -	form. A4

Critical Circle Bishop

Layers
- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. 19 Klei (y=19)
- 3. OB Klei dijk
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : -1,26 [m]
Ym : 3,86 [m]

Radius : 4,59 [m]
Safety : 1,44

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (situatie 3 / h=1m)

Laan 1914 nr 35
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date	12/1/2014	dnw.	-
	-	ctr.	
Annex	-	form.	A4

D-Geo Stability 10.1 : STBU_h1m_dkl 1m.sti

Critical Circle Bishop

Xm : -3,28 [m]
Ym : 8,67 [m]

Radius : 8,89 [m]
Safety : 1,22

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 3 / h=2m)

Laan 1914 nr 35
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Fax

date	dnw.
12/1/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h2m_dkl 1m.sti

Critical Circle Bishop

Layers

- 6. OB Klei dijk
- 5. OB Klei dijk
- 4. 19 Klei (y=19)
- 3. OB Klei dijk
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : -5,88 [m]
Ym : 13,51 [m]

Radius : 13,74 [m]
Safety : 1,08

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 3 / h=3 m)

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Fax

date	12/1/2014	dnw. -
-		ctr.
Annex -		form. A4

D-Geo Stability 10.1 : STBU_h3m_dkl 1m.sti

Critical Circle Bishop

Xm : -8,39 [m]
Ym : 17,46 [m]

Radius : 17,69 [m]
Safety : 1,00

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 3 / h=4m)

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Fax

date	dnw.
12/1/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h4m_dkl 1m.sti

Critical Circle Bishop

Xm : -10,30 [m]
Ym : 19,78 [m]

Radius : 20,01 [m]
Safety : 0,94

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (situatie 3 / h=5m)

Laan 1914 nr 35
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date 12/1/2014
dwg. -
ctr. -
form. A4
Annex -

D-Geo Stability 10.1 : STBU_h5m_dkl 1m.sti

Critical Circle Bishop

Layers
- 5. OB Klei dijk
- 4. OB Klei dijk
- 3. OB Klei dijk
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : -1,26 [m]
Ym : 3,86 [m]

Radius : 4,59 [m]
Safety : 1,36

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (situatie 5 / h=1m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date 12/1/2014
dnw. -
ctr. -
form. A4
Annex -

D-Geo Stability 10.1 : STBU_h1m_dkl 3m.sti

Critical Circle Bishop

Xm : -3,28 [m]
Ym : 7,17 [m]

Radius : 7,89 [m]
Safety : 1,16

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 5 / h=2m)

Laan 1914 nr 35
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Fax

date	dnw.
12/1/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h2m_dkl 3m.sti

Critical Circle Bishop

Layers

- 5. OB Klei dijk
- 4. OB Klei dijk
- 3. OB Klei dijk
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : -5,38 [m]
Ym : 11,01 [m]

Radius : 11,74 [m]
Safety : 1,05

D-Geo Stability 10.1 : STBU_h3m_dkl 3m.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 5 / h=3 m)

Laan 1914 nr 35
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Fax

date	1-12-2014	dnw.	-
	-	ctr.	
Annex	-	form.	A4

Critical Circle Bishop

Layers

- 5. OB Klei dijk
- 4. OB Klei dijk
- 3. OB Klei dijk
- 2. 19 Klei (y=19)
- 1. 20 Zand, matig grof

Xm : -7,89 [m]
Ym : 16,46 [m]

Radius : 16,69 [m]
Safety : 0,98

D-Geo Stability 10.1 : STBU_h4m_dkl 3m.sti

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 5 / h=4m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	dnw.	-
	-	ctr.	
Annex	-	form.	A4

Critical Circle Bishop

Xm : -10,30 [m]
Ym : 19,78 [m]

Radius : 20,01 [m]
Safety : 0,92

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (situatie 5 / h=5m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date 12/1/2014

Annex -

ctr. -

form. A4

dnw. -

D-Geo Stability 10.1 : STBU_h5m_dkl 3m.sti

Critical Circle Bishop

Xm : -7,38 [m]
Ym : 16,01 [m]

Radius : 16,24 [m]
Safety : 1,49

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 8 / h=3 m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	dnw.	-
	-	ctr.	
Annex	-	form.	A4

D-Geo Stability 10.1 : STBU_h3m_dkl 0m_Z.sti

Critical Circle Bishop

Xm : -7,89 [m]
Ym : 16,46 [m]

Radius : 16,19 [m]
Safety : 1,32

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (Situatie 8 / h=4m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	dnw.
12/1/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h4m_dkl 0m_Z.sti

Critical Circle Bishop

Xm : -10,30 [m]
Ym : 19,78 [m]

Radius : 19,51 [m]
Safety : 1,21

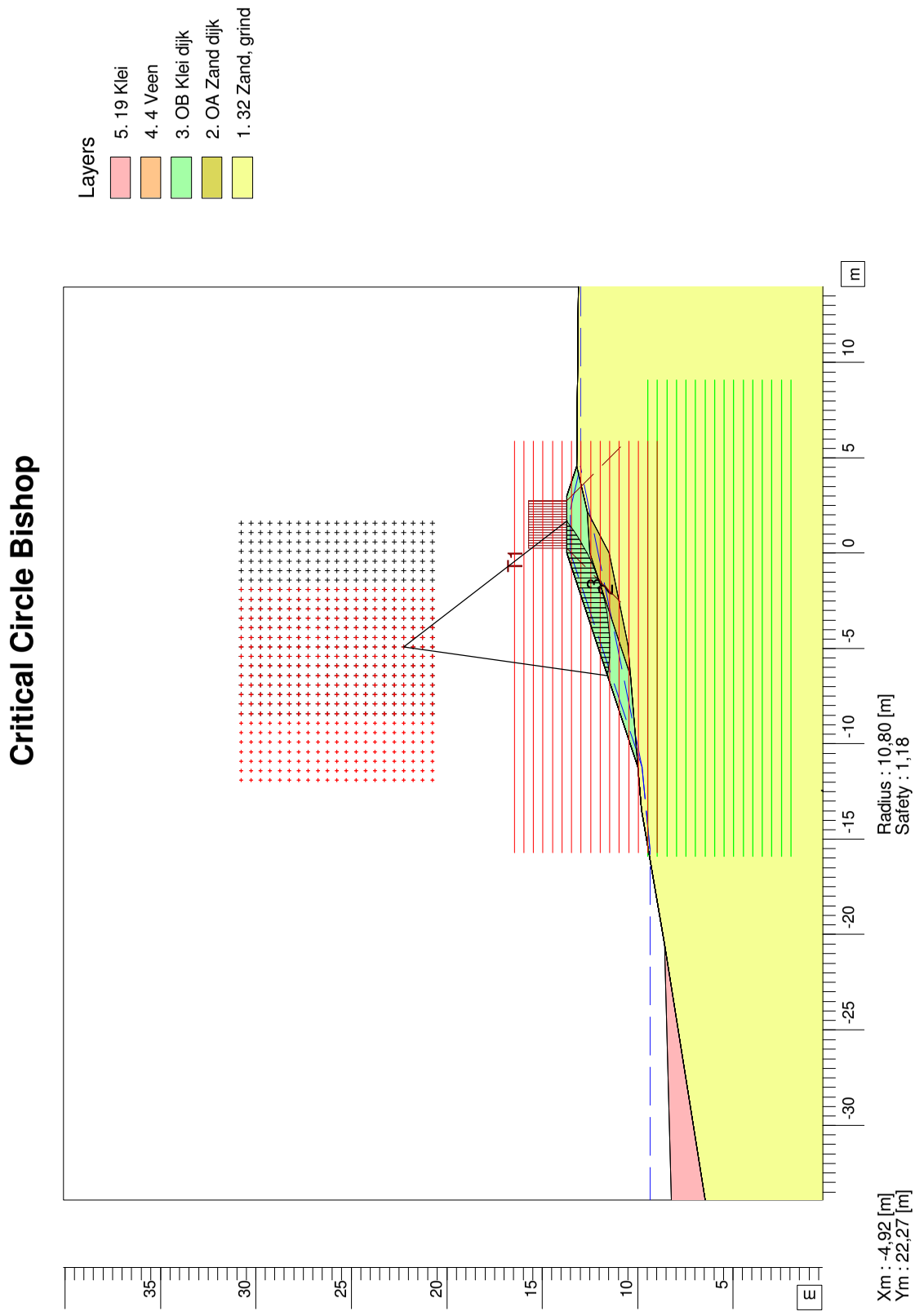
Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU (situatie 8 / h=5m)

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	dnw.
12/1/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU_h5m_dkl 0m_Z.sti



D-Geo Stability 10.1 : STBU_54.091-096.sti

Royal Haskoning DHV
Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

	date 12/1/2014	drw. -
Prioritaire Dijkversterking Waterschap Peel en Maasvallei STBU 54.091-54.096	-	ctr.
	Annex -	form. A4

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 11/13/2014
Time        : 8:58:29 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   5  - X -  | -50.00   -39.00   -20.50   -13.47   -11.21     0.00
   5  - Y -  |   8.10     8.10     8.60     9.80     9.98    13.72
             |
   5  - X -  |   3.00     4.56    25.00
   5  - Y -  |  13.72    13.20    13.00
             |
   4  - X -  | -50.00   -35.00   -20.50   -13.47   -11.21     0.00
   4  - Y -  |   6.30     6.30     8.60     9.80     9.98    13.72
             |
   4  - X -  |   3.00     4.56    25.00
   4  - Y -  |  13.72    13.20    13.00
             |
   3  - X -  | -50.00   -40.00   -35.00   -20.50   -13.47   -11.21
   3  - Y -  |   5.30     5.30     6.30     8.60     9.80     9.98
             |
   3  - X -  |   0.00     3.00     4.56    25.00
   3  - Y -  |  13.72    13.72    13.20    13.00
             |
   2  - X -  | -50.00   -40.00   -35.00   -20.50   -13.47   -11.21
   2  - Y -  |   5.30     5.30     6.30     8.60     9.80     9.98
             |
   2  - X -  |  -6.46     0.00     2.21     4.56    25.00
   2  - Y -  |  10.37    12.52    12.66    13.20    13.00
             |
   1  - X -  | -50.00   -40.00   -35.00   -20.50   -13.47   -11.21
   1  - Y -  |   5.30     5.30     6.30     8.60     9.80     9.98
             |
   1  - X -  |  -6.46    -4.80     0.00     2.21     4.56    25.00
   1  - Y -  |  10.37    10.50    11.50    12.66    13.20    13.00
             |
   0  - X -  | -50.00    25.00
   0  - Y -  | -10.00   -10.00


               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   1  - X -  | -50.00   -15.50   -11.21     0.00     2.30     4.56
   1  - Y -  |   9.36     9.36     9.78    13.52    13.52    13.00
             |
   1  - X -  |  25.00
   1  - Y -  |  13.00
             |
   2  - X -  | -50.00   -15.50   -11.21     4.56    25.00
   2  - Y -  |   9.36     9.36     9.78    13.00    13.00
```

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
5	19 Klei
4	4 Veen
3	OB Klei dijk
2	OA Zand dijk
1	32 Zand, grind

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
5	18.00	18.00	2	2
4	11.00	11.00	2	2
3	18.50	18.50	1	1
2	18.00	20.00	2	2
1	19.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
5	2.40	21.20	-	-	-	-	-
4	1.30	12.10	-	-	-	-	-
3	2.40	23.00	-	-	-	-	-
2	0.00	25.70	-	-	-	-	-
1	0.00	30.30	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -8.42 [m]
X co-ordinate grid right : 1.58 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 20.77 [m]
Y co-ordinate grid top : 30.77 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 9.47 [m]
Y co-ordinate tangent biggest circle : 1.97 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD
============

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	0.25	2.75	45.00	Temporary

TREE ON SLOPE
=============

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS
===

Layer number	Degree of consolidation
5	0
4	0
3	0
2	100
1	100

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -8.92 [m]
X maximum = 1.08 [m]
Y minimum = 20.77 [m]
Y maximum = 30.77 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -9.42 [m]
X maximum = 0.58 [m]
Y minimum = 20.77 [m]
Y maximum = 30.77 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -9.92 [m]
X maximum = 0.08 [m]
Y minimum = 20.77 [m]
Y maximum = 30.77 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -10.42 [m]

```
                X maximum =   -0.42 [m]
                Y minimum =   20.77 [m]
                Y maximum =   30.77 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =  -10.92 [m]
                 X maximum =   -0.92 [m]
                 Y minimum =   20.77 [m]
                 Y maximum =   30.77 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =  -11.42 [m]
                 X maximum =   -1.42 [m]
                 Y minimum =   20.77 [m]
                 Y maximum =   30.77 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =  -11.92 [m]
                 X maximum =   -1.92 [m]
                 Y minimum =   20.77 [m]
                 Y maximum =   30.77 [m]


The center point of the critical circle lies on the edge of the grid.

New grid with  : X minimum =  -11.92 [m]
                 X maximum =   -1.92 [m]
                 Y minimum =   20.77 [m]
                 Y maximum =   30.77 [m]
           tangent minimum =    8.97 [m]
           tangent maximum =   16.47 [m]


Information on the critical circle  : Fmin =      1.179
Calculation method used             : Bishop - C phi
================================================================================

X co-ordinate center point      :        -4.92 [m]
Y co-ordinate center point      :        22.27 [m]
Radius of critical circle       :        10.80 [m]

The center point of the critical circle is enclosed

Total driving moment            :      -457.05 [kNm/m]
Driving moment free water       :         0.00 [kNm/m]
Driving moment external loads   :      -112.55 [kNm/m]
Iterated resisting moment       :       457.05 [kNm/m]
Non-iterated resisting moment   :       530.84 [kNm/m]


                        END OF D-Geo Stability OUTPUT
                        =============================
```

Critical Circle Bishop

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU 54.181-185

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	drw. AHO
-		ctr.
Annex -		form. A4

D-Geo Stability 10.1 : STBU_54.181-185.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 13-11-2014
Time        : 9:03:28

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking Perceel 1
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   9  - X -  | -50.00   -13.15   -10.65     0.00     2.00     6.50
   9  - Y -  |   8.70     9.10     9.10    12.65    12.75    12.90
             |
   9  - X -  |  13.00    25.00
   9  - Y -  |  13.00    13.00
             |
   8  - X -  | -50.00   -13.15   -12.65   -10.65    -4.35     0.00
   8  - Y -  |   8.70     9.10     7.90     7.90    10.00    11.45
             |
   8  - X -  |   2.00     2.00     2.00     6.50    13.00    25.00
   8  - Y -  |  11.55    12.00    12.75    12.90    13.00    13.00
             |
   7  - X -  | -50.00   -12.65   -10.65    -4.35     0.00     2.00
   7  - Y -  |   8.00     7.90     7.90    10.00    11.45    11.55
             |
   7  - X -  |   2.00     2.00     6.50    13.00    25.00
   7  - Y -  |  12.00    12.75    12.90    13.00    13.00
             |
   6  - X -  | -50.00   -12.65   -10.65    -4.35     0.00     2.00
   6  - Y -  |   8.00     7.90     7.90    10.00    11.45    11.55
             |
   6  - X -  |   2.00    10.80    13.00    25.00
   6  - Y -  |  12.00    12.00    13.00    13.00
             |
   5  - X -  | -50.00   -12.65   -10.65    -4.35    10.00    25.00
   5  - Y -  |   8.00     7.90     7.90    10.00    10.03    11.50
             |
   4  - X -  | -50.00   -12.65   -10.65    25.00
   4  - Y -  |   8.00     7.90     7.90     8.00
             |
   3  - X -  | -50.00    25.00
   3  - Y -  |   7.00     7.00
             |
   2  - X -  | -50.00    25.00
   2  - Y -  |   4.00     4.00
             |
   1  - X -  | -50.00    25.00
   1  - Y -  |   2.00     2.00
             |
   0  - X -  | -50.00    25.00
   0  - Y -  | -10.00   -10.00



               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-----------------------------------------------------
```

1	- X -	-50.00	-10.05	0.00	2.00	25.00
1	- Y -	9.10	9.10	12.45	12.55	12.55

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
9	OB Klei dijk
8	20 Zand, matig grof
7	OA Zand dijk
6	19 Klei (y=19)
5	20 Zand, matig grof
4	32 Zand, grind
3	20 Zand, matig grof
2	32 Zand, grind
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
9	18.50	18.50	1	1
8	18.00	20.00	1	1
7	18.00	20.00	1	1
6	19.00	19.00	1	1
5	18.00	20.00	1	1
4	19.00	20.00	1	1
3	18.00	20.00	1	1
2	19.00	20.00	1	1
1	18.00	20.00	1	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
9	2.40	23.00	-	-	-	-	-
8	0.00	27.50	-	-	-	-	-
7	0.00	25.70	-	-	-	-	-
6	2.40	21.20	-	-	-	-	-
5	0.00	27.50	-	-	-	-	-
4	0.00	30.30	-	-	-	-	-
3	0.00	27.50	-	-	-	-	-
2	0.00	30.30	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -13.03 [m]
X co-ordinate grid right : -3.03 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 21.79 [m]
Y co-ordinate grid top : 31.79 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 7.97 [m]
Y co-ordinate tangent biggest circle : 0.47 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	2.00	4.50	45.00	Temporary

TREE ON SLOPE

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS

Layer number	Degree of consolidation
9	0
8	100
7	100
6	0
5	100
4	100
3	100
2	100
1	100

EARTHQUAKE

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -13.03 [m]
X maximum = -3.03 [m]
Y minimum = 21.79 [m]
Y maximum = 31.79 [m]
tangent minimum = 7.47 [m]
tangent maximum = 14.97 [m]

```
Information on the critical circle  : Fmin =      1.047
Calculation method used             : Bishop - C phi
================================================================================

X co-ordinate center point      :        -7.53 [m]
Y co-ordinate center point      :        28.29 [m]
Radius of critical circle       :        19.32 [m]

The center point of the critical circle is enclosed

Total driving moment            :     -2182.97 [kNm/m]
Driving moment free water       :         0.00 [kNm/m]
Driving moment external loads   :      -287.39 [kNm/m]
Iterated resisting moment       :      2182.97 [kNm/m]
Non-iterated resisting moment   :      2275.12 [kNm/m]


                          END OF D-Geo Stability OUTPUT
                          ============================
```

Critical Circle Bishop

Xm : -4,03 [m]
Ym : 20,79 [m]

Radius : 10,82 [m]
Safety : 1,02

Prioritaire Dijkversterking Perceel 1
Waterschap Peel en Maasvallei
STBU 54.185-187

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	dnw.
12/2/2014	-

-	ctr.
Annex -	form. A4

D-Geo Stability 10.1 : STBU P3 1op2.5.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 12/2/2014
Time        : 9:51:11 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkversterkinger
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking Perceel 1
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-------------------------------------------------
             |
   8  - X -  | -50.00   -11.50    -9.50     0.00     2.00     6.50
   8  - Y -  |   8.60     8.60     8.60    12.40    12.40    12.40
             |
   8  - X -  |  25.00
   8  - Y -  |  12.40
             |
   7  - X -  | -50.00   -11.50   -10.80   -10.30    -9.50    -8.23
   7  - Y -  |   8.60     8.60     7.90     7.40     7.40     7.91
             |
   7  - X -  |  -3.00     0.00     2.00     2.00     6.50    25.00
   7  - Y -  |  10.00    11.20    11.20    12.40    12.40    12.40
             |
   6  - X -  | -50.00   -10.80   -10.30    -9.50    -8.23    -3.00
   6  - Y -  |   8.00     7.90     7.40     7.40     7.91    10.00
             |
   6  - X -  |   0.00     2.00     2.00     6.50    25.00
   6  - Y -  |  11.20    11.20    12.40    12.40    12.40
             |
   5  - X -  | -50.00   -10.80   -10.30    -9.50    -8.23    -3.00
   5  - Y -  |   8.00     7.90     7.40     7.40     7.91    10.00
             |
   5  - X -  |  10.00    25.00
   5  - Y -  |  10.03    11.50
             |
   4  - X -  | -50.00   -10.80   -10.30    -9.50    -8.23    25.00
   4  - Y -  |   8.00     7.90     7.40     7.40     7.91     8.00
             |
   3  - X -  | -50.00    25.00
   3  - Y -  |   7.00     7.00
             |
   2  - X -  | -50.00    25.00
   2  - Y -  |   4.00     4.00
             |
   1  - X -  | -50.00    25.00
   1  - Y -  |   2.00     2.00
             |
   0  - X -  | -50.00    25.00
   0  - Y -  | -10.00   -10.00



               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-------------------------------------------------
             |
   1  - X -  | -50.00    -9.00     0.00    25.00
   1  - Y -  |   8.60     8.60    12.20    12.20
             |
```

2	- X -	-50.00 25.00
2	- Y -	8.60 8.60

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
8	OB Klei dijk
7	20 Zand, matig grof
6	19 Klei (y=19)
5	20 Zand, matig grof
4	32 Zand, grind
3	20 Zand, matig grof
2	32 Zand, grind
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
8	18.50	18.50	1	1
7	18.00	20.00	2	2
6	19.00	19.00	1	1
5	18.00	20.00	2	2
4	19.00	20.00	2	2
3	18.00	20.00	2	2
2	19.00	20.00	2	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
8	2.40	23.00	-	-	-	-	-
7	0.00	27.50	-	-	-	-	-
6	2.40	21.20	-	-	-	-	-
5	0.00	27.50	-	-	-	-	-
4	0.00	30.30	-	-	-	-	-
3	0.00	27.50	-	-	-	-	-
2	0.00	30.30	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left	:	-13.03 [m]
X co-ordinate grid right	:	-3.03 [m]
Number of grid points in X - direction	:	21
Y co-ordinate grid bottom	:	21.79 [m]
Y co-ordinate grid top	:	31.79 [m]
Number of grid points in Y - direction	:	21
Y co-ordinate tangent smallest circle	:	7.97 [m]
Y co-ordinate tangent biggest circle	:	0.47 [m]
Number of circles per grid point	:	16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS
==========

No line loads input.

UNIFORM LOAD
============

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	1.00	3.50	45.00	Temporary

TREE ON SLOPE
=============

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS
===

Layer number	Degree of consolidation
8	0
7	100
6	0
5	100
4	100
3	100
2	100
1	100

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -13.03 [m]
X maximum = -3.03 [m]
Y minimum = 21.79 [m]
Y maximum = 31.79 [m]
tangent minimum = 7.47 [m]
tangent maximum = 14.97 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -13.03 [m]
X maximum = -3.03 [m]
Y minimum = 21.29 [m]

```
                  Y maximum =   31.29 [m]

 The center point of the critical circle lies on the edge of the grid.

 New grid with  : X minimum =  -13.03 [m]
                  X maximum =   -3.03 [m]
                  Y minimum =   20.79 [m]
                  Y maximum =   30.79 [m]


 The center point of the critical circle lies on the edge of the grid.

 New grid with  : X minimum =  -13.03 [m]
                  X maximum =   -3.03 [m]
                  Y minimum =   20.29 [m]
                  Y maximum =   30.29 [m]


 Information on the critical circle  : Fmin =      1.020
 Calculation method used             : Bishop - C phi
 ============================================================================

 X co-ordinate center point      :        -4.03 [m]
 Y co-ordinate center point      :        20.79 [m]
 Radius of critical circle       :        10.82 [m]

 The center point of the critical circle is enclosed

 Total driving moment            :      -603.16 [kNm/m]
 Driving moment free water       :         0.00 [kNm/m]
 Driving moment external loads   :      -142.69 [kNm/m]
 Iterated resisting moment       :       603.16 [kNm/m]
 Non-iterated resisting moment   :       614.09 [kNm/m]


                          END OF D-Geo Stability OUTPUT
                          ============================
```

Critical Circle Bishop

Xm : -8,60 [m]
Ym : 30,40 [m]

Radius : 19,21 [m]
Safety : 1,02

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBU DP59.019

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

Annex -	-	12/1/2014	-
form. A4	ctr.	date	dnw.

D-Geo Stability 10.1 : STBU_59.018-021.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 27-11-2014
Time        : 11:54:55

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   5  - X -  | -50.00   -48.60   -14.50   -11.40     0.00     4.50
   5  - Y -  |  11.40    11.40    11.40    11.40    15.20    15.20
             |
   5  - X -  |  15.90    18.40    50.00
   5  - Y -  |  11.40    11.40    11.40
             |
   4  - X -  | -50.00   -48.60   -14.50   -11.40    -8.40    12.90
   4  - Y -  |  11.40    11.40    11.40    11.40    11.40    11.40
             |
   4  - X -  |  15.90    18.40    50.00
   4  - Y -  |  11.40    11.40    11.40
             |
   3  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    -8.40
   3  - Y -  |  11.40    11.40    10.20    10.20    10.40    11.40
             |
   3  - X -  |  12.90    15.90    18.40    50.00
   3  - Y -  |  11.40    11.40    11.40    11.40
             |
   2  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    -8.40
   2  - Y -  |  11.40    11.40    10.20    10.20    10.40    11.40
             |
   2  - X -  |  12.90    15.10    15.90    17.20    18.40    50.00
   2  - Y -  |  11.40    10.40    10.20    10.20    11.40    11.40
             |
   1  - X -  | -50.00   -48.60   -47.00   -12.00   -11.37    15.10
   1  - Y -  |  11.40    11.40    10.20    10.20    10.40    10.40
             |
   1  - X -  |  15.90    17.20    18.40    50.00
   1  - Y -  |  10.20    10.20    11.40    11.40
             |
   0  - X -  | -50.00    50.00
   0  - Y -  | -10.00   -10.00


               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   1  - X -  | -50.00   -14.50   -10.80     0.00     4.50    15.90
   1  - Y -  |  11.40    11.40    11.40    15.00    15.00    11.40
             |
   1  - X -  |  50.00
   1  - Y -  |  11.40
             |
   2  - X -  | -50.00    18.40    50.00
   2  - Y -  |  11.40    11.40    11.40
```

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
5	OB Klei dijk
4	OB Klei dijk
3	OB Klei dijk
2	19 Klei
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
5	18.50	18.50	1	1
4	18.50	18.50	1	2
3	18.50	18.50	1	2
2	18.00	18.00	1	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
5	2.40	23.00	-	-	-	-	-
4	2.40	23.00	-	-	-	-	-
3	2.40	23.00	-	-	-	-	-
2	2.40	21.20	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -11.10 [m]
X co-ordinate grid right : -1.10 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 30.90 [m]
Y co-ordinate grid top : 40.90 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 11.19 [m]
Y co-ordinate tangent biggest circle : 3.68 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD
============

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	0.75	3.25	45.00	Temporary

TREE ON SLOPE
=============

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS
===

Layer number	Degree of consolidation
5	0
4	0
3	0
2	0
1	100

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -11.10 [m]
X maximum = -1.10 [m]
Y minimum = 30.40 [m]
Y maximum = 40.40 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -11.10 [m]
X maximum = -1.10 [m]
Y minimum = 29.90 [m]
Y maximum = 39.90 [m]

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -11.10 [m]
X maximum = -1.10 [m]
Y minimum = 29.90 [m]
Y maximum = 39.90 [m]
tangent minimum = 10.69 [m]
tangent maximum = 18.19 [m]

Information on the critical circle : Fmin = 1.017

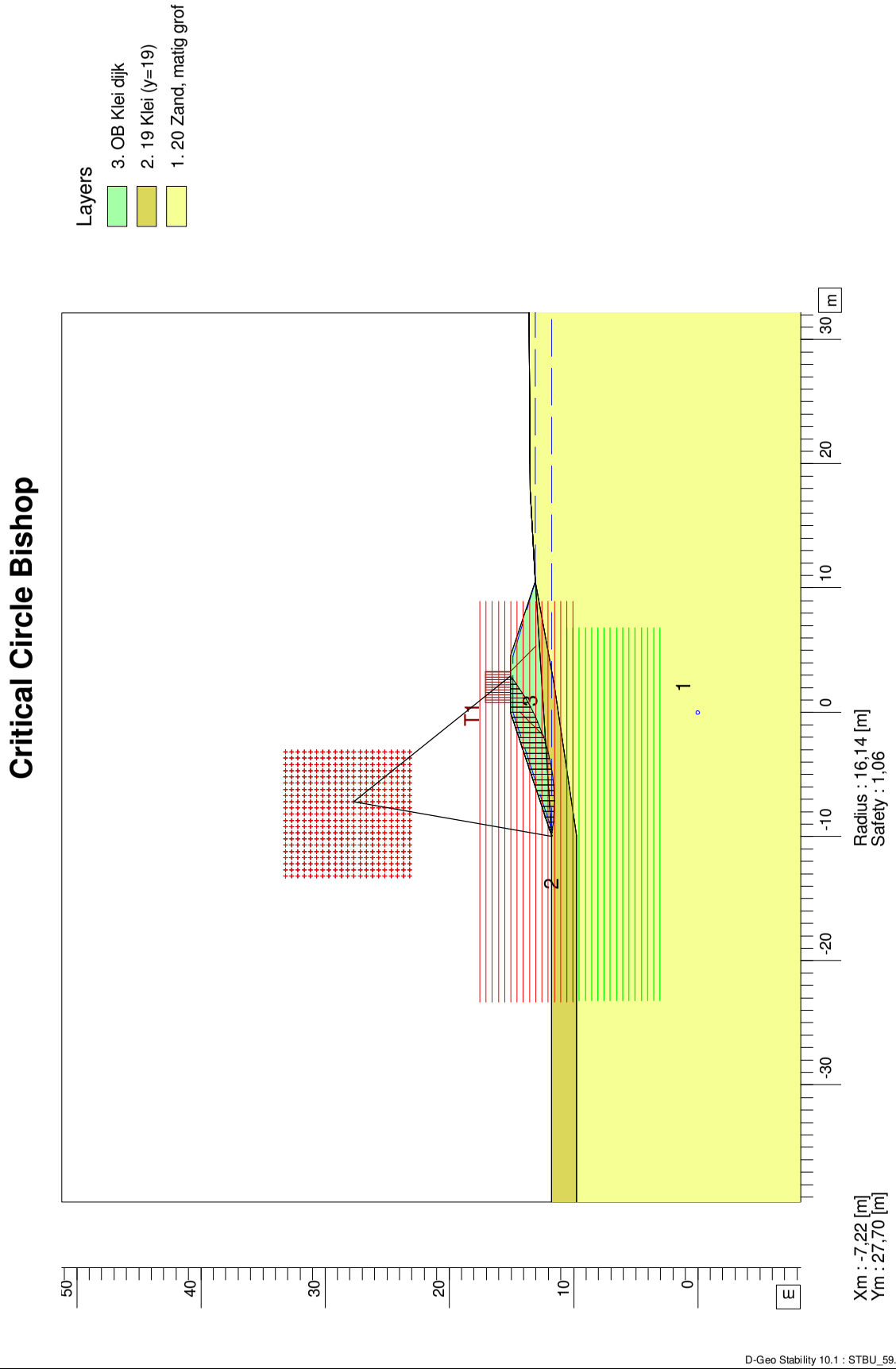
```
Calculation method used             : Bishop - C phi
================================================================================

X co-ordinate center point      :        -8.60 [m]
Y co-ordinate center point      :        30.40 [m]
Radius of critical circle       :        19.21 [m]

The center point of the critical circle is enclosed

Total driving moment            :     -2316.95 [kNm/m]
Driving moment free water       :         0.00 [kNm/m]
Driving moment external loads   :      -338.04 [kNm/m]
Iterated resisting moment       :      2316.95 [kNm/m]
Non-iterated resisting moment   :      2353.00 [kNm/m]


                          END OF D-Geo Stability OUTPUT
                          ============================
```



D-Geo Stability 10.1 : STBU_59.022-023.sti

Royal Haskoning DHV
Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

	date 12/1/2014	drw. AHO
Prioritaire Dijkversterking Waterschap Peel en Maasvallei	-	ctr.
STBU 59.022-59.023	Annex -	form. A4

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 11/13/2014
Time        : 9:07:31 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

Problem identification : Prioritaire Dijkversterking
: Waterschap Peel en Maasvallei

Calculation model : Bishop
Default shear strength : C phi

LAYER BOUNDARIES

Boundary no.	Co-ordinates [m]					
3 - X -	-50.00	-9.93	0.00	4.50	10.50	17.80
3 - Y -	11.80	11.80	15.11	15.11	13.10	13.50
3 - X -	50.00					
3 - Y -	13.70					
2 - X -	-50.00	-9.93	10.50	17.80	50.00	
2 - Y -	11.80	11.80	13.10	13.50	13.70	
1 - X -	-50.00	-9.93	2.25	10.50	17.80	50.00
1 - Y -	9.80	9.80	11.60	13.10	13.50	13.70
0 - X -	-50.00	50.00				
0 - Y -	-10.00	-10.00				

PL LINES

PL line no.	Co-ordinates [m]					
1 - X -	-50.00	-9.41	0.00	4.50	10.50	50.00
1 - Y -	11.80	11.80	14.91	14.91	13.10	13.10
2 - X -	-50.00	50.00				
2 - Y -	11.80	11.80				

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name

```
      3  | OB Klei dijk
      2  | 19 Klei (y=19)
      1  | 20 Zand, matig grof
```

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
3	18.50	18.50	1	99
2	19.00	19.00	1	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
3	2.40	23.00	-	-	-	-	-
2	2.40	21.20	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

```
X co-ordinate grid left                  :  -13.22 [m]
X co-ordinate grid right                 :   -3.22 [m]
Number of grid points in X - direction   :    21

Y co-ordinate grid bottom                :   23.20 [m]
Y co-ordinate grid top                   :   33.20 [m]
Number of grid points in Y - direction   :    21

Y co-ordinate tangent smallest circle    :   10.56 [m]
Y co-ordinate tangent biggest  circle    :    3.06 [m]
Number of circles per grid point         :    16
```

No fixed points input.

```
Total number of center points in the grid:   441
Total number of slip circles in the grid :  7056
```

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	0.75	3.25	45.00	Temporary

TREE ON SLOPE

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS

Layer number	Degree of consolidation
3	0
2	0

```
      1        |       100


               EARTHQUAKE
               ==========

 No earth quake factors were input.


*****************************************************************************
****************  The input has been tested, and is correct.  ****************
*****************************************************************************
□

               RESULTS OF THE SLOPE STABILITY ANALYSIS
               =======================================


 The center point of the critical circle lies on the edge of the grid.

 New grid with  : X minimum =  -13.22 [m]
                  X maximum =   -3.22 [m]
                  Y minimum =   23.20 [m]
                  Y maximum =   33.20 [m]
            tangent minimum =   10.06 [m]
            tangent maximum =   17.56 [m]


 Information on the critical circle  : Fmin =      1.065
 Calculation method used             : Bishop - C phi
 ============================================================================

 X co-ordinate center point      :        -7.22 [m]
 Y co-ordinate center point      :        27.70 [m]
 Radius of critical circle       :        16.14 [m]

 The center point of the critical circle is enclosed

 Total driving moment            :     -1585.94 [kNm/m]
 Driving moment free water       :         0.00 [kNm/m]
 Driving moment external loads   :      -256.89 [kNm/m]
 Iterated resisting moment       :      1585.94 [kNm/m]
 Non-iterated resisting moment   :      1679.22 [kNm/m]


                         END OF D-Geo Stability OUTPUT
                         =============================
```

Critical Circle Bishop

Xm : -7,72 [m]
Ym : 27,20 [m]

Radius : 16,14 [m]
Safety : 1,11

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBU 59.035-59.039 Grondverbetering

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Phone +31 (0)6 46 37 14 07
Fax

Annex -	-	1-12-2014	AHO
form. A4	ctr.	date	drw.

D-Geo Stability 10.1 : STBU_59.035-039 grondverbetering.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 13-11-2014
Time        : 10:34:17

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================


               ECHO OF THE INPUT
               =================


 Problem identification : Prioritaire Dijkversterking
                        : Waterschap Peel en Maasvallei

 Calculation model      : Bishop
 Default shear strength : C phi

               LAYER BOUNDARIES
               ================

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   6  - X -  | -50.00   -11.60     0.00     4.50    10.10    50.00
   6  - Y -  |  11.40    11.40    15.26    15.26    13.40    13.10
             |
   5  - X -  | -50.00   -16.62   -13.30   -11.60     0.00     4.50
   5  - Y -  |  10.40    10.40    10.40    11.40    15.26    15.26
             |
   5  - X -  |  10.10    50.00
   5  - Y -  |  13.40    13.10
             |
   4  - X -  | -50.00   -16.62   -13.30   -11.60    10.10    50.00
   4  - Y -  |  10.40    10.40    10.40    11.40    13.40    13.10
             |
   3  - X -  | -50.00   -16.62   -13.30     2.25    10.10    50.00
   3  - Y -  |  10.40    10.40    10.40    10.40    13.40    13.10
             |
   2  - X -  | -50.00   -16.62   -15.60   -15.00     2.25    10.10
   2  - Y -  |  10.40    10.40     9.40     9.40    10.40    13.40
             |
   2  - X -  |  50.00
   2  - Y -  |  13.10
             |
   1  - X -  | -50.00   -15.60   -15.00     2.25    10.10    50.00
   1  - Y -  |   9.40     9.40     9.40    10.40    13.40    13.10
             |
   0  - X -  | -50.00    50.00
   0  - Y -  | -10.00   -10.00


               PL LINES
               ========

 PL line no. | Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
   1  - X -  | -50.00    -9.42     0.00     4.50    10.10    50.00
   1  - Y -  |  11.92    11.92    15.06    15.06    13.40    13.10
             |
   2  - X -  | -50.00    50.00
   2  - Y -  |  11.92    11.92



 Unit weight of water used for calculation:     9.81 [kN/m3]
 The groundwater level is determined by PL-line number 1
```

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
6	19 Klei
5	OB Klei dijk
4	19 Klei
3	19 Klei
2	4 Veen, zandig
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
6	18.00	18.00	1	99
5	18.50	18.50	1	1
4	18.00	18.00	1	99
3	18.00	18.00	99	2
2	13.00	13.00	99	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
6	2.40	21.20	-	-	-	-	-
5	2.40	23.00	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	2.40	21.20	-	-	-	-	-
2	1.30	12.10	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -13.22 [m]
X co-ordinate grid right : -3.22 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 23.20 [m]
Y co-ordinate grid top : 33.20 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 10.56 [m]
Y co-ordinate tangent biggest circle : 3.06 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	0.75	3.25	45.00	Temporary

TREE ON SLOPE

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS

Layer number	Degree of consolidation
6	100
5	100
4	0
3	0
2	0
1	100

EARTHQUAKE

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -13.22 [m]
X maximum = -3.22 [m]
Y minimum = 23.20 [m]
Y maximum = 33.20 [m]
tangent minimum = 10.06 [m]
tangent maximum = 17.56 [m]

Information on the critical circle : Fmin = 1.109
Calculation method used : Bishop - C phi

X co-ordinate center point : -7.72 [m]
Y co-ordinate center point : 27.20 [m]
Radius of critical circle : 16.14 [m]

The center point of the critical circle is enclosed

Total driving moment : -2137.91 [kNm/m]
Driving moment free water : 24.18 [kNm/m]
Driving moment external loads : -308.39 [kNm/m]
Iterated resisting moment : 2137.91 [kNm/m]
Non-iterated resisting moment : 2346.56 [kNm/m]

END OF D-Geo Stability OUTPUT

Critical Circle Bishop

Xm : -7,72 [m]
Ym : 27,20 [m]

Radius : 16,14 [m]
Safety : 1,09

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBU 59.043-59.048 grondverbetering

Laan 1914 nr 35
3818 EX Amersfoort
Phone
Fax
+31 (0)6 46 37 14 07

Annex -	-	date 12/1/2014	drw. AHO
form. A4	ctr.		

D-Geo Stability 10.1 : STBU_59.043-048 grondverbetering.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 11/13/2014
Time        : 9:19:51 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

```
Problem identification : Prioritaire Dijkversterking
                       : Waterschap Peel en Maasvallei

Calculation model      : Bishop
Default shear strength : C phi
```

LAYER BOUNDARIES

Boundary no.		Co-ordinates [m]					
5	- X -	-50.00	-12.00	0.00	4.50	9.80	50.00
5	- Y -	11.30	11.30	15.31	15.31	13.55	13.24
4	- X -	-50.00	-12.00	9.80	50.00		
4	- Y -	11.30	11.30	13.55	13.24		
3	- X -	-50.00	-15.00	-12.00	0.00	4.50	9.80
3	- Y -	10.30	10.30	10.30	10.00	10.00	11.50
3	- X -	50.00					
3	- Y -	11.50					
2	- X -	-50.00	-15.00	-15.00	-12.00	0.00	4.50
2	- Y -	9.30	9.30	10.30	10.30	10.00	10.00
2	- X -	9.80	50.00				
2	- Y -	11.50	11.50				
1	- X -	-50.00	-15.00	0.00	4.50	9.80	50.00
1	- Y -	9.30	9.30	10.00	10.00	11.50	11.50
0	- X -	-50.00	50.00				
0	- Y -	-10.00	-10.00				

PL LINES

PL line no.		Co-ordinates [m]					
1	- X -	-50.00	-9.42	0.00	4.50	9.80	50.00
1	- Y -	11.97	11.97	15.11	15.11	13.55	13.24
2	- X -	-50.00	50.00				
2	- Y -	11.97	11.97				

```
Unit weight of water used for calculation:     9.81 [kN/m3]
The groundwater level is determined by PL-line number 1
```

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
5	OB Klei dijk
4	19 Klei
3	4 Veen
2	OB Klei dijk
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
5	18.50	18.50	1	1
4	18.00	18.00	1	99
3	11.00	11.00	99	2
2	18.50	18.50	99	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
5	2.40	23.00	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	1.30	12.10	-	-	-	-	-
2	2.40	23.00	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -13.22 [m]
X co-ordinate grid right : -3.22 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 23.20 [m]
Y co-ordinate grid top : 33.20 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 10.56 [m]
Y co-ordinate tangent biggest circle : 3.06 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	0.75	3.25	45.00	Temporary

TREE ON SLOPE
=============

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS
===

Layer number	Degree of consolidation
5	100
4	0
3	0
2	0
1	100

EARTHQUAKE
==========

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS
=======================================

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -13.22 [m]
X maximum = -3.22 [m]
Y minimum = 23.20 [m]
Y maximum = 33.20 [m]
tangent minimum = 10.06 [m]
tangent maximum = 17.56 [m]

Information on the critical circle : Fmin = 1.091
Calculation method used : Bishop - C phi

X co-ordinate center point : -7.72 [m]
Y co-ordinate center point : 27.20 [m]
Radius of critical circle : 16.14 [m]

The center point of the critical circle is enclosed

Total driving moment : -2189.57 [kNm/m]
Driving moment free water : 28.29 [kNm/m]
Driving moment external loads : -316.33 [kNm/m]
Iterated resisting moment : 2189.57 [kNm/m]
Non-iterated resisting moment : 2368.44 [kNm/m]

END OF D-Geo Stability OUTPUT
=============================

Critical Circle Bishop

Xm : -8,22 [m]
Ym : 30,20 [m]

Radius : 18,64 [m]
Safety : 1,09

Prioritaire Dijkversterking
Waterschap Peel en Maasvallei
STBU 59.054-59.059

Laan 1914 nr 35
3818 EX Amersfoort
Phone +31 (0)6 46 37 14 07
Fax

date	12/1/2014	dnw.	-
	-	ctr.	
	Annex -	form.	A4

D-Geo Stability 10.1 : STBU_59.054-059.sti

```
Program     : D-Geo Stability
Version     : 10.1.4.3
License     : Unknown
Company     : Royal HaskoningDHV
Date        : 11/13/2014
Time        : 9:23:29 AM

Output file : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
Input file  : C:\Users\nl85691\Desktop\Box Sync\Box Sync\9X4447 Prioritaire dijkve
==========================    BEGINNING OF DATA     ==========================
```

ECHO OF THE INPUT

Problem identification : Prioritaire Dijkversterking
: Waterschap Peel en Maasvallei

Calculation model : Bishop
Default shear strength : C phi

LAYER BOUNDARIES

Boundary no.		Co-ordinates [m]					
5	- X -	-50.00	-12.00	0.00	4.50	10.10	50.00
5	- Y -	11.60	11.60	15.42	15.42	13.55	13.55
4	- X -	-50.00	-12.00	10.10	50.00		
4	- Y -	11.60	11.60	13.55	13.55		
3	- X -	-50.00	-12.00	2.25	10.10	50.00	
3	- Y -	10.60	10.60	11.00	12.50	12.50	
2	- X -	-50.00	-17.00	-12.00	2.25	10.10	50.00
2	- Y -	10.20	10.20	10.60	11.00	12.50	12.50
1	- X -	-50.00	-17.00	2.25	10.10	50.00	
1	- Y -	10.00	10.00	11.00	12.50	12.50	
0	- X -	-50.00	50.00				
0	- Y -	-10.00	-10.00				

PL LINES

PL line no.		Co-ordinates [m]					
1	- X -	-50.00	-9.48	0.00	4.50	10.10	50.00
1	- Y -	12.06	12.06	15.22	15.22	13.55	13.55
2	- X -	-50.00	50.00				
2	- Y -	12.06	12.06				

Unit weight of water used for calculation: 9.81 [kN/m3]
The groundwater level is determined by PL-line number 1

FORBIDDEN LINES

No forbidden lines were input.

SOIL PROPERTIES

Layer no.	Material name
5	OB Klei dijk
4	19 Klei
3	4 Veen
2	19 Klei (y=19)
1	20 Zand, matig grof

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	PL-line top	PL-line bottom
5	18.50	18.50	1	1
4	18.00	18.00	1	99
3	11.00	11.00	99	99
2	19.00	19.00	99	2
1	18.00	20.00	2	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
5	2.40	23.00	-	-	-	-	-
4	2.40	21.20	-	-	-	-	-
3	1.30	12.10	-	-	-	-	-
2	2.40	21.20	-	-	-	-	-
1	0.00	27.50	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -13.22 [m]
X co-ordinate grid right : -3.22 [m]
Number of grid points in X - direction : 21

Y co-ordinate grid bottom : 23.20 [m]
Y co-ordinate grid top : 33.20 [m]
Number of grid points in Y - direction : 21

Y co-ordinate tangent smallest circle : 10.56 [m]
Y co-ordinate tangent biggest circle : 3.06 [m]
Number of circles per grid point : 16

No fixed points input.

Total number of center points in the grid: 441
Total number of slip circles in the grid : 7056

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	13.33	0.75	3.25	45.00	Temporary

TREE ON SLOPE

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS

Layer number	Degree of consolidation
5	0
4	0
3	0
2	0
1	100

EARTHQUAKE

No earth quake factors were input.

****
********** The input has been tested, and is correct. **********
****

RESULTS OF THE SLOPE STABILITY ANALYSIS

The center point of the critical circle lies on the edge of the grid.

New grid with : X minimum = -13.22 [m]
X maximum = -3.22 [m]
Y minimum = 23.20 [m]
Y maximum = 33.20 [m]
tangent minimum = 10.06 [m]
tangent maximum = 17.56 [m]

Information on the critical circle : Fmin = 1.088
Calculation method used : Bishop - C phi

X co-ordinate center point : -8.22 [m]
Y co-ordinate center point : 30.20 [m]
Radius of critical circle : 18.64 [m]

The center point of the critical circle is enclosed

Total driving moment : -2120.57 [kNm/m]
Driving moment free water : 7.79 [kNm/m]
Driving moment external loads : -324.08 [kNm/m]
Iterated resisting moment : 2120.57 [kNm/m]
Non-iterated resisting moment : 2289.57 [kNm/m]

END OF D-Geo Stability OUTPUT

BIJLAGE 6 Microstabiliteit

cohesive slope protection layer: uplift pressure and shear

Status	Uplift:	*Validated*
	Shear:	*not validated*
Version	1.3	

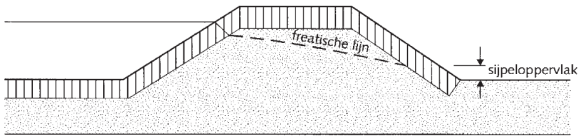
Input cell
Output/calculation cell

Project	Priotitaire dijkversterking
Projectcode	9X4447-116-104
Subject	Uplift due to water pressure in dike core
Author	Andries van Houwelingen + Tom de Wit
Date	19-11-2014
file name	19-11-14_Spreadsheet_STMI_uplift pressure_shear_version1.3

1. Equilibrium cohesive slope protection layer due to uplift pressure in dike core

1.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 123 and 124



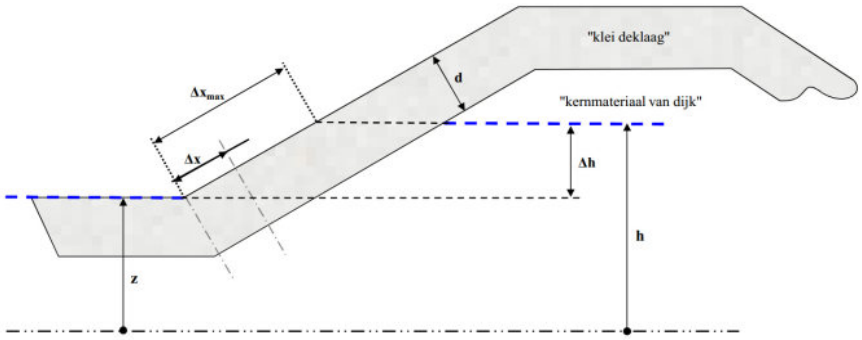
Formula 1: 1-dimentional exclusive friction in clay (in pressures)

$$\cos\alpha \geq \frac{\gamma_d\,\gamma_{m,\rho}\,\gamma_n\,\rho_w(h-z)}{\rho_g\,d}$$

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\frac{2cd}{\gamma_{m;c}} + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\cos\alpha + \frac{\rho_g g}{\gamma_{m;\rho}}\Delta x d\sin\alpha\frac{\tan\varphi}{\gamma_{m;\varphi}} \geq \gamma_n\gamma_d\left(\Delta h - \tfrac{1}{2}\Delta x\sin\alpha\right)\frac{\rho_g g}{\gamma_{m;\rho}}\Delta x$$

1.2 Input



Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,2	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρw	1000	*kg/m3*
volumetric mass of soil (clay)	ρg	1850	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,6	*m*

Partial factor	symbol	value	unit
volumetric mass of water	γm,ρ	1	-
volumetric mass of soil (clay)	γm,ρ	1	-
cohesion	γm,c	1,25	-
friction angle (effective)	γm,φ	1,1	-
overall load factor (product of schadefactor and modelfactor)	γd * γn	2	-

1.3 Output

Formula 1: exclusive friction in clay (in pressures)

	value	unit	
Resistance:	20,66	*kN/m2*	weight perpendicular to slope
Action:	31,39	*kN/m2*	uplift pressure perpendicular to slope
Resistance / Action	0,658201	-	no uplift if resistance/action >= 1

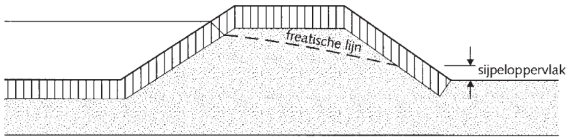
Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Δx_{max}	5,06	*m*	maximum width of the slice of clay
Δx	1,35	*m*	width of clay beloning to the lowest resistance/action value
Check if $\Delta x < \Delta x_{max}$	OK	-	check error in sheet
Resistance:	37,96	*kN/m*	resistance force beloning to the lowest resistance/action value
Action:	36,73	*kN/m*	action force beloning to the lowest resistance/action value
Resistance / Action	1,03343437	-	no uplift if resistance/action >= 1

2. Equilibrium cohesive slope protection layer due to shear

2.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondcontructies (2001)
Page 125



Formula 1: 1-dimentional exclusive friction in clay (in pressures)

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\gamma_n\gamma_d\left[\Delta h d\frac{\rho_g g}{\gamma_{m,\rho}}-\left[\frac{cd}{\gamma_{m,c}}+\frac{c\Delta h}{\gamma_{m,c}\sin\alpha}+\left[\frac{\Delta h}{\tan\alpha}d\frac{\rho_g g}{\gamma_{m,\rho}}-\tfrac{1}{2}\frac{\rho_w g\Delta h^2}{\gamma_{m,\rho}\sin\alpha}\right]\frac{\tan\phi}{\gamma_{m\phi}}\right]\right]\le\frac{cd}{\gamma_{m,c}\sin\alpha}+\tfrac{1}{2}\frac{d^2\rho_g g}{\sin\alpha\gamma_{m,\rho}}$$

2.2 Input

requires the same input parameters as shown in 1.2.
! CHANGE THE PARAMETERS IN 1.2 Input

Parameter	symbol	value	unit
cohesion	c	3	*kN/m2*
friction angle (effective)	φ	27	*degr*
thickness of clay layer (perpendicular to slope)	d	1,2	*m*
gravity	g	9,81	*m/s2*
volumetric mass of water	ρ_w	1000	*kg/m3*
volumetric mass of soil (clay)	ρ_g	1850	*kg/m3*
Slope	1:	3	-
slope angle	α	18,42	*degr*
head difference on lowest point	Δh	1,6	*m*

Partial factor	symbol	value	unit
volumetric mass of water	$\gamma_{m,\rho}$	1	-
volumetric mass of soil (clay)	$\gamma_{m,\rho}$	1	-
cohesion	$\gamma_{m,c}$	1,25	-
friction angle (effective)	$\gamma_{m,\varphi}$	1,1	-
load factor - schadefactor	γ_d	1,1	-
load factor - modelfactor	γ_n	1,1	

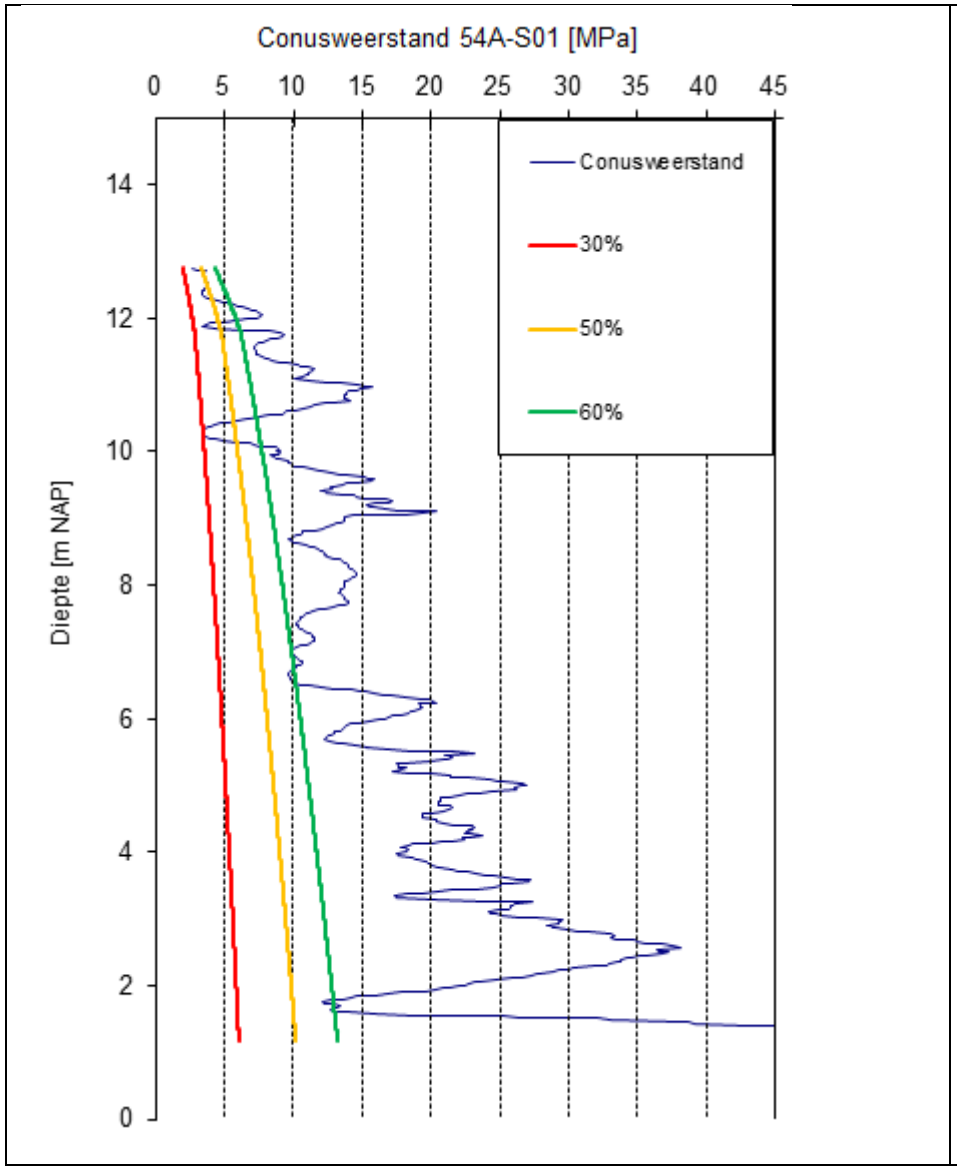
2.4 Output

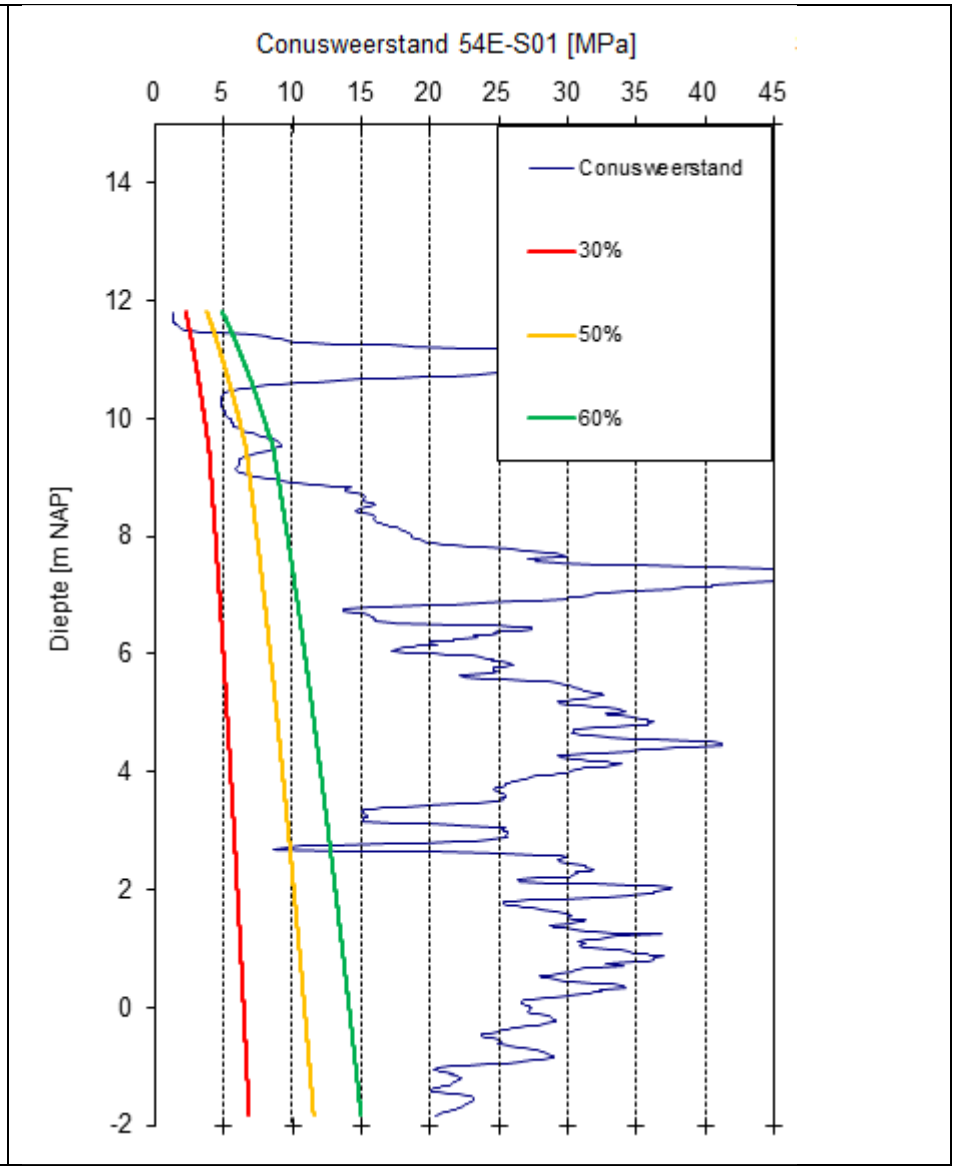
Formula 1: exclusive friction in clay

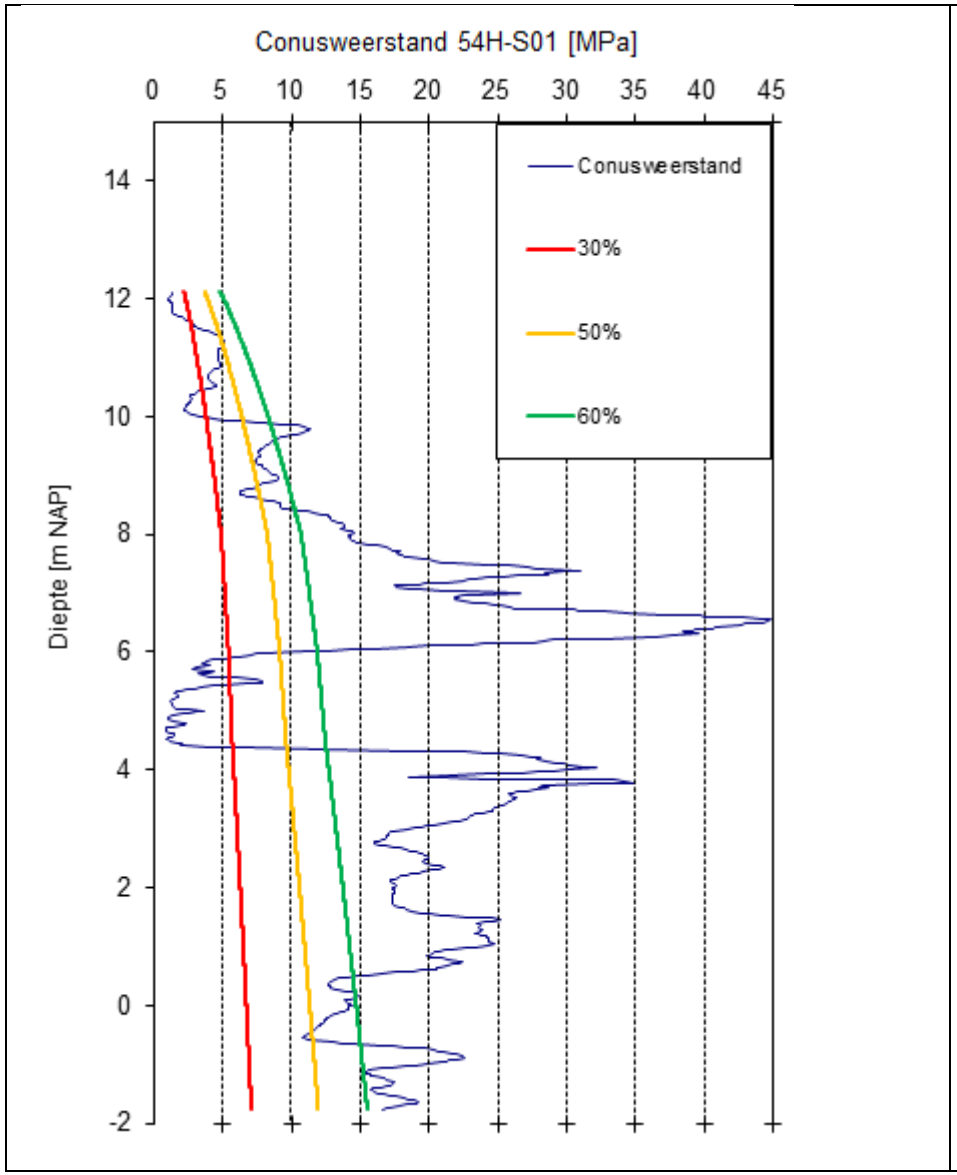
Formula 2: inclusive friction in clay (in forces per meter run)

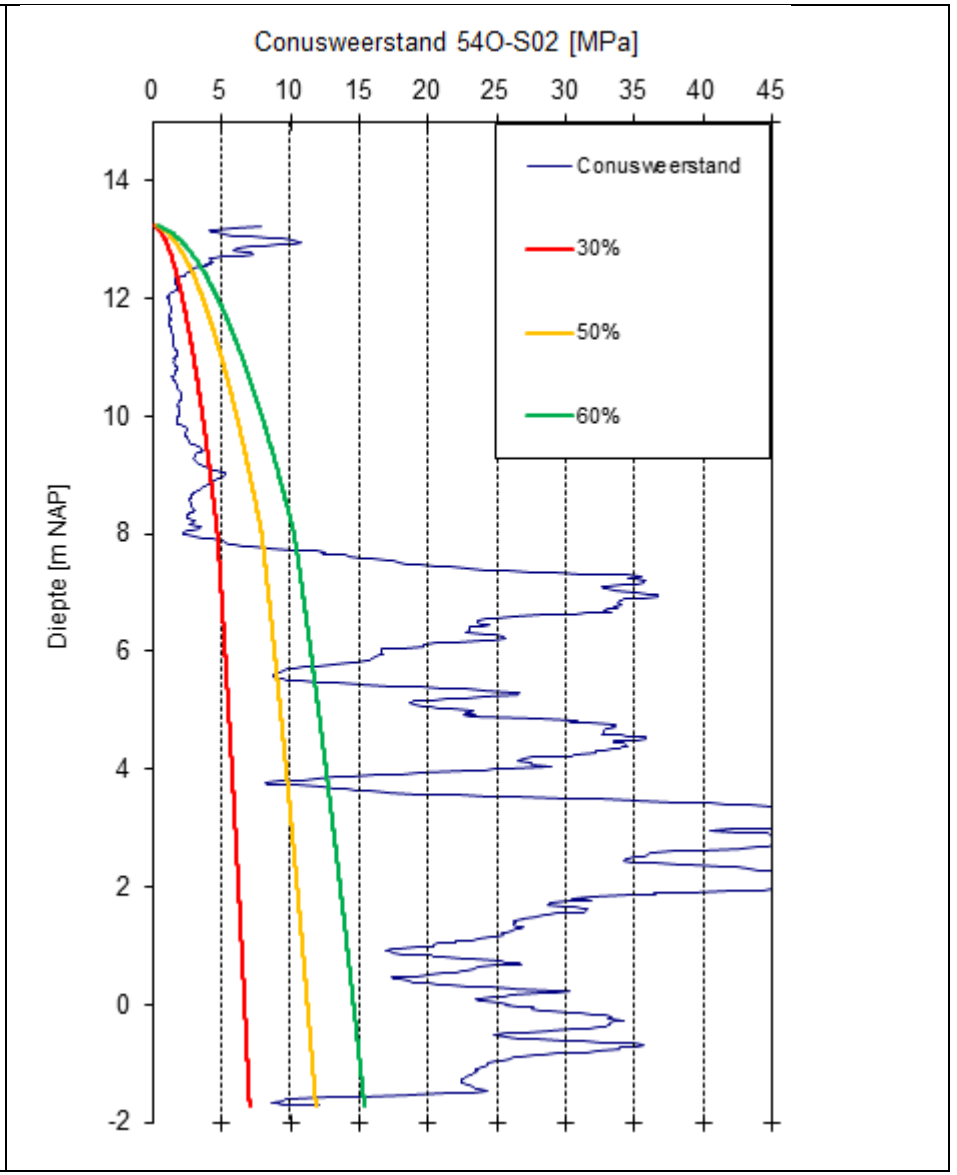
	value	unit	
Action:	-12,39	*kN/m2*	shear pressure perpendicular to slope
Resistance:	50,46	*kN/m2*	resistance clay
Resistance / Action	**OK**	-	no shear if resistance/action >= 1, or OK

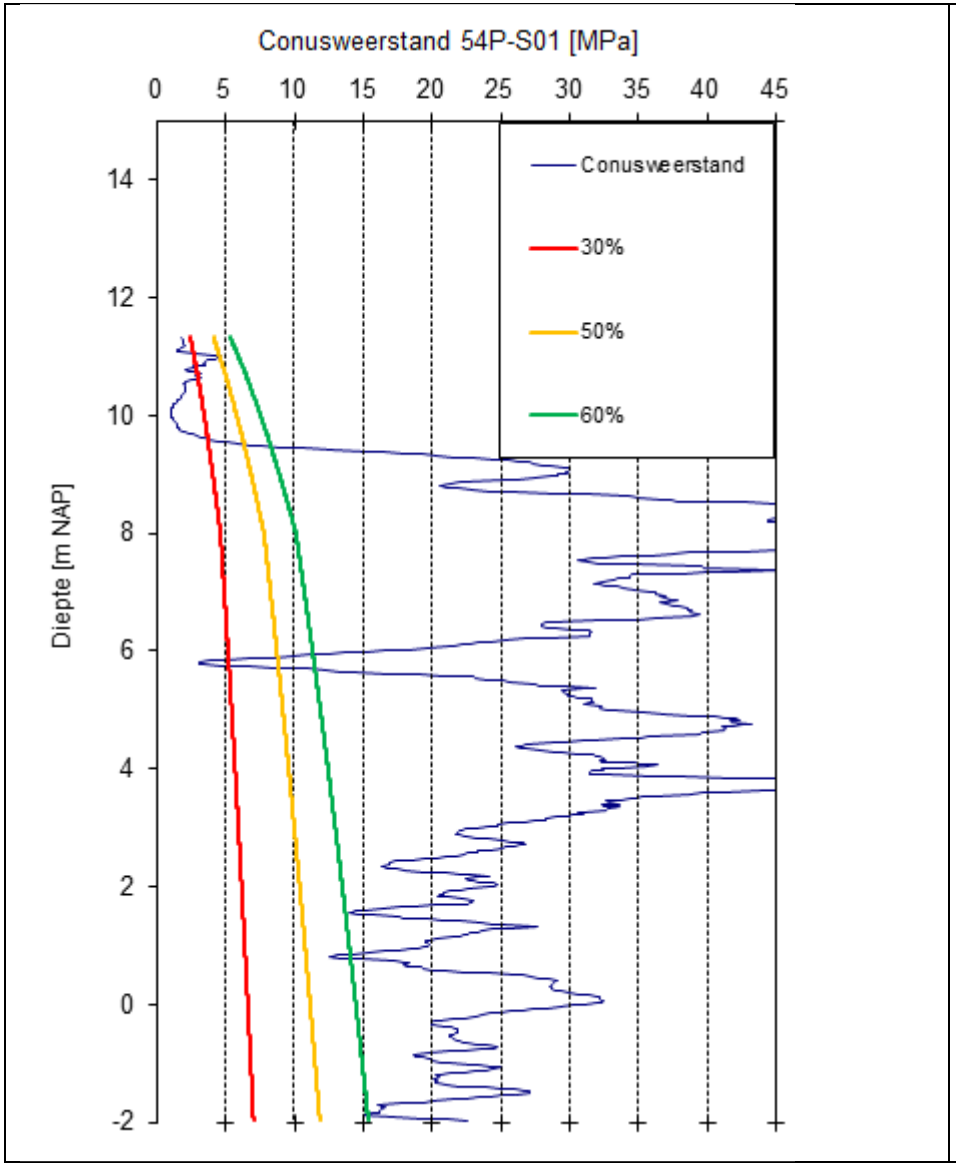
BIJLAGE 7 Stabiliteit voorland

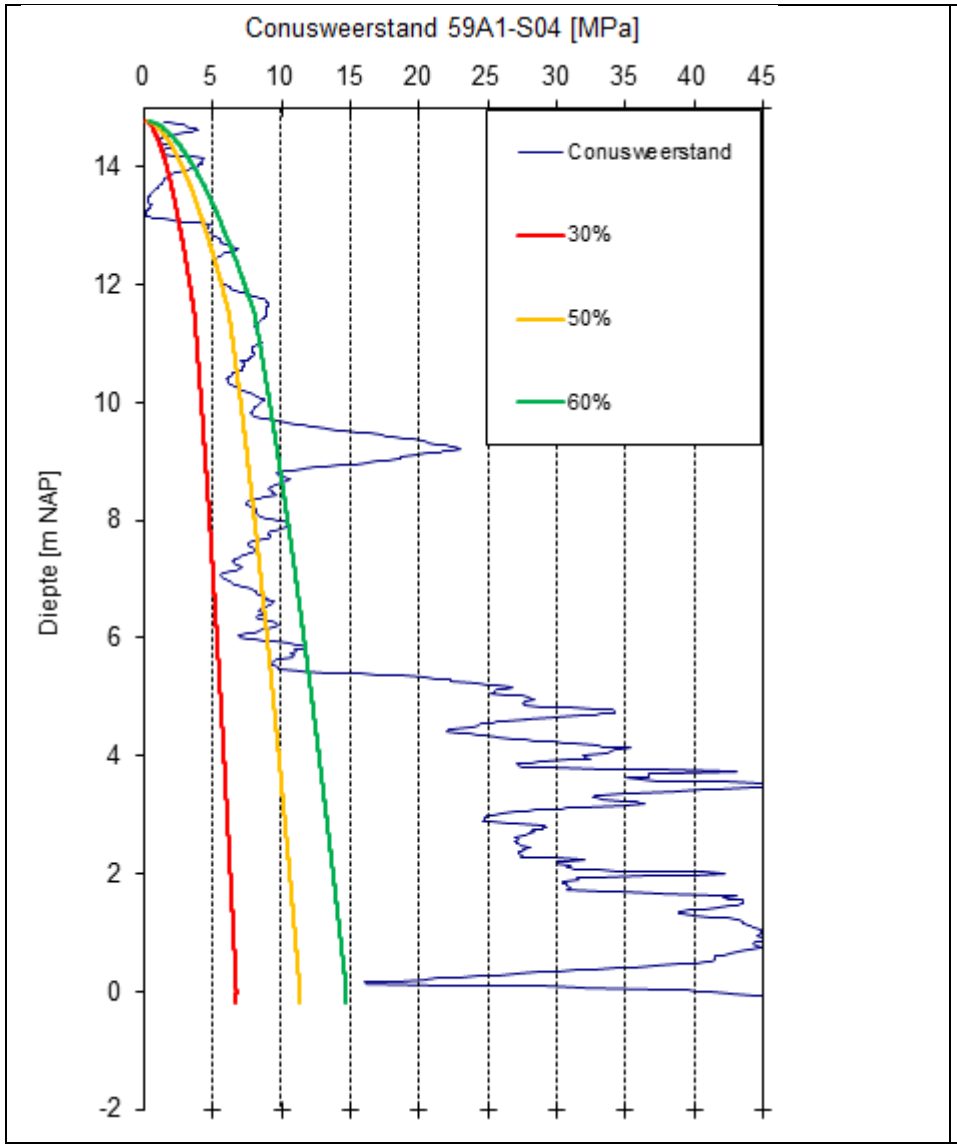

Conusweerstand 54A-S01 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0
Diepte [m NAP]
Conusweerstand
30%
50%
60%

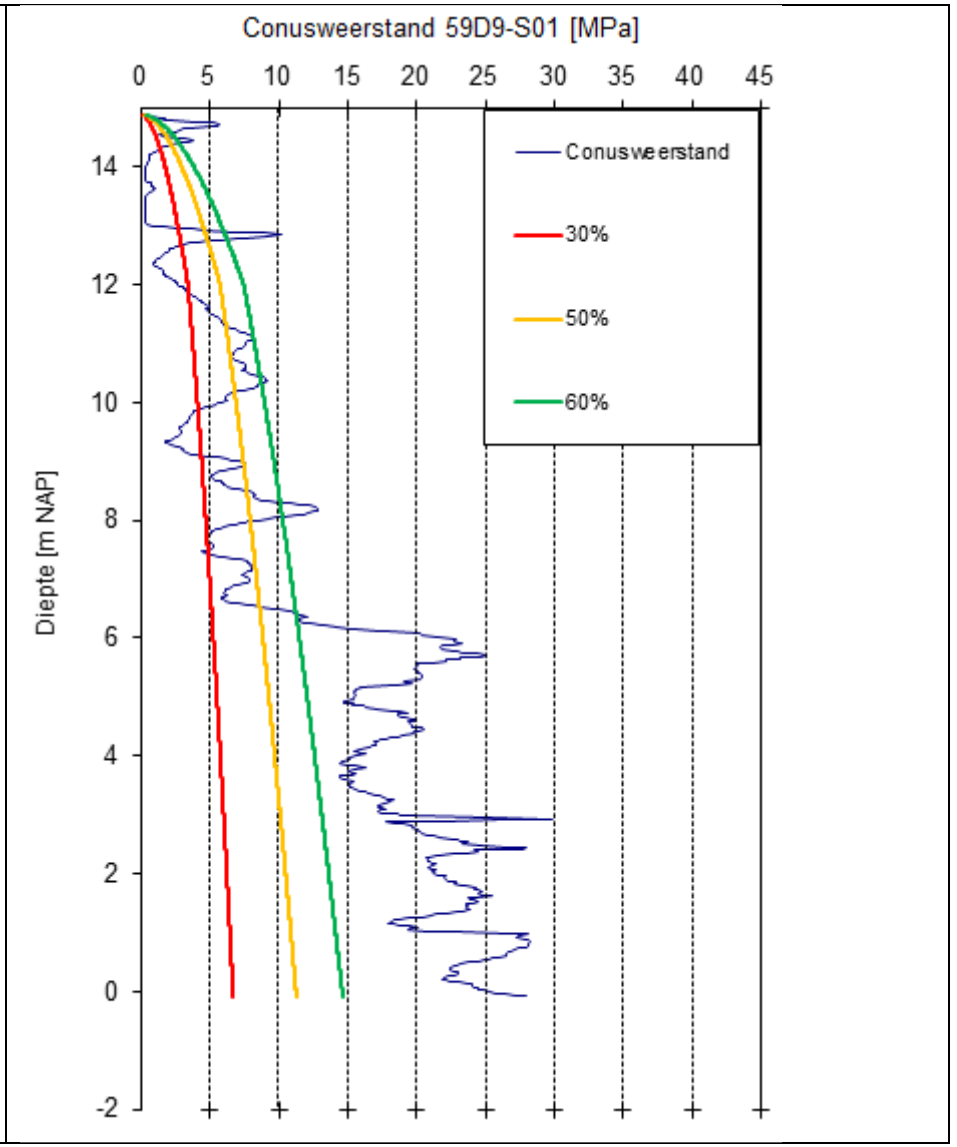

Conusweerstand 54E-S01 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%

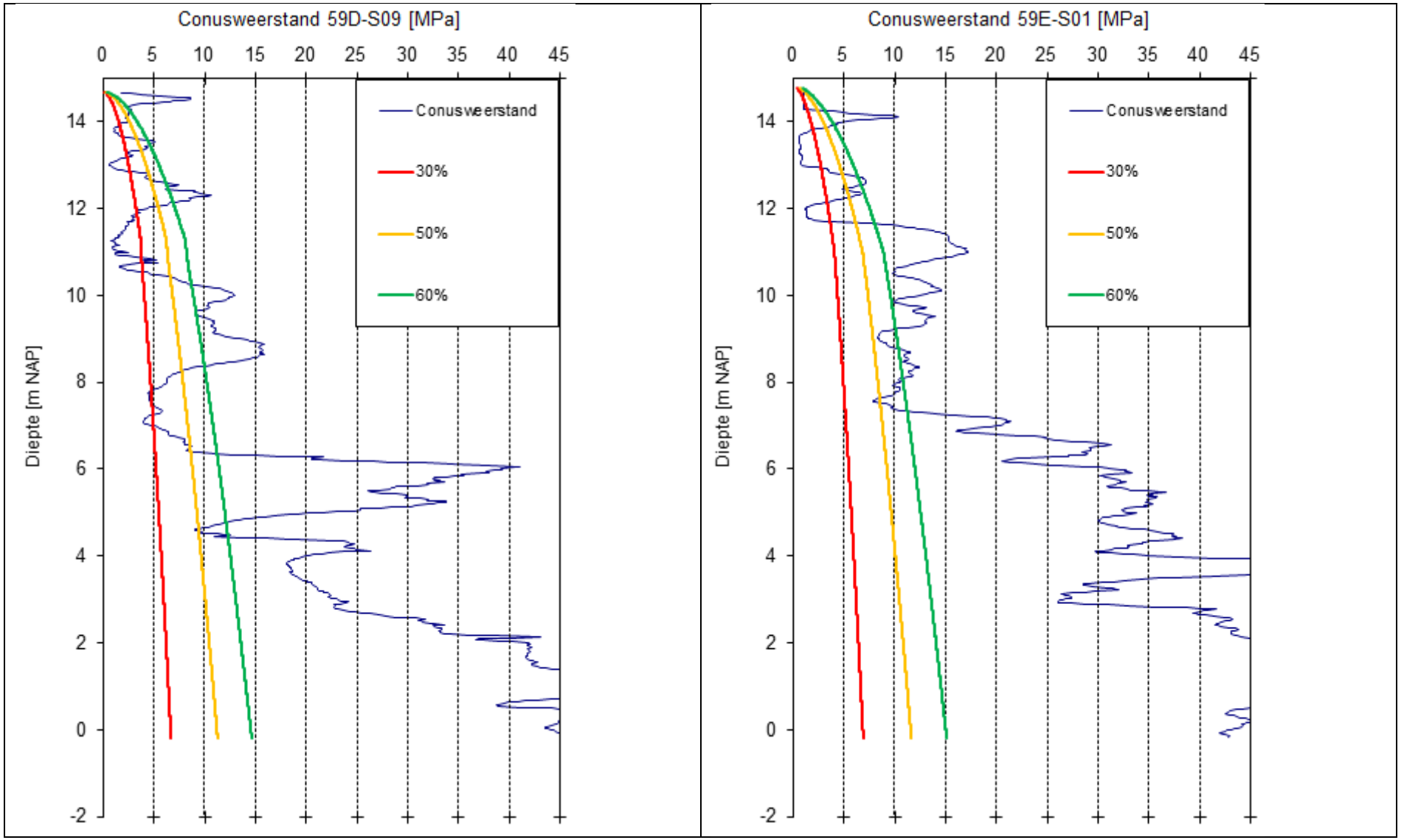

Conusweerstand 54H-S01 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%


Conusweerstand 54O-S02 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%


Conusweerstand 54P-S01 [MPa]
0
5
10
15
20
25
30
35
40
45
14
12
10
8
6
4
2
0
-2
Diepte [m NAP]
Conusweerstand
30%
50%
60%


Conusweerstand 59A1-S04 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%


Conusweerstand 59D9-S01 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%


Conusweerstand 59D-S09 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%
Conusweerstand 59E-S01 [MPa]
0 5 10 15 20 25 30 35 40 45
14 12 10 8 6 4 2 0 -2
Diepte [m NAP]
Conusweerstand
30%
50%
60%

BIJLAGE 8 Zettingen

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	27-11-2014
Time of report:	11:34:36
Date of calculation:	11/25/2014
Time of calculation:	3:47:43 PM
Filename:	C:\..\02 Geotechniek\07 Zetting\Zetting DP54.186-187
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei Zetting DR54.186-187

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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
4 - X -	-30.000	-7.300	-6.500	-4.500	2.500
4 - Y -	8.600	8.600	8.600	9.000	11.450
4 - X -	4.500	25.200	36.300	45.800	
4 - Y -	12.370	12.800	12.400	12.200	
3 - X -	-30.000	-6.500	4.500	10.000	25.200
3 - Y -	8.000	8.000	9.200	9.200	12.800
3 - X -	36.300	45.800			
3 - Y -	12.400	12.200			
2 - X -	-30.000	45.800			
2 - Y -	3.000	3.000			
1 - X -	-30.000	45.800			
1 - Y -	1.000	1.000			
0 - X -	-30.000	45.800			
0 - Y -	0.000	0.000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-30.000	45.800			
1 - Y -	6.600	6.600			

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9.81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000.00 [days]
With maintain profile	
(only for non uniform loads)	
- Material:	Superelevation
- Time:	0.00 [days]
- Unit weight above phreatic.:	18.00 [kN/m³]
- Unit weight below phreatic:	20.00 [kN/m³]
- Iteration stop criterium:	0.10 [m]
Pc (initial):	Variable parallel to the initial effective stress
Pc (per step):	Automatic increased to the final effective stresses
No imaginary surface	
With submerging	
(only for non uniform loads)	
- Iteration stop criterium :	0.10 [m]
Load column width	
- Non-Uniform Loads :	1.00 [m]
- Trapezoidal Loads :	1.00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
4	Klei, zandig	1	1
3	Zand	1	1

Layer number	Material name	PL-line top	PL-line bottom
2	Grind	1	1
1	Zand	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
4	No	18.00	18.00
3	Yes	18.00	20.00
2	Yes	19.00	20.00
1	Yes	18.00	20.00

Layer number	Vert. consolid. coefficient Cv [m²/s]
4	1.00E-06
3	-
2	-
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
4	-	10.00	-
3	-	-	1.30
2	-	-	1.30
1	-	-	1.30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
4	1.00E+02	2.00E+01	1.20E+03	2.40E+02	1.00E+02	2.40E+02
3	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09
2	5.00E+03	1.00E+03	1.00E+09	1.00E+09	5.00E+03	1.00E+09
1	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18.00	20.00

Load number	Co-ordinates [m]					
1 - X -	-7.30	0.75	3.75	4.50		
1 - Y -	8.60	12.62	12.62	12.37		

2.7 Verticals

Vertical number	X co-ordinates [m]				
1 - 5	-30.000	-7.300	-6.500	-4.500	0.750
6 - 10	2.500	3.750	4.500	10.000	25.200
11 - 12	36.300	45.800			

3 Results per Vertical

3.1 Results for Vertical 1 (X = -30.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
8.60	0.001	0.000	0.001	0.001	0.000	0.001
8.50	1.800	0.000	1.800	1.800	0.000	1.800
8.40	3.600	0.000	3.600	3.600	0.000	3.600
8.30	5.400	0.000	5.400	5.400	0.000	5.400
8.20	7.200	0.000	7.200	7.200	0.000	7.200
8.10	9.000	0.000	9.000	9.000	0.000	9.000
8.00	10.800	0.000	10.800	10.800	0.000	10.800
Layer 3						
8.00	10.800	0.000	10.800	10.801	0.000	10.801
7.90	12.600	0.000	12.600	12.600	0.000	12.600
7.80	14.400	0.000	14.400	14.400	0.000	14.400
7.70	16.200	0.000	16.200	16.201	0.000	16.201
7.60	18.000	0.000	18.000	18.001	0.000	18.001
6.60	36.000	0.000	36.000	36.002	0.000	36.002
6.10	46.000	4.905	41.095	46.003	4.905	41.098
5.50	58.000	10.791	47.209	58.005	10.791	47.214
4.60	76.000	19.620	56.380	76.009	19.620	56.389
3.60	96.000	29.430	66.570	96.016	29.430	66.586
3.00	108.000	35.316	72.684	108.022	35.316	72.706
Layer 2						
3.00	108.000	35.316	72.684	108.022	35.316	72.706
2.00	128.000	45.126	82.874	128.035	45.126	82.909
1.00	148.000	54.936	93.064	148.052	54.936	93.116
Layer 1						
1.00	148.000	54.936	93.064	148.052	54.936	93.116
0.50	158.000	59.841	98.159	158.063	59.841	98.222
0.00	168.000	64.746	103.254	168.075	64.746	103.329

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
8.60	8.00	4	0.0000	0.0000	0.0000	0.00
8.00	3.00	3	0.0000	0.0000	0.0000	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.2 Results for Vertical 2 (X = -7.30 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
8.60	0.001	0.000	0.001	2.002	0.000	2.002
8.50	1.800	0.000	1.800	3.842	0.000	3.842
8.40	3.600	0.000	3.600	5.705	0.000	5.705
8.30	5.400	0.000	5.400	7.598	0.000	7.598
8.20	7.200	0.000	7.200	9.522	0.000	9.522
8.10	9.000	0.000	9.000	11.474	0.000	11.474
8.00	10.800	0.000	10.800	13.449	0.000	13.449
Layer 3						
8.00	10.800	0.000	10.800	13.449	0.000	13.449
7.90	12.600	0.000	12.600	15.440	0.000	15.440
7.80	14.400	0.000	14.400	17.442	0.000	17.442
7.70	16.200	0.000	16.200	19.451	0.000	19.451
7.60	18.000	0.000	18.000	21.462	0.000	21.462
6.60	36.000	0.000	36.000	41.407	0.002	41.405
6.10	46.000	4.905	41.095	52.177	4.907	47.270
5.50	58.000	10.791	47.209	64.929	10.793	54.137
4.60	76.000	19.620	56.380	83.765	19.621	64.143
3.60	96.000	29.430	66.570	104.372	29.431	74.941
3.00	108.000	35.316	72.684	116.611	35.317	81.295
Layer 2						
3.00	108.000	35.316	72.684	116.612	35.317	81.295
2.00	128.000	45.126	82.874	136.854	45.126	91.728
1.00	148.000	54.936	93.064	156.948	54.936	102.012
Layer 1						
1.00	148.000	54.936	93.064	156.948	54.936	102.012
0.50	158.000	59.841	98.159	166.953	59.841	107.112
0.00	168.000	64.746	103.254	176.936	64.746	112.190

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0029	0.0002	0.0000	0.0000
3	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0032	0.0002	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
8.60	8.00	4	0.0029	0.0002	0.0039	0.65
8.00	3.00	3	0.0002	0.0000	0.0002	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0032	0.0002	0.0042	

3.3 Results for Vertical 3 (X = -6.50 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
8.60	0.001	0.000	0.001	7.233	0.000	7.233
8.50	1.800	0.000	1.800	9.122	0.000	9.122
8.40	3.600	0.000	3.600	11.040	0.000	11.040
8.30	5.400	0.000	5.400	12.977	0.000	12.977

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
8.20	7.200	0.000	7.200	14.924	0.000	14.924
8.10	9.000	0.000	9.000	16.873	0.000	16.873
8.00	10.800	0.000	10.800	18.817	0.000	18.817
Layer 3						
8.00	10.800	0.000	10.800	18.817	0.000	18.817
7.90	12.600	0.000	12.600	20.754	0.000	20.754
7.80	14.400	0.000	14.400	22.684	0.000	22.684
7.70	16.200	0.000	16.200	24.606	0.000	24.606
7.60	18.000	0.000	18.000	26.522	0.000	26.522
6.60	36.000	0.000	36.000	45.482	0.003	45.479
6.10	46.000	4.905	41.095	55.846	4.908	50.939
5.50	58.000	10.791	47.209	68.186	10.793	57.393
4.60	76.000	19.620	56.380	86.515	19.622	66.893
3.60	96.000	29.430	66.570	106.674	29.431	77.243
3.00	108.000	35.316	72.684	118.689	35.317	83.372
Layer 2						
3.00	108.000	35.316	72.684	118.689	35.317	83.373
2.00	128.000	45.126	82.874	138.613	45.127	93.487
1.00	148.000	54.936	93.064	158.445	54.936	103.509
Layer 1						
1.00	148.000	54.936	93.064	158.445	54.936	103.509
0.50	158.000	59.841	98.159	168.336	59.841	108.495
0.00	168.000	64.746	103.254	178.215	64.746	113.469

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0066	0.0005	0.0000	0.0000
3	0.0000	0.0000	0.0003	0.0000	0.0002	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0070	0.0005	0.0002	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
8.60	8.00	4	0.0066	0.0005	0.0087	1.45
8.00	3.00	3	0.0005	0.0000	0.0005	0.01
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0072	0.0005	0.0093	

3.4 Results for Vertical 4 (X = -4.50 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
9.00	0.001	0.000	0.001	17.722	0.000	17.722
8.90	1.800	0.000	1.800	20.638	0.000	20.638
8.80	3.600	0.000	3.600	22.683	0.000	22.683
8.70	5.400	0.000	5.400	24.733	0.000	24.733
8.61	7.036	0.000	7.036	26.581	0.000	26.581
8.60	7.200	0.000	7.200	26.764	0.000	26.764
8.50	9.000	0.000	9.000	28.759	0.000	28.759
8.40	10.800	0.000	10.800	30.709	0.000	30.709
8.30	12.600	0.000	12.600	32.613	0.000	32.613
8.22	14.073	0.000	14.073	34.142	0.000	34.142
Layer 3						

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
8.22	14.073	0.000	14.073	34.142	0.000	34.142
8.20	14.400	0.000	14.400	34.479	0.000	34.479
8.10	16.200	0.000	16.200	36.313	0.000	36.313
8.00	18.000	0.000	18.000	38.123	0.000	38.123
7.30	30.600	0.000	30.600	50.455	0.000	50.455
6.60	43.200	0.000	43.200	62.507	0.005	62.502
5.61	63.018	9.721	53.297	81.336	9.724	71.612
4.80	79.200	17.658	61.542	96.667	17.660	79.007
3.80	99.200	27.468	71.732	115.640	27.469	88.171
3.00	115.200	35.316	79.884	130.859	35.317	95.542
Layer 2						
3.00	115.200	35.316	79.884	130.859	35.317	95.542
2.00	135.200	45.126	90.074	149.942	45.127	104.816
1.00	155.200	54.936	100.264	169.094	54.936	114.158
Layer 1						
1.00	155.200	54.936	100.264	169.094	54.936	114.158
0.50	165.200	59.841	105.359	178.695	59.841	118.854
0.00	175.200	64.746	110.454	188.312	64.746	123.566

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0087	0.0007	0.0177	0.0015
3	0.0000	0.0000	0.0004	0.0000	0.0009	0.0000
2	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0093	0.0007	0.0186	0.0015

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Total settlement (100% cons.) Secondary 10 [days] [m]	Total settlement (100% cons.) After 10000 [days] [m]	Percentage of original layer height [%]
9.00	8.22	4	0.0265	0.0022	0.0345	4.41
8.22	3.00	3	0.0013	0.0000	0.0013	0.03
3.00	1.00	2	0.0001	0.0000	0.0001	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0279	0.0022	0.0359	

3.5 Results for Vertical 5 (X = 0.75 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
10.84	0.001	0.000	0.001	31.577	0.000	31.577
10.74	1.800	0.000	1.800	33.894	0.000	33.894
10.64	3.600	0.000	3.600	35.329	0.000	35.329
10.54	5.400	0.000	5.400	35.836	0.000	35.836
10.44	7.200	0.000	7.200	36.311	0.000	36.311
10.34	9.000	0.000	9.000	37.764	0.000	37.764
10.24	10.800	0.000	10.800	39.849	0.000	39.849
10.14	12.600	0.000	12.600	42.035	0.000	42.035
10.04	14.400	0.000	14.400	44.108	0.000	44.108
9.94	16.200	0.000	16.200	46.030	0.000	46.030
9.84	18.000	0.000	18.000	47.818	0.000	47.818
9.81	18.419	0.000	18.419	48.218	0.000	48.218
9.29	27.839	0.000	27.839	56.415	0.000	56.415
8.79	36.839	0.000	36.839	63.957	0.000	63.957
Layer 3						
8.79	36.839	0.000	36.839	63.958	0.000	63.958

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
8.00	51.075	0.000	51.075	76.139	0.000	76.139
7.00	69.075	0.000	69.075	91.975	0.000	91.975
6.60	76.275	0.000	76.275	98.424	0.003	98.421
5.90	90.366	6.912	83.454	111.309	6.914	104.395
5.00	108.275	15.696	92.579	127.863	15.698	112.165
4.00	128.275	25.506	102.769	146.521	25.507	121.014
3.00	148.275	35.316	112.959	165.317	35.317	130.000
Layer 2						
3.00	148.275	35.316	112.959	165.317	35.317	130.000
2.00	168.275	45.126	123.149	184.223	45.127	139.096
1.00	188.275	54.936	133.339	203.225	54.936	148.289
Layer 1						
1.00	188.275	54.936	133.339	203.225	54.936	148.289
0.50	198.275	59.841	138.434	212.759	59.841	152.918
0.00	208.275	64.746	143.529	222.314	64.746	157.568

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
4	0.0000	0.0000	0.0131	0.0011	0.0591	0.0049
3	0.0000	0.0000	0.0004	0.0000	0.0004	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0136	0.0011	0.0595	0.0049

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
10.84	8.79	4	0.0722	0.0060	0.0936	4.57
8.79	3.00	3	0.0008	0.0000	0.0008	0.01
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0731	0.0060	0.0945	

3.6 Results for Vertical 6 (X = 2.50 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
11.45	0.001	0.000	0.001	20.155	0.000	20.155
11.35	1.800	0.000	1.800	22.890	0.000	22.890
11.25	3.600	0.000	3.600	24.989	0.000	24.989
11.15	5.400	0.000	5.400	26.771	0.000	26.771
11.05	7.200	0.000	7.200	28.481	0.000	28.481
10.95	9.000	0.000	9.000	30.085	0.000	30.085
10.85	10.800	0.000	10.800	31.579	0.000	31.579
10.75	12.600	0.000	12.600	33.004	0.000	33.004
10.65	14.400	0.000	14.400	34.419	0.000	34.419
10.55	16.200	0.000	16.200	35.872	0.000	35.872
10.45	18.000	0.000	18.000	37.385	0.000	37.385
10.22	22.214	0.000	22.214	41.137	0.000	41.137
9.58	33.627	0.000	33.627	51.830	0.000	51.830
8.98	44.427	0.000	44.427	62.026	0.000	62.026
Layer 3						
8.98	44.427	0.000	44.427	62.026	0.000	62.026
8.20	58.500	0.000	58.500	75.426	0.000	75.426
7.20	76.500	0.000	76.500	92.714	0.000	92.714
6.60	87.300	0.000	87.300	103.132	0.002	103.130

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
5.99	99.482	5.975	93.507	114.944	5.977	108.967
5.00	119.300	15.696	103.604	134.185	15.697	118.487
4.00	139.300	25.506	113.794	153.616	25.507	128.109
3.00	159.300	35.316	123.984	173.054	35.317	137.737
Layer 2						
3.00	159.300	35.316	123.984	173.054	35.317	137.737
2.00	179.300	45.126	134.174	192.495	45.126	147.369
1.00	199.300	54.936	144.364	211.943	54.936	157.007
Layer 1						
1.00	199.300	54.936	144.364	211.943	54.936	157.007
0.50	209.300	59.841	149.459	221.671	59.841	161.830
0.00	219.300	64.746	154.554	231.402	64.746	166.656

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0141	0.0012	0.0377	0.0031
3	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0145	0.0012	0.0377	0.0031

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11.45	8.98	4	0.0517	0.0043	0.0677	2.74
8.98	3.00	3	0.0004	0.0000	0.0004	0.01
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0522	0.0043	0.0681	

3.7 Results for Vertical 7 (X = 3.75 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
12.02	0.001	0.000	0.001	8.450	0.000	8.450
11.93	1.800	0.000	1.800	10.771	0.000	10.771
11.82	3.600	0.000	3.600	12.411	0.000	12.411
11.72	5.400	0.000	5.400	13.681	0.000	13.681
11.63	7.200	0.000	7.200	14.783	0.000	14.783
11.53	9.000	0.000	9.000	16.163	0.000	16.163
11.43	10.800	0.000	10.800	18.116	0.000	18.116
11.32	12.600	0.000	12.600	20.327	0.000	20.327
11.22	14.400	0.000	14.400	22.527	0.000	22.527
11.13	16.200	0.000	16.200	24.633	0.000	24.633
11.03	18.000	0.000	18.000	26.639	0.000	26.639
10.57	26.161	0.000	26.161	35.050	0.000	35.050
9.82	39.723	0.000	39.723	48.785	0.000	48.785
9.12	52.323	0.000	52.323	61.804	0.000	61.804
Layer 3						
9.12	52.323	0.000	52.323	61.804	0.000	61.804
8.20	68.850	0.000	68.850	78.922	0.000	78.922
7.20	86.850	0.000	86.850	97.426	0.000	97.426
6.60	97.650	0.000	97.650	108.443	0.002	108.441
6.06	108.468	5.306	103.162	119.403	5.308	114.095
5.40	121.650	11.772	109.878	132.698	11.773	120.925
4.40	141.650	21.582	120.068	152.761	21.583	131.178

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
3.40	161.650	31.392	130.258	172.717	31.393	141.325
3.00	169.650	35.316	134.334	180.675	35.316	145.359
Layer 2						
3.00	169.650	35.316	134.334	180.675	35.317	145.359
2.00	189.650	45.126	144.524	200.519	45.126	155.393
1.00	209.650	54.936	154.714	220.306	54.936	165.370
Layer 1						
1.00	209.650	54.936	154.714	220.306	54.936	165.370
0.50	219.650	59.841	159.809	230.183	59.841	170.342
0.00	229.650	64.746	164.904	240.051	64.746	175.305

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0133	0.0011	0.0000	0.0000
3	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0136	0.0011	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12.03	9.12	4	0.0133	0.0011	0.0176	0.61
9.12	3.00	3	0.0002	0.0000	0.0002	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0136	0.0011	0.0179	

3.8 Results for Vertical 8 (X = 4.50 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
12.37	0.001	0.000	0.001	1.244	0.000	1.244
12.27	1.800	0.000	1.800	3.946	0.000	3.946
12.17	3.600	0.000	3.600	6.403	0.000	6.403
12.07	5.400	0.000	5.400	8.208	0.000	8.208
11.97	7.200	0.000	7.200	10.009	0.000	10.009
11.87	9.000	0.000	9.000	11.798	0.000	11.798
11.77	10.800	0.000	10.800	13.574	0.000	13.574
11.67	12.600	0.000	12.600	15.346	0.000	15.346
11.57	14.400	0.000	14.400	17.125	0.000	17.125
11.47	16.200	0.000	16.200	18.918	0.000	18.918
11.37	18.000	0.000	18.000	20.732	0.000	20.732
10.79	28.530	0.000	28.530	31.838	0.000	31.838
10.00	42.660	0.000	42.660	47.189	0.000	47.189
9.20	57.060	0.000	57.060	62.671	0.000	62.671
Layer 3						
9.20	57.060	0.000	57.060	62.671	0.000	62.671
8.40	71.460	0.000	71.460	78.013	0.000	78.013
7.40	89.460	0.000	89.460	96.988	0.000	96.988
6.60	103.860	0.000	103.860	112.002	0.001	112.000
6.10	113.860	4.905	108.955	122.313	4.906	117.407
5.40	127.860	11.772	116.088	136.666	11.773	124.893
4.40	147.860	21.582	126.278	157.022	21.583	135.439
3.40	167.860	31.392	136.468	177.232	31.393	145.839
3.00	175.860	35.316	140.544	185.282	35.316	149.965

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
3.00	175.860	35.316	140.544	185.282	35.317	149.965
2.00	195.860	45.126	150.734	205.334	45.126	160.207
1.00	215.860	54.936	160.924	225.301	54.936	170.365
Layer 1						
1.00	215.860	54.936	160.924	225.301	54.936	170.365
0.50	225.860	59.841	166.019	235.259	59.841	175.418
0.00	235.860	64.746	171.114	245.203	64.746	180.457

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0061	0.0005	0.0000	0.0000
3	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0063	0.0005	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12.37	9.20	4	0.0061	0.0005	0.0081	0.26
9.20	3.00	3	0.0002	0.0000	0.0002	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0063	0.0005	0.0083	

3.9 Results for Vertical 9 (X = 10.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
12.48	0.001	0.000	0.001	0.001	0.000	0.001
12.38	1.800	0.000	1.800	1.800	0.000	1.800
12.28	3.600	0.000	3.600	3.600	0.000	3.600
12.18	5.400	0.000	5.400	5.400	0.000	5.400
12.08	7.200	0.000	7.200	7.200	0.000	7.200
11.98	9.000	0.000	9.000	9.000	0.000	9.000
11.88	10.800	0.000	10.800	10.800	0.000	10.800
11.78	12.600	0.000	12.600	12.600	0.000	12.600
11.68	14.400	0.000	14.400	14.400	0.000	14.400
11.58	16.200	0.000	16.200	16.200	0.000	16.200
11.48	18.000	0.000	18.000	18.000	0.000	18.000
10.84	29.558	0.000	29.558	29.561	0.000	29.561
10.00	44.717	0.000	44.717	44.738	0.000	44.738
9.20	59.117	0.000	59.117	59.190	0.000	59.190
Layer 3						
9.20	59.117	0.000	59.117	59.190	0.000	59.190
8.40	73.517	0.000	73.517	73.694	0.000	73.694
7.40	91.517	0.000	91.517	91.912	0.000	91.912
6.60	105.917	0.000	105.917	106.553	0.000	106.553
6.10	115.917	4.905	111.012	116.730	4.905	111.825
5.40	129.917	11.772	118.145	131.002	11.772	119.230
4.40	149.917	21.582	128.335	151.423	21.582	129.841
3.40	169.917	31.392	138.525	171.859	31.392	140.466
3.00	177.917	35.316	142.601	180.031	35.316	144.715
Layer 2						
3.00	177.917	35.316	142.601	180.032	35.316	144.715

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
2.00	197.917	45.126	152.791	200.450	45.126	155.324
1.00	217.917	54.936	162.981	220.838	54.936	165.902
Layer 1						
1.00	217.917	54.936	162.981	220.838	54.936	165.902
0.50	227.917	59.841	168.076	231.018	59.841	171.177
0.00	237.917	64.746	173.171	241.188	64.746	176.442

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12.48	9.20	4	0.0000	0.0000	0.0000	0.00
9.20	3.00	3	0.0000	0.0000	0.0000	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.10 Results for Vertical 10 (X = 25.20 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 3						
12.80	0.001	0.000	0.001	0.001	0.000	0.001
12.70	1.800	0.000	1.800	1.800	0.000	1.800
12.60	3.600	0.000	3.600	3.600	0.000	3.600
12.50	5.400	0.000	5.400	5.400	0.000	5.400
12.40	7.200	0.000	7.200	7.200	0.000	7.200
12.30	9.000	0.000	9.000	9.000	0.000	9.000
12.20	10.800	0.000	10.800	10.800	0.000	10.800
12.10	12.600	0.000	12.600	12.600	0.000	12.600
12.00	14.400	0.000	14.400	14.400	0.000	14.400
11.90	16.200	0.000	16.200	16.200	0.000	16.200
11.80	18.000	0.000	18.000	18.000	0.000	18.000
10.90	34.200	0.000	34.200	34.200	0.000	34.200
9.90	52.200	0.000	52.200	52.200	0.000	52.200
8.90	70.200	0.000	70.200	70.201	0.000	70.201
7.90	88.200	0.000	88.200	88.202	0.000	88.202
7.20	100.800	0.000	100.800	100.804	0.000	100.804
6.60	111.600	0.000	111.600	111.606	0.000	111.606
5.70	129.600	8.829	120.771	129.612	8.829	120.783
4.70	149.600	18.639	130.961	149.622	18.639	130.983
3.70	169.600	28.449	141.151	169.638	28.449	141.189
3.00	183.600	35.316	148.284	183.652	35.316	148.336
Layer 2						
3.00	183.600	35.316	148.284	183.652	35.316	148.336
2.00	203.600	45.126	158.474	203.678	45.126	158.552
1.00	223.600	54.936	168.664	223.710	54.936	168.774
Layer 1						
1.00	223.600	54.936	168.664	223.711	54.936	168.774
0.50	233.600	59.841	173.759	233.729	59.841	173.888

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
0.00	243.600	64.746	178.854	243.750	64.746	179.004

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12.80	3.00	3	0.0000	0.0000	0.0000	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.11 Results for Vertical 11 (X = 36.30 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 3						
12.40	0.001	0.000	0.001	0.001	0.000	0.001
12.30	1.800	0.000	1.800	1.800	0.000	1.800
12.20	3.600	0.000	3.600	3.600	0.000	3.600
12.10	5.400	0.000	5.400	5.400	0.000	5.400
12.00	7.200	0.000	7.200	7.200	0.000	7.200
11.90	9.000	0.000	9.000	9.000	0.000	9.000
11.80	10.800	0.000	10.800	10.800	0.000	10.800
11.70	12.600	0.000	12.600	12.600	0.000	12.600
11.60	14.400	0.000	14.400	14.400	0.000	14.400
11.50	16.200	0.000	16.200	16.200	0.000	16.200
11.40	18.000	0.000	18.000	18.000	0.000	18.000
10.40	36.000	0.000	36.000	36.000	0.000	36.000
9.40	54.000	0.000	54.000	54.000	0.000	54.000
8.40	72.000	0.000	72.000	72.000	0.000	72.000
7.70	84.600	0.000	84.600	84.600	0.000	84.600
7.10	95.400	0.000	95.400	95.401	0.000	95.401
6.60	104.400	0.000	104.400	104.401	0.000	104.401
5.70	122.400	8.829	113.571	122.402	8.829	113.573
4.70	142.400	18.639	123.761	142.404	18.639	123.765
3.70	162.400	28.449	133.951	162.406	28.449	133.957
3.00	176.400	35.316	141.084	176.409	35.316	141.093
Layer 2						
3.00	176.400	35.316	141.084	176.409	35.316	141.093
2.00	196.400	45.126	151.274	196.414	45.126	151.288
1.00	216.400	54.936	161.464	216.421	54.936	161.485
Layer 1						
1.00	216.400	54.936	161.464	216.421	54.936	161.485
0.50	226.400	59.841	166.559	226.425	59.841	166.584
0.00	236.400	64.746	171.654	236.429	64.746	171.683

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12.40	3.00	3	0.0000	0.0000	0.0000	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.12 Results for Vertical 12 (X = 45.80 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 3						
12.20	0.001	0.000	0.001	0.001	0.000	0.001
12.10	1.800	0.000	1.800	1.800	0.000	1.800
12.00	3.600	0.000	3.600	3.600	0.000	3.600
11.90	5.400	0.000	5.400	5.400	0.000	5.400
11.80	7.200	0.000	7.200	7.200	0.000	7.200
11.70	9.000	0.000	9.000	9.000	0.000	9.000
11.60	10.800	0.000	10.800	10.800	0.000	10.800
11.50	12.600	0.000	12.600	12.600	0.000	12.600
11.40	14.400	0.000	14.400	14.400	0.000	14.400
11.30	16.200	0.000	16.200	16.200	0.000	16.200
11.20	18.000	0.000	18.000	18.000	0.000	18.000
10.30	34.200	0.000	34.200	34.200	0.000	34.200
9.30	52.200	0.000	52.200	52.200	0.000	52.200
8.30	70.200	0.000	70.200	70.200	0.000	70.200
7.60	82.800	0.000	82.800	82.800	0.000	82.800
6.60	100.800	0.000	100.800	100.800	0.000	100.800
5.70	118.800	8.829	109.971	118.801	8.829	109.972
4.70	138.800	18.639	120.161	138.801	18.639	120.162
3.70	158.800	28.449	130.351	158.802	28.449	130.353
3.00	172.800	35.316	137.484	172.803	35.316	137.487
Layer 2						
3.00	172.800	35.316	137.484	172.803	35.316	137.487
2.00	192.800	45.126	147.674	192.805	45.126	147.679
1.00	212.800	54.936	157.864	212.807	54.936	157.871
Layer 1						
1.00	212.800	54.936	157.864	212.807	54.936	157.871
0.50	222.800	59.841	162.959	222.808	59.841	162.967
0.00	232.800	64.746	168.054	232.810	64.746	168.064

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12.20	3.00	3	0.0000	0.0000	0.0000	0.00
3.00	1.00	2	0.0000	0.0000	0.0000	0.00
1.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-30.00	0.00	8.60	0.000
2	-7.30	0.00	8.60	0.004
3	-6.50	0.00	8.60	0.009
4	-4.50	0.00	9.00	0.036
5	0.75	0.00	10.84	0.095
6	2.50	0.00	11.45	0.068
7	3.75	0.00	12.03	0.018
8	4.50	0.00	12.37	0.008
9	10.00	0.00	12.48	0.000
10	25.20	0.00	12.80	0.000
11	36.30	0.00	12.40	0.000
12	45.80	0.00	12.20	0.000

4.2 Maintain Profile Calculation Results

Load 1 consists of 12.767 m3 per Width
The extra amount of soil to be added is 0.598 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	27-11-2014
Time of report:	11:35:21
Date of calculation:	26-11-2014
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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
5 - X -	-20.000	-12.800	-12.000	-10.500	-9.700
5 - Y -	12.400	12.550	12.000	12.000	12.550
5 - X -	-4.500	0.000	1.440	3.000	5.300
5 - Y -	12.700	14.150	14.800	14.800	14.100
5 - X -	15.600	18.900	20.000		
5 - Y -	14.200	13.300	13.500		
4 - X -	-20.000	-12.800	-12.000	-10.500	-9.700
4 - Y -	12.400	12.550	12.000	12.000	12.550
4 - X -	-4.500	2.000	5.300	15.600	18.900
4 - Y -	12.700	12.800	14.100	14.200	13.300
4 - X -	20.000				
4 - Y -	13.500				
3 - X -	-20.000	-10.400	-4.500	2.000	5.300
3 - Y -	10.300	10.300	11.700	12.800	14.100
3 - X -	15.600	18.900	20.000		
3 - Y -	14.200	13.300	13.500		
2 - X -	-20.000	-12.800	-10.400	-4.500	2.000
2 - Y -	9.700	9.700	10.300	11.700	12.800
2 - X -	5.300	15.600	18.900	20.000	
2 - Y -	14.100	14.200	13.300	13.500	
1 - X -	-20.000	20.000			
1 - Y -	7.500	7.500			
0 - X -	-20.000	20.000			
0 - Y -	0.000	0.000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-20.000	20.000			
1 - Y -	10.900	10.900			

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9.81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000.00 [days]
With maintain profile	
(only for non uniform loads)	
- Material:	Superelevation
- Time:	0.00 [days]
- Unit weight above phreatic.:	18.00 [kN/m³]
- Unit weight below phreatic:	20.00 [kN/m³]
- Iteration stop criterium:	0.10 [m]
Pc (initial):	Variable parallel to the initial effective stress
Pc (per step):	Automatic increased to the final effective stresses
No imaginary surface	
With submerging	
(only for non uniform loads)	
- Iteration stop criterium :	0.10 [m]

Load column width
- Non-Uniform Loads : 1.00 [m]
- Trapezoidal Loads : 1.00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
5	Klei, zandig	1	1
4	Klei, siltig	1	1
3	Klei, zandig	1	1
2	Zand	1	1
1	Grind	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
5	No	18.00	18.00
4	No	17.00	17.00
3	No	18.00	18.00
2	Yes	18.00	20.00
1	Yes	19.00	20.00

Layer number	Vert. consolid. coefficient Cv [m²/s]
5	1.00E-06
4	1.00E-07
3	1.00E-06
2	-
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
5	-	10.00	-
4	-	10.00	-
3	-	10.00	-
2	-	-	1.30
1	-	-	1.30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
5	1.00E+02	2.00E+01	1.20E+03	2.40E+02	1.00E+02	2.40E+02
4	7.50E+01	1.50E+01	3.20E+02	1.60E+02	7.50E+01	1.60E+02
3	1.00E+02	2.00E+01	1.20E+03	2.40E+02	1.00E+02	2.40E+02
2	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09
1	5.00E+03	1.00E+03	1.00E+09	1.00E+09	5.00E+03	1.00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18.00	20.00

Load number	Co-ordinates [m]					
1 - X -	-12.80	-4.50	0.00	1.44		
1 - Y -	12.55	15.28	15.28	14.80		

2.7 Verticals

Vertical number	X co-ordinates [m]

Vertical number	X co-ordinates [m]				
1 - 5	-20.000	-12.800	-12.000	-10.500	-9.700
6 - 10	-4.500	0.000	1.440	3.000	5.300
11 - 13	15.600	18.900	20.000		

3 Results per Vertical

3.1 Results for Vertical 1 (X = -20.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 4						
12.40	0.001	0.000	0.001	0.002	0.000	0.002
12.30	1.700	0.000	1.700	1.701	0.000	1.701
12.20	3.400	0.000	3.400	3.401	0.000	3.401
12.10	5.100	0.000	5.100	5.101	0.000	5.101
12.00	6.800	0.000	6.800	6.802	0.000	6.802
11.90	8.500	0.000	8.500	8.502	0.000	8.502
11.80	10.200	0.000	10.200	10.202	0.000	10.202
11.70	11.900	0.000	11.900	11.903	0.000	11.903
11.60	13.600	0.000	13.600	13.604	0.000	13.604
11.50	15.300	0.000	15.300	15.304	0.000	15.304
11.40	17.000	0.000	17.000	17.005	0.000	17.005
11.35	17.850	0.000	17.850	17.856	0.000	17.856
10.90	25.500	0.000	25.500	25.513	0.001	25.513
10.30	35.700	5.886	29.814	35.734	5.886	29.848
Layer 3						
10.30	35.700	5.886	29.814	35.734	5.887	29.848
10.00	41.100	8.829	32.271	41.151	8.829	32.322
9.70	46.500	11.772	34.728	46.574	11.772	34.802
Layer 2						
9.70	46.500	11.772	34.728	46.574	11.772	34.802
9.10	58.500	17.658	40.842	58.641	17.658	40.983
8.60	68.500	22.563	45.937	68.721	22.563	46.158
8.10	78.500	27.468	51.032	78.825	27.468	51.356
7.50	90.500	33.354	57.146	90.981	33.354	57.626
Layer 1						
7.50	90.500	33.354	57.146	90.981	33.354	57.626
7.00	100.500	38.259	62.241	101.136	38.259	62.877
6.45	111.500	43.654	67.846	112.331	43.655	68.676
5.45	131.500	53.465	78.035	132.738	53.465	79.273
4.45	151.500	63.275	88.225	153.192	63.275	89.917
3.75	165.500	70.141	95.359	167.524	70.142	97.383
3.25	175.500	75.046	100.454	177.764	75.047	102.718
2.70	186.500	80.442	106.058	189.028	80.442	108.585
1.70	206.500	90.252	116.248	209.495	90.252	119.243
0.70	226.500	100.062	126.438	229.939	100.062	129.877
0.00	240.500	106.929	133.571	244.231	106.929	137.302

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12.40	10.30	4	0.0000	0.0000	0.0000	0.00
10.30	9.70	3	0.0000	0.0000	0.0000	0.00
9.70	7.50	2	0.0000	0.0000	0.0000	0.00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
7.50	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0001	0.0000	0.0001	

3.2 Results for Vertical 2 (X = -12.80 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
12.55	0.001	0.000	0.001	1.589	0.000	1.589
12.45	1.700	0.000	1.700	4.212	0.000	4.212
12.35	3.400	0.000	3.400	6.835	0.000	6.835
12.25	5.100	0.000	5.100	9.236	0.000	9.236
12.15	6.800	0.000	6.800	10.962	0.000	10.962
12.05	8.500	0.000	8.500	12.682	0.000	12.682
11.95	10.200	0.000	10.200	14.389	0.000	14.389
11.85	11.900	0.000	11.900	16.081	0.000	16.081
11.75	13.600	0.000	13.600	17.770	0.000	17.770
11.65	15.300	0.000	15.300	19.481	0.000	19.481
11.55	17.000	0.000	17.000	21.235	0.000	21.235
11.43	19.125	0.000	19.125	23.500	0.000	23.500
10.90	28.050	0.000	28.050	33.671	0.048	33.624
10.30	38.250	5.886	32.364	45.369	5.905	39.465
Layer 3						
10.30	38.250	5.886	32.364	45.370	5.905	39.465
10.00	43.650	8.829	34.821	51.406	8.840	42.566
9.70	49.050	11.772	37.278	57.359	11.775	45.584
Layer 2						
9.70	49.050	11.772	37.278	57.360	11.775	45.584
9.10	61.050	17.658	43.392	70.275	17.661	52.614
8.60	71.050	22.563	48.487	80.883	22.565	58.317
8.10	81.050	27.468	53.582	91.392	27.470	63.922
7.50	93.050	33.354	59.696	103.908	33.356	70.552
Layer 1						
7.50	93.050	33.354	59.696	103.908	33.356	70.552
7.00	103.050	38.259	64.791	114.274	38.261	76.014
6.45	114.050	43.654	70.395	125.621	43.656	81.965
5.45	134.050	53.465	80.586	146.119	53.466	92.653
4.45	154.050	63.275	90.776	166.466	63.275	103.190
3.75	168.050	70.141	97.909	180.629	70.142	110.487
3.25	178.050	75.046	103.004	190.710	75.047	115.663
2.70	189.050	80.442	108.608	201.769	80.443	121.326
1.70	209.050	90.252	118.798	221.801	90.252	131.549
0.70	229.050	100.062	128.988	241.754	100.062	141.692
0.00	243.050	106.929	136.121	255.683	106.929	148.754

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
4	0.0000	0.0000	0.0100	0.0023	0.0000	0.0000
3	0.0000	0.0000	0.0012	0.0001	0.0000	0.0000
2	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0115	0.0024	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12.55	10.30	4	0.0100	0.0023	0.0192	0.85
10.30	9.70	3	0.0012	0.0001	0.0016	0.27
9.70	7.50	2	0.0001	0.0000	0.0001	0.01
7.50	0.00	1	0.0002	0.0000	0.0002	0.00
Total			0.0115	0.0024	0.0211	

3.3 Results for Vertical 3 (X = -12.00 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
12.00	0.001	0.000	0.001	13.690	0.000	13.690
11.90	1.700	0.000	1.700	15.383	0.000	15.383
11.80	3.400	0.000	3.400	17.066	0.000	17.066
11.70	5.100	0.000	5.100	18.741	0.000	18.741
11.60	6.800	0.000	6.800	20.415	0.000	20.415
11.50	8.500	0.000	8.500	22.094	0.000	22.094
11.40	10.200	0.000	10.200	23.780	0.000	23.780
11.30	11.900	0.000	11.900	25.476	0.000	25.476
11.20	13.600	0.000	13.600	27.179	0.000	27.179
11.15	14.450	0.000	14.450	28.034	0.000	28.034
11.10	15.300	0.000	15.300	28.890	0.000	28.890
11.00	17.000	0.000	17.000	30.604	0.000	30.604
10.90	18.700	0.000	18.700	32.491	0.170	32.321
10.30	28.900	5.886	23.014	42.665	5.937	36.728
Layer 3						
10.30	28.900	5.886	23.014	42.665	5.937	36.728
10.10	32.500	7.848	24.652	46.264	7.876	38.388
9.90	36.100	9.810	26.290	49.862	9.817	40.046
Layer 2						
9.90	36.100	9.810	26.290	49.862	9.817	40.046
9.30	48.100	15.696	32.404	61.930	15.701	46.229
8.70	60.100	21.582	38.518	74.032	21.586	52.446
8.10	72.100	27.468	44.632	86.163	27.471	58.692
7.50	84.100	33.354	50.746	98.306	33.356	64.950
Layer 1						
7.50	84.100	33.354	50.746	98.306	33.356	64.950
7.00	94.100	38.259	55.841	108.423	38.261	70.162
6.45	105.100	43.654	61.445	119.537	43.656	75.880
5.45	125.100	53.465	71.635	139.685	53.466	86.219
4.45	145.100	63.275	81.825	159.742	63.276	96.466
3.75	159.100	70.141	88.959	173.726	70.142	103.584
3.25	169.100	75.046	94.053	183.689	75.047	108.641
2.70	180.100	80.442	99.658	194.625	80.443	114.182
1.70	200.100	90.252	109.848	214.456	90.252	124.203
0.70	220.100	100.062	120.038	234.230	100.062	134.168
0.00	234.100	106.929	127.171	248.047	106.929	141.118

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
4	0.0000	0.0000	0.0172	0.0040	0.0180	0.0017
3	0.0000	0.0000	0.0014	0.0001	0.0020	0.0002
2	0.0000	0.0000	0.0002	0.0000	0.0002	0.0000
1	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0190	0.0042	0.0203	0.0019

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12.00	10.30	4	0.0353	0.0057	0.0569	3.35
10.30	9.90	3	0.0034	0.0003	0.0045	1.13
9.90	7.50	2	0.0004	0.0000	0.0004	0.02
7.50	0.00	1	0.0002	0.0000	0.0002	0.00
Total			0.0393	0.0060	0.0621	

3.4 Results for Vertical 4 (X = -10.50 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
12.00	0.001	0.000	0.001	23.901	0.000	23.901
11.90	1.700	0.000	1.700	25.801	0.000	25.801
11.80	3.400	0.000	3.400	27.671	0.000	27.671
11.70	5.100	0.000	5.100	29.474	0.000	29.474
11.60	6.800	0.000	6.800	31.200	0.000	31.200
11.50	8.500	0.000	8.500	32.861	0.000	32.861
11.40	10.200	0.000	10.200	34.475	0.000	34.475
11.30	11.900	0.000	11.900	36.059	0.000	36.059
11.20	13.600	0.000	13.600	37.625	0.000	37.625
11.15	14.450	0.000	14.450	38.404	0.000	38.404
11.10	15.300	0.000	15.300	39.180	0.000	39.180
11.00	17.000	0.000	17.000	40.729	0.000	40.729
10.90	18.700	0.000	18.700	42.543	0.267	42.276
10.30	28.900	5.886	23.014	51.599	5.907	45.692
Layer 3						
10.30	28.900	5.886	23.014	51.600	5.907	45.692
10.29	29.125	6.009	23.116	51.804	6.027	45.777
10.28	29.350	6.131	23.219	52.008	6.146	45.862
Layer 2						
10.27	29.350	6.131	23.219	52.008	6.146	45.862
9.59	43.100	12.876	30.224	64.917	12.886	52.031
8.89	57.100	19.743	37.357	78.291	19.750	58.541
8.20	70.850	26.487	44.363	91.586	26.492	65.094
7.50	84.850	33.354	51.496	105.213	33.357	71.856
Layer 1						
7.50	84.850	33.354	51.496	105.213	33.357	71.856
7.00	94.850	38.259	56.591	114.972	38.262	76.710
6.45	105.850	43.654	62.195	125.713	43.657	82.056
5.45	125.850	53.465	72.385	145.231	53.466	91.765
4.45	145.850	63.275	82.575	164.717	63.276	101.441
3.75	159.850	70.141	89.709	178.336	70.143	108.193
3.25	169.850	75.046	94.803	188.056	75.047	113.008
2.70	180.850	80.442	100.408	198.741	80.443	118.298
1.70	200.850	90.252	110.598	218.159	90.252	127.906
0.70	220.850	100.062	120.788	237.573	100.062	137.510
0.00	234.850	106.929	127.921	251.165	106.929	144.236

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
4	0.0000	0.0000	0.0172	0.0040	0.0565	0.0053
3	0.0000	0.0000	0.0001	0.0000	0.0004	0.0000
2	0.0000	0.0000	0.0002	0.0000	0.0009	0.0000
1	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0179	0.0040	0.0579	0.0053

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12.00	10.30	4	0.0737	0.0093	0.1069	6.29
10.30	10.28	3	0.0005	0.0000	0.0007	2.60
10.28	7.50	2	0.0012	0.0000	0.0012	0.04
7.50	0.00	1	0.0003	0.0000	0.0003	0.00
Total			0.0757	0.0094	0.1091	

3.5 Results for Vertical 5 (X = -9.70 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
12.55	0.001	0.000	0.001	20.616	0.000	20.616
12.45	1.700	0.000	1.700	23.243	0.000	23.243
12.35	3.400	0.000	3.400	25.842	0.000	25.842
12.25	5.100	0.000	5.100	28.228	0.000	28.228
12.15	6.800	0.000	6.800	29.952	0.000	29.952
12.05	8.500	0.000	8.500	31.675	0.000	31.675
11.95	10.200	0.000	10.200	33.371	0.000	33.371
11.85	11.900	0.000	11.900	35.024	0.000	35.024
11.75	13.600	0.000	13.600	36.643	0.000	36.643
11.65	15.300	0.000	15.300	38.256	0.000	38.256
11.55	17.000	0.000	17.000	39.892	0.000	39.892
11.51	17.713	0.000	17.713	40.589	0.000	40.589
10.90	28.050	0.000	28.050	51.494	0.158	51.337
10.47	35.426	4.257	31.170	59.152	4.270	54.882
Layer 2						
10.47	35.426	4.257	31.170	59.152	4.270	54.882
9.68	51.087	11.938	39.149	75.129	11.948	63.181
8.98	65.087	18.805	46.282	89.044	18.812	70.231
8.20	80.748	26.487	54.261	104.390	26.492	77.898
7.50	94.748	33.354	61.394	117.996	33.357	84.639
Layer 1						
7.50	94.749	33.354	61.394	117.997	33.357	84.639
7.00	104.749	38.259	66.489	127.674	38.262	89.412
6.45	115.748	43.654	72.094	138.289	43.657	94.632
5.45	135.748	53.465	82.284	157.532	53.466	104.066
4.45	155.748	63.275	92.474	176.732	63.276	113.456
3.75	169.748	70.141	99.607	190.161	70.143	120.018
3.25	179.748	75.046	104.702	199.752	75.047	124.705
2.70	190.748	80.442	110.306	210.305	80.443	129.862
1.70	210.748	90.252	120.496	229.504	90.252	139.251
0.70	230.748	100.062	130.686	248.728	100.062	148.666
0.00	244.748	106.929	137.819	262.203	106.929	155.274

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0003	0.0000	0.0008	0.0000
1	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0005	0.0000	0.0008	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12.55	10.47	4	0.0000	0.0000	0.1136	5.45

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
10.47	7.50	2	0.0011	0.0000	0.0011	0.04
7.50	0.00	1	0.0003	0.0000	0.0003	0.00
Total			0.0014	0.0000	0.1150	

3.6 Results for Vertical 6 (X = -4.50 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
12.70	0.001	0.000	0.001	47.020	0.000	47.020
12.60	1.700	0.000	1.700	48.811	0.000	48.811
12.50	3.400	0.000	3.400	50.307	0.000	50.307
12.40	5.100	0.000	5.100	52.023	0.000	52.023
12.30	6.800	0.000	6.800	53.839	0.000	53.839
12.20	8.500	0.000	8.500	55.633	0.000	55.633
12.10	10.200	0.000	10.200	57.365	0.000	57.365
12.00	11.900	0.000	11.900	59.029	0.000	59.029
11.90	13.600	0.000	13.600	60.628	0.000	60.628
11.80	15.300	0.000	15.300	62.171	0.000	62.171
11.70	17.000	0.000	17.000	63.667	0.000	63.667
Layer 2						
11.70	17.000	0.000	17.000	63.667	0.000	63.667
10.90	31.400	0.000	31.400	75.631	0.026	75.604
10.20	45.400	6.867	38.533	87.171	6.887	80.284
9.60	57.400	12.753	44.647	97.125	12.768	84.357
8.90	71.400	19.620	51.780	108.877	19.631	89.246
7.90	91.400	29.430	61.970	125.958	29.436	96.521
7.50	99.400	33.354	66.046	132.884	33.359	99.525
Layer 1						
7.50	99.400	33.354	66.046	132.884	33.359	99.525
7.00	109.400	38.259	71.141	141.613	38.263	103.350
6.45	120.400	43.654	76.746	151.300	43.658	107.642
5.45	140.400	53.465	86.936	169.118	53.467	115.652
4.45	160.400	63.275	97.126	187.171	63.276	123.895
3.75	174.400	70.141	104.259	199.930	70.143	129.788
3.25	184.400	75.046	109.354	209.100	75.048	134.052
2.70	195.400	80.442	114.958	219.236	80.443	138.793
1.70	215.400	90.252	125.148	237.786	90.252	147.533
0.70	235.400	100.062	135.338	256.477	100.062	156.415
0.00	249.400	106.929	142.471	269.637	106.929	162.708

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0004	0.0000	0.0030	0.0000
1	0.0000	0.0000	0.0003	0.0000	0.0002	0.0000
Total	0.0000	0.0000	0.0007	0.0000	0.0031	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12.70	11.70	4	0.0000	0.0000	0.1214	12.14
11.70	7.50	2	0.0033	0.0000	0.0033	0.08
7.50	0.00	1	0.0005	0.0000	0.0005	0.01
Total			0.0038	0.0000	0.1252	

3.7 Results for Vertical 7 (X = 0.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
14.15	0.001	0.000	0.001	17.648	0.000	17.648
14.05	1.800	0.000	1.800	20.172	0.000	20.172
13.95	3.600	0.000	3.600	21.939	0.000	21.939
13.85	5.400	0.000	5.400	23.594	0.000	23.594
13.75	7.200	0.000	7.200	25.054	0.000	25.054
13.65	9.000	0.000	9.000	26.374	0.000	26.374
13.55	10.800	0.000	10.800	27.724	0.000	27.724
13.46	12.427	0.000	12.427	29.066	0.000	29.066
13.45	12.600	0.000	12.600	29.216	0.000	29.216
13.35	14.400	0.000	14.400	30.852	0.000	30.852
13.25	16.200	0.000	16.200	32.580	0.000	32.580
13.15	18.000	0.000	18.000	34.351	0.000	34.351
12.77	24.854	0.000	24.854	41.082	0.000	41.082
Layer 4						
12.77	24.854	0.000	24.854	41.082	0.000	41.082
12.62	27.469	0.000	27.469	43.608	0.000	43.608
12.46	30.085	0.000	30.085	46.127	0.000	46.127
Layer 2						
12.46	30.085	0.000	30.085	46.127	0.000	46.127
11.70	43.792	0.000	43.792	59.512	0.000	59.512
10.90	58.192	0.000	58.192	73.944	0.004	73.940
9.98	76.577	9.018	67.559	92.637	9.021	83.616
9.10	94.192	17.658	76.534	110.629	17.661	92.968
8.10	114.192	27.468	86.724	130.986	27.470	103.516
7.50	126.192	33.354	92.838	143.130	33.356	109.774
Layer 1						
7.50	126.193	33.354	92.838	143.130	33.356	109.775
7.00	136.193	38.259	97.933	153.205	38.261	114.944
6.45	147.192	43.654	103.538	164.239	43.656	120.583
5.45	167.192	53.465	113.728	184.186	53.466	130.721
4.45	187.192	63.275	123.918	204.010	63.275	140.734
3.75	201.192	70.141	131.051	217.829	70.142	147.687
3.25	211.192	75.046	136.146	227.677	75.047	152.629
2.70	222.192	80.442	141.750	238.491	80.443	158.049
1.70	242.192	90.252	151.940	258.117	90.252	167.864
0.70	262.192	100.062	162.130	277.709	100.062	177.647
0.00	276.192	106.929	169.263	291.411	106.929	184.482

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0.0000	0.0000	0.0013	0.0003	0.0031	0.0003
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0004	0.0000	0.0001	0.0000
1	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0018	0.0003	0.0032	0.0003

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14.15	12.77	5	0.0044	0.0006	0.0423	3.06
12.77	12.46	4	0.0000	0.0000	0.0067	2.17
12.46	7.50	2	0.0005	0.0000	0.0005	0.01
7.50	0.00	1	0.0002	0.0000	0.0002	0.00
Total			0.0051	0.0006	0.0496	

3.8 Results for Vertical 8 (X = 1.44 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
14.80	0.001	0.000	0.001	0.791	0.000	0.791
14.70	1.800	0.000	1.800	3.501	0.000	3.501
14.60	3.600	0.000	3.600	5.318	0.000	5.318
14.50	5.400	0.000	5.400	7.118	0.000	7.118
14.40	7.200	0.000	7.200	8.885	0.000	8.885
14.30	9.000	0.000	9.000	10.623	0.000	10.623
14.20	10.800	0.000	10.800	12.388	0.000	12.388
14.10	12.600	0.000	12.600	14.270	0.000	14.270
14.00	14.400	0.000	14.400	16.285	0.000	16.285
13.90	16.200	0.000	16.200	18.386	0.000	18.386
13.80	18.000	0.000	18.000	20.515	0.000	20.515
13.80	18.078	0.000	18.078	20.606	0.000	20.606
13.29	27.155	0.000	27.155	31.006	0.000	31.006
12.79	36.155	0.000	36.155	40.859	0.000	40.859
Layer 4						
12.79	36.155	0.000	36.155	40.859	0.000	40.859
12.75	36.887	0.000	36.887	41.659	0.000	41.659
12.71	37.620	0.000	37.620	42.458	0.000	42.458
Layer 2						
12.71	37.620	0.000	37.620	42.458	0.000	42.458
11.80	53.914	0.000	53.914	60.129	0.000	60.129
10.90	70.114	0.000	70.114	77.613	0.002	77.610
10.10	86.062	7.822	78.239	94.605	7.824	86.780
9.30	102.114	15.696	86.418	111.618	15.698	95.920
8.30	122.114	25.506	96.608	132.669	25.508	107.162
7.50	138.114	33.354	104.760	149.376	33.355	116.021
Layer 1						
7.50	138.114	33.354	104.760	149.376	33.355	116.021
7.00	148.114	38.259	109.855	159.754	38.260	121.494
6.45	159.114	43.654	115.459	171.112	43.656	127.457
5.45	179.114	53.465	125.649	191.618	53.465	138.153
4.45	199.114	63.275	135.839	211.954	63.275	148.679
3.75	213.114	70.141	142.972	226.102	70.142	155.960
3.25	223.114	75.046	148.067	236.169	75.047	161.122
2.70	234.114	80.442	153.672	247.210	80.442	166.767
1.70	254.114	90.252	163.862	267.209	90.252	176.957
0.70	274.114	100.062	174.052	287.130	100.062	187.068
0.00	288.114	106.929	181.185	301.038	106.929	194.109

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0005	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14.80	12.79	5	0.0001	0.0000	0.0054	0.27
12.79	12.71	4	0.0000	0.0000	0.0003	0.31
12.71	7.50	2	0.0002	0.0000	0.0002	0.00
7.50	0.00	1	0.0001	0.0000	0.0001	0.00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
Total			0.0005	0.0000	0.0060	

3.9 Results for Vertical 9 (X = 3.00 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
14.80	0.001	0.000	0.001	0.001	0.000	0.001
14.70	1.800	0.000	1.800	1.800	0.000	1.800
14.60	3.600	0.000	3.600	3.601	0.000	3.601
14.50	5.400	0.000	5.400	5.402	0.000	5.402
14.40	7.200	0.000	7.200	7.203	0.000	7.203
14.30	9.000	0.000	9.000	9.006	0.000	9.006
14.20	10.800	0.000	10.800	10.810	0.000	10.810
14.10	12.600	0.000	12.600	12.616	0.000	12.616
14.00	14.400	0.000	14.400	14.425	0.000	14.425
14.00	14.455	0.000	14.455	14.480	0.000	14.480
13.90	16.200	0.000	16.200	16.237	0.000	16.237
13.80	18.000	0.000	18.000	18.055	0.000	18.055
13.19	28.909	0.000	28.909	29.194	0.000	29.194
Layer 2						
13.19	28.909	0.000	28.909	29.195	0.000	29.195
12.50	41.400	0.000	41.400	42.224	0.000	42.224
11.50	59.400	0.000	59.400	61.318	0.000	61.318
10.90	70.200	0.000	70.200	72.855	0.001	72.854
10.35	81.261	5.425	75.835	84.612	5.427	79.185
9.85	91.261	10.330	80.930	95.241	10.332	84.910
9.30	102.200	15.696	86.504	106.857	15.697	91.160
8.30	122.200	25.506	96.694	128.033	25.507	102.526
7.50	138.200	33.354	104.846	144.894	33.355	111.539
Layer 1						
7.50	138.200	33.354	104.846	144.894	33.355	111.539
7.00	148.200	38.259	109.941	155.387	38.260	117.127
6.45	159.200	43.654	115.545	166.888	43.655	123.233
5.45	179.200	53.465	125.735	187.681	53.465	134.216
4.45	199.200	63.275	135.926	208.323	63.275	145.048
3.75	213.200	70.141	143.058	222.688	70.142	152.546
3.25	223.200	75.046	148.154	232.909	75.047	157.863
2.70	234.200	80.442	153.758	244.117	80.442	163.675
1.70	254.200	90.252	163.948	264.408	90.252	174.156
0.70	274.200	100.062	174.138	284.601	100.062	184.539
0.00	288.200	106.929	181.271	298.686	106.929	191.757

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
14.80	13.19	5	0.0000	0.0000	0.0001	0.00
13.19	7.50	2	0.0001	0.0000	0.0001	0.00
7.50	0.00	1	0.0001	0.0000	0.0001	0.00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
Total			0.0002	0.0000	0.0002	

3.10 Results for Vertical 10 (X = 5.30 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
14.10	0.001	0.000	0.001	0.002	0.000	0.002
14.00	1.800	0.000	1.800	1.801	0.000	1.801
13.90	3.600	0.000	3.600	3.602	0.000	3.602
13.80	5.400	0.000	5.400	5.403	0.000	5.403
13.70	7.200	0.000	7.200	7.204	0.000	7.204
13.60	9.000	0.000	9.000	9.006	0.000	9.006
13.50	10.800	0.000	10.800	10.808	0.000	10.808
13.40	12.600	0.000	12.600	12.610	0.000	12.610
13.30	14.400	0.000	14.400	14.414	0.000	14.414
13.20	16.200	0.000	16.200	16.218	0.000	16.218
13.10	18.000	0.000	18.000	18.023	0.000	18.023
12.30	32.400	0.000	32.400	32.510	0.000	32.510
11.30	50.400	0.000	50.400	50.780	0.000	50.780
10.90	57.600	0.000	57.600	58.146	0.001	58.145
10.80	59.600	0.981	58.619	60.192	0.982	59.210
9.90	77.600	9.810	67.790	78.690	9.811	68.879
8.90	97.600	19.620	77.980	99.379	19.621	79.758
7.90	117.600	29.430	88.170	120.151	29.431	90.720
7.50	125.600	33.354	92.246	128.470	33.355	95.115
Layer 1						
7.50	125.600	33.354	92.246	128.470	33.355	95.116
7.00	135.600	38.259	97.341	138.871	38.260	100.611
6.45	146.600	43.654	102.945	150.306	43.655	106.651
5.45	166.600	53.465	113.135	171.070	53.465	117.605
4.45	186.600	63.275	123.325	191.773	63.275	128.498
3.75	200.600	70.141	130.459	206.222	70.142	136.080
3.25	210.600	75.046	135.553	216.518	75.047	141.471
2.70	221.600	80.442	141.158	227.820	80.442	147.378
1.70	241.600	90.252	151.348	248.305	90.252	158.053
0.70	261.600	100.062	161.538	268.709	100.062	168.647
0.00	275.600	106.929	168.671	282.947	106.929	176.018

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
14.10	7.50	2	0.0000	0.0000	0.0000	0.00
7.50	0.00	1	0.0001	0.0000	0.0001	0.00
Total			0.0001	0.0000	0.0001	

3.11 Results for Vertical 11 (X = 15.60 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
14.20	0.001	0.000	0.001	0.001	0.000	0.001
14.10	1.800	0.000	1.800	1.800	0.000	1.800
14.00	3.600	0.000	3.600	3.600	0.000	3.600
13.90	5.400	0.000	5.400	5.400	0.000	5.400
13.80	7.200	0.000	7.200	7.200	0.000	7.200
13.70	9.000	0.000	9.000	9.000	0.000	9.000
13.60	10.800	0.000	10.800	10.800	0.000	10.800
13.50	12.600	0.000	12.600	12.600	0.000	12.600
13.40	14.400	0.000	14.400	14.400	0.000	14.400
13.30	16.200	0.000	16.200	16.200	0.000	16.200
13.20	18.000	0.000	18.000	18.000	0.000	18.000
12.50	30.600	0.000	30.600	30.601	0.000	30.601
11.50	48.600	0.000	48.600	48.603	0.000	48.603
10.90	59.400	0.000	59.400	59.407	0.000	59.406
10.85	60.400	0.490	59.910	60.407	0.491	59.916
9.90	79.400	9.810	69.590	79.419	9.810	69.609
8.90	99.400	19.620	79.780	99.444	19.620	79.824
7.90	119.400	29.430	89.970	119.486	29.430	90.056
7.50	127.400	33.354	94.046	127.508	33.354	94.154
Layer 1						
7.50	127.400	33.354	94.046	127.509	33.354	94.154
7.00	137.400	38.259	99.141	137.542	38.259	99.283
6.45	148.400	43.654	104.746	148.585	43.655	104.930
5.45	168.400	53.465	114.936	168.682	53.465	115.217
4.45	188.400	63.275	125.126	188.803	63.275	125.529
3.75	202.400	70.141	132.259	202.902	70.142	132.761
3.25	212.400	75.046	137.353	212.979	75.047	137.932
2.70	223.400	80.442	142.958	224.069	80.442	143.627
1.70	243.400	90.252	153.148	244.247	90.252	153.995
0.70	263.400	100.062	163.338	264.438	100.062	164.376
0.00	277.400	106.929	170.471	278.579	106.929	171.650

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14.20	7.50	2	0.0000	0.0000	0.0000	0.00
7.50	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.12 Results for Vertical 12 (X = 18.90 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
13.30	0.001	0.000	0.001	0.001	0.000	0.001
13.20	1.800	0.000	1.800	1.800	0.000	1.800
13.10	3.600	0.000	3.600	3.600	0.000	3.600
13.00	5.400	0.000	5.400	5.400	0.000	5.400

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
12.90	7.200	0.000	7.200	7.200	0.000	7.200
12.80	9.000	0.000	9.000	9.000	0.000	9.000
12.70	10.800	0.000	10.800	10.800	0.000	10.800
12.60	12.600	0.000	12.600	12.600	0.000	12.600
12.50	14.400	0.000	14.400	14.400	0.000	14.400
12.40	16.200	0.000	16.200	16.200	0.000	16.200
12.30	18.000	0.000	18.000	18.000	0.000	18.000
11.60	30.600	0.000	30.600	30.601	0.000	30.601
10.90	43.200	0.000	43.200	43.203	0.000	43.203
10.40	53.200	4.905	48.295	53.205	4.905	48.300
9.50	71.200	13.734	57.466	71.212	13.734	57.478
8.50	91.200	23.544	67.656	91.226	23.544	67.682
7.50	111.200	33.354	77.846	111.250	33.354	77.896
Layer 1						
7.50	111.200	33.354	77.846	111.250	33.354	77.896
7.00	121.200	38.259	82.941	121.267	38.259	83.008
6.45	132.200	43.654	88.545	132.288	43.655	88.634
5.45	152.200	53.465	98.735	152.339	53.465	98.874
4.45	172.200	63.275	108.925	172.404	63.275	109.130
3.75	186.200	70.141	116.058	186.459	70.142	116.318
3.25	196.200	75.046	121.153	196.503	75.047	121.457
2.70	207.200	80.442	126.758	207.556	80.442	127.114
1.70	227.200	90.252	136.948	227.663	90.252	137.411
0.70	247.200	100.062	147.138	247.784	100.062	147.722
0.00	261.200	106.929	154.271	261.875	106.929	154.946

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13.30	7.50	2	0.0000	0.0000	0.0000	0.00
7.50	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.13 Results for Vertical 13 (X = 20.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
13.50	0.001	0.000	0.001	0.001	0.000	0.001
13.40	1.800	0.000	1.800	1.800	0.000	1.800
13.30	3.600	0.000	3.600	3.600	0.000	3.600
13.20	5.400	0.000	5.400	5.400	0.000	5.400
13.10	7.200	0.000	7.200	7.200	0.000	7.200
13.00	9.000	0.000	9.000	9.000	0.000	9.000
12.90	10.800	0.000	10.800	10.800	0.000	10.800
12.80	12.600	0.000	12.600	12.600	0.000	12.600
12.70	14.400	0.000	14.400	14.400	0.000	14.400
12.60	16.200	0.000	16.200	16.200	0.000	16.200
12.50	18.000	0.000	18.000	18.000	0.000	18.000
11.70	32.400	0.000	32.400	32.401	0.000	32.401
10.90	46.800	0.000	46.800	46.802	0.000	46.802

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
10.50	54.800	3.924	50.876	54.803	3.924	50.879
9.50	74.800	13.734	61.066	74.809	13.734	61.075
8.50	94.800	23.544	71.256	94.821	23.544	71.277
7.50	114.800	33.354	81.446	114.840	33.354	81.486
Layer 1						
7.50	114.800	33.354	81.446	114.840	33.354	81.486
7.00	124.800	38.259	86.541	124.853	38.259	86.594
6.45	135.800	43.654	92.146	135.870	43.655	92.216
5.45	155.800	53.465	102.336	155.911	53.465	102.447
4.45	175.800	63.275	112.526	175.965	63.275	112.691
3.75	189.800	70.141	119.659	190.011	70.142	119.870
3.25	199.800	75.046	124.754	200.048	75.047	125.001
2.70	210.800	80.442	130.358	211.092	80.442	130.650
1.70	230.800	90.252	140.548	231.183	90.252	140.931
0.70	250.800	100.062	150.738	251.286	100.062	151.224
0.00	264.800	106.929	157.871	265.365	106.929	158.436

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
13.50	7.50	2	0.0000	0.0000	0.0000	0.00
7.50	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-20.00	0.00	12.40	0.000
2	-12.80	0.00	12.55	0.021
3	-12.00	0.00	12.00	0.062
4	-10.50	0.00	12.00	0.109
5	-9.70	0.00	12.55	0.115
6	-4.50	0.00	12.70	0.125
7	0.00	0.00	14.15	0.050
8	1.44	0.00	14.80	0.006
9	3.00	0.00	14.80	0.000
10	5.30	0.00	14.10	0.000
11	15.60	0.00	14.20	0.000
12	18.90	0.00	13.30	0.000
13	20.00	0.00	13.50	0.000

4.2 Maintain Profile Calculation Results

Load 1 consists of 21.366 m3 per Width
The extra amount of soil to be added is 1.305 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	12/1/2014
Time of report:	8:57:58 AM
Date of calculation:	12/1/2014
Time of calculation:	8:57:29 AM
Filename:	C:\..\02 Geotechniek\07 Zetting\Zetting DP59.018-022
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei Zetting DR59.018-022

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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
2 - X -	-30,000	-11,400	18,400	30,000	
2 - Y -	11,400	11,400	11,400	11,400	
1 - X -	-30,000	30,000			
1 - Y -	10,500	10,500			
0 - X -	-30,000	30,000			
0 - Y -	0,000	0,000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-30,000	30,000			
1 - Y -	10,300	10,300			

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9,81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000,00 [days]
With maintain profile	
(only for non uniform loads)	
- Material:	Superelevation
- Time:	0,00 [days]
- Unit weight above phreatic.:	18,00 [kN/m³]
- Unit weight below phreatic:	20,00 [kN/m³]
- Iteration stop criterium:	0,10 [m]
Pc (initial):	Variable parallel to the initial effective stress
Pc (per step):	Automatic increased to the final effective stresses
No imaginary surface	
With submerging	
(only for non uniform loads)	
- Iteration stop criterium :	0,10 [m]
Load column width	
- Non-Uniform Loads :	1,00 [m]
- Trapezoidal Loads :	1,00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
2	Klei, siltig	1	1
1	Zand	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
2	No	17,00	17,00
1	Yes	18,00	20,00

Layer number	Vert. consolid. coefficient Cv [m²/s]
2	1,00E-07
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
2	-	10,00	-
1	-	-	1,30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
2	7,50E+01	1,50E+01	3,20E+02	1,60E+02	7,50E+01	1,60E+02
1	3,00E+03	6,00E+02	1,00E+09	1,00E+09	3,00E+03	1,00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18,00	20,00

Load number	Co-ordinates [m]					
1 - X -	-11,40	0,00	4,50	13,65	16,15	18,40
1 - Y -	11,40	15,19	15,19	12,15	12,15	11,40

2.7 Verticals

Vertical number	X co-ordinates [m]				
1 - 5	-30,000	-11,400	0,000	4,500	13,650
6 - 8	16,150	18,400	30,000		

3 Results per Vertical

3.1 Results for Vertical 1 (X = -30,00 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	0,001	0,000	0,001
11,30	1,700	0,000	1,700	1,700	0,000	1,700
11,20	3,400	0,000	3,400	3,400	0,000	3,400
11,10	5,100	0,000	5,100	5,100	0,000	5,100
11,00	6,800	0,000	6,800	6,800	0,000	6,800
10,95	7,650	0,000	7,650	7,650	0,000	7,650
10,90	8,500	0,000	8,500	8,500	0,000	8,500
10,80	10,200	0,000	10,200	10,200	0,000	10,200
10,70	11,900	0,000	11,900	11,900	0,000	11,900
10,60	13,600	0,000	13,600	13,600	0,000	13,600
10,50	15,300	0,000	15,300	15,300	0,000	15,300
Layer 1						
10,50	15,300	0,000	15,300	15,300	0,000	15,300
10,40	17,100	0,000	17,100	17,100	0,000	17,100
10,30	18,900	0,000	18,900	18,900	0,000	18,900
9,80	28,900	4,905	23,995	28,901	4,905	23,996
9,25	39,900	10,300	29,599	39,902	10,301	29,601
8,25	59,900	20,110	39,790	59,905	20,111	39,795
7,25	79,900	29,921	49,980	79,914	29,921	49,993
6,25	99,900	39,730	60,170	99,930	39,731	60,199
5,25	119,900	49,541	70,359	119,956	49,541	70,416
4,50	134,900	56,898	78,002	134,985	56,898	78,087
3,50	154,900	66,708	88,192	155,036	66,708	88,328
2,50	174,900	76,518	98,382	175,105	76,518	98,587
1,50	194,900	86,328	108,572	195,194	86,328	108,866
0,50	214,900	96,138	118,762	215,302	96,138	119,164
0,00	224,900	101,043	123,857	225,364	101,043	124,321

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
11,40	10,50	2	0,0000	0,0000	0,0000	0,00
10,50	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

3.2 Results for Vertical 2 (X = -11,40 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	1,648	0,000	1,648
11,30	1,700	0,000	1,700	3,354	0,000	3,354

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
11,20	3,400	0,000	3,400	5,063	0,000	5,063
11,10	5,100	0,000	5,100	6,778	0,000	6,778
11,00	6,800	0,000	6,800	8,503	0,000	8,503
10,95	7,650	0,000	7,650	9,371	0,000	9,371
10,90	8,500	0,000	8,500	10,242	0,000	10,242
10,80	10,200	0,000	10,200	11,995	0,000	11,995
10,70	11,900	0,000	11,900	13,764	0,000	13,764
10,60	13,600	0,000	13,600	15,547	0,000	15,547
10,50	15,300	0,000	15,300	17,343	0,000	17,343
Layer 1						
10,50	15,300	0,000	15,300	17,343	0,000	17,343
10,40	17,100	0,000	17,100	19,250	0,000	19,250
10,30	18,900	0,000	18,900	21,169	0,004	21,165
9,80	28,900	4,905	23,995	31,830	4,909	26,921
9,25	39,900	10,300	29,599	43,624	10,304	33,320
8,25	59,900	20,110	39,790	65,108	20,114	44,994
7,25	79,900	29,921	49,980	86,577	29,923	56,653
6,25	99,900	39,730	60,170	107,997	39,733	68,264
5,25	119,900	49,541	70,359	129,348	49,543	79,806
4,50	134,900	56,898	78,002	145,306	56,900	88,406
3,50	154,900	66,708	88,192	166,500	66,709	99,791
2,50	174,900	76,518	98,382	187,592	76,519	111,073
1,50	194,900	86,328	108,572	208,577	86,329	122,248
0,50	214,900	96,138	118,762	229,455	96,138	133,316
0,00	224,900	101,043	123,857	239,854	101,043	138,811

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0039	0,0009	0,0000	0,0000
1	0,0000	0,0000	0,0004	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0044	0,0009	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,40	10,50	2	0,0039	0,0009	0,0076	0,84
10,50	0,00	1	0,0004	0,0000	0,0004	0,00
Total			0,0044	0,0009	0,0080	

3.3 Results for Vertical 3 (X = 0,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	69,906	0,000	69,906
11,30	1,700	0,000	1,700	71,596	0,000	71,596
11,20	3,400	0,000	3,400	73,259	0,000	73,259
11,10	5,100	0,000	5,100	74,867	0,000	74,867
11,00	6,800	0,000	6,800	76,430	0,000	76,430
10,95	7,650	0,000	7,650	77,201	0,000	77,201
10,90	8,500	0,000	8,500	77,970	0,000	77,970
10,80	10,200	0,000	10,200	79,504	0,000	79,504
10,70	11,900	0,000	11,900	81,040	0,000	81,040
10,60	13,600	0,000	13,600	82,580	0,000	82,580
10,50	15,300	0,000	15,300	84,126	0,000	84,126
Layer 1						
10,50	15,300	0,000	15,300	84,126	0,000	84,126

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
10,40	17,100	0,000	17,100	85,775	0,000	85,775
10,30	18,900	0,000	18,900	87,507	0,081	87,425
9,80	28,900	4,905	23,995	96,752	4,976	91,776
9,25	39,900	10,300	29,599	106,888	10,362	96,525
8,25	59,900	20,110	39,790	125,189	20,159	105,031
7,25	79,900	29,921	49,980	143,333	29,957	113,376
6,25	99,900	39,730	60,170	161,349	39,758	121,590
5,25	119,900	49,541	70,359	179,280	49,561	129,719
4,50	134,900	56,898	78,002	192,701	56,914	135,787
3,50	154,900	66,708	88,192	210,591	66,719	143,872
2,50	174,900	76,518	98,382	228,505	76,525	151,980
1,50	194,900	86,328	108,572	246,468	86,332	160,137
0,50	214,900	96,138	118,762	264,498	96,139	168,359
0,00	224,900	101,043	123,857	273,541	101,043	172,498

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0129	0,0030	0,0904	0,0085
1	0,0000	0,0000	0,0009	0,0000	0,0078	0,0000
Total	0,0000	0,0000	0,0138	0,0030	0,0982	0,0085

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,40	10,50	2	0,1032	0,0115	0,1370	15,23
10,50	0,00	1	0,0088	0,0000	0,0088	0,08
Total			0,1120	0,0115	0,1458	

3.4 Results for Vertical 4 (X = 4,50 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	69,020	0,000	69,020
11,30	1,700	0,000	1,700	70,714	0,000	70,714
11,20	3,400	0,000	3,400	72,407	0,000	72,407
11,10	5,100	0,000	5,100	74,094	0,000	74,094
11,00	6,800	0,000	6,800	75,772	0,000	75,772
10,95	7,650	0,000	7,650	76,607	0,000	76,607
10,90	8,500	0,000	8,500	77,438	0,000	77,438
10,80	10,200	0,000	10,200	79,088	0,000	79,088
10,70	11,900	0,000	11,900	80,723	0,000	80,723
10,60	13,600	0,000	13,600	82,343	0,000	82,343
10,50	15,300	0,000	15,300	83,949	0,000	83,949
Layer 1						
10,50	15,300	0,000	15,300	83,949	0,000	83,949
10,40	17,100	0,000	17,100	85,645	0,000	85,645
10,30	18,900	0,000	18,900	87,412	0,082	87,330
9,80	28,900	4,905	23,995	96,738	4,977	91,761
9,25	39,900	10,300	29,599	106,898	10,363	96,536
8,25	59,900	20,110	39,790	125,221	20,159	105,063
7,25	79,900	29,921	49,980	143,386	29,958	113,429
6,25	99,900	39,730	60,170	161,429	39,759	121,670
5,25	119,900	49,541	70,359	179,393	49,561	129,832
4,50	134,900	56,898	78,002	192,841	56,914	135,927
3,50	154,900	66,708	88,192	210,768	66,719	144,049
2,50	174,900	76,518	98,382	228,718	76,525	152,193

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
1,50	194,900	86,328	108,572	246,713	86,332	160,381
0,50	214,900	96,138	118,762	264,768	96,139	168,629
0,00	224,900	101,043	123,857	273,822	101,043	172,779

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0129	0,0030	0,0899	0,0084
1	0,0000	0,0000	0,0009	0,0000	0,0079	0,0000
Total	0,0000	0,0000	0,0138	0,0030	0,0978	0,0084

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,40	10,50	2	0,1028	0,0114	0,1365	15,17
10,50	0,00	1	0,0088	0,0000	0,0088	0,08
Total			0,1116	0,0114	0,1453	

3.5 Results for Vertical 5 (X = 13,65 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	14,773	0,000	14,773
11,30	1,700	0,000	1,700	16,547	0,000	16,547
11,20	3,400	0,000	3,400	18,542	0,000	18,542
11,10	5,100	0,000	5,100	20,537	0,000	20,537
11,00	6,800	0,000	6,800	22,460	0,000	22,460
10,95	7,650	0,000	7,650	23,401	0,000	23,401
10,90	8,500	0,000	8,500	24,331	0,000	24,331
10,80	10,200	0,000	10,200	26,171	0,000	26,171
10,70	11,900	0,000	11,900	27,996	0,000	27,996
10,60	13,600	0,000	13,600	29,813	0,000	29,813
10,50	15,300	0,000	15,300	31,627	0,000	31,627
Layer 1						
10,50	15,300	0,000	15,300	31,627	0,000	31,627
10,40	17,100	0,000	17,100	33,541	0,000	33,541
10,30	18,900	0,000	18,900	35,474	0,018	35,456
9,80	28,900	4,905	23,995	46,051	4,920	41,131
9,25	39,900	10,300	29,599	57,663	10,313	47,351
8,25	59,900	20,110	39,790	78,655	20,119	58,536
7,25	79,900	29,921	49,980	99,520	29,927	69,593
6,25	99,900	39,730	60,170	120,304	39,735	80,569
5,25	119,900	49,541	70,359	141,024	49,544	91,479
4,50	134,900	56,898	78,002	156,520	56,901	99,619
3,50	154,900	66,708	88,192	177,119	66,710	110,409
2,50	174,900	76,518	98,382	197,638	76,520	121,119
1,50	194,900	86,328	108,572	218,072	86,329	131,743
0,50	214,900	96,138	118,762	238,421	96,138	142,283
0,00	224,900	101,043	123,857	248,563	101,043	147,520

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0129	0,0030	0,0172	0,0016
1	0,0000	0,0000	0,0008	0,0000	0,0011	0,0000
Total	0,0000	0,0000	0,0137	0,0030	0,0184	0,0016

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
11,40	10,50	2	0,0301	0,0046	0,0472	5,24
10,50	0,00	1	0,0020	0,0000	0,0020	0,02
Total			0,0321	0,0046	0,0491	

3.6 Results for Vertical 6 (X = 16,15 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	12,628	0,000	12,628
11,30	1,700	0,000	1,700	14,328	0,000	14,328
11,20	3,400	0,000	3,400	16,027	0,000	16,027
11,10	5,100	0,000	5,100	17,721	0,000	17,721
11,00	6,800	0,000	6,800	19,406	0,000	19,406
10,95	7,650	0,000	7,650	20,245	0,000	20,245
10,90	8,500	0,000	8,500	21,081	0,000	21,081
10,80	10,200	0,000	10,200	22,742	0,000	22,742
10,70	11,900	0,000	11,900	24,390	0,000	24,390
10,60	13,600	0,000	13,600	26,027	0,000	26,027
10,50	15,300	0,000	15,300	27,656	0,000	27,656
Layer 1						
10,50	15,300	0,000	15,300	27,656	0,000	27,656
10,40	17,100	0,000	17,100	29,377	0,000	29,377
10,30	18,900	0,000	18,900	31,104	0,009	31,095
9,80	28,900	4,905	23,995	40,694	4,912	35,782
9,25	39,900	10,300	29,599	51,360	10,306	41,054
8,25	59,900	20,110	39,790	71,181	20,115	51,066
7,25	79,900	29,921	49,980	91,447	29,924	61,523
6,25	99,900	39,730	60,170	111,995	39,734	72,261
5,25	119,900	49,541	70,359	132,697	49,543	83,154
4,50	134,900	56,898	78,002	148,273	56,900	91,373
3,50	154,900	66,708	88,192	169,059	66,710	102,349
2,50	174,900	76,518	98,382	189,827	76,519	113,308
1,50	194,900	86,328	108,572	210,553	86,329	124,224
0,50	214,900	96,138	118,762	231,219	96,138	135,081
0,00	224,900	101,043	123,857	241,527	101,043	140,484

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0,0000	0,0000	0,0129	0,0030	0,0087	0,0008
1	0,0000	0,0000	0,0006	0,0000	0,0004	0,0000
Total	0,0000	0,0000	0,0135	0,0030	0,0090	0,0008

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
11,40	10,50	2	0,0215	0,0038	0,0359	3,99
10,50	0,00	1	0,0010	0,0000	0,0010	0,01
Total			0,0225	0,0038	0,0369	

3.7 Results for Vertical 7 (X = 18,40 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	0,457	0,000	0,457
11,30	1,700	0,000	1,700	2,187	0,000	2,187
11,20	3,400	0,000	3,400	4,012	0,000	4,012
11,10	5,100	0,000	5,100	5,921	0,000	5,921
11,00	6,800	0,000	6,800	7,840	0,000	7,840
10,95	7,650	0,000	7,650	8,793	0,000	8,793
10,90	8,500	0,000	8,500	9,739	0,000	9,739
10,80	10,200	0,000	10,200	11,614	0,000	11,614
10,70	11,900	0,000	11,900	13,470	0,000	13,470
10,60	13,600	0,000	13,600	15,314	0,000	15,314
10,50	15,300	0,000	15,300	17,149	0,000	17,149
Layer 1						
10,50	15,300	0,000	15,300	17,149	0,000	17,149
10,40	17,100	0,000	17,100	19,079	0,000	19,079
10,30	18,900	0,000	18,900	21,009	0,003	21,005
9,80	28,900	4,905	23,995	31,613	4,908	26,705
9,25	39,900	10,300	29,599	43,228	10,303	32,925
8,25	59,900	20,110	39,790	64,222	20,113	44,109
7,25	79,900	29,921	49,980	85,129	29,923	55,206
6,25	99,900	39,730	60,170	106,018	39,732	66,286
5,25	119,900	49,541	70,359	126,914	49,542	77,372
4,50	134,900	56,898	78,002	142,590	56,899	85,690
3,50	154,900	66,708	88,192	163,485	66,709	96,776
2,50	174,900	76,518	98,382	184,362	76,519	107,843
1,50	194,900	86,328	108,572	205,205	86,328	118,877
0,50	214,900	96,138	118,762	226,003	96,138	129,865
0,00	224,900	101,043	123,857	236,382	101,043	135,339

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0021	0,0005	0,0000	0,0000
1	0,0000	0,0000	0,0003	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0024	0,0005	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,40	10,50	2	0,0021	0,0005	0,0041	0,45
10,50	0,00	1	0,0003	0,0000	0,0003	0,00
Total			0,0024	0,0005	0,0044	

3.8 Results for Vertical 8 (X = 30,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,40	0,001	0,000	0,001	0,001	0,000	0,001
11,30	1,700	0,000	1,700	1,700	0,000	1,700
11,20	3,400	0,000	3,400	3,400	0,000	3,400
11,10	5,100	0,000	5,100	5,100	0,000	5,100
11,00	6,800	0,000	6,800	6,800	0,000	6,800
10,95	7,650	0,000	7,650	7,650	0,000	7,650
10,90	8,500	0,000	8,500	8,500	0,000	8,500
10,80	10,200	0,000	10,200	10,200	0,000	10,200

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
10,70	11,900	0,000	11,900	11,901	0,000	11,901
10,60	13,600	0,000	13,600	13,601	0,000	13,601
10,50	15,300	0,000	15,300	15,301	0,000	15,301
Layer 1						
10,50	15,300	0,000	15,300	15,301	0,000	15,301
10,40	17,100	0,000	17,100	17,101	0,000	17,101
10,30	18,900	0,000	18,900	18,901	0,000	18,901
9,80	28,900	4,905	23,995	28,902	4,905	23,997
9,25	39,900	10,300	29,599	39,905	10,301	29,605
8,25	59,900	20,110	39,790	59,918	20,111	39,808
7,25	79,900	29,921	49,980	79,948	29,921	50,027
6,25	99,900	39,730	60,170	100,001	39,731	60,270
5,25	119,900	49,541	70,359	120,085	49,541	70,544
4,50	134,900	56,898	78,002	135,171	56,898	78,273
3,50	154,900	66,708	88,192	155,318	66,708	88,610
2,50	174,900	76,518	98,382	175,503	76,518	98,985
1,50	194,900	86,328	108,572	195,725	86,328	109,397
0,50	214,900	96,138	118,762	215,980	96,138	119,842
0,00	224,900	101,043	123,857	226,120	101,043	125,077

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary	Secondary	Primary	Secondary 10 [days]	Primary	Secondary 10 [days]
	[m]	[m]	[m]	[m]	[m]	[m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From	To		Primary	Secondary 10 [days]	After 10000 [days]	
[m]	[m]		[m]	[m]	[m]	[%]
11,40	10,50	2	0,0000	0,0000	0,0000	0,00
10,50	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-30,00	0,00	11,40	0,000
2	-11,40	0,00	11,40	0,008
3	0,00	0,00	11,40	0,146
4	4,50	0,00	11,40	0,145
5	13,65	0,00	11,40	0,049
6	16,15	0,00	11,40	0,037
7	18,40	0,00	11,40	0,004
8	30,00	0,00	11,40	0,000

4.2 Maintain Profile Calculation Results

Load 1 consists of 62,147 m3 per Width
The extra amount of soil to be added is 2,573 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	1-12-2014
Time of report:	14:25:25
Date of calculation:	1-12-2014
Time of calculation:	14:22:17
Filename:	C:\..\02 Geotechniek\07 Zetting\Zetting DP59.033-035
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei Zetting DR59.033-35

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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
3 - X -	-30,000	-21,800	-18,750	-15,000	-6,200
3 - Y -	11,600	11,700	11,300	11,700	12,400
3 - X -	0,000	1,200	4,800	9,500	12,800
3 - Y -	14,600	14,800	14,800	12,600	12,200
3 - X -	16,000	20,000			
3 - Y -	12,300	12,300			
2 - X -	-30,000	-21,800	-18,750	-15,000	-6,200
2 - Y -	11,600	11,700	11,300	11,700	12,400
2 - X -	9,500	12,800	16,000	20,000	
2 - Y -	12,600	12,200	12,300	12,300	
1 - X -	-30,000	-6,200	9,500	20,000	
1 - Y -	9,700	9,700	10,000	10,000	
0 - X -	-30,000	20,000			
0 - Y -	0,000	0,000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-30,000	20,000			
1 - Y -	9,700	9,700			

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9,81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000,00 [days]
With maintain profile	
(only for non uniform loads)	
- Material:	Superelevation
- Time:	0,00 [days]
- Unit weight above phreatic.:	18,00 [kN/m³]
- Unit weight below phreatic:	20,00 [kN/m³]
- Iteration stop criterium:	0,10 [m]
Pc (initial):	Variable parallel to the initial effective stress
Pc (per step):	Automatic increased to the final effective stresses
No imaginary surface	
With submerging	
(only for non uniform loads)	
- Iteration stop criterium :	0,10 [m]
Load column width	
- Non-Uniform Loads :	1,00 [m]
- Trapezoidal Loads :	1,00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
3	Klei, zandig	1	1
2	Klei, siltig	1	1

Layer number	Material name	PL-line top	PL-line bottom
1	Zand	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
3	No	18,00	18,00
2	No	17,00	17,00
1	Yes	18,00	20,00

Layer number	Vert. consolid. coefficient Cv [m²/s]
3	1,00E-06
2	1,00E-07
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
3	-	10,00	-
2	-	10,00	-
1	-	-	1,30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
3	1,00E+02	2,00E+01	1,20E+03	2,40E+02	1,00E+02	2,40E+02
2	7,50E+01	1,50E+01	3,20E+02	1,60E+02	7,50E+01	1,60E+02
1	3,00E+03	6,00E+02	1,00E+09	1,00E+09	3,00E+03	1,00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18,00	20,00

Load number	Co-ordinates [m]					
1 - X -	-15,00	-4,50	0,00	1,20		
1 - Y -	11,70	15,18	15,18	14,80		

2.7 Verticals

Vertical number	X co-ordinates [m]				
1 - 5	-30,000	-21,800	-18,750	-15,000	-6,200
6 - 10	-4,500	0,000	1,200	4,800	9,500
11 - 13	12,800	16,000	20,000		

3 Results per Vertical

3.1 Results for Vertical 1 (X = -30,00 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
11,60	0,001	0,000	0,001	0,001	0,000	0,001
11,50	1,700	0,000	1,700	1,700	0,000	1,700
11,40	3,400	0,000	3,400	3,400	0,000	3,400
11,30	5,100	0,000	5,100	5,101	0,000	5,101
11,20	6,800	0,000	6,800	6,801	0,000	6,801
11,10	8,500	0,000	8,500	8,501	0,000	8,501
11,00	10,200	0,000	10,200	10,201	0,000	10,201
10,90	11,900	0,000	11,900	11,901	0,000	11,901
10,80	13,600	0,000	13,600	13,601	0,000	13,601
10,70	15,300	0,000	15,300	15,301	0,000	15,301
10,65	16,150	0,000	16,150	16,151	0,000	16,151
10,60	17,000	0,000	17,000	17,001	0,000	17,001
9,70	32,300	0,000	32,300	32,305	0,000	32,305
Layer 1						
9,70	32,300	0,000	32,300	32,305	0,000	32,305
8,85	49,300	8,338	40,962	49,311	8,339	40,972
7,85	69,300	18,148	51,151	69,326	18,149	51,177
6,85	89,300	27,959	61,341	89,351	27,959	61,392
5,85	109,300	37,769	71,531	109,390	37,769	71,621
4,85	129,300	47,578	81,722	129,445	47,579	81,866
4,00	146,300	55,917	90,383	146,505	55,917	90,588
3,00	166,300	65,727	100,573	166,592	65,727	100,865
2,00	186,300	75,537	110,763	186,696	75,537	111,159
1,00	206,300	85,347	120,953	206,817	85,347	121,470
0,00	226,300	95,157	131,143	226,951	95,157	131,794

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
11,60	9,70	2	0,0000	0,0000	0,0000	0,00
9,70	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

3.2 Results for Vertical 2 (X = -21,80 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
11,70	0,001	0,000	0,001	0,003	0,000	0,003
11,60	1,700	0,000	1,700	1,702	0,000	1,702
11,50	3,400	0,000	3,400	3,403	0,000	3,403
11,40	5,100	0,000	5,100	5,103	0,000	5,103

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
11,30	6,800	0,000	6,800	6,804	0,000	6,804
11,20	8,500	0,000	8,500	8,504	0,000	8,504
11,10	10,200	0,000	10,200	10,205	0,000	10,205
11,00	11,900	0,000	11,900	11,906	0,000	11,906
10,90	13,600	0,000	13,600	13,607	0,000	13,607
10,80	15,300	0,000	15,300	15,309	0,000	15,309
10,70	17,000	0,000	17,000	17,010	0,000	17,010
9,70	34,000	0,000	34,000	34,042	0,000	34,042
Layer 1						
9,70	34,000	0,000	34,000	34,042	0,000	34,042
8,85	51,000	8,338	42,662	51,106	8,339	42,767
7,85	71,000	18,148	52,852	71,242	18,149	53,093
6,85	91,000	27,959	63,041	91,453	27,959	63,495
5,85	111,000	37,769	73,231	111,735	37,769	73,967
4,85	131,000	47,578	83,422	132,075	47,579	84,496
4,00	148,000	55,917	92,083	149,396	55,917	93,478
3,00	168,000	65,727	102,273	169,795	65,727	104,068
2,00	188,000	75,537	112,463	190,202	75,537	114,665
1,00	208,000	85,347	122,653	210,605	85,347	125,257
0,00	228,000	95,157	132,843	230,991	95,157	135,834

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,70	9,70	2	0,0000	0,0000	0,0000	0,00
9,70	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0001	0,0000	0,0001	

3.3 Results for Vertical 3 (X = -18,75 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,30	0,001	0,000	0,001	0,012	0,000	0,012
11,20	1,700	0,000	1,700	1,713	0,000	1,713
11,10	3,400	0,000	3,400	3,416	0,000	3,416
11,00	5,100	0,000	5,100	5,120	0,000	5,120
10,90	6,800	0,000	6,800	6,824	0,000	6,824
10,80	8,500	0,000	8,500	8,529	0,000	8,529
10,70	10,200	0,000	10,200	10,235	0,000	10,235
10,60	11,900	0,000	11,900	11,941	0,000	11,941
10,50	13,600	0,000	13,600	13,650	0,000	13,650
10,40	15,300	0,000	15,300	15,359	0,000	15,359
10,30	17,000	0,000	17,000	17,069	0,000	17,069
9,70	27,200	0,000	27,200	27,367	0,001	27,366
Layer 1						
9,70	27,200	0,000	27,200	27,367	0,001	27,366
8,85	44,200	8,338	35,862	44,612	8,339	36,272
7,85	64,200	18,148	46,052	65,057	18,149	46,908
6,85	84,200	27,959	56,242	85,629	27,959	57,669
5,85	104,200	37,769	66,431	106,268	37,769	68,499

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
4,85	124,200	47,578	76,621	126,928	47,579	79,349
4,00	141,200	55,917	85,283	144,476	55,918	88,559
3,00	161,200	65,727	95,473	165,086	65,727	99,359
2,00	181,200	75,537	105,663	185,643	75,537	110,105
1,00	201,200	85,347	115,853	206,139	85,347	120,792
0,00	221,200	95,157	126,043	226,571	95,157	131,414

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0002	0,0000	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,30	9,70	2	0,0001	0,0000	0,0002	0,01
9,70	0,00	1	0,0001	0,0000	0,0001	0,00
Total			0,0002	0,0000	0,0003	

3.4 Results for Vertical 4 (X = -15,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
11,70	0,001	0,000	0,001	1,375	0,000	1,375
11,60	1,700	0,000	1,700	3,090	0,000	3,090
11,50	3,400	0,000	3,400	4,815	0,000	4,815
11,40	5,100	0,000	5,100	6,552	0,000	6,552
11,30	6,800	0,000	6,800	8,303	0,000	8,303
11,20	8,500	0,000	8,500	10,068	0,000	10,068
11,10	10,200	0,000	10,200	11,846	0,000	11,846
11,00	11,900	0,000	11,900	13,636	0,000	13,636
10,90	13,600	0,000	13,600	15,436	0,000	15,436
10,80	15,300	0,000	15,300	17,245	0,000	17,245
10,70	17,000	0,000	17,000	19,060	0,000	19,060
9,70	34,000	0,000	34,000	37,367	0,003	37,364
Layer 1						
9,70	34,000	0,000	34,000	37,367	0,003	37,364
8,85	51,000	8,338	42,662	55,488	8,341	47,147
7,85	71,000	18,148	52,852	76,713	18,151	58,562
6,85	91,000	27,959	63,041	97,795	27,961	69,834
5,85	111,000	37,769	73,231	118,716	37,770	80,946
4,85	131,000	47,578	83,422	139,473	47,580	91,893
4,00	148,000	55,917	92,083	156,992	55,918	101,074
3,00	168,000	65,727	102,273	177,469	65,728	111,741
2,00	188,000	75,537	112,463	197,817	75,538	122,279
1,00	208,000	85,347	122,653	218,055	85,347	132,708
0,00	228,000	95,157	132,843	238,201	95,157	143,044

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0050	0,0012	0,0000	0,0000
1	0,0000	0,0000	0,0003	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0053	0,0012	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
11,70	9,70	2	0,0050	0,0012	0,0097	0,49
9,70	0,00	1	0,0003	0,0000	0,0003	0,00
Total			0,0053	0,0012	0,0100	

3.5 Results for Vertical 5 (X = -6,20 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
12,40	0,001	0,000	0,001	42,615	0,000	42,615
12,30	1,700	0,000	1,700	44,874	0,000	44,874
12,20	3,400	0,000	3,400	46,874	0,000	46,874
12,10	5,100	0,000	5,100	48,845	0,000	48,845
12,00	6,800	0,000	6,800	50,748	0,000	50,748
11,90	8,500	0,000	8,500	52,571	0,000	52,571
11,80	10,200	0,000	10,200	54,319	0,000	54,319
11,70	11,900	0,000	11,900	56,003	0,000	56,003
11,60	13,600	0,000	13,600	57,634	0,000	57,634
11,50	15,300	0,000	15,300	59,223	0,000	59,223
11,40	17,000	0,000	17,000	60,776	0,000	60,776
11,05	22,950	0,000	22,950	66,011	0,000	66,011
10,40	34,000	0,000	34,000	75,306	0,000	75,306
9,70	45,900	0,000	45,900	85,163	0,018	85,146
Layer 1						
9,70	45,900	0,000	45,900	85,163	0,018	85,146
8,85	62,900	8,338	54,561	99,696	8,351	91,345
7,85	82,900	18,148	64,752	116,971	18,157	98,814
6,85	102,900	27,959	74,942	134,474	27,964	106,510
5,85	122,900	37,769	85,132	152,208	37,772	114,436
4,85	142,900	47,578	95,322	170,162	47,581	122,581
4,00	159,900	55,917	103,983	185,584	55,919	129,665
3,00	179,900	65,727	114,173	203,900	65,729	138,172
2,00	199,900	75,537	124,363	222,386	75,538	146,848
1,00	219,900	85,347	134,553	241,022	85,347	155,674
0,00	239,900	95,157	144,743	259,792	95,157	164,635

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0,0000	0,0000	0,0201	0,0047	0,1373	0,0129
1	0,0000	0,0000	0,0007	0,0000	0,0011	0,0000
Total	0,0000	0,0000	0,0208	0,0047	0,1384	0,0129

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12,40	9,70	2	0,1574	0,0176	0,2167	8,03
9,70	0,00	1	0,0018	0,0000	0,0018	0,02
Total			0,1592	0,0176	0,2185	

3.6 Results for Vertical 6 (X = -4,50 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 3						
13,00	0,001	0,000	0,001	40,007	0,000	40,007
12,90	1,800	0,000	1,800	42,916	0,000	42,916
12,80	3,600	0,000	3,600	45,151	0,000	45,151
12,71	5,234	0,000	5,234	46,949	0,000	46,949
12,70	5,400	0,000	5,400	47,127	0,000	47,127
12,60	7,200	0,000	7,200	48,975	0,000	48,975
12,50	9,000	0,000	9,000	50,620	0,000	50,620
12,42	10,468	0,000	10,468	51,807	0,000	51,807
Layer 2						
12,42	10,468	0,000	10,468	51,807	0,000	51,807
12,40	10,782	0,000	10,782	52,041	0,000	52,041
12,30	12,482	0,000	12,482	53,255	0,000	53,255
12,20	14,182	0,000	14,182	54,450	0,000	54,450
12,10	15,882	0,000	15,882	55,698	0,000	55,698
12,00	17,582	0,000	17,582	57,026	0,000	57,026
11,08	33,326	0,000	33,326	70,878	0,000	70,878
10,43	44,284	0,000	44,284	80,515	0,000	80,515
9,73	56,184	0,000	56,184	90,912	0,000	90,912
Layer 1						
9,73	56,184	0,000	56,184	90,912	0,000	90,912
9,70	56,769	0,000	56,769	91,438	0,012	91,426
8,87	73,444	8,179	65,265	106,320	8,188	98,132
7,87	93,444	17,989	75,455	124,241	17,995	106,246
6,87	113,444	27,799	85,645	142,287	27,803	114,483
5,87	133,444	37,609	95,835	160,476	37,612	122,863
4,87	153,444	47,419	106,025	178,809	47,422	131,387
4,00	170,769	55,917	114,852	194,803	55,919	138,884
3,00	190,769	65,727	125,042	213,388	65,728	147,660
2,00	210,769	75,537	135,232	232,096	75,538	156,558
1,00	230,769	85,347	145,422	250,914	85,347	165,567
0,00	250,769	95,157	155,612	269,835	95,157	174,678

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
3	0,0000	0,0000	0,0075	0,0006	0,0330	0,0028
2	0,0000	0,0000	0,0108	0,0025	0,0946	0,0089
1	0,0000	0,0000	0,0007	0,0000	0,0005	0,0000
Total	0,0000	0,0000	0,0190	0,0032	0,1282	0,0116

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13,00	12,42	3	0,0406	0,0034	0,0516	8,87
12,42	9,73	2	0,1054	0,0114	0,1465	5,45
9,73	0,00	1	0,0012	0,0000	0,0012	0,01
Total			0,1472	0,0148	0,1993	

3.7 Results for Vertical 7 (X = 0,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 3						
14,60	0,001	0,000	0,001	8,835	0,000	8,835
14,50	1,800	0,000	1,800	11,448	0,000	11,448

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
14,40	3,600	0,000	3,600	13,253	0,000	13,253
14,30	5,400	0,000	5,400	15,005	0,000	15,005
14,20	7,200	0,000	7,200	16,655	0,000	16,655
14,10	9,000	0,000	9,000	18,215	0,000	18,215
14,00	10,800	0,000	10,800	19,783	0,000	19,783
13,90	12,600	0,000	12,600	21,444	0,000	21,444
13,80	14,400	0,000	14,400	23,209	0,000	23,209
13,70	16,200	0,000	16,200	25,047	0,000	25,047
13,60	18,000	0,000	18,000	26,919	0,000	26,919
13,54	19,089	0,000	19,089	28,055	0,000	28,055
12,98	29,178	0,000	29,178	38,424	0,000	38,424
12,48	38,178	0,000	38,178	47,574	0,000	47,574
Layer 2						
12,48	38,179	0,000	38,179	47,574	0,000	47,574
11,85	48,893	0,000	48,893	58,578	0,000	58,578
11,15	60,793	0,000	60,793	70,914	0,000	70,914
10,52	71,507	0,000	71,507	82,079	0,000	82,079
9,82	83,407	0,000	83,407	94,504	0,000	94,504
Layer 1						
9,82	83,407	0,000	83,407	94,504	0,000	94,504
9,70	85,539	0,000	85,539	96,728	0,003	96,725
8,91	101,355	7,757	93,597	113,121	7,760	105,361
7,91	121,355	17,567	103,787	133,772	17,570	116,203
6,91	141,355	27,377	113,977	154,296	27,379	126,917
5,91	161,355	37,187	124,167	174,675	37,189	137,486
4,91	181,355	46,997	134,357	194,913	46,999	147,914
4,00	199,539	55,917	143,622	213,202	55,918	157,284
3,00	219,539	65,727	153,812	233,214	65,728	167,486
2,00	239,539	75,537	164,002	253,136	75,537	177,599
1,00	259,539	85,347	174,192	272,989	85,347	187,642
0,00	279,539	95,157	184,382	292,789	95,157	197,632

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
3	0,0000	0,0000	0,0126	0,0011	0,0000	0,0000
2	0,0000	0,0000	0,0055	0,0013	0,0006	0,0001
1	0,0000	0,0000	0,0003	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0185	0,0023	0,0006	0,0001

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14,60	12,48	3	0,0126	0,0011	0,0167	0,79
12,48	9,82	2	0,0062	0,0014	0,0116	0,43
9,82	0,00	1	0,0003	0,0000	0,0003	0,00
Total			0,0191	0,0024	0,0286	

3.8 Results for Vertical 8 (X = 1,20 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 3						
14,80	0,001	0,000	0,001	0,416	0,000	0,416
14,70	1,800	0,000	1,800	2,384	0,000	2,384
14,60	3,600	0,000	3,600	4,185	0,000	4,185
14,50	5,400	0,000	5,400	6,193	0,000	6,193
14,40	7,200	0,000	7,200	8,357	0,000	8,357

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
14,30	9,000	0,000	9,000	10,495	0,000	10,495
14,20	10,800	0,000	10,800	12,562	0,000	12,562
14,10	12,600	0,000	12,600	14,568	0,000	14,568
14,00	14,400	0,000	14,400	16,528	0,000	16,528
13,90	16,200	0,000	16,200	18,460	0,000	18,460
13,80	18,000	0,000	18,000	20,373	0,000	20,373
13,65	20,752	0,000	20,752	23,279	0,000	23,279
13,09	30,703	0,000	30,703	33,778	0,000	33,778
12,49	41,503	0,000	41,503	45,238	0,000	45,238
Layer 2						
12,49	41,503	0,000	41,503	45,239	0,000	45,239
11,87	52,153	0,000	52,153	56,603	0,000	56,603
11,17	64,053	0,000	64,053	69,293	0,000	69,293
10,54	74,702	0,000	74,702	80,632	0,000	80,632
9,84	86,602	0,000	86,602	93,280	0,000	93,280
Layer 1						
9,84	86,602	0,000	86,602	93,281	0,000	93,281
9,70	89,147	0,000	89,147	95,975	0,002	95,973
8,92	104,733	7,645	97,088	112,346	7,647	104,699
7,92	124,733	17,455	107,278	133,265	17,457	115,809
6,92	144,733	27,265	117,468	154,063	27,266	126,797
5,92	164,733	37,075	127,658	174,724	37,076	137,648
4,92	184,733	46,885	137,848	195,244	46,886	148,358
4,00	203,147	55,917	147,230	214,020	55,918	158,102
3,00	223,147	65,727	157,420	234,296	65,728	168,569
2,00	243,147	75,537	167,610	254,467	75,537	178,930
1,00	263,147	85,347	177,800	274,549	85,347	189,202
0,00	283,147	95,157	187,990	294,557	95,157	199,400

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
3	0,0000	0,0000	0,0031	0,0003	0,0000	0,0000
2	0,0000	0,0000	0,0028	0,0007	0,0000	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0061	0,0009	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14,80	12,49	3	0,0031	0,0003	0,0041	0,18
12,49	9,84	2	0,0028	0,0007	0,0054	0,20
9,84	0,00	1	0,0002	0,0000	0,0002	0,00
Total			0,0061	0,0009	0,0097	

3.9 Results for Vertical 9 (X = 4,80 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 3						
14,80	0,001	0,000	0,001	0,001	0,000	0,001
14,70	1,800	0,000	1,800	1,800	0,000	1,800
14,60	3,600	0,000	3,600	3,600	0,000	3,600
14,50	5,400	0,000	5,400	5,400	0,000	5,400
14,40	7,200	0,000	7,200	7,200	0,000	7,200
14,30	9,000	0,000	9,000	9,000	0,000	9,000
14,20	10,800	0,000	10,800	10,801	0,000	10,801
14,10	12,600	0,000	12,600	12,601	0,000	12,601

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
14,00	14,400	0,000	14,400	14,402	0,000	14,402
13,90	16,200	0,000	16,200	16,203	0,000	16,203
13,80	18,000	0,000	18,000	18,004	0,000	18,004
13,67	20,339	0,000	20,339	20,346	0,000	20,346
13,14	29,878	0,000	29,878	29,908	0,000	29,908
12,54	40,678	0,000	40,678	40,772	0,000	40,772
Layer 2						
12,54	40,678	0,000	40,678	40,772	0,000	40,772
11,93	51,132	0,000	51,132	51,348	0,000	51,348
11,23	63,032	0,000	63,032	63,462	0,000	63,462
10,61	73,487	0,000	73,487	74,168	0,000	74,168
9,91	85,387	0,000	85,387	86,418	0,000	86,418
Layer 1						
9,91	85,387	0,000	85,387	86,418	0,000	86,418
9,70	89,170	0,000	89,170	90,318	0,001	90,318
9,16	100,068	5,346	94,723	101,537	5,346	96,191
8,56	112,068	11,232	100,837	113,917	11,232	102,685
7,56	132,068	21,042	111,027	134,587	21,042	113,545
6,56	152,068	30,852	121,217	155,274	30,852	124,422
5,56	172,068	40,662	131,407	175,946	40,662	135,283
4,96	184,068	46,548	137,521	188,332	46,548	141,784
4,00	203,170	55,917	147,253	208,012	55,917	152,094
3,00	223,170	65,727	157,443	228,559	65,727	162,832
2,00	243,170	75,537	167,633	249,042	75,537	173,504
1,00	263,170	85,347	177,823	269,457	85,347	184,110
0,00	283,170	95,157	188,013	289,807	95,157	194,650

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
3	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0002	0,0001	0,0000	0,0000
1	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0004	0,0001	0,0000	0,0000

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14,80	12,54	3	0,0000	0,0000	0,0000	0,00
12,54	9,91	2	0,0002	0,0001	0,0005	0,02
9,91	0,00	1	0,0001	0,0000	0,0001	0,00
Total			0,0004	0,0001	0,0006	

3.10 Results for Vertical 10 (X = 9,50 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
12,60	0,001	0,000	0,001	0,005	0,000	0,005
12,50	1,700	0,000	1,700	1,705	0,000	1,705
12,40	3,400	0,000	3,400	3,406	0,000	3,406
12,30	5,100	0,000	5,100	5,108	0,000	5,108
12,20	6,800	0,000	6,800	6,809	0,000	6,809
12,10	8,500	0,000	8,500	8,511	0,000	8,511
12,00	10,200	0,000	10,200	10,212	0,000	10,212
11,90	11,900	0,000	11,900	11,914	0,000	11,914
11,80	13,600	0,000	13,600	13,617	0,000	13,617
11,70	15,300	0,000	15,300	15,319	0,000	15,319

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
11,60	17,000	0,000	17,000	17,022	0,000	17,022
11,30	22,100	0,000	22,100	22,131	0,000	22,131
10,70	32,300	0,000	32,300	32,360	0,000	32,360
10,00	44,200	0,000	44,200	44,312	0,000	44,312
Layer 1						
10,00	44,200	0,000	44,200	44,312	0,000	44,312
9,70	49,600	0,000	49,600	49,741	0,000	49,741
9,20	59,600	4,905	54,695	59,800	4,905	54,895
8,60	71,600	10,791	60,809	71,888	10,791	61,097
7,60	91,600	20,601	70,999	92,079	20,601	71,477
6,60	111,600	30,411	81,189	112,320	30,411	81,909
5,60	131,600	40,221	91,379	132,605	40,221	92,384
5,00	143,600	46,107	97,493	144,793	46,107	98,685
4,00	163,600	55,917	107,683	165,125	55,917	109,208
3,00	183,600	65,727	117,873	185,474	65,727	119,746
2,00	203,600	75,537	128,063	205,826	75,537	130,289
1,00	223,600	85,347	138,253	226,175	85,347	140,828
0,00	243,600	95,157	148,443	246,513	95,157	151,356

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12,60	10,00	2	0,0001	0,0000	0,0001	0,00
10,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0001	0,0000	0,0002	

3.11 Results for Vertical 11 (X = 12,80 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
12,20	0,001	0,000	0,001	0,003	0,000	0,003
12,10	1,700	0,000	1,700	1,703	0,000	1,703
12,00	3,400	0,000	3,400	3,403	0,000	3,403
11,90	5,100	0,000	5,100	5,104	0,000	5,104
11,80	6,800	0,000	6,800	6,805	0,000	6,805
11,70	8,500	0,000	8,500	8,505	0,000	8,505
11,60	10,200	0,000	10,200	10,206	0,000	10,206
11,50	11,900	0,000	11,900	11,907	0,000	11,907
11,40	13,600	0,000	13,600	13,608	0,000	13,608
11,30	15,300	0,000	15,300	15,309	0,000	15,309
11,20	17,000	0,000	17,000	17,010	0,000	17,010
11,10	18,700	0,000	18,700	18,711	0,000	18,711
10,60	27,200	0,000	27,200	27,220	0,000	27,220
10,00	37,400	0,000	37,400	37,435	0,000	37,435
Layer 1						
10,00	37,400	0,000	37,400	37,435	0,000	37,435
9,70	42,800	0,000	42,800	42,845	0,000	42,845
9,20	52,800	4,905	47,895	52,866	4,905	47,961
8,60	64,800	10,791	54,009	64,900	10,791	54,109
7,60	84,800	20,601	64,199	84,978	20,601	64,377

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
6,60	104,800	30,411	74,389	105,086	30,411	74,675
5,60	124,800	40,221	84,579	125,224	40,221	85,003
5,00	136,800	46,107	90,693	137,321	46,107	91,214
4,00	156,800	55,917	100,883	157,504	55,917	101,587
3,00	176,800	65,727	111,073	177,710	65,727	111,983
2,00	196,800	75,537	121,263	197,933	75,537	122,396
1,00	216,800	85,347	131,453	218,168	85,347	132,821
0,00	236,800	95,157	141,643	238,409	95,157	143,252

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12,20	10,00	2	0,0000	0,0000	0,0000	0,00
10,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0001	

3.12 Results for Vertical 12 (X = 16,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 2						
12,30	0,001	0,000	0,001	0,002	0,000	0,002
12,20	1,700	0,000	1,700	1,701	0,000	1,701
12,10	3,400	0,000	3,400	3,401	0,000	3,401
12,00	5,100	0,000	5,100	5,101	0,000	5,101
11,90	6,800	0,000	6,800	6,801	0,000	6,801
11,80	8,500	0,000	8,500	8,502	0,000	8,502
11,70	10,200	0,000	10,200	10,202	0,000	10,202
11,60	11,900	0,000	11,900	11,902	0,000	11,902
11,50	13,600	0,000	13,600	13,603	0,000	13,603
11,40	15,300	0,000	15,300	15,303	0,000	15,303
11,30	17,000	0,000	17,000	17,003	0,000	17,003
11,15	19,550	0,000	19,550	19,554	0,000	19,554
10,60	28,900	0,000	28,900	28,908	0,000	28,908
10,00	39,100	0,000	39,100	39,114	0,000	39,114
Layer 1						
10,00	39,100	0,000	39,100	39,114	0,000	39,114
9,70	44,500	0,000	44,500	44,518	0,000	44,518
9,20	54,500	4,905	49,595	54,527	4,905	49,622
8,60	66,500	10,791	55,709	66,542	10,791	55,751
7,60	86,500	20,601	65,899	86,578	20,601	65,977
6,60	106,500	30,411	76,089	106,630	30,411	76,219
5,60	126,500	40,221	86,279	126,701	40,221	86,480
5,00	138,500	46,107	92,393	138,753	46,107	92,646
4,00	158,500	55,917	102,583	158,854	55,917	102,937
3,00	178,500	65,727	112,773	178,974	65,727	113,246
2,00	198,500	75,537	122,963	199,110	75,537	123,573
1,00	218,500	85,347	133,153	219,260	85,347	133,913
0,00	238,500	95,157	143,343	239,422	95,157	144,265

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12,30	10,00	2	0,0000	0,0000	0,0000	0,00
10,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

3.13 Results for Vertical 13 (X = 20,00 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 2						
12,30	0,001	0,000	0,001	0,001	0,000	0,001
12,20	1,700	0,000	1,700	1,700	0,000	1,700
12,10	3,400	0,000	3,400	3,400	0,000	3,400
12,00	5,100	0,000	5,100	5,100	0,000	5,100
11,90	6,800	0,000	6,800	6,801	0,000	6,801
11,80	8,500	0,000	8,500	8,501	0,000	8,501
11,70	10,200	0,000	10,200	10,201	0,000	10,201
11,60	11,900	0,000	11,900	11,901	0,000	11,901
11,50	13,600	0,000	13,600	13,601	0,000	13,601
11,40	15,300	0,000	15,300	15,301	0,000	15,301
11,30	17,000	0,000	17,000	17,001	0,000	17,001
11,15	19,550	0,000	19,550	19,551	0,000	19,551
10,60	28,900	0,000	28,900	28,903	0,000	28,903
10,00	39,100	0,000	39,100	39,105	0,000	39,105
Layer 1						
10,00	39,100	0,000	39,100	39,105	0,000	39,105
9,70	44,500	0,000	44,500	44,507	0,000	44,507
9,20	54,500	4,905	49,595	54,511	4,905	49,606
8,60	66,500	10,791	55,709	66,517	10,791	55,726
7,60	86,500	20,601	65,899	86,532	20,601	65,931
6,60	106,500	30,411	76,089	106,556	30,411	76,145
5,60	126,500	40,221	86,279	126,588	40,221	86,367
5,00	138,500	46,107	92,393	138,613	46,107	92,506
4,00	158,500	55,917	102,583	158,664	55,917	102,747
3,00	178,500	65,727	112,773	178,726	65,727	112,999
2,00	198,500	75,537	122,963	198,799	75,537	123,262
1,00	218,500	85,347	133,153	218,884	85,347	133,537
0,00	238,500	95,157	143,343	238,979	95,157	143,822

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12,30	10,00	2	0,0000	0,0000	0,0000	0,00
10,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-30,00	0,00	11,60	0,000
2	-21,80	0,00	11,70	0,000
3	-18,75	0,00	11,30	0,000
4	-15,00	0,00	11,70	0,010
5	-6,20	0,00	12,40	0,219
6	-4,50	0,00	13,00	0,199
7	0,00	0,00	14,60	0,029
8	1,20	0,00	14,80	0,010
9	4,80	0,00	14,80	0,001
10	9,50	0,00	12,60	0,000
11	12,80	0,00	12,20	0,000
12	16,00	0,00	12,30	0,000
13	20,00	0,00	12,30	0,000

4.2 Maintain Profile Calculation Results

Load 1 consists of 20,038 m3 per Width
The extra amount of soil to be added is 1,896 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	1-12-2014
Time of report:	9:37:08
Date of calculation:	1-12-2014
Time of calculation:	9:36:38
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Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei Zetting DR59.045-46

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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
7 - X -	-30,000	-15,900	-11,500	-10,500	-8,000
7 - Y -	11,600	11,500	11,500	11,000	11,000
7 - X -	-7,000	-6,000	-3,500	0,000	3,300
7 - Y -	11,500	11,500	12,250	13,300	14,300
7 - X -	4,800	9,400	12,400	15,400	18,400
7 - Y -	14,700	14,700	13,600	13,300	13,200
7 - X -	20,000				
7 - Y -	13,600				
6 - X -	-30,000	-15,900	-11,500	-10,500	-8,000
6 - Y -	11,600	11,500	11,500	11,000	11,000
6 - X -	-7,000	-6,000	-3,500	9,400	15,400
6 - Y -	11,500	11,500	12,250	12,250	13,300
6 - X -	18,400	20,000			
6 - Y -	13,200	13,600			
5 - X -	-30,000	-15,900	-11,500	-10,500	-8,000
5 - Y -	11,600	11,500	11,500	11,000	11,000
5 - X -	-7,000	-6,000	-3,500	9,400	15,400
5 - Y -	11,500	11,500	12,250	12,250	10,650
5 - X -	20,000				
5 - Y -	10,650				
4 - X -	-30,000	-11,500	-6,000	9,400	15,400
4 - Y -	10,800	10,800	9,800	9,800	10,650
4 - X -	20,000				
4 - Y -	10,650				
3 - X -	-30,000	-11,500	-6,000	9,400	15,400
3 - Y -	10,600	10,600	9,500	9,500	10,650
3 - X -	20,000				
3 - Y -	10,650				
2 - X -	-30,000	-11,500	-6,000	9,400	15,400
2 - Y -	10,300	10,300	9,500	9,500	10,650
2 - X -	20,000				
2 - Y -	10,650				
1 - X -	-30,000	20,000			
1 - Y -	3,000	3,000			
0 - X -	-30,000	20,000			
0 - Y -	0,000	0,000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-30,000	20,000			
1 - Y -	10,300	10,300			

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9,81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000,00 [days]
With maintain profile	

(only for non uniform loads)
- Material: Superelevation
- Time: 0,00 [days]
- Unit weight above phreatic.: 18,00 [kN/m³]
- Unit weight below phreatic: 20,00 [kN/m³]
- Iteration stop criterium: 0,10 [m]

Pc (initial): Variable parallel to the initial effective stress
Pc (per step): Automatic increased to the final effective stresses
No imaginary surface
With submerging
(only for non uniform loads)
- Iteration stop criterium : 0,10 [m]

Load column width
- Non-Uniform Loads : 1,00 [m]
- Trapezoidal Loads : 1,00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
7	Klei, zandig	1	1
6	Klei, zandig	1	1
5	Klei, siltig	1	1
4	Veen	1	1
3	Klei, siltig	1	1
2	Zand	1	1
1	Grind	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
7	No	18,00	18,00
6	No	18,00	18,00
5	No	17,00	17,00
4	No	13,00	13,00
3	No	17,00	17,00
2	Yes	18,00	20,00
1	Yes	19,00	20,00

Layer number	Vert. consolid. coefficient Cv [m²/s]
7	1,00E-06
6	1,00E-06
5	1,00E-07
4	1,00E-07
3	1,00E-07
2	-
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
7	-	10,00	-
6	-	10,00	-
5	-	10,00	-
4	-	-	1,30
3	-	10,00	-
2	-	-	1,30
1	-	-	1,30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
7	1,00E+02	2,00E+01	1,20E+03	2,40E+02	1,00E+02	2,40E+02
6	1,00E+02	2,00E+01	1,20E+03	2,40E+02	1,00E+02	2,40E+02
5	7,50E+01	1,50E+01	3,20E+02	1,60E+02	7,50E+01	1,60E+02
4	5,00E+01	1,00E+01	1,50E+01	3,00E+01	5,00E+01	3,00E+01
3	7,50E+01	1,50E+01	3,20E+02	1,60E+02	7,50E+01	1,60E+02
2	3,00E+03	6,00E+02	1,00E+09	1,00E+09	3,00E+03	1,00E+09
1	5,00E+03	1,00E+03	1,00E+09	1,00E+09	5,00E+03	1,00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18,00	20,00

Load number	Co-ordinates [m]					
1 - X -	-15,90	-4,50	0,00	3,30		
1 - Y -	11,50	15,30	15,30	14,30		

2.7 Verticals

Vertical number	X co-ordinates [m]				
1 - 5	-30,000	-15,900	-11,500	-10,500	-8,000
6 - 10	-7,000	-6,000	-4,500	-3,500	0,000
11 - 15	3,300	4,800	9,400	12,400	15,400
16 - 17	18,400	20,000			

3 Results per Vertical

3.1 Results for Vertical 1 (X = -30,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
11,60	0,001	0,000	0,001	0,001	0,000	0,001
11,50	1,700	0,000	1,700	1,701	0,000	1,701
11,40	3,400	0,000	3,400	3,401	0,000	3,401
11,30	5,100	0,000	5,100	5,101	0,000	5,101
11,20	6,800	0,000	6,800	6,801	0,000	6,801
11,10	8,500	0,000	8,500	8,501	0,000	8,501
11,00	10,200	0,000	10,200	10,201	0,000	10,201
10,90	11,900	0,000	11,900	11,901	0,000	11,901
10,80	13,600	0,000	13,600	13,601	0,000	13,601
Layer 4						
10,80	13,600	0,000	13,600	13,601	0,000	13,601
10,70	14,900	0,000	14,900	14,901	0,000	14,901
10,60	16,200	0,000	16,200	16,202	0,000	16,202
Layer 3						
10,60	16,200	0,000	16,200	16,202	0,000	16,202
10,45	18,750	0,000	18,750	18,752	0,000	18,752
10,30	21,300	0,000	21,300	21,302	0,000	21,302
Layer 2						
10,30	21,300	0,000	21,300	21,303	0,000	21,302
9,35	40,300	9,319	30,980	40,307	9,320	30,987
8,35	60,300	19,130	41,170	60,318	19,130	41,189
7,35	80,300	28,939	51,361	80,342	28,940	51,403
6,65	94,300	35,806	58,493	94,370	35,807	58,563
5,70	113,300	45,126	68,174	113,425	45,126	68,299
4,70	133,300	54,936	78,364	133,509	54,936	78,573
3,70	153,300	64,746	88,554	153,624	64,746	88,878
3,00	167,300	71,613	95,687	167,723	71,613	96,110
Layer 1						
3,00	167,300	71,613	95,687	167,724	71,613	96,110
2,20	183,300	79,461	103,839	183,856	79,461	104,395
1,50	197,300	86,328	110,972	197,989	86,328	111,661
0,80	211,300	93,195	118,105	212,136	93,195	118,941
0,00	227,300	101,043	126,257	228,320	101,043	127,277

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
3	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,60	10,80	5	0,0000	0,0000	0,0000	0,00
10,80	10,60	4	0,0000	0,0000	0,0000	0,00
10,60	10,30	3	0,0000	0,0000	0,0000	0,00
10,30	3,00	2	0,0000	0,0000	0,0000	0,00
3,00	0,00	1	0,0000	0,0000	0,0000	0,00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
Total			0,0000	0,0000	0,0000	

3.2 Results for Vertical 2 (X = -15,90 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
11,50	0,001	0,000	0,001	1,852	0,000	1,852
11,40	1,700	0,000	1,700	3,567	0,000	3,567
11,30	3,400	0,000	3,400	5,287	0,000	5,287
11,20	5,100	0,000	5,100	7,014	0,000	7,014
11,15	5,950	0,000	5,950	7,882	0,000	7,882
11,10	6,800	0,000	6,800	8,752	0,000	8,752
11,00	8,500	0,000	8,500	10,503	0,000	10,503
10,90	10,200	0,000	10,200	12,269	0,000	12,269
10,80	11,900	0,000	11,900	14,050	0,000	14,050
Layer 4						
10,80	11,900	0,000	11,900	14,051	0,000	14,051
10,70	13,200	0,000	13,200	15,445	0,000	15,445
10,60	14,500	0,000	14,500	16,853	0,000	16,853
Layer 3						
10,60	14,500	0,000	14,500	16,853	0,000	16,853
10,50	16,200	0,000	16,200	18,670	0,000	18,670
10,45	17,050	0,000	17,050	19,582	0,000	19,582
10,30	19,600	0,000	19,600	22,331	0,004	22,327
Layer 2						
10,30	19,600	0,000	19,600	22,332	0,004	22,327
9,35	38,600	9,319	29,281	42,720	9,323	33,397
8,35	58,600	19,130	39,471	64,268	19,133	45,135
7,35	78,600	28,939	49,660	85,867	28,942	56,925
6,65	92,600	35,806	56,793	100,994	35,809	65,185
5,70	111,600	45,126	66,474	121,481	45,128	76,353
4,70	131,600	54,936	76,664	142,930	54,937	87,993
3,70	151,600	64,746	86,854	164,211	64,747	99,464
3,00	165,600	71,613	93,987	178,994	71,614	107,381
Layer 1						
3,00	165,600	71,613	93,987	178,995	71,614	107,381
2,20	181,600	79,461	102,139	195,772	79,462	116,311
1,50	195,600	86,328	109,272	210,353	86,328	124,025
0,80	209,600	93,195	116,405	224,846	93,195	131,651
0,00	225,600	101,043	124,557	241,309	101,043	140,266

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0040	0,0009	0,0000	0,0000
4	0,0000	0,0000	0,0006	0,0021	0,0000	0,0000
3	0,0000	0,0000	0,0006	0,0001	0,0000	0,0000
2	0,0000	0,0000	0,0003	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0055	0,0032	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
11,50	10,80	5	0,0040	0,0009	0,0076	1,08
10,80	10,60	4	0,0006	0,0021	0,0088	4,41

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
10,60	10,30	3	0,0006	0,0001	0,0011	0,36
10,30	3,00	2	0,0003	0,0000	0,0003	0,00
3,00	0,00	1	0,0001	0,0000	0,0001	0,00
Total			0,0055	0,0032	0,0179	

3.3 Results for Vertical 3 (X = -11,50 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
11,50	0,001	0,000	0,001	30,197	0,000	30,197
11,40	1,700	0,000	1,700	32,821	0,000	32,821
11,30	3,400	0,000	3,400	35,397	0,000	35,397
11,20	5,100	0,000	5,100	37,469	0,000	37,469
11,15	5,950	0,000	5,950	38,260	0,000	38,260
11,10	6,800	0,000	6,800	39,042	0,000	39,042
11,00	8,500	0,000	8,500	40,576	0,000	40,576
10,90	10,200	0,000	10,200	42,071	0,000	42,071
10,80	11,900	0,000	11,900	43,524	0,000	43,524
Layer 4						
10,80	11,900	0,000	11,900	43,524	0,000	43,524
10,70	13,200	0,000	13,200	44,550	0,000	44,550
10,60	14,500	0,000	14,500	45,575	0,000	45,575
Layer 3						
10,60	14,500	0,000	14,500	45,575	0,000	45,575
10,50	16,200	0,000	16,200	47,026	0,000	47,026
10,45	17,050	0,000	17,050	47,768	0,000	47,768
10,30	19,600	0,000	19,600	50,115	0,036	50,079
Layer 2						
10,30	19,600	0,000	19,600	50,115	0,036	50,079
9,35	38,600	9,319	29,281	69,761	9,346	60,414
8,35	58,600	19,130	39,471	91,043	19,149	71,894
7,35	78,600	28,939	49,660	111,721	28,953	82,767
6,65	92,600	35,806	56,793	125,866	35,817	90,048
5,70	111,600	45,126	66,474	144,741	45,133	99,608
4,70	131,600	54,936	76,664	164,324	54,941	109,383
3,70	151,600	64,746	86,854	183,710	64,749	118,961
3,00	165,600	71,613	93,987	197,200	71,615	125,586
Layer 1						
3,00	165,600	71,613	93,987	197,201	71,615	125,586
2,20	181,600	79,461	102,139	212,564	79,462	133,102
1,50	195,600	86,328	109,272	225,974	86,329	139,645
0,80	209,600	93,195	116,405	239,365	93,195	146,169
0,00	225,600	101,043	124,557	254,655	101,043	153,612

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0114	0,0027	0,0411	0,0039
4	0,0000	0,0000	0,0010	0,0035	0,0191	0,0064
3	0,0000	0,0000	0,0019	0,0004	0,0114	0,0011
2	0,0000	0,0000	0,0006	0,0000	0,0029	0,0000
1	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0151	0,0066	0,0745	0,0113

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
11,50	10,80	5	0,0525	0,0065	0,0741	10,58
10,80	10,60	4	0,0202	0,0099	0,0515	25,77
10,60	10,30	3	0,0133	0,0015	0,0187	6,22
10,30	3,00	2	0,0035	0,0000	0,0035	0,05
3,00	0,00	1	0,0002	0,0000	0,0002	0,01
Total			0,0896	0,0179	0,1480	

3.4 Results for Vertical 4 (X = -10,50 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
11,00	0,001	0,000	0,001	42,722	0,000	42,722
10,90	1,700	0,000	1,700	44,531	0,000	44,531
10,81	3,245	0,000	3,245	46,174	0,000	46,174
10,80	3,400	0,000	3,400	46,338	0,000	46,338
10,70	5,100	0,000	5,100	48,128	0,000	48,128
10,62	6,491	0,000	6,491	49,575	0,000	49,575
Layer 4						
10,62	6,491	0,000	6,491	49,575	0,000	49,575
10,60	6,727	0,000	6,727	49,821	0,000	49,821
10,51	7,909	0,000	7,909	51,040	0,000	51,040
10,50	8,027	0,000	8,027	51,160	0,000	51,160
10,40	9,327	0,000	9,327	52,477	0,000	52,477
Layer 3						
10,40	9,327	0,000	9,327	52,477	0,000	52,477
10,30	11,027	0,000	11,027	54,372	0,197	54,175
10,28	11,414	0,223	11,191	54,734	0,398	54,336
10,20	12,727	0,981	11,746	55,962	1,083	54,880
10,15	13,500	1,427	12,073	56,683	1,486	55,197
Layer 2						
10,15	13,500	1,427	12,073	56,684	1,486	55,197
10,10	14,591	1,962	12,629	57,760	2,020	55,740
10,00	16,591	2,943	13,648	59,731	2,999	56,732
9,28	31,045	10,033	21,013	73,951	10,077	63,874
8,28	51,045	19,843	31,202	93,451	19,874	73,577
7,28	71,045	29,653	41,393	112,587	29,675	82,912
6,58	85,045	36,520	48,526	125,811	36,537	89,273
5,70	102,591	45,126	57,465	142,257	45,138	97,118
4,70	122,591	54,936	67,655	160,905	54,944	105,961
3,70	142,591	64,746	77,845	179,508	64,750	114,758
3,00	156,591	71,613	84,978	192,526	71,615	120,910
Layer 1						
3,00	156,591	71,613	84,978	192,526	71,616	120,910
2,20	172,591	79,461	93,130	207,414	79,463	127,952
1,50	186,591	86,328	100,263	220,458	86,329	134,129
0,80	200,591	93,195	107,396	233,522	93,195	140,327
0,00	216,591	101,043	115,548	248,483	101,043	147,440

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0082	0,0019	0,0320	0,0030
4	0,0000	0,0000	0,0011	0,0038	0,0351	0,0117
3	0,0000	0,0000	0,0021	0,0005	0,0155	0,0015
2	0,0000	0,0000	0,0006	0,0000	0,0052	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0001	0,0000

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
Total	0,0000	0,0000	0,0123	0,0062	0,0878	0,0161

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
11,00	10,62	5	0,0402	0,0049	0,0554	14,51
10,62	10,40	4	0,0362	0,0155	0,0790	36,23
10,40	10,15	3	0,0176	0,0020	0,0242	9,84
10,15	3,00	2	0,0058	0,0000	0,0058	0,08
3,00	0,00	1	0,0003	0,0000	0,0003	0,01
Total			0,1001	0,0224	0,1646	

3.5 Results for Vertical 5 (X = -8,00 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
11,00	0,001	0,000	0,001	59,908	0,000	59,908
10,90	1,700	0,000	1,700	61,951	0,000	61,951
10,80	3,400	0,000	3,400	64,021	0,000	64,021
10,70	5,100	0,000	5,100	66,062	0,000	66,062
10,60	6,800	0,000	6,800	68,040	0,000	68,040
10,58	7,109	0,000	7,109	68,392	0,000	68,392
10,50	8,500	0,000	8,500	69,948	0,000	69,948
10,40	10,200	0,000	10,200	72,162	0,370	71,792
10,30	11,900	0,000	11,900	74,813	1,232	73,581
10,20	13,600	0,981	12,619	76,441	2,097	74,344
10,16	14,218	1,338	12,880	77,025	2,412	74,612
Layer 4						
10,16	14,218	1,338	12,880	77,025	2,412	74,612
10,10	15,045	1,962	13,083	77,638	2,821	74,816
10,03	15,932	2,631	13,301	78,282	3,261	75,021
10,00	16,345	2,943	13,402	78,579	3,467	75,112
9,90	17,645	3,924	13,721	79,498	4,115	75,382
Layer 3						
9,90	17,646	3,924	13,722	79,498	4,116	75,383
9,85	18,573	4,459	14,114	80,329	4,590	75,739
9,79	19,500	4,994	14,506	81,155	5,066	76,089
Layer 2						
9,79	19,500	4,994	14,506	81,155	5,066	76,089
8,80	39,409	14,760	24,650	99,511	14,812	84,699
7,80	59,409	24,570	34,840	116,985	24,607	92,378
6,80	79,409	34,380	45,029	134,023	34,406	99,617
6,40	87,409	38,304	49,105	140,800	38,327	102,474
5,40	107,318	48,069	59,249	157,691	48,085	109,607
4,40	127,318	57,879	69,439	174,785	57,889	116,896
3,40	147,318	67,689	79,629	192,058	67,694	124,363
3,00	155,318	71,613	83,705	199,022	71,617	127,405
Layer 1						
3,00	155,318	71,613	83,705	199,022	71,617	127,405
2,20	171,318	79,461	91,857	213,048	79,463	133,584
1,50	185,318	86,328	98,990	225,423	86,329	139,094
0,80	199,318	93,195	106,123	237,892	93,196	144,697
0,00	215,318	101,043	114,275	252,251	101,043	151,208

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0125	0,0029	0,0788	0,0074
4	0,0000	0,0000	0,0014	0,0046	0,0387	0,0129
3	0,0000	0,0000	0,0008	0,0002	0,0083	0,0008
2	0,0000	0,0000	0,0006	0,0000	0,0063	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0002	0,0000
Total	0,0000	0,0000	0,0154	0,0077	0,1324	0,0211

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
11,00	10,16	5	0,0913	0,0103	0,1222	14,62
10,16	9,90	4	0,0401	0,0175	0,0900	34,14
9,90	9,79	3	0,0091	0,0010	0,0122	11,20
9,79	3,00	2	0,0069	0,0000	0,0069	0,10
3,00	0,00	1	0,0004	0,0000	0,0004	0,01
Total			0,1478	0,0288	0,2318	

3.6 Results for Vertical 6 (X = -7,00 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
11,50	0,001	0,000	0,001	58,171	0,000	58,171
11,40	1,700	0,000	1,700	60,875	0,000	60,875
11,30	3,400	0,000	3,400	63,615	0,000	63,615
11,20	5,100	0,000	5,100	65,980	0,000	65,980
11,10	6,800	0,000	6,800	67,951	0,000	67,951
11,00	8,500	0,000	8,500	69,930	0,000	69,930
10,90	10,200	0,000	10,200	71,861	0,000	71,861
10,80	11,900	0,000	11,900	73,702	0,000	73,702
10,74	12,905	0,000	12,905	74,744	0,000	74,744
10,70	13,600	0,000	13,600	75,448	0,000	75,448
10,60	15,300	0,000	15,300	77,121	0,000	77,121
10,50	17,000	0,000	17,000	78,752	0,000	78,752
10,30	20,400	0,000	20,400	83,152	1,150	82,002
9,98	25,809	3,121	22,688	88,172	3,978	84,194
Layer 4						
9,98	25,809	3,121	22,688	88,172	3,978	84,194
9,84	27,641	4,504	23,137	89,627	4,984	84,643
9,70	29,473	5,886	23,587	91,087	5,993	85,095
Layer 3						
9,70	29,473	5,886	23,587	91,088	5,993	85,095
9,67	29,936	6,154	23,783	91,526	6,236	85,290
9,65	30,400	6,421	23,979	91,965	6,480	85,485
Layer 2						
9,65	30,400	6,421	23,979	91,965	6,480	85,485
8,72	48,855	15,473	33,382	109,745	15,518	94,228
7,72	68,855	25,283	43,572	127,685	25,316	102,369
6,72	88,855	35,093	53,761	144,881	35,116	109,765
6,32	96,855	39,017	57,837	151,669	39,037	112,632
5,40	115,309	48,069	67,240	167,282	48,083	119,199
4,40	135,309	57,879	77,430	184,260	57,888	126,373
3,40	155,309	67,689	87,620	201,393	67,694	133,699
3,00	163,309	71,613	91,696	208,300	71,616	136,683
Layer 1						
3,00	163,309	71,613	91,696	208,300	71,617	136,683
2,20	179,309	79,461	99,848	222,212	79,463	142,748

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
1,50	193,309	86,328	106,981	234,492	86,329	148,163
0,80	207,309	93,195	114,114	246,872	93,196	153,677
0,00	223,309	101,043	122,266	261,137	101,043	160,094

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary	Secondary	Primary	Secondary 10 [days]	Primary	Secondary 10 [days]
	[m]	[m]	[m]	[m]	[m]	[m]
5	0,0000	0,0000	0,0163	0,0038	0,1248	0,0117
4	0,0000	0,0000	0,0015	0,0049	0,0292	0,0097
3	0,0000	0,0000	0,0003	0,0001	0,0034	0,0003
2	0,0000	0,0000	0,0006	0,0000	0,0050	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0002	0,0000
Total	0,0000	0,0000	0,0187	0,0088	0,1625	0,0217

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From	To		Primary	Secondary 10 [days]	After 10000 [days]	
[m]	[m]		[m]	[m]	[m]	[%]
11,50	9,98	5	0,1410	0,0155	0,1892	12,46
9,98	9,70	4	0,0306	0,0146	0,0765	27,14
9,70	9,65	3	0,0036	0,0004	0,0049	8,97
9,65	3,00	2	0,0056	0,0000	0,0056	0,08
3,00	0,00	1	0,0004	0,0000	0,0004	0,01
Total			0,1813	0,0305	0,2766	

3.7 Results for Vertical 7 (X = -6,00 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
Layer 5						
11,50	0,001	0,000	0,001	63,455	0,000	63,455
11,40	1,700	0,000	1,700	65,482	0,000	65,482
11,30	3,400	0,000	3,400	67,576	0,000	67,576
11,20	5,100	0,000	5,100	69,663	0,000	69,663
11,10	6,800	0,000	6,800	71,669	0,000	71,669
11,00	8,500	0,000	8,500	73,552	0,000	73,552
10,90	10,200	0,000	10,200	75,308	0,000	75,308
10,80	11,900	0,000	11,900	76,958	0,000	76,958
10,70	13,600	0,000	13,600	78,536	0,000	78,536
10,65	14,450	0,000	14,450	79,307	0,000	79,307
10,60	15,300	0,000	15,300	80,071	0,000	80,071
10,50	17,000	0,000	17,000	81,584	0,000	81,584
10,30	20,400	0,000	20,400	85,901	1,308	84,593
9,80	28,900	4,905	23,995	92,972	5,749	87,223
Layer 4						
9,80	28,900	4,905	23,995	92,972	5,749	87,223
9,65	30,850	6,377	24,474	94,235	6,824	87,411
9,50	32,800	7,848	24,952	95,500	7,905	87,595
Layer 2						
9,50	32,800	7,848	24,952	95,500	7,905	87,595
8,65	49,800	16,186	33,614	110,699	16,230	94,468
7,65	69,800	25,997	43,803	128,233	26,029	102,204
6,65	89,800	35,806	53,993	145,436	35,829	109,607
6,25	97,800	39,730	58,069	152,264	39,750	112,514
5,40	114,800	48,069	66,731	166,741	48,083	118,658
4,40	134,800	57,879	76,921	183,811	57,888	125,923
3,40	154,800	67,689	87,111	201,003	67,694	133,309
3,00	162,800	71,613	91,187	207,926	71,617	136,309
Layer 1						

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
3,00	162,800	71,613	91,187	207,926	71,617	136,309
2,20	178,800	79,461	99,339	221,860	79,463	142,397
1,50	192,800	86,328	106,472	234,152	86,329	147,823
0,80	206,800	93,195	113,605	246,537	93,196	153,341
0,00	222,800	101,043	121,757	260,802	101,043	159,759

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0016	0,0052	0,0303	0,0101
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0006	0,0000	0,0049	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0002	0,0000
Total	0,0000	0,0000	0,0023	0,0052	0,0354	0,0101

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,50	9,80	5	0,0319	0,0154	0,2113	12,43
9,80	9,50	4	0,0000	0,0000	0,0802	26,73
9,50	3,00	2	0,0054	0,0000	0,0054	0,08
3,00	0,00	1	0,0004	0,0000	0,0004	0,01
Total			0,0377	0,0154	0,2973	

3.8 Results for Vertical 8 (X = -4,50 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
11,95	0,001	0,000	0,001	63,636	0,000	63,636
11,85	1,700	0,000	1,700	66,318	0,000	66,318
11,75	3,400	0,000	3,400	68,338	0,000	68,338
11,65	5,100	0,000	5,100	70,109	0,000	70,109
11,55	6,800	0,000	6,800	71,393	0,000	71,393
11,45	8,500	0,000	8,500	72,338	0,000	72,338
11,35	10,200	0,000	10,200	73,333	0,000	73,333
11,25	11,900	0,000	11,900	74,597	0,000	74,597
11,15	13,600	0,000	13,600	76,123	0,000	76,123
11,05	15,300	0,000	15,300	77,810	0,000	77,810
10,95	17,000	0,000	17,000	79,559	0,000	79,559
10,88	18,275	0,000	18,275	80,873	0,000	80,873
10,30	28,050	0,000	28,050	91,314	1,116	90,198
9,80	36,550	4,905	31,645	98,248	5,628	92,621
Layer 4						
9,80	36,550	4,905	31,645	98,248	5,628	92,621
9,65	38,500	6,377	32,123	99,453	6,759	92,694
9,50	40,450	7,848	32,602	100,652	7,894	92,758
Layer 2						
9,50	40,450	7,848	32,602	100,652	7,894	92,758
8,65	57,450	16,186	41,264	115,261	16,222	99,039
7,65	77,450	25,997	51,454	132,548	26,022	106,526
6,65	97,450	35,806	61,644	149,915	35,825	114,090
6,25	105,450	39,730	65,720	156,873	39,746	117,127
5,40	122,450	48,069	74,381	171,679	48,080	123,599
4,40	142,450	57,879	84,571	189,153	57,886	131,267
3,40	162,450	67,689	94,761	206,717	67,693	139,025
3,00	170,450	71,613	98,837	213,775	71,616	142,159
Layer 1						

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
3,00	170,450	71,613	98,837	213,775	71,616	142,159
2,20	186,450	79,461	106,989	227,953	79,463	148,490
1,50	200,450	86,328	114,122	240,430	86,329	154,101
0,80	214,450	93,195	121,255	252,977	93,195	159,782
0,00	230,450	101,043	129,407	267,403	101,043	166,360

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0016	0,0052	0,0239	0,0080
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0006	0,0000	0,0038	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0001	0,0000
Total	0,0000	0,0000	0,0023	0,0052	0,0279	0,0080

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11,95	9,80	5	0,0255	0,0132	0,2430	11,30
9,80	9,50	4	0,0000	0,0000	0,0690	22,99
9,50	3,00	2	0,0044	0,0000	0,0044	0,07
3,00	0,00	1	0,0003	0,0000	0,0003	0,01
Total			0,0302	0,0132	0,3166	

3.9 Results for Vertical 9 (X = -3,50 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
12,25	0,001	0,000	0,001	58,869	0,000	58,869
12,15	1,700	0,000	1,700	61,732	0,000	61,732
12,05	3,400	0,000	3,400	64,190	0,000	64,190
11,95	5,100	0,000	5,100	66,201	0,000	66,201
11,85	6,800	0,000	6,800	68,155	0,000	68,155
11,75	8,500	0,000	8,500	69,994	0,000	69,994
11,65	10,200	0,000	10,200	71,683	0,000	71,683
11,55	11,900	0,000	11,900	73,227	0,000	73,227
11,45	13,600	0,000	13,600	74,652	0,000	74,652
11,35	15,300	0,000	15,300	75,998	0,000	75,998
11,25	17,000	0,000	17,000	77,300	0,000	77,300
11,03	20,825	0,000	20,825	80,204	0,000	80,204
10,30	33,150	0,000	33,150	91,162	0,974	90,188
9,80	41,650	4,905	36,745	98,103	5,540	92,563
Layer 4						
9,80	41,650	4,905	36,745	98,104	5,540	92,563
9,65	43,600	6,377	37,224	99,405	6,712	92,694
9,50	45,550	7,848	37,702	100,713	7,886	92,827
Layer 2						
9,50	45,550	7,848	37,702	100,713	7,886	92,827
8,65	62,550	16,186	46,364	115,753	16,216	99,537
7,65	82,550	25,997	56,553	133,465	26,018	107,447
6,65	102,550	35,806	66,743	151,230	35,822	115,409
6,25	110,550	39,730	70,820	158,352	39,744	118,608
5,40	127,550	48,069	79,481	173,511	48,078	125,433
4,40	147,550	57,879	89,671	191,395	57,885	133,510
3,40	167,550	67,689	99,861	209,342	67,692	141,650
3,00	175,550	71,613	103,937	216,543	71,615	144,927
Layer 1						

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
3,00	175,550	71,613	103,937	216,543	71,615	144,927
2,20	191,550	79,461	112,089	230,985	79,462	151,523
1,50	205,550	86,328	119,222	243,672	86,329	157,343
0,80	219,550	93,195	126,355	256,407	93,195	163,212
0,00	235,550	101,043	134,507	271,023	101,043	169,980

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
5	0,0000	0,0000	0,0016	0,0052	0,0195	0,0065
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0006	0,0000	0,0031	0,0000
1	0,0000	0,0000	0,0002	0,0000	0,0001	0,0000
Total	0,0000	0,0000	0,0023	0,0052	0,0226	0,0065

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12,25	9,80	5	0,0211	0,0117	0,2546	10,39
9,80	9,50	4	0,0000	0,0000	0,0609	20,30
9,50	3,00	2	0,0036	0,0000	0,0036	0,06
3,00	0,00	1	0,0002	0,0000	0,0002	0,01
Total			0,0249	0,0117	0,3193	

3.10 Results for Vertical 10 (X = 0,00 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 7						
13,30	0,001	0,000	0,001	36,892	0,000	36,892
13,20	1,800	0,000	1,800	39,452	0,000	39,452
13,10	3,600	0,000	3,600	41,315	0,000	41,315
13,00	5,400	0,000	5,400	43,000	0,000	43,000
12,90	7,200	0,000	7,200	44,365	0,000	44,365
12,80	9,000	0,000	9,000	45,523	0,000	45,523
12,78	9,450	0,000	9,450	45,812	0,000	45,812
12,70	10,800	0,000	10,800	46,736	0,000	46,736
12,60	12,600	0,000	12,600	48,146	0,000	48,146
12,50	14,400	0,000	14,400	49,738	0,000	49,738
12,40	16,200	0,000	16,200	51,436	0,000	51,436
12,30	18,000	0,000	18,000	53,171	0,000	53,171
12,25	18,900	0,000	18,900	54,038	0,000	54,038
Layer 5						
12,25	18,900	0,000	18,900	54,038	0,000	54,038
11,63	29,525	0,000	29,525	63,755	0,000	63,755
11,03	39,725	0,000	39,725	72,834	0,000	72,834
10,30	52,050	0,000	52,050	84,584	0,489	84,095
9,80	60,550	4,905	55,645	92,390	5,243	87,147
Layer 4						
9,80	60,550	4,905	55,645	92,390	5,243	87,147
9,65	62,500	6,377	56,123	94,038	6,550	87,488
9,50	64,450	7,848	56,602	95,698	7,859	87,839
Layer 2						
9,50	64,450	7,848	56,602	95,699	7,859	87,839
8,65	81,450	16,186	65,264	112,136	16,195	95,941
7,65	101,450	25,997	75,454	131,710	26,003	105,708
6,65	121,450	35,806	85,644	151,402	35,811	115,591
6,25	129,450	39,730	89,719	159,289	39,734	119,555

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
5,40	146,450	48,069	98,381	176,041	48,072	127,969
4,40	166,450	57,879	108,571	195,708	57,881	137,827
3,40	186,450	67,689	118,761	215,312	67,690	147,622
3,00	194,450	71,613	122,837	223,135	71,614	151,521
Layer 1						
3,00	194,450	71,613	122,837	223,135	71,614	151,521
2,20	210,450	79,461	130,989	238,748	79,462	159,287
1,50	224,450	86,328	138,122	252,378	86,329	166,049
0,80	238,450	93,195	145,255	265,981	93,195	172,786
0,00	254,450	101,043	153,407	281,501	101,043	180,458

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
7	0,0000	0,0000	0,0080	0,0019	0,0658	0,0062
5	0,0000	0,0000	0,0016	0,0052	0,0054	0,0018
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0005	0,0000	0,0005	0,0000
1	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0102	0,0071	0,0718	0,0080

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13,30	12,25	7	0,0738	0,0080	0,0731	6,96
12,25	9,80	5	0,0070	0,0071	0,1035	4,23
9,80	9,50	4	0,0000	0,0000	0,0333	11,09
9,50	3,00	2	0,0010	0,0000	0,0010	0,02
3,00	0,00	1	0,0001	0,0000	0,0001	0,00
Total			0,0820	0,0151	0,2111	

3.11 Results for Vertical 11 (X = 3,30 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 7						
14,30	0,001	0,000	0,001	0,757	0,000	0,757
14,20	1,800	0,000	1,800	3,026	0,000	3,026
14,10	3,600	0,000	3,600	4,867	0,000	4,867
14,00	5,400	0,000	5,400	6,664	0,000	6,664
13,90	7,200	0,000	7,200	8,510	0,000	8,510
13,80	9,000	0,000	9,000	10,536	0,000	10,536
13,70	10,800	0,000	10,800	12,680	0,000	12,680
13,60	12,600	0,000	12,600	14,841	0,000	14,841
13,50	14,400	0,000	14,400	16,965	0,000	16,965
13,40	16,200	0,000	16,200	19,043	0,000	19,043
13,30	18,000	0,000	18,000	21,078	0,000	21,078
13,28	18,450	0,000	18,450	21,582	0,000	21,582
12,75	27,900	0,000	27,900	31,956	0,000	31,956
12,25	36,900	0,000	36,900	41,814	0,000	41,814
Layer 5						
12,25	36,900	0,000	36,900	41,815	0,000	41,815
11,63	47,525	0,000	47,525	53,553	0,000	53,553
11,03	57,725	0,000	57,725	64,809	0,000	64,809
10,30	70,050	0,000	70,050	78,473	0,116	78,357
9,80	78,550	4,905	73,645	87,761	5,007	82,755
Layer 4						
9,80	78,550	4,905	73,645	87,761	5,007	82,755

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
9,65	80,500	6,377	74,124	89,897	6,429	83,467
9,50	82,450	7,848	74,602	92,028	7,851	84,177
Layer 2						
9,50	82,450	7,848	74,602	92,028	7,851	84,177
8,65	99,450	16,186	83,264	110,279	16,189	94,090
7,65	119,450	25,997	93,454	131,626	25,999	105,627
6,65	139,450	35,806	103,643	152,836	35,809	117,028
6,25	147,450	39,730	107,719	161,281	39,732	121,549
5,40	164,450	48,069	116,381	179,152	48,071	131,081
4,40	184,450	57,879	126,571	200,043	57,880	142,162
3,40	204,450	67,689	136,761	220,790	67,690	153,100
3,00	212,450	71,613	140,837	229,049	71,614	157,435
Layer 1						
3,00	212,450	71,613	140,837	229,049	71,614	157,435
2,20	228,450	79,461	148,989	245,502	79,461	166,040
1,50	242,450	86,328	156,122	259,829	86,328	173,501
0,80	256,450	93,195	163,255	274,096	93,195	180,901
0,00	272,450	101,043	171,407	290,332	101,043	189,289

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
7	0,0000	0,0000	0,0038	0,0009	0,0000	0,0000
5	0,0000	0,0000	0,0007	0,0024	0,0000	0,0000
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0003	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0049	0,0033	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14,30	12,25	7	0,0038	0,0009	0,0053	0,26
12,25	9,80	5	0,0007	0,0024	0,0074	0,30
9,80	9,50	4	0,0000	0,0000	0,0100	3,35
9,50	3,00	2	0,0003	0,0000	0,0003	0,00
3,00	0,00	1	0,0001	0,0000	0,0001	0,00
Total			0,0049	0,0033	0,0230	

3.12 Results for Vertical 12 (X = 4,80 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 7						
14,70	0,001	0,000	0,001	0,001	0,000	0,001
14,60	1,800	0,000	1,800	1,801	0,000	1,801
14,50	3,600	0,000	3,600	3,601	0,000	3,601
14,40	5,400	0,000	5,400	5,402	0,000	5,402
14,30	7,200	0,000	7,200	7,203	0,000	7,203
14,20	9,000	0,000	9,000	9,004	0,000	9,004
14,10	10,800	0,000	10,800	10,807	0,000	10,807
14,00	12,600	0,000	12,600	12,610	0,000	12,610
13,90	14,400	0,000	14,400	14,415	0,000	14,415
13,80	16,200	0,000	16,200	16,222	0,000	16,222
13,70	18,000	0,000	18,000	18,032	0,000	18,032
13,47	22,050	0,000	22,050	22,120	0,000	22,120
12,85	33,300	0,000	33,300	33,642	0,000	33,642
12,25	44,100	0,000	44,100	44,943	0,000	44,943

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
12,25	44,100	0,000	44,100	44,943	0,000	44,943
11,63	54,725	0,000	54,725	56,267	0,000	56,267
11,03	64,925	0,000	64,925	67,241	0,000	67,241
10,30	77,250	0,000	77,250	80,625	0,050	80,574
9,80	85,750	4,905	80,845	89,836	4,950	84,886
Layer 4						
9,80	85,750	4,905	80,845	89,836	4,950	84,886
9,65	87,700	6,377	81,323	91,981	6,400	85,581
9,50	89,650	7,848	81,802	94,125	7,850	86,275
Layer 2						
9,50	89,650	7,848	81,802	94,126	7,850	86,276
8,65	106,650	16,186	90,464	112,343	16,188	96,155
7,65	126,650	25,997	100,654	133,731	25,998	107,733
6,65	146,650	35,806	110,844	155,041	35,808	119,233
6,25	154,650	39,730	114,919	163,538	39,732	123,806
5,40	171,650	48,069	123,581	181,538	48,070	133,467
4,40	191,650	57,879	133,771	202,607	57,880	144,728
3,40	211,650	67,689	143,961	223,556	67,690	155,867
3,00	219,650	71,613	148,037	231,901	71,613	160,288
Layer 1						
3,00	219,650	71,613	148,037	231,901	71,614	160,288
2,20	235,650	79,461	156,189	248,532	79,461	169,070
1,50	249,650	86,328	163,322	263,020	86,328	176,692
0,80	263,650	93,195	170,455	277,450	93,195	184,255
0,00	279,650	101,043	178,607	293,874	101,043	192,831

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
7	0,0000	0,0000	0,0011	0,0003	0,0000	0,0000
5	0,0000	0,0000	0,0003	0,0010	0,0000	0,0000
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0002	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0016	0,0013	0,0000	0,0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14,70	12,25	7	0,0011	0,0003	0,0002	0,01
12,25	9,80	5	0,0003	0,0010	0,0022	0,09
9,80	9,50	4	0,0000	0,0000	0,0044	1,45
9,50	3,00	2	0,0002	0,0000	0,0002	0,00
3,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0016	0,0013	0,0070	

3.13 Results for Vertical 13 (X = 9,40 m; Z = 0,00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 7						
14,70	0,001	0,000	0,001	0,001	0,000	0,001
14,60	1,800	0,000	1,800	1,800	0,000	1,800
14,50	3,600	0,000	3,600	3,600	0,000	3,600
14,40	5,400	0,000	5,400	5,400	0,000	5,400
14,30	7,200	0,000	7,200	7,200	0,000	7,200
14,20	9,000	0,000	9,000	9,000	0,000	9,000

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
14,10	10,800	0,000	10,800	10,800	0,000	10,800
14,00	12,600	0,000	12,600	12,600	0,000	12,600
13,90	14,400	0,000	14,400	14,401	0,000	14,401
13,80	16,200	0,000	16,200	16,201	0,000	16,201
13,70	18,000	0,000	18,000	18,001	0,000	18,001
13,47	22,050	0,000	22,050	22,052	0,000	22,052
12,85	33,300	0,000	33,300	33,307	0,000	33,307
12,25	44,100	0,000	44,100	44,121	0,000	44,121
Layer 5						
12,25	44,100	0,000	44,100	44,121	0,000	44,121
11,63	54,725	0,000	54,725	54,778	0,000	54,778
11,03	64,925	0,000	64,925	65,037	0,000	65,037
10,30	77,250	0,000	77,250	77,484	0,005	77,479
9,80	85,750	4,905	80,845	86,100	4,910	81,191
Layer 4						
9,80	85,750	4,905	80,845	86,101	4,910	81,191
9,65	87,700	6,377	81,323	88,089	6,379	81,710
9,50	89,650	7,848	81,802	90,081	7,849	82,233
Layer 2						
9,50	89,650	7,848	81,802	90,081	7,849	82,233
8,65	106,650	16,186	90,464	107,382	16,187	91,195
7,65	126,650	25,997	100,654	127,847	25,997	101,850
6,65	146,650	35,806	110,844	148,415	35,807	112,608
6,25	154,650	39,730	114,919	156,665	39,731	116,934
5,40	171,650	48,069	123,581	174,230	48,069	126,161
4,40	191,650	57,879	133,771	194,936	57,879	137,056
3,40	211,650	67,689	143,961	215,662	67,689	147,973
3,00	219,650	71,613	148,037	223,953	71,613	152,340
Layer 1						
3,00	219,650	71,613	148,037	223,953	71,613	152,340
2,20	235,650	79,461	156,189	240,531	79,461	161,070
1,50	249,650	86,328	163,322	255,026	86,328	168,698
0,80	263,650	93,195	170,455	269,507	93,195	176,312
0,00	279,650	101,043	178,607	286,034	101,043	184,991

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary	Secondary	Primary	Secondary 10 [days]	Primary	Secondary 10 [days]
	[m]	[m]	[m]	[m]	[m]	[m]
7	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000
5	0,0000	0,0000	0,0000	0,0001	0,0000	0,0000
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0001	0,0001	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From	To		Primary	Secondary 10 [days]	After 10000 [days]	
[m]	[m]		[m]	[m]	[m]	[%]
14,70	12,25	7	0,0001	0,0000	0,0000	0,00
12,25	9,80	5	0,0000	0,0001	0,0001	0,01
9,80	9,50	4	0,0000	0,0000	0,0004	0,14
9,50	3,00	2	0,0000	0,0000	0,0000	0,00
3,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0001	0,0001	0,0006	

3.14 Results for Vertical 14 (X = 12,40 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 7						
13,60	0,001	0,000	0,001	0,001	0,000	0,001
13,50	1,800	0,000	1,800	1,800	0,000	1,800
13,40	3,600	0,000	3,600	3,601	0,000	3,601
13,30	5,400	0,000	5,400	5,401	0,000	5,401
13,20	7,200	0,000	7,200	7,201	0,000	7,201
13,19	7,425	0,000	7,425	7,426	0,000	7,426
13,10	9,000	0,000	9,000	9,001	0,000	9,001
13,00	10,800	0,000	10,800	10,801	0,000	10,801
12,90	12,600	0,000	12,600	12,602	0,000	12,602
12,80	14,400	0,000	14,400	14,402	0,000	14,402
12,78	14,850	0,000	14,850	14,852	0,000	14,852
Layer 6						
12,77	14,850	0,000	14,850	14,852	0,000	14,852
12,70	16,200	0,000	16,200	16,202	0,000	16,202
12,60	18,000	0,000	18,000	18,003	0,000	18,003
12,11	26,775	0,000	26,775	26,781	0,000	26,781
11,45	38,700	0,000	38,700	38,717	0,000	38,717
Layer 5						
11,45	38,700	0,000	38,700	38,717	0,000	38,717
10,84	49,112	0,000	49,112	49,149	0,000	49,149
10,30	58,250	0,000	58,250	58,314	0,001	58,314
10,22	59,525	0,736	58,789	59,594	0,737	58,858
Layer 4						
10,22	59,525	0,736	58,789	59,594	0,737	58,858
10,15	60,500	1,472	59,029	60,574	1,472	59,102
10,07	61,475	2,207	59,268	61,554	2,208	59,346
Layer 2						
10,07	61,475	2,207	59,268	61,554	2,208	59,346
9,24	78,225	10,423	67,802	78,383	10,423	67,959
8,24	98,225	20,233	77,992	98,532	20,233	78,299
7,24	118,225	30,043	88,182	118,750	30,043	88,707
6,54	132,225	36,910	95,315	132,945	36,910	96,034
5,70	148,975	45,126	103,849	149,971	45,126	104,844
4,70	168,975	54,936	114,039	170,356	54,936	115,419
3,70	188,975	64,746	124,229	190,791	64,746	126,045
3,00	202,975	71,613	131,362	205,119	71,613	133,506
Layer 1						
3,00	202,975	71,613	131,362	205,119	71,613	133,506
2,20	218,975	79,461	139,514	221,512	79,461	142,050
1,50	232,975	86,328	146,647	235,865	86,328	149,537
0,80	246,975	93,195	153,780	250,224	93,195	157,029
0,00	262,975	101,043	161,932	266,636	101,043	165,593

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
7	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
6	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
5	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0001	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
13,60	12,78	7	0,0000	0,0000	0,0000	0,00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
12,78	11,45	6	0,0000	0,0000	0,0000	0,00
11,45	10,23	5	0,0000	0,0000	0,0000	0,00
10,23	10,07	4	0,0000	0,0000	0,0001	0,04
10,07	3,00	2	0,0000	0,0000	0,0000	0,00
3,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0001	0,0000	0,0001	

3.15 Results for Vertical 15 (X = 15,40 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
13,30	0,001	0,000	0,001	0,001	0,000	0,001
13,20	1,800	0,000	1,800	1,800	0,000	1,800
13,10	3,600	0,000	3,600	3,600	0,000	3,600
13,00	5,400	0,000	5,400	5,400	0,000	5,400
12,90	7,200	0,000	7,200	7,201	0,000	7,201
12,80	9,000	0,000	9,000	9,001	0,000	9,001
12,70	10,800	0,000	10,800	10,801	0,000	10,801
12,60	12,600	0,000	12,600	12,601	0,000	12,601
12,50	14,400	0,000	14,400	14,401	0,000	14,401
12,40	16,200	0,000	16,200	16,201	0,000	16,201
12,30	18,000	0,000	18,000	18,002	0,000	18,002
11,97	23,850	0,000	23,850	23,853	0,000	23,853
11,35	35,100	0,000	35,100	35,107	0,000	35,107
10,65	47,700	0,000	47,700	47,716	0,000	47,716
Layer 2						
10,65	47,700	0,000	47,700	47,716	0,000	47,716
10,30	54,000	0,000	54,000	54,023	0,000	54,023
9,53	69,500	7,603	61,897	69,547	7,603	61,944
8,53	89,500	17,413	72,087	89,601	17,413	72,188
7,53	109,500	27,223	82,277	109,689	27,223	82,466
6,83	123,500	34,090	89,410	123,774	34,090	89,684
6,00	140,000	42,183	97,817	140,400	42,183	98,217
5,00	160,000	51,993	108,007	160,594	51,993	108,601
4,00	180,000	61,803	118,197	180,830	61,803	119,027
3,00	200,000	71,613	128,387	201,106	71,613	129,493
Layer 1						
3,00	200,000	71,613	128,387	201,107	71,613	129,493
2,20	216,000	79,461	136,539	217,352	79,461	137,891
1,50	230,000	86,328	143,672	231,582	86,328	145,254
0,80	244,000	93,195	150,805	245,825	93,195	152,630
0,00	260,000	101,043	158,957	262,113	101,043	161,070

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
6	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
13,30	10,65	6	0,0000	0,0000	0,0000	0,00
10,65	3,00	2	0,0000	0,0000	0,0000	0,00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
3,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

3.16 Results for Vertical 16 (X = 18,40 m; Z = 0,00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
13,20	0,001	0,000	0,001	0,001	0,000	0,001
13,10	1,800	0,000	1,800	1,800	0,000	1,800
13,00	3,600	0,000	3,600	3,600	0,000	3,600
12,90	5,400	0,000	5,400	5,400	0,000	5,400
12,80	7,200	0,000	7,200	7,200	0,000	7,200
12,70	9,000	0,000	9,000	9,000	0,000	9,000
12,60	10,800	0,000	10,800	10,800	0,000	10,800
12,50	12,600	0,000	12,600	12,601	0,000	12,601
12,40	14,400	0,000	14,400	14,401	0,000	14,401
12,30	16,200	0,000	16,200	16,201	0,000	16,201
12,20	18,000	0,000	18,000	18,001	0,000	18,001
11,93	22,950	0,000	22,950	22,951	0,000	22,951
11,25	35,100	0,000	35,100	35,103	0,000	35,103
10,65	45,900	0,000	45,900	45,907	0,000	45,907
Layer 2						
10,65	45,900	0,000	45,900	45,907	0,000	45,907
10,30	52,200	0,000	52,200	52,210	0,000	52,210
9,53	67,700	7,603	60,097	67,721	7,603	60,118
8,53	87,700	17,413	70,287	87,746	17,413	70,333
7,53	107,700	27,223	80,477	107,788	27,223	80,565
6,83	121,700	34,090	87,610	121,831	34,090	87,741
6,00	138,200	42,183	96,017	138,397	42,183	96,214
5,00	158,200	51,993	106,207	158,502	51,993	106,509
4,00	178,200	61,803	116,397	178,636	61,803	116,833
3,00	198,200	71,613	126,587	198,799	71,613	127,186
Layer 1						
3,00	198,200	71,613	126,587	198,800	71,613	127,186
2,20	214,200	79,461	134,739	214,950	79,461	135,489
1,50	228,200	86,328	141,872	229,096	86,328	142,768
0,80	242,200	93,195	149,005	243,254	93,195	150,059
0,00	258,200	101,043	157,157	259,448	101,043	158,405

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
6	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
13,20	10,65	6	0,0000	0,0000	0,0000	0,00
10,65	3,00	2	0,0000	0,0000	0,0000	0,00
3,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

3.17 Results for Vertical 17 (X = 20,00 m; Z = 0,00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
13,60	0,001	0,000	0,001	0,001	0,000	0,001
13,50	1,800	0,000	1,800	1,800	0,000	1,800
13,40	3,600	0,000	3,600	3,600	0,000	3,600
13,30	5,400	0,000	5,400	5,400	0,000	5,400
13,20	7,200	0,000	7,200	7,200	0,000	7,200
13,10	9,000	0,000	9,000	9,000	0,000	9,000
13,00	10,800	0,000	10,800	10,800	0,000	10,800
12,90	12,600	0,000	12,600	12,600	0,000	12,600
12,80	14,400	0,000	14,400	14,400	0,000	14,400
12,70	16,200	0,000	16,200	16,200	0,000	16,200
12,60	18,000	0,000	18,000	18,000	0,000	18,000
12,13	26,550	0,000	26,550	26,551	0,000	26,551
11,35	40,500	0,000	40,500	40,502	0,000	40,502
10,65	53,100	0,000	53,100	53,105	0,000	53,105
Layer 2						
10,65	53,100	0,000	53,100	53,105	0,000	53,105
10,30	59,400	0,000	59,400	59,407	0,000	59,407
9,53	74,900	7,603	67,297	74,914	7,603	67,311
8,53	94,900	17,413	77,487	94,931	17,413	77,519
7,53	114,900	27,223	87,677	114,961	27,223	87,738
6,83	128,900	34,090	94,810	128,992	34,090	94,902
6,00	145,400	42,183	103,217	145,539	42,183	103,356
5,00	165,400	51,993	113,407	165,617	51,993	113,624
4,00	185,400	61,803	123,597	185,717	61,803	123,914
3,00	205,400	71,613	133,787	205,841	71,613	134,228
Layer 1						
3,00	205,400	71,613	133,787	205,842	71,613	134,228
2,20	221,400	79,461	141,939	221,958	79,461	142,497
1,50	235,400	86,328	149,072	236,073	86,328	149,745
0,80	249,400	93,195	156,205	250,198	93,195	157,003
0,00	265,400	101,043	164,357	266,353	101,043	165,310

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
6	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Total	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
13,60	10,65	6	0,0000	0,0000	0,0000	0,00
10,65	3,00	2	0,0000	0,0000	0,0000	0,00
3,00	0,00	1	0,0000	0,0000	0,0000	0,00
Total			0,0000	0,0000	0,0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-30,00	0,00	11,60	0,000
2	-15,90	0,00	11,50	0,018
3	-11,50	0,00	11,50	0,148
4	-10,50	0,00	11,00	0,165
5	-8,00	0,00	11,00	0,232
6	-7,00	0,00	11,50	0,277
7	-6,00	0,00	11,50	0,297
8	-4,50	0,00	11,95	0,317
9	-3,50	0,00	12,25	0,319
10	0,00	0,00	13,30	0,211
11	3,30	0,00	14,30	0,023
12	4,80	0,00	14,70	0,007
13	9,40	0,00	14,70	0,001
14	12,40	0,00	13,60	0,000
15	15,40	0,00	13,30	0,000
16	18,40	0,00	13,20	0,000
17	20,00	0,00	13,60	0,000

4.2 Maintain Profile Calculation Results

Load 1 consists of 38,410 m3 per Width
The extra amount of soil to be added is 3,650 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	27-11-2014
Time of report:	11:37:04
Date of calculation:	27-11-2014
Time of calculation:	11:15:32
Filename:	C:\..\02 Geotechniek\07 Zetting\Zetting DP59.054-056
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei Zetting DR59.054-056

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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
5 - X -	-30.000	-13.900	-6.150	-3.100	0.000
5 - Y -	12.100	12.200	14.900	14.900	13.900
5 - X -	3.400	8.000	20.000		
5 - Y -	13.200	13.400	13.600		
4 - X -	-30.000	-13.900	-6.150	20.000	
4 - Y -	9.780	9.780	12.500	12.500	
3 - X -	-30.000	-13.900	-6.150	20.000	
3 - Y -	9.780	9.780	11.500	11.500	
2 - X -	-30.000	-13.900	-6.150	20.000	
2 - Y -	9.780	9.780	10.000	10.000	
1 - X -	-30.000	20.000			
1 - Y -	3.000	3.000			
0 - X -	-30.000	20.000			
0 - Y -	0.000	0.000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-30.000	20.000			
1 - Y -	9.941	9.941			

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9.81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000.00 [days]
With maintain profile	
(only for non uniform loads)	
- Material:	Superelevation
- Time:	0.00 [days]
- Unit weight above phreatic.:	18.00 [kN/m³]
- Unit weight below phreatic:	20.00 [kN/m³]
- Iteration stop criterium:	0.10 [m]
Pc (initial):	Variable parallel to the initial effective stress
Pc (per step):	Automatic increased to the final effective stresses
No imaginary surface	
With submerging	
(only for non uniform loads)	
- Iteration stop criterium :	0.10 [m]
Load column width	
- Non-Uniform Loads :	1.00 [m]
- Trapezoidal Loads :	1.00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
5	Klei, zandig	1	1
4	Klei, siltig	1	1

Layer number	Material name	PL-line top	PL-line bottom
3	Zand (los)	1	1
2	Zand	1	1
1	Grind	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
5	No	18.00	18.00
4	No	17.00	17.00
3	Yes	18.00	20.00
2	Yes	18.00	20.00
1	Yes	19.00	20.00

Layer number	Vert. consolid. coefficient Cv [m²/s]
5	1.00E-06
4	1.00E-07
3	-
2	-
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
5	-	10.00	-
4	-	10.00	-
3	-	-	1.30
2	-	-	1.30
1	-	-	1.30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
5	1.00E+02	2.00E+01	1.20E+03	2.40E+02	1.00E+02	2.40E+02
4	7.50E+01	1.50E+01	3.20E+02	1.60E+02	7.50E+01	1.60E+02
3	1.00E+02	2.00E+02	1.00E+09	1.00E+09	1.00E+02	1.00E+09
2	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09
1	5.00E+03	1.00E+03	1.00E+09	1.00E+09	5.00E+03	1.00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18.00	20.00

Load number	Co-ordinates [m]					
1 - X -	-6.15	-4.50	0.00	3.90	6.40	8.00
1 - Y -	14.90	15.41	15.41	14.10	14.10	13.40

2.7 Verticals

Vertical number	X co-ordinates [m]				
1 - 5	-30.000	-13.900	-6.150	-4.500	-3.100
6 - 10	0.000	3.400	3.900	6.400	8.000
11	20.000				

3 Results per Vertical

3.1 Results for Vertical 1 (X = -30.00 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
12.10	0.001	0.000	0.001	0.001	0.000	0.001
12.00	1.800	0.000	1.800	1.800	0.000	1.800
11.90	3.600	0.000	3.600	3.600	0.000	3.600
11.80	5.400	0.000	5.400	5.400	0.000	5.400
11.70	7.200	0.000	7.200	7.200	0.000	7.200
11.60	9.000	0.000	9.000	9.000	0.000	9.000
11.50	10.800	0.000	10.800	10.800	0.000	10.800
11.40	12.600	0.000	12.600	12.601	0.000	12.601
11.30	14.400	0.000	14.400	14.401	0.000	14.401
11.20	16.200	0.000	16.200	16.201	0.000	16.201
11.10	18.000	0.000	18.000	18.001	0.000	18.001
10.94	20.880	0.000	20.880	20.881	0.000	20.881
9.94	38.862	0.000	38.862	38.864	0.000	38.864
9.78	41.760	1.579	40.181	41.763	1.579	40.183
Layer 2						
9.78	41.760	1.580	40.181	41.763	1.580	40.183
8.79	61.560	11.291	50.269	61.566	11.291	50.274
7.79	81.560	21.101	60.459	81.570	21.101	60.469
6.79	101.560	30.911	70.649	101.577	30.911	70.666
6.39	109.560	34.835	74.725	109.581	34.835	74.746
5.40	129.360	44.547	84.813	129.392	44.547	84.845
4.40	149.360	54.357	95.003	149.407	54.357	95.050
3.40	169.360	64.167	105.193	169.426	64.167	105.258
3.00	177.360	68.091	109.269	177.434	68.091	109.343
Layer 1						
3.00	177.360	68.091	109.269	177.434	68.091	109.343
2.20	193.360	75.939	117.421	193.453	75.939	117.514
1.50	207.360	82.806	124.554	207.472	82.806	124.665
0.80	221.360	89.673	131.687	221.492	89.673	131.819
0.00	237.360	97.521	139.839	237.518	97.521	139.997

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12.10	9.78	5	0.0000	0.0000	0.0000	0.00
9.78	3.00	2	0.0000	0.0000	0.0000	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.2 Results for Vertical 2 (X = -13.90 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
12.20	0.001	0.000	0.001	0.016	0.000	0.016
12.10	1.800	0.000	1.800	1.817	0.000	1.817
12.00	3.600	0.000	3.600	3.619	0.000	3.619
11.90	5.400	0.000	5.400	5.422	0.000	5.422
11.80	7.200	0.000	7.200	7.225	0.000	7.225
11.70	9.000	0.000	9.000	9.028	0.000	9.028
11.60	10.800	0.000	10.800	10.832	0.000	10.832
11.50	12.600	0.000	12.600	12.635	0.000	12.635
11.40	14.400	0.000	14.400	14.439	0.000	14.439
11.30	16.200	0.000	16.200	16.244	0.000	16.244
11.20	18.000	0.000	18.000	18.048	0.000	18.048
10.99	21.780	0.000	21.780	21.839	0.000	21.839
10.44	31.662	0.000	31.662	31.756	0.000	31.756
9.94	40.662	0.000	40.662	40.798	0.000	40.797
9.78	43.560	1.579	41.981	43.711	1.580	42.131
Layer 2						
9.78	43.560	1.580	41.981	43.711	1.580	42.131
8.79	63.360	11.291	52.069	63.626	11.292	52.334
7.79	83.360	21.101	62.259	83.776	21.102	62.675
6.79	103.360	30.911	72.449	103.956	30.912	73.045
6.39	111.360	34.835	76.525	112.035	34.836	77.200
5.40	131.160	44.547	86.613	132.041	44.547	87.494
4.40	151.160	54.357	96.803	152.261	54.357	97.903
3.40	171.160	64.167	106.993	172.483	64.167	108.316
3.00	179.160	68.091	111.069	180.572	68.091	112.481
Layer 1						
3.00	179.160	68.091	111.069	180.572	68.091	112.481
2.20	195.160	75.939	119.221	196.747	75.939	120.807
1.50	209.160	82.806	126.354	210.895	82.806	128.089
0.80	223.160	89.673	133.487	225.038	89.673	135.364
0.00	239.160	97.521	141.639	241.193	97.521	143.672

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12.20	9.78	5	0.0000	0.0000	0.0001	0.01
9.78	3.00	2	0.0000	0.0000	0.0000	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0002	

3.3 Results for Vertical 3 (X = -6.15 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
14.90	0.001	0.000	0.001	1.497	0.000	1.497
14.80	1.800	0.000	1.800	3.298	0.000	3.298

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
14.70	3.600	0.000	3.600	5.102	0.000	5.102
14.60	5.400	0.000	5.400	6.909	0.000	6.909
14.50	7.200	0.000	7.200	8.724	0.000	8.724
14.40	9.000	0.000	9.000	10.548	0.000	10.548
14.30	10.800	0.000	10.800	12.383	0.000	12.383
14.20	12.600	0.000	12.600	14.228	0.000	14.228
14.10	14.400	0.000	14.400	16.083	0.000	16.083
14.00	16.200	0.000	16.200	17.945	0.000	17.945
13.90	18.000	0.000	18.000	19.813	0.000	19.813
13.70	21.600	0.000	21.600	23.560	0.000	23.560
13.10	32.400	0.000	32.400	34.812	0.000	34.812
12.50	43.200	0.000	43.200	46.017	0.000	46.017
Layer 4						
12.50	43.200	0.000	43.200	46.017	0.000	46.017
12.00	51.700	0.000	51.700	54.823	0.000	54.823
11.50	60.200	0.000	60.200	63.617	0.000	63.617
Layer 3						
11.50	60.200	0.000	60.200	63.617	0.000	63.617
10.75	73.700	0.000	73.700	77.548	0.000	77.548
10.00	87.200	0.000	87.200	91.473	0.000	91.473
Layer 2						
10.00	87.200	0.000	87.200	91.473	0.000	91.473
9.94	88.262	0.000	88.262	92.569	0.001	92.568
9.20	103.082	7.269	95.813	107.792	7.270	100.522
8.20	123.082	17.079	106.003	128.292	17.080	111.211
7.20	143.082	26.889	116.193	148.720	26.890	121.830
6.50	157.082	33.756	123.326	162.973	33.757	129.216
5.70	173.082	41.604	131.478	179.212	41.605	137.607
4.70	193.082	51.414	141.668	199.440	51.415	148.025
3.70	213.082	61.224	151.858	219.596	61.225	158.372
3.00	227.082	68.091	158.991	233.668	68.091	165.576
Layer 1						
3.00	227.082	68.091	158.991	233.668	68.092	165.576
2.20	243.082	75.939	167.143	249.716	75.939	173.777
1.50	257.082	82.806	174.276	263.734	82.806	180.927
0.80	271.082	89.673	181.409	277.731	89.673	188.058
0.00	287.082	97.521	189.561	293.707	97.521	196.185

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary	Secondary	Primary	Secondary 10 [days]	Primary	Secondary 10 [days]
	[m]	[m]	[m]	[m]	[m]	[m]
5	0.0000	0.0000	0.0037	0.0003	0.0000	0.0000
4	0.0000	0.0000	0.0008	0.0002	0.0000	0.0000
3	0.0000	0.0000	0.0008	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0054	0.0005	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From	To		Primary	Secondary 10 [days]	After 10000 [days]	
[m]	[m]		[m]	[m]	[m]	[%]
14.90	12.50	5	0.0037	0.0003	0.0050	0.21
12.50	11.50	4	0.0008	0.0002	0.0015	0.15
11.50	10.00	3	0.0008	0.0000	0.0008	0.05
10.00	3.00	2	0.0001	0.0000	0.0001	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0054	0.0005	0.0074	

3.4 Results for Vertical 4 (X = -4.50 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
14.90	0.001	0.000	0.001	8.663	0.000	8.663
14.80	1.800	0.000	1.800	10.458	0.000	10.458
14.70	3.600	0.000	3.600	12.249	0.000	12.249
14.60	5.400	0.000	5.400	14.022	0.000	14.022
14.50	7.200	0.000	7.200	15.772	0.000	15.772
14.40	9.000	0.000	9.000	17.496	0.000	17.496
14.30	10.800	0.000	10.800	19.199	0.000	19.199
14.20	12.600	0.000	12.600	20.890	0.000	20.890
14.10	14.400	0.000	14.400	22.575	0.000	22.575
14.00	16.200	0.000	16.200	24.259	0.000	24.259
13.90	18.000	0.000	18.000	25.946	0.000	25.946
13.70	21.600	0.000	21.600	29.340	0.000	29.340
13.10	32.400	0.000	32.400	39.712	0.000	39.712
12.50	43.200	0.000	43.200	50.336	0.000	50.336
Layer 4						
12.50	43.200	0.000	43.200	50.336	0.000	50.336
12.00	51.700	0.000	51.700	58.831	0.000	58.831
11.50	60.200	0.000	60.200	67.414	0.000	67.414
Layer 3						
11.50	60.200	0.000	60.200	67.414	0.000	67.414
10.75	73.700	0.000	73.700	81.135	0.000	81.135
10.00	87.200	0.000	87.200	94.903	0.000	94.903
Layer 2						
10.00	87.200	0.000	87.200	94.903	0.000	94.903
9.94	88.262	0.000	88.262	95.988	0.002	95.986
9.20	103.082	7.269	95.813	111.066	7.271	103.795
8.20	123.082	17.079	106.003	131.356	17.081	114.275
7.20	143.082	26.889	116.193	151.557	26.890	124.667
6.50	157.082	33.756	123.326	165.644	33.757	131.887
5.70	173.082	41.604	131.478	181.692	41.605	140.087
4.70	193.082	51.414	141.668	201.686	51.415	150.271
3.70	213.082	61.224	151.858	221.618	61.225	160.394
3.00	227.082	68.091	158.991	235.543	68.091	167.451
Layer 1						
3.00	227.082	68.091	158.991	235.543	68.092	167.451
2.20	243.082	75.939	167.143	251.433	75.939	175.494
1.50	257.082	82.806	174.276	265.322	82.806	182.515
0.80	271.082	89.673	181.409	279.199	89.673	189.526
0.00	287.082	97.521	189.561	295.048	97.521	197.527

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0.0000	0.0000	0.0121	0.0010	0.0000	0.0000
4	0.0000	0.0000	0.0017	0.0004	0.0000	0.0000
3	0.0000	0.0000	0.0015	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0155	0.0014	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14.90	12.50	5	0.0121	0.0010	0.0160	0.67
12.50	11.50	4	0.0017	0.0004	0.0034	0.34

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	[%]
11.50	10.00	3	0.0015	0.0000	0.0015	0.10
10.00	3.00	2	0.0002	0.0000	0.0002	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0155	0.0014	0.0210	

3.5 Results for Vertical 5 (X = -3.10 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
14.90	0.001	0.000	0.001	9.851	0.000	9.851
14.80	1.800	0.000	1.800	12.550	0.000	12.550
14.70	3.600	0.000	3.600	14.901	0.000	14.901
14.60	5.400	0.000	5.400	16.700	0.000	16.700
14.50	7.200	0.000	7.200	18.494	0.000	18.494
14.40	9.000	0.000	9.000	20.274	0.000	20.274
14.30	10.800	0.000	10.800	22.033	0.000	22.033
14.20	12.600	0.000	12.600	23.769	0.000	23.769
14.10	14.400	0.000	14.400	25.491	0.000	25.491
14.00	16.200	0.000	16.200	27.208	0.000	27.208
13.90	18.000	0.000	18.000	28.931	0.000	28.931
13.70	21.600	0.000	21.600	32.424	0.000	32.424
13.10	32.400	0.000	32.400	43.221	0.000	43.221
12.50	43.200	0.000	43.200	54.167	0.000	54.167
Layer 4						
12.50	43.200	0.000	43.200	54.167	0.000	54.167
12.00	51.700	0.000	51.700	62.798	0.000	62.798
11.50	60.200	0.000	60.200	71.423	0.000	71.423
Layer 3						
11.50	60.200	0.000	60.200	71.423	0.000	71.423
10.75	73.700	0.000	73.700	85.077	0.000	85.077
10.00	87.200	0.000	87.200	98.673	0.000	98.673
Layer 2						
10.00	87.200	0.000	87.200	98.673	0.000	98.673
9.94	88.262	0.000	88.262	99.742	0.002	99.740
9.20	103.082	7.269	95.813	114.589	7.271	107.318
8.20	123.082	17.079	106.003	134.530	17.081	117.449
7.20	143.082	26.889	116.193	154.379	26.891	127.488
6.50	157.082	33.756	123.326	168.228	33.757	134.471
5.70	173.082	41.604	131.478	184.022	41.605	142.416
4.70	193.082	51.414	141.668	203.725	51.415	152.310
3.70	213.082	61.224	151.858	223.400	61.225	162.176
3.00	227.082	68.091	158.991	237.163	68.092	169.072
Layer 1						
3.00	227.082	68.091	158.991	237.164	68.092	169.072
2.20	243.082	75.939	167.143	252.888	75.939	176.948
1.50	257.082	82.806	174.276	266.646	82.806	183.839
0.80	271.082	89.673	181.409	280.405	89.673	190.732
0.00	287.082	97.521	189.561	296.133	97.521	198.612

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0.0000	0.0000	0.0139	0.0012	0.0044	0.0004
4	0.0000	0.0000	0.0024	0.0006	0.0012	0.0001
3	0.0000	0.0000	0.0022	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
Total	0.0000	0.0000	0.0187	0.0017	0.0055	0.0005

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
14.90	12.50	5	0.0183	0.0015	0.0242	1.01
12.50	11.50	4	0.0035	0.0007	0.0062	0.62
11.50	10.00	3	0.0022	0.0000	0.0022	0.14
10.00	3.00	2	0.0002	0.0000	0.0002	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0242	0.0022	0.0328	

3.6 Results for Vertical 6 (X = 0.00 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
13.90	0.001	0.000	0.001	31.561	0.000	31.561
13.80	1.800	0.000	1.800	34.236	0.000	34.236
13.70	3.600	0.000	3.600	34.066	0.000	34.066
13.60	5.400	0.000	5.400	34.668	0.000	34.668
13.50	7.200	0.000	7.200	35.787	0.000	35.787
13.40	9.000	0.000	9.000	37.133	0.000	37.133
13.30	10.800	0.000	10.800	38.570	0.000	38.570
13.20	12.600	0.000	12.600	40.039	0.000	40.039
13.10	14.400	0.000	14.400	41.521	0.000	41.521
13.00	16.200	0.000	16.200	43.011	0.000	43.011
12.90	18.000	0.000	18.000	44.510	0.000	44.510
12.50	25.200	0.000	25.200	50.623	0.000	50.623
Layer 4						
12.50	25.200	0.000	25.200	50.623	0.000	50.623
12.00	33.700	0.000	33.700	57.969	0.000	57.969
11.50	42.200	0.000	42.200	65.452	0.000	65.452
Layer 3						
11.50	42.200	0.000	42.200	65.452	0.000	65.452
10.75	55.700	0.000	55.700	77.601	0.000	77.601
10.00	69.200	0.000	69.200	89.897	0.000	89.897
Layer 2						
10.00	69.200	0.000	69.200	89.897	0.000	89.897
9.94	70.262	0.000	70.262	90.873	0.004	90.869
9.20	85.082	7.269	77.813	104.608	7.272	97.336
8.20	105.082	17.079	88.003	123.260	17.082	106.179
7.20	125.082	26.889	98.193	142.025	26.891	115.134
6.50	139.082	33.756	105.326	155.223	33.758	121.465
5.70	155.082	41.604	113.478	170.366	41.606	128.761
4.70	175.082	51.414	123.668	189.381	51.415	137.966
3.70	195.082	61.224	133.858	208.485	61.225	147.260
3.00	209.082	68.091	140.991	221.908	68.092	153.816
Layer 1						
3.00	209.082	68.091	140.991	221.908	68.092	153.816
2.20	225.082	75.939	149.143	237.295	75.940	161.355
1.50	239.082	82.806	156.276	250.796	82.806	167.990
0.80	253.082	89.673	163.409	264.330	89.673	174.657
0.00	269.082	97.521	171.561	279.835	97.521	182.314

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0.0000	0.0000	0.0113	0.0009	0.0442	0.0037
4	0.0000	0.0000	0.0035	0.0008	0.0191	0.0018
3	0.0000	0.0000	0.0039	0.0000	0.0006	0.0000
2	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0192	0.0018	0.0638	0.0055

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
13.90	12.50	5	0.0555	0.0046	0.0718	5.13
12.50	11.50	4	0.0226	0.0026	0.0325	3.25
11.50	10.00	3	0.0045	0.0000	0.0045	0.30
10.00	3.00	2	0.0004	0.0000	0.0004	0.01
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0830	0.0072	0.1092	

3.7 Results for Vertical 7 (X = 3.40 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
13.20	0.001	0.000	0.001	20.318	0.000	20.318
13.10	1.800	0.000	1.800	22.504	0.000	22.504
13.00	3.600	0.000	3.600	24.757	0.000	24.757
12.90	5.400	0.000	5.400	26.883	0.000	26.883
12.85	6.300	0.000	6.300	27.884	0.000	27.884
12.80	7.200	0.000	7.200	28.849	0.000	28.849
12.70	9.000	0.000	9.000	30.705	0.000	30.705
12.60	10.800	0.000	10.800	32.502	0.000	32.502
12.50	12.600	0.000	12.600	34.275	0.000	34.275
Layer 4						
12.50	12.600	0.000	12.600	34.276	0.000	34.276
12.40	14.300	0.000	14.300	35.942	0.000	35.942
12.30	16.000	0.000	16.000	37.609	0.000	37.609
12.20	17.700	0.000	17.700	39.277	0.000	39.277
12.00	21.100	0.000	21.100	42.619	0.000	42.619
11.50	29.600	0.000	29.600	50.940	0.000	50.940
Layer 3						
11.50	29.600	0.000	29.600	50.941	0.000	50.941
10.75	43.100	0.000	43.100	63.974	0.000	63.974
10.00	56.600	0.000	56.600	76.779	0.000	76.779
Layer 2						
10.00	56.600	0.000	56.600	76.779	0.000	76.779
9.94	57.662	0.000	57.662	77.783	0.004	77.779
9.20	72.482	7.269	65.213	91.768	7.273	84.495
8.20	92.482	17.079	75.403	110.558	17.082	93.476
7.20	112.482	26.889	85.593	129.357	26.891	102.465
6.50	126.482	33.756	92.726	142.554	33.758	108.796
5.70	142.482	41.604	100.878	157.688	41.606	116.082
4.70	162.482	51.414	111.068	176.690	51.415	125.275
3.70	182.482	61.224	121.258	195.786	61.225	134.561
3.00	196.482	68.091	128.391	209.206	68.092	141.114
Layer 1						
3.00	196.482	68.091	128.391	209.206	68.092	141.114
2.20	212.482	75.939	136.543	224.591	75.940	148.652
1.50	226.482	82.806	143.676	238.093	82.806	155.287

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
0.80	240.482	89.673	150.809	251.629	89.673	161.956
0.00	256.482	97.521	158.961	267.137	97.521	169.616

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary	Secondary	Primary	Secondary 10 [days]	Primary	Secondary 10 [days]
	[m]	[m]	[m]	[m]	[m]	[m]
5	0.0000	0.0000	0.0083	0.0007	0.0190	0.0016
4	0.0000	0.0000	0.0054	0.0013	0.0214	0.0020
3	0.0000	0.0000	0.0039	0.0000	0.0010	0.0000
2	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0180	0.0019	0.0414	0.0036

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height
From	To		Primary	Secondary 10 [days]	After 10000 [days]	
[m]	[m]		[m]	[m]	[m]	[%]
13.20	12.50	5	0.0273	0.0023	0.0354	5.06
12.50	11.50	4	0.0267	0.0033	0.0390	3.90
11.50	10.00	3	0.0050	0.0000	0.0050	0.33
10.00	3.00	2	0.0004	0.0000	0.0004	0.01
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0595	0.0055	0.0798	

3.8 Results for Vertical 8 (X = 3.90 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
	S-total	S-water	S-eff.	S-total	S-water	S-eff.
[m]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]
Layer 5						
13.22	0.001	0.000	0.001	17.820	0.000	17.820
13.12	1.800	0.000	1.800	19.761	0.000	19.761
13.02	3.600	0.000	3.600	21.673	0.000	21.673
12.92	5.400	0.000	5.400	23.651	0.000	23.651
12.86	6.496	0.000	6.496	24.873	0.000	24.873
12.82	7.200	0.000	7.200	25.662	0.000	25.662
12.72	9.000	0.000	9.000	27.676	0.000	27.676
12.62	10.800	0.000	10.800	29.676	0.000	29.676
12.52	12.600	0.000	12.600	31.654	0.000	31.654
12.50	12.991	0.000	12.991	32.080	0.000	32.080
Layer 4						
12.50	12.991	0.000	12.991	32.080	0.000	32.080
12.42	14.322	0.000	14.322	33.528	0.000	33.528
12.32	16.022	0.000	16.022	35.356	0.000	35.356
12.22	17.722	0.000	17.722	37.162	0.000	37.162
12.00	21.491	0.000	21.491	41.099	0.000	41.099
11.50	29.991	0.000	29.991	49.733	0.000	49.733
Layer 3						
11.50	29.991	0.000	29.991	49.733	0.000	49.733
10.75	43.491	0.000	43.491	63.020	0.000	63.020
10.00	56.991	0.000	56.991	75.998	0.000	75.998
Layer 2						
10.00	56.991	0.000	56.991	75.998	0.000	75.998
9.94	58.053	0.000	58.053	77.014	0.004	77.010
9.20	72.873	7.269	65.604	91.139	7.273	83.867
8.20	92.873	17.079	75.794	110.095	17.082	93.013
7.20	112.873	26.889	85.984	129.035	26.891	102.143
6.50	126.873	33.756	93.117	142.317	33.758	108.559
5.70	142.873	41.604	101.269	157.536	41.606	115.931
4.70	162.873	51.414	111.459	176.628	51.415	125.213

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
3.70	182.873	61.224	121.649	195.797	61.225	134.572
3.00	196.873	68.091	128.782	209.259	68.092	141.168
Layer 1						
3.00	196.874	68.091	128.782	209.260	68.092	141.168
2.20	212.873	75.939	136.934	224.687	75.940	148.748
1.50	226.873	82.806	144.067	238.221	82.806	155.415
0.80	240.873	89.673	151.200	251.785	89.673	162.112
0.00	256.873	97.521	159.352	267.321	97.521	169.799

Layer number	Swelling Primary [m]	Secondary [m]	Settlement b. Sp. Primary [m]	Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Secondary 10 [days] [m]
5	0.0000	0.0000	0.0084	0.0007	0.0153	0.0013
4	0.0000	0.0000	0.0053	0.0012	0.0179	0.0017
3	0.0000	0.0000	0.0039	0.0000	0.0009	0.0000
2	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0181	0.0019	0.0341	0.0030

Depth From [m]	To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13.22	12.50	5	0.0237	0.0020	0.0309	4.28
12.50	11.50	4	0.0232	0.0029	0.0342	3.42
11.50	10.00	3	0.0048	0.0000	0.0048	0.32
10.00	3.00	2	0.0004	0.0000	0.0004	0.01
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0521	0.0049	0.0704	

3.9 Results for Vertical 9 (X = 6.40 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	Final stress S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 5						
13.33	0.001	0.000	0.001	12.333	0.000	12.333
13.23	1.800	0.000	1.800	14.232	0.000	14.232
13.13	3.600	0.000	3.600	16.017	0.000	16.017
13.03	5.400	0.000	5.400	17.780	0.000	17.780
12.93	7.200	0.000	7.200	19.538	0.000	19.538
12.92	7.474	0.000	7.474	19.806	0.000	19.806
12.83	9.000	0.000	9.000	21.298	0.000	21.298
12.73	10.800	0.000	10.800	23.059	0.000	23.059
12.63	12.600	0.000	12.600	24.815	0.000	24.815
12.53	14.400	0.000	14.400	26.564	0.000	26.564
12.50	14.948	0.000	14.948	27.095	0.000	27.095
Layer 4						
12.50	14.948	0.000	14.948	27.095	0.000	27.095
12.43	16.130	0.000	16.130	28.236	0.000	28.236
12.33	17.830	0.000	17.830	29.870	0.000	29.870
12.00	23.448	0.000	23.448	35.251	0.000	35.251
11.50	31.948	0.000	31.948	43.441	0.000	43.441
Layer 3						
11.50	31.948	0.000	31.948	43.441	0.000	43.441
10.75	45.448	0.000	45.448	56.684	0.000	56.684
10.00	58.948	0.000	58.948	70.096	0.000	70.096
Layer 2						
10.00	58.948	0.000	58.948	70.096	0.000	70.096
9.94	60.010	0.000	60.010	71.158	0.003	71.155

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
9.20	74.830	7.269	67.561	85.947	7.272	78.676
8.20	94.830	17.079	77.751	105.886	17.081	88.805
7.20	114.830	26.889	87.941	125.759	26.891	98.868
6.50	128.830	33.756	95.074	139.628	33.758	105.871
5.70	144.830	41.604	103.226	155.443	41.605	113.838
4.70	164.830	51.414	113.416	175.171	51.415	123.756
3.70	184.830	61.224	123.606	194.867	61.225	133.643
3.00	198.830	68.091	130.739	208.644	68.092	140.553
Layer 1						
3.00	198.830	68.091	130.739	208.644	68.092	140.553
2.20	214.830	75.939	138.891	224.383	75.939	148.444
1.50	228.830	82.806	146.024	238.153	82.806	155.347
0.80	242.830	89.673	153.157	251.924	89.673	162.251
0.00	258.830	97.521	161.309	267.666	97.521	170.145

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0.0000	0.0000	0.0090	0.0007	0.0055	0.0005
4	0.0000	0.0000	0.0049	0.0011	0.0036	0.0003
3	0.0000	0.0000	0.0034	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0176	0.0019	0.0091	0.0008

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Total settlement (100% cons.) Secondary 10 [days] [m]	Total settlement (100% cons.) After 10000 [days] [m]	Percentage of original layer height [%]
13.33	12.50	5	0.0145	0.0012	0.0191	2.30
12.50	11.50	4	0.0085	0.0015	0.0143	1.43
11.50	10.00	3	0.0034	0.0000	0.0034	0.23
10.00	3.00	2	0.0003	0.0000	0.0003	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0267	0.0027	0.0371	

3.10 Results for Vertical 10 (X = 8.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
13.40	0.001	0.000	0.001	1.328	0.000	1.328
13.30	1.800	0.000	1.800	3.256	0.000	3.256
13.20	3.600	0.000	3.600	5.072	0.000	5.072
13.10	5.400	0.000	5.400	6.905	0.000	6.905
13.00	7.200	0.000	7.200	8.774	0.000	8.774
12.95	8.100	0.000	8.100	9.724	0.000	9.724
12.90	9.000	0.000	9.000	10.683	0.000	10.683
12.80	10.800	0.000	10.800	12.626	0.000	12.626
12.70	12.600	0.000	12.600	14.592	0.000	14.592
12.60	14.400	0.000	14.400	16.568	0.000	16.568
12.50	16.200	0.000	16.200	18.549	0.000	18.549
Layer 4						
12.50	16.200	0.000	16.200	18.549	0.000	18.549
12.40	17.900	0.000	17.900	20.427	0.000	20.427
12.00	24.700	0.000	24.700	27.891	0.000	27.891
11.50	33.200	0.000	33.200	37.099	0.000	37.099
Layer 3						
11.50	33.200	0.000	33.200	37.100	0.000	37.100

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
10.75	46.700	0.000	46.700	51.482	0.000	51.482
10.00	60.200	0.000	60.200	65.711	0.000	65.711
Layer 2						
10.00	60.200	0.000	60.200	65.711	0.000	65.711
9.94	61.262	0.000	61.262	66.827	0.002	66.825
9.20	76.082	7.269	68.813	82.235	7.271	74.964
8.20	96.082	17.079	79.003	102.861	17.081	85.781
7.20	116.082	26.889	89.193	123.315	26.890	96.424
6.50	130.082	33.756	96.326	137.542	33.757	103.785
5.70	146.082	41.604	104.478	153.723	41.605	112.118
4.70	166.082	51.414	114.668	173.851	51.415	122.436
3.70	186.082	61.224	124.858	193.892	61.225	132.667
3.00	200.082	68.091	131.991	207.880	68.092	139.788
Layer 1						
3.00	200.082	68.091	131.991	207.880	68.092	139.788
2.20	216.082	75.939	140.143	223.833	75.939	147.894
1.50	230.082	82.806	147.276	237.770	82.806	154.963
0.80	244.082	89.673	154.409	251.690	89.673	162.016
0.00	260.082	97.521	162.561	267.582	97.521	170.061

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
5	0.0000	0.0000	0.0027	0.0002	0.0000	0.0000
4	0.0000	0.0000	0.0016	0.0004	0.0000	0.0000
3	0.0000	0.0000	0.0015	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0059	0.0006	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Total settlement (100% cons.) Secondary 10 [days] [m]	Total settlement (100% cons.) After 10000 [days] [m]	Percentage of original layer height [%]
13.40	12.50	5	0.0027	0.0002	0.0035	0.39
12.50	11.50	4	0.0016	0.0004	0.0031	0.31
11.50	10.00	3	0.0015	0.0000	0.0015	0.10
10.00	3.00	2	0.0002	0.0000	0.0002	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0059	0.0006	0.0083	

3.11 Results for Vertical 11 (X = 20.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 5						
13.60	0.001	0.000	0.001	0.001	0.000	0.001
13.50	1.800	0.000	1.800	1.800	0.000	1.800
13.40	3.600	0.000	3.600	3.600	0.000	3.600
13.30	5.400	0.000	5.400	5.400	0.000	5.400
13.20	7.200	0.000	7.200	7.200	0.000	7.200
13.10	9.000	0.000	9.000	9.000	0.000	9.000
13.05	9.900	0.000	9.900	9.900	0.000	9.900
13.00	10.800	0.000	10.800	10.800	0.000	10.800
12.90	12.600	0.000	12.600	12.600	0.000	12.600
12.80	14.400	0.000	14.400	14.400	0.000	14.400
12.70	16.200	0.000	16.200	16.200	0.000	16.200
12.60	18.000	0.000	18.000	18.000	0.000	18.000
12.50	19.800	0.000	19.800	19.800	0.000	19.800

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 4						
12.50	19.800	0.000	19.800	19.801	0.000	19.801
12.00	28.300	0.000	28.300	28.301	0.000	28.301
11.50	36.800	0.000	36.800	36.803	0.000	36.803
Layer 3						
11.50	36.800	0.000	36.800	36.803	0.000	36.803
10.75	50.300	0.000	50.300	50.308	0.000	50.308
10.00	63.800	0.000	63.800	63.818	0.000	63.818
Layer 2						
10.00	63.800	0.000	63.800	63.818	0.000	63.818
9.94	64.862	0.000	64.862	64.881	0.000	64.881
9.20	79.682	7.269	72.413	79.719	7.269	72.449
8.20	99.682	17.079	82.603	99.757	17.079	82.678
7.20	119.682	26.889	92.793	119.816	26.889	92.927
6.50	133.682	33.756	99.926	133.869	33.756	100.113
5.70	149.682	41.604	108.078	149.943	41.604	108.339
4.70	169.682	51.414	118.268	170.053	51.414	118.638
3.70	189.682	61.224	128.458	190.179	61.224	128.955
3.00	203.682	68.091	135.591	204.275	68.091	136.184
Layer 1						
3.00	203.682	68.091	135.591	204.276	68.091	136.184
2.20	219.682	75.939	143.743	220.392	75.939	144.452
1.50	233.682	82.806	150.876	234.497	82.806	151.691
0.80	247.682	89.673	158.009	248.604	89.673	158.931
0.00	263.682	97.521	166.161	264.728	97.521	167.207

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
13.60	12.50	5	0.0000	0.0000	0.0000	0.00
12.50	11.50	4	0.0000	0.0000	0.0000	0.00
11.50	10.00	3	0.0000	0.0000	0.0000	0.00
10.00	3.00	2	0.0000	0.0000	0.0000	0.00
3.00	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-30.00	0.00	12.10	0.000
2	-13.90	0.00	12.20	0.000
3	-6.15	0.00	14.90	0.007
4	-4.50	0.00	14.90	0.021
5	-3.10	0.00	14.90	0.033
6	0.00	0.00	13.90	0.109
7	3.40	0.00	13.20	0.080
8	3.90	0.00	13.22	0.070
9	6.40	0.00	13.33	0.037
10	8.00	0.00	13.40	0.008
11	20.00	0.00	13.60	0.000

4.2 Maintain Profile Calculation Results

Load 1 consists of 11.810 m3 per Width
The extra amount of soil to be added is 0.806 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

Report for D-Settlement 14.1

Settlement Calculations
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	27-11-2014
Time of report:	11:37:36
Date of calculation:	27-11-2014
Time of calculation:	11:27:43
Filename:	C:\..\02 Geotechniek\07 Zetting\Zetting DP59.058-059
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei Zetting DR59.058-059

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2 Echo of the Input

2.1 Layer Boundaries

Boundary number	Co-ordinates [m]				
6 - X -	-30.000	-14.900	-6.100	-3.000	0.000
6 - Y -	11.700	12.000	15.000	14.900	14.000
6 - X -	3.100	9.200	20.000		
6 - Y -	13.100	13.000	12.900		
5 - X -	-30.000	-14.900	-6.100	-3.000	3.100
5 - Y -	11.000	11.000	12.300	12.300	12.000
5 - X -	20.000				
5 - Y -	12.000				
4 - X -	-30.000	-14.900	-6.100	-3.000	3.100
4 - Y -	11.000	11.000	12.300	12.300	11.500
4 - X -	20.000				
4 - Y -	11.500				
3 - X -	-30.000	-14.900	-6.100	-3.000	3.100
3 - Y -	11.000	11.000	12.300	12.300	10.953
3 - X -	20.000				
3 - Y -	10.953				
2 - X -	-30.000	20.000			
2 - Y -	6.000	6.000			
1 - X -	-30.000	20.000			
1 - Y -	4.800	4.800			
0 - X -	-30.000	20.000			
0 - Y -	0.000	0.000			

2.2 PL Lines

PL line number	Co-ordinates [m]				
1 - X -	-30.000	-14.900	-6.100	20.000	
1 - Y -	10.881	10.881	12.120	12.120	

2.3 General Data

Soil model:	Koppejan
Consolidation model:	Terzaghi
Strain model:	Natural
Groundwater level:	Initial determined by PL-line number 1
Unit weight of water:	9.81 [kN/m³]
Dispersion conditions layer boundaries	
- Top:	drained
- Bottom:	drained
Stress distribution	
- Soil:	Buisman
- Loads:	None
End of consolidation:	10000.00 [days]
With maintain profile	
(only for non uniform loads)	
- Material:	Superelevation
- Time:	0.00 [days]
- Unit weight above phreatic.:	18.00 [kN/m³]
- Unit weight below phreatic:	20.00 [kN/m³]
- Iteration stop criterium:	0.10 [m]
Pc (initial):	Variable parallel to the initial effective stress
Pc (per step):	Automatic increased to the final effective stresses
No imaginary surface	
With submerging	
(only for non uniform loads)	
- Iteration stop criterium :	0.10 [m]
Load column width	
- Non-Uniform Loads :	1.00 [m]

- Trapezoidal Loads : 1.00 [m]

2.4 Soil Profiles

Layer number	Material name	PL-line top	PL-line bottom
6	Klei, siltig	1	1
5	Zand	1	1
4	Klei, siltig	1	1
3	Zand	1	1
2	Grind	1	1
1	Zand	1	1

2.5 Soil Properties

Layer number	Drained	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
6	No	17.00	17.00
5	Yes	18.00	20.00
4	No	17.00	17.00
3	Yes	18.00	20.00
2	Yes	19.00	20.00
1	Yes	18.00	20.00

Layer number	Vert. consolid. coefficient Cv [m²/s]
6	1.00E-07
5	-
4	1.00E-07
3	-
2	-
1	-

Layer number	Precons. pressure [kN/m²]	POP [kN/m²]	OCR [-]
6	-	10.00	-
5	-	-	1.30
4	-	10.00	-
3	-	-	1.30
2	-	-	1.30
1	-	-	1.30

Layer number	Primary compr. coeff.		Secular compr. coef.		Swell constants	
	Cp [-]	Cp' [-]	Cs [-]	Cs' [-]	Ap [-]	As [-]
6	7.50E+01	1.50E+01	3.20E+02	1.60E+02	7.50E+01	1.60E+02
5	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09
4	7.50E+01	1.50E+01	3.20E+02	1.60E+02	7.50E+01	1.60E+02
3	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09
2	5.00E+03	1.00E+03	1.00E+09	1.00E+09	5.00E+03	1.00E+09
1	3.00E+03	6.00E+02	1.00E+09	1.00E+09	3.00E+03	1.00E+09

2.6 Non-Uniform Loads

Load number	Time [days]	Unit weight	
		Unsaturated [kN/m³]	Saturated [kN/m³]
1	0	18.00	20.00

Load number	Co-ordinates [m]					
1 - X -	-6.10	-4.50	0.00	5.20	7.70	9.20
1 - Y -	15.00	15.45	15.45	13.70	13.70	13.00

2.7 Verticals

Vertical number	X co-ordinates [m]				
1 - 5	-30.000	-14.900	-6.100	-4.500	-3.000
6 - 10	0.000	3.100	5.200	7.700	9.200
11	20.000				

3 Results per Vertical

3.1 Results for Vertical 1 (X = -30.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
11.70	0.001	0.000	0.001	0.001	0.000	0.001
11.60	1.700	0.000	1.700	1.700	0.000	1.700
11.50	3.400	0.000	3.400	3.400	0.000	3.400
11.40	5.100	0.000	5.100	5.101	0.000	5.101
11.35	5.950	0.000	5.950	5.951	0.000	5.951
11.30	6.800	0.000	6.800	6.801	0.000	6.801
11.20	8.500	0.000	8.500	8.501	0.000	8.501
11.10	10.200	0.000	10.200	10.201	0.000	10.201
11.00	11.900	0.000	11.900	11.901	0.000	11.901
Layer 3						
11.00	11.900	0.000	11.900	11.901	0.000	11.901
10.90	13.700	0.000	13.700	13.701	0.000	13.701
10.88	14.042	0.000	14.042	14.043	0.000	14.043
10.80	15.662	0.795	14.867	15.663	0.795	14.868
10.70	17.662	1.776	15.886	17.663	1.776	15.888
9.90	33.662	9.624	24.038	33.665	9.624	24.041
8.90	53.662	19.434	34.228	53.667	19.434	34.234
8.50	61.662	23.358	38.304	61.669	23.358	38.311
7.60	79.662	32.187	47.475	79.674	32.187	47.487
6.60	99.662	41.997	57.665	99.682	41.997	57.685
6.00	111.662	47.883	63.779	111.688	47.883	63.806
Layer 2						
6.00	111.662	47.883	63.779	111.688	47.883	63.806
5.40	123.662	53.769	69.893	123.696	53.769	69.927
4.80	135.662	59.655	76.007	135.704	59.655	76.050
Layer 1						
4.80	135.662	59.655	76.007	135.705	59.655	76.050
4.00	151.662	67.503	84.159	151.718	67.503	84.216
3.00	171.662	77.313	94.349	171.739	77.313	94.427
2.40	183.662	83.199	100.463	183.754	83.199	100.555
1.60	199.662	91.047	108.615	199.776	91.047	108.729
0.60	219.662	100.857	118.805	219.807	100.857	118.950
0.00	231.662	106.743	124.919	231.827	106.743	125.084

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
11.70	11.00	6	0.0000	0.0000	0.0000	0.00
11.00	6.00	3	0.0000	0.0000	0.0000	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

3.2 Results for Vertical 2 (X = -14.90 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
12.00	0.001	0.000	0.001	0.015	0.000	0.015
11.90	1.700	0.000	1.700	1.716	0.000	1.716
11.80	3.400	0.000	3.400	3.418	0.000	3.418
11.70	5.100	0.000	5.100	5.120	0.000	5.120
11.60	6.800	0.000	6.800	6.823	0.000	6.823
11.50	8.500	0.000	8.500	8.525	0.000	8.525
11.40	10.200	0.000	10.200	10.228	0.000	10.228
11.30	11.900	0.000	11.900	11.931	0.000	11.931
11.20	13.600	0.000	13.600	13.635	0.000	13.635
11.10	15.300	0.000	15.300	15.338	0.000	15.338
11.00	17.000	0.000	17.000	17.042	0.000	17.042
Layer 3						
11.00	17.000	0.000	17.000	17.042	0.000	17.042
10.88	19.142	0.000	19.142	19.189	0.000	19.189
10.10	34.762	7.662	27.100	34.850	7.662	27.188
9.10	54.762	17.472	37.290	54.929	17.472	37.458
8.50	66.762	23.358	43.404	66.992	23.358	43.634
7.60	84.762	32.187	52.575	85.105	32.187	52.918
6.60	104.762	41.997	62.765	105.257	41.997	63.260
6.00	116.762	47.883	68.879	117.359	47.883	69.476
Layer 2						
6.00	116.762	47.883	68.879	117.359	47.883	69.476
5.40	128.762	53.769	74.993	129.468	53.769	75.699
4.80	140.762	59.655	81.107	141.582	59.655	81.927
Layer 1						
4.80	140.762	59.655	81.107	141.582	59.655	81.927
4.00	156.762	67.503	89.259	157.739	67.503	90.237
3.00	176.762	77.313	99.449	177.942	77.313	100.629
2.40	188.762	83.199	105.563	190.064	83.199	106.866
1.60	204.762	91.047	113.715	206.226	91.047	115.179
0.60	224.762	100.857	123.905	226.424	100.857	125.567
0.00	236.762	106.743	130.019	238.538	106.743	131.795

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
12.00	11.00	6	0.0000	0.0000	0.0001	0.01
11.00	6.00	3	0.0000	0.0000	0.0000	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0002	

3.3 Results for Vertical 3 (X = -6.10 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
15.00	0.001	0.000	0.001	1.432	0.000	1.432
14.90	1.700	0.000	1.700	3.278	0.000	3.278
14.80	3.400	0.000	3.400	4.982	0.000	4.982
14.70	5.100	0.000	5.100	6.688	0.000	6.688
14.60	6.800	0.000	6.800	8.399	0.000	8.399
14.50	8.500	0.000	8.500	10.119	0.000	10.119
14.40	10.200	0.000	10.200	11.848	0.000	11.848
14.30	11.900	0.000	11.900	13.588	0.000	13.588
14.20	13.600	0.000	13.600	15.337	0.000	15.337
14.10	15.300	0.000	15.300	17.095	0.000	17.095
14.00	17.000	0.000	17.000	18.861	0.000	18.861
13.65	22.950	0.000	22.950	25.072	0.000	25.072
13.00	34.000	0.000	34.000	36.621	0.000	36.621
12.30	45.900	0.000	45.900	48.998	0.000	48.998
Layer 3						
12.30	45.900	0.000	45.900	48.998	0.000	48.998
12.12	49.140	0.000	49.140	52.354	0.002	52.352
11.15	68.540	9.516	59.024	72.338	9.518	62.821
10.15	88.540	19.326	69.214	92.913	19.327	73.586
9.15	108.540	29.136	79.404	113.457	29.137	84.320
8.40	123.540	36.493	87.047	128.834	36.494	92.340
7.40	143.540	46.303	97.237	149.281	46.304	102.976
6.40	163.540	56.113	107.427	169.654	56.114	113.540
6.00	171.540	60.037	111.503	177.781	60.038	117.743
Layer 2						
6.00	171.540	60.037	111.503	177.782	60.038	117.744
5.40	183.540	65.923	117.617	189.950	65.924	124.026
4.80	195.540	71.809	123.731	202.092	71.810	130.283
Layer 1						
4.80	195.540	71.809	123.731	202.093	71.810	130.283
4.00	211.540	79.657	131.883	218.243	79.658	138.585
3.00	231.540	89.467	142.073	238.373	89.468	148.906
2.40	243.540	95.353	148.187	250.425	95.354	155.071
1.60	259.540	103.201	156.339	266.465	103.201	163.263
0.60	279.540	113.011	166.529	286.477	113.011	173.465
0.00	291.540	118.897	172.643	298.466	118.897	179.569

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
15.00	12.30	6	0.0000	0.0000	0.0109	0.40
12.30	6.00	3	0.0001	0.0000	0.0001	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0001	0.0000	0.0001	0.00
Total			0.0002	0.0000	0.0111	

3.4 Results for Vertical 4 (X = -4.50 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
14.95	0.001	0.000	0.001	8.802	0.000	8.802
14.85	1.700	0.000	1.700	10.640	0.000	10.640
14.75	3.400	0.000	3.400	12.326	0.000	12.326
14.65	5.100	0.000	5.100	13.993	0.000	13.993
14.55	6.800	0.000	6.800	15.631	0.000	15.631
14.45	8.500	0.000	8.500	17.241	0.000	17.241
14.35	10.200	0.000	10.200	18.832	0.000	18.832
14.25	11.900	0.000	11.900	20.412	0.000	20.412
14.15	13.600	0.000	13.600	21.988	0.000	21.988
14.05	15.300	0.000	15.300	23.566	0.000	23.566
13.95	17.000	0.000	17.000	25.149	0.000	25.149
13.62	22.511	0.000	22.511	30.337	0.000	30.337
13.00	33.123	0.000	33.123	40.571	0.000	40.571
12.30	45.023	0.000	45.023	52.338	0.000	52.338
Layer 3						
12.30	45.023	0.000	45.023	52.339	0.000	52.339
12.12	48.263	0.000	48.263	55.583	0.003	55.580
11.15	67.663	9.516	58.147	75.146	9.518	65.628
10.15	87.663	19.326	68.337	95.456	19.328	76.128
9.15	107.663	29.136	78.527	115.786	29.138	86.649
8.40	122.663	36.493	86.169	131.007	36.495	94.512
7.40	142.663	46.303	96.359	151.239	46.305	104.934
6.40	162.663	56.113	106.549	171.392	56.114	115.277
6.00	170.663	60.037	110.625	179.431	60.038	119.392
Layer 2						
6.00	170.663	60.037	110.625	179.431	60.038	119.393
5.40	182.663	65.923	116.739	191.467	65.924	125.543
4.80	194.663	71.809	122.853	203.479	71.810	131.669
Layer 1						
4.80	194.663	71.809	122.853	203.479	71.810	131.669
4.00	210.663	79.657	131.005	219.460	79.658	139.802
3.00	230.663	89.467	141.195	239.390	89.468	149.923
2.40	242.663	95.353	147.309	251.328	95.354	155.974
1.60	258.663	103.201	155.461	267.225	103.201	164.024
0.60	278.663	113.011	165.651	287.072	113.011	174.061
0.00	290.663	118.897	171.765	298.970	118.897	180.073

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14.95	12.30	6	0.0000	0.0000	0.0336	1.27
12.30	6.00	3	0.0002	0.0000	0.0002	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0001	0.0000	0.0001	0.00
Total			0.0003	0.0000	0.0339	

3.5 Results for Vertical 5 (X = -3.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
14.90	0.001	0.000	0.001	10.855	0.000	10.855
14.80	1.700	0.000	1.700	13.457	0.000	13.457
14.70	3.400	0.000	3.400	15.618	0.000	15.618
14.60	5.100	0.000	5.100	17.329	0.000	17.329
14.50	6.800	0.000	6.800	19.027	0.000	19.027
14.40	8.500	0.000	8.500	20.700	0.000	20.700
14.30	10.200	0.000	10.200	22.345	0.000	22.345
14.20	11.900	0.000	11.900	23.964	0.000	23.964
14.10	13.600	0.000	13.600	25.570	0.000	25.570
14.00	15.300	0.000	15.300	27.174	0.000	27.174
13.90	17.000	0.000	17.000	28.786	0.000	28.786
13.60	22.100	0.000	22.100	33.721	0.000	33.721
13.00	32.300	0.000	32.300	43.896	0.000	43.896
12.30	44.200	0.000	44.200	55.877	0.000	55.877
Layer 3						
12.30	44.200	0.000	44.200	55.878	0.000	55.878
12.12	47.440	0.000	47.440	59.144	0.004	59.139
11.15	66.840	9.516	57.324	78.650	9.519	69.131
10.15	86.840	19.326	67.514	98.720	19.329	79.391
9.15	106.840	29.136	77.704	118.726	29.138	89.588
8.40	121.840	36.493	85.347	133.683	36.495	97.188
7.40	141.840	46.303	95.537	153.560	46.305	107.255
6.40	161.840	56.113	105.727	173.370	56.115	117.255
6.00	169.840	60.037	109.803	181.278	60.039	121.239
Layer 2						
6.00	169.840	60.037	109.803	181.278	60.039	121.239
5.40	181.840	65.923	115.917	193.126	65.924	127.201
4.80	193.840	71.809	122.031	204.959	71.810	133.149
Layer 1						
4.80	193.840	71.809	122.031	204.959	71.810	133.149
4.00	209.840	79.657	130.183	220.720	79.658	141.061
3.00	229.840	89.467	140.373	240.401	89.468	150.933
2.40	241.840	95.353	146.487	252.203	95.354	156.849
1.60	257.840	103.201	154.639	267.936	103.202	164.734
0.60	277.840	113.011	164.829	287.600	113.011	174.589
0.00	289.840	118.897	170.943	299.400	118.897	180.503

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
14.90	12.30	6	0.0000	0.0000	0.0535	2.06
12.30	6.00	3	0.0003	0.0000	0.0003	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0001	0.0000	0.0001	0.00
Total			0.0004	0.0000	0.0539	

3.6 Results for Vertical 6 (X = 0.00 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
14.00	0.001	0.000	0.001	25.335	0.000	25.335
13.90	1.700	0.000	1.700	28.015	0.000	28.015
13.80	3.400	0.000	3.400	30.216	0.000	30.216
13.70	5.100	0.000	5.100	32.004	0.000	32.004
13.60	6.800	0.000	6.800	33.760	0.000	33.760
13.50	8.500	0.000	8.500	35.457	0.000	35.457
13.40	10.200	0.000	10.200	37.079	0.000	37.079
13.30	11.900	0.000	11.900	38.627	0.000	38.627
13.20	13.600	0.000	13.600	40.116	0.000	40.116
13.10	15.300	0.000	15.300	41.568	0.000	41.568
13.08	15.704	0.000	15.704	41.910	0.000	41.910
13.00	17.000	0.000	17.000	43.003	0.000	43.003
12.15	31.408	0.000	31.408	55.499	0.000	55.499
Layer 5						
12.15	31.408	0.000	31.408	55.499	0.000	55.499
12.12	31.992	0.000	31.992	56.114	0.091	56.023
12.03	33.802	0.888	32.915	57.761	0.978	56.783
11.91	36.261	2.094	34.167	60.005	2.183	57.822
Layer 4						
11.91	36.261	2.094	34.168	60.006	2.184	57.822
11.77	38.548	3.413	35.135	62.026	3.463	58.563
11.64	40.835	4.733	36.102	64.055	4.744	59.312
Layer 3						
11.64	40.835	4.733	36.102	64.056	4.744	59.312
11.14	50.835	9.638	41.197	73.292	9.647	63.645
10.62	61.210	14.727	46.483	82.935	14.734	68.201
9.62	81.210	24.537	56.673	101.614	24.542	77.072
8.82	97.210	32.385	64.825	116.609	32.389	84.220
8.32	107.210	37.290	69.920	126.001	37.293	88.708
7.80	117.585	42.379	75.206	135.765	42.382	93.383
6.80	137.585	52.189	85.396	154.642	52.192	102.450
6.00	153.585	60.037	93.548	169.800	60.039	109.761
Layer 2						
6.00	153.586	60.037	93.548	169.800	60.039	109.761
5.40	165.585	65.923	99.662	181.203	65.925	115.278
4.80	177.585	71.809	105.776	192.635	71.811	120.824
Layer 1						
4.80	177.586	71.809	105.776	192.635	71.811	120.824
4.00	193.585	79.657	113.928	207.921	79.658	128.262
3.00	213.585	89.467	124.118	227.095	89.468	137.627
2.40	225.585	95.353	130.232	238.634	95.354	143.280
1.60	241.585	103.201	138.384	254.057	103.202	150.855
0.60	261.585	113.011	148.574	273.390	113.011	160.379
0.00	273.585	118.897	154.688	285.018	118.897	166.120

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0174	0.0041	0.0651	0.0061
5	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
4	0.0000	0.0000	0.0009	0.0002	0.0047	0.0004
3	0.0000	0.0000	0.0004	0.0000	0.0005	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0190	0.0043	0.0703	0.0065

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
14.00	12.15	6	0.0825	0.0102	0.1185	6.41
12.15	11.91	5	0.0001	0.0000	0.0001	0.06
11.91	11.64	4	0.0056	0.0006	0.0080	2.99
11.64	6.00	3	0.0009	0.0000	0.0009	0.02
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0002	0.0000	0.0002	0.00
Total			0.0893	0.0108	0.1277	

3.7 Results for Vertical 7 (X = 3.10 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
13.10	0.001	0.000	0.001	28.012	0.000	28.012
13.00	1.700	0.000	1.700	30.366	0.000	30.366
12.90	3.400	0.000	3.400	30.667	0.000	30.667
12.80	5.100	0.000	5.100	31.571	0.000	31.571
12.70	6.800	0.000	6.800	32.896	0.000	32.896
12.60	8.500	0.000	8.500	34.416	0.000	34.416
12.55	9.350	0.000	9.350	35.211	0.000	35.211
12.50	10.200	0.000	10.200	36.019	0.000	36.019
12.40	11.900	0.000	11.900	37.650	0.000	37.650
12.30	13.600	0.000	13.600	39.286	0.000	39.286
12.20	15.300	0.000	15.300	40.915	0.000	40.915
12.12	16.660	0.000	16.660	42.505	0.296	42.210
12.10	17.000	0.196	16.804	42.817	0.481	42.336
12.00	18.700	1.177	17.523	44.372	1.412	42.960
Layer 5						
12.00	18.700	1.177	17.523	44.372	1.412	42.960
11.75	23.700	3.630	20.070	49.085	3.861	45.224
11.50	28.700	6.082	22.618	53.753	6.312	47.441
Layer 4						
11.50	28.700	6.082	22.618	53.753	6.312	47.441
11.23	33.349	8.765	24.584	57.900	8.884	49.016
10.95	37.999	11.448	26.551	62.038	11.463	50.575
Layer 3						
10.95	37.999	11.448	26.551	62.038	11.463	50.575
10.08	55.529	20.047	35.482	78.228	20.057	58.172
9.08	75.529	29.857	45.672	96.724	29.863	66.861
8.48	87.529	35.743	51.786	107.851	35.747	72.104
7.60	105.059	44.341	60.718	124.160	44.345	79.816
6.60	125.059	54.151	70.908	142.858	54.154	88.705
6.00	137.059	60.037	77.022	154.128	60.039	94.088
Layer 2						
6.00	137.059	60.037	77.022	154.128	60.040	94.088
5.40	149.059	65.923	83.136	165.436	65.925	99.511
4.80	161.059	71.809	89.250	176.782	71.811	104.971
Layer 1						
4.80	161.059	71.809	89.250	176.782	71.811	104.971
4.00	177.059	79.657	97.402	191.968	79.659	112.310
3.00	197.059	89.467	107.592	211.039	89.468	121.571
2.40	209.059	95.353	113.706	222.525	95.354	127.171
1.60	225.059	103.201	121.858	237.886	103.202	134.685
0.60	245.059	113.011	132.048	257.157	113.011	144.146
0.00	257.059	118.897	138.162	268.753	118.897	149.856

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
6	0.0000	0.0000	0.0141	0.0033	0.0474	0.0044
5	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000
4	0.0000	0.0000	0.0025	0.0006	0.0127	0.0012
3	0.0000	0.0000	0.0004	0.0000	0.0009	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0173	0.0039	0.0614	0.0056

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
13.10	12.00	6	0.0615	0.0078	0.0882	8.02
12.00	11.50	5	0.0005	0.0000	0.0005	0.10
11.50	10.95	4	0.0152	0.0018	0.0219	4.00
10.95	6.00	3	0.0013	0.0000	0.0013	0.03
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0002	0.0000	0.0002	0.00
Total			0.0787	0.0095	0.1121	

3.8 Results for Vertical 8 (X = 5.20 m; Z = 0.00 m)

Depth [m]	Initial stress			Final stress		
	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
13.07	0.001	0.000	0.001	12.882	0.000	12.882
12.97	1.700	0.000	1.700	15.042	0.000	15.042
12.87	3.400	0.000	3.400	17.132	0.000	17.132
12.77	5.100	0.000	5.100	19.070	0.000	19.070
12.67	6.800	0.000	6.800	20.942	0.000	20.942
12.57	8.500	0.000	8.500	22.784	0.000	22.784
12.53	9.057	0.000	9.057	23.385	0.000	23.385
12.47	10.200	0.000	10.200	24.616	0.000	24.616
12.37	11.900	0.000	11.900	26.446	0.000	26.446
12.27	13.600	0.000	13.600	28.278	0.000	28.278
12.17	15.300	0.000	15.300	30.114	0.000	30.114
12.12	16.075	0.000	16.075	31.123	0.172	30.951
12.07	17.000	0.534	16.466	32.109	0.691	31.418
12.00	18.115	1.177	16.938	33.297	1.317	31.981
Layer 5						
12.00	18.115	1.177	16.938	33.298	1.317	31.981
11.75	23.115	3.630	19.485	38.638	3.768	34.871
11.50	28.115	6.082	22.033	43.953	6.219	37.734
Layer 4						
11.50	28.115	6.082	22.033	43.953	6.219	37.734
11.23	32.764	8.765	23.999	48.835	8.837	39.997
10.95	37.414	11.448	25.965	53.657	11.458	42.199
Layer 3						
10.95	37.414	11.448	25.966	53.657	11.458	42.199
10.08	54.944	20.047	34.897	71.534	20.054	51.481
9.08	74.944	29.857	45.087	91.371	29.861	61.510
8.48	86.944	35.743	51.201	103.101	35.747	67.354
7.60	104.474	44.341	60.133	120.110	44.344	75.766
6.60	124.474	54.151	70.323	139.427	54.154	85.273
6.00	136.474	60.037	76.437	151.000	60.039	90.961
Layer 2						
6.00	136.474	60.037	76.437	151.000	60.039	90.961
5.40	148.474	65.923	82.551	162.573	65.925	96.648

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
4.80	160.474	71.809	88.665	174.151	71.811	102.340
Layer 1						
4.80	160.474	71.809	88.665	174.151	71.811	102.340
4.00	176.474	79.657	96.817	189.603	79.658	109.945
3.00	196.474	89.467	107.007	208.950	89.468	119.482
2.40	208.474	95.353	113.121	220.577	95.354	125.223
1.60	224.474	103.201	121.273	236.102	103.202	132.900
0.60	244.474	113.011	131.463	255.544	113.011	142.533
0.00	256.474	118.897	137.577	267.229	118.897	148.332

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0139	0.0033	0.0148	0.0014
5	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000
4	0.0000	0.0000	0.0025	0.0006	0.0059	0.0006
3	0.0000	0.0000	0.0004	0.0000	0.0004	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0171	0.0039	0.0214	0.0019

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13.07	12.00	6	0.0287	0.0047	0.0462	4.33
12.00	11.50	5	0.0003	0.0000	0.0003	0.06
11.50	10.95	4	0.0085	0.0012	0.0129	2.36
10.95	6.00	3	0.0008	0.0000	0.0008	0.02
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0002	0.0000	0.0002	0.00
Total			0.0385	0.0058	0.0604	

3.9 Results for Vertical 9 (X = 7.70 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
13.02	0.001	0.000	0.001	10.621	0.000	10.621
12.92	1.700	0.000	1.700	12.401	0.000	12.401
12.82	3.400	0.000	3.400	14.114	0.000	14.114
12.72	5.100	0.000	5.100	15.824	0.000	15.824
12.62	6.800	0.000	6.800	17.522	0.000	17.522
12.52	8.500	0.000	8.500	19.203	0.000	19.203
12.51	8.709	0.000	8.709	19.409	0.000	19.409
12.42	10.200	0.000	10.200	20.867	0.000	20.867
12.32	11.900	0.000	11.900	22.516	0.000	22.516
12.22	13.600	0.000	13.600	24.152	0.000	24.152
12.12	15.300	0.000	15.300	25.806	0.027	25.779
12.12	15.378	0.000	15.378	25.925	0.072	25.854
12.02	17.000	0.936	16.064	27.459	0.994	26.464
12.00	17.418	1.177	16.241	27.853	1.232	26.621
Layer 5						
12.00	17.418	1.177	16.241	27.854	1.232	26.621
11.75	22.418	3.630	18.788	32.646	3.684	28.962
11.50	27.418	6.082	21.336	37.452	6.136	31.317
Layer 4						
11.50	27.418	6.082	21.336	37.453	6.136	31.317
11.23	32.068	8.765	23.302	41.900	8.793	33.107

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
10.95	36.717	11.448	25.269	46.391	11.453	34.938
Layer 3						
10.95	36.717	11.448	25.269	46.392	11.453	34.938
10.08	54.247	20.047	34.200	63.739	20.051	43.688
9.08	74.247	29.857	44.390	83.802	29.860	53.942
8.48	86.247	35.743	50.504	95.883	35.745	60.138
7.60	103.777	44.341	59.436	113.520	44.343	69.176
6.60	123.777	54.151	69.626	133.582	54.153	79.429
6.00	135.777	60.037	75.740	145.582	60.039	85.544
Layer 2						
6.00	135.777	60.037	75.740	145.583	60.039	85.544
5.40	147.777	65.923	81.854	157.556	65.925	91.631
4.80	159.777	71.809	87.968	169.505	71.810	97.695
Layer 1						
4.80	159.777	71.809	87.968	169.505	71.811	97.695
4.00	175.777	79.657	96.120	185.405	79.658	105.746
3.00	195.777	89.467	106.310	205.237	89.468	115.769
2.40	207.777	95.353	112.424	217.120	95.354	121.766
1.60	223.777	103.201	120.576	232.949	103.202	129.747
0.60	243.777	113.011	130.766	252.718	113.011	139.707
0.00	255.777	118.897	136.880	264.574	118.897	145.677

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0137	0.0032	0.0025	0.0002
5	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
4	0.0000	0.0000	0.0026	0.0006	0.0000	0.0000
3	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0168	0.0038	0.0027	0.0002

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13.02	12.00	6	0.0162	0.0034	0.0294	2.87
12.00	11.50	5	0.0002	0.0000	0.0002	0.04
11.50	10.95	4	0.0026	0.0006	0.0050	0.91
10.95	6.00	3	0.0003	0.0000	0.0003	0.01
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0001	0.0000	0.0001	0.00
Total			0.0194	0.0040	0.0350	

3.10 Results for Vertical 10 (X = 9.20 m; Z = 0.00 m)

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
Layer 6						
13.00	0.001	0.000	0.001	1.168	0.000	1.168
12.90	1.700	0.000	1.700	2.886	0.000	2.886
12.80	3.400	0.000	3.400	4.629	0.000	4.629
12.70	5.100	0.000	5.100	6.420	0.000	6.420
12.60	6.800	0.000	6.800	8.258	0.000	8.258
12.50	8.500	0.000	8.500	10.129	0.000	10.129
12.40	10.200	0.000	10.200	12.017	0.000	12.017
12.30	11.900	0.000	11.900	13.908	0.000	13.908
12.20	13.600	0.000	13.600	15.794	0.000	15.794

Depth [m]	Initial stress S-total [kN/m²]	Initial stress S-water [kN/m²]	Initial stress S-eff. [kN/m²]	Final stress S-total [kN/m²]	Final stress S-water [kN/m²]	Final stress S-eff. [kN/m²]
12.12	14.960	0.000	14.960	17.326	0.028	17.298
12.10	15.300	0.196	15.104	17.701	0.223	17.477
12.00	17.000	1.177	15.823	19.567	1.201	18.367
Layer 5						
12.00	17.000	1.177	15.823	19.567	1.201	18.367
11.75	22.000	3.630	18.370	24.954	3.653	21.301
11.50	27.000	6.082	20.918	30.295	6.105	24.189
Layer 4						
11.50	27.000	6.082	20.918	30.295	6.106	24.189
11.23	31.649	8.765	22.884	35.265	8.778	26.487
10.95	36.299	11.448	24.851	40.202	11.451	28.751
Layer 3						
10.95	36.299	11.448	24.851	40.203	11.451	28.751
10.08	53.829	20.047	33.782	58.536	20.049	38.486
9.08	73.829	29.857	43.972	79.279	29.859	49.420
8.48	85.829	35.743	50.086	91.661	35.745	55.916
7.60	103.359	44.341	59.018	109.672	44.343	65.329
6.60	123.359	54.151	69.208	130.110	54.153	75.958
6.00	135.359	60.037	75.322	142.319	60.038	82.280
Layer 2						
6.00	135.359	60.037	75.322	142.319	60.039	82.280
5.40	147.359	65.923	81.436	154.489	65.924	88.564
4.80	159.359	71.809	87.550	166.623	71.810	94.813
Layer 1						
4.80	159.359	71.809	87.550	166.623	71.810	94.813
4.00	175.359	79.657	95.702	182.752	79.658	103.094
3.00	195.359	89.467	105.892	202.843	89.468	113.375
2.40	207.359	95.353	112.006	214.867	95.354	119.513
1.60	223.359	103.201	120.158	230.868	103.201	127.666
0.60	243.359	113.011	130.348	250.829	113.011	137.818
0.00	255.359	118.897	136.462	262.788	118.897	143.891

Layer number	Swelling Primary [m]	Swelling Secondary [m]	Settlement b. Sp. Primary [m]	Settlement b. Sp. Secondary 10 [days] [m]	Settlement a. Sp. Primary [m]	Settlement a. Sp. Secondary 10 [days] [m]
6	0.0000	0.0000	0.0036	0.0008	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0011	0.0002	0.0000	0.0000
3	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0050	0.0011	0.0000	0.0000

Depth From [m]	Depth To [m]	Layer number	Total settlement (100% cons.) Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	Percentage of original layer height [%]
13.00	12.00	6	0.0036	0.0008	0.0069	0.69
12.00	11.50	5	0.0000	0.0000	0.0000	0.00
11.50	10.95	4	0.0011	0.0002	0.0021	0.38
10.95	6.00	3	0.0002	0.0000	0.0002	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0001	0.0000	0.0001	0.00
Total			0.0050	0.0011	0.0093	

3.11 Results for Vertical 11 (X = 20.00 m; Z = 0.00 m)

Depth	Initial stress			Final stress		
[m]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]	S-total [kN/m²]	S-water [kN/m²]	S-eff. [kN/m²]
Layer 6						
12.90	0.001	0.000	0.001	0.001	0.000	0.001
12.80	1.700	0.000	1.700	1.700	0.000	1.700
12.70	3.400	0.000	3.400	3.400	0.000	3.400
12.60	5.100	0.000	5.100	5.100	0.000	5.100
12.50	6.800	0.000	6.800	6.800	0.000	6.800
12.45	7.650	0.000	7.650	7.650	0.000	7.650
12.40	8.500	0.000	8.500	8.501	0.000	8.501
12.30	10.200	0.000	10.200	10.201	0.000	10.201
12.20	11.900	0.000	11.900	11.901	0.000	11.901
12.12	13.260	0.000	13.260	13.261	0.000	13.261
12.10	13.600	0.196	13.404	13.601	0.196	13.405
12.00	15.300	1.177	14.123	15.301	1.177	14.124
Layer 5						
12.00	15.300	1.177	14.123	15.301	1.177	14.124
11.90	17.300	2.158	15.142	17.302	2.158	15.143
11.75	20.300	3.630	16.670	20.302	3.630	16.672
11.50	25.300	6.082	19.218	25.303	6.082	19.220
Layer 4						
11.50	25.300	6.082	19.218	25.303	6.082	19.221
11.23	29.950	8.765	21.184	29.954	8.765	21.188
10.95	34.599	11.448	23.151	34.605	11.448	23.157
Layer 3						
10.95	34.599	11.448	23.151	34.606	11.449	23.157
10.08	52.129	20.047	32.082	52.147	20.047	32.100
9.08	72.129	29.857	42.272	72.175	29.857	42.318
8.48	84.129	35.743	48.386	84.202	35.743	48.459
7.60	101.659	44.341	57.318	101.786	44.341	57.444
6.60	121.659	54.151	67.508	121.871	54.151	67.720
6.00	133.659	60.037	73.622	133.935	60.037	73.897
Layer 2						
6.00	133.659	60.037	73.622	133.935	60.037	73.897
5.40	145.659	65.923	79.736	146.007	65.923	80.083
4.80	157.659	71.809	85.850	158.086	71.809	86.277
Layer 1						
4.80	157.659	71.809	85.850	158.087	71.809	86.277
4.00	173.659	79.657	94.002	174.203	79.657	94.546
3.00	193.659	89.467	104.192	194.363	89.467	104.896
2.40	205.659	95.353	110.306	206.465	95.353	111.111
1.60	221.659	103.201	118.458	222.604	103.201	119.402
0.60	241.659	113.011	128.648	242.780	113.011	129.769
0.00	253.659	118.897	134.762	254.886	118.897	135.989

Layer number	Swelling		Settlement b. Sp.		Settlement a. Sp.	
	Primary [m]	Secondary [m]	Primary [m]	Secondary 10 [days] [m]	Primary [m]	Secondary 10 [days] [m]
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
12.90	12.00	6	0.0000	0.0000	0.0000	0.00
12.00	11.50	5	0.0000	0.0000	0.0000	0.00
11.50	10.95	4	0.0000	0.0000	0.0000	0.00

Depth		Layer number	Total settlement (100% cons.)			Percentage of original layer height [%]
From [m]	To [m]		Primary [m]	Secondary 10 [days] [m]	After 10000 [days] [m]	
10.95	6.00	3	0.0000	0.0000	0.0000	0.00
6.00	4.80	2	0.0000	0.0000	0.0000	0.00
4.80	0.00	1	0.0000	0.0000	0.0000	0.00
Total			0.0000	0.0000	0.0000	

4 Settlements

4.1 Settlements

Vertical number	X co-ordinate [m]	Z co-ordinate [m]	Surface level [m]	Settlement [m]
1	-30.00	0.00	11.70	0.000
2	-14.90	0.00	12.00	0.000
3	-6.10	0.00	15.00	0.011
4	-4.50	0.00	14.95	0.034
5	-3.00	0.00	14.90	0.054
6	0.00	0.00	14.00	0.128
7	3.10	0.00	13.10	0.112
8	5.20	0.00	13.07	0.060
9	7.70	0.00	13.02	0.035
10	9.20	0.00	13.00	0.009
11	20.00	0.00	12.90	0.000

4.2 Maintain Profile Calculation Results

Load 1 consists of 12.645 m3 per Width
The extra amount of soil to be added is 1.072 m3 per Width
This equals the found settlements for non-uniform loads

5 Warnings and errors

List of non-fatal warnings and errors generated during calculation.

1 D-Settlement will incorporate submerging as a one-off load reduction at time zero, due to the limitations of the Terzaghi model. Use the Darcy model for a gradual weight reduction of soil and loading during submerging
2 The Terzaghi model uses one consolidation coefficient for loading/unloading. This can underestimate residual settlements after unloading. Switch to Darcy for, more accurate calculations of the consolidation stage.

End of Report

BIJLAGE 9 Erosieschermen

Report for D-Sheet Piling 14.1

Design of Sheet Pilings
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	12/1/2014
Time of report:	12:31:16 PM
Date of calculation:	11/25/2014
Time of calculation:	2:32:32 PM
Filename:	C:\Users\nl85691\Desktop\08 Schermen\DR54 Keerscherm Kanaalweg I
Project identification:	Waterschap Peel en Maas vallei Prioritaire Dijkversterking 1 DR54.169-170

Verification according to NEN-EN 9997+C1:2012

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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	EC7(NL)-Step 6.1		15,9	20,8	32,9	29,5	Sufficient
1	EC7(NL)-Step 6.2		12,7	-19,9	32,9	29,5	Sufficient
1	EC7(NL)-Step 6.3		21,2	-27,1	33,9	30,3	Sufficient
1	EC7(NL)-Step 6.4		17,2	-25,9	34,0	30,3	Upwards
1	EC7(NL)-Step 6.5	-1,1	14,2	-19,6	23,3	20,8	Sufficient
1	EC7(NL)-Step 6.5 * 1,20		17,1	-23,5			
2	EC7(NL)-Step 6.1		11,0	-14,2	27,0	24,7	Sufficient
2	EC7(NL)-Step 6.2		9,1	-13,7	27,1	24,8	Sufficient
2	EC7(NL)-Step 6.3		13,9	17,4	29,1	27,0	Upwards
2	EC7(NL)-Step 6.4		11,0	-15,6	29,3	27,1	Upwards
2	EC7(NL)-Step 6.5	-0,8	11,0	-14,3	19,3	17,7	Sufficient
2	EC7(NL)-Step 6.5 * 1,20		13,2	-17,1			
3	EC7(NL)-Step 6.1		-450,9	-152,0	60,8	65,7	Sufficient
3	EC7(NL)-Step 6.2		-433,0	152,6	64,6	69,4	Sufficient
3	EC7(NL)-Step 6.3		-476,1	-157,5	63,2	68,0	Sufficient
3	EC7(NL)-Step 6.4		-458,5	155,8	67,5	72,0	Sufficient
3	EC7(NL)-Step 6.5	-29,8	-297,8	131,9	36,4	41,4	Sufficient
3	EC7(NL)-Step 6.5 * 1,20		-357,4	158,3			
4	EC7(NL)-Step 6.1		-472,4	-170,7	61,7	66,5	Sufficient
4	EC7(NL)-Step 6.2		-455,0	-166,6	65,8	70,5	Sufficient
4	EC7(NL)-Step 6.3		**-497,9**	**-176,3**	64,0	68,7	Sufficient
4	EC7(NL)-Step 6.4		-480,6	-172,4	**68,5**	**72,9**	Sufficient
4	EC7(NL)-Step 6.5	**-31,4**	-313,1	136,0	36,8	41,9	Sufficient
4	EC7(NL)-Step 6.5 * 1,20		-375,7	163,2			

Max		**-31,4**	**-497,9**	**-176,3**	**68,5**	**72,9**	Sufficient

2.2 Anchors and Struts

Stage	Verification type	Anchor/strut 60,3*12,5 [2.8]	
		Force [kN]	State
1	Step 6.1	9,25	Elastic
1	Step 6.2	6,05	Elastic
1	Step 6.3	8,88	Elastic
1	Step 6.4	5,82	Elastic
1	Step 6.5 * 1,20	9,64	Elastic
2	Step 6.1	4,99	Elastic
2	Step 6.2	3,31	Elastic
2	Step 6.3	8,41	Elastic
2	Step 6.4	5,35	Elastic
2	Step 6.5 * 1,20	6,52	Elastic
3	Step 6.1	183,11	Elastic
3	Step 6.2	180,93	Elastic
3	Step 6.3	189,78	Elastic
3	Step 6.4	187,71	Elastic
3	Step 6.5 * 1,20	160,24	Elastic
4	Step 6.1	209,69	Elastic
4	Step 6.2	206,62	Elastic
4	Step 6.3	**216,52**	Elastic
4	Step 6.4	213,61	Elastic
4	Step 6.5 * 1,20	182,82	Elastic

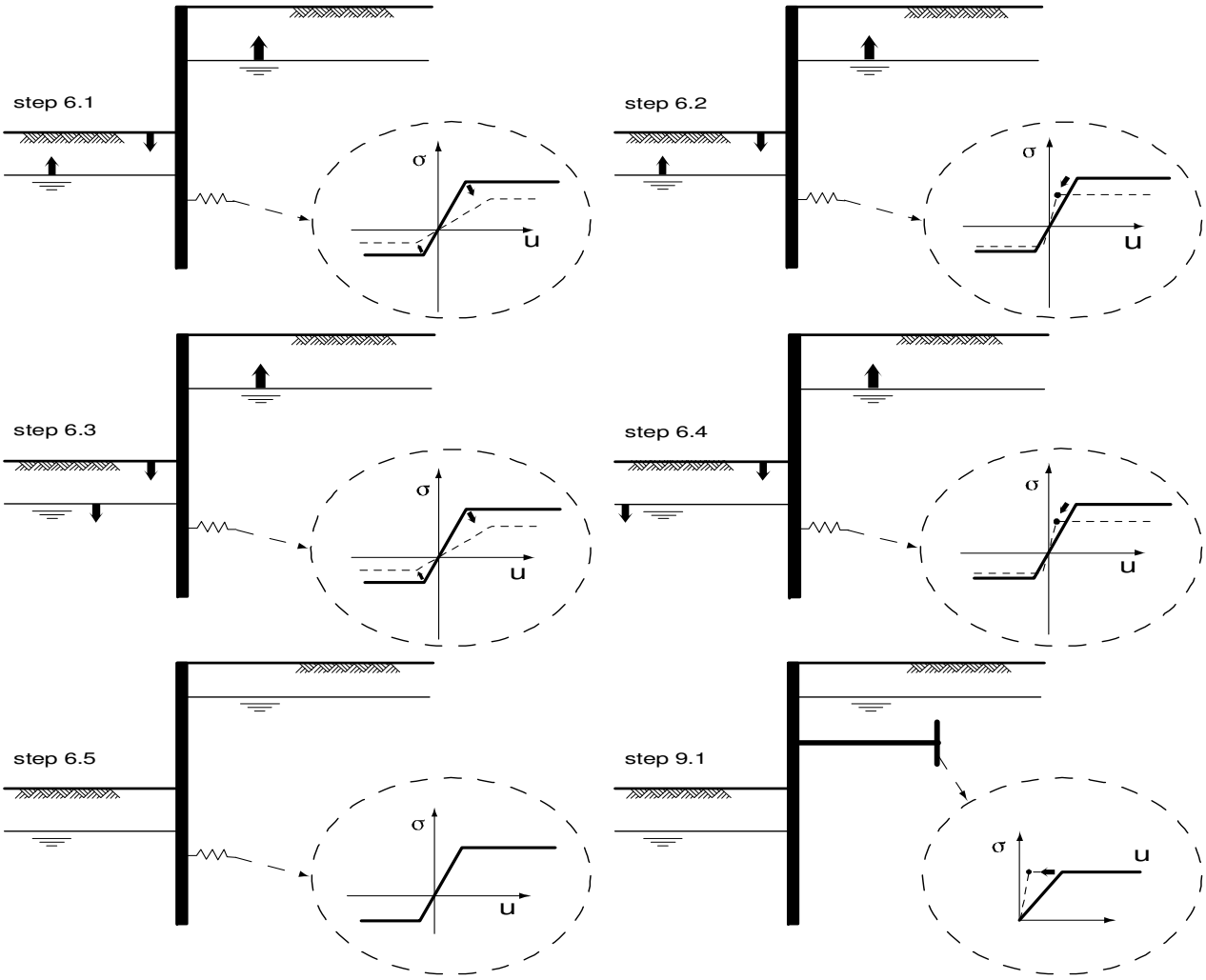
Stage	Verification type	Anchor/strut 60,3*12,5 [2.8]	
		Force [kN]	State
Max		**216,52**	

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 [-]
Aanleg	2,15
MHW	2,57
VAL (MHW)	1,69
VAL (MHW) (Ve...	1,70

2.4 CUR Verification Steps



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	4
Unit weight of water	9,81 kN/m³
Number of curves on spring characteristic	3
Unloading curve on spring characteristic	No

3.2 Sheet Piling Properties

Length	15,02 m
Level top side	13,32 m
Number of sections	1
Pr;max;point	12,00 MPa
Xi factor	0,72

Section name	From [m]	To [m]	Stiffness EI [kNm²/m']	Acting width [m]
AZ 24 -700 (10...	-1,70	13,32	8,5920E+04	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 24 -700 (10...	-1,70	13,32	632,00	1,00	1,00	1,00	632,00

Section name	From [m]	To [m]	Red. factor EI [-]	Note to reduction factor	Corrected stiffness EI [kNm²]
AZ 24 -700 (10...	-1,70	13,32	1,00		85920,00

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
AZ 24 -700 (10...	-1,70	13,32	459,00	1,38	174,00

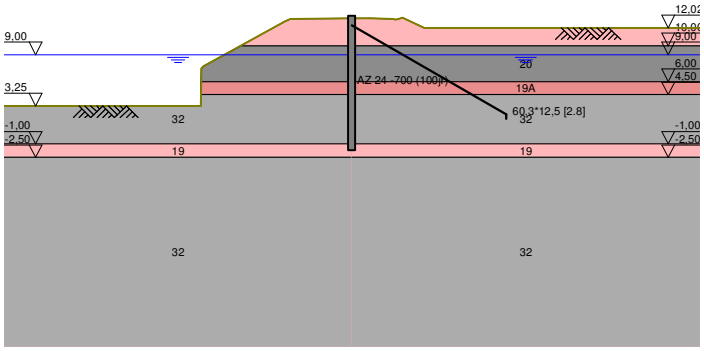
3.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL method A: Partial factors (design values) in all stages Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
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 1: Aanleg

Outline - Stage 1: Aanleg

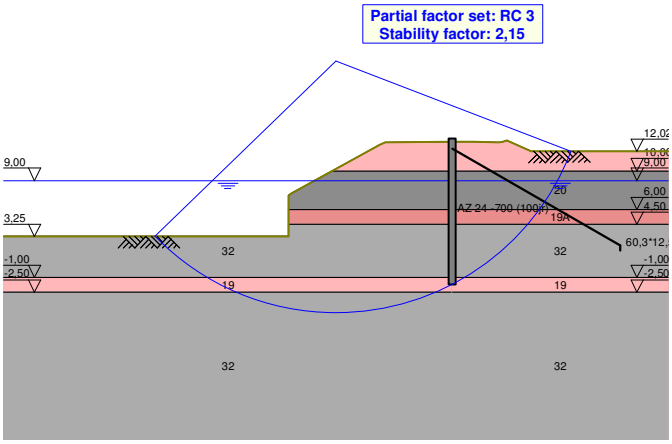


5 Overall Stability Stage 1: Aanleg

Stability factor : 2,15

5.1 Overall Stability

Overall Stability - Stage 1: Aanleg



6 Step 6.1 Stage 1: Aanleg

6.1 Input Data Left

6.1.1 Calculation Method

Calculation method: C, phi, delta

6.1.2 Water Level

Water level: 9,25 [m]

6.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

6.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

6.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,66	0,0	24,9	0,00	0,29	4,75
2	12,35	0,0	42,1	0,00	0,30	3,84
3	12,31	0,0	44,0	0,00	0,30	3,80
4	12,22	2,1	48,6	0,16	0,30	3,71
5	12,11	3,6	54,8	0,24	0,30	3,61
6	11,72	6,4	75,5	0,29	0,31	3,43
7	11,04	11,4	112,6	0,33	0,33	3,29
8	10,35	16,3	128,0	0,35	0,35	2,77
9	9,76	17,7	238,0	0,32	0,32	4,24
10	9,29	20,3	181,4	0,32	0,32	2,83
11	9,03	21,3	90,2	0,32	0,32	1,35
12	8,88	21,8	92,0	0,32	0,32	1,35
13	8,41	23,2	97,5	0,32	0,32	1,35
14	7,95	24,7	102,9	0,32	0,32	1,35
15	7,49	26,1	107,2	0,33	0,33	1,34
16	6,83	28,2	20,5	0,33	0,33	0,33
17	6,25	30,0	20,5	0,33	0,33	0,33
18	5,63	36,0	20,5	0,38	0,38	0,38
19	4,88	38,4	70,5	0,39	0,39	0,72
20	4,16	37,7	260,6	0,36	0,36	2,52
21	3,47	40,2	145,2	0,37	0,37	1,34
22	2,78	42,2	145,5	0,37	0,37	1,28
23	2,09	44,0	198,9	0,37	0,37	1,68
24	1,41	45,6	214,3	0,37	0,37	1,74
25	0,72	47,2	230,3	0,37	0,37	1,80
26	0,03	48,8	246,8	0,37	0,37	1,85
27	-0,66	50,3	263,9	0,36	0,36	1,91
28	-1,35	60,0	69,5	0,42	0,49	0,49

6.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	118,62
19A	56,68
32	327,71
19	48,48
32	0,00

6.4 Input Data Right

6.4.1 Calculation Method

Calculation method: C, phi, delta

6.4.2 Water Level

Water level: 9,05 [m]

6.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

6.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

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	12,99	0,0	11,4	0,00	0,57	17,06
2	12,66	0,0	29,9	0,00	0,54	4,51
3	12,35	0,7	47,7	0,06	0,54	3,85
4	12,31	2,7	49,7	0,21	0,54	3,82
5	12,22	3,3	54,4	0,23	0,54	3,74
6	12,11	4,2	60,9	0,25	0,54	3,66
7	11,72	7,0	79,6	0,30	0,54	3,38
8	11,04	12,0	114,9	0,34	0,54	3,21
9	10,35	17,1	131,5	0,36	0,55	2,74
10	9,76	18,3	228,1	0,32	0,46	3,92
11	9,29	20,9	264,8	0,31	0,46	3,98
12	9,03	22,3	284,3	0,31	0,46	4,01
13	8,88	22,8	290,6	0,32	0,46	4,02
14	8,41	24,2	312,3	0,32	0,47	4,07
15	7,95	25,5	327,4	0,32	0,47	4,04
16	7,49	26,9	333,1	0,32	0,47	3,91
17	6,83	28,9	360,5	0,32	0,48	3,94
18	6,25	30,6	387,7	0,32	0,48	4,00
19	5,63	37,3	295,9	0,37	0,56	2,90
20	4,88	40,0	317,3	0,37	0,57	2,94
21	4,16	38,5	370,8	0,34	0,49	3,24
22	3,47	40,2	404,4	0,33	0,49	3,35
23	2,78	41,9	439,6	0,33	0,50	3,45
24	2,09	43,5	464,1	0,32	0,50	3,47
25	1,41	45,0	485,3	0,32	0,51	3,46
26	0,72	46,5	509,8	0,32	0,51	3,47
27	0,03	48,2	535,3	0,31	0,51	3,49
28	-0,66	49,9	560,9	0,31	0,51	3,50
29	-1,35	59,7	474,7	0,36	0,63	2,86

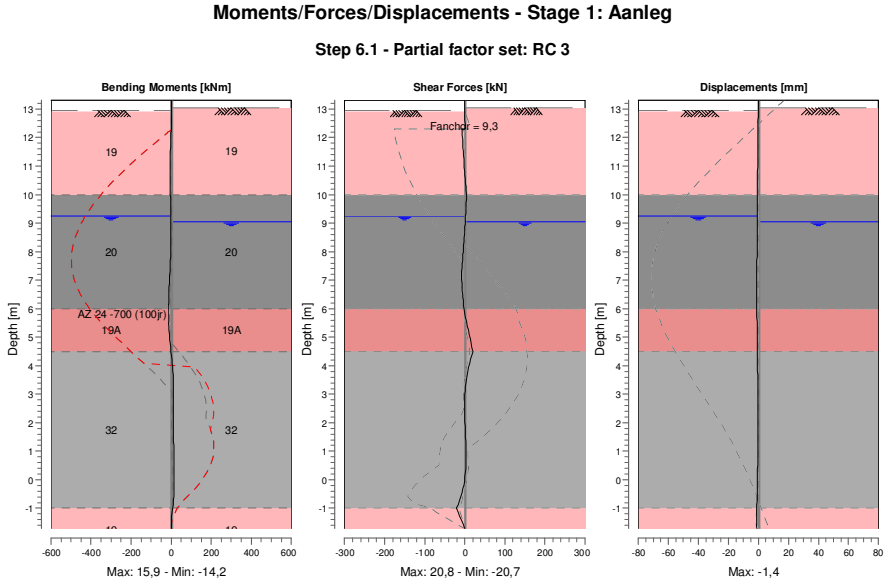
6.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	117,55
19A	82,90
32	297,15
19	70,53
32	0,00

6.7 Calculation Results

Number of iterations: 3

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	13,32	0,0	0,0	0,1
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,3	1,0	-0,1
4	12,37	0,3	1,0	-0,1
4	12,32	0,3	1,2	-0,1
5	12,32	0,3	1,2	-0,1
5	12,30	0,3	1,2	-0,2
6	12,30	0,3	-6,8	-0,2
6	12,15	-0,6	-6,4	-0,2
7	12,15	-0,6	-6,4	-0,2
7	12,07	-1,1	-6,1	-0,2
8	12,07	-1,1	-6,1	-0,2
8	11,38	-4,5	-3,3	-0,4
9	11,38	-4,5	-3,3	-0,4
9	10,69	-5,5	0,3	-0,5
10	10,69	-5,5	0,3	-0,5
10	10,00	-3,9	4,8	-0,6
11	10,00	-3,9	4,8	-0,6
11	9,53	-2,0	3,0	-0,7
12	9,53	-2,0	3,0	-0,7
12	9,05	-1,0	1,3	-0,8
13	9,05	-1,0	1,3	-0,8
13	9,00	-0,9	1,0	-0,8

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	-0,9	1,0	-0,8
14	8,75	-0,8	-0,2	-0,8
15	8,75	-0,8	-0,2	-0,8
15	8,07	-2,1	-3,6	-0,9
16	8,07	-2,1	-3,6	-0,9
16	7,82	-3,1	-4,9	-0,9
17	7,82	-3,1	-4,9	-0,9
17	7,16	-7,5	-8,3	-1,0
18	7,16	-7,5	-8,3	-1,0
18	6,50	-12,0	-5,4	-1,0
19	6,50	-12,0	-5,4	-1,0
19	6,00	-14,0	-2,5	-1,0
20	6,00	-14,0	-2,5	-1,0
20	5,25	-11,7	8,9	-0,9
21	5,25	-11,7	8,9	-0,9
21	4,50	-0,7	**20,8**	-0,7
22	4,50	-0,7	20,7	-0,7
22	3,81	8,8	7,7	-0,5
23	3,81	8,8	7,6	-0,5
23	3,13	11,4	1,0	-0,4
24	3,13	11,4	1,0	-0,4
24	2,44	11,4	-0,3	-0,3
25	2,44	11,4	-0,3	-0,3
25	1,75	11,7	1,3	-0,3
26	1,75	11,7	1,3	-0,3
26	1,06	13,3	3,1	-0,4
27	1,06	13,3	3,1	-0,4
27	0,38	**15,5**	2,3	-0,5
28	0,38	**15,5**	2,3	-0,5
28	-0,31	15,2	-4,4	-0,7
29	-0,31	15,2	-4,4	-0,7
29	-1,00	7,3	-20,6	-1,0
30	-1,00	7,3	-20,7	-1,0
30	-1,70	0,0	0,0	**-1,4**
Max		**15,5**	**20,8**	**-1,4**
Max, minor nodes incl.		15,9	20,8	-1,4

6.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		0,80	0,00	1	4
3	12,96	0,00	0,00	A		0,77	0,00	1	13
3	12,37	3,45	0,00	1	7	6,08	0,00	1	
4	12,37	3,53	0,00	1	9	6,01	0,00	1	
4	12,32	3,83	0,00	1	9	6,46	0,00	1	
5	12,32	3,84	0,00	1	9	6,46	0,00	1	
5	12,30	3,96	0,00	1	9	6,63	0,00	1	
6	12,30	3,98	0,00	1	9	6,63	0,00	1	
6	12,15	4,90	0,00	1	9	7,96	0,00	1	
7	12,15	4,92	0,00	1	9	7,95	0,00	1	
7	12,07	5,41	0,00	1	9	8,66	0,00	1	
8	12,07	5,50	0,00	1	10	8,67	0,00	1	
8	11,38	9,77	0,00	1	10	14,78	0,00	1	
9	11,38	10,51	0,00	1	11	14,92	0,00	1	
9	10,69	14,97	0,00	1	11	21,11	0,00	1	
10	10,69	15,85	0,00	1	14	21,41	0,00	1	
10	10,00	20,43	0,00	1	14	27,71	0,00	1	
11	10,00	22,39	0,00	1	10	18,68	0,00	1	
11	9,53	25,56	0,00	1	10	21,83	0,00	1	

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* [%]
12	9,53	25,58	0,00	1	15	22,17	0,00	1	
12	9,05	28,05	1,96	1	15	25,41	0,00	1	
13	9,05	28,24	1,96	1	32	25,61	0,00	1	
13	9,00	28,44	2,45	1	32	25,77	0,49	1	
14	9,00	28,49	2,45	1	32	25,81	0,49	1	
14	8,75	29,48	4,91	1	32	26,62	2,94	1	
15	8,75	29,65	4,91	1	32	26,79	2,94	1	
15	8,07	32,28	11,58	1	32	29,03	9,61	1	
16	8,07	32,47	11,58	1	32	29,26	9,61	1	
16	7,82	33,41	14,03	1	32	30,11	12,07	1	
17	7,82	33,60	14,03	1	33	30,37	12,07	1	
17	7,16	35,92	20,50	1	33	32,75	18,54	1	
18	7,16	27,20	20,50	P		33,19	18,54	1	
18	6,50	28,94	26,98	P		35,94	25,02	1	
19	6,50	29,25	26,98	P		36,37	25,02	1	
19	6,00	30,55	31,88	P		38,84	29,92	1	
20	6,00	34,92	31,88	P		51,11	29,92	1	
20	5,25	36,68	39,24	P		54,92	37,28	1	
21	5,25	39,07	39,24	2	57	55,49	37,28	1	
21	4,50	40,46	46,60	2	56	59,67	44,64	1	
22	4,50	57,73	46,60	1	23	37,39	44,64	A	
22	3,81	54,25	53,34	1	20	41,77	51,38	1	
23	3,81	54,86	53,34	1	39	42,31	51,38	1	
23	3,13	52,78	60,09	1	36	49,45	58,12	1	
24	3,13	52,99	60,09	1	37	49,97	58,12	1	
24	2,44	52,79	66,83	1	36	55,27	64,87	1	
25	2,44	52,65	66,83	1	27	55,76	64,87	1	
25	1,75	54,39	73,58	1	27	59,16	71,61	1	
26	1,75	54,22	73,58	1	26	59,63	71,61	1	
26	1,06	57,95	80,32	1	27	61,06	78,36	1	
27	1,06	57,72	80,32	1	26	61,51	78,36	1	
27	0,38	63,71	87,06	1	27	60,70	85,10	1	
28	0,38	63,42	87,06	1	26	61,13	85,10	1	
28	-0,31	71,99	93,81	1	29	57,77	91,85	1	
29	-0,31	71,69	93,81	1	28	58,17	91,85	1	
29	-1,00	82,72	100,55	1	31	52,37	98,59	1	
30	-1,00	68,35	100,55	P		99,59	98,59	1	
30	-1,70	70,17	107,42	P		101,91	105,46	1	

*

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	580,4	609,8
Water	588,1	566,8
Total	1168,6	1176,7

Considered as passive side	Left
Maximum passive effective resistance	1965,33 kN
Mobilized passive effective resistance	580,43 kN
Percentage mobilized resistance	29,5 %
Position single support	12,30 m
Maximum passive moment	15597,82 kNm
Mobilized passive moment	5135,07 kNm
Percentage mobilized moment	32,9 %

6.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-142,58
Vertical force passive	132,36
Vertical anchor force	-4,63
Resulting vertical force (no dead weight)	-14,85
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (15 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-142,58
Vertical force passive	132,36
Vertical anchor force	-4,63
Resulting vertical force (no dead weight)	-14,85
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (15 <= 3305)	

6.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	7,30	13,03	19	-10,52
10,00	20	39,31	10,00	20	-38,96
6,00	19A	15,55	6,00	19A	-22,74
4,50	32	57,97	4,50	32	-52,57
-1,00	19	12,23	-1,00	19	-17,79

6.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	9,25	Elastic	Right	Anchor

7 Step 6.2 Stage 1: Aanleg

7.1 Input Data Left

7.1.1 Calculation Method

Calculation method: C, phi, delta

7.1.2 Water Level

Water level: 9,25 [m]

7.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

7.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

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	12,66	0,0	24,9	0,00	0,29	4,75
2	12,35	0,0	42,1	0,00	0,30	3,84
3	12,31	0,0	44,0	0,00	0,30	3,80
4	12,22	2,1	48,6	0,16	0,30	3,71
5	12,11	3,6	54,8	0,24	0,30	3,61
6	11,72	6,4	75,5	0,29	0,31	3,43
7	11,04	11,4	112,6	0,33	0,33	3,29
8	10,35	16,3	128,0	0,35	0,35	2,77
9	9,76	17,7	238,0	0,32	0,32	4,24
10	9,29	20,3	181,4	0,32	0,32	2,83
11	9,03	21,3	90,2	0,32	0,32	1,35
12	8,88	21,8	92,0	0,32	0,32	1,35
13	8,41	23,2	97,5	0,32	0,32	1,35
14	7,95	24,7	102,9	0,32	0,32	1,35
15	7,49	26,1	107,2	0,33	0,33	1,34
16	6,83	28,2	20,5	0,33	0,33	0,33
17	6,25	30,0	20,5	0,33	0,33	0,33
18	5,63	36,0	20,5	0,38	0,38	0,38
19	4,88	38,4	70,5	0,39	0,39	0,72
20	4,16	37,7	260,6	0,36	0,36	2,52
21	3,47	40,2	145,2	0,37	0,37	1,34
22	2,78	42,2	145,5	0,37	0,37	1,28
23	2,09	44,0	198,9	0,37	0,37	1,68
24	1,41	45,6	214,3	0,37	0,37	1,74
25	0,72	47,2	230,3	0,37	0,37	1,80
26	0,03	48,8	246,8	0,37	0,37	1,85
27	-0,66	50,3	263,9	0,36	0,36	1,91
28	-1,35	60,0	69,5	0,42	0,49	0,49

7.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	118,86
19A	56,93
32	326,52
19	48,48
32	0,00

7.4 Input Data Right

7.4.1 Calculation Method

Calculation method: C, phi, delta

7.4.2 Water Level

Water level: 9,05 [m]

7.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

7.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

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	12,99	0,0	11,4	0,00	0,57	17,06
2	12,66	0,0	29,9	0,00	0,54	4,51
3	12,35	0,7	47,7	0,06	0,54	3,85
4	12,31	2,7	49,7	0,21	0,54	3,82
5	12,22	3,3	54,4	0,23	0,54	3,74
6	12,11	4,2	60,9	0,25	0,54	3,66
7	11,72	7,0	79,6	0,30	0,54	3,38
8	11,04	12,0	114,9	0,34	0,54	3,21
9	10,35	17,1	131,5	0,36	0,55	2,74
10	9,76	18,3	228,1	0,32	0,46	3,92
11	9,29	20,9	264,8	0,31	0,46	3,98
12	9,03	22,3	284,3	0,31	0,46	4,01
13	8,88	22,8	290,6	0,32	0,46	4,02
14	8,41	24,2	312,3	0,32	0,47	4,07
15	7,95	25,5	327,4	0,32	0,47	4,04
16	7,49	26,9	333,1	0,32	0,47	3,91
17	6,83	28,9	360,5	0,32	0,48	3,94
18	6,25	30,6	387,7	0,32	0,48	4,00
19	5,63	37,3	295,9	0,37	0,56	2,90
20	4,88	40,0	317,3	0,37	0,57	2,94
21	4,16	38,5	370,8	0,34	0,49	3,24
22	3,47	40,2	404,4	0,33	0,49	3,35
23	2,78	41,9	439,6	0,33	0,50	3,45
24	2,09	43,5	464,1	0,32	0,50	3,47
25	1,41	45,0	485,3	0,32	0,51	3,46
26	0,72	46,5	509,8	0,32	0,51	3,47
27	0,03	48,2	535,3	0,31	0,51	3,49
28	-0,66	49,9	560,9	0,31	0,51	3,50
29	-1,35	59,7	474,7	0,36	0,63	2,86

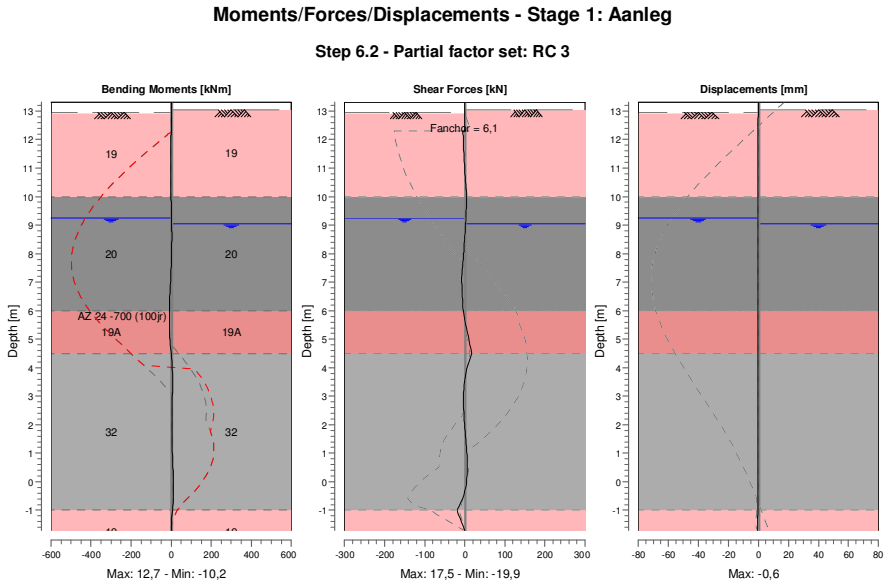
7.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	115,39
19A	81,54
32	300,03
19	69,78
32	0,00

7.7 Calculation Results

Number of iterations: 3

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	13,32	0,0	0,0	0,0
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,1	0,5	-0,1
4	12,37	0,1	0,5	-0,1
4	12,32	0,1	0,6	-0,1
5	12,32	0,1	0,6	-0,1
5	12,30	0,2	0,7	-0,1
6	12,30	0,2	-4,6	-0,1
6	12,15	-0,5	-4,3	-0,1
7	12,15	-0,5	-4,3	-0,1
7	12,07	-0,8	-4,1	-0,1
8	12,07	-0,8	-4,1	-0,1
8	11,38	-3,0	-1,8	-0,2
9	11,38	-3,0	-1,8	-0,2
9	10,69	-3,2	1,3	-0,2
10	10,69	-3,2	1,3	-0,2
10	10,00	-1,0	5,5	-0,2
11	10,00	-1,0	5,5	-0,2
11	9,53	1,2	3,6	-0,2
12	9,53	1,2	3,6	-0,2
12	9,05	2,5	2,0	-0,3
13	9,05	2,5	2,0	-0,3
13	9,00	2,6	1,8	-0,3

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	2,6	1,8	-0,3
14	8,75	2,9	0,7	-0,3
15	8,75	2,9	0,7	-0,3
15	8,07	2,3	-2,5	-0,3
16	8,07	2,3	-2,5	-0,3
16	7,82	1,5	-3,9	-0,3
17	7,82	1,5	-3,9	-0,3
17	7,16	-2,4	-8,1	-0,4
18	7,16	-2,4	-8,1	-0,4
18	6,50	-7,0	-6,0	-0,4
19	6,50	-7,0	-6,0	-0,4
19	6,00	-9,6	-4,2	-0,4
20	6,00	-9,6	-4,2	-0,4
20	5,25	-8,8	6,4	-0,4
21	5,25	-8,8	6,4	-0,4
21	4,50	0,0	17,5	-0,3
22	4,50	0,0	17,5	-0,3
22	3,81	6,6	3,1	-0,2
23	3,81	6,6	3,0	-0,2
23	3,13	6,2	-2,9	-0,1
24	3,13	6,2	-2,9	-0,1
24	2,44	4,1	-2,6	-0,1
25	2,44	4,1	-2,6	-0,1
25	1,75	3,4	0,9	-0,1
26	1,75	3,4	0,9	-0,1
26	1,06	5,4	4,8	-0,1
27	1,06	5,4	4,9	-0,1
27	0,38	9,6	6,4	-0,2
28	0,38	9,6	6,4	-0,2
28	-0,31	**12,7**	0,5	-0,3
29	-0,31	**12,7**	0,5	-0,3
29	-1,00	7,0	-19,8	-0,4
30	-1,00	7,0	**-19,9**	-0,4
30	-1,70	0,0	0,0	**-0,6**
Max		**12,7**	**-19,9**	**-0,6**
Max, minor nodes incl.		12,7	-19,9	-0,6

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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	A	
2	12,96	0,00	0,00	-		0,36	0,00	1	
3	12,96	0,00	0,00	P		0,33	0,00	1	
3	12,37	3,88	0,00	1	8	5,65	0,00	1	
4	12,37	3,96	0,00	1	10	5,58	0,00	1	
4	12,32	4,26	0,00	1	10	6,03	0,00	1	
5	12,32	4,27	0,00	1	10	6,03	0,00	1	
5	12,30	4,39	0,00	1	10	6,21	0,00	1	
6	12,30	4,40	0,00	1	10	6,20	0,00	1	
6	12,15	5,32	0,00	1	10	7,54	0,00	1	
7	12,15	5,35	0,00	1	10	7,53	0,00	1	
7	12,07	5,84	0,00	1	10	8,24	0,00	1	
8	12,07	5,92	0,00	1	11	8,25	0,00	1	
8	11,38	10,15	0,00	1	11	14,40	0,00	1	
9	11,38	10,89	0,00	1	12	14,54	0,00	1	
9	10,69	15,25	0,00	1	12	20,83	0,00	1	
10	10,69	16,12	0,00	1	14	21,14	0,00	1	
10	10,00	20,53	0,00	1	14	27,60	0,00	1	
11	10,00	22,70	0,00	1	10	18,36	0,00	1	
11	9,53	25,54	0,00	1	10	21,85	0,00	1	

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* [%]
12	9,53	25,56	0,00	1	15	22,19	0,00	1	
12	9,05	27,83	1,96	1	15	25,63	0,00	1	
13	9,05	28,02	1,96	1	31	25,83	0,00	1	
13	9,00	28,21	2,45	1	31	26,00	0,49	1	
14	9,00	28,26	2,45	1	31	26,04	0,49	1	
14	8,75	29,23	4,91	1	31	26,87	2,94	1	
15	8,75	29,40	4,91	1	32	27,04	2,94	1	
15	8,07	32,29	11,58	1	32	29,02	9,61	1	
16	8,07	32,48	11,58	1	32	29,25	9,61	1	
16	7,82	33,63	14,03	1	32	29,88	12,07	1	
17	7,82	33,83	14,03	1	33	30,14	12,07	1	
17	7,16	36,91	20,50	1	33	31,76	18,54	1	
18	7,16	27,20	20,50	P		32,20	18,54	1	
18	6,50	28,94	26,98	P		34,17	25,02	1	
19	6,50	29,25	26,98	P		34,59	25,02	1	
19	6,00	30,55	31,88	P		36,71	29,92	1	
20	6,00	34,92	31,88	P		50,04	29,92	1	
20	5,25	36,68	39,24	P		53,94	37,28	1	
21	5,25	39,49	39,24	2	58	54,51	37,28	1	
21	4,50	40,67	46,60	2	57	59,17	44,64	1	
22	4,50	61,04	46,60	1	24	37,39	44,64	A	
22	3,81	54,59	53,34	1	21	41,43	51,38	1	
23	3,81	55,19	53,34	1	39	41,97	51,38	1	
23	3,13	51,74	60,09	1	35	50,49	58,12	1	
24	3,13	51,95	60,09	1	37	51,01	58,12	1	
24	2,44	51,50	66,83	1	35	56,56	64,87	1	
25	2,44	51,35	66,83	1	26	57,06	64,87	1	
25	1,75	52,97	73,58	1	26	60,57	71,61	1	
26	1,75	52,81	73,58	1	25	61,05	71,61	1	
26	1,06	56,22	80,32	1	26	62,79	78,36	1	
27	1,06	55,99	80,32	1	25	63,24	78,36	1	
27	0,38	62,19	87,06	1	27	62,22	85,10	1	
28	0,38	61,91	87,06	1	26	62,65	85,10	1	
28	-0,31	72,83	93,81	1	29	56,94	91,85	1	
29	-0,31	72,52	93,81	1	28	57,34	91,85	1	
29	-1,00	89,36	100,55	1	33	50,95	98,59	A	
30	-1,00	68,35	100,55	P		98,93	98,59	1	
30	-1,70	70,17	107,42	P		100,44	105,46	1	

*

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	580,7	607,4
Water	588,1	566,8
Total	1168,9	1174,2

Considered as passive side	Left
Maximum passive effective resistance	1965,33 kN
Mobilized passive effective resistance	580,73 kN
Percentage mobilized resistance	29,6 %
Position single support	12,30 m
Maximum passive moment	15597,82 kNm
Mobilized passive moment	5128,92 kNm
Percentage mobilized moment	32,9 %

7.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-141,55
Vertical force passive	132,56
Vertical anchor force	-3,03
Resulting vertical force (no dead weight)	-12,02
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (12 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-141,55
Vertical force passive	132,56
Vertical anchor force	-3,03
Resulting vertical force (no dead weight)	-12,02
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (12 <= 3305)	

7.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	7,55	13,03	19	-10,26
10,00	20	39,39	10,00	20	-38,24
6,00	19A	15,61	6,00	19A	-22,37
4,50	32	57,77	4,50	32	-53,08
-1,00	19	12,23	-1,00	19	-17,61

7.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	6,05	Elastic	Right	Anchor

8 Step 6.3 Stage 1: Aanleg

8.1 Input Data Left

8.1.1 Calculation Method

Calculation method: C, phi, delta

8.1.2 Water Level

Water level: 8,75 [m]

8.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

8.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

8.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

8.2 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	12,66	0,0	24,9	0,00	0,28	4,75
2	12,35	0,0	42,1	0,00	0,29	3,84
3	12,31	0,0	44,0	0,00	0,29	3,80
4	12,22	2,1	48,6	0,16	0,29	3,71
5	12,11	3,6	54,8	0,24	0,29	3,61
6	11,72	6,4	75,5	0,29	0,30	3,43
7	11,04	11,4	112,6	0,33	0,33	3,29
8	10,35	16,3	128,0	0,35	0,35	2,77
9	9,76	17,7	238,0	0,32	0,32	4,24
10	9,29	20,4	210,4	0,32	0,32	3,28
11	9,03	21,8	159,5	0,32	0,32	2,33
12	8,88	22,7	162,6	0,32	0,32	2,29
13	8,41	24,5	97,1	0,32	0,32	1,28
14	7,95	25,9	102,9	0,32	0,32	1,29
15	7,49	27,4	107,2	0,33	0,33	1,28
16	6,83	29,4	16,2	0,33	0,33	0,33
17	6,25	31,2	16,2	0,33	0,33	0,33
18	5,63	37,4	16,2	0,38	0,38	0,38
19	4,88	39,9	70,5	0,39	0,39	0,69
20	4,16	39,0	269,0	0,36	0,36	2,51
21	3,47	41,5	147,4	0,37	0,37	1,32
22	2,78	43,5	146,4	0,37	0,37	1,25
23	2,09	45,2	201,8	0,37	0,37	1,66
24	1,41	46,9	217,2	0,37	0,37	1,71
25	0,72	48,5	233,1	0,37	0,37	1,77
26	0,03	50,0	249,6	0,37	0,37	1,83
27	-0,66	51,5	266,7	0,36	0,36	1,89
28	-1,35	61,5	64,2	0,42	0,44	0,44

8.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	126,79
19A	59,38
32	351,79
19	44,91
32	0,00

8.4 Input Data Right

8.4.1 Calculation Method

Calculation method: C, phi, delta

8.4.2 Water Level

Water level: 9,05 [m]

8.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

8.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

8.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

8.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

8.5 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	12,99	0,0	11,4	0,00	0,57	17,06
2	12,66	0,0	29,9	0,00	0,54	4,51
3	12,35	0,7	47,7	0,06	0,54	3,85
4	12,31	2,7	49,7	0,21	0,54	3,82
5	12,22	3,3	54,4	0,23	0,54	3,74
6	12,11	4,2	60,9	0,25	0,54	3,66
7	11,72	7,0	79,6	0,30	0,54	3,38
8	11,04	12,0	114,9	0,34	0,54	3,21
9	10,35	17,1	131,5	0,36	0,55	2,74
10	9,76	18,3	228,1	0,32	0,46	3,92
11	9,29	20,9	264,8	0,31	0,46	3,98
12	9,03	22,3	284,3	0,31	0,46	4,01
13	8,88	22,8	290,6	0,32	0,46	4,02
14	8,41	24,2	312,3	0,32	0,47	4,07
15	7,95	25,5	327,4	0,32	0,47	4,04
16	7,49	26,9	333,1	0,32	0,47	3,91
17	6,83	28,9	360,5	0,32	0,48	3,94
18	6,25	30,6	387,7	0,32	0,48	4,00
19	5,63	37,3	295,9	0,37	0,56	2,90
20	4,88	40,0	317,3	0,37	0,57	2,94
21	4,16	38,5	370,8	0,34	0,49	3,24
22	3,47	40,2	404,4	0,33	0,49	3,35
23	2,78	41,9	439,6	0,33	0,50	3,45
24	2,09	43,5	464,1	0,32	0,50	3,47
25	1,41	45,0	485,3	0,32	0,51	3,46
26	0,72	46,5	509,8	0,32	0,51	3,47
27	0,03	48,2	535,3	0,31	0,51	3,49
28	-0,66	49,9	560,9	0,31	0,51	3,50
29	-1,35	59,7	474,7	0,36	0,63	2,86

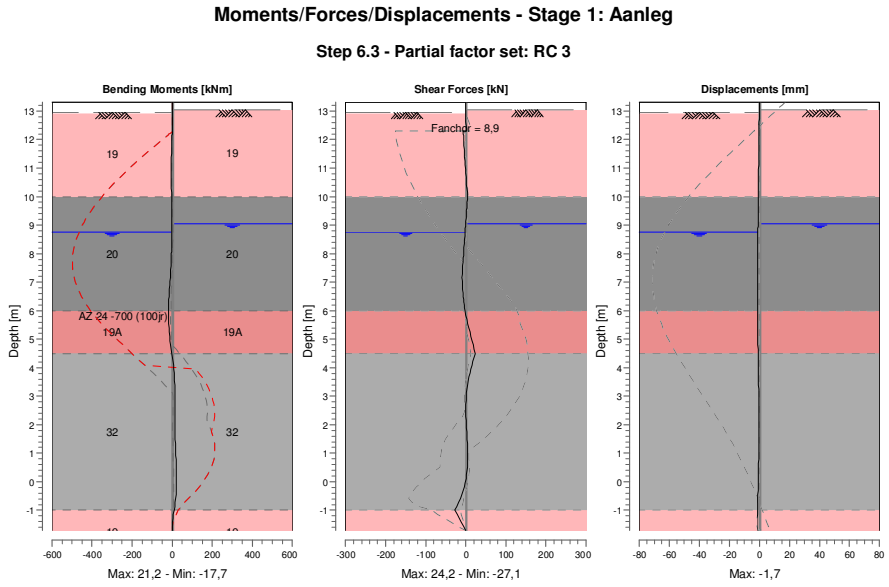
8.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	111,05
19A	81,53
32	284,54
19	69,90
32	0,00

8.7 Calculation Results

Number of iterations: 3

8.7.1 Charts of Moments, Forces and Displacements



8.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,1
1	13,03	0,0	0,0	0,1
2	13,03	0,0	0,0	0,1
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,3	1,1	-0,1
4	12,37	0,3	1,1	-0,1
4	12,32	0,4	1,3	-0,1
5	12,32	0,4	1,3	-0,1
5	12,30	0,4	1,3	-0,1
6	12,30	0,4	-6,4	-0,1
6	12,15	-0,5	-5,9	-0,2
7	12,15	-0,5	-5,9	-0,2
7	12,07	-1,0	-5,7	-0,2
8	12,07	-1,0	-5,7	-0,2
8	11,38	-4,0	-2,8	-0,4
9	11,38	-4,0	-2,8	-0,4
9	10,69	-4,8	0,7	-0,6
10	10,69	-4,8	0,7	-0,6
10	10,00	-2,9	4,8	-0,7
11	10,00	-2,9	4,8	-0,7
11	9,53	-1,2	2,2	-0,8
12	9,53	-1,2	2,2	-0,8
12	9,05	-0,8	-0,4	-0,9
13	9,05	-0,8	-0,4	-0,9
13	9,00	-0,8	-0,7	-0,9

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	-0,8	-0,7	-0,9
14	8,75	-1,2	-1,9	-1,0
15	8,75	-1,2	-1,9	-1,0
15	8,07	-3,5	-5,0	-1,1
16	8,07	-3,5	-5,0	-1,1
16	7,82	-4,9	-6,3	-1,1
17	7,82	-4,9	-6,3	-1,1
17	7,16	-10,2	-9,9	-1,2
18	7,16	-10,2	-9,9	-1,2
18	6,50	-15,5	-6,0	-1,2
19	6,50	-15,5	-6,0	-1,2
19	6,00	-17,6	-2,4	-1,2
20	6,00	-17,6	-2,4	-1,2
20	5,25	-14,5	10,8	-1,1
21	5,25	-14,5	10,8	-1,1
21	4,50	-1,6	24,2	-0,8
22	4,50	-1,6	24,2	-0,8
22	3,81	10,0	10,3	-0,6
23	3,81	10,0	10,3	-0,6
23	3,13	13,8	2,0	-0,5
24	3,13	13,8	2,0	-0,5
24	2,44	14,3	0,3	-0,4
25	2,44	14,3	0,4	-0,4
25	1,75	15,1	2,3	-0,4
26	1,75	15,1	2,3	-0,4
26	1,06	17,6	4,5	-0,4
27	1,06	17,6	4,5	-0,4
27	0,38	**20,6**	3,2	-0,6
28	0,38	**20,6**	3,2	-0,6
28	-0,31	20,2	-6,1	-0,9
29	-0,31	20,2	-6,2	-0,9
29	-1,00	9,5	-27,0	-1,3
30	-1,00	9,5	**-27,1**	-1,3
30	-1,70	0,0	0,0	**-1,7**
Max		**20,6**	**-27,1**	**-1,7**
Max, minor nodes incl.		21,2	-27,1	-1,7

8.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		0,89	0,00	1	4
3	12,96	0,00	0,00	A		0,86	0,00	1	14
3	12,37	3,34	0,00	1	7	6,10	0,00	1	
4	12,37	3,42	0,00	1	8	6,04	0,00	1	
4	12,32	3,72	0,00	1	8	6,48	0,00	1	
5	12,32	3,73	0,00	1	9	6,48	0,00	1	
5	12,30	3,85	0,00	1	9	6,65	0,00	1	
6	12,30	3,86	0,00	1	9	6,65	0,00	1	
6	12,15	4,78	0,00	1	9	7,96	0,00	1	
7	12,15	4,80	0,00	1	9	7,96	0,00	1	
7	12,07	5,29	0,00	1	9	8,66	0,00	1	
8	12,07	5,38	0,00	1	10	8,66	0,00	1	
8	11,38	9,63	0,00	1	10	14,71	0,00	1	
9	11,38	10,58	0,00	1	11	14,85	0,00	1	
9	10,69	15,13	0,00	1	11	20,95	0,00	1	
10	10,69	16,01	0,00	1	14	21,25	0,00	1	
10	10,00	20,68	0,00	1	14	27,46	0,00	1	
11	10,00	23,14	0,00	1	10	17,92	0,00	1	
11	9,53	26,53	0,00	1	10	20,85	0,00	1	

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* [%]
12	9,53	26,66	0,00	1	14	21,20	0,00	1	
12	9,05	29,99	0,00	1	13	24,19	0,00	1	
13	9,05	30,07	0,00	1	19	24,39	0,00	1	
13	9,00	30,42	0,00	1	19	24,53	0,49	1	
14	9,00	30,46	0,00	1	19	24,57	0,49	1	
14	8,75	32,20	0,00	1	19	25,25	2,94	1	
15	8,75	32,37	0,00	1	35	25,42	2,94	1	
15	8,07	35,32	6,67	1	35	27,34	9,61	1	
16	8,07	35,51	6,67	1	35	27,56	9,61	1	
16	7,82	36,55	9,12	1	35	28,30	12,07	1	
17	7,82	36,76	9,12	1	35	28,56	12,07	1	
17	7,16	39,28	15,60	1	36	30,73	18,54	1	
18	7,16	28,56	15,60	P		31,17	18,54	1	
18	6,50	30,28	22,07	P		33,83	25,02	1	
19	6,50	30,60	22,07	P		34,25	25,02	1	
19	6,00	31,89	26,98	P		36,76	29,92	1	
20	6,00	36,54	26,98	P		50,07	29,92	1	
20	5,25	38,28	34,34	P		53,99	37,28	1	
21	5,25	41,10	34,34	2	60	54,56	37,28	1	
21	4,50	42,38	41,69	2	59	58,94	44,64	1	
22	4,50	64,06	41,69	1	24	37,39	44,64	A	
22	3,81	59,21	48,44	1	22	39,57	51,38	A	
23	3,81	59,84	48,44	1	42	39,15	51,38	A	
23	3,13	56,59	55,18	1	38	47,06	58,12	1	
24	3,13	56,82	55,18	1	40	47,58	58,12	1	
24	2,44	55,85	61,93	1	37	53,63	64,87	1	
25	2,44	55,72	61,93	1	28	54,12	64,87	1	
25	1,75	57,16	68,67	1	28	57,79	71,61	1	
26	1,75	57,01	68,67	1	27	58,26	71,61	1	
26	1,06	61,03	75,41	1	28	59,37	78,36	1	
27	1,06	60,81	75,41	1	27	59,82	78,36	1	
27	0,38	67,82	82,16	1	29	57,98	85,10	1	
28	0,38	67,55	82,16	1	28	58,40	85,10	1	
28	-0,31	78,00	88,90	1	31	53,14	91,85	1	
29	-0,31	77,70	88,90	1	30	53,55	91,85	1	
29	-1,00	91,43	95,65	1	34	50,95	98,59	A	
30	-1,00	63,35	95,65	P		98,86	98,59	1	
30	-1,70	64,96	102,51	P		100,86	105,46	1	

*

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

8.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	611,9	588,5
Water	535,6	566,8
Total	1147,5	1155,4

Considered as passive side	Left
Maximum passive effective resistance	2022,57 kN
Mobilized passive effective resistance	611,85 kN
Percentage mobilized resistance	30,3 %
Position single support	12,30 m
Maximum passive moment	15906,15 kNm
Mobilized passive moment	5399,07 kNm
Percentage mobilized moment	33,9 %

8.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-137,61
Vertical force passive	139,18
Vertical anchor force	-4,44
Resulting vertical force (no dead weight)	-2,87
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (3 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-137,61
Vertical force passive	139,18
Vertical anchor force	-4,44
Resulting vertical force (no dead weight)	-2,87
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (3 <= 3305)	

8.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	7,31	13,03	19	-10,47
10,00	20	42,02	10,00	20	-36,80
6,00	19A	16,29	6,00	19A	-22,36
4,50	32	62,24	4,50	32	-50,34
-1,00	19	11,33	-1,00	19	-17,64

8.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	8,88	Elastic	Right	Anchor

9 Step 6.4 Stage 1: Aanleg

9.1 Input Data Left

9.1.1 Calculation Method

Calculation method: C, phi, delta

9.1.2 Water Level

Water level: 8,75 [m]

9.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

9.1.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

9.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

9.2 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	12,66	0,0	24,9	0,00	0,28	4,75
2	12,35	0,0	42,1	0,00	0,29	3,84
3	12,31	0,0	44,0	0,00	0,29	3,80
4	12,22	2,1	48,6	0,16	0,29	3,71
5	12,11	3,6	54,8	0,24	0,29	3,61
6	11,72	6,4	75,5	0,29	0,30	3,43
7	11,04	11,4	112,6	0,33	0,33	3,29
8	10,35	16,3	128,0	0,35	0,35	2,77
9	9,76	17,7	238,0	0,32	0,32	4,24
10	9,29	20,4	210,4	0,32	0,32	3,28
11	9,03	21,8	159,5	0,32	0,32	2,33
12	8,88	22,7	162,6	0,32	0,32	2,29
13	8,41	24,5	97,1	0,32	0,32	1,28
14	7,95	25,9	102,9	0,32	0,32	1,29
15	7,49	27,4	107,2	0,33	0,33	1,28
16	6,83	29,4	16,2	0,33	0,33	0,33
17	6,25	31,2	16,2	0,33	0,33	0,33
18	5,63	37,4	16,2	0,38	0,38	0,38
19	4,88	39,9	70,5	0,39	0,39	0,69
20	4,16	39,0	269,0	0,36	0,36	2,51
21	3,47	41,5	147,4	0,37	0,37	1,32
22	2,78	43,5	146,4	0,37	0,37	1,25
23	2,09	45,2	201,8	0,37	0,37	1,66
24	1,41	46,9	217,2	0,37	0,37	1,71
25	0,72	48,5	233,1	0,37	0,37	1,77
26	0,03	50,0	249,6	0,37	0,37	1,83
27	-0,66	51,5	266,7	0,36	0,36	1,89
28	-1,35	61,5	64,2	0,42	0,44	0,44

9.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	127,02
19A	59,69
32	351,73
19	44,91
32	0,00

9.4 Input Data Right

9.4.1 Calculation Method

Calculation method: C, phi, delta

9.4.2 Water Level

Water level: 9,05 [m]

9.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

9.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

9.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

9.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

9.5 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	12,99	0,0	11,4	0,00	0,57	17,06
2	12,66	0,0	29,9	0,00	0,54	4,51
3	12,35	0,7	47,7	0,06	0,54	3,85
4	12,31	2,7	49,7	0,21	0,54	3,82
5	12,22	3,3	54,4	0,23	0,54	3,74
6	12,11	4,2	60,9	0,25	0,54	3,66
7	11,72	7,0	79,6	0,30	0,54	3,38
8	11,04	12,0	114,9	0,34	0,54	3,21
9	10,35	17,1	131,5	0,36	0,55	2,74
10	9,76	18,3	228,1	0,32	0,46	3,92
11	9,29	20,9	264,8	0,31	0,46	3,98
12	9,03	22,3	284,3	0,31	0,46	4,01
13	8,88	22,8	290,6	0,32	0,46	4,02
14	8,41	24,2	312,3	0,32	0,47	4,07
15	7,95	25,5	327,4	0,32	0,47	4,04
16	7,49	26,9	333,1	0,32	0,47	3,91
17	6,83	28,9	360,5	0,32	0,48	3,94
18	6,25	30,6	387,7	0,32	0,48	4,00
19	5,63	37,3	295,9	0,37	0,56	2,90
20	4,88	40,0	317,3	0,37	0,57	2,94
21	4,16	38,5	370,8	0,34	0,49	3,24
22	3,47	40,2	404,4	0,33	0,49	3,35
23	2,78	41,9	439,6	0,33	0,50	3,45
24	2,09	43,5	464,1	0,32	0,50	3,47
25	1,41	45,0	485,3	0,32	0,51	3,46
26	0,72	46,5	509,8	0,32	0,51	3,47
27	0,03	48,2	535,3	0,31	0,51	3,49
28	-0,66	49,9	560,9	0,31	0,51	3,50
29	-1,35	59,7	474,7	0,36	0,63	2,86

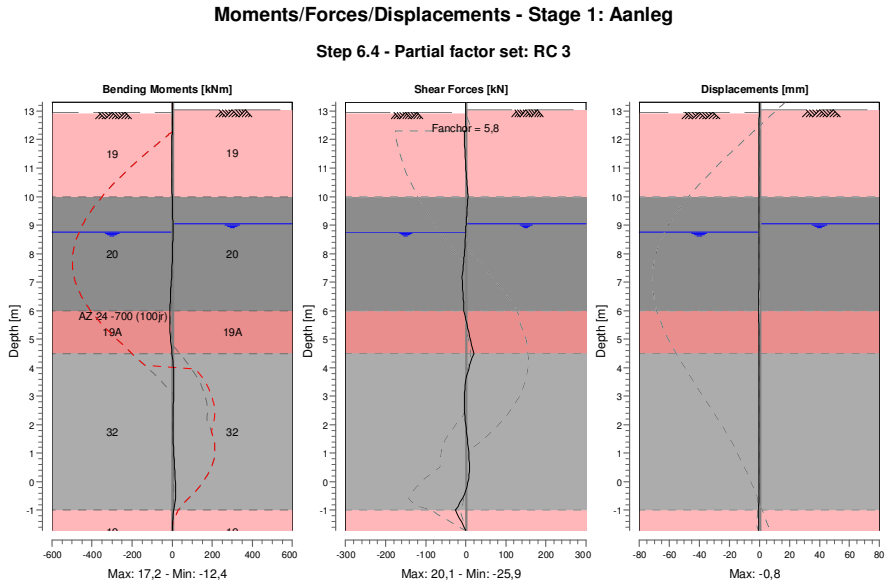
9.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	108,32
19A	79,80
32	289,68
19	68,78
32	0,00

9.7 Calculation Results

Number of iterations: 3

9.7.1 Charts of Moments, Forces and Displacements



9.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,0
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,1	0,6	-0,1
4	12,37	0,1	0,6	-0,1
4	12,32	0,2	0,7	-0,1
5	12,32	0,2	0,7	-0,1
5	12,30	0,2	0,7	-0,1
6	12,30	0,2	-4,3	-0,1
6	12,15	-0,4	-4,0	-0,1
7	12,15	-0,4	-4,0	-0,1
7	12,07	-0,7	-3,8	-0,1
8	12,07	-0,7	-3,8	-0,1
8	11,38	-2,6	-1,4	-0,2
9	11,38	-2,6	-1,4	-0,2
9	10,69	-2,6	1,7	-0,2
10	10,69	-2,6	1,7	-0,2
10	10,00	-0,1	5,7	-0,2
11	10,00	-0,1	5,7	-0,2
11	9,53	2,1	3,2	-0,3
12	9,53	2,1	3,2	-0,3
12	9,05	3,0	0,9	-0,3
13	9,05	3,0	0,9	-0,3
13	9,00	3,1	0,6	-0,3

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	3,1	0,6	-0,3
14	8,75	3,1	-0,4	-0,3
15	8,75	3,1	-0,4	-0,3
15	8,07	2,0	-3,3	-0,4
16	8,07	2,0	-3,3	-0,4
16	7,82	1,0	-4,7	-0,4
17	7,82	1,0	-4,7	-0,4
17	7,16	-3,6	-9,5	-0,5
18	7,16	-3,6	-9,5	-0,5
18	6,50	-9,0	-6,7	-0,5
19	6,50	-9,0	-6,8	-0,5
19	6,00	-11,8	-4,4	-0,5
20	6,00	-11,8	-4,4	-0,5
20	5,25	-10,7	7,7	-0,5
21	5,25	-10,7	7,7	-0,5
21	4,50	-0,4	20,1	-0,3
22	4,50	-0,4	20,1	-0,3
22	3,81	7,6	4,6	-0,2
23	3,81	7,6	4,5	-0,2
23	3,13	7,5	-3,1	-0,1
24	3,13	7,5	-3,1	-0,1
24	2,44	5,2	-2,8	-0,1
25	2,44	5,2	-2,7	-0,1
25	1,75	4,7	1,7	-0,1
26	1,75	4,7	1,7	-0,1
26	1,06	7,7	6,9	-0,1
27	1,06	7,7	6,9	-0,1
27	0,38	13,5	8,6	-0,2
28	0,38	13,5	8,6	-0,2
28	-0,31	**17,2**	-0,3	-0,3
29	-0,31	**17,2**	-0,4	-0,3
29	-1,00	9,0	**-25,9**	-0,5
30	-1,00	9,0	**-25,9**	-0,5
30	-1,70	0,0	0,0	**-0,8**
Max		**17,2**	**-25,9**	**-0,8**
Max, minor nodes incl.		17,2	-25,9	-0,8

9.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	A	
2	12,96	0,00	0,00	-		0,43	0,00	1	
3	12,96	0,00	0,00	P		0,40	0,00	1	
3	12,37	3,76	0,00	1	8	5,68	0,00	1	
4	12,37	3,83	0,00	1	9	5,62	0,00	1	
4	12,32	4,13	0,00	1	9	6,07	0,00	1	
5	12,32	4,14	0,00	1	10	6,06	0,00	1	
5	12,30	4,26	0,00	1	10	6,24	0,00	1	
6	12,30	4,28	0,00	1	10	6,23	0,00	1	
6	12,15	5,18	0,00	1	10	7,56	0,00	1	
7	12,15	5,20	0,00	1	10	7,56	0,00	1	
7	12,07	5,69	0,00	1	10	8,26	0,00	1	
8	12,07	5,77	0,00	1	11	8,27	0,00	1	
8	11,38	9,94	0,00	1	10	14,39	0,00	1	
9	11,38	10,90	0,00	1	12	14,53	0,00	1	
9	10,69	15,32	0,00	1	12	20,76	0,00	1	
10	10,69	16,20	0,00	1	15	21,07	0,00	1	
10	10,00	20,69	0,00	1	14	27,44	0,00	1	
11	10,00	23,19	0,00	1	11	17,88	0,00	1	
11	9,53	26,28	0,00	1	10	21,11	0,00	1	

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* [%]
12	9,53	26,40	0,00	1	13	21,45	0,00	1	
12	9,05	29,62	0,00	1	13	24,56	0,00	1	
13	9,05	29,70	0,00	1	19	24,76	0,00	1	
13	9,00	30,04	0,00	1	19	24,90	0,49	1	
14	9,00	30,09	0,00	1	19	24,94	0,49	1	
14	8,75	31,87	0,00	1	19	25,58	2,94	1	
15	8,75	32,03	0,00	1	34	25,75	2,94	1	
15	8,07	35,44	6,67	1	35	27,21	9,61	1	
16	8,07	35,64	6,67	1	35	27,44	9,61	1	
16	7,82	36,96	9,12	1	35	27,89	12,07	1	
17	7,82	37,17	9,12	1	36	28,15	12,07	1	
17	7,16	40,66	15,60	1	37	29,35	18,54	1	
18	7,16	28,56	15,60	P		29,79	18,54	1	
18	6,50	30,28	22,07	P		31,52	25,02	1	
19	6,50	30,60	22,07	P		31,94	25,02	1	
19	6,00	31,89	26,98	P		34,04	29,92	1	
20	6,00	36,54	26,98	P		48,71	29,92	1	
20	5,25	38,28	34,34	P		52,75	37,28	1	
21	5,25	41,63	34,34	2	60	53,32	37,28	1	
21	4,50	42,66	41,69	2	59	58,29	44,64	1	
22	4,50	68,39	41,69	1	26	37,39	44,64	A	
22	3,81	59,87	48,44	1	22	39,57	51,38	A	
23	3,81	60,50	48,44	1	42	39,15	51,38	A	
23	3,13	55,41	55,18	1	37	48,23	58,12	1	
24	3,13	55,64	55,18	1	39	48,75	58,12	1	
24	2,44	54,18	61,93	1	36	55,29	64,87	1	
25	2,44	54,05	61,93	1	27	55,79	64,87	1	
25	1,75	55,22	68,67	1	27	59,73	71,61	1	
26	1,75	55,06	68,67	1	26	60,21	71,61	1	
26	1,06	58,70	75,41	1	27	61,71	78,36	1	
27	1,06	58,48	75,41	1	26	62,16	78,36	1	
27	0,38	66,05	82,16	1	28	59,74	85,10	1	
28	0,38	65,78	82,16	1	27	60,17	85,10	1	
28	-0,31	79,95	88,90	1	31	51,19	91,85	1	
29	-0,31	79,66	88,90	1	30	51,59	91,85	1	
29	-1,00	101,86	95,65	1	38	50,95	98,59	A	
30	-1,00	63,35	95,65	P		97,81	98,59	1	
30	-1,70	64,96	102,51	P		98,67	105,46	1	

*

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

9.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	613,2	587,2
Water	535,6	566,8
Total	1148,8	1154,0

Considered as passive side	Left
Maximum passive effective resistance	2022,57 kN
Mobilized passive effective resistance	613,18 kN
Percentage mobilized resistance	30,3 %
Position single support	12,30 m
Maximum passive moment	15906,15 kNm
Mobilized passive moment	5408,49 kNm
Percentage mobilized moment	34,0 %

9.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-136,63
Vertical force passive	139,55
Vertical anchor force	-2,91
Resulting vertical force (no dead weight)	0,01
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (0 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-136,63
Vertical force passive	139,55
Vertical anchor force	-2,91
Resulting vertical force (no dead weight)	0,01
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (0 <= 3305)	

9.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	7,53	13,03	19	-10,24
10,00	20	42,09	10,00	20	-35,90
6,00	19A	16,37	6,00	19A	-21,89
4,50	32	62,23	4,50	32	-51,25
-1,00	19	11,33	-1,00	19	-17,35

9.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	5,82	Elastic	Right	Anchor

10 Step 6.5 Stage 1: Aanleg

10.1 Input Data Left

10.1.1 Calculation Method

Calculation method: C, phi, delta

10.1.2 Water Level

Water level: 9,00 [m]

10.1.3 Surface

X [m]	Y [m]
0,00	13,03
6,88	12,98
7,49	12,69
16,63	7,70
16,88	7,49
16,89	3,25

10.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

10.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

10.2 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	12,68	0,0	39,9	0,00	0,22	6,28
2	12,31	0,0	65,2	0,00	0,23	5,06
3	12,22	0,0	71,1	0,00	0,23	4,93
4	11,79	3,8	101,0	0,17	0,24	4,57
5	11,07	8,8	150,5	0,25	0,25	4,33
6	10,36	13,2	147,9	0,28	0,28	3,13
7	9,75	15,5	275,6	0,27	0,27	4,78
8	9,25	18,0	242,7	0,27	0,27	3,68
9	8,77	19,8	114,6	0,27	0,27	1,59
10	8,30	21,1	121,5	0,28	0,28	1,59
11	7,81	22,4	128,5	0,28	0,28	1,60
12	7,29	23,8	132,1	0,28	0,28	1,56
13	6,76	25,2	36,6	0,28	0,28	0,41
14	6,25	26,6	36,6	0,29	0,29	0,39
15	5,63	30,3	36,6	0,31	0,31	0,38
16	4,88	32,4	89,6	0,32	0,32	0,88
17	4,16	32,1	302,3	0,30	0,30	2,85
18	3,47	34,1	180,5	0,31	0,31	1,62
19	2,78	36,0	192,4	0,31	0,31	1,66
20	2,09	38,1	248,9	0,31	0,31	2,06
21	1,41	39,7	268,9	0,31	0,31	2,13
22	0,72	41,0	289,8	0,31	0,31	2,21
23	0,03	42,4	311,5	0,31	0,31	2,29
24	-0,66	43,6	334,1	0,31	0,31	2,37
25	-1,35	52,5	85,6	0,36	0,42	0,59

10.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	109,42
19A	49,95
32	288,77
19	43,76
32	0,00

10.4 Input Data Right

10.4.1 Calculation Method

Calculation method: C, phi, delta

10.4.2 Water Level

Water level: 9,00 [m]

10.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

10.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

10.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

10.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

10.5 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	12,68	0,0	41,6	0,00	0,48	6,47
2	12,31	0,0	67,9	0,00	0,48	5,22
3	12,22	0,0	73,9	0,00	0,48	5,08
4	11,79	3,8	100,5	0,17	0,48	4,50
5	11,07	8,9	150,1	0,25	0,48	4,27
6	10,36	13,4	152,2	0,28	0,49	3,19
7	9,75	15,8	273,2	0,27	0,39	4,68
8	9,25	18,1	320,0	0,27	0,39	4,77
9	8,77	19,9	355,5	0,27	0,40	4,83
10	8,30	21,1	382,5	0,27	0,40	4,90
11	7,81	22,4	393,2	0,27	0,40	4,75
12	7,29	23,8	411,6	0,27	0,40	4,70
13	6,76	25,1	441,1	0,27	0,41	4,77
14	6,25	26,5	470,1	0,27	0,41	4,83
15	5,63	30,0	400,6	0,29	0,50	3,91
16	4,88	32,4	429,8	0,30	0,50	3,96
17	4,16	32,9	491,2	0,29	0,42	4,28
18	3,47	34,3	536,0	0,28	0,42	4,42
19	2,78	35,8	575,6	0,28	0,43	4,51
20	2,09	37,1	606,2	0,28	0,43	4,52
21	1,41	38,4	635,7	0,27	0,43	4,52
22	0,72	39,7	669,4	0,27	0,44	4,54
23	0,03	40,9	703,2	0,27	0,44	4,57
24	-0,66	42,4	737,1	0,26	0,44	4,59
25	-1,35	51,1	613,0	0,31	0,56	3,68

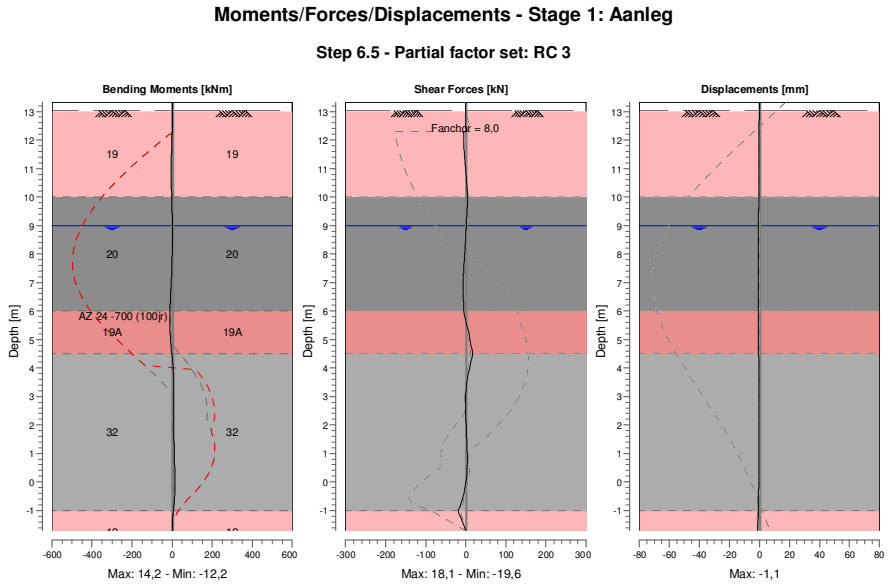
10.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	98,83
19A	73,09
32	251,14
19	63,33
32	0,00

10.7 Calculation Results

Number of iterations: 4

10.7.1 Charts of Moments, Forces and Displacements



10.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,1
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,32	0,2	0,8	-0,1
3	12,32	0,2	0,8	-0,1
3	12,30	0,2	0,9	-0,1
4	12,30	0,2	-6,1	-0,1
4	12,15	-0,7	-5,7	-0,2
5	12,15	-0,7	-5,7	-0,2
5	11,43	-3,9	-3,2	-0,3
6	11,43	-3,9	-3,2	-0,3
6	10,72	-4,9	0,7	-0,4
7	10,72	-4,9	0,7	-0,4
7	10,00	-2,8	5,5	-0,5
8	10,00	-2,8	5,5	-0,5
8	9,50	-0,5	3,3	-0,5
9	9,50	-0,5	3,3	-0,5
9	9,00	0,6	1,3	-0,5
10	9,00	0,6	1,3	-0,5
10	8,54	0,8	-0,5	-0,6
11	8,54	0,8	-0,5	-0,6
11	8,07	0,1	-2,5	-0,6
12	8,07	0,1	-2,5	-0,6
12	7,55	-1,8	-4,8	-0,7
13	7,55	-1,8	-4,8	-0,7
13	7,02	-5,0	-7,2	-0,7
14	7,02	-5,0	-7,2	-0,7
14	6,50	-8,5	-6,3	-0,7
15	6,50	-8,5	-6,3	-0,7
15	6,00	-11,4	-5,1	-0,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	6,00	-11,4	-5,1	-0,7
16	5,25	-10,8	6,9	-0,6
17	5,25	-10,8	6,9	-0,6
17	4,50	-1,6	18,1	-0,5
18	4,50	-1,6	18,1	-0,5
18	3,81	6,6	6,4	-0,4
19	3,81	6,6	6,4	-0,4
19	3,13	8,6	0,5	-0,3
20	3,13	8,6	0,5	-0,3
20	2,44	8,4	-0,3	-0,2
21	2,44	8,4	-0,2	-0,2
21	1,75	8,8	1,5	-0,2
22	1,75	8,8	1,5	-0,2
22	1,06	10,7	3,7	-0,3
23	1,06	10,7	3,7	-0,3
23	0,38	13,3	3,3	-0,4
24	0,38	13,3	3,4	-0,4
24	-0,31	**13,9**	-3,1	-0,5
25	-0,31	**13,9**	-3,1	-0,5
25	-1,00	6,9	-19,5	-0,8
26	-1,00	6,8	**-19,6**	-0,8
26	-1,70	0,0	0,0	**-1,1**
Max		**13,9**	**-19,6**	**-1,1**
Max, minor nodes incl.		14,2	-19,6	-1,1

10.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	A		0,00	0,00	3	88
2	12,32	3,37	0,00	1	4	5,70	0,00	1	
3	12,32	3,46	0,00	1	5	5,62	0,00	1	
3	12,30	3,56	0,00	1	5	5,78	0,00	1	
4	12,30	3,58	0,00	1	6	5,77	0,00	1	
4	12,15	4,31	0,00	1	6	6,95	0,00	1	
5	12,15	4,41	0,00	1	6	6,95	0,00	1	
5	11,43	7,96	0,00	1	6	12,57	0,00	1	
6	11,43	8,34	0,00	1	7	12,70	0,00	1	
6	10,72	11,92	0,00	1	7	18,41	0,00	1	
7	10,72	13,03	0,00	1	10	18,71	0,00	1	
7	10,00	16,79	0,00	1	10	24,57	0,00	1	
8	10,00	19,88	0,00	1	8	15,42	0,00	1	
8	9,50	22,65	0,00	1	8	18,31	0,00	1	
9	9,50	22,79	0,00	1	10	18,66	0,00	1	
9	9,00	25,53	0,00	1	10	21,60	0,00	1	
10	9,00	25,68	0,00	1	23	21,86	0,00	1	
10	8,54	27,23	4,56	1	23	23,15	4,56	1	
11	8,54	27,40	4,56	1	23	23,32	4,56	1	
11	8,07	28,96	9,12	1	23	24,59	9,12	1	
12	8,07	29,15	9,12	1	23	24,82	9,12	1	
12	7,55	30,88	14,26	1	23	26,27	14,26	1	
13	7,55	31,10	14,26	1	24	26,56	14,26	1	
13	7,02	32,74	19,39	1	24	28,09	19,39	1	
14	7,02	26,90	19,39	2	75	28,43	19,39	1	
14	6,50	28,15	24,52	2	75	30,16	24,52	1	
15	6,50	28,39	24,52	2	79	30,52	24,52	1	
15	6,00	29,48	29,43	2	79	32,49	29,43	1	
16	6,00	30,05	29,43	3	84	45,05	29,43	1	
16	5,25	31,42	36,79	3	84	48,37	36,79	1	
17	5,25	35,53	36,79	1	41	48,92	36,79	1	
17	4,50	36,14	44,15	1	39	52,68	44,15	1	

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* [%]
18	4,50	51,82	44,15	1	18	31,95	44,15	A	
18	3,81	47,96	50,89	1	16	34,25	50,89	1	
19	3,81	48,36	50,89	1	27	34,77	50,89	1	
19	3,13	45,84	57,63	1	25	41,55	57,63	1	
20	3,13	46,23	57,63	1	25	42,06	57,63	1	
20	2,44	45,57	64,38	1	23	47,03	64,38	1	
21	2,44	46,19	64,38	1	19	47,52	64,38	1	
21	1,75	47,42	71,12	1	19	50,67	71,12	1	
22	1,75	47,38	71,12	1	18	51,13	71,12	1	
22	1,06	50,56	77,87	1	18	52,35	77,87	1	
23	1,06	50,38	77,87	1	18	52,79	77,87	1	
23	0,38	55,92	84,61	1	19	51,68	84,61	1	
24	0,38	55,74	84,61	1	18	52,10	84,61	1	
24	-0,31	64,17	91,36	1	20	48,12	91,36	1	
25	-0,31	63,90	91,36	1	19	48,52	91,36	1	
25	-1,00	75,26	98,10	1	22	43,23	98,10	A	
26	-1,00	61,58	98,10	2	73	89,52	98,10	1	
26	-1,70	63,46	104,97	2	73	91,41	104,97	1	

*

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

10.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	516,2	523,1
Water	561,6	561,6
Total	1077,7	1084,7

Considered as passive side	Left
Maximum passive effective resistance	2487,06 kN
Mobilized passive effective resistance	516,16 kN
Percentage mobilized resistance	20,8 %
Position single support	12,30 m
Maximum passive moment	19607,06 kNm
Mobilized passive moment	4565,72 kNm
Percentage mobilized moment	23,3 %

10.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-144,13
Vertical force passive	138,92
Vertical anchor force	-4,01
Resulting vertical force (no dead weight)	-9,22
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (9 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-144,13
Vertical force passive	138,92
Vertical anchor force	-4,01
Resulting vertical force (no dead weight)	-9,22
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (9 <= 3305)	

10.7.6 Vertical Force Balance Contribution per Layer

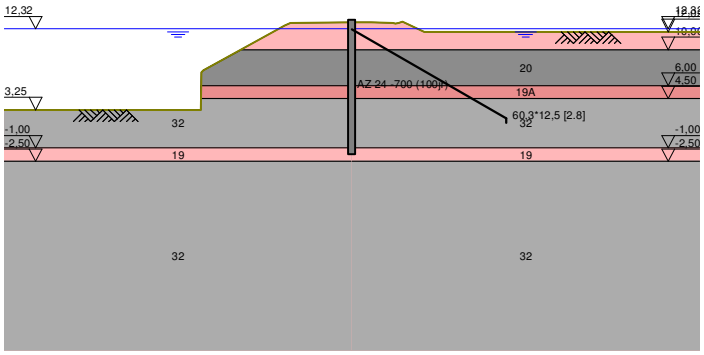
Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,03	19	7,26	13,03	19	-11,00
10,00	20	42,73	10,00	20	-38,59
6,00	19A	16,23	6,00	19A	-23,75
4,50	32	59,59	4,50	32	-51,83
-1,00	19	13,10	-1,00	19	-18,96

10.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	8,03	Elastic	Right	Anchor

11 Outline Stage 2: MHW

Outline - Stage 2: MHW

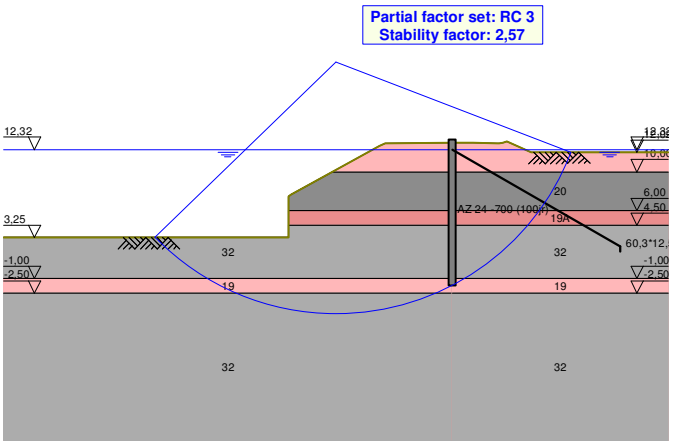


12 Overall Stability Stage 2: MHW

Stability factor : 2,57

12.1 Overall Stability

Overall Stability - Stage 2: MHW



13 Step 6.1 Stage 2: MHW

13.1 Input Data Left

13.1.1 Calculation Method

Calculation method: C, phi, delta

13.1.2 Water Level

Water level: 12,57 [m]

13.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

13.1.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

13.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

13.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,66	0,0	23,9	0,00	0,39	4,55
2	12,35	0,0	35,4	0,00	0,34	4,05
3	12,31	0,0	36,2	0,00	0,33	4,01
4	12,22	0,0	38,3	0,00	0,32	3,94
5	12,11	1,5	41,1	0,14	0,30	3,86
6	11,72	3,0	50,3	0,22	0,26	3,66
7	11,04	5,3	66,9	0,27	0,27	3,48
8	10,35	7,5	48,0	0,31	0,31	1,95
9	9,76	9,3	119,6	0,32	0,32	4,05
10	9,29	10,8	94,7	0,32	0,32	2,79
11	9,03	11,7	90,3	0,32	0,32	2,48
12	8,88	12,1	92,1	0,32	0,32	2,43
13	8,41	13,6	97,5	0,32	0,32	2,32
14	7,95	15,1	102,4	0,33	0,33	2,21
15	7,49	16,5	107,2	0,33	0,33	2,13
16	6,83	18,6	108,3	0,33	0,33	1,93
17	6,25	20,4	13,0	0,33	0,33	0,33
18	5,63	24,3	13,0	0,37	0,37	0,37
19	4,88	26,7	70,5	0,38	0,38	0,99
20	4,16	27,6	210,6	0,36	0,36	2,75
21	3,47	30,0	132,1	0,37	0,37	1,61
22	2,78	32,2	139,0	0,37	0,37	1,58
23	2,09	34,0	180,8	0,36	0,36	1,93
24	1,41	35,7	196,3	0,36	0,36	1,98
25	0,72	37,5	212,5	0,36	0,36	2,03
26	0,03	39,3	229,3	0,36	0,36	2,08
27	-0,66	41,2	246,7	0,36	0,37	2,13
28	-1,35	49,4	107,8	0,41	0,51	0,89

13.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	73,15
19A	38,69
32	256,35
19	42,84
32	0,00

13.4 Input Data Right

13.4.1 Calculation Method

Calculation method: C, phi, delta

13.4.2 Water Level

Water level: 12,37 [m]

13.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

13.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

13.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

13.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

13.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	25,8	206,5	0,36	0,55	2,86
20	4,88	28,5	228,0	0,36	0,56	2,92
21	4,16	28,6	270,9	0,34	0,49	3,21
22	3,47	30,4	304,4	0,33	0,49	3,34
23	2,78	32,2	335,8	0,33	0,50	3,44
24	2,09	33,8	360,4	0,32	0,50	3,46
25	1,41	35,4	382,5	0,32	0,51	3,45
26	0,72	36,9	407,5	0,31	0,51	3,47
27	0,03	38,6	433,1	0,31	0,51	3,49
28	-0,66	40,6	458,7	0,31	0,51	3,50
29	-1,35	48,9	393,6	0,36	0,63	2,87

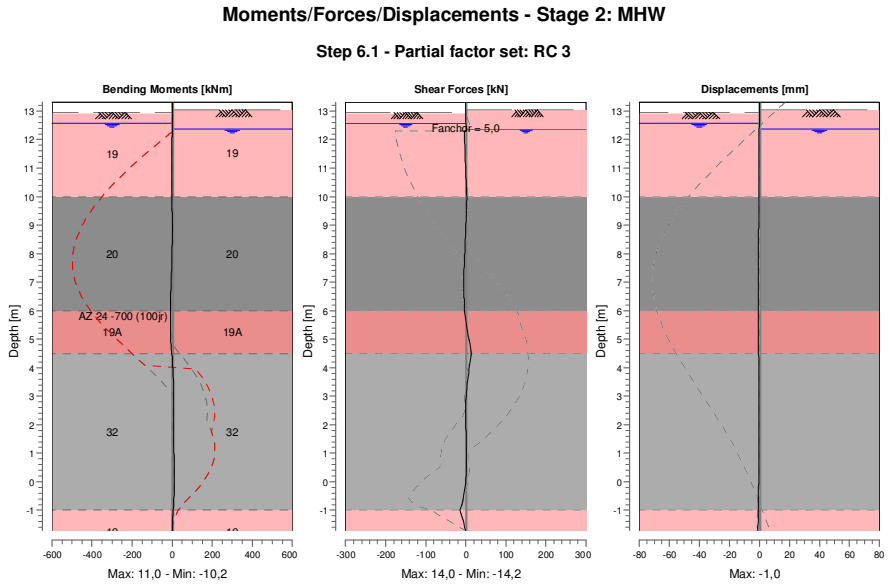
13.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	75,61
19A	58,56
32	239,01
19	58,44
32	0,00

13.7 Calculation Results

Number of iterations: 3

13.7.1 Charts of Moments, Forces and Displacements



13.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,1
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,2	0,8	-0,1
4	12,37	0,2	0,8	-0,1
4	12,32	0,3	0,8	-0,1
5	12,32	0,3	0,8	-0,1
5	12,30	0,3	0,9	-0,1
6	12,30	0,3	-3,4	-0,1
6	12,15	-0,2	-3,2	-0,1
7	12,15	-0,2	-3,2	-0,1
7	12,07	-0,5	-3,1	-0,1
8	12,07	-0,5	-3,1	-0,1
8	11,38	-2,1	-1,4	-0,2
9	11,38	-2,1	-1,4	-0,2
9	10,69	-2,4	0,5	-0,3
10	10,69	-2,4	0,5	-0,3
10	10,00	-1,4	2,4	-0,4
11	10,00	-1,4	2,4	-0,4
11	9,53	-0,5	1,5	-0,4
12	9,53	-0,5	1,5	-0,4
12	9,05	0,0	0,4	-0,5
13	9,05	0,0	0,4	-0,5
13	9,00	0,0	0,3	-0,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	0,0	0,3	-0,5
14	8,75	0,0	-0,4	-0,5
15	8,75	0,0	-0,4	-0,5
15	8,07	-0,9	-2,4	-0,6
16	8,07	-0,9	-2,4	-0,6
16	7,82	-1,6	-3,2	-0,6
17	7,82	-1,6	-3,2	-0,6
17	7,16	-4,5	-5,7	-0,6
18	7,16	-4,5	-5,7	-0,6
18	6,50	-7,9	-4,4	-0,7
19	6,50	-7,9	-4,4	-0,7
19	6,00	-9,7	-2,9	-0,7
20	6,00	-9,7	-2,9	-0,7
20	5,25	-9,0	5,0	-0,6
21	5,25	-9,0	5,0	-0,6
21	4,50	-2,0	14,0	-0,5
22	4,50	-2,0	14,0	-0,5
22	3,81	5,1	7,0	-0,4
23	3,81	5,1	7,0	-0,4
23	3,13	7,9	1,6	-0,3
24	3,13	7,9	1,6	-0,3
24	2,44	8,2	-0,1	-0,3
25	2,44	8,2	-0,1	-0,3
25	1,75	8,4	0,7	-0,2
26	1,75	8,4	0,7	-0,2
26	1,06	9,3	1,9	-0,3
27	1,06	9,3	1,9	-0,3
27	0,38	**10,7**	1,6	-0,4
28	0,38	**10,7**	1,6	-0,4
28	-0,31	10,6	-2,9	-0,5
29	-0,31	10,6	-2,9	-0,5
29	-1,00	5,0	**-14,2**	-0,8
30	-1,00	5,0	**-14,2**	-0,8
30	-1,70	0,0	0,0	**-1,0**
Max		**10,7**	**-14,2**	**-1,0**
Max, minor nodes incl.		11,0	-14,2	-1,0

13.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	A	
2	12,96	0,00	0,00	-		0,82	0,00	1	4
3	12,96	0,00	0,00	P		0,79	0,00	1	13
3	12,37	3,55	1,96	1	9	6,47	0,00	1	
4	12,37	3,09	1,96	1	9	6,38	0,00	1	
4	12,32	3,25	2,45	1	9	6,59	0,49	1	
5	12,32	3,19	2,45	1	9	6,56	0,49	1	
5	12,30	3,25	2,65	1	9	6,64	0,69	1	
6	12,30	3,13	2,65	1	9	6,56	0,69	1	
6	12,15	3,58	4,12	1	9	7,17	2,16	1	
7	12,15	3,41	4,12	1	9	7,07	2,16	1	
7	12,07	3,64	4,91	1	9	7,39	2,94	1	
8	12,07	3,26	4,91	1	8	7,17	2,94	1	
8	11,38	5,03	11,67	1	8	9,78	9,71	1	
9	11,38	5,19	11,67	1	9	9,56	9,71	1	
9	10,69	6,95	18,44	1	9	12,09	16,48	1	
10	10,69	7,65	18,44	1	18	12,11	16,48	1	
10	10,00	9,51	25,21	1	18	14,63	23,25	1	
11	10,00	12,15	25,21	1	11	12,26	23,25	1	
11	9,53	14,02	29,87	1	11	13,92	27,91	1	

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* [%]
12	9,53	14,09	29,87	1	16	13,88	27,91	1	
12	9,05	15,94	34,53	1	16	15,48	32,57	1	
13	9,05	15,98	34,53	1	18	15,47	32,57	1	
13	9,00	16,17	35,02	1	18	15,64	33,06	1	
14	9,00	16,20	35,02	1	18	15,63	33,06	1	
14	8,75	17,16	37,47	1	18	16,45	35,51	1	
15	8,75	17,25	37,47	1	19	16,44	35,51	1	
15	8,07	19,85	44,15	1	19	18,64	42,18	1	
16	8,07	19,95	44,15	1	20	18,63	42,18	1	
16	7,82	20,90	46,60	1	20	19,43	44,64	1	
17	7,82	21,00	46,60	1	21	19,42	44,64	1	
17	7,16	23,41	53,07	1	21	21,45	51,11	1	
18	7,16	17,61	53,07	A	17	21,45	51,11	1	
18	6,50	19,51	59,55	A	17	23,64	57,58	1	
19	6,50	19,66	59,55	A		24,13	57,58	1	
19	6,00	21,10	64,45	A		26,39	62,49	1	
20	6,00	23,33	64,45	A		35,11	62,49	1	
20	5,25	25,26	71,81	A		38,70	69,85	1	
21	5,25	26,32	71,81	1	39	39,27	69,85	1	
21	4,50	28,22	79,17	1	39	43,16	77,20	1	
22	4,50	42,10	79,17	1	21	33,02	77,20	1	
22	3,81	40,59	85,91	1	19	33,48	83,95	1	
23	3,81	40,95	85,91	1	32	33,09	83,95	1	
23	3,13	40,26	92,66	1	29	37,14	90,69	1	
24	3,13	40,37	92,66	1	30	37,62	90,69	1	
24	2,44	40,97	99,40	1	29	42,36	97,44	1	
25	2,44	40,72	99,40	1	23	42,82	97,44	1	
25	1,75	42,69	106,14	1	23	46,21	104,18	1	
26	1,75	42,41	106,14	1	22	46,64	104,18	1	
26	1,06	45,78	112,89	1	23	48,64	110,93	1	
27	1,06	45,52	112,89	1	22	49,04	110,93	1	
27	0,38	50,46	119,63	1	23	49,49	117,67	1	
28	0,38	50,74	119,63	1	23	49,86	117,67	1	
28	-0,31	57,49	126,38	1	24	48,55	124,42	1	
29	-0,31	58,94	126,38	1	24	48,90	124,42	1	
29	-1,00	67,48	133,12	1	27	50,16	131,16	1	
30	-1,00	60,16	133,12	2		82,14	131,16	1	
30	-1,70	62,26	139,99	2		84,83	138,03	1	

*

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

13.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	426,2	458,4
Water	998,8	971,0
Total	1425,0	1429,4

Considered as passive side	Left
Maximum passive effective resistance	1722,38 kN
Mobilized passive effective resistance	426,18 kN
Percentage mobilized resistance	24,7 %
Position single support	12,30 m
Maximum passive moment	14683,90 kNm
Mobilized passive moment	3965,54 kNm
Percentage mobilized moment	27,0 %

13.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-104,90
Vertical force passive	94,84
Vertical anchor force	-2,49
Resulting vertical force (no dead weight)	-12,55
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (13 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-104,90
Vertical force passive	94,84
Vertical anchor force	-2,49
Resulting vertical force (no dead weight)	-12,55
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (13 <= 3305)	

13.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	3,82	13,03	19	-6,75
10,00	20	24,24	10,00	20	-25,06
6,00	19A	10,61	6,00	19A	-16,06
4,50	32	45,35	4,50	32	-42,28
-1,00	19	10,81	-1,00	19	-14,74

13.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	4,99	Elastic	Right	Anchor

14 Step 6.2 Stage 2: MHW

14.1 Input Data Left

14.1.1 Calculation Method

Calculation method: C, phi, delta

14.1.2 Water Level

Water level: 12,57 [m]

14.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

14.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

14.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

14.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,66	0,0	23,9	0,00	0,39	4,55
2	12,35	0,0	35,4	0,00	0,34	4,05
3	12,31	0,0	36,2	0,00	0,33	4,01
4	12,22	0,0	38,3	0,00	0,32	3,94
5	12,11	1,5	41,1	0,14	0,30	3,86
6	11,72	3,0	50,3	0,22	0,26	3,66
7	11,04	5,3	66,9	0,27	0,27	3,48
8	10,35	7,5	48,0	0,31	0,31	1,95
9	9,76	9,3	119,6	0,32	0,32	4,05
10	9,29	10,8	94,7	0,32	0,32	2,79
11	9,03	11,7	90,3	0,32	0,32	2,48
12	8,88	12,1	92,1	0,32	0,32	2,43
13	8,41	13,6	97,5	0,32	0,32	2,32
14	7,95	15,1	102,4	0,33	0,33	2,21
15	7,49	16,5	107,2	0,33	0,33	2,13
16	6,83	18,6	108,3	0,33	0,33	1,93
17	6,25	20,4	13,0	0,33	0,33	0,33
18	5,63	24,3	13,0	0,37	0,37	0,37
19	4,88	26,7	70,5	0,38	0,38	0,99
20	4,16	27,6	210,6	0,36	0,36	2,75
21	3,47	30,0	132,1	0,37	0,37	1,61
22	2,78	32,2	139,0	0,37	0,37	1,58
23	2,09	34,0	180,8	0,36	0,36	1,93
24	1,41	35,7	196,3	0,36	0,36	1,98
25	0,72	37,5	212,5	0,36	0,36	2,03
26	0,03	39,3	229,3	0,36	0,36	2,08
27	-0,66	41,2	246,7	0,36	0,37	2,13
28	-1,35	49,4	107,8	0,41	0,51	0,89

14.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	73,50
19A	38,87
32	256,71
19	42,81
32	0,00

14.4 Input Data Right

14.4.1 Calculation Method

Calculation method: C, phi, delta

14.4.2 Water Level

Water level: 12,37 [m]

14.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

14.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

14.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

14.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

14.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	25,8	206,5	0,36	0,55	2,86
20	4,88	28,5	228,0	0,36	0,56	2,92
21	4,16	28,6	270,9	0,34	0,49	3,21
22	3,47	30,4	304,4	0,33	0,49	3,34
23	2,78	32,2	335,8	0,33	0,50	3,44
24	2,09	33,8	360,4	0,32	0,50	3,46
25	1,41	35,4	382,5	0,32	0,51	3,45
26	0,72	36,9	407,5	0,31	0,51	3,47
27	0,03	38,6	433,1	0,31	0,51	3,49
28	-0,66	40,6	458,7	0,31	0,51	3,50
29	-1,35	48,9	393,6	0,36	0,63	2,87

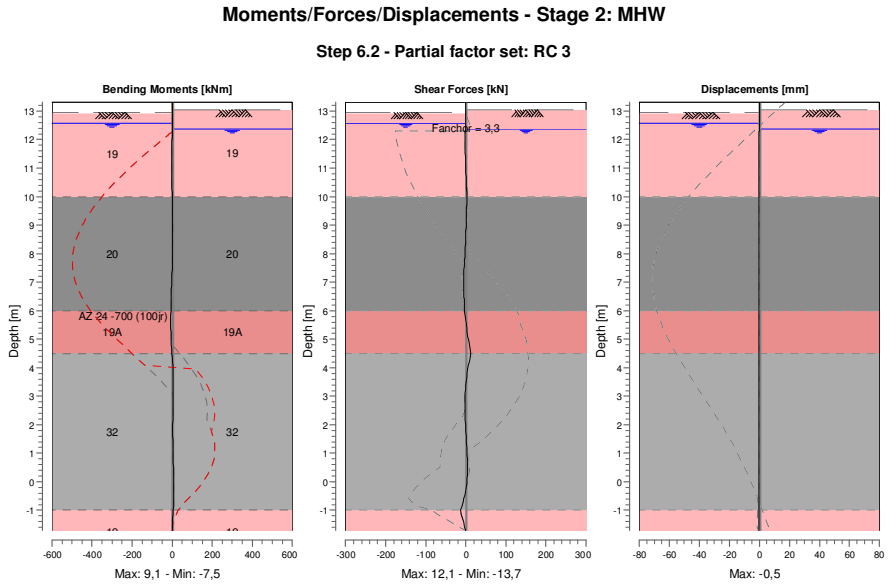
14.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	75,06
19A	57,36
32	241,84
19	57,84
32	0,00

14.7 Calculation Results

Number of iterations: 2

14.7.1 Charts of Moments, Forces and Displacements



14.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,0
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,1	0,5	-0,1
4	12,37	0,1	0,5	-0,1
4	12,32	0,2	0,5	-0,1
5	12,32	0,2	0,5	-0,1
5	12,30	0,2	0,5	-0,1
6	12,30	0,2	-2,3	-0,1
6	12,15	-0,2	-2,2	-0,1
7	12,15	-0,2	-2,2	-0,1
7	12,07	-0,3	-2,1	-0,1
8	12,07	-0,3	-2,1	-0,1
8	11,38	-1,3	-0,7	-0,1
9	11,38	-1,3	-0,7	-0,1
9	10,69	-1,3	1,0	-0,1
10	10,69	-1,3	1,0	-0,1
10	10,00	0,0	2,9	-0,1
11	10,00	0,0	2,9	-0,1
11	9,53	1,2	2,1	-0,1
12	9,53	1,2	2,1	-0,1
12	9,05	2,0	1,0	-0,2
13	9,05	2,0	1,0	-0,2
13	9,00	2,0	0,9	-0,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	2,0	0,9	-0,2
14	8,75	2,2	0,3	-0,2
15	8,75	2,2	0,3	-0,2
15	8,07	1,7	-1,8	-0,2
16	8,07	1,7	-1,8	-0,2
16	7,82	1,1	-2,8	-0,2
17	7,82	1,1	-2,8	-0,2
17	7,16	-1,7	-5,7	-0,3
18	7,16	-1,7	-5,7	-0,3
18	6,50	-5,0	-4,4	-0,3
19	6,50	-5,0	-4,4	-0,3
19	6,00	-6,9	-3,4	-0,3
20	6,00	-6,9	-3,4	-0,3
20	5,25	-6,8	3,9	-0,3
21	5,25	-6,8	3,9	-0,3
21	4,50	-1,0	12,1	-0,2
22	4,50	-1,0	12,1	-0,2
22	3,81	4,3	3,8	-0,1
23	3,81	4,3	3,7	-0,1
23	3,13	4,8	-1,6	-0,1
24	3,13	4,8	-1,6	-0,1
24	2,44	3,3	-2,0	-0,1
25	2,44	3,3	-1,9	-0,1
25	1,75	2,7	0,3	-0,1
26	1,75	2,7	0,4	-0,1
26	1,06	4,0	3,3	-0,1
27	1,06	4,0	3,3	-0,1
27	0,38	6,9	4,6	-0,1
28	0,38	6,9	4,6	-0,1
28	-0,31	**9,1**	0,2	-0,2
29	-0,31	**9,1**	0,1	-0,2
29	-1,00	4,8	-13,6	-0,3
30	-1,00	4,8	**-13,7**	-0,3
30	-1,70	0,0	0,0	**-0,5**
Max		**9,1**	**-13,7**	**-0,5**
Max, minor nodes incl.		9,1	-13,7	-0,5

14.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		0,55	0,00	1	
3	12,96	0,00	0,00	A		0,52	0,00	1	
3	12,37	3,79	1,96	1	10	6,22	0,00	1	
4	12,37	3,33	1,96	1	10	6,14	0,00	1	
4	12,32	3,49	2,45	1	10	6,35	0,49	1	
5	12,32	3,43	2,45	1	10	6,32	0,49	1	
5	12,30	3,49	2,65	1	10	6,40	0,69	1	
6	12,30	3,36	2,65	1	9	6,33	0,69	1	
6	12,15	3,81	4,12	1	9	6,94	2,16	1	
7	12,15	3,64	4,12	1	9	6,84	2,16	1	
7	12,07	3,87	4,91	1	9	7,16	2,94	1	
8	12,07	3,49	4,91	1	9	6,94	2,94	1	
8	11,38	5,21	11,67	1	9	9,60	9,71	1	
9	11,38	5,37	11,67	1	9	9,38	9,71	1	
9	10,69	7,06	18,44	1	9	11,99	16,48	1	
10	10,69	7,75	18,44	1	18	12,00	16,48	1	
10	10,00	9,52	25,21	1	18	14,62	23,25	1	
11	10,00	12,19	25,21	1	11	12,54	23,25	1	
11	9,53	13,91	29,87	1	11	14,01	27,91	1	

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* [%]
12	9,53	13,98	29,87	1	16	13,98	27,91	1	
12	9,05	15,77	34,53	1	16	15,43	32,57	1	
13	9,05	15,81	34,53	1	18	15,42	32,57	1	
13	9,00	16,01	35,02	1	18	15,57	33,06	1	
14	9,00	16,03	35,02	1	18	15,56	33,06	1	
14	8,75	17,03	37,47	1	18	16,34	35,51	1	
15	8,75	17,11	37,47	1	19	16,32	35,51	1	
15	8,07	20,02	44,15	1	19	18,49	42,18	1	
16	8,07	20,12	44,15	1	20	18,48	42,18	1	
16	7,82	21,25	46,60	1	20	19,30	44,64	1	
17	7,82	21,35	46,60	1	21	19,29	44,64	1	
17	7,16	24,38	53,07	1	22	21,47	51,11	1	
18	7,16	17,61	53,07	A	17	21,47	51,11	1	
18	6,50	19,51	59,55	A	17	23,55	57,58	1	
19	6,50	19,66	59,55	A		23,57	57,58	1	
19	6,00	21,10	64,45	A		24,97	62,49	1	
20	6,00	23,33	64,45	A		34,19	62,49	1	
20	5,25	25,26	71,81	A		37,84	69,85	1	
21	5,25	26,62	71,81	1	39	38,41	69,85	1	
21	4,50	28,42	79,17	1	39	42,68	77,20	1	
22	4,50	45,31	79,17	1	22	33,12	77,20	1	
22	3,81	41,29	85,91	1	19	33,11	83,95	1	
23	3,81	41,65	85,91	1	33	32,73	83,95	1	
23	3,13	39,58	92,66	1	29	37,81	90,69	1	
24	3,13	39,69	92,66	1	30	38,30	90,69	1	
24	2,44	39,89	99,40	1	28	43,44	97,44	1	
25	2,44	39,64	99,40	1	23	43,90	97,44	1	
25	1,75	41,52	106,14	1	22	47,38	104,18	1	
26	1,75	41,23	106,14	1	22	47,81	104,18	1	
26	1,06	44,52	112,89	1	22	49,90	110,93	1	
27	1,06	44,25	112,89	1	21	50,30	110,93	1	
27	0,38	49,58	119,63	1	23	50,36	117,67	1	
28	0,38	49,87	119,63	1	22	50,74	117,67	1	
28	-0,31	58,63	126,38	1	25	47,41	124,42	1	
29	-0,31	60,07	126,38	1	25	47,76	124,42	1	
29	-1,00	73,13	133,12	1	29	51,15	131,16	1	
30	-1,00	60,13	133,12	2		81,58	131,16	1	
30	-1,70	62,18	139,99	2		83,65	138,03	1	

*

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

14.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	427,5	458,4
Water	998,8	971,0
Total	1426,4	1429,4

Considered as passive side	Left
Maximum passive effective resistance	1722,38 kN
Mobilized passive effective resistance	427,54 kN
Percentage mobilized resistance	24,8 %
Position single support	12,30 m
Maximum passive moment	14683,90 kNm
Mobilized passive moment	3974,59 kNm
Percentage mobilized moment	27,1 %

14.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-104,61
Vertical force passive	95,18
Vertical anchor force	-1,66
Resulting vertical force (no dead weight)	-11,09
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (11 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-104,61
Vertical force passive	95,18
Vertical anchor force	-1,66
Resulting vertical force (no dead weight)	-11,09
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (11 <= 3305)	

14.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	3,95	13,03	19	-6,62
10,00	20	24,36	10,00	20	-24,88
6,00	19A	10,66	6,00	19A	-15,73
4,50	32	45,41	4,50	32	-42,78
-1,00	19	10,80	-1,00	19	-14,59

14.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	3,31	Elastic	Right	Anchor

15 Step 6.3 Stage 2: MHW

15.1 Input Data Left

15.1.1 Calculation Method

Calculation method: C, phi, delta

15.1.2 Water Level

Water level: 12,07 [m]

15.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

15.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

15.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

15.2 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	12,66	0,0	24,9	0,00	0,37	4,75
2	12,35	0,0	42,1	0,00	0,37	3,84
3	12,31	0,0	44,0	0,00	0,38	3,80
4	12,22	2,1	48,6	0,16	0,38	3,71
5	12,11	3,6	54,8	0,24	0,38	3,61
6	11,72	5,0	65,2	0,27	0,34	3,50
7	11,04	7,3	73,6	0,30	0,30	3,06
8	10,35	9,5	45,5	0,32	0,32	1,55
9	9,76	10,9	145,9	0,32	0,32	4,26
10	9,29	12,4	85,0	0,32	0,32	2,20
11	9,03	13,2	90,3	0,32	0,32	2,19
12	8,88	13,7	91,5	0,32	0,32	2,15
13	8,41	15,1	97,5	0,32	0,32	2,09
14	7,95	16,6	102,9	0,33	0,33	2,02
15	7,49	18,0	107,2	0,33	0,33	1,95
16	6,83	20,1	108,3	0,33	0,33	1,79
17	6,25	21,9	8,3	0,33	0,33	0,33
18	5,63	26,1	8,3	0,37	0,37	0,37
19	4,88	28,6	70,5	0,38	0,38	0,94
20	4,16	29,2	216,6	0,36	0,36	2,69
21	3,47	31,6	133,7	0,37	0,37	1,55
22	2,78	33,8	139,9	0,37	0,37	1,53
23	2,09	35,5	183,1	0,37	0,37	1,89
24	1,41	37,3	198,6	0,36	0,36	1,94
25	0,72	39,0	214,7	0,36	0,36	1,99
26	0,03	40,6	231,5	0,36	0,36	2,04
27	-0,66	42,1	248,9	0,35	0,37	2,09
28	-1,35	50,0	102,1	0,40	0,51	0,83

15.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	87,23
19A	41,84
32	280,22
19	43,71
32	0,00

15.4 Input Data Right

15.4.1 Calculation Method

Calculation method: C, phi, delta

15.4.2 Water Level

Water level: 12,37 [m]

15.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

15.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

15.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

15.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

15.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	25,8	206,5	0,36	0,55	2,86
20	4,88	28,5	228,0	0,36	0,56	2,92
21	4,16	28,6	270,9	0,34	0,49	3,21
22	3,47	30,4	304,4	0,33	0,49	3,34
23	2,78	32,2	335,8	0,33	0,50	3,44
24	2,09	33,8	360,4	0,32	0,50	3,46
25	1,41	35,4	382,5	0,32	0,51	3,45
26	0,72	36,9	407,5	0,31	0,51	3,47
27	0,03	38,6	433,1	0,31	0,51	3,49
28	-0,66	40,6	458,7	0,31	0,51	3,50
29	-1,35	48,9	393,6	0,36	0,63	2,87

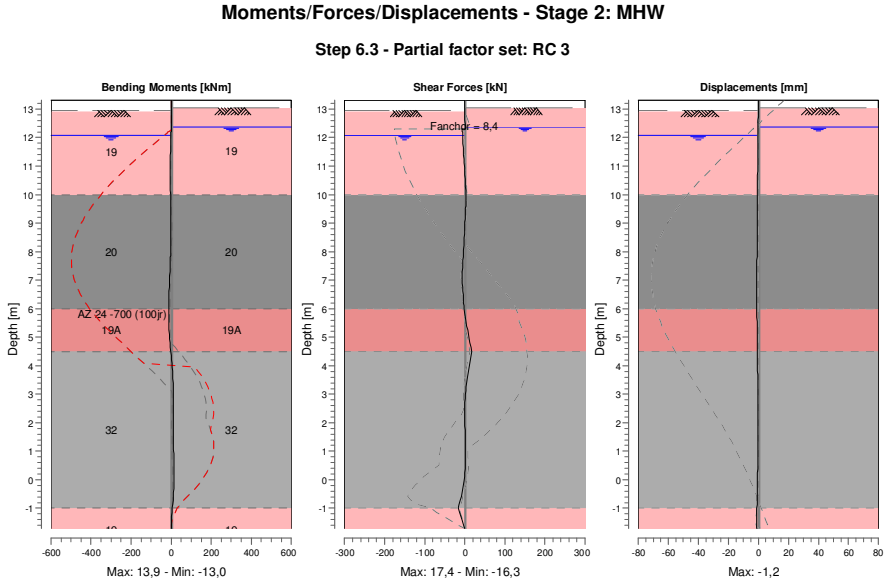
15.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	70,10
19A	56,87
32	230,44
19	58,00
32	0,00

15.7 Calculation Results

Number of iterations: 2

15.7.1 Charts of Moments, Forces and Displacements



15.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,1
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,2	0,9	-0,1
4	12,37	0,2	0,9	-0,1
4	12,32	0,3	1,0	-0,1
5	12,32	0,3	1,0	-0,1
5	12,30	0,3	1,1	-0,1
6	12,30	0,3	-6,2	-0,1
6	12,15	-0,6	-5,8	-0,2
7	12,15	-0,6	-5,8	-0,2
7	12,07	-1,0	-5,6	-0,2
8	12,07	-1,0	-5,6	-0,2
8	11,38	-3,9	-2,9	-0,4
9	11,38	-3,9	-2,9	-0,4
9	10,69	-4,8	0,3	-0,5
10	10,69	-4,8	0,3	-0,5
10	10,00	-3,6	3,3	-0,6
11	10,00	-3,6	3,3	-0,6
11	9,53	-2,3	2,1	-0,7
12	9,53	-2,3	2,1	-0,7
12	9,05	-1,7	0,6	-0,8
13	9,05	-1,7	0,6	-0,8
13	9,00	-1,6	0,4	-0,8

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	-1,6	0,4	-0,8
14	8,75	-1,6	-0,5	-0,8
15	8,75	-1,6	-0,5	-0,8
15	8,07	-2,8	-3,1	-0,9
16	8,07	-2,8	-3,1	-0,9
16	7,82	-3,7	-4,2	-0,9
17	7,82	-3,7	-4,2	-0,9
17	7,16	-7,5	-7,1	-1,0
18	7,16	-7,5	-7,1	-1,0
18	6,50	-11,2	-4,2	-1,0
19	6,50	-11,2	-4,2	-1,0
19	6,00	-12,8	-2,0	-1,0
20	6,00	-12,8	-2,0	-1,0
20	5,25	-10,9	7,3	-0,9
21	5,25	-10,9	7,3	-0,9
21	4,50	-1,8	**17,4**	-0,7
22	4,50	-1,8	**17,4**	-0,7
22	3,81	7,1	8,9	-0,5
23	3,81	7,1	8,9	-0,5
23	3,13	10,8	2,4	-0,4
24	3,13	10,8	2,4	-0,4
24	2,44	11,4	-0,1	-0,3
25	2,44	11,4	-0,1	-0,3
25	1,75	11,5	0,6	-0,3
26	1,75	11,5	0,7	-0,3
26	1,06	12,5	2,0	-0,4
27	1,06	12,5	2,0	-0,4
27	0,38	**13,8**	1,1	-0,5
28	0,38	**13,8**	1,1	-0,5
28	-0,31	12,9	-4,9	-0,7
29	-0,31	12,9	-4,9	-0,7
29	-1,00	5,7	-16,3	-0,9
30	-1,00	5,7	-16,3	-0,9
30	-1,70	0,0	0,0	**-1,2**
Max		**13,8**	**17,4**	**-1,2**
Max, minor nodes incl.		13,9	17,4	-1,2

15.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	A	
2	12,96	0,00	0,00	-		0,86	0,00	1	4
3	12,96	0,00	0,00	P		0,83	0,00	1	14
3	12,37	4,23	0,00	1	8	6,32	0,00	1	
4	12,37	4,31	0,00	1	11	6,23	0,00	1	
4	12,32	4,68	0,00	1	11	6,42	0,49	1	
5	12,32	4,69	0,00	1	11	6,39	0,49	1	
5	12,30	4,84	0,00	1	11	6,46	0,69	1	
6	12,30	4,85	0,00	1	11	6,39	0,69	1	
6	12,15	5,98	0,00	1	11	6,95	2,16	1	
7	12,15	6,00	0,00	1	12	6,85	2,16	1	
7	12,07	6,61	0,00	1	12	7,14	2,94	1	
8	12,07	5,95	0,00	1	11	6,92	2,94	1	
8	11,38	8,33	6,77	1	11	9,32	9,71	1	
9	11,38	7,56	6,77	1	12	9,10	9,71	1	
9	10,69	9,64	13,54	1	12	11,45	16,48	1	
10	10,69	10,23	13,54	1	25	11,47	16,48	1	
10	10,00	12,30	20,31	1	25	13,85	23,25	1	
11	10,00	16,01	20,31	1	12	10,68	23,25	1	
11	9,53	18,09	24,97	1	12	12,33	27,91	1	

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* [%]
12	9,53	18,18	24,97	1	23	12,30	27,91	1	
12	9,05	20,19	29,63	1	22	13,96	32,57	1	
13	9,05	20,24	29,63	1	23	13,94	32,57	1	
13	9,00	20,45	30,12	1	23	14,12	33,06	1	
14	9,00	20,48	30,12	1	23	14,11	33,06	1	
14	8,75	21,51	32,57	1	23	14,99	35,51	1	
15	8,75	21,61	32,57	1	24	14,97	35,51	1	
15	8,07	24,34	39,24	1	23	17,36	42,18	1	
16	8,07	24,46	39,24	1	24	17,34	42,18	1	
16	7,82	25,43	41,69	1	24	18,21	44,64	1	
17	7,82	25,55	41,69	1	25	18,20	44,64	1	
17	7,16	27,94	48,17	1	25	20,45	51,11	1	
18	7,16	19,14	48,17	A	19	20,45	51,11	1	
18	6,50	21,01	54,64	A	19	22,56	57,58	1	
19	6,50	21,20	54,64	A		22,58	57,58	1	
19	6,00	22,61	59,55	A		24,06	62,49	1	
20	6,00	25,19	59,55	A		33,76	62,49	1	
20	5,25	27,09	66,90	A		37,56	69,85	1	
21	5,25	28,79	66,90	1	42	38,13	69,85	1	
21	4,50	30,49	74,26	1	42	42,30	77,20	1	
22	4,50	49,44	74,26	1	24	32,18	77,20	1	
22	3,81	46,24	81,01	1	21	32,95	83,95	1	
23	3,81	46,65	81,01	1	36	32,57	83,95	1	
23	3,13	44,59	87,75	1	32	34,39	90,69	1	
24	3,13	44,69	87,75	1	33	34,88	90,69	1	
24	2,44	44,41	94,49	1	31	40,47	97,44	1	
25	2,44	44,17	94,49	1	25	40,93	97,44	1	
25	1,75	45,80	101,24	1	24	44,63	104,18	1	
26	1,75	45,53	101,24	1	24	45,06	104,18	1	
26	1,06	49,11	107,98	1	24	46,83	110,93	1	
27	1,06	48,82	107,98	1	23	47,24	110,93	1	
27	0,38	54,50	114,73	1	25	46,92	117,67	1	
28	0,38	54,14	114,73	1	24	47,30	117,67	1	
28	-0,31	62,11	121,47	1	26	46,21	124,42	1	
29	-0,31	63,57	121,47	1	26	46,12	124,42	1	
29	-1,00	73,69	128,22	1	29	52,03	131,16	1	
30	-1,00	61,44	128,22	2		81,60	131,16	1	
30	-1,70	63,46	135,08	2		84,10	138,03	1	

*

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

15.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	474,5	441,0
Water	930,0	971,0
Total	1404,6	1412,0

Considered as passive side	Left
Maximum passive effective resistance	1759,86 kN
Mobilized passive effective resistance	474,51 kN
Percentage mobilized resistance	27,0 %
Position single support	12,30 m
Maximum passive moment	14807,77 kNm
Mobilized passive moment	4311,97 kNm
Percentage mobilized moment	29,1 %

15.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-100,68
Vertical force passive	106,41
Vertical anchor force	-4,20
Resulting vertical force (no dead weight)	1,53
Vertical toe capacity Ftoe;d	125,28
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-100,68
Vertical force passive	106,41
Vertical anchor force	-4,20
Resulting vertical force (no dead weight)	1,53
Vertical toe capacity Ftoe;d	3304,80
Resultant goes up	

15.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	5,43	13,03	19	-6,45
10,00	20	28,91	10,00	20	-23,23
6,00	19A	11,48	6,00	19A	-15,60
4,50	32	49,57	4,50	32	-40,77
-1,00	19	11,03	-1,00	19	-14,63

15.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	8,41	Elastic	Right	Anchor

16 Step 6.4 Stage 2: MHW

16.1 Input Data Left

16.1.1 Calculation Method

Calculation method: C, phi, delta

16.1.2 Water Level

Water level: 12,07 [m]

16.1.3 Surface

X [m]	Y [m]
0,00	12,96
6,88	12,91
7,49	12,62
16,63	7,63
16,88	7,42
16,89	3,18

16.1.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

16.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

16.2 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	12,66	0,0	24,9	0,00	0,37	4,75
2	12,35	0,0	42,1	0,00	0,37	3,84
3	12,31	0,0	44,0	0,00	0,38	3,80
4	12,22	2,1	48,6	0,16	0,38	3,71
5	12,11	3,6	54,8	0,24	0,38	3,61
6	11,72	5,0	65,2	0,27	0,34	3,50
7	11,04	7,3	73,6	0,30	0,30	3,06
8	10,35	9,5	45,5	0,32	0,32	1,55
9	9,76	10,9	145,9	0,32	0,32	4,26
10	9,29	12,4	85,0	0,32	0,32	2,20
11	9,03	13,2	90,3	0,32	0,32	2,19
12	8,88	13,7	91,5	0,32	0,32	2,15
13	8,41	15,1	97,5	0,32	0,32	2,09
14	7,95	16,6	102,9	0,33	0,33	2,02
15	7,49	18,0	107,2	0,33	0,33	1,95
16	6,83	20,1	108,3	0,33	0,33	1,79
17	6,25	21,9	8,3	0,33	0,33	0,33
18	5,63	26,1	8,3	0,37	0,37	0,37
19	4,88	28,6	70,5	0,38	0,38	0,94
20	4,16	29,2	216,6	0,36	0,36	2,69
21	3,47	31,6	133,7	0,37	0,37	1,55
22	2,78	33,8	139,9	0,37	0,37	1,53
23	2,09	35,5	183,1	0,37	0,37	1,89
24	1,41	37,3	198,6	0,36	0,36	1,94
25	0,72	39,0	214,7	0,36	0,36	1,99
26	0,03	40,6	231,5	0,36	0,36	2,04
27	-0,66	42,1	248,9	0,35	0,37	2,09
28	-1,35	50,0	102,1	0,40	0,51	0,83

16.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	88,18
19A	42,10
32	281,43
19	43,64
32	0,00

16.4 Input Data Right

16.4.1 Calculation Method

Calculation method: C, phi, delta

16.4.2 Water Level

Water level: 12,37 [m]

16.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

16.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

16.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

16.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

16.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	25,8	206,5	0,36	0,55	2,86
20	4,88	28,5	228,0	0,36	0,56	2,92
21	4,16	28,6	270,9	0,34	0,49	3,21
22	3,47	30,4	304,4	0,33	0,49	3,34
23	2,78	32,2	335,8	0,33	0,50	3,44
24	2,09	33,8	360,4	0,32	0,50	3,46
25	1,41	35,4	382,5	0,32	0,51	3,45
26	0,72	36,9	407,5	0,31	0,51	3,47
27	0,03	38,6	433,1	0,31	0,51	3,49
28	-0,66	40,6	458,7	0,31	0,51	3,50
29	-1,35	48,9	393,6	0,36	0,63	2,87

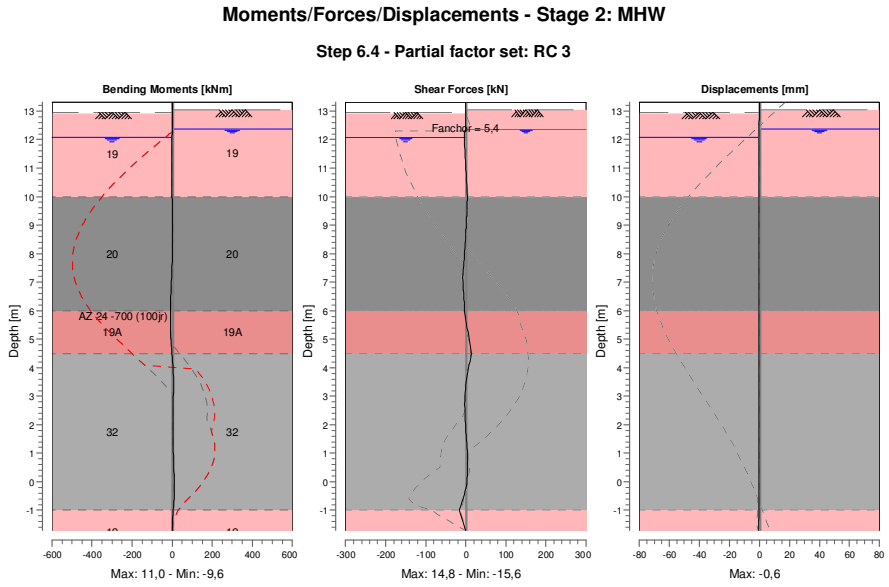
16.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	69,40
19A	55,26
32	234,96
19	57,16
32	0,00

16.7 Calculation Results

Number of iterations: 2

16.7.1 Charts of Moments, Forces and Displacements



16.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,0
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,96	0,0	0,0	0,0
3	12,96	0,0	0,0	0,0
3	12,37	0,1	0,5	-0,1
4	12,37	0,1	0,5	-0,1
4	12,32	0,1	0,5	-0,1
5	12,32	0,1	0,5	-0,1
5	12,30	0,1	0,6	-0,1
6	12,30	0,1	-4,1	-0,1
6	12,15	-0,4	-3,8	-0,1
7	12,15	-0,4	-3,8	-0,1
7	12,07	-0,7	-3,6	-0,1
8	12,07	-0,7	-3,6	-0,1
8	11,38	-2,4	-1,3	-0,2
9	11,38	-2,4	-1,3	-0,2
9	10,69	-2,4	1,5	-0,2
10	10,69	-2,4	1,5	-0,2
10	10,00	-0,4	4,3	-0,2
11	10,00	-0,4	4,3	-0,2
11	9,53	1,3	2,9	-0,2
12	9,53	1,3	2,9	-0,2
12	9,05	2,3	1,3	-0,3
13	9,05	2,3	1,3	-0,3
13	9,00	2,3	1,1	-0,3

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	2,3	1,1	-0,3
14	8,75	2,5	0,2	-0,3
15	8,75	2,5	0,2	-0,3
15	8,07	1,6	-2,8	-0,3
16	8,07	1,6	-2,8	-0,3
16	7,82	0,8	-4,0	-0,3
17	7,82	0,8	-4,0	-0,3
17	7,16	-3,1	-7,8	-0,4
18	7,16	-3,1	-7,8	-0,4
18	6,50	-7,3	-5,0	-0,4
19	6,50	-7,3	-5,0	-0,4
19	6,00	-9,3	-2,7	-0,4
20	6,00	-9,3	-2,7	-0,4
20	5,25	-8,3	5,6	-0,4
21	5,25	-8,3	5,6	-0,4
21	4,50	-0,7	14,8	-0,3
22	4,50	-0,7	14,8	-0,3
22	3,81	5,7	4,6	-0,2
23	3,81	5,7	4,6	-0,2
23	3,13	6,4	-1,7	-0,1
24	3,13	6,4	-1,7	-0,1
24	2,44	4,7	-2,4	-0,1
25	2,44	4,7	-2,4	-0,1
25	1,75	4,0	0,5	-0,1
26	1,75	4,0	0,5	-0,1
26	1,06	5,7	4,1	-0,1
27	1,06	5,7	4,1	-0,1
27	0,38	9,1	5,0	-0,2
28	0,38	9,1	5,0	-0,2
28	-0,31	**11,0**	-1,3	-0,3
29	-0,31	**11,0**	-1,4	-0,3
29	-1,00	5,4	**-15,6**	-0,4
30	-1,00	5,4	**-15,6**	-0,4
30	-1,70	0,0	0,0	**-0,6**
Max		**11,0**	**-15,6**	**-0,6**
Max, minor nodes incl.		11,0	-15,6	-0,6

16.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		0,47	0,00	1	
3	12,96	0,00	0,00	A		0,44	0,00	1	
3	12,37	4,60	0,00	1	9	5,95	0,00	1	
4	12,37	4,68	0,00	1	12	5,86	0,00	1	
4	12,32	5,05	0,00	1	12	6,05	0,49	1	
5	12,32	5,05	0,00	1	12	6,02	0,49	1	
5	12,30	5,20	0,00	1	12	6,10	0,69	1	
6	12,30	5,22	0,00	1	12	6,03	0,69	1	
6	12,15	6,34	0,00	1	12	6,59	2,16	1	
7	12,15	6,36	0,00	1	12	6,49	2,16	1	
7	12,07	6,96	0,00	1	12	6,79	2,94	1	
8	12,07	6,31	0,00	1	11	6,56	2,94	1	
8	11,38	8,64	6,77	1	12	9,02	9,71	1	
9	11,38	7,86	6,77	1	12	8,80	9,71	1	
9	10,69	9,84	13,54	1	12	11,25	16,48	1	
10	10,69	10,44	13,54	1	25	11,26	16,48	1	
10	10,00	12,38	20,31	1	25	13,78	23,25	1	
11	10,00	16,23	20,31	1	12	10,51	23,25	1	
11	9,53	18,09	24,97	1	12	12,08	27,91	1	

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* [%]
12	9,53	18,18	24,97	1	23	12,05	27,91	1	
12	9,05	20,11	29,63	1	22	13,66	32,57	1	
13	9,05	20,16	29,63	1	22	13,65	32,57	1	
13	9,00	20,37	30,12	1	22	13,82	33,06	1	
14	9,00	20,40	30,12	1	23	13,81	33,06	1	
14	8,75	21,49	32,57	1	23	14,68	35,51	1	
15	8,75	21,59	32,57	1	24	14,67	35,51	1	
15	8,07	24,75	39,24	1	24	17,08	42,18	1	
16	8,07	24,87	39,24	1	25	17,06	42,18	1	
16	7,82	26,10	41,69	1	25	17,96	44,64	1	
17	7,82	26,22	41,69	1	26	17,95	44,64	1	
17	7,16	29,45	48,17	1	26	20,32	51,11	1	
18	7,16	19,14	48,17	A	19	20,31	51,11	1	
18	6,50	21,01	54,64	A	19	22,60	57,58	1	
19	6,50	21,20	54,64	A		22,62	57,58	1	
19	6,00	22,61	59,55	A		24,21	62,49	1	
20	6,00	25,19	59,55	A		32,48	62,49	1	
20	5,25	27,09	66,90	A		36,42	69,85	1	
21	5,25	29,22	66,90	1	43	36,99	69,85	1	
21	4,50	30,74	74,26	1	42	41,68	77,20	1	
22	4,50	53,60	74,26	1	26	32,36	77,20	1	
22	3,81	47,10	81,01	1	21	32,74	83,95	1	
23	3,81	47,51	81,01	1	37	32,36	83,95	1	
23	3,13	43,61	87,75	1	32	35,38	90,69	1	
24	3,13	43,71	87,75	1	32	35,86	90,69	1	
24	2,44	42,88	94,49	1	30	42,00	97,44	1	
25	2,44	42,64	94,49	1	24	42,46	97,44	1	
25	1,75	44,18	101,24	1	23	46,25	104,18	1	
26	1,75	43,91	101,24	1	23	46,68	104,18	1	
26	1,06	47,51	107,98	1	23	48,43	110,93	1	
27	1,06	47,22	107,98	1	23	48,83	110,93	1	
27	0,38	53,70	114,73	1	24	47,72	117,67	1	
28	0,38	53,34	114,73	1	24	48,10	117,67	1	
28	-0,31	64,26	121,47	1	27	46,00	124,42	1	
29	-0,31	65,72	121,47	1	27	45,92	124,42	1	
29	-1,00	81,84	128,22	1	32	54,32	131,16	1	
30	-1,00	61,38	128,22	2		80,78	131,16	1	
30	-1,70	63,29	135,08	2		82,51	138,03	1	

*

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

16.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	477,7	441,5
Water	930,0	971,0
Total	1407,7	1412,5

Considered as passive side	Left
Maximum passive effective resistance	1759,86 kN
Mobilized passive effective resistance	477,68 kN
Percentage mobilized resistance	27,1 %
Position single support	12,30 m
Maximum passive moment	14807,77 kNm
Mobilized passive moment	4335,63 kNm
Percentage mobilized moment	29,3 %

16.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-100,38
Vertical force passive	107,20
Vertical anchor force	-2,68
Resulting vertical force (no dead weight)	4,14
Vertical toe capacity Ftoe;d	125,28
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-100,38
Vertical force passive	107,20
Vertical anchor force	-2,68
Resulting vertical force (no dead weight)	4,14
Vertical toe capacity Ftoe;d	3304,80
Resultant goes up	

16.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,96	19	5,63	13,03	19	-6,23
10,00	20	29,22	10,00	20	-23,00
6,00	19A	11,55	6,00	19A	-15,16
4,50	32	49,79	4,50	32	-41,57
-1,00	19	11,01	-1,00	19	-14,42

16.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	5,35	Elastic	Right	Anchor

17 Step 6.5 Stage 2: MHW

17.1 Input Data Left

17.1.1 Calculation Method

Calculation method: C, phi, delta

17.1.2 Water Level

Water level: 12,32 [m]

17.1.3 Surface

X [m]	Y [m]
0,00	13,03
6,88	12,98
7,49	12,69
16,63	7,70
16,88	7,49
16,89	3,25

17.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

17.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

17.2 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	12,68	0,0	39,9	0,00	0,32	6,28
2	12,31	0,0	64,8	0,00	0,32	5,07
3	12,22	0,0	67,4	0,00	0,31	5,00
4	11,79	1,9	80,8	0,11	0,25	4,76
5	11,07	4,6	83,7	0,20	0,21	3,70
6	10,36	6,6	58,5	0,23	0,23	2,08
7	9,75	9,0	144,5	0,27	0,27	4,35
8	9,25	10,4	108,0	0,27	0,27	2,85
9	8,77	11,7	114,9	0,28	0,28	2,71
10	8,30	12,9	121,6	0,28	0,28	2,61
11	7,81	14,3	128,6	0,28	0,28	2,52
12	7,29	15,7	131,7	0,28	0,28	2,37
13	6,76	17,1	132,1	0,28	0,28	2,20
14	6,25	18,5	39,2	0,29	0,29	0,61
15	5,63	20,6	39,2	0,30	0,30	0,57
16	4,88	22,7	89,6	0,31	0,31	1,21
17	4,16	23,9	241,8	0,30	0,30	3,04
18	3,47	25,8	164,2	0,30	0,30	1,93
19	2,78	27,7	181,6	0,31	0,31	2,00
20	2,09	29,9	226,2	0,31	0,31	2,35
21	1,41	31,4	246,4	0,31	0,31	2,42
22	0,72	32,9	267,6	0,31	0,31	2,50
23	0,03	34,3	289,7	0,30	0,30	2,57
24	-0,66	35,6	312,8	0,30	0,30	2,65
25	-1,35	42,4	133,3	0,34	0,44	1,08

17.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	70,81
19A	34,51
32	227,72
19	37,98
32	0,00

17.4 Input Data Right

17.4.1 Calculation Method

Calculation method: C, phi, delta

17.4.2 Water Level

Water level: 12,32 [m]

17.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

17.4.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

17.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

17.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

17.5 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	12,68	0,0	41,6	0,00	0,50	6,47
2	12,31	0,0	67,5	0,00	0,49	5,22
3	12,22	0,0	70,2	0,00	0,49	5,15
4	11,79	2,0	80,2	0,11	0,46	4,68
5	11,07	4,7	83,0	0,21	0,45	3,62
6	10,36	6,8	84,9	0,24	0,45	2,97
7	9,75	9,3	143,4	0,27	0,35	4,24
8	9,25	10,6	169,3	0,27	0,35	4,38
9	8,77	11,8	194,3	0,27	0,36	4,49
10	8,30	13,0	219,3	0,27	0,37	4,60
11	7,81	14,3	229,2	0,27	0,38	4,38
12	7,29	15,7	256,0	0,27	0,39	4,46
13	6,76	17,0	285,3	0,27	0,39	4,58
14	6,25	18,3	314,2	0,27	0,40	4,68
15	5,63	20,4	279,3	0,28	0,49	3,85
16	4,88	22,7	308,4	0,29	0,49	3,93
17	4,16	24,6	357,8	0,29	0,41	4,22
18	3,47	26,1	401,7	0,29	0,42	4,40
19	2,78	27,6	438,6	0,28	0,42	4,48
20	2,09	29,0	469,3	0,28	0,43	4,49
21	1,41	30,4	500,2	0,27	0,43	4,50
22	0,72	31,7	533,9	0,27	0,44	4,53
23	0,03	33,0	567,8	0,26	0,44	4,56
24	-0,66	34,4	601,7	0,26	0,44	4,59
25	-1,35	41,1	507,5	0,30	0,57	3,70

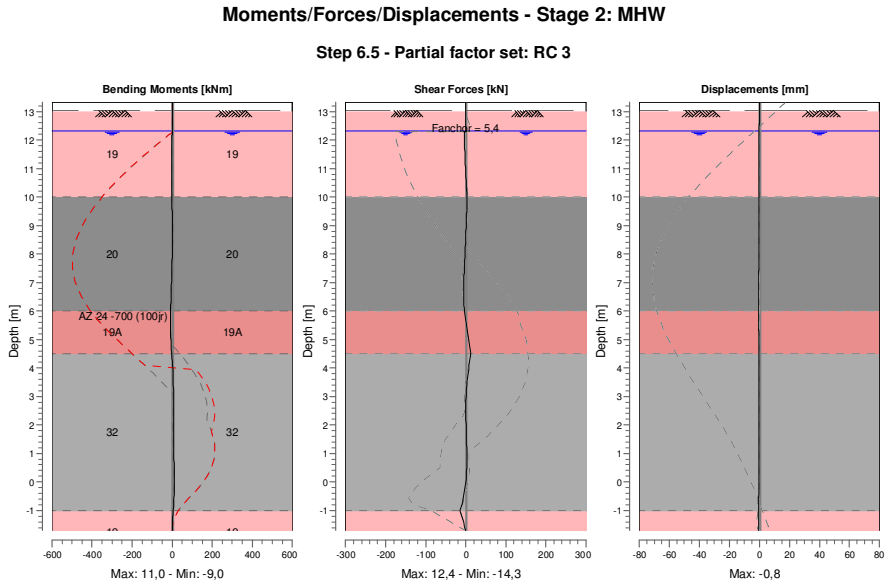
17.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	63,23
19A	51,11
32	201,09
19	52,26
32	0,00

17.7 Calculation Results

Number of iterations: 2

17.7.1 Charts of Moments, Forces and Displacements



17.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	0,0
1	13,03	0,0	0,0	0,0
2	13,03	0,0	0,0	0,0
2	12,32	0,1	0,6	-0,1
3	12,32	0,1	0,6	-0,1
3	12,30	0,2	0,6	-0,1
4	12,30	0,2	-4,1	-0,1
4	12,15	-0,4	-3,8	-0,1
5	12,15	-0,4	-3,8	-0,1
5	11,43	-2,6	-2,1	-0,2
6	11,43	-2,6	-2,1	-0,2
6	10,72	-3,1	0,6	-0,3
7	10,72	-3,1	0,6	-0,3
7	10,00	-1,8	3,4	-0,3
8	10,00	-1,8	3,4	-0,3
8	9,50	-0,3	2,3	-0,4
9	9,50	-0,3	2,3	-0,4
9	9,00	0,5	1,0	-0,4
10	9,00	0,5	1,0	-0,4
10	8,54	0,7	-0,3	-0,4
11	8,54	0,7	-0,3	-0,4
11	8,07	0,2	-1,7	-0,4
12	8,07	0,2	-1,7	-0,4
12	7,55	-1,1	-3,5	-0,5
13	7,55	-1,1	-3,5	-0,5
13	7,02	-3,5	-5,5	-0,5
14	7,02	-3,5	-5,5	-0,5
14	6,50	-6,1	-4,4	-0,5
15	6,50	-6,1	-4,4	-0,5
15	6,00	-8,2	-4,2	-0,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	6,00	-8,2	-4,2	-0,5
16	5,25	-8,3	4,4	-0,5
17	5,25	-8,3	4,4	-0,5
17	4,50	-2,1	12,4	-0,4
18	4,50	-2,1	12,4	-0,4
18	3,81	4,1	6,0	-0,3
19	3,81	4,1	6,0	-0,3
19	3,13	6,5	1,3	-0,2
20	3,13	6,5	1,3	-0,2
20	2,44	6,8	0,2	-0,2
21	2,44	6,8	0,2	-0,2
21	1,75	7,2	1,2	-0,2
22	1,75	7,2	1,2	-0,2
22	1,06	8,6	2,6	-0,2
23	1,06	8,6	2,6	-0,2
23	0,38	10,5	2,2	-0,3
24	0,38	10,5	2,2	-0,3
24	-0,31	**10,6**	-2,9	-0,4
25	-0,31	**10,6**	-2,9	-0,4
25	-1,00	5,0	-14,2	-0,6
26	-1,00	5,0	**-14,3**	-0,6
26	-1,70	0,0	0,0	**-0,8**
Max		**10,6**	**-14,3**	**-0,8**
Max, minor nodes incl.		11,0	-14,3	-0,8

17.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	A		0,00	0,00	P	
2	12,32	4,37	0,00	1	5	6,04	0,00	1	
3	12,32	4,43	0,00	1	7	5,96	0,00	1	
3	12,30	4,49	0,20	1	7	6,03	0,20	1	
4	12,30	4,31	0,20	1	7	5,95	0,20	1	
4	12,15	4,76	1,67	1	7	6,48	1,67	1	
5	12,15	4,02	1,67	1	6	6,18	1,67	1	
5	11,43	5,82	8,70	1	6	8,53	8,70	1	
6	11,43	4,94	8,70	1	7	8,25	8,70	1	
6	10,72	6,41	15,73	1	7	10,52	15,73	1	
7	10,72	7,03	15,73	1	13	10,50	15,73	1	
7	10,00	8,53	22,76	1	13	12,80	22,76	1	
8	10,00	12,25	22,76	1	9	10,20	22,76	1	
8	9,50	13,91	27,66	1	9	11,64	27,66	1	
9	9,50	13,99	27,66	1	14	11,63	27,66	1	
9	9,00	15,63	32,57	1	14	13,05	32,57	1	
10	9,00	15,71	32,57	1	14	13,04	32,57	1	
10	8,54	17,23	37,13	1	14	14,35	37,13	1	
11	8,54	17,32	37,13	1	15	14,34	37,13	1	
11	8,07	18,85	41,69	1	15	15,65	41,69	1	
12	8,07	18,96	41,69	1	15	15,65	41,69	1	
12	7,55	20,67	46,83	1	15	17,11	46,83	1	
13	7,55	20,79	46,83	1	16	17,11	46,83	1	
13	7,02	22,45	51,96	1	16	18,54	51,96	1	
14	7,02	16,51	51,96	1	13	18,54	51,96	1	
14	6,50	17,84	57,09	1	13	19,92	57,09	1	
15	6,50	19,60	57,09	2	52	19,93	57,09	1	
15	6,00	20,81	62,00	2	51	21,36	62,00	1	
16	6,00	19,87	62,00	2	53	30,56	62,00	1	
16	5,25	21,42	69,36	2	53	33,72	69,36	1	
17	5,25	24,86	69,36	1	29	34,29	69,36	1	
17	4,50	25,84	76,71	1	28	37,82	76,71	1	

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* [%]
18	4,50	38,85	76,71	1	17	28,25	76,71	1	
18	3,81	36,57	83,46	1	15	28,74	83,46	1	
19	3,81	36,79	83,46	1	23	28,39	83,46	1	
19	3,13	35,35	90,20	1	21	30,88	90,20	1	
20	3,13	35,56	90,20	1	20	31,38	90,20	1	
20	2,44	35,51	96,95	1	19	35,91	96,95	1	
21	2,44	35,96	96,95	1	16	36,39	96,95	1	
21	1,75	37,43	103,69	1	16	39,46	103,69	1	
22	1,75	37,31	103,69	1	16	39,90	103,69	1	
22	1,06	40,38	110,44	1	16	41,41	110,44	1	
23	1,06	40,11	110,44	1	15	41,82	110,44	1	
23	0,38	45,06	117,18	1	16	41,46	117,18	1	
24	0,38	44,79	117,18	1	16	41,85	117,18	1	
24	-0,31	52,01	123,92	1	18	39,25	123,92	1	
25	-0,31	51,69	123,92	1	17	39,61	123,92	1	
25	-1,00	61,12	130,67	1	19	41,42	130,67	1	
26	-1,00	53,30	130,67	1	41	73,57	130,67	1	
26	-1,70	55,23	137,54	1	41	75,74	137,54	1	

*

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

17.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	386,5	391,3
Water	964,1	964,1
Total	1350,7	1355,4

Considered as passive side	Left
Maximum passive effective resistance	2177,68 kN
Mobilized passive effective resistance	386,53 kN
Percentage mobilized resistance	17,8 %
Position single support	12,30 m
Maximum passive moment	18408,22 kNm
Mobilized passive moment	3549,64 kNm
Percentage mobilized moment	19,3 %

17.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-105,50
Vertical force passive	101,87
Vertical anchor force	-2,72
Resulting vertical force (no dead weight)	-6,35
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (6 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-105,50
Vertical force passive	101,87
Vertical anchor force	-2,72
Resulting vertical force (no dead weight)	-6,35
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (6 <= 3305)	

17.7.6 Vertical Force Balance Contribution per Layer

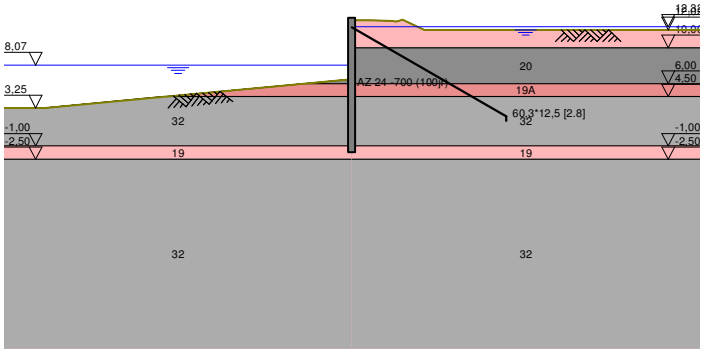
Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,03	19	4,64	13,03	19	-7,05
10,00	20	27,65	10,00	20	-24,69
6,00	19A	11,21	6,00	19A	-16,61
4,50	32	46,99	4,50	32	-41,50
-1,00	19	11,37	-1,00	19	-15,65

17.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	5,43	Elastic	Right	Anchor

18 Outline Stage 3: VAL (MHW)

Outline - Stage 3: VAL (MHW)

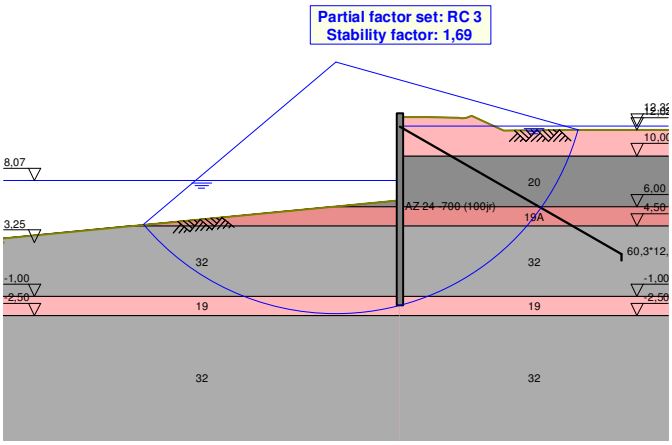


19 Overall Stability Stage 3: VAL (MHW)

Stability factor : 1,69

19.1 Overall Stability

Overall Stability - Stage 3: VAL (MHW)



20 Step 6.1 Stage 3: VAL (MHW)

20.1 Input Data Left

20.1.1 Calculation Method

Calculation method: C, phi, delta

20.1.2 Water Level

Water level: 8,07 [m]

20.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

20.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

20.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

20.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

20.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	504,08
19	18,46
32	0,00

20.4 Input Data Right

20.4.1 Calculation Method

Calculation method: C, phi, delta

20.4.2 Water Level

Water level: 12,37 [m]

20.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

20.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

20.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

20.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

20.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	29,8	243,7	0,36	0,56	2,95
20	4,88	40,5	338,5	0,37	0,57	3,08
21	4,16	42,4	431,5	0,33	0,50	3,40
22	3,47	44,3	462,0	0,33	0,50	3,46
23	2,78	46,0	493,7	0,33	0,51	3,52
24	2,09	47,6	518,4	0,32	0,51	3,53
25	1,41	49,1	540,2	0,32	0,51	3,52
26	0,72	50,6	564,9	0,32	0,51	3,53
27	0,03	52,4	590,4	0,31	0,52	3,54
28	-0,66	54,5	615,9	0,31	0,52	3,55
29	-1,35	65,6	522,5	0,37	0,63	2,91

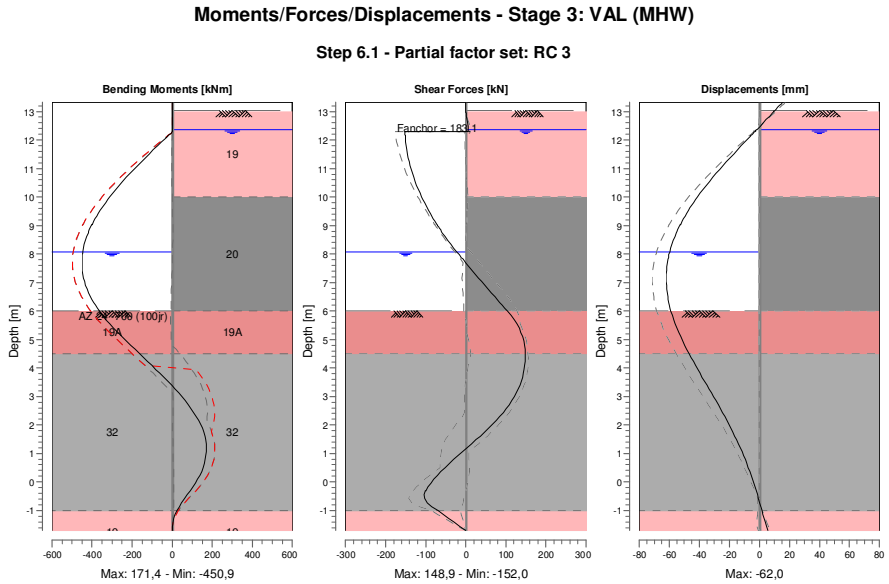
20.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	63,48
19A	52,67
32	290,06
19	86,96
32	0,00

20.7 Calculation Results

Number of iterations: 7

20.7.1 Charts of Moments, Forces and Displacements



20.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	15,4
1	13,03	0,0	0,0	10,2
2	13,03	0,0	0,0	10,2
2	12,96	0,0	0,7	8,9
3	12,96	0,0	0,8	8,9
3	12,37	2,3	6,4	-1,7
4	12,37	2,3	6,4	-1,7
4	12,32	2,6	6,5	-2,6
5	12,32	2,6	6,5	-2,6
5	12,30	2,8	6,5	-3,0
6	12,30	2,8	**-152,0**	-3,0
6	12,15	-20,0	-151,4	-5,7
7	12,15	-20,0	-151,4	-5,7
7	12,07	-32,1	-150,9	-7,2
8	12,07	-32,1	-150,9	-7,2
8	11,38	-134,0	-143,5	-19,4
9	11,38	-134,0	-143,5	-19,4
9	10,69	-228,7	-129,8	-31,0
10	10,69	-228,7	-129,8	-31,0
10	10,00	-311,7	-109,9	-41,2
11	10,00	-311,7	-109,9	-41,2
11	9,53	-359,9	-92,7	-47,3
12	9,53	-359,9	-92,7	-47,3
12	9,05	-399,3	-72,6	-52,5
13	9,05	-399,3	-72,6	-52,5
13	9,00	-402,9	-70,3	-53,0
14	9,00	-402,9	-70,3	-53,0
14	8,75	-419,0	-58,5	-55,2
15	8,75	-419,0	-58,5	-55,2
15	8,07	-446,7	-22,1	-59,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-446,7	-22,1	-59,7
16	7,82	**-450,4**	-7,5	-60,8
17	7,82	**-450,4**	-7,5	-60,8
17	7,16	-442,5	31,8	**-62,0**
18	7,16	-442,5	31,8	**-62,0**
18	6,50	-408,2	72,4	-61,0
19	6,50	-408,2	72,4	-61,0
19	6,00	-364,1	104,1	-58,9
20	6,00	-364,1	104,1	-58,9
20	5,25	-271,5	137,1	-53,7
21	5,25	-271,5	137,1	-53,7
21	4,50	-162,7	148,8	-46,8
22	4,50	-162,7	148,8	-46,8
22	3,81	-61,2	144,2	-39,5
23	3,81	-61,2	144,1	-39,5
23	3,13	32,3	125,8	-31,9
24	3,13	32,3	125,7	-31,9
24	2,44	108,4	93,6	-24,4
25	2,44	108,4	93,4	-24,4
25	1,75	157,6	47,4	-17,6
26	1,75	157,6	47,2	-17,6
26	1,06	171,1	-7,8	-11,5
27	1,06	171,1	-8,0	-11,5
27	0,38	146,8	-61,7	-6,4
28	0,38	146,8	-62,0	-6,4
28	-0,31	90,0	-99,8	-2,1
29	-0,31	90,0	-100,6	-2,1
29	-1,00	24,6	-68,8	1,7
30	-1,00	24,7	-68,3	1,7
30	-1,70	0,0	0,0	5,4
Max		**-450,4**	**-152,0**	**-62,0**
Max, minor nodes incl.		-450,9	-152,0	-62,0

20.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		15,90	0,00	2	70
3	12,96	0,00	0,00	-		5,88	0,00	3	98
3	12,37	0,00	0,00	-		1,33	0,00	1	
4	12,37	0,00	0,00	-		1,25	0,00	1	
4	12,32	0,00	0,00	-		0,64	0,49	A	
5	12,32	0,00	0,00	-		2,44	0,49	A	
5	12,30	0,00	0,00	-		2,47	0,69	A	
6	12,30	0,00	0,00	-		2,61	0,69	A	
6	12,15	0,00	0,00	-		2,87	2,16	A	
7	12,15	0,00	0,00	-		3,06	2,16	A	
7	12,07	0,00	0,00	-		3,20	2,94	A	
8	12,07	0,00	0,00	-		3,70	2,94	A	
8	11,38	0,00	0,00	-		5,14	9,71	A	
9	11,38	0,00	0,00	-		5,93	9,71	A	
9	10,69	0,00	0,00	-		7,55	16,48	A	
10	10,69	0,00	0,00	-		8,21	16,48	A	
10	10,00	0,00	0,00	-		9,95	23,25	A	
11	10,00	0,00	0,00	-		9,84	23,25	A	
11	9,53	0,00	0,00	-		11,31	27,91	A	
12	9,53	0,00	0,00	-		11,28	27,91	A	
12	9,05	0,00	0,00	-		12,74	32,57	A	
13	9,05	0,00	0,00	-		12,72	32,57	A	
13	9,00	0,00	0,00	-		12,87	33,06	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* [%]
14	9,00	0,00	0,00	-		12,87	33,06	A	
14	8,75	0,00	0,00	-		13,63	35,51	A	
15	8,75	0,00	0,00	-		13,61	35,51	A	
15	8,07	0,00	0,00	-		15,67	42,18	A	
16	8,07	0,00	0,00	-		15,65	42,18	A	
16	7,82	0,00	2,45	-		16,41	44,64	A	
17	7,82	0,00	2,45	-		16,40	44,64	A	
17	7,16	0,00	8,93	-		18,38	51,11	A	
18	7,16	0,00	8,93	-		18,38	51,11	A	
18	6,50	0,00	15,40	-		20,37	57,58	A	
19	6,50	0,00	15,40	-		20,38	57,58	A	
19	6,00	0,00	20,31	-		21,89	62,49	A	
20	6,00	0,00	20,31	P		24,87	62,49	A	
20	5,25	34,65	27,66	P		34,68	48,60	A	
21	5,25	23,43	27,66	P		35,44	48,60	A	
21	4,50	46,88	35,02	P		45,47	34,70	A	
22	4,50	38,43	35,02	P		41,33	34,70	A	
22	3,81	59,29	41,77	P		43,53	41,45	A	
23	3,81	60,08	41,77	P		43,20	41,45	A	
23	3,13	81,21	48,51	P		45,38	48,19	A	
24	3,13	81,79	48,51	P		44,94	48,19	A	
24	2,44	103,07	55,25	P		47,11	54,94	A	
25	2,44	103,52	55,25	P		46,56	54,94	A	
25	1,75	124,91	62,00	P		48,71	61,68	A	
26	1,75	125,27	62,00	P		48,06	61,68	A	
26	1,06	128,99	68,74	3	88	50,19	68,43	A	
27	1,06	129,24	68,74	3	88	49,56	68,43	A	
27	0,38	121,44	75,49	2	72	51,67	75,17	A	
28	0,38	121,68	75,49	2	72	51,37	75,17	A	
28	-0,31	91,51	82,23	1	48	53,48	81,92	A	
29	-0,31	92,01	82,23	1	48	53,46	81,92	A	
29	-1,00	21,65	88,98	A		147,95	88,66	1	24
30	-1,00	29,58	88,98	1		116,76	88,66	1	23
30	-1,70	25,85	95,84	A		131,68	95,53	1	25

*

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

20.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	561,9	514,2
Water	468,2	675,6
Total	1030,1	1189,8

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	561,88 kN
Percentage mobilized resistance	65,7 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	5915,89 kNm
Percentage mobilized moment	60,8 %

20.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-114,04
Vertical force passive	104,62
Vertical anchor force	-91,55
Resulting vertical force (no dead weight)	-100,97
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (101 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-114,04
Vertical force passive	104,62
Vertical anchor force	-91,55
Resulting vertical force (no dead weight)	-100,97
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (101 <= 3305)	

20.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-5,31
4,50	32	89,18	10,00	20	-21,04
-1,00	19	4,66	6,00	19A	-14,45
			4,50	32	-51,31
			-1,00	19	-21,94

20.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	183,11	Elastic	Right	Anchor

21 Step 6.2 Stage 3: VAL (MHW)

21.1 Input Data Left

21.1.1 Calculation Method

Calculation method: C, phi, delta

21.1.2 Water Level

Water level: 8,07 [m]

21.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

21.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

21.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

21.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

21.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	536,10
19	17,41
32	0,00

21.4 Input Data Right

21.4.1 Calculation Method

Calculation method: C, phi, delta

21.4.2 Water Level

Water level: 12,37 [m]

21.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

21.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

21.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

21.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

21.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	29,8	243,7	0,36	0,56	2,95
20	4,88	40,5	338,5	0,37	0,57	3,08
21	4,16	42,4	431,5	0,33	0,50	3,40
22	3,47	44,3	462,0	0,33	0,50	3,46
23	2,78	46,0	493,7	0,33	0,51	3,52
24	2,09	47,6	518,4	0,32	0,51	3,53
25	1,41	49,1	540,2	0,32	0,51	3,52
26	0,72	50,6	564,9	0,32	0,51	3,53
27	0,03	52,4	590,4	0,31	0,52	3,54
28	-0,66	54,5	615,9	0,31	0,52	3,55
29	-1,35	65,6	522,5	0,37	0,63	2,91

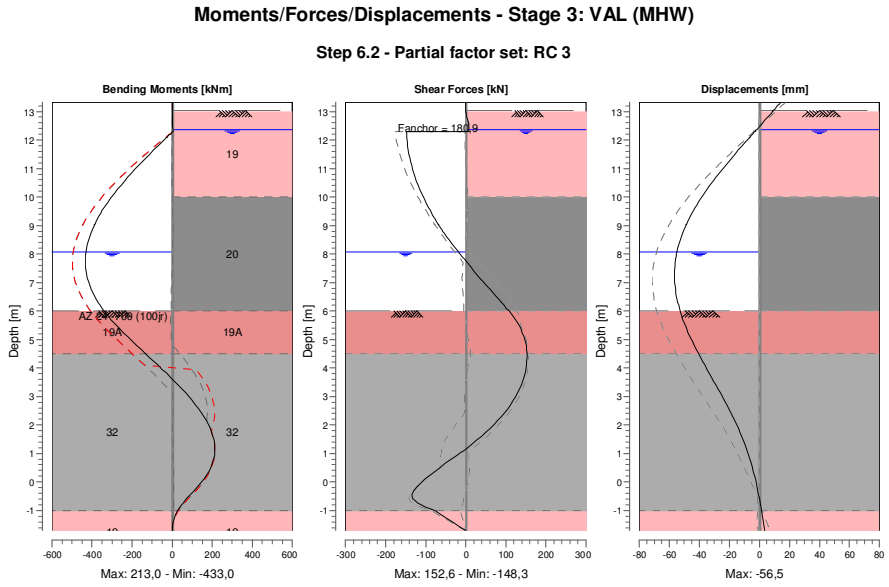
21.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	63,48
19A	52,67
32	310,26
19	94,64
32	0,00

21.7 Calculation Results

Number of iterations: 9

21.7.1 Charts of Moments, Forces and Displacements



21.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	14,2
1	13,03	0,0	0,0	9,3
2	13,03	0,0	0,0	9,3
2	12,96	0,0	0,8	8,1
3	12,96	0,0	0,9	8,1
3	12,37	3,0	8,4	-1,8
4	12,37	3,0	8,3	-1,8
4	12,32	3,4	8,3	-2,6
5	12,32	3,4	8,3	-2,6
5	12,30	3,6	8,4	-3,0
6	12,30	3,6	-148,3	-3,0
6	12,15	-18,6	-147,7	-5,5
7	12,15	-18,6	-147,7	-5,5
7	12,07	-30,4	-147,2	-6,8
8	12,07	-30,4	-147,2	-6,8
8	11,38	-129,8	-139,8	-18,2
9	11,38	-129,8	-139,8	-18,2
9	10,69	-221,9	-126,1	-28,9
10	10,69	-221,9	-126,1	-28,9
10	10,00	-302,4	-106,2	-38,3
11	10,00	-302,4	-106,2	-38,3
11	9,53	-348,8	-89,0	-43,9
12	9,53	-348,8	-89,0	-43,9
12	9,05	-386,4	-68,9	-48,6
13	9,05	-386,4	-68,9	-48,6
13	9,00	-389,8	-66,6	-49,0
14	9,00	-389,8	-66,6	-49,0
14	8,75	-405,0	-54,7	-51,0
15	8,75	-405,0	-54,7	-51,0
15	8,07	-430,2	-18,4	-54,9

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-430,2	-18,4	-54,9
16	7,82	**-433,0**	-3,8	-55,7
17	7,82	**-433,0**	-3,8	-55,7
17	7,16	-422,6	35,5	**-56,5**
18	7,16	-422,6	35,5	**-56,5**
18	6,50	-385,8	76,1	-55,1
19	6,50	-385,8	76,1	-55,1
19	6,00	-339,9	107,8	-52,7
20	6,00	-339,9	107,8	-52,7
20	5,25	-244,5	140,8	-47,4
21	5,25	-244,5	140,8	-47,4
21	4,50	-132,9	**152,5**	-40,5
22	4,50	-132,9	**152,5**	-40,5
22	3,81	-28,9	147,9	-33,3
23	3,81	-28,9	147,8	-33,3
23	3,13	67,1	129,5	-26,0
24	3,13	67,1	129,4	-26,0
24	2,44	145,8	97,3	-19,1
25	2,44	145,8	97,1	-19,1
25	1,75	197,5	51,1	-12,9
26	1,75	197,5	50,9	-12,9
26	1,06	212,7	-9,0	-7,9
27	1,06	212,7	-9,3	-7,9
27	0,38	182,7	-77,0	-4,0
28	0,38	182,7	-77,4	-4,0
28	-0,31	109,8	-129,3	-1,0
29	-0,31	109,8	-130,4	-1,0
29	-1,00	27,8	-77,4	1,3
30	-1,00	27,8	-77,0	1,3
30	-1,70	0,0	0,0	3,5
Max		**-433,0**	**152,5**	**-56,5**
Max, minor nodes incl.		-433,0	152,6	-56,5

21.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		20,31	0,00	3	90
3	12,96	0,00	0,00	-		5,99	0,00	P	
3	12,37	0,00	0,00	-		0,00	0,00	A	
4	12,37	0,00	0,00	-		0,61	0,00	A	
4	12,32	0,00	0,00	-		0,64	0,49	A	
5	12,32	0,00	0,00	-		2,44	0,49	A	
5	12,30	0,00	0,00	-		2,47	0,69	A	
6	12,30	0,00	0,00	-		2,61	0,69	A	
6	12,15	0,00	0,00	-		2,87	2,16	A	
7	12,15	0,00	0,00	-		3,06	2,16	A	
7	12,07	0,00	0,00	-		3,20	2,94	A	
8	12,07	0,00	0,00	-		3,70	2,94	A	
8	11,38	0,00	0,00	-		5,14	9,71	A	
9	11,38	0,00	0,00	-		5,93	9,71	A	
9	10,69	0,00	0,00	-		7,55	16,48	A	
10	10,69	0,00	0,00	-		8,21	16,48	A	
10	10,00	0,00	0,00	-		9,95	23,25	A	
11	10,00	0,00	0,00	-		9,84	23,25	A	
11	9,53	0,00	0,00	-		11,31	27,91	A	
12	9,53	0,00	0,00	-		11,28	27,91	A	
12	9,05	0,00	0,00	-		12,74	32,57	A	
13	9,05	0,00	0,00	-		12,72	32,57	A	
13	9,00	0,00	0,00	-		12,87	33,06	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* [%]
14	9,00	0,00	0,00	-		12,87	33,06	A	
14	8,75	0,00	0,00	-		13,63	35,51	A	
15	8,75	0,00	0,00	-		13,61	35,51	A	
15	8,07	0,00	0,00	-		15,67	42,18	A	
16	8,07	0,00	0,00	-		15,65	42,18	A	
16	7,82	0,00	2,45	-		16,41	44,64	A	
17	7,82	0,00	2,45	-		16,40	44,64	A	
17	7,16	0,00	8,93	-		18,38	51,11	A	
18	7,16	0,00	8,93	-		18,38	51,11	A	
18	6,50	0,00	15,40	-		20,37	57,58	A	
19	6,50	0,00	15,40	-		20,38	57,58	A	
19	6,00	0,00	20,31	-		21,89	62,49	A	
20	6,00	0,00	20,31	P		24,87	62,49	A	
20	5,25	34,65	27,66	P		34,68	48,60	A	
21	5,25	23,43	27,66	P		35,44	48,60	A	
21	4,50	46,88	35,02	P		45,47	34,70	A	
22	4,50	38,43	35,02	P		41,33	34,70	A	
22	3,81	59,29	41,77	P		43,53	41,45	A	
23	3,81	60,08	41,77	P		43,20	41,45	A	
23	3,13	81,21	48,51	P		45,38	48,19	A	
24	3,13	81,79	48,51	P		44,94	48,19	A	
24	2,44	103,07	55,25	P		47,11	54,94	A	
25	2,44	103,52	55,25	P		46,56	54,94	A	
25	1,75	124,91	62,00	P		48,71	61,68	A	
26	1,75	125,27	62,00	P		48,06	61,68	A	
26	1,06	146,72	68,74	P		50,19	68,43	A	
27	1,06	147,03	68,74	P		49,56	68,43	A	
27	0,38	143,86	75,49	3	85	51,67	75,17	A	
28	0,38	144,08	75,49	3	85	51,37	75,17	A	
28	-0,31	101,13	82,23	2	53	53,48	81,92	A	
29	-0,31	101,35	82,23	2	53	53,46	81,92	A	
29	-1,00	21,65	88,98	A		222,39	88,66	1	35
30	-1,00	23,89	88,98	A		123,55	88,66	1	24
30	-1,70	25,85	95,84	A		146,79	95,53	1	28

*

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

21.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	592,9	544,0
Water	468,2	675,6
Total	1061,1	1219,7

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	592,85 kN
Percentage mobilized resistance	69,3 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	6277,35 kNm
Percentage mobilized moment	64,6 %

21.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-120,05
Vertical force passive	110,02
Vertical anchor force	-90,46
Resulting vertical force (no dead weight)	-100,49
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (100 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-120,05
Vertical force passive	110,02
Vertical anchor force	-90,46
Resulting vertical force (no dead weight)	-100,49
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (100 <= 3305)	

21.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-5,80
4,50	32	94,84	10,00	20	-21,04
-1,00	19	4,39	6,00	19A	-14,45
			4,50	32	-54,89
			-1,00	19	-23,88

21.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	180,93	Elastic	Right	Anchor

22 Step 6.3 Stage 3: VAL (MHW)

22.1 Input Data Left

22.1.1 Calculation Method

Calculation method: C, phi, delta

22.1.2 Water Level

Water level: 7,82 [m]

22.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

22.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

22.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

22.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

22.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	523,61
19	18,04
32	0,00

22.4 Input Data Right

22.4.1 Calculation Method

Calculation method: C, phi, delta

22.4.2 Water Level

Water level: 12,37 [m]

22.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

22.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

22.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

22.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

22.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	29,8	243,7	0,36	0,56	2,95
20	4,88	40,5	338,5	0,37	0,57	3,08
21	4,16	42,4	431,5	0,33	0,50	3,40
22	3,47	44,3	462,0	0,33	0,50	3,46
23	2,78	46,0	493,7	0,33	0,51	3,52
24	2,09	47,6	518,4	0,32	0,51	3,53
25	1,41	49,1	540,2	0,32	0,51	3,52
26	0,72	50,6	564,9	0,32	0,51	3,53
27	0,03	52,4	590,4	0,31	0,52	3,54
28	-0,66	54,5	615,9	0,31	0,52	3,55
29	-1,35	65,6	522,5	0,37	0,63	2,91

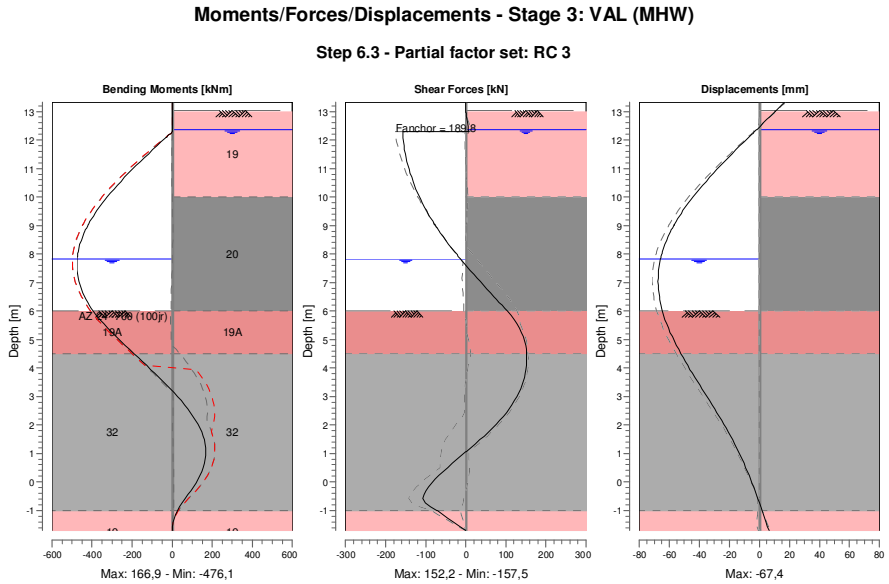
22.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	63,48
19A	52,67
32	290,14
19	87,99
32	0,00

22.7 Calculation Results

Number of iterations: 6

22.7.1 Charts of Moments, Forces and Displacements



22.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	16,7
1	13,03	0,0	0,0	11,0
2	13,03	0,0	0,0	11,0
2	12,96	0,0	0,7	9,6
3	12,96	0,0	0,8	9,6
3	12,37	2,4	6,7	-1,8
4	12,37	2,4	6,7	-1,8
4	12,32	2,7	6,8	-2,7
5	12,32	2,7	6,8	-2,7
5	12,30	2,9	6,8	-3,1
6	12,30	2,9	**-157,5**	-3,1
6	12,15	-20,7	-156,9	-6,0
7	12,15	-20,7	-156,9	-6,0
7	12,07	-33,3	-156,4	-7,6
8	12,07	-33,3	-156,4	-7,6
8	11,38	-139,0	-149,0	-20,7
9	11,38	-139,0	-149,0	-20,7
9	10,69	-237,4	-135,3	-33,1
10	10,69	-237,4	-135,3	-33,1
10	10,00	-324,2	-115,4	-44,2
11	10,00	-324,2	-115,4	-44,2
11	9,53	-375,1	-98,2	-50,8
12	9,53	-375,1	-98,2	-50,8
12	9,05	-417,1	-78,1	-56,4
13	9,05	-417,1	-78,1	-56,4
13	9,00	-420,9	-75,8	-57,0
14	9,00	-420,9	-75,8	-57,0
14	8,75	-438,4	-64,0	-59,4
15	8,75	-438,4	-64,0	-59,4
15	8,07	-469,9	-27,6	-64,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-469,9	-27,6	-64,5
16	7,82	**-474,9**	-12,7	-65,8
17	7,82	**-474,9**	-12,7	-65,8
17	7,16	-469,9	28,2	**-67,4**
18	7,16	-469,9	28,2	**-67,4**
18	6,50	-437,4	70,5	-66,6
19	6,50	-437,4	70,5	-66,6
19	6,00	-394,0	103,3	-64,5
20	6,00	-394,0	103,3	-64,5
20	5,25	-301,2	138,2	-59,3
21	5,25	-301,2	138,2	-59,3
21	4,50	-190,9	151,8	-52,2
22	4,50	-190,9	151,7	-52,2
22	3,81	-86,8	148,8	-44,5
23	3,81	-86,8	148,7	-44,5
23	3,13	10,5	132,1	-36,4
24	3,13	10,5	132,0	-36,4
24	2,44	91,5	101,6	-28,3
25	2,44	91,5	101,4	-28,3
25	1,75	146,8	57,1	-20,7
26	1,75	146,8	56,9	-20,7
26	1,06	166,9	0,8	-13,9
27	1,06	166,9	0,5	-13,9
27	0,38	147,8	-55,8	-8,0
28	0,38	147,8	-56,2	-8,0
28	-0,31	93,0	-99,0	-2,8
29	-0,31	93,1	-100,0	-2,8
29	-1,00	25,8	-72,0	1,8
30	-1,00	25,8	-71,5	1,8
30	-1,70	0,0	0,0	6,3
Max		**-474,9**	**-157,5**	**-67,4**
Max, minor nodes incl.		-476,1	-157,5	-67,4

22.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		16,52	0,00	2	73
3	12,96	0,00	0,00	-		5,99	0,00	P	
3	12,37	0,00	0,00	-		1,28	0,00	1	
4	12,37	0,00	0,00	-		1,19	0,00	1	
4	12,32	0,00	0,00	-		0,64	0,49	A	
5	12,32	0,00	0,00	-		2,44	0,49	A	
5	12,30	0,00	0,00	-		2,47	0,69	A	
6	12,30	0,00	0,00	-		2,61	0,69	A	
6	12,15	0,00	0,00	-		2,87	2,16	A	
7	12,15	0,00	0,00	-		3,06	2,16	A	
7	12,07	0,00	0,00	-		3,20	2,94	A	
8	12,07	0,00	0,00	-		3,70	2,94	A	
8	11,38	0,00	0,00	-		5,14	9,71	A	
9	11,38	0,00	0,00	-		5,93	9,71	A	
9	10,69	0,00	0,00	-		7,55	16,48	A	
10	10,69	0,00	0,00	-		8,21	16,48	A	
10	10,00	0,00	0,00	-		9,95	23,25	A	
11	10,00	0,00	0,00	-		9,84	23,25	A	
11	9,53	0,00	0,00	-		11,31	27,91	A	
12	9,53	0,00	0,00	-		11,28	27,91	A	
12	9,05	0,00	0,00	-		12,74	32,57	A	
13	9,05	0,00	0,00	-		12,72	32,57	A	
13	9,00	0,00	0,00	-		12,87	33,06	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* [%]
14	9,00	0,00	0,00	-		12,87	33,06	A	
14	8,75	0,00	0,00	-		13,63	35,51	A	
15	8,75	0,00	0,00	-		13,61	35,51	A	
15	8,07	0,00	0,00	-		15,67	42,18	A	
16	8,07	0,00	0,00	-		15,65	42,18	A	
16	7,82	0,00	0,00	-		16,41	44,64	A	
17	7,82	0,00	0,00	-		16,40	44,64	A	
17	7,16	0,00	6,47	-		18,38	51,11	A	
18	7,16	0,00	6,47	-		18,38	51,11	A	
18	6,50	0,00	12,95	-		20,37	57,58	A	
19	6,50	0,00	12,95	-		20,38	57,58	A	
19	6,00	0,00	17,85	-		21,89	62,49	A	
20	6,00	0,00	17,85	P		24,87	62,49	A	
20	5,25	34,65	25,21	P		34,68	48,60	A	
21	5,25	23,43	25,21	P		35,44	48,60	A	
21	4,50	46,88	32,57	P		45,47	34,70	A	
22	4,50	38,43	32,57	P		41,33	34,70	A	
22	3,81	59,29	39,31	P		43,53	41,45	A	
23	3,81	60,08	39,31	P		43,20	41,45	A	
23	3,13	81,21	46,06	P		45,38	48,19	A	
24	3,13	81,79	46,06	P		44,94	48,19	A	
24	2,44	103,07	52,80	P		47,11	54,94	A	
25	2,44	103,52	52,80	P		46,56	54,94	A	
25	1,75	124,91	59,55	P		48,71	61,68	A	
26	1,75	125,27	59,55	P		48,06	61,68	A	
26	1,06	134,99	66,29	3	92	50,19	68,43	A	
27	1,06	135,24	66,29	3	92	49,56	68,43	A	
27	0,38	134,26	73,04	2	80	51,67	75,17	A	
28	0,38	134,49	73,04	2	80	51,37	75,17	A	
28	-0,31	100,19	79,78	2	53	53,48	81,92	A	
29	-0,31	100,41	79,78	2	53	53,46	81,92	A	
29	-1,00	21,65	86,52	A		157,67	88,66	1	25
30	-1,00	28,75	86,52	1		117,00	88,66	1	23
30	-1,70	25,85	93,39	A		134,39	95,53	1	25

*

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

22.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	581,0	515,6
Water	444,5	675,6
Total	1025,5	1191,2

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	580,99 kN
Percentage mobilized resistance	68,0 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	6146,32 kNm
Percentage mobilized moment	63,2 %

22.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-114,39
Vertical force passive	107,97
Vertical anchor force	-94,89
Resulting vertical force (no dead weight)	-101,31
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (101 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-114,39
Vertical force passive	107,97
Vertical anchor force	-94,89
Resulting vertical force (no dead weight)	-101,31
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (101 <= 3305)	

22.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-5,38
4,50	32	92,63	10,00	20	-21,04
-1,00	19	4,55	6,00	19A	-14,45
			4,50	32	-51,33
			-1,00	19	-22,20

22.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	189,78	Elastic	Right	Anchor

23 Step 6.4 Stage 3: VAL (MHW)

23.1 Input Data Left

23.1.1 Calculation Method

Calculation method: C, phi, delta

23.1.2 Water Level

Water level: 7,82 [m]

23.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

23.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

23.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

23.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

23.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	558,99
19	17,41
32	0,00

23.4 Input Data Right

23.4.1 Calculation Method

Calculation method: C, phi, delta

23.4.2 Water Level

Water level: 12,37 [m]

23.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

23.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

23.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

23.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

23.5 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	12,99	0,0	11,4	0,00	0,58	17,06
2	12,66	0,0	29,9	0,00	0,56	4,51
3	12,35	0,6	47,0	0,05	0,55	3,87
4	12,31	2,5	47,9	0,20	0,55	3,85
5	12,22	2,7	50,1	0,21	0,54	3,82
6	12,11	3,1	53,1	0,22	0,54	3,77
7	11,72	4,4	60,4	0,26	0,52	3,51
8	11,04	6,7	68,0	0,30	0,51	2,99
9	10,35	9,1	65,6	0,32	0,51	2,33
10	9,76	10,6	119,8	0,32	0,42	3,61
11	9,29	12,0	140,1	0,32	0,43	3,71
12	9,03	12,8	151,0	0,32	0,43	3,75
13	8,88	13,2	157,4	0,32	0,43	3,77
14	8,41	14,6	178,9	0,32	0,44	3,87
15	7,95	16,0	188,0	0,32	0,45	3,71
16	7,49	17,4	203,1	0,32	0,45	3,70
17	6,83	19,4	233,3	0,32	0,46	3,81
18	6,25	21,1	260,3	0,32	0,47	3,90
19	5,63	29,8	243,7	0,36	0,56	2,95
20	4,88	40,5	338,5	0,37	0,57	3,08
21	4,16	42,4	431,5	0,33	0,50	3,40
22	3,47	44,3	462,0	0,33	0,50	3,46
23	2,78	46,0	493,7	0,33	0,51	3,52
24	2,09	47,6	518,4	0,32	0,51	3,53
25	1,41	49,1	540,2	0,32	0,51	3,52
26	0,72	50,6	564,9	0,32	0,51	3,53
27	0,03	52,4	590,4	0,31	0,52	3,54
28	-0,66	54,5	615,9	0,31	0,52	3,55
29	-1,35	65,6	522,5	0,37	0,63	2,91

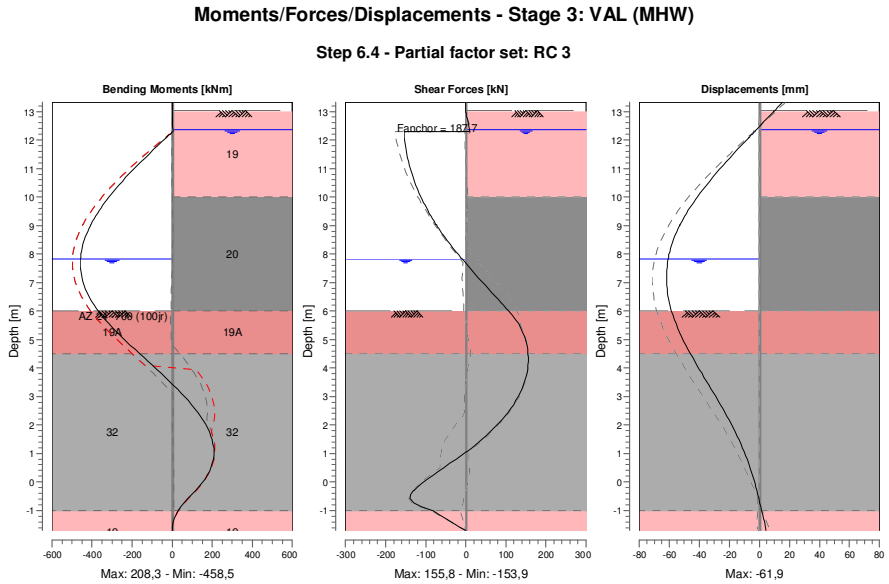
23.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	63,48
19A	52,67
32	311,64
19	98,41
32	0,00

23.7 Calculation Results

Number of iterations: 8

23.7.1 Charts of Moments, Forces and Displacements



23.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	15,4
1	13,03	0,0	0,0	10,1
2	13,03	0,0	0,0	10,1
2	12,96	0,0	0,8	8,8
3	12,96	0,0	0,9	8,8
3	12,37	3,0	8,7	-1,8
4	12,37	3,1	8,6	-1,8
4	12,32	3,5	8,6	-2,7
5	12,32	3,5	8,6	-2,7
5	12,30	3,7	8,7	-3,1
6	12,30	3,7	-153,9	-3,1
6	12,15	-19,4	-153,3	-5,8
7	12,15	-19,4	-153,3	-5,8
7	12,07	-31,6	-152,8	-7,2
8	12,07	-31,6	-152,8	-7,2
8	11,38	-134,8	-145,4	-19,5
9	11,38	-134,8	-145,4	-19,5
9	10,69	-230,8	-131,7	-31,1
10	10,69	-230,8	-131,7	-31,1
10	10,00	-315,1	-111,7	-41,4
11	10,00	-315,1	-111,7	-41,4
11	9,53	-364,2	-94,6	-47,4
12	9,53	-364,2	-94,6	-47,4
12	9,05	-404,4	-74,5	-52,6
13	9,05	-404,4	-74,5	-52,6
13	9,00	-408,1	-72,2	-53,0
14	9,00	-408,1	-72,2	-53,0
14	8,75	-424,7	-60,3	-55,3
15	8,75	-424,7	-60,3	-55,3
15	8,07	-453,7	-24,0	-59,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-453,7	-23,9	-59,7
16	7,82	**-457,8**	-9,1	-60,7
17	7,82	**-457,8**	-9,1	-60,7
17	7,16	-450,4	31,8	**-61,9**
18	7,16	-450,4	31,8	**-61,9**
18	6,50	-415,5	74,1	-60,7
19	6,50	-415,5	74,1	-60,7
19	6,00	-370,3	107,0	-58,4
20	6,00	-370,3	107,0	-58,4
20	5,25	-274,8	141,8	-53,0
21	5,25	-274,8	141,8	-53,0
21	4,50	-161,7	**155,4**	-45,9
22	4,50	-161,7	**155,4**	-45,9
22	3,81	-55,2	152,4	-38,4
23	3,81	-55,2	152,4	-38,4
23	3,13	44,6	135,7	-30,5
24	3,13	44,6	135,6	-30,5
24	2,44	128,2	105,2	-22,9
25	2,44	128,2	105,1	-22,9
25	1,75	185,9	60,8	-16,0
26	1,75	185,9	60,6	-16,0
26	1,06	208,3	2,3	-10,1
27	1,06	208,3	2,1	-10,1
27	0,38	185,9	-68,3	-5,4
28	0,38	185,9	-68,7	-5,4
28	-0,31	116,4	-129,1	-1,6
29	-0,31	116,5	-130,6	-1,6
29	-1,00	30,0	-82,8	1,5
30	-1,00	30,0	-82,5	1,5
30	-1,70	0,0	0,0	4,5
Max		**-457,8**	**155,4**	**-61,9**
Max, minor nodes incl.		-458,5	155,8	-61,9

23.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		20,71	0,00	3	91
3	12,96	0,00	0,00	-		5,99	0,00	P	
3	12,37	0,00	0,00	-		0,00	0,00	A	
4	12,37	0,00	0,00	-		0,61	0,00	A	
4	12,32	0,00	0,00	-		0,64	0,49	A	
5	12,32	0,00	0,00	-		2,44	0,49	A	
5	12,30	0,00	0,00	-		2,47	0,69	A	
6	12,30	0,00	0,00	-		2,61	0,69	A	
6	12,15	0,00	0,00	-		2,87	2,16	A	
7	12,15	0,00	0,00	-		3,06	2,16	A	
7	12,07	0,00	0,00	-		3,20	2,94	A	
8	12,07	0,00	0,00	-		3,70	2,94	A	
8	11,38	0,00	0,00	-		5,14	9,71	A	
9	11,38	0,00	0,00	-		5,93	9,71	A	
9	10,69	0,00	0,00	-		7,55	16,48	A	
10	10,69	0,00	0,00	-		8,21	16,48	A	
10	10,00	0,00	0,00	-		9,95	23,25	A	
11	10,00	0,00	0,00	-		9,84	23,25	A	
11	9,53	0,00	0,00	-		11,31	27,91	A	
12	9,53	0,00	0,00	-		11,28	27,91	A	
12	9,05	0,00	0,00	-		12,74	32,57	A	
13	9,05	0,00	0,00	-		12,72	32,57	A	
13	9,00	0,00	0,00	-		12,87	33,06	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* [%]
14	9,00	0,00	0,00	-		12,87	33,06	A	
14	8,75	0,00	0,00	-		13,63	35,51	A	
15	8,75	0,00	0,00	-		13,61	35,51	A	
15	8,07	0,00	0,00	-		15,67	42,18	A	
16	8,07	0,00	0,00	-		15,65	42,18	A	
16	7,82	0,00	0,00	-		16,41	44,64	A	
17	7,82	0,00	0,00	-		16,40	44,64	A	
17	7,16	0,00	6,47	-		18,38	51,11	A	
18	7,16	0,00	6,47	-		18,38	51,11	A	
18	6,50	0,00	12,95	-		20,37	57,58	A	
19	6,50	0,00	12,95	-		20,38	57,58	A	
19	6,00	0,00	17,85	-		21,89	62,49	A	
20	6,00	0,00	17,85	P		24,87	62,49	A	
20	5,25	34,65	25,21	P		34,68	48,60	A	
21	5,25	23,43	25,21	P		35,44	48,60	A	
21	4,50	46,88	32,57	P		45,47	34,70	A	
22	4,50	38,43	32,57	P		41,33	34,70	A	
22	3,81	59,29	39,31	P		43,53	41,45	A	
23	3,81	60,08	39,31	P		43,20	41,45	A	
23	3,13	81,21	46,06	P		45,38	48,19	A	
24	3,13	81,79	46,06	P		44,94	48,19	A	
24	2,44	103,07	52,80	P		47,11	54,94	A	
25	2,44	103,52	52,80	P		46,56	54,94	A	
25	1,75	124,91	59,55	P		48,71	61,68	A	
26	1,75	125,27	59,55	P		48,06	61,68	A	
26	1,06	146,72	66,29	P		50,19	68,43	A	
27	1,06	147,03	66,29	P		49,56	68,43	A	
27	0,38	154,52	73,04	3	92	51,67	75,17	A	
28	0,38	154,74	73,04	3	92	51,37	75,17	A	
28	-0,31	115,72	79,78	2	61	53,48	81,92	A	
29	-0,31	115,94	79,78	2	61	53,46	81,92	A	
29	-1,00	21,65	86,52	A		251,58	88,66	1	40
30	-1,00	23,89	86,52	A		125,35	88,66	1	24
30	-1,70	25,85	93,39	A		155,75	95,53	1	29

*

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

23.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	615,7	549,5
Water	444,5	675,6
Total	1060,3	1225,1

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	615,74 kN
Percentage mobilized resistance	72,0 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	6560,58 kNm
Percentage mobilized moment	67,5 %

23.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-121,32
Vertical force passive	114,07
Vertical anchor force	-93,86
Resulting vertical force (no dead weight)	-101,11
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (101 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-121,32
Vertical force passive	114,07
Vertical anchor force	-93,86
Resulting vertical force (no dead weight)	-101,11
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (101 <= 3305)	

23.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-5,87
4,50	32	98,89	10,00	20	-21,04
-1,00	19	4,39	6,00	19A	-14,45
			4,50	32	-55,13
			-1,00	19	-24,83

23.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	187,71	Elastic	Right	Anchor

24 Step 6.5 Stage 3: VAL (MHW)

24.1 Input Data Left

24.1.1 Calculation Method

Calculation method: C, phi, delta

24.1.2 Water Level

Water level: 8,07 [m]

24.1.3 Surface

X [m]	Y [m]
0,00	6,50
34,38	3,25

24.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

24.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

24.2 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	6,25	0,6	11,1	0,27	0,27	4,65
2	5,63	-0,4	46,1	0,00	0,24	5,90
3	4,88	1,2	68,5	0,08	0,31	4,93
4	4,16	5,5	79,8	0,27	0,27	3,95
5	3,47	7,3	106,7	0,27	0,30	3,98
6	2,78	9,1	134,6	0,27	0,32	4,03
7	2,09	10,9	162,7	0,27	0,34	4,06
8	1,41	12,7	190,7	0,27	0,35	4,09
9	0,72	14,5	218,7	0,27	0,37	4,11
10	0,03	16,3	246,7	0,27	0,37	4,12
11	-0,66	18,1	274,8	0,27	0,38	4,13
12	-1,35	21,4	239,8	0,30	0,51	3,31

24.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	5,54
19A	75,92
32	401,85
19	26,61
32	0,00

24.4 Input Data Right

24.4.1 Calculation Method

Calculation method: C, phi, delta

24.4.2 Water Level

Water level: 12,32 [m]

24.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

24.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

24.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

24.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

24.5 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	12,68	0,0	41,6	0,00	0,50	6,47
2	12,31	0,0	67,5	0,00	0,49	5,22
3	12,22	0,0	70,2	0,00	0,49	5,15
4	11,79	2,0	80,2	0,11	0,46	4,68
5	11,07	4,7	83,0	0,21	0,45	3,62
6	10,36	6,8	84,9	0,24	0,45	2,97
7	9,75	9,3	143,4	0,27	0,35	4,24
8	9,25	10,6	169,3	0,27	0,35	4,38
9	8,77	11,8	194,3	0,27	0,36	4,49
10	8,30	13,0	219,3	0,27	0,37	4,60
11	7,81	14,3	229,2	0,27	0,38	4,38
12	7,29	15,7	256,0	0,27	0,39	4,46
13	6,76	17,0	285,3	0,27	0,39	4,58
14	6,25	18,3	314,2	0,27	0,40	4,68
15	5,63	23,8	327,9	0,29	0,49	3,94
16	4,88	32,8	453,6	0,30	0,51	4,11
17	4,16	36,0	567,3	0,28	0,43	4,46
18	3,47	37,6	609,3	0,28	0,43	4,55
19	2,78	39,1	646,3	0,28	0,44	4,60
20	2,09	40,5	677,1	0,28	0,44	4,60
21	1,41	41,8	707,5	0,27	0,44	4,60
22	0,72	43,1	741,1	0,27	0,44	4,62
23	0,03	44,3	774,9	0,27	0,45	4,64
24	-0,66	45,7	808,8	0,26	0,45	4,66
25	-1,35	55,3	673,4	0,31	0,57	3,75

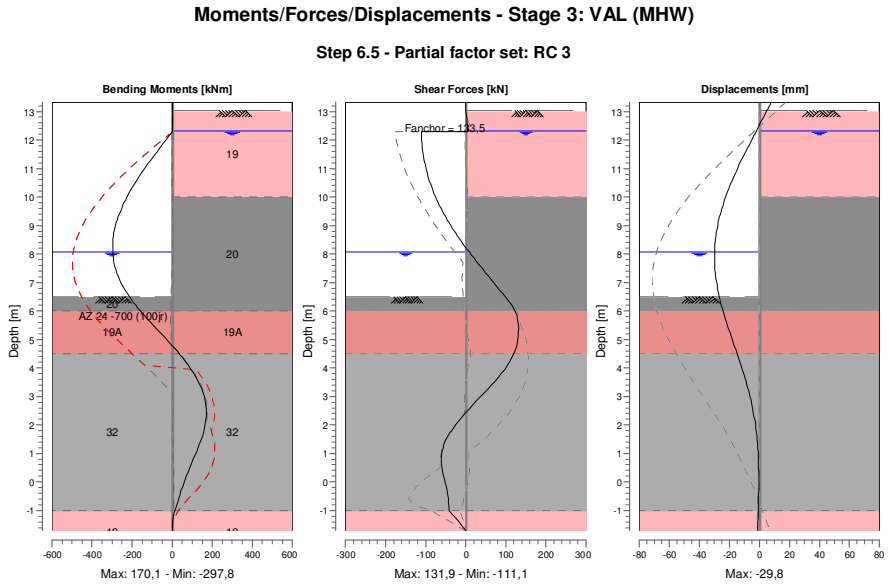
24.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	55,20
19A	42,45
32	244,55
19	68,97
32	0,00

24.7 Calculation Results

Number of iterations: 6

24.7.1 Charts of Moments, Forces and Displacements



24.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	7,9
1	13,03	0,0	0,0	5,0
2	13,03	0,0	0,1	5,0
2	12,32	1,9	4,6	-2,0
3	12,32	1,9	4,5	-2,0
3	12,30	2,0	4,5	-2,2
4	12,30	2,0	-111,1	-2,2
4	12,15	-14,6	-111,0	-3,7
5	12,15	-14,6	-111,0	-3,7
5	11,43	-92,7	-105,9	-10,6
6	11,43	-92,7	-105,9	-10,6
6	10,72	-164,6	-93,8	-17,1
7	10,72	-164,6	-93,8	-17,1
7	10,00	-225,5	-75,1	-22,5
8	10,00	-225,5	-75,1	-22,5
8	9,50	-258,8	-57,9	-25,5
9	9,50	-258,8	-57,9	-25,5
9	9,00	-282,8	-37,6	-27,8
10	9,00	-282,8	-37,6	-27,8
10	8,54	-295,4	-15,9	-29,2
11	8,54	-295,4	-15,9	-29,2
11	8,07	**-297,2**	8,5	**-29,8**
12	8,07	**-297,2**	8,5	**-29,8**
12	7,55	-285,1	37,8	-29,6
13	7,55	-285,1	37,8	-29,6
13	7,02	-257,5	67,8	-28,5
14	7,02	-257,5	67,8	-28,5
14	6,50	-214,0	98,6	-26,6
15	6,50	-214,0	98,6	-26,6
15	6,00	-158,1	123,0	-24,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	6,00	-158,1	123,0	-24,2
16	5,25	-60,8	**131,3**	-19,7
17	5,25	-60,8	**131,3**	-19,7
17	4,50	34,8	120,2	-14,8
18	4,50	34,8	120,2	-14,8
18	3,81	107,9	89,5	-10,5
19	3,81	107,9	89,4	-10,5
19	3,13	154,6	45,9	-6,8
20	3,13	154,6	45,9	-6,8
20	2,44	170,1	-0,2	-3,9
21	2,44	170,1	-0,2	-3,9
21	1,75	156,5	-37,9	-2,0
22	1,75	156,5	-38,0	-2,0
22	1,06	121,6	-58,9	-0,9
23	1,06	121,6	-58,9	-0,9
23	0,38	80,3	-57,8	-0,5
24	0,38	80,3	-57,8	-0,5
24	-0,31	44,4	-46,7	-0,5
25	-0,31	44,4	-46,6	-0,5
25	-1,00	14,6	-41,8	-0,7
26	-1,00	14,6	-41,8	-0,7
26	-1,70	0,0	0,0	-1,1
Max		**-297,2**	**131,3**	**-29,8**
Max, minor nodes incl.		-297,8	131,9	-29,8

24.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,32	0,00	0,00	-		0,00	0,00	A	
3	12,32	0,00	0,00	-		0,00	0,00	A	
3	12,30	0,00	0,00	-		0,00	0,20	A	
4	12,30	0,00	0,00	-		0,00	0,20	A	
4	12,15	0,00	0,00	-		0,00	1,67	A	
5	12,15	0,00	0,00	-		1,62	1,67	A	
5	11,43	0,00	0,00	-		2,28	8,70	A	
6	11,43	0,00	0,00	-		4,11	8,70	A	
6	10,72	0,00	0,00	-		5,28	15,73	A	
7	10,72	0,00	0,00	-		6,09	15,73	A	
7	10,00	0,00	0,00	-		7,41	22,76	A	
8	10,00	0,00	0,00	-		8,59	22,76	A	
8	9,50	0,00	0,00	-		9,91	27,66	A	
9	9,50	0,00	0,00	-		9,90	27,66	A	
9	9,00	0,00	0,00	-		11,22	32,57	A	
10	9,00	0,00	0,00	-		11,21	32,57	A	
10	8,54	0,00	0,00	-		12,42	37,13	A	
11	8,54	0,00	0,00	-		12,42	37,13	A	
11	8,07	0,00	0,00	-		13,63	41,69	A	
12	8,07	0,00	0,00	-		13,62	41,69	A	
12	7,55	0,00	5,13	-		14,98	46,83	A	
13	7,55	0,00	5,13	-		14,98	46,83	A	
13	7,02	0,00	10,27	-		16,33	51,96	A	
14	7,02	0,00	10,27	-		16,33	51,96	A	
14	6,50	0,00	15,40	-		17,68	57,09	A	
15	6,50	0,00	15,40	P		17,69	57,09	A	
15	6,00	22,22	20,31	P		18,99	62,00	A	
16	6,00	28,23	20,31	P		19,86	62,00	A	
16	5,25	55,77	27,66	3	87	27,65	48,11	A	
17	5,25	49,18	27,66	3	92	28,79	48,11	A	
17	4,50	64,18	35,02	2	77	36,90	34,21	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* [%]
18	4,50	66,80	35,02	P		35,06	34,21	A	
18	3,81	92,85	41,77	P		36,91	40,96	A	
19	3,81	93,57	41,77	P		36,67	40,96	A	
19	3,13	103,39	48,51	3	86	38,52	47,70	A	
20	3,13	104,44	48,51	3	86	38,18	47,70	A	
20	2,44	100,10	55,25	2	68	40,01	54,45	A	
21	2,44	100,74	55,25	2	68	39,59	54,45	A	
21	1,75	89,83	62,00	2	51	41,42	61,19	A	
22	1,75	90,38	62,00	2	51	40,92	61,19	A	
22	1,06	53,45	68,74	1	26	42,73	67,94	A	
23	1,06	54,03	68,74	1	26	42,17	67,94	A	
23	0,38	39,03	75,49	1	17	54,13	74,68	1	
24	0,38	39,57	75,49	1	17	54,48	74,68	1	
24	-0,31	42,42	82,23	1	16	57,09	81,42	1	
25	-0,31	42,94	82,23	1	16	57,41	81,42	1	
25	-1,00	55,74	88,98	1	19	56,77	88,17	1	
26	-1,00	36,36	88,98	1	16	97,67	88,17	1	
26	-1,70	39,66	95,84	1	16	99,36	95,04	1	

*

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

24.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	509,9	425,3
Water	468,2	668,8
Total	978,1	1094,0

Considered as passive side	Left
Maximum passive effective resistance	1232,01 kN
Mobilized passive effective resistance	509,91 kN
Percentage mobilized resistance	41,4 %
Position single support	12,30 m
Maximum passive moment	13765,14 kNm
Mobilized passive moment	5006,27 kNm
Percentage mobilized moment	36,4 %

24.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-110,69
Vertical force passive	117,72
Vertical anchor force	-66,77
Resulting vertical force (no dead weight)	-59,74
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (60 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-110,69
Vertical force passive	117,72
Vertical anchor force	-66,77
Resulting vertical force (no dead weight)	-59,74
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (60 <= 3305)	

24.7.6 Vertical Force Balance Contribution per Layer

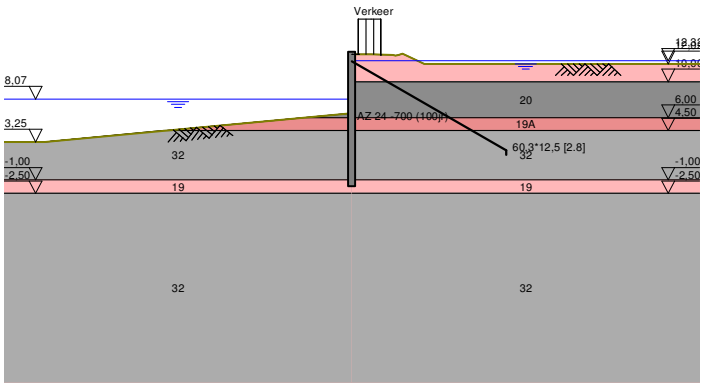
Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,50	20	2,16	13,03	19	-4,22
6,00	19A	24,67	10,00	20	-21,56
4,50	32	82,93	6,00	19A	-13,79
-1,00	19	7,97	4,50	32	-50,47
			-1,00	19	-20,65

24.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	133,53	Elastic	Right	Anchor

25 Outline Stage 4: VAL (MHW) (Verkeer)

Outline - Stage 4: VAL (MHW) (Verkeer)

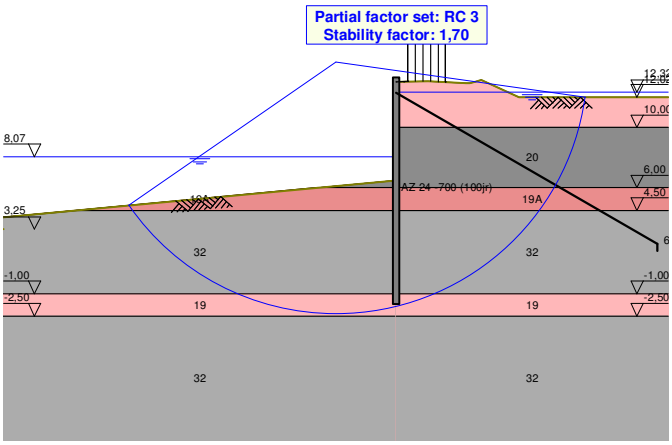


26 Overall Stability Stage 4: VAL (MHW) (Verkeer)

Stability factor : 1,70

26.1 Overall Stability

Overall Stability - Stage 4: VAL (MHW) (Verkeer)



27 Step 6.1 Stage 4: VAL (MHW) (Verkeer)

27.1 Input Data Left

27.1.1 Calculation Method

Calculation method: C, phi, delta

27.1.2 Water Level

Water level: 8,07 [m]

27.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

27.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

27.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

27.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

27.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	511,15
19	18,12
32	0,00

27.4 Input Data Right

27.4.1 Calculation Method

Calculation method: C, phi, delta

27.4.2 Water Level

Water level: 12,37 [m]

27.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

27.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

27.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

27.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

27.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	0,00
	0,75	0,00
	0,75	16,66
	3,25	16,66
	3,25	0,00

27.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,99	0,0	11,4	0,00	2,01	17,02
2	12,66	0,0	42,5	0,00	1,38	5,81
3	12,35	3,7	139,7	0,25	1,02	9,49
4	12,31	7,0	137,1	0,46	1,00	8,99
5	12,22	7,7	118,8	0,46	0,94	7,19
6	12,11	8,4	112,7	0,46	0,88	6,19
7	11,72	10,4	68,5	0,44	0,70	2,93
8	11,04	13,2	59,3	0,42	0,55	1,91
9	10,35	15,5	71,5	0,42	0,49	1,93
10	9,76	16,8	142,0	0,40	0,40	3,38
11	9,29	18,2	161,2	0,39	0,39	3,47
12	9,03	17,5	156,5	0,36	0,39	3,20
13	8,88	17,7	162,5	0,35	0,39	3,24
14	8,41	17,9	179,9	0,33	0,40	3,31
15	7,95	18,0	187,3	0,31	0,41	3,21
16	7,49	18,1	206,6	0,29	0,42	3,31
17	6,83	18,2	236,3	0,27	0,43	3,47
18	6,25	18,9	262,9	0,26	0,44	3,59
19	5,63	26,4	233,3	0,30	0,53	2,62
20	4,88	38,2	333,5	0,33	0,55	2,88
21	4,16	44,4	438,2	0,34	0,48	3,31
22	3,47	45,9	469,5	0,33	0,49	3,39
23	2,78	47,1	495,7	0,32	0,49	3,42
24	2,09	48,6	519,6	0,32	0,50	3,44
25	1,41	50,1	541,3	0,32	0,50	3,43
26	0,72	51,4	566,0	0,31	0,50	3,45
27	0,03	52,1	591,3	0,31	0,51	3,47
28	-0,66	53,9	616,8	0,30	0,51	3,48
29	-1,35	65,0	516,5	0,36	0,62	2,82

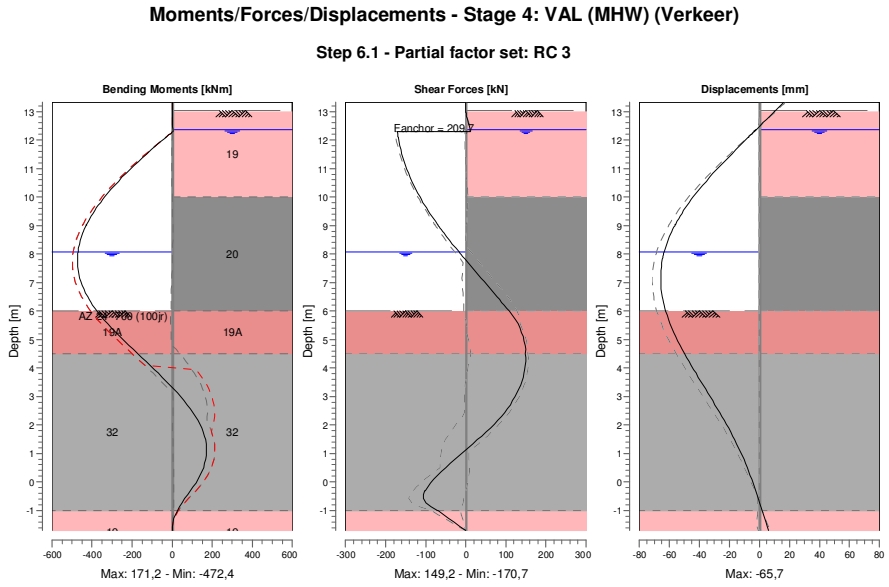
27.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	71,97
19A	48,49
32	295,84
19	87,91
32	0,00

27.7 Calculation Results

Number of iterations: 5

27.7.1 Charts of Moments, Forces and Displacements



27.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	16,2
1	13,03	0,0	0,0	10,6
2	13,03	0,0	0,0	10,6
2	12,96	0,0	0,8	9,2
3	12,96	0,0	0,8	9,2
3	12,37	3,1	10,2	-2,1
4	12,37	3,1	10,3	-2,1
4	12,32	3,7	10,7	-3,1
5	12,32	3,7	10,7	-3,1
5	12,30	3,9	10,9	-3,4
6	12,30	3,9	**-170,7**	-3,4
6	12,15	-21,6	-169,1	-6,3
7	12,15	-21,6	-169,1	-6,3
7	12,07	-35,1	-168,1	-7,9
8	12,07	-35,1	-168,1	-7,9
8	11,38	-147,5	-156,6	-20,9
9	11,38	-147,5	-156,6	-20,9
9	10,69	-249,7	-138,5	-33,1
10	10,69	-249,7	-138,5	-33,1
10	10,00	-337,2	-114,1	-44,0
11	10,00	-337,2	-114,1	-44,0
11	9,53	-386,8	-94,0	-50,4
12	9,53	-386,8	-94,0	-50,4
12	9,05	-426,1	-71,0	-55,8
13	9,05	-426,1	-71,0	-55,8
13	9,00	-429,6	-68,5	-56,3
14	9,00	-429,6	-68,5	-56,3
14	8,75	-445,1	-55,5	-58,7
15	8,75	-445,1	-55,5	-58,7
15	8,07	-470,0	-16,9	-63,4

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-470,0	-16,9	-63,4
16	7,82	**-472,4**	-1,9	-64,4
17	7,82	**-472,4**	-1,9	-64,4
17	7,16	-460,6	37,9	**-65,7**
18	7,16	-460,6	37,9	**-65,7**
18	6,50	-422,5	77,8	-64,6
19	6,50	-422,5	77,8	-64,6
19	6,00	-376,0	108,3	-62,4
20	6,00	-376,0	108,3	-62,4
20	5,25	-281,0	138,8	-57,0
21	5,25	-281,0	138,8	-57,0
21	4,50	-171,5	148,9	-49,8
22	4,50	-171,5	148,9	-49,8
22	3,81	-69,5	145,6	-42,2
23	3,81	-69,5	145,5	-42,2
23	3,13	25,4	128,3	-34,2
24	3,13	25,4	128,2	-34,2
24	2,44	103,5	96,8	-26,4
25	2,44	103,5	96,7	-26,4
25	1,75	155,2	51,4	-19,1
26	1,75	155,2	51,1	-19,1
26	1,06	171,2	-4,7	-12,6
27	1,06	171,2	-4,9	-12,6
27	0,38	148,7	-60,1	-7,1
28	0,38	148,7	-60,4	-7,1
28	-0,31	91,8	-101,1	-2,3
29	-0,31	91,9	-102,0	-2,3
29	-1,00	25,1	-70,1	1,9
30	-1,00	25,1	-69,6	1,9
30	-1,70	0,0	0,0	6,0
Max		**-472,4**	**-170,7**	**-65,7**
Max, minor nodes incl.		-472,4	-170,7	-65,7

27.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		18,07	0,00	2	79
3	12,96	0,00	0,00	-		7,04	0,00	3	91
3	12,37	0,00	0,00	-		13,42	0,00	1	
4	12,37	0,00	0,00	-		8,21	0,00	1	
4	12,32	0,00	0,00	-		7,96	0,49	1	
5	12,32	0,00	0,00	-		9,45	0,49	1	
5	12,30	0,00	0,00	-		9,62	0,69	1	
6	12,30	0,00	0,00	-		8,99	0,69	1	
6	12,15	0,00	0,00	-		10,15	2,16	1	
7	12,15	0,00	0,00	-		9,22	2,16	1	
7	12,07	0,00	0,00	-		9,74	2,94	1	
8	12,07	0,00	0,00	-		8,33	2,94	A	
8	11,38	0,00	0,00	-		12,17	9,71	A	
9	11,38	0,00	0,00	-		11,67	9,71	A	
9	10,69	0,00	0,00	-		14,52	16,48	A	
10	10,69	0,00	0,00	-		14,25	16,48	A	
10	10,00	0,00	0,00	-		16,59	23,25	A	
11	10,00	0,00	0,00	-		15,89	23,25	A	12
11	9,53	0,00	0,00	-		17,68	27,91	A	12
12	9,53	0,00	0,00	-		17,31	27,91	A	
12	9,05	0,00	0,00	-		19,00	32,57	A	
13	9,05	0,00	0,00	-		17,46	32,57	A	
13	9,00	0,00	0,00	-		17,62	33,06	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* [%]
14	9,00	0,00	0,00	-		17,31	33,06	A	
14	8,75	0,00	0,00	-		18,10	35,51	A	
15	8,75	0,00	0,00	-		16,88	35,51	A	
15	8,07	0,00	0,00	-		18,85	42,18	A	
16	8,07	0,00	0,00	-		17,65	42,18	A	
16	7,82	0,00	2,45	-		18,33	44,64	A	
17	7,82	0,00	2,45	-		17,25	44,64	A	
17	7,16	0,00	8,93	-		18,93	51,11	A	
18	7,16	0,00	8,93	-		17,44	51,11	A	
18	6,50	0,00	15,40	-		18,99	57,58	A	
19	6,50	0,00	15,40	-		18,36	57,58	A	
19	6,00	0,00	20,31	-		19,50	62,49	A	
20	6,00	0,00	20,31	P		22,44	62,49	A	
20	5,25	34,65	27,66	P		30,41	48,60	A	
21	5,25	23,43	27,66	P		33,79	48,60	A	
21	4,50	46,88	35,02	P		42,67	34,70	A	
22	4,50	38,43	35,02	P		43,40	34,70	A	
22	3,81	59,29	41,77	P		45,50	41,45	A	
23	3,81	60,08	41,77	P		44,85	41,45	A	
23	3,13	81,21	48,51	P		46,94	48,19	A	
24	3,13	81,79	48,51	P		46,04	48,19	A	
24	2,44	103,07	55,25	P		48,10	54,94	A	
25	2,44	103,52	55,25	P		47,60	54,94	A	
25	1,75	124,91	62,00	P		49,66	61,68	A	
26	1,75	125,27	62,00	P		49,08	61,68	A	
26	1,06	131,74	68,74	3	90	51,12	68,43	A	
27	1,06	131,99	68,74	3	90	50,43	68,43	A	
27	0,38	126,78	75,49	2	75	52,46	75,17	A	
28	0,38	127,02	75,49	2	75	51,14	75,17	A	
28	-0,31	95,93	82,23	2	50	53,13	81,92	A	
29	-0,31	96,15	82,23	2	50	52,86	81,92	A	
29	-1,00	21,65	88,98	A		154,33	88,66	1	25
30	-1,00	28,94	88,98	1		117,55	88,66	1	23
30	-1,70	25,85	95,84	A		133,60	95,53	1	25

*

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

27.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	568,6	544,0
Water	468,2	675,6
Total	1036,8	1219,7

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	568,62 kN
Percentage mobilized resistance	66,5 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	5995,13 kNm
Percentage mobilized moment	61,7 %

27.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-121,71
Vertical force passive	105,79
Vertical anchor force	-104,85
Resulting vertical force (no dead weight)	-120,77
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (121 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-121,71
Vertical force passive	105,79
Vertical anchor force	-104,85
Resulting vertical force (no dead weight)	-120,77
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (121 <= 3305)	

27.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-10,04
4,50	32	90,43	10,00	20	-23,85
-1,00	19	4,57	6,00	19A	-13,30
			4,50	32	-52,34
			-1,00	19	-22,18

27.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	209,69	Elastic	Right	Anchor

28 Step 6.2 Stage 4: VAL (MHW) (Verkeer)

28.1 Input Data Left

28.1.1 Calculation Method

Calculation method: C, phi, delta

28.1.2 Water Level

Water level: 8,07 [m]

28.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

28.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

28.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

28.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

28.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	545,54
19	17,41
32	0,00

28.4 Input Data Right

28.4.1 Calculation Method

Calculation method: C, phi, delta

28.4.2 Water Level

Water level: 12,37 [m]

28.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

28.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

28.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

28.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

28.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	0,00
	0,75	0,00
	0,75	16,66
	3,25	16,66
	3,25	0,00

28.5 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	12,99	0,0	11,4	0,00	2,01	17,02
2	12,66	0,0	42,5	0,00	1,38	5,81
3	12,35	3,7	139,7	0,25	1,02	9,49
4	12,31	7,0	137,1	0,46	1,00	8,99
5	12,22	7,7	118,8	0,46	0,94	7,19
6	12,11	8,4	112,7	0,46	0,88	6,19
7	11,72	10,4	68,5	0,44	0,70	2,93
8	11,04	13,2	59,3	0,42	0,55	1,91
9	10,35	15,5	71,5	0,42	0,49	1,93
10	9,76	16,8	142,0	0,40	0,40	3,38
11	9,29	18,2	161,2	0,39	0,39	3,47
12	9,03	17,5	156,5	0,36	0,39	3,20
13	8,88	17,7	162,5	0,35	0,39	3,24
14	8,41	17,9	179,9	0,33	0,40	3,31
15	7,95	18,0	187,3	0,31	0,41	3,21
16	7,49	18,1	206,6	0,29	0,42	3,31
17	6,83	18,2	236,3	0,27	0,43	3,47
18	6,25	18,9	262,9	0,26	0,44	3,59
19	5,63	26,4	233,3	0,30	0,53	2,62
20	4,88	38,2	333,5	0,33	0,55	2,88
21	4,16	44,4	438,2	0,34	0,48	3,31
22	3,47	45,9	469,5	0,33	0,49	3,39
23	2,78	47,1	495,7	0,32	0,49	3,42
24	2,09	48,6	519,6	0,32	0,50	3,44
25	1,41	50,1	541,3	0,32	0,50	3,43
26	0,72	51,4	566,0	0,31	0,50	3,45
27	0,03	52,1	591,3	0,31	0,51	3,47
28	-0,66	53,9	616,8	0,30	0,51	3,48
29	-1,35	65,0	516,5	0,36	0,62	2,82

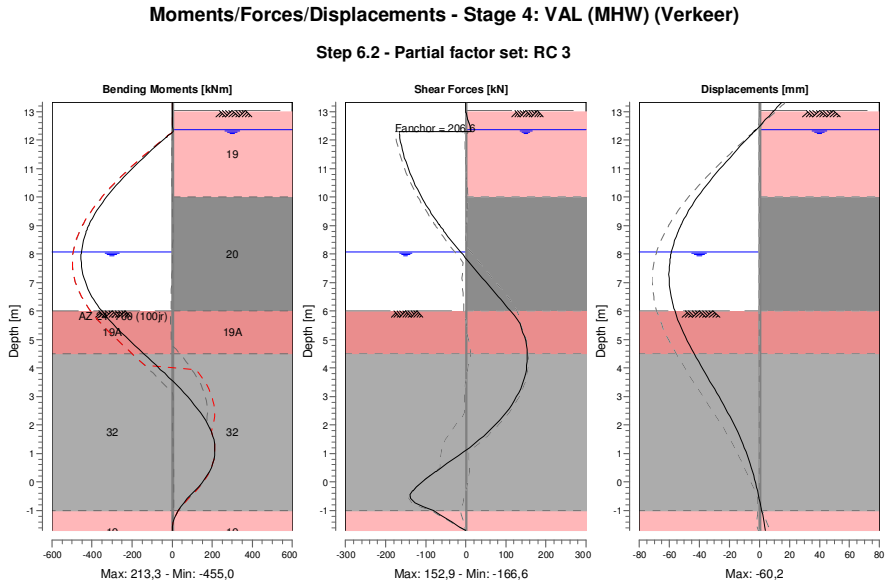
28.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	71,97
19A	48,49
32	317,33
19	97,12
32	0,00

28.7 Calculation Results

Number of iterations: 5

28.7.1 Charts of Moments, Forces and Displacements



28.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	14,9
1	13,03	0,0	0,0	9,7
2	13,03	0,0	0,0	9,7
2	12,96	0,0	0,8	8,4
3	12,96	0,0	0,9	8,4
3	12,37	3,8	12,0	-2,1
4	12,37	3,8	11,9	-2,1
4	12,32	4,4	12,2	-3,0
5	12,32	4,4	12,2	-3,0
5	12,30	4,6	12,3	-3,4
6	12,30	4,6	**-166,6**	-3,4
6	12,15	-20,3	-165,3	-6,1
7	12,15	-20,3	-165,3	-6,1
7	12,07	-33,4	-164,4	-7,5
8	12,07	-33,4	-164,4	-7,5
8	11,38	-143,3	-152,9	-19,7
9	11,38	-143,3	-152,9	-19,7
9	10,69	-242,9	-134,8	-31,1
10	10,69	-242,9	-134,8	-31,1
10	10,00	-327,9	-110,4	-41,1
11	10,00	-327,9	-110,4	-41,1
11	9,53	-375,7	-90,3	-47,0
12	9,53	-375,7	-90,3	-47,0
12	9,05	-413,2	-67,3	-51,9
13	9,05	-413,2	-67,3	-51,9
13	9,00	-416,5	-64,8	-52,3
14	9,00	-416,5	-64,8	-52,3
14	8,75	-431,1	-51,8	-54,4
15	8,75	-431,1	-51,8	-54,4
15	8,07	-453,5	-13,2	-58,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-453,5	-13,2	-58,5
16	7,82	**-455,0**	1,8	-59,4
17	7,82	**-455,0**	1,8	-59,4
17	7,16	-440,7	41,6	**-60,1**
18	7,16	-440,7	41,6	**-60,1**
18	6,50	-400,1	81,5	-58,7
19	6,50	-400,1	81,5	-58,7
19	6,00	-351,8	112,0	-56,2
20	6,00	-351,8	112,0	-56,2
20	5,25	-254,1	142,5	-50,7
21	5,25	-254,1	142,5	-50,7
21	4,50	-141,7	152,6	-43,4
22	4,50	-141,7	152,6	-43,4
22	3,81	-37,2	149,3	-36,0
23	3,81	-37,2	149,3	-36,0
23	3,13	60,2	132,0	-28,3
24	3,13	60,2	131,9	-28,3
24	2,44	140,9	100,5	-21,0
25	2,44	140,9	100,4	-21,0
25	1,75	195,1	55,1	-14,4
26	1,75	195,1	54,9	-14,4
26	1,06	213,3	-4,4	-8,9
27	1,06	213,3	-4,7	-8,9
27	0,38	186,1	-74,2	-4,6
28	0,38	186,1	-74,6	-4,6
28	-0,31	113,6	-131,2	-1,2
29	-0,31	113,6	-132,5	-1,2
29	-1,00	28,8	-79,9	1,5
30	-1,00	28,8	-79,5	1,5
30	-1,70	0,0	0,0	4,1
Max		**-455,0**	**-166,6**	**-60,1**
Max, minor nodes incl.		-455,0	-166,6	-60,2

28.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		22,39	0,00	3	98
3	12,96	0,00	0,00	-		7,27	0,00	3	94
3	12,37	0,00	0,00	-		10,12	0,00	1	
4	12,37	0,00	0,00	-		5,61	0,00	1	
4	12,32	0,00	0,00	-		5,65	0,49	1	
5	12,32	0,00	0,00	-		7,14	0,49	1	
5	12,30	0,00	0,00	-		7,17	0,69	1	
6	12,30	0,00	0,00	-		7,15	0,69	A	
6	12,15	0,00	0,00	-		8,19	2,16	A	
7	12,15	0,00	0,00	-		8,18	2,16	A	
7	12,07	0,00	0,00	-		8,72	2,94	A	
8	12,07	0,00	0,00	-		8,33	2,94	A	
8	11,38	0,00	0,00	-		12,17	9,71	A	
9	11,38	0,00	0,00	-		11,67	9,71	A	
9	10,69	0,00	0,00	-		14,52	16,48	A	
10	10,69	0,00	0,00	-		14,25	16,48	A	
10	10,00	0,00	0,00	-		16,59	23,25	A	
11	10,00	0,00	0,00	-		15,89	23,25	A	12
11	9,53	0,00	0,00	-		17,68	27,91	A	12
12	9,53	0,00	0,00	-		17,31	27,91	A	
12	9,05	0,00	0,00	-		19,00	32,57	A	
13	9,05	0,00	0,00	-		17,46	32,57	A	
13	9,00	0,00	0,00	-		17,62	33,06	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* [%]
14	9,00	0,00	0,00	-		17,31	33,06	A	
14	8,75	0,00	0,00	-		18,10	35,51	A	
15	8,75	0,00	0,00	-		16,88	35,51	A	
15	8,07	0,00	0,00	-		18,85	42,18	A	
16	8,07	0,00	0,00	-		17,65	42,18	A	
16	7,82	0,00	2,45	-		18,33	44,64	A	
17	7,82	0,00	2,45	-		17,25	44,64	A	
17	7,16	0,00	8,93	-		18,93	51,11	A	
18	7,16	0,00	8,93	-		17,44	51,11	A	
18	6,50	0,00	15,40	-		18,99	57,58	A	
19	6,50	0,00	15,40	-		18,36	57,58	A	
19	6,00	0,00	20,31	-		19,50	62,49	A	
20	6,00	0,00	20,31	P		22,44	62,49	A	
20	5,25	34,65	27,66	P		30,41	48,60	A	
21	5,25	23,43	27,66	P		33,79	48,60	A	
21	4,50	46,88	35,02	P		42,67	34,70	A	
22	4,50	38,43	35,02	P		43,40	34,70	A	
22	3,81	59,29	41,77	P		45,50	41,45	A	
23	3,81	60,08	41,77	P		44,85	41,45	A	
23	3,13	81,21	48,51	P		46,94	48,19	A	
24	3,13	81,79	48,51	P		46,04	48,19	A	
24	2,44	103,07	55,25	P		48,10	54,94	A	
25	2,44	103,52	55,25	P		47,60	54,94	A	
25	1,75	124,91	62,00	P		49,66	61,68	A	
26	1,75	125,27	62,00	P		49,08	61,68	A	
26	1,06	146,72	68,74	P		51,12	68,43	A	
27	1,06	147,03	68,74	P		50,43	68,43	A	
27	0,38	148,56	75,49	3	88	52,46	75,17	A	
28	0,38	148,78	75,49	3	88	51,14	75,17	A	
28	-0,31	106,30	82,23	2	56	53,13	81,92	A	
29	-0,31	106,51	82,23	2	56	52,86	81,92	A	
29	-1,00	21,65	88,98	A		239,21	88,66	1	38
30	-1,00	23,89	88,98	A		125,38	88,66	1	25
30	-1,70	25,85	95,84	A		152,04	95,53	1	29

*

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

28.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	602,3	575,9
Water	468,2	675,6
Total	1070,5	1251,5

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	602,28 kN
Percentage mobilized resistance	70,5 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	6393,15 kNm
Percentage mobilized moment	65,8 %

28.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-128,13
Vertical force passive	111,69
Vertical anchor force	-103,31
Resulting vertical force (no dead weight)	-119,75
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (120 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-128,13
Vertical force passive	111,69
Vertical anchor force	-103,31
Resulting vertical force (no dead weight)	-119,75
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (120 <= 3305)	

28.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-10,33
4,50	32	96,51	10,00	20	-23,85
-1,00	19	4,39	6,00	19A	-13,30
			4,50	32	-56,14
			-1,00	19	-24,50

28.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	206,62	Elastic	Right	Anchor

29 Step 6.3 Stage 4: VAL (MHW) (Verkeer)

29.1 Input Data Left

29.1.1 Calculation Method

Calculation method: C, phi, delta

29.1.2 Water Level

Water level: 7,82 [m]

29.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

29.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

29.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

29.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

29.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	530,06
19	17,87
32	0,00

29.4 Input Data Right

29.4.1 Calculation Method

Calculation method: C, phi, delta

29.4.2 Water Level

Water level: 12,37 [m]

29.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

29.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

29.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,00	9230,77	9230,77	4615,38	4615,38
19A	6,00	4615,38	4615,38	3076,92	3076,92
32	4,50	30769,23	30769,23	15384,62	15384,62
19	-1,00	3076,92	3076,92	1538,46	1538,46
32	-2,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,00	2307,69	2307,69
19A	6,00	1538,46	1538,46
32	4,50	7692,31	7692,31
19	-1,00	615,38	615,38
32	-2,50	7692,31	7692,31

29.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

29.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	0,00
	0,75	0,00
	0,75	16,66
	3,25	16,66
	3,25	0,00

29.5 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	12,99	0,0	11,4	0,00	2,01	17,02
2	12,66	0,0	42,5	0,00	1,38	5,81
3	12,35	3,7	139,7	0,25	1,02	9,49
4	12,31	7,0	137,1	0,46	1,00	8,99
5	12,22	7,7	118,8	0,46	0,94	7,19
6	12,11	8,4	112,7	0,46	0,88	6,19
7	11,72	10,4	68,5	0,44	0,70	2,93
8	11,04	13,2	59,3	0,42	0,55	1,91
9	10,35	15,5	71,5	0,42	0,49	1,93
10	9,76	16,8	142,0	0,40	0,40	3,38
11	9,29	18,2	161,2	0,39	0,39	3,47
12	9,03	17,5	156,5	0,36	0,39	3,20
13	8,88	17,7	162,5	0,35	0,39	3,24
14	8,41	17,9	179,9	0,33	0,40	3,31
15	7,95	18,0	187,3	0,31	0,41	3,21
16	7,49	18,1	206,6	0,29	0,42	3,31
17	6,83	18,2	236,3	0,27	0,43	3,47
18	6,25	18,9	262,9	0,26	0,44	3,59
19	5,63	26,4	233,3	0,30	0,53	2,62
20	4,88	38,2	333,5	0,33	0,55	2,88
21	4,16	44,4	438,2	0,34	0,48	3,31
22	3,47	45,9	469,5	0,33	0,49	3,39
23	2,78	47,1	495,7	0,32	0,49	3,42
24	2,09	48,6	519,6	0,32	0,50	3,44
25	1,41	50,1	541,3	0,32	0,50	3,43
26	0,72	51,4	566,0	0,31	0,50	3,45
27	0,03	52,1	591,3	0,31	0,51	3,47
28	-0,66	53,9	616,8	0,30	0,51	3,48
29	-1,35	65,0	516,5	0,36	0,62	2,82

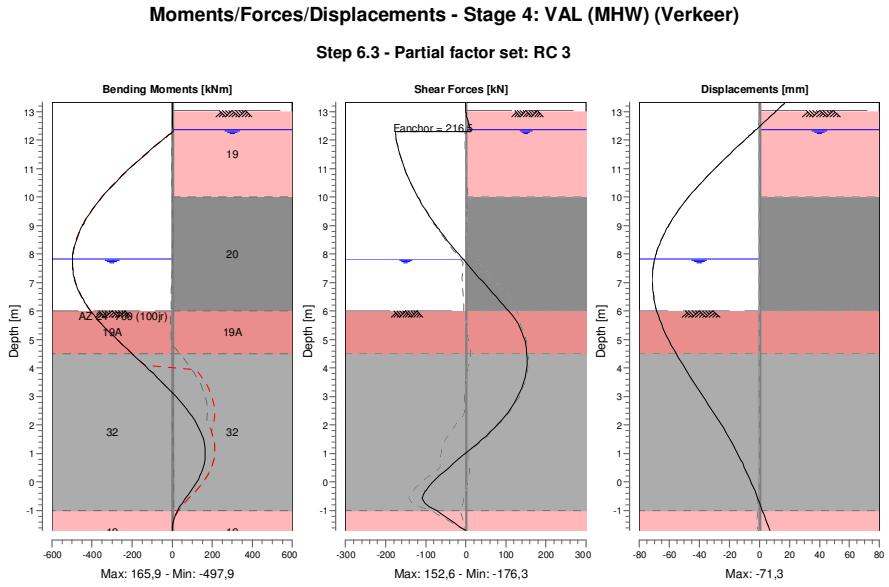
29.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	71,97
19A	48,49
32	295,58
19	88,97
32	0,00

29.7 Calculation Results

Number of iterations: 4

29.7.1 Charts of Moments, Forces and Displacements



29.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	17,4
1	13,03	0,0	0,0	11,5
2	13,03	0,0	0,0	11,5
2	12,96	0,0	0,8	10,0
3	12,96	0,0	0,9	10,0
3	12,37	3,2	10,5	-2,1
4	12,37	3,2	10,6	-2,1
4	12,32	3,8	11,0	-3,1
5	12,32	3,8	11,0	-3,1
5	12,30	4,0	11,2	-3,6
6	12,30	4,0	**-176,3**	-3,6
6	12,15	-22,3	-174,7	-6,6
7	12,15	-22,3	-174,7	-6,6
7	12,07	-36,3	-173,7	-8,3
8	12,07	-36,3	-173,7	-8,3
8	11,38	-152,6	-162,2	-22,2
9	11,38	-152,6	-162,2	-22,2
9	10,69	-258,6	-144,1	-35,4
10	10,69	-258,6	-144,1	-35,4
10	10,00	-350,0	-119,7	-47,1
11	10,00	-350,0	-119,7	-47,1
11	9,53	-402,3	-99,6	-54,0
12	9,53	-402,3	-99,6	-54,0
12	9,05	-444,2	-76,6	-59,9
13	9,05	-444,2	-76,6	-59,9
13	9,00	-448,0	-74,1	-60,5
14	9,00	-448,0	-74,1	-60,5
14	8,75	-464,9	-61,1	-63,1
15	8,75	-464,9	-61,1	-63,1
15	8,07	-493,7	-22,6	-68,3

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-493,7	-22,6	-68,3
16	7,82	**-497,4**	-7,2	-69,6
17	7,82	**-497,4**	-7,2	-69,6
17	7,16	-488,6	34,2	**-71,2**
18	7,16	-488,6	34,2	**-71,2**
18	6,50	-452,4	75,7	-70,4
19	6,50	-452,4	75,7	-70,4
19	6,00	-406,6	107,5	-68,3
20	6,00	-406,6	107,5	-68,3
20	5,25	-311,7	139,8	-62,9
21	5,25	-311,7	139,8	-62,9
21	4,50	-200,7	151,7	-55,4
22	4,50	-200,7	151,7	-55,4
22	3,81	-96,2	150,1	-47,4
23	3,81	-96,2	150,1	-47,4
23	3,13	2,4	134,5	-38,9
24	3,13	2,4	134,4	-38,9
24	2,44	85,3	104,7	-30,4
25	2,44	85,3	104,6	-30,4
25	1,75	143,0	61,0	-22,4
26	1,75	143,0	60,8	-22,4
26	1,06	165,9	4,3	-15,1
27	1,06	165,9	4,0	-15,1
27	0,38	148,7	-53,5	-8,7
28	0,38	148,7	-53,8	-8,7
28	-0,31	94,5	-99,5	-3,1
29	-0,31	94,6	-100,5	-3,1
29	-1,00	26,2	-73,2	2,0
30	-1,00	26,2	-72,6	2,0
30	-1,70	0,0	0,0	7,0
Max		**-497,4**	**-176,3**	**-71,2**
Max, minor nodes incl.		-497,9	-176,3	-71,3

29.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		18,49	0,00	3	81
3	12,96	0,00	0,00	-		7,16	0,00	3	92
3	12,37	0,00	0,00	-		13,37	0,00	1	
4	12,37	0,00	0,00	-		8,16	0,00	1	
4	12,32	0,00	0,00	-		7,96	0,49	1	
5	12,32	0,00	0,00	-		9,45	0,49	1	
5	12,30	0,00	0,00	-		9,61	0,69	1	
6	12,30	0,00	0,00	-		8,98	0,69	1	
6	12,15	0,00	0,00	-		10,12	2,16	1	
7	12,15	0,00	0,00	-		9,19	2,16	1	
7	12,07	0,00	0,00	-		9,70	2,94	1	
8	12,07	0,00	0,00	-		8,33	2,94	A	
8	11,38	0,00	0,00	-		12,17	9,71	A	
9	11,38	0,00	0,00	-		11,67	9,71	A	
9	10,69	0,00	0,00	-		14,52	16,48	A	
10	10,69	0,00	0,00	-		14,25	16,48	A	
10	10,00	0,00	0,00	-		16,59	23,25	A	
11	10,00	0,00	0,00	-		15,89	23,25	A	12
11	9,53	0,00	0,00	-		17,68	27,91	A	12
12	9,53	0,00	0,00	-		17,31	27,91	A	
12	9,05	0,00	0,00	-		19,00	32,57	A	
13	9,05	0,00	0,00	-		17,46	32,57	A	
13	9,00	0,00	0,00	-		17,62	33,06	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* [%]
14	9,00	0,00	0,00	-		17,31	33,06	A	
14	8,75	0,00	0,00	-		18,10	35,51	A	
15	8,75	0,00	0,00	-		16,88	35,51	A	
15	8,07	0,00	0,00	-		18,85	42,18	A	
16	8,07	0,00	0,00	-		17,65	42,18	A	
16	7,82	0,00	0,00	-		18,33	44,64	A	
17	7,82	0,00	0,00	-		17,25	44,64	A	
17	7,16	0,00	6,47	-		18,93	51,11	A	
18	7,16	0,00	6,47	-		17,44	51,11	A	
18	6,50	0,00	12,95	-		18,99	57,58	A	
19	6,50	0,00	12,95	-		18,36	57,58	A	
19	6,00	0,00	17,85	-		19,50	62,49	A	
20	6,00	0,00	17,85	P		22,44	62,49	A	
20	5,25	34,65	25,21	P		30,41	48,60	A	
21	5,25	23,43	25,21	P		33,79	48,60	A	
21	4,50	46,88	32,57	P		42,67	34,70	A	
22	4,50	38,43	32,57	P		43,40	34,70	A	
22	3,81	59,29	39,31	P		45,50	41,45	A	
23	3,81	60,08	39,31	P		44,85	41,45	A	
23	3,13	81,21	46,06	P		46,94	48,19	A	
24	3,13	81,79	46,06	P		46,04	48,19	A	
24	2,44	103,07	52,80	P		48,10	54,94	A	
25	2,44	103,52	52,80	P		47,60	54,94	A	
25	1,75	124,91	59,55	P		49,66	61,68	A	
26	1,75	125,27	59,55	P		49,08	61,68	A	
26	1,06	138,08	66,29	3	94	51,12	68,43	A	
27	1,06	138,33	66,29	3	94	50,43	68,43	A	
27	0,38	136,53	73,04	3	81	52,46	75,17	A	
28	0,38	136,75	73,04	3	81	51,14	75,17	A	
28	-0,31	102,40	79,78	2	54	53,13	81,92	A	
29	-0,31	102,61	79,78	2	54	52,86	81,92	A	
29	-1,00	21,65	86,52	A		163,79	88,66	1	26
30	-1,00	28,13	86,52	1		117,77	88,66	1	23
30	-1,70	25,85	93,39	A		136,42	95,53	1	26

*

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

29.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	587,3	545,1
Water	444,5	675,6
Total	1031,8	1220,7

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	587,27 kN
Percentage mobilized resistance	68,7 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	6221,30 kNm
Percentage mobilized moment	64,0 %

29.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-122,00
Vertical force passive	109,07
Vertical anchor force	-108,26
Resulting vertical force (no dead weight)	-121,19
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (121 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-122,00
Vertical force passive	109,07
Vertical anchor force	-108,26
Resulting vertical force (no dead weight)	-121,19
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (121 <= 3305)	

29.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-10,11
4,50	32	93,77	10,00	20	-23,85
-1,00	19	4,51	6,00	19A	-13,30
			4,50	32	-52,29
			-1,00	19	-22,45

29.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	216,52	Elastic	Right	Anchor

30 Step 6.4 Stage 4: VAL (MHW) (Verkeer)

30.1 Input Data Left

30.1.1 Calculation Method

Calculation method: C, phi, delta

30.1.2 Water Level

Water level: 7,82 [m]

30.1.3 Surface

X [m]	Y [m]
0,00	6,00
34,38	2,75

30.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

30.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

30.2 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	5,63	0,0	17,3	0,00	0,21	5,66
2	4,88	0,0	35,2	0,00	0,34	3,83
3	4,16	5,2	48,9	0,34	0,34	3,14
4	3,47	7,4	70,6	0,33	0,36	3,18
5	2,78	9,6	92,4	0,33	0,39	3,20
6	2,09	11,8	114,2	0,33	0,41	3,22
7	1,41	14,0	136,0	0,33	0,42	3,23
8	0,72	16,2	157,8	0,33	0,43	3,23
9	0,03	18,4	179,6	0,33	0,44	3,24
10	-0,66	20,5	201,3	0,33	0,45	3,24
11	-1,35	24,9	182,0	0,36	0,57	2,67

30.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	0,00
19A	39,34
32	566,72
19	17,41
32	0,00

30.4 Input Data Right

30.4.1 Calculation Method

Calculation method: C, phi, delta

30.4.2 Water Level

Water level: 12,37 [m]

30.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

30.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,00	18,00	20,00	0,00	27,51	18,34
19A	6,00	18,50	18,50	2,14	23,01	15,34
32	4,50	19,00	20,00	0,00	27,96	10,03
19	-1,00	18,00	18,00	2,14	21,24	14,16
32	-2,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

30.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,00	27000,00	27000,00	13500,00	13500,00
19A	6,00	13500,00	13500,00	9000,00	9000,00
32	4,50	90000,00	90000,00	45000,00	45000,00
19	-1,00	9000,00	9000,00	4500,00	4500,00
32	-2,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,00	6750,00	6750,00
19A	6,00	4500,00	4500,00
32	4,50	22500,00	22500,00
19	-1,00	1800,00	1800,00
32	-2,50	22500,00	22500,00

30.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

30.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	0,00
	0,75	0,00
	0,75	16,66
	3,25	16,66
	3,25	0,00

30.5 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	12,99	0,0	11,4	0,00	2,01	17,02
2	12,66	0,0	42,5	0,00	1,38	5,81
3	12,35	3,7	139,7	0,25	1,02	9,49
4	12,31	7,0	137,1	0,46	1,00	8,99
5	12,22	7,7	118,8	0,46	0,94	7,19
6	12,11	8,4	112,7	0,46	0,88	6,19
7	11,72	10,4	68,5	0,44	0,70	2,93
8	11,04	13,2	59,3	0,42	0,55	1,91
9	10,35	15,5	71,5	0,42	0,49	1,93
10	9,76	16,8	142,0	0,40	0,40	3,38
11	9,29	18,2	161,2	0,39	0,39	3,47
12	9,03	17,5	156,5	0,36	0,39	3,20
13	8,88	17,7	162,5	0,35	0,39	3,24
14	8,41	17,9	179,9	0,33	0,40	3,31
15	7,95	18,0	187,3	0,31	0,41	3,21
16	7,49	18,1	206,6	0,29	0,42	3,31
17	6,83	18,2	236,3	0,27	0,43	3,47
18	6,25	18,9	262,9	0,26	0,44	3,59
19	5,63	26,4	233,3	0,30	0,53	2,62
20	4,88	38,2	333,5	0,33	0,55	2,88
21	4,16	44,4	438,2	0,34	0,48	3,31
22	3,47	45,9	469,5	0,33	0,49	3,39
23	2,78	47,1	495,7	0,32	0,49	3,42
24	2,09	48,6	519,6	0,32	0,50	3,44
25	1,41	50,1	541,3	0,32	0,50	3,43
26	0,72	51,4	566,0	0,31	0,50	3,45
27	0,03	52,1	591,3	0,31	0,51	3,47
28	-0,66	53,9	616,8	0,30	0,51	3,48
29	-1,35	65,0	516,5	0,36	0,62	2,82

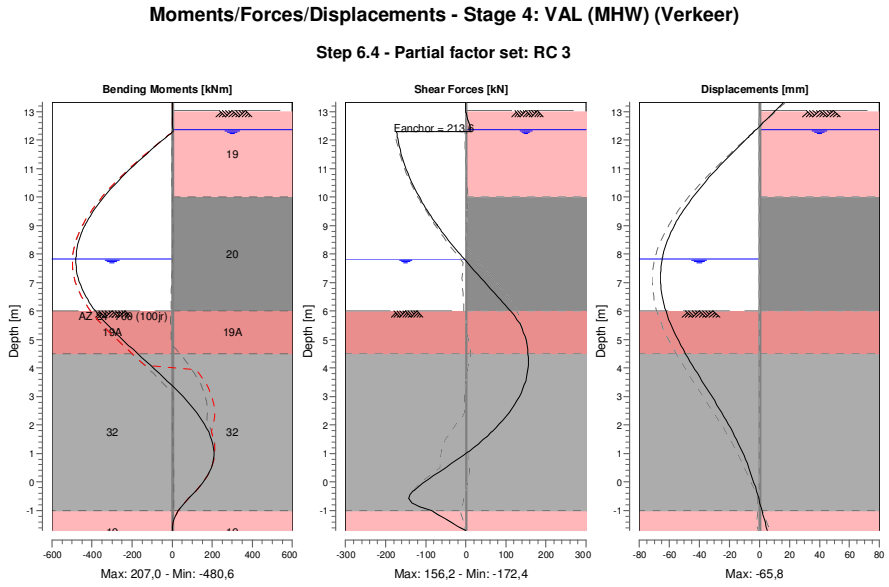
30.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	71,97
19A	48,49
32	317,10
19	100,99
32	0,00

30.7 Calculation Results

Number of iterations: 5

30.7.1 Charts of Moments, Forces and Displacements



30.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	16,2
1	13,03	0,0	0,0	10,6
2	13,03	0,0	0,0	10,6
2	12,96	0,0	0,8	9,2
3	12,96	0,0	1,0	9,2
3	12,37	3,9	12,3	-2,2
4	12,37	3,9	12,2	-2,2
4	12,32	4,5	12,5	-3,1
5	12,32	4,5	12,5	-3,1
5	12,30	4,7	12,6	-3,5
6	12,30	4,7	**-172,4**	-3,5
6	12,15	-21,0	-171,0	-6,4
7	12,15	-21,0	-171,0	-6,4
7	12,07	-34,7	-170,1	-7,9
8	12,07	-34,7	-170,1	-7,9
8	11,38	-148,5	-158,6	-21,1
9	11,38	-148,5	-158,6	-21,1
9	10,69	-252,1	-140,5	-33,3
10	10,69	-252,1	-140,5	-33,3
10	10,00	-341,0	-116,1	-44,2
11	10,00	-341,0	-116,1	-44,2
11	9,53	-391,5	-96,0	-50,7
12	9,53	-391,5	-96,0	-50,7
12	9,05	-431,8	-73,0	-56,1
13	9,05	-431,8	-73,0	-56,1
13	9,00	-435,4	-70,5	-56,6
14	9,00	-435,4	-70,5	-56,6
14	8,75	-451,4	-57,5	-58,9
15	8,75	-451,4	-57,5	-58,9
15	8,07	-477,7	-19,0	-63,6

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	8,07	-477,7	-19,0	-63,6
16	7,82	**-480,6**	-3,6	-64,6
17	7,82	**-480,6**	-3,6	-64,6
17	7,16	-469,3	37,8	**-65,8**
18	7,16	-469,3	37,8	**-65,8**
18	6,50	-430,7	79,3	-64,6
19	6,50	-430,7	79,3	-64,6
19	6,00	-383,2	111,1	-62,2
20	6,00	-383,2	111,1	-62,2
20	5,25	-285,5	143,4	-56,6
21	5,25	-285,5	143,4	-56,6
21	4,50	-171,8	155,3	-49,2
22	4,50	-171,8	155,3	-49,2
22	3,81	-64,9	153,7	-41,3
23	3,81	-64,9	153,7	-41,3
23	3,13	36,2	138,1	-33,1
24	3,13	36,2	138,0	-33,1
24	2,44	121,6	108,3	-25,1
25	2,44	121,6	108,2	-25,1
25	1,75	181,8	64,6	-17,8
26	1,75	181,8	64,4	-17,8
26	1,06	207,0	6,8	-11,4
27	1,06	207,0	6,6	-11,4
27	0,38	187,7	-64,5	-6,1
28	0,38	187,7	-64,9	-6,1
28	-0,31	119,5	-129,5	-1,9
29	-0,31	119,6	-131,2	-1,9
29	-1,00	31,1	-85,5	1,7
30	-1,00	31,1	-85,1	1,7
30	-1,70	0,0	0,0	5,2
Max		**-480,6**	**-172,4**	**-65,8**
Max, minor nodes incl.		-480,6	-172,4	-65,8

30.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,96	0,00	0,00	-		22,76	0,00	P	
3	12,96	0,00	0,00	-		7,29	0,00	3	94
3	12,37	0,00	0,00	-		10,12	0,00	1	
4	12,37	0,00	0,00	-		5,61	0,00	1	
4	12,32	0,00	0,00	-		5,63	0,49	1	
5	12,32	0,00	0,00	-		7,12	0,49	1	
5	12,30	0,00	0,00	-		7,14	0,69	1	
6	12,30	0,00	0,00	-		7,15	0,69	A	
6	12,15	0,00	0,00	-		8,19	2,16	A	
7	12,15	0,00	0,00	-		8,18	2,16	A	
7	12,07	0,00	0,00	-		8,72	2,94	A	
8	12,07	0,00	0,00	-		8,33	2,94	A	
8	11,38	0,00	0,00	-		12,17	9,71	A	
9	11,38	0,00	0,00	-		11,67	9,71	A	
9	10,69	0,00	0,00	-		14,52	16,48	A	
10	10,69	0,00	0,00	-		14,25	16,48	A	
10	10,00	0,00	0,00	-		16,59	23,25	A	
11	10,00	0,00	0,00	-		15,89	23,25	A	12
11	9,53	0,00	0,00	-		17,68	27,91	A	12
12	9,53	0,00	0,00	-		17,31	27,91	A	
12	9,05	0,00	0,00	-		19,00	32,57	A	
13	9,05	0,00	0,00	-		17,46	32,57	A	
13	9,00	0,00	0,00	-		17,62	33,06	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* [%]
14	9,00	0,00	0,00	-		17,31	33,06	A	
14	8,75	0,00	0,00	-		18,10	35,51	A	
15	8,75	0,00	0,00	-		16,88	35,51	A	
15	8,07	0,00	0,00	-		18,85	42,18	A	
16	8,07	0,00	0,00	-		17,65	42,18	A	
16	7,82	0,00	0,00	-		18,33	44,64	A	
17	7,82	0,00	0,00	-		17,25	44,64	A	
17	7,16	0,00	6,47	-		18,93	51,11	A	
18	7,16	0,00	6,47	-		17,44	51,11	A	
18	6,50	0,00	12,95	-		18,99	57,58	A	
19	6,50	0,00	12,95	-		18,36	57,58	A	
19	6,00	0,00	17,85	-		19,50	62,49	A	
20	6,00	0,00	17,85	P		22,44	62,49	A	
20	5,25	34,65	25,21	P		30,41	48,60	A	
21	5,25	23,43	25,21	P		33,79	48,60	A	
21	4,50	46,88	32,57	P		42,67	34,70	A	
22	4,50	38,43	32,57	P		43,40	34,70	A	
22	3,81	59,29	39,31	P		45,50	41,45	A	
23	3,81	60,08	39,31	P		44,85	41,45	A	
23	3,13	81,21	46,06	P		46,94	48,19	A	
24	3,13	81,79	46,06	P		46,04	48,19	A	
24	2,44	103,07	52,80	P		48,10	54,94	A	
25	2,44	103,52	52,80	P		47,60	54,94	A	
25	1,75	124,91	59,55	P		49,66	61,68	A	
26	1,75	125,27	59,55	P		49,08	61,68	A	
26	1,06	146,72	66,29	P		51,12	68,43	A	
27	1,06	147,03	66,29	P		50,43	68,43	A	
27	0,38	160,24	73,04	3	95	52,46	75,17	A	
28	0,38	160,46	73,04	3	95	51,14	75,17	A	
28	-0,31	122,79	79,78	2	65	53,13	81,92	A	
29	-0,31	123,01	79,78	2	65	52,86	81,92	A	
29	-1,00	21,65	86,52	A		266,95	88,66	1	42
30	-1,00	23,89	86,52	A		127,04	88,66	1	25
30	-1,70	25,85	93,39	A		161,42	95,53	1	31

*

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

30.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	623,5	579,8
Water	444,5	675,6
Total	1068,0	1255,4

Considered as passive side	Left
Maximum passive effective resistance	854,84 kN
Mobilized passive effective resistance	623,47 kN
Percentage mobilized resistance	72,9 %
Position single support	12,30 m
Maximum passive moment	9722,97 kNm
Mobilized passive moment	6656,37 kNm
Percentage mobilized moment	68,5 %

30.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-129,14
Vertical force passive	115,44
Vertical anchor force	-106,80
Resulting vertical force (no dead weight)	-120,50
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (120 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-129,14
Vertical force passive	115,44
Vertical anchor force	-106,80
Resulting vertical force (no dead weight)	-120,50
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (120 <= 3305)	

30.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,00	19A	10,79	13,03	19	-10,41
4,50	32	100,26	10,00	20	-23,85
-1,00	19	4,39	6,00	19A	-13,30
			4,50	32	-56,10
			-1,00	19	-25,48

30.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	213,61	Elastic	Right	Anchor

31 Step 6.5 Stage 4: VAL (MHW) (Verkeer)

31.1 Input Data Left

31.1.1 Calculation Method

Calculation method: C, phi, delta

31.1.2 Water Level

Water level: 8,07 [m]

31.1.3 Surface

X [m]	Y [m]
0,00	6,50
34,38	3,25

31.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,50	n.a.	n.a.	n.a.	0,00	0,00
19	-1,00	n.a.	n.a.	n.a.	0,00	0,00
32	-2,50	n.a.	n.a.	n.a.	0,00	0,00

31.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

31.2 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	6,25	0,6	11,1	0,27	0,27	4,65
2	5,63	-0,4	46,1	0,00	0,24	5,90
3	4,88	1,2	68,5	0,08	0,31	4,93
4	4,16	5,5	79,8	0,27	0,27	3,95
5	3,47	7,3	106,7	0,27	0,30	3,98
6	2,78	9,1	134,6	0,27	0,32	4,03
7	2,09	10,9	162,7	0,27	0,34	4,06
8	1,41	12,7	190,7	0,27	0,35	4,09
9	0,72	14,5	218,7	0,27	0,37	4,11
10	0,03	16,3	246,7	0,27	0,37	4,12
11	-0,66	18,1	274,8	0,27	0,38	4,13
12	-1,35	21,4	239,8	0,30	0,51	3,31

31.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	5,54
19A	76,70
32	406,97
19	26,43
32	0,00

31.4 Input Data Right

31.4.1 Calculation Method

Calculation method: C, phi, delta

31.4.2 Water Level

Water level: 12,32 [m]

31.4.3 Surface

X [m]	Y [m]
0,00	13,03
2,12	13,05
4,62	12,96
4,88	12,95
5,22	13,00
5,63	13,15
8,14	12,00
13,33	12,02

31.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,00	18,00	20,00	0,00	32,00	16,60
19A	6,00	18,50	18,50	3,00	27,00	18,00
32	4,50	19,00	20,00	0,00	32,50	11,66
19	-1,00	18,00	18,00	3,00	25,00	16,67
32	-2,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,00	1,00	1,00	Fine
19A	6,00	1,00	1,00	Fine
32	4,50	1,00	1,00	Fine
19	-1,00	1,00	1,00	Fine
32	-2,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,00	n.a.	n.a.	n.a.	0,00	0,00
19A	6,00	n.a.	n.a.	n.a.	0,00	-42,50
32	4,50	n.a.	n.a.	n.a.	-42,50	-42,50
19	-1,00	n.a.	n.a.	n.a.	-42,50	-42,50
32	-2,50	n.a.	n.a.	n.a.	-42,50	-42,50

31.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,00	12000,00	12000,00	6000,00	6000,00
19A	6,00	6000,00	6000,00	4000,00	4000,00
32	4,50	40000,00	40000,00	20000,00	20000,00
19	-1,00	4000,00	4000,00	2000,00	2000,00
32	-2,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,00	3000,00	3000,00
19A	6,00	2000,00	2000,00
32	4,50	10000,00	10000,00
19	-1,00	800,00	800,00
32	-2,50	10000,00	10000,00

31.4.6 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']
60,3*12,5 [2.8]	12,30	2,100E+09	6,700E-04	20,00	-30,00	257,80	n.a.

31.4.7 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	0,00
	0,75	0,00
	0,75	13,33
	3,25	13,33
	3,25	0,00

31.5 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	12,68	0,0	68,3	0,00	1,19	9,86
2	12,31	0,0	128,9	0,00	0,86	8,50
3	12,22	0,0	129,1	0,00	0,82	7,90
4	11,79	6,1	89,7	0,28	0,64	4,10
5	11,07	9,1	72,2	0,31	0,50	2,45
6	10,36	11,3	90,9	0,32	0,44	2,55
7	9,75	13,5	163,3	0,33	0,34	3,99
8	9,25	14,8	186,1	0,32	0,34	4,09
9	8,77	15,1	199,4	0,30	0,34	3,99
10	8,30	16,1	217,7	0,30	0,35	4,02
11	7,81	16,3	230,9	0,28	0,35	3,95
12	7,29	16,4	259,0	0,26	0,36	4,10
13	6,76	16,6	287,8	0,24	0,37	4,24
14	6,25	17,2	316,3	0,24	0,38	4,37
15	5,63	22,0	319,9	0,25	0,47	3,63
16	4,88	30,9	450,6	0,27	0,49	3,92
17	4,16	36,0	573,4	0,27	0,42	4,36
18	3,47	38,7	614,9	0,28	0,42	4,46
19	2,78	39,7	647,7	0,28	0,42	4,49
20	2,09	41,1	677,9	0,27	0,43	4,50
21	1,41	42,4	708,3	0,27	0,43	4,51
22	0,72	43,6	741,8	0,27	0,43	4,54
23	0,03	44,4	775,5	0,26	0,44	4,56
24	-0,66	45,5	809,3	0,26	0,44	4,58
25	-1,35	54,7	665,9	0,30	0,56	3,65

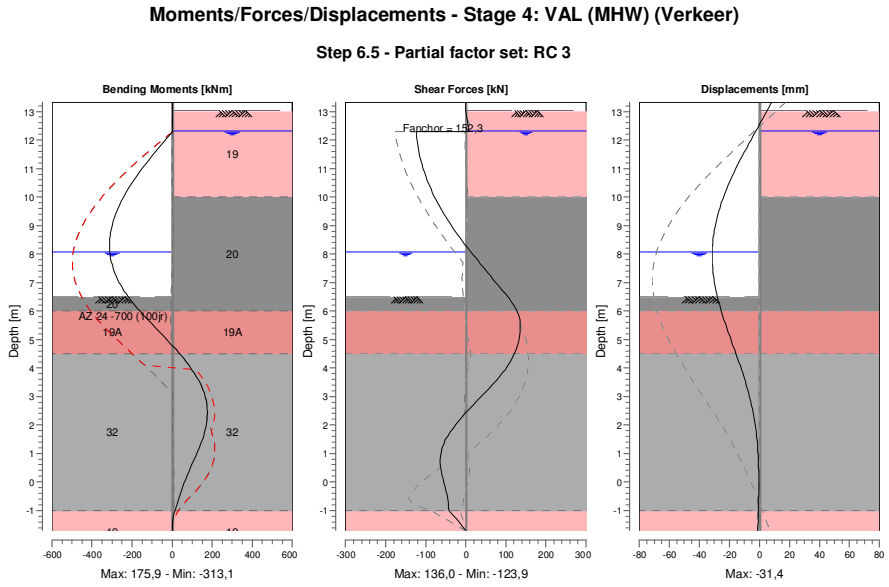
31.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	62,99
19A	39,64
32	247,69
19	69,18
32	0,00

31.7 Calculation Results

Number of iterations: 5

31.7.1 Charts of Moments, Forces and Displacements



31.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	8,2
1	13,03	0,0	0,0	5,1
2	13,03	0,0	0,1	5,1
2	12,32	2,7	8,1	-2,3
3	12,32	2,7	8,0	-2,3
3	12,30	2,9	8,1	-2,5
4	12,30	2,9	-123,9	-2,5
4	12,15	-15,6	-122,9	-4,1
5	12,15	-15,6	-122,9	-4,1
5	11,43	-101,2	-114,8	-11,4
6	11,43	-101,2	-114,8	-11,4
6	10,72	-178,4	-99,6	-18,2
7	10,72	-178,4	-99,6	-18,2
7	10,00	-242,3	-77,7	-23,9
8	10,00	-242,3	-77,7	-23,9
8	9,50	-276,5	-58,4	-27,0
9	9,50	-276,5	-58,4	-27,0
9	9,00	-300,2	-35,9	-29,4
10	9,00	-300,2	-35,9	-29,4
10	8,54	**-311,6**	-12,7	-30,8
11	8,54	**-311,6**	-12,7	-30,8
11	8,07	**-311,6**	13,1	**-31,4**
12	8,07	**-311,6**	13,1	**-31,4**
12	7,55	-296,9	43,4	-31,2
13	7,55	-296,9	43,4	-31,2
13	7,02	-266,2	73,9	-30,0
14	7,02	-266,2	73,9	-30,0
14	6,50	-219,6	104,4	-27,9
15	6,50	-219,6	104,4	-27,9
15	6,00	-161,0	128,2	-25,4

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	6,00	-161,0	128,2	-25,4
16	5,25	-60,3	**134,9**	-20,7
17	5,25	-60,3	**134,9**	-20,7
17	4,50	37,4	121,8	-15,6
18	4,50	37,4	121,8	-15,6
18	3,81	111,5	91,1	-11,1
19	3,81	111,5	91,0	-11,1
19	3,13	159,5	47,6	-7,2
20	3,13	159,5	47,6	-7,2
20	2,44	175,9	0,6	-4,2
21	2,44	175,9	0,6	-4,2
21	1,75	162,4	-38,1	-2,1
22	1,75	162,4	-38,3	-2,1
22	1,06	126,7	-61,0	-0,9
23	1,06	126,7	-61,0	-0,9
23	0,38	83,6	-61,0	-0,5
24	0,38	83,6	-60,9	-0,5
24	-0,31	45,6	-49,2	-0,4
25	-0,31	45,6	-49,1	-0,4
25	-1,00	14,7	-42,1	-0,7
26	-1,00	14,7	-42,2	-0,7
26	-1,70	0,0	0,0	-1,0
Max		**-311,6**	**134,9**	**-31,4**
Max, minor nodes incl.		-313,1	136,0	-31,4

31.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,03	0,00	0,00	-		0,00	0,00	-	
2	13,03	0,00	0,00	-		0,00	0,00	P	
2	12,32	0,00	0,00	-		10,27	0,00	1	
3	12,32	0,00	0,00	-		5,44	0,00	1	
3	12,30	0,00	0,00	-		5,55	0,20	1	
4	12,30	0,00	0,00	-		4,98	0,20	1	
4	12,15	0,00	0,00	-		5,71	1,67	1	
5	12,15	0,00	0,00	-		4,85	1,67	A	
5	11,43	0,00	0,00	-		7,24	8,70	A	
6	11,43	0,00	0,00	-		8,02	8,70	A	
6	10,72	0,00	0,00	-		10,12	15,73	A	
7	10,72	0,00	0,00	-		10,31	15,73	A	
7	10,00	0,00	0,00	-		12,14	22,76	A	
8	10,00	0,00	0,00	-		12,67	22,76	A	
8	9,50	0,00	0,00	-		14,22	27,66	A	
9	9,50	0,00	0,00	-		14,04	27,66	A	
9	9,00	0,00	0,00	-		15,53	32,57	A	
10	9,00	0,00	0,00	-		14,46	32,57	A	
10	8,54	0,00	0,00	-		15,73	37,13	A	
11	8,54	0,00	0,00	-		15,44	37,13	A	
11	8,07	0,00	0,00	-		16,67	41,69	A	
12	8,07	0,00	0,00	-		15,64	41,69	A	
12	7,55	0,00	5,13	-		16,94	46,83	A	
13	7,55	0,00	5,13	-		15,84	46,83	A	
13	7,02	0,00	10,27	-		17,05	51,96	A	
14	7,02	0,00	10,27	-		16,01	51,96	A	
14	6,50	0,00	15,40	-		17,15	57,09	A	
15	6,50	0,00	15,40	P		16,63	57,09	A	
15	6,00	22,22	20,31	P		17,69	62,00	A	
16	6,00	28,23	20,31	P		18,64	62,00	A	
16	5,25	56,41	27,66	3	88	25,35	48,11	A	
17	5,25	49,81	27,66	3	93	27,24	48,11	A	
17	4,50	66,07	35,02	2	79	34,47	34,21	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* [%]
18	4,50	66,80	35,02	P		35,12	34,21	A	
18	3,81	92,85	41,77	P		36,84	40,96	A	
19	3,81	93,57	41,77	P		37,85	40,96	A	
19	3,13	104,66	48,51	3	87	39,63	47,70	A	
20	3,13	105,71	48,51	3	87	38,84	47,70	A	
20	2,44	102,72	55,25	2	69	40,60	54,45	A	
21	2,44	103,36	55,25	2	69	40,19	54,45	A	
21	1,75	91,27	62,00	2	52	41,94	61,19	A	
22	1,75	91,82	62,00	2	52	41,49	61,19	A	
22	1,06	55,66	68,74	1	27	43,23	67,94	A	
23	1,06	56,23	68,74	1	27	42,72	67,94	A	
23	0,38	39,26	75,49	1	17	53,92	74,68	1	
24	0,38	39,81	75,49	1	17	54,37	74,68	1	
24	-0,31	41,41	82,23	1	16	58,12	81,42	1	
25	-0,31	41,92	82,23	1	16	58,55	81,42	1	
25	-1,00	53,75	88,98	1	19	58,77	88,17	1	
26	-1,00	36,16	88,98	1	16	97,98	88,17	1	
26	-1,70	39,37	95,84	1	16	99,65	95,04	1	

*

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

31.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	515,6	447,3
Water	468,2	668,8
Total	983,8	1116,1

Considered as passive side	Left
Maximum passive effective resistance	1232,01 kN
Mobilized passive effective resistance	515,63 kN
Percentage mobilized resistance	41,9 %
Position single support	12,30 m
Maximum passive moment	13765,14 kNm
Mobilized passive moment	5058,99 kNm
Percentage mobilized moment	36,8 %

31.7.5 Vertical Force Balance

Xi factor	0,72
Partial material factor	1,20
Maximum point resistance	12,00 [MPa]

Vertical force balance unplugged	Force [kN]
Vertical force active	-117,63
Vertical force passive	118,98
Vertical anchor force	-76,17
Resulting vertical force (no dead weight)	-74,82
Vertical toe capacity Ftoe;d	125,28
Vertical toe capacity is sufficient (75 <= 125)	

Vertical force balance plugged	Force [kN]
Vertical force active	-117,63
Vertical force passive	118,98
Vertical anchor force	-76,17
Resulting vertical force (no dead weight)	-74,82
Vertical toe capacity Ftoe;d	3304,80
Vertical toe capacity is sufficient (75 <= 3305)	

31.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
6,50	20	2,16	13,03	19	-8,33
6,00	19A	24,92	10,00	20	-24,60
4,50	32	83,98	6,00	19A	-12,88
-1,00	19	7,92	4,50	32	-51,11
			-1,00	19	-20,72

31.7.7 Anchors/Struts

Anchor/strut name	Level [m]	E-Modulus [kN/m²]	Force [kN]	State	Side	Type
60,3*12,5 [2.8]	12,30	2,100E+09	152,35	Elastic	Right	Anchor

End of Report

Bepaling corrosie op damwanden

Project:	Prioritaire dijkversterking	Datum:	1-12-2014	Blad	1 van 2
Projectnummer:	9x4447	Naam:	GLI		
Omschrijving:	Corrosie en controle staalspanning Kanaalweg DP54.169-170	Versie:	1.0		

Toepassingsgebied

Spreadsheet is toepasbaar voor berekeningen van gereduceerde eigenschappen van damwandprofielen:
Z-profielen

Uitgangspunten

Corrosie snelheden

Corrosieafname is bepaald conform NEN-EN 1993-5:2008/NB:2012 art. 4.4

Table 4-1: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in soils, with or without groundwater

Required design working life	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils (sand, silt, clay, schist, ...)	0,00	0,30	0,60	0,90	1,20
Polluted natural soils and industrial sites	0,15	0,75	1,50	2,25	3,00
Aggressive natural soils (swamp, marsh, peat, ...)	0,20	1,00	1,75	2,50	3,25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0,18	0,70	1,20	1,70	2,20
Non-compacted and aggressive fills (ashes, slag, ...)	0,50	2,00	3,25	4,50	5,75

Notes:
1) Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.
2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Table 4-2: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in fresh water or in sea water

Required design working life	5 years	25 years	50 years	75 years	100 years
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0,15	0,55	0,90	1,15	1,40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0,30	1,30	2,30	3,30	4,30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0,55	1,90	3,75	5,60	7,50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0,25	0,90	1,75	2,60	3,50

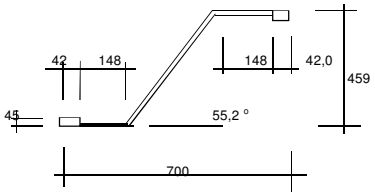
Notes:
1) The highest corrosion rate is usually found in the splash zone or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the permanent immersion zone, see Figure 4-1.
2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Levensduur			100	jaar		
Zijde 1	Grondzijde		2,2	mm	/	100 jaar
Zijde 2	Rivierzijde		2,2	mm	+ /	100 jaar
Totaal			**4,4**	**mm**	/	**100 jaar**

Traagheidsmoment on-aangetaste damwand

type : AZ24-700

lengte onder tot hoek			148,5	mm
lengte boven tot hoek			148,5	mm
lengte plank	b		700,0	mm
tot hoogte profiel	h		459,0	mm
dikte horizontale delen	t		11,2	mm
dikte schuine stuk	s		11,2	mm
hoek schuine stuk			55,2	°
halve lengte slot		±	42,0	mm
dikte slot		±	44,8	mm
Contact lengte /m^1			1,343	m^2/m^1

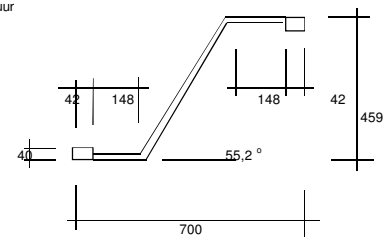


Per plank		***Per m1***		***Per m1 (conform tabellen)***		afwijking
A =	13349,9 mm^2	A =	191 cm^2/m	A =	174 cm^2/m	1,10 -
G =	104,8 kg/m^1	G =	150 kg/m^1	G =	136 kg/m^2	1,10 -
z =	229,5 mm					
I_{xx} =	41907,4 cm^4	I_{xx} =	59868 cm^4/m	I_{xx} =	55820 cm^4/m	1,07 -
W =	1826,0 cm^3	W =	2609 cm^3/m	W =	2430 cm^3/m	1,07 -
Wp =	2242,5 cm^3	W =	3204 cm^3/m	W =	2867 cm^3/m	1,12

Traagheidsmoment aangetaste damwand

type : ***AZ24-700***

levensduur constructie			100	jaar
afname wanddikte			4,4	mm gedurende de levensduur
lengte onder tot hoek			148,5	mm
lengte boven tot hoek			148,5	mm
lengte plank	b		700,0	mm
tot hoogte profiel	h		459,0	mm
dikte horizontale delen	t		6,8	mm
dikte schuine stuk	s		6,8	mm
hoek schuine stuk			55,2	°
halve lengte slot		±	42,0	mm
dikte slot		±	40,4	mm



Per plank		***Per m1***	
A =	9214,1 mm^2	A =	13163,0 mm^2
G =	72,3 kg/m^1	G =	103,3 kg/m^1
z =	229,5 mm		
I_{xx} =	30716,9 cm^4	I_{xx} =	43881,3 cm^4
W =	1338,4 cm^3	W =	1912,0 cm^3
Wp =	1603,1 cm^3	Wp =	2290 cm^3

Reductiefactoren voor profielgrootheden

475,1415254

Onderstaand zijn de reductiefactoren weergegeven na een levensduur van:
100 jaar

	γ_{cor}	***Per m1 (conform tabellen)***		***Per m1 (conform tabellen)*** incl. corrosie afname	
A =	0,690 -	A =	174 cm^2/m	A =	120 cm^2/m
G =	0,690 -	G =	136 kg/m^2	G =	94 kg/m^2
I_{xx} =	0,733 -	I_{xx} =	55820 cm^4/m	I_{xx} =	40914 cm^4/m
W =	0,733 -	W =	2430 cm^3/m	W =	1781 cm^3/m
Wp =	0,715	Wp =	2867 cm3/m	Wp =	2049 cm^3/m

Bepaling corrosie op damwanden

Project:	Prioritaire dijkversterking	Datum:	1-12-2014	Blad	1 van 2
Projectnummer:	9x4447	Naam:	GLI		
Omschrijving:	Corrosie en controle staalspanning Kanaalweg DP54.169-170	Versie:	1.0		

Bepaling opneembaar moment op damwanden IE = 8,59E+04 kNm2/m1

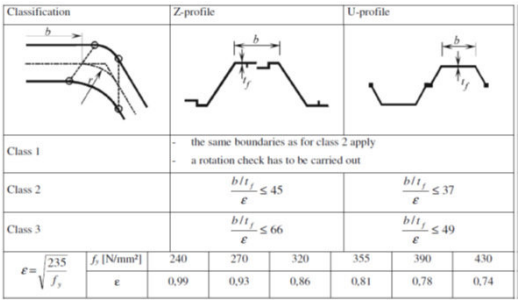
Uitgangspunten

Staalkwaliteit S355GP Mu 632 kNm/m

vloeispanning	fy	355	(sheet alleen geldig voor Z-profielen)
Treksterkte	fu	480	

Profielklasse is bepaald aan de hand van tabel 5-1 van de NEN-EN 1993-5

epsilon	e	0,81	
Type profiel		Z	



Met corrosie

Breedte van de flens	b	381	
Dikte van de flens	tf	6,8	
	b/t_f	69	
	ε		
Profielklasse		**4**	

Indien van toepassing, toelaatbare spanning om in profielklasse 3 te vallen

	b/tf	56	
toelaatbare epsion	e_toelaatbaar	0,85	
Toelaatbare spanning		326	
	e	0,8489	

Voor het bepalen van het moment is aangenomen dat voor profielklasse 4 de spanning wordt gereduceerd. Alternatieve methode is een plooicontrole uitvoeren.

	M_{Ed}	499,3	kNm/m	
	V_{Ed}	176,6	kN/m	
	N_{Ed}	108,4	kN/m	
kniklente	L	13	m	
Factor voor scheve buig	β_B	1	[-]	
	β_D	1	[-]	
Reductie voor meer dan 5 meter waterstands verschil	ρ_p	1	[-]	
	$M_{c,Rd}$	581	kNm/m	(5.2) of (5.3)
	c	551	mm	(figuur 5-1)
	A_V	3075	mm2	(5.6)

w	(b/t_{min}) ε = 20,0	(b/t_{min}) ε = 30,0	(b/t_{min}) ε = 40,0	(b/t_{min}) ε = 50,0
5,0	1,00	1,00	1,00	1,00
10,0	0,99	0,97	0,95	0,87
15,0	0,98	0,96	0,92	0,76
20,0	0,98	0,94	0,88	0,60

Key:
- b is the width of the flange, but b should not be taken as less than $c/\sqrt{2}$, where c is the slant height of the web
- t_{min} is the lesser of t_f or t_w
- t_f is the flange thickness
- t_w is the web thickness
- w is the differential head in m

$\varepsilon = \sqrt{\frac{235}{f_y}}$; f_y is the yield strength in N/mm².

Notes:
1) ρ_p = 1,0 may be used if the interlocks of Z-piles are welded.
2) Intermediate values may be interpolated linearly.

$c/t_w > 72\ \varepsilon$

81,0 61,1

Dwarskracht plooi noodzakelijk

relatieve stijfheid	λ	1,10		(5.8)
	f_{bv}	142	N/mm^2	(tabel 6-1 van de NEN-EN 1993-1-3)
	$V_{b,Rd}$	623	kN/m	(5.7)
	$V_{PL,Rd}$	827	kN/m	(5.5)

Dwarskracht meer dan 50% van $V_{PL,Rd}$ $V_{Ed}/V_{PL,Rd}$ 0,21 < 0,5

formules 5.10 en 5.9 niet van toepassing

	p	0,33	[-]	(5.10)
	$M_{V,Rd}$	581	kNm/m	(5.9)
	N_{CR}	5018	kN/m	(5.12)

Controle of stabiliteitscontrole nodig is N_{Ed}/N_{CR} 0,022 < 0,04 (5.11)

Geen stabiliteitscontrole nodig

	λ	0,88	[-] (5.13 toelichting)
	N_{PL}	3916	kN/m (5.13 toelichting)
	α	0,76	[-] (Tabel 6.1 van de NEN-EN 1993-1-1 curve d)
	ϕ	1,15	[-] (6.49, toelichting NEN-EN 1993-1-1)
	χ	0,53	[-] (6.49 van de NEN-EN 1993-1-1)

Controle stabiliteit Buiging en Normaalkracht

Controle volgens 5,13 1,04 [-]

Check of Normaalkracht meegenomen moet worden in controle moment

$N_{Ed}/N_{PL,Rd}$ 0,03 < 0,1

Normaalkracht hoeft NIET meegenomen worden in berekening

Mc,Rd 581 (5.2) of (5.3)

UC stabiliteit	0,00
UC sterkte, moment	0,86
UC sterkte, dwarskracht	0,28
UC sterkte, normaalkract	0,03
UC sterkte, gecombineerd	0,86
UC totaal	**0,86**

Report for D-Sheet Piling 14.1

Design of Sheet Pilings
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	12/1/2014
Time of report:	12:35:20 PM
Date of calculation:	11/25/2014
Time of calculation:	2:47:36 PM
Filename:	C:\Users\nl85691\Desktop\08 Schermen\DR54 Keerscherm Kanaalweg II
Project identification:	Waterschap Peel en Maas vallei Prioritaire Dijkversterking 1 DR54.170-172

Verification according to NEN-EN 9997+C1:2012

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2 Summary

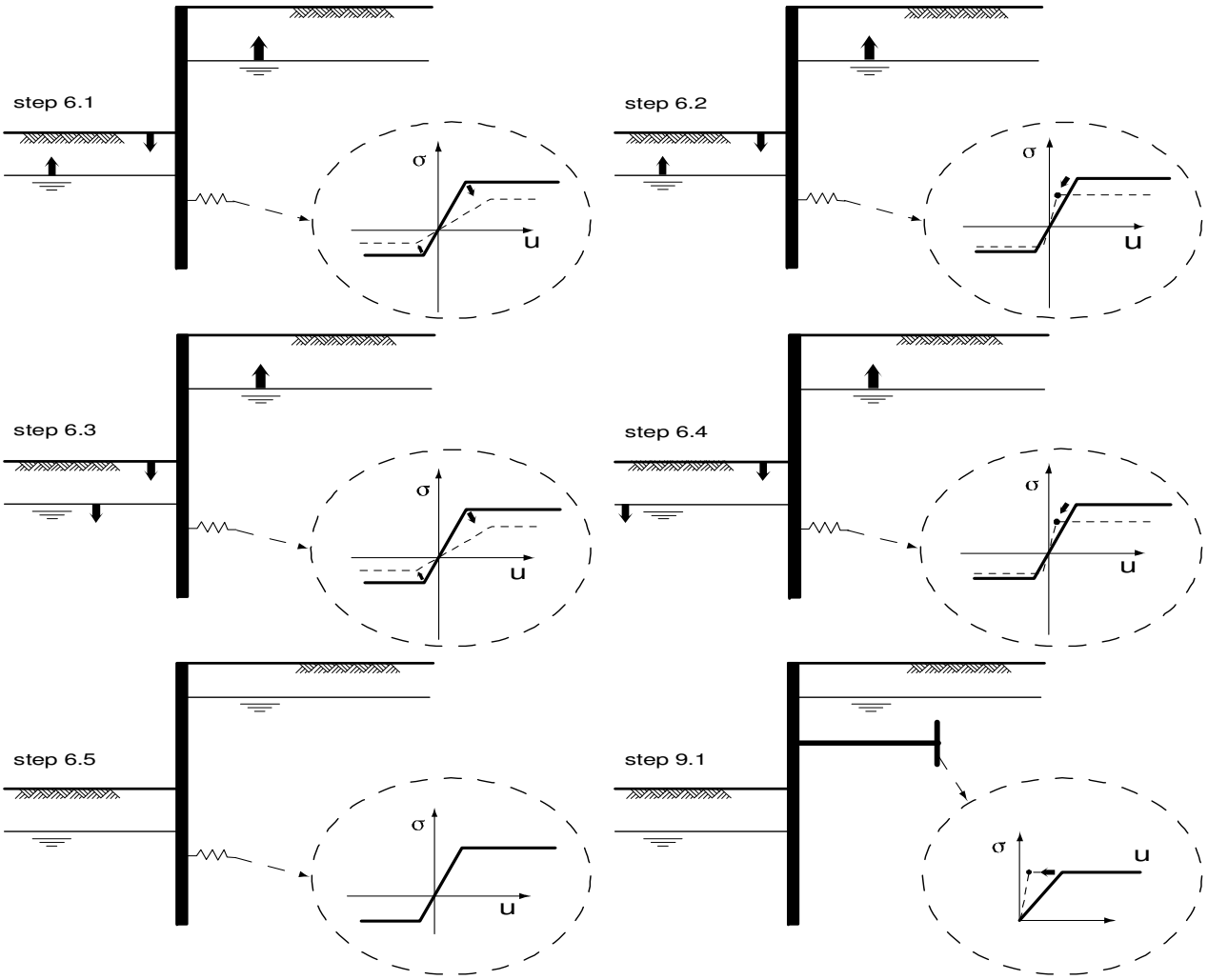
2.1 Overview per Stage and Test

Stage no.	Verification type	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
1	EC7(NL)-Step 6.1		4,2	-6,9	**0,0**	16,8	---
1	EC7(NL)-Step 6.2		2,6	-6,0	**0,0**	16,8	---
1	EC7(NL)-Step 6.3		5,2	-8,4	**0,0**	16,9	---
1	EC7(NL)-Step 6.4		3,1	-7,3	**0,0**	16,9	---
1	EC7(NL)-Step 6.5	0,5	4,0	-7,2	**0,0**	11,7	---
1	EC7(NL)-Step 6.5 * 1,20		4,8	-8,6			
2	EC7(NL)-Step 6.1		2,0	-3,3	**0,0**	15,5	---
2	EC7(NL)-Step 6.2		1,2	-2,9	**0,0**	15,5	---
2	EC7(NL)-Step 6.3		2,9	-4,8	**0,0**	16,5	---
2	EC7(NL)-Step 6.4		1,2	-2,9	**0,0**	15,5	---
2	EC7(NL)-Step 6.5	0,2	1,9	-3,5	**0,0**	10,9	---
2	EC7(NL)-Step 6.5 * 1,20		2,3	-4,1			
3	EC7(NL)-Step 6.1		352,8	-152,2	**0,0**	59,5	---
3	EC7(NL)-Step 6.2		352,1	-138,6	**0,0**	57,6	---
3	EC7(NL)-Step 6.3		297,1	-110,6	**0,0**	55,3	---
3	EC7(NL)-Step 6.4		294,9	92,3	**0,0**	53,2	---
3	EC7(NL)-Step 6.5	-80,3	164,1	66,2	**0,0**	33,3	---
3	EC7(NL)-Step 6.5 * 1,20		196,9	79,4			
4	EC7(NL)-Step 6.1		461,7	**-214,4**	**0,0**	**67,3**	---
4	EC7(NL)-Step 6.2		**462,3**	-205,2	**0,0**	66,2	---
4	EC7(NL)-Step 6.3		394,6	-156,8	**0,0**	61,1	---
4	EC7(NL)-Step 6.4		394,4	-143,4	**0,0**	59,3	---
4	EC7(NL)-Step 6.5	**-102,1**	205,1	78,5	**0,0**	34,8	---
4	EC7(NL)-Step 6.5 * 1,20		246,1	94,2			
Max		**-102,1**	**462,3**	**-214,4**	**0,0**	**67,3**	---

2.2 Overall Stability per Stage

Stage name	Stability factor [-]
Aanleg	7,13
MHW	11,01
VAL (MHW)	2,52
VAL (MHW) (Ve...	2,49

2.3 CUR Verification Steps



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	4
Unit weight of water	9,81 kN/m³
Number of curves on spring characteristic	3
Unloading curve on spring characteristic	No

3.2 Sheet Piling Properties

Length	11,50 m
Level top side	13,40 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 20 -700	1,90	13,40	5,9841E+04	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 20 -700	1,90	13,40	480,00	1,00	1,00	1,00	480,00

Section name	From [m]	To [m]	Red. factor EI [-]	Note to reduction factor	Corrected stiffness EI [kNm²]
AZ 20 -700	1,90	13,40	1,00		59840,00

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
AZ 20 -700	1,90	13,40	421,00	1,33	152,00

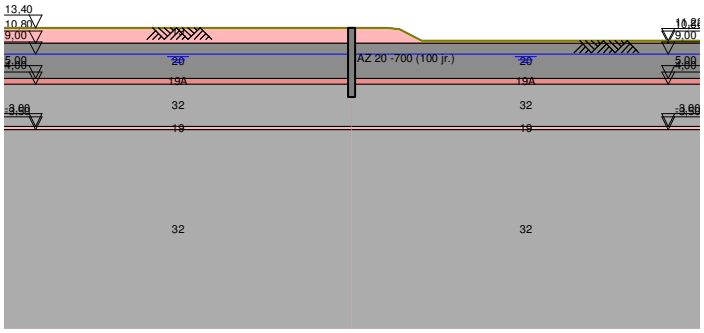
3.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL method A: Partial factors (design values) in all stages Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
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 1: Aanleg

Outline - Stage 1: Aanleg

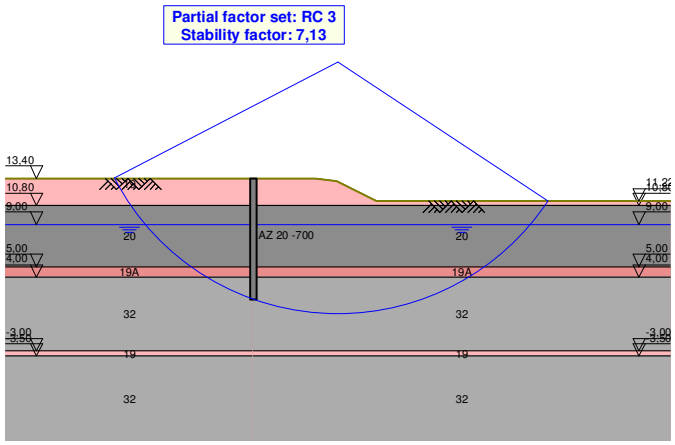


5 Overall Stability Stage 1: Aanleg

Stability factor : 7,13

5.1 Overall Stability

Overall Stability - Stage 1: Aanleg



6 Step 6.1 Stage 1: Aanleg

6.1 Input Data Left

6.1.1 Calculation Method

Calculation method: C, phi, delta

6.1.2 Water Level

Water level: 9,05 [m]

6.1.3 Surface

X [m]	Y [m]
0,00	13,40

6.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	12,2	0,00	0,64	12,36
3	13,20	0,0	20,5	0,00	0,64	5,55
4	12,88	0,1	37,6	0,01	0,64	4,04
5	12,51	3,9	58,1	0,24	0,64	3,62
6	12,23	5,9	73,0	0,28	0,64	3,48
7	11,93	8,2	90,0	0,31	0,64	3,39
8	11,47	11,4	114,6	0,33	0,64	3,31
9	11,03	14,7	139,2	0,34	0,64	3,26
10	10,64	15,4	239,5	0,31	0,54	4,82
11	10,31	17,2	264,1	0,31	0,54	4,75
12	9,99	19,1	290,4	0,31	0,54	4,73
13	9,64	21,0	319,5	0,31	0,54	4,72
14	9,26	23,2	351,1	0,31	0,54	4,71
15	9,06	24,3	367,7	0,31	0,54	4,71
16	9,03	24,4	369,7	0,31	0,54	4,71
17	8,91	24,8	375,2	0,31	0,54	4,71
18	8,79	25,2	381,1	0,31	0,54	4,71
19	8,48	26,1	395,5	0,31	0,54	4,70
20	7,95	27,8	421,0	0,31	0,54	4,70
21	7,41	29,5	446,6	0,31	0,54	4,70
22	6,88	31,2	472,2	0,31	0,54	4,70
23	6,34	32,9	497,8	0,31	0,54	4,70
24	5,80	34,6	523,4	0,31	0,54	4,70
25	5,27	36,3	549,1	0,31	0,54	4,70
26	4,75	43,2	429,3	0,35	0,61	3,53
27	4,25	44,8	443,7	0,36	0,61	3,52
28	3,74	42,8	493,8	0,33	0,53	3,77
29	3,21	44,6	513,0	0,33	0,53	3,76
30	2,69	46,4	532,3	0,33	0,53	3,76
31	2,16	48,1	551,6	0,33	0,53	3,75

6.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	247,59
19A	73,45
32	139,57
19	0,00
32	0,00

6.4 Input Data Right

6.4.1 Calculation Method

Calculation method: C, phi, delta

6.4.2 Water Level

Water level: 9,25 [m]

6.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

6.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

6.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

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	13,38	0,0	10,0	0,00	0,51	37,16
2	13,35	0,0	12,2	0,00	0,51	12,36
3	13,20	0,0	20,5	0,00	0,51	5,55
4	12,88	0,1	37,6	0,01	0,51	4,04
5	12,51	3,9	58,1	0,24	0,51	3,62
6	12,23	5,9	73,0	0,28	0,51	3,49
7	11,93	8,2	90,0	0,31	0,51	3,40
8	11,47	11,4	114,6	0,33	0,51	3,32
9	11,03	14,7	139,2	0,35	0,52	3,28
10	10,64	15,4	228,5	0,31	0,42	4,64
11	10,31	17,2	227,0	0,31	0,42	4,13
12	9,99	19,1	232,1	0,31	0,43	3,83
13	9,64	21,0	248,3	0,32	0,43	3,72
14	9,26	23,1	251,0	0,31	0,43	3,43
15	9,06	23,8	247,8	0,32	0,43	3,29
16	9,03	23,9	246,5	0,32	0,43	3,26
17	8,91	24,3	241,0	0,32	0,43	3,15
18	8,79	24,7	238,7	0,32	0,43	3,07
19	8,48	25,6	247,4	0,32	0,43	3,07
20	7,95	27,3	264,9	0,32	0,44	3,10
21	7,41	29,0	284,6	0,32	0,44	3,15
22	6,88	30,7	305,6	0,32	0,44	3,21
23	6,34	32,4	327,5	0,32	0,45	3,27
24	5,80	34,1	350,1	0,33	0,45	3,34
25	5,27	35,9	373,3	0,33	0,46	3,41
26	4,75	42,5	262,2	0,37	0,54	2,30
27	4,25	43,8	275,4	0,37	0,54	2,34
28	3,74	41,7	332,0	0,34	0,46	2,73
29	3,21	43,3	349,3	0,34	0,47	2,76
30	2,69	44,8	369,7	0,34	0,47	2,82
31	2,16	46,4	396,3	0,34	0,48	2,92

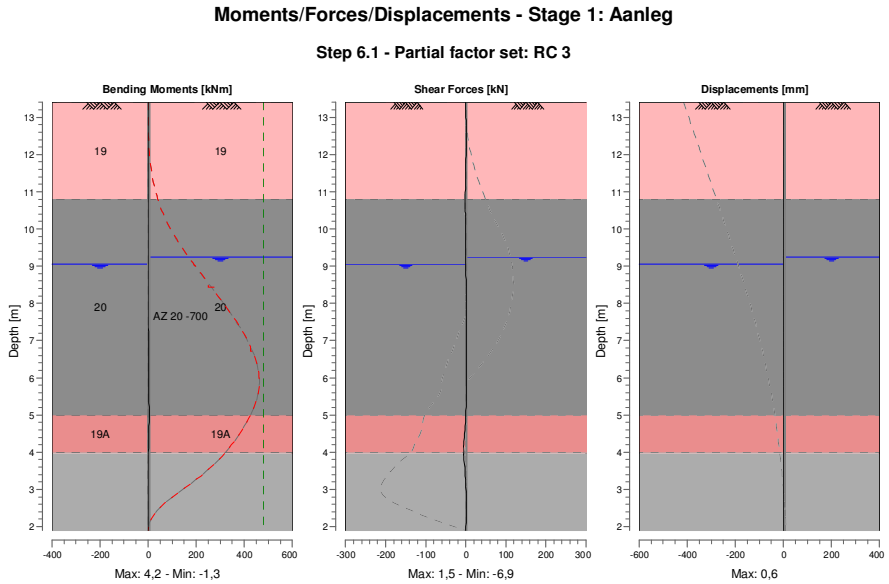
6.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	241,53
19A	64,28
32	142,33
19	0,00
32	0,00

6.7 Calculation Results

Number of iterations: 2

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	13,40	0,0	0,0	0,3
1	13,37	0,0	0,0	0,3
2	13,37	0,0	0,0	0,3
2	13,32	0,0	0,1	0,3
3	13,32	0,0	0,1	0,3
3	13,07	0,1	0,5	0,3
4	13,07	0,1	0,5	0,3
4	12,70	0,3	0,8	0,4
5	12,70	0,3	0,8	0,4
5	12,32	0,6	0,9	0,4
6	12,32	0,6	0,9	0,4
6	12,15	0,8	0,8	0,4
7	12,15	0,8	0,8	0,4
7	11,70	1,0	0,3	0,4
8	11,70	1,0	0,3	0,4
8	11,25	1,0	-0,5	0,4
9	11,25	1,0	-0,5	0,4
9	10,80	0,5	-1,8	0,4
10	10,80	0,5	-1,8	0,4
10	10,47	0,1	-1,1	0,4
11	10,47	0,1	-1,1	0,4
11	10,15	-0,2	-0,6	0,4
12	10,15	-0,2	-0,6	0,4
12	9,82	-0,4	-0,3	**0,5**
13	9,82	-0,4	-0,3	**0,5**
13	9,45	-0,4	0,0	**0,5**
14	9,45	-0,4	0,0	**0,5**
14	9,07	-0,4	0,2	**0,5**
15	9,07	-0,4	0,2	**0,5**
15	9,05	-0,4	0,2	**0,5**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	-0,4	0,2	**0,5**
16	9,00	-0,4	0,3	**0,5**
17	9,00	-0,4	0,3	**0,5**
17	8,82	-0,3	0,5	**0,5**
18	8,82	-0,3	0,5	**0,5**
18	8,75	-0,3	0,5	**0,5**
19	8,75	-0,3	0,5	**0,5**
19	8,21	0,1	1,0	**0,5**
20	8,21	0,1	1,0	**0,5**
20	7,68	0,7	1,3	**0,5**
21	7,68	0,7	1,3	**0,5**
21	7,14	1,5	1,4	**0,5**
22	7,14	1,5	1,4	**0,5**
22	6,61	2,3	1,5	**0,5**
23	6,61	2,3	1,5	**0,5**
23	6,07	3,1	1,4	**0,5**
24	6,07	3,1	1,4	**0,5**
24	5,54	3,8	1,1	**0,5**
25	5,54	3,8	1,1	**0,5**
25	5,00	**4,2**	0,3	**0,5**
26	5,00	**4,2**	0,3	**0,5**
26	4,50	3,5	-3,1	0,4
27	4,50	3,5	-3,1	0,4
27	4,00	1,1	**-6,9**	0,4
28	4,00	1,1	**-6,9**	0,4
28	3,48	-1,1	-1,8	0,3
29	3,48	-1,1	-1,8	0,3
29	2,95	-1,2	0,9	0,2
30	2,95	-1,2	0,9	0,2
30	2,42	-0,5	1,5	0,2
31	2,42	-0,5	1,5	0,2
31	1,90	0,0	0,0	0,1
Max		**4,2**	**-6,9**	**0,5**
Max, minor nodes incl.		4,2	-6,9	0,6

6.7.3 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	13,40	0,00	0,00	A		0,00	0,00	P	
1	13,37	0,00	0,00	A		1,24	0,00	1	6
2	13,37	0,00	0,00	A		1,24	0,00	1	19
2	13,32	0,00	0,00	A		1,70	0,00	1	10
3	13,32	0,00	0,00	A		1,70	0,00	1	21
3	13,07	2,77	0,00	1		4,02	0,00	1	12
4	13,07	2,77	0,00	1		4,03	0,00	1	17
4	12,70	7,01	0,00	1		7,50	0,00	1	15
5	12,70	7,01	0,00	1		7,52	0,00	1	16
5	12,32	11,26	0,00	1		10,99	0,00	1	16
6	12,32	11,26	0,00	1		11,01	0,00	1	16
6	12,15	13,18	0,00	1		12,59	0,00	1	16
7	12,15	13,18	0,00	1		12,62	0,00	1	17
7	11,70	18,29	0,00	1		16,78	0,00	1	16
8	11,70	18,29	0,00	1		16,87	0,00	1	17
8	11,25	23,40	0,00	1		21,03	0,00	1	16
9	11,25	23,40	0,00	1		21,17	0,00	1	17
9	10,80	28,53	0,00	1		25,31	0,00	1	17
10	10,80	21,22	0,00	1		23,45	0,00	1	11
10	10,47	24,29	0,00	1		25,92	0,00	1	11
11	10,47	24,29	0,00	1		26,08	0,00	1	12
11	10,15	27,36	0,00	1		28,56	0,00	1	12
12	10,15	27,36	0,00	1		28,74	0,00	1	13
12	9,82	30,43	0,00	1		31,23	0,00	1	13

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* [%]
13	9,82	30,43	0,00	1		31,46	0,00	1	13
13	9,45	33,99	0,00	1		34,37	0,00	1	13
14	9,45	33,99	0,00	1		34,65	0,00	1	14
14	9,07	37,53	0,00	1		36,81	1,77	1	14
15	9,07	37,53	0,00	1		36,82	1,77	1	15
15	9,05	37,72	0,00	1		36,91	1,96	1	15
16	9,05	37,72	0,00	1		36,91	1,96	1	15
16	9,00	37,98	0,49	1		37,13	2,45	1	15
17	9,00	37,98	0,49	1		37,14	2,45	1	16
17	8,82	38,91	2,26	1		37,93	4,22	1	16
18	8,82	38,91	2,26	1		37,94	4,22	1	16
18	8,75	39,27	2,94	1		38,25	4,91	1	16
19	8,75	39,27	2,94	1		38,32	4,91	1	16
19	8,21	42,03	8,20	1		40,65	10,16	1	16
20	8,21	42,03	8,20	1		40,84	10,16	1	16
20	7,68	44,80	13,45	1		43,16	15,42	1	16
21	7,68	44,80	13,45	1		43,44	15,42	1	16
21	7,14	47,59	18,71	1		45,72	20,67	1	16
22	7,14	47,59	18,71	1		46,08	20,67	1	16
22	6,61	50,46	23,96	1		48,30	25,93	1	15
23	6,61	50,46	23,96	1		48,72	25,93	1	15
23	6,07	53,42	29,22	1		50,85	31,18	1	15
24	6,07	53,42	29,22	1		51,32	31,18	1	15
24	5,54	56,52	34,48	1		53,33	36,44	1	15
25	5,54	56,52	34,48	1		53,84	36,44	1	15
25	5,00	59,79	39,73	1		55,70	41,69	1	15
26	5,00	70,56	39,73	1		62,29	41,69	1	24
26	4,50	73,44	44,64	1		64,04	46,60	1	24
27	4,50	73,44	44,64	1		64,55	46,60	1	24
27	4,00	76,39	49,54	1		66,25	51,50	1	24
28	4,00	56,51	49,54	1		66,80	51,50	1	21
28	3,48	61,60	54,69	1		66,71	56,65	1	20
29	3,48	61,60	54,69	1		67,29	56,65	1	20
29	2,95	66,56	59,84	1		67,36	61,80	1	19
30	2,95	66,56	59,84	1		67,95	61,80	1	19
30	2,42	71,36	64,99	1		68,21	66,95	1	18
31	2,42	71,36	64,99	1		68,79	66,95	1	18
31	1,90	76,09	70,14	1		69,15	72,10	1	17

*

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	496,4	482,2
Water	250,8	265,0
Total	747,2	747,2

Considered as passive side	Right
Maximum passive effective resistance	2872,36 kN
Mobilized passive effective resistance	482,21 kN
Percentage mobilized resistance	16,8 %

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	-135,93
Vertical force passive	131,45
Resulting vertical force (no dead weight)	-4,48
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (4 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-135,93
Vertical force passive	131,45
Resulting vertical force (no dead weight)	-4,48
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (4 > 0)	

6.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-9,04	13,40	19	8,59
10,80	20	-82,05	10,80	20	80,04
5,00	19A	-20,15	5,00	19A	17,63
4,00	32	-24,69	4,00	32	25,18

7 Step 6.2 Stage 1: Aanleg

7.1 Input Data Left

7.1.1 Calculation Method

Calculation method: C, phi, delta

7.1.2 Water Level

Water level: 9,05 [m]

7.1.3 Surface

X [m]	Y [m]
0,00	13,40

7.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	12,2	0,00	0,64	12,36
3	13,07	0,0	27,3	0,00	0,64	4,60
4	12,57	3,0	54,7	0,20	0,64	3,66
5	12,23	5,9	73,0	0,28	0,64	3,48
6	11,93	8,2	90,0	0,31	0,64	3,39
7	11,47	11,4	114,6	0,33	0,64	3,31
8	11,03	14,7	139,2	0,34	0,64	3,26
9	10,64	15,4	239,5	0,31	0,54	4,82
10	10,31	17,2	264,1	0,31	0,54	4,75
11	9,99	19,1	290,4	0,31	0,54	4,73
12	9,64	21,0	319,5	0,31	0,54	4,72
13	9,26	23,2	351,1	0,31	0,54	4,71
14	9,06	24,3	367,7	0,31	0,54	4,71
15	9,03	24,4	369,7	0,31	0,54	4,71
16	8,91	24,8	375,2	0,31	0,54	4,71
17	8,79	25,2	381,1	0,31	0,54	4,71
18	8,48	26,1	395,5	0,31	0,54	4,70
19	7,95	27,8	421,0	0,31	0,54	4,70
20	7,41	29,5	446,6	0,31	0,54	4,70
21	6,88	31,2	472,2	0,31	0,54	4,70
22	6,34	32,9	497,8	0,31	0,54	4,70
23	5,80	34,6	523,4	0,31	0,54	4,70
24	5,27	36,3	549,1	0,31	0,54	4,70
25	4,75	43,2	429,3	0,35	0,61	3,53
26	4,25	44,8	443,7	0,36	0,61	3,52
27	3,74	42,8	493,8	0,33	0,53	3,77
28	3,21	44,6	513,0	0,33	0,53	3,76
29	2,69	46,4	532,3	0,33	0,53	3,76
30	2,16	48,1	551,6	0,33	0,53	3,75

7.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	247,35
19A	73,30
32	139,99
19	0,00
32	0,00

7.4 Input Data Right

7.4.1 Calculation Method

Calculation method: C, phi, delta

7.4.2 Water Level

Water level: 9,25 [m]

7.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

7.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

7.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

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	13,38	0,0	10,0	0,00	0,51	37,16
2	13,35	0,0	12,2	0,00	0,51	12,36
3	13,07	0,0	27,3	0,00	0,51	4,60
4	12,57	3,0	54,7	0,20	0,51	3,66
5	12,23	5,9	73,0	0,28	0,51	3,49
6	11,93	8,2	90,0	0,31	0,51	3,40
7	11,47	11,4	114,6	0,33	0,51	3,32
8	11,03	14,7	139,2	0,35	0,52	3,28
9	10,64	15,4	228,5	0,31	0,42	4,64
10	10,31	17,2	227,0	0,31	0,42	4,13
11	9,99	19,1	232,1	0,31	0,43	3,83
12	9,64	21,0	248,3	0,32	0,43	3,72
13	9,26	23,1	251,0	0,31	0,43	3,43
14	9,06	23,8	247,8	0,32	0,43	3,29
15	9,03	23,9	246,5	0,32	0,43	3,26
16	8,91	24,3	241,0	0,32	0,43	3,15
17	8,79	24,7	238,7	0,32	0,43	3,07
18	8,48	25,6	247,4	0,32	0,43	3,07
19	7,95	27,3	264,9	0,32	0,44	3,10
20	7,41	29,0	284,6	0,32	0,44	3,15
21	6,88	30,7	305,6	0,32	0,44	3,21
22	6,34	32,4	327,5	0,32	0,45	3,27
23	5,80	34,1	350,1	0,33	0,45	3,34
24	5,27	35,9	373,3	0,33	0,46	3,41
25	4,75	42,5	262,2	0,37	0,54	2,30
26	4,25	43,8	275,4	0,37	0,54	2,34
27	3,74	41,7	332,0	0,34	0,46	2,73
28	3,21	43,3	349,3	0,34	0,47	2,76
29	2,69	44,8	369,7	0,34	0,47	2,82
30	2,16	46,4	396,3	0,34	0,48	2,92

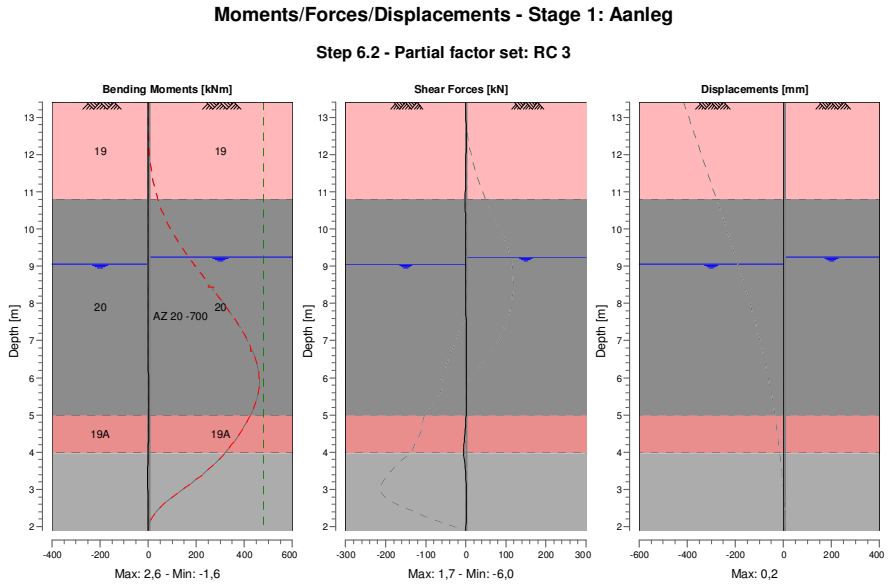
7.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	241,78
19A	64,44
32	141,91
19	0,00
32	0,00

7.7 Calculation Results

Number of iterations: 2

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	13,40	0,0	0,0	0,1
1	13,37	0,0	0,0	0,1
2	13,37	0,0	0,0	0,1
2	13,32	0,0	0,1	0,1
3	13,32	0,0	0,1	0,1
3	12,82	0,2	0,7	0,1
4	12,82	0,2	0,7	0,1
4	12,32	0,6	0,8	0,1
5	12,32	0,6	0,8	0,1
5	12,15	0,7	0,7	0,1
6	12,15	0,7	0,7	0,1
6	11,70	1,0	0,3	0,1
7	11,70	1,0	0,3	0,1
7	11,25	0,9	-0,5	0,1
8	11,25	0,9	-0,5	0,1
8	10,80	0,5	-1,7	0,1
9	10,80	0,5	-1,7	0,1
9	10,47	0,0	-1,1	0,1
10	10,47	0,0	-1,1	0,1
10	10,15	-0,2	-0,6	**0,2**
11	10,15	-0,2	-0,6	**0,2**
11	9,82	-0,4	-0,3	**0,2**
12	9,82	-0,4	-0,3	**0,2**
12	9,45	-0,5	-0,1	**0,2**
13	9,45	-0,5	-0,1	**0,2**
13	9,07	-0,5	0,0	**0,2**
14	9,07	-0,5	0,0	**0,2**
14	9,05	-0,5	0,0	**0,2**
15	9,05	-0,5	0,0	**0,2**
15	9,00	-0,5	0,0	**0,2**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	-0,5	0,0	**0,2**
16	8,82	-0,5	0,1	**0,2**
17	8,82	-0,5	0,1	**0,2**
17	8,75	-0,5	0,2	**0,2**
18	8,75	-0,5	0,2	**0,2**
18	8,21	-0,3	0,4	**0,2**
19	8,21	-0,3	0,4	**0,2**
19	7,68	0,0	0,6	**0,2**
20	7,68	0,0	0,6	**0,2**
20	7,14	0,3	0,7	**0,2**
21	7,14	0,3	0,7	**0,2**
21	6,61	0,8	0,9	**0,2**
22	6,61	0,8	0,9	**0,2**
22	6,07	1,3	1,1	**0,2**
23	6,07	1,3	1,1	**0,2**
23	5,54	2,0	1,1	**0,2**
24	5,54	2,0	1,2	**0,2**
24	5,00	**2,5**	0,9	**0,2**
25	5,00	**2,5**	0,9	**0,2**
25	4,50	2,2	-2,4	**0,2**
26	4,50	2,2	-2,4	**0,2**
26	4,00	0,1	**-6,0**	0,1
27	4,00	0,1	**-6,0**	0,1
27	3,48	-1,6	-0,9	0,1
28	3,48	-1,6	-0,9	0,1
28	2,95	-1,3	1,4	0,1
29	2,95	-1,3	1,4	0,1
29	2,42	-0,5	1,5	0,1
30	2,42	-0,5	1,5	0,1
30	1,90	0,0	0,0	0,0
Max		**2,5**	**-6,0**	**0,2**
Max, minor nodes incl.		2,6	-6,0	0,2

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	13,40	0,00	0,00	A		0,00	0,00	P	
1	13,37	0,00	0,00	A		1,17	0,00	1	6
2	13,37	0,00	0,00	A		1,17	0,00	1	17
2	13,32	0,01	0,00	1		1,64	0,00	1	9
3	13,32	0,01	0,00	1		1,64	0,00	1	25
3	12,82	5,62	0,00	1		6,32	0,00	1	13
4	12,82	5,62	0,00	1		6,33	0,00	1	17
4	12,32	11,24	0,00	1		11,00	0,00	1	15
5	12,32	11,24	0,00	1		11,03	0,00	1	16
5	12,15	13,16	0,00	1		12,61	0,00	1	16
6	12,15	13,16	0,00	1		12,65	0,00	1	17
6	11,70	18,25	0,00	1		16,83	0,00	1	16
7	11,70	18,25	0,00	1		16,92	0,00	1	17
7	11,25	23,36	0,00	1		21,07	0,00	1	16
8	11,25	23,36	0,00	1		21,21	0,00	1	17
8	10,80	28,51	0,00	1		25,33	0,00	1	17
9	10,80	21,16	0,00	1		23,51	0,00	1	11
9	10,47	24,29	0,00	1		25,92	0,00	1	11
10	10,47	24,29	0,00	1		26,08	0,00	1	12
10	10,15	27,42	0,00	1		28,50	0,00	1	12
11	10,15	27,42	0,00	1		28,68	0,00	1	13
11	9,82	30,54	0,00	1		31,12	0,00	1	13
12	9,82	30,54	0,00	1		31,35	0,00	1	13
12	9,45	34,14	0,00	1		34,21	0,00	1	13
13	9,45	34,14	0,00	1		34,49	0,00	1	14
13	9,07	37,72	0,00	1		36,63	1,77	1	14

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* [%]
14	9,07	37,72	0,00	1		36,64	1,77	1	15
14	9,05	37,90	0,00	1		36,73	1,96	1	15
15	9,05	37,90	0,00	1		36,73	1,96	1	15
15	9,00	38,16	0,49	1		36,94	2,45	1	15
16	9,00	38,16	0,49	1		36,95	2,45	1	16
16	8,82	39,10	2,26	1		37,74	4,22	1	16
17	8,82	39,10	2,26	1		37,76	4,22	1	16
17	8,75	39,46	2,94	1		38,06	4,91	1	16
18	8,75	39,46	2,94	1		38,13	4,91	1	16
18	8,21	42,19	8,20	1		40,49	10,16	1	16
19	8,21	42,19	8,20	1		40,69	10,16	1	16
19	7,68	44,87	13,45	1		43,08	15,42	1	16
20	7,68	44,87	13,45	1		43,37	15,42	1	16
20	7,14	47,56	18,71	1		45,76	20,67	1	16
21	7,14	47,56	18,71	1		46,12	20,67	1	16
21	6,61	50,28	23,96	1		48,48	25,93	1	16
22	6,61	50,28	23,96	1		48,90	25,93	1	15
22	6,07	53,11	29,22	1		51,16	31,18	1	15
23	6,07	53,11	29,22	1		51,64	31,18	1	15
23	5,54	56,11	34,48	1		53,74	36,44	1	15
24	5,54	56,11	34,48	1		54,26	36,44	1	15
24	5,00	59,36	39,73	1		56,12	41,69	1	15
25	5,00	70,35	39,73	1		62,50	41,69	1	24
25	4,50	73,28	44,64	1		64,20	46,60	1	24
26	4,50	73,28	44,64	1		64,71	46,60	1	24
26	4,00	76,33	49,54	1		66,30	51,50	1	24
27	4,00	56,14	49,54	1		67,17	51,50	1	21
27	3,48	61,86	54,69	1		66,45	56,65	1	20
28	3,48	61,86	54,69	1		67,03	56,65	1	20
28	2,95	67,00	59,84	1		66,93	61,80	1	19
29	2,95	67,00	59,84	1		67,51	61,80	1	19
29	2,42	71,60	64,99	1		67,97	66,95	1	18
30	2,42	71,60	64,99	1		68,56	66,95	1	18
30	1,90	75,98	70,14	1		69,26	72,10	1	17

*

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	496,4	482,2
Water	250,8	265,0
Total	747,2	747,2

Considered as passive side	Right
Maximum passive effective resistance	2872,36 kN
Mobilized passive effective resistance	482,21 kN
Percentage mobilized resistance	16,8 %

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	-135,87
Vertical force passive	131,50
Resulting vertical force (no dead weight)	-4,37
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (4 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-135,87
Vertical force passive	131,50
Resulting vertical force (no dead weight)	-4,37
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (4 > 0)	

7.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-9,03	13,40	19	8,60
10,80	20	-81,97	10,80	20	80,12
5,00	19A	-20,11	5,00	19A	17,67
4,00	32	-24,77	4,00	32	25,11

8 Step 6.3 Stage 1: Aanleg

8.1 Input Data Left

8.1.1 Calculation Method

Calculation method: C, phi, delta

8.1.2 Water Level

Water level: 9,05 [m]

8.1.3 Surface

X [m]	Y [m]
0,00	13,40

8.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

8.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

8.2 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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	12,2	0,00	0,64	12,36
3	13,20	0,0	20,5	0,00	0,64	5,55
4	12,88	0,1	37,6	0,01	0,64	4,04
5	12,51	3,9	58,1	0,24	0,64	3,62
6	12,23	5,9	73,0	0,28	0,64	3,48
7	11,93	8,2	90,0	0,31	0,64	3,39
8	11,47	11,4	114,6	0,33	0,64	3,31
9	11,03	14,7	139,2	0,34	0,64	3,26
10	10,64	15,4	239,5	0,31	0,54	4,82
11	10,31	17,2	264,1	0,31	0,54	4,75
12	9,99	19,1	290,4	0,31	0,54	4,73
13	9,64	21,0	319,5	0,31	0,54	4,72
14	9,26	23,2	351,1	0,31	0,54	4,71
15	9,06	24,3	367,7	0,31	0,54	4,71
16	9,03	24,4	369,7	0,31	0,54	4,71
17	8,91	24,8	375,2	0,31	0,54	4,71
18	8,79	25,2	381,1	0,31	0,54	4,71
19	8,48	26,1	395,5	0,31	0,54	4,70
20	7,95	27,8	421,0	0,31	0,54	4,70
21	7,41	29,5	446,6	0,31	0,54	4,70
22	6,88	31,2	472,2	0,31	0,54	4,70
23	6,34	32,9	497,8	0,31	0,54	4,70
24	5,80	34,6	523,4	0,31	0,54	4,70
25	5,27	36,3	549,1	0,31	0,54	4,70
26	4,75	43,2	429,3	0,35	0,61	3,53
27	4,25	44,8	443,7	0,36	0,61	3,52
28	3,74	42,8	493,8	0,33	0,53	3,77
29	3,21	44,6	513,0	0,33	0,53	3,76
30	2,69	46,4	532,3	0,33	0,53	3,76
31	2,16	48,1	551,6	0,33	0,53	3,75

8.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	242,31
19A	72,96
32	135,99
19	0,00
32	0,00

8.4 Input Data Right

8.4.1 Calculation Method

Calculation method: C, phi, delta

8.4.2 Water Level

Water level: 8,75 [m]

8.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

8.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

8.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

8.5 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	13,38	0,0	10,0	0,00	0,51	37,16
2	13,35	0,0	12,2	0,00	0,51	12,36
3	13,20	0,0	20,5	0,00	0,51	5,55
4	12,88	0,1	37,6	0,01	0,51	4,04
5	12,51	3,9	58,1	0,24	0,51	3,62
6	12,23	5,9	73,0	0,28	0,51	3,49
7	11,93	8,2	90,0	0,31	0,51	3,40
8	11,47	11,4	114,6	0,33	0,51	3,32
9	11,03	14,7	139,2	0,35	0,52	3,28
10	10,64	15,4	228,5	0,31	0,42	4,64
11	10,31	17,2	227,0	0,31	0,42	4,13
12	9,99	19,1	232,1	0,31	0,43	3,83
13	9,64	21,0	248,3	0,32	0,43	3,72
14	9,26	23,2	252,9	0,32	0,43	3,45
15	9,06	24,3	256,4	0,32	0,44	3,34
16	9,03	24,5	256,7	0,32	0,44	3,32
17	8,91	25,1	257,1	0,32	0,44	3,24
18	8,79	25,8	259,4	0,32	0,44	3,19
19	8,48	26,9	268,3	0,32	0,44	3,18
20	7,95	28,6	284,4	0,32	0,44	3,18
21	7,41	30,3	303,3	0,32	0,44	3,22
22	6,88	32,0	323,9	0,32	0,45	3,27
23	6,34	33,7	345,6	0,32	0,45	3,33
24	5,80	35,3	368,1	0,33	0,46	3,39
25	5,27	37,1	391,2	0,33	0,46	3,45
26	4,75	43,9	275,4	0,37	0,54	2,34
27	4,25	45,3	288,5	0,37	0,54	2,38
28	3,74	43,0	346,4	0,34	0,47	2,76
29	3,21	44,6	363,6	0,34	0,47	2,79
30	2,69	46,1	383,8	0,34	0,47	2,84
31	2,16	47,7	410,2	0,34	0,48	2,94

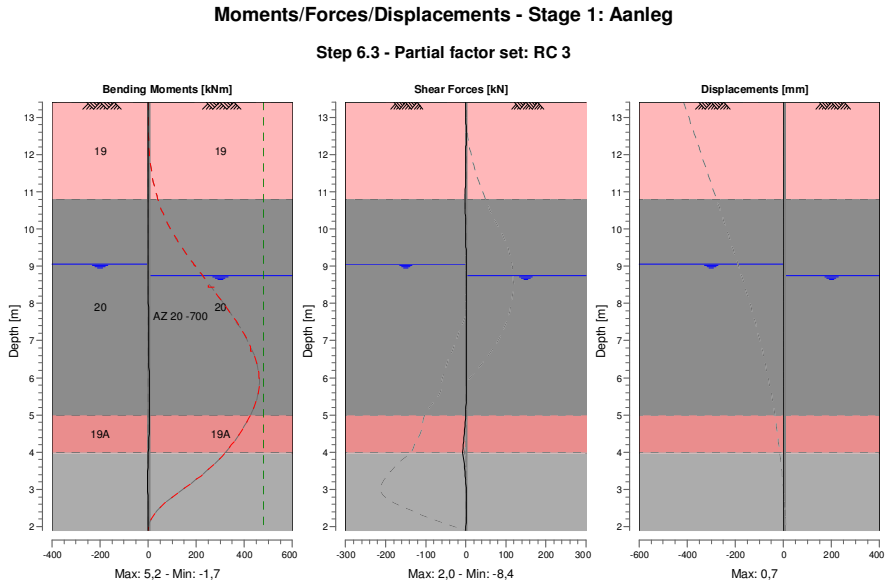
8.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	255,88
19A	67,35
32	150,62
19	0,00
32	0,00

8.7 Calculation Results

Number of iterations: 2

8.7.1 Charts of Moments, Forces and Displacements



8.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,3
1	13,37	0,0	0,0	0,3
2	13,37	0,0	0,0	0,3
2	13,32	0,0	0,1	0,3
3	13,32	0,0	0,1	0,3
3	13,07	0,1	0,4	0,3
4	13,07	0,1	0,4	0,3
4	12,70	0,3	0,7	0,3
5	12,70	0,3	0,7	0,3
5	12,32	0,5	0,7	0,4
6	12,32	0,5	0,7	0,4
6	12,15	0,6	0,6	0,4
7	12,15	0,6	0,6	0,4
7	11,70	0,8	0,1	0,4
8	11,70	0,8	0,1	0,4
8	11,25	0,7	-0,8	0,4
9	11,25	0,7	-0,8	0,4
9	10,80	0,0	-2,0	0,4
10	10,80	0,0	-2,0	0,4
10	10,47	-0,5	-1,2	0,5
11	10,47	-0,5	-1,2	0,5
11	10,15	-0,8	-0,6	0,5
12	10,15	-0,8	-0,6	0,5
12	9,82	-0,9	0,0	0,5
13	9,82	-0,9	0,0	0,5
13	9,45	-0,7	0,7	0,5
14	9,45	-0,7	0,7	0,5
14	9,07	-0,4	1,3	0,6
15	9,07	-0,4	1,3	0,6
15	9,05	-0,3	1,3	0,6

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	-0,3	1,3	0,6
16	9,00	-0,3	1,4	0,6
17	9,00	-0,3	1,4	0,6
17	8,82	0,0	1,5	0,6
18	8,82	0,0	1,5	0,6
18	8,75	0,1	1,5	0,6
19	8,75	0,1	1,5	0,6
19	8,21	0,9	1,5	0,6
20	8,21	0,9	1,5	0,6
20	7,68	1,7	1,5	0,6
21	7,68	1,7	1,5	0,6
21	7,14	2,6	1,5	**0,7**
22	7,14	2,6	1,6	**0,7**
22	6,61	3,4	1,6	**0,7**
23	6,61	3,4	1,6	**0,7**
23	6,07	4,2	1,4	**0,7**
24	6,07	4,2	1,4	**0,7**
24	5,54	4,9	1,0	**0,7**
25	5,54	4,9	1,0	**0,7**
25	5,00	**5,2**	0,1	0,6
26	5,00	**5,2**	0,1	0,6
26	4,50	4,3	-4,0	0,6
27	4,50	4,3	-4,0	0,6
27	4,00	1,2	**-8,4**	0,5
28	4,00	1,2	**-8,4**	0,5
28	3,48	-1,4	-2,2	0,4
29	3,48	-1,4	-2,2	0,4
29	2,95	-1,5	1,2	0,3
30	2,95	-1,5	1,2	0,3
30	2,42	-0,6	1,9	0,2
31	2,42	-0,6	1,9	0,2
31	1,90	0,0	0,0	0,1
Max		**5,2**	**-8,4**	**0,7**
Max, minor nodes incl.		5,2	-8,4	0,7

8.7.3 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	13,40	0,00	0,00	A		0,00	0,00	P	
1	13,37	0,00	0,00	A		1,11	0,00	1	6
2	13,37	0,00	0,00	A		1,11	0,00	1	17
2	13,32	0,07	0,00	1		1,58	0,00	1	9
3	13,32	0,07	0,00	1		1,58	0,00	1	20
3	13,07	2,88	0,00	1		3,91	0,00	1	12
4	13,07	2,88	0,00	1		3,92	0,00	1	16
4	12,70	7,10	0,00	1		7,42	0,00	1	14
5	12,70	7,10	0,00	1		7,43	0,00	1	16
5	12,32	11,32	0,00	1		10,93	0,00	1	16
6	12,32	11,32	0,00	1		10,95	0,00	1	16
6	12,15	13,24	0,00	1		12,54	0,00	1	16
7	12,15	13,24	0,00	1		12,57	0,00	1	16
7	11,70	18,31	0,00	1		16,76	0,00	1	16
8	11,70	18,31	0,00	1		16,85	0,00	1	17
8	11,25	23,39	0,00	1		21,04	0,00	1	16
9	11,25	23,39	0,00	1		21,18	0,00	1	17
9	10,80	28,48	0,00	1		25,36	0,00	1	17
10	10,80	21,08	0,00	1		23,59	0,00	1	11
10	10,47	24,06	0,00	1		26,15	0,00	1	11
11	10,47	24,06	0,00	1		26,31	0,00	1	12
11	10,15	27,04	0,00	1		28,88	0,00	1	12
12	10,15	27,04	0,00	1		29,07	0,00	1	13
12	9,82	30,00	0,00	1		31,66	0,00	1	13

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* [%]
13	9,82	30,00	0,00	1		31,89	0,00	1	14
13	9,45	33,43	0,00	1		34,93	0,00	1	13
14	9,45	33,43	0,00	1		35,21	0,00	1	15
14	9,07	36,84	0,00	1		38,27	0,00	1	14
15	9,07	36,84	0,00	1		38,44	0,00	1	15
15	9,05	37,02	0,00	1		38,60	0,00	1	15
16	9,05	37,02	0,00	1		38,63	0,00	1	15
16	9,00	37,26	0,49	1		39,04	0,00	1	15
17	9,00	37,26	0,49	1		39,14	0,00	1	16
17	8,82	38,12	2,26	1		40,61	0,00	1	15
18	8,82	38,12	2,26	1		40,72	0,00	1	16
18	8,75	38,46	2,94	1		41,29	0,00	1	16
19	8,75	38,46	2,94	1		41,37	0,00	1	16
19	8,21	41,04	8,20	1		43,90	5,26	1	16
20	8,21	41,04	8,20	1		44,08	5,26	1	16
20	7,68	43,67	13,45	1		46,56	10,51	1	16
21	7,68	43,67	13,45	1		46,82	10,51	1	16
21	7,14	46,37	18,71	1		49,22	15,77	1	16
22	7,14	46,37	18,71	1		49,56	15,77	1	16
22	6,61	49,18	23,96	1		51,84	21,02	1	16
23	6,61	49,18	23,96	1		52,25	21,02	1	15
23	6,07	52,15	29,22	1		54,39	26,28	1	15
24	6,07	52,15	29,22	1		54,86	26,28	1	15
24	5,54	55,30	34,48	1		56,82	31,53	1	15
25	5,54	55,30	34,48	1		57,33	31,53	1	15
25	5,00	58,66	39,73	1		59,10	36,79	1	15
26	5,00	70,00	39,73	1		65,42	36,79	1	24
26	4,50	72,94	44,64	1		67,11	41,69	1	24
27	4,50	72,94	44,64	1		67,61	41,69	1	24
27	4,00	75,97	49,54	1		69,24	46,60	1	24
28	4,00	53,72	49,54	1		71,83	46,60	1	21
28	3,48	59,39	54,69	1		71,17	51,75	1	20
29	3,48	59,39	54,69	1		71,75	51,75	1	20
29	2,95	64,89	59,84	1		71,29	56,90	1	19
30	2,95	64,89	59,84	1		71,87	56,90	1	19
30	2,42	70,18	64,99	1		71,64	62,05	1	18
31	2,42	70,18	64,99	1		72,22	62,05	1	18
31	1,90	75,38	70,14	1		72,11	67,20	1	17

*

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

8.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	487,2	507,8
Water	250,8	230,2
Total	737,9	738,0

Considered as passive side	Right
Maximum passive effective resistance	2999,69 kN
Mobilized passive effective resistance	507,80 kN
Percentage mobilized resistance	16,9 %

8.7.5 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	-133,43
Vertical force passive	138,48
Resulting vertical force (no dead weight)	5,05
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-133,43
Vertical force passive	138,48
Resulting vertical force (no dead weight)	5,05
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

8.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-9,07	13,40	19	8,56
10,80	20	-80,30	10,80	20	84,80
5,00	19A	-20,01	5,00	19A	18,47
4,00	32	-24,06	4,00	32	26,65

9 Step 6.4 Stage 1: Aanleg

9.1 Input Data Left

9.1.1 Calculation Method

Calculation method: C, phi, delta

9.1.2 Water Level

Water level: 9,05 [m]

9.1.3 Surface

X [m]	Y [m]
0,00	13,40

9.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

9.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

9.2 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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	12,2	0,00	0,64	12,36
3	13,07	0,0	27,3	0,00	0,64	4,60
4	12,57	3,0	54,7	0,20	0,64	3,66
5	12,23	5,9	73,0	0,28	0,64	3,48
6	11,93	8,2	90,0	0,31	0,64	3,39
7	11,47	11,4	114,6	0,33	0,64	3,31
8	11,03	14,7	139,2	0,34	0,64	3,26
9	10,64	15,4	239,5	0,31	0,54	4,82
10	10,31	17,2	264,1	0,31	0,54	4,75
11	9,99	19,1	290,4	0,31	0,54	4,73
12	9,64	21,0	319,5	0,31	0,54	4,72
13	9,26	23,2	351,1	0,31	0,54	4,71
14	9,06	24,3	367,7	0,31	0,54	4,71
15	9,03	24,4	369,7	0,31	0,54	4,71
16	8,91	24,8	375,2	0,31	0,54	4,71
17	8,79	25,2	381,1	0,31	0,54	4,71
18	8,48	26,1	395,5	0,31	0,54	4,70
19	7,95	27,8	421,0	0,31	0,54	4,70
20	7,41	29,5	446,6	0,31	0,54	4,70
21	6,88	31,2	472,2	0,31	0,54	4,70
22	6,34	32,9	497,8	0,31	0,54	4,70
23	5,80	34,6	523,4	0,31	0,54	4,70
24	5,27	36,3	549,1	0,31	0,54	4,70
25	4,75	43,2	429,3	0,35	0,61	3,53
26	4,25	44,8	443,7	0,36	0,61	3,52
27	3,74	42,8	493,8	0,33	0,53	3,77
28	3,21	44,6	513,0	0,33	0,53	3,76
29	2,69	46,4	532,3	0,33	0,53	3,76
30	2,16	48,1	551,6	0,33	0,53	3,75

9.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	241,96
19A	72,79
32	136,56
19	0,00
32	0,00

9.4 Input Data Right

9.4.1 Calculation Method

Calculation method: C, phi, delta

9.4.2 Water Level

Water level: 8,75 [m]

9.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

9.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

9.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

9.5 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	13,38	0,0	10,0	0,00	0,51	37,16
2	13,35	0,0	12,2	0,00	0,51	12,36
3	13,07	0,0	27,3	0,00	0,51	4,60
4	12,57	3,0	54,7	0,20	0,51	3,66
5	12,23	5,9	73,0	0,28	0,51	3,49
6	11,93	8,2	90,0	0,31	0,51	3,40
7	11,47	11,4	114,6	0,33	0,51	3,32
8	11,03	14,7	139,2	0,35	0,52	3,28
9	10,64	15,4	228,5	0,31	0,42	4,64
10	10,31	17,2	227,0	0,31	0,42	4,13
11	9,99	19,1	232,1	0,31	0,43	3,83
12	9,64	21,0	248,3	0,32	0,43	3,72
13	9,26	23,2	252,9	0,32	0,43	3,45
14	9,06	24,3	256,4	0,32	0,44	3,34
15	9,03	24,5	256,7	0,32	0,44	3,32
16	8,91	25,1	257,1	0,32	0,44	3,24
17	8,79	25,8	259,4	0,32	0,44	3,19
18	8,48	26,9	268,3	0,32	0,44	3,18
19	7,95	28,6	284,4	0,32	0,44	3,18
20	7,41	30,3	303,3	0,32	0,44	3,22
21	6,88	32,0	323,9	0,32	0,45	3,27
22	6,34	33,7	345,6	0,32	0,45	3,33
23	5,80	35,3	368,1	0,33	0,46	3,39
24	5,27	37,1	391,2	0,33	0,46	3,45
25	4,75	43,9	275,4	0,37	0,54	2,34
26	4,25	45,3	288,5	0,37	0,54	2,38
27	3,74	43,0	346,4	0,34	0,47	2,76
28	3,21	44,6	363,6	0,34	0,47	2,79
29	2,69	46,1	383,8	0,34	0,47	2,84
30	2,16	47,7	410,2	0,34	0,48	2,94

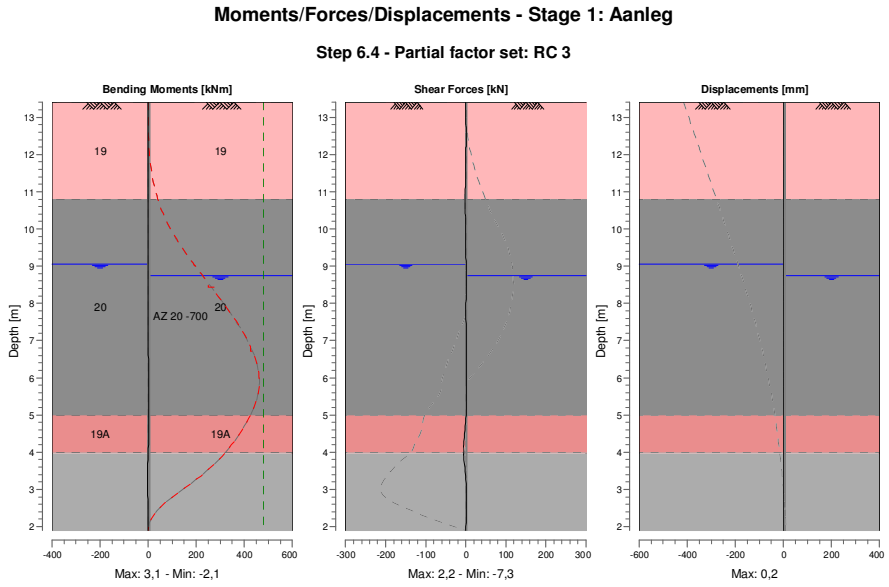
9.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	256,23
19A	67,52
32	150,06
19	0,00
32	0,00

9.7 Calculation Results

Number of iterations: 2

9.7.1 Charts of Moments, Forces and Displacements



9.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,1
1	13,37	0,0	0,0	0,1
2	13,37	0,0	0,0	0,1
2	13,32	0,0	0,1	0,1
3	13,32	0,0	0,1	0,1
3	12,82	0,2	0,6	0,1
4	12,82	0,2	0,6	0,1
4	12,32	0,5	0,7	0,1
5	12,32	0,5	0,7	0,1
5	12,15	0,6	0,6	0,1
6	12,15	0,6	0,6	0,1
6	11,70	0,8	0,1	0,1
7	11,70	0,8	0,1	0,1
7	11,25	0,7	-0,7	0,1
8	11,25	0,7	-0,7	0,1
8	10,80	0,1	-1,9	**0,2**
9	10,80	0,1	-1,9	**0,2**
9	10,47	-0,4	-1,2	**0,2**
10	10,47	-0,4	-1,2	**0,2**
10	10,15	-0,7	-0,6	**0,2**
11	10,15	-0,7	-0,6	**0,2**
11	9,82	-0,8	-0,2	**0,2**
12	9,82	-0,8	-0,2	**0,2**
12	9,45	-0,8	0,3	**0,2**
13	9,45	-0,8	0,3	**0,2**
13	9,07	-0,6	0,7	**0,2**
14	9,07	-0,6	0,7	**0,2**
14	9,05	-0,5	0,7	**0,2**
15	9,05	-0,5	0,7	**0,2**
15	9,00	-0,5	0,8	**0,2**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	-0,5	0,8	**0,2**
16	8,82	-0,4	0,9	**0,2**
17	8,82	-0,4	0,9	**0,2**
17	8,75	-0,3	0,8	**0,2**
18	8,75	-0,3	0,8	**0,2**
18	8,21	0,1	0,6	**0,2**
19	8,21	0,1	0,6	**0,2**
19	7,68	0,4	0,6	**0,2**
20	7,68	0,4	0,6	**0,2**
20	7,14	0,8	0,7	**0,2**
21	7,14	0,8	0,7	**0,2**
21	6,61	1,2	0,9	**0,2**
22	6,61	1,2	0,9	**0,2**
22	6,07	1,8	1,2	**0,2**
23	6,07	1,8	1,2	**0,2**
23	5,54	2,4	1,2	**0,2**
24	5,54	2,4	1,2	**0,2**
24	5,00	**3,0**	0,9	**0,2**
25	5,00	**3,0**	0,9	**0,2**
25	4,50	2,6	-2,9	**0,2**
26	4,50	2,6	-2,9	**0,2**
26	4,00	0,0	**-7,3**	**0,2**
27	4,00	0,0	**-7,3**	**0,2**
27	3,48	-2,0	-1,1	0,1
28	3,48	-2,0	-1,1	0,1
28	2,95	-1,7	1,7	0,1
29	2,95	-1,7	1,7	0,1
29	2,42	-0,6	1,9	0,1
30	2,42	-0,6	1,9	0,1
30	1,90	0,0	0,0	0,0
Max		**3,0**	**-7,3**	**0,2**
Max, minor nodes incl.		3,1	-7,3	0,2

9.7.3 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	13,40	0,00	0,00	A		0,00	0,00	P	
1	13,37	0,00	0,00	A		1,10	0,00	1	5
2	13,37	0,00	0,00	A		1,10	0,00	1	16
2	13,32	0,08	0,00	1		1,57	0,00	1	9
3	13,32	0,08	0,00	1		1,57	0,00	1	24
3	12,82	5,68	0,00	1		6,26	0,00	1	13
4	12,82	5,68	0,00	1		6,27	0,00	1	16
4	12,32	11,29	0,00	1		10,95	0,00	1	15
5	12,32	11,29	0,00	1		10,98	0,00	1	16
5	12,15	13,20	0,00	1		12,57	0,00	1	16
6	12,15	13,20	0,00	1		12,60	0,00	1	17
6	11,70	18,28	0,00	1		16,80	0,00	1	16
7	11,70	18,28	0,00	1		16,89	0,00	1	17
7	11,25	23,38	0,00	1		21,06	0,00	1	16
8	11,25	23,38	0,00	1		21,19	0,00	1	17
8	10,80	28,49	0,00	1		25,35	0,00	1	17
9	10,80	21,12	0,00	1		23,55	0,00	1	11
9	10,47	24,18	0,00	1		26,04	0,00	1	11
10	10,47	24,18	0,00	1		26,20	0,00	1	12
10	10,15	27,21	0,00	1		28,71	0,00	1	12
11	10,15	27,21	0,00	1		28,89	0,00	1	13
11	9,82	30,22	0,00	1		31,44	0,00	1	13
12	9,82	30,22	0,00	1		31,67	0,00	1	13
12	9,45	33,67	0,00	1		34,69	0,00	1	13
13	9,45	33,67	0,00	1		34,97	0,00	1	14
13	9,07	37,07	0,00	1		38,04	0,00	1	14

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* [%]
14	9,07	37,07	0,00	1		38,21	0,00	1	15
14	9,05	37,25	0,00	1		38,37	0,00	1	15
15	9,05	37,25	0,00	1		38,40	0,00	1	15
15	9,00	37,48	0,49	1		38,81	0,00	1	15
16	9,00	37,48	0,49	1		38,91	0,00	1	15
16	8,82	38,33	2,26	1		40,40	0,00	1	15
17	8,82	38,33	2,26	1		40,51	0,00	1	16
17	8,75	38,66	2,94	1		41,09	0,00	1	16
18	8,75	38,66	2,94	1		41,17	0,00	1	16
18	8,21	41,16	8,20	1		43,79	5,26	1	16
19	8,21	41,16	8,20	1		43,96	5,26	1	16
19	7,68	43,67	13,45	1		46,55	10,51	1	16
20	7,68	43,67	13,45	1		46,82	10,51	1	16
20	7,14	46,24	18,71	1		49,35	15,77	1	16
21	7,14	46,24	18,71	1		49,69	15,77	1	16
21	6,61	48,91	23,96	1		52,12	21,02	1	16
22	6,61	48,91	23,96	1		52,53	21,02	1	16
22	6,07	51,73	29,22	1		54,81	26,28	1	16
23	6,07	51,73	29,22	1		55,27	26,28	1	15
23	5,54	54,78	34,48	1		57,34	31,53	1	15
24	5,54	54,78	34,48	1		57,84	31,53	1	15
24	5,00	58,15	39,73	1		59,60	36,79	1	15
25	5,00	69,74	39,73	1		65,67	36,79	1	24
25	4,50	72,76	44,64	1		67,29	41,69	1	24
26	4,50	72,76	44,64	1		67,79	41,69	1	24
26	4,00	75,92	49,54	1		69,30	46,60	1	24
27	4,00	53,36	49,54	1		72,18	46,60	1	21
27	3,48	59,78	54,69	1		70,78	51,75	1	20
28	3,48	59,78	54,69	1		71,35	51,75	1	20
28	2,95	65,45	59,84	1		70,72	56,90	1	19
29	2,95	65,45	59,84	1		71,30	56,90	1	19
29	2,42	70,45	64,99	1		71,37	62,05	1	18
30	2,42	70,45	64,99	1		71,95	62,05	1	18
30	1,90	75,19	70,14	1		72,30	67,20	1	17

*

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

9.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	487,2	507,8
Water	250,8	230,2
Total	737,9	737,9

Considered as passive side	Right
Maximum passive effective resistance	2999,69 kN
Mobilized passive effective resistance	507,79 kN
Percentage mobilized resistance	16,9 %

9.7.5 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	-133,36
Vertical force passive	138,55
Resulting vertical force (no dead weight)	5,19
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-133,36
Vertical force passive	138,55
Resulting vertical force (no dead weight)	5,19
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

9.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-9,05	13,40	19	8,57
10,80	20	-80,18	10,80	20	84,91
5,00	19A	-19,96	5,00	19A	18,52
4,00	32	-24,16	4,00	32	26,55

10 Step 6.5 Stage 1: Aanleg

10.1 Input Data Left

10.1.1 Calculation Method

Calculation method: C, phi, delta

10.1.2 Water Level

Water level: 9,00 [m]

10.1.3 Surface

X [m]	Y [m]
0,00	13,40

10.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

10.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

10.2 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	13,36	0,0	18,4	0,00	0,58	25,53
2	13,07	0,0	38,9	0,00	0,58	6,54
3	12,57	0,2	74,1	0,01	0,58	4,96
4	12,23	3,9	97,7	0,19	0,58	4,66
5	11,93	5,9	119,5	0,22	0,58	4,50
6	11,47	8,7	151,2	0,25	0,58	4,36
7	11,03	11,5	182,8	0,27	0,58	4,28
8	10,64	13,2	285,7	0,26	0,47	5,75
9	10,31	14,7	317,4	0,27	0,47	5,71
10	9,88	16,8	360,8	0,27	0,47	5,69
11	9,34	19,4	415,5	0,27	0,47	5,68
12	9,04	20,9	446,5	0,27	0,47	5,68
13	8,71	21,8	466,4	0,27	0,47	5,68
14	8,14	23,4	499,4	0,27	0,47	5,68
15	7,57	24,9	532,3	0,27	0,47	5,68
16	7,00	26,5	565,3	0,27	0,47	5,68
17	6,43	28,0	598,4	0,27	0,47	5,68
18	5,86	29,6	631,4	0,27	0,47	5,68
19	5,29	31,1	664,4	0,27	0,47	5,68
20	4,75	35,4	570,7	0,29	0,55	4,67
21	4,25	36,8	590,3	0,29	0,55	4,67
22	3,74	35,6	645,2	0,27	0,46	4,91
23	3,21	37,0	670,9	0,27	0,46	4,91
24	2,69	38,5	696,6	0,27	0,46	4,90
25	2,16	40,0	722,4	0,27	0,46	4,90

10.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	211,53
19A	65,63
32	118,83
19	0,00
32	0,00

10.4 Input Data Right

10.4.1 Calculation Method

Calculation method: C, phi, delta

10.4.2 Water Level

Water level: 9,00 [m]

10.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

10.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

10.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

10.5 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	13,36	0,0	18,4	0,00	0,45	25,53
2	13,07	0,0	38,9	0,00	0,45	6,54
3	12,57	0,2	74,1	0,01	0,45	4,96
4	12,23	3,9	97,7	0,19	0,45	4,67
5	11,93	5,9	119,5	0,22	0,45	4,51
6	11,47	8,7	151,2	0,25	0,45	4,38
7	11,03	11,5	177,8	0,27	0,46	4,19
8	10,64	13,2	254,1	0,27	0,35	5,15
9	10,31	14,7	250,9	0,27	0,35	4,56
10	9,88	16,8	274,5	0,27	0,36	4,39
11	9,34	19,4	291,7	0,27	0,36	4,06
12	9,04	20,9	303,9	0,27	0,37	3,94
13	8,71	21,8	302,1	0,27	0,37	3,76
14	8,14	23,4	320,0	0,27	0,37	3,74
15	7,57	24,9	344,5	0,27	0,37	3,79
16	7,00	26,5	371,2	0,28	0,37	3,86
17	6,43	28,0	399,4	0,28	0,38	3,95
18	5,86	29,6	428,7	0,28	0,38	4,03
19	5,29	31,1	458,7	0,28	0,39	4,12
20	4,75	35,4	366,7	0,31	0,47	3,17
21	4,25	36,9	384,8	0,31	0,48	3,22
22	3,74	35,5	448,3	0,29	0,39	3,63
23	3,21	36,8	472,2	0,29	0,40	3,68
24	2,69	38,1	499,7	0,29	0,40	3,76
25	2,16	39,4	534,7	0,29	0,41	3,88

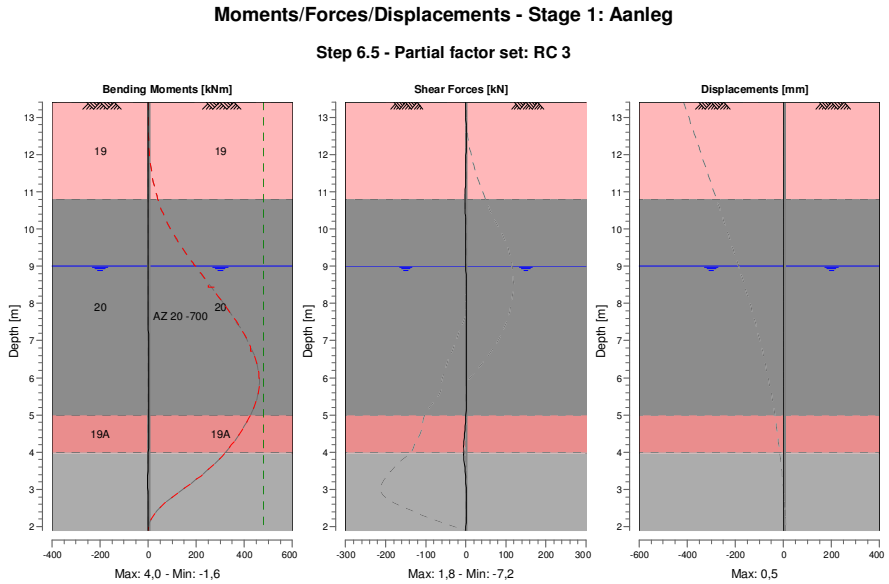
10.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	213,77
19A	58,03
32	126,02
19	0,00
32	0,00

10.7 Calculation Results

Number of iterations: 2

10.7.1 Charts of Moments, Forces and Displacements



10.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,2
1	13,32	0,0	0,1	0,2
2	13,32	0,0	0,1	0,2
2	12,82	0,2	0,7	0,3
3	12,82	0,2	0,7	0,3
3	12,32	0,6	0,8	0,3
4	12,32	0,6	0,8	0,3
4	12,15	0,7	0,7	0,3
5	12,15	0,7	0,7	0,3
5	11,70	0,9	0,2	0,3
6	11,70	0,9	0,2	0,3
6	11,25	0,9	-0,6	0,3
7	11,25	0,9	-0,6	0,3
7	10,80	0,3	-1,8	0,3
8	10,80	0,3	-1,8	0,3
8	10,47	-0,2	-1,2	0,3
9	10,47	-0,2	-1,2	0,3
9	10,15	-0,4	-0,6	0,4
10	10,15	-0,4	-0,6	0,4
10	9,61	-0,6	0,0	0,4
11	9,61	-0,6	0,0	0,4
11	9,07	-0,4	0,5	0,4
12	9,07	-0,4	0,5	0,4
12	9,00	-0,4	0,5	0,4
13	9,00	-0,4	0,5	0,4
13	8,43	0,0	0,8	0,4
14	8,43	0,0	0,8	0,4
14	7,86	0,5	1,1	0,4
15	7,86	0,5	1,1	0,4
15	7,29	1,2	1,2	**0,5**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	7,29	1,2	1,2	**0,5**
16	6,71	2,0	1,4	**0,5**
17	6,71	2,0	1,4	**0,5**
17	6,14	2,8	1,4	**0,5**
18	6,14	2,8	1,4	**0,5**
18	5,57	3,5	1,1	**0,5**
19	5,57	3,5	1,1	**0,5**
19	5,00	**4,0**	0,4	0,4
20	5,00	**4,0**	0,4	0,4
20	4,50	3,3	-3,2	0,4
21	4,50	3,3	-3,2	0,4
21	4,00	0,8	**-7,2**	0,3
22	4,00	0,8	**-7,2**	0,3
22	3,48	-1,4	-1,6	0,3
23	3,48	-1,4	-1,7	0,3
23	2,95	-1,4	1,2	0,2
24	2,95	-1,4	1,2	0,2
24	2,42	-0,6	1,7	0,1
25	2,42	-0,6	1,7	0,1
25	1,90	0,0	0,0	0,1
Max		**4,0**	**-7,2**	**0,5**
Max, minor nodes incl.		4,0	-7,2	0,5

10.7.3 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	13,40	0,00	0,00	A		0,00	0,00	P	
1	13,32	0,00	0,00	A		1,57	0,00	1	4
2	13,32	0,00	0,00	A		1,57	0,00	1	17
2	12,82	5,00	0,00	1		5,68	0,00	1	8
3	12,82	5,00	0,00	1		5,69	0,00	1	11
3	12,32	10,10	0,00	1		9,79	0,00	1	10
4	12,32	10,10	0,00	1		9,82	0,00	1	11
4	12,15	11,84	0,00	1		11,21	0,00	1	11
5	12,15	11,84	0,00	1		11,25	0,00	1	11
5	11,70	16,44	0,00	1		14,94	0,00	1	11
6	11,70	16,44	0,00	1		15,02	0,00	1	11
6	11,25	21,06	0,00	1		18,70	0,00	1	11
7	11,25	21,06	0,00	1		18,83	0,00	1	12
7	10,80	25,68	0,00	1		22,51	0,00	1	12
8	10,80	17,98	0,00	1		20,32	0,00	1	8
8	10,47	20,63	0,00	1		22,42	0,00	1	8
9	10,47	20,63	0,00	1		22,57	0,00	1	9
9	10,15	23,28	0,00	1		24,69	0,00	1	9
10	10,15	23,28	0,00	1		24,92	0,00	1	10
10	9,61	27,65	0,00	1		28,47	0,00	1	10
11	9,61	27,65	0,00	1		28,84	0,00	1	11
11	9,07	32,00	0,00	1		32,45	0,00	1	10
12	9,07	32,00	0,00	1		32,69	0,00	1	11
12	9,00	32,56	0,00	1		33,16	0,00	1	11
13	9,00	32,56	0,00	1		33,21	0,00	1	11
13	8,43	35,03	5,61	1		35,43	5,61	1	11
14	8,43	35,03	5,61	1		35,55	5,61	1	11
14	7,86	37,50	11,21	1		37,75	11,21	1	11
15	7,86	37,50	11,21	1		37,99	11,21	1	11
15	7,29	40,00	16,82	1		40,15	16,82	1	11
16	7,29	40,00	16,82	1		40,47	16,82	1	11
16	6,71	42,59	22,42	1		42,55	22,42	1	11
17	6,71	42,59	22,42	1		42,95	22,42	1	11
17	6,14	45,30	28,03	1		44,91	28,03	1	11
18	6,14	45,30	28,03	1		45,37	28,03	1	11
18	5,57	48,20	33,63	1		47,17	33,63	1	11

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* [%]
19	5,57	48,20	33,63	1		47,68	33,63	1	11
19	5,00	51,32	39,24	1		49,26	39,24	1	10
20	5,00	62,97	39,24	1		56,33	39,24	1	16
20	4,50	65,61	44,15	1		57,80	44,15	1	16
21	4,50	65,61	44,15	1		58,28	44,15	1	15
21	4,00	68,34	49,05	1		59,69	49,05	1	15
22	4,00	46,81	49,05	1		60,30	49,05	1	14
22	3,48	51,89	54,20	1		59,52	54,20	1	13
23	3,48	51,89	54,20	1		60,07	54,20	1	13
23	2,95	56,74	59,35	1		59,55	59,35	1	12
24	2,95	56,74	59,35	1		60,11	59,35	1	12
24	2,42	61,34	64,50	1		59,87	64,50	1	12
25	2,42	61,34	64,50	1		60,43	64,50	1	11
25	1,90	65,84	69,65	1		60,31	69,65	1	11

*

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

10.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	428,2	428,2
Water	247,3	247,3
Total	675,4	675,4

Considered as passive side	Right
Maximum passive effective resistance	3669,31 kN
Mobilized passive effective resistance	428,17 kN
Percentage mobilized resistance	11,7 %

10.7.5 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	-138,08
Vertical force passive	137,42
Resulting vertical force (no dead weight)	-0,66
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-138,08
Vertical force passive	137,42
Resulting vertical force (no dead weight)	-0,66
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

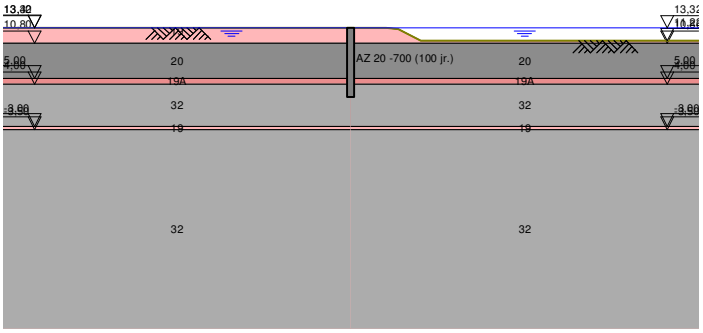
10.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-9,64	13,40	19	9,09
10,80	20	-82,60	10,80	20	83,47
5,00	19A	-21,32	5,00	19A	18,86

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
4,00	32	-24,52	4,00	32	26,01

11 Outline Stage 2: MHW

Outline - Stage 2: MHW

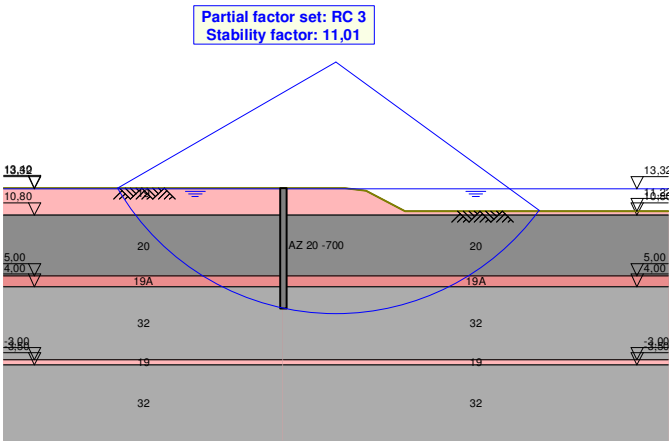


12 Overall Stability Stage 2: MHW

Stability factor : 11,01

12.1 Overall Stability

Overall Stability - Stage 2: MHW



13 Step 6.1 Stage 2: MHW

13.1 Input Data Left

13.1.1 Calculation Method

Calculation method: C, phi, delta

13.1.2 Water Level

Water level: 13,37 [m]

13.1.3 Surface

X [m]	Y [m]
0,00	13,40

13.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

13.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

13.2 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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	11,5	0,00	0,64	15,42
3	13,20	0,0	15,2	0,00	0,64	7,72
4	12,88	0,0	23,0	0,00	0,64	5,08
5	12,51	0,0	32,4	0,00	0,64	4,26
6	12,23	0,0	39,2	0,00	0,64	3,98
7	11,93	1,5	46,9	0,12	0,64	3,79
8	11,47	3,9	58,1	0,24	0,64	3,62
9	11,03	5,4	69,3	0,27	0,64	3,51
10	10,64	7,2	112,6	0,31	0,54	4,85
11	10,31	8,3	126,7	0,31	0,54	4,77
12	9,99	9,3	141,6	0,31	0,54	4,74
13	9,64	10,4	158,0	0,31	0,54	4,72
14	9,26	11,6	175,8	0,31	0,54	4,71
15	9,06	12,2	185,2	0,31	0,54	4,71
16	9,03	12,3	186,9	0,31	0,54	4,71
17	8,91	12,7	192,4	0,31	0,54	4,71
18	8,79	13,1	198,3	0,31	0,54	4,71
19	8,48	14,1	212,7	0,31	0,54	4,71
20	7,95	15,7	238,3	0,31	0,54	4,70
21	7,41	17,4	263,9	0,31	0,54	4,70
22	6,88	19,1	289,5	0,31	0,54	4,70
23	6,34	20,8	315,1	0,31	0,54	4,70
24	5,80	22,5	340,7	0,31	0,54	4,70
25	5,27	24,2	366,4	0,31	0,54	4,70
26	4,75	28,6	295,5	0,34	0,61	3,57
27	4,25	30,2	310,0	0,35	0,61	3,56
28	3,74	30,1	346,9	0,33	0,53	3,77
29	3,21	31,9	366,3	0,33	0,53	3,76
30	2,69	33,6	385,7	0,33	0,53	3,75
31	2,16	35,4	405,2	0,33	0,53	3,75

13.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	146,87
19A	50,82
32	104,20
19	0,00
32	0,00

13.4 Input Data Right

13.4.1 Calculation Method

Calculation method: C, phi, delta

13.4.2 Water Level

Water level: 13,40 [m]

13.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

13.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

13.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

13.5 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	13,38	0,0	9,6	0,00	0,51	78,00
2	13,35	0,0	10,6	0,00	0,51	23,50
3	13,20	0,0	14,3	0,00	0,51	8,54
4	12,88	0,0	22,2	0,00	0,51	5,23
5	12,51	0,0	31,5	0,00	0,51	4,31
6	12,23	0,0	38,3	0,00	0,51	4,02
7	11,93	1,1	46,0	0,09	0,51	3,82
8	11,47	3,8	57,2	0,24	0,51	3,65
9	11,03	5,3	68,4	0,27	0,52	3,54
10	10,64	7,1	104,9	0,31	0,42	4,61
11	10,31	8,2	101,7	0,31	0,43	3,91
12	9,99	9,2	108,5	0,31	0,43	3,71
13	9,64	10,3	119,7	0,32	0,44	3,66
14	9,26	11,5	126,0	0,32	0,44	3,46
15	9,06	12,1	132,4	0,32	0,44	3,45
16	9,03	12,2	134,0	0,32	0,45	3,46
17	8,91	12,6	138,9	0,32	0,45	3,49
18	8,79	13,0	142,4	0,32	0,45	3,47
19	8,48	14,0	150,2	0,32	0,45	3,41
20	7,95	15,7	170,9	0,32	0,46	3,47
21	7,41	17,4	193,3	0,32	0,46	3,55
22	6,88	19,1	216,3	0,32	0,47	3,63
23	6,34	20,7	239,8	0,32	0,48	3,70
24	5,80	22,4	263,8	0,32	0,48	3,77
25	5,27	24,2	288,0	0,32	0,49	3,84
26	4,75	28,6	222,3	0,36	0,56	2,79
27	4,25	30,0	235,8	0,36	0,57	2,82
28	3,74	29,8	275,4	0,34	0,49	3,12
29	3,21	31,5	293,4	0,34	0,49	3,14
30	2,69	33,2	312,6	0,34	0,50	3,18
31	2,16	34,8	333,6	0,34	0,50	3,23

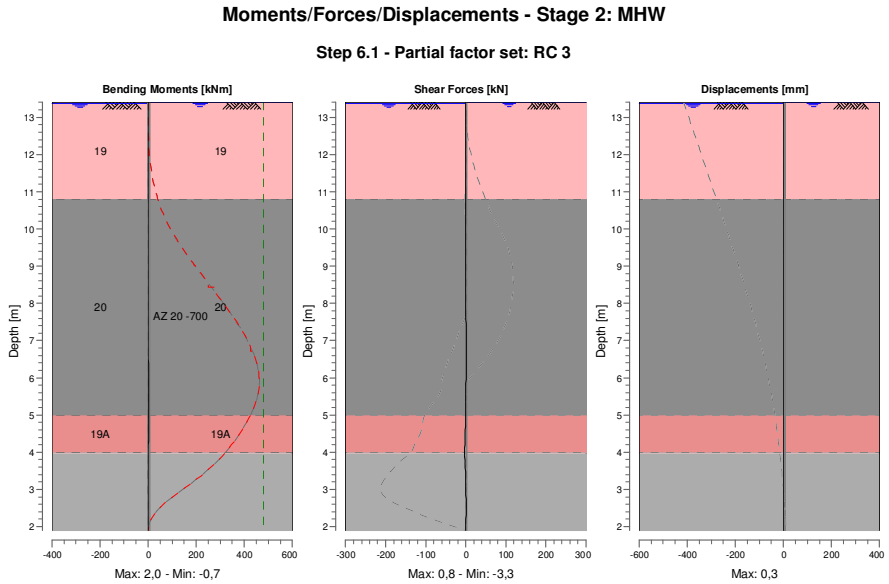
13.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	146,06
19A	47,10
32	106,90
19	0,00
32	0,00

13.7 Calculation Results

Number of iterations: 2

13.7.1 Charts of Moments, Forces and Displacements



13.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,1
1	13,37	0,0	0,0	0,1
2	13,37	0,0	0,0	0,1
2	13,32	0,0	0,0	0,1
3	13,32	0,0	0,0	0,1
3	13,07	0,0	0,2	0,1
4	13,07	0,0	0,2	0,1
4	12,70	0,1	0,3	0,1
5	12,70	0,1	0,3	0,1
5	12,32	0,2	0,3	0,2
6	12,32	0,2	0,3	0,2
6	12,15	0,3	0,3	0,2
7	12,15	0,3	0,3	0,2
7	11,70	0,4	0,1	0,2
8	11,70	0,4	0,1	0,2
8	11,25	0,4	-0,3	0,2
9	11,25	0,4	-0,3	0,2
9	10,80	0,2	-0,8	0,2
10	10,80	0,2	-0,8	0,2
10	10,47	0,0	-0,5	0,2
11	10,47	0,0	-0,5	0,2
11	10,15	-0,2	-0,3	0,2
12	10,15	-0,2	-0,3	0,2
12	9,82	-0,2	-0,1	0,2
13	9,82	-0,2	-0,1	0,2
13	9,45	-0,2	0,1	0,2
14	9,45	-0,2	0,1	0,2
14	9,07	-0,1	0,3	0,2
15	9,07	-0,1	0,3	0,2
15	9,05	-0,1	0,3	0,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	-0,1	0,3	0,2
16	9,00	-0,1	0,3	0,2
17	9,00	-0,1	0,3	0,2
17	8,82	0,0	0,3	0,2
18	8,82	0,0	0,3	0,2
18	8,75	0,0	0,4	0,2
19	8,75	0,0	0,4	0,2
19	8,21	0,2	0,5	0,2
20	8,21	0,2	0,5	0,2
20	7,68	0,5	0,6	**0,3**
21	7,68	0,5	0,6	**0,3**
21	7,14	0,8	0,6	**0,3**
22	7,14	0,8	0,6	**0,3**
22	6,61	1,2	0,7	**0,3**
23	6,61	1,2	0,7	**0,3**
23	6,07	1,6	0,6	**0,3**
24	6,07	1,6	0,6	**0,3**
24	5,54	1,9	0,5	**0,3**
25	5,54	1,9	0,5	**0,3**
25	5,00	**2,0**	0,1	0,2
26	5,00	**2,0**	0,1	0,2
26	4,50	1,7	-1,5	0,2
27	4,50	1,7	-1,5	0,2
27	4,00	0,5	**-3,3**	0,2
28	4,00	0,5	**-3,3**	0,2
28	3,48	-0,5	-0,9	0,1
29	3,48	-0,5	-0,9	0,1
29	2,95	-0,6	0,4	0,1
30	2,95	-0,6	0,4	0,1
30	2,42	-0,2	0,7	0,1
31	2,42	-0,2	0,7	0,1
31	1,90	0,0	0,0	0,1
Max		**2,0**	**-3,3**	**0,3**
Max, minor nodes incl.		2,0	-3,3	0,3

13.7.3 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	13,40	0,00	0,00	P		0,00	0,00	A	
1	13,37	0,59	0,00	1	3	0,51	0,29	1	3
2	13,37	0,59	0,00	1	7	0,51	0,29	1	9
2	13,32	0,59	0,49	1		0,72	0,78	1	5
3	13,32	0,59	0,49	1		0,72	0,78	1	13
3	13,07	1,50	2,94	1		1,77	3,24	1	8
4	13,07	1,50	2,94	1		1,78	3,24	1	13
4	12,70	3,43	6,62	1		3,36	6,92	1	11
5	12,70	3,43	6,62	1		3,37	6,92	1	14
5	12,32	5,36	10,30	1		4,95	10,59	1	13
6	12,32	5,36	10,30	1		4,96	10,59	1	14
6	12,15	6,23	11,97	1		5,68	12,26	1	14
7	12,15	6,23	11,97	1		5,70	12,26	1	15
7	11,70	8,55	16,38	1		7,60	16,68	1	14
8	11,70	8,55	16,38	1		7,64	16,68	1	15
8	11,25	10,87	20,80	1		9,54	21,09	1	15
9	11,25	10,87	20,80	1		9,60	21,09	1	15
9	10,80	13,19	25,21	1		11,50	25,51	1	15
10	10,80	9,88	25,21	1		10,64	25,51	1	11
10	10,47	11,61	28,40	1		12,06	28,69	1	11
11	10,47	11,61	28,40	1		12,20	28,69	1	13
11	10,15	13,33	31,59	1		13,64	31,88	1	13
12	10,15	13,33	31,59	1		13,78	31,88	1	13
12	9,82	15,06	34,78	1		15,23	35,07	1	13

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* [%]
13	9,82	15,06	34,78	1		15,39	35,07	1	14
13	9,45	17,05	38,48	1		17,09	38,77	1	14
14	9,45	17,05	38,48	1		17,27	38,77	1	14
14	9,07	19,05	42,18	1		18,99	42,48	1	14
15	9,07	19,05	42,18	1		19,09	42,48	1	14
15	9,05	19,15	42,38	1		19,18	42,67	1	14
16	9,05	19,15	42,38	1		19,19	42,67	1	14
16	9,00	19,42	42,87	1		19,42	43,16	1	14
17	9,00	19,42	42,87	1		19,48	43,16	1	14
17	8,82	20,37	44,64	1		20,31	44,93	1	14
18	8,82	20,37	44,64	1		20,37	44,93	1	14
18	8,75	20,74	45,32	1		20,69	45,62	1	14
19	8,75	20,74	45,32	1		20,85	45,62	1	15
19	8,21	23,56	50,58	1		23,32	50,87	1	15
20	8,21	23,56	50,58	1		23,61	50,87	1	15
20	7,68	26,40	55,83	1		26,10	56,13	1	15
21	7,68	26,40	55,83	1		26,41	56,13	1	14
21	7,14	29,26	61,09	1		28,90	61,38	1	14
22	7,14	29,26	61,09	1		29,22	61,38	1	14
22	6,61	32,15	66,34	1		31,69	66,64	1	14
23	6,61	32,15	66,34	1		32,02	66,64	1	14
23	6,07	35,10	71,60	1		34,46	71,89	1	14
24	6,07	35,10	71,60	1		34,80	71,89	1	14
24	5,54	38,12	76,85	1		37,19	77,15	1	14
25	5,54	38,12	76,85	1		37,53	77,15	1	13
25	5,00	41,22	82,11	1		39,87	82,40	1	13
26	5,00	48,05	82,11	1		44,80	82,40	1	21
26	4,50	50,81	87,01	1		46,96	87,31	1	21
27	4,50	50,81	87,01	1		47,25	87,31	1	21
27	4,00	53,61	91,92	1		49,40	92,21	1	20
28	4,00	41,86	91,92	1		47,52	92,21	1	18
28	3,48	45,80	97,07	1		48,89	97,36	1	17
29	3,48	45,80	97,07	1		49,23	97,36	1	17
29	2,95	49,67	102,22	1		50,68	102,51	1	17
30	2,95	49,67	102,22	1		51,01	102,51	1	17
30	2,42	53,46	107,37	1		52,56	107,66	1	16
31	2,42	53,46	107,37	1		52,88	107,66	1	16
31	1,90	57,21	112,52	1		54,49	112,81	1	16

*

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

13.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	318,8	315,4
Water	645,3	648,7
Total	964,1	964,1

Considered as passive side	Right
Maximum passive effective resistance	2030,11 kN
Mobilized passive effective resistance	315,45 kN
Percentage mobilized resistance	15,5 %

13.7.5 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	-85,32
Vertical force passive	84,12
Resulting vertical force (no dead weight)	-1,20
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-85,32
Vertical force passive	84,12
Resulting vertical force (no dead weight)	-1,20
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

13.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-4,27	13,40	19	3,88
10,80	20	-48,67	10,80	20	48,40
5,00	19A	-13,94	5,00	19A	12,92
4,00	32	-18,43	4,00	32	18,91

14 Step 6.2 Stage 2: MHW

14.1 Input Data Left

14.1.1 Calculation Method

Calculation method: C, phi, delta

14.1.2 Water Level

Water level: 13,37 [m]

14.1.3 Surface

X [m]	Y [m]
0,00	13,40

14.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

14.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

14.2 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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	11,5	0,00	0,64	15,42
3	13,07	0,0	18,4	0,00	0,64	6,13
4	12,57	0,0	30,8	0,00	0,64	4,35
5	12,23	0,0	39,2	0,00	0,64	3,98
6	11,93	1,5	46,9	0,12	0,64	3,79
7	11,47	3,9	58,1	0,24	0,64	3,62
8	11,03	5,4	69,3	0,27	0,64	3,51
9	10,64	7,2	112,6	0,31	0,54	4,85
10	10,31	8,3	126,7	0,31	0,54	4,77
11	9,99	9,3	141,6	0,31	0,54	4,74
12	9,64	10,4	158,0	0,31	0,54	4,72
13	9,26	11,6	175,8	0,31	0,54	4,71
14	9,06	12,2	185,2	0,31	0,54	4,71
15	9,03	12,3	186,9	0,31	0,54	4,71
16	8,91	12,7	192,4	0,31	0,54	4,71
17	8,79	13,1	198,3	0,31	0,54	4,71
18	8,48	14,1	212,7	0,31	0,54	4,71
19	7,95	15,7	238,3	0,31	0,54	4,70
20	7,41	17,4	263,9	0,31	0,54	4,70
21	6,88	19,1	289,5	0,31	0,54	4,70
22	6,34	20,8	315,1	0,31	0,54	4,70
23	5,80	22,5	340,7	0,31	0,54	4,70
24	5,27	24,2	366,4	0,31	0,54	4,70
25	4,75	28,6	295,5	0,34	0,61	3,57
26	4,25	30,2	310,0	0,35	0,61	3,56
27	3,74	30,1	346,9	0,33	0,53	3,77
28	3,21	31,9	366,3	0,33	0,53	3,76
29	2,69	33,6	385,7	0,33	0,53	3,75
30	2,16	35,4	405,2	0,33	0,53	3,75

14.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	146,74
19A	50,75
32	104,41
19	0,00
32	0,00

14.4 Input Data Right

14.4.1 Calculation Method

Calculation method: C, phi, delta

14.4.2 Water Level

Water level: 13,40 [m]

14.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

14.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

14.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

14.5 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	13,38	0,0	9,6	0,00	0,51	78,00
2	13,35	0,0	10,6	0,00	0,51	23,50
3	13,07	0,0	17,5	0,00	0,51	6,46
4	12,57	0,0	29,9	0,00	0,51	4,41
5	12,23	0,0	38,3	0,00	0,51	4,02
6	11,93	1,1	46,0	0,09	0,51	3,82
7	11,47	3,8	57,2	0,24	0,51	3,65
8	11,03	5,3	68,4	0,27	0,52	3,54
9	10,64	7,1	104,9	0,31	0,42	4,61
10	10,31	8,2	101,7	0,31	0,43	3,91
11	9,99	9,2	108,5	0,31	0,43	3,71
12	9,64	10,3	119,7	0,32	0,44	3,66
13	9,26	11,5	126,0	0,32	0,44	3,46
14	9,06	12,1	132,4	0,32	0,44	3,45
15	9,03	12,2	134,0	0,32	0,45	3,46
16	8,91	12,6	138,9	0,32	0,45	3,49
17	8,79	13,0	142,4	0,32	0,45	3,47
18	8,48	14,0	150,2	0,32	0,45	3,41
19	7,95	15,7	170,9	0,32	0,46	3,47
20	7,41	17,4	193,3	0,32	0,46	3,55
21	6,88	19,1	216,3	0,32	0,47	3,63
22	6,34	20,7	239,8	0,32	0,48	3,70
23	5,80	22,4	263,8	0,32	0,48	3,77
24	5,27	24,2	288,0	0,32	0,49	3,84
25	4,75	28,6	222,3	0,36	0,56	2,79
26	4,25	30,0	235,8	0,36	0,57	2,82
27	3,74	29,8	275,4	0,34	0,49	3,12
28	3,21	31,5	293,4	0,34	0,49	3,14
29	2,69	33,2	312,6	0,34	0,50	3,18
30	2,16	34,8	333,6	0,34	0,50	3,23

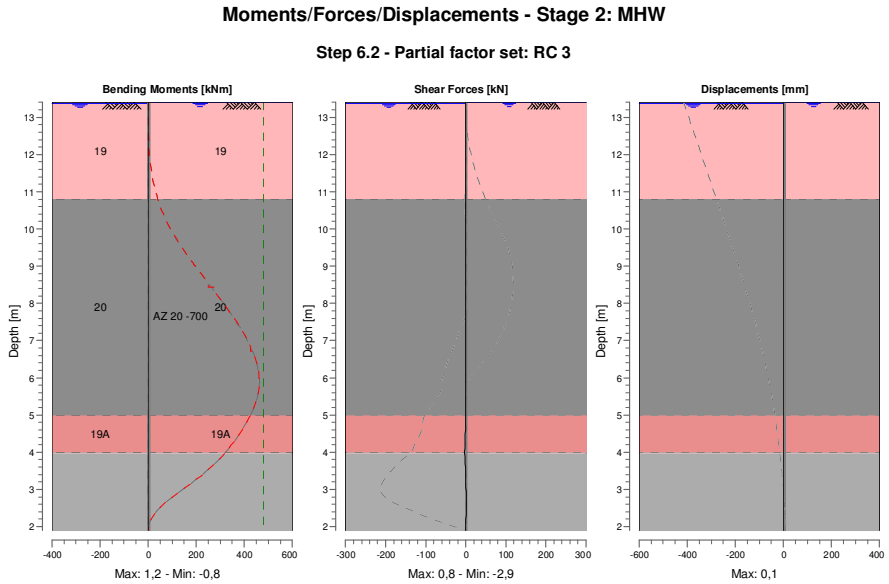
14.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	146,19
19A	47,17
32	106,69
19	0,00
32	0,00

14.7 Calculation Results

Number of iterations: 2

14.7.1 Charts of Moments, Forces and Displacements



14.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,0
1	13,37	0,0	0,0	0,0
2	13,37	0,0	0,0	0,0
2	13,32	0,0	0,0	0,0
3	13,32	0,0	0,0	0,0
3	12,82	0,1	0,3	0,0
4	12,82	0,1	0,3	0,0
4	12,32	0,2	0,3	**0,1**
5	12,32	0,2	0,3	**0,1**
5	12,15	0,3	0,3	**0,1**
6	12,15	0,3	0,3	**0,1**
6	11,70	0,4	0,1	**0,1**
7	11,70	0,4	0,1	**0,1**
7	11,25	0,4	-0,2	**0,1**
8	11,25	0,4	-0,2	**0,1**
8	10,80	0,2	-0,8	**0,1**
9	10,80	0,2	-0,8	**0,1**
9	10,47	0,0	-0,5	**0,1**
10	10,47	0,0	-0,5	**0,1**
10	10,15	-0,2	-0,3	**0,1**
11	10,15	-0,2	-0,3	**0,1**
11	9,82	-0,2	-0,1	**0,1**
12	9,82	-0,2	-0,1	**0,1**
12	9,45	-0,2	0,0	**0,1**
13	9,45	-0,2	0,0	**0,1**
13	9,07	-0,2	0,1	**0,1**
14	9,07	-0,2	0,1	**0,1**
14	9,05	-0,2	0,1	**0,1**
15	9,05	-0,2	0,1	**0,1**
15	9,00	-0,2	0,1	**0,1**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	-0,2	0,1	**0,1**
16	8,82	-0,2	0,1	**0,1**
17	8,82	-0,2	0,1	**0,1**
17	8,75	-0,2	0,1	**0,1**
18	8,75	-0,2	0,1	**0,1**
18	8,21	-0,1	0,2	**0,1**
19	8,21	-0,1	0,2	**0,1**
19	7,68	0,1	0,2	**0,1**
20	7,68	0,1	0,2	**0,1**
20	7,14	0,2	0,3	**0,1**
21	7,14	0,2	0,3	**0,1**
21	6,61	0,4	0,4	**0,1**
22	6,61	0,4	0,4	**0,1**
22	6,07	0,7	0,5	**0,1**
23	6,07	0,7	0,5	**0,1**
23	5,54	0,9	0,5	**0,1**
24	5,54	0,9	0,5	**0,1**
24	5,00	**1,2**	0,4	**0,1**
25	5,00	**1,2**	0,4	**0,1**
25	4,50	1,0	-1,1	**0,1**
26	4,50	1,0	-1,1	**0,1**
26	4,00	0,0	**-2,9**	**0,1**
27	4,00	0,0	**-2,9**	**0,1**
27	3,48	-0,8	-0,4	0,0
28	3,48	-0,8	-0,4	0,0
28	2,95	-0,7	0,7	0,0
29	2,95	-0,7	0,7	0,0
29	2,42	-0,2	0,7	0,0
30	2,42	-0,2	0,7	0,0
30	1,90	0,0	0,0	0,0
Max		**1,2**	**-2,9**	**0,1**
Max, minor nodes incl.		1,2	-2,9	0,1

14.7.3 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	13,40	0,00	0,00	P		0,00	0,00	A	
1	13,37	0,54	0,00	1	3	0,48	0,29	1	3
2	13,37	0,54	0,00	1	6	0,48	0,29	1	8
2	13,32	0,55	0,49	1		0,69	0,78	1	5
3	13,32	0,55	0,49	1		0,69	0,78	1	16
3	12,82	2,80	5,40	1		2,82	5,69	1	9
4	12,82	2,80	5,40	1		2,83	5,69	1	14
4	12,32	5,35	10,30	1		4,96	10,59	1	13
5	12,32	5,35	10,30	1		4,97	10,59	1	14
5	12,15	6,22	11,97	1		5,69	12,26	1	14
6	12,15	6,22	11,97	1		5,71	12,26	1	15
6	11,70	8,53	16,38	1		7,61	16,68	1	14
7	11,70	8,53	16,38	1		7,66	16,68	1	15
7	11,25	10,85	20,80	1		9,55	21,09	1	15
8	11,25	10,85	20,80	1		9,61	21,09	1	16
8	10,80	13,19	25,21	1		11,50	25,51	1	15
9	10,80	9,87	25,21	1		10,65	25,51	1	11
9	10,47	11,63	28,40	1		12,05	28,69	1	11
10	10,47	11,63	28,40	1		12,18	28,69	1	13
10	10,15	13,38	31,59	1		13,59	31,88	1	13
11	10,15	13,38	31,59	1		13,74	31,88	1	13
11	9,82	15,12	34,78	1		15,17	35,07	1	13
12	9,82	15,12	34,78	1		15,32	35,07	1	14
12	9,45	17,14	38,48	1		17,01	38,77	1	13
13	9,45	17,14	38,48	1		17,19	38,77	1	14
13	9,07	19,13	42,18	1		18,90	42,48	1	14

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* [%]
14	9,07	19,13	42,18	1		19,00	42,48	1	14
14	9,05	19,24	42,38	1		19,09	42,67	1	14
15	9,05	19,24	42,38	1		19,11	42,67	1	14
15	9,00	19,50	42,87	1		19,34	43,16	1	14
16	9,00	19,50	42,87	1		19,39	43,16	1	14
16	8,82	20,45	44,64	1		20,22	44,93	1	14
17	8,82	20,45	44,64	1		20,29	44,93	1	14
17	8,75	20,82	45,32	1		20,61	45,62	1	14
18	8,75	20,82	45,32	1		20,76	45,62	1	15
18	8,21	23,62	50,58	1		23,26	50,87	1	15
19	8,21	23,62	50,58	1		23,55	50,87	1	15
19	7,68	26,42	55,83	1		26,08	56,13	1	14
20	7,68	26,42	55,83	1		26,39	56,13	1	14
20	7,14	29,23	61,09	1		28,93	61,38	1	14
21	7,14	29,23	61,09	1		29,25	61,38	1	14
21	6,61	32,06	66,34	1		31,78	66,64	1	14
22	6,61	32,06	66,34	1		32,11	66,64	1	14
22	6,07	34,95	71,60	1		34,62	71,89	1	14
23	6,07	34,95	71,60	1		34,95	71,89	1	14
23	5,54	37,92	76,85	1		37,39	77,15	1	14
24	5,54	37,92	76,85	1		37,73	77,15	1	14
24	5,00	41,02	82,11	1		40,07	82,40	1	13
25	5,00	47,95	82,11	1		44,90	82,40	1	21
25	4,50	50,74	87,01	1		47,03	87,31	1	21
26	4,50	50,74	87,01	1		47,33	87,31	1	21
26	4,00	53,58	91,92	1		49,42	92,21	1	20
27	4,00	41,70	91,92	1		47,68	92,21	1	18
27	3,48	45,94	97,07	1		48,76	97,36	1	17
28	3,48	45,94	97,07	1		49,09	97,36	1	17
28	2,95	49,88	102,22	1		50,47	102,51	1	17
29	2,95	49,88	102,22	1		50,79	102,51	1	17
29	2,42	53,57	107,37	1		52,45	107,66	1	16
30	2,42	53,57	107,37	1		52,77	107,66	1	16
30	1,90	57,15	112,52	1		54,55	112,81	1	16

*

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

14.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	318,8	315,4
Water	645,3	648,7
Total	964,1	964,1

Considered as passive side	Right
Maximum passive effective resistance	2030,11 kN
Mobilized passive effective resistance	315,44 kN
Percentage mobilized resistance	15,5 %

14.7.5 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	-85,29
Vertical force passive	84,14
Resulting vertical force (no dead weight)	-1,15
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-85,29
Vertical force passive	84,14
Resulting vertical force (no dead weight)	-1,15
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

14.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-4,27	13,40	19	3,88
10,80	20	-48,63	10,80	20	48,45
5,00	19A	-13,92	5,00	19A	12,94
4,00	32	-18,47	4,00	32	18,87

15 Step 6.3 Stage 2: MHW

15.1 Input Data Left

15.1.1 Calculation Method

Calculation method: C, phi, delta

15.1.2 Water Level

Water level: 13,37 [m]

15.1.3 Surface

X [m]	Y [m]
0,00	13,40

15.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

15.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

15.2 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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	11,5	0,00	0,64	15,42
3	13,20	0,0	15,2	0,00	0,64	7,72
4	12,88	0,0	23,0	0,00	0,64	5,08
5	12,51	0,0	32,4	0,00	0,64	4,26
6	12,23	0,0	39,2	0,00	0,64	3,98
7	11,93	1,5	46,9	0,12	0,64	3,79
8	11,47	3,9	58,1	0,24	0,64	3,62
9	11,03	5,4	69,3	0,27	0,64	3,51
10	10,64	7,2	112,6	0,31	0,54	4,85
11	10,31	8,3	126,7	0,31	0,54	4,77
12	9,99	9,3	141,6	0,31	0,54	4,74
13	9,64	10,4	158,0	0,31	0,54	4,72
14	9,26	11,6	175,8	0,31	0,54	4,71
15	9,06	12,2	185,2	0,31	0,54	4,71
16	9,03	12,3	186,9	0,31	0,54	4,71
17	8,91	12,7	192,4	0,31	0,54	4,71
18	8,79	13,1	198,3	0,31	0,54	4,71
19	8,48	14,1	212,7	0,31	0,54	4,71
20	7,95	15,7	238,3	0,31	0,54	4,70
21	7,41	17,4	263,9	0,31	0,54	4,70
22	6,88	19,1	289,5	0,31	0,54	4,70
23	6,34	20,8	315,1	0,31	0,54	4,70
24	5,80	22,5	340,7	0,31	0,54	4,70
25	5,27	24,2	366,4	0,31	0,54	4,70
26	4,75	28,6	295,5	0,34	0,61	3,57
27	4,25	30,2	310,0	0,35	0,61	3,56
28	3,74	30,1	346,9	0,33	0,53	3,77
29	3,21	31,9	366,3	0,33	0,53	3,76
30	2,69	33,6	385,7	0,33	0,53	3,75
31	2,16	35,4	405,2	0,33	0,53	3,75

15.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	139,26
19A	50,34
32	100,66
19	0,00
32	0,00

15.4 Input Data Right

15.4.1 Calculation Method

Calculation method: C, phi, delta

15.4.2 Water Level

Water level: 13,07 [m]

15.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

15.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

15.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

15.5 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	13,38	0,0	10,0	0,00	0,56	37,16
2	13,35	0,0	12,2	0,00	0,56	12,36
3	13,20	0,0	20,5	0,00	0,56	5,55
4	12,88	0,0	32,0	0,00	0,54	4,28
5	12,51	1,0	41,3	0,10	0,52	3,92
6	12,23	2,6	48,1	0,20	0,52	3,77
7	11,93	3,6	55,8	0,24	0,51	3,66
8	11,47	5,1	67,0	0,27	0,51	3,55
9	11,03	6,6	73,9	0,29	0,51	3,28
10	10,64	8,1	98,1	0,31	0,41	3,79
11	10,31	9,2	103,7	0,31	0,41	3,56
12	9,99	10,2	114,5	0,32	0,42	3,54
13	9,64	11,3	120,8	0,32	0,42	3,38
14	9,26	12,5	129,6	0,32	0,43	3,28
15	9,06	13,1	136,7	0,32	0,43	3,30
16	9,03	13,2	137,3	0,32	0,43	3,29
17	8,91	13,6	139,4	0,32	0,43	3,25
18	8,79	14,0	141,5	0,32	0,44	3,21
19	8,48	15,0	152,2	0,32	0,44	3,24
20	7,95	16,7	173,6	0,32	0,45	3,33
21	7,41	18,4	195,7	0,32	0,45	3,42
22	6,88	20,1	218,5	0,32	0,46	3,50
23	6,34	21,8	241,7	0,32	0,47	3,59
24	5,80	23,5	265,4	0,32	0,47	3,66
25	5,27	25,2	289,5	0,32	0,48	3,73
26	4,75	29,6	219,9	0,36	0,56	2,68
27	4,25	31,0	233,4	0,36	0,56	2,71
28	3,74	30,6	274,6	0,34	0,48	3,03
29	3,21	32,1	292,5	0,34	0,49	3,06
30	2,69	33,7	313,0	0,34	0,49	3,11
31	2,16	35,2	335,8	0,33	0,49	3,18

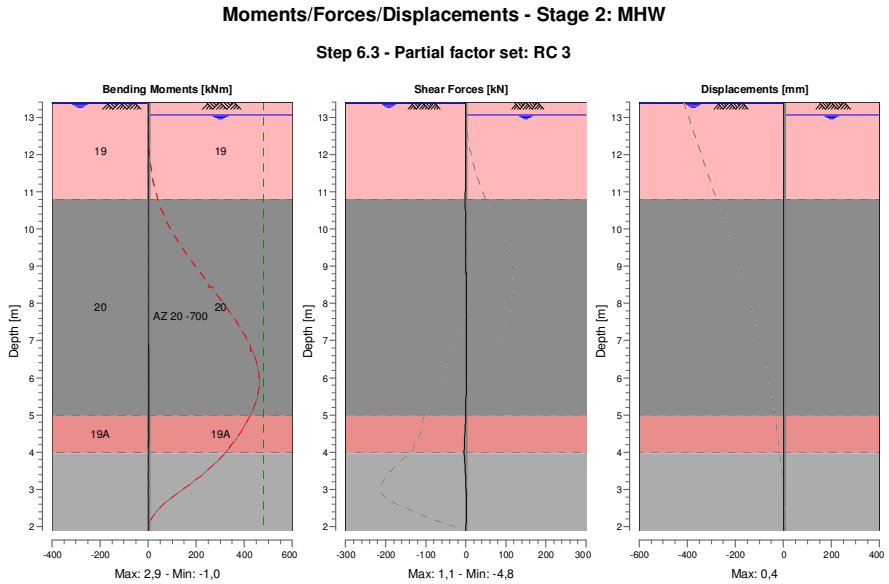
15.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	157,94
19A	48,39
32	111,63
19	0,00
32	0,00

15.7 Calculation Results

Number of iterations: 2

15.7.1 Charts of Moments, Forces and Displacements



15.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,3
1	13,37	0,0	0,0	0,3
2	13,37	0,0	0,0	0,3
2	13,32	0,0	0,1	0,3
3	13,32	0,0	0,1	0,3
3	13,07	0,1	0,4	0,3
4	13,07	0,1	0,4	0,3
4	12,70	0,2	0,5	0,3
5	12,70	0,2	0,5	0,3
5	12,32	0,4	0,5	0,3
6	12,32	0,4	0,5	0,3
6	12,15	0,5	0,4	**0,4**
7	12,15	0,5	0,4	**0,4**
7	11,70	0,6	0,0	**0,4**
8	11,70	0,6	0,0	**0,4**
8	11,25	0,4	-0,6	**0,4**
9	11,25	0,4	-0,6	**0,4**
9	10,80	0,0	-1,5	**0,4**
10	10,80	0,0	-1,5	**0,4**
10	10,47	-0,4	-0,9	**0,4**
11	10,47	-0,4	-0,9	**0,4**
11	10,15	-0,6	-0,5	**0,4**
12	10,15	-0,6	-0,5	**0,4**
12	9,82	-0,7	-0,1	**0,4**
13	9,82	-0,7	-0,1	**0,4**
13	9,45	-0,7	0,2	**0,4**
14	9,45	-0,7	0,2	**0,4**
14	9,07	-0,6	0,5	**0,4**
15	9,07	-0,6	0,5	**0,4**
15	9,05	-0,5	0,5	**0,4**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	-0,5	0,5	**0,4**
16	9,00	-0,5	0,5	**0,4**
17	9,00	-0,5	0,5	**0,4**
17	8,82	-0,4	0,6	**0,4**
18	8,82	-0,4	0,6	**0,4**
18	8,75	-0,4	0,6	**0,4**
19	8,75	-0,4	0,6	**0,4**
19	8,21	0,0	0,8	**0,4**
20	8,21	0,0	0,8	**0,4**
20	7,68	0,5	1,0	**0,4**
21	7,68	0,5	1,0	**0,4**
21	7,14	1,1	1,0	**0,4**
22	7,14	1,1	1,0	**0,4**
22	6,61	1,6	1,0	**0,4**
23	6,61	1,6	1,0	**0,4**
23	6,07	2,2	0,9	**0,4**
24	6,07	2,2	0,9	**0,4**
24	5,54	2,6	0,7	**0,4**
25	5,54	2,6	0,7	**0,4**
25	5,00	**2,9**	0,1	**0,4**
26	5,00	**2,9**	0,1	**0,4**
26	4,50	2,4	-2,2	0,3
27	4,50	2,4	-2,2	0,3
27	4,00	0,6	**-4,8**	0,3
28	4,00	0,6	**-4,8**	0,3
28	3,48	-0,9	-1,2	0,2
29	3,48	-0,9	-1,2	0,2
29	2,95	-0,9	0,7	0,2
30	2,95	-0,9	0,7	0,2
30	2,42	-0,4	1,1	0,1
31	2,42	-0,4	1,1	0,1
31	1,90	0,0	0,0	0,1
Max		**2,9**	**-4,8**	**0,4**
Max, minor nodes incl.		2,9	-4,8	0,4

15.7.3 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	13,40	0,00	0,00	A		0,00	0,00	P	
1	13,37	0,00	0,00	A		1,34	0,00	1	7
2	13,37	0,00	0,00	A		1,34	0,00	1	20
2	13,32	0,00	0,49	A		1,85	0,00	1	10
3	13,32	0,00	0,49	A		1,85	0,00	1	23
3	13,07	0,86	2,94	1		4,39	0,00	1	13
4	13,07	0,86	2,94	1		4,28	0,00	1	17
4	12,70	2,81	6,62	1		5,96	3,68	1	15
5	12,70	2,81	6,62	1		5,78	3,68	1	16
5	12,32	4,75	10,30	1		7,40	7,36	1	16
6	12,32	4,75	10,30	1		7,30	7,36	1	16
6	12,15	5,64	11,97	1		8,02	9,03	1	16
7	12,15	5,64	11,97	1		7,96	9,03	1	16
7	11,70	7,98	16,38	1		9,83	13,44	1	16
8	11,70	7,98	16,38	1		9,77	13,44	1	16
8	11,25	10,32	20,80	1		11,62	17,85	1	16
9	11,25	10,32	20,80	1		11,62	17,85	1	17
9	10,80	12,67	25,21	1		13,44	22,27	1	17
10	10,80	8,33	25,21	1		13,26	22,27	1	14
10	10,47	10,11	28,40	1		14,58	25,46	1	14
11	10,47	10,11	28,40	1		14,71	25,46	1	15
11	10,15	11,89	31,59	1		16,04	28,65	1	15
12	10,15	11,89	31,59	1		16,18	28,65	1	15
12	9,82	13,66	34,78	1		17,54	31,83	1	15

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* [%]
13	9,82	13,66	34,78	1		17,70	31,83	1	15
13	9,45	15,69	38,48	1		19,30	35,54	1	15
14	9,45	15,69	38,48	1		19,49	35,54	1	16
14	9,07	17,71	42,18	1		21,11	39,24	1	16
15	9,07	17,71	42,18	1		21,22	39,24	1	16
15	9,05	17,82	42,38	1		21,31	39,44	1	16
16	9,05	17,82	42,38	1		21,33	39,44	1	16
16	9,00	18,09	42,87	1		21,55	39,93	1	16
17	9,00	18,09	42,87	1		21,61	39,93	1	16
17	8,82	19,04	44,64	1		22,40	41,69	1	16
18	8,82	19,04	44,64	1		22,47	41,69	1	16
18	8,75	19,42	45,32	1		22,78	42,38	1	16
19	8,75	19,42	45,32	1		22,95	42,38	1	16
19	8,21	22,26	50,58	1		25,32	47,63	1	16
20	8,21	22,26	50,58	1		25,66	47,63	1	16
20	7,68	25,10	55,83	1		28,05	52,89	1	15
21	7,68	25,10	55,83	1		28,42	52,89	1	15
21	7,14	27,96	61,09	1		30,80	58,15	1	15
22	7,14	27,96	61,09	1		31,19	58,15	1	15
22	6,61	30,88	66,34	1		33,55	63,40	1	15
23	6,61	30,88	66,34	1		33,95	63,40	1	15
23	6,07	33,86	71,60	1		36,27	68,66	1	14
24	6,07	33,86	71,60	1		36,68	68,66	1	14
24	5,54	36,94	76,85	1		38,93	73,91	1	14
25	5,54	36,94	76,85	1		39,34	73,91	1	14
25	5,00	40,14	82,11	1		41,50	79,17	1	14
26	5,00	47,51	82,11	1		46,18	79,17	1	22
26	4,50	50,33	87,01	1		48,22	84,07	1	21
27	4,50	50,33	87,01	1		48,57	84,07	1	21
27	4,00	53,20	91,92	1		50,58	88,98	1	21
28	4,00	39,17	91,92	1		50,81	88,98	1	19
28	3,48	43,64	97,07	1		51,58	94,13	1	18
29	3,48	43,64	97,07	1		51,98	94,13	1	18
29	2,95	48,01	102,22	1		52,87	99,28	1	18
30	2,95	48,01	102,22	1		53,26	99,28	1	17
30	2,42	52,25	107,37	1		54,30	104,43	1	17
31	2,42	52,25	107,37	1		54,68	104,43	1	17
31	1,90	56,45	112,52	1		55,80	109,58	1	16

*

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

15.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	305,7	339,0
Water	645,3	612,0
Total	951,0	951,0

Considered as passive side	Right
Maximum passive effective resistance	2060,42 kN
Mobilized passive effective resistance	339,00 kN
Percentage mobilized resistance	16,4 %

15.7.5 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	-81,66
Vertical force passive	90,67
Resulting vertical force (no dead weight)	9,01
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-81,66
Vertical force passive	90,67
Resulting vertical force (no dead weight)	9,01
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

15.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-3,89	13,40	19	5,31
10,80	20	-46,15	10,80	20	52,34
5,00	19A	-13,81	5,00	19A	13,27
4,00	32	-17,81	4,00	32	19,75

16 Step 6.4 Stage 2: MHW

16.1 Input Data Left

16.1.1 Calculation Method

Calculation method: C, phi, delta

16.1.2 Water Level

Water level: 13,37 [m]

16.1.3 Surface

X [m]	Y [m]
0,00	13,40

16.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

16.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

16.2 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	13,38	0,0	10,0	0,00	0,64	37,16
2	13,35	0,0	11,5	0,00	0,64	15,42
3	13,07	0,0	18,4	0,00	0,64	6,13
4	12,57	0,0	30,8	0,00	0,64	4,35
5	12,23	0,0	39,2	0,00	0,64	3,98
6	11,93	1,5	46,9	0,12	0,64	3,79
7	11,47	3,9	58,1	0,24	0,64	3,62
8	11,03	5,4	69,3	0,27	0,64	3,51
9	10,64	7,2	112,6	0,31	0,54	4,85
10	10,31	8,3	126,7	0,31	0,54	4,77
11	9,99	9,3	141,6	0,31	0,54	4,74
12	9,64	10,4	158,0	0,31	0,54	4,72
13	9,26	11,6	175,8	0,31	0,54	4,71
14	9,06	12,2	185,2	0,31	0,54	4,71
15	9,03	12,3	186,9	0,31	0,54	4,71
16	8,91	12,7	192,4	0,31	0,54	4,71
17	8,79	13,1	198,3	0,31	0,54	4,71
18	8,48	14,1	212,7	0,31	0,54	4,71
19	7,95	15,7	238,3	0,31	0,54	4,70
20	7,41	17,4	263,9	0,31	0,54	4,70
21	6,88	19,1	289,5	0,31	0,54	4,70
22	6,34	20,8	315,1	0,31	0,54	4,70
23	5,80	22,5	340,7	0,31	0,54	4,70
24	5,27	24,2	366,4	0,31	0,54	4,70
25	4,75	28,6	295,5	0,34	0,61	3,57
26	4,25	30,2	310,0	0,35	0,61	3,56
27	3,74	30,1	346,9	0,33	0,53	3,77
28	3,21	31,9	366,3	0,33	0,53	3,76
29	2,69	33,6	385,7	0,33	0,53	3,75
30	2,16	35,4	405,2	0,33	0,53	3,75

16.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	146,74
19A	50,75
32	104,41
19	0,00
32	0,00

16.4 Input Data Right

16.4.1 Calculation Method

Calculation method: C, phi, delta

16.4.2 Water Level

Water level: 13,40 [m]

16.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

16.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

16.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

16.5 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	13,38	0,0	9,6	0,00	0,51	78,00
2	13,35	0,0	10,6	0,00	0,51	23,50
3	13,07	0,0	17,5	0,00	0,51	6,46
4	12,57	0,0	29,9	0,00	0,51	4,41
5	12,23	0,0	38,3	0,00	0,51	4,02
6	11,93	1,1	46,0	0,09	0,51	3,82
7	11,47	3,8	57,2	0,24	0,51	3,65
8	11,03	5,3	68,4	0,27	0,52	3,54
9	10,64	7,1	104,9	0,31	0,42	4,61
10	10,31	8,2	101,7	0,31	0,43	3,91
11	9,99	9,2	108,5	0,31	0,43	3,71
12	9,64	10,3	119,7	0,32	0,44	3,66
13	9,26	11,5	126,0	0,32	0,44	3,46
14	9,06	12,1	132,4	0,32	0,44	3,45
15	9,03	12,2	134,0	0,32	0,45	3,46
16	8,91	12,6	138,9	0,32	0,45	3,49
17	8,79	13,0	142,4	0,32	0,45	3,47
18	8,48	14,0	150,2	0,32	0,45	3,41
19	7,95	15,7	170,9	0,32	0,46	3,47
20	7,41	17,4	193,3	0,32	0,46	3,55
21	6,88	19,1	216,3	0,32	0,47	3,63
22	6,34	20,7	239,8	0,32	0,48	3,70
23	5,80	22,4	263,8	0,32	0,48	3,77
24	5,27	24,2	288,0	0,32	0,49	3,84
25	4,75	28,6	222,3	0,36	0,56	2,79
26	4,25	30,0	235,8	0,36	0,57	2,82
27	3,74	29,8	275,4	0,34	0,49	3,12
28	3,21	31,5	293,4	0,34	0,49	3,14
29	2,69	33,2	312,6	0,34	0,50	3,18
30	2,16	34,8	333,6	0,34	0,50	3,23

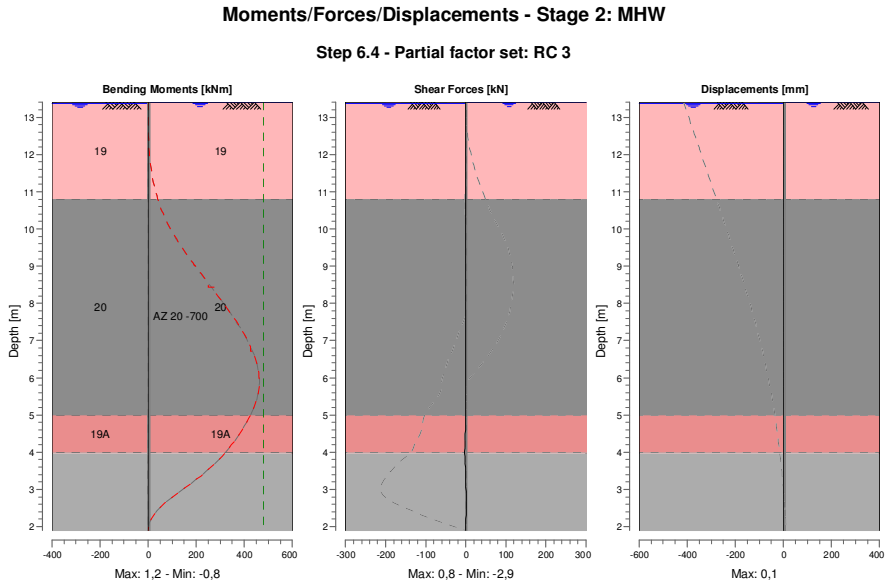
16.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	146,19
19A	47,17
32	106,69
19	0,00
32	0,00

16.7 Calculation Results

Number of iterations: 2

16.7.1 Charts of Moments, Forces and Displacements



16.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,0
1	13,37	0,0	0,0	0,0
2	13,37	0,0	0,0	0,0
2	13,32	0,0	0,0	0,0
3	13,32	0,0	0,0	0,0
3	12,82	0,1	0,3	0,0
4	12,82	0,1	0,3	0,0
4	12,32	0,2	0,3	**0,1**
5	12,32	0,2	0,3	**0,1**
5	12,15	0,3	0,3	**0,1**
6	12,15	0,3	0,3	**0,1**
6	11,70	0,4	0,1	**0,1**
7	11,70	0,4	0,1	**0,1**
7	11,25	0,4	-0,2	**0,1**
8	11,25	0,4	-0,2	**0,1**
8	10,80	0,2	-0,8	**0,1**
9	10,80	0,2	-0,8	**0,1**
9	10,47	0,0	-0,5	**0,1**
10	10,47	0,0	-0,5	**0,1**
10	10,15	-0,2	-0,3	**0,1**
11	10,15	-0,2	-0,3	**0,1**
11	9,82	-0,2	-0,1	**0,1**
12	9,82	-0,2	-0,1	**0,1**
12	9,45	-0,2	0,0	**0,1**
13	9,45	-0,2	0,0	**0,1**
13	9,07	-0,2	0,1	**0,1**
14	9,07	-0,2	0,1	**0,1**
14	9,05	-0,2	0,1	**0,1**
15	9,05	-0,2	0,1	**0,1**
15	9,00	-0,2	0,1	**0,1**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	-0,2	0,1	**0,1**
16	8,82	-0,2	0,1	**0,1**
17	8,82	-0,2	0,1	**0,1**
17	8,75	-0,2	0,1	**0,1**
18	8,75	-0,2	0,1	**0,1**
18	8,21	-0,1	0,2	**0,1**
19	8,21	-0,1	0,2	**0,1**
19	7,68	0,1	0,2	**0,1**
20	7,68	0,1	0,2	**0,1**
20	7,14	0,2	0,3	**0,1**
21	7,14	0,2	0,3	**0,1**
21	6,61	0,4	0,4	**0,1**
22	6,61	0,4	0,4	**0,1**
22	6,07	0,7	0,5	**0,1**
23	6,07	0,7	0,5	**0,1**
23	5,54	0,9	0,5	**0,1**
24	5,54	0,9	0,5	**0,1**
24	5,00	**1,2**	0,4	**0,1**
25	5,00	**1,2**	0,4	**0,1**
25	4,50	1,0	-1,1	**0,1**
26	4,50	1,0	-1,1	**0,1**
26	4,00	0,0	**-2,9**	**0,1**
27	4,00	0,0	**-2,9**	**0,1**
27	3,48	-0,8	-0,4	0,0
28	3,48	-0,8	-0,4	0,0
28	2,95	-0,7	0,7	0,0
29	2,95	-0,7	0,7	0,0
29	2,42	-0,2	0,7	0,0
30	2,42	-0,2	0,7	0,0
30	1,90	0,0	0,0	0,0
Max		**1,2**	**-2,9**	**0,1**
Max, minor nodes incl.		1,2	-2,9	0,1

16.7.3 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	13,40	0,00	0,00	P		0,00	0,00	A	
1	13,37	0,47	0,00	1	2	0,48	0,29	1	2
2	13,37	0,47	0,00	1	6	0,48	0,29	1	8
2	13,32	0,48	0,49	1		0,69	0,78	1	4
3	13,32	0,48	0,49	1		0,69	0,78	1	16
3	12,82	2,80	5,40	1		2,82	5,69	1	9
4	12,82	2,80	5,40	1		2,83	5,69	1	14
4	12,32	5,35	10,30	1		4,96	10,59	1	13
5	12,32	5,35	10,30	1		4,97	10,59	1	14
5	12,15	6,22	11,97	1		5,69	12,26	1	14
6	12,15	6,22	11,97	1		5,71	12,26	1	15
6	11,70	8,53	16,38	1		7,61	16,68	1	14
7	11,70	8,53	16,38	1		7,65	16,68	1	15
7	11,25	10,85	20,80	1		9,55	21,09	1	15
8	11,25	10,85	20,80	1		9,61	21,09	1	16
8	10,80	13,19	25,21	1		11,50	25,51	1	15
9	10,80	9,87	25,21	1		10,65	25,51	1	11
9	10,47	11,63	28,40	1		12,05	28,69	1	11
10	10,47	11,63	28,40	1		12,18	28,69	1	13
10	10,15	13,38	31,59	1		13,59	31,88	1	13
11	10,15	13,38	31,59	1		13,74	31,88	1	13
11	9,82	15,12	34,78	1		15,17	35,07	1	13
12	9,82	15,12	34,78	1		15,32	35,07	1	14
12	9,45	17,13	38,48	1		17,01	38,77	1	13
13	9,45	17,13	38,48	1		17,19	38,77	1	14
13	9,07	19,13	42,18	1		18,90	42,48	1	14

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* [%]
14	9,07	19,13	42,18	1		19,00	42,48	1	14
14	9,05	19,24	42,38	1		19,09	42,67	1	14
15	9,05	19,24	42,38	1		19,11	42,67	1	14
15	9,00	19,50	42,87	1		19,34	43,16	1	14
16	9,00	19,50	42,87	1		19,39	43,16	1	14
16	8,82	20,45	44,64	1		20,22	44,93	1	14
17	8,82	20,45	44,64	1		20,29	44,93	1	14
17	8,75	20,82	45,32	1		20,61	45,62	1	14
18	8,75	20,82	45,32	1		20,76	45,62	1	15
18	8,21	23,62	50,58	1		23,26	50,87	1	15
19	8,21	23,62	50,58	1		23,55	50,87	1	15
19	7,68	26,42	55,83	1		26,08	56,13	1	14
20	7,68	26,42	55,83	1		26,39	56,13	1	14
20	7,14	29,23	61,09	1		28,93	61,38	1	14
21	7,14	29,23	61,09	1		29,25	61,38	1	14
21	6,61	32,06	66,34	1		31,78	66,64	1	14
22	6,61	32,06	66,34	1		32,11	66,64	1	14
22	6,07	34,95	71,60	1		34,62	71,89	1	14
23	6,07	34,95	71,60	1		34,95	71,89	1	14
23	5,54	37,92	76,85	1		37,39	77,15	1	14
24	5,54	37,92	76,85	1		37,73	77,15	1	14
24	5,00	41,02	82,11	1		40,07	82,40	1	13
25	5,00	47,95	82,11	1		44,90	82,40	1	21
25	4,50	50,74	87,01	1		47,03	87,31	1	21
26	4,50	50,74	87,01	1		47,33	87,31	1	21
26	4,00	53,58	91,92	1		49,42	92,21	1	20
27	4,00	41,70	91,92	1		47,68	92,21	1	18
27	3,48	45,94	97,07	1		48,76	97,36	1	17
28	3,48	45,94	97,07	1		49,09	97,36	1	17
28	2,95	49,88	102,22	1		50,47	102,51	1	17
29	2,95	49,88	102,22	1		50,79	102,51	1	17
29	2,42	53,57	107,37	1		52,45	107,66	1	16
30	2,42	53,57	107,37	1		52,77	107,66	1	16
30	1,90	57,15	112,52	1		54,55	112,81	1	16

*

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

16.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	318,8	315,4
Water	645,3	648,7
Total	964,1	964,1

Considered as passive side	Right
Maximum passive effective resistance	2030,11 kN
Mobilized passive effective resistance	315,44 kN
Percentage mobilized resistance	15,5 %

16.7.5 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	-85,29
Vertical force passive	84,14
Resulting vertical force (no dead weight)	-1,15
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-85,29
Vertical force passive	84,14
Resulting vertical force (no dead weight)	-1,15
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

16.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-4,27	13,40	19	3,88
10,80	20	-48,63	10,80	20	48,45
5,00	19A	-13,92	5,00	19A	12,94
4,00	32	-18,47	4,00	32	18,87

17 Step 6.5 Stage 2: MHW

17.1 Input Data Left

17.1.1 Calculation Method

Calculation method: C, phi, delta

17.1.2 Water Level

Water level: 13,32 [m]

17.1.3 Surface

X [m]	Y [m]
0,00	13,40

17.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

17.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

17.2 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	13,36	0,0	18,4	0,00	0,58	25,53
2	13,07	0,0	29,3	0,00	0,58	8,39
3	12,57	0,0	45,3	0,00	0,58	5,97
4	12,23	0,0	56,0	0,00	0,58	5,43
5	11,93	0,0	66,0	0,00	0,58	5,13
6	11,47	0,3	80,4	0,02	0,58	4,86
7	11,03	3,7	94,8	0,18	0,58	4,69
8	10,64	6,3	136,9	0,27	0,47	5,77
9	10,31	7,2	154,9	0,27	0,47	5,73
10	9,88	8,4	179,4	0,27	0,47	5,70
11	9,34	9,8	210,3	0,27	0,47	5,69
12	9,04	10,7	227,8	0,27	0,47	5,69
13	8,71	11,5	246,3	0,27	0,47	5,68
14	8,14	13,1	279,2	0,27	0,47	5,68
15	7,57	14,6	312,2	0,27	0,47	5,68
16	7,00	16,2	345,2	0,27	0,47	5,68
17	6,43	17,7	378,2	0,27	0,47	5,68
18	5,86	19,3	411,3	0,27	0,47	5,68
19	5,29	20,8	444,3	0,27	0,47	5,68
20	4,75	23,2	395,1	0,28	0,55	4,74
21	4,25	24,6	414,7	0,28	0,55	4,73
22	3,74	25,1	454,5	0,27	0,46	4,91
23	3,21	26,5	480,3	0,27	0,46	4,91
24	2,69	28,0	506,1	0,27	0,46	4,90
25	2,16	29,5	532,0	0,27	0,46	4,90

17.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	126,75
19A	45,62
32	89,78
19	0,00
32	0,00

17.4 Input Data Right

17.4.1 Calculation Method

Calculation method: C, phi, delta

17.4.2 Water Level

Water level: 13,32 [m]

17.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

17.4.4 Soil Material Properties in Profile: 54H

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

17.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

17.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	13,36	0,0	18,4	0,00	0,51	25,53
2	13,07	0,0	29,3	0,00	0,47	8,39
3	12,57	0,0	45,3	0,00	0,45	5,98
4	12,23	0,0	56,0	0,00	0,45	5,44
5	11,93	0,0	66,0	0,00	0,45	5,14
6	11,47	0,3	80,4	0,02	0,45	4,88
7	11,03	3,7	89,0	0,18	0,45	4,43
8	10,64	6,3	102,9	0,27	0,35	4,37
9	10,31	7,2	112,0	0,27	0,35	4,19
10	9,88	8,4	128,7	0,27	0,36	4,15
11	9,34	9,8	144,2	0,27	0,37	3,97
12	9,04	10,7	159,8	0,27	0,37	4,06
13	8,71	11,5	171,2	0,27	0,38	4,03
14	8,14	13,1	195,3	0,27	0,38	4,07
15	7,57	14,6	224,0	0,27	0,39	4,18
16	7,00	16,2	253,7	0,27	0,40	4,30
17	6,43	17,7	284,0	0,27	0,40	4,40
18	5,86	19,3	314,9	0,28	0,41	4,50
19	5,29	20,8	346,3	0,28	0,41	4,59
20	4,75	23,2	299,0	0,29	0,50	3,73
21	4,25	24,7	317,5	0,29	0,50	3,77
22	3,74	25,1	361,1	0,28	0,42	4,07
23	3,21	26,4	385,7	0,28	0,42	4,11
24	2,69	27,7	412,3	0,28	0,42	4,17
25	2,16	29,1	441,0	0,28	0,43	4,25

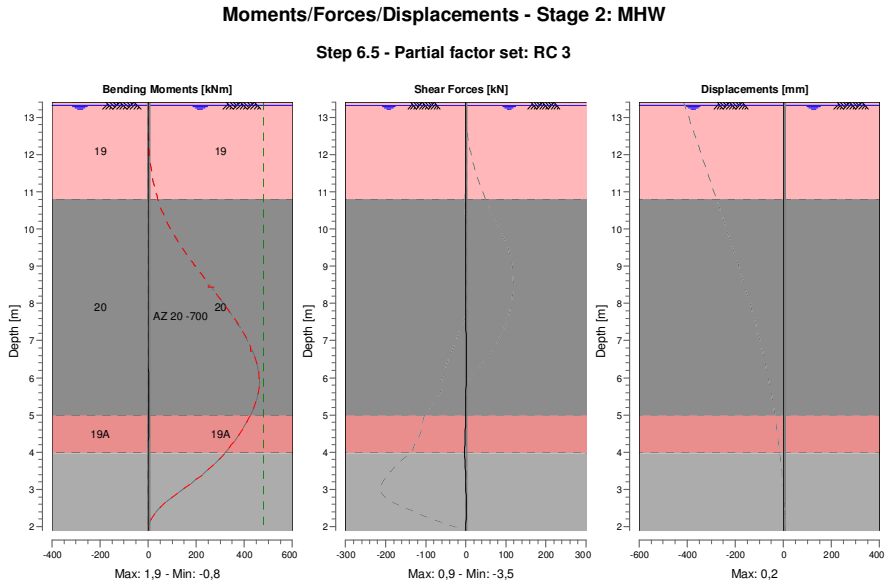
17.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	127,83
19A	41,98
32	93,23
19	0,00
32	0,00

17.7 Calculation Results

Number of iterations: 2

17.7.1 Charts of Moments, Forces and Displacements



17.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	0,1
1	13,32	0,0	0,0	0,1
2	13,32	0,0	0,0	0,1
2	12,82	0,1	0,3	0,1
3	12,82	0,1	0,3	0,1
3	12,32	0,3	0,4	0,1
4	12,32	0,3	0,4	0,1
4	12,15	0,3	0,3	0,1
5	12,15	0,3	0,3	0,1
5	11,70	0,4	0,1	**0,2**
6	11,70	0,4	0,1	**0,2**
6	11,25	0,4	-0,3	**0,2**
7	11,25	0,4	-0,3	**0,2**
7	10,80	0,1	-0,9	**0,2**
8	10,80	0,1	-0,9	**0,2**
8	10,47	-0,1	-0,6	**0,2**
9	10,47	-0,1	-0,6	**0,2**
9	10,15	-0,2	-0,3	**0,2**
10	10,15	-0,2	-0,3	**0,2**
10	9,61	-0,3	0,0	**0,2**
11	9,61	-0,3	0,0	**0,2**
11	9,07	-0,2	0,2	**0,2**
12	9,07	-0,2	0,2	**0,2**
12	9,00	-0,2	0,2	**0,2**
13	9,00	-0,2	0,2	**0,2**
13	8,43	0,0	0,4	**0,2**
14	8,43	0,0	0,4	**0,2**
14	7,86	0,3	0,5	**0,2**
15	7,86	0,3	0,5	**0,2**
15	7,29	0,6	0,6	**0,2**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	7,29	0,6	0,6	**0,2**
16	6,71	0,9	0,6	**0,2**
17	6,71	0,9	0,6	**0,2**
17	6,14	1,3	0,7	**0,2**
18	6,14	1,3	0,7	**0,2**
18	5,57	1,7	0,5	**0,2**
19	5,57	1,7	0,5	**0,2**
19	5,00	**1,9**	0,2	**0,2**
20	5,00	**1,9**	0,2	**0,2**
20	4,50	1,6	-1,5	**0,2**
21	4,50	1,6	-1,5	**0,2**
21	4,00	0,4	**-3,5**	**0,2**
22	4,00	0,4	**-3,5**	**0,2**
22	3,48	-0,7	-0,8	0,1
23	3,48	-0,7	-0,8	0,1
23	2,95	-0,7	0,6	0,1
24	2,95	-0,7	0,6	0,1
24	2,42	-0,3	0,8	0,1
25	2,42	-0,3	0,8	0,1
25	1,90	0,0	0,0	0,0
Max		**1,9**	**-3,5**	**0,2**
Max, minor nodes incl.		1,9	-3,5	0,2

17.7.3 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	13,40	0,00	0,00	P		0,00	0,00	A	
1	13,32	0,46	0,00	1		1,20	0,00	1	3
2	13,32	0,46	0,00	1		1,14	0,00	1	9
2	12,82	2,69	4,91	1		3,10	4,91	1	7
3	12,82	2,69	4,91	1		3,01	4,91	1	9
3	12,32	5,01	9,81	1		4,89	9,81	1	9
4	12,32	5,01	9,81	1		4,87	9,81	1	9
4	12,15	5,80	11,48	1		5,51	11,48	1	9
5	12,15	5,80	11,48	1		5,50	11,48	1	10
5	11,70	7,89	15,89	1		7,17	15,89	1	10
6	11,70	7,89	15,89	1		7,19	15,89	1	10
6	11,25	9,99	20,31	1		8,85	20,31	1	10
7	11,25	9,99	20,31	1		8,90	20,31	1	11
7	10,80	12,09	24,72	1		10,55	24,72	1	11
8	10,80	8,42	24,72	1		9,59	24,72	1	10
8	10,47	9,93	27,91	1		10,77	27,91	1	10
9	10,47	9,93	27,91	1		10,90	27,91	1	10
9	10,15	11,44	31,10	1		12,09	31,10	1	10
10	10,15	11,44	31,10	1		12,28	31,10	1	10
10	9,61	13,94	36,40	1		14,29	36,40	1	10
11	9,61	13,94	36,40	1		14,54	36,40	1	11
11	9,07	16,42	41,69	1		16,60	41,69	1	11
12	9,07	16,42	41,69	1		16,75	41,69	1	11
12	9,00	16,74	42,38	1		17,02	42,38	1	11
13	9,00	16,74	42,38	1		17,18	42,38	1	11
13	8,43	19,35	47,98	1		19,40	47,98	1	11
14	8,43	19,35	47,98	1		19,72	47,98	1	11
14	7,86	21,96	53,59	1		21,96	53,59	1	11
15	7,86	21,96	53,59	1		22,30	53,59	1	10
15	7,29	24,59	59,20	1		24,55	59,20	1	10
16	7,29	24,59	59,20	1		24,90	59,20	1	10
16	6,71	27,26	64,80	1		27,15	64,80	1	10
17	6,71	27,26	64,80	1		27,51	64,80	1	10
17	6,14	29,99	70,41	1		29,72	70,41	1	10
18	6,14	29,99	70,41	1		30,09	70,41	1	10
18	5,57	32,80	76,01	1		32,24	76,01	1	10

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* [%]
19	5,57	32,80	76,01	1		32,61	76,01	1	10
19	5,00	35,73	81,62	1		34,68	81,62	1	10
20	5,00	43,11	81,62	1		39,97	81,62	1	14
20	4,50	45,61	86,52	1		41,83	86,52	1	14
21	4,50	45,61	86,52	1		42,13	86,52	1	14
21	4,00	48,15	91,43	1		43,98	91,43	1	14
22	4,00	35,48	91,43	1		42,00	91,43	1	12
22	3,48	39,21	96,58	1		42,84	96,58	1	12
23	3,48	39,21	96,58	1		43,18	96,58	1	12
23	2,95	42,83	101,73	1		44,14	101,73	1	11
24	2,95	42,83	101,73	1		44,48	101,73	1	11
24	2,42	46,33	106,88	1		45,59	106,88	1	11
25	2,42	46,33	106,88	1		45,91	106,88	1	11
25	1,90	49,77	112,03	1		47,09	112,03	1	10

*

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

17.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	277,9	277,9
Water	639,7	639,7
Total	917,6	917,6

Considered as passive side	Right
Maximum passive effective resistance	2553,39 kN
Mobilized passive effective resistance	277,86 kN
Percentage mobilized resistance	10,9 %

17.7.5 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	-87,55
Vertical force passive	87,23
Resulting vertical force (no dead weight)	-0,32
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is sufficient (0 <= 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-87,55
Vertical force passive	87,23
Resulting vertical force (no dead weight)	-0,32
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is sufficient (0 <= 0)	

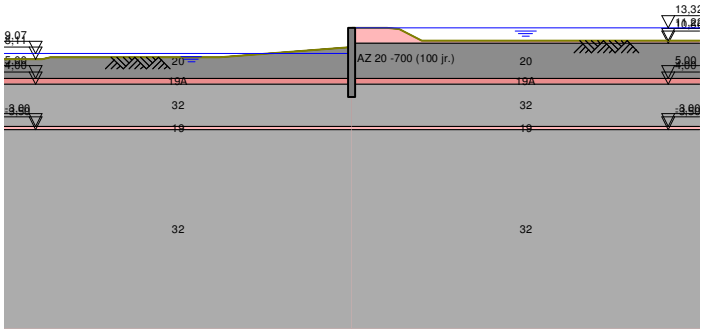
17.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,40	19	-4,71	13,40	19	4,44
10,80	20	-49,49	10,80	20	49,92
5,00	19A	-14,82	5,00	19A	13,64

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
4,00	32	-18,53	4,00	32	19,24

18 Outline Stage 3: VAL (MHW)

Outline - Stage 3: VAL (MHW)

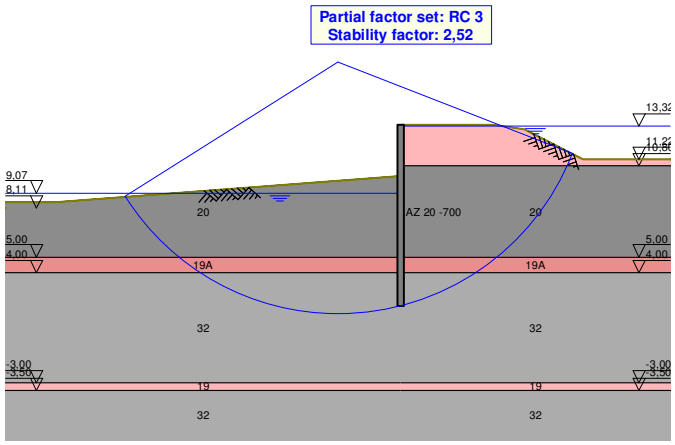


19 Overall Stability Stage 3: VAL (MHW)

Stability factor : 2,52

19.1 Overall Stability

Overall Stability - Stage 3: VAL (MHW)



20 Step 6.1 Stage 3: VAL (MHW)

20.1 Input Data Left

20.1.1 Calculation Method

Calculation method: C, phi, delta

20.1.2 Water Level

Water level: 9,32 [m]

20.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

20.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

20.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

20.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	2,8	35,9	0,30	0,30	3,89
3	9,06	3,4	42,9	0,31	0,31	3,87
4	9,03	3,5	44,0	0,31	0,31	3,86
5	8,91	3,9	47,6	0,31	0,31	3,81
6	8,79	4,2	51,4	0,31	0,32	3,77
7	8,48	5,1	60,6	0,31	0,34	3,68
8	7,95	6,7	76,7	0,31	0,36	3,57
9	7,41	8,2	95,0	0,31	0,39	3,58
10	6,88	9,8	115,5	0,31	0,41	3,66
11	6,34	11,3	136,3	0,31	0,42	3,72
12	5,80	12,9	157,1	0,31	0,44	3,77
13	5,27	14,4	177,9	0,31	0,45	3,81
14	4,75	16,8	143,3	0,33	0,53	2,80
15	4,25	18,2	156,5	0,33	0,54	2,83
16	3,74	19,5	185,8	0,33	0,47	3,11
17	3,21	21,1	202,9	0,33	0,47	3,13
18	2,69	22,7	219,7	0,33	0,48	3,15
19	2,16	24,4	236,0	0,33	0,48	3,15

20.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	418,83
19A	79,26
32	127,97
19	0,00
32	0,00

20.4 Input Data Right

20.4.1 Calculation Method

Calculation method: C, phi, delta

20.4.2 Water Level

Water level: 13,37 [m]

20.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

20.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

20.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

20.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	13,38	0,0	10,0	0,00	0,58	37,16
2	13,35	0,0	11,5	0,00	0,56	15,42
3	13,20	0,0	15,2	0,00	0,52	7,73
4	12,88	0,0	23,0	0,00	0,51	5,09
5	12,51	0,0	32,4	0,00	0,51	4,27
6	12,23	0,0	39,2	0,00	0,51	3,99
7	11,93	1,5	46,9	0,12	0,51	3,80

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
8	11,47	3,9	58,1	0,25	0,51	3,63
9	11,03	5,4	69,3	0,28	0,52	3,53
10	10,64	7,2	104,5	0,31	0,42	4,54
11	10,31	8,3	100,2	0,31	0,43	3,81
12	9,99	9,3	108,9	0,31	0,43	3,69
13	9,64	10,4	119,9	0,32	0,44	3,64
14	9,26	11,6	125,9	0,32	0,44	3,43
15	9,06	12,2	132,9	0,32	0,44	3,44
16	9,03	12,3	134,4	0,32	0,44	3,45
17	8,91	12,7	139,1	0,32	0,45	3,47
18	8,79	13,1	142,3	0,32	0,45	3,44
19	8,48	14,1	150,3	0,32	0,45	3,39
20	7,95	15,7	171,1	0,32	0,46	3,46
21	7,41	17,4	193,5	0,32	0,46	3,54
22	6,88	19,1	216,5	0,32	0,47	3,62
23	6,34	20,8	240,0	0,32	0,47	3,69
24	5,80	22,5	263,9	0,32	0,48	3,76
25	5,27	24,3	288,1	0,32	0,48	3,83
26	4,75	32,5	259,3	0,36	0,57	2,87
27	4,25	41,7	346,1	0,36	0,58	3,01
28	3,74	43,5	436,4	0,33	0,50	3,35
29	3,21	45,2	451,8	0,33	0,50	3,34
30	2,69	46,9	469,3	0,33	0,51	3,35
31	2,16	48,5	488,6	0,33	0,51	3,36

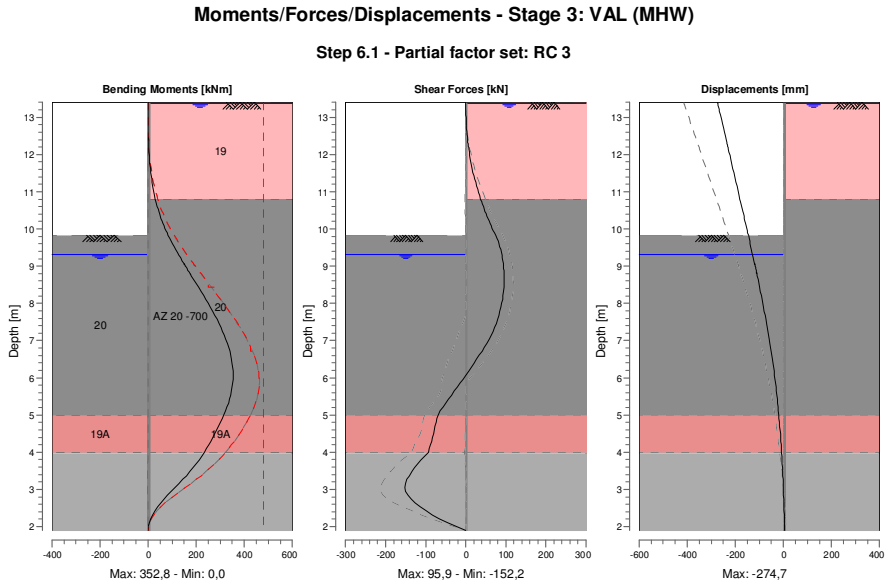
20.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	92,23
19A	37,10
32	225,26
19	0,00
32	0,00

20.7 Calculation Results

Number of iterations: 7

20.7.1 Charts of Moments, Forces and Displacements



20.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-274,7**
1	13,37	0,0	0,0	-273,6
2	13,37	0,0	0,0	-273,6
2	13,32	0,0	0,0	-271,8
3	13,32	0,0	0,0	-271,8
3	13,07	0,0	0,4	-262,7
4	13,07	0,0	0,4	-262,7
4	12,70	0,5	2,2	-249,1
5	12,70	0,5	2,2	-249,1
5	12,32	1,9	5,4	-235,5
6	12,32	1,9	5,4	-235,5
6	12,15	3,0	7,3	-229,4
7	12,15	3,0	7,3	-229,4
7	11,70	7,8	14,4	-213,1
8	11,70	7,8	14,4	-213,1
8	11,25	16,4	24,5	-196,8
9	11,25	16,4	24,5	-196,8
9	10,80	30,2	37,3	-180,6
10	10,80	30,2	37,3	-180,6
10	10,47	44,1	48,3	-168,9
11	10,47	44,1	48,3	-168,9
11	10,15	61,8	60,8	-157,4
12	10,15	61,8	60,8	-157,4
12	9,82	83,7	74,6	-145,9
13	9,82	83,7	74,5	-145,9
13	9,45	114,5	87,4	-132,8
14	9,45	114,5	87,3	-132,8
14	9,07	148,8	93,6	-119,9
15	9,07	148,8	93,5	-119,9
15	9,05	150,7	93,8	-119,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	150,7	93,8	-119,2
16	9,00	155,4	94,3	-117,6
17	9,00	155,4	94,3	-117,6
17	8,82	172,5	95,5	-111,6
18	8,82	172,5	95,5	-111,6
18	8,75	179,2	95,7	-109,3
19	8,75	179,2	95,7	-109,3
19	8,21	230,1	93,0	-92,2
20	8,21	230,1	93,0	-92,2
20	7,68	277,6	82,6	-76,3
21	7,68	277,6	82,6	-76,3
21	7,14	317,1	63,4	-61,6
22	7,14	317,1	63,4	-61,6
22	6,61	343,5	34,1	-48,5
23	6,61	343,5	34,1	-48,5
23	6,07	**352,8**	0,3	-37,0
24	6,07	**352,8**	0,3	-37,0
24	5,54	343,4	-35,8	-27,2
25	5,54	343,4	-35,8	-27,2
25	5,00	314,7	-69,9	-19,1
26	5,00	314,7	-69,8	-19,1
26	4,50	277,2	-80,7	-12,8
27	4,50	277,2	-80,8	-12,8
27	4,00	233,6	-93,1	-7,7
28	4,00	233,6	-93,2	-7,7
28	3,48	173,1	-134,7	-3,4
29	3,48	173,1	-135,0	-3,4
29	2,95	95,9	**-150,0**	0,1
30	2,95	95,9	**-150,0**	0,1
30	2,42	28,1	-99,4	3,2
31	2,42	28,1	-99,4	3,2
31	1,90	0,0	-0,2	6,1
Max		**352,8**	**-150,0**	**-274,7**
Max, minor nodes incl.		352,8	-152,2	-274,7

20.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,07	0,00	0,00	-		0,00	2,94	A	
4	13,07	0,00	0,00	-		0,00	2,94	A	
4	12,70	0,00	0,00	-		0,00	6,62	A	
5	12,70	0,00	0,00	-		0,00	6,62	A	
5	12,32	0,00	0,00	-		0,00	10,30	A	
6	12,32	0,00	0,00	-		0,00	10,30	A	
6	12,15	0,00	0,00	-		0,00	11,97	A	
7	12,15	0,00	0,00	-		1,27	11,97	A	
7	11,70	0,00	0,00	-		1,72	16,38	A	
8	11,70	0,00	0,00	-		3,48	16,38	A	
8	11,25	0,00	0,00	-		4,37	20,80	A	
9	11,25	0,00	0,00	-		4,91	20,80	A	
9	10,80	0,00	0,00	-		5,91	25,21	A	
10	10,80	0,00	0,00	-		6,72	25,21	A	
10	10,47	0,00	0,00	-		7,73	28,40	A	
11	10,47	0,00	0,00	-		7,75	28,40	A	
11	10,15	0,00	0,00	-		8,76	31,59	A	
12	10,15	0,00	0,00	-		8,78	31,59	A	
12	9,82	0,00	0,00	-		9,79	34,78	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* [%]
13	9,82	0,00	0,00	P		9,81	34,78	A	
13	9,45	26,07	0,00	P		10,98	38,48	A	
14	9,45	25,16	0,00	P		11,01	38,48	A	
14	9,07	40,81	2,45	P		12,18	42,18	A	
15	9,07	40,62	2,45	P		12,19	42,18	A	
15	9,05	41,34	2,65	P		12,25	42,38	A	
16	9,05	41,17	2,65	P		12,26	42,38	A	
16	9,00	42,97	3,14	P		12,41	42,87	A	
17	9,00	42,45	3,14	P		12,42	42,87	A	
17	8,82	48,86	4,91	P		12,98	44,64	A	
18	8,82	48,29	4,91	P		12,99	44,64	A	
18	8,75	50,75	5,59	P		13,20	45,32	A	
19	8,75	49,57	5,59	P		13,22	45,32	A	
19	8,21	67,99	10,85	P		14,88	50,58	A	
20	8,21	65,93	10,85	P		14,92	50,58	A	
20	7,68	83,82	16,10	P		16,58	55,83	A	
21	7,68	84,17	16,10	P		16,62	55,83	A	
21	7,14	102,17	21,36	P		18,27	61,09	A	
22	7,14	104,49	21,36	P		18,32	61,09	A	
22	6,61	120,41	26,61	3	98	19,97	66,34	A	
23	6,61	121,84	26,61	3	97	20,01	66,34	A	
23	6,07	125,72	31,87	3	87	21,67	71,60	A	
24	6,07	126,98	31,87	3	87	21,71	71,60	A	
24	5,54	132,35	37,12	3	80	23,36	76,85	A	
25	5,54	133,47	37,12	3	80	23,46	76,85	A	
25	5,00	121,52	42,38	2	65	25,12	82,11	A	
26	5,00	87,86	42,38	2	64	27,98	82,11	A	
26	4,50	79,61	47,28	2	54	36,93	66,17	A	
27	4,50	80,34	47,28	2	54	37,23	66,17	A	
27	4,00	66,49	52,19	1	41	46,25	50,23	A	
28	4,00	136,29	52,19	2	77	42,63	50,23	A	
28	3,48	106,44	57,34	2	55	44,31	55,38	A	
29	3,48	107,08	57,34	2	55	44,33	55,38	A	
29	2,95	28,86	62,49	1		72,08	60,53	1	16
30	2,95	29,26	62,49	1		72,36	60,53	1	16
30	2,42	23,40	67,64	A		169,42	65,68	1	35
31	2,42	23,38	67,64	A		169,70	65,68	1	35
31	1,90	25,02	72,79	A		252,29	70,83	2	51

*

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

20.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	626,1	359,5
Water	270,1	536,9
Total	896,1	896,4

Considered as passive side	Left
Maximum passive effective resistance	1052,86 kN
Mobilized passive effective resistance	626,07 kN
Percentage mobilized resistance	59,5 %

20.7.5 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	-81,82
Vertical force passive	183,18
Resulting vertical force (no dead weight)	101,36
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-81,82
Vertical force passive	183,18
Resulting vertical force (no dead weight)	101,36
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

20.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	138,80	13,40	19	-1,23
5,00	19A	21,74	10,80	20	-30,57
4,00	32	22,64	5,00	19A	-10,17
			4,00	32	-39,85

21 Step 6.2 Stage 3: VAL (MHW)

21.1 Input Data Left

21.1.1 Calculation Method

Calculation method: C, phi, delta

21.1.2 Water Level

Water level: 9,32 [m]

21.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

21.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

21.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

21.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	2,8	35,9	0,30	0,30	3,89
3	9,06	3,4	42,9	0,31	0,31	3,87
4	9,03	3,5	44,0	0,31	0,31	3,86
5	8,91	3,9	47,6	0,31	0,31	3,81
6	8,79	4,2	51,4	0,31	0,32	3,77
7	8,48	5,1	60,6	0,31	0,34	3,68
8	7,95	6,7	76,7	0,31	0,36	3,57
9	7,41	8,2	95,0	0,31	0,39	3,58
10	6,88	9,8	115,5	0,31	0,41	3,66
11	6,34	11,3	136,3	0,31	0,42	3,72
12	5,80	12,9	157,1	0,31	0,44	3,77
13	5,27	14,4	177,9	0,31	0,45	3,81
14	4,75	16,8	143,3	0,33	0,53	2,80
15	4,25	18,2	156,5	0,33	0,54	2,83
16	3,74	19,5	185,8	0,33	0,47	3,11
17	3,21	21,1	202,9	0,33	0,47	3,13
18	2,69	22,7	219,7	0,33	0,48	3,15
19	2,16	24,4	236,0	0,33	0,48	3,15

21.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	435,00
19A	76,46
32	95,20
19	0,00
32	0,00

21.4 Input Data Right

21.4.1 Calculation Method

Calculation method: C, phi, delta

21.4.2 Water Level

Water level: 13,37 [m]

21.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

21.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

21.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

21.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	13,38	0,0	10,0	0,00	0,58	37,16
2	13,35	0,0	11,5	0,00	0,56	15,42
3	13,07	0,0	18,4	0,00	0,52	6,13
4	12,57	0,0	30,8	0,00	0,51	4,35
5	12,23	0,0	39,2	0,00	0,51	3,99
6	11,93	1,5	46,9	0,12	0,51	3,80
7	11,47	3,9	58,1	0,25	0,51	3,63

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
8	11,03	5,4	69,3	0,28	0,52	3,53
9	10,64	7,2	104,5	0,31	0,42	4,54
10	10,31	8,3	100,2	0,31	0,43	3,81
11	9,99	9,3	108,9	0,31	0,43	3,69
12	9,64	10,4	119,9	0,32	0,44	3,64
13	9,26	11,6	125,9	0,32	0,44	3,43
14	9,06	12,2	132,9	0,32	0,44	3,44
15	9,03	12,3	134,4	0,32	0,44	3,45
16	8,91	12,7	139,1	0,32	0,45	3,47
17	8,79	13,1	142,3	0,32	0,45	3,44
18	8,48	14,1	150,3	0,32	0,45	3,39
19	7,95	15,7	171,1	0,32	0,46	3,46
20	7,41	17,4	193,5	0,32	0,46	3,54
21	6,88	19,1	216,5	0,32	0,47	3,62
22	6,34	20,8	240,0	0,32	0,47	3,69
23	5,80	22,5	263,9	0,32	0,48	3,76
24	5,27	24,3	288,1	0,32	0,48	3,83
25	4,75	32,5	259,3	0,36	0,57	2,87
26	4,25	41,7	346,1	0,36	0,58	3,01
27	3,74	43,5	436,4	0,33	0,50	3,35
28	3,21	45,2	451,8	0,33	0,50	3,34
29	2,69	46,9	469,3	0,33	0,51	3,35
30	2,16	48,5	488,6	0,33	0,51	3,36

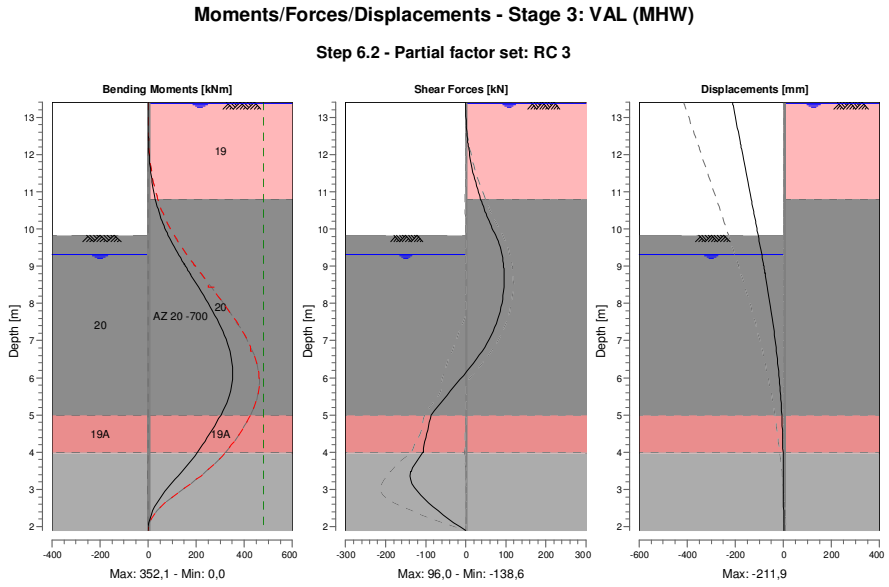
21.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	92,23
19A	37,21
32	205,90
19	0,00
32	0,00

21.7 Calculation Results

Number of iterations: 7

21.7.1 Charts of Moments, Forces and Displacements



21.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-211,9**
1	13,37	0,0	0,0	-211,0
2	13,37	0,0	0,0	-211,0
2	13,32	0,0	0,0	-209,5
3	13,32	0,0	0,0	-209,5
3	12,82	0,3	1,5	-194,4
4	12,82	0,3	1,5	-194,4
4	12,32	1,9	5,4	-179,3
5	12,32	1,9	5,4	-179,3
5	12,15	3,0	7,3	-174,2
6	12,15	3,0	7,3	-174,2
6	11,70	7,8	14,4	-160,6
7	11,70	7,8	14,4	-160,6
7	11,25	16,4	24,5	-147,1
8	11,25	16,4	24,5	-147,1
8	10,80	30,2	37,3	-133,6
9	10,80	30,2	37,3	-133,6
9	10,47	44,1	48,3	-123,9
10	10,47	44,1	48,3	-123,9
10	10,15	61,8	60,8	-114,3
11	10,15	61,8	60,8	-114,3
11	9,82	83,7	74,6	-104,8
12	9,82	83,7	74,6	-104,8
12	9,45	114,6	87,4	-94,0
13	9,45	114,6	87,4	-94,0
13	9,07	148,9	93,7	-83,5
14	9,07	148,9	93,7	-83,5
14	9,05	150,8	93,9	-82,9
15	9,05	150,8	93,9	-82,9
15	9,00	155,5	94,4	-81,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	155,5	94,4	-81,5
16	8,82	172,6	95,6	-76,7
17	8,82	172,6	95,6	-76,7
17	8,75	179,3	95,8	-74,8
18	8,75	179,3	95,8	-74,8
18	8,21	230,3	93,2	-61,0
19	8,21	230,3	93,2	-61,0
19	7,68	277,8	82,8	-48,3
20	7,68	277,8	82,8	-48,3
20	7,14	317,4	63,5	-36,9
21	7,14	317,4	63,5	-36,9
21	6,61	343,9	34,1	-27,0
22	6,61	343,9	34,1	-27,0
22	6,07	**352,0**	-5,2	-18,8
23	6,07	**352,0**	-5,3	-18,8
23	5,54	338,0	-46,7	-12,3
24	5,54	338,0	-46,8	-12,3
24	5,00	302,1	-85,9	-7,4
25	5,00	302,1	-85,9	-7,4
25	4,50	256,2	-97,4	-4,1
26	4,50	256,2	-97,5	-4,1
26	4,00	205,0	-106,3	-1,9
27	4,00	205,0	-106,5	-1,9
27	3,48	140,2	-136,4	-0,4
28	3,48	140,2	**-136,7**	-0,4
28	2,95	70,0	-121,0	0,3
29	2,95	70,0	-120,8	0,3
29	2,42	19,0	-69,7	0,8
30	2,42	19,0	-69,7	0,8
30	1,90	0,0	0,0	1,1
Max		**352,0**	**-136,7**	**-211,9**
Max, minor nodes incl.		352,1	-138,6	-211,9

21.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	12,82	0,00	0,00	-		0,00	5,40	A	
4	12,82	0,00	0,00	-		0,00	5,40	A	
4	12,32	0,00	0,00	-		0,00	10,30	A	
5	12,32	0,00	0,00	-		0,00	10,30	A	
5	12,15	0,00	0,00	-		0,00	11,97	A	
6	12,15	0,00	0,00	-		1,27	11,97	A	
6	11,70	0,00	0,00	-		1,72	16,38	A	
7	11,70	0,00	0,00	-		3,48	16,38	A	
7	11,25	0,00	0,00	-		4,37	20,80	A	
8	11,25	0,00	0,00	-		4,91	20,80	A	
8	10,80	0,00	0,00	-		5,91	25,21	A	
9	10,80	0,00	0,00	-		6,72	25,21	A	
9	10,47	0,00	0,00	-		7,73	28,40	A	
10	10,47	0,00	0,00	-		7,75	28,40	A	
10	10,15	0,00	0,00	-		8,76	31,59	A	
11	10,15	0,00	0,00	-		8,78	31,59	A	
11	9,82	0,00	0,00	-		9,79	34,78	A	
12	9,82	0,00	0,00	P		9,81	34,78	A	
12	9,45	26,07	0,00	P		10,98	38,48	A	
13	9,45	25,16	0,00	P		11,01	38,48	A	
13	9,07	40,81	2,45	P		12,18	42,18	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* [%]
14	9,07	40,62	2,45	P		12,19	42,18	A	
14	9,05	41,34	2,65	P		12,25	42,38	A	
15	9,05	41,17	2,65	P		12,26	42,38	A	
15	9,00	42,97	3,14	P		12,41	42,87	A	
16	9,00	42,45	3,14	P		12,42	42,87	A	
16	8,82	48,86	4,91	P		12,98	44,64	A	
17	8,82	48,29	4,91	P		12,99	44,64	A	
17	8,75	50,75	5,59	P		13,20	45,32	A	
18	8,75	49,57	5,59	P		13,22	45,32	A	
18	8,21	67,99	10,85	P		14,88	50,58	A	
19	8,21	65,93	10,85	P		14,92	50,58	A	
19	7,68	83,82	16,10	P		16,58	55,83	A	
20	7,68	84,17	16,10	P		16,62	55,83	A	
20	7,14	102,17	21,36	P		18,27	61,09	A	
21	7,14	104,49	21,36	P		18,32	61,09	A	
21	6,61	122,94	26,61	P		19,97	66,34	A	
22	6,61	125,00	26,61	P		20,01	66,34	A	
22	6,07	139,60	31,87	3	97	21,67	71,60	A	
23	6,07	140,86	31,87	3	97	21,71	71,60	A	
23	5,54	139,07	37,12	3	84	23,36	76,85	A	
24	5,54	140,18	37,12	3	84	23,46	76,85	A	
24	5,00	127,77	42,38	2	69	25,12	82,11	A	
25	5,00	92,77	42,38	2	68	27,98	82,11	A	
25	4,50	77,86	47,28	2	53	36,93	66,17	A	
26	4,50	78,59	47,28	2	53	37,23	66,17	A	
26	4,00	55,95	52,19	1	35	48,54	50,23	1	
27	4,00	117,13	52,19	2	66	42,63	50,23	A	
27	3,48	68,99	57,34	1	36	44,31	55,38	A	
28	3,48	69,41	57,34	1	36	44,33	55,38	A	
28	2,95	21,76	62,49	A		98,86	60,53	1	21
29	2,95	21,76	62,49	A		99,13	60,53	1	22
29	2,42	23,40	67,64	A		141,67	65,68	1	30
30	2,42	23,38	67,64	A		141,95	65,68	1	30
30	1,90	25,02	72,79	A		175,51	70,83	1	35

*

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

21.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	606,6	340,2
Water	270,1	536,9
Total	876,7	877,1

Considered as passive side	Left
Maximum passive effective resistance	1052,86 kN
Mobilized passive effective resistance	606,65 kN
Percentage mobilized resistance	57,6 %

21.7.5 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	-78,43
Vertical force passive	181,97
Resulting vertical force (no dead weight)	103,54
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-78,43
Vertical force passive	181,97
Resulting vertical force (no dead weight)	103,54
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

21.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	144,16	13,40	19	-1,23
5,00	19A	20,97	10,80	20	-30,57
4,00	32	16,84	5,00	19A	-10,21
			4,00	32	-36,43

22 Step 6.3 Stage 3: VAL (MHW)

22.1 Input Data Left

22.1.1 Calculation Method

Calculation method: C, phi, delta

22.1.2 Water Level

Water level: 8,82 [m]

22.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

22.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

22.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

22.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	3,0	39,0	0,31	0,31	4,02
3	9,06	4,1	52,7	0,31	0,33	4,02
4	9,03	4,3	55,1	0,31	0,33	4,02
5	8,91	4,9	63,0	0,31	0,35	4,02
6	8,79	5,4	70,3	0,31	0,35	4,01
7	8,48	6,3	79,8	0,31	0,36	3,92
8	7,95	7,9	96,4	0,31	0,37	3,80
9	7,41	9,4	112,8	0,31	0,39	3,71
10	6,88	11,0	129,0	0,31	0,40	3,65
11	6,34	12,5	145,1	0,31	0,42	3,59
12	5,80	14,1	160,9	0,31	0,43	3,54
13	5,27	15,6	179,5	0,31	0,44	3,56
14	4,75	18,2	140,3	0,33	0,53	2,55
15	4,25	19,7	153,6	0,33	0,53	2,61
16	3,74	20,7	186,0	0,33	0,46	2,94
17	3,21	22,4	202,7	0,33	0,46	2,97
18	2,69	24,0	219,5	0,33	0,47	2,99
19	2,16	25,6	236,4	0,33	0,47	3,02

22.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	438,49
19A	65,08
32	112,29
19	0,00
32	0,00

22.4 Input Data Right

22.4.1 Calculation Method

Calculation method: C, phi, delta

22.4.2 Water Level

Water level: 13,37 [m]

22.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

22.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

22.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

22.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	13,38	0,0	10,0	0,00	0,58	37,16
2	13,35	0,0	11,5	0,00	0,56	15,42
3	13,20	0,0	15,2	0,00	0,52	7,73
4	12,88	0,0	23,0	0,00	0,51	5,09
5	12,51	0,0	32,4	0,00	0,51	4,27
6	12,23	0,0	39,2	0,00	0,51	3,99
7	11,93	1,5	46,9	0,12	0,51	3,80

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
8	11,47	3,9	58,1	0,25	0,51	3,63
9	11,03	5,4	69,3	0,28	0,52	3,53
10	10,64	7,2	104,5	0,31	0,42	4,54
11	10,31	8,3	100,2	0,31	0,43	3,81
12	9,99	9,3	108,9	0,31	0,43	3,69
13	9,64	10,4	119,9	0,32	0,44	3,64
14	9,26	11,6	125,9	0,32	0,44	3,43
15	9,06	12,2	132,9	0,32	0,44	3,44
16	9,03	12,3	134,4	0,32	0,44	3,45
17	8,91	12,7	139,1	0,32	0,45	3,47
18	8,79	13,1	142,3	0,32	0,45	3,44
19	8,48	14,1	150,3	0,32	0,45	3,39
20	7,95	15,7	171,1	0,32	0,46	3,46
21	7,41	17,4	193,5	0,32	0,46	3,54
22	6,88	19,1	216,5	0,32	0,47	3,62
23	6,34	20,8	240,0	0,32	0,47	3,69
24	5,80	22,5	263,9	0,32	0,48	3,76
25	5,27	24,3	288,1	0,32	0,48	3,83
26	4,75	32,5	259,3	0,36	0,57	2,87
27	4,25	41,7	346,1	0,36	0,58	3,01
28	3,74	43,5	436,4	0,33	0,50	3,35
29	3,21	45,2	451,8	0,33	0,50	3,34
30	2,69	46,9	469,3	0,33	0,51	3,35
31	2,16	48,5	488,6	0,33	0,51	3,36

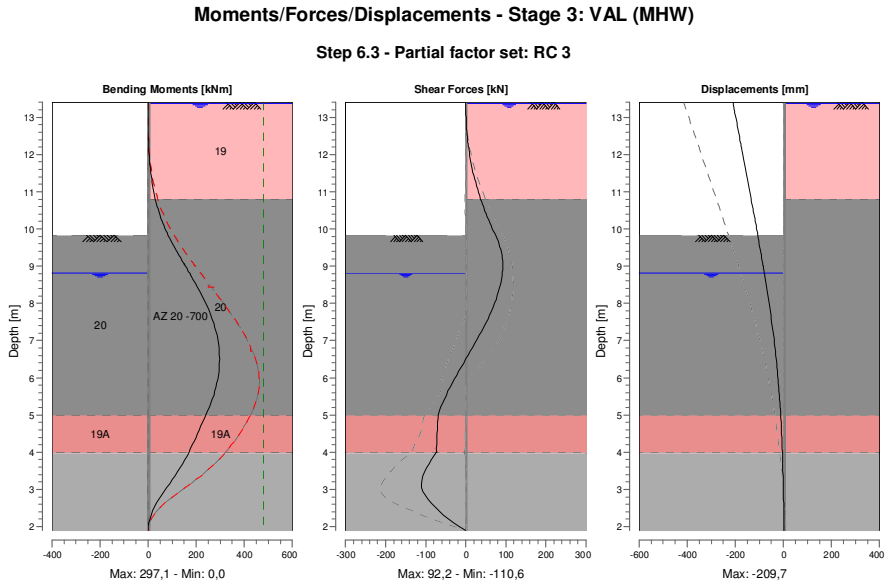
22.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	92,23
19A	37,70
32	179,42
19	0,00
32	0,00

22.7 Calculation Results

Number of iterations: 6

22.7.1 Charts of Moments, Forces and Displacements



22.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-209,7**
1	13,37	0,0	0,0	-208,9
2	13,37	0,0	0,0	-208,9
2	13,32	0,0	0,0	-207,4
3	13,32	0,0	0,0	-207,4
3	13,07	0,0	0,4	-200,1
4	13,07	0,0	0,4	-200,1
4	12,70	0,5	2,2	-189,2
5	12,70	0,5	2,2	-189,2
5	12,32	1,9	5,4	-178,3
6	12,32	1,9	5,4	-178,3
6	12,15	3,0	7,3	-173,4
7	12,15	3,0	7,3	-173,4
7	11,70	7,8	14,4	-160,3
8	11,70	7,8	14,4	-160,3
8	11,25	16,4	24,5	-147,3
9	11,25	16,4	24,5	-147,3
9	10,80	30,2	37,3	-134,3
10	10,80	30,2	37,3	-134,3
10	10,47	44,1	48,3	-125,0
11	10,47	44,1	48,3	-125,0
11	10,15	61,8	60,8	-115,8
12	10,15	61,8	60,8	-115,8
12	9,82	83,7	74,6	-106,7
13	9,82	83,7	74,5	-106,7
13	9,45	114,5	87,4	-96,2
14	9,45	114,5	87,3	-96,2
14	9,07	148,7	92,2	-86,1
15	9,07	148,7	92,2	-86,1
15	9,05	150,5	92,2	-85,6

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	150,5	92,2	-85,6
16	9,00	155,1	92,2	-84,3
17	9,00	155,1	92,2	-84,3
17	8,82	171,6	91,0	-79,6
18	8,82	171,6	91,0	-79,6
18	8,75	178,0	90,1	-77,8
19	8,75	178,0	90,1	-77,8
19	8,21	223,7	78,8	-64,6
20	8,21	223,7	78,8	-64,6
20	7,68	261,1	59,5	-52,4
21	7,68	261,1	59,5	-52,4
21	7,14	286,2	33,4	-41,5
22	7,14	286,2	33,4	-41,5
22	6,61	**296,8**	5,8	-32,0
23	6,61	**296,8**	5,8	-32,0
23	6,07	292,2	-23,1	-23,9
24	6,07	292,2	-23,2	-23,9
24	5,54	272,7	-48,9	-17,1
25	5,54	272,7	-48,9	-17,1
25	5,00	240,8	-69,5	-11,7
26	5,00	240,8	-69,5	-11,7
26	4,50	205,6	-71,6	-7,7
27	4,50	205,6	-71,6	-7,7
27	4,00	169,3	-73,1	-4,6
28	4,00	169,3	-73,2	-4,6
28	3,48	122,7	-102,4	-2,0
29	3,48	122,7	-102,7	-2,0
29	2,95	65,8	**-107,0**	0,0
30	2,95	65,8	-106,9	0,0
30	2,42	18,8	-67,2	1,7
31	2,42	18,8	-67,2	1,7
31	1,90	0,0	0,0	3,3
Max		**296,8**	**-107,0**	**-209,7**
Max, minor nodes incl.		297,1	-110,6	-209,7

22.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,07	0,00	0,00	-		0,00	2,94	A	
4	13,07	0,00	0,00	-		0,00	2,94	A	
4	12,70	0,00	0,00	-		0,00	6,62	A	
5	12,70	0,00	0,00	-		0,00	6,62	A	
5	12,32	0,00	0,00	-		0,00	10,30	A	
6	12,32	0,00	0,00	-		0,00	10,30	A	
6	12,15	0,00	0,00	-		0,00	11,97	A	
7	12,15	0,00	0,00	-		1,27	11,97	A	
7	11,70	0,00	0,00	-		1,72	16,38	A	
8	11,70	0,00	0,00	-		3,48	16,38	A	
8	11,25	0,00	0,00	-		4,37	20,80	A	
9	11,25	0,00	0,00	-		4,91	20,80	A	
9	10,80	0,00	0,00	-		5,91	25,21	A	
10	10,80	0,00	0,00	-		6,72	25,21	A	
10	10,47	0,00	0,00	-		7,73	28,40	A	
11	10,47	0,00	0,00	-		7,75	28,40	A	
11	10,15	0,00	0,00	-		8,76	31,59	A	
12	10,15	0,00	0,00	-		8,78	31,59	A	
12	9,82	0,00	0,00	-		9,79	34,78	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* [%]
13	9,82	0,00	0,00	P		9,81	34,78	A	
13	9,45	26,07	0,00	P		10,98	38,48	A	
14	9,45	25,99	0,00	P		11,01	38,48	A	
14	9,07	52,02	0,00	P		12,18	42,18	A	
15	9,07	52,01	0,00	P		12,19	42,18	A	
15	9,05	53,39	0,00	P		12,25	42,38	A	
16	9,05	53,39	0,00	P		12,26	42,38	A	
16	9,00	56,83	0,00	P		12,41	42,87	A	
17	9,00	56,83	0,00	P		12,42	42,87	A	
17	8,82	69,24	0,00	P		12,98	44,64	A	
18	8,82	69,02	0,00	P		12,99	44,64	A	
18	8,75	71,64	0,69	P		13,20	45,32	A	
19	8,75	70,01	0,69	P		13,22	45,32	A	
19	8,21	89,60	5,94	P		14,88	50,58	A	
20	8,21	86,91	5,94	P		14,92	50,58	A	
20	7,68	105,93	11,20	P		16,58	55,83	A	
21	7,68	103,53	11,20	P		16,62	55,83	A	
21	7,14	114,52	16,45	3	94	18,27	61,09	A	
22	7,14	113,04	16,45	3	94	18,32	61,09	A	
22	6,61	118,02	21,71	3	85	19,97	66,34	A	
23	6,61	116,64	21,71	3	86	20,01	66,34	A	
23	6,07	121,01	26,96	2	79	21,67	71,60	A	
24	6,07	120,41	26,96	2	79	21,71	71,60	A	
24	5,54	110,55	32,22	2	65	23,36	76,85	A	
25	5,54	110,95	32,22	2	65	23,46	76,85	A	
25	5,00	104,42	37,47	2	55	25,12	82,11	A	
26	5,00	73,77	37,47	2	55	27,98	82,11	A	
26	4,50	65,51	42,38	1	45	36,93	66,17	A	
27	4,50	65,92	42,38	1	44	37,23	66,17	A	
27	4,00	53,45	47,28	1	34	52,70	50,23	1	
28	4,00	110,90	47,28	2	62	42,63	50,23	A	
28	3,48	91,32	52,43	1	47	44,31	55,38	A	
29	3,48	91,78	52,43	1	47	44,33	55,38	A	
29	2,95	32,57	57,58	1		69,60	60,53	1	15
30	2,95	33,02	57,58	1		69,88	60,53	1	15
30	2,42	24,82	62,73	A		124,48	65,68	1	26
31	2,42	24,82	62,73	A		124,76	65,68	1	26
31	1,90	26,45	67,89	A		176,38	70,83	1	35

*

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

22.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	615,9	314,2
Water	234,9	536,9
Total	850,7	851,1

Considered as passive side	Left
Maximum passive effective resistance	1114,14 kN
Mobilized passive effective resistance	615,86 kN
Percentage mobilized resistance	55,3 %

22.7.5 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	-73,88
Vertical force passive	183,03
Resulting vertical force (no dead weight)	109,15
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-73,88
Vertical force passive	183,03
Resulting vertical force (no dead weight)	109,15
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

22.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	145,32	13,40	19	-1,23
5,00	19A	17,85	10,80	20	-30,57
4,00	32	19,87	5,00	19A	-10,34
			4,00	32	-31,74

23 Step 6.4 Stage 3: VAL (MHW)

23.1 Input Data Left

23.1.1 Calculation Method

Calculation method: C, phi, delta

23.1.2 Water Level

Water level: 8,82 [m]

23.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

23.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

23.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

23.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	3,0	39,0	0,31	0,31	4,02
3	9,06	4,1	52,7	0,31	0,33	4,02
4	9,03	4,3	55,1	0,31	0,33	4,02
5	8,91	4,9	63,0	0,31	0,35	4,02
6	8,79	5,4	70,3	0,31	0,35	4,01
7	8,48	6,3	79,8	0,31	0,36	3,92
8	7,95	7,9	96,4	0,31	0,37	3,80
9	7,41	9,4	112,8	0,31	0,39	3,71
10	6,88	11,0	129,0	0,31	0,40	3,65
11	6,34	12,5	145,1	0,31	0,42	3,59
12	5,80	14,1	160,9	0,31	0,43	3,54
13	5,27	15,6	179,5	0,31	0,44	3,56
14	4,75	18,2	140,3	0,33	0,53	2,55
15	4,25	19,7	153,6	0,33	0,53	2,61
16	3,74	20,7	186,0	0,33	0,46	2,94
17	3,21	22,4	202,7	0,33	0,46	2,97
18	2,69	24,0	219,5	0,33	0,47	2,99
19	2,16	25,6	236,4	0,33	0,47	3,02

23.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	457,70
19A	57,16
32	77,32
19	0,00
32	0,00

23.4 Input Data Right

23.4.1 Calculation Method

Calculation method: C, phi, delta

23.4.2 Water Level

Water level: 13,37 [m]

23.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

23.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

23.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

23.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	13,38	0,0	10,0	0,00	0,58	37,16
2	13,35	0,0	11,5	0,00	0,56	15,42
3	13,07	0,0	18,4	0,00	0,52	6,13
4	12,57	0,0	30,8	0,00	0,51	4,35
5	12,23	0,0	39,2	0,00	0,51	3,99
6	11,93	1,5	46,9	0,12	0,51	3,80
7	11,47	3,9	58,1	0,25	0,51	3,63

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
8	11,03	5,4	69,3	0,28	0,52	3,53
9	10,64	7,2	104,5	0,31	0,42	4,54
10	10,31	8,3	100,2	0,31	0,43	3,81
11	9,99	9,3	108,9	0,31	0,43	3,69
12	9,64	10,4	119,9	0,32	0,44	3,64
13	9,26	11,6	125,9	0,32	0,44	3,43
14	9,06	12,2	132,9	0,32	0,44	3,44
15	9,03	12,3	134,4	0,32	0,44	3,45
16	8,91	12,7	139,1	0,32	0,45	3,47
17	8,79	13,1	142,3	0,32	0,45	3,44
18	8,48	14,1	150,3	0,32	0,45	3,39
19	7,95	15,7	171,1	0,32	0,46	3,46
20	7,41	17,4	193,5	0,32	0,46	3,54
21	6,88	19,1	216,5	0,32	0,47	3,62
22	6,34	20,8	240,0	0,32	0,47	3,69
23	5,80	22,5	263,9	0,32	0,48	3,76
24	5,27	24,3	288,1	0,32	0,48	3,83
25	4,75	32,5	259,3	0,36	0,57	2,87
26	4,25	41,7	346,1	0,36	0,58	3,01
27	3,74	43,5	436,4	0,33	0,50	3,35
28	3,21	45,2	451,8	0,33	0,50	3,34
29	2,69	46,9	469,3	0,33	0,51	3,35
30	2,16	48,5	488,6	0,33	0,51	3,36

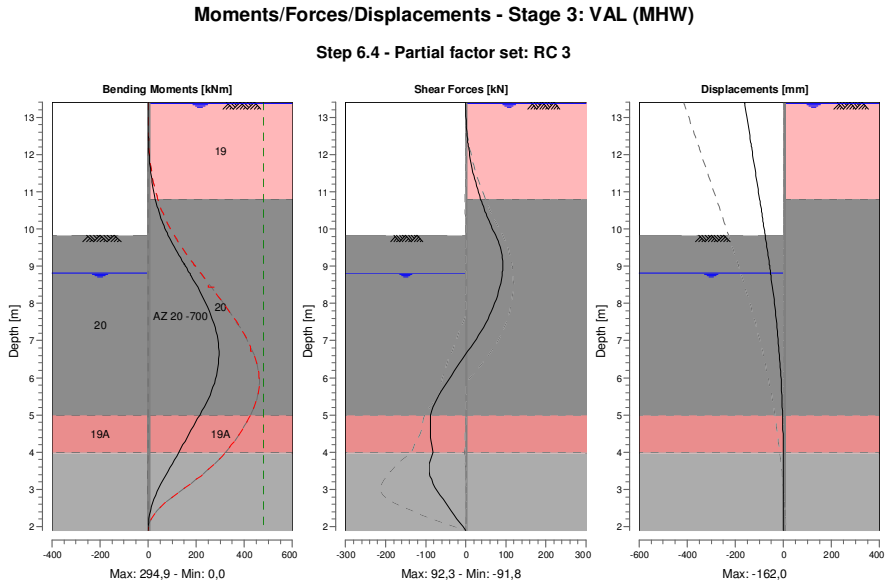
23.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	92,23
19A	40,90
32	152,45
19	0,00
32	0,00

23.7 Calculation Results

Number of iterations: 8

23.7.1 Charts of Moments, Forces and Displacements



23.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-162,0**
1	13,37	0,0	0,0	-161,2
2	13,37	0,0	0,0	-161,2
2	13,32	0,0	0,0	-160,0
3	13,32	0,0	0,0	-160,0
3	12,82	0,3	1,5	-147,9
4	12,82	0,3	1,5	-147,9
4	12,32	1,9	5,4	-135,7
5	12,32	1,9	5,4	-135,7
5	12,15	3,0	7,3	-131,6
6	12,15	3,0	7,3	-131,6
6	11,70	7,8	14,4	-120,7
7	11,70	7,8	14,4	-120,7
7	11,25	16,4	24,5	-109,8
8	11,25	16,4	24,5	-109,8
8	10,80	30,2	37,3	-98,9
9	10,80	30,2	37,3	-98,9
9	10,47	44,1	48,3	-91,2
10	10,47	44,1	48,3	-91,2
10	10,15	61,8	60,8	-83,5
11	10,15	61,8	60,8	-83,5
11	9,82	83,7	74,6	-75,9
12	9,82	83,7	74,6	-75,9
12	9,45	114,6	87,4	-67,3
13	9,45	114,6	87,4	-67,3
13	9,07	148,7	**92,3**	-59,0
14	9,07	148,7	**92,3**	-59,0
14	9,05	150,6	**92,3**	-58,5
15	9,05	150,6	**92,3**	-58,5
15	9,00	155,2	**92,3**	-57,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	155,2	**92,3**	-57,5
16	8,82	171,7	91,1	-53,6
17	8,82	171,7	91,1	-53,6
17	8,75	178,1	90,2	-52,2
18	8,75	178,1	90,2	-52,2
18	8,21	223,8	78,9	-41,5
19	8,21	223,8	78,9	-41,5
19	7,68	261,3	59,6	-31,9
20	7,68	261,3	59,6	-31,9
20	7,14	286,4	32,4	-23,6
21	7,14	286,4	32,4	-23,6
21	6,61	**294,9**	-1,8	-16,6
22	6,61	**294,9**	-1,8	-16,6
22	6,07	284,8	-35,8	-11,0
23	6,07	284,8	-35,8	-11,0
23	5,54	257,0	-66,9	-6,8
24	5,54	257,0	-66,9	-6,8
24	5,00	214,9	-88,6	-3,8
25	5,00	214,9	-88,7	-3,8
25	4,50	170,6	-88,0	-1,9
26	4,50	170,6	-88,1	-1,9
26	4,00	127,9	-81,2	-0,8
27	4,00	127,9	-81,4	-0,8
27	3,48	81,2	-91,3	-0,1
28	3,48	81,2	-91,3	-0,1
28	2,95	37,8	-70,2	0,1
29	2,95	37,8	-70,1	0,1
29	2,42	9,6	-36,4	0,2
30	2,42	9,6	-36,4	0,2
30	1,90	0,0	0,0	0,2
Max		**294,9**	**92,3**	**-162,0**
Max, minor nodes incl.		294,9	92,3	-162,0

23.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	12,82	0,00	0,00	-		0,00	5,40	A	
4	12,82	0,00	0,00	-		0,00	5,40	A	
4	12,32	0,00	0,00	-		0,00	10,30	A	
5	12,32	0,00	0,00	-		0,00	10,30	A	
5	12,15	0,00	0,00	-		0,00	11,97	A	
6	12,15	0,00	0,00	-		1,27	11,97	A	
6	11,70	0,00	0,00	-		1,72	16,38	A	
7	11,70	0,00	0,00	-		3,48	16,38	A	
7	11,25	0,00	0,00	-		4,37	20,80	A	
8	11,25	0,00	0,00	-		4,91	20,80	A	
8	10,80	0,00	0,00	-		5,91	25,21	A	
9	10,80	0,00	0,00	-		6,72	25,21	A	
9	10,47	0,00	0,00	-		7,73	28,40	A	
10	10,47	0,00	0,00	-		7,75	28,40	A	
10	10,15	0,00	0,00	-		8,76	31,59	A	
11	10,15	0,00	0,00	-		8,78	31,59	A	
11	9,82	0,00	0,00	-		9,79	34,78	A	
12	9,82	0,00	0,00	P		9,81	34,78	A	
12	9,45	26,07	0,00	P		10,98	38,48	A	
13	9,45	25,99	0,00	P		11,01	38,48	A	
13	9,07	52,02	0,00	P		12,18	42,18	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* [%]
14	9,07	52,01	0,00	P		12,19	42,18	A	
14	9,05	53,39	0,00	P		12,25	42,38	A	
15	9,05	53,39	0,00	P		12,26	42,38	A	
15	9,00	56,83	0,00	P		12,41	42,87	A	
16	9,00	56,83	0,00	P		12,42	42,87	A	
16	8,82	69,24	0,00	P		12,98	44,64	A	
17	8,82	69,02	0,00	P		12,99	44,64	A	
17	8,75	71,64	0,69	P		13,20	45,32	A	
18	8,75	70,01	0,69	P		13,22	45,32	A	
18	8,21	89,60	5,94	P		14,88	50,58	A	
19	8,21	86,91	5,94	P		14,92	50,58	A	
19	7,68	105,93	11,20	P		16,58	55,83	A	
20	7,68	103,53	11,20	P		16,62	55,83	A	
20	7,14	122,12	16,45	P		18,27	61,09	A	
21	7,14	119,91	16,45	P		18,32	61,09	A	
21	6,61	130,68	21,71	3	95	19,97	66,34	A	
22	6,61	129,32	21,71	3	95	20,01	66,34	A	
22	6,07	128,95	26,96	3	84	21,67	71,60	A	
23	6,07	127,64	26,96	3	84	21,71	71,60	A	
23	5,54	117,28	32,22	2	69	23,36	76,85	A	
24	5,54	117,69	32,22	2	69	23,46	76,85	A	
24	5,00	102,77	37,47	2	55	25,12	82,11	A	
25	5,00	72,47	37,47	2	54	27,98	82,11	A	
25	4,50	55,92	42,38	1	38	36,93	66,17	A	
26	4,50	56,32	42,38	1	38	37,23	66,17	A	
26	4,00	42,95	47,28	1	27	63,20	50,23	1	
27	4,00	91,68	47,28	2	51	42,63	50,23	A	
27	3,48	43,13	52,43	1	22	53,47	55,38	1	
28	3,48	43,59	52,43	1	22	53,75	55,38	1	
28	2,95	23,19	57,58	A		79,45	60,53	1	17
29	2,95	23,19	57,58	A		79,72	60,53	1	17
29	2,42	24,82	62,73	A		89,23	65,68	1	19
30	2,42	24,82	62,73	A		89,50	65,68	1	19
30	1,90	26,45	67,89	A		94,39	70,83	1	19

*

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

23.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	592,2	290,4
Water	234,9	536,9
Total	827,1	827,4

Considered as passive side	Left
Maximum passive effective resistance	1114,14 kN
Mobilized passive effective resistance	592,19 kN
Percentage mobilized resistance	53,1 %

23.7.5 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	-69,98
Vertical force passive	181,04
Resulting vertical force (no dead weight)	111,06
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-69,98
Vertical force passive	181,04
Resulting vertical force (no dead weight)	111,06
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

23.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	151,68	13,40	19	-1,23
5,00	19A	15,68	10,80	20	-30,57
4,00	32	13,68	5,00	19A	-11,22
			4,00	32	-26,97

24 Step 6.5 Stage 3: VAL (MHW)

24.1 Input Data Left

24.1.1 Calculation Method

Calculation method: C, phi, delta

24.1.2 Water Level

Water level: 9,07 [m]

24.1.3 Surface

X [m]	Y [m]
0,00	10,15
22,00	8,50
50,10	8,50
51,50	8,11

24.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

24.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

24.2 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	9,88	1,2	22,3	0,27	0,27	4,83
2	9,34	3,7	66,9	0,27	0,27	4,82
3	9,04	5,0	90,5	0,27	0,29	4,81
4	8,71	5,8	102,5	0,27	0,29	4,69
5	8,14	7,3	123,6	0,27	0,31	4,55
6	7,57	8,7	144,4	0,27	0,32	4,44
7	7,00	10,1	165,0	0,27	0,34	4,36
8	6,43	11,6	185,4	0,27	0,35	4,29
9	5,86	13,0	205,6	0,27	0,36	4,23
10	5,29	14,4	229,6	0,27	0,37	4,26
11	4,75	15,5	201,4	0,26	0,46	3,44
12	4,25	16,8	218,2	0,27	0,47	3,49
13	3,74	18,2	254,1	0,27	0,39	3,79
14	3,21	19,6	275,6	0,27	0,39	3,83
15	2,69	21,0	297,3	0,27	0,40	3,86
16	2,16	22,3	319,9	0,27	0,40	3,91

24.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	383,69
19A	36,35
32	87,69
19	0,00
32	0,00

24.4 Input Data Right

24.4.1 Calculation Method

Calculation method: C, phi, delta

24.4.2 Water Level

Water level: 13,32 [m]

24.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

24.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

24.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

24.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	13,36	0,0	18,4	0,00	0,51	25,53
2	13,07	0,0	29,3	0,00	0,47	8,39
3	12,57	0,0	45,3	0,00	0,45	5,98
4	12,23	0,0	56,0	0,00	0,45	5,44
5	11,93	0,0	66,0	0,00	0,45	5,14
6	11,47	0,3	80,4	0,02	0,45	4,88
7	11,03	3,7	89,0	0,18	0,45	4,43

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
8	10,64	6,3	102,9	0,27	0,35	4,37
9	10,31	7,2	112,0	0,27	0,35	4,19
10	9,88	8,4	128,7	0,27	0,36	4,15
11	9,34	9,8	144,2	0,27	0,37	3,97
12	9,04	10,7	159,8	0,27	0,37	4,06
13	8,71	11,5	171,2	0,27	0,38	4,03
14	8,14	13,1	195,3	0,27	0,38	4,07
15	7,57	14,6	224,0	0,27	0,39	4,18
16	7,00	16,2	253,7	0,27	0,40	4,30
17	6,43	17,7	284,0	0,27	0,40	4,40
18	5,86	19,3	314,9	0,28	0,41	4,50
19	5,29	20,8	346,3	0,28	0,41	4,59
20	4,75	26,4	347,3	0,29	0,50	3,83
21	4,25	34,5	461,6	0,30	0,51	4,00
22	3,74	36,3	569,7	0,28	0,43	4,37
23	3,21	37,7	591,9	0,28	0,43	4,37
24	2,69	39,0	617,0	0,28	0,44	4,39
25	2,16	40,4	644,2	0,28	0,44	4,43

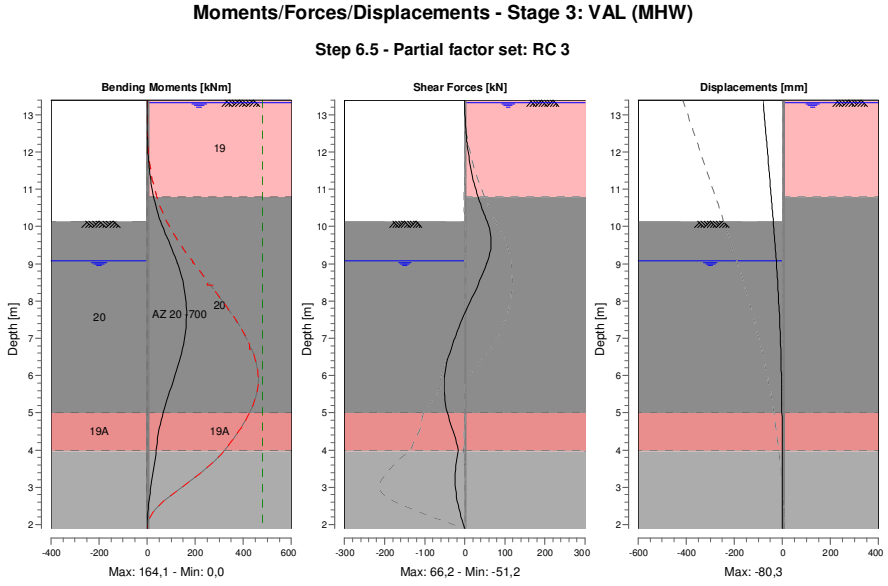
24.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	79,67
19A	44,13
32	103,11
19	0,00
32	0,00

24.7 Calculation Results

Number of iterations: 6

24.7.1 Charts of Moments, Forces and Displacements



24.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-80,3**
1	13,32	0,0	0,0	-79,3
2	13,32	0,0	0,0	-79,3
2	12,82	0,2	1,2	-72,7
3	12,82	0,2	1,2	-72,7
3	12,32	1,6	4,9	-66,2
4	12,32	1,6	4,9	-66,2
4	12,15	2,6	6,7	-64,0
5	12,15	2,6	6,7	-64,0
5	11,70	7,0	12,9	-58,1
6	11,70	7,0	12,9	-58,1
6	11,25	14,5	21,1	-52,2
7	11,25	14,5	21,1	-52,2
7	10,80	26,6	32,9	-46,4
8	10,80	26,6	32,9	-46,4
8	10,47	39,0	43,5	-42,3
9	10,47	39,0	43,5	-42,3
9	10,15	55,0	55,5	-38,2
10	10,15	55,0	55,5	-38,2
10	9,61	88,8	**66,2**	-31,7
11	9,61	88,8	**66,2**	-31,7
11	9,07	122,8	56,6	-25,6
12	9,07	122,8	56,6	-25,6
12	9,00	126,7	54,2	-24,9
13	9,00	126,7	54,2	-24,9
13	8,43	151,8	32,7	-19,2
14	8,43	151,8	32,7	-19,2
14	7,86	**163,4**	7,7	-14,3
15	7,86	**163,4**	7,6	-14,3
15	7,29	161,2	-14,8	-10,3
16	7,29	161,2	-14,7	-10,3
16	6,71	147,2	-34,1	-7,1
17	6,71	147,2	-34,2	-7,1
17	6,14	123,0	-48,5	-4,8
18	6,14	123,0	-48,5	-4,8
18	5,57	94,1	-50,8	-3,2
19	5,57	94,1	-50,8	-3,2
19	5,00	66,6	-44,0	-2,0
20	5,00	66,6	-44,0	-2,0
20	4,50	48,4	-29,1	-1,3
21	4,50	48,4	-29,1	-1,3
21	4,00	37,3	-15,4	-0,8
22	4,00	37,3	-15,4	-0,8
22	3,48	26,8	-23,5	-0,5
23	3,48	26,8	-23,5	-0,5
23	2,95	14,2	-23,0	-0,3
24	2,95	14,2	-22,9	-0,3
24	2,42	4,1	-14,5	-0,1
25	2,42	4,1	-14,5	-0,1
25	1,90	0,0	0,0	0,0
Max		**163,4**	**66,2**	**-80,3**
Max, minor nodes incl.		164,1	66,2	-80,3

24.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,32	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,00	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* [%]
2	12,82	0,00	0,00	-		0,00	4,91	A	
3	12,82	0,00	0,00	-		0,00	4,91	A	
3	12,32	0,00	0,00	-		0,00	9,81	A	
4	12,32	0,00	0,00	-		0,00	9,81	A	
4	12,15	0,00	0,00	-		0,00	11,48	A	
5	12,15	0,00	0,00	-		0,00	11,48	A	
5	11,70	0,00	0,00	-		0,00	15,89	A	
6	11,70	0,00	0,00	-		0,23	15,89	A	
6	11,25	0,00	0,00	-		0,28	20,31	A	
7	11,25	0,00	0,00	-		3,36	20,31	A	
7	10,80	0,00	0,00	-		4,02	24,72	A	
8	10,80	0,00	0,00	-		5,88	24,72	A	
8	10,47	0,00	0,00	-		6,75	27,91	A	
9	10,47	0,00	0,00	-		6,76	27,91	A	
9	10,15	0,00	0,00	-		7,63	31,10	A	
10	10,15	0,00	0,00	P		7,65	31,10	A	
10	9,61	44,66	0,00	P		9,08	36,40	A	
11	9,61	44,60	0,00	P		9,11	36,40	A	
11	9,07	85,70	0,00	3	96	10,55	41,69	A	
12	9,07	85,51	0,00	3	96	10,57	41,69	A	
12	9,00	86,87	0,69	3	94	10,75	42,38	A	
13	9,00	85,44	0,69	3	95	10,77	42,38	A	
13	8,43	96,56	6,29	3	84	12,28	47,98	A	
14	8,43	94,18	6,29	3	85	12,32	47,98	A	
14	7,86	98,90	11,90	2	73	13,83	53,59	A	
15	7,86	97,75	11,90	2	74	13,87	53,59	A	
15	7,29	93,71	17,50	2	60	15,38	59,20	A	
16	7,29	92,65	17,50	2	60	15,42	59,20	A	
16	6,71	91,35	23,11	2	52	16,93	64,80	A	
17	6,71	90,49	23,11	2	52	16,97	64,80	A	
17	6,14	73,90	28,72	1	38	18,48	70,41	A	
18	6,14	74,43	28,72	1	38	18,52	70,41	A	
18	5,57	56,49	34,32	1	26	20,03	76,01	A	
19	5,57	57,02	34,32	1	26	20,07	76,01	A	
19	5,00	45,31	39,93	1	19	21,58	81,62	A	
20	5,00	38,28	39,93	1	20	27,09	81,62	1	
20	4,50	35,94	44,83	1	17	43,73	65,68	1	
21	4,50	36,33	44,83	1	17	44,81	65,68	1	
21	4,00	35,25	49,74	1	16	60,49	49,74	1	
22	4,00	58,25	49,74	1	24	35,64	49,74	A	
22	3,48	46,28	54,89	1	18	37,81	54,89	1	
23	3,48	46,73	54,89	1	18	38,08	54,89	1	
23	2,95	39,71	60,04	1	14	49,23	60,04	1	
24	2,95	40,15	60,04	1	14	49,50	60,04	1	
24	2,42	35,81	65,19	1	12	58,01	65,19	1	
25	2,42	36,23	65,19	1	12	58,28	65,19	1	
25	1,90	32,77	70,34	1		65,96	70,34	1	10

*

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

24.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	507,7	228,7
Water	252,2	531,3
Total	759,9	760,0

Considered as passive side	Left
Maximum passive effective resistance	1526,96 kN
Mobilized passive effective resistance	507,73 kN
Percentage mobilized resistance	33,3 %

24.7.5 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	-67,26
Vertical force passive	179,73
Resulting vertical force (no dead weight)	112,47
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

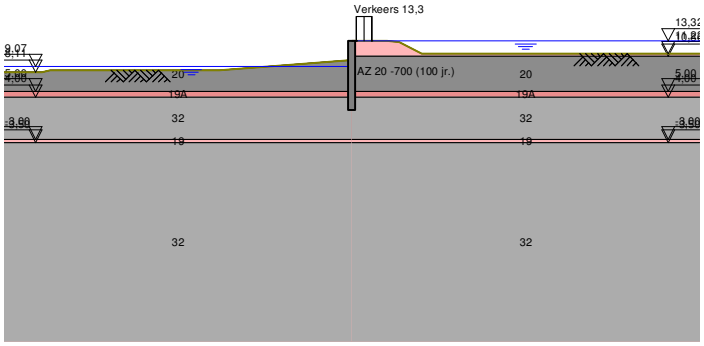
Vertical force balance plugged	Force [kN]
Vertical force active	-67,26
Vertical force passive	179,73
Resulting vertical force (no dead weight)	112,47
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

24.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
10,15	20	149,82	13,40	19	-0,53
5,00	19A	11,81	10,80	20	-31,11
4,00	32	18,10	5,00	19A	-14,34
			4,00	32	-21,28

25 Outline Stage 4: VAL (MHW) (Verkeer)

Outline - Stage 4: VAL (MHW) (Verkeer)

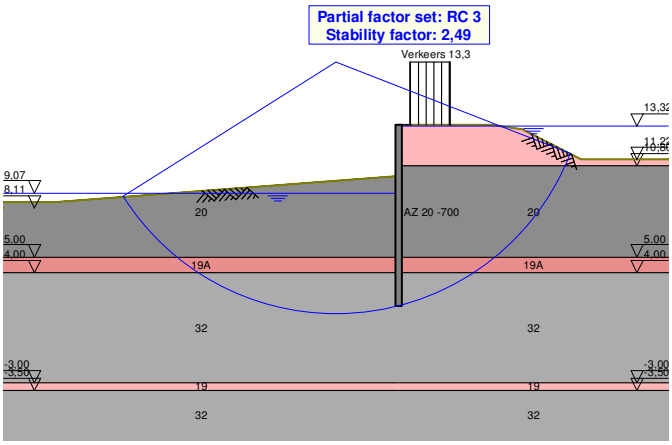


26 Overall Stability Stage 4: VAL (MHW) (Verkeer)

Stability factor : 2,49

26.1 Overall Stability

Overall Stability - Stage 4: VAL (MHW) (Verkeer)



27 Step 6.1 Stage 4: VAL (MHW) (Verkeer)

27.1 Input Data Left

27.1.1 Calculation Method

Calculation method: C, phi, delta

27.1.2 Water Level

Water level: 9,32 [m]

27.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

27.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

27.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

27.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	2,8	35,9	0,30	0,30	3,89
3	9,06	3,4	42,9	0,31	0,31	3,87
4	9,03	3,5	44,0	0,31	0,31	3,86
5	8,91	3,9	47,6	0,31	0,31	3,81
6	8,79	4,2	51,4	0,31	0,32	3,77
7	8,48	5,1	60,6	0,31	0,34	3,68
8	7,95	6,7	76,7	0,31	0,36	3,57
9	7,41	8,2	95,0	0,31	0,39	3,58
10	6,88	9,8	115,5	0,31	0,41	3,66
11	6,34	11,3	136,3	0,31	0,42	3,72
12	5,80	12,9	157,1	0,31	0,44	3,77
13	5,27	14,4	177,9	0,31	0,45	3,81
14	4,75	16,8	143,3	0,33	0,53	2,80
15	4,25	18,2	156,5	0,33	0,54	2,83
16	3,74	19,5	185,8	0,33	0,47	3,11
17	3,21	21,1	202,9	0,33	0,47	3,13
18	2,69	22,7	219,7	0,33	0,48	3,15
19	2,16	24,4	236,0	0,33	0,48	3,15

27.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	447,89
19A	103,35
32	157,59
19	0,00
32	0,00

27.4 Input Data Right

27.4.1 Calculation Method

Calculation method: C, phi, delta

27.4.2 Water Level

Water level: 13,37 [m]

27.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

27.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

27.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

27.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

27.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	13,38	0,0	10,0	0,00	1,71	37,15
2	13,35	0,0	11,5	0,00	2,05	15,37
3	13,20	0,0	15,2	0,00	2,36	7,23
4	12,88	0,0	42,5	0,00	1,64	7,11
5	12,51	3,8	103,9	0,33	1,05	9,03
6	12,23	7,1	86,9	0,46	0,83	5,68
7	11,93	8,4	51,4	0,44	0,68	2,68
8	11,47	10,2	44,6	0,42	0,57	1,85
9	11,03	11,9	50,0	0,42	0,51	1,77
10	10,64	13,6	125,1	0,43	0,43	3,92
11	10,31	14,7	110,7	0,42	0,42	3,15
12	9,99	15,3	111,7	0,40	0,40	2,91
13	9,64	15,3	120,0	0,37	0,39	2,88
14	9,26	16,1	132,6	0,36	0,40	2,94
15	9,06	16,3	136,4	0,35	0,40	2,91
16	9,03	16,3	136,9	0,34	0,40	2,90
17	8,91	16,4	139,0	0,34	0,40	2,88
18	8,79	16,4	143,2	0,33	0,40	2,90
19	8,48	16,6	154,9	0,32	0,40	2,97
20	7,95	16,9	176,0	0,30	0,41	3,09
21	7,41	17,1	197,9	0,28	0,42	3,20
22	6,88	17,3	220,4	0,26	0,43	3,31
23	6,34	18,1	243,4	0,25	0,44	3,41
24	5,80	20,1	266,9	0,26	0,45	3,50
25	5,27	22,5	290,8	0,28	0,45	3,59
26	4,75	31,8	251,2	0,33	0,54	2,62
27	4,25	41,3	330,3	0,34	0,55	2,74
28	3,74	44,5	443,0	0,33	0,49	3,28
29	3,21	46,5	460,5	0,33	0,49	3,29
30	2,69	47,5	472,4	0,33	0,49	3,26
31	2,16	49,0	491,1	0,33	0,49	3,28

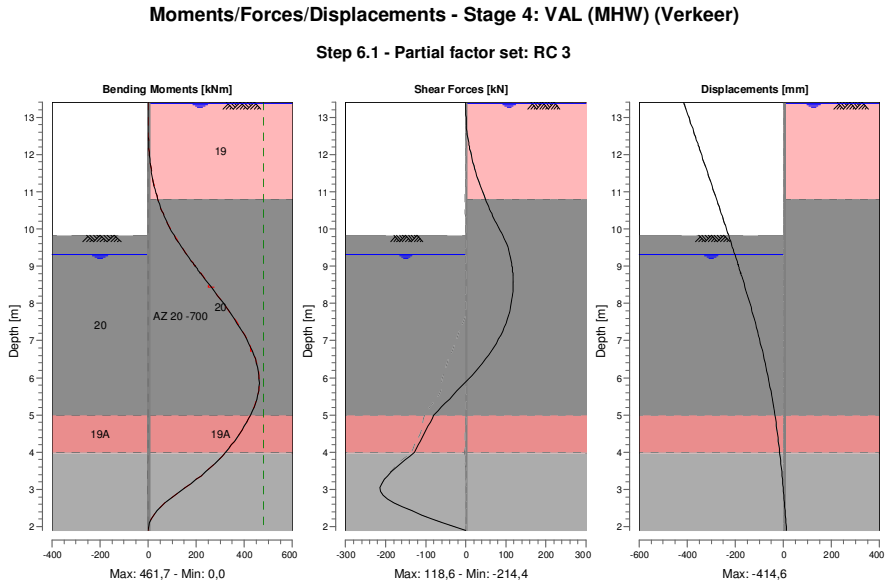
27.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	100,22
19A	36,53
32	289,26
19	0,00
32	0,00

27.7 Calculation Results

Number of iterations: 6

27.7.1 Charts of Moments, Forces and Displacements



27.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-414,6**
1	13,37	0,0	0,0	-413,0
2	13,37	0,0	0,0	-413,0
2	13,32	0,0	0,0	-410,4
3	13,32	0,0	0,0	-410,4
3	13,07	0,0	0,4	-397,3
4	13,07	0,0	0,4	-397,3
4	12,70	0,5	2,2	-377,6
5	12,70	0,5	2,2	-377,6
5	12,32	2,1	6,8	-357,9
6	12,32	2,1	6,8	-357,9
6	12,15	3,6	9,9	-348,9
7	12,15	3,6	9,9	-348,9
7	11,70	10,2	20,1	-325,3
8	11,70	10,2	20,1	-325,3
8	11,25	22,1	33,1	-301,7
9	11,25	22,1	33,1	-301,7
9	10,80	40,4	48,7	-278,2
10	10,80	40,4	48,7	-278,2
10	10,47	58,3	61,9	-261,3
11	10,47	58,3	61,9	-261,3
11	10,15	80,7	76,4	-244,5
12	10,15	80,7	76,4	-244,5
12	9,82	108,1	92,1	-227,9
13	9,82	108,1	92,1	-227,9
13	9,45	145,9	106,8	-208,8
14	9,45	145,9	106,7	-208,8
14	9,07	187,8	114,7	-190,0
15	9,07	187,8	114,7	-190,0
15	9,05	190,1	115,0	-189,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	190,1	115,0	-189,1
16	9,00	195,9	115,7	-186,6
17	9,00	195,9	115,7	-186,6
17	8,82	216,9	117,5	-177,9
18	8,82	216,9	117,5	-177,9
18	8,75	225,1	118,0	-174,5
19	8,75	225,1	118,0	-174,5
19	8,21	288,4	116,7	-149,4
20	8,21	288,4	116,7	-149,4
20	7,68	348,7	106,9	-125,6
21	7,68	348,7	106,9	-125,6
21	7,14	401,1	87,5	-103,5
22	7,14	401,1	87,5	-103,5
22	6,61	440,3	57,1	-83,4
23	6,61	440,3	57,1	-83,4
23	6,07	**460,3**	16,1	-65,3
24	6,07	**460,3**	16,1	-65,3
24	5,54	456,2	-31,5	-49,5
25	5,54	456,2	-31,5	-49,5
25	5,00	426,5	-79,5	-35,8
26	5,00	426,5	-79,5	-35,8
26	4,50	380,7	-103,9	-24,9
27	4,50	380,7	-104,0	-24,9
27	4,00	322,8	-127,5	-15,5
28	4,00	322,8	-127,5	-15,5
28	3,48	240,3	-185,2	-7,2
29	3,48	240,3	-185,7	-7,2
29	2,95	132,9	-213,5	0,1
30	2,95	132,8	**-213,7**	0,1
30	2,42	36,8	-135,1	6,8
31	2,42	36,8	-134,9	6,8
31	1,90	0,0	-0,2	13,2
Max		**460,3**	**-213,7**	**-414,6**
Max, minor nodes incl.		461,7	-214,4	-414,6

27.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,07	0,00	0,00	-		0,00	2,94	A	
4	13,07	0,00	0,00	-		0,00	2,94	A	
4	12,70	0,00	0,00	-		0,00	6,62	A	
5	12,70	0,00	0,00	-		2,89	6,62	A	
5	12,32	0,00	0,00	-		4,69	10,30	A	
6	12,32	0,00	0,00	-		6,54	10,30	A	
6	12,15	0,00	0,00	-		7,58	11,97	A	
7	12,15	0,00	0,00	-		7,22	11,97	A	
7	11,70	0,00	0,00	-		9,56	16,38	A	
8	11,70	0,00	0,00	-		9,22	16,38	A	
8	11,25	0,00	0,00	-		11,14	20,80	A	
9	11,25	0,00	0,00	-		11,00	20,80	A	
9	10,80	0,00	0,00	-		12,67	25,21	A	
10	10,80	0,00	0,00	-		12,90	25,21	A	11
10	10,47	0,00	0,00	-		14,32	28,40	A	11
11	10,47	0,00	0,00	-		14,02	28,40	A	13
11	10,15	0,00	0,00	-		15,35	31,59	A	13
12	10,15	0,00	0,00	-		14,65	31,59	A	14
12	9,82	0,00	0,00	-		15,88	34,78	A	14

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* [%]
13	9,82	0,00	0,00	P		14,68	34,78	A	
13	9,45	26,07	0,00	P		15,98	38,48	A	
14	9,45	25,16	0,00	P		15,49	38,48	A	
14	9,07	40,81	2,45	P		16,73	42,18	A	
15	9,07	40,62	2,45	P		16,22	42,18	A	
15	9,05	41,34	2,65	P		16,29	42,38	A	
16	9,05	41,17	2,65	P		16,20	42,38	A	
16	9,00	42,97	3,14	P		16,36	42,87	A	
17	9,00	42,45	3,14	P		16,08	42,87	A	
17	8,82	48,86	4,91	P		16,64	44,64	A	
18	8,82	48,29	4,91	P		16,33	44,64	A	
18	8,75	50,75	5,59	P		16,54	45,32	A	
19	8,75	49,57	5,59	P		15,85	45,32	A	
19	8,21	67,99	10,85	P		17,38	50,58	A	
20	8,21	65,93	10,85	P		16,18	50,58	A	
20	7,68	83,82	16,10	P		17,61	55,83	A	
21	7,68	84,17	16,10	P		16,47	55,83	A	
21	7,14	102,17	21,36	P		17,80	61,09	A	
22	7,14	104,49	21,36	P		16,71	61,09	A	
22	6,61	122,94	26,61	P		17,96	66,34	A	
23	6,61	125,00	26,61	P		17,54	66,34	A	
23	6,07	143,80	31,87	P		18,76	71,60	A	
24	6,07	145,63	31,87	P		19,47	71,60	A	
24	5,54	149,45	37,12	3	91	20,74	76,85	A	
25	5,54	150,57	37,12	3	91	21,82	76,85	A	
25	5,00	153,12	42,38	3	82	23,17	82,11	A	
26	5,00	112,12	42,38	3	82	27,67	82,11	A	
26	4,50	103,41	47,28	2	70	35,84	66,17	A	
27	4,50	104,14	47,28	2	70	37,08	66,17	A	
27	4,00	89,84	52,19	2	56	45,53	50,23	A	
28	4,00	159,62	52,19	3	90	43,74	50,23	A	
28	3,48	137,71	57,34	2	72	45,32	55,38	A	
29	3,48	138,35	57,34	2	72	45,65	55,38	A	
29	2,95	28,02	62,49	1		73,01	60,53	1	16
30	2,95	28,43	62,49	1		73,43	60,53	1	16
30	2,42	23,40	67,64	A		251,18	65,68	2	52
31	2,42	23,38	67,64	A		252,33	65,68	2	52
31	1,90	25,02	72,79	A		312,31	70,83	2	63

*

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

27.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	708,8	442,4
Water	270,1	536,9
Total	978,9	979,3

Considered as passive side	Left
Maximum passive effective resistance	1052,86 kN
Mobilized passive effective resistance	708,83 kN
Percentage mobilized resistance	67,3 %

27.7.5 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	-98,53
Vertical force passive	204,66
Resulting vertical force (no dead weight)	106,13
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-98,53
Vertical force passive	204,66
Resulting vertical force (no dead weight)	106,13
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

27.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	148,43	13,40	19	-4,12
5,00	19A	28,35	10,80	20	-33,21
4,00	32	27,88	5,00	19A	-10,02
			4,00	32	-51,17

28 Step 6.2 Stage 4: VAL (MHW) (Verkeer)

28.1 Input Data Left

28.1.1 Calculation Method

Calculation method: C, phi, delta

28.1.2 Water Level

Water level: 9,32 [m]

28.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

28.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

28.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

28.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	2,8	35,9	0,30	0,30	3,89
3	9,06	3,4	42,9	0,31	0,31	3,87
4	9,03	3,5	44,0	0,31	0,31	3,86
5	8,91	3,9	47,6	0,31	0,31	3,81
6	8,79	4,2	51,4	0,31	0,32	3,77
7	8,48	5,1	60,6	0,31	0,34	3,68
8	7,95	6,7	76,7	0,31	0,36	3,57
9	7,41	8,2	95,0	0,31	0,39	3,58
10	6,88	9,8	115,5	0,31	0,41	3,66
11	6,34	11,3	136,3	0,31	0,42	3,72
12	5,80	12,9	157,1	0,31	0,44	3,77
13	5,27	14,4	177,9	0,31	0,45	3,81
14	4,75	16,8	143,3	0,33	0,53	2,80
15	4,25	18,2	156,5	0,33	0,54	2,83
16	3,74	19,5	185,8	0,33	0,47	3,11
17	3,21	21,1	202,9	0,33	0,47	3,13
18	2,69	22,7	219,7	0,33	0,48	3,15
19	2,16	24,4	236,0	0,33	0,48	3,15

28.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	455,92
19A	104,06
32	137,22
19	0,00
32	0,00

28.4 Input Data Right

28.4.1 Calculation Method

Calculation method: C, phi, delta

28.4.2 Water Level

Water level: 13,37 [m]

28.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

28.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

28.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

28.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

28.5 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	13,38	0,0	10,0	0,00	1,71	37,15
2	13,35	0,0	11,5	0,00	2,05	15,37
3	13,07	0,0	22,3	0,00	2,10	6,39
4	12,57	2,9	95,2	0,27	1,12	8,99
5	12,23	7,1	86,9	0,46	0,83	5,68
6	11,93	8,4	51,4	0,44	0,68	2,68
7	11,47	10,2	44,6	0,42	0,57	1,85
8	11,03	11,9	50,0	0,42	0,51	1,77
9	10,64	13,6	125,1	0,43	0,43	3,92
10	10,31	14,7	110,7	0,42	0,42	3,15
11	9,99	15,3	111,7	0,40	0,40	2,91
12	9,64	15,3	120,0	0,37	0,39	2,88
13	9,26	16,1	132,6	0,36	0,40	2,94
14	9,06	16,3	136,4	0,35	0,40	2,91
15	9,03	16,3	136,9	0,34	0,40	2,90
16	8,91	16,4	139,0	0,34	0,40	2,88
17	8,79	16,4	143,2	0,33	0,40	2,90
18	8,48	16,6	154,9	0,32	0,40	2,97
19	7,95	16,9	176,0	0,30	0,41	3,09
20	7,41	17,1	197,9	0,28	0,42	3,20
21	6,88	17,3	220,4	0,26	0,43	3,31
22	6,34	18,1	243,4	0,25	0,44	3,41
23	5,80	20,1	266,9	0,26	0,45	3,50
24	5,27	22,5	290,8	0,28	0,45	3,59
25	4,75	31,8	251,2	0,33	0,54	2,62
26	4,25	41,3	330,3	0,34	0,55	2,74
27	3,74	44,5	443,0	0,33	0,49	3,28
28	3,21	46,5	460,5	0,33	0,49	3,29
29	2,69	47,5	472,4	0,33	0,49	3,26
30	2,16	49,0	491,1	0,33	0,49	3,28

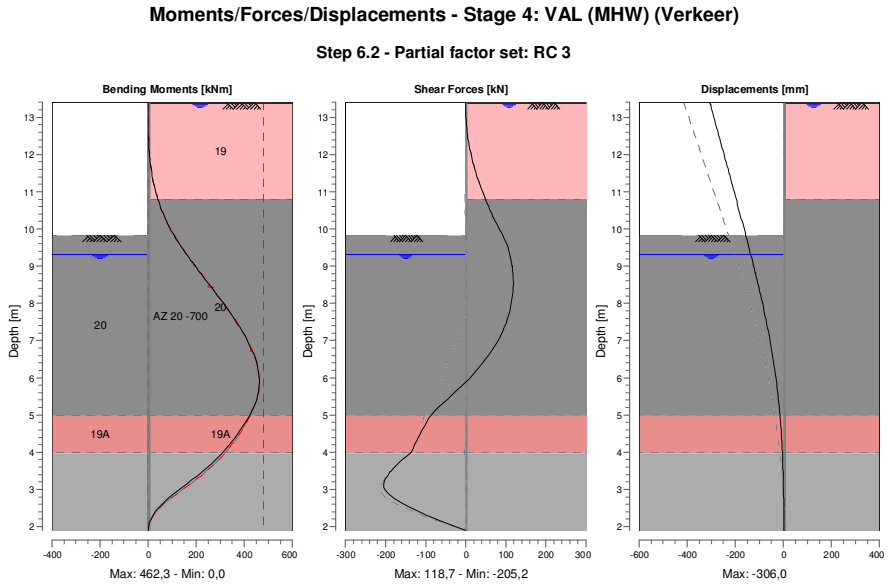
28.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	100,22
19A	36,53
32	277,83
19	0,00
32	0,00

28.7 Calculation Results

Number of iterations: 7

28.7.1 Charts of Moments, Forces and Displacements



28.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-306,0**
1	13,37	0,0	0,0	-304,7
2	13,37	0,0	0,0	-304,7
2	13,32	0,0	0,0	-302,6
3	13,32	0,0	0,0	-302,6
3	12,82	0,3	1,5	-281,5
4	12,82	0,3	1,5	-281,5
4	12,32	2,2	6,8	-260,5
5	12,32	2,2	6,8	-260,5
5	12,15	3,6	9,9	-253,3
6	12,15	3,6	9,9	-253,3
6	11,70	10,3	20,1	-234,4
7	11,70	10,3	20,1	-234,4
7	11,25	22,1	33,1	-215,4
8	11,25	22,1	33,1	-215,4
8	10,80	40,4	48,7	-196,6
9	10,80	40,4	48,7	-196,6
9	10,47	58,4	61,9	-183,1
10	10,47	58,4	61,9	-183,1
10	10,15	80,8	76,4	-169,7
11	10,15	80,8	76,4	-169,7
11	9,82	108,1	92,1	-156,4
12	9,82	108,1	92,1	-156,4
12	9,45	145,9	106,9	-141,2
13	9,45	145,9	106,9	-141,2
13	9,07	187,9	114,8	-126,4
14	9,07	187,9	114,8	-126,4
14	9,05	190,2	115,1	-125,6
15	9,05	190,2	115,1	-125,6
15	9,00	196,0	115,8	-123,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	196,0	115,8	-123,7
16	8,82	217,0	117,7	-116,8
17	8,82	217,0	117,7	-116,8
17	8,75	225,3	118,2	-114,2
18	8,75	225,3	118,2	-114,2
18	8,21	288,6	116,8	-94,6
19	8,21	288,6	116,8	-94,6
19	7,68	349,0	107,1	-76,5
20	7,68	349,0	107,1	-76,5
20	7,14	401,6	87,6	-60,0
21	7,14	401,6	87,6	-60,0
21	6,61	440,8	57,3	-45,4
22	6,61	440,8	57,3	-45,4
22	6,07	**460,9**	16,3	-32,9
23	6,07	**460,9**	16,2	-32,9
23	5,54	456,3	-34,7	-22,6
24	5,54	456,3	-34,8	-22,6
24	5,00	423,5	-87,4	-14,5
25	5,00	423,5	-87,4	-14,5
25	4,50	373,3	-113,4	-8,8
26	4,50	373,3	-113,5	-8,8
26	4,00	310,8	-136,1	-4,6
27	4,00	310,8	-136,3	-4,6
27	3,48	224,8	-187,8	-1,6
28	3,48	224,8	-188,5	-1,6
28	2,95	119,6	**-198,4**	0,4
29	2,95	119,6	-198,1	0,4
29	2,42	32,7	-121,6	1,8
30	2,42	32,7	-121,3	1,8
30	1,90	0,0	0,0	3,0
Max		**460,9**	**-198,4**	**-306,0**
Max, minor nodes incl.		462,3	-205,2	-306,0

28.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	12,82	0,00	0,00	-		0,00	5,40	A	
4	12,82	0,00	0,00	-		1,86	5,40	A	
4	12,32	0,00	0,00	-		3,82	10,30	A	
5	12,32	0,00	0,00	-		6,54	10,30	A	
5	12,15	0,00	0,00	-		7,58	11,97	A	
6	12,15	0,00	0,00	-		7,22	11,97	A	
6	11,70	0,00	0,00	-		9,56	16,38	A	
7	11,70	0,00	0,00	-		9,22	16,38	A	
7	11,25	0,00	0,00	-		11,14	20,80	A	
8	11,25	0,00	0,00	-		11,00	20,80	A	
8	10,80	0,00	0,00	-		12,67	25,21	A	
9	10,80	0,00	0,00	-		12,90	25,21	A	11
9	10,47	0,00	0,00	-		14,32	28,40	A	11
10	10,47	0,00	0,00	-		14,02	28,40	A	13
10	10,15	0,00	0,00	-		15,35	31,59	A	13
11	10,15	0,00	0,00	-		14,65	31,59	A	14
11	9,82	0,00	0,00	-		15,88	34,78	A	14
12	9,82	0,00	0,00	P		14,68	34,78	A	
12	9,45	26,07	0,00	P		15,98	38,48	A	
13	9,45	25,16	0,00	P		15,49	38,48	A	
13	9,07	40,81	2,45	P		16,73	42,18	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* [%]
14	9,07	40,62	2,45	P		16,22	42,18	A	
14	9,05	41,34	2,65	P		16,29	42,38	A	
15	9,05	41,17	2,65	P		16,20	42,38	A	
15	9,00	42,97	3,14	P		16,36	42,87	A	
16	9,00	42,45	3,14	P		16,08	42,87	A	
16	8,82	48,86	4,91	P		16,64	44,64	A	
17	8,82	48,29	4,91	P		16,33	44,64	A	
17	8,75	50,75	5,59	P		16,54	45,32	A	
18	8,75	49,57	5,59	P		15,85	45,32	A	
18	8,21	67,99	10,85	P		17,38	50,58	A	
19	8,21	65,93	10,85	P		16,18	50,58	A	
19	7,68	83,82	16,10	P		17,61	55,83	A	
20	7,68	84,17	16,10	P		16,47	55,83	A	
20	7,14	102,17	21,36	P		17,80	61,09	A	
21	7,14	104,49	21,36	P		16,71	61,09	A	
21	6,61	122,94	26,61	P		17,96	66,34	A	
22	6,61	125,00	26,61	P		17,54	66,34	A	
22	6,07	143,80	31,87	P		18,76	71,60	A	
23	6,07	145,63	31,87	P		19,47	71,60	A	
23	5,54	162,28	37,12	3	99	20,74	76,85	A	
24	5,54	163,39	37,12	3	98	21,82	76,85	A	
24	5,00	158,24	42,38	3	85	23,17	82,11	A	
25	5,00	115,53	42,38	3	85	27,67	82,11	A	
25	4,50	105,03	47,28	2	71	35,84	66,17	A	
26	4,50	105,76	47,28	2	71	37,08	66,17	A	
26	4,00	85,78	52,19	2	53	45,53	50,23	A	
27	4,00	154,35	52,19	3	87	43,74	50,23	A	
27	3,48	117,03	57,34	2	61	45,32	55,38	A	
28	3,48	117,68	57,34	2	61	45,65	55,38	A	
28	2,95	21,76	62,49	A		102,68	60,53	1	22
29	2,95	21,76	62,49	A		103,11	60,53	1	22
29	2,42	23,40	67,64	A		232,82	65,68	1	48
30	2,42	23,38	67,64	A		233,24	65,68	1	48
30	1,90	25,02	72,79	A		276,27	70,83	2	55

*

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

28.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	697,2	430,9
Water	270,1	536,9
Total	967,3	967,8

Considered as passive side	Left
Maximum passive effective resistance	1052,86 kN
Mobilized passive effective resistance	697,20 kN
Percentage mobilized resistance	66,2 %

28.7.5 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	-96,51
Vertical force passive	203,91
Resulting vertical force (no dead weight)	107,40
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-96,51
Vertical force passive	203,91
Resulting vertical force (no dead weight)	107,40
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

28.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	151,09	13,40	19	-4,12
5,00	19A	28,54	10,80	20	-33,21
4,00	32	24,28	5,00	19A	-10,02
			4,00	32	-49,15

29 Step 6.3 Stage 4: VAL (MHW) (Verkeer)

29.1 Input Data Left

29.1.1 Calculation Method

Calculation method: C, phi, delta

29.1.2 Water Level

Water level: 8,82 [m]

29.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

29.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

29.1.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

29.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	3,0	39,0	0,31	0,31	4,02
3	9,06	4,1	52,7	0,31	0,33	4,02
4	9,03	4,3	55,1	0,31	0,33	4,02
5	8,91	4,9	63,0	0,31	0,35	4,02
6	8,79	5,4	70,3	0,31	0,35	4,01
7	8,48	6,3	79,8	0,31	0,36	3,92
8	7,95	7,9	96,4	0,31	0,37	3,80
9	7,41	9,4	112,8	0,31	0,39	3,71
10	6,88	11,0	129,0	0,31	0,40	3,65
11	6,34	12,5	145,1	0,31	0,42	3,59
12	5,80	14,1	160,9	0,31	0,43	3,54
13	5,27	15,6	179,5	0,31	0,44	3,56
14	4,75	18,2	140,3	0,33	0,53	2,55
15	4,25	19,7	153,6	0,33	0,53	2,61
16	3,74	20,7	186,0	0,33	0,46	2,94
17	3,21	22,4	202,7	0,33	0,46	2,97
18	2,69	24,0	219,5	0,33	0,47	2,99
19	2,16	25,6	236,4	0,33	0,47	3,02

29.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	473,85
19A	79,27
32	128,14
19	0,00
32	0,00

29.4 Input Data Right

29.4.1 Calculation Method

Calculation method: C, phi, delta

29.4.2 Water Level

Water level: 13,37 [m]

29.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

29.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

29.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	10,80	9230,77	9230,77	4615,38	4615,38
19A	5,00	4615,38	4615,38	3076,92	3076,92
32	4,00	30769,23	30769,23	15384,62	15384,62
19	-3,00	3076,92	3076,92	1538,46	1538,46
32	-3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	10,80	2307,69	2307,69
19A	5,00	1538,46	1538,46
32	4,00	7692,31	7692,31
19	-3,00	615,38	615,38
32	-3,50	7692,31	7692,31

29.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

29.5 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	13,38	0,0	10,0	0,00	1,71	37,15
2	13,35	0,0	11,5	0,00	2,05	15,37
3	13,20	0,0	15,2	0,00	2,36	7,23
4	12,88	0,0	42,5	0,00	1,64	7,11
5	12,51	3,8	103,9	0,33	1,05	9,03
6	12,23	7,1	86,9	0,46	0,83	5,68
7	11,93	8,4	51,4	0,44	0,68	2,68
8	11,47	10,2	44,6	0,42	0,57	1,85
9	11,03	11,9	50,0	0,42	0,51	1,77
10	10,64	13,6	125,1	0,43	0,43	3,92
11	10,31	14,7	110,7	0,42	0,42	3,15
12	9,99	15,3	111,7	0,40	0,40	2,91
13	9,64	15,3	120,0	0,37	0,39	2,88
14	9,26	16,1	132,6	0,36	0,40	2,94
15	9,06	16,3	136,4	0,35	0,40	2,91
16	9,03	16,3	136,9	0,34	0,40	2,90
17	8,91	16,4	139,0	0,34	0,40	2,88
18	8,79	16,4	143,2	0,33	0,40	2,90
19	8,48	16,6	154,9	0,32	0,40	2,97
20	7,95	16,9	176,0	0,30	0,41	3,09
21	7,41	17,1	197,9	0,28	0,42	3,20
22	6,88	17,3	220,4	0,26	0,43	3,31
23	6,34	18,1	243,4	0,25	0,44	3,41
24	5,80	20,1	266,9	0,26	0,45	3,50
25	5,27	22,5	290,8	0,28	0,45	3,59
26	4,75	31,8	251,2	0,33	0,54	2,62
27	4,25	41,3	330,3	0,34	0,55	2,74
28	3,74	44,5	443,0	0,33	0,49	3,28
29	3,21	46,5	460,5	0,33	0,49	3,29
30	2,69	47,5	472,4	0,33	0,49	3,26
31	2,16	49,0	491,1	0,33	0,49	3,28

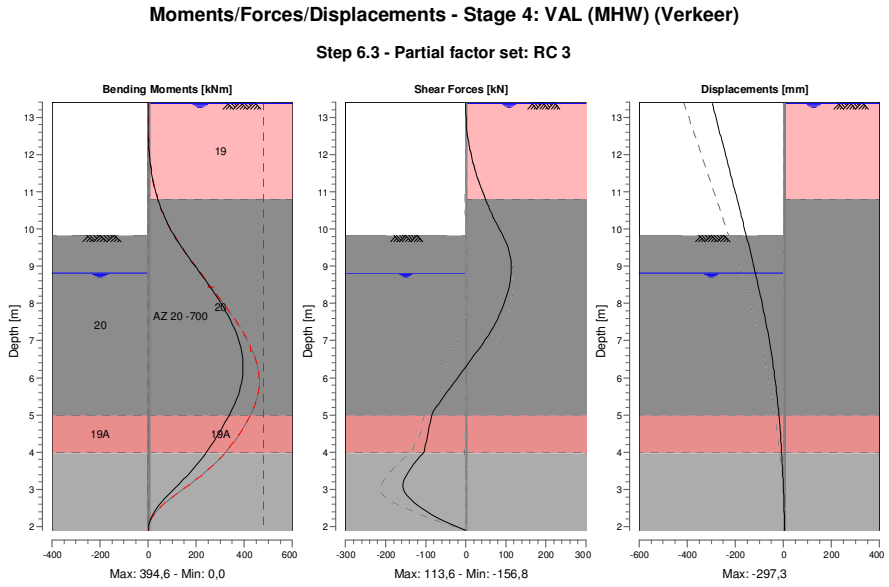
29.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	100,22
19A	36,53
32	226,59
19	0,00
32	0,00

29.7 Calculation Results

Number of iterations: 5

29.7.1 Charts of Moments, Forces and Displacements



29.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-297,3**
1	13,37	0,0	0,0	-296,1
2	13,37	0,0	0,0	-296,1
2	13,32	0,0	0,0	-294,1
3	13,32	0,0	0,0	-294,1
3	13,07	0,0	0,4	-284,0
4	13,07	0,0	0,4	-284,0
4	12,70	0,5	2,2	-269,0
5	12,70	0,5	2,2	-269,0
5	12,32	2,1	6,8	-253,9
6	12,32	2,1	6,8	-253,9
6	12,15	3,6	9,9	-247,0
7	12,15	3,6	9,9	-247,0
7	11,70	10,2	20,1	-229,0
8	11,70	10,2	20,1	-229,0
8	11,25	22,1	33,1	-210,9
9	11,25	22,1	33,1	-210,9
9	10,80	40,4	48,7	-192,9
10	10,80	40,4	48,7	-192,9
10	10,47	58,3	61,9	-180,0
11	10,47	58,3	61,9	-180,0
11	10,15	80,7	76,4	-167,2
12	10,15	80,7	76,4	-167,2
12	9,82	108,1	92,1	-154,6
13	9,82	108,1	92,1	-154,6
13	9,45	145,9	106,8	-140,1
14	9,45	145,9	106,7	-140,1
14	9,07	187,6	113,3	-126,0
15	9,07	187,6	113,3	-126,0
15	9,05	189,9	113,4	-125,3

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,05	189,9	113,4	-125,3
16	9,00	195,6	113,6	-123,5
17	9,00	195,6	113,6	-123,5
17	8,82	216,0	113,1	-116,9
18	8,82	216,0	113,1	-116,9
18	8,75	223,9	112,4	-114,4
19	8,75	223,9	112,4	-114,4
19	8,21	281,9	102,5	-95,9
20	8,21	281,9	102,5	-95,9
20	7,68	332,2	83,8	-78,7
21	7,68	332,2	83,8	-78,7
21	7,14	370,2	56,4	-63,1
22	7,14	370,2	56,4	-63,1
22	6,61	391,3	21,3	-49,2
23	6,61	391,3	21,3	-49,2
23	6,07	**392,9**	-15,4	-37,3
24	6,07	**392,9**	-15,5	-37,3
24	5,54	374,8	-52,3	-27,2
25	5,54	374,8	-52,3	-27,2
25	5,00	337,5	-85,5	-18,9
26	5,00	337,5	-85,5	-18,9
26	4,50	292,7	-94,2	-12,6
27	4,50	292,7	-94,2	-12,6
27	4,00	243,0	-104,4	-7,5
28	4,00	243,0	-104,5	-7,5
28	3,48	177,4	-142,6	-3,3
29	3,48	177,5	-143,0	-3,3
29	2,95	97,1	**-153,6**	0,2
30	2,95	97,1	-153,5	0,2
30	2,42	28,3	-100,4	3,1
31	2,42	28,3	-100,3	3,1
31	1,90	0,0	-0,1	6,0
Max		**392,9**	**-153,6**	**-297,3**
Max, minor nodes incl.		394,6	-156,8	-297,3

29.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,07	0,00	0,00	-		0,00	2,94	A	
4	13,07	0,00	0,00	-		0,00	2,94	A	
4	12,70	0,00	0,00	-		0,00	6,62	A	
5	12,70	0,00	0,00	-		2,89	6,62	A	
5	12,32	0,00	0,00	-		4,69	10,30	A	
6	12,32	0,00	0,00	-		6,54	10,30	A	
6	12,15	0,00	0,00	-		7,58	11,97	A	
7	12,15	0,00	0,00	-		7,22	11,97	A	
7	11,70	0,00	0,00	-		9,56	16,38	A	
8	11,70	0,00	0,00	-		9,22	16,38	A	
8	11,25	0,00	0,00	-		11,14	20,80	A	
9	11,25	0,00	0,00	-		11,00	20,80	A	
9	10,80	0,00	0,00	-		12,67	25,21	A	
10	10,80	0,00	0,00	-		12,90	25,21	A	11
10	10,47	0,00	0,00	-		14,32	28,40	A	11
11	10,47	0,00	0,00	-		14,02	28,40	A	13
11	10,15	0,00	0,00	-		15,35	31,59	A	13
12	10,15	0,00	0,00	-		14,65	31,59	A	14
12	9,82	0,00	0,00	-		15,88	34,78	A	14

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* [%]
13	9,82	0,00	0,00	P		14,68	34,78	A	
13	9,45	26,07	0,00	P		15,98	38,48	A	
14	9,45	25,99	0,00	P		15,49	38,48	A	
14	9,07	52,02	0,00	P		16,73	42,18	A	
15	9,07	52,01	0,00	P		16,22	42,18	A	
15	9,05	53,39	0,00	P		16,29	42,38	A	
16	9,05	53,39	0,00	P		16,20	42,38	A	
16	9,00	56,83	0,00	P		16,36	42,87	A	
17	9,00	56,83	0,00	P		16,08	42,87	A	
17	8,82	69,24	0,00	P		16,64	44,64	A	
18	8,82	69,02	0,00	P		16,33	44,64	A	
18	8,75	71,64	0,69	P		16,54	45,32	A	
19	8,75	70,01	0,69	P		15,85	45,32	A	
19	8,21	89,60	5,94	P		17,38	50,58	A	
20	8,21	86,91	5,94	P		16,18	50,58	A	
20	7,68	105,93	11,20	P		17,61	55,83	A	
21	7,68	103,53	11,20	P		16,47	55,83	A	
21	7,14	122,12	16,45	P		17,80	61,09	A	
22	7,14	119,91	16,45	P		16,71	61,09	A	
22	6,61	131,29	21,71	3	95	17,96	66,34	A	
23	6,61	129,91	21,71	3	95	17,54	66,34	A	
23	6,07	132,88	26,96	3	86	18,76	71,60	A	
24	6,07	131,57	26,96	3	87	19,47	71,60	A	
24	5,54	135,79	32,22	2	80	20,74	76,85	A	
25	5,54	136,19	32,22	2	80	21,82	76,85	A	
25	5,00	122,39	37,47	2	65	23,17	82,11	A	
26	5,00	87,89	37,47	2	65	27,67	82,11	A	
26	4,50	79,22	42,38	2	55	35,84	66,17	A	
27	4,50	80,28	42,38	2	54	37,08	66,17	A	
27	4,00	67,07	47,28	1	42	45,53	50,23	A	
28	4,00	135,66	47,28	2	76	43,74	50,23	A	
28	3,48	105,85	52,43	2	55	45,32	55,38	A	
29	3,48	106,72	52,43	2	55	45,65	55,38	A	
29	2,95	27,63	57,58	1		74,63	60,53	1	16
30	2,95	28,08	57,58	1		75,05	60,53	1	16
30	2,42	24,82	62,73	A		169,04	65,68	1	35
31	2,42	24,82	62,73	A		169,46	65,68	1	35
31	1,90	26,45	67,89	A		252,13	70,83	2	51

*

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

29.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	681,3	379,7
Water	234,9	536,9
Total	916,1	916,6

Considered as passive side	Left
Maximum passive effective resistance	1114,14 kN
Mobilized passive effective resistance	681,26 kN
Percentage mobilized resistance	61,1 %

29.7.5 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	-87,44
Vertical force passive	201,44
Resulting vertical force (no dead weight)	114,00
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-87,44
Vertical force passive	201,44
Resulting vertical force (no dead weight)	114,00
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

29.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	157,03	13,40	19	-4,12
5,00	19A	21,74	10,80	20	-33,21
4,00	32	22,67	5,00	19A	-10,02
			4,00	32	-40,09

30 Step 6.4 Stage 4: VAL (MHW) (Verkeer)

30.1 Input Data Left

30.1.1 Calculation Method

Calculation method: C, phi, delta

30.1.2 Water Level

Water level: 8,82 [m]

30.1.3 Surface

X [m]	Y [m]
0,00	9,82
22,00	8,18
50,10	8,18
51,50	7,79

30.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

30.1.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

30.2 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	9,64	1,0	13,0	0,31	0,31	4,03
2	9,26	3,0	39,0	0,31	0,31	4,02
3	9,06	4,1	52,7	0,31	0,33	4,02
4	9,03	4,3	55,1	0,31	0,33	4,02
5	8,91	4,9	63,0	0,31	0,35	4,02
6	8,79	5,4	70,3	0,31	0,35	4,01
7	8,48	6,3	79,8	0,31	0,36	3,92
8	7,95	7,9	96,4	0,31	0,37	3,80
9	7,41	9,4	112,8	0,31	0,39	3,71
10	6,88	11,0	129,0	0,31	0,40	3,65
11	6,34	12,5	145,1	0,31	0,42	3,59
12	5,80	14,1	160,9	0,31	0,43	3,54
13	5,27	15,6	179,5	0,31	0,44	3,56
14	4,75	18,2	140,3	0,33	0,53	2,55
15	4,25	19,7	153,6	0,33	0,53	2,61
16	3,74	20,7	186,0	0,33	0,46	2,94
17	3,21	22,4	202,7	0,33	0,46	2,97
18	2,69	24,0	219,5	0,33	0,47	2,99
19	2,16	25,6	236,4	0,33	0,47	3,02

30.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	491,79
19A	75,53
32	92,86
19	0,00
32	0,00

30.4 Input Data Right

30.4.1 Calculation Method

Calculation method: C, phi, delta

30.4.2 Water Level

Water level: 13,37 [m]

30.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

30.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	10,80	18,00	20,00	0,00	27,51	18,34
19A	5,00	18,50	18,50	2,14	23,01	15,34
32	4,00	19,00	20,00	0,00	27,96	10,03
19	-3,00	18,00	18,00	2,14	21,24	14,16
32	-3,50	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

30.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	10,80	27000,00	27000,00	13500,00	13500,00
19A	5,00	13500,00	13500,00	9000,00	9000,00
32	4,00	90000,00	90000,00	45000,00	45000,00
19	-3,00	9000,00	9000,00	4500,00	4500,00
32	-3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	10,80	6750,00	6750,00
19A	5,00	4500,00	4500,00
32	4,00	22500,00	22500,00
19	-3,00	1800,00	1800,00
32	-3,50	22500,00	22500,00

30.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

30.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	13,38	0,0	10,0	0,00	1,71	37,15
2	13,35	0,0	11,5	0,00	2,05	15,37
3	13,07	0,0	22,3	0,00	2,10	6,39
4	12,57	2,9	95,2	0,27	1,12	8,99
5	12,23	7,1	86,9	0,46	0,83	5,68
6	11,93	8,4	51,4	0,44	0,68	2,68
7	11,47	10,2	44,6	0,42	0,57	1,85
8	11,03	11,9	50,0	0,42	0,51	1,77
9	10,64	13,6	125,1	0,43	0,43	3,92
10	10,31	14,7	110,7	0,42	0,42	3,15
11	9,99	15,3	111,7	0,40	0,40	2,91
12	9,64	15,3	120,0	0,37	0,39	2,88
13	9,26	16,1	132,6	0,36	0,40	2,94
14	9,06	16,3	136,4	0,35	0,40	2,91
15	9,03	16,3	136,9	0,34	0,40	2,90
16	8,91	16,4	139,0	0,34	0,40	2,88
17	8,79	16,4	143,2	0,33	0,40	2,90
18	8,48	16,6	154,9	0,32	0,40	2,97
19	7,95	16,9	176,0	0,30	0,41	3,09
20	7,41	17,1	197,9	0,28	0,42	3,20
21	6,88	17,3	220,4	0,26	0,43	3,31
22	6,34	18,1	243,4	0,25	0,44	3,41
23	5,80	20,1	266,9	0,26	0,45	3,50
24	5,27	22,5	290,8	0,28	0,45	3,59
25	4,75	31,8	251,2	0,33	0,54	2,62
26	4,25	41,3	330,3	0,34	0,55	2,74
27	3,74	44,5	443,0	0,33	0,49	3,28
28	3,21	46,5	460,5	0,33	0,49	3,29
29	2,69	47,5	472,4	0,33	0,49	3,26
30	2,16	49,0	491,1	0,33	0,49	3,28

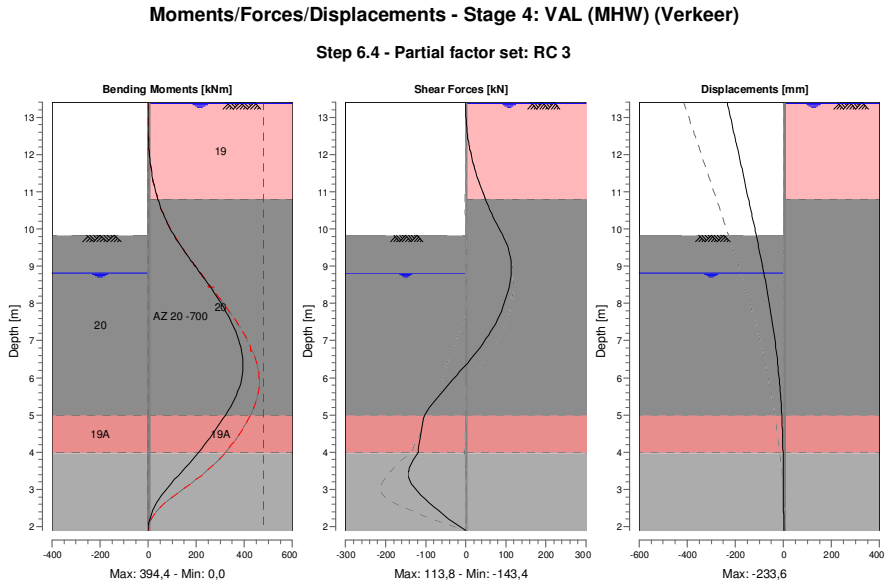
30.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	100,22
19A	36,79
32	205,28
19	0,00
32	0,00

30.7 Calculation Results

Number of iterations: 6

30.7.1 Charts of Moments, Forces and Displacements



30.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-233,6**
1	13,37	0,0	0,0	-232,6
2	13,37	0,0	0,0	-232,6
2	13,32	0,0	0,0	-230,9
3	13,32	0,0	0,0	-230,9
3	12,82	0,3	1,5	-213,8
4	12,82	0,3	1,5	-213,8
4	12,32	2,2	6,8	-196,8
5	12,32	2,2	6,8	-196,8
5	12,15	3,6	9,9	-191,0
6	12,15	3,6	9,9	-191,0
6	11,70	10,3	20,1	-175,8
7	11,70	10,3	20,1	-175,8
7	11,25	22,1	33,1	-160,5
8	11,25	22,1	33,1	-160,5
8	10,80	40,4	48,7	-145,3
9	10,80	40,4	48,7	-145,3
9	10,47	58,4	61,9	-134,4
10	10,47	58,4	61,9	-134,4
10	10,15	80,8	76,4	-123,6
11	10,15	80,8	76,4	-123,6
11	9,82	108,1	92,1	-113,0
12	9,82	108,1	92,1	-113,0
12	9,45	145,9	106,9	-100,9
13	9,45	145,9	106,9	-100,9
13	9,07	187,8	113,4	-89,1
14	9,07	187,8	113,4	-89,1
14	9,05	190,0	113,6	-88,5
15	9,05	190,0	113,6	-88,5
15	9,00	195,7	113,7	-87,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,00	195,7	113,7	-87,0
16	8,82	216,2	113,2	-81,6
17	8,82	216,2	113,2	-81,6
17	8,75	224,1	112,6	-79,5
18	8,75	224,1	112,6	-79,5
18	8,21	282,2	102,6	-64,3
19	8,21	282,2	102,6	-64,3
19	7,68	332,6	83,9	-50,4
20	7,68	332,6	83,9	-50,4
20	7,14	370,6	56,6	-38,1
21	7,14	370,6	56,6	-38,1
21	6,61	**391,7**	20,6	-27,6
22	6,61	**391,7**	20,6	-27,6
22	6,07	391,4	-22,8	-19,0
23	6,07	391,4	-22,9	-19,0
23	5,54	367,7	-65,1	-12,2
24	5,54	367,7	-65,2	-12,2
24	5,00	322,1	-103,3	-7,2
25	5,00	322,1	-103,4	-7,2
25	4,50	268,2	-112,3	-3,9
26	4,50	268,2	-112,3	-3,9
26	4,00	210,2	-118,4	-1,7
27	4,00	210,2	-118,6	-1,7
27	3,48	140,4	-143,1	-0,3
28	3,48	140,3	**-143,3**	-0,3
28	2,95	68,7	-120,8	0,4
29	2,95	68,8	-120,6	0,4
29	2,42	18,4	-68,0	0,7
30	2,42	18,4	-68,0	0,7
30	1,90	0,0	0,0	1,0
Max		**391,7**	**-143,3**	**-233,6**
Max, minor nodes incl.		394,4	-143,4	-233,6

30.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,37	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,49	A	
3	13,32	0,00	0,00	-		0,00	0,49	A	
3	12,82	0,00	0,00	-		0,00	5,40	A	
4	12,82	0,00	0,00	-		1,86	5,40	A	
4	12,32	0,00	0,00	-		3,82	10,30	A	
5	12,32	0,00	0,00	-		6,54	10,30	A	
5	12,15	0,00	0,00	-		7,58	11,97	A	
6	12,15	0,00	0,00	-		7,22	11,97	A	
6	11,70	0,00	0,00	-		9,56	16,38	A	
7	11,70	0,00	0,00	-		9,22	16,38	A	
7	11,25	0,00	0,00	-		11,14	20,80	A	
8	11,25	0,00	0,00	-		11,00	20,80	A	
8	10,80	0,00	0,00	-		12,67	25,21	A	
9	10,80	0,00	0,00	-		12,90	25,21	A	11
9	10,47	0,00	0,00	-		14,32	28,40	A	11
10	10,47	0,00	0,00	-		14,02	28,40	A	13
10	10,15	0,00	0,00	-		15,35	31,59	A	13
11	10,15	0,00	0,00	-		14,65	31,59	A	14
11	9,82	0,00	0,00	-		15,88	34,78	A	14
12	9,82	0,00	0,00	P		14,68	34,78	A	
12	9,45	26,07	0,00	P		15,98	38,48	A	
13	9,45	25,99	0,00	P		15,49	38,48	A	
13	9,07	52,02	0,00	P		16,73	42,18	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* [%]
14	9,07	52,01	0,00	P		16,22	42,18	A	
14	9,05	53,39	0,00	P		16,29	42,38	A	
15	9,05	53,39	0,00	P		16,20	42,38	A	
15	9,00	56,83	0,00	P		16,36	42,87	A	
16	9,00	56,83	0,00	P		16,08	42,87	A	
16	8,82	69,24	0,00	P		16,64	44,64	A	
17	8,82	69,02	0,00	P		16,33	44,64	A	
17	8,75	71,64	0,69	P		16,54	45,32	A	
18	8,75	70,01	0,69	P		15,85	45,32	A	
18	8,21	89,60	5,94	P		17,38	50,58	A	
19	8,21	86,91	5,94	P		16,18	50,58	A	
19	7,68	105,93	11,20	P		17,61	55,83	A	
20	7,68	103,53	11,20	P		16,47	55,83	A	
20	7,14	122,12	16,45	P		17,80	61,09	A	
21	7,14	119,91	16,45	P		16,71	61,09	A	
21	6,61	138,18	21,71	P		17,96	66,34	A	
22	6,61	136,07	21,71	P		17,54	66,34	A	
22	6,07	146,87	26,96	3	95	18,76	71,60	A	
23	6,07	145,56	26,96	3	96	19,47	71,60	A	
23	5,54	142,36	32,22	3	84	20,74	76,85	A	
24	5,54	142,88	32,22	3	84	21,82	76,85	A	
24	5,00	127,62	37,47	2	68	23,17	82,11	A	
25	5,00	92,00	37,47	2	68	27,67	82,11	A	
25	4,50	76,72	42,38	2	53	35,84	66,17	A	
26	4,50	77,78	42,38	2	52	37,08	66,17	A	
26	4,00	55,29	47,28	1	35	50,76	50,23	1	
27	4,00	114,11	47,28	2	64	43,74	50,23	A	
27	3,48	61,21	52,43	1	32	45,32	55,38	A	
28	3,48	61,68	52,43	1	32	45,65	55,38	A	
28	2,95	23,19	57,58	A		101,33	60,53	1	22
29	2,95	23,19	57,58	A		101,76	60,53	1	22
29	2,42	24,82	62,73	A		137,91	65,68	1	29
30	2,42	24,82	62,73	A		138,33	65,68	1	29
30	1,90	26,45	67,89	A		165,76	70,83	1	33

*

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

30.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	660,2	358,6
Water	234,9	536,9
Total	895,0	895,5

Considered as passive side	Left
Maximum passive effective resistance	1114,14 kN
Mobilized passive effective resistance	660,17 kN
Percentage mobilized resistance	59,3 %

30.7.5 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	-83,74
Vertical force passive	200,12
Resulting vertical force (no dead weight)	116,38
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-83,74
Vertical force passive	200,12
Resulting vertical force (no dead weight)	116,38
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

30.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,82	20	162,98	13,40	19	-4,12
5,00	19A	20,72	10,80	20	-33,21
4,00	32	16,43	5,00	19A	-10,09
			4,00	32	-36,32

31 Step 6.5 Stage 4: VAL (MHW) (Verkeer)

31.1 Input Data Left

31.1.1 Calculation Method

Calculation method: C, phi, delta

31.1.2 Water Level

Water level: 9,07 [m]

31.1.3 Surface

X [m]	Y [m]
0,00	10,15
22,00	8,50
50,10	8,50
51,50	8,11

31.1.4 Soil Material Properties in Profile: 54H

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	0,00
32	4,00	n.a.	n.a.	n.a.	0,00	0,00
19	-3,00	n.a.	n.a.	n.a.	0,00	0,00
32	-3,50	n.a.	n.a.	n.a.	0,00	0,00

31.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

31.2 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	9,88	1,2	22,3	0,27	0,27	4,83
2	9,34	3,7	66,9	0,27	0,27	4,82
3	9,04	5,0	90,5	0,27	0,29	4,81
4	8,71	5,8	102,5	0,27	0,29	4,69
5	8,14	7,3	123,6	0,27	0,31	4,55
6	7,57	8,7	144,4	0,27	0,32	4,44
7	7,00	10,1	165,0	0,27	0,34	4,36
8	6,43	11,6	185,4	0,27	0,35	4,29
9	5,86	13,0	205,6	0,27	0,36	4,23
10	5,29	14,4	229,6	0,27	0,37	4,26
11	4,75	15,5	201,4	0,26	0,46	3,44
12	4,25	16,8	218,2	0,27	0,47	3,49
13	3,74	18,2	254,1	0,27	0,39	3,79
14	3,21	19,6	275,6	0,27	0,39	3,83
15	2,69	21,0	297,3	0,27	0,40	3,86
16	2,16	22,3	319,9	0,27	0,40	3,91

31.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	413,90
19A	36,35
32	80,47
19	0,00
32	0,00

31.4 Input Data Right

31.4.1 Calculation Method

Calculation method: C, phi, delta

31.4.2 Water Level

Water level: 13,32 [m]

31.4.3 Surface

X [m]	Y [m]
0,00	13,40
5,87	13,40
7,87	13,14
11,62	11,22
25,87	11,22

31.4.4 Soil Material Properties in Profile: 54H (VAL)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	10,80	18,00	20,00	0,00	32,00	16,60
19A	5,00	18,50	18,50	3,00	27,00	18,00
32	4,00	19,00	20,00	0,00	32,50	11,66
19	-3,00	18,00	18,00	3,00	25,00	16,67
32	-3,50	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	10,80	1,00	1,00	Fine
19A	5,00	1,00	1,00	Fine
32	4,00	1,00	1,00	Fine
19	-3,00	1,00	1,00	Fine
32	-3,50	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]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	10,80	n.a.	n.a.	n.a.	0,00	0,00
19A	5,00	n.a.	n.a.	n.a.	0,00	-41,69
32	4,00	n.a.	n.a.	n.a.	-41,69	-41,69
19	-3,00	n.a.	n.a.	n.a.	-41,69	-41,69
32	-3,50	n.a.	n.a.	n.a.	-41,69	-41,69

31.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	10,80	12000,00	12000,00	6000,00	6000,00
19A	5,00	6000,00	6000,00	4000,00	4000,00
32	4,00	40000,00	40000,00	20000,00	20000,00
19	-3,00	4000,00	4000,00	2000,00	2000,00
32	-3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	800,00	800,00
20	10,80	3000,00	3000,00
19A	5,00	2000,00	2000,00
32	4,00	10000,00	10000,00
19	-3,00	800,00	800,00
32	-3,50	10000,00	10000,00

31.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	13,30
	3,25	13,30
	3,25	0,00

31.5 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	13,36	0,0	18,4	0,00	1,42	25,50
2	13,07	0,0	45,3	0,00	1,61	11,67
3	12,57	0,0	106,8	0,00	0,97	10,29
4	12,23	0,0	78,4	0,00	0,73	5,33
5	11,93	5,3	69,0	0,29	0,61	3,77
6	11,47	6,8	63,2	0,29	0,51	2,75
7	11,03	8,1	62,0	0,30	0,46	2,29
8	10,64	10,6	131,9	0,35	0,36	4,30
9	10,31	11,5	121,2	0,34	0,35	3,58
10	9,88	12,4	129,8	0,32	0,34	3,41
11	9,34	13,2	152,3	0,31	0,34	3,53
12	9,04	14,0	162,8	0,31	0,34	3,54
13	8,71	14,7	173,4	0,30	0,35	3,55
14	8,14	15,2	199,9	0,28	0,35	3,70
15	7,57	15,5	228,2	0,26	0,36	3,85
16	7,00	15,7	257,3	0,24	0,37	3,99
17	6,43	16,3	287,1	0,23	0,38	4,12
18	5,86	17,9	317,6	0,24	0,39	4,24
19	5,29	19,5	348,6	0,24	0,39	4,35
20	4,75	25,4	341,2	0,27	0,48	3,59
21	4,25	33,8	450,6	0,28	0,50	3,76
22	3,74	36,8	575,7	0,27	0,42	4,28
23	3,21	38,6	599,7	0,28	0,42	4,30
24	2,69	39,6	619,0	0,27	0,42	4,29
25	2,16	40,6	646,3	0,27	0,43	4,34

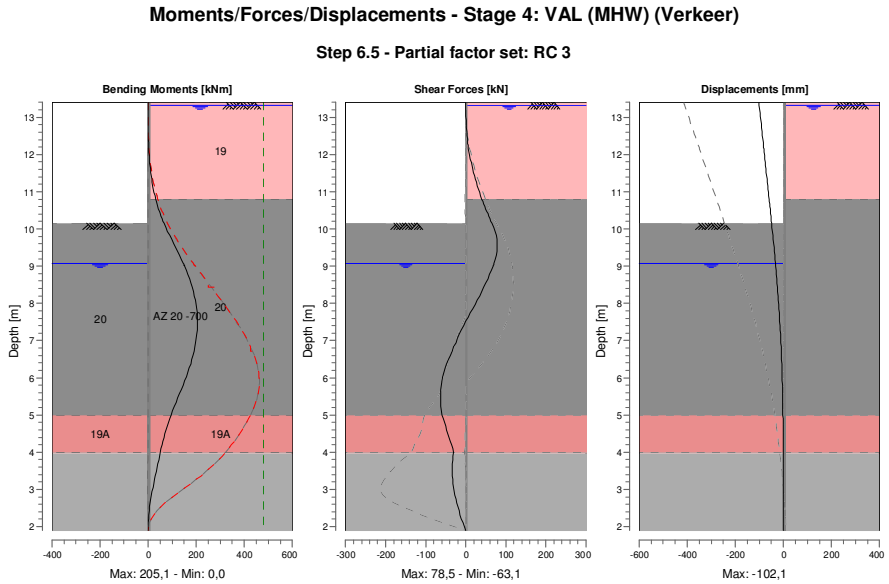
31.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	87,54
19A	44,34
32	110,75
19	0,00
32	0,00

31.7 Calculation Results

Number of iterations: 5

31.7.1 Charts of Moments, Forces and Displacements



31.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,40	0,0	0,0	**-102,1**
1	13,32	0,0	0,0	-100,7
2	13,32	0,0	0,0	-100,7
2	12,82	0,2	1,2	-92,5
3	12,82	0,2	1,2	-92,5
3	12,32	1,6	4,9	-84,2
4	12,32	1,6	4,9	-84,2
4	12,15	2,6	6,7	-81,4
5	12,15	2,6	6,7	-81,4
5	11,70	7,5	15,2	-74,0
6	11,70	7,5	15,2	-74,0
6	11,25	16,7	26,4	-66,6
7	11,25	16,7	26,4	-66,6
7	10,80	31,6	40,2	-59,3
8	10,80	31,6	40,2	-59,3
8	10,47	46,6	52,2	-54,1
9	10,47	46,6	52,2	-54,1
9	10,15	65,7	65,6	-48,9
10	10,15	65,7	65,6	-48,9
10	9,61	105,5	**78,4**	-40,6
11	9,61	105,5	**78,4**	-40,6
11	9,07	146,6	70,5	-32,9
12	9,07	146,6	70,5	-32,9
12	9,00	151,5	68,0	-31,9
13	9,00	151,5	68,0	-31,9
13	8,43	184,0	44,9	-24,6
14	8,43	184,0	44,9	-24,6
14	7,86	202,1	17,6	-18,3
15	7,86	202,1	17,6	-18,3
15	7,29	**203,9**	-10,5	-13,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	7,29	**203,9**	-10,5	-13,1
16	6,71	190,9	-34,3	-8,9
17	6,71	190,9	-34,4	-8,9
17	6,14	165,1	-55,0	-5,8
18	6,14	165,1	-55,0	-5,8
18	5,57	130,7	-63,1	-3,6
19	5,57	130,7	-63,0	-3,6
19	5,00	95,3	-59,1	-2,2
20	5,00	95,3	-59,1	-2,2
20	4,50	69,5	-44,5	-1,3
21	4,50	69,5	-44,5	-1,3
21	4,00	50,8	-30,3	-0,7
22	4,00	50,8	-30,3	-0,7
22	3,48	33,7	-33,8	-0,4
23	3,48	33,7	-33,8	-0,4
23	2,95	16,8	-28,8	-0,2
24	2,95	16,8	-28,8	-0,2
24	2,42	4,6	-16,9	0,0
25	2,42	4,6	-16,8	0,0
25	1,90	0,0	0,0	0,1
Max		**203,9**	**78,4**	**-102,1**
Max, minor nodes incl.		205,1	78,5	-102,1

31.7.3 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	13,40	0,00	0,00	-		0,00	0,00	A	
1	13,32	0,00	0,00	-		0,00	0,00	A	
2	13,32	0,00	0,00	-		0,00	0,00	A	
2	12,82	0,00	0,00	-		0,00	4,91	A	
3	12,82	0,00	0,00	-		0,00	4,91	A	
3	12,32	0,00	0,00	-		0,00	9,81	A	
4	12,32	0,00	0,00	-		0,00	9,81	A	
4	12,15	0,00	0,00	-		0,00	11,48	A	
5	12,15	0,00	0,00	-		4,53	11,48	A	
5	11,70	0,00	0,00	-		5,97	15,89	A	
6	11,70	0,00	0,00	-		6,10	15,89	A	
6	11,25	0,00	0,00	-		7,38	20,31	A	
7	11,25	0,00	0,00	-		7,53	20,31	A	
7	10,80	0,00	0,00	-		8,70	24,72	A	
8	10,80	0,00	0,00	-		10,05	24,72	A	
8	10,47	0,00	0,00	-		11,19	27,91	A	
9	10,47	0,00	0,00	-		10,99	27,91	A	
9	10,15	0,00	0,00	-		12,07	31,10	A	
10	10,15	0,00	0,00	P		11,53	31,10	A	
10	9,61	44,66	0,00	P		13,20	36,40	A	
11	9,61	44,60	0,00	P		12,42	36,40	A	
11	9,07	89,23	0,00	P		13,95	41,69	A	
12	9,07	88,96	0,00	P		13,95	41,69	A	
12	9,00	92,10	0,69	P		14,14	42,38	A	
13	9,00	89,95	0,69	P		13,92	42,38	A	
13	8,43	102,01	6,29	3	89	15,50	47,98	A	
14	8,43	99,63	6,29	3	89	14,43	47,98	A	
14	7,86	109,62	11,90	3	81	15,88	53,59	A	
15	7,86	107,51	11,90	3	81	14,78	53,59	A	
15	7,29	102,81	17,50	2	66	16,13	59,20	A	
16	7,29	101,75	17,50	2	66	15,07	59,20	A	
16	6,71	97,18	23,11	2	55	16,34	64,80	A	
17	6,71	96,32	23,11	2	55	15,69	64,80	A	
17	6,14	86,13	28,72	1	44	16,90	70,41	A	
18	6,14	86,67	28,72	1	45	17,27	70,41	A	
18	5,57	62,31	34,32	1	29	18,51	76,01	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* [%]
19	5,57	62,84	34,32	1	29	18,89	76,01	A	
19	5,00	47,10	39,93	1	20	20,16	81,62	A	
20	5,00	39,18	39,93	1	20	26,72	81,62	1	
20	4,50	35,85	44,83	1	17	43,73	65,68	1	
21	4,50	36,25	44,83	1	17	45,34	65,68	1	
21	4,00	34,71	49,74	1	15	60,97	49,74	1	
22	4,00	54,64	49,74	1	22	39,73	49,74	1	
22	3,48	41,91	54,89	1	16	42,28	54,89	1	
23	3,48	42,37	54,89	1	16	42,66	54,89	1	
23	2,95	35,89	60,04	1	13	53,13	60,04	1	
24	2,95	36,33	60,04	1	13	53,51	60,04	1	
24	2,42	33,05	65,19	1	11	60,83	65,19	1	
25	2,42	33,48	65,19	1	11	61,20	65,19	1	
25	1,90	31,21	70,34	1		67,57	70,34	1	10

*

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

31.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	530,7	251,7
Water	252,2	531,3
Total	782,9	783,0

Considered as passive side	Left
Maximum passive effective resistance	1526,96 kN
Mobilized passive effective resistance	530,72 kN
Percentage mobilized resistance	34,8 %

31.7.5 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	-74,16
Vertical force passive	190,04
Resulting vertical force (no dead weight)	115,88
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-74,16
Vertical force passive	190,04
Resulting vertical force (no dead weight)	115,88
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

31.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
10,15	20	161,62	13,40	19	-2,71
5,00	19A	11,81	10,80	20	-34,18
4,00	32	16,60	5,00	19A	-14,41

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
			4,00	32	-22,85

End of Report

Bepaling corrosie op damwanden

Project:	Prioritaire dijkversterking	Datum:	1-12-2014	Blad	1 van 2
Projectnummer:	9x4447	Naam:	GLI		
Omschrijving:	Corrosie en controle staalspanning Kanaalweg DP54.170-172	Versie:	1.0		

Toepassingsgebied

Spreadsheet is toepasbaar voor berekeningen van gereduceerde eigenschappen van damwandprofielen:
Z-profielen

Uitgangspunten

Corrosie snelheden

Corrosieafname is bepaald conform NEN-EN 1993-5:2008/NB:2012 art. 4.4

Table 4-1: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in soils, with or without groundwater

Required design working life	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils (sand, silt, clay, schist, ...)	0,00	0,30	0,60	0,90	1,20
Polluted natural soils and industrial sites	0,15	0,75	1,50	2,25	3,00
Aggressive natural soils (swamp, marsh, peat, ...)	0,20	1,00	1,75	2,50	3,25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0,18	0,70	1,20	1,70	2,20
Non-compacted and aggressive fills (ashes, slag, ...)	0,50	2,00	3,25	4,50	5,75

Notes:
1) Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.
2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Table 4-2: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in fresh water or in sea water

Required design working life	5 years	25 years	50 years	75 years	100 years
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0,15	0,55	0,90	1,15	1,40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0,30	1,30	2,30	3,30	4,30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0,55	1,90	3,75	5,60	7,50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0,25	0,90	1,75	2,60	3,50

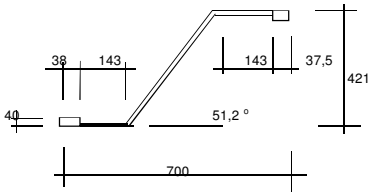
Notes:
1) The highest corrosion rate is usually found in the splash zone or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the permanent immersion zone, see Figure 4-1.
2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Levensduur			100	jaar		
Zijde 1	Grondzijde		2,2	mm	/	100 jaar
Zijde 2	Rivierzijde		2,2	mm	+ /	100 jaar
Totaal			**4,4**	**mm**	/	**100 jaar**

Traagheidsmoment on-aangetaste damwand

type : AZ20-700

lengte onder tot hoek			143,3	mm
lengte boven tot hoek			143,3	mm
lengte plank	b		700,0	mm
tot hoogte profiel	h		421,0	mm
dikte horizontale delen	t		10,0	mm
dikte schuine stuk	s		10,0	mm
hoek schuine stuk			51,2	°
halve lengte slot		±	37,5	mm
dikte slot		±	40,0	mm
Contact lengte /m^1			1,288	m^2/m^1

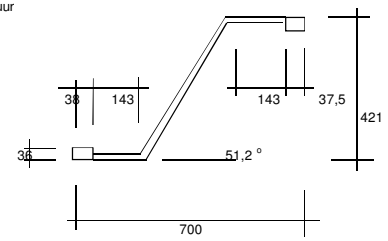


Per plank		***Per m1***		***Per m1 (conform tabellen)***		afwijking
A =	11267,1 mm^2	A =	161 cm^2/m	A =	152 cm^2/m	1,06 -
G =	88,4 kg/m^1	G =	126 kg/m^1	G =	119 kg/m^2	1,06 -
z =	210,5 mm					
I_{xx} =	29246,9 cm^4	I_{xx} =	41781 cm^4/m	I_{xx} =	40960 cm^4/m	1,02 -
W =	1389,4 cm^3	W =	1985 cm^3/m	W =	1945 cm^3/m	1,02 -
Wp =	1728,8 cm^3	W =	2470 cm^3/m	W =	2296 cm^3/m	1,08

Traagheidsmoment aangetaste damwand

type : ***AZ20-700***

levensduur constructie			100	jaar
afname wanddikte			4,4	mm gedurende de levensduur
lengte onder tot hoek			143,3	mm
lengte boven tot hoek			143,3	mm
lengte plank	b		700,0	mm
tot hoogte profiel	h		421,0	mm
dikte horizontale delen	t		5,6	mm
dikte schuine stuk	s		5,6	mm
hoek schuine stuk			51,2	°
halve lengte slot		±	37,5	mm
dikte slot		±	35,6	mm



Per plank		***Per m1***	
A =	7299,6 mm^2	A =	10428,0 mm^2
G =	57,3 kg/m^1	G =	81,9 kg/m^1
z =	210,5 mm		
I_{xx} =	20346,8 cm^4	I_{xx} =	29066,9 cm^4
W =	966,6 cm^3	W =	1380,9 cm^3
Wp =	1166,1 cm^3	Wp =	1666 cm^3

Reductiefactoren voor profielgrootheden

343,1415766

Onderstaand zijn de reductiefactoren weergegeven na een levensduur van:
100 jaar

	γ_{cor}	***Per m1 (conform tabellen)***		***Per m1 (conform tabellen)*** incl. corrosie afname	
A =	0,648 -	A =	152 cm^2/m	A =	98 cm^2/m
G =	0,648 -	G =	119 kg/m^2	G =	77 kg/m^2
I_{xx} =	0,696 -	I_{xx} =	40960 cm^4/m	I_{xx} =	28496 cm^4/m
W =	0,696 -	W =	1945 cm^3/m	W =	1353 cm^3/m
Wp =	0,675	Wp =	2296 cm3/m	Wp =	1549 cm^3/m

Bepaling corrosie op damwanden

Project:	Prioritaire dijkversterking	Datum:	1-12-2014	Blad	1 van 2
Projectnummer:	9x4447	Naam:	GLI		
Omschrijving:	Corrosie en controle staalspanning Kanaalweg DP54.170-172	Versie:	1.0		

Bepaling opneembaar moment op damwanden IE = 59840,588 kNm2/m1

Uitgangspunten

Staalkwaliteit S355GP — Mu 480 kNm/m

vloeispanning	fy	355	(sheet alleen geldig voor Z-profielen)
Treksterkte	fu	480	

Profielklasse is bepaald aan de hand van tabel 5-1 van de NEN-EN 1993-5

epsilon	e	0,81	
Type profiel		Z	

Met corrosie

Breedte van de flens	b	362	
Dikte van de flens	tf	5,6	
	b/t_f	79	
	ε		
Profielklasse		**4**	

Indien van toepassing, toelaatbare spanning om in profielklasse 3 te vallen

	b/tf	65	
toelaatbare epsion	e_toelaatbaar	0,98	
Toelaatbare spanning		246	
	e	0,9781	

Classification	Z-profile	U-profile
Class 1	- the same boundaries as for class 2 apply - a rotation check has to be carried out	
Class 2	$\frac{b/t_f}{\varepsilon} \le 45$	$\frac{b/t_f}{\varepsilon} \le 37$
Class 3	$\frac{b/t_f}{\varepsilon} \le 66$	$\frac{b/t_f}{\varepsilon} \le 49$

$\varepsilon = \sqrt{235/f_y}$	f_y [N/mm²]	240	270	320	355	390	430
	ε	0,99	0,93	0,86	0,81	0,78	0,74

Voor het bepalen van het moment is aangenomen dat voor profielklasse 4 de spanning wordt gereduceerd. Alternatieve methode is een plooicontrole uitvoeren.

	M_{Ed}	480	kNm/m	
	V_{Ed}	0	kN/m	
	N_{Ed}	0	kN/m	
kniklente	L	13	m	
Factor voor scheve buig	β_B	1	[-]	
	β_D	1	[-]	
Reductie voor meer dan 5 meter waterstands verschil				
	ρ_p	1	[-]	
	$M_{c,Rd}$	332	kNm/m	(5.2) of (5.3)
	c	533	mm	(figuur 5-1)
	A_V	2326	mm2	(5.6)

$c/t_w > 72\,\varepsilon$

95,2 70,4

Dwarskracht plooi noodzakelijk

relatieve stijfheid	λ	1,13		(5.8)
	f_{bv}	105	N/mm^2	(tabel 6-1 van de NEN-EN 1993-1-3)
	$V_{b,Rd}$	348	kN/m	(5.7)
	$V_{PL,Rd}$	471	kN/m	(5.5)

Dwarskracht meer dan 50% van $V_{PL,Rd}$ $V_{Ed}/V_{PL,Rd}$ 0,00 < 0,5

formules 5.10 en 5.9 niet van toepassing

	p	1,00	[-]	(5.10)
	$M_{V,Rd}$	332	kNm/m	(5.9)
	N_{CR}	3495	kN/m	(5.12)

Controle of stabiliteitscontrole nodig is N_{Ed}/N_{CR} 0,000 < 0,04 (5.11)

Geen stabiliteitscontrole nodig

	λ	0,83	[-] (5.13 toelichting)
	N_{PL}	2419	kN/m (5.13 toelichting)
	α	0,76	[-] (Tabel 6.1 van de NEN-EN 1993-1-1 curve d)
	ϕ	1,09	[-] (6.49, toelichting NEN-EN 1993-1-1)
	χ	0,56	[-] (6.49 van de NEN-EN 1993-1-1)

Controle stabiliteit Buiging en Normaalkracht

Controle volgens 5,13 1,66 [-]

Check of Normaalkracht meegenomen moet worden in controle moment

$N_{Ed}/N_{PL,Rd}$ 0,00 < 0,1

Normaalkracht hoeft NIET meegenomen worden in berekening

Mc,Rd 332 (5.2) of (5.3)

UC stabiliteit	0,00
UC sterkte, moment	1,45
UC sterkte, dwarskracht	0,00
UC sterkte, normaalkract	0,00
UC sterkte, gecombineerd	1,45
UC totaal	**1,45**

w	(b/t_{min}) $\varepsilon = 20,0$	(b/t_{min}) $\varepsilon = 30,0$	(b/t_{min}) $\varepsilon = 40,0$	(b/t_{min}) $\varepsilon = 50,0$
5,0	1,00	1,00	1,00	1,00
10,0	0,99	0,97	0,95	0,87
15,0	0,98	0,96	0,92	0,76
20,0	0,98	0,94	0,88	0,60

Key:
- b is the width of the flange, but b should not be taken as less than $c/\sqrt{2}$, where c is the slant height of the web
- t_{min} is the lesser of t_f or t_w
- t_f is the flange thickness
- t_w is the web thickness
- w is the differential head in m

$\varepsilon = \sqrt{235/f_y}$; f_y is the yield strength in N/mm².

Notes:
1) $\rho_p = 1,0$ may be used if the interlocks of Z-piles are welded.
2) Intermediate values may be interpolated linearly.

Report for D-Sheet Piling 14.1

Design of Sheet Pilings
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	12/1/2014
Time of report:	12:42:48 PM
Date of calculation:	11/25/2014
Time of calculation:	3:05:38 PM
Filename:	C:\Users\nl85691\Desktop\08 Schermen\DR54 Keerscherm Maasstaete
Project identification:	Waterschap Peel en Maas vallei Prioritaire Dijkversterking 1 DR54 - Maasstaete - Gecorrodeerd

Verification according to NEN-EN 9997+C1:2012

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2 Summary

2.1 Overview per Stage and Test

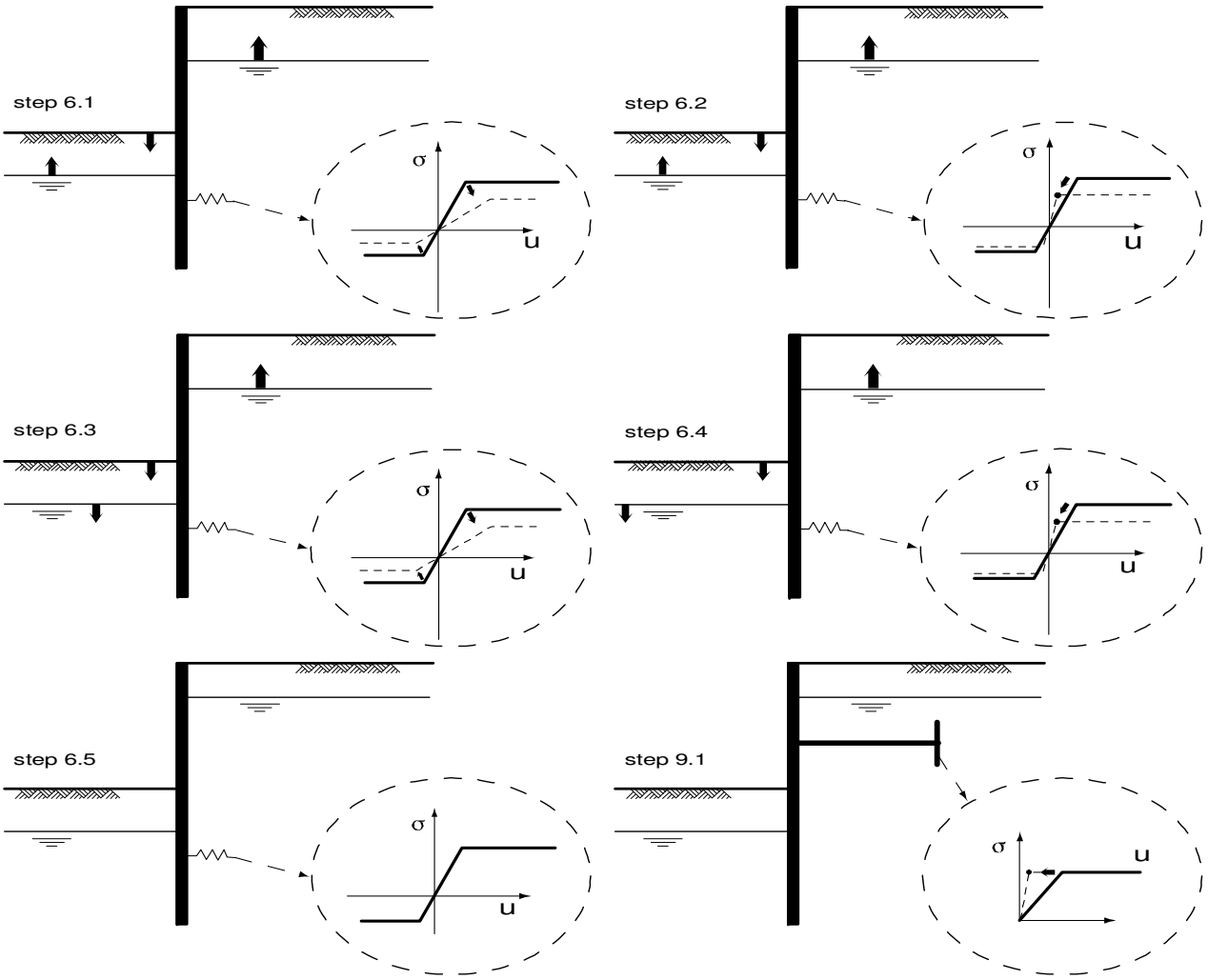
Stage no.	Verification type	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
1	EC7(NL)-Step 6.1		-3,3	5,0	**0,0**	21,2	---
1	EC7(NL)-Step 6.2		-2,3	3,5	**0,0**	21,1	---
1	EC7(NL)-Step 6.3		-3,3	5,9	**0,0**	21,2	---
1	EC7(NL)-Step 6.4		-2,3	4,4	**0,0**	21,2	---
1	EC7(NL)-Step 6.5	-0,6	-3,1	5,0	**0,0**	14,4	---
1	EC7(NL)-Step 6.5 * 1,20		-3,8	6,0			
2	EC7(NL)-Step 6.1		-85,5	40,2	**0,0**	29,5	---
2	EC7(NL)-Step 6.2		-80,4	45,8	**0,0**	30,4	---
2	EC7(NL)-Step 6.3		-85,9	40,2	**0,0**	30,7	---
2	EC7(NL)-Step 6.4		-79,7	45,4	**0,0**	31,3	---
2	EC7(NL)-Step 6.5	20,1	-37,1	19,4	**0,0**	17,0	---
2	EC7(NL)-Step 6.5 * 1,20		-44,5	23,3			
3	EC7(NL)-Step 6.1		-84,4	39,5	**0,0**	30,7	---
3	EC7(NL)-Step 6.2		-78,9	44,3	**0,0**	31,6	---
3	EC7(NL)-Step 6.3		-85,5	39,9	**0,0**	32,3	---
3	EC7(NL)-Step 6.4		-82,6	46,3	**0,0**	33,2	---
3	EC7(NL)-Step 6.5	26,3	-48,2	25,3	**0,0**	18,4	---
3	EC7(NL)-Step 6.5 * 1,20		-57,9	30,4			
4	EC7(NL)-Step 6.1		-213,9	146,2	**0,0**	64,4	---
4	EC7(NL)-Step 6.2		-213,8	146,1	**0,0**	64,5	---
4	EC7(NL)-Step 6.3		**-216,7**	**146,7**	**0,0**	65,0	---
4	EC7(NL)-Step 6.4		-216,6	146,6	**0,0**	**65,1**	---
4	EC7(NL)-Step 6.5	**69,7**	-99,1	48,3	**0,0**	25,1	---
4	EC7(NL)-Step 6.5 * 1,20		-118,9	57,9			

Max		**69,7**	**-216,7**	**146,7**	**0,0**	**65,1**	---

2.2 Overall Stability per Stage

Stage name	Stability factor [-]
Aanleg	3,37
MHW	4,91
MHW +0,5	4,54
MHW +1,0	3,57

2.3 CUR Verification Steps



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	4
Unit weight of water	9,81 kN/m³
Number of curves on spring characteristic	3
Unloading curve on spring characteristic	No

3.2 Sheet Piling Properties

Length	9,67 m
Level top side	13,32 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 12 -770	3,65	13,32	2,8424E+04	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 12 -770	3,65	13,32	279,00	1,00	1,00	1,00	279,00

Section name	From [m]	To [m]	Red. factor EI [-]	Note to reduction factor	Corrected stiffness EI [kNm²]
AZ 12 -770	3,65	13,32	1,00		28420,00

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
AZ 12 -770	3,65	13,32	344,00	1,20	120,00

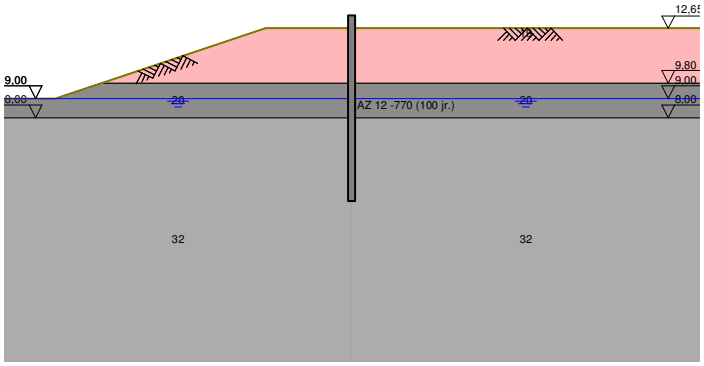
3.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL method A: Partial factors (design values) in all stages Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
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 1: Aanleg

Outline - Stage 1: Aanleg

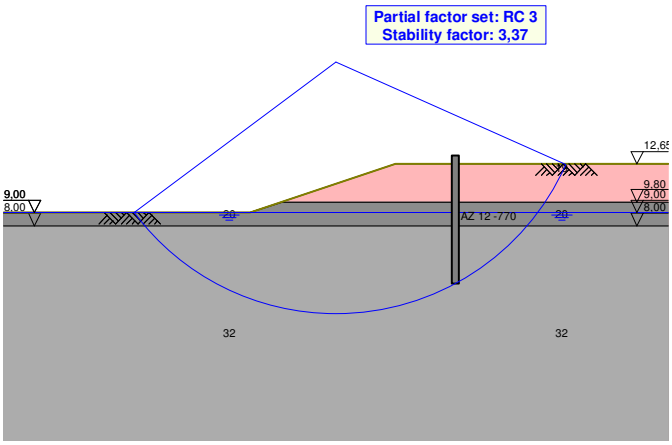


5 Overall Stability Stage 1: Aanleg

Stability factor : 3,37

5.1 Overall Stability

Overall Stability - Stage 1: Aanleg



6 Step 6.1 Stage 1: Aanleg

6.1 Input Data Left

6.1.1 Calculation Method

Calculation method: C, phi, delta

6.1.2 Water Level

Water level: 9,25 [m]

6.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

6.1.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Neutral [-]	Passive [-]	Additional pore pressure Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

6.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	18,3	0,00	0,42	6,16
2	12,26	0,0	30,6	0,00	0,42	4,36
3	12,18	0,0	35,3	0,00	0,42	4,13
4	11,96	1,6	47,1	0,13	0,42	3,79
5	11,57	5,3	68,1	0,27	0,42	3,53
6	11,19	8,0	89,1	0,31	0,43	3,41
7	10,92	10,0	104,1	0,32	0,43	3,37
8	10,79	10,9	110,9	0,33	0,43	3,35
9	10,51	13,0	107,4	0,34	0,44	2,83
10	10,04	16,4	109,3	0,36	0,45	2,37
11	9,61	17,0	201,6	0,32	0,35	3,77
12	9,24	18,9	218,0	0,32	0,36	3,65
13	9,03	19,7	222,3	0,32	0,36	3,61
14	8,88	20,2	155,1	0,32	0,36	2,47
15	8,56	21,2	130,0	0,32	0,36	1,98
16	8,19	22,4	143,9	0,32	0,36	2,09
17	7,76	25,0	84,2	0,34	0,36	1,16
18	7,28	26,6	127,3	0,35	0,36	1,66
19	6,79	28,2	150,3	0,35	0,37	1,86
20	6,31	30,0	167,1	0,35	0,38	1,97
21	5,83	31,5	182,3	0,35	0,39	2,06
22	5,34	32,7	196,5	0,35	0,39	2,12
23	4,86	33,9	210,2	0,35	0,40	2,18
24	4,38	35,1	224,1	0,35	0,41	2,23
25	3,89	36,3	238,4	0,35	0,42	2,28

6.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	49,14
32	185,56

6.4 Input Data Right

6.4.1 Calculation Method

Calculation method: C, phi, delta

6.4.2 Water Level

Water level: 9,05 [m]

6.4.3 Surface

X [m]	Y [m]
0,00	12,65

6.4.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

6.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

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	12,48	0,0	18,3	0,00	0,64	6,16
2	12,26	0,0	30,6	0,00	0,64	4,36
3	12,18	0,0	35,3	0,00	0,64	4,13
4	11,96	1,6	47,1	0,12	0,64	3,79
5	11,57	5,3	68,1	0,27	0,64	3,52
6	11,19	8,0	89,1	0,31	0,64	3,39
7	10,92	10,0	104,1	0,32	0,64	3,34
8	10,79	10,9	110,9	0,33	0,64	3,32
9	10,51	13,0	126,2	0,34	0,64	3,28
10	10,04	16,4	152,2	0,35	0,64	3,24
11	9,61	17,0	263,1	0,31	0,54	4,81
12	9,24	19,1	291,7	0,31	0,54	4,75
13	9,03	20,2	307,9	0,31	0,54	4,73
14	8,88	20,7	314,7	0,31	0,54	4,73
15	8,56	21,7	329,1	0,31	0,54	4,72
16	8,19	22,9	346,6	0,31	0,54	4,71
17	7,76	25,5	292,6	0,33	0,53	3,75
18	7,28	27,1	310,3	0,33	0,53	3,74
19	6,79	28,8	328,1	0,33	0,53	3,74
20	6,31	30,4	346,0	0,33	0,53	3,73
21	5,83	32,0	364,0	0,33	0,53	3,73
22	5,34	33,6	382,0	0,33	0,53	3,72
23	4,86	35,3	400,1	0,33	0,53	3,72
24	4,38	36,9	418,2	0,33	0,53	3,72
25	3,89	38,5	436,4	0,33	0,53	3,72

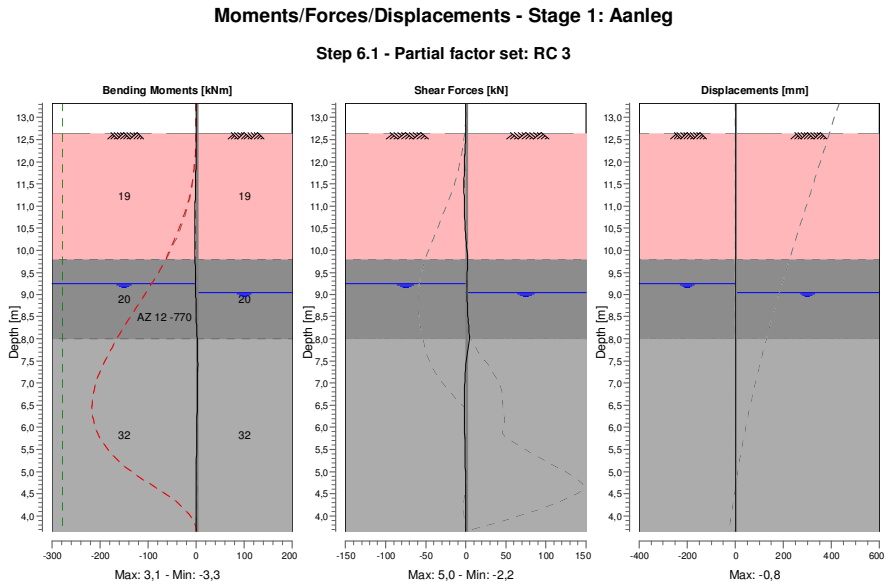
6.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	53,80
32	189,12

6.7 Calculation Results

Number of iterations: 2

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	13,32	0,0	0,0	-0,6
1	13,20	0,0	0,0	-0,6
2	13,20	0,0	0,0	-0,6
2	13,15	0,0	0,0	-0,6
3	13,15	0,0	0,0	-0,6
3	12,70	0,0	0,0	-0,7
4	12,70	0,0	0,0	-0,7
4	12,65	0,0	0,0	-0,7
5	12,65	0,0	0,0	-0,7
5	12,32	-0,1	-0,9	-0,7
6	12,32	-0,1	-0,9	-0,7
6	12,20	-0,3	-1,3	-0,7
7	12,20	-0,3	-1,3	-0,7
7	12,15	-0,3	-1,4	-0,7
8	12,15	-0,3	-1,4	-0,7
8	11,77	-1,0	-2,0	-0,7
9	11,77	-1,0	-2,0	-0,7
9	11,38	-1,8	-2,2	**-0,8**
10	11,38	-1,8	-2,2	**-0,8**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
10	11,00	-2,6	-1,8	**-0,8**
11	11,00	-2,6	-1,8	**-0,8**
11	10,84	-2,9	-1,5	**-0,8**
12	10,84	-2,9	-1,5	**-0,8**
12	10,75	-3,0	-1,3	**-0,8**
13	10,75	-3,0	-1,3	**-0,8**
13	10,28	**-3,3**	0,2	-0,7
14	10,28	**-3,3**	0,2	-0,7
14	9,80	-2,7	2,6	-0,7
15	9,80	-2,7	2,6	-0,7
15	9,43	-1,9	1,9	-0,6
16	9,43	-1,9	1,9	-0,6
16	9,05	-1,2	1,8	-0,6
17	9,05	-1,2	1,8	-0,6
17	9,00	-1,1	1,8	-0,6
18	9,00	-1,1	1,8	-0,6
18	8,75	-0,7	2,1	-0,5
19	8,75	-0,7	2,1	-0,5
19	8,38	0,3	3,1	-0,5
20	8,38	0,3	3,1	-0,5
20	8,00	1,8	**5,0**	-0,4
21	8,00	1,8	**5,0**	-0,4
21	7,52	3,1	0,8	-0,3
22	7,52	3,1	0,8	-0,3
22	7,03	2,9	-1,2	-0,3
23	7,03	2,9	-1,2	-0,3
23	6,55	2,1	-1,7	-0,3
24	6,55	2,1	-1,7	-0,3
24	6,07	1,3	-1,6	-0,2
25	6,07	1,3	-1,6	-0,2
25	5,58	0,6	-1,1	-0,2
26	5,58	0,6	-1,1	-0,2
26	5,10	0,2	-0,6	-0,3
27	5,10	0,2	-0,6	-0,3
27	4,62	0,0	-0,2	-0,3
28	4,62	0,0	-0,2	-0,3
28	4,13	0,0	0,0	-0,3
29	4,13	0,0	0,0	-0,3
29	3,65	0,0	0,0	-0,3
Max		**-3,3**	**5,0**	**-0,8**
Max, minor nodes incl.		-3,3	5,0	-0,8

6.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	P		0,00	0,00	A	
5	12,32	4,63	0,00	1	13	1,63	0,00	1	
6	12,32	4,64	0,00	1	18	1,63	0,00	1	
6	12,20	5,56	0,00	1	16	2,98	0,00	1	
7	12,20	5,56	0,00	1	17	2,98	0,00	1	
7	12,15	5,95	0,00	1	16	3,55	0,00	1	
8	12,15	5,96	0,00	1	17	3,55	0,00	1	
8	11,77	8,91	0,00	1	15	7,87	0,00	1	
9	11,77	8,96	0,00	1	16	7,87	0,00	1	

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* [%]
9	11,38	11,90	0,00	1	15	12,21	0,00	1	
10	11,38	12,01	0,00	1	15	12,21	0,00	1	
10	11,00	14,92	0,00	1	15	16,58	0,00	1	
11	11,00	15,04	0,00	1	15	16,58	0,00	1	
11	10,84	16,29	0,00	1	15	18,48	0,00	1	
12	10,84	16,35	0,00	1	15	18,48	0,00	1	
12	10,75	16,99	0,00	1	15	19,45	0,00	1	
13	10,75	17,15	0,00	1	18	19,45	0,00	1	
13	10,28	20,69	0,00	1	17	24,97	0,00	1	
14	10,28	21,06	0,00	1	21	24,97	0,00	1	
14	9,80	24,55	0,00	1	21	30,56	0,00	1	
15	9,80	24,17	0,00	1	13	21,14	0,00	1	
15	9,43	25,94	0,00	1	12	25,24	0,00	1	
16	9,43	26,34	0,00	1	13	25,24	0,00	1	
16	9,05	27,34	1,96	1	12	29,44	0,00	1	
17	9,05	27,32	1,96	1	12	29,44	0,00	1	
17	9,00	27,40	2,45	1	12	29,79	0,49	1	
18	9,00	27,40	2,45	1	18	29,79	0,49	1	
18	8,75	27,78	4,91	1	18	31,57	2,94	1	
19	8,75	27,84	4,91	1	22	31,57	2,94	1	
19	8,38	28,38	8,58	1	21	34,27	6,62	1	
20	8,38	28,54	8,58	1	20	34,27	6,62	1	
20	8,00	29,08	12,26	1	20	36,95	10,30	1	
21	8,00	37,42	12,26	1	46	27,83	10,30	1	
21	7,52	36,63	17,00	1	43	32,71	15,04	1	
22	7,52	37,04	17,00	1	30	32,71	15,04	1	
22	7,03	37,00	21,75	1	28	36,84	19,78	1	
23	7,03	37,51	21,75	1	26	36,84	19,78	1	
23	6,55	38,20	26,49	1	25	40,25	24,52	1	
24	6,55	38,78	26,49	1	24	40,25	24,52	1	
24	6,07	40,03	31,23	1	24	43,13	29,27	1	
25	6,07	40,68	31,23	1	23	43,13	29,27	1	
25	5,58	42,28	35,97	1	23	45,67	34,01	1	
26	5,58	42,98	35,97	1	22	45,67	34,01	1	
26	5,10	44,77	40,71	1	22	48,05	38,75	1	
27	5,10	45,51	40,71	1	22	48,05	38,75	1	
27	4,62	47,40	45,45	1	22	50,36	43,49	1	
28	4,62	48,17	45,45	1	22	50,36	43,49	1	
28	4,13	50,10	50,19	1	22	52,66	48,23	1	
29	4,13	50,90	50,19	1	22	52,66	48,23	1	
29	3,65	52,87	54,94	1	22	54,95	52,97	1	

*

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	272,5	283,3
Water	153,8	143,0
Total	426,3	426,3

Considered as passive side	Left
Maximum passive effective resistance	1288,21 kN
Mobilized passive effective resistance	272,48 kN
Percentage mobilized resistance	21,1 %

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	-61,47
Vertical force passive	58,64
Resulting vertical force (no dead weight)	-2,83
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (3 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-61,47
Vertical force passive	58,64
Resulting vertical force (no dead weight)	-2,83
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (3 > 0)	

6.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	9,53	12,65	19	-10,18
9,80	20	16,29	9,80	20	-17,83
8,00	32	32,83	8,00	32	-33,46

7 Step 6.2 Stage 1: Aanleg

7.1 Input Data Left

7.1.1 Calculation Method

Calculation method: C, phi, delta

7.1.2 Water Level

Water level: 9,25 [m]

7.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

7.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

7.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

7.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	18,3	0,00	0,42	6,16
2	12,26	0,0	30,6	0,00	0,42	4,36
3	12,18	0,0	35,3	0,00	0,42	4,13
4	11,96	1,6	47,1	0,13	0,42	3,79
5	11,57	5,3	68,1	0,27	0,42	3,53
6	11,19	8,0	89,1	0,31	0,43	3,41
7	10,92	10,0	104,1	0,32	0,43	3,37
8	10,79	10,9	110,9	0,33	0,43	3,35
9	10,51	13,0	107,4	0,34	0,44	2,83
10	10,04	16,4	109,3	0,36	0,45	2,37
11	9,61	17,0	201,6	0,32	0,35	3,77
12	9,24	18,9	218,0	0,32	0,36	3,65
13	9,03	19,7	222,3	0,32	0,36	3,61
14	8,88	20,2	155,1	0,32	0,36	2,47
15	8,56	21,2	130,0	0,32	0,36	1,98
16	8,19	22,4	143,9	0,32	0,36	2,09
17	7,76	25,0	84,2	0,34	0,36	1,16
18	7,28	26,6	127,3	0,35	0,36	1,66
19	6,79	28,2	150,3	0,35	0,37	1,86
20	6,31	30,0	167,1	0,35	0,38	1,97
21	5,83	31,5	182,3	0,35	0,39	2,06
22	5,34	32,7	196,5	0,35	0,39	2,12
23	4,86	33,9	210,2	0,35	0,40	2,18
24	4,38	35,1	224,1	0,35	0,41	2,23
25	3,89	36,3	238,4	0,35	0,42	2,28

7.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	49,84
32	184,85

7.4 Input Data Right

7.4.1 Calculation Method

Calculation method: C, phi, delta

7.4.2 Water Level

Water level: 9,05 [m]

7.4.3 Surface

X [m]	Y [m]
0,00	12,65

7.4.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

7.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

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	12,48	0,0	18,3	0,00	0,64	6,16
2	12,26	0,0	30,6	0,00	0,64	4,36
3	12,18	0,0	35,3	0,00	0,64	4,13
4	11,96	1,6	47,1	0,12	0,64	3,79
5	11,57	5,3	68,1	0,27	0,64	3,52
6	11,19	8,0	89,1	0,31	0,64	3,39
7	10,92	10,0	104,1	0,32	0,64	3,34
8	10,79	10,9	110,9	0,33	0,64	3,32
9	10,51	13,0	126,2	0,34	0,64	3,28
10	10,04	16,4	152,2	0,35	0,64	3,24
11	9,61	17,0	263,1	0,31	0,54	4,81
12	9,24	19,1	291,7	0,31	0,54	4,75
13	9,03	20,2	307,9	0,31	0,54	4,73
14	8,88	20,7	314,7	0,31	0,54	4,73
15	8,56	21,7	329,1	0,31	0,54	4,72
16	8,19	22,9	346,6	0,31	0,54	4,71
17	7,76	25,5	292,6	0,33	0,53	3,75
18	7,28	27,1	310,3	0,33	0,53	3,74
19	6,79	28,8	328,1	0,33	0,53	3,74
20	6,31	30,4	346,0	0,33	0,53	3,73
21	5,83	32,0	364,0	0,33	0,53	3,73
22	5,34	33,6	382,0	0,33	0,53	3,72
23	4,86	35,3	400,1	0,33	0,53	3,72
24	4,38	36,9	418,2	0,33	0,53	3,72
25	3,89	38,5	436,4	0,33	0,53	3,72

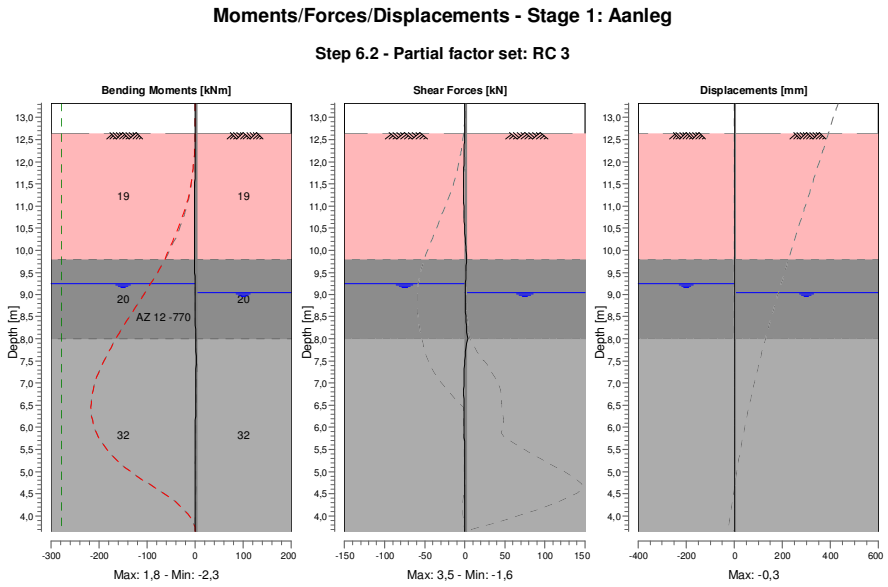
7.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	53,10
32	189,83

7.7 Calculation Results

Number of iterations: 3

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	13,32	0,0	0,0	-0,1
1	13,20	0,0	0,0	-0,1
2	13,20	0,0	0,0	-0,1
2	13,15	0,0	0,0	-0,1
3	13,15	0,0	0,0	-0,1
3	12,70	0,0	0,0	-0,2
4	12,70	0,0	0,0	-0,2
4	12,65	0,0	0,0	-0,2
5	12,65	0,0	0,0	-0,2
5	12,32	-0,1	-0,7	-0,2
6	12,32	-0,1	-0,7	-0,2
6	12,20	-0,2	-0,9	-0,2
7	12,20	-0,2	-0,9	-0,2
7	12,15	-0,2	-1,0	-0,2
8	12,15	-0,2	-1,0	-0,2
8	11,77	-0,7	-1,5	-0,2
9	11,77	-0,7	-1,5	-0,2
9	11,38	-1,3	-1,6	**-0,3**
10	11,38	-1,3	-1,6	**-0,3**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
10	11,00	-1,9	-1,3	**-0,3**
11	11,00	-1,9	-1,3	**-0,3**
11	10,84	-2,1	-1,0	**-0,3**
12	10,84	-2,1	-1,0	**-0,3**
12	10,75	-2,2	-0,9	**-0,3**
13	10,75	-2,2	-0,9	**-0,3**
13	10,28	**-2,3**	0,5	**-0,3**
14	10,28	**-2,3**	0,5	**-0,3**
14	9,80	-1,6	2,5	**-0,3**
15	9,80	-1,6	2,5	**-0,3**
15	9,43	-0,9	1,3	-0,2
16	9,43	-0,9	1,3	-0,2
16	9,05	-0,5	0,8	-0,2
17	9,05	-0,5	0,8	-0,2
17	9,00	-0,5	0,8	-0,2
18	9,00	-0,5	0,8	-0,2
18	8,75	-0,3	0,8	-0,2
19	8,75	-0,3	0,8	-0,2
19	8,38	0,1	1,7	-0,2
20	8,38	0,1	1,7	-0,2
20	8,00	1,1	**3,5**	-0,1
21	8,00	1,1	**3,5**	-0,1
21	7,52	1,8	-0,1	-0,1
22	7,52	1,8	-0,1	-0,1
22	7,03	1,4	-1,3	-0,1
23	7,03	1,4	-1,3	-0,1
23	6,55	0,8	-1,2	-0,1
24	6,55	0,8	-1,2	-0,1
24	6,07	0,3	-0,8	-0,1
25	6,07	0,3	-0,8	-0,1
25	5,58	0,0	-0,3	-0,1
26	5,58	0,0	-0,3	-0,1
26	5,10	-0,1	0,0	-0,1
27	5,10	-0,1	0,0	-0,1
27	4,62	-0,1	0,1	-0,1
28	4,62	-0,1	0,1	-0,1
28	4,13	0,0	0,1	-0,1
29	4,13	0,0	0,1	-0,1
29	3,65	0,0	0,0	-0,1
Max		**-2,3**	**3,5**	**-0,3**
Max, minor nodes incl.		-2,3	3,5	-0,3

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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	P		0,00	0,00	A	
5	12,32	4,19	0,00	1	11	2,07	0,00	1	
6	12,32	4,19	0,00	1	16	2,07	0,00	1	
6	12,20	5,18	0,00	1	15	3,36	0,00	1	
7	12,20	5,18	0,00	1	16	3,36	0,00	1	
7	12,15	5,59	0,00	1	15	3,90	0,00	1	
8	12,15	5,60	0,00	1	16	3,90	0,00	1	
8	11,77	8,74	0,00	1	15	8,04	0,00	1	
9	11,77	8,80	0,00	1	16	8,04	0,00	1	

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* [%]
9	11,38	11,91	0,00	1	15	12,21	0,00	1	
10	11,38	12,01	0,00	1	16	12,21	0,00	1	
10	11,00	15,07	0,00	1	15	16,44	0,00	1	
11	11,00	15,18	0,00	1	15	16,44	0,00	1	
11	10,84	16,48	0,00	1	15	18,28	0,00	1	
12	10,84	16,54	0,00	1	15	18,28	0,00	1	
12	10,75	17,20	0,00	1	15	19,24	0,00	1	
13	10,75	17,36	0,00	1	18	19,24	0,00	1	
13	10,28	20,97	0,00	1	18	24,69	0,00	1	
14	10,28	21,34	0,00	1	21	24,69	0,00	1	
14	9,80	24,82	0,00	1	21	30,30	0,00	1	
15	9,80	24,97	0,00	1	13	20,34	0,00	1	
15	9,43	26,60	0,00	1	12	24,59	0,00	1	
16	9,43	27,00	0,00	1	13	24,59	0,00	1	
16	9,05	27,82	1,96	1	12	28,96	0,00	1	
17	9,05	27,80	1,96	1	13	28,96	0,00	1	
17	9,00	27,85	2,45	1	13	29,34	0,49	1	
18	9,00	27,85	2,45	1	18	29,34	0,49	1	
18	8,75	28,11	4,91	1	18	31,25	2,94	1	
19	8,75	28,16	4,91	1	22	31,25	2,94	1	
19	8,38	28,50	8,58	1	22	34,15	6,62	1	
20	8,38	28,65	8,58	1	21	34,15	6,62	1	
20	8,00	29,00	12,26	1	20	37,03	10,30	1	
21	8,00	37,15	12,26	1	46	28,10	10,30	1	
21	7,52	35,85	17,00	1	42	33,49	15,04	1	
22	7,52	36,26	17,00	1	29	33,49	15,04	1	
22	7,03	36,23	21,75	1	28	37,61	19,78	1	
23	7,03	36,73	21,75	1	25	37,61	19,78	1	
23	6,55	37,74	26,49	1	25	40,71	24,52	1	
24	6,55	38,33	26,49	1	24	40,71	24,52	1	
24	6,07	39,94	31,23	1	23	43,22	29,27	1	
25	6,07	40,58	31,23	1	23	43,22	29,27	1	
25	5,58	42,43	35,97	1	23	45,52	34,01	1	
26	5,58	43,13	35,97	1	23	45,52	34,01	1	
26	5,10	45,03	40,71	1	23	47,79	38,75	1	
27	5,10	45,77	40,71	1	22	47,79	38,75	1	
27	4,62	47,63	45,45	1	22	50,12	43,49	1	
28	4,62	48,41	45,45	1	22	50,12	43,49	1	
28	4,13	50,26	50,19	1	22	52,50	48,23	1	
29	4,13	51,05	50,19	1	22	52,50	48,23	1	
29	3,65	52,92	54,94	1	22	54,90	52,97	1	

*

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	272,4	283,2
Water	153,8	143,0
Total	426,3	426,3

Considered as passive side	Left
Maximum passive effective resistance	1288,21 kN
Mobilized passive effective resistance	272,45 kN
Percentage mobilized resistance	21,1 %

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	-61,35
Vertical force passive	58,74
Resulting vertical force (no dead weight)	-2,61
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (3 > 0)	

Vertical force balance plugged	Force [kN]
Vertical force active	-61,35
Vertical force passive	58,74
Resulting vertical force (no dead weight)	-2,61
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (3 > 0)	

7.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	9,53	12,65	19	-10,17
9,80	20	16,52	9,80	20	-17,60
8,00	32	32,70	8,00	32	-33,58

8 Step 6.3 Stage 1: Aanleg

8.1 Input Data Left

8.1.1 Calculation Method

Calculation method: C, phi, delta

8.1.2 Water Level

Water level: 8,75 [m]

8.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

8.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

8.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

8.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	18,3	0,00	0,41	6,16
2	12,26	0,0	30,6	0,00	0,41	4,36
3	12,18	0,0	35,3	0,00	0,41	4,13
4	11,96	1,6	47,1	0,13	0,42	3,79
5	11,57	5,3	68,1	0,27	0,42	3,53
6	11,19	8,0	89,1	0,31	0,42	3,41
7	10,92	10,0	104,1	0,32	0,43	3,37
8	10,79	10,9	110,9	0,33	0,43	3,35
9	10,51	13,0	107,4	0,34	0,43	2,83
10	10,04	16,4	109,3	0,36	0,44	2,37
11	9,61	17,0	201,6	0,32	0,35	3,77
12	9,24	19,1	220,2	0,32	0,36	3,69
13	9,03	20,3	231,7	0,32	0,36	3,66
14	8,88	21,1	238,8	0,32	0,36	3,63
15	8,56	22,4	177,6	0,32	0,37	2,55
16	8,19	23,6	157,8	0,32	0,37	2,17
17	7,76	26,2	93,9	0,34	0,36	1,23
18	7,28	27,9	132,8	0,35	0,37	1,65
19	6,79	29,5	156,1	0,35	0,37	1,85
20	6,31	31,3	173,4	0,35	0,38	1,96
21	5,83	32,8	189,1	0,35	0,39	2,04
22	5,34	34,0	204,1	0,35	0,40	2,12
23	4,86	35,2	218,0	0,35	0,40	2,17
24	4,38	36,4	232,0	0,35	0,41	2,22
25	3,89	37,5	246,3	0,35	0,42	2,27

8.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	52,02
32	200,82

8.4 Input Data Right

8.4.1 Calculation Method

Calculation method: C, phi, delta

8.4.2 Water Level

Water level: 9,05 [m]

8.4.3 Surface

X [m]	Y [m]
0,00	12,65

8.4.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

8.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

8.5 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	12,48	0,0	18,3	0,00	0,64	6,16
2	12,26	0,0	30,6	0,00	0,64	4,36
3	12,18	0,0	35,3	0,00	0,64	4,13
4	11,96	1,6	47,1	0,12	0,64	3,79
5	11,57	5,3	68,1	0,27	0,64	3,52
6	11,19	8,0	89,1	0,31	0,64	3,39
7	10,92	10,0	104,1	0,32	0,64	3,34
8	10,79	10,9	110,9	0,33	0,64	3,32
9	10,51	13,0	126,2	0,34	0,64	3,28
10	10,04	16,4	152,2	0,35	0,64	3,24
11	9,61	17,0	263,1	0,31	0,54	4,81
12	9,24	19,1	291,7	0,31	0,54	4,75
13	9,03	20,2	307,9	0,31	0,54	4,73
14	8,88	20,7	314,7	0,31	0,54	4,73
15	8,56	21,7	329,1	0,31	0,54	4,72
16	8,19	22,9	346,6	0,31	0,54	4,71
17	7,76	25,5	292,6	0,33	0,53	3,75
18	7,28	27,1	310,3	0,33	0,53	3,74
19	6,79	28,8	328,1	0,33	0,53	3,74
20	6,31	30,4	346,0	0,33	0,53	3,73
21	5,83	32,0	364,0	0,33	0,53	3,73
22	5,34	33,6	382,0	0,33	0,53	3,72
23	4,86	35,3	400,1	0,33	0,53	3,72
24	4,38	36,9	418,2	0,33	0,53	3,72
25	3,89	38,5	436,4	0,33	0,53	3,72

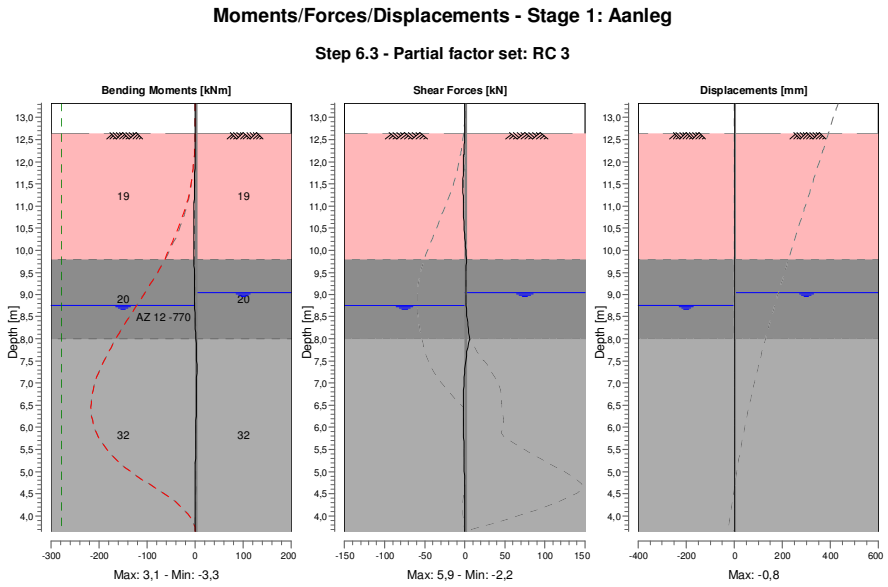
8.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	52,80
32	182,16

8.7 Calculation Results

Number of iterations: 2

8.7.1 Charts of Moments, Forces and Displacements



8.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	-0,6
1	13,20	0,0	0,0	-0,6
2	13,20	0,0	0,0	-0,6
2	13,15	0,0	0,0	-0,6
3	13,15	0,0	0,0	-0,6
3	12,70	0,0	0,0	-0,7
4	12,70	0,0	0,0	-0,7
4	12,65	0,0	0,0	-0,7
5	12,65	0,0	0,0	-0,7
5	12,32	-0,1	-0,9	-0,7
6	12,32	-0,1	-0,9	-0,7
6	12,20	-0,3	-1,2	-0,7
7	12,20	-0,3	-1,2	-0,7
7	12,15	-0,3	-1,4	-0,7
8	12,15	-0,3	-1,4	-0,7
8	11,77	-1,0	-2,0	-0,7
9	11,77	-1,0	-2,0	-0,7
9	11,38	-1,8	-2,2	**-0,8**
10	11,38	-1,8	-2,2	**-0,8**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
10	11,00	-2,6	-1,9	**-0,8**
11	11,00	-2,6	-1,9	**-0,8**
11	10,84	-2,9	-1,6	**-0,8**
12	10,84	-2,9	-1,6	**-0,8**
12	10,75	-3,0	-1,4	**-0,8**
13	10,75	-3,0	-1,4	**-0,8**
13	10,28	**-3,3**	0,1	**-0,8**
14	10,28	**-3,3**	0,1	**-0,8**
14	9,80	-2,8	2,4	-0,7
15	9,80	-2,8	2,4	-0,7
15	9,43	-2,1	1,4	-0,7
16	9,43	-2,1	1,4	-0,7
16	9,05	-1,6	1,1	-0,6
17	9,05	-1,6	1,1	-0,6
17	9,00	-1,6	1,2	-0,6
18	9,00	-1,6	1,2	-0,6
18	8,75	-1,2	1,7	-0,6
19	8,75	-1,2	1,7	-0,6
19	8,38	-0,3	3,4	-0,5
20	8,38	-0,3	3,4	-0,5
20	8,00	1,4	**5,9**	-0,5
21	8,00	1,4	**5,9**	-0,5
21	7,52	3,0	1,3	-0,4
22	7,52	3,0	1,3	-0,4
22	7,03	3,0	-1,0	-0,3
23	7,03	3,0	-1,0	-0,3
23	6,55	2,3	-1,7	-0,3
24	6,55	2,3	-1,7	-0,3
24	6,07	1,4	-1,6	-0,3
25	6,07	1,4	-1,6	-0,3
25	5,58	0,7	-1,2	-0,3
26	5,58	0,7	-1,2	-0,3
26	5,10	0,3	-0,6	-0,3
27	5,10	0,3	-0,6	-0,3
27	4,62	0,1	-0,2	-0,3
28	4,62	0,1	-0,2	-0,3
28	4,13	0,0	0,0	-0,3
29	4,13	0,0	0,0	-0,3
29	3,65	0,0	0,0	-0,3
Max		**-3,3**	**5,9**	**-0,8**
Max, minor nodes incl.		-3,3	5,9	-0,8

8.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	P		0,00	0,00	A	
5	12,32	4,61	0,00	1	13	1,63	0,00	1	
6	12,32	4,61	0,00	1	18	1,63	0,00	1	
6	12,20	5,54	0,00	1	16	2,98	0,00	1	
7	12,20	5,54	0,00	1	17	2,98	0,00	1	
7	12,15	5,93	0,00	1	16	3,54	0,00	1	
8	12,15	5,94	0,00	1	17	3,54	0,00	1	
8	11,77	8,89	0,00	1	15	7,84	0,00	1	
9	11,77	8,94	0,00	1	16	7,84	0,00	1	

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* [%]
9	11,38	11,88	0,00	1	15	12,16	0,00	1	
10	11,38	11,99	0,00	1	15	12,16	0,00	1	
10	11,00	14,91	0,00	1	15	16,51	0,00	1	
11	11,00	15,02	0,00	1	15	16,51	0,00	1	
11	10,84	16,27	0,00	1	15	18,39	0,00	1	
12	10,84	16,33	0,00	1	15	18,39	0,00	1	
12	10,75	16,97	0,00	1	15	19,36	0,00	1	
13	10,75	17,13	0,00	1	18	19,36	0,00	1	
13	10,28	20,68	0,00	1	17	24,85	0,00	1	
14	10,28	21,05	0,00	1	21	24,85	0,00	1	
14	9,80	24,54	0,00	1	21	30,41	0,00	1	
15	9,80	24,46	0,00	1	13	20,69	0,00	1	
15	9,43	26,27	0,00	1	12	24,74	0,00	1	
16	9,43	26,69	0,00	1	13	24,74	0,00	1	
16	9,05	28,43	0,00	1	12	28,88	0,00	1	
17	9,05	28,70	0,00	1	12	28,88	0,00	1	
17	9,00	28,93	0,00	1	12	29,23	0,49	1	
18	9,00	29,12	0,00	1	13	29,23	0,49	1	
18	8,75	30,25	0,00	1	12	30,99	2,94	1	
19	8,75	30,45	0,00	1	18	30,99	2,94	1	
19	8,38	31,02	3,68	1	17	33,67	6,62	1	
20	8,38	31,14	3,68	1	20	33,67	6,62	1	
20	8,00	31,70	7,36	1	20	36,36	10,30	1	
21	8,00	41,34	7,36	1	45	25,86	10,30	1	
21	7,52	40,46	12,10	1	42	30,86	15,04	1	
22	7,52	40,83	12,10	1	32	30,86	15,04	1	
22	7,03	40,68	16,84	1	30	35,12	19,78	1	
23	7,03	41,15	16,84	1	27	35,12	19,78	1	
23	6,55	41,75	21,58	1	26	38,64	24,52	1	
24	6,55	42,30	21,58	1	25	38,64	24,52	1	
24	6,07	43,49	26,32	1	25	41,59	29,27	1	
25	6,07	44,12	26,32	1	24	41,59	29,27	1	
25	5,58	45,68	31,07	1	24	44,17	34,01	1	
26	5,58	46,37	31,07	1	23	44,17	34,01	1	
26	5,10	48,15	35,81	1	23	46,56	38,75	1	
27	5,10	48,88	35,81	1	23	46,56	38,75	1	
27	4,62	50,77	40,55	1	23	48,87	43,49	1	
28	4,62	51,53	40,55	1	23	48,87	43,49	1	
28	4,13	53,47	45,29	1	23	51,17	48,23	1	
29	4,13	54,26	45,29	1	22	51,17	48,23	1	
29	3,65	56,23	50,03	1	22	53,45	52,97	1	

*

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

8.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	290,6	275,1
Water	127,6	143,0
Total	418,2	418,2

Considered as passive side	Left
Maximum passive effective resistance	1370,04 kN
Mobilized passive effective resistance	290,58 kN
Percentage mobilized resistance	21,2 %

8.7.5 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	-59,86
Vertical force passive	62,29
Resulting vertical force (no dead weight)	2,43
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-59,86
Vertical force passive	62,29
Resulting vertical force (no dead weight)	2,43
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

8.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	9,52	12,65	19	-10,13
9,80	20	17,24	9,80	20	-17,50
8,00	32	35,53	8,00	32	-32,23

9 Step 6.4 Stage 1: Aanleg

9.1 Input Data Left

9.1.1 Calculation Method

Calculation method: C, phi, delta

9.1.2 Water Level

Water level: 8,75 [m]

9.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

9.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

9.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

9.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	18,3	0,00	0,41	6,16
2	12,26	0,0	30,6	0,00	0,41	4,36
3	12,18	0,0	35,3	0,00	0,41	4,13
4	11,96	1,6	47,1	0,13	0,42	3,79
5	11,57	5,3	68,1	0,27	0,42	3,53
6	11,19	8,0	89,1	0,31	0,42	3,41
7	10,92	10,0	104,1	0,32	0,43	3,37
8	10,79	10,9	110,9	0,33	0,43	3,35
9	10,51	13,0	107,4	0,34	0,43	2,83
10	10,04	16,4	109,3	0,36	0,44	2,37
11	9,61	17,0	201,6	0,32	0,35	3,77
12	9,24	19,1	220,2	0,32	0,36	3,69
13	9,03	20,3	231,7	0,32	0,36	3,66
14	8,88	21,1	238,8	0,32	0,36	3,63
15	8,56	22,4	177,6	0,32	0,37	2,55
16	8,19	23,6	157,8	0,32	0,37	2,17
17	7,76	26,2	93,9	0,34	0,36	1,23
18	7,28	27,9	132,8	0,35	0,37	1,65
19	6,79	29,5	156,1	0,35	0,37	1,85
20	6,31	31,3	173,4	0,35	0,38	1,96
21	5,83	32,8	189,1	0,35	0,39	2,04
22	5,34	34,0	204,1	0,35	0,40	2,12
23	4,86	35,2	218,0	0,35	0,40	2,17
24	4,38	36,4	232,0	0,35	0,41	2,22
25	3,89	37,5	246,3	0,35	0,42	2,27

9.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	52,80
32	200,08

9.4 Input Data Right

9.4.1 Calculation Method

Calculation method: C, phi, delta

9.4.2 Water Level

Water level: 9,05 [m]

9.4.3 Surface

X [m]	Y [m]
0,00	12,65

9.4.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

9.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

9.5 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	12,48	0,0	18,3	0,00	0,64	6,16
2	12,26	0,0	30,6	0,00	0,64	4,36
3	12,18	0,0	35,3	0,00	0,64	4,13
4	11,96	1,6	47,1	0,12	0,64	3,79
5	11,57	5,3	68,1	0,27	0,64	3,52
6	11,19	8,0	89,1	0,31	0,64	3,39
7	10,92	10,0	104,1	0,32	0,64	3,34
8	10,79	10,9	110,9	0,33	0,64	3,32
9	10,51	13,0	126,2	0,34	0,64	3,28
10	10,04	16,4	152,2	0,35	0,64	3,24
11	9,61	17,0	263,1	0,31	0,54	4,81
12	9,24	19,1	291,7	0,31	0,54	4,75
13	9,03	20,2	307,9	0,31	0,54	4,73
14	8,88	20,7	314,7	0,31	0,54	4,73
15	8,56	21,7	329,1	0,31	0,54	4,72
16	8,19	22,9	346,6	0,31	0,54	4,71
17	7,76	25,5	292,6	0,33	0,53	3,75
18	7,28	27,1	310,3	0,33	0,53	3,74
19	6,79	28,8	328,1	0,33	0,53	3,74
20	6,31	30,4	346,0	0,33	0,53	3,73
21	5,83	32,0	364,0	0,33	0,53	3,73
22	5,34	33,6	382,0	0,33	0,53	3,72
23	4,86	35,3	400,1	0,33	0,53	3,72
24	4,38	36,9	418,2	0,33	0,53	3,72
25	3,89	38,5	436,4	0,33	0,53	3,72

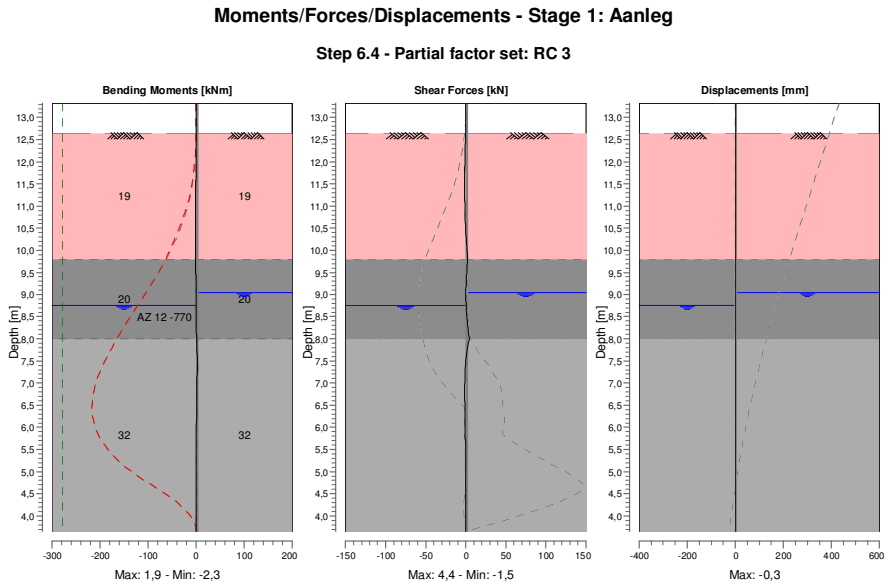
9.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	52,02
32	182,90

9.7 Calculation Results

Number of iterations: 3

9.7.1 Charts of Moments, Forces and Displacements



9.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	-0,1
1	13,20	0,0	0,0	-0,1
2	13,20	0,0	0,0	-0,1
2	13,15	0,0	0,0	-0,1
3	13,15	0,0	0,0	-0,1
3	12,70	0,0	0,0	-0,2
4	12,70	0,0	0,0	-0,2
4	12,65	0,0	0,0	-0,2
5	12,65	0,0	0,0	-0,2
5	12,32	-0,1	-0,7	-0,2
6	12,32	-0,1	-0,7	-0,2
6	12,20	-0,2	-0,9	-0,2
7	12,20	-0,2	-0,9	-0,2
7	12,15	-0,2	-1,0	-0,2
8	12,15	-0,2	-1,0	-0,2
8	11,77	-0,7	-1,4	-0,2
9	11,77	-0,7	-1,4	-0,2
9	11,38	-1,3	-1,5	**-0,3**
10	11,38	-1,3	-1,5	**-0,3**

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
10	11,00	-1,8	-1,2	**-0,3**
11	11,00	-1,8	-1,2	**-0,3**
11	10,84	-2,0	-1,0	**-0,3**
12	10,84	-2,0	-1,0	**-0,3**
12	10,75	-2,1	-0,8	**-0,3**
13	10,75	-2,1	-0,8	**-0,3**
13	10,28	**-2,2**	0,5	**-0,3**
14	10,28	**-2,2**	0,5	**-0,3**
14	9,80	-1,6	2,5	**-0,3**
15	9,80	-1,6	2,5	**-0,3**
15	9,43	-1,0	0,9	**-0,3**
16	9,43	-1,0	0,9	**-0,3**
16	9,05	-0,8	0,2	-0,2
17	9,05	-0,8	0,2	-0,2
17	9,00	-0,8	0,2	-0,2
18	9,00	-0,8	0,2	-0,2
18	8,75	-0,7	0,5	-0,2
19	8,75	-0,7	0,5	-0,2
19	8,38	-0,3	2,0	-0,2
20	8,38	-0,3	2,0	-0,2
20	8,00	0,9	**4,4**	-0,2
21	8,00	0,9	**4,4**	-0,2
21	7,52	1,9	0,2	-0,1
22	7,52	1,9	0,2	-0,1
22	7,03	1,5	-1,2	-0,1
23	7,03	1,5	-1,2	-0,1
23	6,55	0,9	-1,3	-0,1
24	6,55	0,9	-1,3	-0,1
24	6,07	0,3	-0,8	-0,1
25	6,07	0,3	-0,8	-0,1
25	5,58	0,0	-0,4	-0,1
26	5,58	0,0	-0,4	-0,1
26	5,10	-0,1	0,0	-0,1
27	5,10	-0,1	-0,1	-0,1
27	4,62	-0,1	0,1	-0,1
28	4,62	-0,1	0,1	-0,1
28	4,13	0,0	0,1	-0,1
29	4,13	0,0	0,1	-0,1
29	3,65	0,0	0,0	-0,1
Max		**-2,2**	**4,4**	**-0,3**
Max, minor nodes incl.		-2,3	4,4	-0,3

9.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	P		0,00	0,00	A	
5	12,32	4,15	0,00	1	11	2,09	0,00	1	
6	12,32	4,16	0,00	1	16	2,09	0,00	1	
6	12,20	5,14	0,00	1	15	3,37	0,00	1	
7	12,20	5,15	0,00	1	15	3,37	0,00	1	
7	12,15	5,56	0,00	1	15	3,91	0,00	1	
8	12,15	5,57	0,00	1	16	3,91	0,00	1	
8	11,77	8,71	0,00	1	14	8,02	0,00	1	
9	11,77	8,76	0,00	1	16	8,02	0,00	1	

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* [%]
9	11,38	11,87	0,00	1	15	12,17	0,00	1	
10	11,38	11,97	0,00	1	15	12,17	0,00	1	
10	11,00	15,03	0,00	1	15	16,38	0,00	1	
11	11,00	15,15	0,00	1	15	16,38	0,00	1	
11	10,84	16,45	0,00	1	15	18,22	0,00	1	
12	10,84	16,51	0,00	1	15	18,22	0,00	1	
12	10,75	17,17	0,00	1	15	19,17	0,00	1	
13	10,75	17,33	0,00	1	18	19,17	0,00	1	
13	10,28	20,94	0,00	1	18	24,58	0,00	1	
14	10,28	21,32	0,00	1	21	24,58	0,00	1	
14	9,80	24,80	0,00	1	21	30,15	0,00	1	
15	9,80	25,24	0,00	1	13	19,91	0,00	1	
15	9,43	26,94	0,00	1	13	24,07	0,00	1	
16	9,43	27,36	0,00	1	13	24,07	0,00	1	
16	9,05	28,95	0,00	1	12	28,35	0,00	1	
17	9,05	29,22	0,00	1	13	28,35	0,00	1	
17	9,00	29,43	0,00	1	13	28,72	0,49	1	
18	9,00	29,63	0,00	1	13	28,72	0,49	1	
18	8,75	30,64	0,00	1	12	30,60	2,94	1	
19	8,75	30,84	0,00	1	18	30,60	2,94	1	
19	8,38	31,21	3,68	1	17	33,48	6,62	1	
20	8,38	31,33	3,68	1	20	33,48	6,62	1	
20	8,00	31,66	7,36	1	20	36,39	10,30	1	
21	8,00	41,24	7,36	1	45	25,97	10,30	1	
21	7,52	39,71	12,10	1	41	31,61	15,04	1	
22	7,52	40,08	12,10	1	31	31,61	15,04	1	
22	7,03	39,85	16,84	1	29	35,95	19,78	1	
23	7,03	40,32	16,84	1	26	35,95	19,78	1	
23	6,55	41,21	21,58	1	26	39,17	24,52	1	
24	6,55	41,77	21,58	1	25	39,17	24,52	1	
24	6,07	43,33	26,32	1	24	41,74	29,27	1	
25	6,07	43,96	26,32	1	24	41,74	29,27	1	
25	5,58	45,81	31,07	1	24	44,05	34,01	1	
26	5,58	46,49	31,07	1	23	44,05	34,01	1	
26	5,10	48,40	35,81	1	23	46,31	38,75	1	
27	5,10	49,13	35,81	1	23	46,31	38,75	1	
27	4,62	51,02	40,55	1	23	48,63	43,49	1	
28	4,62	51,78	40,55	1	23	48,63	43,49	1	
28	4,13	53,65	45,29	1	23	50,99	48,23	1	
29	4,13	54,44	45,29	1	23	50,99	48,23	1	
29	3,65	56,32	50,03	1	22	53,36	52,97	1	

*

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

9.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	290,6	275,1
Water	127,6	143,0
Total	418,1	418,1

Considered as passive side	Left
Maximum passive effective resistance	1370,04 kN
Mobilized passive effective resistance	290,55 kN
Percentage mobilized resistance	21,2 %

9.7.5 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	-59,73
Vertical force passive	62,40
Resulting vertical force (no dead weight)	2,67
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-59,73
Vertical force passive	62,40
Resulting vertical force (no dead weight)	2,67
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

9.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	9,50	12,65	19	-10,13
9,80	20	17,50	9,80	20	-17,24
8,00	32	35,40	8,00	32	-32,36

10 Step 6.5 Stage 1: Aanleg

10.1 Input Data Left

10.1.1 Calculation Method

Calculation method: C, phi, delta

10.1.2 Water Level

Water level: 9,00 [m]

10.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

10.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

10.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

10.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	27,2	0,00	0,35	9,17
2	12,23	0,0	44,9	0,00	0,35	6,01
3	11,96	0,0	64,4	0,00	0,35	5,18
4	11,57	2,2	91,3	0,12	0,36	4,74
5	11,19	5,8	118,3	0,22	0,36	4,54
6	10,80	8,2	126,2	0,25	0,37	3,83
7	10,40	10,7	128,0	0,27	0,37	3,20
8	10,00	13,2	136,8	0,28	0,38	2,92
9	9,60	14,5	235,2	0,27	0,28	4,38
10	9,20	16,5	258,9	0,27	0,29	4,29
11	8,83	17,9	234,6	0,27	0,29	3,60
12	8,50	18,8	162,4	0,28	0,29	2,38
13	8,17	19,7	173,3	0,28	0,29	2,44
14	7,76	21,2	128,8	0,28	0,29	1,73
15	7,28	22,6	168,4	0,29	0,29	2,14
16	6,79	23,9	193,2	0,29	0,30	2,34
17	6,31	25,3	213,4	0,29	0,30	2,46
18	5,83	26,6	232,6	0,29	0,31	2,57
19	5,34	28,2	250,8	0,30	0,32	2,65
20	4,86	29,3	268,8	0,30	0,33	2,73
21	4,38	30,3	287,3	0,30	0,33	2,81
22	3,89	31,2	306,3	0,29	0,34	2,88

10.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	42,80
32	163,02

10.4 Input Data Right

10.4.1 Calculation Method

Calculation method: C, phi, delta

10.4.2 Water Level

Water level: 9,00 [m]

10.4.3 Surface

X [m]	Y [m]
0,00	12,65

10.4.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

10.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

10.5 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	12,48	0,0	27,2	0,00	0,58	9,17
2	12,23	0,0	44,9	0,00	0,58	6,01
3	11,96	0,0	64,4	0,00	0,58	5,17
4	11,57	2,2	91,3	0,12	0,58	4,72
5	11,19	5,8	118,3	0,22	0,58	4,51
6	10,80	8,2	145,9	0,25	0,58	4,38
7	10,40	10,7	174,0	0,26	0,58	4,30
8	10,00	13,2	202,2	0,28	0,58	4,24
9	9,60	14,5	315,2	0,26	0,47	5,74
10	9,20	16,5	354,4	0,27	0,47	5,71
11	8,83	17,9	383,8	0,27	0,47	5,69
12	8,50	18,8	402,7	0,27	0,47	5,69
13	8,17	19,7	421,7	0,27	0,47	5,68
14	7,76	21,2	383,8	0,27	0,46	4,90
15	7,28	22,6	407,6	0,27	0,46	4,89
16	6,79	23,9	431,4	0,27	0,46	4,89
17	6,31	25,3	455,3	0,27	0,46	4,89
18	5,83	26,6	479,2	0,27	0,46	4,89
19	5,34	27,9	503,1	0,27	0,46	4,89
20	4,86	29,3	527,1	0,27	0,46	4,88
21	4,38	30,6	551,0	0,27	0,46	4,88
22	3,89	32,0	575,0	0,27	0,46	4,88

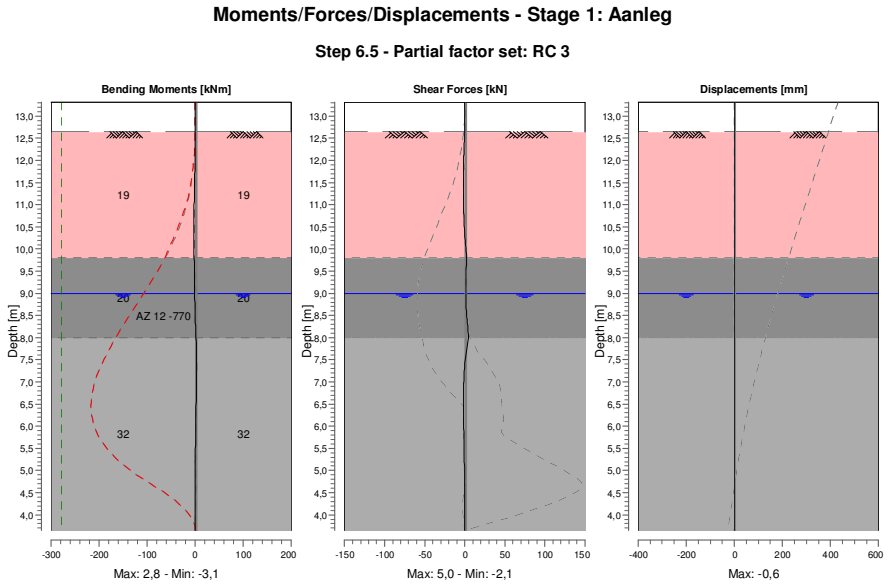
10.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	45,31
32	158,01

10.7 Calculation Results

Number of iterations: 2

10.7.1 Charts of Moments, Forces and Displacements



10.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	-0,4
1	13,15	0,0	0,0	-0,4
2	13,15	0,0	0,0	-0,4
2	12,90	0,0	0,0	-0,5
3	12,90	0,0	0,0	-0,5
3	12,65	0,0	0,0	-0,5
4	12,65	0,0	0,0	-0,5
4	12,32	-0,1	-0,9	-0,5
5	12,32	-0,1	-0,9	-0,5
5	12,15	-0,3	-1,3	-0,5
6	12,15	-0,3	-1,3	-0,5
6	11,77	-0,9	-1,9	**-0,6**
7	11,77	-0,9	-1,9	**-0,6**
7	11,38	-1,7	-2,1	**-0,6**
8	11,38	-1,7	-2,1	**-0,6**
8	11,00	-2,5	-1,7	**-0,6**
9	11,00	-2,5	-1,7	**-0,6**
9	10,60	-3,0	-0,9	**-0,6**
10	10,60	-3,0	-0,9	**-0,6**
10	10,20	**-3,1**	0,5	**-0,6**
11	10,20	**-3,1**	0,5	**-0,6**
11	9,80	-2,5	2,5	**-0,6**
12	9,80	-2,5	2,5	**-0,6**
12	9,40	-1,7	1,5	-0,5
13	9,40	-1,7	1,5	-0,5
13	9,00	-1,2	1,4	-0,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	-1,2	1,4	-0,5
14	8,67	-0,7	1,9	-0,4
15	8,67	-0,7	1,9	-0,4
15	8,33	0,2	3,2	-0,4
16	8,33	0,2	3,1	-0,4
16	8,00	1,5	**5,0**	-0,3
17	8,00	1,5	**5,0**	-0,3
17	7,52	2,8	0,7	-0,3
18	7,52	2,8	0,7	-0,3
18	7,03	2,6	-1,2	-0,2
19	7,03	2,6	-1,2	-0,2
19	6,55	1,8	-1,7	-0,2
20	6,55	1,8	-1,7	-0,2
20	6,07	1,0	-1,4	-0,2
21	6,07	1,0	-1,4	-0,2
21	5,58	0,4	-0,9	-0,2
22	5,58	0,4	-0,9	-0,2
22	5,10	0,1	-0,4	-0,2
23	5,10	0,1	-0,4	-0,2
23	4,62	0,0	-0,1	-0,2
24	4,62	0,0	-0,1	-0,2
24	4,13	0,0	0,1	-0,2
25	4,13	0,0	0,1	-0,2
25	3,65	0,0	0,0	-0,2
Max		**-3,1**	**5,0**	**-0,6**
Max, minor nodes incl.		-3,1	5,0	-0,6

10.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,15	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
2	12,90	0,00	0,00	-		0,00	0,00	-	
3	12,90	0,00	0,00	-		0,00	0,00	-	
3	12,65	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	P		0,00	0,00	A	
4	12,32	4,18	0,00	1	8	1,34	0,00	1	
5	12,32	4,18	0,00	1	12	1,34	0,00	1	
5	12,15	5,32	0,00	1	10	3,05	0,00	1	
6	12,15	5,34	0,00	1	11	3,05	0,00	1	
6	11,77	7,90	0,00	1	10	6,91	0,00	1	
7	11,77	7,95	0,00	1	11	6,91	0,00	1	
7	11,38	10,50	0,00	1	10	10,79	0,00	1	
8	11,38	10,60	0,00	1	10	10,79	0,00	1	
8	11,00	13,13	0,00	1	10	14,70	0,00	1	
9	11,00	13,29	0,00	1	12	14,70	0,00	1	
9	10,60	15,89	0,00	1	11	18,84	0,00	1	
10	10,60	16,12	0,00	1	14	18,84	0,00	1	
10	10,20	18,67	0,00	1	13	23,04	0,00	1	
11	10,20	18,99	0,00	1	15	23,04	0,00	1	
11	9,80	21,49	0,00	1	15	27,32	0,00	1	
12	9,80	20,97	0,00	1	10	17,20	0,00	1	
12	9,40	22,36	0,00	1	9	21,10	0,00	1	
13	9,40	22,79	0,00	1	9	21,10	0,00	1	
13	9,00	24,09	0,00	1	9	25,12	0,00	1	
14	9,00	24,32	0,00	1	11	25,12	0,00	1	
14	8,67	24,59	3,27	1	10	27,31	3,27	1	
15	8,67	24,62	3,27	1	15	27,31	3,27	1	
15	8,33	24,84	6,54	1	15	29,52	6,54	1	
16	8,33	24,94	6,54	1	15	29,52	6,54	1	
16	8,00	25,17	9,81	1	14	31,73	9,81	1	

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	8,00	34,01	9,81	1	27	21,97	9,81	1	
17	7,52	32,70	14,55	1	25	26,74	14,55	1	
18	7,52	33,05	14,55	1	20	26,74	14,55	1	
18	7,03	32,61	19,29	1	19	30,64	19,29	1	
19	7,03	33,06	19,29	1	18	30,64	19,29	1	
19	6,55	33,45	24,03	1	17	33,72	24,03	1	
20	6,55	33,98	24,03	1	16	33,72	24,03	1	
20	6,07	34,98	28,78	1	16	36,21	28,78	1	
21	6,07	35,58	28,78	1	16	36,21	28,78	1	
21	5,58	36,94	33,52	1	16	38,36	33,52	1	
22	5,58	37,59	33,52	1	15	38,36	33,52	1	
22	5,10	39,13	38,26	1	15	40,35	38,26	1	
23	5,10	39,82	38,26	1	15	40,35	38,26	1	
23	4,62	41,43	43,00	1	15	42,30	43,00	1	
24	4,62	42,16	43,00	1	15	42,30	43,00	1	
24	4,13	43,80	47,74	1	15	44,25	47,74	1	
25	4,13	44,55	47,74	1	15	44,25	47,74	1	
25	3,65	46,22	52,48	1	15	46,21	52,48	1	

*

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

10.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	239,1	239,1
Water	140,4	140,4
Total	379,5	379,5

Considered as passive side	Left
Maximum passive effective resistance	1656,47 kN
Mobilized passive effective resistance	239,10 kN
Percentage mobilized resistance	14,4 %

10.7.5 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	-61,02
Vertical force passive	60,32
Resulting vertical force (no dead weight)	-0,70
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

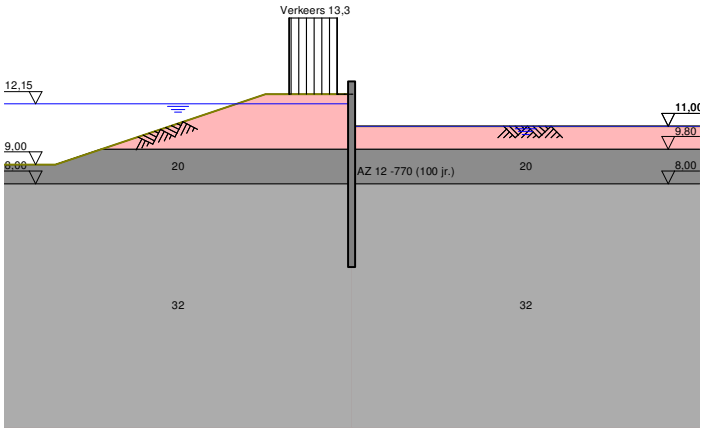
Vertical force balance plugged	Force [kN]
Vertical force active	-61,02
Vertical force passive	60,32
Resulting vertical force (no dead weight)	-0,70
Vertical toe capacity Ftoe;d	0,00
Vertical toe capacity is not sufficient (1 > 0)	

10.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	9,97	12,65	19	-10,72
9,80	20	16,71	9,80	20	-17,69
8,00	32	33,64	8,00	32	-32,61

11 Outline Stage 2: MHW

Outline - Stage 2: MHW

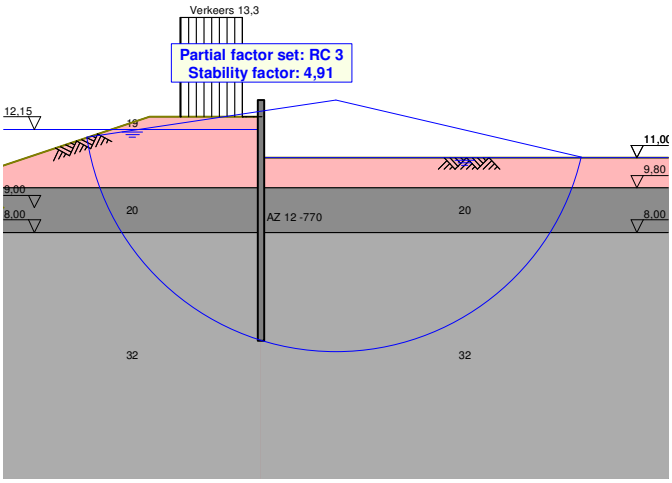


12 Overall Stability Stage 2: MHW

Stability factor : 4,91

12.1 Overall Stability

Overall Stability - Stage 2: MHW



13 Step 6.1 Stage 2: MHW

13.1 Input Data Left

13.1.1 Calculation Method

Calculation method: C, phi, delta

13.1.2 Water Level

Water level: 12,20 [m]

13.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

13.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

13.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

13.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

13.2 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	12,48	0,0	18,3	0,00	1,54	6,01
2	12,26	0,0	33,3	0,00	1,27	4,29
3	12,18	0,0	46,4	0,00	1,19	4,89
4	11,96	3,1	98,8	0,25	1,01	7,83
5	11,57	8,3	67,5	0,46	0,75	3,71
6	11,19	10,1	38,4	0,44	0,60	1,67
7	10,92	11,2	41,3	0,43	0,53	1,59
8	10,79	11,7	42,7	0,43	0,50	1,56
9	10,51	12,7	45,6	0,42	0,46	1,52
10	10,04	14,4	50,7	0,42	0,42	1,49
11	9,61	15,6	145,0	0,41	0,41	3,84
12	9,24	16,9	94,3	0,41	0,41	2,29
13	9,03	17,6	98,8	0,41	0,41	2,29
14	8,88	17,0	101,7	0,38	0,38	2,29
15	8,56	17,1	107,9	0,36	0,36	2,29
16	8,19	17,3	117,8	0,34	0,34	2,34
17	7,76	18,4	82,7	0,34	0,34	1,53
18	7,28	18,9	113,8	0,33	0,35	1,96
19	6,79	19,3	130,8	0,31	0,36	2,11
20	6,31	20,0	145,6	0,30	0,37	2,21
21	5,83	20,7	160,0	0,30	0,38	2,28
22	5,34	22,4	174,9	0,30	0,40	2,36
23	4,86	24,1	190,0	0,31	0,41	2,43
24	4,38	25,9	205,6	0,31	0,42	2,50
25	3,89	28,0	221,0	0,32	0,42	2,56

13.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	30,23
32	125,81

13.4 Input Data Right

13.4.1 Calculation Method

Calculation method: C, phi, delta

13.4.2 Water Level

Water level: 11,00 [m]

13.4.3 Surface

X [m]	Y [m]
0,00	10,84

13.4.4 Soil Material Properties in Profile: 54O_kelder (MHW)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	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]
19	15,00	n.a.	n.a.	n.a.	0,00	4,51
20	9,80	n.a.	n.a.	n.a.	4,51	11,28
32	8,00	n.a.	n.a.	n.a.	11,28	11,28

13.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

13.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	10,4	0,00	0,64	4,66
4	9,61	0,0	25,4	0,00	0,54	4,91
5	9,24	0,0	36,1	0,00	0,54	4,76
6	9,03	0,0	42,3	0,00	0,54	4,73
7	8,88	0,0	46,8	0,00	0,54	4,72
8	8,56	3,4	56,2	0,28	0,54	4,71
9	8,19	4,4	67,4	0,31	0,54	4,70
10	7,76	5,9	67,6	0,33	0,53	3,76
11	7,28	7,5	85,8	0,33	0,53	3,74
12	6,79	9,1	103,9	0,33	0,53	3,73
13	6,31	10,8	122,0	0,33	0,53	3,72
14	5,83	12,4	140,2	0,33	0,53	3,72
15	5,34	14,0	158,4	0,33	0,53	3,72
16	4,86	15,6	176,6	0,33	0,53	3,71
17	4,38	17,2	194,8	0,33	0,53	3,71

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
18	3,89	18,8	213,1	0,33	0,53	3,71

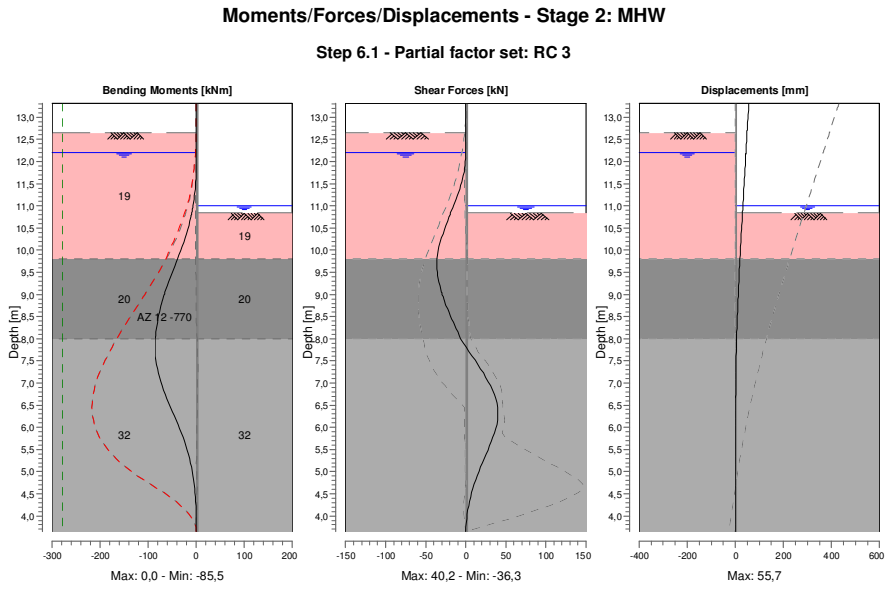
13.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	66,82
32	134,40

13.7 Calculation Results

Number of iterations: 6

13.7.1 Charts of Moments, Forces and Displacements



13.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**55,7**
1	13,20	0,0	0,0	54,5
2	13,20	0,0	0,0	54,5
2	13,15	0,0	0,0	53,9
3	13,15	0,0	0,0	53,9
3	12,70	0,0	0,0	49,2
4	12,70	0,0	0,0	49,2
4	12,65	0,0	0,0	48,7
5	12,65	0,0	0,0	48,7
5	12,32	0,0	0,0	45,2
6	12,32	0,0	0,0	45,2
6	12,20	0,0	0,0	43,9
7	12,20	0,0	0,0	43,9
7	12,15	0,0	0,0	43,4
8	12,15	0,0	0,0	43,4

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
8	11,77	-0,3	-2,1	39,4
9	11,77	-0,3	-2,1	39,4
9	11,38	-2,1	-7,7	35,3
10	11,38	-2,1	-7,7	35,3
10	11,00	-6,5	-15,3	31,3
11	11,00	-6,5	-15,3	31,3
11	10,84	-9,3	-19,1	29,6
12	10,84	-9,3	-19,1	29,6
12	10,75	-11,0	-20,8	28,7
13	10,75	-11,0	-20,8	28,7
13	10,28	-23,2	-30,6	23,8
14	10,28	-23,2	-30,6	23,8
14	9,80	-39,3	-36,2	19,1
15	9,80	-39,3	-36,2	19,1
15	9,43	-52,7	-34,9	15,6
16	9,43	-52,7	-34,9	15,6
16	9,05	-65,0	-30,1	12,4
17	9,05	-65,0	-30,1	12,4
17	9,00	-66,5	-29,3	12,0
18	9,00	-66,5	-29,3	12,0
18	8,75	-73,3	-24,5	10,0
19	8,75	-73,3	-24,5	10,0
19	8,38	-80,8	-15,6	7,4
20	8,38	-80,8	-15,6	7,4
20	8,00	**-84,9**	-6,5	5,2
21	8,00	**-84,9**	-6,5	5,2
21	7,52	-83,7	11,6	2,9
22	7,52	-83,7	11,7	2,9
22	7,03	-74,0	28,1	1,4
23	7,03	-74,0	28,1	1,4
23	6,55	-57,3	**38,9**	0,4
24	6,55	-57,3	**38,9**	0,4
24	6,07	-38,1	38,8	-0,1
25	6,07	-38,1	38,8	-0,1
25	5,58	-21,3	29,8	-0,3
26	5,58	-21,3	29,7	-0,3
26	5,10	-9,7	18,6	-0,2
27	5,10	-9,7	18,6	-0,2
27	4,62	-3,2	9,0	-0,2
28	4,62	-3,2	9,0	-0,2
28	4,13	-0,5	2,7	0,0
29	4,13	-0,5	2,7	0,0
29	3,65	0,0	0,0	0,1
Max		**-84,9**	**38,9**	**55,7**
Max, minor nodes incl.		-85,5	40,2	55,7

13.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	A		0,00	0,00	-	
5	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,20	0,00	0,00	A		0,00	0,00	-	
7	12,20	0,00	0,00	A		0,00	0,00	-	

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* [%]
7	12,15	0,00	0,49	A		0,00	0,00	-	
8	12,15	2,42	0,49	A		0,00	0,00	-	
8	11,77	3,80	4,25	A		0,00	0,00	-	
9	11,77	7,09	4,25	A		0,00	0,00	-	
9	11,38	9,50	8,01	A		0,00	0,00	-	
10	11,38	9,08	8,01	A		0,00	0,00	-	
10	11,00	11,05	11,77	A		0,00	0,00	-	
11	11,00	10,82	11,77	A		0,00	0,00	-	
11	10,84	11,57	13,39	A		0,00	1,62	-	
12	10,84	11,49	13,39	A		0,00	5,23	P	
12	10,75	11,86	14,22	A		0,00	6,14	P	
13	10,75	11,75	14,22	A		0,00	6,14	P	
13	10,28	13,59	18,88	A		0,00	11,21	P	
14	10,28	13,56	18,88	A		2,28	11,21	P	
14	9,80	15,17	23,54	A		16,67	16,28	3	90
15	9,80	14,89	23,54	A	11	19,48	16,28	P	
15	9,43	16,35	27,22	A	11	31,32	21,37	P	
16	9,43	16,17	27,22	A	18	30,35	21,37	P	
16	9,05	17,55	30,90	A	18	37,86	26,46	3	91
17	9,05	17,47	30,90	A	18	37,70	26,46	3	91
17	9,00	17,65	31,39	A	18	38,39	27,14	3	89
18	9,00	16,62	31,39	A	17	38,33	27,14	3	89
18	8,75	17,46	33,84	A	17	41,93	30,53	3	83
19	8,75	16,52	33,84	A	16	42,03	30,53	3	83
19	8,38	17,69	37,52	A	16	43,31	35,62	2	70
20	8,38	16,75	37,52	A	15	43,37	35,62	2	70
20	8,00	17,85	41,20	A	15	41,94	40,71	2	57
21	8,00	17,73	41,20	A	22	53,65	40,71	3	92
21	7,52	19,11	45,94	A	22	57,14	45,45	2	74
22	7,52	18,23	45,94	A		57,01	45,45	2	74
22	7,03	19,54	50,69	A		50,63	50,19	2	53
23	7,03	18,70	50,69	A		50,53	50,19	2	53
23	6,55	19,95	55,43	A		30,34	54,93	1	27
24	6,55	19,34	55,43	A		30,34	54,93	1	27
24	6,07	27,81	60,17	1	19	16,63	59,68	1	
25	6,07	28,57	60,17	1	18	16,63	59,68	1	
25	5,58	35,49	64,91	1	22	13,59	64,42	1	
26	5,58	36,26	64,91	1	21	13,59	64,42	1	
26	5,10	37,73	69,65	1	21	16,34	69,16	1	
27	5,10	38,50	69,65	1	21	16,34	69,16	1	
27	4,62	37,46	74,39	1	19	21,65	73,90	1	
28	4,62	38,22	74,39	1	19	21,65	73,90	1	
28	4,13	36,35	79,13	1	17	27,85	78,64	1	
29	4,13	37,11	79,13	1	17	27,85	78,64	1	
29	3,65	35,11	83,88	1		34,22	83,38	1	15

*

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

13.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	180,0	206,0
Water	358,6	332,5
Total	538,5	538,5

Considered as passive side	Right
Maximum passive effective resistance	698,35 kN
Mobilized passive effective resistance	206,00 kN
Percentage mobilized resistance	29,5 %

13.7.5 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	-38,32
Vertical force passive	47,13
Resulting vertical force (no dead weight)	8,81
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-38,32
Vertical force passive	47,13
Resulting vertical force (no dead weight)	8,81
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

13.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-6,04	10,84	19	1,21
9,80	20	-10,02	9,80	20	22,14
8,00	32	-22,26	8,00	32	23,78

14 Step 6.2 Stage 2: MHW

14.1 Input Data Left

14.1.1 Calculation Method

Calculation method: C, phi, delta

14.1.2 Water Level

Water level: 12,20 [m]

14.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

14.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

14.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

14.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

14.2 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	12,48	0,0	18,3	0,00	1,54	6,01
2	12,26	0,0	33,3	0,00	1,27	4,29
3	12,18	0,0	46,4	0,00	1,19	4,89
4	11,96	3,1	98,8	0,25	1,01	7,83
5	11,57	8,3	67,5	0,46	0,75	3,71
6	11,19	10,1	38,4	0,44	0,60	1,67
7	10,92	11,2	41,3	0,43	0,53	1,59
8	10,79	11,7	42,7	0,43	0,50	1,56
9	10,51	12,7	45,6	0,42	0,46	1,52
10	10,04	14,4	50,7	0,42	0,42	1,49
11	9,61	15,6	145,0	0,41	0,41	3,84
12	9,24	16,9	94,3	0,41	0,41	2,29
13	9,03	17,6	98,8	0,41	0,41	2,29
14	8,88	17,0	101,7	0,38	0,38	2,29
15	8,56	17,1	107,9	0,36	0,36	2,29
16	8,19	17,3	117,8	0,34	0,34	2,34
17	7,76	18,4	82,7	0,34	0,34	1,53
18	7,28	18,9	113,8	0,33	0,35	1,96
19	6,79	19,3	130,8	0,31	0,36	2,11
20	6,31	20,0	145,6	0,30	0,37	2,21
21	5,83	20,7	160,0	0,30	0,38	2,28
22	5,34	22,4	174,9	0,30	0,40	2,36
23	4,86	24,1	190,0	0,31	0,41	2,43
24	4,38	25,9	205,6	0,31	0,42	2,50
25	3,89	28,0	221,0	0,32	0,42	2,56

14.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	30,23
32	131,84

14.4 Input Data Right

14.4.1 Calculation Method

Calculation method: C, phi, delta

14.4.2 Water Level

Water level: 11,00 [m]

14.4.3 Surface

X [m]	Y [m]
0,00	10,84

14.4.4 Soil Material Properties in Profile: 54O_kelder (MHW)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	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]
19	15,00	n.a.	n.a.	n.a.	0,00	4,51
20	9,80	n.a.	n.a.	n.a.	4,51	11,28
32	8,00	n.a.	n.a.	n.a.	11,28	11,28

14.4.5 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]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

14.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	10,4	0,00	0,64	4,66
4	9,61	0,0	25,4	0,00	0,54	4,91
5	9,24	0,0	36,1	0,00	0,54	4,76
6	9,03	0,0	42,3	0,00	0,54	4,73
7	8,88	0,0	46,8	0,00	0,54	4,72
8	8,56	3,4	56,2	0,28	0,54	4,71
9	8,19	4,4	67,4	0,31	0,54	4,70
10	7,76	5,9	67,6	0,33	0,53	3,76
11	7,28	7,5	85,8	0,33	0,53	3,74
12	6,79	9,1	103,9	0,33	0,53	3,73
13	6,31	10,8	122,0	0,33	0,53	3,72
14	5,83	12,4	140,2	0,33	0,53	3,72
15	5,34	14,0	158,4	0,33	0,53	3,72
16	4,86	15,6	176,6	0,33	0,53	3,71
17	4,38	17,2	194,8	0,33	0,53	3,71

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
18	3,89	18,8	213,1	0,33	0,53	3,71

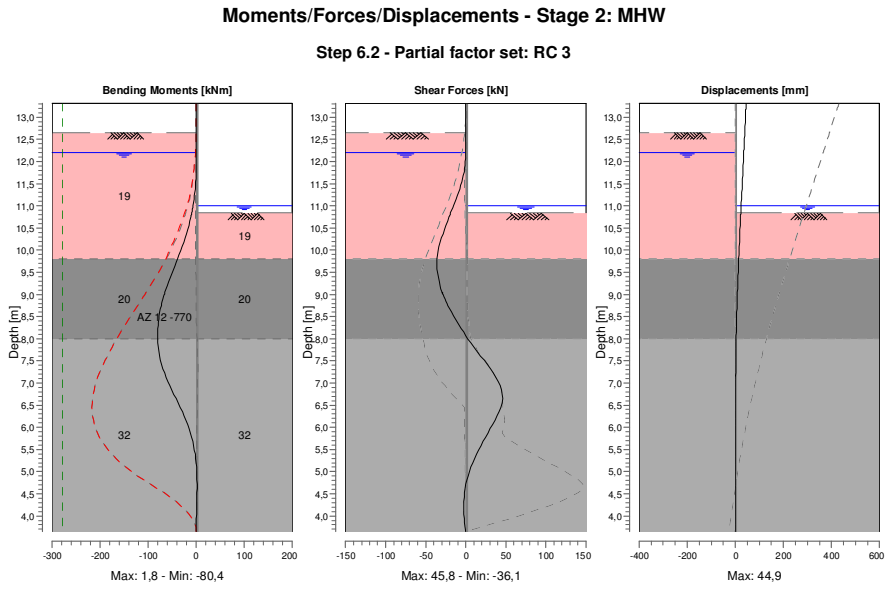
14.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	75,32
32	131,72

14.7 Calculation Results

Number of iterations: 7

14.7.1 Charts of Moments, Forces and Displacements



14.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**44,9**
1	13,20	0,0	0,0	43,9
2	13,20	0,0	0,0	43,9
2	13,15	0,0	0,0	43,4
3	13,15	0,0	0,0	43,4
3	12,70	0,0	0,0	39,4
4	12,70	0,0	0,0	39,4
4	12,65	0,0	0,0	38,9
5	12,65	0,0	0,0	38,9
5	12,32	0,0	0,0	36,0
6	12,32	0,0	0,0	36,0
6	12,20	0,0	0,0	34,9
7	12,20	0,0	0,0	34,9
7	12,15	0,0	0,0	34,5
8	12,15	0,0	0,0	34,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
8	11,77	-0,3	-2,1	31,0
9	11,77	-0,3	-2,1	31,0
9	11,38	-2,1	-7,7	27,6
10	11,38	-2,1	-7,7	27,6
10	11,00	-6,5	-15,3	24,2
11	11,00	-6,5	-15,3	24,2
11	10,84	-9,3	-19,1	22,7
12	10,84	-9,3	-19,1	22,7
12	10,75	-11,0	-20,8	22,0
13	10,75	-11,0	-20,8	22,0
13	10,28	-23,2	-30,6	17,9
14	10,28	-23,2	-30,6	17,9
14	9,80	-39,3	-36,0	13,9
15	9,80	-39,3	-36,0	13,9
15	9,43	-52,7	-34,8	11,0
16	9,43	-52,7	-34,8	11,0
16	9,05	-64,9	-29,5	8,4
17	9,05	-64,9	-29,5	8,4
17	9,00	-66,3	-28,5	8,1
18	9,00	-66,3	-28,5	8,1
18	8,75	-72,7	-22,1	6,5
19	8,75	-72,7	-22,1	6,5
19	8,38	-78,8	-10,5	4,5
20	8,38	-78,8	-10,5	4,5
20	8,00	**-80,4**	2,1	2,9
21	8,00	**-80,4**	2,2	2,9
21	7,52	-74,4	22,7	1,3
22	7,52	-74,4	22,8	1,3
22	7,03	-58,8	40,3	0,4
23	7,03	-58,8	40,4	0,4
23	6,55	-37,3	**45,2**	0,0
24	6,55	-37,3	**45,2**	0,0
24	6,07	-18,1	33,4	-0,2
25	6,07	-18,1	33,4	-0,2
25	5,58	-5,4	19,0	-0,1
26	5,58	-5,4	19,0	-0,1
26	5,10	0,6	6,6	-0,1
27	5,10	0,6	6,5	-0,1
27	4,62	1,8	-0,6	0,0
28	4,62	1,8	-0,6	0,0
28	4,13	0,8	-2,5	0,0
29	4,13	0,8	-2,5	0,0
29	3,65	0,0	0,0	0,1
Max		**-80,4**	**45,2**	**44,9**
Max, minor nodes incl.		-80,4	45,8	44,9

14.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	A		0,00	0,00	-	
5	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,20	0,00	0,00	A		0,00	0,00	-	
7	12,20	0,00	0,00	A		0,00	0,00	-	

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* [%]
7	12,15	0,00	0,49	A		0,00	0,00	-	
8	12,15	2,42	0,49	A		0,00	0,00	-	
8	11,77	3,80	4,25	A		0,00	0,00	-	
9	11,77	7,09	4,25	A		0,00	0,00	-	
9	11,38	9,50	8,01	A		0,00	0,00	-	
10	11,38	9,08	8,01	A		0,00	0,00	-	
10	11,00	11,05	11,77	A		0,00	0,00	-	
11	11,00	10,82	11,77	A		0,00	0,00	-	
11	10,84	11,57	13,39	A		0,00	1,62	-	
12	10,84	11,49	13,39	A		0,00	5,23	P	
12	10,75	11,86	14,22	A		0,00	6,14	P	
13	10,75	11,75	14,22	A		0,00	6,14	P	
13	10,28	13,59	18,88	A		0,00	11,21	P	
14	10,28	13,56	18,88	A		2,28	11,21	P	
14	9,80	15,17	23,54	A		18,50	16,28	P	
15	9,80	14,89	23,54	A	11	19,48	16,28	P	
15	9,43	16,35	27,22	A	11	31,32	21,37	P	
16	9,43	16,17	27,22	A	18	30,35	21,37	P	
16	9,05	17,55	30,90	A	18	41,82	26,46	P	
17	9,05	17,47	30,90	A	18	41,59	26,46	P	
17	9,00	17,65	31,39	A	18	43,11	27,14	P	
18	9,00	16,62	31,39	A	17	43,02	27,14	P	
18	8,75	17,46	33,84	A	17	48,89	30,53	3	97
19	8,75	16,52	33,84	A	16	49,02	30,53	3	97
19	8,38	17,69	37,52	A	16	52,02	35,62	3	84
20	8,38	16,75	37,52	A	15	52,00	35,62	3	84
20	8,00	17,85	41,20	A	15	49,94	40,71	2	68
21	8,00	17,73	41,20	A	22	58,39	40,71	P	
21	7,52	19,11	45,94	A	22	62,60	45,45	3	81
22	7,52	18,23	45,94	A		62,36	45,45	3	81
22	7,03	19,54	50,69	A		49,02	50,19	2	52
23	7,03	18,70	50,69	A		48,92	50,19	2	52
23	6,55	25,98	55,43	1	19	14,42	54,93	1	
24	6,55	26,71	55,43	1	19	14,42	54,93	1	
24	6,07	40,30	60,17	1	27	11,57	59,68	A	
25	6,07	41,05	60,17	1	26	11,57	59,68	A	
25	5,58	40,91	64,91	1	25	13,19	64,42	A	
26	5,58	41,68	64,91	1	24	13,19	64,42	A	
26	5,10	37,16	69,65	1	21	16,91	69,16	1	
27	5,10	37,93	69,65	1	20	16,91	69,16	1	
27	4,62	33,59	74,39	1	17	25,52	73,90	1	
28	4,62	34,35	74,39	1	17	25,52	73,90	1	
28	4,13	31,23	79,13	1		32,97	78,64	1	16
29	4,13	31,99	79,13	1		32,97	78,64	1	16
29	3,65	29,50	83,88	1		39,82	83,38	1	18

*

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

14.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	186,0	212,0
Water	358,6	332,5
Total	544,6	544,4

Considered as passive side	Right
Maximum passive effective resistance	698,35 kN
Mobilized passive effective resistance	211,97 kN
Percentage mobilized resistance	30,4 %

14.7.5 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	-39,38
Vertical force passive	49,51
Resulting vertical force (no dead weight)	10,13
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-39,38
Vertical force passive	49,51
Resulting vertical force (no dead weight)	10,13
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

14.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-6,04	10,84	19	1,25
9,80	20	-10,02	9,80	20	24,96
8,00	32	-23,32	8,00	32	23,30

15 Step 6.3 Stage 2: MHW

15.1 Input Data Left

15.1.1 Calculation Method

Calculation method: C, phi, delta

15.1.2 Water Level

Water level: 12,20 [m]

15.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

15.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

15.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

15.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

15.2 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	12,48	0,0	18,3	0,00	1,54	6,01
2	12,26	0,0	33,3	0,00	1,27	4,29
3	12,18	0,0	46,4	0,00	1,19	4,89
4	11,96	3,1	98,8	0,25	1,01	7,83
5	11,57	8,3	67,5	0,46	0,75	3,71
6	11,19	10,1	38,4	0,44	0,60	1,67
7	10,92	11,2	41,3	0,43	0,53	1,59
8	10,79	11,7	42,7	0,43	0,50	1,56
9	10,51	12,7	45,6	0,42	0,46	1,52
10	10,04	14,4	50,7	0,42	0,42	1,49
11	9,61	15,6	145,0	0,41	0,41	3,84
12	9,24	16,9	94,3	0,41	0,41	2,29
13	9,03	17,6	98,8	0,41	0,41	2,29
14	8,88	17,0	101,7	0,38	0,38	2,29
15	8,56	17,1	107,9	0,36	0,36	2,29
16	8,19	17,3	117,8	0,34	0,34	2,34
17	7,76	18,4	82,7	0,34	0,34	1,53
18	7,28	18,9	113,8	0,33	0,35	1,96
19	6,79	19,3	130,8	0,31	0,36	2,11
20	6,31	20,0	145,6	0,30	0,37	2,21
21	5,83	20,7	160,0	0,30	0,38	2,28
22	5,34	22,4	174,9	0,30	0,40	2,36
23	4,86	24,1	190,0	0,31	0,41	2,43
24	4,38	25,9	205,6	0,31	0,42	2,50
25	3,89	28,0	221,0	0,32	0,42	2,56

15.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	30,23
32	123,64

15.4 Input Data Right

15.4.1 Calculation Method

Calculation method: C, phi, delta

15.4.2 Water Level

Water level: 10,75 [m]

15.4.3 Surface

X [m]	Y [m]
0,00	10,84

15.4.4 Soil Material Properties in Profile: 54O_kelder (MHW)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	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]
19	15,00	n.a.	n.a.	n.a.	0,00	4,51
20	9,80	n.a.	n.a.	n.a.	4,51	11,28
32	8,00	n.a.	n.a.	n.a.	11,28	11,28

15.4.5 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]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

15.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	15,7	0,00	0,64	5,14
4	9,61	0,0	29,4	0,00	0,54	4,89
5	9,24	0,0	40,0	0,00	0,54	4,75
6	9,03	0,0	46,3	0,00	0,54	4,73
7	8,88	1,9	50,7	0,18	0,54	4,72
8	8,56	4,0	60,1	0,31	0,54	4,71
9	8,19	4,7	71,4	0,31	0,54	4,70
10	7,76	6,2	70,8	0,33	0,53	3,76
11	7,28	7,8	88,9	0,33	0,53	3,74
12	6,79	9,4	107,0	0,33	0,53	3,73
13	6,31	11,0	125,2	0,33	0,53	3,72
14	5,83	12,7	143,3	0,33	0,53	3,72
15	5,34	14,3	161,5	0,33	0,53	3,72
16	4,86	15,9	179,7	0,33	0,53	3,71
17	4,38	17,5	198,0	0,33	0,53	3,71

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
18	3,89	19,1	216,2	0,33	0,53	3,71

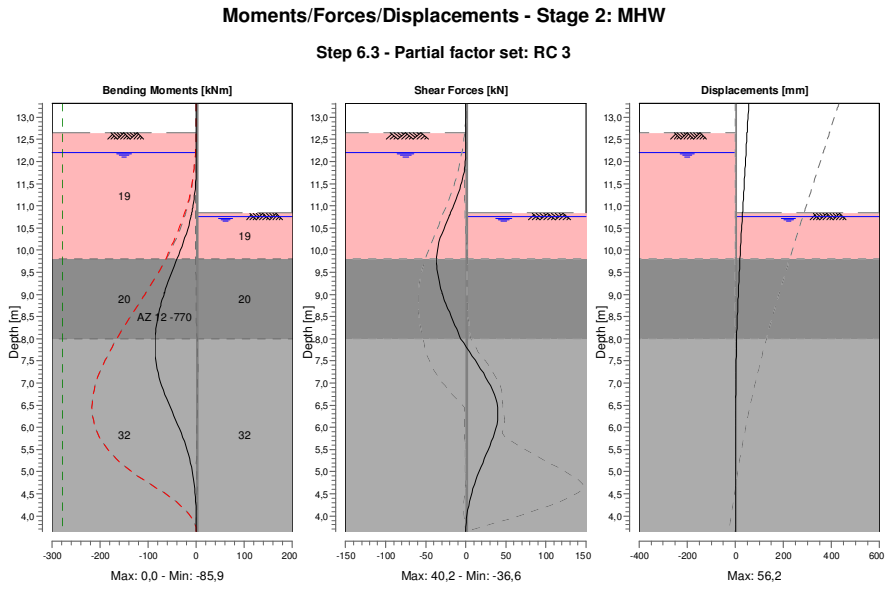
15.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	71,84
32	142,74

15.7 Calculation Results

Number of iterations: 6

15.7.1 Charts of Moments, Forces and Displacements



15.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**56,2**
1	13,20	0,0	0,0	54,9
2	13,20	0,0	0,0	54,9
2	13,15	0,0	0,0	54,4
3	13,15	0,0	0,0	54,4
3	12,70	0,0	0,0	49,6
4	12,70	0,0	0,0	49,6
4	12,65	0,0	0,0	49,1
5	12,65	0,0	0,0	49,1
5	12,32	0,0	0,0	45,6
6	12,32	0,0	0,0	45,6
6	12,20	0,0	0,0	44,3
7	12,20	0,0	0,0	44,3
7	12,15	0,0	0,0	43,8
8	12,15	0,0	0,0	43,8

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
8	11,77	-0,3	-2,1	39,7
9	11,77	-0,3	-2,1	39,7
9	11,38	-2,1	-7,7	35,6
10	11,38	-2,1	-7,7	35,6
10	11,00	-6,5	-15,3	31,5
11	11,00	-6,5	-15,3	31,5
11	10,84	-9,3	-19,2	29,8
12	10,84	-9,3	-19,2	29,8
12	10,75	-11,0	-21,1	28,9
13	10,75	-11,0	-21,1	28,9
13	10,28	-23,6	-32,0	24,0
14	10,28	-23,6	-32,0	24,0
14	9,80	-40,2	-36,6	19,3
15	9,80	-40,2	-36,6	19,3
15	9,43	-53,7	-34,8	15,7
16	9,43	-53,7	-34,8	15,7
16	9,05	-65,9	-29,8	12,5
17	9,05	-65,9	-29,8	12,5
17	9,00	-67,3	-29,0	12,1
18	9,00	-67,3	-29,0	12,1
18	8,75	-74,0	-24,0	10,1
19	8,75	-74,0	-24,0	10,1
19	8,38	-81,3	-15,2	7,5
20	8,38	-81,3	-15,2	7,5
20	8,00	**-85,4**	-6,4	5,2
21	8,00	**-85,4**	-6,4	5,2
21	7,52	-84,1	11,7	3,0
22	7,52	-84,1	11,8	3,0
22	7,03	-74,4	28,0	1,4
23	7,03	-74,4	28,0	1,4
23	6,55	-57,8	38,8	0,4
24	6,55	-57,8	38,8	0,4
24	6,07	-38,5	**39,0**	-0,1
25	6,07	-38,5	**39,0**	-0,1
25	5,58	-21,6	30,2	-0,2
26	5,58	-21,6	30,1	-0,2
26	5,10	-9,8	18,8	-0,2
27	5,10	-9,8	18,8	-0,2
27	4,62	-3,2	9,1	-0,1
28	4,62	-3,2	9,1	-0,1
28	4,13	-0,5	2,7	0,0
29	4,13	-0,5	2,7	0,0
29	3,65	0,0	0,0	0,1
Max		**-85,4**	**39,0**	**56,2**
Max, minor nodes incl.		-85,9	40,2	56,2

15.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	A		0,00	0,00	-	
5	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,20	0,00	0,00	A		0,00	0,00	-	
7	12,20	0,00	0,00	A		0,00	0,00	-	

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* [%]
7	12,15	0,00	0,49	A		0,00	0,00	-	
8	12,15	2,42	0,49	A		0,00	0,00	-	
8	11,77	3,80	4,25	A		0,00	0,00	-	
9	11,77	7,09	4,25	A		0,00	0,00	-	
9	11,38	9,50	8,01	A		0,00	0,00	-	
10	11,38	9,08	8,01	A		0,00	0,00	-	
10	11,00	11,05	11,77	A		0,00	0,00	-	
11	11,00	10,82	11,77	A		0,00	0,00	-	
11	10,84	11,57	13,39	A		0,00	0,00	-	
12	10,84	11,49	13,39	A		0,00	3,61	P	
12	10,75	11,86	14,22	A		0,00	3,69	P	
13	10,75	11,75	14,22	A		0,00	3,69	P	
13	10,28	13,59	18,88	A		0,00	8,76	P	
14	10,28	13,56	18,88	A		6,79	8,76	P	
14	9,80	15,17	23,54	A		21,07	13,83	3	85
15	9,80	14,89	23,54	A	11	23,46	13,83	P	
15	9,43	16,35	27,22	A	11	35,24	18,92	P	
16	9,43	16,17	27,22	A	18	34,28	18,92	P	
16	9,05	17,55	30,90	A	18	40,59	24,01	3	89
17	9,05	17,47	30,90	A	18	40,44	24,01	3	89
17	9,00	17,65	31,39	A	18	41,13	24,69	3	87
18	9,00	16,62	31,39	A	17	41,22	24,69	3	88
18	8,75	17,46	33,84	A	17	44,76	28,08	3	82
19	8,75	16,52	33,84	A	16	44,80	28,08	3	82
19	8,38	17,69	37,52	A	16	45,23	33,17	2	69
20	8,38	16,75	37,52	A	15	45,21	33,17	2	69
20	8,00	17,85	41,20	A	15	43,74	38,26	2	57
21	8,00	17,73	41,20	A	22	56,08	38,26	3	91
21	7,52	19,11	45,94	A	22	59,22	43,00	2	74
22	7,52	18,23	45,94	A		59,09	43,00	2	74
22	7,03	19,54	50,69	A		52,59	47,74	2	54
23	7,03	18,70	50,69	A		52,49	47,74	2	54
23	6,55	19,95	55,43	A		33,02	52,48	1	28
24	6,55	19,34	55,43	A		33,02	52,48	1	28
24	6,07	27,12	60,17	1	18	19,14	57,22	1	
25	6,07	27,87	60,17	1	18	19,14	57,22	1	
25	5,58	34,80	64,91	1	21	15,42	61,97	1	
26	5,58	35,57	64,91	1	21	15,42	61,97	1	
26	5,10	36,97	69,65	1	21	17,55	66,71	1	
27	5,10	37,74	69,65	1	20	17,55	66,71	1	
27	4,62	36,60	74,39	1	19	22,96	71,45	1	
28	4,62	37,36	74,39	1	19	22,96	71,45	1	
28	4,13	35,39	79,13	1	17	29,25	76,19	1	
29	4,13	36,15	79,13	1	17	29,25	76,19	1	
29	3,65	34,05	83,88	1		35,72	80,93	1	16

*

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

15.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	177,8	221,6
Water	358,6	314,7
Total	536,4	536,3

Considered as passive side	Right
Maximum passive effective resistance	721,54 kN
Mobilized passive effective resistance	221,55 kN
Percentage mobilized resistance	30,7 %

15.7.5 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	-37,93
Vertical force passive	50,82
Resulting vertical force (no dead weight)	12,89
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-37,93
Vertical force passive	50,82
Resulting vertical force (no dead weight)	12,89
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

15.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-6,04	10,84	19	1,76
9,80	20	-10,02	9,80	20	23,81
8,00	32	-21,87	8,00	32	25,25

16 Step 6.4 Stage 2: MHW

16.1 Input Data Left

16.1.1 Calculation Method

Calculation method: C, phi, delta

16.1.2 Water Level

Water level: 12,20 [m]

16.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

16.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

16.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

16.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	16,63
	3,25	16,63
	3,25	0,00

16.2 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	12,48	0,0	18,3	0,00	1,54	6,01
2	12,26	0,0	33,3	0,00	1,27	4,29
3	12,18	0,0	46,4	0,00	1,19	4,89
4	11,96	3,1	98,8	0,25	1,01	7,83
5	11,57	8,3	67,5	0,46	0,75	3,71
6	11,19	10,1	38,4	0,44	0,60	1,67
7	10,92	11,2	41,3	0,43	0,53	1,59
8	10,79	11,7	42,7	0,43	0,50	1,56
9	10,51	12,7	45,6	0,42	0,46	1,52
10	10,04	14,4	50,7	0,42	0,42	1,49
11	9,61	15,6	145,0	0,41	0,41	3,84
12	9,24	16,9	94,3	0,41	0,41	2,29
13	9,03	17,6	98,8	0,41	0,41	2,29
14	8,88	17,0	101,7	0,38	0,38	2,29
15	8,56	17,1	107,9	0,36	0,36	2,29
16	8,19	17,3	117,8	0,34	0,34	2,34
17	7,76	18,4	82,7	0,34	0,34	1,53
18	7,28	18,9	113,8	0,33	0,35	1,96
19	6,79	19,3	130,8	0,31	0,36	2,11
20	6,31	20,0	145,6	0,30	0,37	2,21
21	5,83	20,7	160,0	0,30	0,38	2,28
22	5,34	22,4	174,9	0,30	0,40	2,36
23	4,86	24,1	190,0	0,31	0,41	2,43
24	4,38	25,9	205,6	0,31	0,42	2,50
25	3,89	28,0	221,0	0,32	0,42	2,56

16.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	30,23
32	127,88

16.4 Input Data Right

16.4.1 Calculation Method

Calculation method: C, phi, delta

16.4.2 Water Level

Water level: 10,75 [m]

16.4.3 Surface

X [m]	Y [m]
0,00	10,84

16.4.4 Soil Material Properties in Profile: 54O_kelder (MHW)

Layer name	Level [m]	Unit weight		Cohesion	Friction angle phi	Delta friction angle
		Unsat [kN/m³]	Sat [kN/m³]	[kN/m²]	[deg]	[deg]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	4,51
20	9,80	n.a.	n.a.	n.a.	4,51	11,28
32	8,00	n.a.	n.a.	n.a.	11,28	11,28

16.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

16.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	15,7	0,00	0,64	5,14
4	9,61	0,0	29,4	0,00	0,54	4,89
5	9,24	0,0	40,0	0,00	0,54	4,75
6	9,03	0,0	46,3	0,00	0,54	4,73
7	8,88	1,9	50,7	0,18	0,54	4,72
8	8,56	4,0	60,1	0,31	0,54	4,71
9	8,19	4,7	71,4	0,31	0,54	4,70
10	7,76	6,2	70,8	0,33	0,53	3,76
11	7,28	7,8	88,9	0,33	0,53	3,74
12	6,79	9,4	107,0	0,33	0,53	3,73
13	6,31	11,0	125,2	0,33	0,53	3,72
14	5,83	12,7	143,3	0,33	0,53	3,72
15	5,34	14,3	161,5	0,33	0,53	3,72
16	4,86	15,9	179,7	0,33	0,53	3,71
17	4,38	17,5	198,0	0,33	0,53	3,71

Segment number	Level [m]	Horizontal pressure		Fictive earth pressure coefficients		
		Active [kN/m²]	Passive [kN/m²]	Ka [-]	Ko [-]	Kp [-]
18	3,89	19,1	216,2	0,33	0,53	3,71

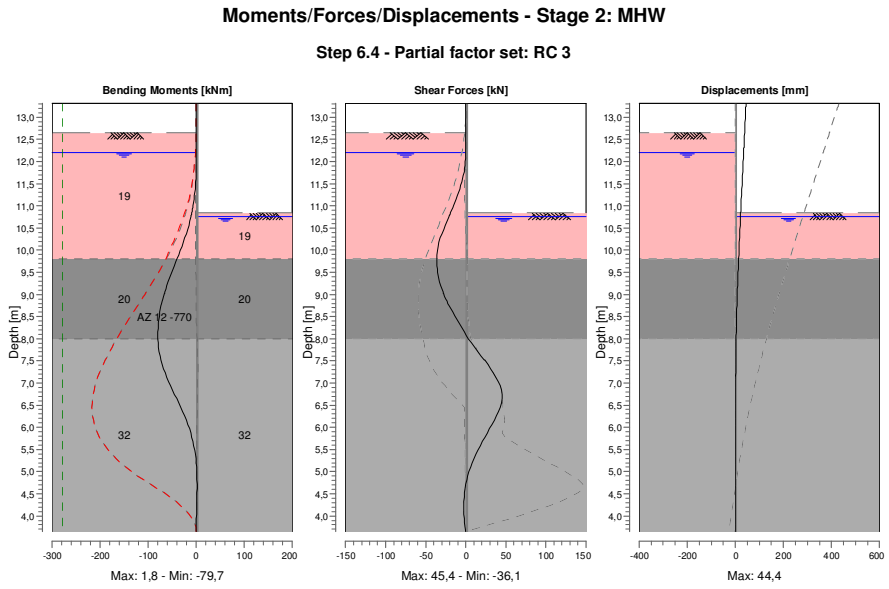
16.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	80,77
32	137,49

16.7 Calculation Results

Number of iterations: 6

16.7.1 Charts of Moments, Forces and Displacements



16.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**44,4**
1	13,20	0,0	0,0	43,4
2	13,20	0,0	0,0	43,4
2	13,15	0,0	0,0	42,9
3	13,15	0,0	0,0	42,9
3	12,70	0,0	0,0	38,9
4	12,70	0,0	0,0	38,9
4	12,65	0,0	0,0	38,5
5	12,65	0,0	0,0	38,5
5	12,32	0,0	0,0	35,6
6	12,32	0,0	0,0	35,6
6	12,20	0,0	0,0	34,5
7	12,20	0,0	0,0	34,5
7	12,15	0,0	0,0	34,0
8	12,15	0,0	0,0	34,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
8	11,77	-0,3	-2,1	30,6
9	11,77	-0,3	-2,1	30,6
9	11,38	-2,1	-7,7	27,2
10	11,38	-2,1	-7,7	27,2
10	11,00	-6,5	-15,3	23,8
11	11,00	-6,5	-15,3	23,8
11	10,84	-9,3	-19,2	22,4
12	10,84	-9,3	-19,2	22,4
12	10,75	-11,0	-21,1	21,7
13	10,75	-11,0	-21,1	21,7
13	10,28	-23,6	-32,0	17,6
14	10,28	-23,6	-32,0	17,6
14	9,80	-40,1	-36,1	13,7
15	9,80	-40,1	-36,1	13,7
15	9,43	-53,5	-34,3	10,8
16	9,43	-53,5	-34,3	10,8
16	9,05	-65,4	-28,5	8,2
17	9,05	-65,4	-28,5	8,2
17	9,00	-66,8	-27,4	7,9
18	9,00	-66,8	-27,4	7,9
18	8,75	-72,8	-20,8	6,4
19	8,75	-72,8	-20,8	6,4
19	8,38	-78,5	-9,3	4,4
20	8,38	-78,5	-9,2	4,4
20	8,00	**-79,6**	3,1	2,8
21	8,00	**-79,6**	3,1	2,8
21	7,52	-73,2	23,4	1,3
22	7,52	-73,2	23,5	1,3
22	7,03	-57,5	40,3	0,4
23	7,03	-57,5	40,4	0,4
23	6,55	-36,1	**44,8**	0,0
24	6,55	-36,1	**44,8**	0,0
24	6,07	-17,1	32,7	-0,1
25	6,07	-17,1	32,7	-0,1
25	5,58	-4,8	18,1	-0,1
26	5,58	-4,8	18,1	-0,1
26	5,10	0,8	5,9	-0,1
27	5,10	0,8	5,9	-0,1
27	4,62	1,7	-0,8	0,0
28	4,62	1,7	-0,8	0,0
28	4,13	0,8	-2,5	0,1
29	4,13	0,8	-2,5	0,1
29	3,65	0,0	0,0	0,1
Max		**-79,6**	**44,8**	**44,4**
Max, minor nodes incl.		-79,7	45,4	44,4

16.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	-		0,00	0,00	-	
5	12,65	0,00	0,00	A		0,00	0,00	-	
5	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,32	0,00	0,00	A		0,00	0,00	-	
6	12,20	0,00	0,00	A		0,00	0,00	-	
7	12,20	0,00	0,00	A		0,00	0,00	-	

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* [%]
7	12,15	0,00	0,49	A		0,00	0,00	-	
8	12,15	2,42	0,49	A		0,00	0,00	-	
8	11,77	3,80	4,25	A		0,00	0,00	-	
9	11,77	7,09	4,25	A		0,00	0,00	-	
9	11,38	9,50	8,01	A		0,00	0,00	-	
10	11,38	9,08	8,01	A		0,00	0,00	-	
10	11,00	11,05	11,77	A		0,00	0,00	-	
11	11,00	10,82	11,77	A		0,00	0,00	-	
11	10,84	11,57	13,39	A		0,00	0,00	-	
12	10,84	11,49	13,39	A		0,00	3,61	P	
12	10,75	11,86	14,22	A		0,00	3,69	P	
13	10,75	11,75	14,22	A		0,00	3,69	P	
13	10,28	13,59	18,88	A		0,00	8,76	P	
14	10,28	13,56	18,88	A		6,79	8,76	P	
14	9,80	15,17	23,54	A		24,66	13,83	P	
15	9,80	14,89	23,54	A	11	23,46	13,83	P	
15	9,43	16,35	27,22	A	11	35,24	18,92	P	
16	9,43	16,17	27,22	A	18	34,28	18,92	P	
16	9,05	17,55	30,90	A	18	45,74	24,01	P	
17	9,05	17,47	30,90	A	18	45,51	24,01	P	
17	9,00	17,65	31,39	A	18	47,03	24,69	P	
18	9,00	16,62	31,39	A	17	46,94	24,69	P	
18	8,75	17,46	33,84	A	17	51,32	28,08	3	94
19	8,75	16,52	33,84	A	16	51,36	28,08	3	94
19	8,38	17,69	37,52	A	16	54,46	33,17	3	83
20	8,38	16,75	37,52	A	15	54,41	33,17	3	83
20	8,00	17,85	41,20	A	15	50,95	38,26	2	66
21	8,00	17,73	41,20	A	22	61,53	38,26	P	
21	7,52	19,11	45,94	A	22	64,51	43,00	3	81
22	7,52	18,23	45,94	A		64,27	43,00	3	81
22	7,03	19,54	50,69	A		50,29	47,74	2	51
23	7,03	18,70	50,69	A		50,19	47,74	2	51
23	6,55	25,53	55,43	1	19	16,68	52,48	1	14
24	6,55	26,25	55,43	1	19	16,68	52,48	1	14
24	6,07	38,82	60,17	1	26	11,84	57,22	A	
25	6,07	39,57	60,17	1	25	11,84	57,22	A	
25	5,58	39,13	64,91	1	24	13,46	61,97	A	
26	5,58	39,90	64,91	1	23	13,46	61,97	A	
26	5,10	35,51	69,65	1	20	19,17	66,71	1	
27	5,10	36,28	69,65	1	20	19,17	66,71	1	
27	4,62	32,22	74,39	1		27,33	71,45	1	14
28	4,62	32,99	74,39	1		27,33	71,45	1	14
28	4,13	30,15	79,13	1		34,49	76,19	1	17
29	4,13	30,91	79,13	1		34,49	76,19	1	17
29	3,65	28,69	83,88	1		41,08	80,93	1	18

*

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

16.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	182,1	225,7
Water	358,6	314,7
Total	540,6	540,5

Considered as passive side	Right
Maximum passive effective resistance	721,54 kN
Mobilized passive effective resistance	225,73 kN
Percentage mobilized resistance	31,3 %

16.7.5 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	-38,68
Vertical force passive	52,98
Resulting vertical force (no dead weight)	14,30
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-38,68
Vertical force passive	52,98
Resulting vertical force (no dead weight)	14,30
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

16.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-6,04	10,84	19	1,88
9,80	20	-10,02	9,80	20	26,77
8,00	32	-22,62	8,00	32	24,32

17 Step 6.5 Stage 2: MHW

17.1 Input Data Left

17.1.1 Calculation Method

Calculation method: C, phi, delta

17.1.2 Water Level

Water level: 12,15 [m]

17.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

17.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

17.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

17.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeers 13,3	0,00	0,00
	0,75	0,00
	0,75	13,30
	3,25	13,30
	3,25	0,00

17.2 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	12,48	0,0	27,2	0,00	1,27	9,00
2	12,23	0,0	65,9	0,00	1,05	8,08
3	11,96	0,0	121,4	0,00	0,86	9,63
4	11,57	3,7	78,6	0,21	0,65	4,45
5	11,19	6,7	49,6	0,30	0,52	2,24
6	10,80	8,0	54,7	0,30	0,45	2,09
7	10,40	9,2	60,0	0,31	0,40	2,01
8	10,00	10,4	65,3	0,31	0,37	1,97
9	9,60	12,4	136,1	0,34	0,34	3,72
10	9,20	13,5	112,3	0,34	0,34	2,79
11	8,83	14,1	124,5	0,32	0,32	2,86
12	8,50	14,4	132,3	0,31	0,31	2,85
13	8,17	15,3	140,1	0,31	0,31	2,84
14	7,76	16,0	116,1	0,30	0,30	2,20
15	7,28	16,4	145,6	0,29	0,29	2,56
16	6,79	16,7	165,6	0,27	0,30	2,72
17	6,31	17,0	184,3	0,26	0,31	2,83
18	5,83	17,6	203,0	0,25	0,32	2,94
19	5,34	18,9	222,7	0,26	0,33	3,04
20	4,86	20,3	242,7	0,26	0,34	3,14
21	4,38	21,7	263,2	0,27	0,35	3,23
22	3,89	23,4	283,5	0,27	0,36	3,31

17.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	24,93
32	102,24

17.4 Input Data Right

17.4.1 Calculation Method

Calculation method: C, phi, delta

17.4.2 Water Level

Water level: 11,00 [m]

17.4.3 Surface

X [m]	Y [m]
0,00	11,00

17.4.4 Soil Material Properties in Profile: 54O_kelder (MHW)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	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]
19	15,00	n.a.	n.a.	n.a.	0,00	4,51
20	9,80	n.a.	n.a.	n.a.	4,51	11,28
32	8,00	n.a.	n.a.	n.a.	11,28	11,28

17.4.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

17.5 Calculated Earth Pressure Coefficients Right

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Fictive earth pressure coefficients Ko [-]	Fictive earth pressure coefficients Kp [-]
1	10,80	0,0	15,5	0,00	0,00	0,00
2	10,40	0,0	15,5	0,00	0,58	16,81
3	10,00	0,0	26,5	0,00	0,58	6,87
4	9,60	0,0	38,5	0,00	0,47	5,82
5	9,20	0,0	52,6	0,00	0,47	5,73
6	8,83	0,0	65,7	0,00	0,47	5,70
7	8,50	1,4	77,8	0,10	0,47	5,69
8	8,17	4,2	89,9	0,27	0,47	5,68
9	7,76	5,3	94,8	0,27	0,46	4,90
10	7,28	6,6	118,8	0,27	0,46	4,89
11	6,79	7,9	142,7	0,27	0,46	4,89
12	6,31	9,3	166,7	0,27	0,46	4,88
13	5,83	10,6	190,7	0,27	0,46	4,88
14	5,34	11,9	214,7	0,27	0,46	4,88
15	4,86	13,3	238,7	0,27	0,46	4,88
16	4,38	14,6	262,8	0,27	0,46	4,88
17	3,89	16,0	286,8	0,27	0,46	4,88

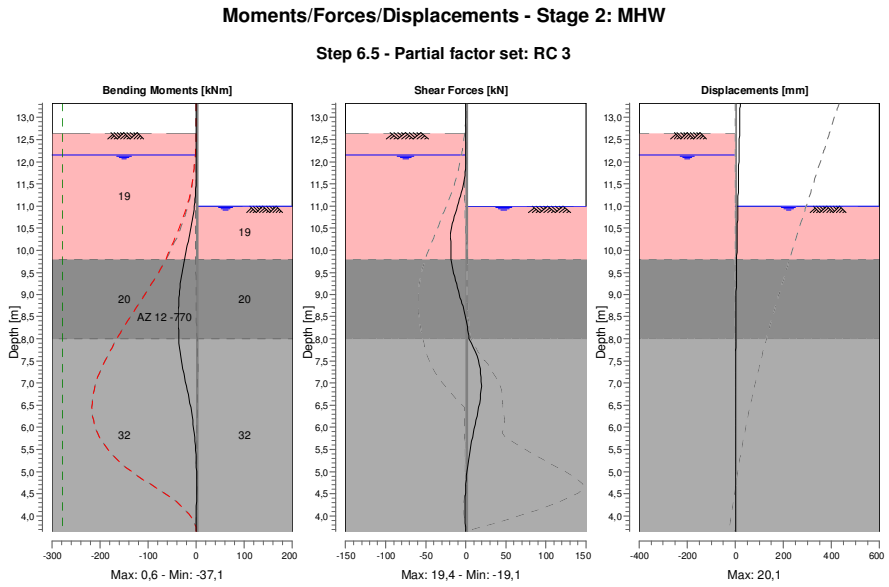
17.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	53,67
32	98,38

17.7 Calculation Results

Number of iterations: 5

17.7.1 Charts of Moments, Forces and Displacements



17.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**20,1**
1	13,15	0,0	0,0	19,4
2	13,15	0,0	0,0	19,4
2	12,90	0,0	0,0	18,4
3	12,90	0,0	0,0	18,4
3	12,65	0,0	0,0	17,3
4	12,65	0,0	0,0	17,3
4	12,32	0,0	0,0	15,9
5	12,32	0,0	0,0	15,9
5	12,15	0,0	0,0	15,2
6	12,15	0,0	0,0	15,2
6	11,77	-0,1	-0,7	13,6
7	11,77	-0,1	-0,7	13,6
7	11,38	-1,0	-4,3	12,0
8	11,38	-1,0	-4,3	12,0
8	11,00	-3,8	-10,5	10,4
9	11,00	-3,8	-10,5	10,4
9	10,60	-9,2	-16,7	8,7
10	10,60	-9,2	-16,7	8,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
10	10,20	-16,6	-18,7	7,1
11	10,20	-16,6	-18,6	7,1
11	9,80	-24,2	-18,7	5,6
12	9,80	-24,2	-18,7	5,6
12	9,40	-30,8	-13,9	4,3
13	9,40	-30,8	-13,8	4,3
13	9,00	-35,1	-8,0	3,1
14	9,00	-35,1	-8,0	3,1
14	8,67	-36,9	-2,5	2,2
15	8,67	-36,9	-2,6	2,2
15	8,33	**-37,0**	1,6	1,5
16	8,33	**-37,0**	1,5	1,5
16	8,00	-36,0	3,8	0,9
17	8,00	-36,1	3,9	0,9
17	7,52	-31,0	15,7	0,4
18	7,52	-31,0	15,7	0,4
18	7,03	-22,3	**19,3**	0,0
19	7,03	-22,3	**19,3**	0,0
19	6,55	-13,2	17,3	-0,1
20	6,55	-13,2	17,3	-0,1
20	6,07	-6,1	11,9	-0,1
21	6,07	-6,1	11,8	-0,1
21	5,58	-1,8	6,3	-0,1
22	5,58	-1,8	6,3	-0,1
22	5,10	0,2	2,2	0,0
23	5,10	0,2	2,2	0,0
23	4,62	0,6	-0,2	0,0
24	4,62	0,6	-0,2	0,0
24	4,13	0,3	-0,8	0,0
25	4,13	0,3	-0,8	0,0
25	3,65	0,0	0,0	0,1
Max		**-37,0**	**19,3**	**20,1**
Max, minor nodes incl.		-37,1	19,4	20,1

17.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,15	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
2	12,90	0,00	0,00	-		0,00	0,00	-	
3	12,90	0,00	0,00	-		0,00	0,00	-	
3	12,65	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	A		0,00	0,00	-	
4	12,32	0,00	0,00	A		0,00	0,00	-	
5	12,32	0,00	0,00	A		0,00	0,00	-	
5	12,15	0,00	0,00	A		0,00	0,00	-	
6	12,15	0,00	0,00	A		0,00	0,00	-	
6	11,77	0,00	3,76	A		0,00	0,00	-	
7	11,77	3,19	3,76	A		0,00	0,00	-	
7	11,38	4,19	7,52	A		0,00	0,00	-	
8	11,38	6,04	7,52	A		0,00	0,00	-	
8	11,00	7,31	11,28	A		0,00	0,00	-	
9	11,00	7,37	11,28	A		0,00	3,47	P	
9	10,60	8,54	15,21	A		0,00	7,74	P	
10	10,60	8,65	15,21	A		0,00	7,74	P	
10	10,20	9,71	19,13	A		23,05	12,01	2	57
11	10,20	9,87	19,13	A		13,40	12,01	3	82
11	9,80	10,87	23,05	A		20,26	16,28	2	55
12	9,80	11,72	23,05	A	9	26,85	16,28	3	87
12	9,40	12,99	26,98	A	9	32,37	21,71	2	70
13	9,40	12,87	26,98	A	12	32,10	21,71	2	71

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* [%]
13	9,00	14,08	30,90	A	12	33,36	27,14	2	56
14	9,00	13,64	30,90	A	11	33,25	27,14	2	56
14	8,67	14,60	34,17	A	11	32,37	31,66	1	45
15	8,67	13,93	34,17	A	11	32,92	31,66	1	46
15	8,33	14,82	37,44	A	11	24,90	36,19	1	30
16	8,33	14,85	37,44	A	11	26,43	36,19	1	32
16	8,00	15,74	40,71	A	11	19,64	40,71	1	20
17	8,00	15,37	40,71	A	14	45,12	40,71	2	55
17	7,52	16,62	45,45	A	14	31,21	45,45	1	29
18	7,52	15,77	45,45	A		31,21	45,45	1	29
18	7,03	16,95	50,19	A		18,25	50,19	1	14
19	7,03	16,12	50,19	A		18,25	50,19	1	14
19	6,55	22,41	54,94	1	13	13,43	54,93	1	
20	6,55	23,05	54,94	1	13	13,43	54,93	1	
20	6,07	25,28	59,68	1	13	13,60	59,68	1	
21	6,07	25,96	59,68	1	13	13,60	59,68	1	
21	5,58	26,15	64,42	1	13	16,19	64,42	1	
22	5,58	26,83	64,42	1	12	16,19	64,42	1	
22	5,10	26,42	69,16	1	12	20,03	69,16	1	
23	5,10	27,12	69,16	1	11	20,03	69,16	1	
23	4,62	26,77	73,90	1		24,06	73,90	1	10
24	4,62	27,46	73,90	1		24,06	73,90	1	10
24	4,13	27,34	78,64	1		27,91	78,64	1	10
25	4,13	28,03	78,64	1		27,91	78,64	1	10
25	3,65	28,04	83,39	1		31,67	83,38	1	11

*

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

17.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	142,2	163,6
Water	354,4	333,1
Total	496,5	496,6

Considered as passive side	Right
Maximum passive effective resistance	961,13 kN
Mobilized passive effective resistance	163,56 kN
Percentage mobilized resistance	17,0 %

17.7.5 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	-35,32
Vertical force passive	44,70
Resulting vertical force (no dead weight)	9,38
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

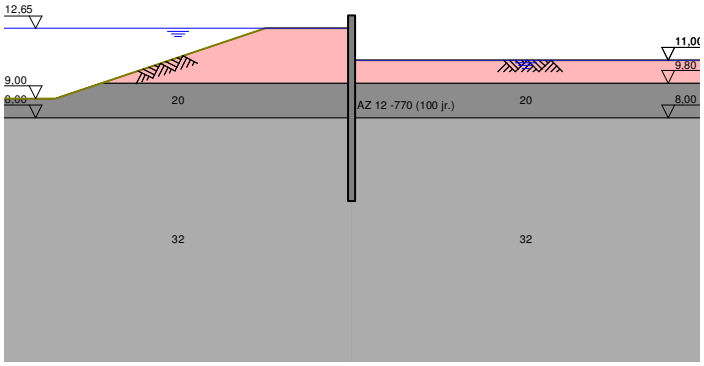
Vertical force balance plugged	Force [kN]
Vertical force active	-35,32
Vertical force passive	44,70
Resulting vertical force (no dead weight)	9,38
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

17.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-4,49	11,00	19	3,45
9,80	20	-9,74	9,80	20	20,96
8,00	32	-21,10	8,00	32	20,30

18 Outline Stage 3: MHW +0,5

Outline - Stage 3: MHW +0,5

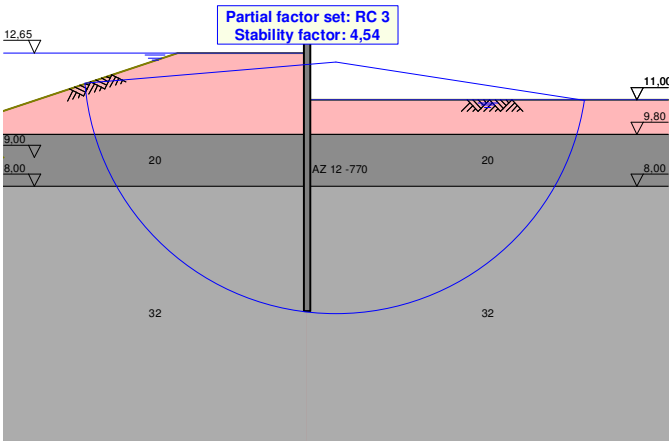


19 Overall Stability Stage 3: MHW +0,5

Stability factor : 4,54

19.1 Overall Stability

Overall Stability - Stage 3: MHW +0,5



20 Step 6.1 Stage 3: MHW +0,5

20.1 Input Data Left

20.1.1 Calculation Method

Calculation method: C, phi, delta

20.1.2 Water Level

Water level: 12,70 [m]

20.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

20.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

20.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

20.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

20.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	116,48

20.4 Input Data Right

20.4.1 Calculation Method

Calculation method: C, phi, delta

20.4.2 Water Level

Water level: 11,00 [m]

20.4.3 Surface

X [m]	Y [m]
0,00	10,84

20.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+0.5)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	6,47
20	9,80	n.a.	n.a.	n.a.	6,47	16,18
32	8,00	n.a.	n.a.	n.a.	16,18	16,18

20.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

20.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,64	25,78
4	9,61	0,0	14,5	0,00	0,54	4,98
5	9,24	0,0	22,6	0,00	0,54	4,81
6	9,03	0,0	27,3	0,00	0,54	4,76
7	8,88	0,0	30,6	0,00	0,54	4,74
8	8,56	0,0	37,5	0,00	0,54	4,72
9	8,19	2,5	45,9	0,26	0,54	4,71
10	7,76	4,3	49,1	0,33	0,53	3,75
11	7,28	5,9	67,3	0,33	0,53	3,73
12	6,79	7,5	85,5	0,33	0,53	3,72
13	6,31	9,2	103,7	0,33	0,53	3,72
14	5,83	10,8	121,9	0,33	0,53	3,72
15	5,34	12,4	140,1	0,33	0,53	3,71
16	4,86	14,0	158,3	0,33	0,53	3,71
17	4,38	15,6	176,6	0,33	0,53	3,71
18	3,89	17,2	194,8	0,33	0,53	3,71

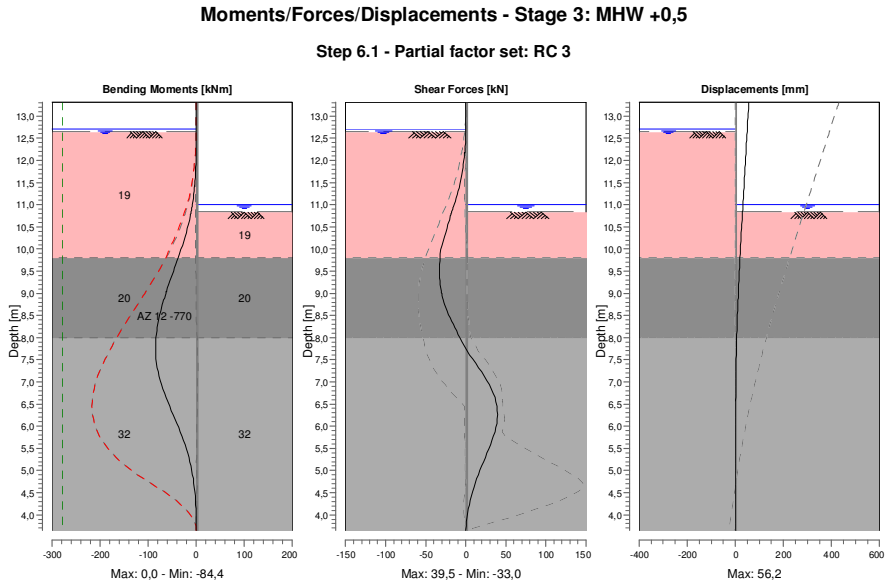
20.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	52,12
32	126,24

20.7 Calculation Results

Number of iterations: 4

20.7.1 Charts of Moments, Forces and Displacements



20.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**56,2**
1	13,20	0,0	0,0	54,9
2	13,20	0,0	0,0	54,9
2	13,15	0,0	0,0	54,4
3	13,15	0,0	0,0	54,4
3	12,70	0,0	0,0	49,6
4	12,70	0,0	0,0	49,6
4	12,65	0,0	0,0	49,1
5	12,65	0,0	0,0	49,1
5	12,32	-0,1	-0,7	45,6
6	12,32	-0,1	-0,7	45,6
6	12,20	-0,2	-1,2	44,4
7	12,20	-0,2	-1,2	44,4
7	12,15	-0,3	-1,5	43,8
8	12,15	-0,3	-1,5	43,8
8	11,77	-1,3	-4,3	39,8
9	11,77	-1,3	-4,3	39,8
9	11,38	-3,7	-8,5	35,7
10	11,38	-3,7	-8,5	35,7
10	11,00	-8,1	-14,5	31,7
11	11,00	-8,1	-14,5	31,7
11	10,84	-10,8	-17,8	30,0
12	10,84	-10,8	-17,8	30,0
12	10,75	-12,3	-19,1	29,1
13	10,75	-12,3	-19,1	29,1
13	10,28	-23,2	-26,6	24,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-23,2	-26,6	24,2
14	9,80	-37,5	-32,0	19,6
15	9,80	-37,5	-32,0	19,6
15	9,43	-49,8	-32,9	16,1
16	9,43	-49,8	-32,9	16,1
16	9,05	-61,8	-30,5	12,8
17	9,05	-61,8	-30,5	12,8
17	9,00	-63,3	-30,0	12,4
18	9,00	-63,3	-30,0	12,4
18	8,75	-70,3	-26,2	10,4
19	8,75	-70,3	-26,2	10,4
19	8,38	-78,7	-17,6	7,8
20	8,38	-78,7	-17,6	7,8
20	8,00	**-83,4**	-7,7	5,5
21	8,00	**-83,4**	-7,7	5,5
21	7,52	**-83,4**	8,7	3,2
22	7,52	**-83,4**	8,7	3,2
22	7,03	-74,9	25,9	1,6
23	7,03	-74,9	26,0	1,6
23	6,55	-59,2	37,7	0,5
24	6,55	-59,2	37,7	0,5
24	6,07	-40,3	**38,8**	0,0
25	6,07	-40,3	**38,8**	0,0
25	5,58	-23,2	30,8	-0,2
26	5,58	-23,2	30,8	-0,2
26	5,10	-10,9	20,0	-0,2
27	5,10	-10,9	20,0	-0,2
27	4,62	-3,8	10,2	-0,1
28	4,62	-3,8	10,1	-0,1
28	4,13	-0,6	3,3	0,0
29	4,13	-0,6	3,3	0,0
29	3,65	0,0	0,0	0,1
Max		**-83,4**	**38,8**	**56,2**
Max, minor nodes incl.		-84,4	39,5	56,2

20.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,49	-		0,00	0,00	-	
5	12,65	0,00	0,49	A		0,00	0,00	-	
5	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,15	0,00	5,40	A		0,00	0,00	-	
8	12,15	0,00	5,40	A		0,00	0,00	-	
8	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,38	0,00	12,92	A		0,00	0,00	-	
10	11,38	0,74	12,92	A		0,00	0,00	-	
10	11,00	0,96	16,68	A		0,00	0,00	-	
11	11,00	3,02	16,68	A		0,00	0,00	-	
11	10,84	3,32	18,30	A		0,00	1,62	-	
12	10,84	3,50	18,30	A		0,00	6,80	P	
12	10,75	3,66	19,13	A		0,00	7,74	P	

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* [%]
13	10,75	4,18	19,13	1		0,00	7,74	P	
13	10,28	5,55	23,79	1		0,00	12,99	P	
14	10,28	6,97	23,79	1		0,00	12,99	P	
14	9,80	8,52	28,45	1		16,80	18,24	1	32
15	9,80	7,27	28,45	A		9,99	18,24	P	
15	9,43	8,43	32,13	A		18,95	23,94	P	
16	9,43	8,46	32,13	A		18,28	23,94	P	
16	9,05	9,61	35,81	A		26,92	29,65	P	
17	9,05	9,63	35,81	A		26,69	29,65	P	
17	9,00	9,79	36,30	A		27,83	30,41	P	
18	9,00	9,80	36,30	A		27,72	30,41	P	
18	8,75	10,57	38,75	A		33,41	34,21	P	
19	8,75	10,60	38,75	A		33,26	34,21	P	
19	8,38	11,75	42,43	A		41,30	39,91	3	99
20	8,38	11,79	42,43	A		41,36	39,91	3	99
20	8,00	12,93	46,11	A		40,12	45,61	3	80
21	8,00	13,67	46,11	A		39,89	45,61	P	
21	7,52	15,22	50,85	A		55,23	50,35	3	95
22	7,52	15,30	50,85	A		55,10	50,35	3	95
22	7,03	16,85	55,59	A		49,67	55,09	2	65
23	7,03	16,93	55,59	A		49,57	55,09	2	65
23	6,55	18,48	60,33	A		31,68	59,83	1	33
24	6,55	18,68	60,33	A		31,68	59,83	1	34
24	6,07	24,38	65,07	1	17	16,37	64,58	1	15
25	6,07	24,88	65,07	1	17	16,37	64,58	1	15
25	5,58	33,23	69,81	1	21	12,84	69,32	1	
26	5,58	33,73	69,81	1	21	12,84	69,32	1	
26	5,10	36,15	74,56	1	21	14,40	74,06	1	
27	5,10	36,65	74,56	1	21	14,40	74,06	1	
27	4,62	36,22	79,30	1	19	19,42	78,80	1	
28	4,62	36,72	79,30	1	19	19,42	78,80	1	
28	4,13	35,28	84,04	1	17	25,47	83,54	1	
29	4,13	35,78	84,04	1	17	25,47	83,54	1	
29	3,65	34,16	88,78	1		31,74	88,28	1	16

*

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

20.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	141,8	181,7
Water	401,7	361,8
Total	543,5	543,5

Considered as passive side	Right
Maximum passive effective resistance	592,07 kN
Mobilized passive effective resistance	181,68 kN
Percentage mobilized resistance	30,7 %

20.7.5 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	-28,44
Vertical force passive	40,44
Resulting vertical force (no dead weight)	12,00
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-28,44
Vertical force passive	40,44
Resulting vertical force (no dead weight)	12,00
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

20.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,80	10,84	19	0,84
9,80	20	-6,03	9,80	20	17,27
8,00	32	-20,61	8,00	32	22,33

21 Step 6.2 Stage 3: MHW +0,5

21.1 Input Data Left

21.1.1 Calculation Method

Calculation method: C, phi, delta

21.1.2 Water Level

Water level: 12,70 [m]

21.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

21.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

21.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

21.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

21.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	122,84

21.4 Input Data Right

21.4.1 Calculation Method

Calculation method: C, phi, delta

21.4.2 Water Level

Water level: 11,00 [m]

21.4.3 Surface

X [m]	Y [m]
0,00	10,84

21.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+0.5)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	6,47
20	9,80	n.a.	n.a.	n.a.	6,47	16,18
32	8,00	n.a.	n.a.	n.a.	16,18	16,18

21.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

21.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,64	25,78
4	9,61	0,0	14,5	0,00	0,54	4,98
5	9,24	0,0	22,6	0,00	0,54	4,81
6	9,03	0,0	27,3	0,00	0,54	4,76
7	8,88	0,0	30,6	0,00	0,54	4,74
8	8,56	0,0	37,5	0,00	0,54	4,72
9	8,19	2,5	45,9	0,26	0,54	4,71
10	7,76	4,3	49,1	0,33	0,53	3,75
11	7,28	5,9	67,3	0,33	0,53	3,73
12	6,79	7,5	85,5	0,33	0,53	3,72
13	6,31	9,2	103,7	0,33	0,53	3,72
14	5,83	10,8	121,9	0,33	0,53	3,72
15	5,34	12,4	140,1	0,33	0,53	3,71
16	4,86	14,0	158,3	0,33	0,53	3,71
17	4,38	15,6	176,6	0,33	0,53	3,71
18	3,89	17,2	194,8	0,33	0,53	3,71

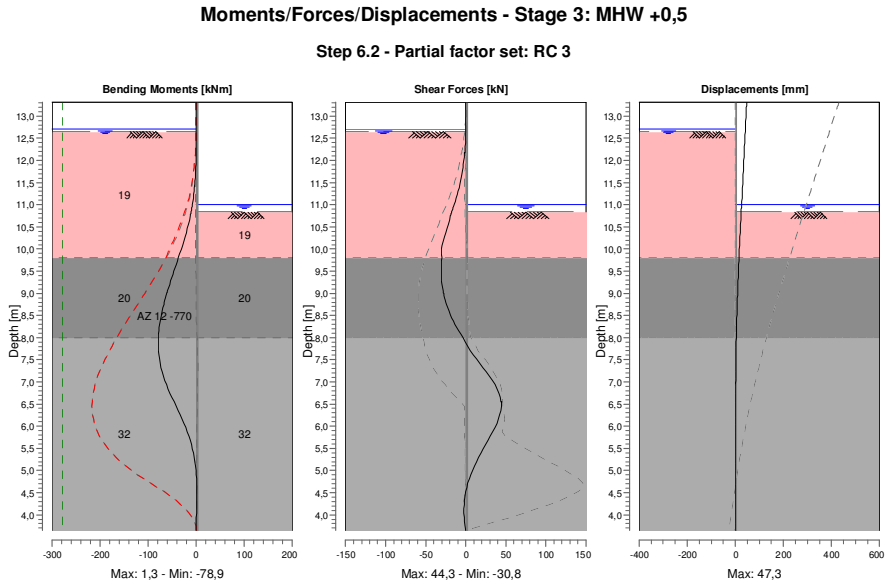
21.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	54,14
32	128,22

21.7 Calculation Results

Number of iterations: 5

21.7.1 Charts of Moments, Forces and Displacements



21.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**47,3**
1	13,20	0,0	0,0	46,2
2	13,20	0,0	0,0	46,2
2	13,15	0,0	0,0	45,8
3	13,15	0,0	0,0	45,8
3	12,70	0,0	0,0	41,6
4	12,70	0,0	0,0	41,6
4	12,65	0,0	0,0	41,1
5	12,65	0,0	0,0	41,1
5	12,32	-0,1	-0,7	38,1
6	12,32	-0,1	-0,7	38,1
6	12,20	-0,2	-1,2	37,0
7	12,20	-0,2	-1,2	37,0
7	12,15	-0,3	-1,5	36,5
8	12,15	-0,3	-1,5	36,5
8	11,77	-1,3	-4,3	33,0
9	11,77	-1,3	-4,3	33,0
9	11,38	-3,7	-8,5	29,4
10	11,38	-3,7	-8,5	29,4
10	11,00	-8,1	-14,5	25,9
11	11,00	-8,1	-14,5	25,9
11	10,84	-10,8	-17,8	24,4
12	10,84	-10,8	-17,8	24,4
12	10,75	-12,3	-19,1	23,6
13	10,75	-12,3	-19,1	23,6
13	10,28	-23,1	-26,5	19,4

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-23,1	-26,5	19,4
14	9,80	-37,1	-29,7	15,4
15	9,80	-37,1	-29,7	15,4
15	9,43	-48,5	-30,7	12,4
16	9,43	-48,5	-30,7	12,4
16	9,05	-59,7	-28,3	9,6
17	9,05	-59,7	-28,3	9,6
17	9,00	-61,1	-27,7	9,3
18	9,00	-61,1	-27,7	9,3
18	8,75	-67,6	-23,9	7,6
19	8,75	-67,6	-23,9	7,6
19	8,38	-75,0	-15,4	5,5
20	8,38	-75,0	-15,4	5,5
20	8,00	**-78,7**	-3,4	3,6
21	8,00	**-78,7**	-3,3	3,6
21	7,52	-76,6	13,2	1,9
22	7,52	-76,6	13,2	1,9
22	7,03	-65,2	33,2	0,7
23	7,03	-65,3	33,3	0,7
23	6,55	-46,0	44,1	0,1
24	6,55	-46,0	**44,2**	0,1
24	6,07	-25,3	38,7	-0,1
25	6,07	-25,3	38,7	-0,1
25	5,58	-9,9	24,7	-0,2
26	5,58	-9,9	24,6	-0,2
26	5,10	-1,4	10,9	-0,1
27	5,10	-1,4	10,9	-0,1
27	4,62	1,2	1,2	0,0
28	4,62	1,2	1,2	0,0
28	4,13	0,7	-2,2	0,0
29	4,13	0,7	-2,2	0,0
29	3,65	0,0	0,0	0,1
Max		**-78,7**	**44,2**	**47,3**
Max, minor nodes incl.		-78,9	44,3	47,3

21.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,49	-		0,00	0,00	-	
5	12,65	0,00	0,49	A		0,00	0,00	-	
5	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,15	0,00	5,40	A		0,00	0,00	-	
8	12,15	0,00	5,40	A		0,00	0,00	-	
8	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,38	0,00	12,92	A		0,00	0,00	-	
10	11,38	0,74	12,92	A		0,00	0,00	-	
10	11,00	0,96	16,68	A		0,00	0,00	-	
11	11,00	3,02	16,68	A		0,00	0,00	-	
11	10,84	3,32	18,30	A		0,00	1,62	-	
12	10,84	3,50	18,30	A		0,00	6,80	P	
12	10,75	3,66	19,13	A		0,00	7,74	P	

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* [%]
13	10,75	4,02	19,13	A		0,00	7,74	P	
13	10,28	5,00	23,79	A		0,00	12,99	P	
14	10,28	5,54	23,79	A		0,00	12,99	P	
14	9,80	6,61	28,45	A		27,08	18,24	2	52
15	9,80	7,27	28,45	A		9,99	18,24	P	
15	9,43	8,43	32,13	A		18,95	23,94	P	
16	9,43	8,46	32,13	A		18,28	23,94	P	
16	9,05	9,61	35,81	A		26,92	29,65	P	
17	9,05	9,63	35,81	A		26,69	29,65	P	
17	9,00	9,79	36,30	A		27,83	30,41	P	
18	9,00	9,80	36,30	A		27,72	30,41	P	
18	8,75	10,57	38,75	A		33,41	34,21	P	
19	8,75	10,60	38,75	A		33,26	34,21	P	
19	8,38	11,75	42,43	A		41,76	39,91	P	
20	8,38	11,79	42,43	A		41,65	39,91	P	
20	8,00	12,93	46,11	A		49,06	45,61	3	98
21	8,00	13,67	46,11	A		39,89	45,61	P	
21	7,52	15,22	50,85	A		58,35	50,35	P	
22	7,52	15,30	50,85	A		58,12	50,35	P	
22	7,03	16,85	55,59	A		54,04	55,09	2	71
23	7,03	16,93	55,59	A		53,94	55,09	2	71
23	6,55	18,48	60,33	A		24,13	59,83	1	25
24	6,55	18,68	60,33	A		24,13	59,83	1	26
24	6,07	36,35	65,07	1	25	12,81	64,58	1	
25	6,07	36,84	65,07	1	25	12,81	64,58	1	
25	5,58	41,22	69,81	1	26	11,58	69,32	A	
26	5,58	41,72	69,81	1	26	11,58	69,32	A	
26	5,10	38,35	74,56	1	22	13,20	74,06	A	
27	5,10	38,85	74,56	1	22	13,20	74,06	A	
27	4,62	34,08	79,30	1	18	21,56	78,80	1	
28	4,62	34,58	79,30	1	18	21,56	78,80	1	
28	4,13	30,55	84,04	1		30,21	83,54	1	16
29	4,13	31,04	84,04	1		30,21	83,54	1	16
29	3,65	27,58	88,78	1		38,32	88,28	1	19

*

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

21.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	147,2	187,0
Water	401,7	361,8
Total	548,9	548,7

Considered as passive side	Right
Maximum passive effective resistance	592,07 kN
Mobilized passive effective resistance	186,97 kN
Percentage mobilized resistance	31,6 %

21.7.5 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	-29,32
Vertical force passive	41,79
Resulting vertical force (no dead weight)	12,47
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-29,32
Vertical force passive	41,79
Resulting vertical force (no dead weight)	12,47
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

21.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,56	10,84	19	1,16
9,80	20	-6,03	9,80	20	17,94
8,00	32	-21,73	8,00	32	22,68

22 Step 6.3 Stage 3: MHW +0,5

22.1 Input Data Left

22.1.1 Calculation Method

Calculation method: C, phi, delta

22.1.2 Water Level

Water level: 12,70 [m]

22.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

22.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

22.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

22.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

22.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	114,39

22.4 Input Data Right

22.4.1 Calculation Method

Calculation method: C, phi, delta

22.4.2 Water Level

Water level: 10,75 [m]

22.4.3 Surface

X [m]	Y [m]
0,00	10,84

22.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+0.5)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	6,47
20	9,80	n.a.	n.a.	n.a.	6,47	16,18
32	8,00	n.a.	n.a.	n.a.	16,18	16,18

22.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

22.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,64	7,73
4	9,61	0,0	18,5	0,00	0,54	4,95
5	9,24	0,0	26,5	0,00	0,54	4,78
6	9,03	0,0	31,1	0,00	0,54	4,75
7	8,88	0,0	34,5	0,00	0,54	4,73
8	8,56	0,5	41,4	0,06	0,54	4,72
9	8,19	3,3	49,8	0,31	0,54	4,71
10	7,76	4,6	52,3	0,33	0,53	3,75
11	7,28	6,2	70,5	0,33	0,53	3,74
12	6,79	7,8	88,6	0,33	0,53	3,73
13	6,31	9,4	106,8	0,33	0,53	3,72
14	5,83	11,0	125,0	0,33	0,53	3,72
15	5,34	12,7	143,2	0,33	0,53	3,71
16	4,86	14,3	161,5	0,33	0,53	3,71
17	4,38	15,9	179,7	0,33	0,53	3,71
18	3,89	17,5	198,0	0,33	0,53	3,71

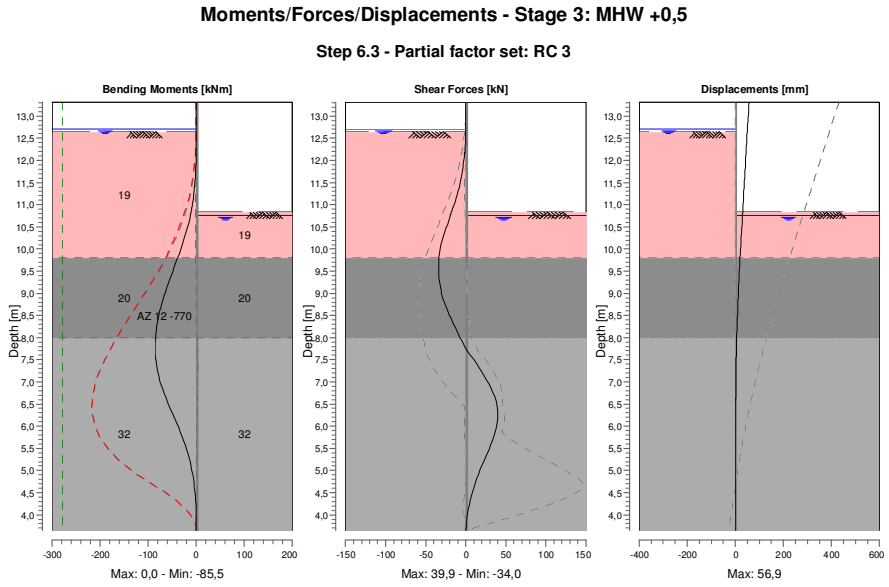
22.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	58,33
32	134,36

22.7 Calculation Results

Number of iterations: 5

22.7.1 Charts of Moments, Forces and Displacements



22.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**56,9**
1	13,20	0,0	0,0	55,6
2	13,20	0,0	0,0	55,6
2	13,15	0,0	0,0	55,1
3	13,15	0,0	0,0	55,1
3	12,70	0,0	0,0	50,3
4	12,70	0,0	0,0	50,3
4	12,65	0,0	0,0	49,7
5	12,65	0,0	0,0	49,7
5	12,32	-0,1	-0,7	46,2
6	12,32	-0,1	-0,7	46,2
6	12,20	-0,2	-1,2	44,9
7	12,20	-0,2	-1,2	44,9
7	12,15	-0,3	-1,5	44,4
8	12,15	-0,3	-1,5	44,4
8	11,77	-1,3	-4,3	40,2
9	11,77	-1,3	-4,3	40,2
9	11,38	-3,7	-8,5	36,1
10	11,38	-3,7	-8,5	36,1
10	11,00	-8,1	-14,5	32,1
11	11,00	-8,1	-14,5	32,1
11	10,84	-10,8	-17,9	30,3
12	10,84	-10,8	-17,9	30,3
12	10,75	-12,3	-19,4	29,4
13	10,75	-12,3	-19,4	29,4
13	10,28	-23,6	-28,0	24,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-23,6	-28,0	24,5
14	9,80	-38,5	-33,3	19,7
15	9,80	-38,5	-33,3	19,7
15	9,43	-51,2	-33,7	16,2
16	9,43	-51,2	-33,7	16,2
16	9,05	-63,4	-30,7	12,9
17	9,05	-63,4	-30,7	12,9
17	9,00	-64,9	-30,1	12,5
18	9,00	-64,9	-30,1	12,5
18	8,75	-72,0	-25,9	10,5
19	8,75	-72,0	-25,9	10,5
19	8,38	-80,1	-17,0	7,8
20	8,38	-80,1	-17,0	7,8
20	8,00	**-84,6**	-7,2	5,6
21	8,00	**-84,6**	-7,2	5,6
21	7,52	-84,4	9,4	3,2
22	7,52	-84,4	9,5	3,2
22	7,03	-75,6	26,4	1,6
23	7,03	-75,6	26,5	1,6
23	6,55	-59,6	38,1	0,6
24	6,55	-59,6	38,1	0,6
24	6,07	-40,5	**39,2**	0,0
25	6,07	-40,5	**39,2**	0,0
25	5,58	-23,3	31,2	-0,2
26	5,58	-23,3	31,2	-0,2
26	5,10	-10,9	20,1	-0,2
27	5,10	-10,9	20,0	-0,2
27	4,62	-3,7	10,1	-0,1
28	4,62	-3,7	10,1	-0,1
28	4,13	-0,6	3,2	0,0
29	4,13	-0,6	3,2	0,0
29	3,65	0,0	0,0	0,1
Max		**-84,6**	**39,2**	**56,9**
Max, minor nodes incl.		-85,5	39,9	56,9

22.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,49	-		0,00	0,00	-	
5	12,65	0,00	0,49	A		0,00	0,00	-	
5	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,15	0,00	5,40	A		0,00	0,00	-	
8	12,15	0,00	5,40	A		0,00	0,00	-	
8	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,38	0,00	12,92	A		0,00	0,00	-	
10	11,38	0,74	12,92	A		0,00	0,00	-	
10	11,00	0,96	16,68	A		0,00	0,00	-	
11	11,00	3,02	16,68	A		0,00	0,00	-	
11	10,84	3,32	18,30	A		0,00	0,00	-	
12	10,84	3,50	18,30	A		0,00	5,18	P	
12	10,75	3,66	19,13	A		0,00	5,29	P	

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* [%]
13	10,75	4,02	19,13	A		0,00	5,29	P	
13	10,28	5,36	23,79	1		0,00	10,54	P	
14	10,28	6,78	23,79	1		0,00	10,54	P	
14	9,80	8,41	28,45	1		19,91	15,79	3	91
15	9,80	7,27	28,45	A		14,06	15,79	P	
15	9,43	8,43	32,13	A		22,97	21,49	P	
16	9,43	8,46	32,13	A		22,19	21,49	P	
16	9,05	9,61	35,81	A		30,80	27,19	P	
17	9,05	9,63	35,81	A		30,57	27,19	P	
17	9,00	9,79	36,30	A		31,71	27,95	P	
18	9,00	9,80	36,30	A		31,61	27,95	P	
18	8,75	10,57	38,75	A		37,29	31,75	P	
19	8,75	10,60	38,75	A		37,16	31,75	P	
19	8,38	11,75	42,43	A		43,21	37,46	3	95
20	8,38	11,79	42,43	A		43,18	37,46	3	95
20	8,00	12,93	46,11	A		41,90	43,16	2	78
21	8,00	13,67	46,11	A		43,05	43,16	P	
21	7,52	15,22	50,85	A		57,25	47,90	3	93
22	7,52	15,30	50,85	A		57,12	47,90	3	93
22	7,03	16,85	55,59	A		51,46	52,64	2	65
23	7,03	16,93	55,59	A		51,36	52,64	2	65
23	6,55	18,48	60,33	A		33,95	57,38	1	35
24	6,55	18,68	60,33	A		33,95	57,38	1	35
24	6,07	23,91	65,07	1		18,65	62,12	1	16
25	6,07	24,40	65,07	1		18,65	62,12	1	16
25	5,58	32,61	69,81	1	20	14,01	66,86	1	
26	5,58	33,11	69,81	1	20	14,01	66,86	1	
26	5,10	35,37	74,56	1	20	15,62	71,61	1	
27	5,10	35,87	74,56	1	20	15,62	71,61	1	
27	4,62	35,30	79,30	1	19	20,78	76,35	1	
28	4,62	35,80	79,30	1	19	20,78	76,35	1	
28	4,13	34,24	84,04	1	17	26,96	81,09	1	
29	4,13	34,74	84,04	1	17	26,96	81,09	1	
29	3,65	33,00	88,78	1		33,35	85,83	1	16

*

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

22.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	139,6	197,1
Water	401,7	344,1
Total	541,3	541,2

Considered as passive side	Right
Maximum passive effective resistance	609,81 kN
Mobilized passive effective resistance	197,13 kN
Percentage mobilized resistance	32,3 %

22.7.5 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	-28,02
Vertical force passive	44,22
Resulting vertical force (no dead weight)	16,20
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-28,02
Vertical force passive	44,22
Resulting vertical force (no dead weight)	16,20
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

22.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,76	10,84	19	1,12
9,80	20	-6,03	9,80	20	19,33
8,00	32	-20,24	8,00	32	23,77

23 Step 6.4 Stage 3: MHW +0,5

23.1 Input Data Left

23.1.1 Calculation Method

Calculation method: C, phi, delta

23.1.2 Water Level

Water level: 12,70 [m]

23.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

23.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

23.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

23.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

23.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	120,35

23.4 Input Data Right

23.4.1 Calculation Method

Calculation method: C, phi, delta

23.4.2 Water Level

Water level: 10,75 [m]

23.4.3 Surface

X [m]	Y [m]
0,00	10,84

23.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+0.5)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	6,47
20	9,80	n.a.	n.a.	n.a.	6,47	16,18
32	8,00	n.a.	n.a.	n.a.	16,18	16,18

23.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

23.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,64	7,73
4	9,61	0,0	18,5	0,00	0,54	4,95
5	9,24	0,0	26,5	0,00	0,54	4,78
6	9,03	0,0	31,1	0,00	0,54	4,75
7	8,88	0,0	34,5	0,00	0,54	4,73
8	8,56	0,5	41,4	0,06	0,54	4,72
9	8,19	3,3	49,8	0,31	0,54	4,71
10	7,76	4,6	52,3	0,33	0,53	3,75
11	7,28	6,2	70,5	0,33	0,53	3,74
12	6,79	7,8	88,6	0,33	0,53	3,73
13	6,31	9,4	106,8	0,33	0,53	3,72
14	5,83	11,0	125,0	0,33	0,53	3,72
15	5,34	12,7	143,2	0,33	0,53	3,71
16	4,86	14,3	161,5	0,33	0,53	3,71
17	4,38	15,9	179,7	0,33	0,53	3,71
18	3,89	17,5	198,0	0,33	0,53	3,71

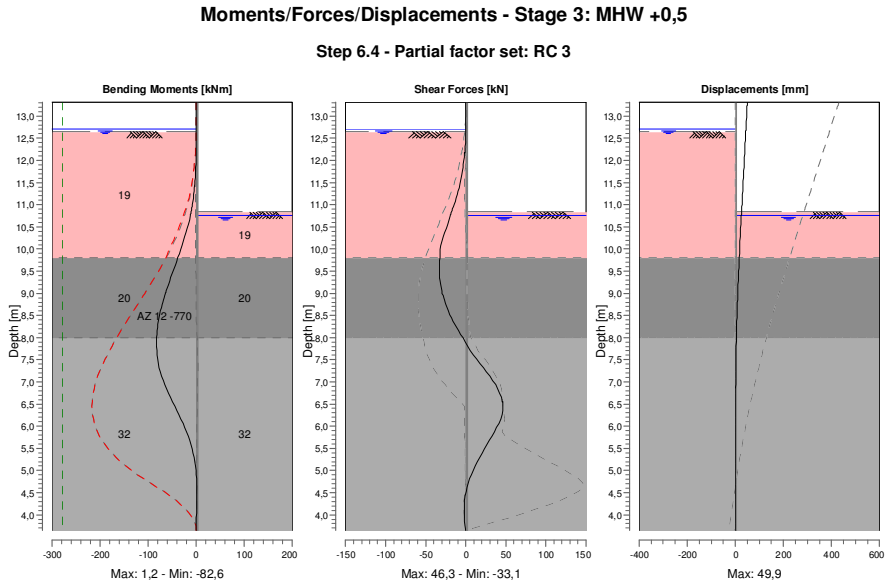
23.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	61,13
32	136,52

23.7 Calculation Results

Number of iterations: 4

23.7.1 Charts of Moments, Forces and Displacements



23.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**49,9**
1	13,20	0,0	0,0	48,8
2	13,20	0,0	0,0	48,8
2	13,15	0,0	0,0	48,3
3	13,15	0,0	0,0	48,3
3	12,70	0,0	0,0	43,9
4	12,70	0,0	0,0	43,9
4	12,65	0,0	0,0	43,4
5	12,65	0,0	0,0	43,4
5	12,32	-0,1	-0,7	40,2
6	12,32	-0,1	-0,7	40,2
6	12,20	-0,2	-1,2	39,0
7	12,20	-0,2	-1,2	39,0
7	12,15	-0,3	-1,5	38,6
8	12,15	-0,3	-1,5	38,6
8	11,77	-1,3	-4,3	34,8
9	11,77	-1,3	-4,3	34,8
9	11,38	-3,7	-8,5	31,1
10	11,38	-3,7	-8,5	31,1
10	11,00	-8,1	-14,5	27,4
11	11,00	-8,1	-14,5	27,4
11	10,84	-10,8	-17,9	25,9
12	10,84	-10,8	-17,9	25,9
12	10,75	-12,3	-19,4	25,0
13	10,75	-12,3	-19,4	25,0
13	10,28	-23,6	-27,9	20,6

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-23,6	-27,9	20,6
14	9,80	-38,3	-32,4	16,3
15	9,80	-38,3	-32,4	16,3
15	9,43	-50,7	-32,8	13,2
16	9,43	-50,7	-32,8	13,2
16	9,05	-62,5	-29,9	10,3
17	9,05	-62,5	-29,9	10,3
17	9,00	-64,0	-29,2	9,9
18	9,00	-64,0	-29,2	9,9
18	8,75	-70,8	-25,1	8,2
19	8,75	-70,8	-25,1	8,2
19	8,38	-78,6	-16,0	5,9
20	8,38	-78,6	-16,0	5,9
20	8,00	**-82,4**	-3,5	3,9
21	8,00	**-82,4**	-3,5	3,9
21	7,52	-80,3	13,4	2,0
22	7,52	-80,3	13,4	2,0
22	7,03	-68,8	33,7	0,8
23	7,03	-68,8	33,8	0,8
23	6,55	-49,1	**45,8**	0,2
24	6,55	-49,1	**45,8**	0,2
24	6,07	-27,4	41,2	-0,1
25	6,07	-27,4	41,1	-0,1
25	5,58	-11,0	26,4	-0,2
26	5,58	-11,0	26,4	-0,2
26	5,10	-1,9	11,8	-0,1
27	5,10	-1,9	11,8	-0,1
27	4,62	1,1	1,6	0,0
28	4,62	1,1	1,6	0,0
28	4,13	0,7	-2,1	0,0
29	4,13	0,7	-2,1	0,0
29	3,65	0,0	0,0	0,1
Max		**-82,4**	**45,8**	**49,9**
Max, minor nodes incl.		-82,6	46,3	49,9

23.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
3	13,15	0,00	0,00	-		0,00	0,00	-	
3	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,70	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,49	-		0,00	0,00	-	
5	12,65	0,00	0,49	A		0,00	0,00	-	
5	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,32	0,00	3,73	A		0,00	0,00	-	
6	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,20	0,00	4,91	A		0,00	0,00	-	
7	12,15	0,00	5,40	A		0,00	0,00	-	
8	12,15	0,00	5,40	A		0,00	0,00	-	
8	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,77	0,00	9,16	A		0,00	0,00	-	
9	11,38	0,00	12,92	A		0,00	0,00	-	
10	11,38	0,74	12,92	A		0,00	0,00	-	
10	11,00	0,96	16,68	A		0,00	0,00	-	
11	11,00	3,02	16,68	A		0,00	0,00	-	
11	10,84	3,32	18,30	A		0,00	0,00	-	
12	10,84	3,50	18,30	A		0,00	5,18	P	
12	10,75	3,66	19,13	A		0,00	5,29	P	

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* [%]
13	10,75	4,02	19,13	A		0,00	5,29	P	
13	10,28	5,00	23,79	A		0,00	10,54	P	
14	10,28	5,54	23,79	A		0,00	10,54	P	
14	9,80	6,61	28,45	A		21,96	15,79	P	
15	9,80	7,27	28,45	A		14,06	15,79	P	
15	9,43	8,43	32,13	A		22,97	21,49	P	
16	9,43	8,46	32,13	A		22,19	21,49	P	
16	9,05	9,61	35,81	A		30,80	27,19	P	
17	9,05	9,63	35,81	A		30,57	27,19	P	
17	9,00	9,79	36,30	A		31,71	27,95	P	
18	9,00	9,80	36,30	A		31,61	27,95	P	
18	8,75	10,57	38,75	A		37,29	31,75	P	
19	8,75	10,60	38,75	A		37,16	31,75	P	
19	8,38	11,75	42,43	A		45,65	37,46	P	
20	8,38	11,79	42,43	A		45,55	37,46	P	
20	8,00	12,93	46,11	A		50,93	43,16	3	94
21	8,00	13,67	46,11	A		43,05	43,16	P	
21	7,52	15,22	50,85	A		61,53	47,90	P	
22	7,52	15,30	50,85	A		61,27	47,90	P	
22	7,03	16,85	55,59	A		58,12	52,64	2	73
23	7,03	16,93	55,59	A		58,01	52,64	2	73
23	6,55	18,48	60,33	A		29,98	57,38	1	31
24	6,55	18,68	60,33	A		29,98	57,38	1	31
24	6,07	34,82	65,07	1	24	13,14	62,12	1	
25	6,07	35,31	65,07	1	24	13,14	62,12	1	
25	5,58	40,65	69,81	1	26	11,85	66,86	A	
26	5,58	41,15	69,81	1	25	11,85	66,86	A	
26	5,10	37,94	74,56	1	22	13,47	71,61	A	
27	5,10	38,44	74,56	1	22	13,47	71,61	A	
27	4,62	33,51	79,30	1	18	22,57	76,35	1	
28	4,62	34,00	79,30	1	18	22,57	76,35	1	
28	4,13	29,71	84,04	1		31,49	81,09	1	17
29	4,13	30,21	84,04	1		31,49	81,09	1	17
29	3,65	27,56	88,78	A		39,88	85,83	1	19

*

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

23.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	144,7	202,2
Water	401,7	344,1
Total	546,5	546,3

Considered as passive side	Right
Maximum passive effective resistance	609,81 kN
Mobilized passive effective resistance	202,19 kN
Percentage mobilized resistance	33,2 %

23.7.5 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	-28,88
Vertical force passive	45,56
Resulting vertical force (no dead weight)	16,68
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-28,88
Vertical force passive	45,56
Resulting vertical force (no dead weight)	16,68
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

23.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,56	10,84	19	1,15
9,80	20	-6,03	9,80	20	20,26
8,00	32	-21,29	8,00	32	24,15

24 Step 6.5 Stage 3: MHW +0,5

24.1 Input Data Left

24.1.1 Calculation Method

Calculation method: C, phi, delta

24.1.2 Water Level

Water level: 12,65 [m]

24.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

24.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

24.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

24.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	20,9	0,00	0,35	15,44
2	12,23	0,0	28,9	0,00	0,35	8,51
3	11,96	0,0	37,8	0,00	0,35	6,68
4	11,57	0,0	50,1	0,00	0,35	5,71
5	11,19	0,0	62,4	0,00	0,36	5,26
6	10,80	0,0	61,8	0,00	0,36	4,12
7	10,40	1,3	63,4	0,07	0,37	3,49
8	10,00	4,2	67,8	0,20	0,38	3,18
9	9,60	6,7	100,6	0,27	0,28	4,06
10	9,20	7,8	118,1	0,27	0,29	4,12
11	8,83	8,8	113,1	0,27	0,30	3,51
12	8,50	9,7	126,3	0,28	0,31	3,57
13	8,17	10,6	140,0	0,28	0,32	3,63
14	7,76	12,0	125,4	0,28	0,32	2,96
15	7,28	13,3	138,1	0,28	0,33	2,95
16	6,79	14,7	158,0	0,29	0,34	3,07
17	6,31	16,0	176,9	0,29	0,35	3,16
18	5,83	17,3	196,0	0,29	0,35	3,25
19	5,34	19,0	215,6	0,29	0,36	3,32
20	4,86	20,3	236,0	0,29	0,37	3,41
21	4,38	21,4	257,2	0,29	0,38	3,49
22	3,89	22,6	278,4	0,29	0,38	3,56

24.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	15,56
32	96,71

24.4 Input Data Right

24.4.1 Calculation Method

Calculation method: C, phi, delta

24.4.2 Water Level

Water level: 11,00 [m]

24.4.3 Surface

X [m]	Y [m]
0,00	11,00

24.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+0.5)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	6,47
20	9,80	n.a.	n.a.	n.a.	6,47	16,18
32	8,00	n.a.	n.a.	n.a.	16,18	16,18

24.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

24.5 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	10,80	0,0	15,5	0,00	0,00	0,00
2	10,40	0,0	15,5	0,00	0,00	0,00
3	10,00	0,0	15,5	0,00	0,58	7,89
4	9,60	0,0	25,3	0,00	0,47	5,87
5	9,20	0,0	35,9	0,00	0,47	5,76
6	8,83	0,0	45,7	0,00	0,47	5,71
7	8,50	0,0	54,7	0,00	0,47	5,70
8	8,17	0,0	63,7	0,00	0,47	5,69
9	7,76	3,6	70,7	0,25	0,46	4,89
10	7,28	5,3	94,7	0,27	0,46	4,89
11	6,79	6,6	118,7	0,27	0,46	4,89
12	6,31	7,9	142,7	0,27	0,46	4,88
13	5,83	9,3	166,7	0,27	0,46	4,88
14	5,34	10,6	190,8	0,27	0,46	4,88
15	4,86	12,0	214,8	0,27	0,46	4,88
16	4,38	13,3	238,8	0,27	0,46	4,88
17	3,89	14,6	262,8	0,27	0,46	4,88

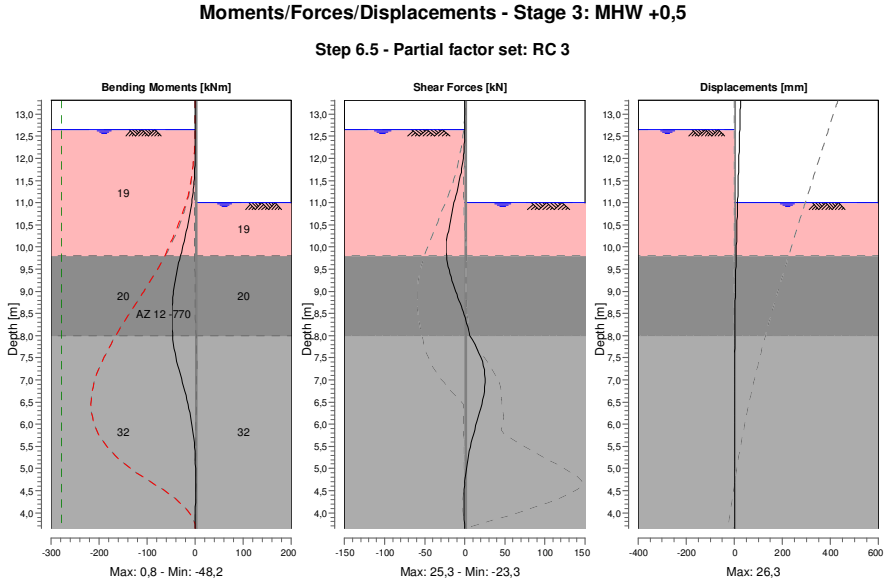
24.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	52,82
32	90,78

24.7 Calculation Results

Number of iterations: 5

24.7.1 Charts of Moments, Forces and Displacements



24.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**26,3**
1	13,15	0,0	0,0	25,3
2	13,15	0,0	0,0	25,3
2	12,90	0,0	0,0	24,0
3	12,90	0,0	0,0	24,0
3	12,65	0,0	0,0	22,6
4	12,65	0,0	0,0	22,6
4	12,32	-0,1	-0,5	20,7
5	12,32	-0,1	-0,5	20,7
5	12,15	-0,2	-1,2	19,8
6	12,15	-0,2	-1,2	19,8
6	11,77	-1,1	-3,8	17,7
7	11,77	-1,1	-3,8	17,7
7	11,38	-3,3	-7,9	15,6
8	11,38	-3,3	-7,9	15,6
8	11,00	-7,3	-13,4	13,5
9	11,00	-7,3	-13,4	13,5
9	10,60	-13,6	-17,7	11,3
10	10,60	-13,6	-17,7	11,3
10	10,20	-21,6	-22,4	9,2
11	10,20	-21,6	-22,4	9,2
11	9,80	-30,8	-22,5	7,3
12	9,80	-30,8	-22,4	7,3
12	9,40	-39,1	-18,5	5,5
13	9,40	-39,1	-18,5	5,5
13	9,00	-45,1	-11,3	4,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	-45,1	-11,3	4,0
14	8,67	-47,7	-4,3	2,9
15	8,67	-47,7	-4,3	2,9
15	8,33	**-48,2**	1,5	1,9
16	8,33	**-48,2**	1,4	1,9
16	8,00	-46,9	5,9	1,2
17	8,00	-46,9	6,0	1,2
17	7,52	-40,3	20,2	0,5
18	7,52	-40,3	20,2	0,5
18	7,03	-28,9	**25,3**	0,1
19	7,03	-28,9	**25,3**	0,1
19	6,55	-17,1	22,4	-0,1
20	6,55	-17,1	22,4	-0,1
20	6,07	-7,9	15,3	-0,1
21	6,07	-7,9	15,3	-0,1
21	5,58	-2,3	8,2	-0,1
22	5,58	-2,3	8,2	-0,1
22	5,10	0,2	2,8	0,0
23	5,10	0,2	2,8	0,0
23	4,62	0,8	-0,2	0,0
24	4,62	0,8	-0,2	0,0
24	4,13	0,4	-1,1	0,1
25	4,13	0,4	-1,1	0,1
25	3,65	0,0	0,0	0,1
Max		**-48,2**	**25,3**	**26,3**
Max, minor nodes incl.		-48,2	25,3	26,3

24.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,15	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
2	12,90	0,00	0,00	-		0,00	0,00	-	
3	12,90	0,00	0,00	-		0,00	0,00	-	
3	12,65	0,00	0,00	-		0,00	0,00	-	
4	12,65	0,00	0,00	A		0,00	0,00	-	
4	12,32	0,00	3,24	A		0,00	0,00	-	
5	12,32	0,00	3,24	A		0,00	0,00	-	
5	12,15	0,00	4,91	A		0,00	0,00	-	
6	12,15	0,00	4,91	A		0,00	0,00	-	
6	11,77	0,00	8,67	A		0,00	0,00	-	
7	11,77	0,00	8,67	A		0,00	0,00	-	
7	11,38	0,00	12,43	A		0,00	0,00	-	
8	11,38	0,00	12,43	A		0,00	0,00	-	
8	11,00	0,00	16,19	A		0,00	0,00	-	
9	11,00	0,00	16,19	A		0,00	4,98	P	
9	10,60	0,00	20,11	A		0,00	9,40	P	
10	10,60	1,17	20,11	A		0,00	9,40	P	
10	10,20	1,39	24,03	A		0,00	13,82	P	
11	10,20	3,89	24,03	A		4,58	13,82	P	
11	9,80	4,50	27,96	A		20,95	18,24	2	79
12	9,80	6,22	27,96	A		19,70	18,24	P	
12	9,40	7,27	31,88	A		30,96	24,32	P	
13	9,40	7,31	31,88	A		30,37	24,32	P	
13	9,00	8,36	35,81	A		33,64	30,41	3	81
14	9,00	8,39	35,81	A		33,45	30,41	3	81
14	8,67	9,26	39,08	A		32,75	35,47	2	65
15	8,67	9,30	39,08	A		33,29	35,47	2	66
15	8,33	10,17	42,35	A		28,27	40,54	1	48
16	8,33	10,20	42,35	A		29,62	40,54	2	50
16	8,00	11,07	45,62	A		20,74	45,61	1	30

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	8,00	11,33	45,62	A		45,94	45,61	2	78
17	7,52	12,61	50,36	A		33,46	50,35	1	40
18	7,52	12,67	50,36	A		33,46	50,35	1	40
18	7,03	15,16	55,10	1		16,73	55,09	1	16
19	7,03	14,20	55,10	1		16,73	55,09	1	16
19	6,55	22,36	59,84	1	14	10,33	59,83	1	
20	6,55	22,84	59,84	1	13	10,33	59,83	1	
20	6,07	25,63	64,58	1	14	10,22	64,58	1	
21	6,07	26,11	64,58	1	14	10,22	64,58	1	
21	5,58	26,22	69,32	1	13	13,17	69,32	1	
22	5,58	26,71	69,32	1	13	13,17	69,32	1	
22	5,10	26,01	74,07	1	12	17,55	74,06	1	
23	5,10	26,49	74,07	1	12	17,55	74,06	1	
23	4,62	25,85	78,81	1		22,12	78,80	1	10
24	4,62	26,33	78,81	1		22,12	78,80	1	10
24	4,13	25,94	83,55	1		26,47	83,54	1	11
25	4,13	26,43	83,55	1		26,47	83,54	1	11
25	3,65	26,18	88,29	1		30,71	88,28	1	11

*

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

24.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	114,5	149,3
Water	397,3	362,6
Total	511,8	511,9

Considered as passive side	Right
Maximum passive effective resistance	810,80 kN
Mobilized passive effective resistance	149,25 kN
Percentage mobilized resistance	18,4 %

24.7.5 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	-26,69
Vertical force passive	41,05
Resulting vertical force (no dead weight)	14,36
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

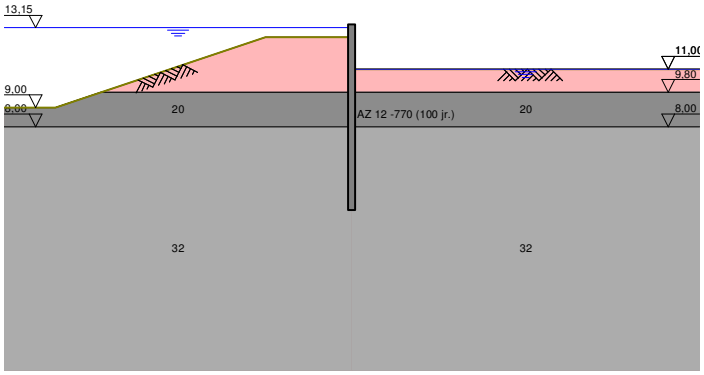
Vertical force balance plugged	Force [kN]
Vertical force active	-26,69
Vertical force passive	41,05
Resulting vertical force (no dead weight)	14,36
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

24.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-0,66	11,00	19	1,69
9,80	20	-6,08	9,80	20	20,63
8,00	32	-19,96	8,00	32	18,73

25 Outline Stage 4: MHW +1,0

Outline - Stage 4: MHW +1,0

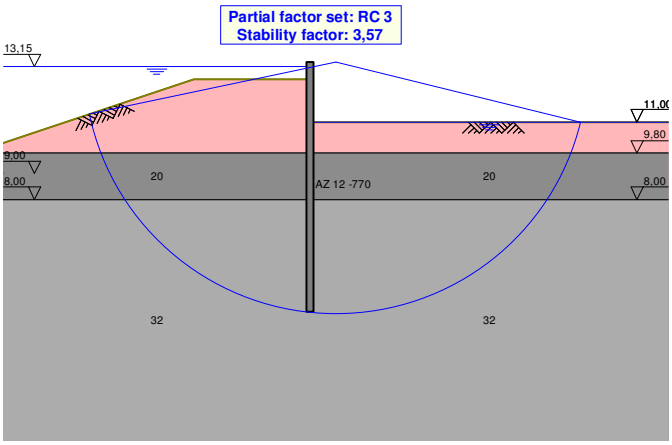


26 Overall Stability Stage 4: MHW +1,0

Stability factor : 3,57

26.1 Overall Stability

Overall Stability - Stage 4: MHW +1,0



27 Step 6.1 Stage 4: MHW +1,0

27.1 Input Data Left

27.1.1 Calculation Method

Calculation method: C, phi, delta

27.1.2 Water Level

Water level: 13,20 [m]

27.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

27.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

27.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

27.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

27.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	226,03

27.4 Input Data Right

27.4.1 Calculation Method

Calculation method: C, phi, delta

27.4.2 Water Level

Water level: 11,00 [m]

27.4.3 Surface

X [m]	Y [m]
0,00	10,84

27.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+1.0)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	8,44
20	9,80	n.a.	n.a.	n.a.	8,44	21,09
32	8,00	n.a.	n.a.	n.a.	21,09	21,09

27.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

27.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,00	0,00
4	9,61	0,0	3,2	0,00	0,54	5,11
5	9,24	0,0	9,0	0,00	0,54	4,96
6	9,03	0,0	12,1	0,00	0,54	4,88
7	8,88	0,0	14,3	0,00	0,54	4,84
8	8,56	0,0	18,9	0,00	0,54	4,78
9	8,19	0,0	24,3	0,00	0,54	4,74
10	7,76	0,7	30,6	0,08	0,53	3,73
11	7,28	4,3	48,8	0,33	0,53	3,72
12	6,79	5,9	67,0	0,33	0,53	3,72
13	6,31	7,5	85,3	0,33	0,53	3,71
14	5,83	9,2	103,5	0,33	0,53	3,71
15	5,34	10,8	121,8	0,33	0,53	3,71
16	4,86	12,4	140,0	0,33	0,53	3,71
17	4,38	14,0	158,3	0,33	0,53	3,71
18	3,89	15,6	176,6	0,33	0,53	3,71

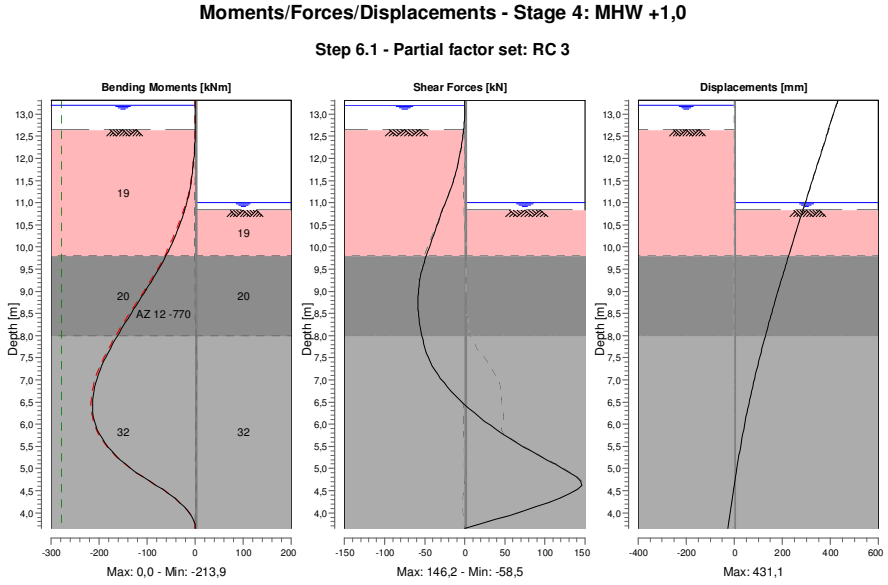
27.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	24,98
32	281,39

27.7 Calculation Results

Number of iterations: 8

27.7.1 Charts of Moments, Forces and Displacements



27.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**431,1**
1	13,20	0,0	0,0	424,1
2	13,20	0,0	0,0	424,1
2	13,15	0,0	0,0	421,1
3	13,15	0,0	0,0	421,1
3	12,70	-0,2	-1,2	394,7
4	12,70	-0,2	-1,2	394,7
4	12,65	-0,3	-1,5	391,8
5	12,65	-0,3	-1,5	391,8
5	12,32	-1,1	-3,8	372,5
6	12,32	-1,1	-3,8	372,5
6	12,20	-1,6	-4,9	365,4
7	12,20	-1,6	-4,9	365,4
7	12,15	-1,9	-5,4	362,5
8	12,15	-1,9	-5,4	362,5
8	11,77	-4,8	-10,1	340,0
9	11,77	-4,8	-10,1	340,0
9	11,38	-9,8	-16,2	317,6
10	11,38	-9,8	-16,2	317,6
10	11,00	-17,5	-24,1	295,2
11	11,00	-17,5	-24,1	295,2
11	10,84	-21,8	-28,1	285,6
12	10,84	-21,8	-28,1	285,6
12	10,75	-24,2	-29,7	280,7
13	10,75	-24,2	-29,7	280,7
13	10,28	-40,5	-38,6	253,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-40,5	-38,6	253,2
14	9,80	-61,0	-48,0	226,0
15	9,80	-61,0	-48,0	226,0
15	9,43	-80,3	-54,1	204,9
16	9,43	-80,3	-54,1	204,9
16	9,05	-101,3	-57,6	184,2
17	9,05	-101,3	-57,6	184,2
17	9,00	-104,2	-57,8	181,5
18	9,00	-104,2	-57,8	181,5
18	8,75	-118,7	-58,5	168,0
19	8,75	-118,7	-58,5	168,0
19	8,38	-140,5	-57,2	148,3
20	8,38	-140,5	-57,2	148,3
20	8,00	-161,3	-53,4	129,2
21	8,00	-161,3	-53,4	129,2
21	7,52	-185,7	-45,9	105,9
22	7,52	-185,7	-45,8	105,9
22	7,03	-204,4	-30,3	84,1
23	7,03	-204,4	-30,2	84,1
23	6,55	**-213,6**	-6,6	63,9
24	6,55	**-213,6**	-6,6	63,9
24	6,07	-209,5	25,0	45,5
25	6,07	-209,5	25,0	45,5
25	5,58	-188,1	64,6	28,8
26	5,58	-188,1	64,6	28,8
26	5,10	-145,7	111,9	13,7
27	5,10	-145,7	112,2	13,7
27	4,62	-81,4	146,1	-0,3
28	4,62	-81,3	**146,2**	-0,3
28	4,13	-22,2	88,9	-13,6
29	4,13	-22,2	88,6	-13,6
29	3,65	0,0	0,0	-26,7
Max		**-213,6**	**146,2**	**431,1**
Max, minor nodes incl.		-213,9	146,2	431,1

27.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,49	-		0,00	0,00	-	
3	13,15	0,00	0,49	-		0,00	0,00	-	
3	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,65	0,00	5,40	-		0,00	0,00	-	
5	12,65	0,00	5,40	A		0,00	0,00	-	
5	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,15	0,00	10,30	A		0,00	0,00	-	
8	12,15	0,00	10,30	A		0,00	0,00	-	
8	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,38	0,00	17,82	A		0,00	0,00	-	
10	11,38	0,74	17,82	A		0,00	0,00	-	
10	11,00	0,96	21,58	A		0,00	0,00	-	
11	11,00	3,02	21,58	A		0,00	0,00	-	
11	10,84	3,32	23,20	A		0,00	1,62	-	
12	10,84	3,50	23,20	A		0,00	8,38	P	
12	10,75	3,66	24,03	A		0,00	9,35	P	

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* [%]
13	10,75	4,02	24,03	A		0,00	9,35	P	
13	10,28	5,00	28,69	A		0,00	14,78	P	
14	10,28	5,54	28,69	A		0,00	14,78	P	
14	9,80	6,61	33,35	A		0,00	20,21	P	
15	9,80	7,27	33,35	A		0,19	20,21	P	
15	9,43	8,43	37,03	A		6,25	26,53	P	
16	9,43	8,46	37,03	A		6,06	26,53	P	
16	9,05	9,61	40,71	A		11,94	32,84	P	
17	9,05	9,63	40,71	A		11,76	32,84	P	
17	9,00	9,79	41,20	A		12,53	33,68	P	
18	9,00	9,80	41,20	A		12,42	33,68	P	
18	8,75	10,57	43,65	A		16,24	37,89	P	
19	8,75	10,60	43,65	A		16,04	37,89	P	
19	8,38	11,75	47,33	A		21,71	44,21	P	
20	8,38	11,79	47,33	A		21,54	44,21	P	
20	8,00	12,93	51,01	A		27,16	50,52	P	
21	8,00	13,67	51,01	A		21,37	50,52	P	
21	7,52	15,22	55,75	A		39,74	55,26	P	
22	7,52	15,30	55,75	A		39,65	55,26	P	
22	7,03	16,85	60,49	A		57,97	60,00	P	
23	7,03	16,93	60,49	A		57,89	60,00	P	
23	6,55	18,48	65,24	A		76,19	64,74	P	
24	6,55	18,68	65,24	A		76,14	64,74	P	
24	6,07	20,24	69,98	A		94,42	69,49	P	
25	6,07	20,36	69,98	A		94,39	69,49	P	
25	5,58	21,93	74,72	A		112,67	74,23	P	
26	5,58	21,80	74,72	A		112,64	74,23	P	
26	5,10	23,35	79,46	A		123,91	78,97	3	95
27	5,10	23,22	79,46	A		123,90	78,97	3	95
27	4,62	41,00	84,20	1	22	13,20	83,71	A	
28	4,62	41,50	84,20	1	21	13,20	83,71	A	
28	4,13	174,74	88,94	3	85	14,82	88,45	A	
29	4,13	177,54	88,94	3	85	14,82	88,45	A	
29	3,65	219,50	93,69	3	99	16,43	93,19	A	

*

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

27.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	250,4	306,4
Water	447,4	391,2
Total	697,8	697,5

Considered as passive side	Right
Maximum passive effective resistance	475,41 kN
Mobilized passive effective resistance	306,37 kN
Percentage mobilized resistance	64,4 %

27.7.5 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	-47,58
Vertical force passive	58,06
Resulting vertical force (no dead weight)	10,48
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-47,58
Vertical force passive	58,06
Resulting vertical force (no dead weight)	10,48
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

27.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,56	10,84	19	0,00
9,80	20	-6,03	9,80	20	8,28
8,00	32	-39,99	8,00	32	49,78

28 Step 6.2 Stage 4: MHW +1,0

28.1 Input Data Left

28.1.1 Calculation Method

Calculation method: C, phi, delta

28.1.2 Water Level

Water level: 13,20 [m]

28.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

28.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

28.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

28.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

28.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	226,30

28.4 Input Data Right

28.4.1 Calculation Method

Calculation method: C, phi, delta

28.4.2 Water Level

Water level: 11,00 [m]

28.4.3 Surface

X [m]	Y [m]
0,00	10,84

28.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+1.0)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	8,44
20	9,80	n.a.	n.a.	n.a.	8,44	21,09
32	8,00	n.a.	n.a.	n.a.	21,09	21,09

28.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

28.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,00	0,00
4	9,61	0,0	3,2	0,00	0,54	5,11
5	9,24	0,0	9,0	0,00	0,54	4,96
6	9,03	0,0	12,1	0,00	0,54	4,88
7	8,88	0,0	14,3	0,00	0,54	4,84
8	8,56	0,0	18,9	0,00	0,54	4,78
9	8,19	0,0	24,3	0,00	0,54	4,74
10	7,76	0,7	30,6	0,08	0,53	3,73
11	7,28	4,3	48,8	0,33	0,53	3,72
12	6,79	5,9	67,0	0,33	0,53	3,72
13	6,31	7,5	85,3	0,33	0,53	3,71
14	5,83	9,2	103,5	0,33	0,53	3,71
15	5,34	10,8	121,8	0,33	0,53	3,71
16	4,86	12,4	140,0	0,33	0,53	3,71
17	4,38	14,0	158,3	0,33	0,53	3,71
18	3,89	15,6	176,6	0,33	0,53	3,71

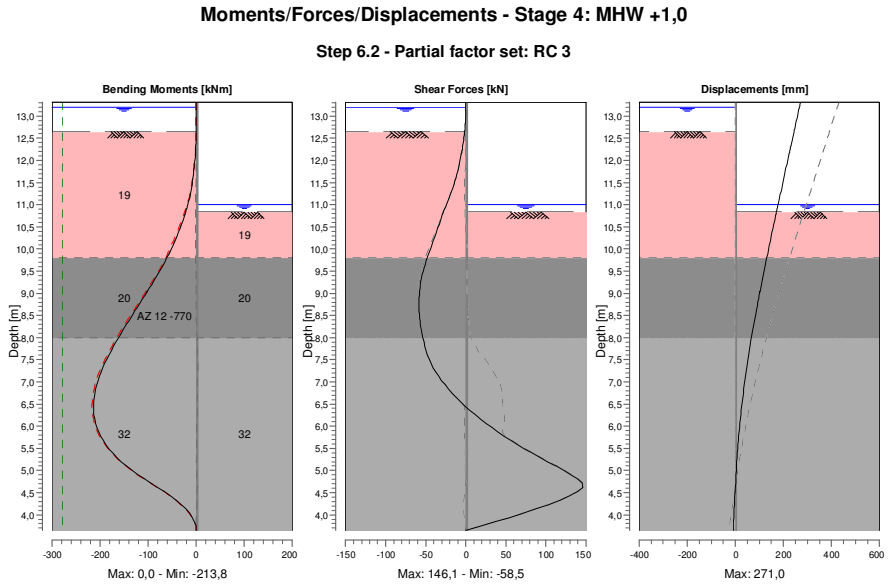
28.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	24,98
32	281,52

28.7 Calculation Results

Number of iterations: 8

28.7.1 Charts of Moments, Forces and Displacements



28.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**271,0**
1	13,20	0,0	0,0	266,2
2	13,20	0,0	0,0	266,2
2	13,15	0,0	0,0	264,2
3	13,15	0,0	0,0	264,2
3	12,70	-0,2	-1,2	246,1
4	12,70	-0,2	-1,2	246,1
4	12,65	-0,3	-1,5	244,1
5	12,65	-0,3	-1,5	244,1
5	12,32	-1,1	-3,8	230,8
6	12,32	-1,1	-3,8	230,8
6	12,20	-1,6	-4,9	226,0
7	12,20	-1,6	-4,9	226,0
7	12,15	-1,9	-5,4	224,0
8	12,15	-1,9	-5,4	224,0
8	11,77	-4,8	-10,1	208,6
9	11,77	-4,8	-10,1	208,6
9	11,38	-9,8	-16,2	193,2
10	11,38	-9,8	-16,2	193,2
10	11,00	-17,5	-24,1	177,9
11	11,00	-17,5	-24,1	177,9
11	10,84	-21,8	-28,1	171,3
12	10,84	-21,8	-28,1	171,3
12	10,75	-24,2	-29,7	167,9
13	10,75	-24,2	-29,7	167,9
13	10,28	-40,5	-38,6	149,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-40,5	-38,6	149,2
14	9,80	-61,0	-48,0	130,8
15	9,80	-61,0	-48,0	130,8
15	9,43	-80,3	-54,1	116,6
16	9,43	-80,3	-54,1	116,6
16	9,05	-101,3	-57,6	102,8
17	9,05	-101,3	-57,6	102,8
17	9,00	-104,2	-57,8	101,0
18	9,00	-104,2	-57,8	101,0
18	8,75	-118,7	-58,5	92,1
19	8,75	-118,7	-58,5	92,1
19	8,38	-140,5	-57,2	79,2
20	8,38	-140,5	-57,2	79,2
20	8,00	-161,3	-53,4	67,1
21	8,00	-161,3	-53,4	67,1
21	7,52	-185,6	-45,8	52,7
22	7,52	-185,6	-45,8	52,7
22	7,03	-204,3	-30,2	39,7
23	7,03	-204,3	-30,0	39,7
23	6,55	**-213,5**	-6,4	28,5
24	6,55	**-213,5**	-6,4	28,5
24	6,07	-209,2	25,2	19,0
25	6,07	-209,2	25,1	19,0
25	5,58	-187,9	64,7	11,2
26	5,58	-187,9	64,7	11,2
26	5,10	-145,4	112,1	4,9
27	5,10	-145,4	112,4	4,9
27	4,62	-80,9	**146,1**	-0,2
28	4,62	-80,8	**146,1**	-0,2
28	4,13	-22,0	88,2	-4,6
29	4,13	-22,0	88,0	-4,6
29	3,65	0,0	0,0	-8,8
Max		**-213,5**	**146,1**	**271,0**
Max, minor nodes incl.		-213,8	146,1	271,0

28.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,49	-		0,00	0,00	-	
3	13,15	0,00	0,49	-		0,00	0,00	-	
3	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,65	0,00	5,40	-		0,00	0,00	-	
5	12,65	0,00	5,40	A		0,00	0,00	-	
5	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,15	0,00	10,30	A		0,00	0,00	-	
8	12,15	0,00	10,30	A		0,00	0,00	-	
8	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,38	0,00	17,82	A		0,00	0,00	-	
10	11,38	0,74	17,82	A		0,00	0,00	-	
10	11,00	0,96	21,58	A		0,00	0,00	-	
11	11,00	3,02	21,58	A		0,00	0,00	-	
11	10,84	3,32	23,20	A		0,00	1,62	-	
12	10,84	3,50	23,20	A		0,00	8,38	P	
12	10,75	3,66	24,03	A		0,00	9,35	P	

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* [%]
13	10,75	4,02	24,03	A		0,00	9,35	P	
13	10,28	5,00	28,69	A		0,00	14,78	P	
14	10,28	5,54	28,69	A		0,00	14,78	P	
14	9,80	6,61	33,35	A		0,00	20,21	P	
15	9,80	7,27	33,35	A		0,19	20,21	P	
15	9,43	8,43	37,03	A		6,25	26,53	P	
16	9,43	8,46	37,03	A		6,06	26,53	P	
16	9,05	9,61	40,71	A		11,94	32,84	P	
17	9,05	9,63	40,71	A		11,76	32,84	P	
17	9,00	9,79	41,20	A		12,53	33,68	P	
18	9,00	9,80	41,20	A		12,42	33,68	P	
18	8,75	10,57	43,65	A		16,24	37,89	P	
19	8,75	10,60	43,65	A		16,04	37,89	P	
19	8,38	11,75	47,33	A		21,71	44,21	P	
20	8,38	11,79	47,33	A		21,54	44,21	P	
20	8,00	12,93	51,01	A		27,16	50,52	P	
21	8,00	13,67	51,01	A		21,37	50,52	P	
21	7,52	15,22	55,75	A		39,74	55,26	P	
22	7,52	15,30	55,75	A		39,65	55,26	P	
22	7,03	16,85	60,49	A		57,97	60,00	P	
23	7,03	16,93	60,49	A		57,89	60,00	P	
23	6,55	18,48	65,24	A		76,19	64,74	P	
24	6,55	18,68	65,24	A		76,14	64,74	P	
24	6,07	20,24	69,98	A		94,42	69,49	P	
25	6,07	20,36	69,98	A		94,39	69,49	P	
25	5,58	21,93	74,72	A		112,67	74,23	P	
26	5,58	21,80	74,72	A		112,64	74,23	P	
26	5,10	23,35	79,46	A		125,88	78,97	3	96
27	5,10	23,22	79,46	A		125,87	78,97	3	96
27	4,62	47,39	84,20	1	25	13,20	83,71	A	
28	4,62	47,89	84,20	1	25	13,20	83,71	A	
28	4,13	174,32	88,94	3	85	14,82	88,45	A	
29	4,13	177,12	88,94	3	84	14,82	88,45	A	
29	3,65	217,11	93,69	3	98	16,43	93,19	A	

*

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

28.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	250,7	306,5
Water	447,4	391,2
Total	698,0	697,7

Considered as passive side	Right
Maximum passive effective resistance	475,41 kN
Mobilized passive effective resistance	306,51 kN
Percentage mobilized resistance	64,5 %

28.7.5 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	-47,62
Vertical force passive	58,08
Resulting vertical force (no dead weight)	10,46
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-47,62
Vertical force passive	58,08
Resulting vertical force (no dead weight)	10,46
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

28.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,56	10,84	19	0,00
9,80	20	-6,03	9,80	20	8,28
8,00	32	-40,04	8,00	32	49,80

29 Step 6.3 Stage 4: MHW +1,0

29.1 Input Data Left

29.1.1 Calculation Method

Calculation method: C, phi, delta

29.1.2 Water Level

Water level: 13,20 [m]

29.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

29.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

29.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

29.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

29.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	224,52

29.4 Input Data Right

29.4.1 Calculation Method

Calculation method: C, phi, delta

29.4.2 Water Level

Water level: 10,75 [m]

29.4.3 Surface

X [m]	Y [m]
0,00	10,84

29.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+1.0)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	8,44
20	9,80	n.a.	n.a.	n.a.	8,44	21,09
32	8,00	n.a.	n.a.	n.a.	21,09	21,09

29.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	3076,92	3076,92	1538,46	1538,46
20	9,80	9230,77	9230,77	4615,38	4615,38
32	8,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	615,38	615,38
20	9,80	2307,69	2307,69
32	8,00	7692,31	7692,31

29.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,00	0,00
4	9,61	0,0	7,4	0,00	0,54	5,05
5	9,24	0,0	12,9	0,00	0,54	4,88
6	9,03	0,0	16,0	0,00	0,54	4,82
7	8,88	0,0	18,2	0,00	0,54	4,79
8	8,56	0,0	22,7	0,00	0,54	4,75
9	8,19	0,0	28,2	0,00	0,54	4,73
10	7,76	1,9	33,7	0,21	0,53	3,74
11	7,28	4,6	52,0	0,33	0,53	3,73
12	6,79	6,2	70,2	0,33	0,53	3,72
13	6,31	7,8	88,4	0,33	0,53	3,71
14	5,83	9,4	106,7	0,33	0,53	3,71
15	5,34	11,0	124,9	0,33	0,53	3,71
16	4,86	12,7	143,2	0,33	0,53	3,71
17	4,38	14,3	161,4	0,33	0,53	3,71
18	3,89	15,9	179,7	0,33	0,53	3,71

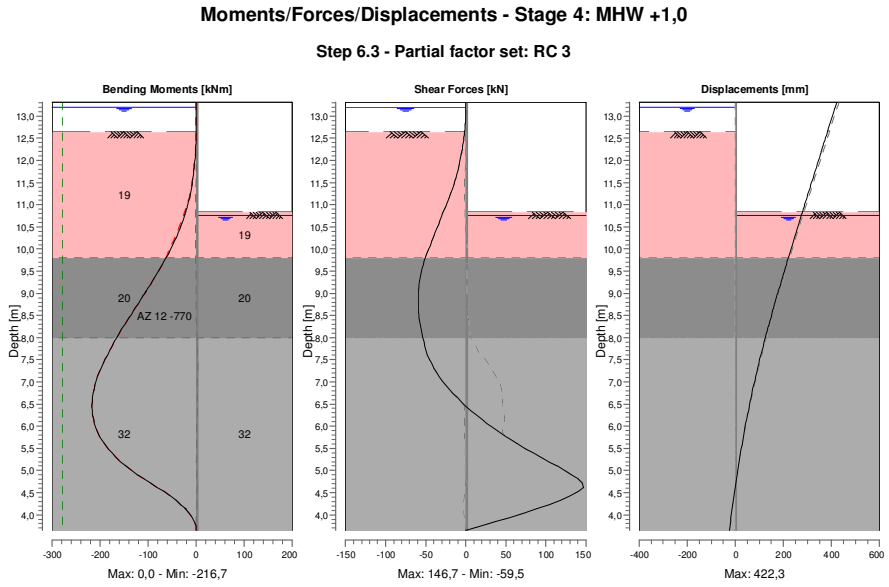
29.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	32,07
32	290,50

29.7 Calculation Results

Number of iterations: 8

29.7.1 Charts of Moments, Forces and Displacements



29.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**422,3**
1	13,20	0,0	0,0	415,4
2	13,20	0,0	0,0	415,4
2	13,15	0,0	0,0	412,5
3	13,15	0,0	0,0	412,5
3	12,70	-0,2	-1,2	386,5
4	12,70	-0,2	-1,2	386,5
4	12,65	-0,3	-1,5	383,6
5	12,65	-0,3	-1,5	383,6
5	12,32	-1,1	-3,8	364,5
6	12,32	-1,1	-3,8	364,5
6	12,20	-1,6	-4,9	357,6
7	12,20	-1,6	-4,9	357,6
7	12,15	-1,9	-5,4	354,7
8	12,15	-1,9	-5,4	354,7
8	11,77	-4,8	-10,1	332,6
9	11,77	-4,8	-10,1	332,6
9	11,38	-9,8	-16,2	310,5
10	11,38	-9,8	-16,2	310,5
10	11,00	-17,5	-24,1	288,4
11	11,00	-17,5	-24,1	288,4
11	10,84	-21,8	-28,3	278,9
12	10,84	-21,8	-28,3	278,9
12	10,75	-24,3	-30,0	274,0
13	10,75	-24,3	-30,0	274,0
13	10,28	-40,9	-40,1	247,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-40,9	-40,1	247,0
14	9,80	-62,4	-50,6	220,2
15	9,80	-62,4	-50,6	220,2
15	9,43	-82,5	-56,1	199,4
16	9,43	-82,5	-56,1	199,4
16	9,05	-104,2	-59,0	179,0
17	9,05	-104,2	-59,0	179,0
17	9,00	-107,2	-59,2	176,4
18	9,00	-107,2	-59,2	176,4
18	8,75	-122,0	-59,5	163,1
19	8,75	-122,0	-59,5	163,1
19	8,38	-144,1	-57,7	143,7
20	8,38	-144,1	-57,7	143,7
20	8,00	-165,0	-53,4	125,1
21	8,00	-165,0	-53,4	125,1
21	7,52	-189,2	-45,5	102,3
22	7,52	-189,2	-45,4	102,3
22	7,03	-207,7	-29,5	81,0
23	7,03	-207,7	-29,5	81,0
23	6,55	**-216,4**	-5,5	61,4
24	6,55	**-216,4**	-5,5	61,4
24	6,07	-211,7	26,4	43,6
25	6,07	-211,7	26,4	43,6
25	5,58	-189,6	66,3	27,5
26	5,58	-189,6	66,3	27,5
26	5,10	-146,3	113,7	13,0
27	5,10	-146,3	114,0	13,0
27	4,62	-81,4	146,6	-0,4
28	4,62	-81,3	**146,7**	-0,4
28	4,13	-22,1	88,8	-13,0
29	4,13	-22,2	88,6	-13,0
29	3,65	0,0	0,0	-25,5
Max		**-216,4**	**146,7**	**422,3**
Max, minor nodes incl.		-216,7	146,7	422,3

29.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,49	-		0,00	0,00	-	
3	13,15	0,00	0,49	-		0,00	0,00	-	
3	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,65	0,00	5,40	-		0,00	0,00	-	
5	12,65	0,00	5,40	A		0,00	0,00	-	
5	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,15	0,00	10,30	A		0,00	0,00	-	
8	12,15	0,00	10,30	A		0,00	0,00	-	
8	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,38	0,00	17,82	A		0,00	0,00	-	
10	11,38	0,74	17,82	A		0,00	0,00	-	
10	11,00	0,96	21,58	A		0,00	0,00	-	
11	11,00	3,02	21,58	A		0,00	0,00	-	
11	10,84	3,32	23,20	A		0,00	0,00	-	
12	10,84	3,50	23,20	A		0,00	6,76	P	
12	10,75	3,66	24,03	A		0,00	6,90	P	

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* [%]
13	10,75	4,02	24,03	A		0,00	6,90	P	
13	10,28	5,00	28,69	A		0,00	12,33	P	
14	10,28	5,54	28,69	A		0,00	12,33	P	
14	9,80	6,61	33,35	A		0,00	17,76	P	
15	9,80	7,27	33,35	A		4,40	17,76	P	
15	9,43	8,43	37,03	A		10,38	24,07	P	
16	9,43	8,46	37,03	A		10,03	24,07	P	
16	9,05	9,61	40,71	A		15,82	30,39	P	
17	9,05	9,63	40,71	A		15,63	30,39	P	
17	9,00	9,79	41,20	A		16,39	31,23	P	
18	9,00	9,80	41,20	A		16,29	31,23	P	
18	8,75	10,57	43,65	A		20,08	35,44	P	
19	8,75	10,60	43,65	A		19,91	35,44	P	
19	8,38	11,75	47,33	A		25,55	41,75	P	
20	8,38	11,79	47,33	A		25,42	41,75	P	
20	8,00	12,93	51,01	A		31,02	48,07	P	
21	8,00	13,67	51,01	A		24,52	48,07	P	
21	7,52	15,22	55,75	A		42,93	52,81	P	
22	7,52	15,30	55,75	A		42,80	52,81	P	
22	7,03	16,85	60,49	A		61,15	57,55	P	
23	7,03	16,93	60,49	A		61,04	57,55	P	
23	6,55	18,48	65,24	A		79,35	62,29	P	
24	6,55	18,68	65,24	A		79,27	62,29	P	
24	6,07	20,24	69,98	A		97,57	67,03	P	
25	6,07	20,36	69,98	A		97,51	67,03	P	
25	5,58	21,93	74,72	A		115,80	71,78	P	
26	5,58	21,80	74,72	A		115,76	71,78	P	
26	5,10	23,35	79,46	A		124,23	76,52	3	93
27	5,10	23,22	79,46	A		124,22	76,52	3	93
27	4,62	43,10	84,20	1	23	13,47	81,26	A	
28	4,62	43,60	84,20	1	23	13,47	81,26	A	
28	4,13	173,30	88,94	3	84	15,09	86,00	A	
29	4,13	176,09	88,94	3	84	15,09	86,00	A	
29	3,65	216,44	93,69	3	98	16,71	90,74	A	

*

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

29.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	248,9	322,6
Water	447,4	373,4
Total	696,2	696,0

Considered as passive side	Right
Maximum passive effective resistance	496,13 kN
Mobilized passive effective resistance	322,58 kN
Percentage mobilized resistance	65,0 %

29.7.5 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	-47,31
Vertical force passive	62,02
Resulting vertical force (no dead weight)	14,71
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-47,31
Vertical force passive	62,02
Resulting vertical force (no dead weight)	14,71
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

29.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,56	10,84	19	0,00
9,80	20	-6,03	9,80	20	10,63
8,00	32	-39,72	8,00	32	51,39

30 Step 6.4 Stage 4: MHW +1,0

30.1 Input Data Left

30.1.1 Calculation Method

Calculation method: C, phi, delta

30.1.2 Water Level

Water level: 13,20 [m]

30.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

30.1.4 Soil Material Properties in Profile: 54O

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

30.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

30.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	13,3	0,00	0,41	9,87
2	12,26	0,0	19,0	0,00	0,41	5,94
3	12,18	0,0	21,1	0,00	0,41	5,43
4	11,96	0,0	26,5	0,00	0,41	4,68
5	11,57	0,0	36,0	0,00	0,41	4,11
6	11,19	0,8	45,6	0,07	0,42	3,84
7	10,92	3,2	52,4	0,23	0,42	3,73
8	10,79	3,6	55,5	0,24	0,42	3,69
9	10,51	4,5	52,2	0,26	0,43	3,02
10	10,04	6,1	53,9	0,29	0,44	2,57
11	9,61	7,8	87,9	0,32	0,35	3,56
12	9,24	9,0	101,6	0,32	0,36	3,59
13	9,03	9,7	109,2	0,32	0,36	3,60
14	8,88	10,2	113,7	0,32	0,37	3,58
15	8,56	11,2	104,0	0,32	0,38	2,99
16	8,19	12,4	117,6	0,32	0,39	3,07
17	7,76	14,4	89,8	0,34	0,39	2,12
18	7,28	16,1	107,1	0,34	0,40	2,28
19	6,79	17,7	124,0	0,34	0,41	2,41
20	6,31	19,5	138,9	0,35	0,42	2,48
21	5,83	21,1	153,5	0,35	0,43	2,54
22	5,34	22,6	168,3	0,35	0,44	2,60
23	4,86	24,0	183,6	0,35	0,44	2,65
24	4,38	25,4	199,5	0,34	0,45	2,70
25	3,89	26,8	215,8	0,34	0,46	2,76

30.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	18,19
32	224,82

30.4 Input Data Right

30.4.1 Calculation Method

Calculation method: C, phi, delta

30.4.2 Water Level

Water level: 10,75 [m]

30.4.3 Surface

X [m]	Y [m]
0,00	10,84

30.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+1.0)

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]
19	15,00	18,00	18,00	2,14	21,24	14,16
20	9,80	18,00	20,00	0,00	27,51	18,34
32	8,00	19,00	20,00	0,00	27,96	10,03

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	8,44
20	9,80	n.a.	n.a.	n.a.	8,44	21,09
32	8,00	n.a.	n.a.	n.a.	21,09	21,09

30.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	9000,00	9000,00	4500,00	4500,00
20	9,80	27000,00	27000,00	13500,00	13500,00
32	8,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	1800,00	1800,00
20	9,80	6750,00	6750,00
32	8,00	22500,00	22500,00

30.5 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	10,79	0,0	9,2	0,00	0,00	0,00
2	10,51	0,0	9,2	0,00	0,00	0,00
3	10,04	0,0	9,2	0,00	0,00	0,00
4	9,61	0,0	7,4	0,00	0,54	5,05
5	9,24	0,0	12,9	0,00	0,54	4,88
6	9,03	0,0	16,0	0,00	0,54	4,82
7	8,88	0,0	18,2	0,00	0,54	4,79
8	8,56	0,0	22,7	0,00	0,54	4,75
9	8,19	0,0	28,2	0,00	0,54	4,73
10	7,76	1,9	33,7	0,21	0,53	3,74
11	7,28	4,6	52,0	0,33	0,53	3,73
12	6,79	6,2	70,2	0,33	0,53	3,72
13	6,31	7,8	88,4	0,33	0,53	3,71
14	5,83	9,4	106,7	0,33	0,53	3,71
15	5,34	11,0	124,9	0,33	0,53	3,71
16	4,86	12,7	143,2	0,33	0,53	3,71
17	4,38	14,3	161,4	0,33	0,53	3,71
18	3,89	15,9	179,7	0,33	0,53	3,71

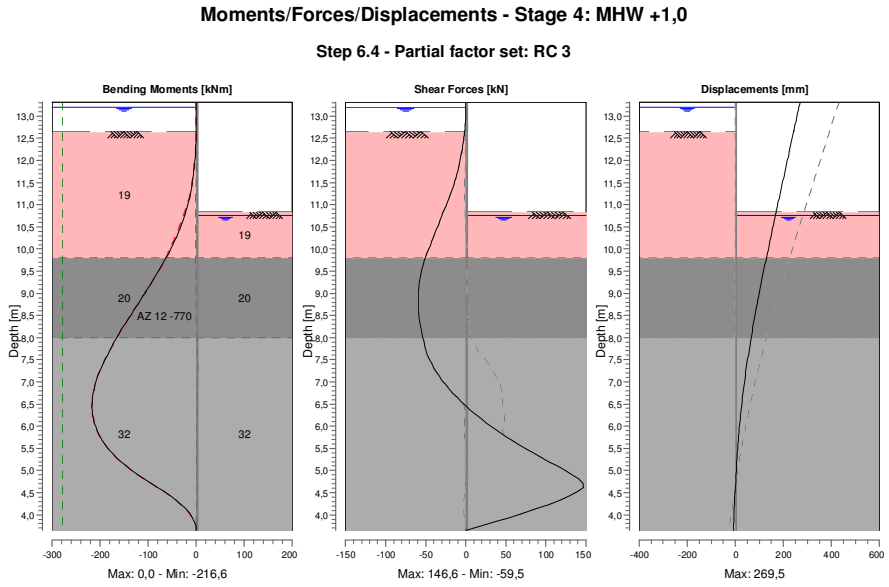
30.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	32,07
32	290,67

30.7 Calculation Results

Number of iterations: 8

30.7.1 Charts of Moments, Forces and Displacements



30.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**269,5**
1	13,20	0,0	0,0	264,7
2	13,20	0,0	0,0	264,7
2	13,15	0,0	0,0	262,7
3	13,15	0,0	0,0	262,7
3	12,70	-0,2	-1,2	244,6
4	12,70	-0,2	-1,2	244,6
4	12,65	-0,3	-1,5	242,6
5	12,65	-0,3	-1,5	242,6
5	12,32	-1,1	-3,8	229,3
6	12,32	-1,1	-3,8	229,3
6	12,20	-1,6	-4,9	224,5
7	12,20	-1,6	-4,9	224,5
7	12,15	-1,9	-5,4	222,5
8	12,15	-1,9	-5,4	222,5
8	11,77	-4,8	-10,1	207,1
9	11,77	-4,8	-10,1	207,1
9	11,38	-9,8	-16,2	191,7
10	11,38	-9,8	-16,2	191,7
10	11,00	-17,5	-24,1	176,4
11	11,00	-17,5	-24,1	176,4
11	10,84	-21,8	-28,3	169,8
12	10,84	-21,8	-28,3	169,8
12	10,75	-24,3	-30,0	166,4
13	10,75	-24,3	-30,0	166,4
13	10,28	-40,9	-40,1	147,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	10,28	-40,9	-40,1	147,7
14	9,80	-62,4	-50,6	129,3
15	9,80	-62,4	-50,6	129,3
15	9,43	-82,5	-56,1	115,1
16	9,43	-82,5	-56,1	115,1
16	9,05	-104,2	-59,0	101,3
17	9,05	-104,2	-59,0	101,3
17	9,00	-107,2	-59,2	99,5
18	9,00	-107,2	-59,2	99,5
18	8,75	-122,0	-59,5	90,6
19	8,75	-122,0	-59,5	90,6
19	8,38	-144,1	-57,7	77,9
20	8,38	-144,1	-57,7	77,9
20	8,00	-165,0	-53,4	65,8
21	8,00	-165,0	-53,3	65,8
21	7,52	-189,2	-45,4	51,5
22	7,52	-189,2	-45,4	51,5
22	7,03	-207,6	-29,4	38,7
23	7,03	-207,6	-29,3	38,7
23	6,55	**-216,3**	-5,4	27,6
24	6,55	**-216,3**	-5,3	27,6
24	6,07	-211,5	26,6	18,3
25	6,07	-211,5	26,5	18,3
25	5,58	-189,4	66,4	10,7
26	5,58	-189,4	66,4	10,7
26	5,10	-146,0	114,0	4,7
27	5,10	-146,0	114,3	4,7
27	4,62	-80,9	146,5	-0,2
28	4,62	-80,8	**146,6**	-0,2
28	4,13	-21,9	88,1	-4,4
29	4,13	-22,0	87,9	-4,4
29	3,65	0,0	0,0	-8,4
Max		**-216,3**	**146,6**	**269,5**
Max, minor nodes incl.		-216,6	146,6	269,5

30.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,20	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,49	-		0,00	0,00	-	
3	13,15	0,00	0,49	-		0,00	0,00	-	
3	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,70	0,00	4,91	-		0,00	0,00	-	
4	12,65	0,00	5,40	-		0,00	0,00	-	
5	12,65	0,00	5,40	A		0,00	0,00	-	
5	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,32	0,00	8,63	A		0,00	0,00	-	
6	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,20	0,00	9,81	A		0,00	0,00	-	
7	12,15	0,00	10,30	A		0,00	0,00	-	
8	12,15	0,00	10,30	A		0,00	0,00	-	
8	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,77	0,00	14,06	A		0,00	0,00	-	
9	11,38	0,00	17,82	A		0,00	0,00	-	
10	11,38	0,74	17,82	A		0,00	0,00	-	
10	11,00	0,96	21,58	A		0,00	0,00	-	
11	11,00	3,02	21,58	A		0,00	0,00	-	
11	10,84	3,32	23,20	A		0,00	0,00	-	
12	10,84	3,50	23,20	A		0,00	6,76	P	
12	10,75	3,66	24,03	A		0,00	6,90	P	

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* [%]
13	10,75	4,02	24,03	A		0,00	6,90	P	
13	10,28	5,00	28,69	A		0,00	12,33	P	
14	10,28	5,54	28,69	A		0,00	12,33	P	
14	9,80	6,61	33,35	A		0,00	17,76	P	
15	9,80	7,27	33,35	A		4,40	17,76	P	
15	9,43	8,43	37,03	A		10,38	24,07	P	
16	9,43	8,46	37,03	A		10,03	24,07	P	
16	9,05	9,61	40,71	A		15,82	30,39	P	
17	9,05	9,63	40,71	A		15,63	30,39	P	
17	9,00	9,79	41,20	A		16,39	31,23	P	
18	9,00	9,80	41,20	A		16,29	31,23	P	
18	8,75	10,57	43,65	A		20,08	35,44	P	
19	8,75	10,60	43,65	A		19,91	35,44	P	
19	8,38	11,75	47,33	A		25,55	41,75	P	
20	8,38	11,79	47,33	A		25,42	41,75	P	
20	8,00	12,93	51,01	A		31,02	48,07	P	
21	8,00	13,67	51,01	A		24,52	48,07	P	
21	7,52	15,22	55,75	A		42,93	52,81	P	
22	7,52	15,30	55,75	A		42,80	52,81	P	
22	7,03	16,85	60,49	A		61,15	57,55	P	
23	7,03	16,93	60,49	A		61,04	57,55	P	
23	6,55	18,48	65,24	A		79,35	62,29	P	
24	6,55	18,68	65,24	A		79,27	62,29	P	
24	6,07	20,24	69,98	A		97,57	67,03	P	
25	6,07	20,36	69,98	A		97,51	67,03	P	
25	5,58	21,93	74,72	A		115,80	71,78	P	
26	5,58	21,80	74,72	A		115,76	71,78	P	
26	5,10	23,35	79,46	A		125,98	76,52	3	94
27	5,10	23,22	79,46	A		125,97	76,52	3	94
27	4,62	50,23	84,20	1	27	13,47	81,26	A	
28	4,62	50,73	84,20	1	26	13,47	81,26	A	
28	4,13	172,83	88,94	3	84	15,09	86,00	A	
29	4,13	175,62	88,94	3	84	15,09	86,00	A	
29	3,65	213,98	93,69	3	96	16,71	90,74	A	

*

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

30.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	249,2	322,7
Water	447,4	373,4
Total	696,5	696,2

Considered as passive side	Right
Maximum passive effective resistance	496,13 kN
Mobilized passive effective resistance	322,74 kN
Percentage mobilized resistance	65,0 %

30.7.5 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	-47,36
Vertical force passive	62,05
Resulting vertical force (no dead weight)	14,69
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-47,36
Vertical force passive	62,05
Resulting vertical force (no dead weight)	14,69
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

30.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-1,56	10,84	19	0,00
9,80	20	-6,03	9,80	20	10,63
8,00	32	-39,77	8,00	32	51,42

31 Step 6.5 Stage 4: MHW +1,0

31.1 Input Data Left

31.1.1 Calculation Method

Calculation method: C, phi, delta

31.1.2 Water Level

Water level: 13,15 [m]

31.1.3 Surface

X [m]	Y [m]
0,00	12,65
4,50	12,65
15,45	9,00

31.1.4 Soil Material Properties in Profile: 54O

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients Active [-]	Neutral [-]	Passive [-]	Additional pore pressure Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	0,00
20	9,80	n.a.	n.a.	n.a.	0,00	0,00
32	8,00	n.a.	n.a.	n.a.	0,00	0,00

31.1.5 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]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

31.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	12,48	0,0	20,9	0,00	0,35	15,44
2	12,23	0,0	28,9	0,00	0,35	8,51
3	11,96	0,0	37,8	0,00	0,35	6,68
4	11,57	0,0	50,1	0,00	0,35	5,71
5	11,19	0,0	62,4	0,00	0,36	5,26
6	10,80	0,0	61,8	0,00	0,36	4,12
7	10,40	1,3	63,4	0,07	0,37	3,49
8	10,00	4,2	67,8	0,20	0,38	3,18
9	9,60	6,7	100,6	0,27	0,28	4,06
10	9,20	7,8	118,1	0,27	0,29	4,12
11	8,83	8,8	113,1	0,27	0,30	3,51
12	8,50	9,7	126,3	0,28	0,31	3,57
13	8,17	10,6	140,0	0,28	0,32	3,63
14	7,76	12,0	125,4	0,28	0,32	2,96
15	7,28	13,3	138,1	0,28	0,33	2,95
16	6,79	14,7	158,0	0,29	0,34	3,07
17	6,31	16,0	176,9	0,29	0,35	3,16
18	5,83	17,3	196,0	0,29	0,35	3,25
19	5,34	19,0	215,6	0,29	0,36	3,32
20	4,86	20,3	236,0	0,29	0,37	3,41
21	4,38	21,4	257,2	0,29	0,38	3,49
22	3,89	22,6	278,4	0,29	0,38	3,56

31.3 Calculated Force from a layer Left

Name	Force
19	0,00
20	15,56
32	106,81

31.4 Input Data Right

31.4.1 Calculation Method

Calculation method: C, phi, delta

31.4.2 Water Level

Water level: 11,00 [m]

31.4.3 Surface

X [m]	Y [m]
0,00	11,00

31.4.4 Soil Material Properties in Profile: 54O_kelder (MHW+1.0)

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]
19	15,00	18,00	18,00	3,00	25,00	16,67
20	9,80	18,00	20,00	0,00	32,00	16,60
32	8,00	19,00	20,00	0,00	32,50	11,66

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
19	15,00	1,00	1,00	Fine
20	9,80	1,00	1,00	Fine
32	8,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
19	15,00	n.a.	n.a.	n.a.	0,00	8,44
20	9,80	n.a.	n.a.	n.a.	8,44	21,09
32	8,00	n.a.	n.a.	n.a.	21,09	21,09

31.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
19	15,00	4000,00	4000,00	2000,00	2000,00
20	9,80	12000,00	12000,00	6000,00	6000,00
32	8,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
19	15,00	800,00	800,00
20	9,80	3000,00	3000,00
32	8,00	10000,00	10000,00

31.5 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	10,80	0,0	15,5	0,00	0,00	0,00
2	10,40	0,0	15,5	0,00	0,00	0,00
3	10,00	0,0	15,5	0,00	0,58	208,30
4	9,60	0,0	12,0	0,00	0,47	5,92
5	9,20	0,0	19,1	0,00	0,47	5,81
6	8,83	0,0	25,6	0,00	0,47	5,76
7	8,50	0,0	31,5	0,00	0,47	5,73
8	8,17	0,0	37,4	0,00	0,47	5,71
9	7,76	0,0	46,6	0,00	0,46	4,89
10	7,28	2,8	70,7	0,20	0,46	4,88
11	6,79	5,3	94,7	0,27	0,46	4,88
12	6,31	6,6	118,7	0,27	0,46	4,88
13	5,83	7,9	142,7	0,27	0,46	4,88
14	5,34	9,3	166,8	0,27	0,46	4,88
15	4,86	10,6	190,8	0,27	0,46	4,88
16	4,38	12,0	214,8	0,27	0,46	4,88
17	3,89	13,3	238,9	0,27	0,46	4,88

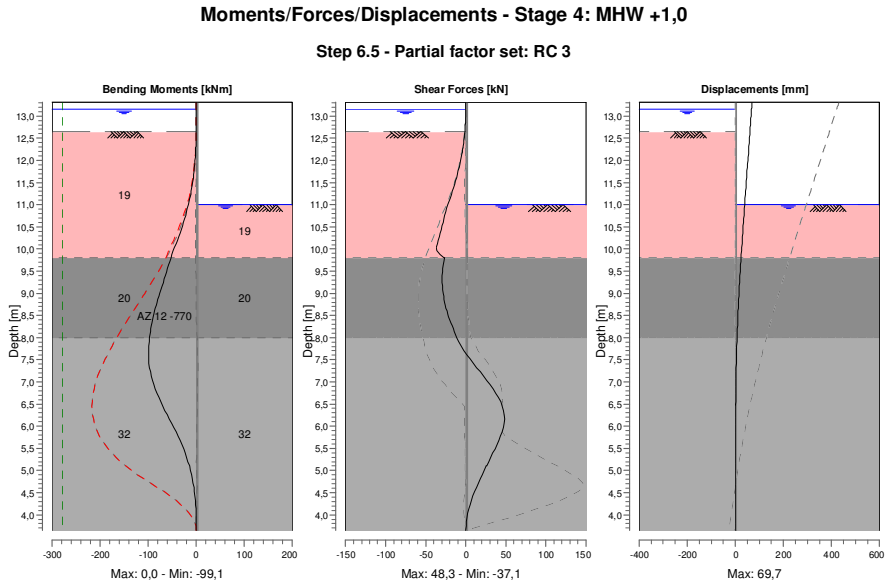
31.6 Calculated Force from a layer Right

Name	Force
19	0,00
20	42,87
32	117,87

31.7 Calculation Results

Number of iterations: 5

31.7.1 Charts of Moments, Forces and Displacements



31.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	13,32	0,0	0,0	**69,7**
1	13,15	0,0	0,0	67,4
2	13,15	0,0	0,0	67,4
2	12,90	0,0	-0,3	64,1
3	12,90	0,0	-0,3	64,1
3	12,65	-0,2	-1,2	60,7
4	12,65	-0,2	-1,2	60,7
4	12,32	-0,9	-3,4	56,3
5	12,32	-0,9	-3,4	56,3
5	12,15	-1,6	-4,9	54,0
6	12,15	-1,6	-4,9	54,0
6	11,77	-4,3	-9,4	48,9
7	11,77	-4,3	-9,4	48,9
7	11,38	-9,0	-15,3	43,9
8	11,38	-9,0	-15,3	43,9
8	11,00	-16,2	-22,7	38,8
9	11,00	-16,2	-22,7	38,8
9	10,60	-26,5	-28,4	33,7
10	10,60	-26,5	-28,4	33,7
10	10,20	-39,0	-34,3	28,7
11	10,20	-39,0	-34,3	28,7
11	9,80	-52,9	-27,0	23,9
12	9,80	-52,9	-26,9	23,9
12	9,40	-64,2	-29,4	19,4
13	9,40	-64,2	-29,3	19,4
13	9,00	-75,9	-28,2	15,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	9,00	-75,9	-28,2	15,2
14	8,67	-84,7	-24,6	12,1
15	8,67	-84,7	-24,6	12,1
15	8,33	-92,0	-18,6	9,3
16	8,33	-92,0	-18,6	9,3
16	8,00	-97,0	-11,1	6,9
17	8,00	-97,0	-11,1	6,9
17	7,52	**-98,8**	5,4	4,0
18	7,52	**-98,8**	5,4	4,0
18	7,03	-91,1	26,3	2,0
19	7,03	-91,1	26,4	2,0
19	6,55	-73,9	43,7	0,7
20	6,55	-73,9	43,7	0,7
20	6,07	-51,1	**48,0**	0,0
21	6,07	-51,1	**48,0**	0,0
21	5,58	-29,8	38,8	-0,3
22	5,58	-29,8	38,8	-0,3
22	5,10	-14,2	25,9	-0,3
23	5,10	-14,2	25,9	-0,3
23	4,62	-4,7	13,4	-0,2
24	4,62	-4,7	13,4	-0,2
24	4,13	-0,7	4,0	-0,1
25	4,13	-0,7	4,0	-0,1
25	3,65	0,0	0,0	0,1
Max		**-98,8**	**48,0**	**69,7**
Max, minor nodes incl.		-99,1	48,3	69,7

31.7.3 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	13,32	0,00	0,00	-		0,00	0,00	-	
1	13,15	0,00	0,00	-		0,00	0,00	-	
2	13,15	0,00	0,00	-		0,00	0,00	-	
2	12,90	0,00	2,45	-		0,00	0,00	-	
3	12,90	0,00	2,45	-		0,00	0,00	-	
3	12,65	0,00	4,91	-		0,00	0,00	-	
4	12,65	0,00	4,91	A		0,00	0,00	-	
4	12,32	0,00	8,14	A		0,00	0,00	-	
5	12,32	0,00	8,14	A		0,00	0,00	-	
5	12,15	0,00	9,81	A		0,00	0,00	-	
6	12,15	0,00	9,81	A		0,00	0,00	-	
6	11,77	0,00	13,57	A		0,00	0,00	-	
7	11,77	0,00	13,57	A		0,00	0,00	-	
7	11,38	0,00	17,33	A		0,00	0,00	-	
8	11,38	0,00	17,33	A		0,00	0,00	-	
8	11,00	0,00	21,09	A		0,00	0,00	-	
9	11,00	0,00	21,09	A		0,00	6,49	P	
9	10,60	0,00	25,02	A		0,00	11,07	P	
10	10,60	1,17	25,02	A		0,00	11,07	P	
10	10,20	1,39	28,94	A		0,00	15,64	P	
11	10,20	3,89	28,94	A		0,00	15,64	P	
11	9,80	4,50	32,86	A		86,08	20,21	1	30
12	9,80	6,22	32,86	A		8,21	20,21	P	
12	9,40	7,27	36,79	A		15,69	26,95	P	
13	9,40	7,31	36,79	A		15,42	26,95	P	
13	9,00	8,36	40,71	A		22,78	33,68	P	
14	9,00	8,39	40,71	A		22,55	33,68	P	
14	8,67	9,26	43,98	A		28,62	39,29	P	
15	8,67	9,30	43,98	A		28,46	39,29	P	
15	8,33	10,17	47,25	A		34,50	44,91	P	
16	8,33	10,20	47,25	A		34,39	44,91	P	
16	8,00	11,07	50,52	A		34,15	50,52	3	85

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	8,00	11,33	50,52	A		34,59	50,52	P	
17	7,52	12,61	55,26	A		54,01	55,26	3	92
18	7,52	12,67	55,26	A		54,00	55,26	3	92
18	7,03	13,95	60,00	A		55,12	60,00	2	67
19	7,03	14,01	60,00	A		55,11	60,00	2	67
19	6,55	15,29	64,75	A		40,25	64,74	1	38
20	6,55	15,35	64,75	A		40,25	64,74	1	38
20	6,07	20,20	69,49	1	11	13,38	69,49	1	10
21	6,07	20,68	69,49	1	11	13,38	69,49	1	10
21	5,58	33,41	74,23	1	16	8,61	74,23	A	
22	5,58	33,90	74,23	1	16	8,61	74,23	A	
22	5,10	36,69	78,97	1	16	9,95	78,97	A	
23	5,10	37,18	78,97	1	16	9,95	78,97	A	
23	4,62	35,17	83,71	1	14	11,29	83,71	A	
24	4,62	35,66	83,71	1	14	11,29	83,71	A	
24	4,13	31,97	88,45	1	12	18,18	88,45	1	
25	4,13	32,45	88,45	1	12	18,18	88,45	1	
25	3,65	28,46	93,19	1		26,16	93,19	1	10

*

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

31.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	124,6	175,0
Water	442,7	392,3
Total	567,3	567,2

Considered as passive side	Right
Maximum passive effective resistance	696,39 kN
Mobilized passive effective resistance	174,97 kN
Percentage mobilized resistance	25,1 %

31.7.5 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	-28,78
Vertical force passive	45,33
Resulting vertical force (no dead weight)	16,55
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-28,78
Vertical force passive	45,33
Resulting vertical force (no dead weight)	16,55
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

31.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
12,65	19	-0,66	11,00	19	4,26
9,80	20	-6,08	9,80	20	16,74
8,00	32	-22,04	8,00	32	24,32

End of Report

Bepaling corrosie op damwanden

Project:	Prioritaire dijkversterking	Datum:	1-12-2014	Blad	1 van 2
Projectnummer:	9x4447	Naam:	GLI		
Omschrijving:	Corrosie en controle staalspanning Maasstaete	Versie:	1.0		

Toepassingsgebied

Spreadsheet is toepasbaar voor berekeningen van gereduceerde eigenschappen van damwandprofielen:
Z-profielen

Uitgangspunten

Corrosie snelheden

Corrosieafname is bepaald conform NEN-EN 1993-5:2008/NB:2012 art. 4.4

Table 4-1: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in soils, with or without groundwater

Required design working life	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils (sand, silt, clay, schist, ...)	0,00	0,30	0,60	0,90	1,20
Polluted natural soils and industrial sites	0,15	0,75	1,50	2,25	3,00
Aggressive natural soils (swamp, marsh, peat, ...)	0,20	1,00	1,75	2,50	3,25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0,18	0,70	1,20	1,70	2,20
Non-compacted and aggressive fills (ashes, slag, ...)	0,50	2,00	3,25	4,50	5,75

Notes:
1) Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.
2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Table 4-2: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in fresh water or in sea water

Required design working life	5 years	25 years	50 years	75 years	100 years
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0,15	0,55	0,90	1,15	1,40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0,30	1,30	2,30	3,30	4,30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0,55	1,90	3,75	5,60	7,50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0,25	0,90	1,75	2,60	3,50

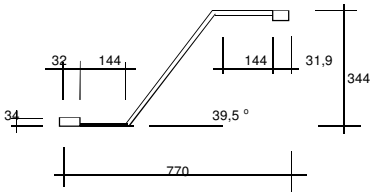
Notes:
1) The highest corrosion rate is usually found in the splash zone or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the permanent immersion zone, see Figure 4-1.
2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Levensduur			100	jaar		
Zijde 1	Grondzijde		2,2	mm	/	100 jaar
Zijde 2	Rivierzijde		2,2	mm	+ /	100 jaar
Totaal			**4,4**	**mm**	/	**100 jaar**

Traagheidsmoment on-aangetaste damwand

type : AZ 12-770

lengte onder tot hoek			144,5	mm
lengte boven tot hoek			144,5	mm
lengte plank	b		770,0	mm
tot hoogte profiel	h		344,0	mm
dikte horizontale delen	t		8,5	mm
dikte schuine stuk	s		8,5	mm
hoek schuine stuk			39,5	°
halve lengte slot		±	31,9	mm
dikte slot		±	34,0	mm
Contact lengte /m^1			1,160	m^2/m^1

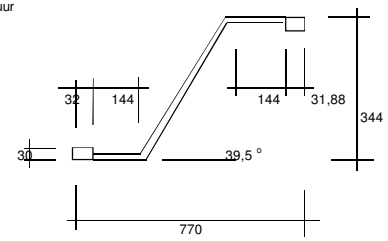


Per plank		***Per m1***		***Per m1 (conform tabellen)***		afwijking
A =	9220,4 mm^2	A =	120 cm^2/m	A =	120 cm^2/m	1,00 -
G =	72,4 kg/m^1	G =	94 kg/m^1	G =	94 kg/m^2	1,00 -
z =	172,0 mm					
I_{xx} =	15024,5 cm^4	I_{xx} =	19512 cm^4/m	I_{xx} =	21430 cm^4/m	0,91 -
W =	873,5 cm^3	W =	1134 cm^3/m	W =	1245 cm^3/m	0,91 -
Wp =	1143,3 cm^3	W =	1485 cm^3/m	W =	1480 cm^3/m	1,00

Traagheidsmoment aangetaste damwand

type : ***AZ 12-770***

levensduur constructie			100	jaar
afname wanddikte			4,4	mm gedurende de levensduur
lengte onder tot hoek			144,5	mm
lengte boven tot hoek			144,5	mm
lengte plank	b		770,0	mm
tot hoogte profiel	h		344,0	mm
dikte horizontale delen	t		4,1	mm
dikte schuine stuk	s		4,1	mm
hoek schuine stuk			39,5	°
halve lengte slot		±	31,9	mm
dikte slot		±	29,6	mm



Per plank		***Per m1***	
A =	5289,0 mm^2	A =	6868,8 mm^2
G =	41,5 kg/m^1	G =	53,9 kg/m^1
z =	172,0 mm		
I_{xx} =	9489,6 cm^4	I_{xx} =	12324,2 cm^4
W =	551,7 cm^3	W =	716,5 cm^3
Wp =	688,7 cm^3	Wp =	894 cm^3

Reductiefactoren voor profielgrootheden

195,8609614

Onderstaand zijn de reductiefactoren weergegeven na een levensduur van:
100 jaar

	γ_{cor}	***Per m1 (conform tabellen)***		***Per m1 (conform tabellen)*** incl. corrosie afname	
A =	0,574 -	A =	120 cm^2/m	A =	69 cm^2/m
G =	0,574 -	G =	94 kg/m^2	G =	54 kg/m^2
I_{xx} =	0,632 -	I_{xx} =	21430 cm^4/m	I_{xx} =	13535 cm^4/m
W =	0,632 -	W =	1245 cm^3/m	W =	786 cm^3/m
Wp =	0,602	Wp =	1480 cm3/m	Wp =	891 cm^3/m

Bepaling corrosie op damwanden

Project:	Prioritaire dijkversterking	Datum:	1-12-2014	Blad	1 van 2
Projectnummer:	9x4447	Naam:	GLI		
Omschrijving:	Corrosie en controle staalspanning Maasstaete	Versie:	1.0		

Bepaling opneembaar moment op damwanden IE = 28424,25 kNm2/m1

Uitgangspunten

Staalkwaliteit S355GP Mu 279 kNm/m

vloeispanning	fy	355	(sheet alleen geldig voor Z-profielen)
Treksterkte	fu	480	

Profielklasse is bepaald aan de hand van tabel 5-1 van de NEN-EN 1993-5

epsilon	e	0,81	
Type profiel		Z	

Met corrosie

Breedte van de flens	b	353	
Dikte van de flens	tf	4,1	
	b/t_f	106	
	ε		
Profielklasse		**4**	

Indien van toepassing, toelaatbare spanning om in profielklasse 3 te vallen

	b/tf	86	
toelaatbare epsion	e_toelaatbaar	1,30	
Toelaatbare spanning		138	
	e	1,30338	

Classification	Z-profile	U-profile
Class 1	- the same boundaries as for class 2 apply - a rotation check has to be carried out	
Class 2	$\frac{b/t_f}{\varepsilon} \le 45$	$\frac{b/t_f}{\varepsilon} \le 37$
Class 3	$\frac{b/t_f}{\varepsilon} \le 66$	$\frac{b/t_f}{\varepsilon} \le 49$

$\varepsilon = \sqrt{235/f_y}$	f_y [N/mm²]	240	270	320	355	390	430
	ε	0,99	0,93	0,86	0,81	0,78	0,74

Voor het bepalen van het moment is aangenomen dat voor profielklasse 4 de spanning wordt gereduceerd. Alternatieve methode is een plooicontrole uitvoeren.

	M_{Ed}	200	kNm/m	
	V_{Ed}	115	kN/m	
	N_{Ed}	0	kN/m	
kniklente	L	1,65	m	
Factor voor scheve buig	β_B	1	[-]	
	β_D	1	[-]	
Reductie voor meer dan 5 meter waterstands verschil	ρ_p	1	[-]	
	$M_{c,Rd}$	109	kNm/m	(5.2) of (5.3)
	c	534	mm	(figuur 5-1)
	A_V	1394	mm2	(5.6)

$c/t_w > 72\,\varepsilon$

130,3 93,8

Dwarskracht plooi noodzakelijk

relatieve stijfheid	λ	1,16		(5.8)
	f_{bv}	57	N/mm^2	(tabel 6-1 van de NEN-EN 1993-1-3)
	$V_{b,Rd}$	104	kN/m	(5.7)
	$V_{PL,Rd}$	145	kN/m	(5.5)

Dwarskracht meer dan 50% van $V_{PL,Rd}$ $V_{Ed}/V_{PL,Rd}$ 0,80 > 0,5

formules hieronder van toepassing

	p	0,35	[-]	(5.10)
	$M_{V,Rd}$	109	kNm/m	(5.9)
	N_{CR}	103044	kN/m	(5.12)

Controle of stabiliteitscontrole nodig is N_{Ed}/N_{CR} 0,000 < 0,04 (5.11)

Geen stabiliteitscontrole nodig

λ	0,10	[-]	(5.13 toelichting)
N_{PL}	952	kN/m	(5.13 toelichting)
α	0,76	[-]	(Tabel 6.1 van de NEN-EN 1993-1-1 curve d)
ϕ	0,47	[-]	(6.49, toelichting NEN-EN 1993-1-1)
χ	1,09	[-]	(6.49 van de NEN-EN 1993-1-1)

Controle stabiliteit Buiging en Normaalkracht

Controle volgens 5,13 2,11 [-]

Check of Normaalkracht meegenomen moet worden in controle moment

$N_{Ed}/N_{PL,Rd}$ 0,00 < 0,1

Normaalkracht hoeft NIET meegenomen worden in berekening

MV,Rd 109 (5.9)

UC stabiliteit	0,00
UC sterkte, moment	1,84
UC sterkte, dwarskracht	1,11
UC sterkte, normaalkract	0,00
UC sterkte, gecombineerd	1,84
UC totaal	**1,84**

w	(b/t_{min}) ε = 20,0	(b/t_{min}) ε = 30,0	(b/t_{min}) ε = 40,0	(b/t_{min}) ε = 50,0
5,0	1,00	1,00	1,00	1,00
10,0	0,99	0,97	0,95	0,87
15,0	0,98	0,96	0,92	0,76
20,0	0,98	0,94	0,88	0,60

Key:
- b is the width of the flange, but b should not be taken as less than $c/\sqrt{2}$, where c is the slant height of the web
- t_{min} is the lesser of t_f or t_w
- t_f is the flange thickness
- t_w is the web thickness
- w is the differential head in m
- $\varepsilon = \sqrt{235/f_y}$; f_y is the yield strength in N/mm².

Notes:
1) ρ_p = 1,0 may be used if the interlocks of Z-piles are welded.
2) Intermediate values may be interpolated linearly.

Report for D-Sheet Piling 14.1

Design of Sheet Pilings
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	4-12-2014
Time of report:	14:37:57
Date of calculation:	4-12-2014
Time of calculation:	11:39:30
Filename:	C:\..\02 Geotechniek\08 Schermen\DR56 Erosiescherm Hengeland 1A
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei DR56 Erosiescherm Hengeland 1A (DP56.051)

Verification according to NEN-EN 9997+C1:2012

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2 Summary

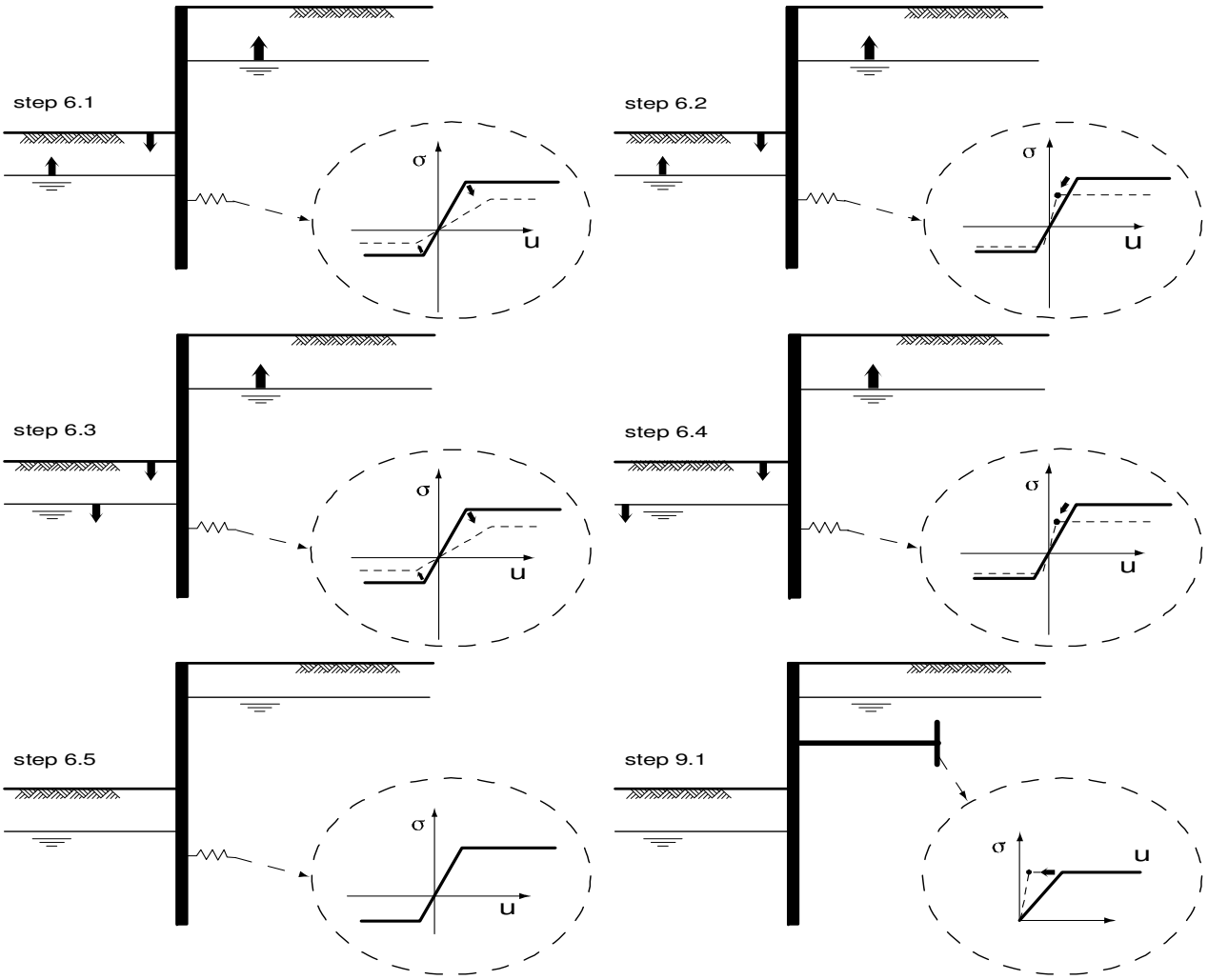
2.1 Overview per Stage and Test

Stage no.	Verification type	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
1	EC7(NL)-Step 6.3		-154,9	70,7	**0,0**	45,1	---
1	EC7(NL)-Step 6.4		-154,7	69,0	**0,0**	44,3	---
1	EC7(NL)-Step 6.5	31,6	-79,6	-38,2	**0,0**	23,8	---
1	EC7(NL)-Step 6.5 * 1,20		-95,5	-45,8			
2	EC7(NL)-Step 6.3		-264,8	169,1	**0,0**	**70,0**	---
2	EC7(NL)-Step 6.4		-264,8	169,2	**0,0**	69,9	---
2	EC7(NL)-Step 6.5	62,6	-135,8	-55,7	**0,0**	29,5	---
2	EC7(NL)-Step 6.5 * 1,20		-163,0	-66,9			
3	EC7(NL)-Step 6.3		**-300,0**	**186,4**	**0,0**	69,4	---
3	EC7(NL)-Step 6.4		**-300,0**	186,1	**0,0**	69,3	---
3	EC7(NL)-Step 6.5	**65,7**	-144,1	-58,6	**0,0**	28,0	---
3	EC7(NL)-Step 6.5 * 1,20		-172,9	-70,3			
Max		**65,7**	**-300,0**	**186,4**	**0,0**	**70,0**	---

2.2 Overall Stability per Stage

Stage name	Stability factor [-]
Ontwerp groene...	2,76
Robuustheid	2,33
Robuustheid + ...	2,45

2.3 CUR Verification Steps



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	10,00 kN/m³
Number of curves on spring characteristic	3
Unloading curve on spring characteristic	No

3.2 Sheet Piling Properties

Length	9,03 m
Level top side	14,63 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 18 -700	5,60	14,63	7,9380E+04	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 18 -700	5,60	14,63	639,00	1,00	1,00	0,51	325,89

Section name	From [m]	To [m]	Red. factor EI [-]	Note to reduction factor	Corrected stiffness EI [kNm²]
AZ 18 -700	5,60	14,63	0,51	(9-4,4)/9=0,51	40480,00

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
AZ 18 -700	5,60	14,63	420,00	1,33	139,00

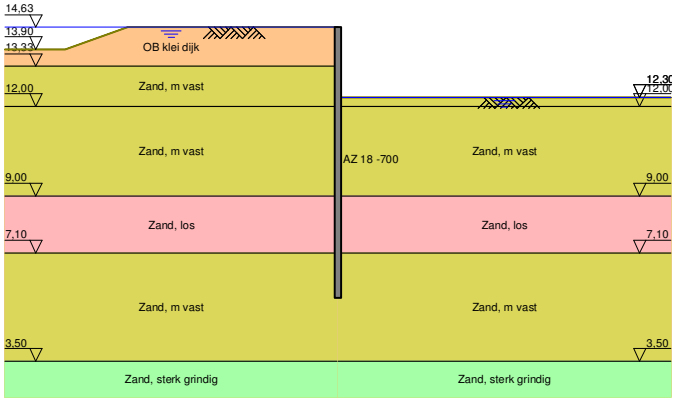
3.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL method A: Partial factors (design values) in all stages Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
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 1: Ontwerp groene kering

Outline - Stage 1: Ontwerp groene kering

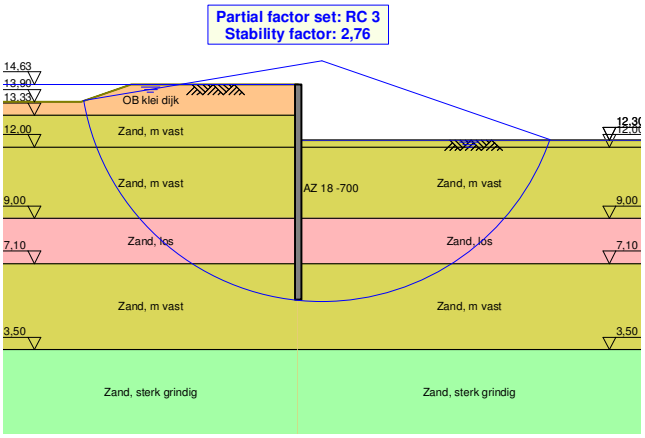


5 Overall Stability Stage 1: Ontwerp groene kering

Stability factor : 2,76

5.1 Overall Stability

Overall Stability - Stage 1: Ontwerp groene kering



6 Step 6.3 Stage 1: Ontwerp groene kering

6.1 Input Data Left

6.1.1 Calculation Method

Calculation method: C, phi, delta

6.1.2 Water Level

Water level: 14,63 [m]

6.1.3 Surface

X [m]	Y [m]
0,00	14,63
7,00	14,63
9,10	13,90

6.1.4 Soil Material Properties in Profile: DR56-SO08 (L +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-7,00
Zand, los	9,00	n.a.	n.a.	n.a.	-7,00	-11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	-11,65	-11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-11,65	-11,65

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]
OB klei dijk	15,13	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,63	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,33	15384,62	15384,62	7692,31	7692,31
Zand, m vast	12,00	15384,62	15384,62	7692,31	7692,31
Zand, los	9,00	9230,77	9230,77	4615,38	4615,38

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, m vast	7,10	15384,62	15384,62	7692,31	7692,31
Zand, sterk gri...	3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	615,38	615,38
OB klei dijk	14,63	615,38	615,38
Zand, m vast	13,33	3846,15	3846,15
Zand, m vast	12,00	3846,15	3846,15
Zand, los	9,00	2307,69	2307,69
Zand, m vast	7,10	3846,15	3846,15
Zand, sterk gri...	3,50	7692,31	7692,31

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	14,62	0,0	10,3	0,00	0,56	121,34
2	14,41	0,0	16,5	0,00	0,56	8,75
3	14,01	0,0	28,2	0,00	0,56	5,31
4	13,60	0,0	39,9	0,00	0,56	4,57
5	13,37	0,0	46,8	0,00	0,56	4,36
6	13,16	2,9	52,9	0,23	0,52	4,15
7	12,81	5,4	66,8	0,34	0,52	4,13
8	12,47	6,6	80,8	0,34	0,53	4,13
9	12,18	7,5	92,6	0,34	0,53	4,12
10	12,06	8,0	97,7	0,34	0,53	4,12
11	12,03	8,1	99,1	0,34	0,53	4,12
12	11,83	8,9	93,0	0,34	0,53	3,54
13	11,50	10,2	105,8	0,34	0,53	3,48
14	11,17	11,6	123,7	0,34	0,53	3,59
15	10,80	13,1	140,5	0,34	0,54	3,61
16	10,40	14,8	158,9	0,34	0,54	3,63
17	10,00	16,5	178,4	0,34	0,54	3,67
18	9,60	18,1	198,1	0,34	0,54	3,70
19	9,20	19,8	218,0	0,34	0,54	3,74
20	8,78	21,5	239,3	0,34	0,55	3,77
21	8,32	23,4	262,1	0,34	0,55	3,80
22	7,93	25,1	281,9	0,34	0,55	3,82
23	7,60	26,4	298,8	0,34	0,55	3,84
24	7,27	27,8	315,7	0,34	0,55	3,85
25	7,05	28,7	326,3	0,34	0,55	3,86
26	6,83	29,5	335,4	0,34	0,55	3,87
27	6,47	30,6	349,7	0,34	0,55	3,88
28	6,13	31,8	364,0	0,34	0,55	3,89
29	5,78	33,0	378,4	0,34	0,55	3,90

6.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	7,42
Zand, m vast	43,14
Zand, los	46,71
Zand, m vast	98,97
Zand, sterk grindig	0,00

6.4 Input Data Right

6.4.1 Calculation Method

Calculation method: C, phi, delta

6.4.2 Water Level

Water level: 12,05 [m]

6.4.3 Surface

X [m]	Y [m]
0,00	12,07

6.4.4 Soil Material Properties in Profile: DR56-SO08 (R +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	7,00
Zand, los	9,00	n.a.	n.a.	n.a.	7,00	11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	11,65	11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	11,65	11,65

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]
OB klei dijk	15,13	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,63	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,33	15384,62	15384,62	7692,31	7692,31
Zand, m vast	12,00	15384,62	15384,62	7692,31	7692,31
Zand, los	9,00	9230,77	9230,77	4615,38	4615,38
Zand, m vast	7,10	15384,62	15384,62	7692,31	7692,31
Zand, sterk gri...	3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	615,38	615,38
OB klei dijk	14,63	615,38	615,38
Zand, m vast	13,33	3846,15	3846,15
Zand, m vast	12,00	3846,15	3846,15
Zand, los	9,00	2307,69	2307,69
Zand, m vast	7,10	3846,15	3846,15
Zand, sterk gri...	3,50	7692,31	7692,31

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	12,06	0,1	0,6	0,34	0,57	4,11
2	12,03	0,2	2,3	0,34	0,57	4,11
3	11,83	0,7	8,6	0,34	0,57	4,11
4	11,50	1,6	19,1	0,34	0,57	4,11
5	11,17	2,4	29,5	0,34	0,57	4,11
6	10,80	3,4	41,1	0,34	0,57	4,11
7	10,40	4,4	53,7	0,34	0,57	4,11
8	10,00	5,4	66,3	0,34	0,57	4,11
9	9,60	6,4	78,9	0,34	0,57	4,11
10	9,20	7,5	91,5	0,34	0,57	4,11
11	8,78	8,6	104,7	0,34	0,57	4,11
12	8,32	9,7	118,7	0,34	0,57	4,11
13	7,93	10,7	130,8	0,34	0,57	4,11
14	7,60	11,5	141,2	0,34	0,57	4,11
15	7,27	12,4	151,5	0,34	0,57	4,11
16	7,05	13,0	158,7	0,34	0,57	4,11
17	6,83	13,7	168,0	0,34	0,57	4,11
18	6,47	14,9	182,4	0,34	0,57	4,11
19	6,13	16,1	196,7	0,34	0,57	4,11
20	5,78	17,3	211,1	0,34	0,57	4,11

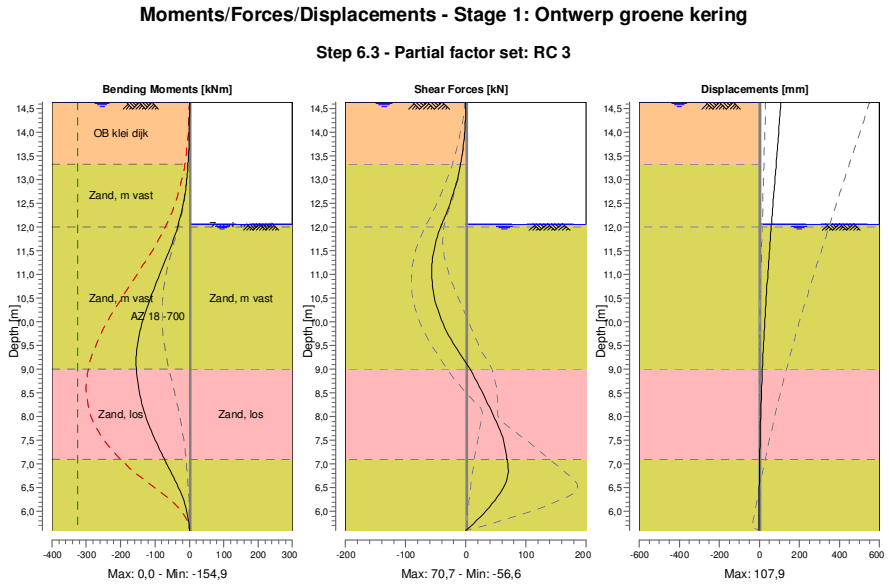
6.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	0,13
Zand, m vast	148,30
Zand, los	121,38
Zand, m vast	34,27
Zand, sterk grindig	0,00

6.7 Calculation Results

Number of iterations: 6

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	14,63	0,0	0,0	**107,9**
1	14,61	0,0	0,0	107,5
2	14,61	0,0	0,0	107,5
2	14,21	-0,1	-0,9	100,0
3	14,21	-0,1	-0,9	100,0
3	13,80	-0,9	-3,4	92,5
4	13,80	-0,9	-3,4	92,5
4	13,40	-3,1	-7,6	85,1
5	13,40	-3,1	-7,6	85,1
5	13,33	-3,7	-8,4	83,8
6	13,33	-3,7	-8,4	83,8
6	12,99	-7,6	-14,5	77,4
7	12,99	-7,6	-14,5	77,4
7	12,64	-13,9	-22,6	71,1
8	12,64	-13,9	-22,6	71,1
8	12,30	-23,3	-32,3	64,8
9	12,30	-23,3	-32,3	64,8
9	12,07	-31,6	-39,7	60,6
10	12,07	-31,6	-39,8	60,6
10	12,05	-32,3	-40,3	60,3
11	12,05	-32,3	-40,4	60,3
11	12,00	-34,4	-42,0	59,4
12	12,00	-34,4	-42,0	59,4
12	11,67	-49,9	-50,4	53,4
13	11,67	-49,9	-50,4	53,4
13	11,33	-67,6	-55,3	47,6
14	11,33	-67,6	-55,3	47,6
14	11,00	-86,3	-56,6	42,0
15	11,00	-86,3	-56,6	42,0
15	10,60	-108,5	-53,5	35,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	10,60	-108,5	-53,5	35,5
16	10,20	-128,4	-45,2	29,5
17	10,20	-128,4	-45,2	29,5
17	9,80	-144,0	-31,8	24,0
18	9,80	-144,0	-31,7	24,0
18	9,40	-153,2	-13,4	19,1
19	9,40	-153,2	-13,2	19,1
19	9,00	**-154,4**	7,2	14,8
20	9,00	**-154,4**	7,3	14,8
20	8,55	-146,8	26,0	10,6
21	8,55	-146,8	26,0	10,6
21	8,10	-131,2	43,1	7,2
22	8,10	-131,2	43,1	7,2
22	7,77	-114,8	55,2	5,1
23	7,77	-114,8	55,2	5,1
23	7,43	-94,8	64,1	3,3
24	7,43	-94,8	64,1	3,3
24	7,10	-72,6	68,4	1,8
25	7,10	-72,6	68,5	1,8
25	7,00	-65,6	69,9	1,4
26	7,00	-65,6	**70,0**	1,4
26	6,65	-41,1	67,7	0,0
27	6,65	-41,1	67,7	0,0
27	6,30	-19,8	52,4	-1,2
28	6,30	-19,8	52,3	-1,2
28	5,95	-5,3	29,4	-2,4
29	5,95	-5,3	29,4	-2,4
29	5,60	0,0	0,0	-3,5
Max		**-154,4**	**70,0**	**107,9**
Max, minor nodes incl.		-154,9	70,7	107,9

6.7.3 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	14,63	0,00	0,00	A		0,00	0,00	-	
1	14,61	0,00	0,20	A		0,00	0,00	-	
2	14,61	0,00	0,20	A		0,00	0,00	-	
2	14,21	0,00	4,23	A		0,00	0,00	-	
3	14,21	0,00	4,23	A		0,00	0,00	-	
3	13,80	0,00	8,27	A		0,00	0,00	-	
4	13,80	0,00	8,27	A		0,00	0,00	-	
4	13,40	0,00	12,30	A		0,00	0,00	-	
5	13,40	0,00	12,30	A		0,00	0,00	-	
5	13,33	0,00	13,00	A		0,00	0,00	-	
6	13,33	2,53	13,00	A		0,00	0,00	-	
6	12,99	3,32	16,43	A		0,00	0,00	-	
7	12,99	4,85	16,43	A		0,00	0,00	-	
7	12,64	5,99	19,87	A		0,00	0,00	-	
8	12,64	6,00	19,87	A		0,00	0,00	-	
8	12,30	7,15	23,30	A		0,00	0,00	-	
9	12,30	7,16	23,30	A		0,00	0,00	-	
9	12,07	7,94	25,63	A		0,00	0,00	-	
10	12,07	7,94	25,63	A		0,00	0,00	P	
10	12,05	8,00	25,80	A		1,26	0,00	P	
11	12,05	8,00	25,80	A		1,26	0,00	P	
11	12,00	8,16	26,30	A		3,31	0,50	P	
12	12,00	8,17	26,30	A		3,31	0,50	P	
12	11,67	9,54	28,86	A		13,80	4,61	P	
13	11,67	9,55	28,86	A		13,80	4,61	P	
13	11,33	10,92	31,41	A		24,30	8,72	P	
14	11,33	10,93	31,41	A		24,30	8,72	P	
14	11,00	12,31	33,97	A		34,79	12,83	P	

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* [%]
15	11,00	12,32	33,97	A		34,79	12,83	P	
15	10,60	13,96	37,03	A		47,39	17,77	P	
16	10,60	13,97	37,03	A		47,39	17,77	P	
16	10,20	15,62	40,10	A		59,98	22,70	P	
17	10,20	15,63	40,10	A		59,98	22,70	P	
17	9,80	17,27	43,17	A		72,57	27,63	P	
18	9,80	17,29	43,17	A		72,57	27,63	P	
18	9,40	18,93	46,23	A		82,24	32,57	3	97
19	9,40	18,94	46,23	A		82,24	32,57	3	97
19	9,00	20,59	49,30	A		85,22	37,50	3	87
20	9,00	20,60	49,30	A		76,39	37,50	2	78
20	8,55	22,47	52,70	A		71,56	43,10	2	64
21	8,55	22,48	52,70	A		71,56	43,10	2	64
21	8,10	24,35	56,10	A		68,56	48,70	2	55
22	8,10	24,36	56,10	A		68,56	48,70	2	55
22	7,77	25,74	58,61	A		65,83	52,85	1	48
23	7,77	25,75	58,61	A		65,83	52,85	1	48
23	7,43	27,13	61,13	A		50,75	57,00	1	35
24	7,43	27,15	61,13	A		50,75	57,00	1	35
24	7,10	29,82	63,65	1		38,06	61,15	1	24
25	7,10	28,54	63,65	A		49,03	61,15	1	31
25	7,00	28,87	64,65	A		43,18	62,15	1	27
26	7,00	28,88	64,65	A		43,18	62,15	1	27
26	6,65	48,48	68,15	1		24,49	65,65	1	14
27	6,65	48,56	68,15	1		24,49	65,65	1	14
27	6,30	69,19	71,65	1	19	15,49	69,15	A	
28	6,30	69,27	71,65	1	19	15,49	69,15	A	
28	5,95	88,95	75,15	1	24	16,67	72,65	A	
29	5,95	89,04	75,15	1	24	16,67	72,65	A	
29	5,60	108,44	78,65	1	28	17,84	76,15	A	

*

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	196,3	304,1
Water	362,0	253,7
Total	558,3	557,8

Considered as passive side	Right
Maximum passive effective resistance	674,68 kN
Mobilized passive effective resistance	304,07 kN
Percentage mobilized resistance	45,1 %

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	-60,48
Vertical force passive	93,71
Resulting vertical force (no dead weight)	33,23
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-60,48
Vertical force passive	93,71
Resulting vertical force (no dead weight)	33,23
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]
14,63	OB klei dijk	0,00	12,07	Zand, m vast	0,04
13,33	Zand, m vast	-2,29	12,00	Zand, m vast	45,70
12,00	Zand, m vast	-13,30	9,00	Zand, los	37,41
9,00	Zand, los	-14,40	7,10	Zand, m vast	10,56
7,10	Zand, m vast	-30,50			

7 Step 6.4 Stage 1: Ontwerp groene kering

7.1 Input Data Left

7.1.1 Calculation Method

Calculation method: C, phi, delta

7.1.2 Water Level

Water level: 14,63 [m]

7.1.3 Surface

X [m]	Y [m]
0,00	14,63
7,00	14,63
9,10	13,90

7.1.4 Soil Material Properties in Profile: DR56-SO08 (L +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-7,00
Zand, los	9,00	n.a.	n.a.	n.a.	-7,00	-11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	-11,65	-11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-11,65	-11,65

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]
OB klei dijk	15,13	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,63	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,33	45000,00	45000,00	22500,00	22500,00
Zand, m vast	12,00	45000,00	45000,00	22500,00	22500,00
Zand, los	9,00	27000,00	27000,00	13500,00	13500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, m vast	7,10	45000,00	45000,00	22500,00	22500,00
Zand, sterk gri...	3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	1800,00	1800,00
OB klei dijk	14,63	1800,00	1800,00
Zand, m vast	13,33	11250,00	11250,00
Zand, m vast	12,00	11250,00	11250,00
Zand, los	9,00	6750,00	6750,00
Zand, m vast	7,10	11250,00	11250,00
Zand, sterk gri...	3,50	22500,00	22500,00

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	14,62	0,0	10,3	0,00	0,56	121,34
2	14,41	0,0	16,5	0,00	0,56	8,75
3	14,01	0,0	28,2	0,00	0,56	5,31
4	13,60	0,0	39,9	0,00	0,56	4,57
5	13,37	0,0	46,8	0,00	0,56	4,36
6	13,16	2,9	52,9	0,23	0,52	4,15
7	12,81	5,4	66,8	0,34	0,52	4,13
8	12,47	6,6	80,8	0,34	0,53	4,13
9	12,18	7,5	92,6	0,34	0,53	4,12
10	12,06	8,0	97,7	0,34	0,53	4,12
11	12,03	8,1	99,1	0,34	0,53	4,12
12	11,83	8,9	93,0	0,34	0,53	3,54
13	11,50	10,2	105,8	0,34	0,53	3,48
14	11,17	11,6	123,7	0,34	0,53	3,59
15	10,80	13,1	140,5	0,34	0,54	3,61
16	10,40	14,8	158,9	0,34	0,54	3,63
17	10,00	16,5	178,4	0,34	0,54	3,67
18	9,60	18,1	198,1	0,34	0,54	3,70
19	9,20	19,8	218,0	0,34	0,54	3,74
20	8,78	21,5	239,3	0,34	0,55	3,77
21	8,32	23,4	262,1	0,34	0,55	3,80
22	7,93	25,1	281,9	0,34	0,55	3,82
23	7,60	26,4	298,8	0,34	0,55	3,84
24	7,27	27,8	315,7	0,34	0,55	3,85
25	7,05	28,7	326,3	0,34	0,55	3,86
26	6,83	29,5	335,4	0,34	0,55	3,87
27	6,47	30,6	349,7	0,34	0,55	3,88
28	6,13	31,8	364,0	0,34	0,55	3,89
29	5,78	33,0	378,4	0,34	0,55	3,90

7.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	7,42
Zand, m vast	43,14
Zand, los	48,07
Zand, m vast	92,76
Zand, sterk grindig	0,00

7.4 Input Data Right

7.4.1 Calculation Method

Calculation method: C, phi, delta

7.4.2 Water Level

Water level: 12,05 [m]

7.4.3 Surface

X [m]	Y [m]
0,00	12,07

7.4.4 Soil Material Properties in Profile: DR56-SO08 (R +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	7,00
Zand, los	9,00	n.a.	n.a.	n.a.	7,00	11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	11,65	11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	11,65	11,65

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]
OB klei dijk	15,13	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,63	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,33	45000,00	45000,00	22500,00	22500,00
Zand, m vast	12,00	45000,00	45000,00	22500,00	22500,00
Zand, los	9,00	27000,00	27000,00	13500,00	13500,00
Zand, m vast	7,10	45000,00	45000,00	22500,00	22500,00
Zand, sterk gri...	3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	1800,00	1800,00
OB klei dijk	14,63	1800,00	1800,00
Zand, m vast	13,33	11250,00	11250,00
Zand, m vast	12,00	11250,00	11250,00
Zand, los	9,00	6750,00	6750,00
Zand, m vast	7,10	11250,00	11250,00
Zand, sterk gri...	3,50	22500,00	22500,00

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	12,06	0,1	0,6	0,34	0,57	4,11
2	12,03	0,2	2,3	0,34	0,57	4,11
3	11,83	0,7	8,6	0,34	0,57	4,11
4	11,50	1,6	19,1	0,34	0,57	4,11
5	11,17	2,4	29,5	0,34	0,57	4,11
6	10,80	3,4	41,1	0,34	0,57	4,11
7	10,40	4,4	53,7	0,34	0,57	4,11
8	10,00	5,4	66,3	0,34	0,57	4,11
9	9,60	6,4	78,9	0,34	0,57	4,11
10	9,20	7,5	91,5	0,34	0,57	4,11
11	8,78	8,6	104,7	0,34	0,57	4,11
12	8,32	9,7	118,7	0,34	0,57	4,11
13	7,93	10,7	130,8	0,34	0,57	4,11
14	7,60	11,5	141,2	0,34	0,57	4,11
15	7,27	12,4	151,5	0,34	0,57	4,11
16	7,05	13,0	158,7	0,34	0,57	4,11
17	6,83	13,7	168,0	0,34	0,57	4,11
18	6,47	14,9	182,4	0,34	0,57	4,11
19	6,13	16,1	196,7	0,34	0,57	4,11
20	5,78	17,3	211,1	0,34	0,57	4,11

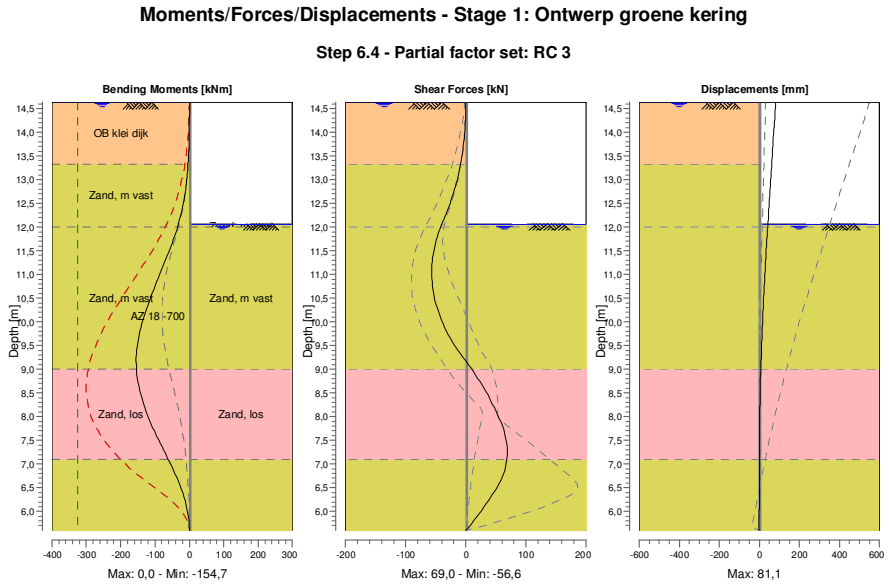
7.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	0,13
Zand, m vast	151,23
Zand, los	119,18
Zand, m vast	28,65
Zand, sterk grindig	0,00

7.7 Calculation Results

Number of iterations: 7

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	14,63	0,0	0,0	**81,1**
1	14,61	0,0	0,0	80,8
2	14,61	0,0	0,0	80,8
2	14,21	-0,1	-0,9	74,7
3	14,21	-0,1	-0,9	74,7
3	13,80	-0,9	-3,4	68,6
4	13,80	-0,9	-3,4	68,6
4	13,40	-3,1	-7,6	62,5
5	13,40	-3,1	-7,6	62,5
5	13,33	-3,7	-8,4	61,4
6	13,33	-3,7	-8,4	61,4
6	12,99	-7,6	-14,5	56,2
7	12,99	-7,6	-14,5	56,2
7	12,64	-13,9	-22,6	51,1
8	12,64	-13,9	-22,6	51,1
8	12,30	-23,3	-32,3	45,9
9	12,30	-23,3	-32,3	45,9
9	12,07	-31,6	-39,7	42,5
10	12,07	-31,6	-39,8	42,5
10	12,05	-32,3	-40,3	42,3
11	12,05	-32,3	-40,4	42,3
11	12,00	-34,4	-42,0	41,5
12	12,00	-34,4	-42,0	41,5
12	11,67	-49,9	-50,4	36,7
13	11,67	-49,9	-50,4	36,7
13	11,33	-67,6	-55,3	32,0
14	11,33	-67,6	-55,3	32,0
14	11,00	-86,3	-56,6	27,5
15	11,00	-86,3	-56,6	27,5
15	10,60	-108,5	-53,5	22,4

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	10,60	-108,5	-53,5	22,4
16	10,20	-128,4	-45,2	17,8
17	10,20	-128,4	-45,2	17,8
17	9,80	-144,0	-31,8	13,6
18	9,80	-144,0	-31,7	13,6
18	9,40	-153,2	-13,2	10,0
19	9,40	-153,2	-13,0	10,0
19	9,00	**-153,8**	10,2	7,0
20	9,00	**-153,8**	10,3	7,0
20	8,55	-144,1	32,5	4,4
21	8,55	-144,1	32,5	4,4
21	8,10	-125,2	50,8	2,5
22	8,10	-125,2	50,8	2,5
22	7,77	-106,3	62,2	1,5
23	7,77	-106,3	62,2	1,5
23	7,43	-84,4	**68,2**	0,8
24	7,43	-84,4	**68,2**	0,8
24	7,10	-61,5	67,9	0,3
25	7,10	-61,5	67,9	0,3
25	7,00	-54,8	67,1	0,2
26	7,00	-54,8	67,1	0,2
26	6,65	-32,6	57,9	-0,1
27	6,65	-32,6	57,9	-0,1
27	6,30	-15,1	41,5	-0,3
28	6,30	-15,1	41,5	-0,3
28	5,95	-3,9	22,0	-0,5
29	5,95	-3,9	22,0	-0,5
29	5,60	0,0	0,0	-0,6
Max		**-153,8**	**68,2**	**81,1**
Max, minor nodes incl.		-154,7	69,0	81,1

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	14,63	0,00	0,00	A		0,00	0,00	-	
1	14,61	0,00	0,20	A		0,00	0,00	-	
2	14,61	0,00	0,20	A		0,00	0,00	-	
2	14,21	0,00	4,23	A		0,00	0,00	-	
3	14,21	0,00	4,23	A		0,00	0,00	-	
3	13,80	0,00	8,27	A		0,00	0,00	-	
4	13,80	0,00	8,27	A		0,00	0,00	-	
4	13,40	0,00	12,30	A		0,00	0,00	-	
5	13,40	0,00	12,30	A		0,00	0,00	-	
5	13,33	0,00	13,00	A		0,00	0,00	-	
6	13,33	2,53	13,00	A		0,00	0,00	-	
6	12,99	3,32	16,43	A		0,00	0,00	-	
7	12,99	4,85	16,43	A		0,00	0,00	-	
7	12,64	5,99	19,87	A		0,00	0,00	-	
8	12,64	6,00	19,87	A		0,00	0,00	-	
8	12,30	7,15	23,30	A		0,00	0,00	-	
9	12,30	7,16	23,30	A		0,00	0,00	-	
9	12,07	7,94	25,63	A		0,00	0,00	-	
10	12,07	7,94	25,63	A		0,00	0,00	P	
10	12,05	8,00	25,80	A		1,26	0,00	P	
11	12,05	8,00	25,80	A		1,26	0,00	P	
11	12,00	8,16	26,30	A		3,31	0,50	P	
12	12,00	8,17	26,30	A		3,31	0,50	P	
12	11,67	9,54	28,86	A		13,80	4,61	P	
13	11,67	9,55	28,86	A		13,80	4,61	P	
13	11,33	10,92	31,41	A		24,30	8,72	P	
14	11,33	10,93	31,41	A		24,30	8,72	P	
14	11,00	12,31	33,97	A		34,79	12,83	P	

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* [%]
15	11,00	12,32	33,97	A		34,79	12,83	P	
15	10,60	13,96	37,03	A		47,39	17,77	P	
16	10,60	13,97	37,03	A		47,39	17,77	P	
16	10,20	15,62	40,10	A		59,98	22,70	P	
17	10,20	15,63	40,10	A		59,98	22,70	P	
17	9,80	17,27	43,17	A		72,57	27,63	P	
18	9,80	17,29	43,17	A		72,57	27,63	P	
18	9,40	18,93	46,23	A		85,17	32,57	P	
19	9,40	18,94	46,23	A		85,17	32,57	P	
19	9,00	20,59	49,30	A		92,70	37,50	3	95
20	9,00	20,60	49,30	A		82,14	37,50	3	84
20	8,55	22,47	52,70	A		77,29	43,10	2	69
21	8,55	22,48	52,70	A		77,29	43,10	2	69
21	8,10	24,35	56,10	A		68,78	48,70	2	55
22	8,10	24,36	56,10	A		68,78	48,70	2	55
22	7,77	25,74	58,61	A		58,78	52,85	1	43
23	7,77	25,75	58,61	A		58,78	52,85	1	43
23	7,43	27,13	61,13	A		40,79	57,00	1	28
24	7,43	27,15	61,13	A		40,79	57,00	1	28
24	7,10	38,84	63,65	1		29,04	61,15	1	19
25	7,10	33,95	63,65	1		33,99	61,15	1	22
25	7,00	39,47	64,65	1		29,58	62,15	1	18
26	7,00	39,52	64,65	1		29,58	62,15	1	18
26	6,65	54,50	68,15	1	16	18,46	65,65	1	
27	6,65	54,58	68,15	1	16	18,46	65,65	1	
27	6,30	65,08	71,65	1	18	15,49	69,15	A	
28	6,30	65,16	71,65	1	18	15,49	69,15	A	
28	5,95	73,53	75,15	1	20	16,67	72,65	A	
29	5,95	73,61	75,15	1	20	16,67	72,65	A	
29	5,60	81,37	78,65	1	21	17,84	76,15	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	191,4	299,2
Water	362,0	253,7
Total	553,4	552,9

Considered as passive side	Right
Maximum passive effective resistance	674,68 kN
Mobilized passive effective resistance	299,18 kN
Percentage mobilized resistance	44,3 %

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	-58,99
Vertical force passive	92,20
Resulting vertical force (no dead weight)	33,21
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-58,99
Vertical force passive	92,20
Resulting vertical force (no dead weight)	33,21
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]
14,63	OB klei dijk	0,00	12,07	Zand, m vast	0,04
13,33	Zand, m vast	-2,29	12,00	Zand, m vast	46,61
12,00	Zand, m vast	-13,30	9,00	Zand, los	36,73
9,00	Zand, los	-14,81	7,10	Zand, m vast	8,83
7,10	Zand, m vast	-28,59			

8 Step 6.5 Stage 1: Ontwerp groene kering

8.1 Input Data Left

8.1.1 Calculation Method

Calculation method: C, phi, delta

8.1.2 Water Level

Water level: 14,63 [m]

8.1.3 Surface

X [m]	Y [m]
0,00	14,63
7,00	14,63
9,10	13,90

8.1.4 Soil Material Properties in Profile: DR56-SO08 (L +0,5)

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]
OB klei dijk	15,13	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,63	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,33	18,00	20,00	0,00	30,00	20,00
Zand, m vast	12,00	18,00	20,00	0,00	30,00	20,00
Zand, los	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	7,10	18,00	20,00	0,00	30,00	20,00
Zand, sterk gri...	3,50	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-7,00
Zand, los	9,00	n.a.	n.a.	n.a.	-7,00	-11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	-11,65	-11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-11,65	-11,65

8.1.5 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]
OB klei dijk	15,13	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,63	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,33	20000,00	20000,00	10000,00	10000,00
Zand, m vast	12,00	20000,00	20000,00	10000,00	10000,00
Zand, los	9,00	12000,00	12000,00	6000,00	6000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, m vast	7,10	20000,00	20000,00	10000,00	10000,00
Zand, sterk gri...	3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	800,00	800,00
OB klei dijk	14,63	800,00	800,00
Zand, m vast	13,33	5000,00	5000,00
Zand, m vast	12,00	5000,00	5000,00
Zand, los	9,00	3000,00	3000,00
Zand, m vast	7,10	5000,00	5000,00
Zand, sterk gri...	3,50	10000,00	10000,00

8.2 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	14,62	0,0	17,7	0,00	0,50	208,79
2	14,41	0,0	25,9	0,00	0,50	13,76
3	14,01	0,0	41,5	0,00	0,50	7,81
4	13,60	0,0	57,0	0,00	0,50	6,53
5	13,37	0,0	66,1	0,00	0,50	6,16
6	13,16	0,0	74,3	0,00	0,45	5,83
7	12,81	3,0	93,5	0,18	0,46	5,78
8	12,47	5,5	108,3	0,28	0,46	5,53
9	12,15	6,4	103,0	0,28	0,46	4,52
10	11,83	7,4	123,3	0,28	0,46	4,69
11	11,50	8,5	149,6	0,28	0,46	4,92
12	11,17	9,7	170,3	0,28	0,47	4,94
13	10,80	10,9	193,1	0,28	0,47	4,96
14	10,40	12,3	220,4	0,28	0,47	5,03
15	10,00	13,7	248,0	0,28	0,47	5,10
16	9,60	15,1	275,8	0,28	0,47	5,15
17	9,20	16,4	303,8	0,28	0,48	5,20
18	8,78	17,9	333,7	0,28	0,48	5,25
19	8,32	19,5	365,6	0,28	0,48	5,29
20	7,93	20,8	393,4	0,28	0,48	5,33
21	7,60	22,0	417,1	0,28	0,48	5,35
22	7,27	23,2	440,8	0,28	0,48	5,38
23	7,05	23,9	455,5	0,28	0,48	5,39
24	6,83	24,5	468,3	0,28	0,48	5,40
25	6,47	25,5	488,4	0,28	0,49	5,42
26	6,13	26,5	508,4	0,28	0,49	5,44
27	5,78	27,4	528,4	0,28	0,49	5,45

8.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	4,81
Zand, m vast	35,90
Zand, los	53,70
Zand, m vast	58,20
Zand, sterk grindig	0,00

8.4 Input Data Right

8.4.1 Calculation Method

Calculation method: C, phi, delta

8.4.2 Water Level

Water level: 12,30 [m]

8.4.3 Surface

X [m]	Y [m]
0,00	12,30

8.4.4 Soil Material Properties in Profile: DR56-SO08 (R +0,5)

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]
OB klei dijk	15,13	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,63	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,33	18,00	20,00	0,00	30,00	20,00
Zand, m vast	12,00	18,00	20,00	0,00	30,00	20,00
Zand, los	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	7,10	18,00	20,00	0,00	30,00	20,00
Zand, sterk gri...	3,50	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	7,00
Zand, los	9,00	n.a.	n.a.	n.a.	7,00	11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	11,65	11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	11,65	11,65

8.4.5 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]
OB klei dijk	15,13	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,63	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,33	20000,00	20000,00	10000,00	10000,00
Zand, m vast	12,00	20000,00	20000,00	10000,00	10000,00
Zand, los	9,00	12000,00	12000,00	6000,00	6000,00
Zand, m vast	7,10	20000,00	20000,00	10000,00	10000,00
Zand, sterk gri...	3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	800,00	800,00
OB klei dijk	14,63	800,00	800,00
Zand, m vast	13,33	5000,00	5000,00
Zand, m vast	12,00	5000,00	5000,00
Zand, los	9,00	3000,00	3000,00
Zand, m vast	7,10	5000,00	5000,00
Zand, sterk gri...	3,50	10000,00	10000,00

8.5 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	12,15	0,4	8,6	0,28	0,50	5,74
2	11,83	1,2	24,5	0,28	0,50	5,74
3	11,50	1,9	39,2	0,28	0,50	5,74
4	11,17	2,6	53,9	0,28	0,50	5,74
5	10,80	3,4	70,0	0,28	0,50	5,74
6	10,40	4,3	87,6	0,28	0,50	5,74
7	10,00	5,1	105,2	0,28	0,50	5,74
8	9,60	6,0	122,8	0,28	0,50	5,74
9	9,20	6,8	140,4	0,28	0,50	5,74
10	8,78	7,7	158,9	0,28	0,50	5,74
11	8,32	8,7	178,4	0,28	0,50	5,74
12	7,93	9,5	195,4	0,28	0,50	5,74
13	7,60	10,2	209,8	0,28	0,50	5,74
14	7,27	10,9	224,3	0,28	0,50	5,74
15	7,05	11,4	234,4	0,28	0,50	5,74
16	6,83	12,0	247,3	0,28	0,50	5,74
17	6,47	13,0	267,4	0,28	0,50	5,74
18	6,13	14,0	287,4	0,28	0,50	5,74
19	5,78	15,0	307,5	0,28	0,50	5,74

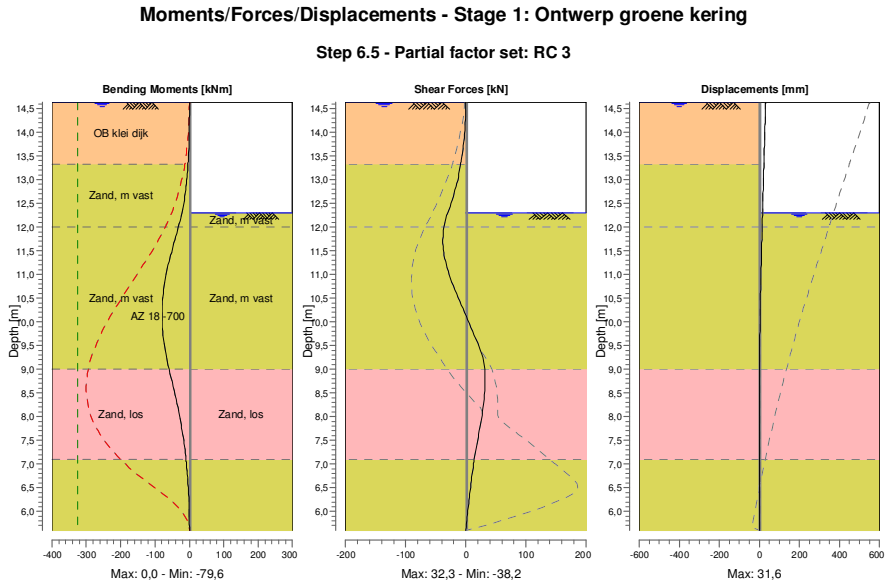
8.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	2,58
Zand, m vast	152,66
Zand, los	44,44
Zand, m vast	44,26
Zand, sterk grindig	0,00

8.7 Calculation Results

Number of iterations: 6

8.7.1 Charts of Moments, Forces and Displacements



8.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**31,6**
1	14,61	0,0	0,0	31,5
2	14,61	0,0	0,0	31,5
2	14,21	-0,1	-0,9	28,7
3	14,21	-0,1	-0,9	28,7
3	13,80	-0,9	-3,4	25,9
4	13,80	-0,9	-3,4	25,9
4	13,40	-3,1	-7,6	23,1
5	13,40	-3,1	-7,6	23,1
5	13,33	-3,7	-8,4	22,7
6	13,33	-3,7	-8,4	22,7
6	12,99	-7,4	-13,5	20,3
7	12,99	-7,4	-13,5	20,3
7	12,64	-13,2	-20,8	18,0
8	12,64	-13,2	-20,8	18,0
8	12,30	-21,9	-30,0	15,7
9	12,30	-21,9	-30,0	15,7
9	12,00	-32,0	-36,4	13,7
10	12,00	-32,0	-36,4	13,7
10	11,67	-44,6	**-38,1**	11,7
11	11,67	-44,6	**-38,1**	11,7
11	11,33	-56,9	-34,9	9,7
12	11,33	-56,9	-34,9	9,7
12	11,00	-67,4	-27,6	7,9
13	11,00	-67,4	-27,6	7,9
13	10,60	-76,1	-15,6	6,0
14	10,60	-76,1	-15,4	6,0
14	10,20	**-79,6**	-1,9	4,4
15	10,20	**-79,6**	-1,8	4,4
15	9,80	-77,6	11,5	3,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,80	-77,6	11,6	3,1
16	9,40	-70,3	24,3	2,1
17	9,40	-70,3	24,4	2,1
17	9,00	-58,9	32,0	1,3
18	9,00	-58,9	32,0	1,3
18	8,55	-44,4	31,7	0,8
19	8,55	-44,4	31,7	0,8
19	8,10	-30,9	27,9	0,5
20	8,10	-30,9	27,9	0,5
20	7,77	-22,3	23,6	0,3
21	7,77	-22,3	23,6	0,3
21	7,43	-15,2	18,8	0,3
22	7,43	-15,2	18,8	0,3
22	7,10	-9,8	13,9	0,3
23	7,10	-9,8	13,9	0,3
23	7,00	-8,4	12,9	0,2
24	7,00	-8,4	12,9	0,2
24	6,65	-4,6	9,2	0,3
25	6,65	-4,6	9,2	0,3
25	6,30	-1,9	5,8	0,3
26	6,30	-1,9	5,8	0,3
26	5,95	-0,5	2,7	0,3
27	5,95	-0,5	2,7	0,3
27	5,60	0,0	0,0	0,3
Max		**-79,6**	**-38,1**	**31,6**
Max, minor nodes incl.		-79,6	-38,2	31,6

8.7.3 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	14,63	0,00	0,00	A		0,00	0,00	-	
1	14,61	0,00	0,20	A		0,00	0,00	-	
2	14,61	0,00	0,20	A		0,00	0,00	-	
2	14,21	0,00	4,23	A		0,00	0,00	-	
3	14,21	0,00	4,23	A		0,00	0,00	-	
3	13,80	0,00	8,27	A		0,00	0,00	-	
4	13,80	0,00	8,27	A		0,00	0,00	-	
4	13,40	0,00	12,30	A		0,00	0,00	-	
5	13,40	0,00	12,30	A		0,00	0,00	-	
5	13,33	0,00	13,00	A		0,00	0,00	-	
6	13,33	0,00	13,00	A		0,00	0,00	-	
6	12,99	0,00	16,43	A		0,00	0,00	-	
7	12,99	2,67	16,43	A		0,00	0,00	-	
7	12,64	3,30	19,87	A		0,00	0,00	-	
8	12,64	4,99	19,87	A		0,00	0,00	-	
8	12,30	5,94	23,30	A		0,00	0,00	-	
9	12,30	5,95	23,30	A		0,00	0,00	P	
9	12,00	6,78	26,30	A		17,21	3,00	P	
10	12,00	6,79	26,30	A		17,21	3,00	P	
10	11,67	7,94	28,86	A		31,87	7,11	P	
11	11,67	7,95	28,86	A		31,87	7,11	P	
11	11,33	9,09	31,41	A		46,53	11,22	P	
12	11,33	9,10	31,41	A		46,53	11,22	P	
12	11,00	10,24	33,97	A		54,41	15,33	3	89
13	11,00	10,25	33,97	A		54,41	15,33	3	89
13	10,60	11,62	37,03	A		63,07	20,27	3	80
14	10,60	11,63	37,03	A		63,07	20,27	3	80
14	10,20	13,00	40,10	A		61,15	25,20	2	63
15	10,20	13,01	40,10	A		61,15	25,20	2	63
15	9,80	14,37	43,17	A		60,84	30,13	2	53
16	9,80	14,39	43,17	A		60,84	30,13	2	53
16	9,40	15,75	46,23	A		52,65	35,07	1	40

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	9,40	15,77	46,23	A		52,65	35,07	1	40
17	9,00	17,13	49,30	A		39,70	40,00	1	27
18	9,00	17,15	49,30	A		29,02	40,00	1	19
18	8,55	22,15	52,70	1		24,25	45,60	1	14
19	8,55	22,27	52,70	1		24,25	45,60	1	14
19	8,10	28,71	56,10	1		22,15	51,20	1	12
20	8,10	28,81	56,10	1		22,15	51,20	1	12
20	7,77	32,34	58,61	1		21,84	55,35	1	11
21	7,77	32,42	58,61	1		21,84	55,35	1	11
21	7,43	35,22	61,13	1		22,26	59,50	1	10
22	7,43	35,31	61,13	1		22,26	59,50	1	10
22	7,10	37,60	63,65	1		23,20	63,65	1	10
23	7,10	35,64	63,65	1		25,21	63,65	1	11
23	7,00	36,16	64,65	1		25,67	64,65	1	11
24	7,00	36,21	64,65	1		25,67	64,65	1	11
24	6,65	37,73	68,15	1		27,55	68,15	1	11
25	6,65	37,81	68,15	1		27,55	68,15	1	11
25	6,30	39,06	71,65	1		29,71	71,65	1	11
26	6,30	39,14	71,65	1		29,71	71,65	1	11
26	5,95	40,26	75,15	1		32,00	75,15	1	11
27	5,95	40,34	75,15	1		32,00	75,15	1	11
27	5,60	41,44	78,65	1		34,32	78,65	1	11

*

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

8.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	152,6	243,9
Water	362,0	270,1
Total	514,6	514,1

Considered as passive side	Right
Maximum passive effective resistance	1025,56 kN
Mobilized passive effective resistance	243,95 kN
Percentage mobilized resistance	23,8 %

8.7.5 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	-55,55
Vertical force passive	88,79
Resulting vertical force (no dead weight)	33,24
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

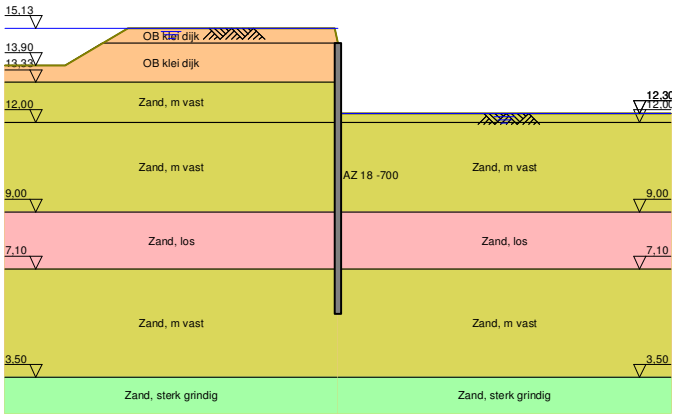
Vertical force balance plugged	Force [kN]
Vertical force active	-55,55
Vertical force passive	88,79
Resulting vertical force (no dead weight)	33,24
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

8.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	0,00	12,30	Zand, m vast	0,94
13,33	Zand, m vast	-1,75	12,00	Zand, m vast	55,57
12,00	Zand, m vast	-13,07	9,00	Zand, los	16,18
9,00	Zand, los	-19,55	7,10	Zand, m vast	16,11
7,10	Zand, m vast	-21,18			

9 Outline Stage 2: Robuustheid

Outline - Stage 2: Robuustheid

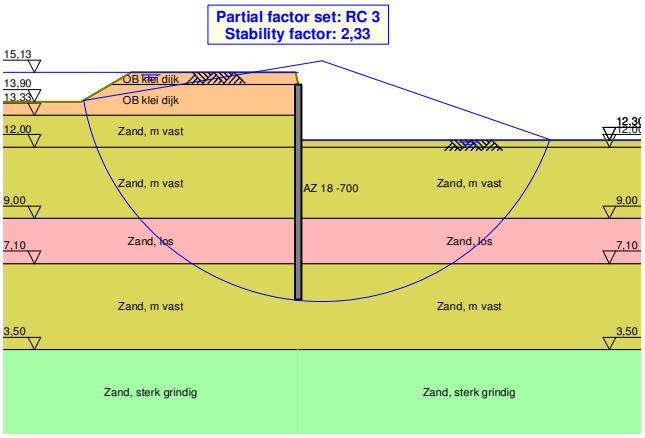


10 Overall Stability Stage 2: Robuustheid

Stability factor : 2,33

10.1 Overall Stability

Overall Stability - Stage 2: Robuustheid



11 Step 6.3 Stage 2: Robuustheid

11.1 Input Data Left

11.1.1 Calculation Method

Calculation method: C, phi, delta

11.1.2 Water Level

Water level: 15,13 [m]

11.1.3 Surface

X [m]	Y [m]
0,00	14,63
0,10	15,13
7,00	15,13
9,10	13,90

11.1.4 Soil Material Properties in Profile: DR56-SO08 (L +1,0)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-8,50
Zand, los	9,00	n.a.	n.a.	n.a.	-8,50	-14,15
Zand, m vast	7,10	n.a.	n.a.	n.a.	-14,15	-14,15
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-14,15	-14,15

11.1.5 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]
OB klei dijk	15,13	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,63	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,33	15384,62	15384,62	7692,31	7692,31
Zand, m vast	12,00	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, los	9,00	9230,77	9230,77	4615,38	4615,38
Zand, m vast	7,10	15384,62	15384,62	7692,31	7692,31
Zand, sterk gri...	3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	615,38	615,38
OB klei dijk	14,63	615,38	615,38
Zand, m vast	13,33	3846,15	3846,15
Zand, m vast	12,00	3846,15	3846,15
Zand, los	9,00	2307,69	2307,69
Zand, m vast	7,10	3846,15	3846,15
Zand, sterk gri...	3,50	7692,31	7692,31

11.2 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	14,62	0,0	440,6	0,00	0,78	219,73
2	14,41	0,0	31,0	0,00	0,97	6,17
3	14,01	0,0	42,7	0,00	0,70	4,68
4	13,60	1,1	54,4	0,09	0,63	4,28
5	13,37	3,2	61,3	0,21	0,60	4,15
6	13,16	5,7	70,3	0,34	0,56	4,18
7	12,81	6,9	84,4	0,34	0,54	4,17
8	12,47	8,0	75,6	0,34	0,53	3,19
9	12,18	9,0	83,2	0,34	0,53	3,14
10	12,06	9,4	88,1	0,34	0,52	3,17
11	12,03	9,5	89,4	0,34	0,52	3,18
12	11,83	10,3	99,5	0,34	0,52	3,26
13	11,50	11,8	115,6	0,34	0,52	3,33
14	11,17	13,2	129,9	0,34	0,52	3,34
15	10,80	14,8	146,3	0,34	0,52	3,36
16	10,40	16,5	165,8	0,34	0,52	3,41
17	10,00	18,2	185,7	0,34	0,52	3,46
18	9,60	19,9	205,8	0,34	0,53	3,51
19	9,20	21,7	226,0	0,34	0,53	3,55
20	8,78	23,5	247,9	0,34	0,53	3,60
21	8,32	25,5	271,3	0,34	0,53	3,64
22	7,93	27,2	291,7	0,34	0,53	3,67
23	7,60	28,6	309,2	0,34	0,53	3,69
24	7,27	30,1	326,7	0,34	0,54	3,72
25	7,05	31,0	337,5	0,34	0,54	3,73
26	6,83	31,7	346,6	0,34	0,54	3,74
27	6,47	32,9	360,8	0,34	0,54	3,76
28	6,13	34,1	375,0	0,34	0,54	3,77
29	5,78	35,6	389,2	0,35	0,54	3,79

11.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,67
Zand, m vast	9,80
Zand, m vast	48,18
Zand, los	50,66
Zand, m vast	201,23
Zand, sterk grindig	0,00

11.4 Input Data Right

11.4.1 Calculation Method

Calculation method: C, phi, delta

11.4.2 Water Level

Water level: 12,05 [m]

11.4.3 Surface

X [m]	Y [m]
0,00	12,07

11.4.4 Soil Material Properties in Profile: DR56-SO08 (R +1,0)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	8,50
Zand, los	9,00	n.a.	n.a.	n.a.	8,50	14,15
Zand, m vast	7,10	n.a.	n.a.	n.a.	14,15	14,15
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	14,15	14,15

11.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,63	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,33	15384,62	15384,62	7692,31	7692,31
Zand, m vast	12,00	15384,62	15384,62	7692,31	7692,31
Zand, los	9,00	9230,77	9230,77	4615,38	4615,38
Zand, m vast	7,10	15384,62	15384,62	7692,31	7692,31
Zand, sterk gri...	3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	615,38	615,38
OB klei dijk	14,63	615,38	615,38
Zand, m vast	13,33	3846,15	3846,15
Zand, m vast	12,00	3846,15	3846,15
Zand, los	9,00	2307,69	2307,69
Zand, m vast	7,10	3846,15	3846,15
Zand, sterk gri...	3,50	7692,31	7692,31

11.5 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	12,06	0,1	0,6	0,34	0,57	4,11
2	12,03	0,2	2,3	0,34	0,57	4,11
3	11,83	0,7	8,2	0,34	0,57	4,11
4	11,50	1,5	18,0	0,34	0,57	4,11
5	11,17	2,3	27,8	0,34	0,57	4,11
6	10,80	3,2	38,6	0,34	0,57	4,11
7	10,40	4,1	50,4	0,34	0,57	4,11
8	10,00	5,1	62,2	0,34	0,57	4,11
9	9,60	6,0	73,9	0,34	0,57	4,11
10	9,20	7,0	85,7	0,34	0,57	4,11
11	8,78	8,0	98,1	0,34	0,57	4,11
12	8,32	9,1	111,1	0,34	0,57	4,11
13	7,93	10,0	122,4	0,34	0,57	4,11
14	7,60	10,8	132,0	0,34	0,57	4,11
15	7,27	11,6	141,6	0,34	0,57	4,11
16	7,05	12,1	148,5	0,34	0,57	4,11
17	6,83	12,9	157,7	0,34	0,57	4,11
18	6,47	14,1	172,1	0,34	0,57	4,11
19	6,13	15,2	186,5	0,34	0,57	4,11
20	5,78	16,4	200,8	0,34	0,57	4,11

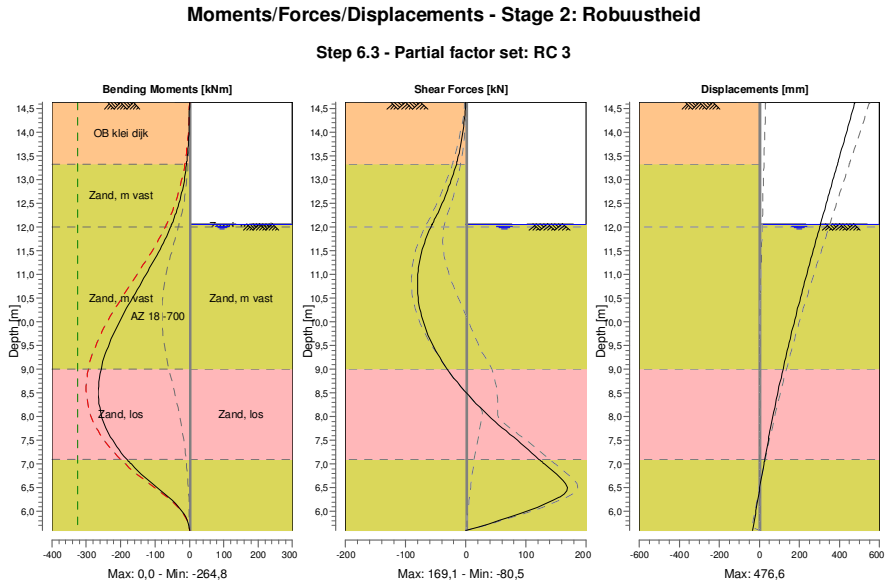
11.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	0,13
Zand, m vast	142,36
Zand, los	217,85
Zand, m vast	83,58
Zand, sterk grindig	0,00

11.7 Calculation Results

Number of iterations: 7

11.7.1 Charts of Moments, Forces and Displacements



11.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**476,6**
1	14,61	0,0	-0,1	475,2
2	14,61	0,0	-0,1	475,2
2	14,21	-0,6	-3,0	448,3
3	14,21	-0,6	-3,0	448,3
3	13,80	-2,6	-7,6	421,3
4	13,80	-2,6	-7,6	421,3
4	13,40	-7,0	-14,2	394,3
5	13,40	-7,0	-14,2	394,3
5	13,33	-8,0	-15,6	389,7
6	13,33	-8,0	-15,6	389,7
6	12,99	-14,8	-24,4	366,8
7	12,99	-14,8	-24,4	366,8
7	12,64	-24,9	-34,7	343,9
8	12,64	-24,9	-34,7	343,9
8	12,30	-38,8	-46,5	321,1
9	12,30	-38,8	-46,5	321,1
9	12,07	-50,7	-55,5	305,7
10	12,07	-50,7	-55,5	305,7
10	12,05	-51,6	-56,2	304,6
11	12,05	-51,6	-56,3	304,6
11	12,00	-54,5	-58,2	301,3
12	12,00	-54,5	-58,2	301,3
12	11,67	-75,8	-68,8	279,4
13	11,67	-75,8	-68,8	279,4
13	11,33	-100,0	-76,1	257,7
14	11,33	-100,0	-76,1	257,7
14	11,00	-126,1	-79,9	236,3
15	11,00	-126,1	-79,9	236,3
15	10,60	-158,2	-79,9	211,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	10,60	-158,2	-79,9	211,1
16	10,20	-189,4	-75,0	186,5
17	10,20	-189,4	-75,0	186,5
17	9,80	-217,6	-65,2	162,7
18	9,80	-217,6	-65,1	162,7
18	9,40	-240,8	-50,4	139,7
19	9,40	-240,8	-50,2	139,7
19	9,00	-257,1	-30,6	117,6
20	9,00	-257,1	-30,5	117,6
20	8,55	**-264,8**	-2,5	94,1
21	8,55	**-264,8**	-2,5	94,1
21	8,10	-258,5	31,6	71,8
22	8,10	-258,5	31,6	71,8
22	7,77	-243,2	60,9	56,2
23	7,77	-243,2	60,9	56,2
23	7,43	-217,7	91,8	41,2
24	7,43	-217,7	91,8	41,2
24	7,10	-182,1	121,3	26,8
25	7,10	-182,1	121,3	26,8
25	7,00	-169,5	131,2	22,6
26	7,00	-169,5	131,3	22,6
26	6,65	-117,9	161,7	8,1
27	6,65	-117,9	**162,1**	8,1
27	6,30	-60,0	156,2	-6,0
28	6,30	-60,0	155,8	-6,0
28	5,95	-16,3	89,4	-19,9
29	5,95	-16,3	89,4	-19,9
29	5,60	0,0	0,0	-33,7
Max		**-264,8**	**162,1**	**476,6**
Max, minor nodes incl.		-264,8	169,1	476,6

11.7.3 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	14,63	0,00	5,00	A		0,00	0,00	-	
1	14,61	0,00	5,20	A		0,00	0,00	-	
2	14,61	0,00	5,20	A		0,00	0,00	-	
2	14,21	0,00	9,23	A		0,00	0,00	-	
3	14,21	0,00	9,23	A		0,00	0,00	-	
3	13,80	0,00	13,27	A		0,00	0,00	-	
4	13,80	0,95	13,27	A		0,00	0,00	-	
4	13,40	1,26	17,30	A		0,00	0,00	-	
5	13,40	3,11	17,30	A		0,00	0,00	-	
5	13,33	3,24	18,00	A		0,00	0,00	-	
6	13,33	5,14	18,00	A		0,00	0,00	-	
6	12,99	6,32	21,43	A		0,00	0,00	-	
7	12,99	6,27	21,43	A		0,00	0,00	-	
7	12,64	7,43	24,87	A		0,00	0,00	-	
8	12,64	7,43	24,87	A		0,00	0,00	-	
8	12,30	8,59	28,30	A		0,00	0,00	-	
9	12,30	8,59	28,30	A		0,00	0,00	-	
9	12,07	9,37	30,63	A		0,00	0,00	-	
10	12,07	9,37	30,63	A		0,00	0,00	P	
10	12,05	9,43	30,80	A		1,26	0,00	P	
11	12,05	9,43	30,80	A		1,26	0,00	P	
11	12,00	9,59	31,30	A		3,31	0,50	P	
12	12,00	9,60	31,30	A		3,31	0,50	P	
12	11,67	11,03	33,69	A		13,12	4,78	P	
13	11,67	11,04	33,69	A		13,12	4,78	P	
13	11,33	12,46	36,08	A		22,93	9,06	P	
14	11,33	12,47	36,08	A		22,93	9,06	P	
14	11,00	13,90	38,47	A		32,74	13,33	P	

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* [%]
15	11,00	13,91	38,47	A		32,74	13,33	P	
15	10,60	15,62	41,33	A		44,51	18,47	P	
16	10,60	15,64	41,33	A		44,51	18,47	P	
16	10,20	17,34	44,20	A		56,28	23,60	P	
17	10,20	17,36	44,20	A		56,28	23,60	P	
17	9,80	19,07	47,07	A		68,06	28,73	P	
18	9,80	19,09	47,07	A		68,06	28,73	P	
18	9,40	20,79	49,93	A		79,83	33,87	P	
19	9,40	20,81	49,93	A		79,83	33,87	P	
19	9,00	22,51	52,80	A		91,60	39,00	P	
20	9,00	22,54	52,80	A		91,60	39,00	P	
20	8,55	24,47	55,96	A		104,58	44,84	P	
21	8,55	24,50	55,96	A		104,58	44,84	P	
21	8,10	26,43	59,12	A		117,57	50,68	P	
22	8,10	26,45	59,12	A		117,57	50,68	P	
22	7,77	27,89	61,47	A		127,19	55,00	P	
23	7,77	27,90	61,47	A		127,19	55,00	P	
23	7,43	29,34	63,81	A		124,44	59,33	3	91
24	7,43	29,36	63,81	A		124,44	59,33	3	91
24	7,10	30,79	66,15	A		119,89	63,65	3	82
25	7,10	30,80	66,15	A		133,62	63,65	3	91
25	7,00	31,13	67,15	A		131,00	64,65	3	87
26	7,00	31,15	67,15	A		131,00	64,65	3	87
26	6,65	32,30	70,65	A		100,18	68,15	2	61
27	6,65	32,32	70,65	A		100,18	68,15	2	61
27	6,30	144,80	74,15	1	39	14,65	71,65	A	
28	6,30	144,92	74,15	1	39	14,65	71,65	A	
28	5,95	237,05	77,65	2	62	15,83	75,15	A	
29	5,95	237,64	77,65	2	62	15,83	75,15	A	
29	5,60	300,89	81,15	2	76	17,00	78,65	A	

*

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

11.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	310,5	443,9
Water	397,4	263,5
Total	707,9	707,4

Considered as passive side	Right
Maximum passive effective resistance	634,44 kN
Mobilized passive effective resistance	443,93 kN
Percentage mobilized resistance	70,0 %

11.7.5 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	-95,68
Vertical force passive	136,82
Resulting vertical force (no dead weight)	41,14
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-95,68
Vertical force passive	136,82
Resulting vertical force (no dead weight)	41,14
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

11.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	-0,18	12,07	Zand, m vast	0,04
13,33	Zand, m vast	-3,02	12,00	Zand, m vast	43,88
12,00	Zand, m vast	-14,85	9,00	Zand, los	67,14
9,00	Zand, los	-15,61	7,10	Zand, m vast	25,76
7,10	Zand, m vast	-62,02			

12 Step 6.4 Stage 2: Robuustheid

12.1 Input Data Left

12.1.1 Calculation Method

Calculation method: C, phi, delta

12.1.2 Water Level

Water level: 15,13 [m]

12.1.3 Surface

X [m]	Y [m]
0,00	14,63
0,10	15,13
7,00	15,13
9,10	13,90

12.1.4 Soil Material Properties in Profile: DR56-SO08 (L +1,0)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-8,50
Zand, los	9,00	n.a.	n.a.	n.a.	-8,50	-14,15
Zand, m vast	7,10	n.a.	n.a.	n.a.	-14,15	-14,15
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-14,15	-14,15

12.1.5 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]
OB klei dijk	15,13	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,63	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,33	45000,00	45000,00	22500,00	22500,00
Zand, m vast	12,00	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1 Top [kN/m³]	Branch 1 Bottom [kN/m³]	Branch 2 Top [kN/m³]	Branch 2 Bottom [kN/m³]
Zand, los	9,00	27000,00	27000,00	13500,00	13500,00
Zand, m vast	7,10	45000,00	45000,00	22500,00	22500,00
Zand, sterk gri...	3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3 Top [kN/m³]	Branch 3 Bottom [kN/m³]
OB klei dijk	15,13	1800,00	1800,00
OB klei dijk	14,63	1800,00	1800,00
Zand, m vast	13,33	11250,00	11250,00
Zand, m vast	12,00	11250,00	11250,00
Zand, los	9,00	6750,00	6750,00
Zand, m vast	7,10	11250,00	11250,00
Zand, sterk gri...	3,50	22500,00	22500,00

12.2 Calculated Earth Pressure Coefficients Left

Segment number	Level [m]	Horizontal pressure Active [kN/m²]	Horizontal pressure Passive [kN/m²]	Fictive earth pressure coefficients Ka [-]	Ko [-]	Kp [-]
1	14,62	0,0	440,6	0,00	0,78	219,73
2	14,41	0,0	31,0	0,00	0,97	6,17
3	14,01	0,0	42,7	0,00	0,70	4,68
4	13,60	1,1	54,4	0,09	0,63	4,28
5	13,37	3,2	61,3	0,21	0,60	4,15
6	13,16	5,7	70,3	0,34	0,56	4,18
7	12,81	6,9	84,4	0,34	0,54	4,17
8	12,47	8,0	75,6	0,34	0,53	3,19
9	12,18	9,0	83,2	0,34	0,53	3,14
10	12,06	9,4	88,1	0,34	0,52	3,17
11	12,03	9,5	89,4	0,34	0,52	3,18
12	11,83	10,3	99,5	0,34	0,52	3,26
13	11,50	11,8	115,6	0,34	0,52	3,33
14	11,17	13,2	129,9	0,34	0,52	3,34
15	10,80	14,8	146,3	0,34	0,52	3,36
16	10,40	16,5	165,8	0,34	0,52	3,41
17	10,00	18,2	185,7	0,34	0,52	3,46
18	9,60	19,9	205,8	0,34	0,53	3,51
19	9,20	21,7	226,0	0,34	0,53	3,55
20	8,78	23,5	247,9	0,34	0,53	3,60
21	8,32	25,5	271,3	0,34	0,53	3,64
22	7,93	27,2	291,7	0,34	0,53	3,67
23	7,60	28,6	309,2	0,34	0,53	3,69
24	7,27	30,1	326,7	0,34	0,54	3,72
25	7,05	31,0	337,5	0,34	0,54	3,73
26	6,83	31,7	346,6	0,34	0,54	3,74
27	6,47	32,9	360,8	0,34	0,54	3,76
28	6,13	34,1	375,0	0,34	0,54	3,77
29	5,78	35,6	389,2	0,35	0,54	3,79

12.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,67
Zand, m vast	9,80
Zand, m vast	48,18
Zand, los	50,66
Zand, m vast	200,80
Zand, sterk grindig	0,00

12.4 Input Data Right

12.4.1 Calculation Method

Calculation method: C, phi, delta

12.4.2 Water Level

Water level: 12,05 [m]

12.4.3 Surface

X [m]	Y [m]
0,00	12,07

12.4.4 Soil Material Properties in Profile: DR56-SO08 (R +1,0)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	8,50
Zand, los	9,00	n.a.	n.a.	n.a.	8,50	14,15
Zand, m vast	7,10	n.a.	n.a.	n.a.	14,15	14,15
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	14,15	14,15

12.4.5 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]
OB klei dijk	15,13	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,63	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,33	45000,00	45000,00	22500,00	22500,00
Zand, m vast	12,00	45000,00	45000,00	22500,00	22500,00
Zand, los	9,00	27000,00	27000,00	13500,00	13500,00
Zand, m vast	7,10	45000,00	45000,00	22500,00	22500,00
Zand, sterk gri...	3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	1800,00	1800,00
OB klei dijk	14,63	1800,00	1800,00
Zand, m vast	13,33	11250,00	11250,00
Zand, m vast	12,00	11250,00	11250,00
Zand, los	9,00	6750,00	6750,00
Zand, m vast	7,10	11250,00	11250,00
Zand, sterk gri...	3,50	22500,00	22500,00

12.5 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	12,06	0,1	0,6	0,34	0,57	4,11
2	12,03	0,2	2,3	0,34	0,57	4,11
3	11,83	0,7	8,2	0,34	0,57	4,11
4	11,50	1,5	18,0	0,34	0,57	4,11
5	11,17	2,3	27,8	0,34	0,57	4,11
6	10,80	3,2	38,6	0,34	0,57	4,11
7	10,40	4,1	50,4	0,34	0,57	4,11
8	10,00	5,1	62,2	0,34	0,57	4,11
9	9,60	6,0	73,9	0,34	0,57	4,11
10	9,20	7,0	85,7	0,34	0,57	4,11
11	8,78	8,0	98,1	0,34	0,57	4,11
12	8,32	9,1	111,1	0,34	0,57	4,11
13	7,93	10,0	122,4	0,34	0,57	4,11
14	7,60	10,8	132,0	0,34	0,57	4,11
15	7,27	11,6	141,6	0,34	0,57	4,11
16	7,05	12,1	148,5	0,34	0,57	4,11
17	6,83	12,9	157,7	0,34	0,57	4,11
18	6,47	14,1	172,1	0,34	0,57	4,11
19	6,13	15,2	186,5	0,34	0,57	4,11
20	5,78	16,4	200,8	0,34	0,57	4,11

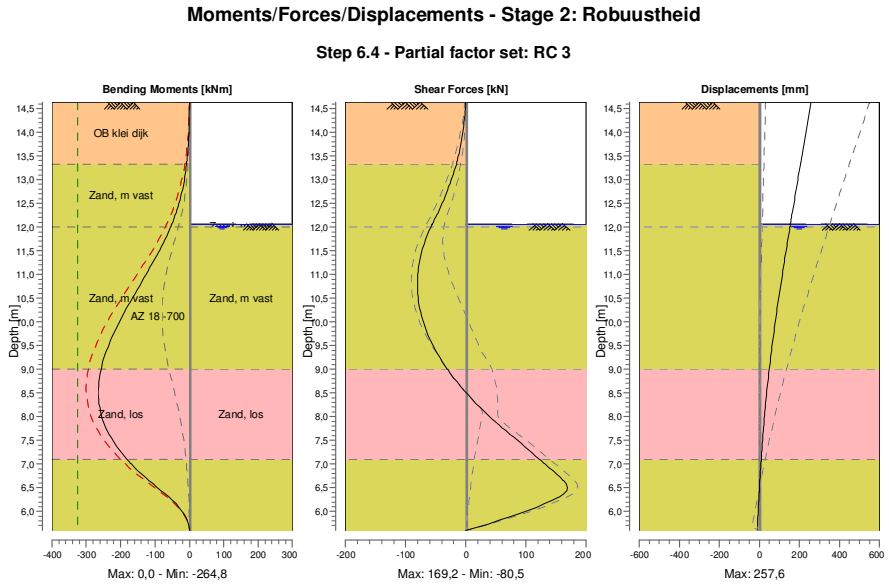
12.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	0,13
Zand, m vast	142,36
Zand, los	218,66
Zand, m vast	82,33
Zand, sterk grindig	0,00

12.7 Calculation Results

Number of iterations: 7

12.7.1 Charts of Moments, Forces and Displacements



12.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**257,6**
1	14,61	0,0	-0,1	256,8
2	14,61	0,0	-0,1	256,8
2	14,21	-0,6	-3,0	240,6
3	14,21	-0,6	-3,0	240,6
3	13,80	-2,6	-7,6	224,5
4	13,80	-2,6	-7,6	224,5
4	13,40	-7,0	-14,2	208,3
5	13,40	-7,0	-14,2	208,3
5	13,33	-8,0	-15,6	205,5
6	13,33	-8,0	-15,6	205,5
6	12,99	-14,8	-24,4	191,8
7	12,99	-14,8	-24,4	191,8
7	12,64	-24,9	-34,7	178,1
8	12,64	-24,9	-34,7	178,1
8	12,30	-38,8	-46,5	164,5
9	12,30	-38,8	-46,5	164,5
9	12,07	-50,7	-55,5	155,3
10	12,07	-50,7	-55,5	155,3
10	12,05	-51,6	-56,2	154,6
11	12,05	-51,6	-56,3	154,6
11	12,00	-54,5	-58,2	152,7
12	12,00	-54,5	-58,2	152,7
12	11,67	-75,8	-68,8	139,7
13	11,67	-75,8	-68,8	139,7
13	11,33	-100,0	-76,1	127,0
14	11,33	-100,0	-76,1	127,0
14	11,00	-126,1	-79,9	114,5
15	11,00	-126,1	-79,9	114,5
15	10,60	-158,2	-79,9	100,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	10,60	-158,2	-79,9	100,0
16	10,20	-189,4	-75,0	86,1
17	10,20	-189,4	-75,0	86,1
17	9,80	-217,6	-65,2	72,9
18	9,80	-217,6	-65,1	72,9
18	9,40	-240,8	-50,4	60,6
19	9,40	-240,8	-50,2	60,6
19	9,00	-257,1	-30,6	49,3
20	9,00	-257,1	-30,4	49,3
20	8,55	**-264,8**	-2,5	37,8
21	8,55	**-264,8**	-2,5	37,8
21	8,10	-258,4	31,7	27,5
22	8,10	-258,4	31,7	27,5
22	7,77	-243,1	60,9	20,8
23	7,77	-243,1	61,0	20,8
23	7,43	-217,5	92,4	14,7
24	7,43	-217,5	92,4	14,7
24	7,10	-181,7	122,2	9,3
25	7,10	-181,7	122,2	9,3
25	7,00	-169,0	132,1	7,7
26	7,00	-169,0	132,1	7,7
26	6,65	-117,2	162,2	2,6
27	6,65	-117,2	**162,6**	2,6
27	6,30	-59,3	155,0	-2,1
28	6,30	-59,3	154,6	-2,1
28	5,95	-16,0	88,3	-6,7
29	5,95	-16,0	88,3	-6,7
29	5,60	0,0	0,0	-11,2
Max		**-264,8**	**162,6**	**257,6**
Max, minor nodes incl.		-264,8	169,2	257,6

12.7.3 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	14,63	0,00	5,00	A		0,00	0,00	-	
1	14,61	0,00	5,20	A		0,00	0,00	-	
2	14,61	0,00	5,20	A		0,00	0,00	-	
2	14,21	0,00	9,23	A		0,00	0,00	-	
3	14,21	0,00	9,23	A		0,00	0,00	-	
3	13,80	0,00	13,27	A		0,00	0,00	-	
4	13,80	0,95	13,27	A		0,00	0,00	-	
4	13,40	1,26	17,30	A		0,00	0,00	-	
5	13,40	3,11	17,30	A		0,00	0,00	-	
5	13,33	3,24	18,00	A		0,00	0,00	-	
6	13,33	5,14	18,00	A		0,00	0,00	-	
6	12,99	6,32	21,43	A		0,00	0,00	-	
7	12,99	6,27	21,43	A		0,00	0,00	-	
7	12,64	7,43	24,87	A		0,00	0,00	-	
8	12,64	7,43	24,87	A		0,00	0,00	-	
8	12,30	8,59	28,30	A		0,00	0,00	-	
9	12,30	8,59	28,30	A		0,00	0,00	-	
9	12,07	9,37	30,63	A		0,00	0,00	-	
10	12,07	9,37	30,63	A		0,00	0,00	P	
10	12,05	9,43	30,80	A		1,26	0,00	P	
11	12,05	9,43	30,80	A		1,26	0,00	P	
11	12,00	9,59	31,30	A		3,31	0,50	P	
12	12,00	9,60	31,30	A		3,31	0,50	P	
12	11,67	11,03	33,69	A		13,12	4,78	P	
13	11,67	11,04	33,69	A		13,12	4,78	P	
13	11,33	12,46	36,08	A		22,93	9,06	P	
14	11,33	12,47	36,08	A		22,93	9,06	P	
14	11,00	13,90	38,47	A		32,74	13,33	P	

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* [%]
15	11,00	13,91	38,47	A		32,74	13,33	P	
15	10,60	15,62	41,33	A		44,51	18,47	P	
16	10,60	15,64	41,33	A		44,51	18,47	P	
16	10,20	17,34	44,20	A		56,28	23,60	P	
17	10,20	17,36	44,20	A		56,28	23,60	P	
17	9,80	19,07	47,07	A		68,06	28,73	P	
18	9,80	19,09	47,07	A		68,06	28,73	P	
18	9,40	20,79	49,93	A		79,83	33,87	P	
19	9,40	20,81	49,93	A		79,83	33,87	P	
19	9,00	22,51	52,80	A		91,60	39,00	P	
20	9,00	22,54	52,80	A		91,60	39,00	P	
20	8,55	24,47	55,96	A		104,58	44,84	P	
21	8,55	24,50	55,96	A		104,58	44,84	P	
21	8,10	26,43	59,12	A		117,57	50,68	P	
22	8,10	26,45	59,12	A		117,57	50,68	P	
22	7,77	27,89	61,47	A		127,19	55,00	P	
23	7,77	27,90	61,47	A		127,19	55,00	P	
23	7,43	29,34	63,81	A		125,93	59,33	3	92
24	7,43	29,36	63,81	A		125,93	59,33	3	92
24	7,10	30,79	66,15	A		120,12	63,65	3	82
25	7,10	30,80	66,15	A		134,01	63,65	3	92
25	7,00	31,13	67,15	A		131,01	64,65	3	87
26	7,00	31,15	67,15	A		131,01	64,65	3	87
26	6,65	32,30	70,65	A		98,40	68,15	2	60
27	6,65	32,32	70,65	A		98,40	68,15	2	60
27	6,30	147,60	74,15	1	40	14,65	71,65	A	
28	6,30	147,72	74,15	1	40	14,65	71,65	A	
28	5,95	235,32	77,65	2	62	15,83	75,15	A	
29	5,95	235,91	77,65	2	62	15,83	75,15	A	
29	5,60	296,23	81,15	2	75	17,00	78,65	A	

*

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

12.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	310,1	443,5
Water	397,4	263,5
Total	707,5	707,0

Considered as passive side	Right
Maximum passive effective resistance	634,44 kN
Mobilized passive effective resistance	443,48 kN
Percentage mobilized resistance	69,9 %

12.7.5 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	-95,55
Vertical force passive	136,68
Resulting vertical force (no dead weight)	41,13
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-95,55
Vertical force passive	136,68
Resulting vertical force (no dead weight)	41,13
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

12.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	-0,18	12,07	Zand, m vast	0,04
13,33	Zand, m vast	-3,02	12,00	Zand, m vast	43,88
12,00	Zand, m vast	-14,85	9,00	Zand, los	67,39
9,00	Zand, los	-15,61	7,10	Zand, m vast	25,37
7,10	Zand, m vast	-61,88			

13 Step 6.5 Stage 2: Robuustheid

13.1 Input Data Left

13.1.1 Calculation Method

Calculation method: C, phi, delta

13.1.2 Water Level

Water level: 15,13 [m]

13.1.3 Surface

X [m]	Y [m]
0,00	14,63
0,10	15,13
7,00	15,13
9,10	13,90

13.1.4 Soil Material Properties in Profile: DR56-SO08 (L +1,0)

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]
OB klei dijk	15,13	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,63	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,33	18,00	20,00	0,00	30,00	20,00
Zand, m vast	12,00	18,00	20,00	0,00	30,00	20,00
Zand, los	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	7,10	18,00	20,00	0,00	30,00	20,00
Zand, sterk gri...	3,50	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-8,50
Zand, los	9,00	n.a.	n.a.	n.a.	-8,50	-14,15
Zand, m vast	7,10	n.a.	n.a.	n.a.	-14,15	-14,15
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-14,15	-14,15

13.1.5 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]
OB klei dijk	15,13	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,63	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,33	20000,00	20000,00	10000,00	10000,00
Zand, m vast	12,00	20000,00	20000,00	10000,00	10000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, los	9,00	12000,00	12000,00	6000,00	6000,00
Zand, m vast	7,10	20000,00	20000,00	10000,00	10000,00
Zand, sterk gri...	3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	800,00	800,00
OB klei dijk	14,63	800,00	800,00
Zand, m vast	13,33	5000,00	5000,00
Zand, m vast	12,00	5000,00	5000,00
Zand, los	9,00	3000,00	3000,00
Zand, m vast	7,10	5000,00	5000,00
Zand, sterk gri...	3,50	10000,00	10000,00

13.2 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	14,62	0,0	693,3	0,00	0,78	345,74
2	14,41	0,0	45,2	0,00	0,95	8,98
3	14,01	0,0	60,8	0,00	0,67	6,65
4	13,60	0,0	76,3	0,00	0,58	6,00
5	13,37	0,0	85,4	0,00	0,56	5,78
6	13,16	0,9	98,7	0,06	0,51	5,87
7	12,81	5,7	84,6	0,28	0,49	4,18
8	12,47	6,7	96,7	0,28	0,48	4,09
9	12,15	7,6	115,8	0,28	0,47	4,31
10	11,83	8,6	137,4	0,28	0,46	4,51
11	11,50	9,8	156,8	0,28	0,46	4,52
12	11,17	11,0	176,1	0,28	0,46	4,52
13	10,80	12,3	201,1	0,28	0,46	4,62
14	10,40	13,7	228,9	0,28	0,46	4,71
15	10,00	15,2	257,0	0,28	0,46	4,80
16	9,60	16,6	285,4	0,28	0,46	4,87
17	9,20	18,0	314,0	0,28	0,46	4,94
18	8,78	19,6	344,8	0,28	0,47	5,00
19	8,32	21,2	377,7	0,28	0,47	5,06
20	7,93	22,6	406,5	0,28	0,47	5,11
21	7,60	23,8	431,0	0,28	0,47	5,15
22	7,27	25,0	455,6	0,28	0,47	5,18
23	7,05	25,8	470,7	0,28	0,47	5,20
24	6,83	26,4	483,5	0,28	0,47	5,22
25	6,47	27,4	503,4	0,29	0,47	5,24
26	6,13	28,4	523,4	0,29	0,48	5,27
27	5,78	29,3	543,3	0,29	0,48	5,29

13.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	6,83
Zand, m vast	40,09
Zand, los	51,57
Zand, m vast	70,43
Zand, sterk grindig	0,00

13.4 Input Data Right

13.4.1 Calculation Method

Calculation method: C, phi, delta

13.4.2 Water Level

Water level: 12,30 [m]

13.4.3 Surface

X [m]	Y [m]
0,00	12,30

13.4.4 Soil Material Properties in Profile: DR56-SO08 (R +1,0)

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]
OB klei dijk	15,13	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,63	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,33	18,00	20,00	0,00	30,00	20,00
Zand, m vast	12,00	18,00	20,00	0,00	30,00	20,00
Zand, los	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	7,10	18,00	20,00	0,00	30,00	20,00
Zand, sterk gri...	3,50	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	8,50
Zand, los	9,00	n.a.	n.a.	n.a.	8,50	14,15
Zand, m vast	7,10	n.a.	n.a.	n.a.	14,15	14,15
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	14,15	14,15

13.4.5 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]
OB klei dijk	15,13	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,63	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,33	20000,00	20000,00	10000,00	10000,00
Zand, m vast	12,00	20000,00	20000,00	10000,00	10000,00
Zand, los	9,00	12000,00	12000,00	6000,00	6000,00
Zand, m vast	7,10	20000,00	20000,00	10000,00	10000,00
Zand, sterk gri...	3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	800,00	800,00
OB klei dijk	14,63	800,00	800,00
Zand, m vast	13,33	5000,00	5000,00
Zand, m vast	12,00	5000,00	5000,00
Zand, los	9,00	3000,00	3000,00
Zand, m vast	7,10	5000,00	5000,00
Zand, sterk gri...	3,50	10000,00	10000,00

13.5 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	12,15	0,4	8,6	0,28	0,50	5,74
2	11,83	1,2	24,1	0,28	0,50	5,74
3	11,50	1,8	37,8	0,28	0,50	5,74
4	11,17	2,5	51,5	0,28	0,50	5,74
5	10,80	3,2	66,6	0,28	0,50	5,74
6	10,40	4,0	83,0	0,28	0,50	5,74
7	10,00	4,8	99,4	0,28	0,50	5,74
8	9,60	5,6	115,9	0,28	0,50	5,74
9	9,20	6,4	132,3	0,28	0,50	5,74
10	8,78	7,3	149,6	0,28	0,50	5,74
11	8,32	8,2	167,8	0,28	0,50	5,74
12	7,93	8,9	183,6	0,28	0,50	5,74
13	7,60	9,6	197,0	0,28	0,50	5,74
14	7,27	10,2	210,4	0,28	0,50	5,74
15	7,05	10,7	220,0	0,28	0,50	5,74
16	6,83	11,3	232,9	0,28	0,50	5,74
17	6,47	12,3	253,0	0,28	0,50	5,74
18	6,13	13,3	273,1	0,28	0,50	5,74
19	5,78	14,3	293,2	0,28	0,50	5,74

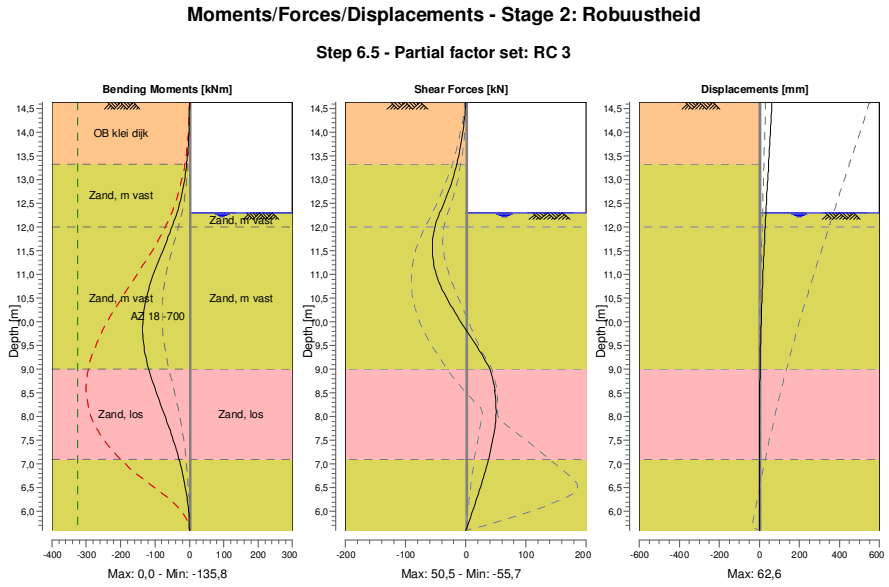
13.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	2,58
Zand, m vast	190,79
Zand, los	59,36
Zand, m vast	32,80
Zand, sterk grindig	0,00

13.7 Calculation Results

Number of iterations: 4

13.7.1 Charts of Moments, Forces and Displacements



13.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**62,6**
1	14,61	0,0	-0,1	62,4
2	14,61	0,0	-0,1	62,4
2	14,21	-0,6	-3,0	57,1
3	14,21	-0,6	-3,0	57,1
3	13,80	-2,6	-7,6	51,9
4	13,80	-2,6	-7,6	51,9
4	13,40	-6,9	-13,7	46,7
5	13,40	-6,9	-13,7	46,7
5	13,33	-7,9	-14,9	45,8
6	13,33	-7,9	-14,9	45,8
6	12,99	-14,2	-22,0	41,3
7	12,99	-14,2	-22,0	41,3
7	12,64	-23,4	-31,9	37,0
8	12,64	-23,4	-31,9	37,0
8	12,30	-36,3	-43,4	32,7
9	12,30	-36,3	-43,4	32,7
9	12,00	-50,7	-51,5	29,0
10	12,00	-50,7	-51,5	29,0
10	11,67	-68,6	**-55,5**	25,0
11	11,67	-68,6	**-55,5**	25,0
11	11,33	-87,1	-54,6	21,3
12	11,33	-87,1	-54,6	21,3
12	11,00	-104,5	-49,0	17,7
13	11,00	-104,5	-48,9	17,7
13	10,60	-121,7	-35,8	13,9
14	10,60	-121,7	-35,7	13,9
14	10,20	-132,6	-18,2	10,5
15	10,20	-132,6	-18,0	10,5
15	9,80	**-135,8**	2,2	7,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,80	**-135,8**	2,4	7,7
16	9,40	-130,8	22,3	5,4
17	9,40	-130,8	22,5	5,4
17	9,00	-118,1	40,5	3,6
18	9,00	-118,1	40,6	3,6
18	8,55	-97,9	48,2	2,1
19	8,55	-97,9	48,2	2,1
19	8,10	-75,5	50,4	1,1
20	8,10	-75,5	50,5	1,1
20	7,77	-58,9	48,6	0,6
21	7,77	-58,9	48,6	0,6
21	7,43	-43,5	43,9	0,3
22	7,43	-43,5	43,9	0,3
22	7,10	-29,8	37,6	0,1
23	7,10	-29,8	37,6	0,1
23	7,00	-26,2	35,7	0,1
24	7,00	-26,2	35,7	0,1
24	6,65	-15,0	27,9	0,0
25	6,65	-15,0	27,9	0,0
25	6,30	-6,8	19,1	-0,1
26	6,30	-6,8	19,1	-0,1
26	5,95	-1,7	9,7	-0,1
27	5,95	-1,7	9,7	-0,1
27	5,60	0,0	0,0	-0,1
Max		**-135,8**	**-55,5**	**62,6**
Max, minor nodes incl.		-135,8	-55,7	62,6

13.7.3 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	14,63	0,00	5,00	A		0,00	0,00	-	
1	14,61	0,00	5,20	A		0,00	0,00	-	
2	14,61	0,00	5,20	A		0,00	0,00	-	
2	14,21	0,00	9,23	A		0,00	0,00	-	
3	14,21	0,00	9,23	A		0,00	0,00	-	
3	13,80	0,00	13,27	A		0,00	0,00	-	
4	13,80	0,00	13,27	A		0,00	0,00	-	
4	13,40	0,00	17,30	A		0,00	0,00	-	
5	13,40	0,00	17,30	A		0,00	0,00	-	
5	13,33	0,00	18,00	A		0,00	0,00	-	
6	13,33	0,84	18,00	A		0,00	0,00	-	
6	12,99	1,03	21,43	A		0,00	0,00	-	
7	12,99	5,21	21,43	A		0,00	0,00	-	
7	12,64	6,17	24,87	A		0,00	0,00	-	
8	12,64	6,18	24,87	A		0,00	0,00	-	
8	12,30	7,14	28,30	A		0,00	0,00	-	
9	12,30	7,14	28,30	A		0,00	0,00	P	
9	12,00	7,98	31,30	A		17,21	3,00	P	
10	12,00	7,98	31,30	A		17,21	3,00	P	
10	11,67	9,17	33,69	A		30,92	7,28	P	
11	11,67	9,18	33,69	A		30,92	7,28	P	
11	11,33	10,37	36,08	A		44,62	11,56	P	
12	11,33	10,38	36,08	A		44,62	11,56	P	
12	11,00	11,57	38,47	A		58,33	15,83	P	
13	11,00	11,58	38,47	A		58,33	15,83	P	
13	10,60	13,00	41,33	A		74,77	20,97	P	
14	10,60	13,01	41,33	A		74,77	20,97	P	
14	10,20	14,43	44,20	A		79,50	26,10	3	87
15	10,20	14,45	44,20	A		79,50	26,10	3	87
15	9,80	15,87	47,07	A		85,50	31,23	2	79
16	9,80	15,88	47,07	A		85,50	31,23	2	79
16	9,40	17,30	49,93	A		77,36	36,37	2	62

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	9,40	17,32	49,93	A		77,36	36,37	2	62
17	9,00	18,74	52,80	A		73,92	41,50	2	53
18	9,00	18,76	52,80	A		55,08	41,50	1	39
18	8,55	20,37	55,96	A		39,00	47,34	1	25
19	8,55	20,39	55,96	A		39,00	47,34	1	25
19	8,10	22,81	59,12	1		28,80	53,18	1	16
20	8,10	22,93	59,12	1		28,80	53,18	1	16
20	7,77	30,63	61,47	1		24,24	57,50	1	13
21	7,77	30,74	61,47	1		24,24	57,50	1	13
21	7,43	36,50	63,81	1		21,62	61,83	1	11
22	7,43	36,62	63,81	1		21,62	61,83	1	11
22	7,10	40,94	66,15	1		20,44	66,15	1	9
23	7,10	40,00	66,15	1		21,46	66,15	1	10
23	7,00	41,28	67,15	1		21,13	67,15	1	9
24	7,00	41,34	67,15	1		21,13	67,15	1	9
24	6,65	44,90	70,65	1	9	20,91	70,65	1	
25	6,65	45,00	70,65	1	9	20,91	70,65	1	
25	6,30	47,65	74,15	1	9	21,61	74,15	1	
26	6,30	47,75	74,15	1	9	21,61	74,15	1	
26	5,95	49,97	77,65	1	9	22,74	77,65	1	
27	5,95	50,08	77,65	1	9	22,74	77,65	1	
27	5,60	52,18	81,15	1	9	23,98	81,15	1	

*

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

13.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	168,9	285,5
Water	397,4	279,9
Total	566,3	565,5

Considered as passive side	Right
Maximum passive effective resistance	969,34 kN
Mobilized passive effective resistance	285,53 kN
Percentage mobilized resistance	29,5 %

13.7.5 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	-61,48
Vertical force passive	103,93
Resulting vertical force (no dead weight)	42,45
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

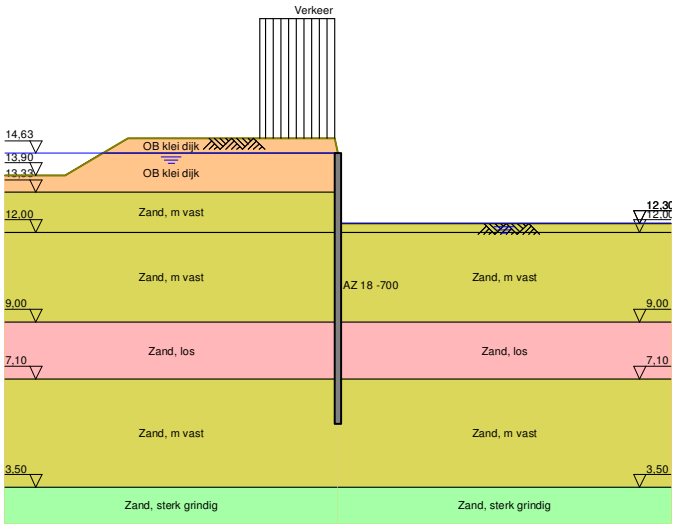
Vertical force balance plugged	Force [kN]
Vertical force active	-61,48
Vertical force passive	103,93
Resulting vertical force (no dead weight)	42,45
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

13.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	0,00	12,30	Zand, m vast	0,94
13,33	Zand, m vast	-2,48	12,00	Zand, m vast	69,44
12,00	Zand, m vast	-14,59	9,00	Zand, los	21,61
9,00	Zand, los	-18,77	7,10	Zand, m vast	11,94
7,10	Zand, m vast	-25,63			

14 Outline Stage 3: Robuustheid + verkeer

Outline - Stage 3: Robuustheid + verkeer

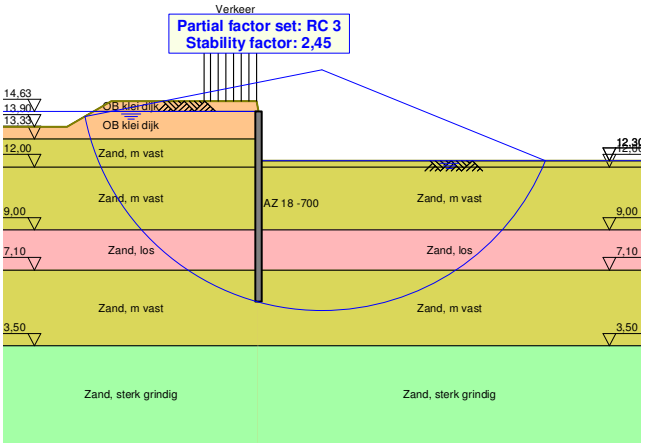


15 Overall Stability Stage 3: Robuustheid + verkeer

Stability factor : 2,45

15.1 Overall Stability

Overall Stability - Stage 3: Robuustheid + verkeer



16 Step 6.3 Stage 3: Robuustheid + verkeer

16.1 Input Data Left

16.1.1 Calculation Method

Calculation method: C, phi, delta

16.1.2 Water Level

Water level: 14,63 [m]

16.1.3 Surface

X [m]	Y [m]
0,00	14,63
0,10	15,13
7,00	15,13
9,10	13,90

16.1.4 Soil Material Properties in Profile: DR56-SO08 (L +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-7,00
Zand, los	9,00	n.a.	n.a.	n.a.	-7,00	-11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	-11,65	-11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-11,65	-11,65

16.1.5 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]
OB klei dijk	15,13	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,63	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,33	15384,62	15384,62	7692,31	7692,31
Zand, m vast	12,00	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, los	9,00	9230,77	9230,77	4615,38	4615,38
Zand, m vast	7,10	15384,62	15384,62	7692,31	7692,31
Zand, sterk gri...	3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	615,38	615,38
OB klei dijk	14,63	615,38	615,38
Zand, m vast	13,33	3846,15	3846,15
Zand, m vast	12,00	3846,15	3846,15
Zand, los	9,00	2307,69	2307,69
Zand, m vast	7,10	3846,15	3846,15
Zand, sterk gri...	3,50	7692,31	7692,31

16.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,10	16,66
	2,60	16,66

16.2 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	14,62	96,3	2003,2	5,72	5,72	118,92
2	14,41	7,9	92,4	0,35	0,88	4,13
3	14,01	9,2	68,7	0,33	0,65	2,46
4	13,60	10,5	52,7	0,33	0,55	1,66
5	13,37	11,3	58,1	0,34	0,51	1,73
6	13,16	13,3	74,2	0,38	0,47	2,10
7	12,81	14,1	79,2	0,37	0,45	2,07
8	12,47	15,3	91,2	0,37	0,43	2,21
9	12,18	16,3	99,9	0,37	0,43	2,29
10	12,06	16,7	100,8	0,37	0,42	2,26
11	12,03	16,8	102,0	0,37	0,42	2,27
12	11,83	17,6	108,8	0,38	0,42	2,32
13	11,50	18,1	122,9	0,36	0,42	2,45
14	11,17	18,2	137,6	0,34	0,43	2,56
15	10,80	18,3	153,8	0,32	0,43	2,67
16	10,40	18,4	171,6	0,30	0,44	2,78
17	10,00	18,6	189,7	0,28	0,45	2,87
18	9,60	19,1	208,1	0,27	0,45	2,96
19	9,20	20,9	226,7	0,28	0,46	3,04
20	8,78	23,3	246,9	0,29	0,47	3,12
21	8,32	25,9	268,5	0,31	0,47	3,19
22	7,93	27,6	287,6	0,31	0,48	3,25
23	7,60	29,1	303,9	0,32	0,48	3,30
24	7,27	30,5	320,4	0,32	0,49	3,34
25	7,05	31,4	330,6	0,32	0,49	3,37
26	6,83	32,2	339,4	0,32	0,49	3,39
27	6,47	33,4	353,3	0,32	0,49	3,42
28	6,13	34,7	367,2	0,33	0,50	3,46
29	5,78	35,9	381,2	0,33	0,50	3,49

16.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	13,74
Zand, m vast	19,57
Zand, m vast	56,11
Zand, los	51,21
Zand, m vast	219,57
Zand, sterk grindig	0,00

16.4 Input Data Right

16.4.1 Calculation Method

Calculation method: C, phi, delta

16.4.2 Water Level

Water level: 12,05 [m]

16.4.3 Surface

X [m]	Y [m]
0,00	12,07

16.4.4 Soil Material Properties in Profile: DR56-SO08 (R +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	7,00
Zand, los	9,00	n.a.	n.a.	n.a.	7,00	11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	11,65	11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	11,65	11,65

16.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,63	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,33	15384,62	15384,62	7692,31	7692,31
Zand, m vast	12,00	15384,62	15384,62	7692,31	7692,31
Zand, los	9,00	9230,77	9230,77	4615,38	4615,38
Zand, m vast	7,10	15384,62	15384,62	7692,31	7692,31
Zand, sterk gri...	3,50	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	615,38	615,38
OB klei dijk	14,63	615,38	615,38
Zand, m vast	13,33	3846,15	3846,15
Zand, m vast	12,00	3846,15	3846,15
Zand, los	9,00	2307,69	2307,69
Zand, m vast	7,10	3846,15	3846,15
Zand, sterk gri...	3,50	7692,31	7692,31

16.5 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	12,06	0,1	0,6	0,34	0,57	4,11
2	12,03	0,2	2,3	0,34	0,57	4,11
3	11,83	0,7	8,6	0,34	0,57	4,11
4	11,50	1,6	19,1	0,34	0,57	4,11
5	11,17	2,4	29,5	0,34	0,57	4,11
6	10,80	3,4	41,1	0,34	0,57	4,11
7	10,40	4,4	53,7	0,34	0,57	4,11
8	10,00	5,4	66,3	0,34	0,57	4,11
9	9,60	6,4	78,9	0,34	0,57	4,11
10	9,20	7,5	91,5	0,34	0,57	4,11
11	8,78	8,6	104,7	0,34	0,57	4,11
12	8,32	9,7	118,7	0,34	0,57	4,11
13	7,93	10,7	130,8	0,34	0,57	4,11
14	7,60	11,5	141,2	0,34	0,57	4,11
15	7,27	12,4	151,5	0,34	0,57	4,11
16	7,05	13,0	158,7	0,34	0,57	4,11
17	6,83	13,7	168,0	0,34	0,57	4,11
18	6,47	14,9	182,4	0,34	0,57	4,11
19	6,13	16,1	196,7	0,34	0,57	4,11
20	5,78	17,3	211,1	0,34	0,57	4,11

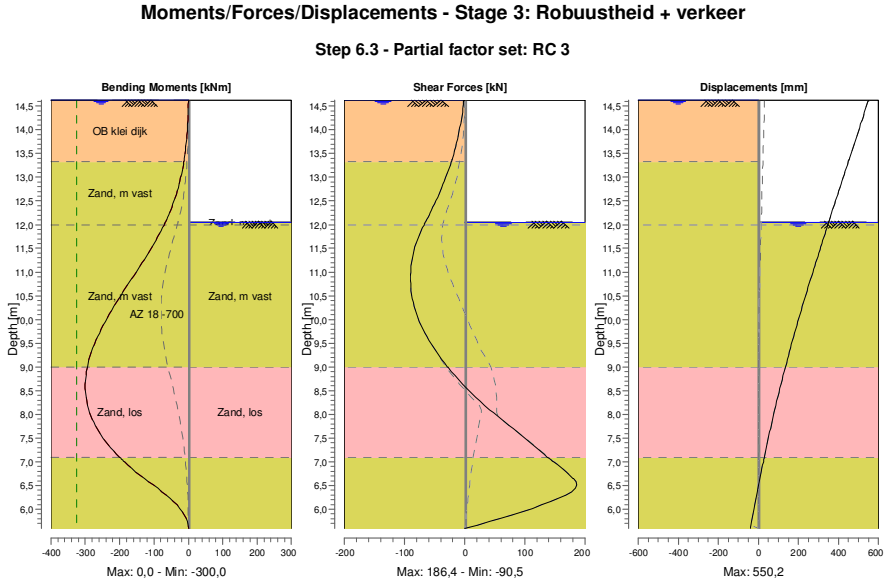
16.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	0,13
Zand, m vast	151,60
Zand, los	230,76
Zand, m vast	85,46
Zand, sterk grindig	0,00

16.7 Calculation Results

Number of iterations: 8

16.7.1 Charts of Moments, Forces and Displacements



16.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**550,2**
1	14,61	0,0	-1,9	548,6
2	14,61	0,0	-1,9	548,6
2	14,21	-1,5	-5,9	517,3
3	14,21	-1,5	-5,9	517,3
3	13,80	-5,0	-12,1	486,0
4	13,80	-5,0	-12,1	486,0
4	13,40	-11,6	-20,5	454,7
5	13,40	-11,6	-20,5	454,7
5	13,33	-13,1	-22,2	449,3
6	13,33	-13,1	-22,2	449,3
6	12,99	-22,3	-31,8	422,7
7	12,99	-22,3	-31,8	422,7
7	12,64	-35,1	-42,9	396,2
8	12,64	-35,1	-42,9	396,2
8	12,30	-51,9	-55,5	369,8
9	12,30	-51,9	-55,5	369,8
9	12,07	-65,9	-65,0	352,0
10	12,07	-65,9	-65,1	352,0
10	12,05	-67,1	-65,8	350,7
11	12,05	-67,1	-65,9	350,7
11	12,00	-70,4	-67,9	346,8
12	12,00	-70,4	-67,9	346,8
12	11,67	-95,0	-79,2	321,5
13	11,67	-95,0	-79,2	321,5
13	11,33	-122,8	-86,7	296,5

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	11,33	-122,8	-86,7	296,5
14	11,00	-152,4	-90,3	271,7
15	11,00	-152,4	-90,3	271,7
15	10,60	-188,5	-89,2	242,6
16	10,60	-188,5	-89,2	242,6
16	10,20	-223,0	-82,5	214,3
17	10,20	-223,0	-82,4	214,3
17	9,80	-253,6	-69,9	186,8
18	9,80	-253,6	-69,7	186,8
18	9,40	-278,1	-51,7	160,3
19	9,40	-278,1	-51,5	160,3
19	9,00	-294,2	-28,4	134,9
20	9,00	-294,2	-28,3	134,9
20	8,55	**-300,0**	3,6	107,7
21	8,55	**-300,0**	3,6	107,7
21	8,10	-290,1	41,5	82,0
22	8,10	-290,1	41,5	82,0
22	7,77	-271,0	73,6	64,0
23	7,77	-271,0	73,6	64,0
23	7,43	-240,9	106,6	46,6
24	7,43	-240,9	106,6	46,6
24	7,10	-200,2	137,7	29,9
25	7,10	-200,2	137,8	29,9
25	7,00	-185,9	148,1	25,0
26	7,00	-185,9	148,2	25,0
26	6,65	-128,1	180,1	8,3
27	6,65	-128,1	**180,6**	8,3
27	6,30	-64,5	168,3	-8,2
28	6,30	-64,5	167,9	-8,2
28	5,95	-17,5	96,3	-24,4
29	5,95	-17,5	96,3	-24,4
29	5,60	0,0	0,0	-40,5
Max		**-300,0**	**180,6**	**550,2**
Max, minor nodes incl.		-300,0	186,4	550,2

16.7.3 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	14,63	71,49	0,00	A	5	0,00	0,00	-	
1	14,61	97,27	0,20	A	5	0,00	0,00	-	
2	14,61	5,99	0,20	A		0,00	0,00	-	
2	14,21	9,02	4,23	A		0,00	0,00	-	
3	14,21	8,46	4,23	A		0,00	0,00	-	
3	13,80	9,88	8,27	A		0,00	0,00	-	
4	13,80	9,95	8,27	A		0,00	0,00	-	
4	13,40	11,08	12,30	A		0,00	0,00	-	
5	13,40	11,20	12,30	A		0,00	0,00	-	
5	13,33	11,39	13,00	A		0,00	0,00	-	
6	13,33	12,71	13,00	A		0,00	0,00	-	
6	12,99	13,86	16,43	A		0,00	0,00	-	
7	12,99	13,59	16,43	A		0,00	0,00	-	
7	12,64	14,66	19,87	A		0,00	0,00	-	
8	12,64	14,76	19,87	A		0,00	0,00	-	
8	12,30	15,80	23,30	A		0,00	0,00	-	
9	12,30	15,90	23,30	A		0,00	0,00	-	
9	12,07	16,60	25,63	A		0,00	0,00	-	
10	12,07	16,64	25,63	A		0,00	0,00	P	
10	12,05	16,70	25,80	A		1,26	0,00	P	
11	12,05	16,71	25,80	A		1,26	0,00	P	
11	12,00	16,86	26,30	A		3,31	0,50	P	
12	12,00	16,90	26,30	A		3,31	0,50	P	
12	11,67	18,20	28,86	A		13,80	4,61	P	

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* [%]
13	11,67	17,52	28,86	A		13,80	4,61	P	
13	11,33	18,77	31,41	A		24,30	8,72	P	
14	11,33	17,63	31,41	A		24,30	8,72	P	
14	11,00	18,82	33,97	A		34,79	12,83	P	
15	11,00	17,66	33,97	A		34,79	12,83	P	
15	10,60	19,00	37,03	A		47,39	17,77	P	
16	10,60	17,81	37,03	A		47,39	17,77	P	
16	10,20	19,08	40,10	A		59,98	22,70	P	
17	10,20	17,96	40,10	A		59,98	22,70	P	
17	9,80	19,16	43,17	A		72,57	27,63	P	
18	9,80	18,49	43,17	A		72,57	27,63	P	
18	9,40	19,65	46,23	A		85,17	32,57	P	
19	9,40	20,34	46,23	A		85,17	32,57	P	
19	9,00	21,55	49,30	A		97,76	37,50	P	
20	9,00	22,56	49,30	A		97,76	37,50	P	
20	8,55	24,01	52,70	A		111,72	43,10	P	
21	8,55	25,12	52,70	A		111,72	43,10	P	
21	8,10	26,64	56,10	A		125,67	48,70	P	
22	8,10	27,05	56,10	A		125,67	48,70	P	
22	7,77	28,20	58,61	A		134,41	52,85	3	99
23	7,77	28,51	58,61	A		134,41	52,85	3	99
23	7,43	29,68	61,13	A		129,95	57,00	3	89
24	7,43	29,95	61,13	A		129,95	57,00	3	89
24	7,10	31,14	63,65	A		126,55	61,15	3	81
25	7,10	31,30	63,65	A		139,09	61,15	3	89
25	7,00	31,58	64,65	A		135,60	62,15	3	84
26	7,00	31,74	64,65	A		135,60	62,15	3	84
26	6,65	32,72	68,15	A		102,20	65,65	2	58
27	6,65	32,95	68,15	A		102,20	65,65	2	58
27	6,30	177,25	71,65	1	49	15,49	69,15	A	
28	6,30	177,59	71,65	1	49	15,49	69,15	A	
28	5,95	254,85	75,15	2	68	16,67	72,65	A	
29	5,95	255,66	75,15	2	68	16,67	72,65	A	
29	5,60	315,10	78,65	3	81	17,84	76,15	A	

*

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

16.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	360,2	468,0
Water	362,0	253,7
Total	722,2	721,7

Considered as passive side	Right
Maximum passive effective resistance	674,68 kN
Mobilized passive effective resistance	467,96 kN
Percentage mobilized resistance	69,4 %

16.7.5 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	-110,55
Vertical force passive	144,22
Resulting vertical force (no dead weight)	33,67
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-110,55
Vertical force passive	144,22
Resulting vertical force (no dead weight)	33,67
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

16.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	-3,77	12,07	Zand, m vast	0,04
13,33	Zand, m vast	-6,03	12,00	Zand, m vast	46,72
12,00	Zand, m vast	-17,29	9,00	Zand, los	71,12
9,00	Zand, los	-15,78	7,10	Zand, m vast	26,34
7,10	Zand, m vast	-67,67			

17 Step 6.4 Stage 3: Robuustheid + verkeer

17.1 Input Data Left

17.1.1 Calculation Method

Calculation method: C, phi, delta

17.1.2 Water Level

Water level: 14,63 [m]

17.1.3 Surface

X [m]	Y [m]
0,00	14,63
0,10	15,13
7,00	15,13
9,10	13,90

17.1.4 Soil Material Properties in Profile: DR56-SO08 (L +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-7,00
Zand, los	9,00	n.a.	n.a.	n.a.	-7,00	-11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	-11,65	-11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-11,65	-11,65

17.1.5 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]
OB klei dijk	15,13	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,63	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,33	45000,00	45000,00	22500,00	22500,00
Zand, m vast	12,00	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, los	9,00	27000,00	27000,00	13500,00	13500,00
Zand, m vast	7,10	45000,00	45000,00	22500,00	22500,00
Zand, sterk gri...	3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	1800,00	1800,00
OB klei dijk	14,63	1800,00	1800,00
Zand, m vast	13,33	11250,00	11250,00
Zand, m vast	12,00	11250,00	11250,00
Zand, los	9,00	6750,00	6750,00
Zand, m vast	7,10	11250,00	11250,00
Zand, sterk gri...	3,50	22500,00	22500,00

17.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,10	16,66
	2,60	16,66

17.2 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	14,62	96,3	2003,2	5,72	5,72	118,92
2	14,41	7,9	92,4	0,35	0,88	4,13
3	14,01	9,2	68,7	0,33	0,65	2,46
4	13,60	10,5	52,7	0,33	0,55	1,66
5	13,37	11,3	58,1	0,34	0,51	1,73
6	13,16	13,3	74,2	0,38	0,47	2,10
7	12,81	14,1	79,2	0,37	0,45	2,07
8	12,47	15,3	91,2	0,37	0,43	2,21
9	12,18	16,3	99,9	0,37	0,43	2,29
10	12,06	16,7	100,8	0,37	0,42	2,26
11	12,03	16,8	102,0	0,37	0,42	2,27
12	11,83	17,6	108,8	0,38	0,42	2,32
13	11,50	18,1	122,9	0,36	0,42	2,45
14	11,17	18,2	137,6	0,34	0,43	2,56
15	10,80	18,3	153,8	0,32	0,43	2,67
16	10,40	18,4	171,6	0,30	0,44	2,78
17	10,00	18,6	189,7	0,28	0,45	2,87
18	9,60	19,1	208,1	0,27	0,45	2,96
19	9,20	20,9	226,7	0,28	0,46	3,04
20	8,78	23,3	246,9	0,29	0,47	3,12
21	8,32	25,9	268,5	0,31	0,47	3,19
22	7,93	27,6	287,6	0,31	0,48	3,25
23	7,60	29,1	303,9	0,32	0,48	3,30
24	7,27	30,5	320,4	0,32	0,49	3,34
25	7,05	31,4	330,6	0,32	0,49	3,37
26	6,83	32,2	339,4	0,32	0,49	3,39
27	6,47	33,4	353,3	0,32	0,49	3,42
28	6,13	34,7	367,2	0,33	0,50	3,46
29	5,78	35,9	381,2	0,33	0,50	3,49

17.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	13,74
Zand, m vast	19,57
Zand, m vast	56,11
Zand, los	51,21
Zand, m vast	219,09
Zand, sterk grindig	0,00

17.4 Input Data Right

17.4.1 Calculation Method

Calculation method: C, phi, delta

17.4.2 Water Level

Water level: 12,05 [m]

17.4.3 Surface

X [m]	Y [m]
0,00	12,07

17.4.4 Soil Material Properties in Profile: DR56-SO08 (R +0,5)

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]
OB klei dijk	15,13	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,63	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,33	18,00	20,00	0,00	25,69	17,13
Zand, m vast	12,00	18,00	20,00	0,00	25,69	17,13
Zand, los	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	7,10	18,00	20,00	0,00	25,69	17,13
Zand, sterk gri...	3,50	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	7,00
Zand, los	9,00	n.a.	n.a.	n.a.	7,00	11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	11,65	11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	11,65	11,65

17.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,63	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,33	45000,00	45000,00	22500,00	22500,00
Zand, m vast	12,00	45000,00	45000,00	22500,00	22500,00
Zand, los	9,00	27000,00	27000,00	13500,00	13500,00
Zand, m vast	7,10	45000,00	45000,00	22500,00	22500,00
Zand, sterk gri...	3,50	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	1800,00	1800,00
OB klei dijk	14,63	1800,00	1800,00
Zand, m vast	13,33	11250,00	11250,00
Zand, m vast	12,00	11250,00	11250,00
Zand, los	9,00	6750,00	6750,00
Zand, m vast	7,10	11250,00	11250,00
Zand, sterk gri...	3,50	22500,00	22500,00

17.5 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	12,06	0,1	0,6	0,34	0,57	4,11
2	12,03	0,2	2,3	0,34	0,57	4,11
3	11,83	0,7	8,6	0,34	0,57	4,11
4	11,50	1,6	19,1	0,34	0,57	4,11
5	11,17	2,4	29,5	0,34	0,57	4,11
6	10,80	3,4	41,1	0,34	0,57	4,11
7	10,40	4,4	53,7	0,34	0,57	4,11
8	10,00	5,4	66,3	0,34	0,57	4,11
9	9,60	6,4	78,9	0,34	0,57	4,11
10	9,20	7,5	91,5	0,34	0,57	4,11
11	8,78	8,6	104,7	0,34	0,57	4,11
12	8,32	9,7	118,7	0,34	0,57	4,11
13	7,93	10,7	130,8	0,34	0,57	4,11
14	7,60	11,5	141,2	0,34	0,57	4,11
15	7,27	12,4	151,5	0,34	0,57	4,11
16	7,05	13,0	158,7	0,34	0,57	4,11
17	6,83	13,7	168,0	0,34	0,57	4,11
18	6,47	14,9	182,4	0,34	0,57	4,11
19	6,13	16,1	196,7	0,34	0,57	4,11
20	5,78	17,3	211,1	0,34	0,57	4,11

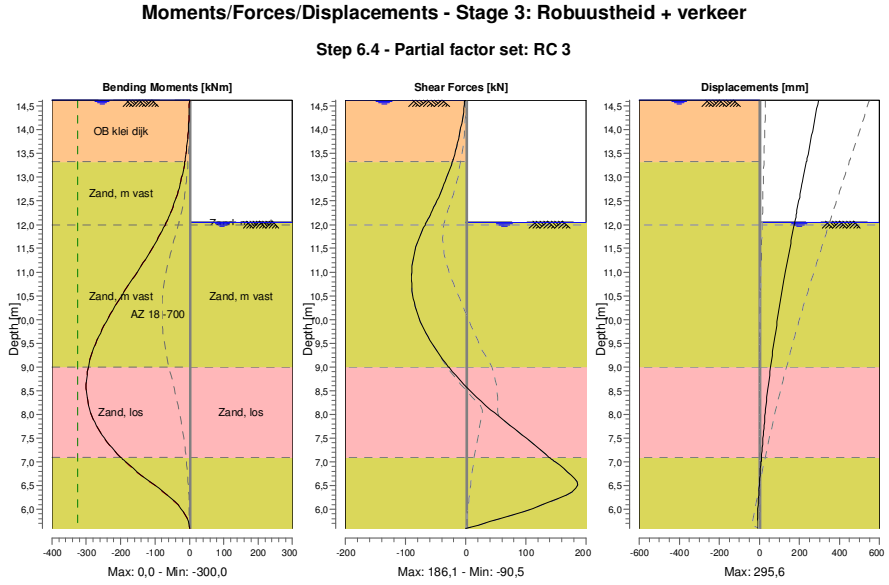
17.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	0,13
Zand, m vast	151,60
Zand, los	231,58
Zand, m vast	84,15
Zand, sterk grindig	0,00

17.7 Calculation Results

Number of iterations: 11

17.7.1 Charts of Moments, Forces and Displacements



17.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**295,6**
1	14,61	0,0	-1,9	294,7
2	14,61	0,0	-1,9	294,7
2	14,21	-1,5	-5,9	275,9
3	14,21	-1,5	-5,9	275,9
3	13,80	-5,0	-12,1	257,2
4	13,80	-5,0	-12,1	257,2
4	13,40	-11,6	-20,5	238,5
5	13,40	-11,6	-20,5	238,5
5	13,33	-13,1	-22,2	235,3
6	13,33	-13,1	-22,2	235,3
6	12,99	-22,3	-31,8	219,4
7	12,99	-22,3	-31,8	219,4
7	12,64	-35,1	-42,9	203,6
8	12,64	-35,1	-42,9	203,6
8	12,30	-51,9	-55,5	187,9
9	12,30	-51,9	-55,5	187,9
9	12,07	-65,9	-65,0	177,3
10	12,07	-65,9	-65,1	177,3
10	12,05	-67,1	-65,8	176,6
11	12,05	-67,1	-65,9	176,6
11	12,00	-70,4	-67,9	174,3
12	12,00	-70,4	-67,9	174,3
12	11,67	-95,0	-79,2	159,4
13	11,67	-95,0	-79,2	159,4
13	11,33	-122,8	-86,7	144,7

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	11,33	-122,8	-86,7	144,7
14	11,00	-152,4	-90,3	130,4
15	11,00	-152,4	-90,3	130,4
15	10,60	-188,5	-89,2	113,8
16	10,60	-188,5	-89,2	113,8
16	10,20	-223,0	-82,5	97,9
17	10,20	-223,0	-82,4	97,9
17	9,80	-253,6	-69,9	82,9
18	9,80	-253,6	-69,7	82,9
18	9,40	-278,1	-51,7	68,9
19	9,40	-278,1	-51,5	68,9
19	9,00	-294,2	-28,4	56,0
20	9,00	-294,2	-28,2	56,0
20	8,55	**-300,0**	3,6	42,9
21	8,55	**-300,0**	3,6	42,9
21	8,10	-290,1	41,6	31,2
22	8,10	-290,1	41,6	31,2
22	7,77	-271,0	73,6	23,5
23	7,77	-271,0	73,7	23,5
23	7,43	-240,8	107,3	16,6
24	7,43	-240,8	107,3	16,6
24	7,10	-199,7	138,6	10,3
25	7,10	-199,7	138,6	10,3
25	7,00	-185,4	149,0	8,5
26	7,00	-185,4	149,0	8,5
26	6,65	-127,3	180,5	2,7
27	6,65	-127,3	**181,1**	2,7
27	6,30	-63,9	167,1	-2,8
28	6,30	-63,8	166,6	-2,8
28	5,95	-17,3	95,3	-8,1
29	5,95	-17,3	95,2	-8,1
29	5,60	0,0	0,0	-13,4
Max		**-300,0**	**181,1**	**295,6**
Max, minor nodes incl.		-300,0	186,1	295,6

17.7.3 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	14,63	71,49	0,00	A	5	0,00	0,00	-	
1	14,61	97,27	0,20	A	5	0,00	0,00	-	
2	14,61	5,99	0,20	A		0,00	0,00	-	
2	14,21	9,02	4,23	A		0,00	0,00	-	
3	14,21	8,46	4,23	A		0,00	0,00	-	
3	13,80	9,88	8,27	A		0,00	0,00	-	
4	13,80	9,95	8,27	A		0,00	0,00	-	
4	13,40	11,08	12,30	A		0,00	0,00	-	
5	13,40	11,20	12,30	A		0,00	0,00	-	
5	13,33	11,39	13,00	A		0,00	0,00	-	
6	13,33	12,71	13,00	A		0,00	0,00	-	
6	12,99	13,86	16,43	A		0,00	0,00	-	
7	12,99	13,59	16,43	A		0,00	0,00	-	
7	12,64	14,66	19,87	A		0,00	0,00	-	
8	12,64	14,76	19,87	A		0,00	0,00	-	
8	12,30	15,80	23,30	A		0,00	0,00	-	
9	12,30	15,90	23,30	A		0,00	0,00	-	
9	12,07	16,60	25,63	A		0,00	0,00	-	
10	12,07	16,64	25,63	A		0,00	0,00	P	
10	12,05	16,70	25,80	A		1,26	0,00	P	
11	12,05	16,71	25,80	A		1,26	0,00	P	
11	12,00	16,86	26,30	A		3,31	0,50	P	
12	12,00	16,90	26,30	A		3,31	0,50	P	
12	11,67	18,20	28,86	A		13,80	4,61	P	

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* [%]
13	11,67	17,52	28,86	A		13,80	4,61	P	
13	11,33	18,77	31,41	A		24,30	8,72	P	
14	11,33	17,63	31,41	A		24,30	8,72	P	
14	11,00	18,82	33,97	A		34,79	12,83	P	
15	11,00	17,66	33,97	A		34,79	12,83	P	
15	10,60	19,00	37,03	A		47,39	17,77	P	
16	10,60	17,81	37,03	A		47,39	17,77	P	
16	10,20	19,08	40,10	A		59,98	22,70	P	
17	10,20	17,96	40,10	A		59,98	22,70	P	
17	9,80	19,16	43,17	A		72,57	27,63	P	
18	9,80	18,49	43,17	A		72,57	27,63	P	
18	9,40	19,65	46,23	A		85,17	32,57	P	
19	9,40	20,34	46,23	A		85,17	32,57	P	
19	9,00	21,55	49,30	A		97,76	37,50	P	
20	9,00	22,56	49,30	A		97,76	37,50	P	
20	8,55	24,01	52,70	A		111,72	43,10	P	
21	8,55	25,12	52,70	A		111,72	43,10	P	
21	8,10	26,64	56,10	A		125,67	48,70	P	
22	8,10	27,05	56,10	A		125,67	48,70	P	
22	7,77	28,20	58,61	A		134,52	52,85	3	99
23	7,77	28,51	58,61	A		134,52	52,85	3	99
23	7,43	29,68	61,13	A		131,40	57,00	3	90
24	7,43	29,95	61,13	A		131,40	57,00	3	90
24	7,10	31,14	63,65	A		126,53	61,15	3	81
25	7,10	31,30	63,65	A		139,33	61,15	3	89
25	7,00	31,58	64,65	A		135,47	62,15	3	84
26	7,00	31,74	64,65	A		135,47	62,15	3	84
26	6,65	32,72	68,15	A		100,14	65,65	2	57
27	6,65	32,95	68,15	A		100,14	65,65	2	57
27	6,30	179,41	71,65	1	50	15,49	69,15	A	
28	6,30	179,75	71,65	1	50	15,49	69,15	A	
28	5,95	252,38	75,15	2	68	16,67	72,65	A	
29	5,95	253,19	75,15	2	67	16,67	72,65	A	
29	5,60	313,27	78,65	3	81	17,84	76,15	A	

*

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

17.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	359,7	467,5
Water	362,0	253,7
Total	721,7	721,2

Considered as passive side	Right
Maximum passive effective resistance	674,68 kN
Mobilized passive effective resistance	467,46 kN
Percentage mobilized resistance	69,3 %

17.7.5 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	-110,40
Vertical force passive	144,07
Resulting vertical force (no dead weight)	33,67
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-110,40
Vertical force passive	144,07
Resulting vertical force (no dead weight)	33,67
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

17.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	-3,77	12,07	Zand, m vast	0,04
13,33	Zand, m vast	-6,03	12,00	Zand, m vast	46,72
12,00	Zand, m vast	-17,29	9,00	Zand, los	71,37
9,00	Zand, los	-15,78	7,10	Zand, m vast	25,93
7,10	Zand, m vast	-67,52			

18 Step 6.5 Stage 3: Robuustheid + verkeer

18.1 Input Data Left

18.1.1 Calculation Method

Calculation method: C, phi, delta

18.1.2 Water Level

Water level: 14,63 [m]

18.1.3 Surface

X [m]	Y [m]
0,00	14,63
0,10	15,13
7,00	15,13
9,10	13,90

18.1.4 Soil Material Properties in Profile: DR56-SO08 (L +0,5)

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]
OB klei dijk	15,13	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,63	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,33	18,00	20,00	0,00	30,00	20,00
Zand, m vast	12,00	18,00	20,00	0,00	30,00	20,00
Zand, los	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	7,10	18,00	20,00	0,00	30,00	20,00
Zand, sterk gri...	3,50	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	-7,00
Zand, los	9,00	n.a.	n.a.	n.a.	-7,00	-11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	-11,65	-11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	-11,65	-11,65

18.1.5 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]
OB klei dijk	15,13	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,63	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,33	20000,00	20000,00	10000,00	10000,00
Zand, m vast	12,00	20000,00	20000,00	10000,00	10000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, los	9,00	12000,00	12000,00	6000,00	6000,00
Zand, m vast	7,10	20000,00	20000,00	10000,00	10000,00
Zand, sterk gri...	3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	800,00	800,00
OB klei dijk	14,63	800,00	800,00
Zand, m vast	13,33	5000,00	5000,00
Zand, m vast	12,00	5000,00	5000,00
Zand, los	9,00	3000,00	3000,00
Zand, m vast	7,10	5000,00	5000,00
Zand, sterk gri...	3,50	10000,00	10000,00

18.1.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,10	13,33
	2,60	13,33

18.2 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	14,62	28,3	2430,2	1,98	1,98	169,60
2	14,41	4,6	108,8	0,23	0,89	5,54
3	14,01	5,7	90,5	0,23	0,65	3,61
4	13,60	6,8	74,2	0,24	0,54	2,57
5	13,37	7,4	71,8	0,24	0,51	2,33
6	13,16	10,2	90,8	0,31	0,46	2,78
7	12,81	10,8	102,0	0,30	0,43	2,86
8	12,47	11,8	120,7	0,31	0,41	3,12
9	12,15	12,7	133,3	0,31	0,40	3,22
10	11,83	13,7	143,6	0,31	0,40	3,23
11	11,50	14,8	163,8	0,31	0,40	3,41
12	11,17	15,5	184,7	0,30	0,40	3,58
13	10,80	15,5	207,8	0,28	0,40	3,74
14	10,40	15,6	233,3	0,26	0,40	3,89
15	10,00	15,7	259,1	0,24	0,41	4,03
16	9,60	16,4	285,4	0,24	0,41	4,16
17	9,20	17,9	312,0	0,25	0,41	4,27
18	8,78	19,6	340,7	0,25	0,42	4,38
19	8,32	21,7	371,5	0,26	0,42	4,49
20	7,93	23,1	398,5	0,27	0,43	4,58
21	7,60	24,3	421,6	0,27	0,43	4,64
22	7,27	25,5	444,8	0,27	0,43	4,70
23	7,05	26,3	459,2	0,27	0,44	4,74
24	6,83	26,9	471,8	0,27	0,44	4,77
25	6,47	27,9	491,4	0,27	0,44	4,82
26	6,13	28,9	511,1	0,27	0,44	4,86
27	5,78	29,9	530,8	0,28	0,45	4,90

18.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	7,90
Zand, m vast	15,06
Zand, m vast	47,57
Zand, los	54,09

Name	Force
Zand, m vast	71,95
Zand, sterk grindig	0,00

18.4 Input Data Right

18.4.1 Calculation Method

Calculation method: C, phi, delta

18.4.2 Water Level

Water level: 12,30 [m]

18.4.3 Surface

X [m]	Y [m]
0,00	12,30

18.4.4 Soil Material Properties in Profile: DR56-SO08 (R +0,5)

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]
OB klei dijk	15,13	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,63	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,33	18,00	20,00	0,00	30,00	20,00
Zand, m vast	12,00	18,00	20,00	0,00	30,00	20,00
Zand, los	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	7,10	18,00	20,00	0,00	30,00	20,00
Zand, sterk gri...	3,50	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,13	1,00	1,00	Fine
OB klei dijk	14,63	1,00	1,00	Fine
Zand, m vast	13,33	1,00	1,00	Fine
Zand, m vast	12,00	1,00	1,00	Fine
Zand, los	9,00	1,00	1,00	Fine
Zand, m vast	7,10	1,00	1,00	Fine
Zand, sterk gri...	3,50	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]
OB klei dijk	15,13	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,63	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,33	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	12,00	n.a.	n.a.	n.a.	0,00	7,00
Zand, los	9,00	n.a.	n.a.	n.a.	7,00	11,65
Zand, m vast	7,10	n.a.	n.a.	n.a.	11,65	11,65
Zand, sterk gri...	3,50	n.a.	n.a.	n.a.	11,65	11,65

18.4.5 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]
OB klei dijk	15,13	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,63	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,33	20000,00	20000,00	10000,00	10000,00
Zand, m vast	12,00	20000,00	20000,00	10000,00	10000,00
Zand, los	9,00	12000,00	12000,00	6000,00	6000,00
Zand, m vast	7,10	20000,00	20000,00	10000,00	10000,00
Zand, sterk gri...	3,50	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,13	800,00	800,00
OB klei dijk	14,63	800,00	800,00
Zand, m vast	13,33	5000,00	5000,00
Zand, m vast	12,00	5000,00	5000,00
Zand, los	9,00	3000,00	3000,00
Zand, m vast	7,10	5000,00	5000,00
Zand, sterk gri...	3,50	10000,00	10000,00

18.5 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	12,15	0,4	8,6	0,28	0,50	5,74
2	11,83	1,2	24,5	0,28	0,50	5,74
3	11,50	1,9	39,2	0,28	0,50	5,74
4	11,17	2,6	53,9	0,28	0,50	5,74
5	10,80	3,4	70,0	0,28	0,50	5,74
6	10,40	4,3	87,6	0,28	0,50	5,74
7	10,00	5,1	105,2	0,28	0,50	5,74
8	9,60	6,0	122,8	0,28	0,50	5,74
9	9,20	6,8	140,4	0,28	0,50	5,74
10	8,78	7,7	158,9	0,28	0,50	5,74
11	8,32	8,7	178,4	0,28	0,50	5,74
12	7,93	9,5	195,4	0,28	0,50	5,74
13	7,60	10,2	209,8	0,28	0,50	5,74
14	7,27	10,9	224,3	0,28	0,50	5,74
15	7,05	11,4	234,4	0,28	0,50	5,74
16	6,83	12,0	247,3	0,28	0,50	5,74
17	6,47	13,0	267,4	0,28	0,50	5,74
18	6,13	14,0	287,4	0,28	0,50	5,74
19	5,78	15,0	307,5	0,28	0,50	5,74

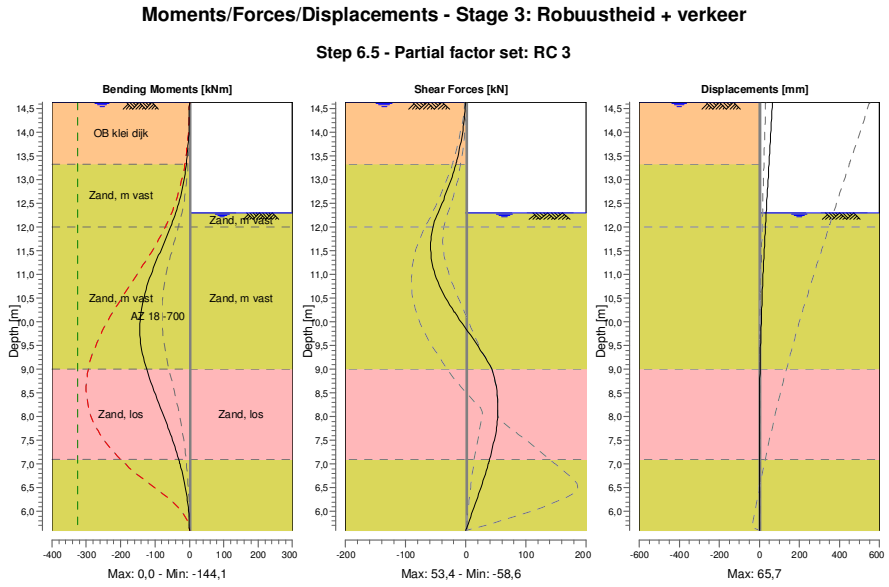
18.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	0,00
Zand, m vast	2,58
Zand, m vast	193,78
Zand, los	58,95
Zand, m vast	32,27
Zand, sterk grindig	0,00

18.7 Calculation Results

Number of iterations: 5

18.7.1 Charts of Moments, Forces and Displacements



18.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,63	0,0	0,0	**65,7**
1	14,61	0,0	-0,6	65,5
2	14,61	0,0	-0,6	65,5
2	14,21	-0,7	-3,2	59,9
3	14,21	-0,7	-3,2	59,9
3	13,80	-2,9	-8,1	54,4
4	13,80	-2,9	-8,1	54,4
4	13,40	-7,5	-14,9	48,9
5	13,40	-7,5	-14,9	48,9
5	13,33	-8,6	-16,3	47,9
6	13,33	-8,6	-16,3	47,9
6	12,99	-15,6	-24,9	43,2
7	12,99	-15,6	-24,9	43,2
7	12,64	-25,8	-34,8	38,6
8	12,64	-25,8	-34,8	38,6
8	12,30	-39,7	-46,3	34,1
9	12,30	-39,7	-46,3	34,1
9	12,00	-54,9	-54,5	30,2
10	12,00	-54,9	-54,5	30,2
10	11,67	-73,9	**-58,4**	26,0
11	11,67	-73,9	**-58,4**	26,0
11	11,33	-93,3	-57,3	22,1
12	11,33	-93,3	-57,3	22,1
12	11,00	-111,6	-51,3	18,4
13	11,00	-111,6	-51,2	18,4
13	10,60	-129,5	-37,4	14,3
14	10,60	-129,5	-37,3	14,3
14	10,20	-140,8	-18,8	10,8
15	10,20	-140,8	-18,6	10,8
15	9,80	**-144,0**	3,0	7,8

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
16	9,80	**-144,0**	3,2	7,8
16	9,40	-138,3	24,7	5,4
17	9,40	-138,3	24,9	5,4
17	9,00	-124,6	43,6	3,5
18	9,00	-124,6	43,7	3,5
18	8,55	-102,9	51,5	2,0
19	8,55	-102,9	51,5	2,0
19	8,10	-79,1	53,4	1,0
20	8,10	-79,1	53,4	1,0
20	7,77	-61,6	51,3	0,5
21	7,77	-61,6	51,3	0,5
21	7,43	-45,3	46,3	0,2
22	7,43	-45,3	46,3	0,2
22	7,10	-30,9	39,7	0,0
23	7,10	-30,9	39,7	0,0
23	7,00	-27,0	37,5	0,0
24	7,00	-27,0	37,5	0,0
24	6,65	-15,4	28,9	-0,1
25	6,65	-15,4	28,9	-0,1
25	6,30	-6,9	19,6	-0,1
26	6,30	-6,9	19,6	-0,1
26	5,95	-1,7	9,9	-0,2
27	5,95	-1,7	9,9	-0,2
27	5,60	0,0	0,0	-0,2
Max		**-144,0**	**-58,4**	**65,7**
Max, minor nodes incl.		-144,1	-58,6	65,7

18.7.3 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	14,63	19,78	0,00	A	1	0,00	0,00	-	
1	14,61	28,65	0,20	A	1	0,00	0,00	-	
2	14,61	3,36	0,20	A		0,00	0,00	-	
2	14,21	5,29	4,23	A		0,00	0,00	-	
3	14,21	5,17	4,23	A		0,00	0,00	-	
3	13,80	6,14	8,27	A		0,00	0,00	-	
4	13,80	6,37	8,27	A		0,00	0,00	-	
4	13,40	7,18	12,30	A		0,00	0,00	-	
5	13,40	7,37	12,30	A		0,00	0,00	-	
5	13,33	7,50	13,00	A		0,00	0,00	-	
6	13,33	9,66	13,00	A		0,00	0,00	-	
6	12,99	10,64	16,43	A		0,00	0,00	-	
7	12,99	10,37	16,43	A		0,00	0,00	-	
7	12,64	11,28	19,87	A		0,00	0,00	-	
8	12,64	11,34	19,87	A		0,00	0,00	-	
8	12,30	12,24	23,30	A		0,00	0,00	-	
9	12,30	12,30	23,30	A		0,00	0,00	P	
9	12,00	13,08	26,30	A		17,21	3,00	P	
10	12,00	13,13	26,30	A		17,21	3,00	P	
10	11,67	14,24	28,86	A		31,87	7,11	P	
11	11,67	14,28	28,86	A		31,87	7,11	P	
11	11,33	15,39	31,41	A		46,11	11,22	3	99
12	11,33	14,93	31,41	A		46,11	11,22	3	99
12	11,00	16,01	33,97	A		59,59	15,33	3	97
13	11,00	14,91	33,97	A		59,59	15,33	3	97
13	10,60	16,12	37,03	A		75,82	20,27	3	96
14	10,60	15,02	37,03	A		75,82	20,27	3	96
14	10,20	16,15	40,10	A		80,37	25,20	3	83
15	10,20	15,13	40,10	A		80,37	25,20	3	83
15	9,80	16,19	43,17	A		86,72	30,13	2	76
16	9,80	15,84	43,17	A		86,72	30,13	2	76
16	9,40	17,57	46,23	1		78,14	35,07	2	59

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	9,40	17,81	46,23	1		78,14	35,07	2	59
17	9,00	20,10	49,30	1		74,02	40,00	1	50
18	9,00	20,01	49,30	1		55,30	40,00	1	37
18	8,55	21,64	52,70	1		38,78	45,60	1	23
19	8,55	22,16	52,70	1		38,78	45,60	1	23
19	8,10	24,08	56,10	1		28,43	51,20	1	15
20	8,10	24,43	56,10	1		28,43	51,20	1	15
20	7,77	31,82	58,61	1		23,90	55,35	1	12
21	7,77	32,11	58,61	1		23,90	55,35	1	12
21	7,43	37,48	61,13	1		21,41	59,50	1	10
22	7,43	37,78	61,13	1		21,41	59,50	1	10
22	7,10	41,67	63,65	1		20,41	63,65	1	9
23	7,10	41,70	63,65	1		20,57	63,65	1	9
23	7,00	42,85	64,65	1	9	20,31	64,65	1	
24	7,00	43,02	64,65	1	9	20,31	64,65	1	
24	6,65	46,11	68,15	1	10	20,32	68,15	1	
25	6,65	46,38	68,15	1	10	20,32	68,15	1	
25	6,30	48,54	71,65	1	10	21,29	71,65	1	
26	6,30	48,80	71,65	1	10	21,29	71,65	1	
26	5,95	50,54	75,15	1	10	22,68	75,15	1	
27	5,95	50,80	75,15	1	10	22,68	75,15	1	
27	5,60	52,43	78,65	1	10	24,20	78,65	1	

*

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

18.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	196,6	287,6
Water	362,0	270,1
Total	558,6	557,7

Considered as passive side	Right
Maximum passive effective resistance	1025,56 kN
Mobilized passive effective resistance	287,59 kN
Percentage mobilized resistance	28,0 %

18.7.5 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	-71,24
Vertical force passive	104,67
Resulting vertical force (no dead weight)	33,43
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-71,24
Vertical force passive	104,67
Resulting vertical force (no dead weight)	33,43
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

18.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
14,63	OB klei dijk	-2,57	12,30	Zand, m vast	0,94
13,33	Zand, m vast	-5,48	12,00	Zand, m vast	70,53
12,00	Zand, m vast	-17,31	9,00	Zand, los	21,46
9,00	Zand, los	-19,69	7,10	Zand, m vast	11,75
7,10	Zand, m vast	-26,19			

End of Report

Report for D-Sheet Piling 14.1

Design of Sheet Pilings
Developed by Deltares

Company:	Royal HaskoningDHV
Date of report:	12/1/2014
Time of report:	12:45:31 PM
Date of calculation:	13-11-2014
Time of calculation:	14:43:23
Filename:	C:\Users\nl85691\Desktop\08 Schermen\DR56 Erosiescherm Hengeland 3A
Project identification:	Prioritaire dijkversterking Waterschap Peel en Maasvallei DR56 Erosiescherm Hengeland 3A (DP56.053)

Verification according to NEN-EN 9997+C1:2012

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2 Summary

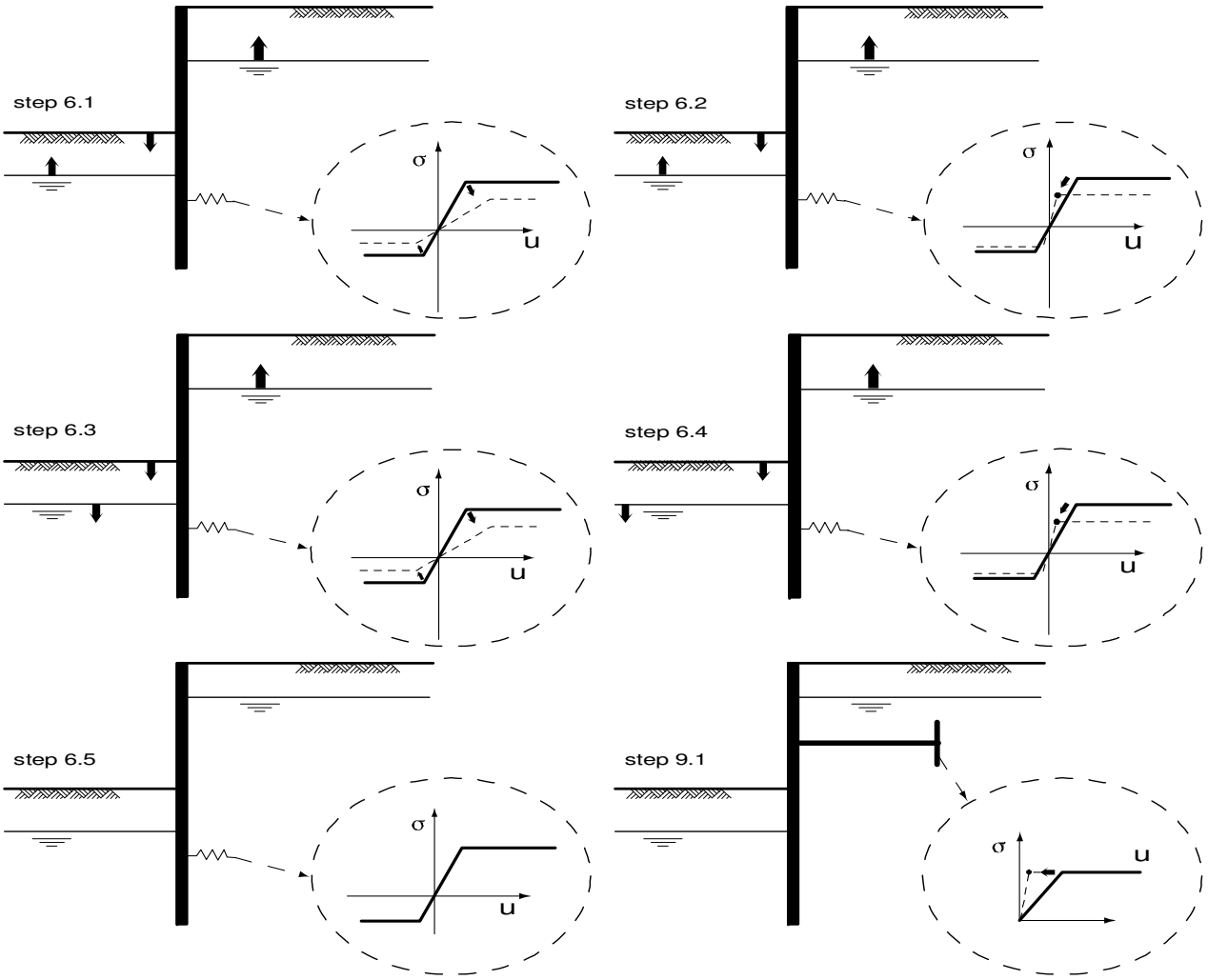
2.1 Overview per Stage and Test

Stage no.	Verification type	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
1	EC7(NL)-Step 6.1		28,4	-16,7	**0,0**	57,8	---
1	EC7(NL)-Step 6.2		24,4	15,1	**0,0**	57,3	---
1	EC7(NL)-Step 6.3		26,2	15,1	**0,0**	54,7	---
1	EC7(NL)-Step 6.4		24,2	15,1	**0,0**	54,0	---
1	EC7(NL)-Step 6.5	-6,5	8,5	7,3	**0,0**	36,9	---
1	EC7(NL)-Step 6.5 * 1,20		10,2	8,8			
2	EC7(NL)-Step 6.1		**77,5**	**-58,7**	**0,0**	**86,2**	---
2	EC7(NL)-Step 6.2		**77,5**	**-58,7**	**0,0**	**86,2**	---
2	EC7(NL)-Step 6.3		63,7	-36,9	**0,0**	73,4	---
2	EC7(NL)-Step 6.4		62,6	-35,7	**0,0**	72,7	---
2	EC7(NL)-Step 6.5	**-18,8**	24,6	16,4	**0,0**	48,1	---
2	EC7(NL)-Step 6.5 * 1,20		29,5	19,7			
Max		**-18,8**	**77,5**	**-58,7**	**0,0**	**86,2**	---

2.2 Overall Stability per Stage

Stage name	Stability factor [-]
Val MHW +0,5 m	1,63
Val MHW +1,0 m	1,40

2.3 CUR Verification Steps



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	2
Unit weight of water	10,00 kN/m³
Number of curves on spring characteristic	3
Unloading curve on spring characteristic	No

3.2 Sheet Piling Properties

Length	6,51 m
Level top side	14,61 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]
ZK 785-8	8,10	14,61	2,7934E+04	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']
ZK 785-8	8,10	14,61	228,00	1,00	1,00	0,45	102,60

Section name	From [m]	To [m]	Red. factor EI [-]	Note to reduction factor	Corrected stiffness EI [kNm²]
ZK 785-8	8,10	14,61	0,45	(8-4,4)/8=0,45	12570,00

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
ZK 785-8	8,10	14,61	279,00	1,33	106,00

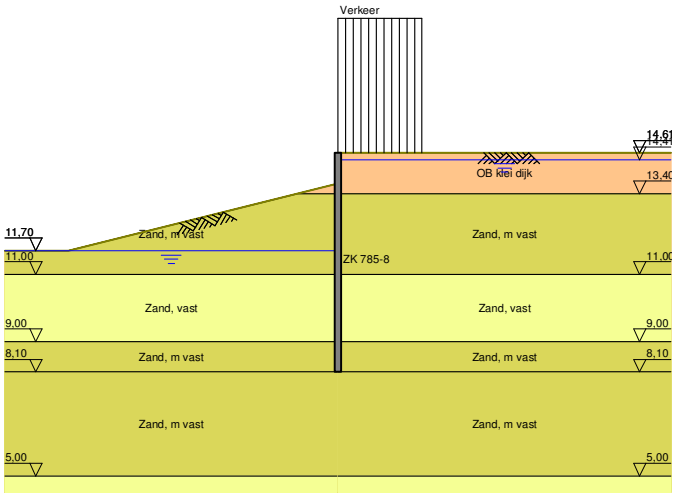
3.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL method A: Partial factors (design values) in all stages Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
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 1: Val MHW +0,5 m

Outline - Stage 1: Val MHW +0,5 m

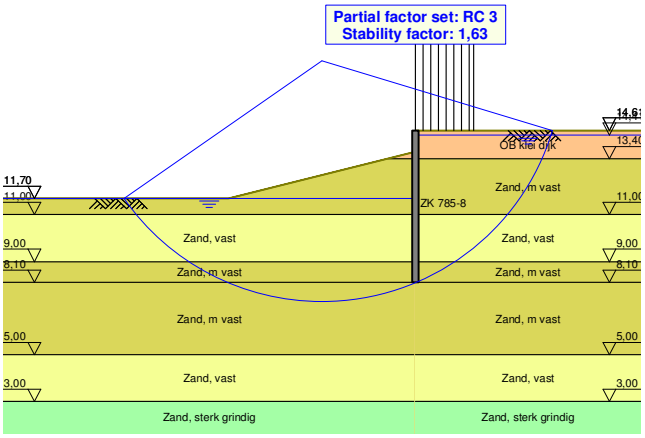


5 Overall Stability Stage 1: Val MHW +0,5 m

Stability factor : 1,63

5.1 Overall Stability

Overall Stability - Stage 1: Val MHW +0,5 m



6 Step 6.1 Stage 1: Val MHW +0,5 m

6.1 Input Data Left

6.1.1 Calculation Method

Calculation method: C, phi, delta

6.1.2 Water Level

Water level: 11,95 [m]

6.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

6.1.4 Soil Material Properties in Profile: 56B-S01 (L +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	9,03	13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	13,55	13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	13,55	13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	13,55	13,55

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]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,4	61,8	0,34	0,34	2,46
7	11,75	9,0	36,6	0,34	0,34	1,37
8	11,63	9,4	47,3	0,34	0,34	1,71
9	11,50	9,7	47,5	0,34	0,34	1,66
10	11,34	10,1	55,0	0,34	0,34	1,85
11	11,11	10,6	60,5	0,34	0,34	1,93
12	10,86	10,1	91,0	0,31	0,31	2,79
13	10,57	10,4	78,6	0,31	0,31	2,35
14	10,29	10,7	76,7	0,31	0,33	2,23
15	10,00	11,0	78,3	0,31	0,34	2,22
16	9,71	11,3	82,2	0,31	0,35	2,27
17	9,43	11,5	87,3	0,31	0,37	2,35
18	9,14	11,8	92,8	0,31	0,38	2,44
19	8,85	13,2	71,0	0,34	0,43	1,82
20	8,55	13,5	79,8	0,34	0,44	2,00
21	8,25	13,7	88,0	0,34	0,46	2,15

6.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	90,39
Zand, vast	86,33
Zand, m vast	19,36
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

6.4 Input Data Right

6.4.1 Calculation Method

Calculation method: C, phi, delta

6.4.2 Water Level

Water level: 14,46 [m]

6.4.3 Surface

X [m]	Y [m]
0,00	14,61

6.4.4 Soil Material Properties in Profile: 56B-S01 (R +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	-9,03	-13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-13,55	-13,55

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]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

6.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

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	14,54	4,3	71,7	0,24	0,92	3,97
2	14,44	4,9	77,1	0,25	0,83	3,92
3	14,29	5,4	81,3	0,26	0,75	3,90
4	14,05	6,1	88,1	0,27	0,65	3,86
5	13,82	6,9	58,8	0,28	0,58	2,38
6	13,65	7,4	53,5	0,29	0,55	2,06
7	13,50	7,9	56,6	0,29	0,52	2,09
8	13,24	10,1	70,7	0,35	0,47	2,42
9	12,92	11,2	82,9	0,35	0,44	2,60
10	12,60	12,2	87,3	0,36	0,43	2,53
11	12,28	13,3	98,2	0,36	0,43	2,66
12	11,96	14,4	110,7	0,36	0,44	2,80
13	11,75	15,1	119,0	0,37	0,44	2,89
14	11,63	15,5	123,9	0,37	0,44	2,94
15	11,50	15,9	128,9	0,37	0,44	2,99
16	11,34	16,5	135,3	0,37	0,45	3,04
17	11,11	16,8	144,3	0,36	0,45	3,12
18	10,86	15,6	187,8	0,32	0,44	3,83
19	10,57	15,9	207,2	0,30	0,45	3,94
20	10,29	16,3	226,1	0,29	0,46	4,01
21	10,00	16,5	236,9	0,28	0,46	3,95
22	9,71	16,8	256,2	0,26	0,47	4,02
23	9,43	17,1	275,6	0,25	0,47	4,08
24	9,14	17,3	295,0	0,24	0,48	4,14
25	8,85	19,8	267,7	0,26	0,51	3,56
26	8,55	22,0	285,9	0,28	0,51	3,60
27	8,25	24,4	304,6	0,29	0,52	3,64

6.6 Calculated Force from a layer Right

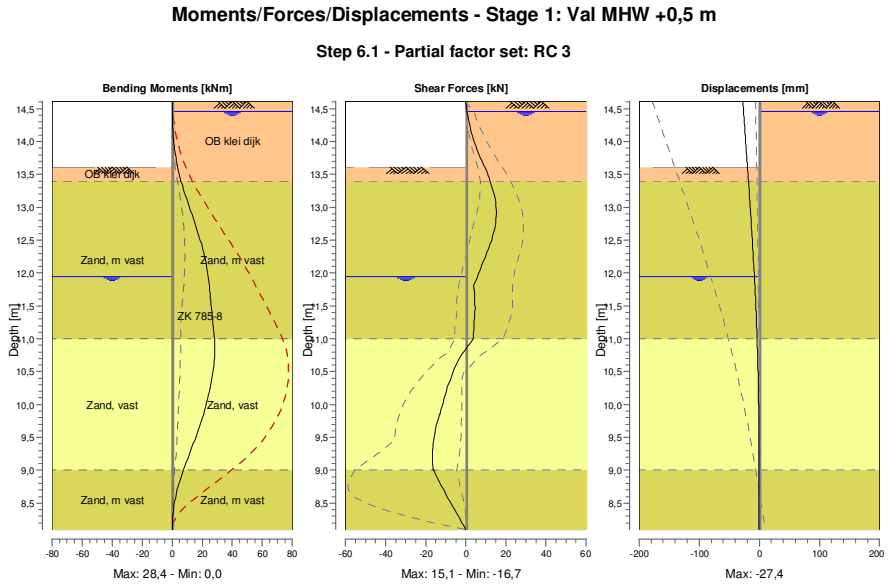
Name	Force
OB klei dijk	0,00
OB klei dijk	7,51
Zand, m vast	32,48
Zand, vast	34,04
Zand, m vast	33,27
Zand, m vast	0,00

Name	Force
Zand, vast	0,00
Zand, sterk grindig	0,00

6.7 Calculation Results

Number of iterations: 6

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	14,61	0,0	0,0	**-27,4**
1	14,46	0,0	0,6	-26,3
2	14,46	0,0	0,6	-26,3
2	14,41	0,1	0,8	-25,9
3	14,41	0,1	0,8	-25,9
3	14,17	0,5	2,5	-24,1
4	14,17	0,5	2,5	-24,1
4	13,94	1,3	4,9	-22,3
5	13,94	1,3	4,9	-22,3
5	13,70	2,9	8,1	-20,4
6	13,70	2,9	8,1	-20,4
6	13,61	3,7	9,5	-19,8
7	13,61	3,7	9,5	-19,8
7	13,40	5,9	12,2	-18,2
8	13,40	5,9	12,2	-18,2
8	13,08	10,3	14,8	-15,8
9	13,08	10,3	14,8	-15,8
9	12,76	15,1	14,8	-13,5
10	12,76	15,1	14,8	-13,5
10	12,44	19,5	12,2	-11,3
11	12,44	19,5	12,2	-11,3
11	12,12	22,8	8,0	-9,3
12	12,12	22,8	8,0	-9,3

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	11,80	24,7	3,9	-7,5
13	11,80	24,7	3,9	-7,5
13	11,70	25,1	4,5	-7,0
14	11,70	25,1	4,5	-7,0
14	11,55	25,8	4,5	-6,2
15	11,55	25,8	4,5	-6,2
15	11,45	26,2	4,6	-5,8
16	11,45	26,2	4,6	-5,8
16	11,22	27,2	4,2	-4,8
17	11,22	27,2	4,1	-4,8
17	11,00	28,1	4,0	-3,9
18	11,00	28,1	4,0	-3,9
18	10,71	**28,2**	-3,0	-2,9
19	10,71	**28,2**	-3,0	-2,9
19	10,43	26,7	-7,2	-2,1
20	10,43	26,7	-7,2	-2,1
20	10,14	24,2	-10,3	-1,5
21	10,14	24,2	-10,3	-1,5
21	9,86	20,9	-13,0	-1,0
22	9,86	20,9	-13,0	-1,0
22	9,57	16,8	-15,4	-0,7
23	9,57	16,8	-15,4	-0,7
23	9,29	12,2	**-16,6**	-0,5
24	9,29	12,2	**-16,6**	-0,5
24	9,00	7,4	-16,2	-0,4
25	9,00	7,4	-16,2	-0,4
25	8,70	3,3	-11,0	-0,3
26	8,70	3,3	-11,0	-0,3
26	8,40	0,8	-5,6	-0,2
27	8,40	0,8	-5,6	-0,2
27	8,10	0,0	0,0	-0,2
Max		**28,2**	**-16,6**	**-27,4**
Max, minor nodes incl.		28,4	-16,7	-27,4

6.7.3 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	14,61	0,00	0,00	-		0,00	0,00	A	
1	14,46	0,00	0,00	-		4,65	0,00	A	
2	14,46	0,00	0,00	-		4,87	0,00	A	
2	14,41	0,00	0,00	-		4,97	0,50	A	
3	14,41	0,00	0,00	-		5,12	0,50	A	
3	14,17	0,00	0,00	-		5,63	2,87	A	
4	14,17	0,00	0,00	-		5,87	2,87	A	
4	13,94	0,00	0,00	-		6,39	5,23	A	
5	13,94	0,00	0,00	-		6,63	5,23	A	
5	13,70	0,00	0,00	-		7,14	7,60	A	
6	13,70	0,00	0,00	-		7,31	7,60	A	
6	13,61	0,00	0,00	-		7,51	8,51	A	
7	13,61	0,00	0,00	P		7,66	8,51	A	
7	13,40	9,42	0,00	P		8,11	10,60	A	
8	13,40	8,00	0,00	P		9,61	10,60	A	
8	13,08	19,91	0,00	P		10,55	13,80	A	
9	13,08	20,48	0,00	P		10,70	13,80	A	
9	12,76	32,76	0,00	P		11,62	17,00	A	
10	12,76	32,82	0,00	P		11,78	17,00	A	
10	12,44	45,15	0,00	P		12,69	20,20	A	
11	12,44	45,16	0,00	P		12,85	20,20	A	
11	12,12	51,00	0,00	3	89	13,76	23,40	A	
12	12,12	49,78	0,00	3	89	13,92	23,40	A	
12	11,80	53,09	1,50	3	83	14,84	26,60	A	
13	11,80	34,20	1,50	3	96	14,94	26,60	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* [%]
13	11,70	34,21	2,50	3	93	15,23	27,60	A	
14	11,70	40,27	2,50	3	88	15,29	27,60	A	
14	11,55	40,59	4,00	3	85	15,73	29,10	A	
15	11,55	39,68	4,00	3	86	15,78	29,10	A	
15	11,45	39,90	5,00	3	84	16,07	30,10	A	
16	11,45	43,47	5,00	3	82	16,14	30,10	A	
16	11,22	43,10	7,25	2	77	16,81	32,35	A	
17	11,22	43,93	7,25	2	75	16,43	32,35	A	
17	11,00	41,52	9,50	2	67	17,09	34,60	A	
18	11,00	67,44	9,50	2	76	15,04	34,60	A	
18	10,71	60,25	13,65	2	66	16,20	36,17	A	
19	10,71	55,05	13,65	2	72	15,39	36,17	A	
19	10,43	49,27	17,79	2	62	16,50	37,73	A	
20	10,43	47,98	17,79	2	64	15,72	37,73	A	
20	10,14	43,64	21,94	2	57	16,79	39,30	A	
21	10,14	43,61	21,94	2	57	16,03	39,30	A	
21	9,86	40,60	26,09	2	52	17,06	40,87	A	
22	9,86	41,39	26,09	2	51	16,33	40,87	A	
22	9,57	34,96	30,24	1	42	17,31	42,44	A	
23	9,57	35,45	30,24	1	41	16,60	42,44	A	
23	9,29	29,26	34,38	1	33	17,55	44,00	A	
24	9,29	29,75	34,38	1	33	17,78	44,00	1	
24	9,00	26,02	38,53	1	28	23,71	45,57	1	
25	9,00	22,21	38,53	1	32	31,62	45,57	1	
25	8,70	21,24	43,04	1	30	35,10	47,06	1	
26	8,70	21,73	43,04	1	28	35,46	47,06	1	
26	8,40	21,16	47,54	1	26	38,60	48,56	1	
27	8,40	21,65	47,54	1	25	38,94	48,56	1	
27	8,10	21,21	52,05	1	24	41,99	50,05	1	

*

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	197,1	107,3
Water	93,3	183,1
Total	290,4	290,4

Considered as passive side	Left
Maximum passive effective resistance	340,79 kN
Mobilized passive effective resistance	197,05 kN
Percentage mobilized resistance	57,8 %

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	-33,59
Vertical force passive	62,66
Resulting vertical force (no dead weight)	29,07
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-33,59
Vertical force passive	62,66
Resulting vertical force (no dead weight)	29,07
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]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-2,06
13,40	Zand, m vast	27,86	13,40	Zand, m vast	-10,01
11,00	Zand, vast	28,57	11,00	Zand, vast	-11,27
9,00	Zand, m vast	5,97	9,00	Zand, m vast	-10,26

7 Step 6.2 Stage 1: Val MHW +0,5 m

7.1 Input Data Left

7.1.1 Calculation Method

Calculation method: C, phi, delta

7.1.2 Water Level

Water level: 11,95 [m]

7.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

7.1.4 Soil Material Properties in Profile: 56B-S01 (L +0,5)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	9,03	13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	13,55	13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	13,55	13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	13,55	13,55

7.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,4	61,8	0,34	0,34	2,46
7	11,75	9,0	36,6	0,34	0,34	1,37
8	11,63	9,4	47,3	0,34	0,34	1,71
9	11,50	9,7	47,5	0,34	0,34	1,66
10	11,34	10,1	55,0	0,34	0,34	1,85
11	11,11	10,6	60,5	0,34	0,34	1,93
12	10,86	10,1	91,0	0,31	0,31	2,79
13	10,57	10,4	78,6	0,31	0,31	2,35
14	10,29	10,7	76,7	0,31	0,33	2,23
15	10,00	11,0	78,3	0,31	0,34	2,22
16	9,71	11,3	82,2	0,31	0,35	2,27
17	9,43	11,5	87,3	0,31	0,37	2,35
18	9,14	11,8	92,8	0,31	0,38	2,44
19	8,85	13,2	71,0	0,34	0,43	1,82
20	8,55	13,5	79,8	0,34	0,44	2,00
21	8,25	13,7	88,0	0,34	0,46	2,15

7.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	95,38
Zand, vast	75,51
Zand, m vast	23,54
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

7.4 Input Data Right

7.4.1 Calculation Method

Calculation method: C, phi, delta

7.4.2 Water Level

Water level: 14,46 [m]

7.4.3 Surface

X [m]	Y [m]
0,00	14,61

7.4.4 Soil Material Properties in Profile: 56B-S01 (R +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	-9,03	-13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-13,55	-13,55

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]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

7.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

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	14,54	4,3	71,7	0,24	0,92	3,97
2	14,44	4,9	77,1	0,25	0,83	3,92
3	14,29	5,4	81,3	0,26	0,75	3,90
4	14,05	6,1	88,1	0,27	0,65	3,86
5	13,82	6,9	58,8	0,28	0,58	2,38
6	13,65	7,4	53,5	0,29	0,55	2,06
7	13,50	7,9	56,6	0,29	0,52	2,09
8	13,24	10,1	70,7	0,35	0,47	2,42
9	12,92	11,2	82,9	0,35	0,44	2,60
10	12,60	12,2	87,3	0,36	0,43	2,53
11	12,28	13,3	98,2	0,36	0,43	2,66
12	11,96	14,4	110,7	0,36	0,44	2,80
13	11,75	15,1	119,0	0,37	0,44	2,89
14	11,63	15,5	123,9	0,37	0,44	2,94
15	11,50	15,9	128,9	0,37	0,44	2,99
16	11,34	16,5	135,3	0,37	0,45	3,04
17	11,11	16,8	144,3	0,36	0,45	3,12
18	10,86	15,6	187,8	0,32	0,44	3,83
19	10,57	15,9	207,2	0,30	0,45	3,94
20	10,29	16,3	226,1	0,29	0,46	4,01
21	10,00	16,5	236,9	0,28	0,46	3,95
22	9,71	16,8	256,2	0,26	0,47	4,02
23	9,43	17,1	275,6	0,25	0,47	4,08
24	9,14	17,3	295,0	0,24	0,48	4,14
25	8,85	19,8	267,7	0,26	0,51	3,56
26	8,55	22,0	285,9	0,28	0,51	3,60
27	8,25	24,4	304,6	0,29	0,52	3,64

7.6 Calculated Force from a layer Right

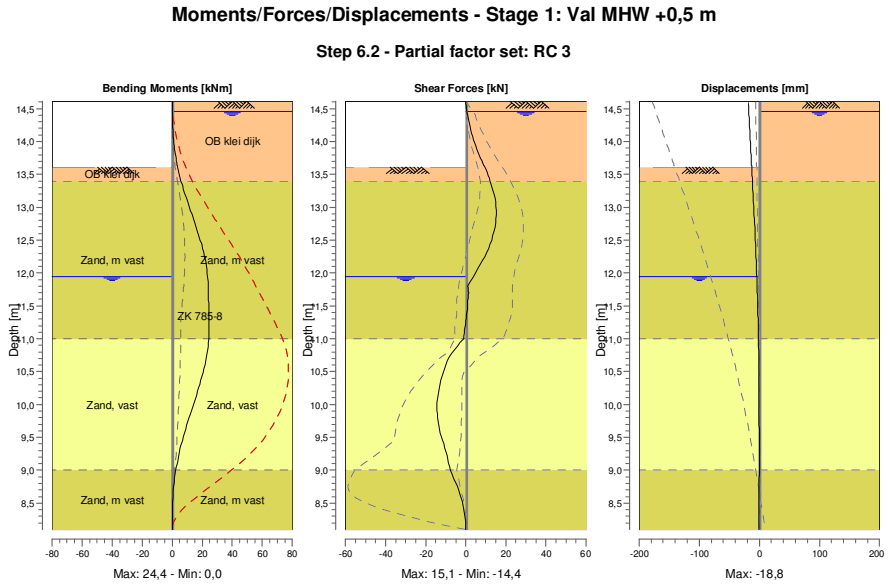
Name	Force
OB klei dijk	0,00
OB klei dijk	7,51
Zand, m vast	32,48
Zand, vast	36,60
Zand, m vast	29,09
Zand, m vast	0,00

Name	Force
Zand, vast	0,00
Zand, sterk grindig	0,00

7.7 Calculation Results

Number of iterations: 7

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	14,61	0,0	0,0	**-18,8**
1	14,46	0,0	0,6	-17,9
2	14,46	0,0	0,6	-17,9
2	14,41	0,1	0,8	-17,6
3	14,41	0,1	0,8	-17,6
3	14,17	0,5	2,5	-16,2
4	14,17	0,5	2,5	-16,2
4	13,94	1,3	4,9	-14,8
5	13,94	1,3	4,9	-14,8
5	13,70	2,9	8,1	-13,4
6	13,70	2,9	8,1	-13,4
6	13,61	3,7	9,5	-12,9
7	13,61	3,7	9,5	-12,9
7	13,40	5,9	12,2	-11,6
8	13,40	5,9	12,2	-11,6
8	13,08	10,3	**14,8**	-9,8
9	13,08	10,3	**14,8**	-9,8
9	12,76	15,1	**14,8**	-8,1
10	12,76	15,1	**14,8**	-8,1
10	12,44	19,5	12,2	-6,5
11	12,44	19,5	12,2	-6,5
11	12,12	22,7	7,0	-5,0
12	12,12	22,7	7,0	-5,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	11,80	23,9	1,0	-3,8
13	11,80	23,9	1,0	-3,8
13	11,70	24,1	1,4	-3,4
14	11,70	24,1	1,4	-3,4
14	11,55	24,2	0,9	-2,9
15	11,55	24,2	0,9	-2,9
15	11,45	24,3	0,8	-2,6
16	11,45	24,3	0,8	-2,6
16	11,22	**24,4**	-0,2	-2,0
17	11,22	**24,4**	-0,2	-2,0
17	11,00	24,2	-1,0	-1,5
18	11,00	24,2	-1,1	-1,5
18	10,71	22,8	-8,4	-1,0
19	10,71	22,8	-8,4	-1,0
19	10,43	19,9	-11,9	-0,6
20	10,43	19,9	-11,9	-0,6
20	10,14	16,2	-13,8	-0,3
21	10,14	16,2	-13,8	-0,3
21	9,86	12,1	-14,2	-0,2
22	9,86	12,1	-14,2	-0,2
22	9,57	8,2	-12,7	-0,1
23	9,57	8,2	-12,7	-0,1
23	9,29	4,9	-9,9	-0,1
24	9,29	4,9	-9,9	-0,1
24	9,00	2,4	-7,8	-0,1
25	9,00	2,4	-7,8	-0,1
25	8,70	0,8	-3,6	-0,2
26	8,70	0,8	-3,6	-0,2
26	8,40	0,1	-1,0	-0,2
27	8,40	0,1	-1,0	-0,2
27	8,10	0,0	0,0	-0,3
Max		**24,4**	**14,8**	**-18,8**
Max, minor nodes incl.		24,4	15,1	-18,8

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	14,61	0,00	0,00	-		0,00	0,00	A	
1	14,46	0,00	0,00	-		4,65	0,00	A	
2	14,46	0,00	0,00	-		4,87	0,00	A	
2	14,41	0,00	0,00	-		4,97	0,50	A	
3	14,41	0,00	0,00	-		5,12	0,50	A	
3	14,17	0,00	0,00	-		5,63	2,87	A	
4	14,17	0,00	0,00	-		5,87	2,87	A	
4	13,94	0,00	0,00	-		6,39	5,23	A	
5	13,94	0,00	0,00	-		6,63	5,23	A	
5	13,70	0,00	0,00	-		7,14	7,60	A	
6	13,70	0,00	0,00	-		7,31	7,60	A	
6	13,61	0,00	0,00	-		7,51	8,51	A	
7	13,61	0,00	0,00	P		7,66	8,51	A	
7	13,40	9,42	0,00	P		8,11	10,60	A	
8	13,40	8,00	0,00	P		9,61	10,60	A	
8	13,08	19,91	0,00	P		10,55	13,80	A	
9	13,08	20,48	0,00	P		10,70	13,80	A	
9	12,76	32,76	0,00	P		11,62	17,00	A	
10	12,76	32,82	0,00	P		11,78	17,00	A	
10	12,44	45,15	0,00	P		12,69	20,20	A	
11	12,44	45,16	0,00	P		12,85	20,20	A	
11	12,12	57,53	0,00	P		13,76	23,40	A	
12	12,12	55,76	0,00	P		13,92	23,40	A	
12	11,80	57,64	1,50	3	90	14,84	26,60	A	
13	11,80	35,74	1,50	P		14,94	26,60	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* [%]
13	11,70	36,74	2,50	P		15,23	27,60	A	
14	11,70	44,16	2,50	3	96	15,29	27,60	A	
14	11,55	43,58	4,00	3	91	15,73	29,10	A	
15	11,55	42,67	4,00	3	92	15,78	29,10	A	
15	11,45	42,35	5,00	3	89	16,07	30,10	A	
16	11,45	45,92	5,00	3	87	16,14	30,10	A	
16	11,22	45,69	7,25	3	82	16,81	32,35	A	
17	11,22	47,22	7,25	3	81	16,43	32,35	A	
17	11,00	43,44	9,50	2	71	17,09	34,60	A	
18	11,00	71,19	9,50	3	80	15,04	34,60	A	
18	10,71	59,35	13,65	2	65	16,20	36,17	A	
19	10,71	54,15	13,65	2	70	15,39	36,17	A	
19	10,43	45,72	17,79	2	58	16,50	37,73	A	
20	10,43	44,43	17,79	2	59	15,72	37,73	A	
20	10,14	39,13	21,94	2	51	16,79	39,30	A	
21	10,14	39,10	21,94	2	51	16,03	39,30	A	
21	9,86	28,60	26,09	1	36	17,06	40,87	A	
22	9,86	29,08	26,09	1	36	16,33	40,87	A	
22	9,57	23,56	30,24	1	29	20,13	42,44	1	
23	9,57	24,04	30,24	1	28	20,51	42,44	1	
23	9,29	23,35	34,38	1	27	23,34	44,00	1	
24	9,29	23,83	34,38	1	26	23,70	44,00	1	
24	9,00	26,09	38,53	1	28	23,64	45,57	1	
25	9,00	22,24	38,53	1	32	31,58	45,57	1	
25	8,70	24,40	43,04	1	34	31,94	47,06	1	
26	8,70	24,89	43,04	1	32	32,30	47,06	1	
26	8,40	27,33	47,54	1	34	32,42	48,56	1	
27	8,40	27,82	47,54	1	32	32,76	48,56	1	
27	8,10	30,33	52,05	1	34	32,86	50,05	1	

*

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	195,4	105,7
Water	93,3	183,1
Total	288,7	288,7

Considered as passive side	Left
Maximum passive effective resistance	340,79 kN
Mobilized passive effective resistance	195,40 kN
Percentage mobilized resistance	57,3 %

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	-33,15
Vertical force passive	61,90
Resulting vertical force (no dead weight)	28,75
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-33,15
Vertical force passive	61,90
Resulting vertical force (no dead weight)	28,75
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]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-2,06
13,40	Zand, m vast	29,40	13,40	Zand, m vast	-10,01
11,00	Zand, vast	24,99	11,00	Zand, vast	-12,11
9,00	Zand, m vast	7,25	9,00	Zand, m vast	-8,97

8 Step 6.3 Stage 1: Val MHW +0,5 m

8.1 Input Data Left

8.1.1 Calculation Method

Calculation method: C, phi, delta

8.1.2 Water Level

Water level: 11,45 [m]

8.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

8.1.4 Soil Material Properties in Profile: 56B-S01 (L +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	9,03	13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	13,55	13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	13,55	13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	13,55	13,55

8.1.5 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]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

8.2 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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,5	63,7	0,34	0,34	2,54
7	11,75	9,6	71,8	0,34	0,34	2,54
8	11,63	10,2	76,6	0,34	0,34	2,54
9	11,50	10,9	81,5	0,34	0,34	2,54
10	11,34	11,4	81,5	0,34	0,34	2,42
11	11,11	12,0	72,2	0,34	0,34	2,04
12	10,86	11,4	102,2	0,31	0,32	2,79
13	10,57	11,7	89,3	0,31	0,33	2,39
14	10,29	11,9	86,7	0,31	0,34	2,27
15	10,00	12,2	87,4	0,31	0,35	2,23
16	9,71	12,5	90,2	0,31	0,36	2,25
17	9,43	12,8	95,1	0,31	0,37	2,32
18	9,14	13,0	100,5	0,31	0,38	2,40
19	8,85	14,5	76,2	0,34	0,43	1,78
20	8,55	14,8	85,1	0,34	0,44	1,95
21	8,25	15,0	93,3	0,34	0,45	2,09

8.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	97,26
Zand, vast	90,00
Zand, m vast	23,50
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

8.4 Input Data Right

8.4.1 Calculation Method

Calculation method: C, phi, delta

8.4.2 Water Level

Water level: 14,46 [m]

8.4.3 Surface

X [m]	Y [m]
0,00	14,61

8.4.4 Soil Material Properties in Profile: 56B-S01 (R +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	-9,03	-13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-13,55	-13,55

8.4.5 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]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

8.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

8.5 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	14,54	4,3	71,7	0,24	0,92	3,97
2	14,44	4,9	77,1	0,25	0,83	3,92
3	14,29	5,4	81,3	0,26	0,75	3,90
4	14,05	6,1	88,1	0,27	0,65	3,86
5	13,82	6,9	58,8	0,28	0,58	2,38
6	13,65	7,4	53,5	0,29	0,55	2,06
7	13,50	7,9	56,6	0,29	0,52	2,09
8	13,24	10,1	70,7	0,35	0,47	2,42
9	12,92	11,2	82,9	0,35	0,44	2,60
10	12,60	12,2	87,3	0,36	0,43	2,53
11	12,28	13,3	98,2	0,36	0,43	2,66
12	11,96	14,4	110,7	0,36	0,44	2,80
13	11,75	15,1	119,0	0,37	0,44	2,89
14	11,63	15,5	123,9	0,37	0,44	2,94
15	11,50	15,9	128,9	0,37	0,44	2,99
16	11,34	16,5	135,3	0,37	0,45	3,04
17	11,11	16,8	144,3	0,36	0,45	3,12
18	10,86	15,6	187,8	0,32	0,44	3,83
19	10,57	15,9	207,2	0,30	0,45	3,94
20	10,29	16,3	226,1	0,29	0,46	4,01
21	10,00	16,5	236,9	0,28	0,46	3,95
22	9,71	16,8	256,2	0,26	0,47	4,02
23	9,43	17,1	275,6	0,25	0,47	4,08
24	9,14	17,3	295,0	0,24	0,48	4,14
25	8,85	19,8	267,7	0,26	0,51	3,56
26	8,55	22,0	285,9	0,28	0,51	3,60
27	8,25	24,4	304,6	0,29	0,52	3,64

8.6 Calculated Force from a layer Right

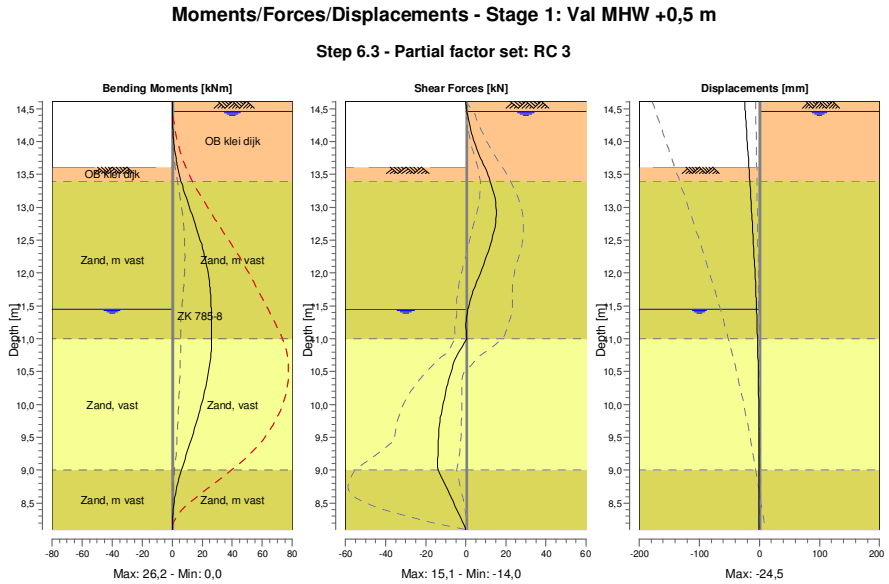
Name	Force
OB klei dijk	0,00
OB klei dijk	7,51
Zand, m vast	32,48
Zand, vast	33,32
Zand, m vast	30,69
Zand, m vast	0,00

Name	Force
Zand, vast	0,00
Zand, sterk grindig	0,00

8.7 Calculation Results

Number of iterations: 6

8.7.1 Charts of Moments, Forces and Displacements



8.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-24,5**
1	14,46	0,0	0,6	-23,4
2	14,46	0,0	0,6	-23,4
2	14,41	0,1	0,8	-23,1
3	14,41	0,1	0,8	-23,1
3	14,17	0,5	2,5	-21,4
4	14,17	0,5	2,5	-21,4
4	13,94	1,3	4,9	-19,7
5	13,94	1,3	4,9	-19,7
5	13,70	2,9	8,1	-18,1
6	13,70	2,9	8,1	-18,1
6	13,61	3,7	9,5	-17,5
7	13,61	3,7	9,5	-17,5
7	13,40	5,9	12,2	-16,0
8	13,40	5,9	12,2	-16,0
8	13,08	10,3	**14,8**	-13,8
9	13,08	10,3	**14,8**	-13,8
9	12,76	15,1	**14,8**	-11,7
10	12,76	15,1	**14,8**	-11,7
10	12,44	19,5	12,3	-9,8
11	12,44	19,5	12,3	-9,8
11	12,12	22,9	8,8	-8,0
12	12,12	22,9	8,8	-8,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	11,80	25,1	4,6	-6,4
13	11,80	25,1	4,6	-6,4
13	11,70	25,5	3,4	-5,9
14	11,70	25,5	3,4	-5,9
14	11,55	25,9	1,9	-5,2
15	11,55	25,9	1,9	-5,2
15	11,45	26,0	1,1	-4,8
16	11,45	26,0	1,1	-4,8
16	11,22	26,1	0,1	-4,0
17	11,22	26,1	0,1	-4,0
17	11,00	**26,2**	0,6	-3,2
18	11,00	**26,2**	0,6	-3,2
18	10,71	25,5	-4,9	-2,4
19	10,71	25,5	-4,9	-2,4
19	10,43	23,7	-8,1	-1,8
20	10,43	23,7	-8,1	-1,8
20	10,14	21,0	-10,3	-1,3
21	10,14	21,0	-10,3	-1,3
21	9,86	17,8	-12,3	-0,9
22	9,86	17,8	-12,3	-0,9
22	9,57	14,0	-13,5	-0,7
23	9,57	14,0	-13,5	-0,7
23	9,29	10,1	-13,9	-0,6
24	9,29	10,1	-13,9	-0,6
24	9,00	6,1	-14,0	-0,5
25	9,00	6,1	-14,0	-0,5
25	8,70	2,7	-9,1	-0,4
26	8,70	2,7	-9,1	-0,4
26	8,40	0,7	-4,4	-0,4
27	8,40	0,7	-4,4	-0,4
27	8,10	0,0	0,0	-0,4
Max		**26,2**	**14,8**	**-24,5**
Max, minor nodes incl.		26,2	15,1	-24,5

8.7.3 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	14,61	0,00	0,00	-		0,00	0,00	A	
1	14,46	0,00	0,00	-		4,65	0,00	A	
2	14,46	0,00	0,00	-		4,87	0,00	A	
2	14,41	0,00	0,00	-		4,97	0,50	A	
3	14,41	0,00	0,00	-		5,12	0,50	A	
3	14,17	0,00	0,00	-		5,63	2,87	A	
4	14,17	0,00	0,00	-		5,87	2,87	A	
4	13,94	0,00	0,00	-		6,39	5,23	A	
5	13,94	0,00	0,00	-		6,63	5,23	A	
5	13,70	0,00	0,00	-		7,14	7,60	A	
6	13,70	0,00	0,00	-		7,31	7,60	A	
6	13,61	0,00	0,00	-		7,51	8,51	A	
7	13,61	0,00	0,00	P		7,66	8,51	A	
7	13,40	9,42	0,00	P		8,11	10,60	A	
8	13,40	8,00	0,00	P		9,61	10,60	A	
8	13,08	19,91	0,00	P		10,55	13,80	A	
9	13,08	20,48	0,00	P		10,70	13,80	A	
9	12,76	32,76	0,00	P		11,62	17,00	A	
10	12,76	32,82	0,00	P		11,78	17,00	A	
10	12,44	43,17	0,00	3	96	12,69	20,20	A	
11	12,44	43,17	0,00	3	96	12,85	20,20	A	
11	12,12	49,24	0,00	3	86	13,76	23,40	A	
12	12,12	49,20	0,00	3	86	13,92	23,40	A	
12	11,80	54,62	0,00	2	78	14,84	26,60	A	
13	11,80	54,61	0,00	2	78	14,94	26,60	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* [%]
13	11,70	54,21	0,00	2	73	15,23	27,60	A	
14	11,70	54,20	0,00	2	74	15,29	27,60	A	
14	11,55	53,76	0,00	2	68	15,73	29,10	A	
15	11,55	53,75	0,00	2	68	15,78	29,10	A	
15	11,45	53,56	0,00	2	64	16,07	30,10	A	
16	11,45	52,14	0,00	2	66	16,14	30,10	A	
16	11,22	50,15	2,25	2	60	16,81	32,35	A	
17	11,22	45,44	2,25	2	64	16,43	32,35	A	
17	11,00	43,68	4,50	2	59	17,09	34,60	A	
18	11,00	66,76	4,50	2	66	15,04	34,60	A	
18	10,71	60,95	8,65	2	59	16,20	36,17	A	
19	10,71	55,56	8,65	2	63	15,39	36,17	A	
19	10,43	51,03	12,79	2	57	16,50	37,73	A	
20	10,43	49,48	12,79	2	58	15,72	37,73	A	
20	10,14	46,22	16,94	2	53	16,79	39,30	A	
21	10,14	45,87	16,94	2	53	16,03	39,30	A	
21	9,86	42,54	21,09	1	48	17,06	40,87	A	
22	9,86	42,99	21,09	1	48	16,33	40,87	A	
22	9,57	36,16	25,24	1	40	17,31	42,44	A	
23	9,57	36,63	25,24	1	39	16,60	42,44	A	
23	9,29	32,61	29,38	1	34	17,55	44,00	A	
24	9,29	33,09	29,38	1	33	16,85	44,00	A	
24	9,00	31,12	33,53	1	31	20,24	45,57	1	
25	9,00	25,69	33,53	1	34	29,89	45,57	1	
25	8,70	25,50	38,04	1	33	32,58	47,06	1	
26	8,70	25,99	38,04	1	31	32,94	47,06	1	
26	8,40	26,12	42,54	1	30	35,36	48,56	1	
27	8,40	26,61	42,54	1	29	35,70	48,56	1	
27	8,10	26,85	47,05	1	28	38,06	50,05	1	

*

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

8.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	211,7	104,0
Water	75,3	183,1
Total	287,0	287,1

Considered as passive side	Left
Maximum passive effective resistance	387,17 kN
Mobilized passive effective resistance	211,74 kN
Percentage mobilized resistance	54,7 %

8.7.5 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	-32,56
Vertical force passive	67,27
Resulting vertical force (no dead weight)	34,71
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-32,56
Vertical force passive	67,27
Resulting vertical force (no dead weight)	34,71
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

8.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-2,06
13,40	Zand, m vast	29,98	13,40	Zand, m vast	-10,01
11,00	Zand, vast	29,78	11,00	Zand, vast	-11,03
9,00	Zand, m vast	7,24	9,00	Zand, m vast	-9,46

9 Step 6.4 Stage 1: Val MHW +0,5 m

9.1 Input Data Left

9.1.1 Calculation Method

Calculation method: C, phi, delta

9.1.2 Water Level

Water level: 11,45 [m]

9.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

9.1.4 Soil Material Properties in Profile: 56B-S01 (L +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	9,03	13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	13,55	13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	13,55	13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	13,55	13,55

9.1.5 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]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

9.2 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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,5	63,7	0,34	0,34	2,54
7	11,75	9,6	71,8	0,34	0,34	2,54
8	11,63	10,2	76,6	0,34	0,34	2,54
9	11,50	10,9	81,5	0,34	0,34	2,54
10	11,34	11,4	81,5	0,34	0,34	2,42
11	11,11	12,0	72,2	0,34	0,34	2,04
12	10,86	11,4	102,2	0,31	0,32	2,79
13	10,57	11,7	89,3	0,31	0,33	2,39
14	10,29	11,9	86,7	0,31	0,34	2,27
15	10,00	12,2	87,4	0,31	0,35	2,23
16	9,71	12,5	90,2	0,31	0,36	2,25
17	9,43	12,8	95,1	0,31	0,37	2,32
18	9,14	13,0	100,5	0,31	0,38	2,40
19	8,85	14,5	76,2	0,34	0,43	1,78
20	8,55	14,8	85,1	0,34	0,44	1,95
21	8,25	15,0	93,3	0,34	0,45	2,09

9.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	102,99
Zand, vast	77,77
Zand, m vast	27,32
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

9.4 Input Data Right

9.4.1 Calculation Method

Calculation method: C, phi, delta

9.4.2 Water Level

Water level: 14,46 [m]

9.4.3 Surface

X [m]	Y [m]
0,00	14,61

9.4.4 Soil Material Properties in Profile: 56B-S01 (R +0,5)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	-9,03	-13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-13,55	-13,55

9.4.5 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]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

9.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

9.5 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	14,54	4,3	71,7	0,24	0,92	3,97
2	14,44	4,9	77,1	0,25	0,83	3,92
3	14,29	5,4	81,3	0,26	0,75	3,90
4	14,05	6,1	88,1	0,27	0,65	3,86
5	13,82	6,9	58,8	0,28	0,58	2,38
6	13,65	7,4	53,5	0,29	0,55	2,06
7	13,50	7,9	56,6	0,29	0,52	2,09
8	13,24	10,1	70,7	0,35	0,47	2,42
9	12,92	11,2	82,9	0,35	0,44	2,60
10	12,60	12,2	87,3	0,36	0,43	2,53
11	12,28	13,3	98,2	0,36	0,43	2,66
12	11,96	14,4	110,7	0,36	0,44	2,80
13	11,75	15,1	119,0	0,37	0,44	2,89
14	11,63	15,5	123,9	0,37	0,44	2,94
15	11,50	15,9	128,9	0,37	0,44	2,99
16	11,34	16,5	135,3	0,37	0,45	3,04
17	11,11	16,8	144,3	0,36	0,45	3,12
18	10,86	15,6	187,8	0,32	0,44	3,83
19	10,57	15,9	207,2	0,30	0,45	3,94
20	10,29	16,3	226,1	0,29	0,46	4,01
21	10,00	16,5	236,9	0,28	0,46	3,95
22	9,71	16,8	256,2	0,26	0,47	4,02
23	9,43	17,1	275,6	0,25	0,47	4,08
24	9,14	17,3	295,0	0,24	0,48	4,14
25	8,85	19,8	267,7	0,26	0,51	3,56
26	8,55	22,0	285,9	0,28	0,51	3,60
27	8,25	24,4	304,6	0,29	0,52	3,64

9.6 Calculated Force from a layer Right

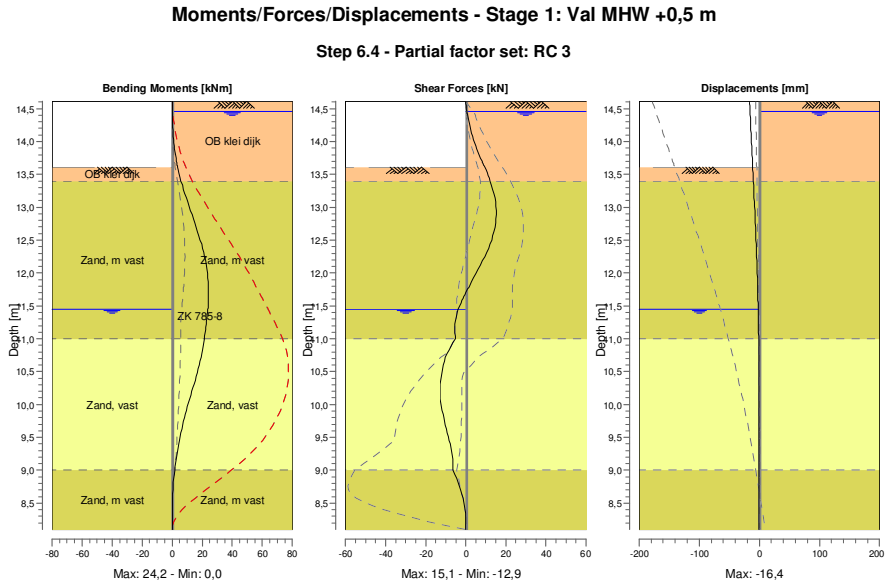
Name	Force
OB klei dijk	0,00
OB klei dijk	7,51
Zand, m vast	32,48
Zand, vast	34,46
Zand, m vast	26,87
Zand, m vast	0,00

Name	Force
Zand, vast	0,00
Zand, sterk grindig	0,00

9.7 Calculation Results

Number of iterations: 6

9.7.1 Charts of Moments, Forces and Displacements



9.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-16,4**
1	14,46	0,0	0,6	-15,6
2	14,46	0,0	0,6	-15,6
2	14,41	0,1	0,8	-15,4
3	14,41	0,1	0,8	-15,4
3	14,17	0,5	2,5	-14,1
4	14,17	0,5	2,5	-14,1
4	13,94	1,3	4,9	-12,8
5	13,94	1,3	4,9	-12,8
5	13,70	2,9	8,1	-11,5
6	13,70	2,9	8,1	-11,5
6	13,61	3,7	9,5	-11,1
7	13,61	3,7	9,5	-11,1
7	13,40	5,9	12,2	-10,0
8	13,40	5,9	12,2	-10,0
8	13,08	10,3	**14,8**	-8,3
9	13,08	10,3	**14,8**	-8,3
9	12,76	15,1	**14,8**	-6,8
10	12,76	15,1	**14,8**	-6,8
10	12,44	19,5	12,2	-5,3
11	12,44	19,5	12,2	-5,3
11	12,12	22,7	7,2	-4,1
12	12,12	22,7	7,2	-4,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	11,80	24,1	1,8	-3,0
13	11,80	24,1	1,8	-3,0
13	11,70	**24,2**	0,1	-2,7
14	11,70	**24,2**	0,1	-2,7
14	11,55	24,0	-2,4	-2,3
15	11,55	24,0	-2,4	-2,3
15	11,45	23,7	-3,7	-2,0
16	11,45	23,7	-3,7	-2,0
16	11,22	22,6	-5,5	-1,5
17	11,22	22,6	-5,5	-1,5
17	11,00	21,4	-5,1	-1,1
18	11,00	21,4	-5,1	-1,1
18	10,71	19,2	-10,2	-0,7
19	10,71	19,2	-10,2	-0,7
19	10,43	16,0	-12,3	-0,4
20	10,43	16,0	-12,3	-0,4
20	10,14	12,3	-12,8	-0,3
21	10,14	12,3	-12,8	-0,3
21	9,86	8,8	-11,4	-0,2
22	9,86	8,8	-11,4	-0,2
22	9,57	5,9	-9,2	-0,1
23	9,57	5,9	-9,2	-0,1
23	9,29	3,6	-7,1	-0,1
24	9,29	3,6	-7,1	-0,1
24	9,00	1,7	-6,3	-0,2
25	9,00	1,7	-6,3	-0,2
25	8,70	0,4	-2,5	-0,2
26	8,70	0,4	-2,5	-0,2
26	8,40	0,0	-0,4	-0,3
27	8,40	0,0	-0,4	-0,3
27	8,10	0,0	0,0	-0,3
Max		**24,2**	**14,8**	**-16,4**
Max, minor nodes incl.		24,2	15,1	-16,4

9.7.3 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	14,61	0,00	0,00	-		0,00	0,00	A	
1	14,46	0,00	0,00	-		4,65	0,00	A	
2	14,46	0,00	0,00	-		4,87	0,00	A	
2	14,41	0,00	0,00	-		4,97	0,50	A	
3	14,41	0,00	0,00	-		5,12	0,50	A	
3	14,17	0,00	0,00	-		5,63	2,87	A	
4	14,17	0,00	0,00	-		5,87	2,87	A	
4	13,94	0,00	0,00	-		6,39	5,23	A	
5	13,94	0,00	0,00	-		6,63	5,23	A	
5	13,70	0,00	0,00	-		7,14	7,60	A	
6	13,70	0,00	0,00	-		7,31	7,60	A	
6	13,61	0,00	0,00	-		7,51	8,51	A	
7	13,61	0,00	0,00	P		7,66	8,51	A	
7	13,40	9,42	0,00	P		8,11	10,60	A	
8	13,40	8,00	0,00	P		9,61	10,60	A	
8	13,08	19,91	0,00	P		10,55	13,80	A	
9	13,08	20,48	0,00	P		10,70	13,80	A	
9	12,76	32,76	0,00	P		11,62	17,00	A	
10	12,76	32,82	0,00	P		11,78	17,00	A	
10	12,44	45,15	0,00	P		12,69	20,20	A	
11	12,44	45,16	0,00	P		12,85	20,20	A	
11	12,12	54,27	0,00	3	94	13,76	23,40	A	
12	12,12	54,23	0,00	3	94	13,92	23,40	A	
12	11,80	58,55	0,00	3	84	14,84	26,60	A	
13	11,80	58,52	0,00	3	84	14,94	26,60	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* [%]
13	11,70	60,03	0,00	3	81	15,23	27,60	A	
14	11,70	60,01	0,00	3	81	15,29	27,60	A	
14	11,55	59,57	0,00	2	75	15,73	29,10	A	
15	11,55	59,56	0,00	2	75	15,78	29,10	A	
15	11,45	58,01	0,00	2	70	16,07	30,10	A	
16	11,45	56,59	0,00	2	71	16,14	30,10	A	
16	11,22	52,05	2,25	2	62	16,81	32,35	A	
17	11,22	47,34	2,25	2	67	16,43	32,35	A	
17	11,00	43,70	4,50	2	59	17,09	34,60	A	
18	11,00	66,81	4,50	2	66	15,04	34,60	A	
18	10,71	58,00	8,65	2	56	16,20	36,17	A	
19	10,71	52,60	8,65	2	60	15,39	36,17	A	
19	10,43	46,73	12,79	2	52	16,50	37,73	A	
20	10,43	45,19	12,79	2	53	15,72	37,73	A	
20	10,14	36,42	16,94	1	42	16,79	39,30	A	
21	10,14	36,85	16,94	1	43	16,03	39,30	A	
21	9,86	29,15	21,09	1	33	17,06	40,87	A	
22	9,86	29,60	21,09	1	33	16,33	40,87	A	
22	9,57	27,11	25,24	1	30	18,26	42,44	1	
23	9,57	27,58	25,24	1	29	18,63	42,44	1	
23	9,29	28,57	29,38	1	30	19,78	44,00	1	
24	9,29	29,04	29,38	1	29	20,13	44,00	1	
24	9,00	32,16	33,53	1	32	19,21	45,57	1	
25	9,00	26,21	33,53	1	35	29,37	45,57	1	
25	8,70	28,58	38,04	1	37	29,50	47,06	1	
26	8,70	29,07	38,04	1	35	29,86	47,06	1	
26	8,40	31,61	42,54	1	37	29,87	48,56	1	
27	8,40	32,10	42,54	1	35	30,21	48,56	1	
27	8,10	34,67	47,05	1	37	30,24	50,05	1	

*

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

9.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	209,1	101,3
Water	75,3	183,1
Total	284,4	284,4

Considered as passive side	Left
Maximum passive effective resistance	387,17 kN
Mobilized passive effective resistance	209,06 kN
Percentage mobilized resistance	54,0 %

9.7.5 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	-31,75
Vertical force passive	66,16
Resulting vertical force (no dead weight)	34,41
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-31,75
Vertical force passive	66,16
Resulting vertical force (no dead weight)	34,41
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

9.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-2,06
13,40	Zand, m vast	31,74	13,40	Zand, m vast	-10,01
11,00	Zand, vast	25,73	11,00	Zand, vast	-11,40
9,00	Zand, m vast	8,42	9,00	Zand, m vast	-8,28

10 Step 6.5 Stage 1: Val MHW +0,5 m

10.1 Input Data Left

10.1.1 Calculation Method

Calculation method: C, phi, delta

10.1.2 Water Level

Water level: 11,70 [m]

10.1.3 Surface

X [m]	Y [m]
0,00	13,70
8,00	11,70

10.1.4 Soil Material Properties in Profile: 56B-S01 (L +0,5)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,11	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,61	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,40	18,00	20,00	0,00	30,00	20,00
Zand, vast	11,00	18,00	20,00	0,00	32,00	16,60
Zand, m vast	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	8,10	18,00	20,00	0,00	30,00	20,00
Zand, vast	5,00	18,00	20,00	0,00	32,00	16,60
Zand, sterk gri...	3,00	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	9,03	13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	13,55	13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	13,55	13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	13,55	13,55

10.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,61	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,40	20000,00	20000,00	10000,00	10000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	40000,00	40000,00	20000,00	20000,00
Zand, m vast	9,00	20000,00	20000,00	10000,00	10000,00
Zand, m vast	8,10	20000,00	20000,00	10000,00	10000,00
Zand, vast	5,00	40000,00	40000,00	20000,00	20000,00
Zand, sterk gri...	3,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	800,00	800,00
OB klei dijk	14,61	800,00	800,00
Zand, m vast	13,40	5000,00	5000,00
Zand, vast	11,00	10000,00	10000,00
Zand, m vast	9,00	5000,00	5000,00
Zand, m vast	8,10	5000,00	5000,00
Zand, vast	5,00	10000,00	10000,00
Zand, sterk gri...	3,00	10000,00	10000,00

10.2 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	13,55	0,0	7,9	0,00	0,00	3,39
2	13,24	0,6	23,0	0,09	0,09	3,25
3	12,92	3,8	39,1	0,32	0,32	3,28
4	12,60	5,2	55,1	0,31	0,31	3,29
5	12,28	6,6	71,1	0,30	0,30	3,29
6	11,96	8,0	87,1	0,30	0,30	3,29
7	11,75	8,9	97,6	0,30	0,30	3,29
8	11,58	9,3	92,5	0,30	0,30	2,96
9	11,35	9,4	78,2	0,29	0,29	2,37
10	11,12	9,9	86,1	0,29	0,29	2,48
11	10,86	9,8	101,2	0,27	0,27	2,81
12	10,57	10,1	95,0	0,27	0,27	2,58
13	10,29	10,3	96,2	0,27	0,27	2,55
14	10,00	10,6	100,0	0,27	0,27	2,59
15	9,71	10,8	105,2	0,27	0,27	2,66
16	9,43	11,1	111,4	0,27	0,28	2,76
17	9,14	11,3	118,0	0,27	0,30	2,85
18	8,85	12,1	119,6	0,29	0,35	2,83
19	8,55	12,3	127,8	0,29	0,36	2,96
20	8,25	12,6	135,9	0,28	0,37	3,08

10.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	1,83
Zand, m vast	82,53
Zand, vast	70,67
Zand, m vast	23,01
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

10.4 Input Data Right

10.4.1 Calculation Method

Calculation method: C, phi, delta

10.4.2 Water Level

Water level: 14,41 [m]

10.4.3 Surface

X [m]	Y [m]
0,00	14,61

10.4.4 Soil Material Properties in Profile: 56B-S01 (R +0,5)

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]
OB klei dijk	15,11	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,61	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,40	18,00	20,00	0,00	30,00	20,00
Zand, vast	11,00	18,00	20,00	0,00	32,00	16,60
Zand, m vast	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	8,10	18,00	20,00	0,00	30,00	20,00
Zand, vast	5,00	18,00	20,00	0,00	32,00	16,60
Zand, sterk gri...	3,00	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-9,03
Zand, m vast	9,00	n.a.	n.a.	n.a.	-9,03	-13,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-13,55	-13,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-13,55	-13,55

10.4.5 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]
OB klei dijk	15,11	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,61	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,40	20000,00	20000,00	10000,00	10000,00
Zand, vast	11,00	40000,00	40000,00	20000,00	20000,00
Zand, m vast	9,00	20000,00	20000,00	10000,00	10000,00
Zand, m vast	8,10	20000,00	20000,00	10000,00	10000,00
Zand, vast	5,00	40000,00	40000,00	20000,00	20000,00
Zand, sterk gri...	3,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	800,00	800,00
OB klei dijk	14,61	800,00	800,00
Zand, m vast	13,40	5000,00	5000,00
Zand, vast	11,00	10000,00	10000,00
Zand, m vast	9,00	5000,00	5000,00
Zand, m vast	8,10	5000,00	5000,00
Zand, vast	5,00	10000,00	10000,00
Zand, sterk gri...	3,00	10000,00	10000,00

10.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	13,33
	2,50	13,33

10.5 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	14,51	1,7	86,1	0,11	0,88	5,68
2	14,29	2,6	99,1	0,14	0,73	5,50
3	14,05	3,2	108,2	0,16	0,63	5,41
4	13,82	3,9	72,8	0,18	0,56	3,33
5	13,55	4,6	75,2	0,19	0,51	3,14
6	13,24	7,6	97,0	0,29	0,45	3,66
7	12,92	8,5	115,0	0,29	0,42	3,92
8	12,60	9,4	120,6	0,29	0,41	3,77
9	12,28	10,3	137,0	0,30	0,41	3,95
10	11,96	11,2	154,9	0,30	0,41	4,15
11	11,75	11,8	166,7	0,30	0,41	4,27
12	11,58	12,2	176,1	0,30	0,41	4,35
13	11,35	12,9	189,3	0,30	0,42	4,46
14	11,12	13,5	202,5	0,30	0,42	4,56
15	10,86	13,6	219,7	0,29	0,40	4,65
16	10,57	14,1	242,8	0,28	0,41	4,76
17	10,29	14,4	266,1	0,26	0,41	4,86
18	10,00	14,7	289,7	0,25	0,42	4,95
19	9,71	15,0	313,1	0,24	0,42	5,02
20	9,43	15,3	336,4	0,23	0,43	5,08
21	9,14	15,6	359,9	0,22	0,43	5,13
22	8,85	17,2	388,3	0,23	0,46	5,24
23	8,55	18,8	414,2	0,24	0,46	5,28
24	8,25	20,7	439,8	0,25	0,47	5,32

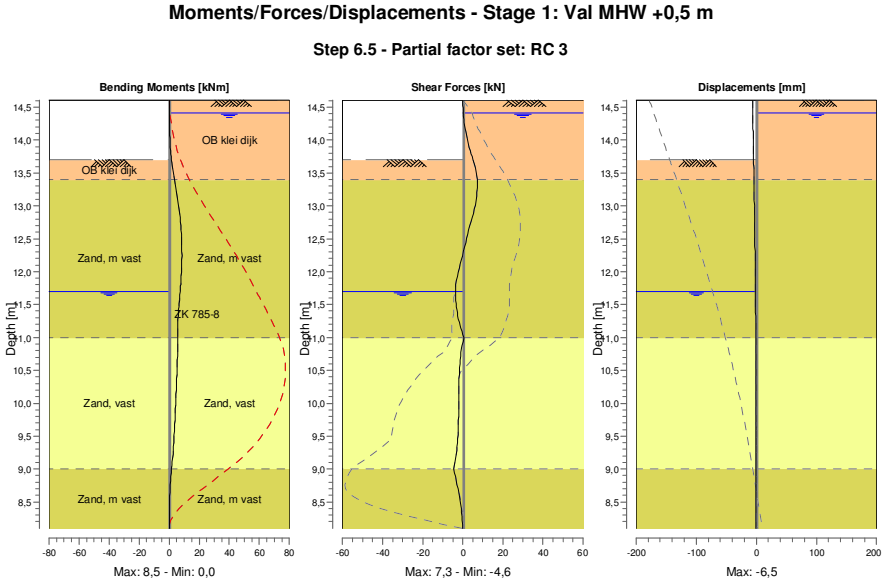
10.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	3,98
Zand, m vast	25,22
Zand, vast	29,38
Zand, m vast	23,52
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

10.7 Calculation Results

Number of iterations: 5

10.7.1 Charts of Moments, Forces and Displacements



10.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-6,5**
1	14,41	0,0	0,3	-6,1
2	14,41	0,0	0,3	-6,1
2	14,17	0,2	1,2	-5,6
3	14,17	0,2	1,2	-5,6
3	13,94	0,7	2,8	-5,2
4	13,94	0,7	2,8	-5,2
4	13,70	1,6	5,1	-4,7
5	13,70	1,6	5,1	-4,7
5	13,40	3,5	**7,3**	-4,1
6	13,40	3,5	7,2	-4,1
6	13,08	5,8	6,6	-3,5
7	13,08	5,8	6,6	-3,5
7	12,76	7,5	4,1	-2,9
8	12,76	7,5	4,1	-2,9
8	12,44	**8,4**	1,4	-2,4
9	12,44	**8,4**	1,4	-2,4
9	12,12	**8,4**	-1,2	-2,0
10	12,12	**8,4**	-1,2	-2,0
10	11,80	7,6	-3,4	-1,6
11	11,80	7,6	-3,4	-1,6
11	11,70	7,3	-3,6	-1,5
12	11,70	7,3	-3,6	-1,5
12	11,47	6,4	-3,2	-1,3
13	11,47	6,4	-3,2	-1,3
13	11,23	5,8	-1,8	-1,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	11,23	5,8	-1,7	-1,1
14	11,00	5,7	0,6	-1,0
15	11,00	5,7	0,6	-1,0
15	10,71	5,6	-1,1	-0,8
16	10,71	5,6	-1,1	-0,8
16	10,43	5,1	-1,8	-0,7
17	10,43	5,1	-1,8	-0,7
17	10,14	4,6	-2,0	-0,6
18	10,14	4,6	-2,0	-0,6
18	9,86	4,0	-2,0	-0,5
19	9,86	4,0	-2,0	-0,5
19	9,57	3,4	-2,2	-0,5
20	9,57	3,4	-2,2	-0,5
20	9,29	2,7	-3,0	-0,5
21	9,29	2,7	-3,0	-0,5
21	9,00	1,6	-4,6	-0,5
22	9,00	1,6	-4,6	-0,5
22	8,70	0,6	-2,4	-0,5
23	8,70	0,6	-2,4	-0,5
23	8,40	0,1	-0,8	-0,5
24	8,40	0,1	-0,8	-0,5
24	8,10	0,0	0,0	-0,5
Max		**8,4**	**7,3**	**-6,5**
Max, minor nodes incl.		8,5	7,3	-6,5

10.7.3 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	14,61	0,00	0,00	-		0,00	0,00	A	
1	14,41	0,00	0,00	-		1,90	0,00	A	
2	14,41	0,00	0,00	-		2,45	0,00	A	
2	14,17	0,00	0,00	-		2,74	2,37	A	
3	14,17	0,00	0,00	-		3,07	2,37	A	
3	13,94	0,00	0,00	-		3,39	4,73	A	
4	13,94	0,00	0,00	-		3,70	4,73	A	
4	13,70	0,00	0,00	-		4,03	7,10	A	
5	13,70	0,00	0,00	P		4,37	7,10	A	
5	13,40	10,19	0,00	2	65	4,80	10,10	A	
6	13,40	15,14	0,00	P		7,19	10,10	A	
6	13,08	26,41	0,00	3	86	8,00	13,30	A	
7	13,08	26,80	0,00	3	86	8,10	13,30	A	
7	12,76	34,25	0,00	2	73	8,89	16,50	A	
8	12,76	34,25	0,00	2	73	9,00	16,50	A	
8	12,44	37,74	0,00	2	60	9,78	19,70	A	
9	12,44	37,73	0,00	2	60	9,89	19,70	A	
9	12,12	41,60	0,00	2	53	10,68	22,90	A	
10	12,12	41,58	0,00	2	53	10,78	22,90	A	
10	11,80	41,19	0,00	1	43	11,58	26,10	A	
11	11,80	41,13	0,00	1	43	11,64	26,10	A	
11	11,70	39,58	0,00	1	40	11,89	27,10	A	
12	11,70	39,55	0,00	1	44	11,94	27,10	A	
12	11,47	35,81	2,33	1	38	12,53	29,43	A	
13	11,47	35,44	2,33	1	47	12,59	29,43	A	
13	11,23	32,24	4,67	1	40	13,18	31,77	A	
14	11,23	32,23	4,67	1	38	13,23	31,77	A	
14	11,00	29,54	7,00	1	33	13,84	34,10	A	
15	11,00	48,46	7,00	1	48	13,07	34,10	A	
15	10,71	42,25	11,15	1	41	14,15	35,67	A	
16	10,71	42,28	11,15	1	45	13,54	35,67	A	
16	10,43	37,52	15,29	1	39	14,57	37,23	A	
17	10,43	37,54	15,29	1	39	13,91	37,23	A	
17	10,14	34,12	19,44	1	35	14,90	38,80	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* [%]
18	10,14	34,13	19,44	1	35	14,26	38,80	A	
18	9,86	31,91	23,59	1	32	15,22	40,37	A	
19	9,86	31,91	23,59	1	31	14,58	40,37	A	
19	9,57	30,74	27,74	1	29	15,51	41,94	A	
20	9,57	31,14	27,74	1	28	14,88	41,94	A	
20	9,29	30,86	31,88	1	27	15,78	43,50	A	
21	9,29	31,32	31,88	1	27	15,20	43,50	A	
21	9,00	31,74	36,03	1	27	16,06	45,07	A	
22	9,00	24,13	36,03	1	20	23,45	45,07	1	
22	8,70	24,73	40,54	1	20	25,10	46,56	1	
23	8,70	25,20	40,54	1	20	25,35	46,56	1	
23	8,40	25,90	45,04	1	20	26,94	48,06	1	
24	8,40	26,37	45,04	1	20	27,18	48,06	1	
24	8,10	27,11	49,55	1	20	28,77	49,55	1	

*

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

10.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	178,0	82,1
Water	84,0	179,9
Total	262,0	262,0

Considered as passive side	Left
Maximum passive effective resistance	482,88 kN
Mobilized passive effective resistance	178,04 kN
Percentage mobilized resistance	36,9 %

10.7.5 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	-30,49
Vertical force passive	66,56
Resulting vertical force (no dead weight)	36,07
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-30,49
Vertical force passive	66,56
Resulting vertical force (no dead weight)	36,07
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

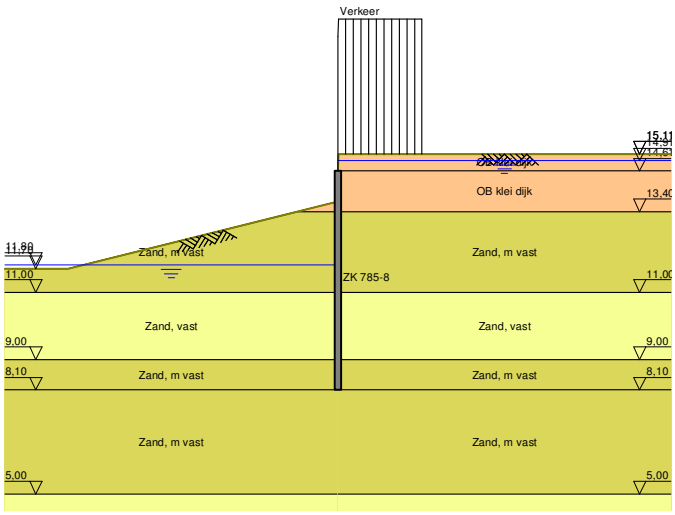
10.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,70	OB klei dijk	0,59	14,61	OB klei dijk	-1,29
13,40	Zand, m vast	30,04	13,40	Zand, m vast	-9,18
11,00	Zand, vast	27,55	11,00	Zand, vast	-11,45

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,00	Zand, m vast	8,38	9,00	Zand, m vast	-8,56

11 Outline Stage 2: Val MHW +1,0 m

Outline - Stage 2: Val MHW +1,0 m

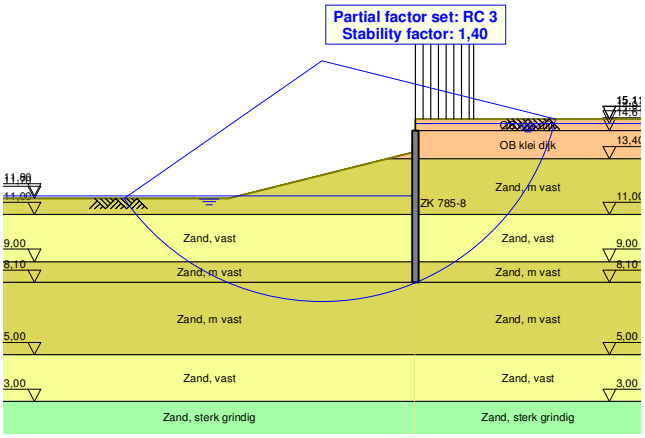


12 Overall Stability Stage 2: Val MHW +1,0 m

Stability factor : 1,40

12.1 Overall Stability

Overall Stability - Stage 2: Val MHW +1,0 m



13 Step 6.1 Stage 2: Val MHW +1,0 m

13.1 Input Data Left

13.1.1 Calculation Method

Calculation method: C, phi, delta

13.1.2 Water Level

Water level: 12,05 [m]

13.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

13.1.4 Soil Material Properties in Profile: 56B-S01 (L +1,0)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	13,37	15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	15,55	15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	15,55	15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	15,55	15,55

13.1.5 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]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

13.2 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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,2	50,4	0,34	0,34	2,07
7	11,75	8,8	43,4	0,34	0,34	1,68
8	11,63	9,1	46,6	0,34	0,34	1,74
9	11,50	9,4	47,4	0,34	0,34	1,71
10	11,34	9,8	54,0	0,34	0,34	1,87
11	11,11	10,4	59,5	0,34	0,34	1,94
12	10,86	9,8	86,5	0,31	0,31	2,74
13	10,57	9,9	70,8	0,31	0,31	2,23
14	10,29	10,0	65,7	0,31	0,32	2,05
15	10,00	10,1	64,7	0,31	0,33	2,00
16	9,71	10,2	66,1	0,31	0,34	2,02
17	9,43	10,3	68,7	0,31	0,35	2,08
18	9,14	10,4	71,6	0,31	0,36	2,15
19	8,85	11,7	53,5	0,34	0,42	1,56
20	8,55	12,2	67,0	0,34	0,43	1,86
21	8,25	12,7	79,3	0,34	0,45	2,10

13.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	98,72
Zand, vast	138,36
Zand, m vast	18,56
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

13.4 Input Data Right

13.4.1 Calculation Method

Calculation method: C, phi, delta

13.4.2 Water Level

Water level: 14,91 [m]

13.4.3 Surface

X [m]	Y [m]
0,00	14,61
0,01	15,11

13.4.4 Soil Material Properties in Profile: 56B-S01 (R +1,0)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	-13,37	-15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-15,55	-15,55

13.4.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

13.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

13.5 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	14,54	23,6	355,5	1,02	1,02	15,44
2	14,44	6,7	93,3	0,28	0,70	3,88
3	14,29	7,2	57,3	0,28	0,65	2,27
4	14,05	7,9	57,1	0,29	0,58	2,11
5	13,82	8,7	62,3	0,30	0,54	2,16
6	13,65	9,2	66,1	0,31	0,51	2,20
7	13,50	9,7	69,7	0,31	0,50	2,25
8	13,24	11,7	88,2	0,35	0,46	2,67
9	12,92	12,8	100,9	0,36	0,45	2,83
10	12,60	13,8	107,7	0,36	0,44	2,83
11	12,28	14,9	116,4	0,37	0,44	2,86
12	11,96	16,0	129,1	0,37	0,45	2,99
13	11,75	16,7	137,5	0,37	0,45	3,06
14	11,63	16,7	142,5	0,36	0,45	3,11
15	11,50	16,6	147,5	0,35	0,45	3,15
16	11,34	16,5	154,1	0,34	0,46	3,19
17	11,11	16,5	163,1	0,33	0,46	3,26
18	10,86	15,4	211,2	0,29	0,45	3,97
19	10,57	15,9	233,6	0,28	0,45	4,06
20	10,29	16,4	256,0	0,27	0,46	4,14
21	10,00	16,9	269,1	0,25	0,47	4,06
22	9,71	17,3	291,3	0,24	0,47	4,13
23	9,43	18,0	313,7	0,24	0,48	4,18
24	9,14	19,7	336,0	0,25	0,48	4,23
25	8,85	23,2	303,1	0,28	0,51	3,63
26	8,55	25,6	318,2	0,30	0,51	3,66
27	8,25	27,1	333,3	0,30	0,51	3,69

13.6 Calculated Force from a layer Right

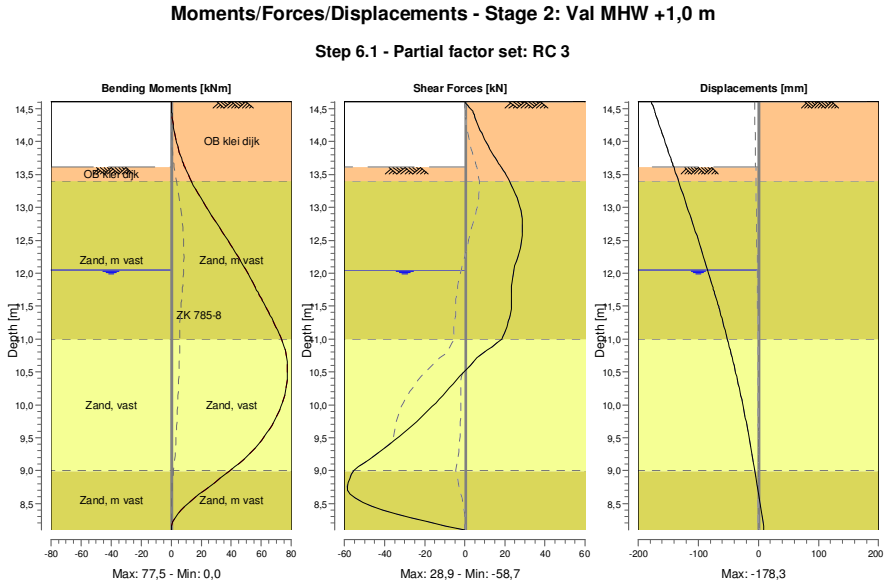
Name	Force
OB klei dijk	0,00
OB klei dijk	12,26
Zand, m vast	35,38
Zand, vast	34,18
Zand, m vast	74,21

Name	Force
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

13.7 Calculation Results

Number of iterations: 9

13.7.1 Charts of Moments, Forces and Displacements



13.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-178,3**
1	14,46	0,3	4,0	-172,7
2	14,46	0,3	4,0	-172,7
2	14,41	0,5	4,6	-170,8
3	14,41	0,5	4,6	-170,8
3	14,17	1,9	7,7	-161,9
4	14,17	1,9	7,7	-161,9
4	13,94	4,2	11,6	-153,0
5	13,94	4,2	11,6	-153,0
5	13,70	7,5	16,3	-144,1
6	13,70	7,5	16,3	-144,1
6	13,61	9,1	18,3	-140,7
7	13,61	9,1	18,3	-140,7
7	13,40	13,3	22,2	-132,9
8	13,40	13,3	22,2	-132,9
8	13,08	21,3	26,9	-121,1
9	13,08	21,3	26,9	-121,1
9	12,76	30,2	28,8	-109,4
10	12,76	30,2	28,8	-109,4
10	12,44	39,4	28,1	-98,0
11	12,44	39,4	28,1	-98,0
11	12,12	48,0	24,9	-86,9

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	12,12	48,0	24,9	-86,9
12	11,80	55,7	23,2	-76,2
13	11,80	55,7	23,2	-76,2
13	11,70	58,0	23,4	-72,9
14	11,70	58,0	23,4	-72,9
14	11,55	61,5	23,4	-68,1
15	11,55	61,5	23,4	-68,1
15	11,45	63,9	23,2	-65,0
16	11,45	63,9	23,2	-65,0
16	11,22	68,9	21,4	-58,1
17	11,22	68,9	21,4	-58,1
17	11,00	73,4	18,4	-51,5
18	11,00	73,4	18,4	-51,5
18	10,71	76,9	6,1	-43,6
19	10,71	76,9	6,1	-43,6
19	10,43	**77,4**	-2,7	-36,1
20	10,43	**77,4**	-2,7	-36,1
20	10,14	75,5	-11,0	-29,2
21	10,14	75,5	-11,0	-29,2
21	9,86	71,1	-20,1	-22,7
22	9,86	71,1	-20,1	-22,7
22	9,57	63,9	-30,5	-16,7
23	9,57	63,9	-30,5	-16,7
23	9,29	53,5	-42,5	-11,1
24	9,29	53,5	-42,5	-11,1
24	9,00	39,4	-55,3	-5,9
25	9,00	39,4	-55,4	-5,9
25	8,70	22,2	-58,6	-0,7
26	8,70	22,2	**-58,7**	-0,7
26	8,40	6,6	-40,8	4,4
27	8,40	6,6	-40,8	4,4
27	8,10	0,0	-0,1	9,4
Max		**77,4**	**-58,7**	**-178,3**
Max, minor nodes incl.		77,5	-58,7	-178,3

13.7.3 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	14,61	0,00	0,00	-		17,01	3,00	A	7
1	14,46	0,00	0,00	-		24,36	4,50	A	7
2	14,46	0,00	0,00	-		6,64	4,50	A	
2	14,41	0,00	0,00	-		6,77	5,00	A	
3	14,41	0,00	0,00	-		6,87	5,00	A	
3	14,17	0,00	0,00	-		7,43	7,37	A	
4	14,17	0,00	0,00	-		7,65	7,37	A	
4	13,94	0,00	0,00	-		8,17	9,73	A	
5	13,94	0,00	0,00	-		8,41	9,73	A	
5	13,70	0,00	0,00	-		8,92	12,10	A	
6	13,70	0,00	0,00	-		9,09	12,10	A	
6	13,61	0,00	0,00	-		9,29	13,01	A	
7	13,61	0,00	0,00	P		9,45	13,01	A	
7	13,40	9,42	0,00	P		9,89	15,10	A	
8	13,40	7,99	0,00	P		11,23	15,10	A	
8	13,08	19,91	0,00	P		12,14	18,30	A	
9	13,08	20,48	0,00	P		12,30	18,30	A	
9	12,76	32,76	0,00	P		13,21	21,50	A	
10	12,76	32,82	0,00	P		13,37	21,50	A	
10	12,44	45,15	0,00	P		14,29	24,70	A	
11	12,44	45,16	0,00	P		14,44	24,70	A	
11	12,12	57,53	0,00	P		15,37	27,90	A	
12	12,12	46,84	0,00	P		15,51	27,90	A	
12	11,80	51,78	2,50	P		16,45	31,10	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* [%]
13	11,80	41,97	2,50	P		16,50	31,10	A	
13	11,70	43,20	3,50	P		16,80	32,10	A	
14	11,70	44,79	3,50	P		16,44	32,10	A	
14	11,55	46,71	5,00	P		16,88	33,60	A	
15	11,55	45,91	5,00	P		16,46	33,60	A	
15	11,45	47,16	6,00	P		16,75	34,60	A	
16	11,45	51,52	6,00	P		16,22	34,60	A	
16	11,22	54,63	8,25	P		16,85	36,85	A	
17	11,22	56,88	8,25	P		16,15	36,85	A	
17	11,00	60,15	10,50	P		16,77	39,10	A	
18	11,00	84,80	10,50	P		14,79	39,10	A	
18	10,71	85,45	15,27	P		16,03	40,05	A	
19	10,71	69,38	15,27	P		15,31	40,05	A	
19	10,43	69,96	20,03	P		16,51	40,99	A	
20	10,43	64,37	20,03	P		15,82	40,99	A	
20	10,14	64,94	24,80	P		16,98	41,94	A	
21	10,14	63,39	24,80	P		16,29	41,94	A	
21	9,86	63,99	29,57	P		17,41	42,89	A	
22	9,86	64,75	29,57	P		16,74	42,89	A	
22	9,57	65,41	34,34	P		17,82	43,84	A	
23	9,57	67,30	34,34	P		17,49	43,84	A	
23	9,29	68,02	39,10	P		18,56	44,78	A	
24	9,29	70,16	39,10	P		19,19	44,78	A	
24	9,00	63,42	43,87	3	89	20,30	45,73	A	
25	9,00	42,97	43,87	3	84	22,74	45,73	A	
25	8,70	24,76	47,60	1	46	32,96	48,00	1	
26	8,70	25,37	47,60	1	39	33,23	48,00	1	
26	8,40	12,31	51,32	A		113,00	50,28	1	35
27	8,40	12,25	51,32	A		113,26	50,28	1	35
27	8,10	12,83	55,05	A		175,94	52,55	2	52

*

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

13.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	256,6	156,0
Water	104,4	205,1
Total	361,0	361,1

Considered as passive side	Left
Maximum passive effective resistance	297,77 kN
Mobilized passive effective resistance	256,61 kN
Percentage mobilized resistance	86,2 %

13.7.5 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	-48,45
Vertical force passive	82,19
Resulting vertical force (no dead weight)	33,74
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-48,45
Vertical force passive	82,19
Resulting vertical force (no dead weight)	33,74
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

13.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-3,36
13,40	Zand, m vast	30,43	13,40	Zand, m vast	-10,90
11,00	Zand, vast	45,78	11,00	Zand, vast	-11,31
9,00	Zand, m vast	5,72	9,00	Zand, m vast	-22,87

14 Step 6.2 Stage 2: Val MHW +1,0 m

14.1 Input Data Left

14.1.1 Calculation Method

Calculation method: C, phi, delta

14.1.2 Water Level

Water level: 12,05 [m]

14.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

14.1.4 Soil Material Properties in Profile: 56B-S01 (L +1,0)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	13,37	15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	15,55	15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	15,55	15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	15,55	15,55

14.1.5 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]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

14.2 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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,2	50,4	0,34	0,34	2,07
7	11,75	8,8	43,4	0,34	0,34	1,68
8	11,63	9,1	46,6	0,34	0,34	1,74
9	11,50	9,4	47,4	0,34	0,34	1,71
10	11,34	9,8	54,0	0,34	0,34	1,87
11	11,11	10,4	59,5	0,34	0,34	1,94
12	10,86	9,8	86,5	0,31	0,31	2,74
13	10,57	9,9	70,8	0,31	0,31	2,23
14	10,29	10,0	65,7	0,31	0,32	2,05
15	10,00	10,1	64,7	0,31	0,33	2,00
16	9,71	10,2	66,1	0,31	0,34	2,02
17	9,43	10,3	68,7	0,31	0,35	2,08
18	9,14	10,4	71,6	0,31	0,36	2,15
19	8,85	11,7	53,5	0,34	0,42	1,56
20	8,55	12,2	67,0	0,34	0,43	1,86
21	8,25	12,7	79,3	0,34	0,45	2,10

14.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	98,72
Zand, vast	138,45
Zand, m vast	18,45
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

14.4 Input Data Right

14.4.1 Calculation Method

Calculation method: C, phi, delta

14.4.2 Water Level

Water level: 14,91 [m]

14.4.3 Surface

X [m]	Y [m]
0,00	14,61
0,01	15,11

14.4.4 Soil Material Properties in Profile: 56B-S01 (R +1,0)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	-13,37	-15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-15,55	-15,55

14.4.5 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]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

14.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

14.5 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	14,54	23,6	355,5	1,02	1,02	15,44
2	14,44	6,7	93,3	0,28	0,70	3,88
3	14,29	7,2	57,3	0,28	0,65	2,27
4	14,05	7,9	57,1	0,29	0,58	2,11
5	13,82	8,7	62,3	0,30	0,54	2,16
6	13,65	9,2	66,1	0,31	0,51	2,20
7	13,50	9,7	69,7	0,31	0,50	2,25
8	13,24	11,7	88,2	0,35	0,46	2,67
9	12,92	12,8	100,9	0,36	0,45	2,83
10	12,60	13,8	107,7	0,36	0,44	2,83
11	12,28	14,9	116,4	0,37	0,44	2,86
12	11,96	16,0	129,1	0,37	0,45	2,99
13	11,75	16,7	137,5	0,37	0,45	3,06
14	11,63	16,7	142,5	0,36	0,45	3,11
15	11,50	16,6	147,5	0,35	0,45	3,15
16	11,34	16,5	154,1	0,34	0,46	3,19
17	11,11	16,5	163,1	0,33	0,46	3,26
18	10,86	15,4	211,2	0,29	0,45	3,97
19	10,57	15,9	233,6	0,28	0,45	4,06
20	10,29	16,4	256,0	0,27	0,46	4,14
21	10,00	16,9	269,1	0,25	0,47	4,06
22	9,71	17,3	291,3	0,24	0,47	4,13
23	9,43	18,0	313,7	0,24	0,48	4,18
24	9,14	19,7	336,0	0,25	0,48	4,23
25	8,85	23,2	303,1	0,28	0,51	3,63
26	8,55	25,6	318,2	0,30	0,51	3,66
27	8,25	27,1	333,3	0,30	0,51	3,69

14.6 Calculated Force from a layer Right

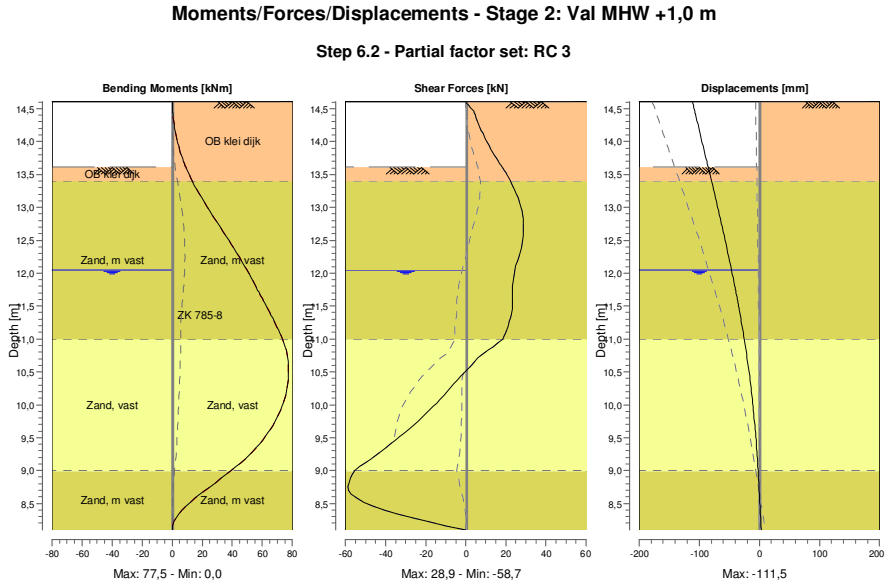
Name	Force
OB klei dijk	0,00
OB klei dijk	12,26
Zand, m vast	35,38
Zand, vast	34,18
Zand, m vast	74,23

Name	Force
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

14.7 Calculation Results

Number of iterations: 9

14.7.1 Charts of Moments, Forces and Displacements



14.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-111,5**
1	14,46	0,3	4,0	-107,5
2	14,46	0,3	4,0	-107,5
2	14,41	0,5	4,6	-106,2
3	14,41	0,5	4,6	-106,2
3	14,17	1,9	7,7	-99,9
4	14,17	1,9	7,7	-99,9
4	13,94	4,2	11,6	-93,7
5	13,94	4,2	11,6	-93,7
5	13,70	7,5	16,3	-87,5
6	13,70	7,5	16,3	-87,5
6	13,61	9,1	18,3	-85,1
7	13,61	9,1	18,3	-85,1
7	13,40	13,3	22,2	-79,7
8	13,40	13,3	22,2	-79,7
8	13,08	21,3	26,9	-71,4
9	13,08	21,3	26,9	-71,4
9	12,76	30,2	28,8	-63,3
10	12,76	30,2	28,8	-63,3
10	12,44	39,4	28,1	-55,5
11	12,44	39,4	28,1	-55,5
11	12,12	48,0	24,9	-48,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	12,12	48,0	24,9	-48,0
12	11,80	55,7	23,2	-40,9
13	11,80	55,7	23,2	-40,9
13	11,70	58,0	23,4	-38,8
14	11,70	58,0	23,4	-38,8
14	11,55	61,5	23,4	-35,6
15	11,55	61,5	23,4	-35,6
15	11,45	63,9	23,2	-33,6
16	11,45	63,9	23,2	-33,6
16	11,22	68,9	21,4	-29,3
17	11,22	68,9	21,4	-29,3
17	11,00	73,4	18,4	-25,2
18	11,00	73,4	18,4	-25,2
18	10,71	76,9	6,1	-20,5
19	10,71	76,9	6,1	-20,5
19	10,43	**77,4**	-2,7	-16,2
20	10,43	**77,4**	-2,7	-16,2
20	10,14	75,5	-11,1	-12,5
21	10,14	75,5	-11,1	-12,5
21	9,86	71,0	-20,1	-9,3
22	9,86	71,0	-20,1	-9,3
22	9,57	63,8	-30,5	-6,5
23	9,57	63,8	-30,5	-6,5
23	9,29	53,4	-42,5	-4,1
24	9,29	53,4	-42,5	-4,1
24	9,00	39,4	-55,4	-2,1
25	9,00	39,4	-55,5	-2,1
25	8,70	22,1	-58,6	-0,2
26	8,70	22,1	**-58,7**	-0,2
26	8,40	6,6	-40,5	1,5
27	8,40	6,6	-40,5	1,5
27	8,10	0,0	-0,1	3,2
Max		**77,4**	**-58,7**	**-111,5**
Max, minor nodes incl.		77,5	-58,7	-111,5

14.7.3 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	14,61	0,00	0,00	-		17,01	3,00	A	7
1	14,46	0,00	0,00	-		24,36	4,50	A	7
2	14,46	0,00	0,00	-		6,64	4,50	A	
2	14,41	0,00	0,00	-		6,77	5,00	A	
3	14,41	0,00	0,00	-		6,87	5,00	A	
3	14,17	0,00	0,00	-		7,43	7,37	A	
4	14,17	0,00	0,00	-		7,65	7,37	A	
4	13,94	0,00	0,00	-		8,17	9,73	A	
5	13,94	0,00	0,00	-		8,41	9,73	A	
5	13,70	0,00	0,00	-		8,92	12,10	A	
6	13,70	0,00	0,00	-		9,09	12,10	A	
6	13,61	0,00	0,00	-		9,29	13,01	A	
7	13,61	0,00	0,00	P		9,45	13,01	A	
7	13,40	9,42	0,00	P		9,89	15,10	A	
8	13,40	7,99	0,00	P		11,23	15,10	A	
8	13,08	19,91	0,00	P		12,14	18,30	A	
9	13,08	20,48	0,00	P		12,30	18,30	A	
9	12,76	32,76	0,00	P		13,21	21,50	A	
10	12,76	32,82	0,00	P		13,37	21,50	A	
10	12,44	45,15	0,00	P		14,29	24,70	A	
11	12,44	45,16	0,00	P		14,44	24,70	A	
11	12,12	57,53	0,00	P		15,37	27,90	A	
12	12,12	46,84	0,00	P		15,51	27,90	A	
12	11,80	51,78	2,50	P		16,45	31,10	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* [%]
13	11,80	41,97	2,50	P		16,50	31,10	A	
13	11,70	43,20	3,50	P		16,80	32,10	A	
14	11,70	44,79	3,50	P		16,44	32,10	A	
14	11,55	46,71	5,00	P		16,88	33,60	A	
15	11,55	45,91	5,00	P		16,46	33,60	A	
15	11,45	47,16	6,00	P		16,75	34,60	A	
16	11,45	51,52	6,00	P		16,22	34,60	A	
16	11,22	54,63	8,25	P		16,85	36,85	A	
17	11,22	56,88	8,25	P		16,15	36,85	A	
17	11,00	60,15	10,50	P		16,77	39,10	A	
18	11,00	84,80	10,50	P		14,79	39,10	A	
18	10,71	85,45	15,27	P		16,03	40,05	A	
19	10,71	69,38	15,27	P		15,31	40,05	A	
19	10,43	69,96	20,03	P		16,51	40,99	A	
20	10,43	64,37	20,03	P		15,82	40,99	A	
20	10,14	64,94	24,80	P		16,98	41,94	A	
21	10,14	63,39	24,80	P		16,29	41,94	A	
21	9,86	63,99	29,57	P		17,41	42,89	A	
22	9,86	64,75	29,57	P		16,74	42,89	A	
22	9,57	65,41	34,34	P		17,82	43,84	A	
23	9,57	67,30	34,34	P		17,49	43,84	A	
23	9,29	68,02	39,10	P		18,56	44,78	A	
24	9,29	70,16	39,10	P		19,19	44,78	A	
24	9,00	63,75	43,87	3	90	20,30	45,73	A	
25	9,00	43,14	43,87	3	84	22,74	45,73	A	
25	8,70	23,44	47,60	1	43	34,28	48,00	1	
26	8,70	24,05	47,60	1	37	34,55	48,00	1	
26	8,40	12,31	51,32	A		112,94	50,28	1	35
27	8,40	12,25	51,32	A		113,20	50,28	1	35
27	8,10	12,83	55,05	A		175,13	52,55	2	52

*

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

14.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	256,6	156,1
Water	104,4	205,1
Total	361,0	361,1

Considered as passive side	Left
Maximum passive effective resistance	297,77 kN
Mobilized passive effective resistance	256,60 kN
Percentage mobilized resistance	86,2 %

14.7.5 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	-48,45
Vertical force passive	82,19
Resulting vertical force (no dead weight)	33,74
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-48,45
Vertical force passive	82,19
Resulting vertical force (no dead weight)	33,74
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

14.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-3,36
13,40	Zand, m vast	30,43	13,40	Zand, m vast	-10,90
11,00	Zand, vast	45,81	11,00	Zand, vast	-11,31
9,00	Zand, m vast	5,69	9,00	Zand, m vast	-22,88

15 Step 6.3 Stage 2: Val MHW +1,0 m

15.1 Input Data Left

15.1.1 Calculation Method

Calculation method: C, phi, delta

15.1.2 Water Level

Water level: 11,55 [m]

15.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

15.1.4 Soil Material Properties in Profile: 56B-S01 (L +1,0)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	13,37	15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	15,55	15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	15,55	15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	15,55	15,55

15.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

15.2 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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,5	63,7	0,34	0,34	2,54
7	11,75	9,6	71,8	0,34	0,34	2,54
8	11,63	10,2	76,6	0,34	0,34	2,54
9	11,50	10,7	78,8	0,34	0,34	2,49
10	11,34	11,1	71,1	0,34	0,34	2,16
11	11,11	11,7	65,9	0,34	0,34	1,91
12	10,86	11,0	96,5	0,31	0,31	2,72
13	10,57	11,1	78,7	0,31	0,32	2,21
14	10,29	11,2	72,6	0,31	0,32	2,02
15	10,00	11,3	70,0	0,31	0,33	1,93
16	9,71	11,4	71,1	0,31	0,34	1,95
17	9,43	11,5	73,5	0,31	0,35	2,00
18	9,14	11,6	76,3	0,31	0,36	2,06
19	8,85	13,0	55,4	0,34	0,41	1,45
20	8,55	13,5	69,4	0,34	0,43	1,74
21	8,25	14,0	82,0	0,34	0,44	1,98

15.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	116,66
Zand, vast	115,92
Zand, m vast	13,33
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

15.4 Input Data Right

15.4.1 Calculation Method

Calculation method: C, phi, delta

15.4.2 Water Level

Water level: 14,91 [m]

15.4.3 Surface

X [m]	Y [m]
0,00	14,61
0,01	15,11

15.4.4 Soil Material Properties in Profile: 56B-S01 (R +1,0)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	-13,37	-15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-15,55	-15,55

15.4.5 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]
OB klei dijk	15,11	3076,92	3076,92	1538,46	1538,46
OB klei dijk	14,61	3076,92	3076,92	1538,46	1538,46
Zand, m vast	13,40	15384,62	15384,62	7692,31	7692,31
Zand, vast	11,00	30769,23	30769,23	15384,62	15384,62
Zand, m vast	9,00	15384,62	15384,62	7692,31	7692,31
Zand, m vast	8,10	15384,62	15384,62	7692,31	7692,31

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	5,00	30769,23	30769,23	15384,62	15384,62
Zand, sterk gri...	3,00	30769,23	30769,23	15384,62	15384,62

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	615,38	615,38
OB klei dijk	14,61	615,38	615,38
Zand, m vast	13,40	3846,15	3846,15
Zand, vast	11,00	7692,31	7692,31
Zand, m vast	9,00	3846,15	3846,15
Zand, m vast	8,10	3846,15	3846,15
Zand, vast	5,00	7692,31	7692,31
Zand, sterk gri...	3,00	7692,31	7692,31

15.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

15.5 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	14,54	23,6	355,5	1,02	1,02	15,44
2	14,44	6,7	93,3	0,28	0,70	3,88
3	14,29	7,2	57,3	0,28	0,65	2,27
4	14,05	7,9	57,1	0,29	0,58	2,11
5	13,82	8,7	62,3	0,30	0,54	2,16
6	13,65	9,2	66,1	0,31	0,51	2,20
7	13,50	9,7	69,7	0,31	0,50	2,25
8	13,24	11,7	88,2	0,35	0,46	2,67
9	12,92	12,8	100,9	0,36	0,45	2,83
10	12,60	13,8	107,7	0,36	0,44	2,83
11	12,28	14,9	116,4	0,37	0,44	2,86
12	11,96	16,0	129,1	0,37	0,45	2,99
13	11,75	16,7	137,5	0,37	0,45	3,06
14	11,63	16,7	142,5	0,36	0,45	3,11
15	11,50	16,6	147,5	0,35	0,45	3,15
16	11,34	16,5	154,1	0,34	0,46	3,19
17	11,11	16,5	163,1	0,33	0,46	3,26
18	10,86	15,4	211,2	0,29	0,45	3,97
19	10,57	15,9	233,6	0,28	0,45	4,06
20	10,29	16,4	256,0	0,27	0,46	4,14
21	10,00	16,9	269,1	0,25	0,47	4,06
22	9,71	17,3	291,3	0,24	0,47	4,13
23	9,43	18,0	313,7	0,24	0,48	4,18
24	9,14	19,7	336,0	0,25	0,48	4,23
25	8,85	23,2	303,1	0,28	0,51	3,63
26	8,55	25,6	318,2	0,30	0,51	3,66
27	8,25	27,1	333,3	0,30	0,51	3,69

15.6 Calculated Force from a layer Right

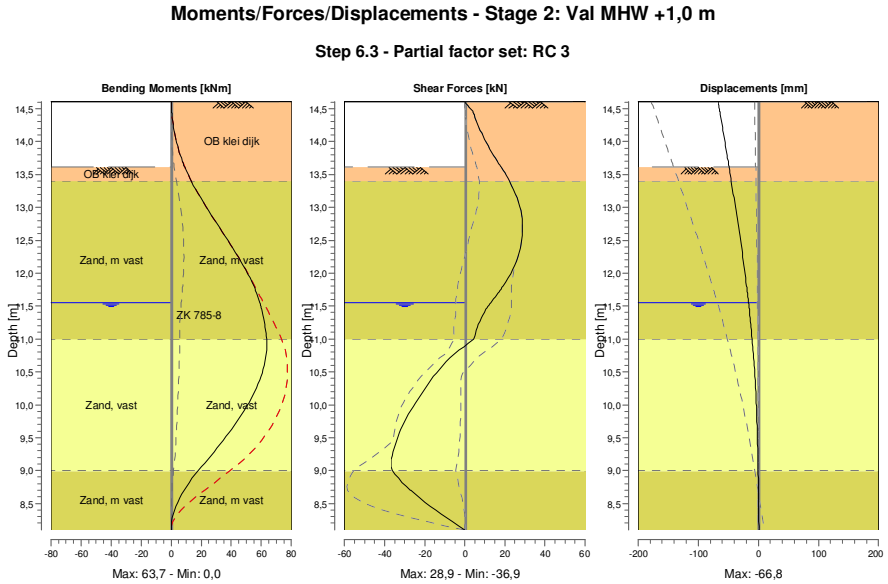
Name	Force
OB klei dijk	0,00
OB klei dijk	12,26
Zand, m vast	35,38
Zand, vast	34,79
Zand, m vast	45,36

Name	Force
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

15.7 Calculation Results

Number of iterations: 11

15.7.1 Charts of Moments, Forces and Displacements



15.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-66,8**
1	14,46	0,3	4,0	-64,1
2	14,46	0,3	4,0	-64,1
2	14,41	0,5	4,6	-63,2
3	14,41	0,5	4,6	-63,2
3	14,17	1,9	7,7	-58,9
4	14,17	1,9	7,7	-58,9
4	13,94	4,2	11,6	-54,6
5	13,94	4,2	11,6	-54,6
5	13,70	7,5	16,3	-50,4
6	13,70	7,5	16,3	-50,4
6	13,61	9,1	18,3	-48,8
7	13,61	9,1	18,3	-48,8
7	13,40	13,3	22,2	-45,0
8	13,40	13,3	22,2	-45,0
8	13,08	21,3	26,9	-39,4
9	13,08	21,3	26,9	-39,4
9	12,76	30,2	28,8	-34,0
10	12,76	30,2	28,8	-34,0
10	12,44	39,4	28,1	-28,8
11	12,44	39,4	28,1	-28,8
11	12,12	48,0	24,9	-24,0

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	12,12	48,0	24,9	-24,0
12	11,80	55,1	19,0	-19,5
13	11,80	55,1	19,0	-19,5
13	11,70	56,9	16,7	-18,2
14	11,70	56,9	16,7	-18,2
14	11,55	59,1	13,0	-16,3
15	11,55	59,1	13,0	-16,3
15	11,45	60,3	10,6	-15,2
16	11,45	60,3	10,6	-15,2
16	11,22	62,2	6,8	-12,7
17	11,22	62,2	6,8	-12,7
17	11,00	**63,5**	4,5	-10,4
18	11,00	**63,5**	4,5	-10,4
18	10,71	63,0	-7,5	-7,9
19	10,71	63,0	-7,5	-7,9
19	10,43	59,7	-15,6	-5,8
20	10,43	59,7	-15,6	-5,8
20	10,14	54,3	-22,1	-4,1
21	10,14	54,3	-22,1	-4,1
21	9,86	47,1	-28,1	-2,8
22	9,86	47,1	-28,1	-2,8
22	9,57	38,4	-32,6	-1,7
23	9,57	38,4	-32,6	-1,7
23	9,29	28,6	-35,7	-0,9
24	9,29	28,6	-35,7	-0,9
24	9,00	18,2	-36,2	-0,3
25	9,00	18,2	**-36,3**	-0,3
25	8,70	8,5	-27,1	0,2
26	8,70	8,5	-27,1	0,2
26	8,40	2,2	-14,6	0,6
27	8,40	2,2	-14,6	0,6
27	8,10	0,0	0,0	1,1
Max		**63,5**	**-36,3**	**-66,8**
Max, minor nodes incl.		63,7	-36,9	-66,8

15.7.3 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	14,61	0,00	0,00	-		17,01	3,00	A	7
1	14,46	0,00	0,00	-		24,36	4,50	A	7
2	14,46	0,00	0,00	-		6,64	4,50	A	
2	14,41	0,00	0,00	-		6,77	5,00	A	
3	14,41	0,00	0,00	-		6,87	5,00	A	
3	14,17	0,00	0,00	-		7,43	7,37	A	
4	14,17	0,00	0,00	-		7,65	7,37	A	
4	13,94	0,00	0,00	-		8,17	9,73	A	
5	13,94	0,00	0,00	-		8,41	9,73	A	
5	13,70	0,00	0,00	-		8,92	12,10	A	
6	13,70	0,00	0,00	-		9,09	12,10	A	
6	13,61	0,00	0,00	-		9,29	13,01	A	
7	13,61	0,00	0,00	P		9,45	13,01	A	
7	13,40	9,42	0,00	P		9,89	15,10	A	
8	13,40	8,00	0,00	P		11,23	15,10	A	
8	13,08	19,91	0,00	P		12,14	18,30	A	
9	13,08	20,48	0,00	P		12,30	18,30	A	
9	12,76	32,76	0,00	P		13,21	21,50	A	
10	12,76	32,82	0,00	P		13,37	21,50	A	
10	12,44	45,15	0,00	P		14,29	24,70	A	
11	12,44	45,16	0,00	P		14,44	24,70	A	
11	12,12	57,53	0,00	P		15,37	27,90	A	
12	12,12	57,51	0,00	P		15,51	27,90	A	
12	11,80	69,91	0,00	P		16,45	31,10	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* [%]
13	11,80	69,88	0,00	P		16,50	31,10	A	
13	11,70	73,35	0,00	3	99	16,80	32,10	A	
14	11,70	73,33	0,00	3	99	16,44	32,10	A	
14	11,55	74,88	0,00	3	94	16,88	33,60	A	
15	11,55	73,95	0,00	3	95	16,46	33,60	A	
15	11,45	73,82	1,00	3	93	16,75	34,60	A	
16	11,45	67,62	1,00	3	98	16,22	34,60	A	
16	11,22	66,89	3,25	3	92	16,85	36,85	A	
17	11,22	60,66	3,25	3	94	16,15	36,85	A	
17	11,00	59,96	5,50	3	89	16,77	39,10	A	
18	11,00	92,14	5,50	3	96	14,79	39,10	A	
18	10,71	86,30	10,27	3	89	16,03	40,05	A	
19	10,71	74,43	10,27	3	95	15,31	40,05	A	
19	10,43	69,56	15,03	3	88	16,51	40,99	A	
20	10,43	65,35	15,03	3	90	15,82	40,99	A	
20	10,14	61,46	19,80	3	84	16,98	41,94	A	
21	10,14	59,61	19,80	3	85	16,29	41,94	A	
21	9,86	56,30	24,57	2	80	17,41	42,89	A	
22	9,86	56,65	24,57	2	80	16,74	42,89	A	
22	9,57	43,96	29,34	2	62	17,82	43,84	A	
23	9,57	44,72	29,34	2	61	17,49	43,84	A	
23	9,29	38,32	34,10	2	52	18,56	44,78	A	
24	9,29	39,19	34,10	2	52	19,19	44,78	A	
24	9,00	23,83	38,87	1	31	28,97	45,73	1	
25	9,00	20,57	38,87	1	38	36,34	45,73	1	
25	8,70	13,38	42,60	1		45,95	48,00	1	15
26	8,70	13,99	42,60	1		46,22	48,00	1	15
26	8,40	13,77	46,32	A		54,88	50,28	1	17
27	8,40	13,72	46,32	A		55,13	50,28	1	17
27	8,10	14,29	50,05	A		63,53	52,55	1	19

*

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

15.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	246,9	127,8
Water	85,9	205,1
Total	332,8	332,8

Considered as passive side	Left
Maximum passive effective resistance	336,56 kN
Mobilized passive effective resistance	246,87 kN
Percentage mobilized resistance	73,3 %

15.7.5 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	-39,76
Vertical force passive	78,68
Resulting vertical force (no dead weight)	38,92
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-39,76
Vertical force passive	78,68
Resulting vertical force (no dead weight)	38,92
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

15.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-3,36
13,40	Zand, m vast	35,95	13,40	Zand, m vast	-10,90
11,00	Zand, vast	38,36	11,00	Zand, vast	-11,51
9,00	Zand, m vast	4,11	9,00	Zand, m vast	-13,98

16 Step 6.4 Stage 2: Val MHW +1,0 m

16.1 Input Data Left

16.1.1 Calculation Method

Calculation method: C, phi, delta

16.1.2 Water Level

Water level: 11,55 [m]

16.1.3 Surface

X [m]	Y [m]
0,00	13,61
8,00	11,61

16.1.4 Soil Material Properties in Profile: 56B-S01 (L +1,0)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	13,37	15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	15,55	15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	15,55	15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	15,55	15,55

16.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

16.2 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	13,50	0,0	4,7	0,00	0,00	2,91
2	13,24	1,3	14,0	0,23	0,23	2,47
3	12,92	3,9	26,6	0,37	0,37	2,54
4	12,60	5,5	39,0	0,36	0,36	2,54
5	12,28	7,2	51,3	0,35	0,35	2,54
6	11,96	8,5	63,7	0,34	0,34	2,54
7	11,75	9,6	71,8	0,34	0,34	2,54
8	11,63	10,2	76,6	0,34	0,34	2,54
9	11,50	10,7	78,8	0,34	0,34	2,49
10	11,34	11,1	71,1	0,34	0,34	2,16
11	11,11	11,7	65,9	0,34	0,34	1,91
12	10,86	11,0	96,5	0,31	0,31	2,72
13	10,57	11,1	78,7	0,31	0,32	2,21
14	10,29	11,2	72,6	0,31	0,32	2,02
15	10,00	11,3	70,0	0,31	0,33	1,93
16	9,71	11,4	71,1	0,31	0,34	1,95
17	9,43	11,5	73,5	0,31	0,35	2,00
18	9,14	11,6	76,3	0,31	0,36	2,06
19	8,85	13,0	55,4	0,34	0,41	1,45
20	8,55	13,5	69,4	0,34	0,43	1,74
21	8,25	14,0	82,0	0,34	0,44	1,98

16.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	0,97
Zand, m vast	119,64
Zand, vast	107,75
Zand, m vast	16,46
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

16.4 Input Data Right

16.4.1 Calculation Method

Calculation method: C, phi, delta

16.4.2 Water Level

Water level: 14,91 [m]

16.4.3 Surface

X [m]	Y [m]
0,00	14,61
0,01	15,11

16.4.4 Soil Material Properties in Profile: 56B-S01 (R +1,0)

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]
OB klei dijk	15,11	18,50	18,50	2,14	23,01	15,34
OB klei dijk	14,61	18,50	18,50	2,14	23,01	15,34
Zand, m vast	13,40	18,00	20,00	0,00	25,69	17,13
Zand, vast	11,00	18,00	20,00	0,00	27,51	18,31
Zand, m vast	9,00	18,00	20,00	0,00	25,69	17,13
Zand, m vast	8,10	18,00	20,00	0,00	25,69	17,13
Zand, vast	5,00	18,00	20,00	0,00	27,51	18,31
Zand, sterk gri...	3,00	19,00	20,00	0,00	30,26	10,12

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	-13,37	-15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-15,55	-15,55

16.4.5 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]
OB klei dijk	15,11	9000,00	9000,00	4500,00	4500,00
OB klei dijk	14,61	9000,00	9000,00	4500,00	4500,00
Zand, m vast	13,40	45000,00	45000,00	22500,00	22500,00
Zand, vast	11,00	90000,00	90000,00	45000,00	45000,00
Zand, m vast	9,00	45000,00	45000,00	22500,00	22500,00
Zand, m vast	8,10	45000,00	45000,00	22500,00	22500,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	5,00	90000,00	90000,00	45000,00	45000,00
Zand, sterk gri...	3,00	90000,00	90000,00	45000,00	45000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	1800,00	1800,00
OB klei dijk	14,61	1800,00	1800,00
Zand, m vast	13,40	11250,00	11250,00
Zand, vast	11,00	22500,00	22500,00
Zand, m vast	9,00	11250,00	11250,00
Zand, m vast	8,10	11250,00	11250,00
Zand, vast	5,00	22500,00	22500,00
Zand, sterk gri...	3,00	22500,00	22500,00

16.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	16,66
	2,50	16,66

16.5 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	14,54	23,6	355,5	1,02	1,02	15,44
2	14,44	6,7	93,3	0,28	0,70	3,88
3	14,29	7,2	57,3	0,28	0,65	2,27
4	14,05	7,9	57,1	0,29	0,58	2,11
5	13,82	8,7	62,3	0,30	0,54	2,16
6	13,65	9,2	66,1	0,31	0,51	2,20
7	13,50	9,7	69,7	0,31	0,50	2,25
8	13,24	11,7	88,2	0,35	0,46	2,67
9	12,92	12,8	100,9	0,36	0,45	2,83
10	12,60	13,8	107,7	0,36	0,44	2,83
11	12,28	14,9	116,4	0,37	0,44	2,86
12	11,96	16,0	129,1	0,37	0,45	2,99
13	11,75	16,7	137,5	0,37	0,45	3,06
14	11,63	16,7	142,5	0,36	0,45	3,11
15	11,50	16,6	147,5	0,35	0,45	3,15
16	11,34	16,5	154,1	0,34	0,46	3,19
17	11,11	16,5	163,1	0,33	0,46	3,26
18	10,86	15,4	211,2	0,29	0,45	3,97
19	10,57	15,9	233,6	0,28	0,45	4,06
20	10,29	16,4	256,0	0,27	0,46	4,14
21	10,00	16,9	269,1	0,25	0,47	4,06
22	9,71	17,3	291,3	0,24	0,47	4,13
23	9,43	18,0	313,7	0,24	0,48	4,18
24	9,14	19,7	336,0	0,25	0,48	4,23
25	8,85	23,2	303,1	0,28	0,51	3,63
26	8,55	25,6	318,2	0,30	0,51	3,66
27	8,25	27,1	333,3	0,30	0,51	3,69

16.6 Calculated Force from a layer Right

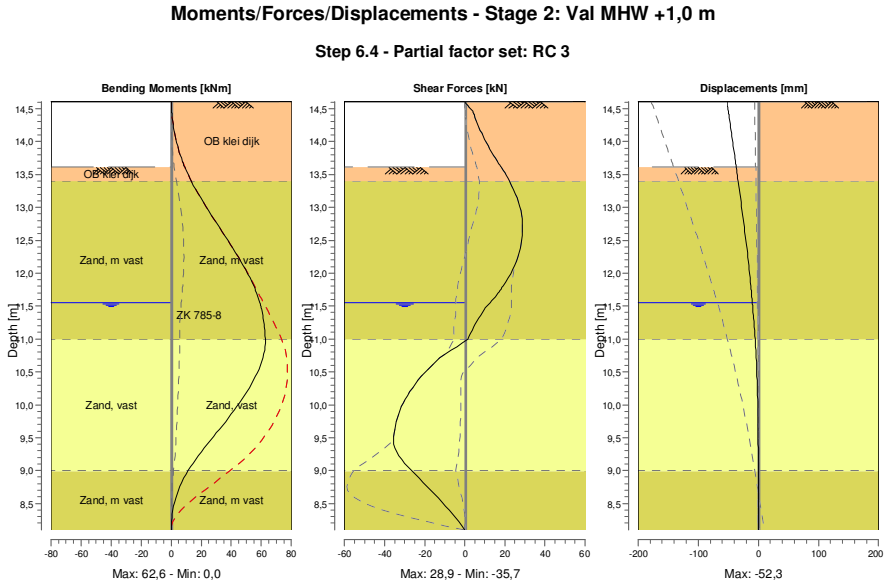
Name	Force
OB klei dijk	0,00
OB klei dijk	12,26
Zand, m vast	35,38
Zand, vast	39,27
Zand, m vast	38,85

Name	Force
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

16.7 Calculation Results

Number of iterations: 7

16.7.1 Charts of Moments, Forces and Displacements



16.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-52,3**
1	14,46	0,3	4,0	-50,0
2	14,46	0,3	4,0	-50,0
2	14,41	0,5	4,6	-49,2
3	14,41	0,5	4,6	-49,2
3	14,17	1,9	7,7	-45,5
4	14,17	1,9	7,7	-45,5
4	13,94	4,2	11,6	-41,9
5	13,94	4,2	11,6	-41,9
5	13,70	7,5	16,3	-38,3
6	13,70	7,5	16,3	-38,3
6	13,61	9,1	18,3	-36,9
7	13,61	9,1	18,3	-36,9
7	13,40	13,3	22,2	-33,7
8	13,40	13,3	22,2	-33,7
8	13,08	21,3	26,9	-29,0
9	13,08	21,3	26,9	-29,0
9	12,76	30,2	28,8	-24,4
10	12,76	30,2	28,8	-24,4
10	12,44	39,4	28,1	-20,1
11	12,44	39,4	28,1	-20,1
11	12,12	48,0	24,9	-16,1

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
12	12,12	48,0	24,9	-16,1
12	11,80	55,1	19,0	-12,4
13	11,80	55,1	19,0	-12,4
13	11,70	56,9	16,7	-11,4
14	11,70	56,9	16,7	-11,4
14	11,55	59,1	12,6	-9,9
15	11,55	59,1	12,6	-9,9
15	11,45	60,2	9,8	-9,0
16	11,45	60,2	9,8	-9,0
16	11,22	61,9	5,0	-7,1
17	11,22	61,9	5,0	-7,1
17	11,00	**62,6**	1,5	-5,4
18	11,00	**62,6**	1,5	-5,4
18	10,71	61,0	-12,5	-3,7
19	10,71	61,0	-12,5	-3,7
19	10,43	56,1	-21,8	-2,4
20	10,43	56,1	-21,8	-2,4
20	10,14	48,9	-28,6	-1,4
21	10,14	48,9	-28,6	-1,4
21	9,86	40,0	-33,1	-0,7
22	9,86	40,0	-33,1	-0,7
22	9,57	30,2	**-35,3**	-0,3
23	9,57	30,2	**-35,3**	-0,3
23	9,29	20,1	-34,0	-0,1
24	9,29	20,1	-34,0	-0,1
24	9,00	11,3	-26,6	0,0
25	9,00	11,3	-26,6	0,0
25	8,70	4,8	-16,9	0,0
26	8,70	4,8	-16,9	0,0
26	8,40	1,1	-7,8	0,0
27	8,40	1,1	-7,8	0,0
27	8,10	0,0	0,0	-0,1
Max		**62,6**	**-35,3**	**-52,3**
Max, minor nodes incl.		62,6	-35,7	-52,3

16.7.3 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	14,61	0,00	0,00	-		17,01	3,00	A	7
1	14,46	0,00	0,00	-		24,36	4,50	A	7
2	14,46	0,00	0,00	-		6,64	4,50	A	
2	14,41	0,00	0,00	-		6,77	5,00	A	
3	14,41	0,00	0,00	-		6,87	5,00	A	
3	14,17	0,00	0,00	-		7,43	7,37	A	
4	14,17	0,00	0,00	-		7,65	7,37	A	
4	13,94	0,00	0,00	-		8,17	9,73	A	
5	13,94	0,00	0,00	-		8,41	9,73	A	
5	13,70	0,00	0,00	-		8,92	12,10	A	
6	13,70	0,00	0,00	-		9,09	12,10	A	
6	13,61	0,00	0,00	-		9,29	13,01	A	
7	13,61	0,00	0,00	P		9,45	13,01	A	
7	13,40	9,42	0,00	P		9,89	15,10	A	
8	13,40	8,00	0,00	P		11,23	15,10	A	
8	13,08	19,91	0,00	P		12,14	18,30	A	
9	13,08	20,48	0,00	P		12,30	18,30	A	
9	12,76	32,76	0,00	P		13,21	21,50	A	
10	12,76	32,82	0,00	P		13,37	21,50	A	
10	12,44	45,15	0,00	P		14,29	24,70	A	
11	12,44	45,16	0,00	P		14,44	24,70	A	
11	12,12	57,53	0,00	P		15,37	27,90	A	
12	12,12	57,51	0,00	P		15,51	27,90	A	
12	11,80	69,91	0,00	P		16,45	31,10	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* [%]
13	11,80	69,88	0,00	P		16,50	31,10	A	
13	11,70	73,76	0,00	P		16,80	32,10	A	
14	11,70	73,73	0,00	P		16,44	32,10	A	
14	11,55	79,56	0,00	P		16,88	33,60	A	
15	11,55	77,88	0,00	P		16,46	33,60	A	
15	11,45	79,70	1,00	P		16,75	34,60	A	
16	11,45	69,31	1,00	P		16,22	34,60	A	
16	11,22	72,89	3,25	P		16,85	36,85	A	
17	11,22	64,28	3,25	P		16,15	36,85	A	
17	11,00	67,05	5,50	3	99	16,77	39,10	A	
18	11,00	96,17	5,50	P		14,79	39,10	A	
18	10,71	93,82	10,27	3	97	16,03	40,05	A	
19	10,71	78,46	10,27	P		15,31	40,05	A	
19	10,43	72,33	15,03	3	92	16,51	40,99	A	
20	10,43	68,12	15,03	3	94	15,82	40,99	A	
20	10,14	59,86	19,80	3	82	16,98	41,94	A	
21	10,14	57,95	19,80	3	83	16,29	41,94	A	
21	9,86	46,29	24,57	2	66	17,41	42,89	A	
22	9,86	46,59	24,57	2	66	16,74	42,89	A	
22	9,57	36,82	29,34	2	52	17,82	43,84	A	
23	9,57	37,58	29,34	2	51	17,49	43,84	A	
23	9,29	21,20	34,10	1	29	28,63	44,78	1	
24	9,29	21,58	34,10	1	28	28,96	44,78	1	
24	9,00	14,45	38,87	1	19	38,35	45,73	1	
25	9,00	15,88	38,87	1	29	41,03	45,73	1	
25	8,70	16,35	42,60	1	29	42,98	48,00	1	
26	8,70	16,96	42,60	1	25	43,25	48,00	1	
26	8,40	19,10	46,32	1	27	43,58	50,28	1	
27	8,40	19,70	46,32	1	25	43,84	50,28	1	
27	8,10	22,31	50,05	1	27	43,76	52,55	1	

*

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

16.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	244,8	125,8
Water	85,9	205,1
Total	330,7	330,8

Considered as passive side	Left
Maximum passive effective resistance	336,56 kN
Mobilized passive effective resistance	244,82 kN
Percentage mobilized resistance	72,7 %

16.7.5 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	-39,23
Vertical force passive	77,87
Resulting vertical force (no dead weight)	38,64
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-39,23
Vertical force passive	77,87
Resulting vertical force (no dead weight)	38,64
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

16.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,61	OB klei dijk	0,27	14,61	OB klei dijk	-3,36
13,40	Zand, m vast	36,87	13,40	Zand, m vast	-10,90
11,00	Zand, vast	35,65	11,00	Zand, vast	-12,99
9,00	Zand, m vast	5,07	9,00	Zand, m vast	-11,97

17 Step 6.5 Stage 2: Val MHW +1,0 m

17.1 Input Data Left

17.1.1 Calculation Method

Calculation method: C, phi, delta

17.1.2 Water Level

Water level: 11,80 [m]

17.1.3 Surface

X [m]	Y [m]
0,00	13,70
8,00	11,70

17.1.4 Soil Material Properties in Profile: 56B-S01 (L +1,0)

Layer name	Level [m]	Unit weight		Cohesion [kN/m²]	Friction angle phi [deg]	Delta friction angle [deg]
		Unsat [kN/m³]	Sat [kN/m³]			
OB klei dijk	15,11	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,61	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,40	18,00	20,00	0,00	30,00	20,00
Zand, vast	11,00	18,00	20,00	0,00	32,00	16,60
Zand, m vast	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	8,10	18,00	20,00	0,00	30,00	20,00
Zand, vast	5,00	18,00	20,00	0,00	32,00	16,60
Zand, sterk gri...	3,00	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	1,00	1,00	Fine

Layer name	Level [m]	Earth pressure coefficients			Additional pore pressure	
		Active [-]	Neutral [-]	Passive [-]	Top [kN/m²]	Bottom [kN/m²]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	13,37	15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	15,55	15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	15,55	15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	15,55	15,55

17.1.5 Modulus of Subgrade Reaction (Secant)

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,61	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,40	20000,00	20000,00	10000,00	10000,00

Layer name	Level [m]	Branch 1		Branch 2	
		Top [kN/m³]	Bottom [kN/m³]	Top [kN/m³]	Bottom [kN/m³]
Zand, vast	11,00	40000,00	40000,00	20000,00	20000,00
Zand, m vast	9,00	20000,00	20000,00	10000,00	10000,00
Zand, m vast	8,10	20000,00	20000,00	10000,00	10000,00
Zand, vast	5,00	40000,00	40000,00	20000,00	20000,00
Zand, sterk gri...	3,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	800,00	800,00
OB klei dijk	14,61	800,00	800,00
Zand, m vast	13,40	5000,00	5000,00
Zand, vast	11,00	10000,00	10000,00
Zand, m vast	9,00	5000,00	5000,00
Zand, m vast	8,10	5000,00	5000,00
Zand, vast	5,00	10000,00	10000,00
Zand, sterk gri...	3,00	10000,00	10000,00

17.2 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	13,55	0,0	7,9	0,00	0,00	3,39
2	13,24	0,6	23,0	0,09	0,09	3,25
3	12,92	3,8	39,1	0,32	0,32	3,28
4	12,60	5,2	55,1	0,31	0,31	3,29
5	12,28	6,6	71,1	0,30	0,30	3,29
6	11,96	8,0	87,1	0,30	0,30	3,29
7	11,75	8,8	93,8	0,30	0,30	3,20
8	11,58	9,1	73,2	0,30	0,30	2,40
9	11,35	9,2	76,7	0,29	0,29	2,38
10	11,12	9,7	84,6	0,29	0,29	2,49
11	10,86	9,5	96,2	0,27	0,27	2,76
12	10,57	9,6	85,6	0,27	0,27	2,44
13	10,29	9,7	83,2	0,27	0,27	2,35
14	10,00	9,8	83,6	0,27	0,27	2,34
15	9,71	9,9	85,7	0,27	0,27	2,38
16	9,43	10,0	88,8	0,27	0,27	2,45
17	9,14	10,1	92,3	0,27	0,28	2,52
18	8,85	10,8	95,4	0,29	0,33	2,54
19	8,55	11,2	109,3	0,29	0,35	2,78
20	8,25	11,7	122,7	0,29	0,36	2,99

17.3 Calculated Force from a layer Left

Name	Force
OB klei dijk	0,00
OB klei dijk	2,24
Zand, m vast	109,37
Zand, vast	73,55
Zand, m vast	20,82
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

17.4 Input Data Right

17.4.1 Calculation Method

Calculation method: C, phi, delta

17.4.2 Water Level

Water level: 14,91 [m]

17.4.3 Surface

X [m]	Y [m]
0,00	14,61
0,01	15,11

17.4.4 Soil Material Properties in Profile: 56B-S01 (R +1,0)

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]
OB klei dijk	15,11	18,50	18,50	3,00	27,00	18,00
OB klei dijk	14,61	18,50	18,50	3,00	27,00	18,00
Zand, m vast	13,40	18,00	20,00	0,00	30,00	20,00
Zand, vast	11,00	18,00	20,00	0,00	32,00	16,60
Zand, m vast	9,00	18,00	20,00	0,00	30,00	20,00
Zand, m vast	8,10	18,00	20,00	0,00	30,00	20,00
Zand, vast	5,00	18,00	20,00	0,00	32,00	16,60
Zand, sterk gri...	3,00	19,00	20,00	0,00	35,00	11,70

Layer name	Level [m]	Shell factor [-]	OCR [-]	Grain type
OB klei dijk	15,11	1,00	1,00	Fine
OB klei dijk	14,61	1,00	1,00	Fine
Zand, m vast	13,40	1,00	1,00	Fine
Zand, vast	11,00	1,00	1,00	Fine
Zand, m vast	9,00	1,00	1,00	Fine
Zand, m vast	8,10	1,00	1,00	Fine
Zand, vast	5,00	1,00	1,00	Fine
Zand, sterk gri...	3,00	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]
OB klei dijk	15,11	n.a.	n.a.	n.a.	0,00	0,00
OB klei dijk	14,61	n.a.	n.a.	n.a.	0,00	0,00
Zand, m vast	13,40	n.a.	n.a.	n.a.	0,00	0,00
Zand, vast	11,00	n.a.	n.a.	n.a.	0,00	-13,37
Zand, m vast	9,00	n.a.	n.a.	n.a.	-13,37	-15,55
Zand, m vast	8,10	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, vast	5,00	n.a.	n.a.	n.a.	-15,55	-15,55
Zand, sterk gri...	3,00	n.a.	n.a.	n.a.	-15,55	-15,55

17.4.5 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]
OB klei dijk	15,11	4000,00	4000,00	2000,00	2000,00
OB klei dijk	14,61	4000,00	4000,00	2000,00	2000,00
Zand, m vast	13,40	20000,00	20000,00	10000,00	10000,00
Zand, vast	11,00	40000,00	40000,00	20000,00	20000,00
Zand, m vast	9,00	20000,00	20000,00	10000,00	10000,00
Zand, m vast	8,10	20000,00	20000,00	10000,00	10000,00
Zand, vast	5,00	40000,00	40000,00	20000,00	20000,00
Zand, sterk gri...	3,00	40000,00	40000,00	20000,00	20000,00

Layer name	Level [m]	Branch 3	
		Top [kN/m³]	Bottom [kN/m³]
OB klei dijk	15,11	800,00	800,00
OB klei dijk	14,61	800,00	800,00
Zand, m vast	13,40	5000,00	5000,00
Zand, vast	11,00	10000,00	10000,00
Zand, m vast	9,00	5000,00	5000,00
Zand, m vast	8,10	5000,00	5000,00
Zand, vast	5,00	10000,00	10000,00
Zand, sterk gri...	3,00	10000,00	10000,00

17.4.6 Surcharge Loads

Name	Distance [m]	Load [kN/m²]
Verkeer	0,00	13,33
	2,50	13,33

17.5 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	14,51	9,0	345,9	0,45	0,75	17,31
2	14,29	3,9	68,4	0,18	0,65	3,11
3	14,05	4,6	75,1	0,19	0,58	3,15
4	13,82	5,2	82,5	0,20	0,54	3,21
5	13,55	5,9	91,4	0,21	0,50	3,31
6	13,24	8,8	120,1	0,29	0,45	4,00
7	12,92	9,7	138,5	0,30	0,44	4,23
8	12,60	10,6	146,1	0,30	0,43	4,13
9	12,28	11,5	160,3	0,30	0,42	4,21
10	11,96	12,4	178,5	0,30	0,42	4,38
11	11,75	13,0	190,4	0,30	0,42	4,48
12	11,58	13,4	199,9	0,31	0,43	4,55
13	11,35	13,9	213,1	0,30	0,43	4,64
14	11,12	13,9	226,4	0,29	0,43	4,73
15	10,86	13,5	244,9	0,26	0,41	4,79
16	10,57	14,0	271,7	0,25	0,42	4,89
17	10,29	14,5	298,6	0,24	0,42	4,98
18	10,00	15,0	325,9	0,23	0,42	5,06
19	9,71	15,4	352,8	0,22	0,43	5,12
20	9,43	16,4	379,7	0,22	0,43	5,17
21	9,14	17,8	406,7	0,23	0,43	5,22
22	8,85	19,7	435,4	0,24	0,46	5,32
23	8,55	21,3	456,8	0,25	0,46	5,35
24	8,25	22,7	477,9	0,25	0,46	5,38

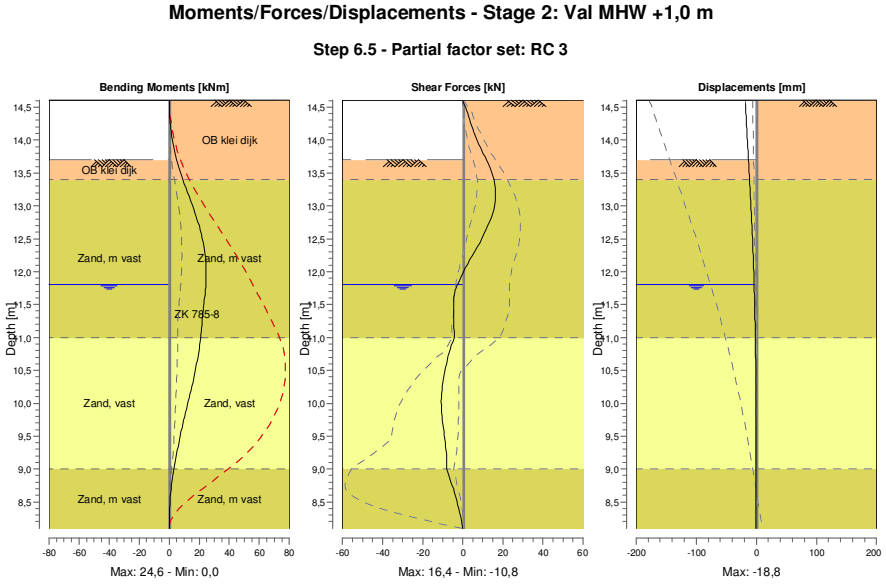
17.6 Calculated Force from a layer Right

Name	Force
OB klei dijk	0,00
OB klei dijk	6,77
Zand, m vast	27,84
Zand, vast	34,26
Zand, m vast	26,93
Zand, m vast	0,00
Zand, vast	0,00
Zand, sterk grindig	0,00

17.7 Calculation Results

Number of iterations: 5

17.7.1 Charts of Moments, Forces and Displacements



17.7.2 Moments, Forces and Displacements

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
1	14,61	0,0	0,0	**-18,8**
1	14,41	0,2	2,5	-17,5
2	14,41	0,2	2,5	-17,5
2	14,17	1,1	4,9	-16,1
3	14,17	1,1	4,9	-16,1
3	13,94	2,6	8,0	-14,6
4	13,94	2,6	8,0	-14,6
4	13,70	5,0	11,9	-13,2
5	13,70	5,0	11,9	-13,2
5	13,40	9,2	15,5	-11,4
6	13,40	9,2	15,5	-11,4
6	13,08	14,3	**16,3**	-9,6
7	13,08	14,3	**16,3**	-9,6
7	12,76	19,2	13,3	-7,9
8	12,76	19,2	13,3	-7,9
8	12,44	22,7	8,4	-6,4
9	12,44	22,7	8,4	-6,4
9	12,12	**24,4**	2,4	-5,0
10	12,12	**24,4**	2,4	-5,0
10	11,80	24,3	-2,7	-3,8
11	11,80	24,3	-2,7	-3,8
11	11,70	24,0	-4,0	-3,5
12	11,70	24,0	-4,0	-3,5
12	11,47	23,0	-4,6	-2,8
13	11,47	23,0	-4,6	-2,8
13	11,23	21,9	-4,4	-2,2

Segment number	Level [m]	Moment [kNm]	Shear force [kN]	Displacement [mm]
14	11,23	21,9	-4,4	-2,2
14	11,00	20,9	-4,2	-1,8
15	11,00	20,9	-4,2	-1,8
15	10,71	19,2	-7,5	-1,3
16	10,71	19,2	-7,5	-1,3
16	10,43	16,8	-9,3	-0,9
17	10,43	16,8	-9,3	-0,9
17	10,14	13,9	-10,6	-0,7
18	10,14	13,9	-10,6	-0,7
18	9,86	10,9	-10,5	-0,5
19	9,86	10,9	-10,5	-0,5
19	9,57	8,0	-9,4	-0,4
20	9,57	8,0	-9,4	-0,4
20	9,29	5,5	-8,3	-0,4
21	9,29	5,5	-8,3	-0,4
21	9,00	3,2	-8,1	-0,4
22	9,00	3,2	-8,1	-0,4
22	8,70	1,3	-4,7	-0,5
23	8,70	1,3	-4,7	-0,5
23	8,40	0,3	-2,0	-0,5
24	8,40	0,3	-2,0	-0,5
24	8,10	0,0	0,0	-0,5
Max		**24,4**	**16,3**	**-18,8**
Max, minor nodes incl.		24,6	16,4	-18,8

17.7.3 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	14,61	0,00	0,00	-		5,97	3,00	A	
1	14,41	0,00	0,00	-		9,41	5,00	A	
2	14,41	0,00	0,00	-		3,75	5,00	A	
2	14,17	0,00	0,00	-		4,11	7,37	A	
3	14,17	0,00	0,00	-		4,40	7,37	A	
3	13,94	0,00	0,00	-		4,75	9,73	A	
4	13,94	0,00	0,00	-		5,03	9,73	A	
4	13,70	0,00	0,00	-		5,39	12,10	A	
5	13,70	0,00	0,00	P		5,70	12,10	A	
5	13,40	13,83	0,00	3	88	6,16	15,10	A	
6	13,40	15,14	0,00	P		8,40	15,10	A	
6	13,08	30,83	0,00	P		9,19	18,30	A	
7	13,08	31,13	0,00	P		9,29	18,30	A	
7	12,76	44,90	0,00	3	96	10,08	21,50	A	
8	12,76	44,96	0,00	3	95	10,18	21,50	A	
8	12,44	53,13	0,00	3	84	10,98	24,70	A	
9	12,44	53,16	0,00	3	84	11,07	24,70	A	
9	12,12	58,02	0,00	2	73	11,87	27,90	A	
10	12,12	57,99	0,00	2	73	11,96	27,90	A	
10	11,80	57,86	0,00	2	61	12,78	31,10	A	
11	11,80	56,92	0,00	2	61	12,82	31,10	A	
11	11,70	56,06	1,00	2	59	13,08	32,10	A	
12	11,70	50,13	1,00	2	70	13,12	32,10	A	
12	11,47	45,30	3,33	2	60	13,72	34,43	A	
13	11,47	44,99	3,33	2	60	13,62	34,43	A	
13	11,23	43,43	5,67	2	55	14,22	36,77	A	
14	11,23	44,78	5,67	2	54	13,58	36,77	A	
14	11,00	43,82	8,00	2	50	14,16	39,10	A	
15	11,00	56,77	8,00	2	59	12,90	39,10	A	
15	10,71	51,62	12,77	2	53	14,06	40,05	A	
16	10,71	47,56	12,77	2	56	13,45	40,05	A	
16	10,43	43,96	17,53	2	51	14,57	40,99	A	
17	10,43	42,84	17,53	2	52	13,98	40,99	A	
17	10,14	37,00	22,30	1	44	15,05	41,94	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* [%]
18	10,14	37,02	22,30	1	44	14,47	41,94	A	
18	9,86	31,02	27,07	1	37	18,26	42,89	1	
19	9,86	31,03	27,07	1	36	17,57	42,89	1	
19	9,57	27,87	31,84	1	32	20,61	43,84	1	
20	9,57	27,88	31,84	1	32	19,93	43,84	1	
20	9,29	26,82	36,60	1	30	21,73	44,78	1	
21	9,29	26,88	36,60	1	29	21,10	44,78	1	
21	9,00	27,25	41,37	1	29	22,11	45,73	1	
22	9,00	20,67	41,37	1	22	28,35	45,73	1	
22	8,70	21,80	45,10	1	22	29,36	48,00	1	
23	8,70	22,42	45,10	1	21	29,53	48,00	1	
23	8,40	23,78	48,82	1	21	30,36	50,28	1	
24	8,40	24,37	48,82	1	20	30,52	50,28	1	
24	8,10	25,82	52,55	1	21	31,32	52,55	1	

*

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

17.7.4 Soil Collapse

Horizontal soil pressure	Left [kN]	Right [kN]
Effective	206,0	95,8
Water	94,8	205,1
Total	300,8	300,8

Considered as passive side	Left
Maximum passive effective resistance	428,61 kN
Mobilized passive effective resistance	205,98 kN
Percentage mobilized resistance	48,1 %

17.7.5 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	-35,49
Vertical force passive	76,79
Resulting vertical force (no dead weight)	41,30
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

Vertical force balance plugged	Force [kN]
Vertical force active	-35,49
Vertical force passive	76,79
Resulting vertical force (no dead weight)	41,30
Vertical toe capacity Ftoe;d	0,00
Resultant goes up	

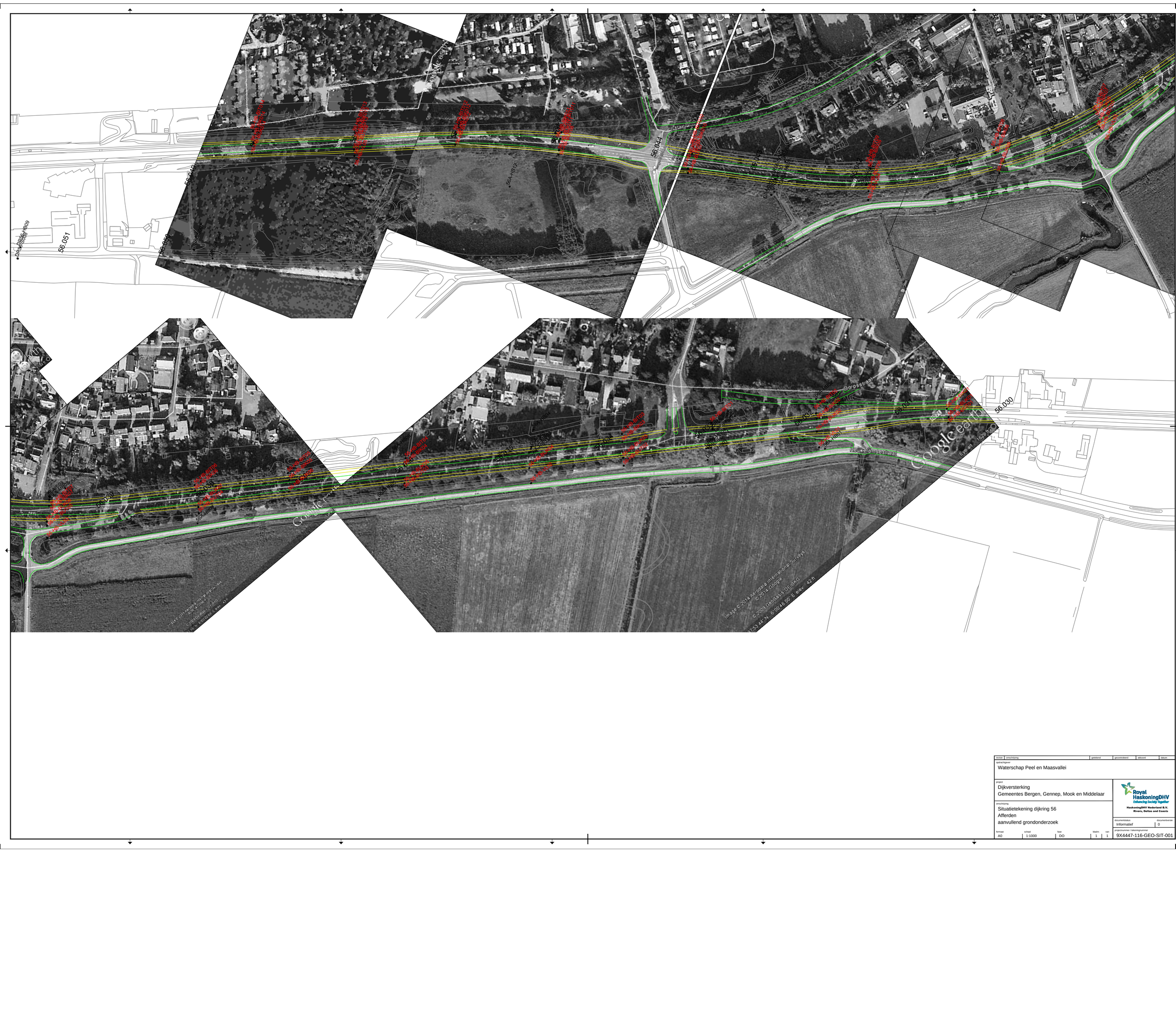
17.7.6 Vertical Force Balance Contribution per Layer

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
13,70	OB klei dijk	0,73	14,61	OB klei dijk	-2,20
13,40	Zand, m vast	39,81	13,40	Zand, m vast	-10,13
11,00	Zand, vast	28,68	11,00	Zand, vast	-13,36

Left			Right		
Level [m]	Layer name	Contribution [kN]	Level [m]	Layer name	Contribution [kN]
9,00	Zand, m vast	7,58	9,00	Zand, m vast	-9,80

End of Report

BIJLAGE 10 Aanvullend geotechnisch onderzoek DR56A



revisie	omschrijving	getekend	gecontroleerd	akkoord	datum

opdrachtgever
Waterschap Peel en Maasvallei

project
Dijkversterking
Gemeentes Bergen, Gennep, Mook en Middelaar

omschrijving
Situatietekening dijkring 56
Afferden
aanvullend grondonderzoek

Royal HaskoningDHV
Enhancing Society Together
HaskoningDHV Nederland B.V.
Rivers, Deltas and Coasts

documentstatus	documentversie
Informatief	0

formaat	schaal	fase	bladnr.	van
A0	1:1000	DO	1	1

projectnummer / tekeningnummer
9X4447-116-GEO-SIT-001

Rapportage Boorprofielen

Opdrachtgever: Royal Haskoning DHV b.v.
Uw projectcode: 9X4447-116-100
Uw projectnaam: Dijkverbetering te Afferden

Meetpunt: 56-HB-BIK010

Datum:	10-12-2014
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Y:	405645,759
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GLG (cm-mv):	niet herkenbaar
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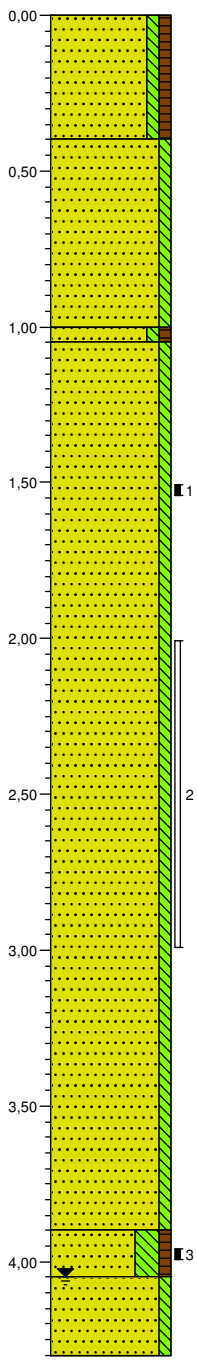

14,97 groenstrook
Zand, matig grof, zwak siltig, zwak humeus, K-waarde: 1, lichtbruin, M50-230

14,57
Zand, matig grof, zwak siltig, K-waarde: 20, geelcreme, M50-320

13,97
13,92 Zand, matig grof, zwak siltig, zwak humeus, K-waarde: 1,5, lichtbruin, M50-260

Zand, matig grof, zwak siltig, K-waarde: 35, geelcreme, M50-400

11,07
Zand, matig grof, sterk siltig, zwak humeus, K-waarde: 0,6, licht grijsbruin, M50-230

10,92 Zand, zeer grof, zwak siltig, K-waarde: 40, geelcreme, M50-480

10,67

Meetpunt: 56-HB-BIK011

Datum:	10-12-2014
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Y:	405758,021
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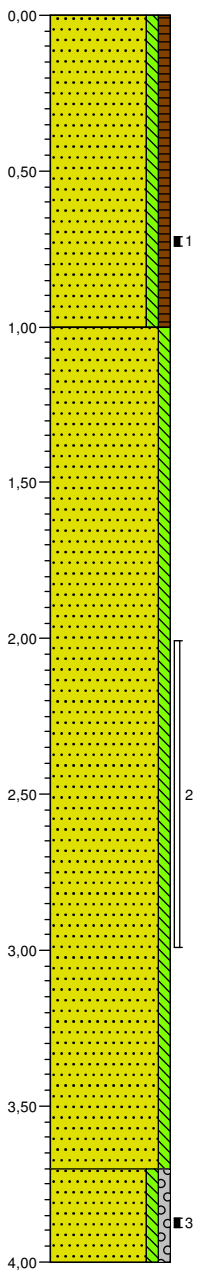

15,37 groenstrook
Zand, matig grof, zwak siltig, zwak humeus, K-waarde: 1, lichtbruin, M50-300

14,37
Zand, matig grof, zwak siltig, K-waarde: 1, donkergeel, M50-300

11,67
Zand, uiterst grof, zwak siltig, zwak grindig, K-waarde: 60, geelcreme, M50-450

11,37

Boorprofiel uitgetekend comform NEN 5104
Schaal 1: 25

Rapportage Boorprofielen

Opdrachtgever: Royal Haskoning DHV b.v.
Uw projectcode: 9X4447-116-100
Uw projectnaam: Dijkverbetering te Afferden

Meetpunt: 56-HB-BIT010

Datum: 10-12-2014
X: 197634,621
Y: 405646,339
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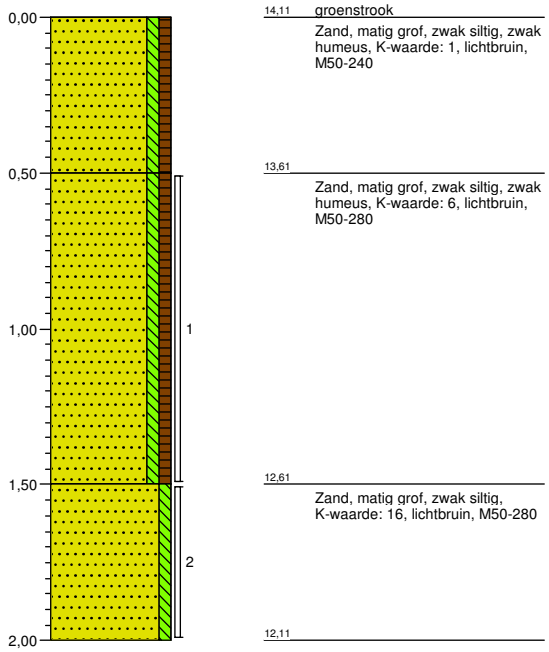

Meetpunt: 56-HB-BIT011

Datum: 10-12-2014
X: 197607,249
Y: 405769,439
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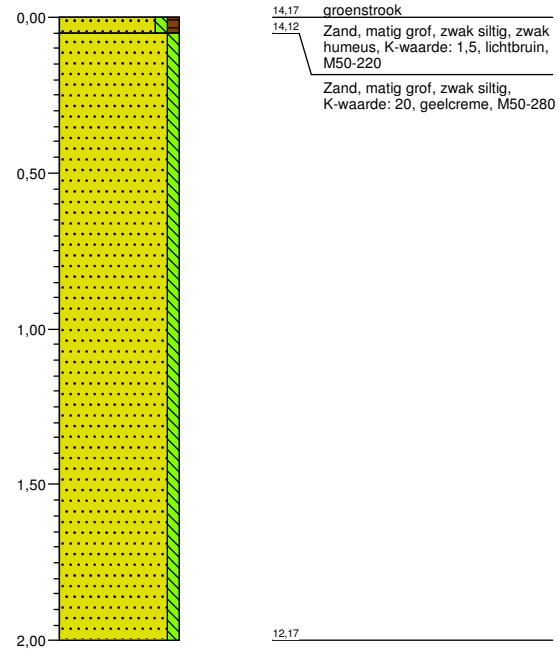

Boorprofiel uitgetekend comform NEN 5104
Schaal 1: 25

Rapportage Boorprofielen

Opdrachtgever: Royal Haskoning DHV b.v.
Uw projectcode: 9X4447-116-100
Uw projectnaam: Dijkverbetering te Afferden

Meetpunt: 56-HB-BUK012

Datum:	10-12-2014
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Y:	405881,646
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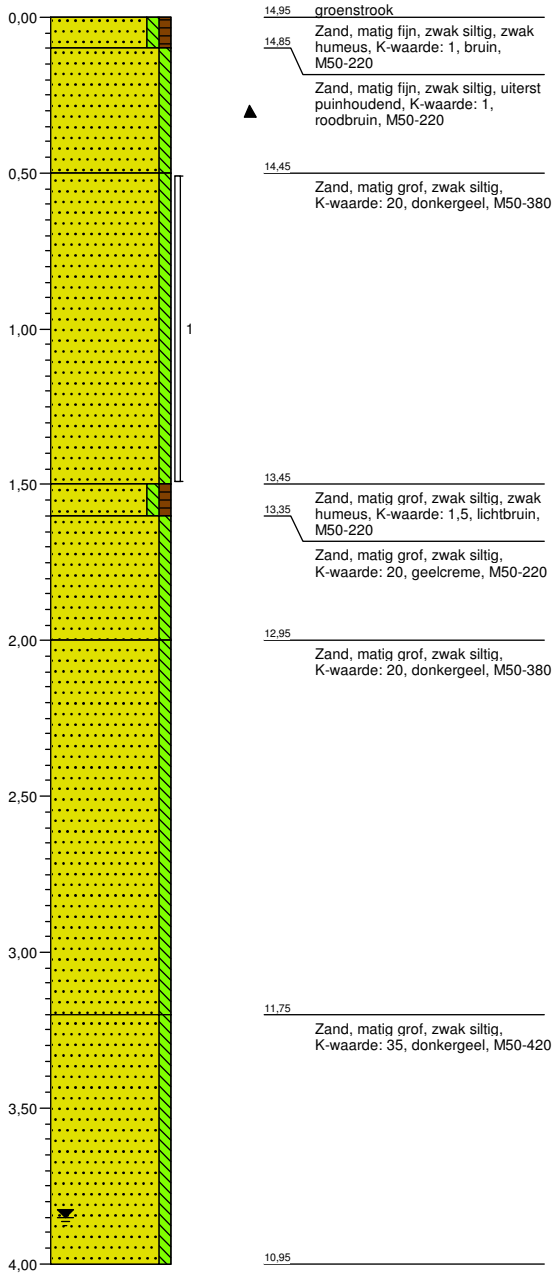

Meetpunt: 56-HB-BUK013

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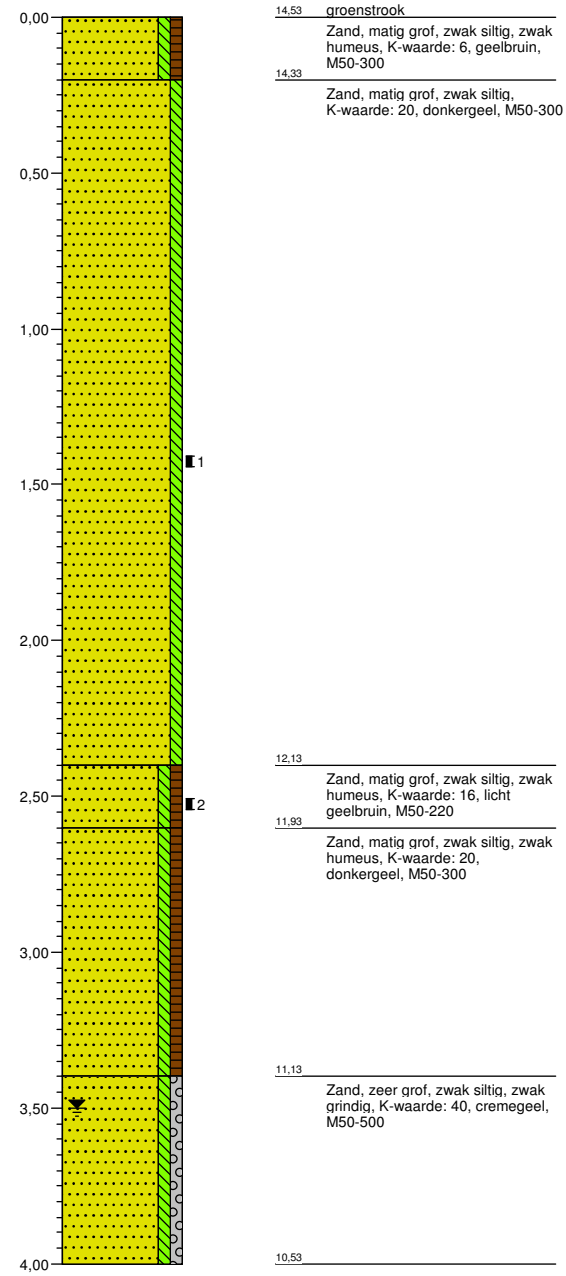

2

Boorprofiel uitgetekend comform NEN 5104
Schaal 1: 25

Rapportage Boorprofielen

Opdrachtgever: Royal Haskoning DHV b.v.
Uw projectcode: 9X4447-116-100
Uw projectnaam: Dijkverbetering te Afferden

Meetpunt: 56-HB-BUK014

Datum: 10-12-2014
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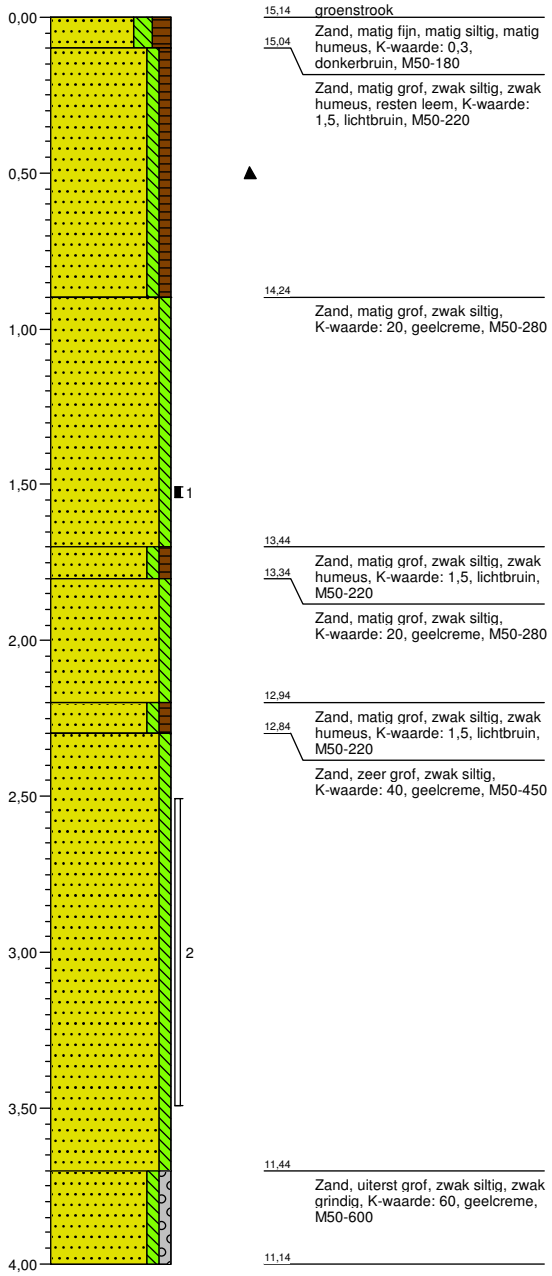

Meetpunt: 56-HB-BUT09

Datum: 10-12-2014
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Y: 405939,055
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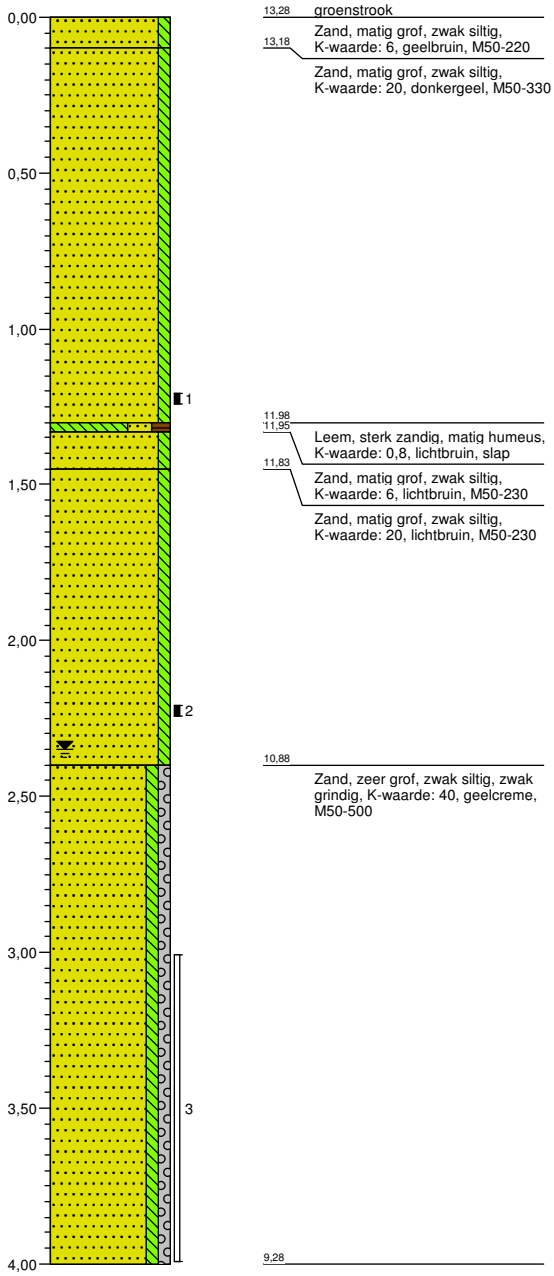
GWS: 235



Boorprofiel uitgetekend comform NEN 5104
Schaal 1: 25

Rapportage Boorprofielen

Opdrachtgever: Royal Haskoning DHV b.v.
Uw projectcode: 9X4447-116-100
Uw projectnaam: Dijkverbetering te Afferden

Meetpunt: 56-HB-VL04

Datum:	10-12-2014
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Y:	405459,338
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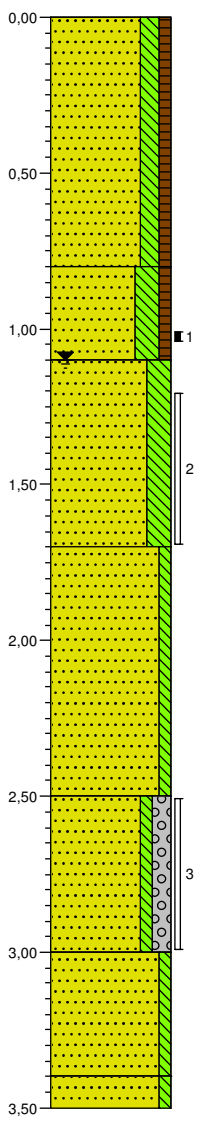
GWS:	110



12,00 groenstrook
Zand, matig fijn, matig siltig, zwak humeus, matig riethoudend, zwak puinhoudend, K-waarde: 0,3, lichtbruin, M50-300

11,20
Zand, matig fijn, sterk siltig, zwak humeus, zwak riethoudend, sporen puin, K-waarde: 0,3, donkergrijs, M50-300

10,90
Zand, matig grof, sterk siltig, K-waarde: 0,3, lichtgrijs, M50-380

10,30
Zand, matig grof, zwak siltig, K-waarde: 6, licht cremebruin, M50-320

9,50
Zand, zeer grof, zwak siltig, matig grindig, K-waarde: 45, licht cremebruin, M50-600

9,00
Zand, matig grof, zwak siltig, K-waarde: 35, licht cremebruin, M50-400

8,60
Zand, zeer grof, zwak siltig, K-waarde: 35, licht cremebruin, M50-600

8,50

Meetpunt: 56-HB-VL05

Datum:	10-12-2014
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Y:	405935,892
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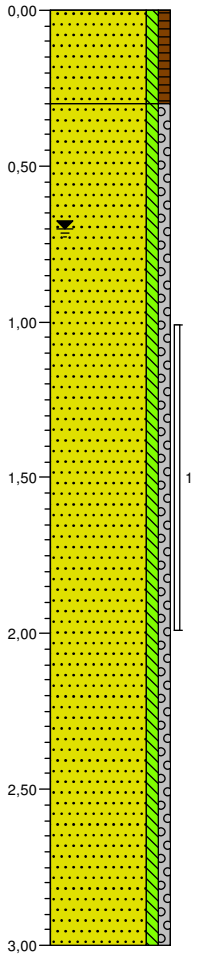


11,60 bosgrond
Zand, matig fijn, zwak siltig, zwak humeus, K-waarde: 2, lichtbruin, M50-220

11,30
Zand, matig grof, zwak siltig, zwak grindig, K-waarde: 20, geelcreme, M50-300

8,60

Boorprofiel uitgetekend comform NEN 5104
Schaal 1: 25

BIJLAGE 11 Aanvullend boomtechnisch onderzoek DR56A

Notitie ‘Erosie bij bomen op dijken’

Aan	:	J. Cools MSc Royal HaskoningDHV Nederland B.V.
Van	:	S. Driessen Bomenwacht Nederland
Datum	:	16 december 2014
Projectcode	:	14494

Inleiding

Deze notitie richt zich op de erosiebestendigheid van de bodem rond bomen op dijken en de rol die de (mate van) wapening door boomwortels daarin speelt.

Algemeen

Bij erosie vindt slijtage plaats van een vast oppervlak, daarbij wordt grondmateriaal verplaatst of het verdwijnt. Erosie wordt vooral veroorzaakt door wind, stromend water en ijs. Bij watererosie worden gronddeeltjes als gevolg van regendruppels en stromend water losgemaakt en getransporteerd (*bron: Bodemacademie.nl*).

Erosie op waterkeringen (dijken)

Erosiebestendigheid is een wezenlijk onderdeel van de beoordeling van de waterkering op veiligheid, juist als die ‘overstroombaar’ moet functioneren. Hierbij draait het om het faalmechanisme erosiebestendigheid, conform toetsspoor. Dit raakt aan de stabiliteit, indien er vervorming van het maaiveldoppervlak ontstaat.

Bij versterking van dijken vormen eventueel aanwezige bomen een aandachtspunt. De dijk wordt (deels) versterkt om erosie en daarmee verzwakking van het dijklichaam tegen te gaan. Een boom vormt een bijzonder object, zowel op als in het dijklichaam.

In Nederland worden bomen beschouwd als Niet-Waterkerende Objecten. De dijk moet voor bomen wel getoetst worden.

Een dijk zonder bomen is makkelijker te toetsen dan een dijk met bomen. Bovendien zijn bomen levende organismen, deze veranderen dus in de loop van de tijd. Er kunnen over bomen op dijken verschillende vragen gesteld worden. De *volgende* vragen spelen in deze notitie een rol:

- Heeft een boom invloed op de erosiebestendigheid van een dijk door invloed op de (gras)begroeiing, waterstroming, wateroverloop en mogelijke andere invloeden?
- Heeft een boomwortelstelsel invloed op een dijk in de vorm van bewapening of juist ondermijning?

In deze notitie worden de diverse invloeden van enerzijds erosie op bomen en anderzijds bomen op erosie op een rij gezet. Eerst bespreken we de situatie in Nederland, daarna literatuur uit het buitenland.

Huidige beoordeling in Nederland

Algemeen

In Nederland wordt ten aanzien van bomen op waterkerende dijken (met name op het buitentalud en de kruin) het principe ‘nee, tenzij’ gehanteerd. Bomen worden gezien als extra onzekerheidsfactoren in de berekeningen. Toezicht, beheer en onderhoud van dijken worden bemoeilijkt door beplanting en de invloed van bomen op de erosiebestendigheid is niet goed in beeld. Uit oogpunt van cultuurhistorie, landschapsschoon en natuurwaarden wordt bij bestaande (boom)beplanting ‘ja, tenzij’ gehanteerd, waarbij de beoordeling vanuit veiligheidsoogpunt aan de conservatieve kant is (*bron: STOWA 2002-20*).

Kwel en piping

In de ‘Handleiding voor beplanting op en nabij primaire waterkeringen’ (2000-06) geeft STOWA aan dat niet bekend is of kwel langs beworteling van levende beplanting naar de watervoerende zandlaag mogelijk is. Een voorwaarde zou wel zijn dat de wortels contact maken met een watervoerende zandlaag.

De ‘TAW leidraad voor ontwerp, beheer en onderhoud van constructies in, op en nabij waterkeringen (1976)’, geeft aan dat afgestorven boomwortels holle ruimten kunnen veroorzaken in het dijklichaam.

Dit kunnen lange gangenstelsels zijn. Hierdoor kan de microstabiliteit afnemen. Ook kan er piping ontstaan in de vorm van zandmeevoerende wellen. Wortelresten (bijvoorbeeld na het rooien van een boom) dienen daarom zo goed mogelijk verwijderd te worden. Dit wordt door GeoDelft onderschreven.

STOWA geeft aan in haar 'Aanvulling op de rapportages beplanting op en nabij waterkeringen' (2002-20) dat bij zanddijken op een zandondergrond piping in principe geen rol speelt. Bij een zanddijk met een afdekkende kleilaag vindt beworteling vaak plaats in de kleilaag, waardoor deze dus oppervlakkig blijft. Dit is het gevolg van de abrupte overgang van grondsoorten, dit kan een (fysieke) blokkade vormen. Daarbij vormt vastgepakt zand (sterk verdichte structuur) een extra belemmering. Een kleidijk heeft een min of meer uniforme samenstelling, waarin wortels ongehinderd kunnen groeien mits het geen zware, verdichte klei betreft.

Bodemverweking

Door windvang van de boom zou de stam in meer of mindere mate gaan bewegen in de ondergrond. Door de beweging kan ruimte in de bodem ontstaan, waar vervolgens regenwater binnen kan dringen. Uiteindelijk kan daardoor de grond verweken en gevoeliger zijn voor erosie. Dit speelt met name bij ondiep gewortelde bomen en weinig ontwatering. (*Bron: Notitie Kaden en Waterkeringvreemde elementen, Hoogheemraadschap van Delfland, 1999*). Verweking wordt overigens niet gezien als faalmechanisme (*bron: Handleiding voor beplanting op en nabij primaire waterkeringen, STOWA 2000-06*).
Op dit moment is het fenomeen verweking opnieuw een aandachtspunt aan het worden, er wordt weer meer over nagedacht (*bron: R. van Braak, Bomenwacht Nederland*).

Wapening door beworteling

De bovenste kleilaag op een talud is de belangrijkste laag voor het beschermen van het dijklichaam tegen erosie door water. De aanwezigheid van beworteling als gevolg van vegetatie draagt bij aan de stevigheid. Om deze reden worden taluds meestal ingezaaid met gras dat via een gesloten mat een dicht wortelpakket geeft.

Ook kruidachtigen, struiken en bomen zorgen voor stevige beworteling, naar verwachting vooral in de bovenste laag van het talud waar voeding, zuurstof en voldoende water voor groei aanwezig is.

De vraag is in hoeverre deze beplantingsvormen een dicht wortelpakket vormen en in hoeverre de wortels van verschillende soorten beplanting elkaar kunnen versterken of mogelijkerwijs juist beconcurreren.

De kans op erosie bij een boom wordt vergroot door begrazing. Hierbij wordt grasondergroei vertrapt en de bodemstructuur verdicht, waardoor deze voor doorworteling door gras en kruiden minder geschikt is. Ook krijgt het talud een ongelijkmatiger oppervlak waardoor af- c.q. langsstromend water meer aangrijpingspunten op de gronddeeltjes krijgt. Zonder enige begroeiing (regulier is gras) mist de dijk bewapening door de afwezigheid van een wortelpakket dat samenhang geeft (*bronnen onder andere 'TAW leidraad voor ontwerp, beheer en onderhoud van constructies in, op en nabij waterkeringen, 1976' en 'Handreiking Constructief ontwerpen, GeoDelft 1994'*)

De aanwezigheid van wortelstelsels van bomen verhoogt de cohesie in de bodem, waardoor de ondergrond een vorm van wapening verkrijgt. Deze cohesieverhoging is afhankelijk van zowel de grondsoort als de boomsoort en bevindt zich tussen een waarde van 1,0 en 17,5 kN/m^2. De meest voorkomende waarde (vaak op kleiige gronden) ligt tussen 3 en 5 kN/m^2. Bij meerdere beplantingen bij elkaar kan deze bewapening een boogwerking krijgen (*bron: Handreiking Constructief ontwerpen, GeoDelft 1994*).

Van oudsher worden overal ter wereld hellingen beplant met gras, struiken en/of bomen om erosie tegen te gaan (*bron: Erosie, W.F. Hermans, 1960*).

Beïnvloeding waterstroming

Een boom op een talud zal bij waterstroming rondom de stamvoet meer turbulentie geven, waardoor meer erosie zou kunnen optreden. Dit is vooral een risico bij hoge stroomsnelheden. De aanwezigheid van het wortelgestel zal daarentegen ook meer wapening en kluitvorming geven en daarmee meer weerstand tegen diezelfde erosie. (*bron: Handreiking Constructief ontwerpen, GeoDelft 1994*).

Op de kruin van een dijk kunnen bomen en struiken bij een overslagdebiet van meer dan 0,1 l/s/m extra erosie rondom de begroeiing veroorzaken, met een straal van enkele meters.

Ditzelfde geldt in mindere mate voor beplanting op het binnentalud (*bron: Handleiding voor beplanting op en nabij primaire waterkeringen, STOWA 2000-06*).

Binnen een afstand van enkele malen de stamdiameter (gemeten op 130 cm hoogte) is het effect van extra erosie rond beplanting bij hoog water niet meer merkbaar. De stromings-concentratie beperkt zich tot ongeveer tweemaal de diameter van het omstroomde object (*bron: STOWA 2000-04*).

Dijkbeplanting bestaande uit meerdere bomen en/of struiken op het buitentalud en de buitenteen, kan golfslag en stroming zodanig breken dat de aanwezigheid ervan positief uitpakt voor de te verwachten omvang van de erosie (*bron: STOWA 2000-06*).
Een onderzoek in het kader van het project 'Groene Schild' (Deltares, Arcadis, Fugro, 2013) geeft aan dat een wilgenbos aan de voorzijde van de dijk van een golfhoogte van circa 1 meter ongeveer 0,5 meter af kan halen.

Literatuur in buitenland

Ook in andere delen van Europa en de wereld bestaan er vragen omtrent de aanwezigheid van bomen op waterkeringen. De visie op de wenselijkheid van bomen op waterkeringen en de hoeveelheid kennis over bomen op waterkeringen is echter heel verschillend.

De U.S. Army Corps of Engineers (USACE) hanteert de strakke stelling dat bomen op dijken niet toelaatbaar zijn. Bestaande bomen op waterkeringen worden in fasen verwijderd en eventueel vervangen door nieuwe exemplaren in het omliggende landschap.
Een precieze onderbouwing van de stelling is niet te vinden. Mogelijk bestaan er wel risicoberekeningen, deze zijn echter als 'classified' voor niet-USACE mensen niet in te zien.

Een bewortelingsonderzoek in de Verenigde Staten bij een dijk langs de Sacramento River (jaren 1990) toonde aan dat diverse gecombineerde (boom)beplantingen extra stevigheid verschaften. De bomen op het talud (diverse soorten) bleke hadden een uitgebreid wortelstelsel ontwikkeld in de bovenste 10 inches (25,4 cm) van de dijk. De wortels van verschillende individuele bomen versterkten elkaar en vormden op deze wijze een samenhangend netwerk (*bron: T. Griggs, River Partners Journal, 2009*).

Een uitgebreid Frans onderzoek naar beworteling in dijken (*bron: Zanetti et al., 2008*) toont aan dat het bewortelingspatroon van een boom in een dijklichaam afhankelijk is van diverse variabelen. Onderkend wordt dat rond een boom een sterkere, meer eroderende waterstroming bestaat, maar tevens wordt aangegeven dat uit diverse onderzoeken is gebleken dat beworteling een bodemversterkende werking heeft.

De meeste wortels zijn gevonden in de bovenste 30 cm van een dijklichaam.
Wortels kunnen in principe wel dieper reiken (tot meer dan 2 meter) maar zijn daarbij zeer afhankelijk van een voldoende aanvoer van voeding, zuurstof en vocht. Een voedselarme ondergrond waarin water niet doordringt of snel wegvloeit, kent weinig beworteling.
In compacte grond werd zelfs nagenoeg geen beworteling gevonden.

Gesteld is dat de aanwezigheid van water de mate van vertakking van de wortels bepaald. Wanneer in de omgeving een toevoer (stroom, rivier) van water is, zullen wortels zich daarop richten en vanuit de boom lange, dikke wortels vormen in de richting van het waterlichaam. Als de watertoevoer slechts bestaat uit de indringing van regenwater zullen wortels veel meer en fijnere vertakkingen hebben. Daarnaast heeft elke boomsoort zijn specifieke bewortelingspatroon qua diepte, dikte en structuur en brengt de ene boomsoort meer risico's met zich mee dan de andere. Dit laatste werd ook geconcludeerd in een Duits onderzoek (*bron: Bayerisches Landesambt, 1990*).

Afgestorven wortels kunnen gangen in de ondergrond veroorzaken. In losse grond (bijvoorbeeld grof zand) bestaat hier volgens Zanetti weinig kans op. In compacte grond kunnen deze gangen lang standhouden en een risico vormen voor doorsijpelend water dat op deze wijze een weg in en door het dijklichaam kan vinden.

De London Dykes Hazard Tree Assessment (2011) gaat bij het beoordelen van de risico's van bomen op dijken uit van gezonde bomen die goed worden onderhouden. Vervolgens zijn er wel boomsoorten en -vormen die meer risico opleveren vanwege hoogte, bewortelingspatroon, groeisnelheid (houtsterkte) of kroondichtheid (meer schaduwval is minder ondergroei).

Conclusie en discussie

Het merendeel van de onderzoeken zijn gericht op het bepalen van het risico van de boom voor de dijk. Een aantal resultaten hieruit zijn wederkerig te gebruiken voor het bepalen van het risico van dijkerosie voor de bomen.

Bij erosie door water worden gronddeeltjes weggespoeld. Als dit plaatsvindt bij een boom, kan theoretisch gezien gronduitspoeling bij het wortelgestel plaatsvinden waardoor de stabiliteit van de boom kan verminderen. Vervolgens zou deze stabiliteitsvermindering weer een risico van de boom voor de dijk met zich mee kunnen brengen.

Ook is het mogelijk dat zich tussen de wortelkluit van een boom en de aangebrachte kleilaag een overgangsgebied bevindt waar geen stevige klei zit, maar ook geen of slechts weinig beworteling. Indien een dergelijke overgangsgebied aanwezig is, zal dit de zwakste plek in het talud zijn. Het is overigens ook goed mogelijk dat boomwortels de klei juist opzoeken als voedingsrijke laag en daarmee voor extra stevigheid en samenhang zorgen. Dit kan onder andere afhankelijk zijn van de boomsoort, de gebruikte grondsoorten en mogelijk ook de hellingsgraad van het talud.

Verweking van de bodem als mogelijk faalmechanisme wordt tegenwoordig wel weer overwogen. Daarbij speelt vooral een verzadigde ondergrond een rol waarin boomwortels ondiep wortelen. Bij beweging van de wortels in de bodem verliest de grond langzaam haar samenhang en vormt zo een zwakkere plek.

Uit de diverse bronnen blijkt dat er wel kennis bestaat over erosie, bomen en dijken, maar dat deze versnipperd is en elkaar soms tegenspreekt. Er zijn weinig kwantitatieve gegevens beschikbaar, waardoor het afwegen van de diverse positieve en negatieve invloeden op theoretische basis eigenlijk niet mogelijk is. Veel is afhankelijk van de specifieke ondergrond, de opbouw van het dijklichaam en de betreffende boomsoort. Hiervoor is (nog) geen representatief model.

In veel gevallen zal de beoordeling van erosiebestendigheid bij bomen op dijken blijven neerkomen op maatwerk, afgestemd op de specifieke situatie ter plekke.

In de door Bomenwacht Nederland, Fugro en Royal HaskoningDHV gezamenlijk ontwikkelde methode BomenT® wordt gesteld dat:

- Een stabiele (gezonde) boom een overcapaciteit heeft, waardoor eerst de grond rond het wortelpakket erodeert en wegspoelt en daarna de boom zelf pas instabiel wordt;
- een minder stabiele boom sneller bezwijkt na nat worden van de groeiplaats.

BIJLAGE 12 Berekening stroomsnelheid DR56A

BEREKENING STROOMSNELHEID EN LAAGDIKTE BIJ GOLFOVERSLAG

Op basis van: [1] TR Golfoploop en golfoverslag bij dijken (TAW, 2002)
[2] Article "The Wave run-up simulator, theory and first pilot test" in Coastal Engineering (J. van der Meer e.a., 2012)

Resultaten voor huidige situatie (huidig talud)

Volgens Van der Meer [2]

$u_{2\%} = c_{u2\%}(g(R_{u2\%}-Z_A))^{0.5}$

$u_{2\%}$ = 3.0 [m/s]

$h_{2\%} = c_{h2\%}(R_{u2\%}-Z_A)$

$h_{2\%}$ = 0.076 [m]

Volgens [1]

$u_{A;2\%} = c_{A;u}(g*Hs)^{0.5}*(Ru2\%-Z_A)/Hs)^{0.5}$

$u_{A;2\%}$ = 2.6 [m/s]

Maximale oploopsnelheid op talud/kruin, overschreden door 2% van de oplopende golven

$h_{A;h} = c_{A;h} * Hs * (R_{u2\%}-Z_A)/Hs$

$h_{A;2\%}$ = 0.125 [m]

Maximale stroomdikte op talud/kruin, overschreden door 2% van de oplovende golven

Voor Z_A gelijk aan de vrije kruinhoogte; aangenomen wordt dat deze stroomsnelheid en stroomdikte over de hele kruin en binnentalud constant is.

Resultaten voor verflauwd buitentalud (1:3)

Volgens Van der Meer [2]

$u_{2\%} = c_{u2\%}(g(R_{u2\%}-Z_A))^{0.5}$

$u_{2\%}$ = 2.4 [m/s]

$h_{2\%} = c_{h2\%}(R_{u2\%}-Z_A)$

$h_{2\%}$ = 0.050 [m]

Volgens [1]

$u_{A;2\%} = c_{A;u}(g*Hs)^{0.5}*(Ru2\%-Z_A)/Hs)^{0.5}$

$u_{A;2\%}$ = 2.1 [m/s]

Maximale oploopsnelheid op talud/kruin, overschreden door 2% van de oplopende golven

$h_{A;h} = c_{A;h} * Hs * (R_{u2\%}-Z_A)/Hs$

$h_{A;2\%}$ = 0.083 [m]

Maximale stroomdikte op talud/kruin, overschreden door 2% van de oplovende golven

Input

	DWP 167				Bron
	Huidig talud	*Talud 1:3*			
$c_{u2\%}$ =	1.55	1.55	[-]	coefficent voor stroomsnelheid	[2]
$c_{h2\%}$ =	0.20	0.20	[-]	coefficent voor stroomdikte	[2]
$c_{A;u}$ =	1.33	1.33	[-]	coefficent voor stroomsnelheid	[1]
$c_{A;h}$ =	0.33	0.33	[-]	coefficent voor stroomdikte; volgens Schüttrumpf (2002)	[1]
$R_{u2\%} = z_{2\%}$ =	1.11	0.98	[m]	2%-golfoploopniveau boven de stilwaterlijn	Hydra-R o.v.b. HR2006
Hs =	0.41	0.41	[m]	significante golfhoogte bij de teen van de dijk	Hydra-R o.v.b. HR2006
SWL =	14.22	14.22	[NAP m]	Stilwaterlijn	
H_{kruin} =	14.95	14.95	[NAP m]	Kruinhoogte (buitenkruin)	Kempkes inmeting
$Z_A = h_k$ =	0.73	0.73	[m]	Vrije kruinhooge (H_{kruin} - SWL)	
g =	9.81	9.81	[m/s2]	Zwaartekrachtversnelling	

BIJLAGE 13 Grondwaterstroming Plaxis DR56A

BIJLAGE

Opsteller	:	ir. J.E. Cools
Dossier	:	9X4447
Project	:	PRIO1 Dijkvak 56A Afferden
Betreft	:	Resultaten grondwaterstroming in Plaxis (Plaxflow)
Datum	:	9 maart 2015
Status	:	Definitief

1 INLEIDING

Om inzicht te krijgen in het verloop van de freatische grondwaterstand zijn met behulp van Plaxis (Eindige Elementen Model) grondwaterstromingsberekeningen uitgevoerd. De grondwaterstroming is bepaald voor de volgende situaties:

- Situatie met maatgevend hoog water (MHW) +normale neerslag + infiltratie door golfoverslag;
- Situatie met gemiddeld hoog water (GHW) + extreme neerslag.

De situatie met MHW is beschouwd als niet-stationaire stroming met een belastingsduur van 24 uur, ongeveer gelijk aan de maximale stormduur. De situatie met GHG is beschouwd als stationaire situatie.

Er is voor de dijkring geen waterstandstatistiek beschikbaar om nauwkeurig een GHW te bepalen. De inschatting van de GHW is overgenomen uit het Achtergrondrapport Waterbouw. De GHW bedraagt circa 3,35 m beneden MHW.

Beschouwd zijn twee representatieve dwarsprofielen:

- DWP167 voor de dijksectie DR56A.1 met een kleideklaag onder de dijk;
- DWP151 voor dijksectie DR56A.2 met een zandondergrond.

2 INPUT PLAXIS

2.1 Begrenzing model

Voor de begrenzing van het model in Plaxis zijn een fictief intredepunt en uittredepunt gekozen. Bij het intredepunt is aangenomen dat de stijghoogte in het watervoerende zandpakket gelijk is aan de buitenwaterstand. Bij het uittredepunt is de stijghoogte gelijk aan de langdurige gemiddelde stijghoogte van NAP +11,67 m.

<u>DWP 167: Zanddijk op een kleideklaag</u>
De ligging van het fictieve in- en uittredepunt voor DWP167 is bepaald op basis van de lekfactor conform het Technisch Rapport Waterspanningen bij Dijken (TAW, 2004). De lekfactor is afhankelijk van de doorlaatcapaciteit van het systeem en wordt bepaald door de weerstand van de toplaag en het doorlaatvermogen van de onderliggende zandlaag. De lekfactor is gelijk aan de wortel van het product van doorlaatvermogen of transmissiviteit T (kD-waarde) en toplaagweerstand c (hydraulische weerstand):

$\lambda = \sqrt{(Tc)}$

Waarin:

λ	=	lekfactor [m]
T	=	transmissiviteit (kD-waarde) van het zandpakket [m2/dag]
c	=	toplaagweerstand/hydraulische weerstand [dag]
k	=	doorlatendheid van zandlaag [m/dag]
D	=	dikte van de zandlaag [m]

Voor DWP167 geldt: $\lambda_{voorland} = \sqrt{}(36 \times 24 \times (4/0{,}15) \approx 150$ m

$\lambda_{achterland} = \sqrt{}(36 \times 24 \times (0{,}5/0{,}15) \approx 50$ m

DWP 151: Zanddijk op zandondergrond

Voor DWP151 met een zanddijk op een zandondergrond ligt het intredepunt nabij de buitenteen (begrenzing bekleding). Binnenwaarts wordt de stijghoogte begrensd door het maaiveldniveau (bij een hogere stijghoogte treedt afstroming plaats). De afstand achter de dijk waar weer het polderpeil aanwezig is, is afhankelijk van de toevoer van water door het watervoerend pakket. Indien dit punt te dicht bij de dijk gekozen wordt, wordt de waterspanning (sterk) onderschat. Als rand voor het model is daarom een afstand van 60 m aangehouden, gelijk aan 2 maal de dikte van het watervoerende zandpakket.

2.2 Doorlatendheid grond

De in de berekening aangehouden doorlatendheid is aangeven in onderstaande tabel. De doorlatendheid van het zand is gebaseerd op de aanwezige korrelgrootteverdelingen (gemiddelde waarde van de methoden Den Rooijen (1992) en Kozeny (MOS)). De doorlatendheid voor de onder- en leeflaag van de kleibekleding zijn respectievelijk de onder- en bovengrens voor de doorlatendheid zoals vastgesteld bij infiltratieproeven [Handreiking Toetsen Grasbekleding t.b.v. het opstellen van het beheerdersoordeel (BO) in de verlengde derde toetsronde, RWS, 2012].

Tabel 2-1 Doorlatendheid grond

Grondlaag	Doorlatendheid [m/d]
Zand, matig fijn, losse pakking (dijkkern)	10
Zand, matig tot zeer grof (ondergrond)	35
Klei (ondergrond)	0,15
Kleibekleding (1 m onderlaag)	0,1
Leeflaag (bovenste 0,3 m)	1

2.3 Invloed van neerslag

Gerekend is met een normale neerslag van 7 mm/dag en een extreme neerslag van 22 mm/dag gedurende 7 dagen conform het Technisch Rapport Waterspanningen bij Dijken (TAW, 2004). Aangenomen is dat regenwater dat op de wegverharding valt wordt afgevoerd naar de binnen- en buitenkruin, zodat ter plaatse van de bomen op de kruin meer regenwater infiltreert in de dijk. Dit resulteert in de volgende infiltratiedebieten:

- DWP167 - binnen- en buitenwaarts: neerslag over een breedte van circa 12 m infiltreert over een breedte van circa 2 m:
  - Infiltratie bij normale neerslag: 12 x0,007 / 2 = 0,04 m^3/d/m
  - Infiltratie bij extreme neerslag: 12 x0,022 / 2 = 0,13 m^3/d/m
- DWP151 - buitenwaarts: neerslag over een breedte van circa 17 m infiltreert over een breedte van circa 2 m:
  - Infiltratie bij normale neerslag: 17 x0,007 / 2 = 0,06 m^3/d/m
  - Infiltratie bij extreme neerslag: 17 x0,022 / 2 = 0,19 m^3/d/m

- DWP151 – binnenwaarts: neerslag over een breedte van circa 7 m infiltreert over een breedte van circa 2 m:
    - Infiltratie bij normale neerslag: 7 x0,007 / 2 = 0,02 m^3/d/m
    - Infiltratie bij extreme neerslag: 7 x0,022 / 2 = 0,08 m^3/d/m

2.4 Invloed van infiltratie door golfoverslag

Bij golfoverslagdebieten van meer dan 0,1 l/m/s wordt algemeen aangenomen dat infiltratie kan optreden. Voor dijksectie 56A.2, waarvoor DWP 151 representatief is, bedraagt het overslagdebiet minder dan 0,1 l/m/s. Voor deze dijksectie is in de modellering geen rekening gehouden met infiltratie door golfoverslag.

Bij DWP 167 bedraagt het overslagdebiet 0,2 l/m/s. Voor dijksectie 56A.1 (met DWP167 als representatief profiel) dient dus in de grondwaterstromingsberekening rekening te worden gehouden met infiltratie door golfoverslag. Infiltratie kan alleen optreden indien er een wateraanbod, ofwel een waterlaagje, op het talud aanwezig is. Bij infiltratie door golfoverslag maakt het niet veel uit hoe dik het waterlaagje is. Bij golfoverslag komen golfvolumes met onregelmatige tussentijden en in onregelmatige hoeveelheden over het binnentalud. Voor de berekeningen is aangenomen dat de kruin en de taluds nat blijven.
Aangenomen is, dat infiltratie kan optreden ter plaatse van de kleibekleding en ter plaatse van de bomen met dunnere deklaag. Scheuren, wormgangen en wortelkanalen creëren een voor klei vrij hoge doorlatendheid, waardoor de infiltratiesnelheid in de orde van 10^{-5} tot 10^{-4} m/s is, ofwel in de orde van 0,1 à 0,01 l/s per m^2 dijkoppervlak [Handreiking Toetsen Grasbekleding t.b.v. het opstellen van het beheerdersoordeel (BO) in de verlengde derde toetsronde, RWS, 2012]. In de berekening is uitgegaan van:

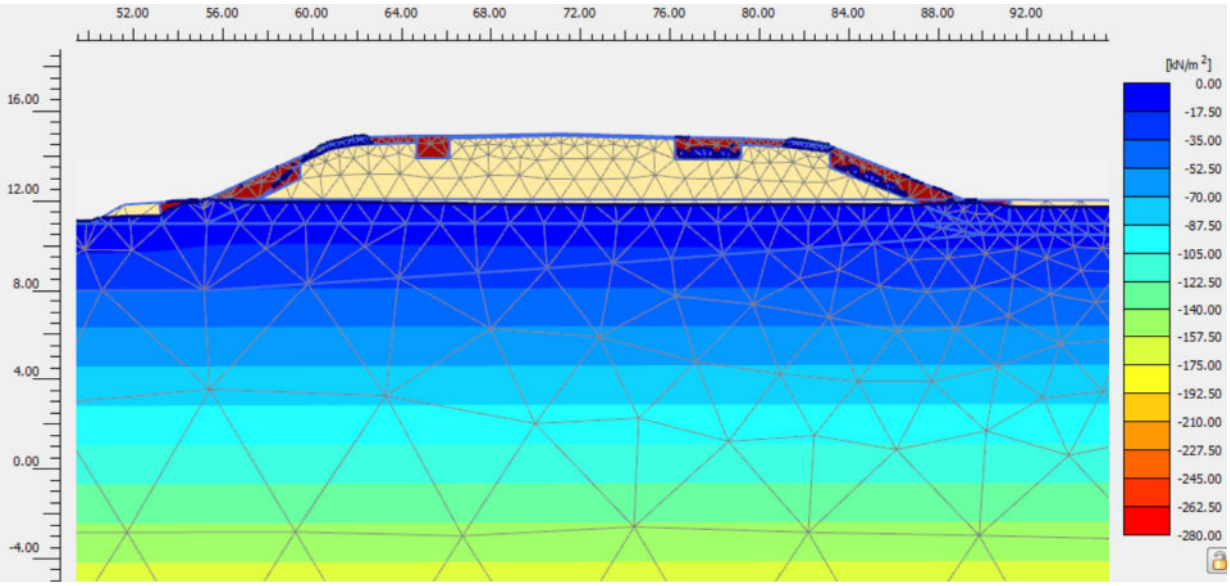
- 8,6 m^3/dag/m^2 (bovengrens) ter plaatse van de bomen (maximaal 0,3m doorwortelde toplaag);
- 0,86 m^3/dag/m^2 ter plaatse van de kleideklaag (1 m + 0,3m toplaag)

In vergelijking met de infiltratie door neerslag is infiltratie door golfoverslag maatgevend.

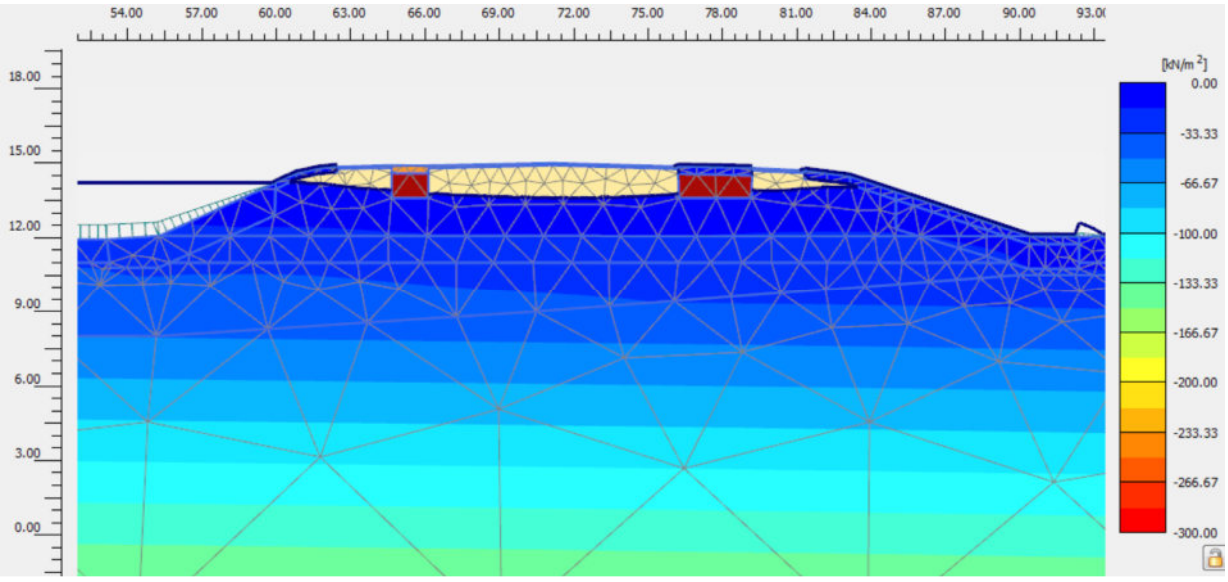
3 RESULTATEN DWP167 (ZANDDIJK OP KLEILAAG)

Grondwaterstanden bij kleibekleding op het binnentalud

In de onderstaande figuren 3-1 en 3-2 zijn de waterspanningen weergegeven voor de twee beschouwde situaties met GHW en MHW. In beide situaties is ervan uitgegaan dat een kleibekleding op het binnentalud wordt aangebracht om erosie door golfoverslag tegen te gaan. Aangenomen is dat de kleibekleding aansluit op de kleilaag in de ondergrond. In tabel 3-1 is de grondwaterstand aangegeven voor verschillende locaties in het profiel.



Figuur 3-1 Waterdruk bij GHW + extreme neerslag (stationair)



Figuur 3-2 Waterdruk bij MHW + normale neerslag + infiltratie door overslag (24 uur, niet-stationair)

-

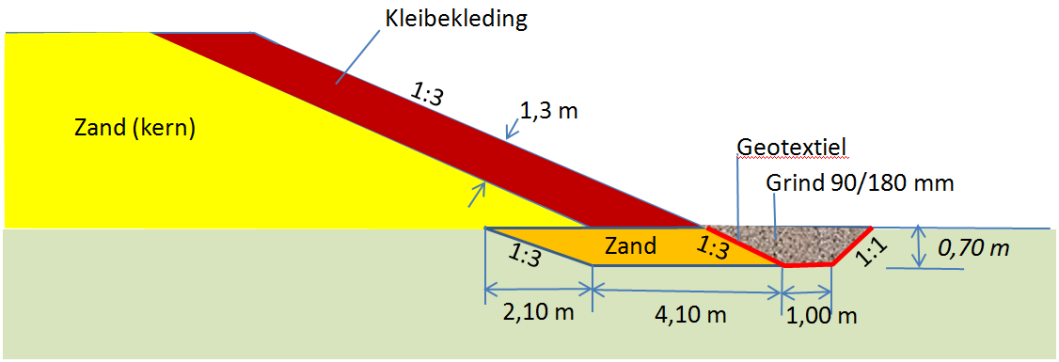
Tabel 3-1 Berekende grondwaterstanden voor DWP167

Rekengeval:	GHW + extreme neerslag	MHW + normale neerslag + infiltratie		
Grondwaterstand	**Stationair**	**Stationair**	**Na 24 uur**	**Opmerking**
Freatische lijn t.p.v. bomen op buitenkruinlijn	NAP +12,0 m	NAP +14,6 m	NAP +14,2 m	Verweking
Freatische lijn onder kleibekleding binnentalud	NAP +11,9 m	NAP +14,0 m	NAP +13,9 m	Opdrukken
Stijghoogte onder deklaag in de binnenteen	NAP +11,6 m	NAP +12,5 m	NAP +12,5 m	Geen opdrijven

Uit de modellering volgt dat onder maatgevende omstandigheden de zandkern bijna volledig verzadigd raakt. Als gevolg van de hoge freatische lijn nabij de binnen- en buitenkruin kan het zand bij de bomen op de kruin verweken onder cyclische windbelastingen, waardoor de bekledingslaag op het binnentalud kan worden opgedrukt of afschuiven. Een maatregel in de vorm van teendrainage is nodig om de freatische lijn te verlagen.

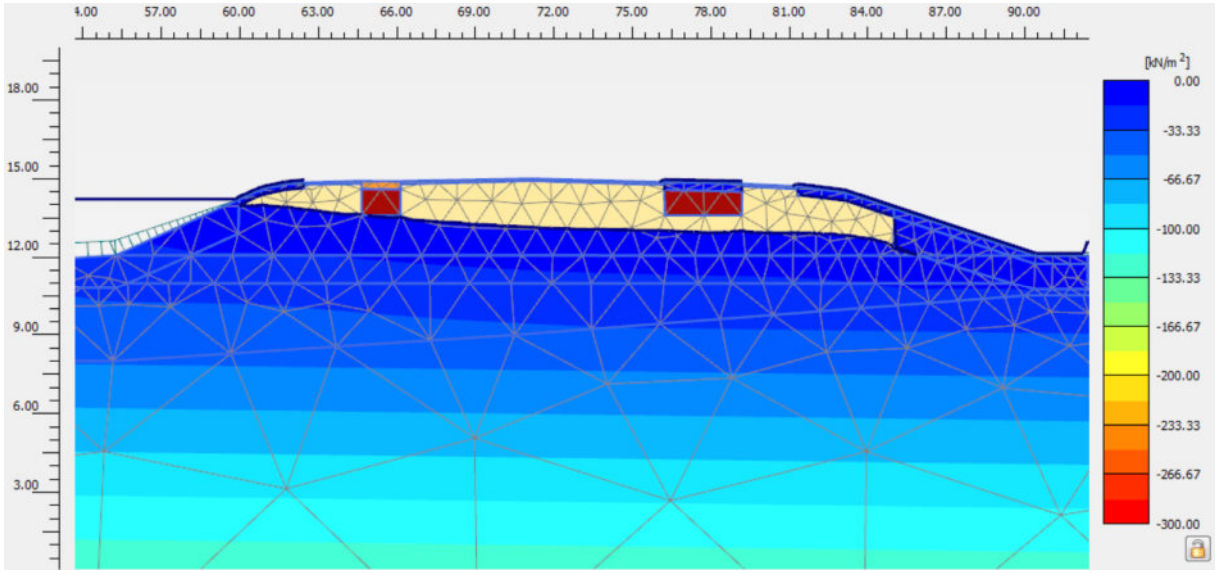
Maatregel om freatische lijn te verlagen

Om de freatische lijn te verlagen dient een drainageconstructie te worden aangebracht nabij de binnenteen. De drainageconstructie kan bestaan uit teendrainage. Een principe van de teendrainage is weergegeven in onderstaande figuur.



Figuur 3-3 Principe teendrainage voor dijksectie 56A.1

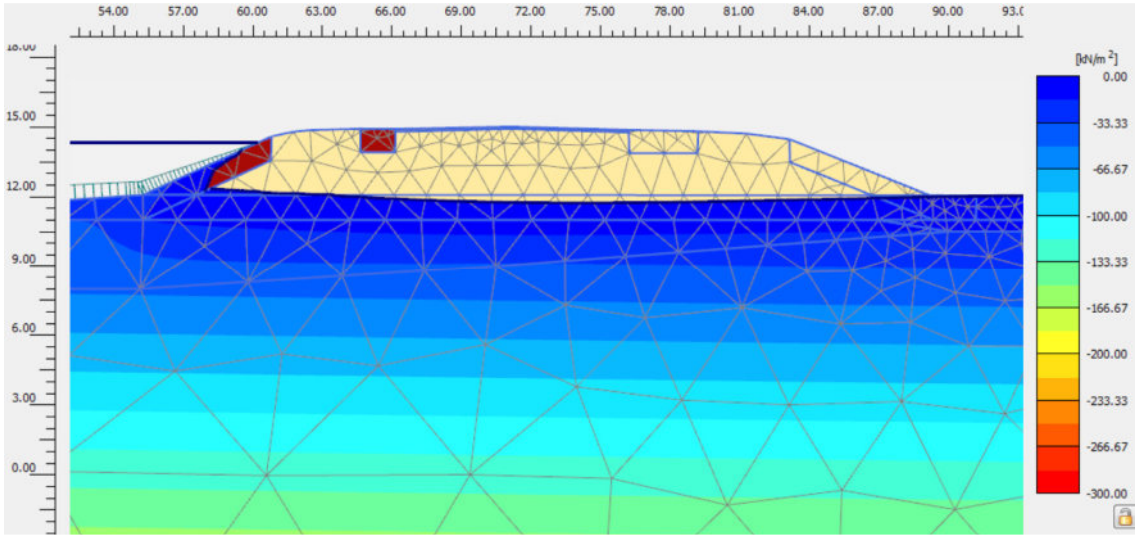
In Plaxis is de drainage gemodelleerd als een potentiaallijn onder de bekleding met een potentiaal van NAP +12,0 m, gelijk aan maaiveldniveau. De berekende verhanglijn is weergegeven in onderstaande figuur.



Figuur 3-4 Dijkprofiel met drainage - Waterdruk bij MHW + normale neerslag + infiltratie door overslag (24 uur, niet-stationair)

Als gevolg van de drainage in de binnenteen wordt de freatische lijn nabij de buitenkruinlijn verlaagd tot NAP +13,9 m (ca. 1 m onder maaiveld) en nabij de binnenkruinlijn tot NAP +12,8 m. Bij deze waterstanden wordt geen instabiliteit van de bomen door verweking van het zand verwacht.
Onder de kleibekleding op het binnentalud bedraagt de grondwaterstand maximaal NAP +12,3 m, waardoor geen opdrukken van de bekleding zal optreden.

Grondwaterstand bij situatie zonder kleibekleding op het binnentalud
Beschouwd is ook de situatie, waarbij op het binnentalud geen kleibekleding aanwezig is omdat het overslagdebiet kleiner is dan 0,1 l/m/s. Er is in dat geval ook geen infiltratie door overslag, wel door neerslag. De binnenteen kan in dat geval vrij draineren. Het verloop van de grondwaterstand is aangegeven in de volgende figuur.

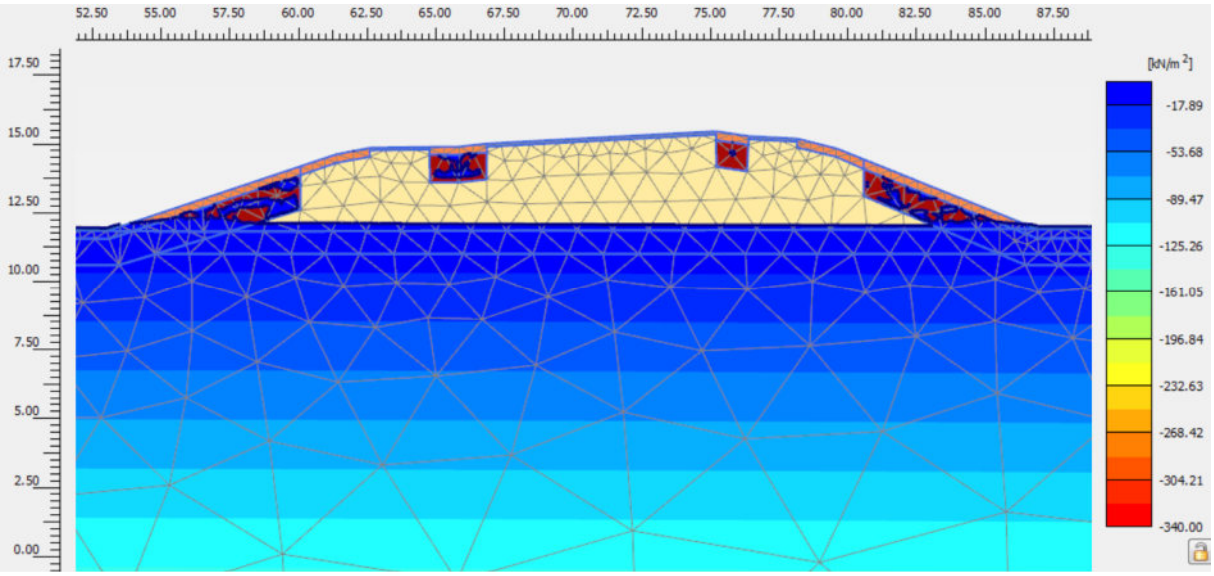


Figuur 3-5 Waterdruk bij MHW + normale neerslag (24 uur, niet-stationair)

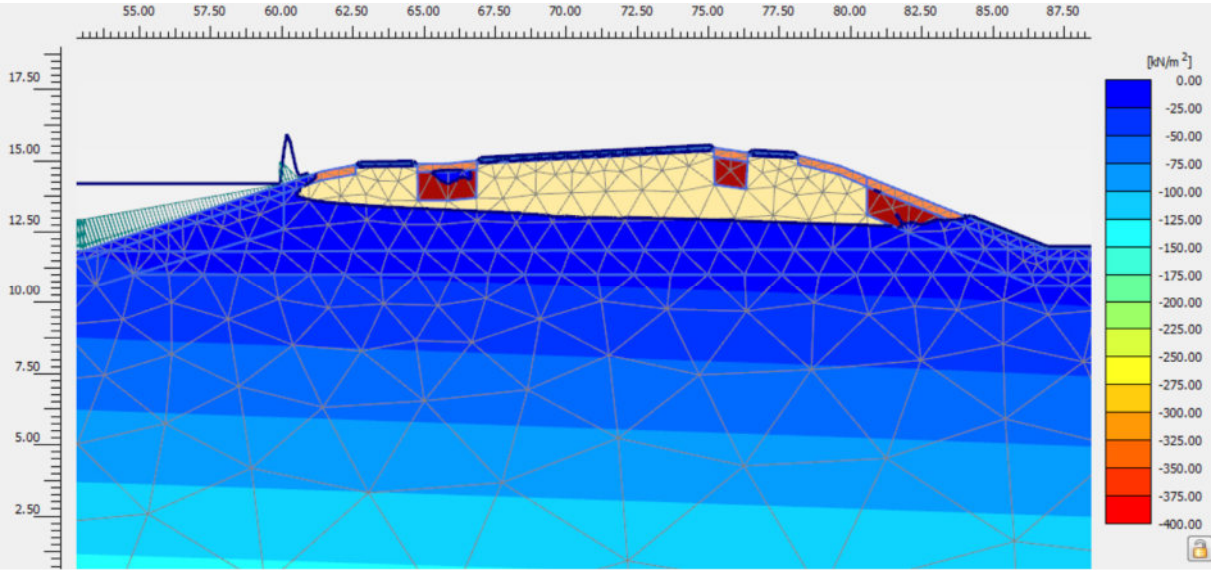
Uit bovenstaande figuur blijkt dat de freatische lijn snel daalt in de zandige kern van de waterkering.

4 RESULTATEN DWP151(ZANDDIJK OP ZANDONDERGROND)

In de onderstaande figuren 4-1 en 4-2 zijn de waterspanningen weergegeven voor de twee beschouwde situaties met GHW en MHW. In tabel 4-1 is de grondwaterstand aangegeven voor verschillende locaties in het profiel.



Figuur 4-1 Waterdruk bij GHW + extreme neerslag (stationair)



Figuur 4-2 Waterdruk bij MHW + normale neerslag (24 uur, niet-stationair)

Tabel 4-1 Berekende grondwaterstanden voor DWP151

Rekengeval:	GHW + extreme neerslag	MHW + normale neerslag		
Grondwaterstand	**Stationair**	**Stationair**	**Na 24 uur**	**Opmerking**
Freatische lijn t.p.v. bomen op buitenkruinlijn	NAP +12,1 m	NAP +13,5 m	NAP +13,5 m	Geen verweking
Freatische lijn onder kleibekleding binnentalud	NAP +12,0 m	NAP +12,7 m	NAP +12,7 m	Geen opdrukken

5 AANBEVELINGEN VOOR HET ONTWERP

Opdrijven deklaag
De stijghoogte onder de deklaag (DWP167) op het niveau NAP +10,5 m bedraagt in de het meest ongunstige geval NAP +12,5 m. De opdrijfveiligheid bedraagt in dat geval 1,47 (=38/19) en is hoger dan de vereiste veiligheidsfactor van 1,2. Er is geen gevaar voor opdrijven op opbarsten. Vermoedelijk zal door plaatselijk ontbreken van de deklaag de stijghoogte in werkelijkheid lager zijn dan berekend.

Verweking zand ter plaatse van de bomen
Uit de modellering in Plaxis volgt dat zonder maatregelen verweking van de zandkern kan optreden bij DWP 167 (dijksectie 56A.1). Als maatregel dient drainage nabij de binnenteen te worden aangebracht. De freatische grondwaterstand blijft zo minimaal 1,0 m beneden kruinniveau, waardoor geen verweking van zand ter plaatse van de bomen kan optreden.
Bij DWP 151 (dijksectie 56A.2) blijft de freatische lijn in de meest ongunstige stationaire situatie circa 1,5 m onder het kruinniveau. Vanwege deze lage ligging kan geen verweking van het zand door cyclische windbelastingen optreden.
De aanleg van de drainage is nodig omdat de nieuw aan te brengen kleibekleding de teen van de dijk niet meer voldoende draineert. Het aanbrengen van deze drainage leidt niet tot een verhoging van de kwel ten opzichte van de huidige situatie.

Microstabiliteit: opdrukken deklaag
Bij een dikte van de kleilaag van 1,2 m en een taludhelling van 1:3, bedraagt het maximaal toelaatbare stijghoogte-/grondwaterstandsverschil ten opzichte van de bovenkant bekleding in de teen (Δh) 1,6 m, zie bijlage 3 van het hoofdrapport. Bij DWP 151 bedraagt het grondwaterstandsverschil 0,7 m en is toelaatbaar. Bij DWP 167 (dijksectie 56A.1) wordt bij aanwezigheid van drainage een maximaal grondwaterstandsverschil van 0,4 m verwacht. Er wordt geen micro-instabiliteit verwacht.

BIJLAGE 14 Specificaties Secumat

Product combination of geogrid and erosion control layer

Secumat® 20/20 Q1 ES 401

NAUE GmbH & Co. KG
Geweerbestrasse 2
32339 Espelkamp-Fiestel
Germany
Phone:+49 5743 41-0 Fax: +49 5743 41-240
E-Mail: info@naue.com Internet: www.naue.com

0799-CPR-20

Product description: Composite of a laid geogrid made of stretched, monolithic polypropylene (PP) flat bars with welded junctions and an erosion control layer used for the reinforcement in many fields of civil engineering including road construction, landfill and hydraulic engineering

Property	Test method*	Unit	
Total product			
Mass per unit area	EN ISO 9864	g/m²	555
Thickness	DIN EN ISO 9863-1	mm	20.0
Geogrid			*20/20 Q1*
Raw material	-	-	polypropylene (PP), white
Mass per unit area	EN ISO 9864	g/m²	155
Max. tensile strength, md / cmd**	EN ISO 10319	kN/m	≥ 20 / ≥ 20
Elongation at nominal strength, md / cmd**	EN ISO 10319	%	≤ 8 / ≤ 8
Tensile strength at 1% elongation, md / cmd**	EN ISO 10319	kN/m	4 / 4
Tensile strength at 2% elongation, md / cmd**	EN ISO 10319	kN/m	8 / 8
Tensile strength at 5% elongation, md / cmd**	EN ISO 10319	kN/m	16 / 16
Aperture size, md x cmd**	-	mm x mm	approx. 33 x 33
Production specific elongation	-	%	0
Erosion contol layer			*ES 401*
Raw material	-	-	polypropylene (PP), black
Mass per unit area	EN ISO 9864	g/m²	400
Roll dimensions, width x length	-	m x m	2.00 x 30

*based on, **md = machine direction, cmd = cross machine direction

Secumat®
General Installation Guidelines
NAUE GmbH & Co. KG

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The following installation recommendation contains generic installation guidelines. It is presented as a general format, not as a direct substitute for a project specific surface erosion control specification. In the event of a conflict, the requirement of the project specification will supersede these recommendations. This recommendation does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this guideline to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. The information contained herein has been compiled by NAUE GmbH & Co. KG, Germany, and is, to the best of our knowledge, true and accurate. There is no implied or expressed warranty. Final determination of suitability for use contemplated is the sole responsibility of the user. This information is subject to change without notice.

1. Scope
These installation instructions apply to all Secumat® surface erosion control products, which are three-dimensional mats consisting of a UV-stabilized, labyrinth-like extruded monofilament polymer core.

2. Application
Secumat® erosion control mats are designed for near-surface erosion, such as erosion caused by mechanical effects like wind, rain and stormwater runoff. In addition to controlling surface erosion, Secumat® helps to anchor and reinforce the root zone of plants for true, long-term performance and defence against erosion. Applications include installation on flat areas and steep slopes in general construction and civil engineering, along roadways, for landscaping, water courses and streams and in landfill construction/closure and mining remediation.

3. Transport and Storage
Secumat® erosion control mats are supplied in rolls and wrapped with a protective film for shipping and storage. Lightweight but durable, and protected by the cover film, the rolls may be transported and stored in horizontal or vertical alignment. Ideally, rolls should remain in their original protective sleeves until ready to be used on site. While Secumat® is designed for high performance in exposed conditions, it is always recommended not to store material rolls in an exposed environment for a prolonged period of time prior to use.

When unloading Secumat® rolls from the delivery truck or containers, suitable equipment should be used to ensure maximum material performance and safety (e.g., boards, lifting belts, other lifting equipment).

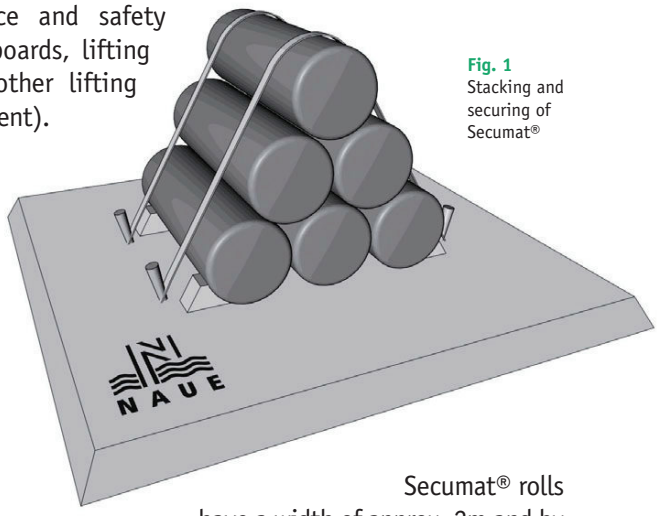


Fig. 1
Stacking and securing of Secumat®

Secumat® rolls have a width of approx. 2m and by virtue of their low weight of approx. 30kg, can be handled safely by hand if lifting equipment is not present. Job safety standards should always be observed. Rolls should never be dropped from the truck. Special rain protection is not required. Secumat® rolls can be stacked, but not more than 3 layers high. No additional loads should be applied to the rolls in storage, the surface on which they are stored should be flat and dry and the rolls must be secured to prevent slipping, falling over, or rolling away. It must be ensured that rolls cannot move at any time once stacked and stored (fig. 1).

4. Subgrade/Site Preparation

Secumat® performs best when in intimate contact with underlying soil. When preparing the subgrade of slopes or flat areas (fig. 2), care should first be taken to meet the designed earthworks specifications, such as for soil compaction and grade.

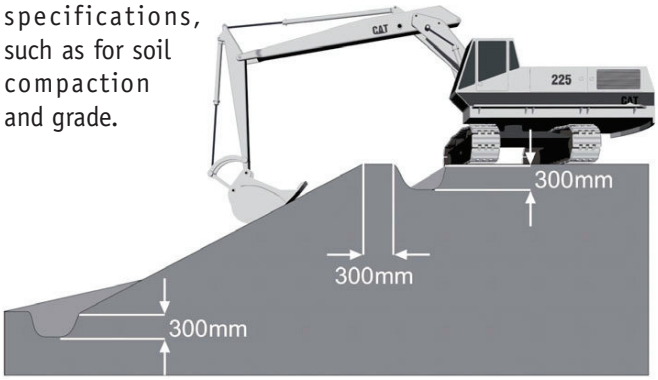


Fig. 2
Levelling of subgrade prior to Secumat® installation (top, resp. toe anchor trenches optional, according to design requirements)

The area should be as free as possible of protrusions, such as from roots and rocks. The base on which Secumat® is installed should be as level as possible or as specified. It is the responsibility of the earthwork contractor and/or the site engineer that the subgrade meets the requirements and is approved prior to Secumat® installation.

5. Installation

5.1 Roll Protection. The rolls of Secumat® can be installed quickly and without specialised labor, but general care for construction materials must be observed. The protective wrapping on Secumat® rolls should not be removed until shortly before installation.

5.2 Design Appropriateness. The Secumat® installer should consult the project design or planning engineer prior to installation to ensure that the site's relevant design conditions (e.g., maximum slope angle, anchor trench preparation, etc.) have been satisfied and are ready for the installation of Secumat® erosion control materials.

5.3 Unrolling of Secumat®. If no anchor trench is considered pin Secumat® at the top of the slope to the soil prior to unrolling the erosion control mat down the slope. If an anchor trench is present, secure the Secumat® rolls in the trench with pins (fig. 4) prior to fully unrolling (fig. 3 and 9).

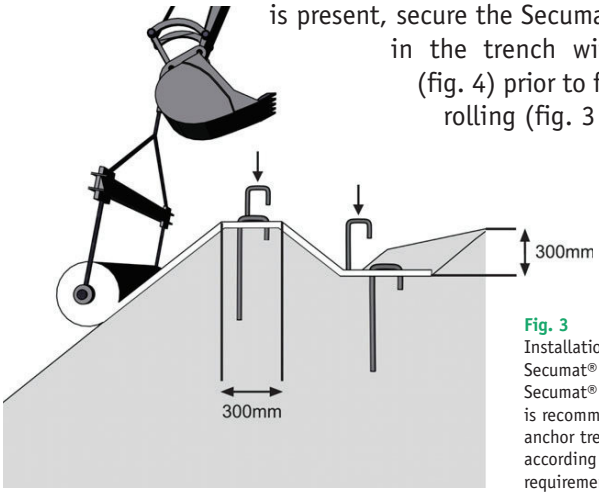
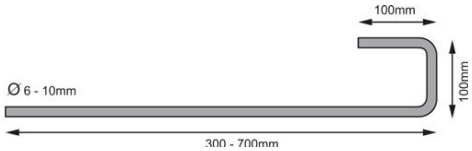


Fig. 3
Installation of Secumat® (pinning of Secumat® on the top is recommended; anchor trench optional, according to design requirements)

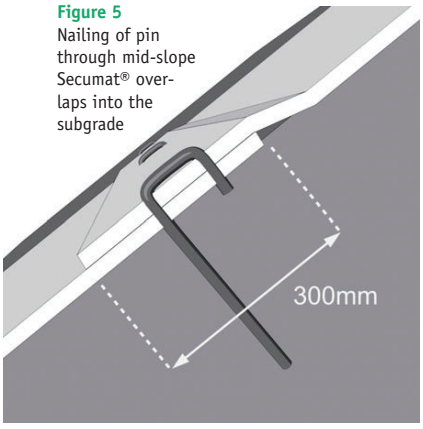
Figure 4
Typical pin for securing Secumat® against the subgrade



After full unrolling, the sheets should be pinned into place along the slope as soon as possible to protect the installed alignment from wind shifts and uplift (fig. 5 – 9). Also, before soil and vegetation seeding is applied, the anchor trench should be filled and compacted to specifications for optimal site safety and performance. Prior to pinning of the entire Secumat® ensure that the installed material lies flat against the subgrade.

NOTE: Vehicle traffic is not allowed on Secumat® panels, and vehicle use on the project area even before the installation of erosion control materials should be limited or forbidden. These precautions will protect the erosion control materials and ensure that their contact with the prepared subgrade is optimal.

Figure 5
Nailing of pin through mid-slope Secumat® overlaps into the subgrade



5.4 Anchoring Pins. Secumat® may be used on slopes > 1:5 (V:H) and < 1:1.5 with the use of anchoring pins (fig. 4 - 9). Steeper slopes need additional pinning and optional an integrated Secugrid® geogrid. Secumat® sheets running down the slope can be 100mm overlapped or butt-jointed, but pins (fig. 5 - 9) should be used to join and secure abutting panels. Other pins, such as U-shape pins might also be suitable. The length of the stakes depends on the particular soil conditions. It is advisable to consult the design engineer before installation.

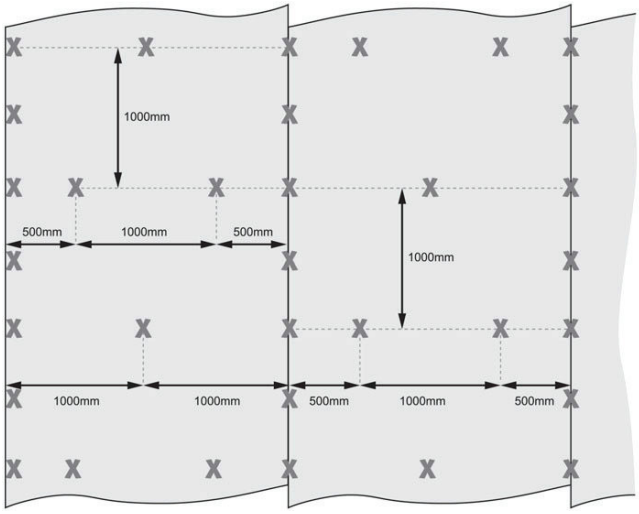


Figure 6
Grid of recommended nailing with pins through Secumat® into the subgrade

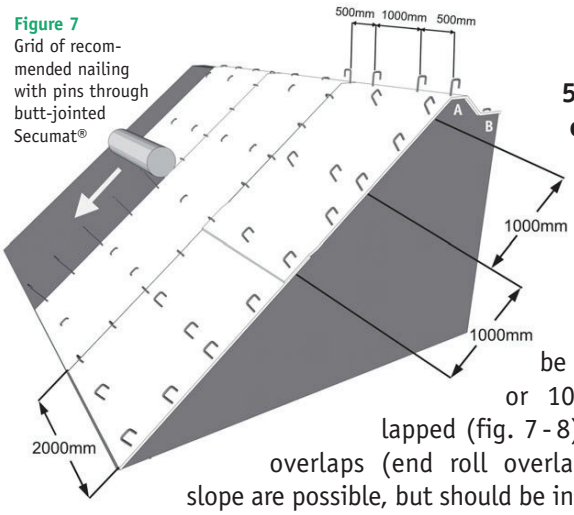


Figure 7
Grid of recommended nailing with pins through butt-jointed Secumat®

5.5 Securing of overlaps. Adjacent rolls running down the slope can be butt-jointed or 100mm overlapped (fig. 7 - 8). Secumat® overlaps (end roll overlaps) on the slope are possible, but should be in direction of the down-hill slope and be min 300mm wide (fig. 5). Extra pinning every 500mm is recommended.

In waterstreams overlaps of 150mm should be made overlapping in downstream direction. All overlaps should be pinned at max. 1 meter and in severe flow conditions the pinning is recommended to be every 500mm.

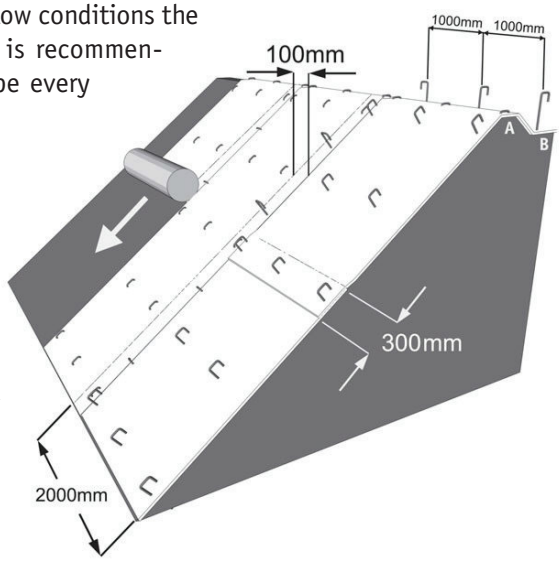


Figure 8
Grid of recommended nailing with pins through overlapped Secumat®

5.6. Cutting Rolls. The cutting of Secumat® erosion control mats can be made with standard cutting devices, such as electric rotary cutters, textile scissors and similar tools to meet site-specific geometries. On-site cutting is permissible, such as to meet the slope length (either at toe or anchor trench) or to accommodate site-specific protrusions, such as pipe penetrations. In cases of protrusions, additional anchoring of the Secumat® roll is advisable around these cuts to ensure flat, intimate contact with the soil. Sections should be fastened with pins around the protrusion approx. every 300mm and to all surrounding panels in a 500mm pattern before soil and vegetation media are placed.

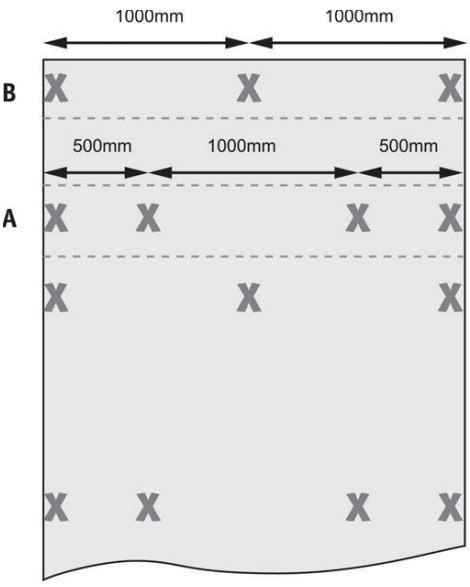


Figure 9
Secumat® pin nailing at the top and in the anchor trench

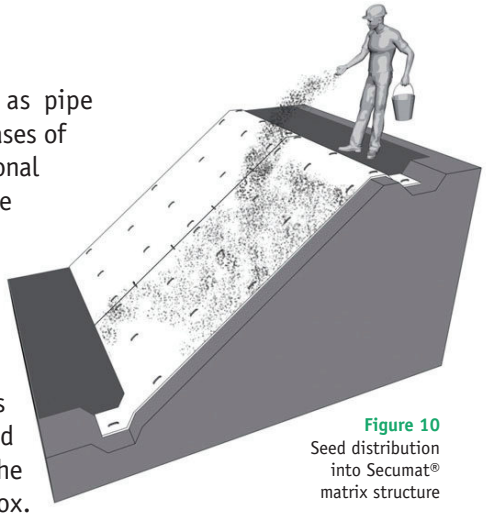


Figure 10
Seed distribution into Secumat® matrix structure

6. Filling/Seeding.
Secumat® is fully functional once positioned and secured. It is ready to be filled with topsoil and vegetation-promoting materials, including hydroseed and other hydraulic growth mediums (fig. 10).

Typically 20 - 30g/m² of suitable seeds (2/3 placed prior to soil filling) are sufficient. In embankment areas, fill should be placed from bottom to top. Secugrid® supported Secumat® types allow a soil filling from top to bottom (fig. 11 - 12). Check slope stability issues prior to soil filling process from top to bottom, especially with driving equipment. Any placing of topsoil material into position should be performed lightly and with care and can be done by raking or with equipment. Secumat® without geogrid support is not designed to transfer stresses.

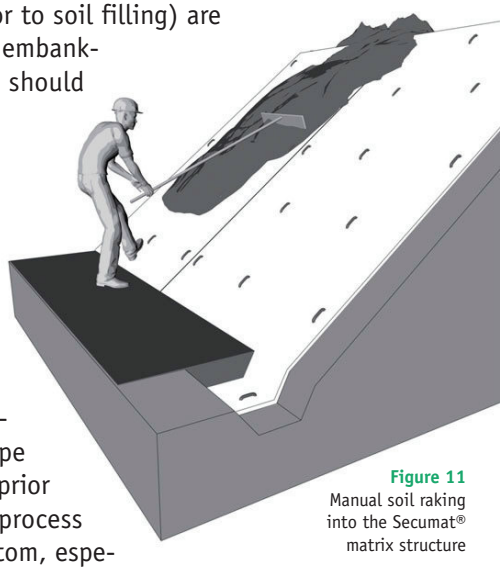


Figure 11
Manual soil raking into the Secumat® matrix structure

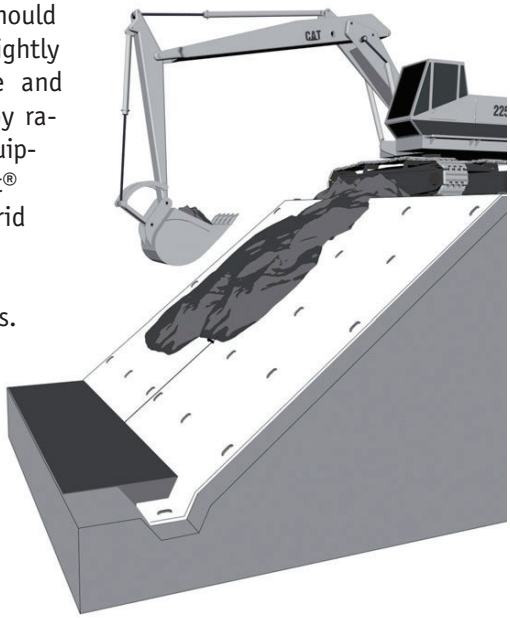


Figure 12
Soil placement on top of Secumat® with equipment

Therefore it is not suitable to store soil in piles on Secumat® on slopes, prior to the filling process. Also, uniformity in any vegetation-promoting cover layer is strongly recommended.

On site soil conditions should allow vegetation growth. Seed mixtures should be as per specification or should be suitable for the climate conditions of the installation. An immediate watering of the soil filling as well as the use of fertilisers can be beneficial for an immediate growth.

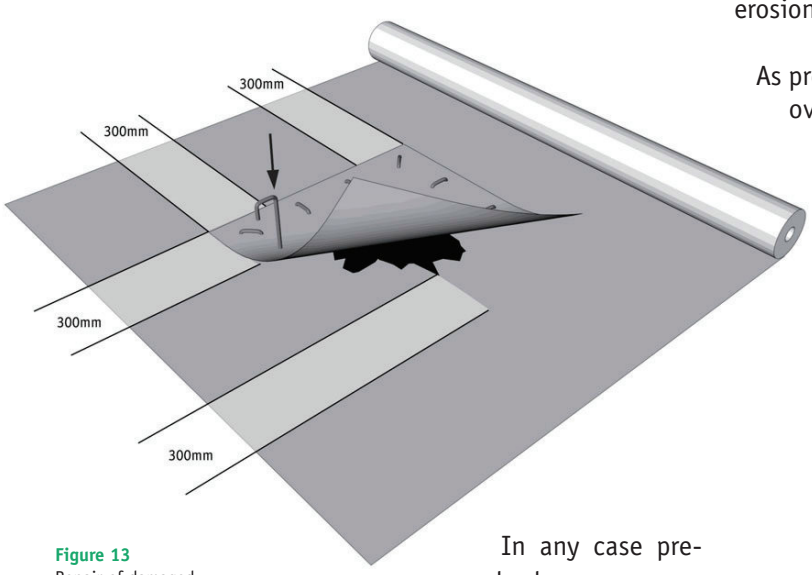


Figure 13
Repair of damaged Secumat® sections

In any case prevent strong concentrations of water run-off by reasonable measure, e.g. small bund along the shoulder or water diversion through pipes laid on the slope.

7. Repair/Replacement. In the event that Secumat® rolls have been damaged during installation, it is possible to cut out damaged sections and install new material. Repaired sections should be joined to all surrounding panels (min. 300mm) and fastened with pins in place before soil and vegetation media are placed (fig. 13).

8. For more information
Secumat® is resistant to environmental influences and supports the development of roots for long-term vegetation and erosion control. Secumat® rolls are installed quickly and economically, and the speedy establishment of vegetation is ensured, even on demanding steep slopes.

Secumat® can also be installed as part of NAUE's reinforced Green Skin and Desert Skin systems for performance on even more extreme slopes for new and corrective erosion control and vegetation promotion.

As products and installation approaches may be updated over time, it is advised to always check with the manufacturer that the product data and installation instructions you have are the most current.

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