Memo

ONDERWERP
The View II - Aanpassing funderingssysteem hoogbouw

PROJECTNUMMER
10583923

DATUM
18 december 2023

ONZE REFERENTIE
FY25RHYSV4VD-436530461-20068:P01

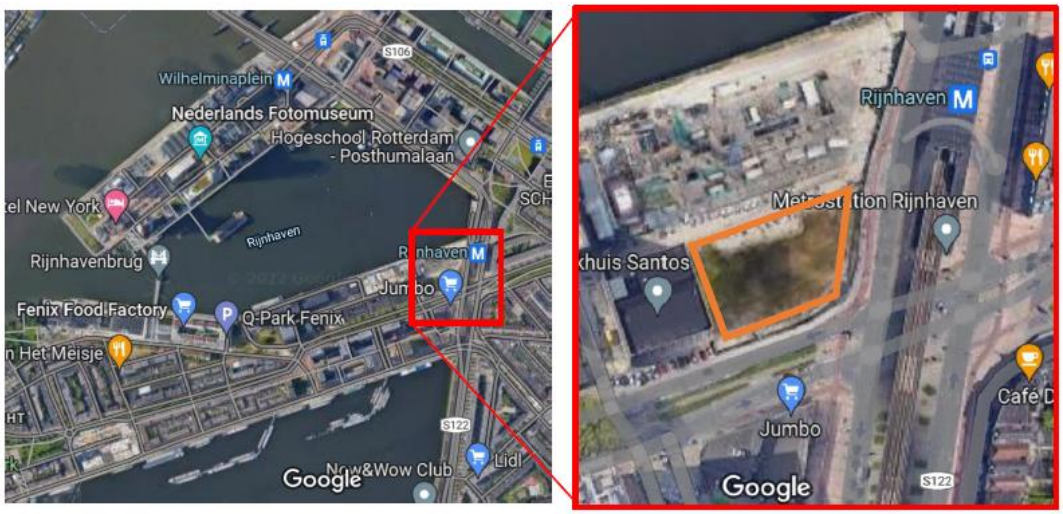
VAN
[redacted]

AAN
Bouw- en Woningtoezicht Rotterdam

KOPIE AAN
[redacted]

1 Introductie

In het centrum van Rotterdam zal het appartementencomplex en hotel The View worden gerealiseerd in opdracht van The View of Rotterdam B.V. The View ligt aan de Rijnhaven, zie Figuur 1-1. De tweede fase van The View (The View II) bestaat uit een laagbouw gedeelte (hoogte ca. 19 m) en een hoogbouwtoren met ca. 34 verdiepingen (hoogte ca. 128 m) met onder beide een 2-laags parkeerkelder. De laagbouw heeft ca. 5 verdiepingen en bestrijkt ca. 50% van het oppervlak van The View II, de hoogbouwtoren bestrijkt de rest.



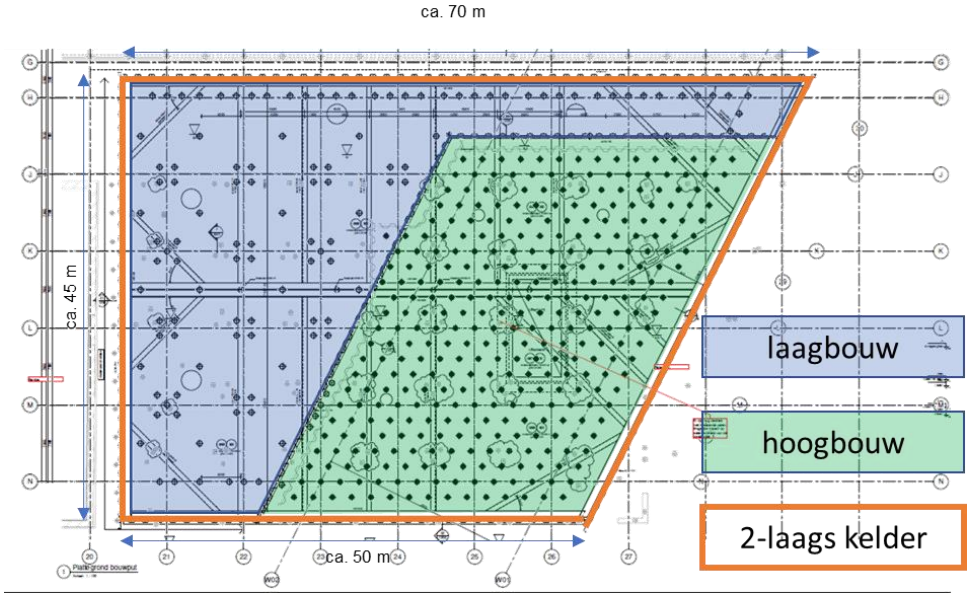
Figuur 1 Locatie The View II (oranje kader)

Een plattegrond van de bouwkuip van The View II is weergegeven in Figuur 1-2. Het huidige funderingssysteem van de hoogbouw bestaat uit het toepassen van geheide prefab betonpalen ☒ 450 x 450 mm in de Pleistocene zandlaag rond NAP -23 m. Na overleg met Bouw- en Woningtoezicht betreffende het verhogen van de afsnuitwaarde is besloten om dit in vervolgberekeningen niet mee te nemen. Het gevolg is dat het plan met prefab palen naar een dieper PPN moet en de risico's ten aanzien van paalbreuk, het niet op diepte komen van palen en de geluidsoverlast toenemen. Daarnaast komt door vertraging van de bouwplanning de opening van het hotel in The View I (gelegen op ca. 20 m van de heiwerkzaamheden) in dezelfde tijdsperiode, waardoor geheide paalsystemen voor veel overlast zullen zorgen voor het hotel.

Om bovenstaande redenen is gekozen voor een alternatief funderingssysteem dat zowel trillings- als geluidsarm is. Dit systeem betreft een in de grond gevormde, grondverdringende betonpaal met verloren punt. Deze wordt gemaakt door een stalen hulpbuis met behulp van groutinjectie schroevend in te brengen. Na het installeren van de hulpbuis wordt

een prefab betonkern in de hulpbuis geplaatst om de krachten in te leiden. Vervolgens wordt de hulpbuis onder toevoeging van cementgrout getrokken.

De voorliggende memo betreft de aanpassing van het funderingssysteem van de hoogbouw (groene gedeelte in figuur 2) als gevolg van opmerkingen gemaakt door Bouw- en Woningtoezicht op het funderingssysteem uit het DO.



Figuur 2 Plattegrond bouwkuip en fundering The View II [15]

2 Inhoudsopgave

3 Referenties

Projectspecifieke referenties

De gehanteerde project specifieke referenties zijn weergegeven in de onderstaande opsomming:

[1]. VII-ARC-REP-GT-DO-0008_The View II Geotechnisch ontwerp DO, 15-12-2022
[2]. Arcadis, The View of Rotterdam Fase 2 (The View II) – Uitgangspunten constructieve DO, kenmerk D10005099
[3]. VII-ARC-VII-Z1-F1-DR-SE-TO-11101, technische tekening met bestaand palenplan en sonderingen, 08-12-2023
[4]. R1603796-15 - The View II - Veldwerk bestaande uit sonderingen, 17-10-2018, MOS
[5]. R1603796-21 - The View II - Veldwerk bestaande uit sonderingen, 29-05-2019, MOS
[6]. R1603796-22 - The View II - Veldwerk bestaande uit een diepe boring, 20-10-2019, MOS
[7]. R1603796-17 - The View II - Labonderzoek bestaande uit resultaten samendrukkingsproeven, 02-03-2020, MOS
[8]. R2203015-01 - The View II - Boring, labonderzoek en peilbuizen, 19-04-2023, MOS

[9]. R2203015-02 - The View II – Aanvullende sonderingen, 07-12-2023, MOS
[10]. VII-ARC-VII-F1-DR-SE-DO-1100 – Palenplan, 15-12-2022, Arcadis.

Normen en richtlijnen

De gehanteerde normen en richtlijnen zijn weergegeven in de onderstaande opsomming:

[A] NEN-EN 1990 Grondslagen voor het constructief ontwerp, 2019
[B] NEN 9997-1 Geotechnisch ontwerp: Algemene regels, 2017
[C] Handboek funderingen - Deel A en B, 2019
[D] NEN-EN 12699 Uitvoering van bijzonder geotechnisch werk - Verdringingspalen

4 Paalbelasting hoogbouw

De hoogbouw heeft een parallelogramvormig oppervlak en zal worden gefundeerd op 415 palen, welke zich op regelmatige afstand in een driehoekspatroon onder de keldervloer bevinden. De palen hebben een hart-op-hartafstand van ca. 1,9 m in x-richting en ca. 1,788m in de andere richting [10]. De palen zullen worden ingestort in een gewapende betonvloer van 2 m dik. Door de dikke gewapende betonvloer zal de verticale belasting van de hoogbouw gelijkmatig verdeeld worden over de palen, hierdoor is dit een stijve fundering. Op basis van het constructief ontwerp zijn de volgende paalbelastingen opgegeven [2]:

- BGT - druk ($F_{c;k}$): 2133 kN/paal.
- UGT - druk ($F_{c;d}$): 3100 kN/paal.

De draagkracht van de palen van de hoogbouw is getoetst in de UGT. De fundering van de hoogbouw zal bestaan uit een in de grond gevormde, grondverdringende betonpaal met verloren punt ø 540/680 mm (diameter hulpbuis/diameter punt) welke worden gefundeerd in de eerste (pleistocene) zandlaag. De eerste (pleistocene) zandlaag bevindt zich tussen NAP -16,5 m à NAP -19 m tot NAP -27,5 à NAP -31 m. De huidige conusweerstand in de zandlaag is gemiddeld 15 MPa of hoger, met lokale uitschieters naar beneden of boven.

5 Uitgangspunten

De volgende uitgangspunten zijn bij de draagkrachtberekeningen gehanteerd:

- Rekenwaarde paalbelasting 3100 kN/paal druk. Er is in de eindfase geen trekbelasting werkend op de paal.
- Conform [C] kan voor de bepaling van de schachtwrijving ingeval van groutinjectie de diameter van de schroefpunt worden aangehouden.
- De draagkracht van de fundering is gebaseerd op de relevante sonderingen 1, 28, B, C, E, F, G, I, J, K, H1, H2, H3, H4, H5, H6 en H7 [9][10][11]. Voor een nadere analyse van de sonderingen wordt verwezen naar Bijlage A en B.
- Tabel A.10b (stijf bouwwerk) van NEN 9997-1 wordt gehanteerd voor de bepaling van ξ_3 en ξ_4. Dit is nader uitgewerkt in bijlage B.

Correlatiefactoren ξ voor een stijf bouwwerk							
ξ voor n =	1	2	3	4	5	7	10
ξ_3 [a]	1,26	1,20	1,18	1,17	1,17	1,15	1,14
ξ_4 [a]	1,26	0,96	0,94	0,93	0,93	0,92	0,91
[a] De factor 1,1 volgens NEN-EN 1997-1+C1+A1:2016, 7.6.2.3 (7) is al verwerkt in de factoren van tabel A.10b.							

- De positieve schachtwrijving berekend vanaf de eerste (pleistocene) zandlaag.
- Voor de uitwerking van de paalfundering in dit memo is uitgegaan van verticaal, centrisch en op druk belaste palen. Momenten, trekbelastingen, horizontale belastingen en paalgroepswerking zijn waar noodzakelijk beschouwd in de algehele hoofdrapportage [1] en hebben geen impact op de resultaten uit dit memo.

- Conform NEN 9997-1 [B] zijn de volgende partiele factoren gehanteerd voor de uiterste grenstoestand:
  - γ_b = 1,2 [-] (punt)
  - γ_s = 1,2 [-] (schacht)
- Bij de draagkrachtberekeningen zijn de volgende paalfactoren aangehouden, conform de NEN 9997-1 [B]:
  - α_p = 0,63 [-] (punt)
  - α_s = 0,009 [-] (schacht - druk)
  - s = 1,0 [-] (paalvoetvorm)
  - β = 1,0 [-] (vorm van de doorsnede). De rekendiameter van de schacht (d_{eq}) is gelijk aan die van de punt (D_{eq}).
- De palen zullen verdiept worden aangebracht vanaf NAP +1 m. De kop van de palen wordt verdiept weggezet met paalkopniveau op NAP -5,0 m. Zo snel mogelijk na het realiseren van de palen dient de zone tussen werkniveau (NAP +1,0 m) en paalkop (ca. NAP -5,0 m) afgevuld te worden met zand om vervorming van de bouwkuipwand en onveilige situaties in de bouwkuip te voorkomen. Na het aanbrengen van de paalfundering zal de bouwkuip worden ontgraven tot ca. NAP -5,3 m en zullen de paalkoppen worden gesneld.
- De conusweerstand in de diepere ondergrond zal reduceren door de ontgraving. In D-Foundations is de reductie van de conusweerstand ingeschat o.b.v. de methode Begemann. Volgens deze methode zal de conusweerstand in de eerste (pleistocene) zandlaag licht reduceren. Dit effect is nader beschreven in Bijlage B.

Het is mogelijk dat de samendrukbare lagen aan de buitenzijde van de hoogbouw aan de oost- en zuidzijde zorgen voor een extra negatieve kleefbelasting langs de kelderwand. Aan de binnen-, west- en noordzijde van de paalfundering wordt de (samendrukbare) grond tussen de palen niet ontlast door de diepe ontgraving. Om deze reden zal de grond hier nauwelijks zakken en zal er geen negatieve kleef langs de palen optreden.

Negatieve kleef langs de funderingspalen aan de oost- en zuidzijde van de hoogbouw treedt niet op omdat de fundering meer zakt dan de lagen beneden NAP -5,0 m.

De negatieve kleef is berekend langs de kelderwand. Voor de berekeningen wordt verwezen naar Bijlage C. De resultaten van de negatieve kleef zijn:

- Negatieve kleef langs 75 m kelderwand: 72 kN/m * 75 m = 5.400 kN

Negatieve kleef is beschouwd in het constructieve model en daarmee al meegenomen in de weergegeven rekenwaarde voor de belastingen.

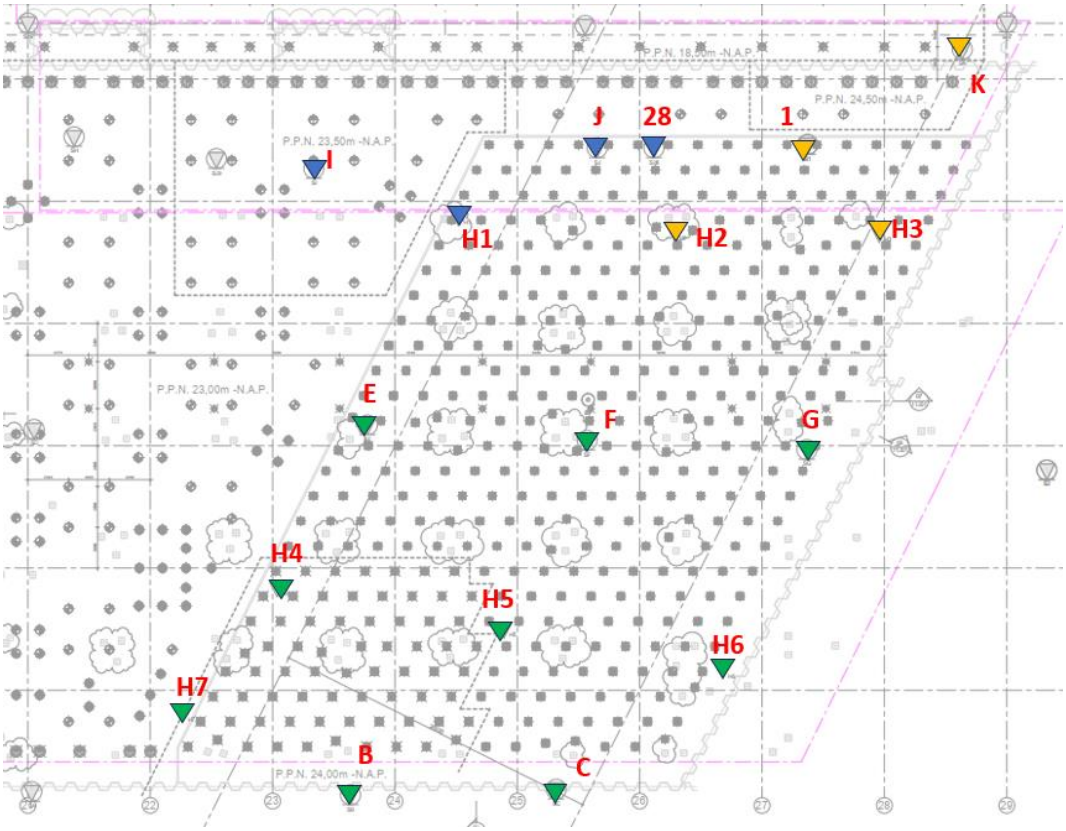
6 Berekeningsmethode

Op basis van de grondopbouw weergegeven in de sonderingen is een aantal blokken bepaald waarvoor het paalpuntniveau is bepaald, weergegeven in Tabel 1. Per blok is bepaald wat de ξ_3 en ξ_4 factoren dienen te zijn. Een visueel overzicht is weergegeven in Figuur 3.

Tabel 1 Overzicht blokken hoogbouw

Blok	Sonderingen	n [-]	ξ_3 en ξ_4 [-]	Maximale ontgraving [m NAP]
Blok 1 (oranje)	K, H3, H2, 1	4	1,17 / 0,93	-5,3
Blok 2 (blauw)	I, J, H1, 28	4	1,17 / 0,93	-5,3
Blok 3 (groen)	E, F, G, H4, H5, H6, H7, B, C	9	1,15 / 0,92	-5,3

Er is onderscheid gemaakt in een aantal blokken omdat in de eerste (pleistocene) zandlaag ter plaatse van de hoogbouw van The View II bevat op de relevante diepte (tussen bovenkant zandlaag en 4D onder paalpunt) lokaal teruggangen in de conusweerstand zijn waargenomen. Op basis van het labonderzoek is echter vastgesteld dat dit geen silt- of klei verstoringen betreffen, alle boorbeschrijvingen geven zwak siltig aan [6][8].



Figuur 3 Visuele weergave sonderingen en blokken

7 Resultaten paalfundering hoogbouw

De draagkracht van de in de grond gevormde, grondverdringende betonpaal met verloren punt ø 540/680 mm is berekend volgens paragraaf 7.6.2 van de NEN 9997-1 [B], waarin de puntweerstand (R_b) en schachtwrijving (R_s) los van elkaar beschouwd worden. Volgens de toetsing van de UGT moet voldaan worden aan:

$$F_{c;d} \leq R_{c;net;d},$$

Waarbij:

$$R_{c;net;d} = R_{c;d}$$

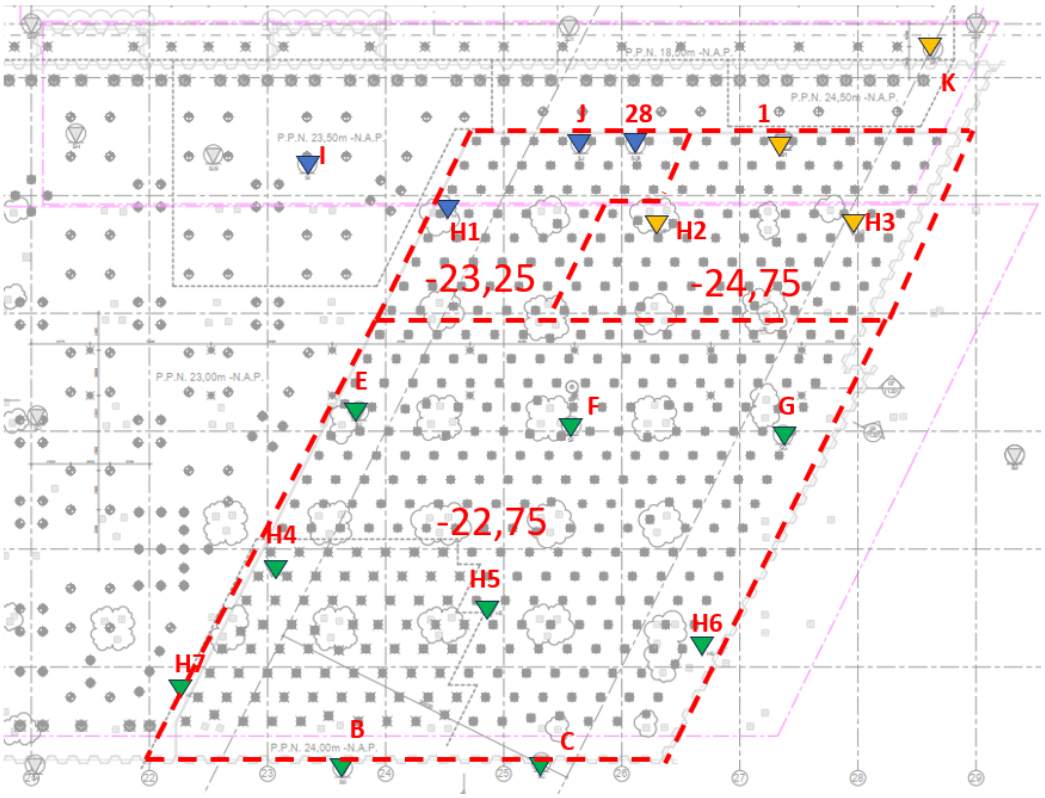
In Tabel 2 is te zien dat voor ieder blok geldt dat 3100 kN < $R_{c;net;d}$, de draagkracht van de paalfundering voldoet. Ook is de variatie per blok lager of gelijk aan 12%, hiermee mogen de sonderingen in de gekozen blokken gecombineerd worden en kunnen de ξ_3 en ξ_4 voor een stijf bouwwerk toegepast worden. De twee meter dikke funderingsplaat vangt eventuele verschilzakkingen op. Een visuele weergave is weergegeven in Figuur 4. De totale analyse is weergeven in Bijlage B en Bijlage D.

Tabel 2 Resultaten paalpuntniveau, draagkracht en variatiecoëfficiënt

Blok	Bovenkant paal [m NAP]	PPN [m NAP]	F_{UGT} [kN]	$R_{c,net,d}$ [kN]	UC [-]	Variatie [%]
Blok 1	-5,0 m	-24,75	3100	3115	0,995 ≤ 1,0 → OK	10 ≤ 12% → OK
Blok 2	-5,0 m	-23,25	3100	3189	0,972 ≤ 1,0 → OK	7 ≤ 12% → OK
Blok 3	-5,0 m	-22,75	3100	3317	0,935 ≤ 1,0 → OK	12 ≤12% → OK

De laag karakteristieke veerstijfheid van de palen is gelijk aan 135 MN/m. Voor de bepaling van de paalkopzakking en paalveerstijfheid wordt verwezen naar Bijlage B.

Door de constructeur dient de paal(kop)wapening gedimensioneerd te worden. In de hulpbuis 540 mm kan zowel een vierkant 350 mm of achtkant 430 mm prefab betonkern toegepast worden. Dit is afhankelijk van de leverancier en dient door de aannemer nader uitgewerkt te worden.



Figuur 4 Visuele weergave paalpuntniveau per blok

8 Uitvoering

Tijdens de uitvoering dient rekening gehouden te worden met minimale hart-op-hartafstanden. De minimale hart-op-hartafstand van naburige palen met een ouderdom van een dag is 2,25 à 2,5 x d_{voet}. Bij een hart-op-hartafstand van

minimaal 4 x d_{voet} kan een kortere wachttijd aangehouden worden. De check op de minimale afstand is weergegeven in Tabel 3. Hieruit blijkt dat aan 2,25 x D wordt voldaan maar niet aan 2,5 x D. Palen dienen om-en-om aangebracht te worden en een minimale ouderdom van een dag te hebben.

Tabel 3 Check minimale hart-op-hartafstand

Minimale afstand 2,25 x D =		**1530 mm**		
Minimale afstand 2,50 x D =		**1700 mm**		
Grid	1900 mm	x-richting	➔	OK
	1788 mm	y-richting	➔	OK
Minimale afstand 4,0 x **D** =		**2720 mm**		

Minimale afstand (dagmaat) tot bestaande funderingspalen niet verwijderde palen van de oude Jumbo vanwege de uitvoering en/of toleranties is circa 0,4 m. De draagkracht van de bestaande funderingspalen is niet relevant omdat deze geen functie meer hebben.

Tijdens het realiseren van de palen dient het gat tussen NAP +1,0 m en NAP -5,0 m afgevuld te worden met zand en/of beton om vervorming en/of instabiliteit van de bouwkuip te voorkomen. Vanwege eisen uit de “NEN-EN 12699 Uitvoering van bijzonder geotechnisch werk – Verdringingspalen” dienen de palen afgestort te worden tot het werkniveau van waaraf de palen worden vervaardigd, tenzij voldoende ervaring is opgedaan en de geometrie en de sterkte gegarandeerd kunnen worden. De afweging tussen zand, grind en/of beton is aan de aannemer in alle gevallen dient het gat opgevuld te worden in verband met stabiliteit van de bouwkuipwanden.

Vanwege het dichte palenplan dient rekening gehouden te worden met zwaar schroefwerk. Het zorgvuldig installeren van de palen en afstemmen van de groutinjectie is van belang. Daarnaast moet het funderingsbedrijf met zijn gekozen volgorde te voorkomen dat reeds gemaakte palen worden beïnvloed door het boren van naastgelegen palen.

9 Conclusie

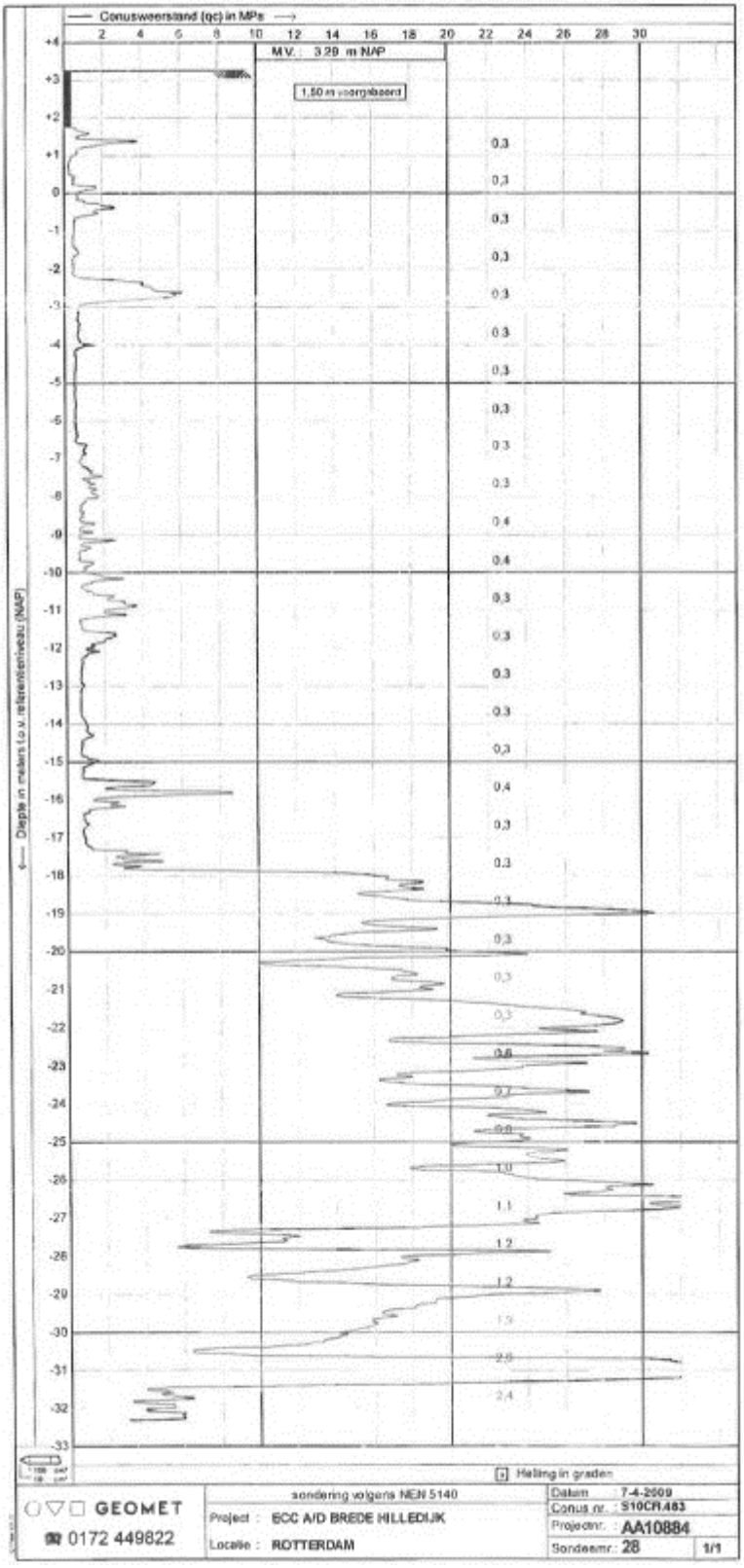
Op basis van de draagkrachtberekeningen dient een grond gevormde, grondverdringende betonpaal met verloren punt ø 540/680 mm met groutinjectie toegepast te worden. In de hulpbuis dient een prefab kern (achtkantig 430 of vierkant 350) toegepast te worden. De bovenkant van de betonkern dient op ca. NAP -5,0 m te worden gerealiseerd. Het paalpuntniveau varieert op basis van de berekeningen:

- Blok 1 NAP -24,75 m
- Blok 2 NAP -23,25 m
- Blok 3 NAP -22,75 m

De draagkracht van de blokken is in alle gevallen hoger dat de vooraf gedefinieerde grenswaarde van 3100 kN. De laag karakteristieke gemiddelde (van de blokken) veerwaarde is gelijk aan 135 MN/m.

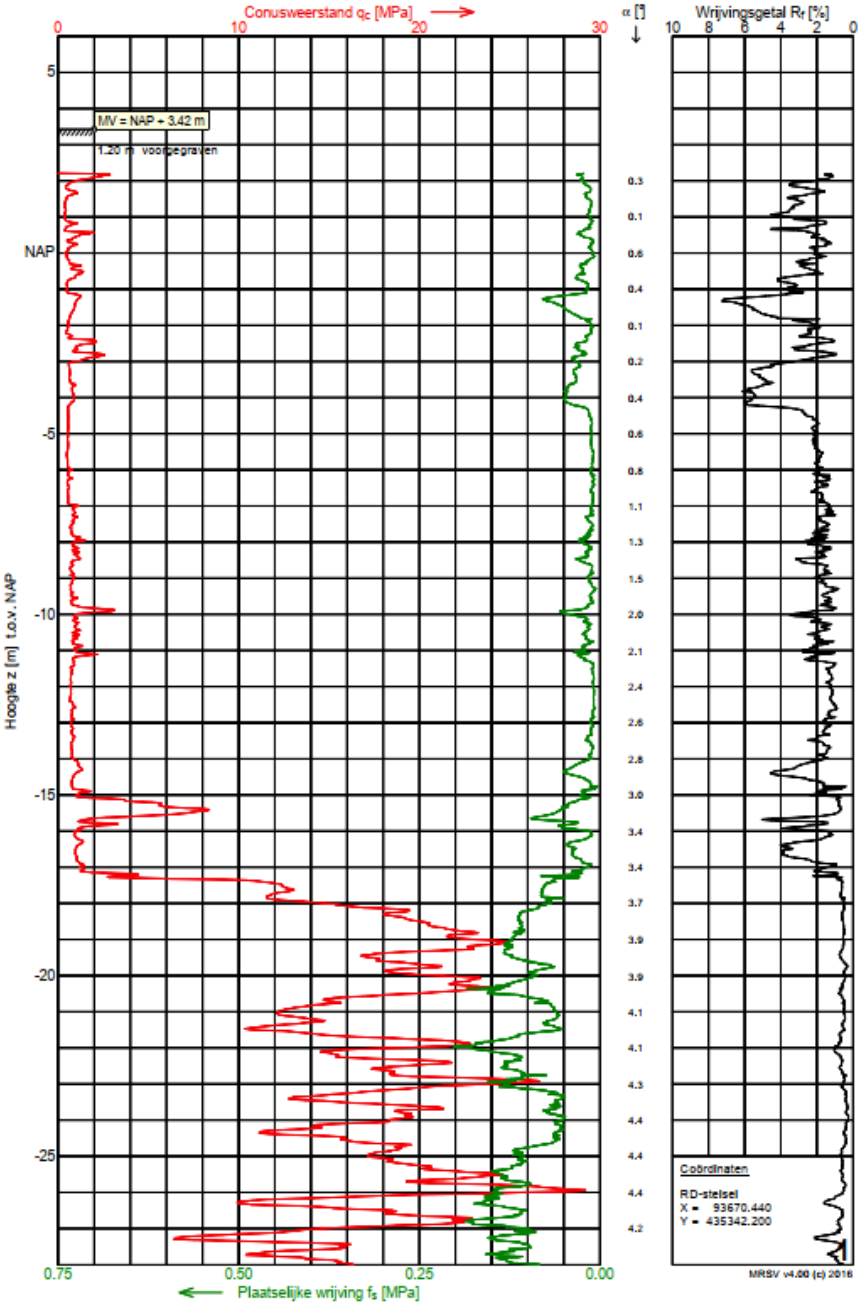
Het dichte palenveld stelt specifieke randvoorwaarden aan de uitvoering van de funderingspalen, zie hoofdstuk 8. De uitvoering, gekozen heivolgorde en kwaliteit blijft te allen tijde de verantwoordelijkheid van de aannemer.

Bijlage A – Grondonderzoek



Sondering 1

Opdracht	: 1603796	Conus nummer	: S15-CFII.951	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 10-09-2018	Opp. conuspunt	: 1500 mm^2	Sondeerunit	: SW11
Project	: The View fase 2 Jumbo			Blad	: 1 van 3



Sondering B

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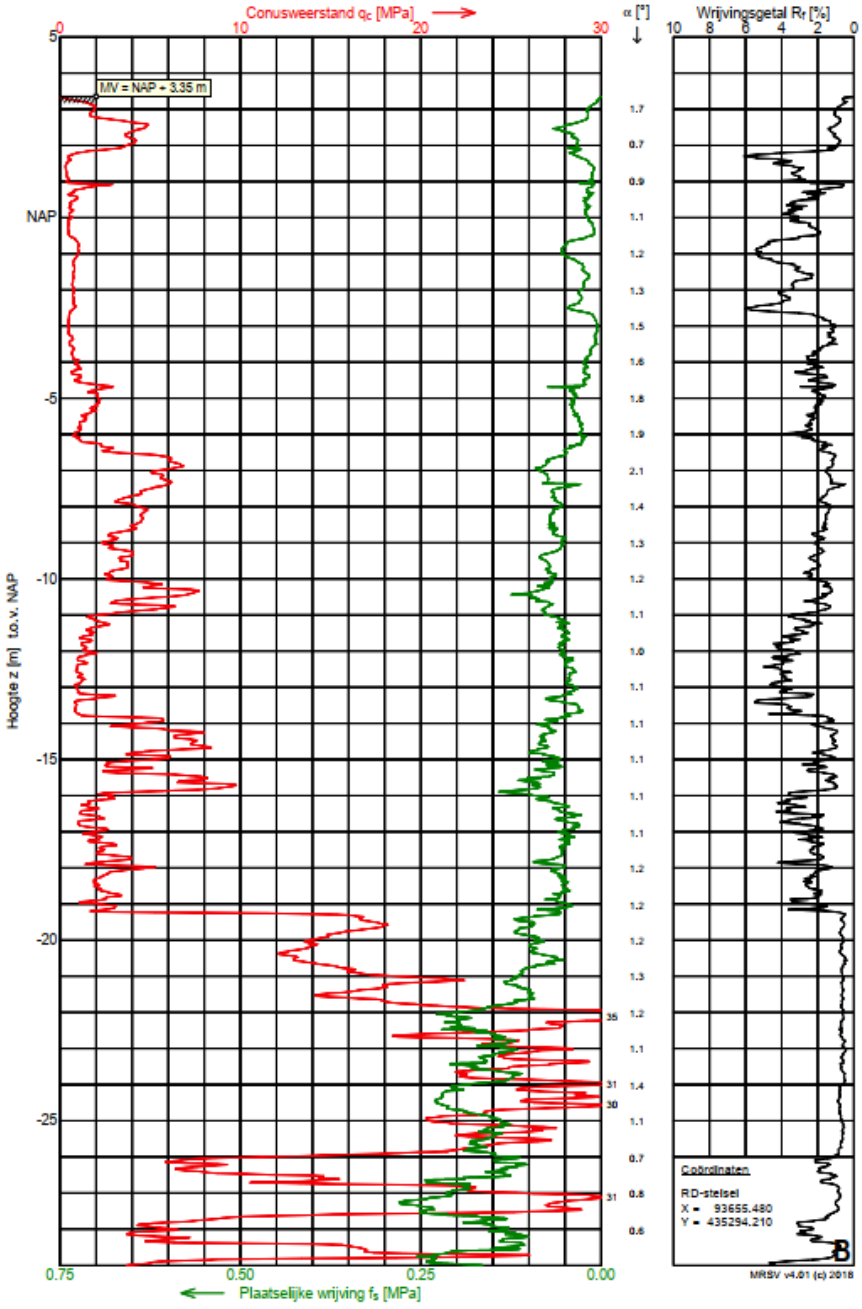

Sondering C

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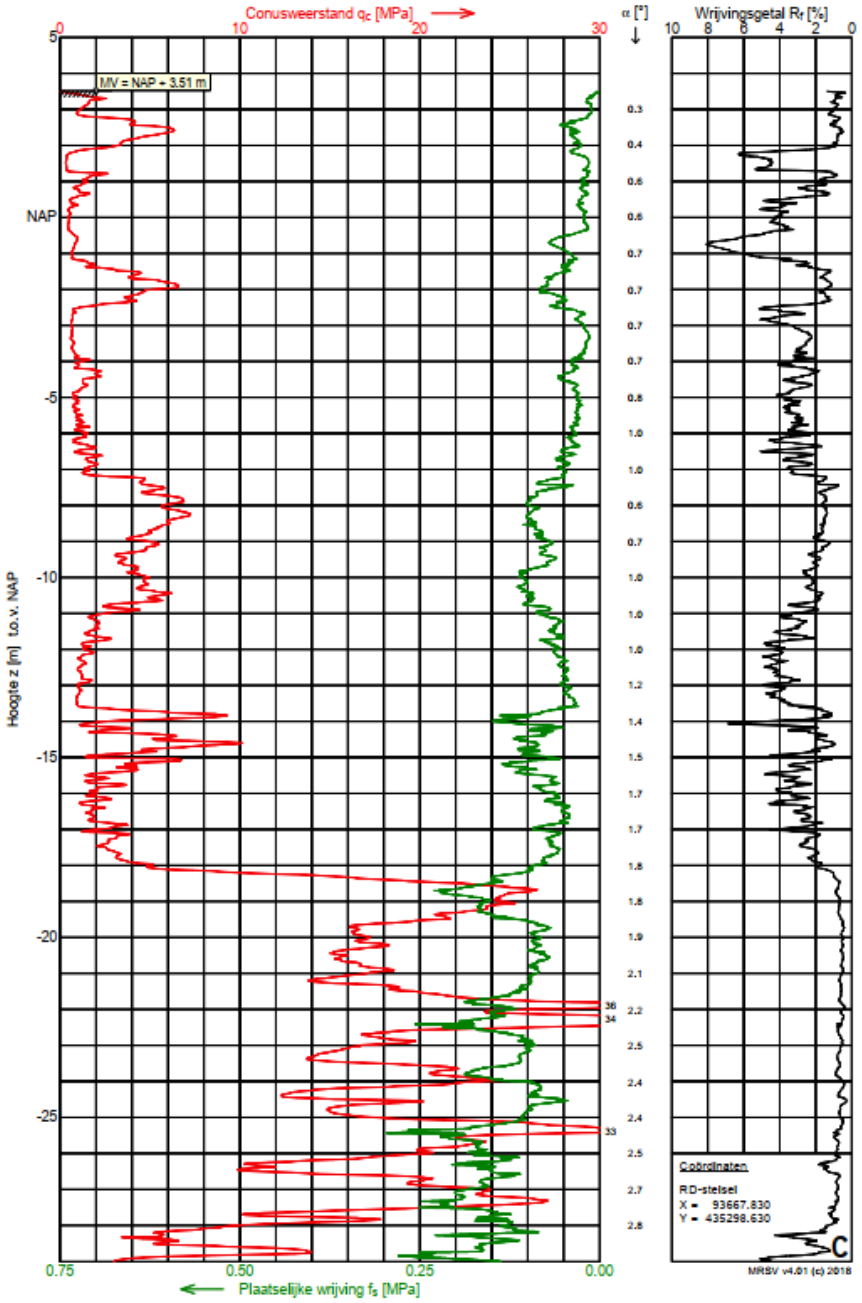

Sondering F

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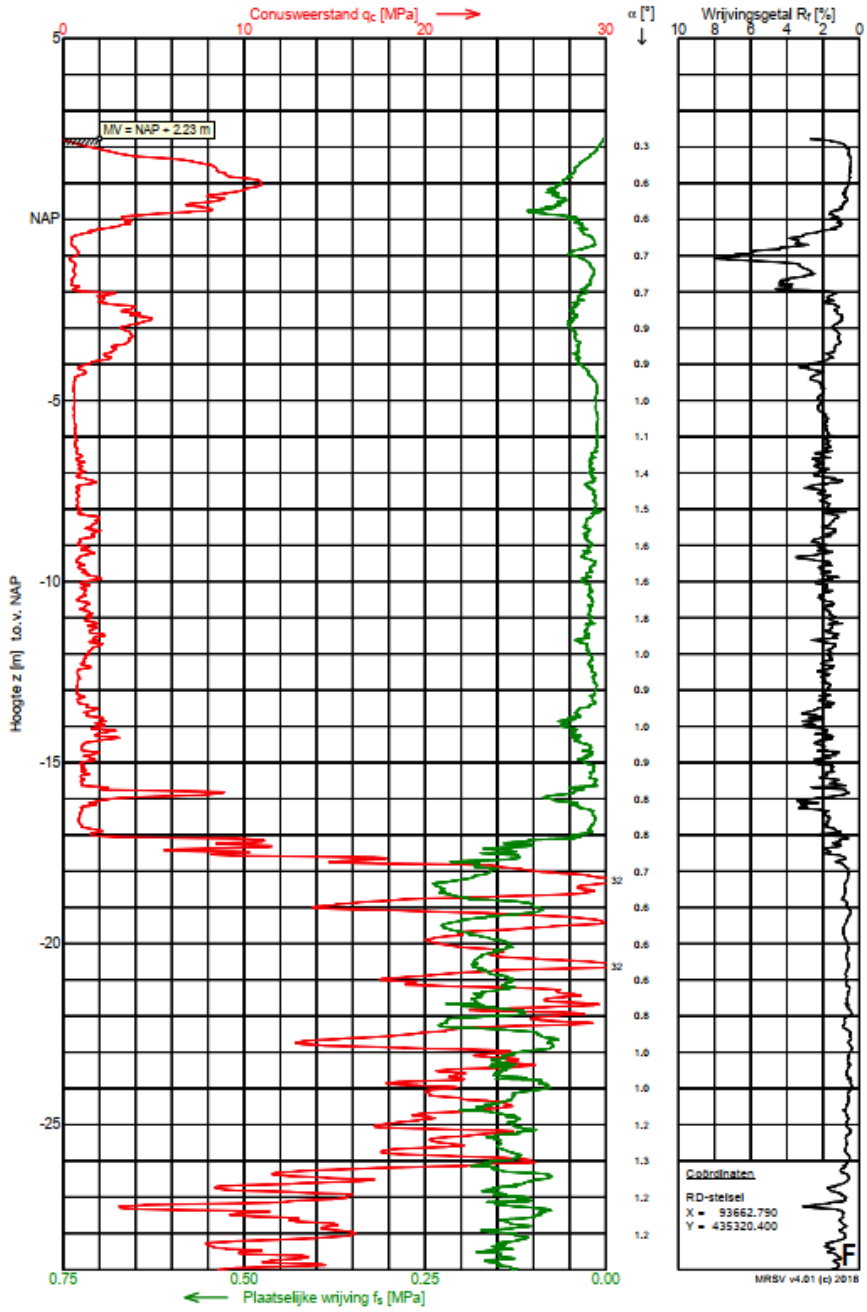
Project	: The View fase 2 Jumbo			Blad	: 1 van 3



Sondering G

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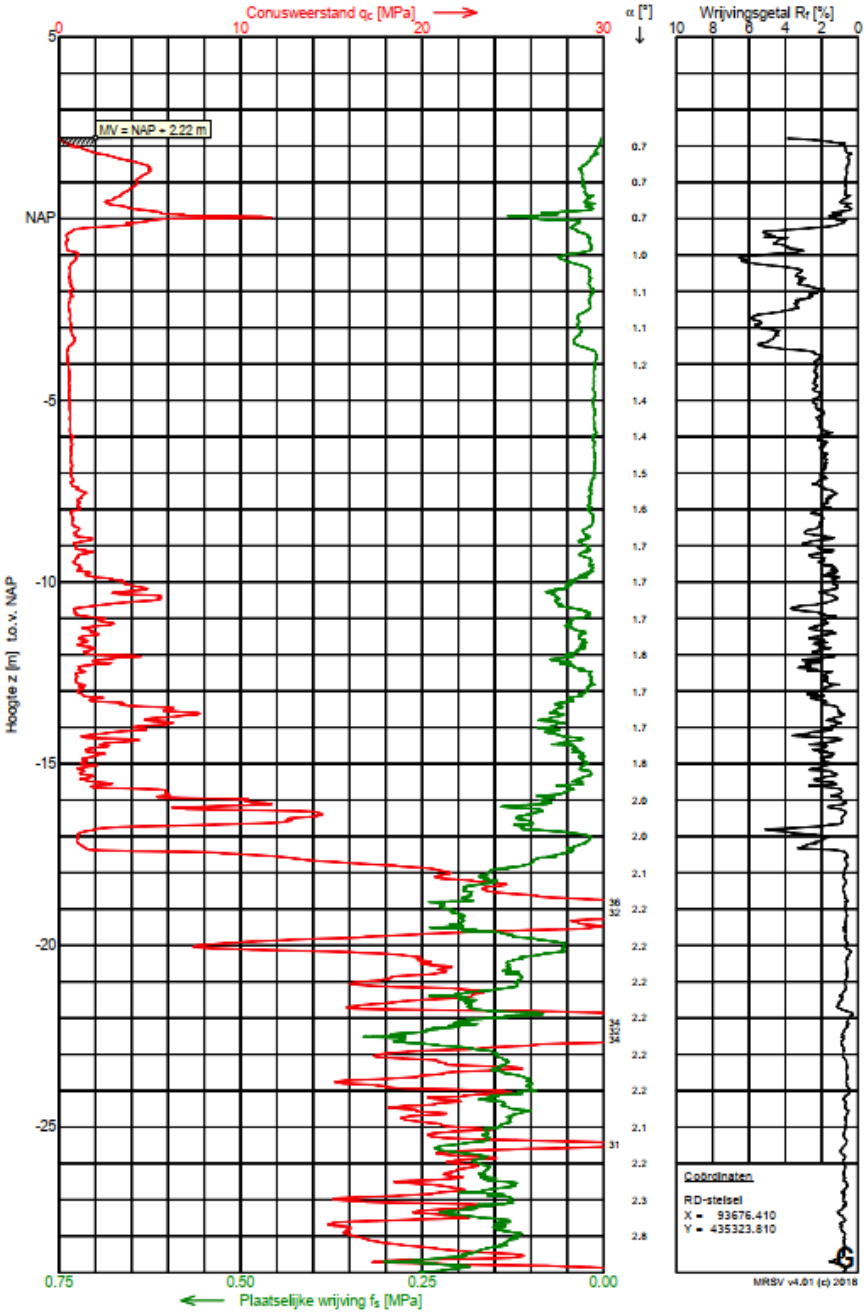

Sondering I

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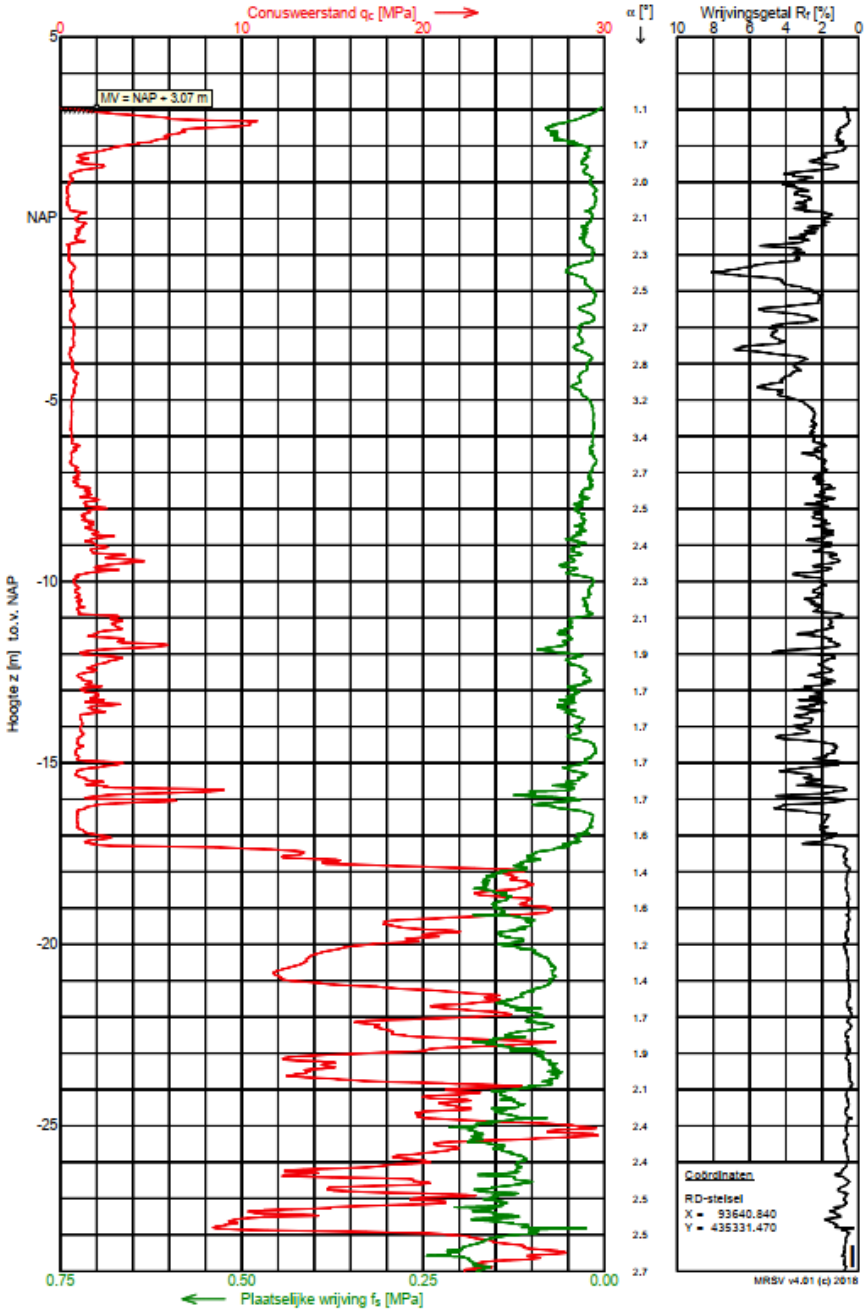

Sondering J

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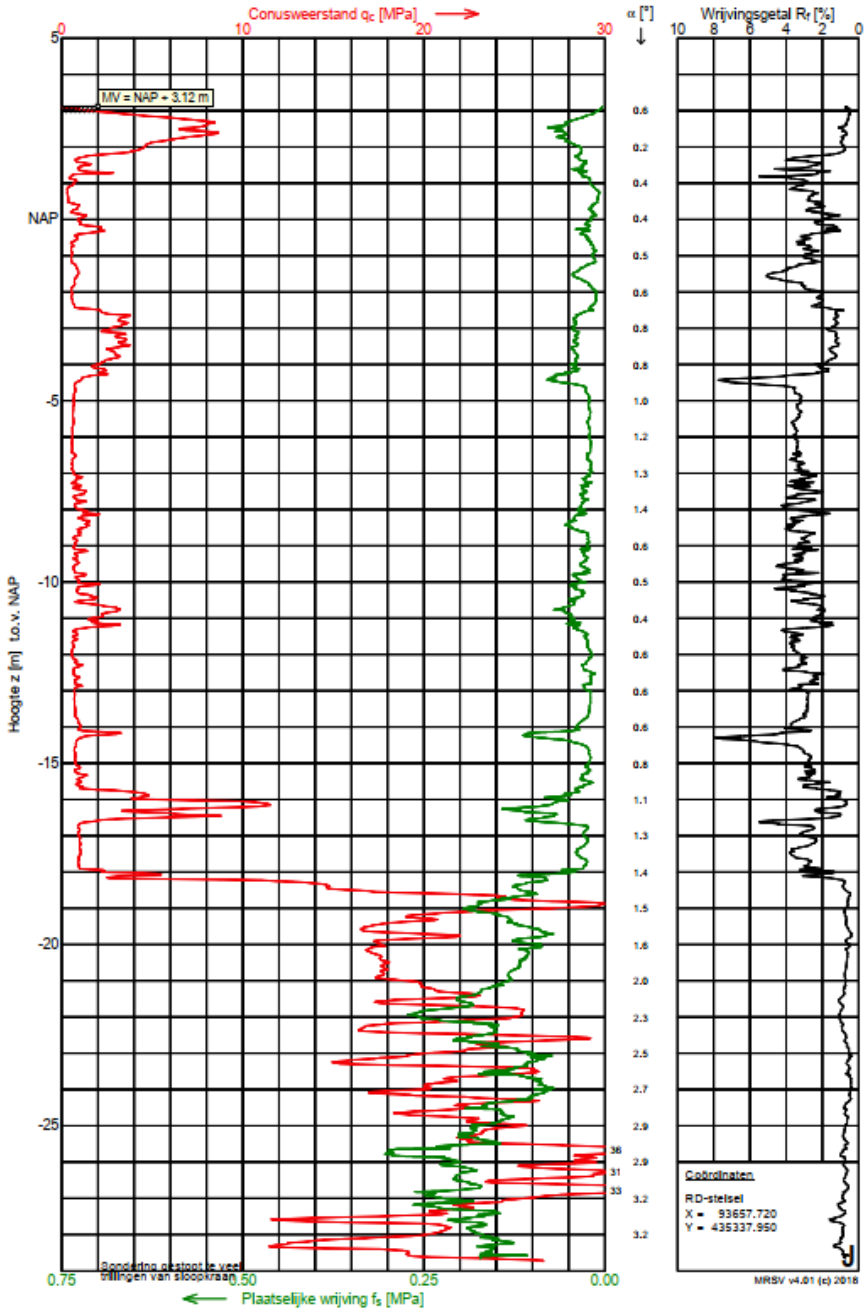

Sondering K

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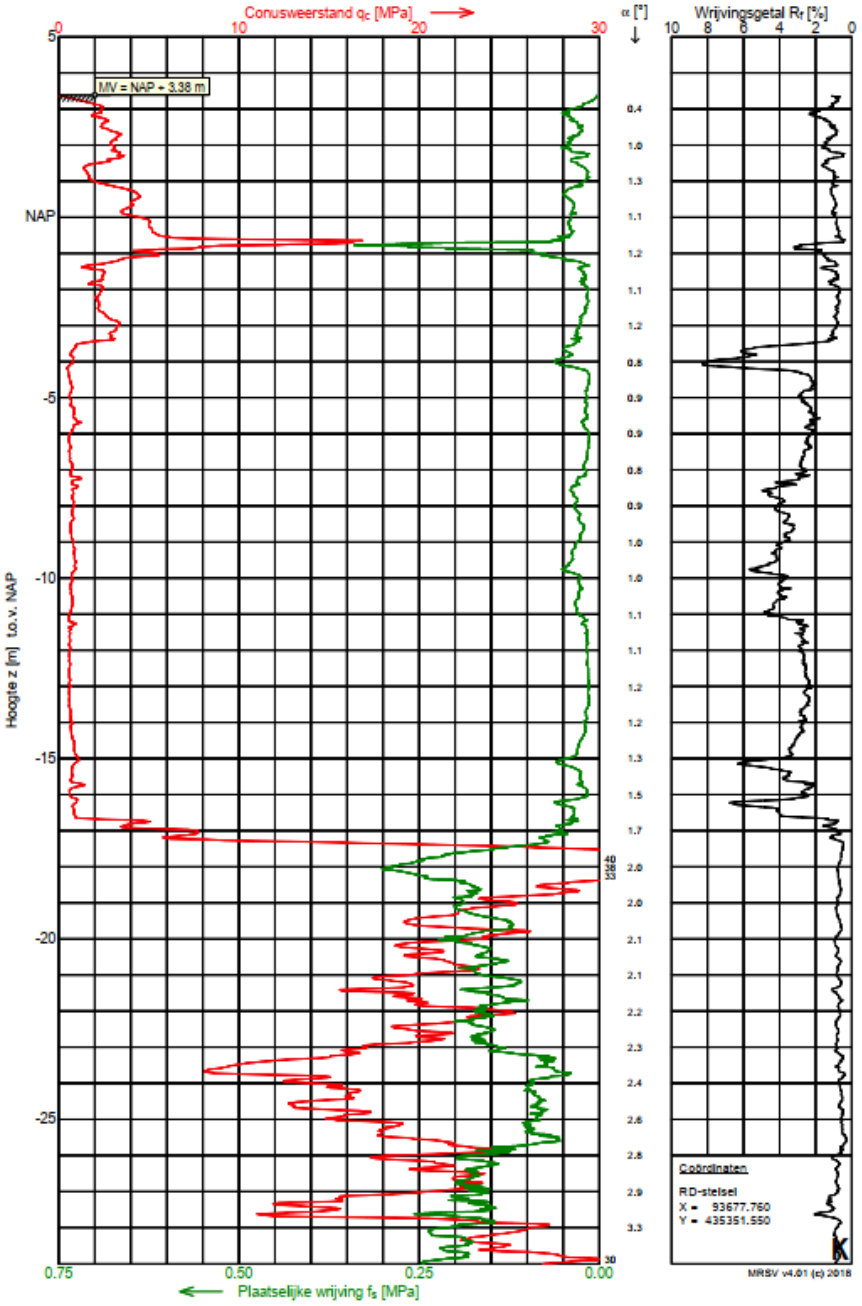
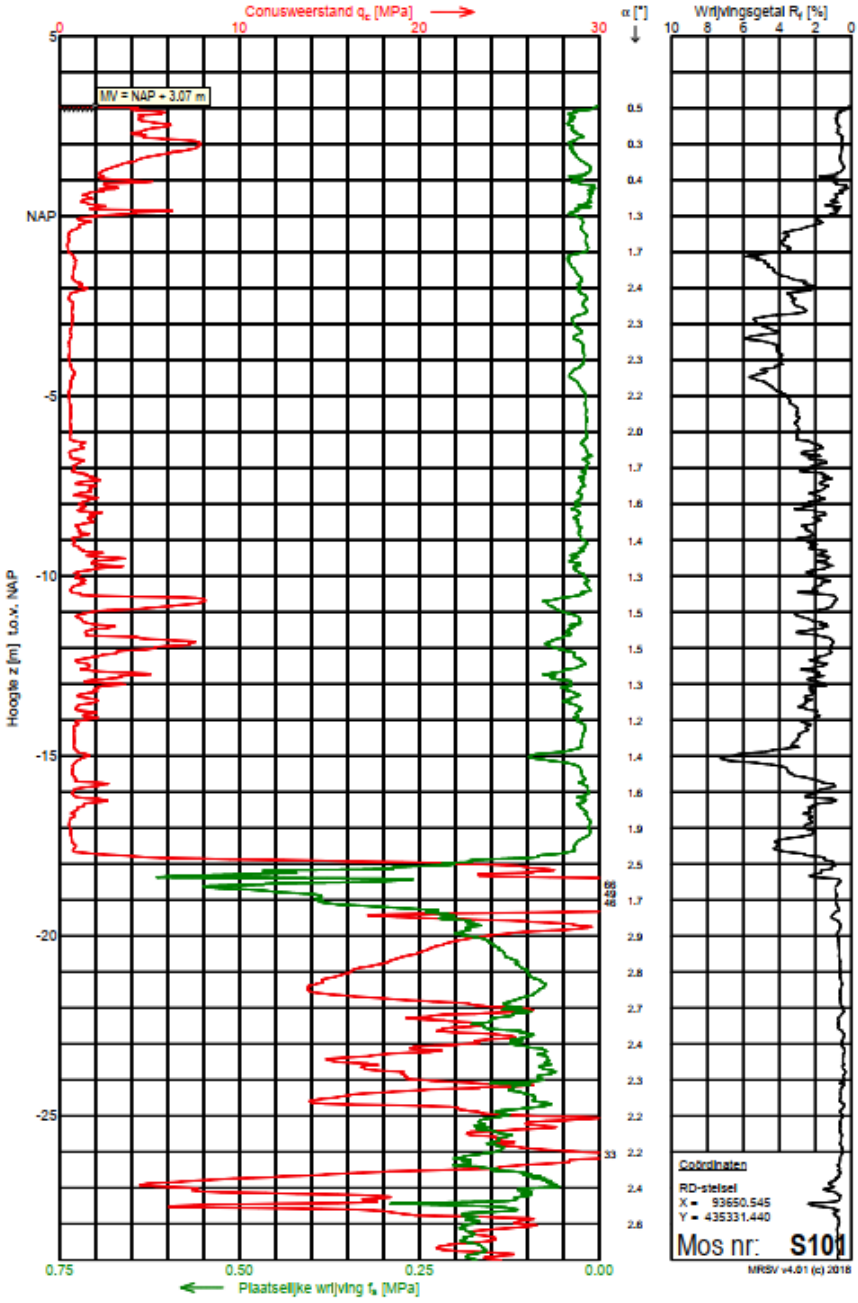
Datum	: 14-02-2019	Opp. conuspunt	: 1500 mm^2	Sondeerunit	: SW11
Project	: The View fase 2 Jumbo			Blad	: 1 van 3



Sondering H1

Opdracht	: 2203015	Conus nummer	: S15-CFII.2005	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 30-11-2023	Opp. conuspunt	: 1500 mm²	Sondeerunit	: SW11
Project	: The View II			Blad	: 1 van 2

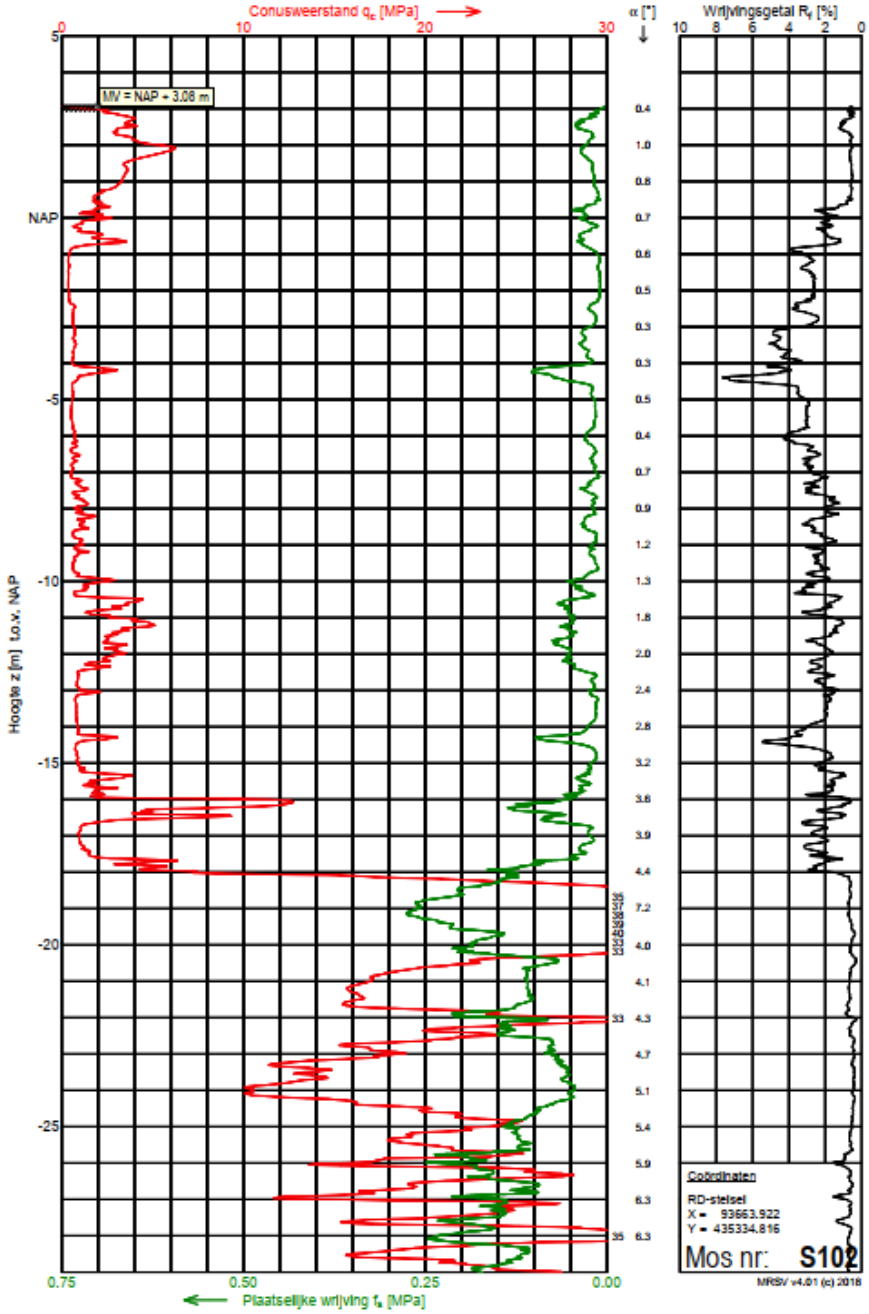


Sondering H2

Opdracht : 2203015
Plaats : Rotterdam
Datum : 01-12-2023
Project : The View II

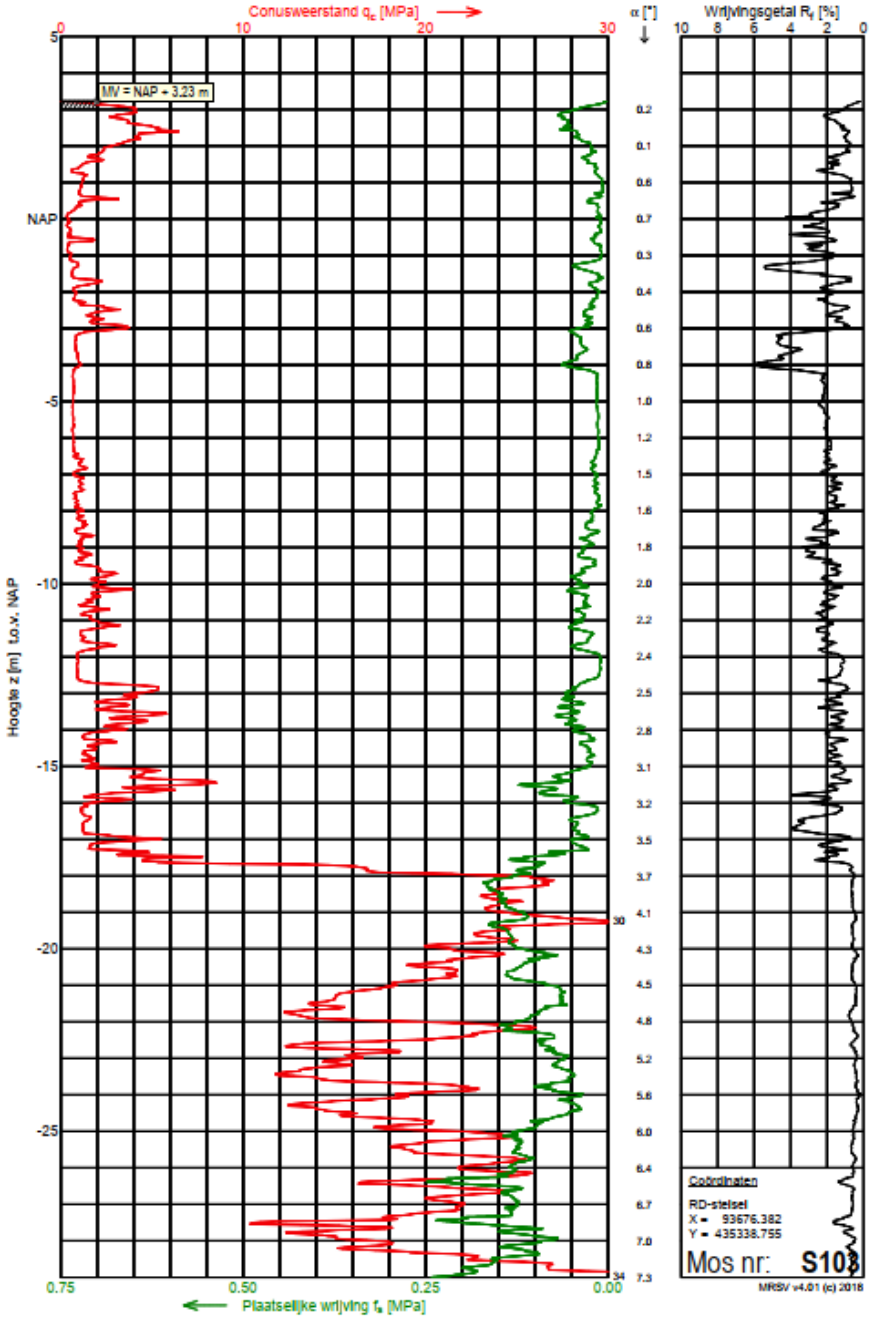
Conus nummer : S15-CFII.2005
Soort conus : Elektrisch
Opp. conuspunt : 1500 mm²

NEN-EN-ISO-22476-1
Klasse 3, type TE1
Sondeerunit : SW11
Blad : 1 van 2



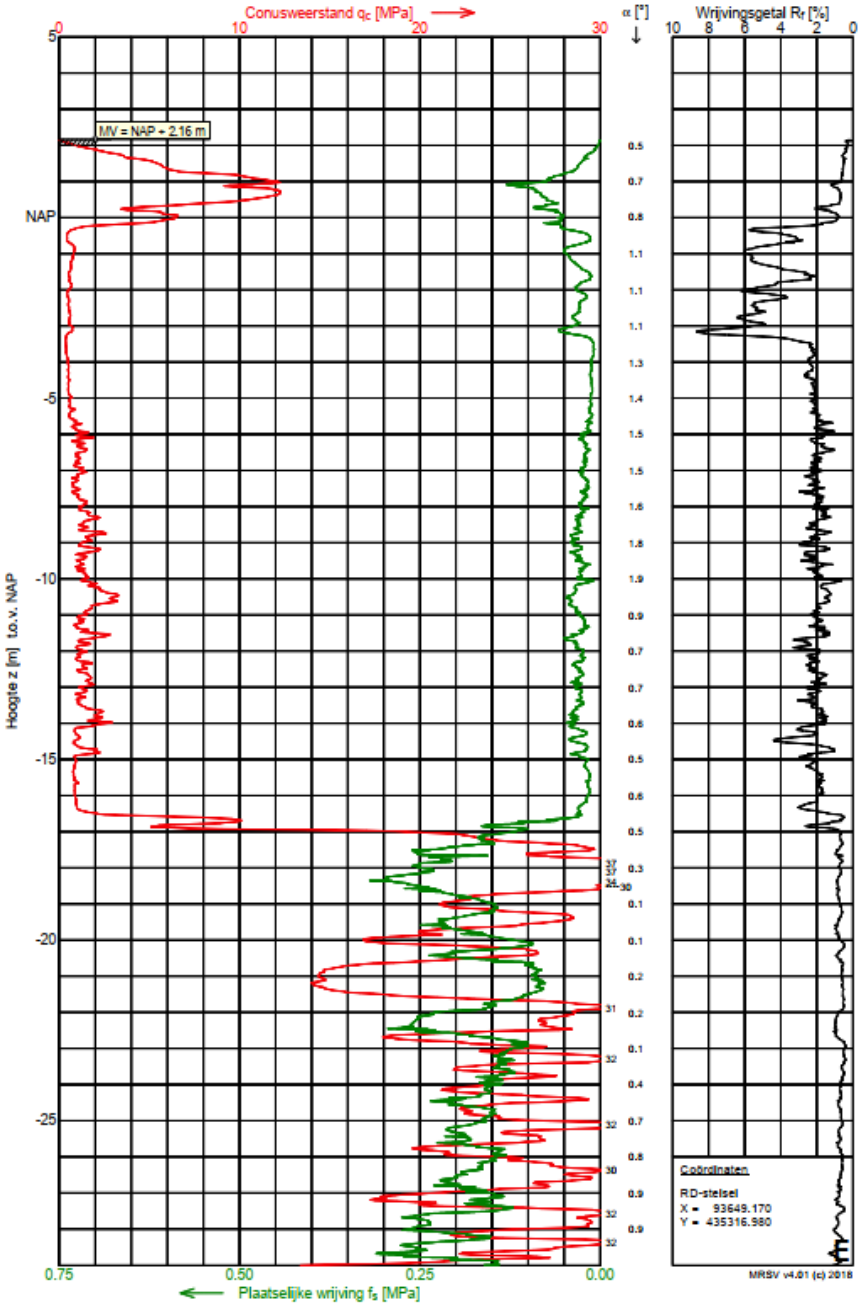
Sondering H3

Opdracht	: 2203015	Conus nummer	: S15-CFII.2005	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 01-12-2023	Opp. conuspunt	: 1500 mm²	Sondeerunit	: SW11
Project	: The View II			Blad	: 1 van 2



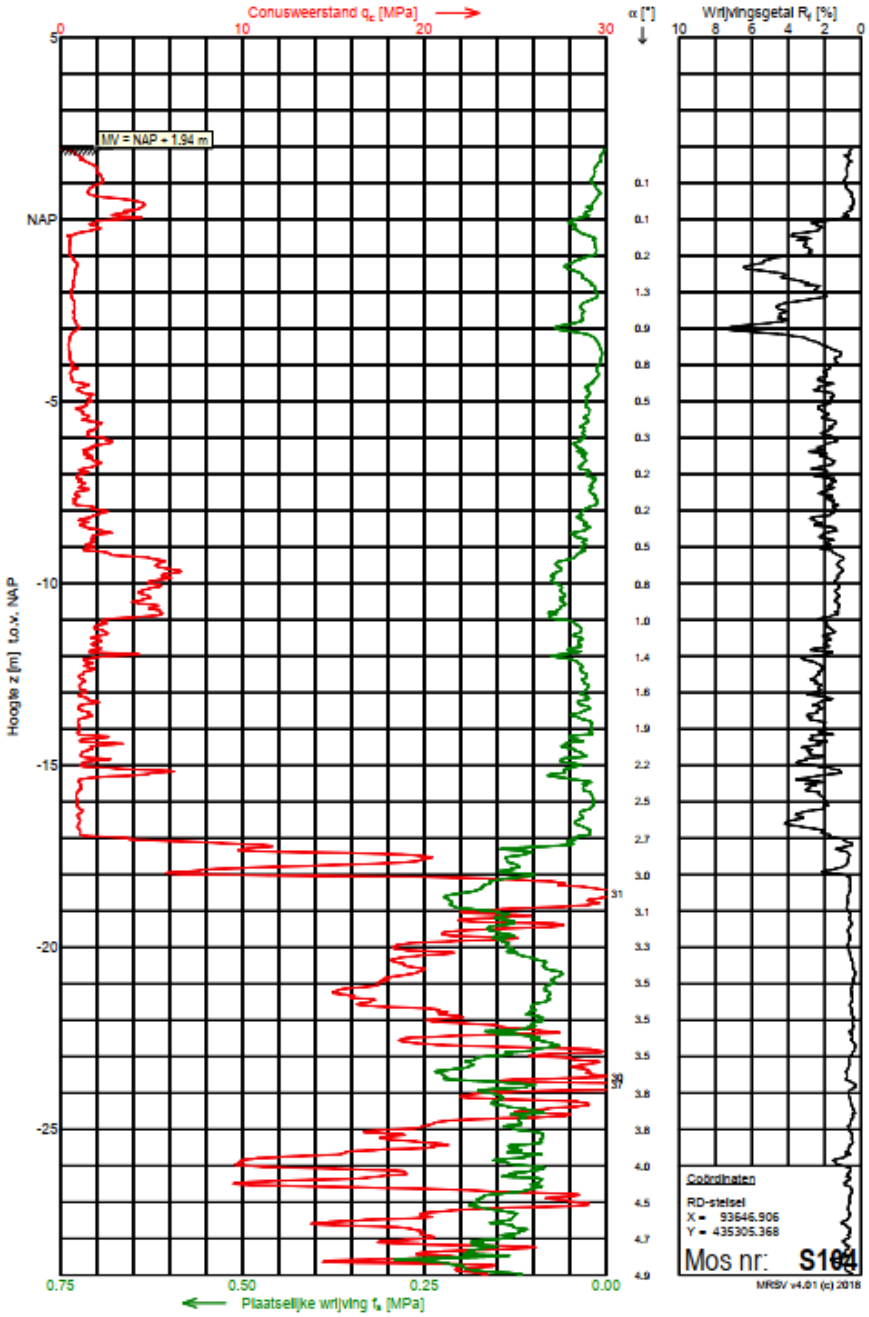
Sondering E

Opdracht	: 1603796	Conus nummer	: S15-CFII.951	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 24-05-2019	Opp. conuspunt	: 1500 mm^2	Sondeerunit	: SW11
Project	: The View fase 2 Jumbo			Blad	: 1 van 3



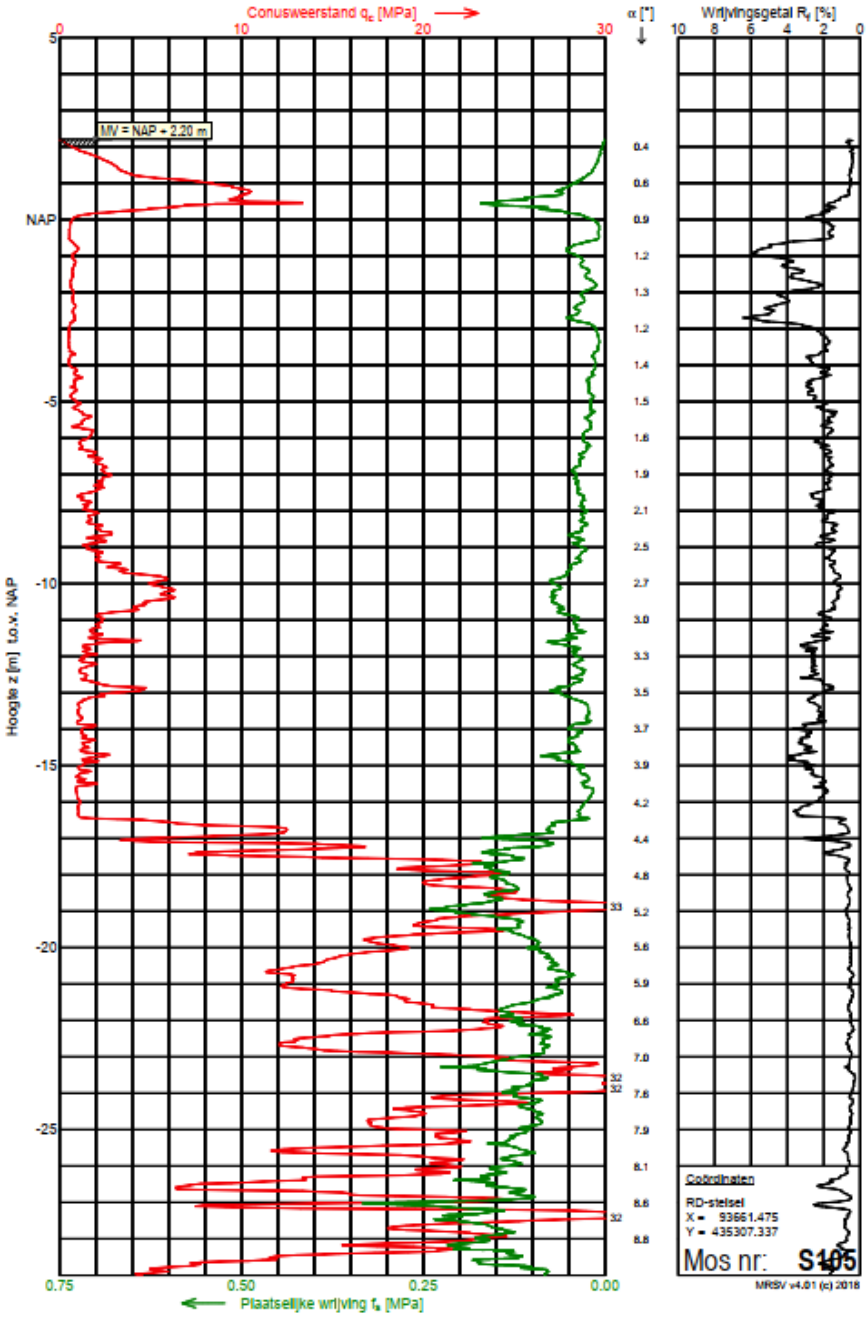
Sondering H4

Opdracht	: 2203015	Conus nummer	: S15-CFII.2005	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 30-11-2023	Opp. conuspunt	: 1500 mm²	Sondeerunit	: SW11
Project	: The View II			Blad	: 1 van 2



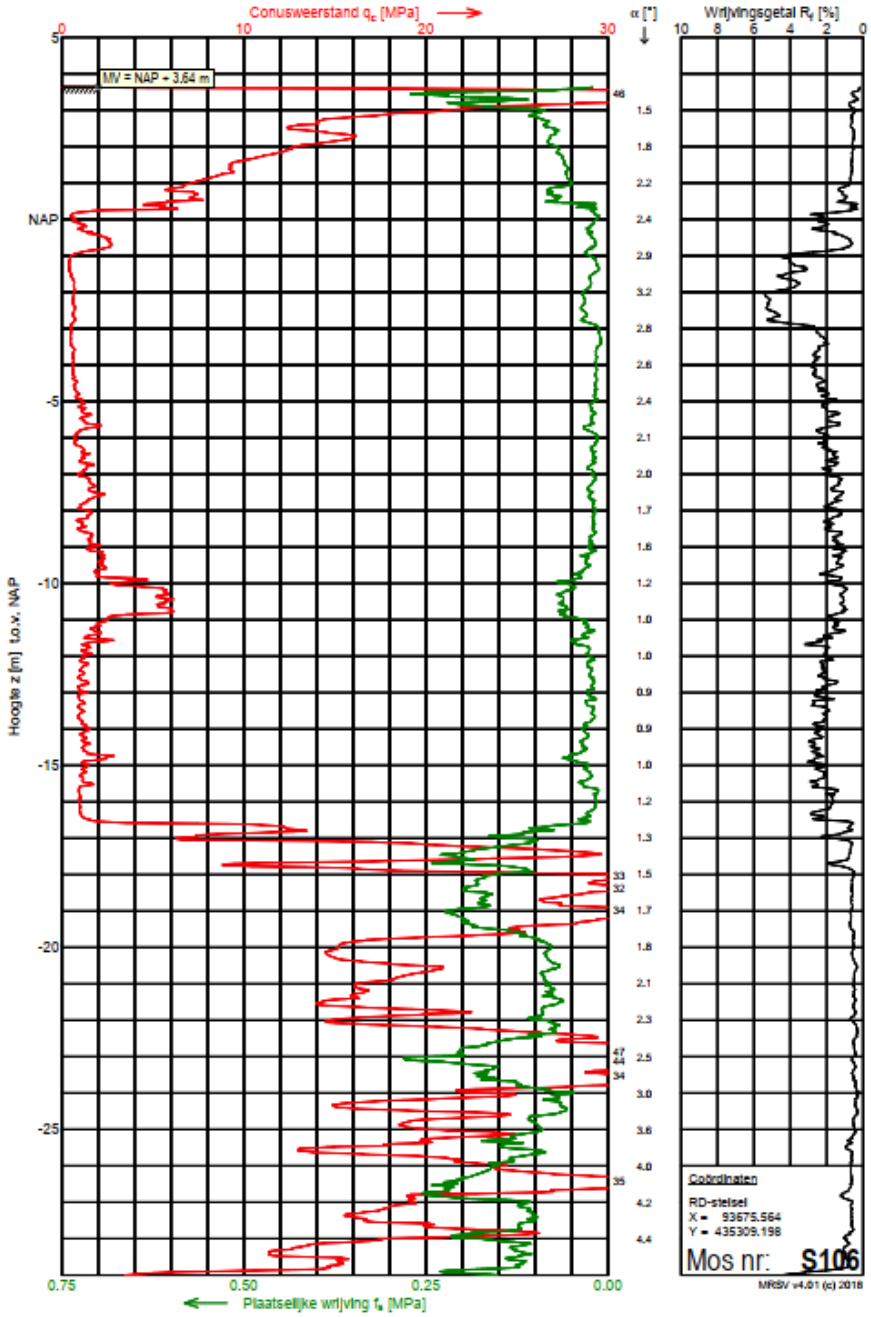
Sondering H5

Opdracht	: 2203015	Conus nummer	: S15-CFII.2005	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 30-11-2023	Opp. conuspunt	: 1500 mm²	Sondeerunit	: SW11
Project	: The View II			Blad	: 1 van 2



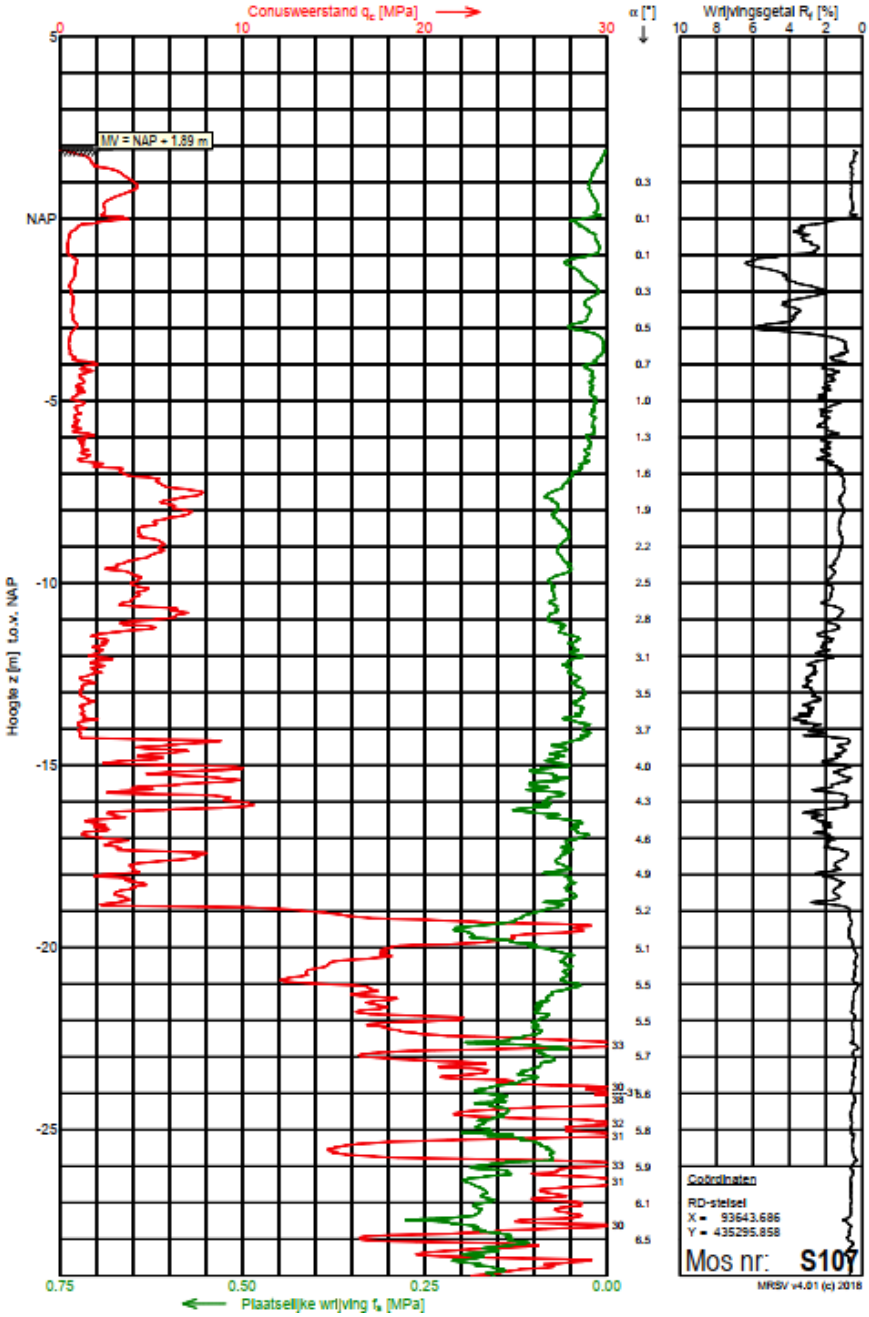
Sondering H6

Opdracht	: 2203015	Conus nummer	: S15-CFII.2005	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 01-12-2023	Opp. conuspunt	: 1500 mm²	Sondeerunit	: SW11
Project	: The View II			Blad	: 1 van 2



Sondering H7

Opdracht	: 2203015	Conus nummer	: S15-CFII.2005	NEN-EN-ISO-22476-1	
Plaats	: Rotterdam	Soort conus	: Elektrisch	Klasse 3, type TE1	
Datum	: 30-11-2023	Opp. conuspunt	: 1500 mm²	Sondeerunit	: SW11
Project	: The View II			Blad	: 1 van 2



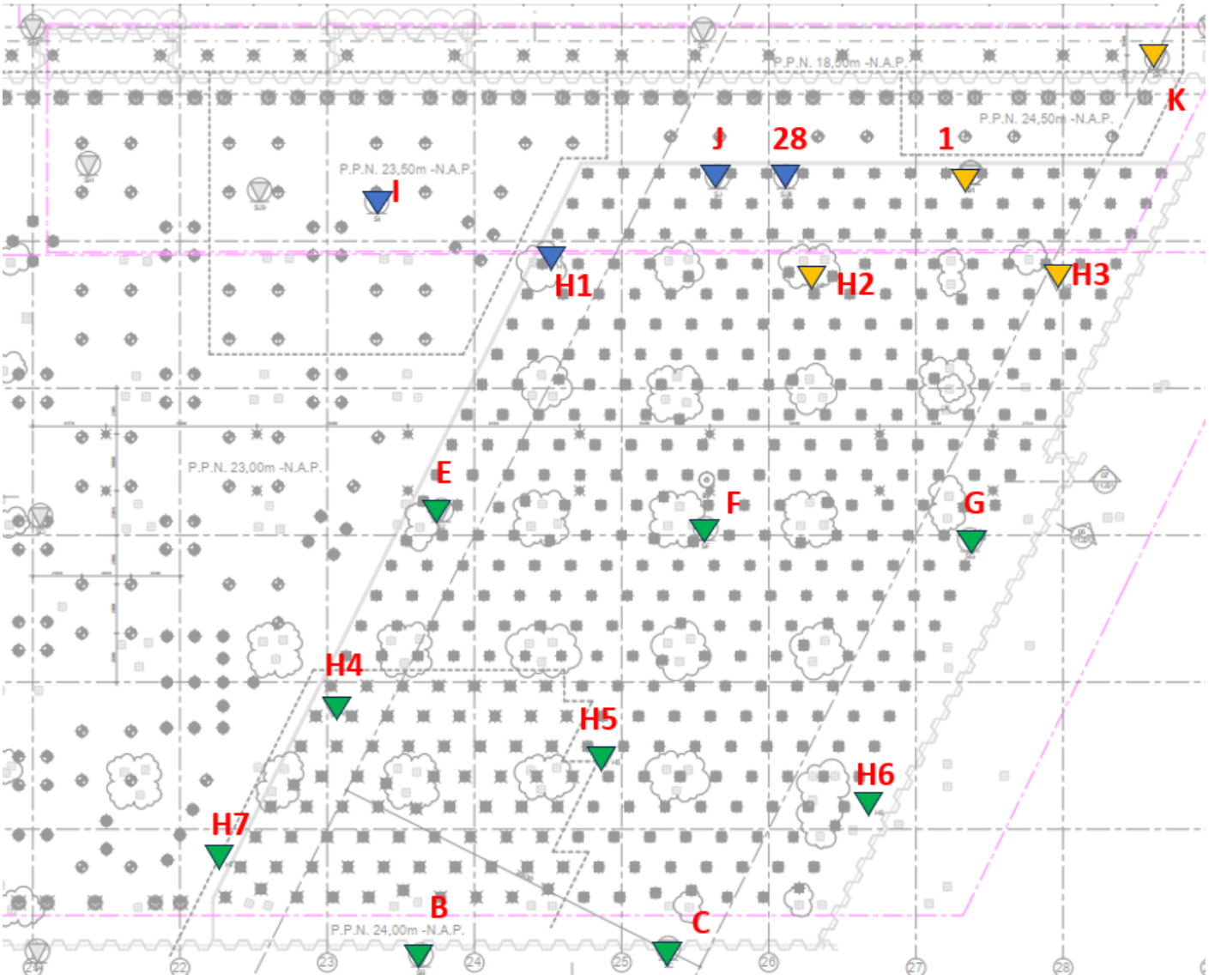
Bijlage B – Analyse sonderingen en resultaten

Analyse sonderingen

Op basis van de sonderingen is een onderscheid gemaakt in drie individuele blokken sonderingen. Dit onderscheid is gemaakt op basis van verkregen draagkracht, spreiding in resultaten en locatie. Dit is weergegeven in het onderstaande figuren.

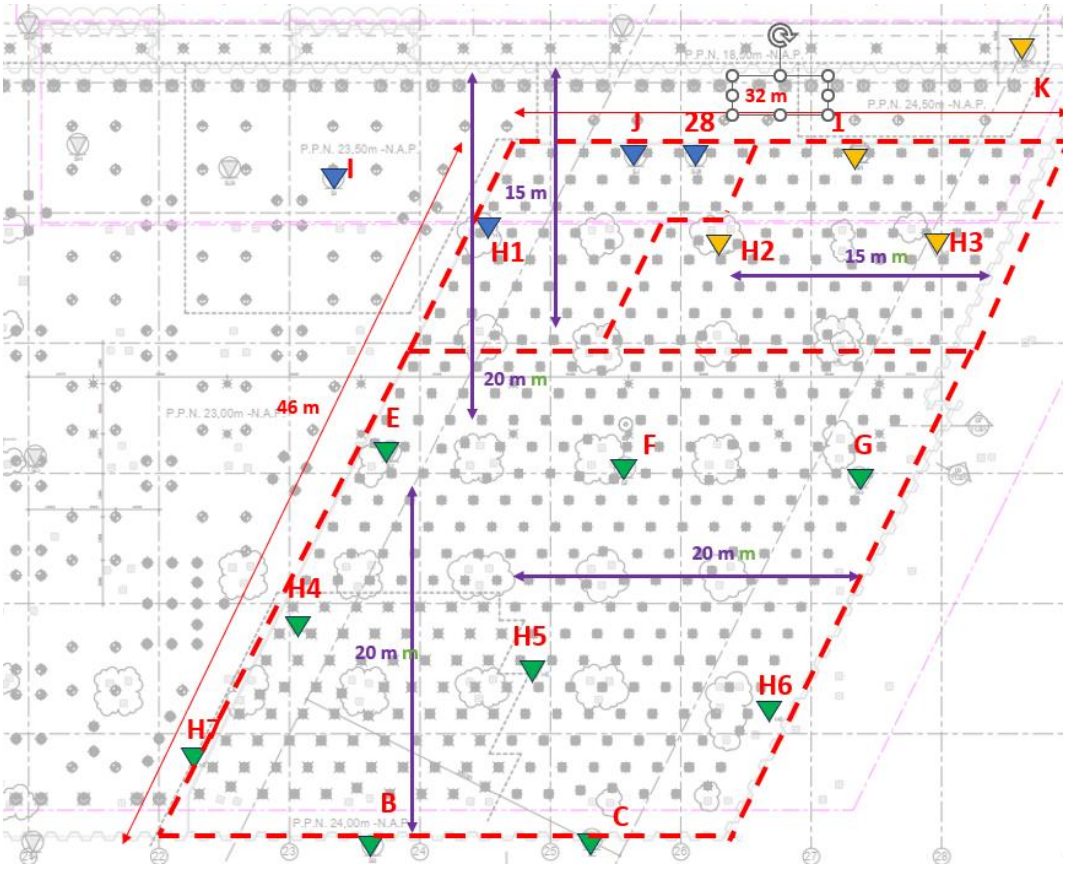
Correlatiefactoren ξ voor een stijf bouwwerk							
ξ voor n =	1	2	3	4	5	7	10
ξ_3 [a]	1,26	1,20	1,18	1,17	1,17	1,15	1,14
ξ_4 [a]	1,26	0,96	0,94	0,93	0,93	0,92	0,91

[a] De factor 1,1 volgens NEN-EN 1997-1+C1+~~A1:2016~~ 6.2.3 (7) is al verwerkt in de factoren van tabel A.10b.



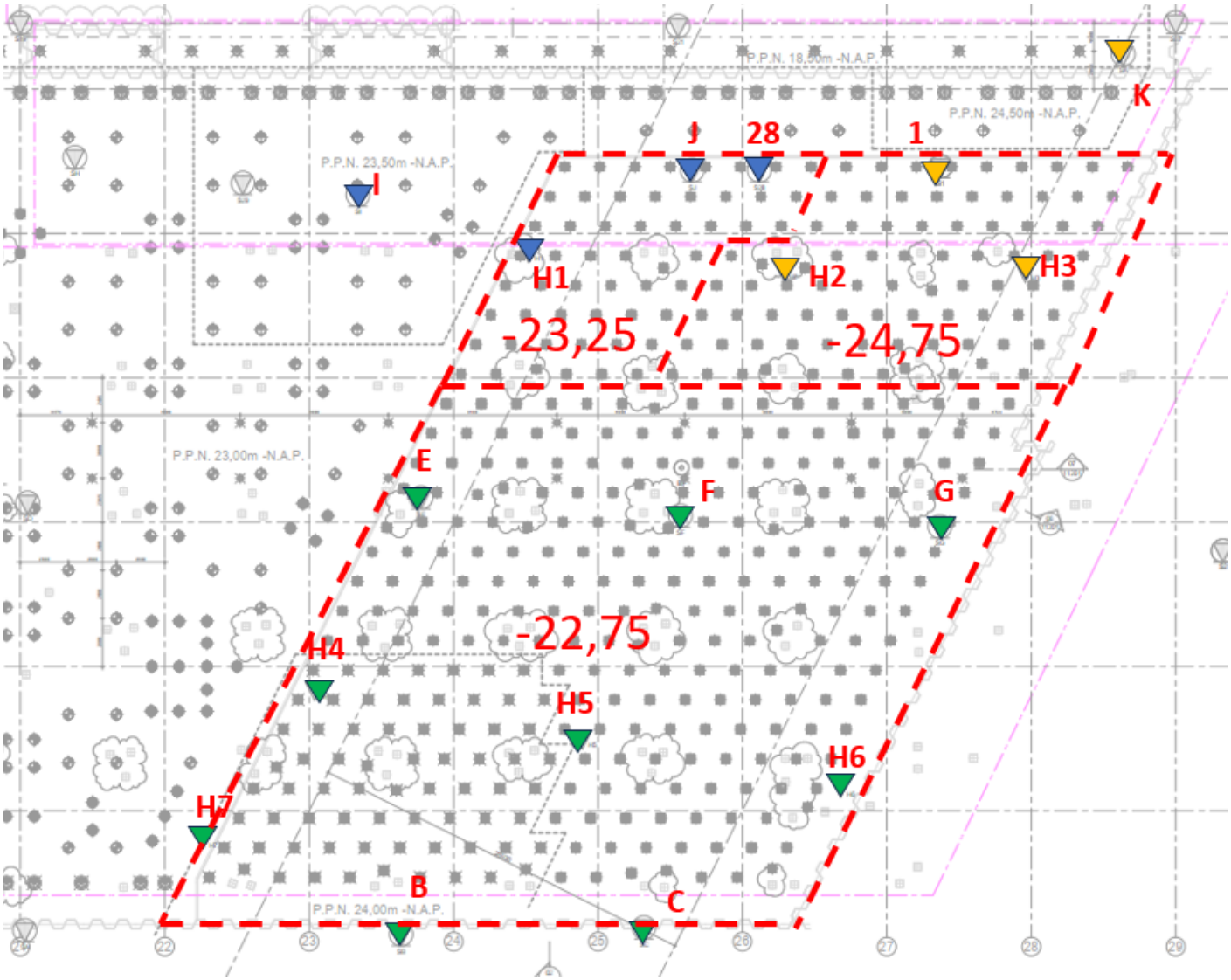
Blok	Sonderingen	n [-]	ξ_3 en ξ_4 [-]
Blok 1 (oranje)	K, H3, H2, 1	4	1,17 / 0,93
Blok 2 (blauw)	I, J, H1, 28	4	1,17 / 0,93
Blok 3 (groen)	E, F, G, H4, H5, H6, H7, B, C	9	1,15 / 0,92

Op basis van de ingedeelde blokken is bepaald wat de afstand dient te zijn waarover gereduceerd dient te worden conform Begemann. Hieruit volgen de afstanden zoals weergegeven in onderstaande figuur en tabel.



Blok	Max ontgraving	Begemann reductie conus
Blok 1 (oranje)	NAP -5,3 m	15 m
Blok 2 (blauw)	NAP -5,3 m	15 m
Blok 3 (groen)	NAP -5,3 m	20 m

Resultaten
Op basis van de uitgangspunten uit de memo, de sonderingen en onderverdeling in blokken is het PPN van de blokken bepaald. Dit is weergegeven in de onderstaande tabel en figuur.



Blok	Sonderingen	PPN [m NAP]	F_{UGT} [kN]	$R_{c,net,d}$ [kN]	UC [-]	Variatie [%]
Blok 1	K, H3, H2, 1	-24,75	3100	3115	0,995 ≤ 1,0 → OK	10 ≤ 12% → OK
Blok 2	I, J, H1, 28	-23,25	3100	3189	0,972 ≤ 1,0 → OK	7 ≤ 12% → OK
Blok 3	E, F, G, H4, H5, H6, H7, B, C	-22,75	3100	3317	0,935 ≤ 1,0 → OK	12 ≤12% → OK

Veerkarakteristiek
Op basis van de bovenstaande resultaten is tevens de vervorming aan de kop van de paal beschouwd, dit gegeven de BGT- belasting op de palen.

Hierbij is k bepaald met behulp van de onderstaande formule:

$$k = F_{BGT}/(s_b + s_{el}{}^*)$$

s_{el}* De elastische verkorting van de paal is bepaald met het oppervlak van de boorbuis in plaats van de punt diameter. De verhouding in oppervlak is gelijk aan 1,57.

De gemiddelde verticale veerconstante is gelijk aan 135 MN/n. Dit betreft de laag karakteristieke veerwaarde van de palen.

	Sonderingen	**n [-]**	**F_{BGT} [kN]**	**F_{UGT} [kN]**	**s_b [m]**	**s_{el} [m]**	**$s_{el,corr}$ [m]***	**s_1 [m]**	**k [MN/m]**
Blok 1	K, H3, H2, 1	4	2133	3100	0,007	0,005	0,008	0,015	143
Blok 2	I, J, H1, 28	4	2133	3100	0,007	0,005	0,008	0,015	143
Blok 3	E, F, G, H4, H5, H6, H7, B, C	9	2133	3100	0,010	0,005	0,008	0,018	119

**Correctie heeft plaatsgevonden op de elastische verkorting.*
***s2 wordt apart bepaald in de beschouwing van de zakkingen die uit de laag van Kedichem komen.*

	Diameter [mm]	**Oppervlak [m2]**
D_{punt}	680	0,36
$D_{boorbuis}$	540	0,23

Bijlage C – Bepaling negatieve kleef

Report for D-Foundations 22.1

Design and Verification according to Eurocode 7 of Bearing/Tension Piles and Shallow Foundations
Developed by Deltares

Company:	<Not Registered> <Not Registered>
Date of report:	23-11-2022
Time of report:	16:21:35
Report with version:	22.1.1.36055
Date of calculation:	23-11-2022
Time of calculation:	16:19:06
Calculated with version:	22.1.1.36055
File name:	The View II - Negatieve kleef Hoogbouw - kelderwand
Project identification:	The View II Negatieve kleef hoogbouw - kelderwand D-Foundations The View II - Negatieve kleef Hoogbouw - kelderwand

1 Table of Contents

2 Input Data

2.1 General Input Data

Model	Bearing Piles (EC7-NL)

2.2 General Report Data

Geotechnical consultant :	
Design engineer superstructure :	
Principal :	
Title 1 :	The View II
Title 2 :	Negatieve kleef hoogbouw - kelderwand
Title 3 :	D-Foundations The View II - Negatieve kleef Hoogbouw - kelderwand
Number of project :	-
Location of project :	

2.3 Application Area Model Bearing Piles

The verifications performed by the model BEARING PILES of D-FOUNDATIONS concern pile foundations on which axial static or quasi-static loads cause pressures in the piles. The calculations of pile forces and pile displacements are based on Cone Penetration Tests. Possible rise of (tension-)piles and horizontal displacements of piles and/or pile groups are not taken into account.

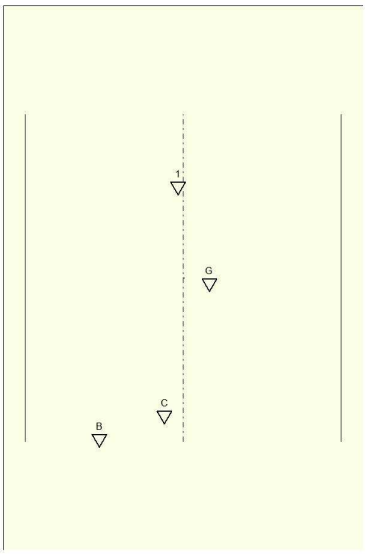
2.4 Superstructure

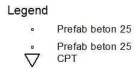
Rigidity of the superstructure :	Rigid

2.5 General CPT Data

Number of CPT's :	4
Timing of CPT's :	CPT - Install - Excavation

2.5.1 View of CPT's in Foundation Plan





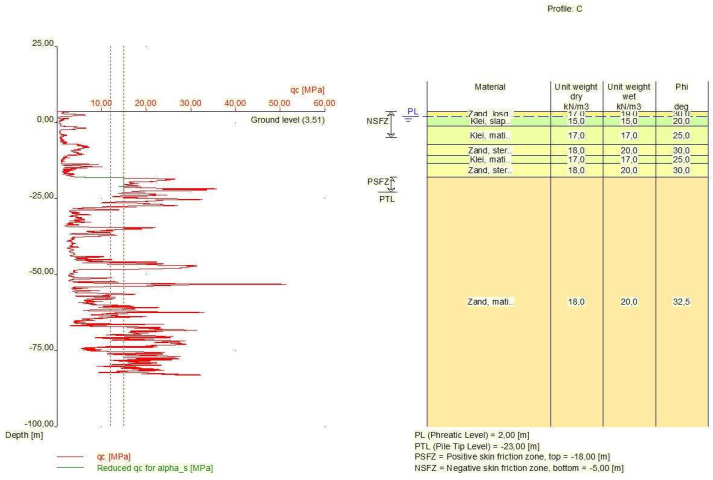
Name CPT	Pile tip level [m R.L.]	Top of pos. friction zone [m R.L.]	Bottom of neg. friction zone [m R.L.]	X-coor-dinate [m]	Y-coor-dinate [m]
C	-23,00	-18,00	-5,00	93667,83	435298,63
B	-24,00	-19,20	-5,00	93655,48	435294,21
G	-23,00	-17,40	-5,00	93676,41	435323,81
1	-23,00	-17,20	-5,00	93670,44	435342,20

2.6 Soil Data

Number of soil profiles (= number of CPT's) : 4

2.6.1 Soil Profile C

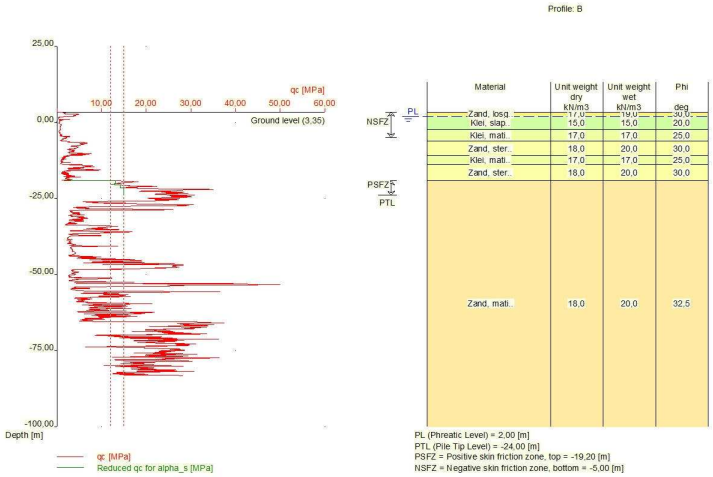
Belonging to CPT	C
Surface level in [m. reference level] :	3,51
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,00
Top of positive skin friction zone in [m. reference level] :	-18,00
Bottom of negative skin friction zone in [m. reference level] :	-5,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,12
Number of layers in profile :	7



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,510	17,00	19,00	30,00	Sand	0,200
2	2,000	15,00	15,00	20,00	Clay	--
3	-1,300	17,00	17,00	25,00	Clay	--
4	-7,339	18,00	20,00	30,00	Sand	0,200
5	-11,000	17,00	17,00	25,00	Clay	--
6	-13,500	18,00	20,00	30,00	Sand	0,200
7	-18,000	18,00	20,00	32,50	Sand	0,200

2.6.2 Soil Profile B

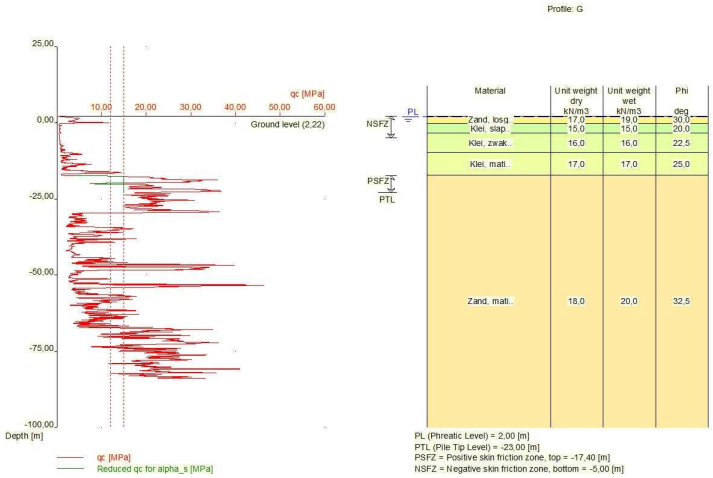
Belonging to CPT	B
Surface level in [m. reference level] :	3,35
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-24,00
Top of positive skin friction zone in [m. reference level] :	-19,20
Bottom of negative skin friction zone in [m. reference level] :	-5,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,12
Number of layers in profile :	7



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,350	17,00	19,00	30,00	Sand	0,200
2	2,000	15,00	15,00	20,00	Clay	--
3	-2,500	17,00	17,00	25,00	Clay	--
4	-6,260	18,00	20,00	30,00	Sand	0,200
5	-11,000	17,00	17,00	25,00	Clay	--
6	-13,800	18,00	20,00	30,00	Sand	0,200
7	-19,200	18,00	20,00	32,50	Sand	0,200

2.6.3 Soil Profile G

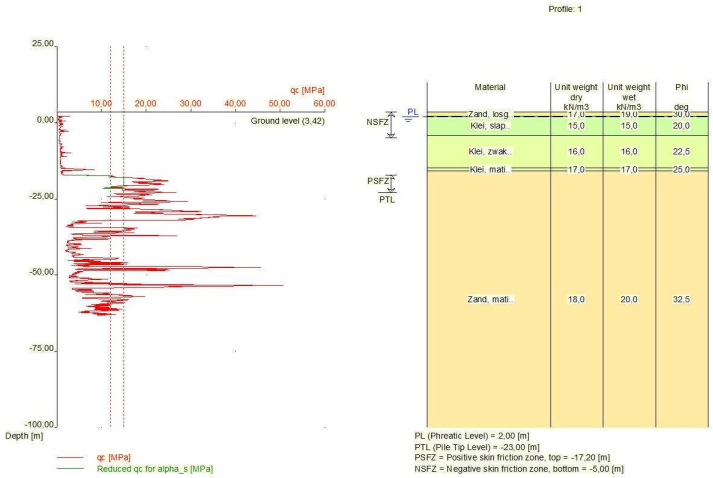
Belonging to CPT	G
Surface level in [m. reference level] :	2,22
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,00
Top of positive skin friction zone in [m. reference level] :	-17,40
Bottom of negative skin friction zone in [m. reference level] :	-5,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,12
Number of layers in profile :	5



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	2,220	17,00	19,00	30,00	Sand	0,200
2	-0,190	15,00	15,00	20,00	Clay	--
3	-3,500	16,00	16,00	22,50	Clay	--
4	-9,810	17,00	17,00	25,00	Clay	--
5	-17,310	18,00	20,00	32,50	Sand	0,200

2.6.4 Soil Profile 1

Belonging to CPT	1
Surface level in [m. reference level] :	3,42
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,00
Top of positive skin friction zone in [m. reference level] :	-17,20
Bottom of negative skin friction zone in [m. reference level] :	-5,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,12
Number of layers in profile :	5



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,420	17,00	19,00	30,00	Sand	0,200
2	2,210	15,00	15,00	20,00	Clay	--
3	-4,200	16,00	16,00	22,50	Clay	--
4	-14,910	17,00	17,00	25,00	Clay	--
5	-15,810	18,00	20,00	32,50	Sand	0,200

2.7 Pile Types

2.7.1 Pile type : Prefab beton 250x250

Pile type : Prefabricated concrete pile

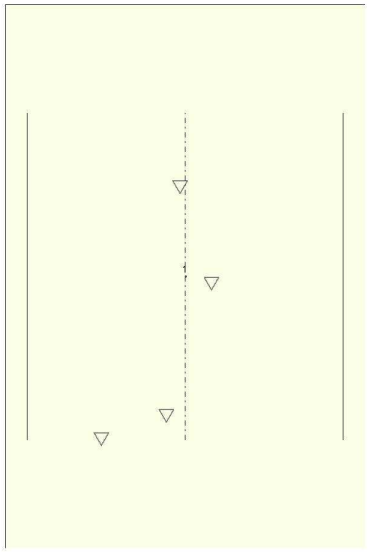
Materialtype for pile : Concrete
Slip layer : None
Pile shape : Rectangular pile
beta (Shape factor) according to figure 7.i, NEN 9997-1:2016.
s (factor for the influence of the shape of the crosssection of the pile base) according to NEN 9997-1:2016.

Pile dimensions :
Smallest side pile tip [m] : 0,250
Largest side pile tip [m] : 0,250

2.8 Foundation Plan

Number of piles : 1
Number of collaborating piles* : 1
* : 0 = not defined, 1 = non rigid superstructure, >1 = rigid superstructure

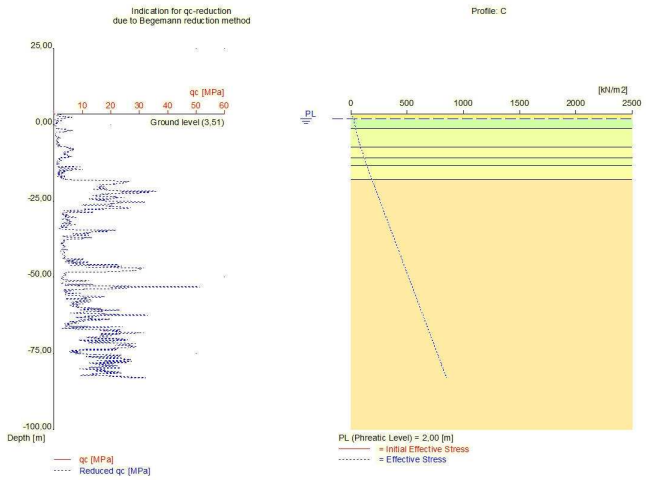
2.8.1 View of Foundation Plan



Pile nr/name	X-coor-dinate [m]	Y-coor-dinate [m]	Fc;d (EQU/STR/GEO) [kN]	Fc;d (SLS) [kN]	P0 [kN/m2]	Pile head level [m R.L.]
1: 1	93671,41	435324,81	3200,00	2133,00	0,00	3,90

2.9 Excavation Data

Excavation level in [m. reference level] :	3,50
Reduction model :	Begemann
Distance edge pile to excavation boundary [m] :	30,00



2.10 Overruled Parameters

User defined Factor xi3 [-] :	1,15
User defined Factor xi4 [-] :	0,92

2.11 Model Options

Suppress pile group (for negative skin friction)
Create intermediate results file
Use reduction for continuous flight auger piles (standard)
Use the influence of excavations (standard).

2.12 Model Options

Selected pile types :

- -Prefab beton 250x250

Selected profiles :

- -C
- -B
- -G
- -1

3 Bearing Piles (EC7-NL): Results Preliminary Design, Bearing capacity at fixed pile tip lev

3.1 Errors and Warnings

Warning : The factor xi3 (NEN 9997-1:2016) is user defined. Evidence to support this from the NEN deviating value has to be provided.
Warning : The factor xi4 (NEN 9997-1:2016) is user defined. Evidence to support this from the NEN deviating value has to be provided.

3.2 Remarks

When checking the survey and testing of soil according to NEN 9997-1:2016 art. 3.2.3 section (e), the program uses the provided CPT test level. It does NOT take into account possible different pile tip levels. When different pile tip levels are used in this calculation, the user itself must check for possibly required additional survey and testing of soil.

Note : The calculations performed are based on a single pile for limit state EQU/STR/GEO (= ultimate limit state). Due to the nature of preliminary design, a single pile is always assumed. A possible pileplan is disregarded when using the preliminary design option. Hence a non rigid superstructure is assumed and pile group effects are not considered.

3.3 Calculation Parameters

3.3.1 Pile Factors

gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
xi3 (user defined) :	1,15
xi4 (user defined) :	0,92

3.3.2 Pile type : Prefab beton 250x250

Pile type :	Prefabricated concrete pile
Materialtype for pile :	Concrete
Slip layer :	None
Pile shape :	Rectangular pile
beta (Shape factor: figure 7.i, NEN 9997-1:2016 art. 7.6.2.3(g) : Pile tip) :	1,00
s (NEN 9997-1:2016 art. 7.6.2.3(h) : factor for the influence of the shape of the crosssection of the pile base) :	1,00
Pile dimensions :	
Smallest side pile tip [m] :	0,250
Largest side pile tip [m] :	0,250

Number/Name CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
1:C	0,0100	--	0,7000
4:B	0,0100	--	0,7000
2:G	0,0100	--	0,7000
3:1	0,0100	--	0,7000

3.4 Results for pile type : Prefab beton 250x250

Number/Name CPT	Level [m R.L.]	Groundlevel [m R.L.]	Rb;cal;max [kN]	Rs;cal;max [kN]	Rc;cal;max [kN]	Rc;d [kN]	F;nsf;k [kN]	Fnsf;d [kN]
1:C	-23.00	3,51	613	729	1343	973	83	83
4:B	-24.00	3,35	929	680	1609	1166	76	76
2:G	-23.00	2,22	719	811	1531	1109	50	50
3:1	-23.00	3,42	587	811	1398	1013	76	76

3.5 Summary Net Bearing Capacity in kN

Number/Name CPT	Groundlevel [m R.L.]	Level [m R.L.]	Prefab beton.. Rc;net;d [kN]
1:C	3,51	-23,00	890,00
4:B	3,35	-24,00	1090,00
2:G	2,22	-23,00	1059,00
3:1	3,42	-23,00	937,00

End of Report

Bijlage D – Draagkracht hoogbouw

Report for D-Foundations 22.1

Design and Verification according to Eurocode 7 of Bearing/Tension Piles and Shallow Foundations
Developed by Deltares

Company:	<Not Registered> <Not Registered>
Date of report:	11/12/2023
Time of report:	15:12:41
Report with version:	22.1.1.36055
Date of calculation:	11/12/2023
Time of calculation:	15:12:06
Calculated with version:	22.1.1.36055
File name:	Schroef-combipalen 540-680 -24,75
Project identification:	The View II Hoogbouw - Blok 1 D-Foundations Schroef-combipalen 540-680 -24,75

1 Table of Contents

2 Input Data

2.1 General Input Data

Model	Bearing Piles (EC7-NL)

2.2 General Report Data

Geotechnical consultant :	[redacted]
Design engineer superstructure :	[redacted]
Principal :	
Title 1 :	The View II
Title 2 :	Hoogbouw - Blok 1
Title 3 :	D-Foundations Schroef-combipalen 540-680 -24,75
Number of project :	-
Location of project :	Rotterdam

2.3 Application Area Model Bearing Piles

The verifications performed by the model BEARING PILES of D-FOUNDATIONS concern pile foundations on which axial static or quasi-static loads cause pressures in the piles. The calculations of pile forces and pile displacements are based on Cone Penetration Tests. Possible rise of (tension-)piles and horizontal displacements of piles and/or pile groups are not taken into account.

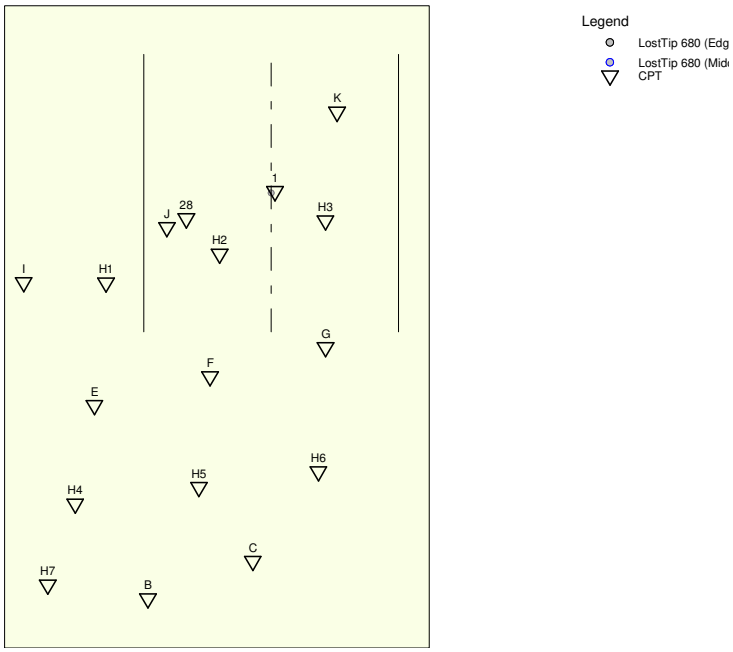
2.4 Superstructure

Rigidity of the superstructure :	Rigid

2.5 General CPT Data

Number of CPT's :	4
Timing of CPT's :	CPT - Excavation - Install

2.5.1 View of CPT's in Foundation Plan



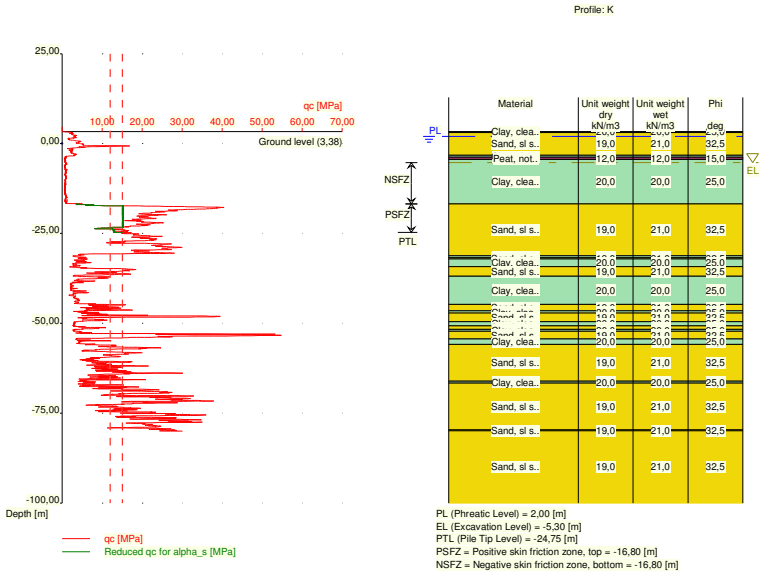
Name CPT	Pile tip level [m R.L.]	Top of pos. friction zone [m R.L.]	Bottom of neg. friction zone [m R.L.]	X-coor-dinate [m]	Y-coor-dinate [m]
K	-24,75	-16,80	-16,80	93677,76	435351,55
H3	-24,75	-17,30	-17,30	93676,38	435338,76
H2	-24,75	-17,70	-17,70	93663,92	435334,82
1	-24,75	-17,10	-17,10	93670,44	435342,20

2.6 Soil Data

Number of soil profiles (= number of CPT's) : 4

2.6.1 Soil Profile K

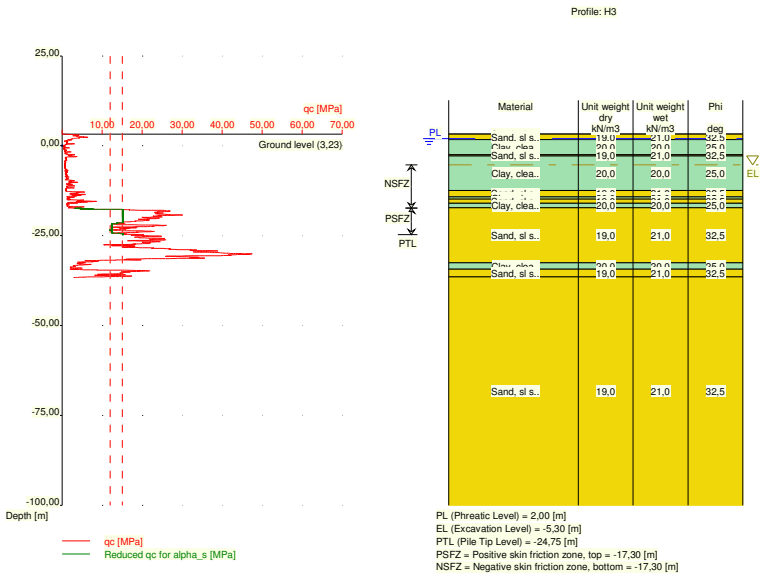
Belonging to CPT	K
Surface level in [m. reference level] :	3,38
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-24,75
Top of positive skin friction zone in [m. reference level] :	-16,80
Bottom of negative skin friction zone in [m. reference level] :	-16,80
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	25



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,380	20,00	20,00	25,00	Clay	--
2	3,370	20,00	20,00	25,00	Clay	--
3	3,070	19,00	21,00	32,50	Sand	0,200
4	-3,230	20,00	20,00	25,00	Clay	--
5	-3,830	12,00	12,00	15,00	Peat	--
6	-4,449	20,00	20,00	25,00	Clay	--
7	-16,770	19,00	21,00	32,50	Sand	0,200
8	-31,189	20,00	20,00	25,00	Clay	--
9	-31,790	19,00	21,00	32,50	Sand	0,200
10	-32,090	20,00	20,00	25,00	Clay	--
11	-34,190	19,00	21,00	32,50	Sand	0,200
12	-36,909	20,00	20,00	25,00	Clay	--
13	-44,730	19,00	21,00	32,50	Sand	0,200
14	-46,530	20,00	20,00	25,00	Clay	--
15	-47,130	19,00	21,00	32,50	Sand	0,200
16	-49,530	20,00	20,00	25,00	Clay	--
17	-50,750	19,00	21,00	32,50	Sand	0,200
18	-51,650	20,00	20,00	25,00	Clay	--
19	-52,250	19,00	21,00	32,50	Sand	0,200
20	-54,350	20,00	20,00	25,00	Clay	--
21	-55,850	19,00	21,00	32,50	Sand	0,200
22	-66,070	20,00	20,00	25,00	Clay	--
23	-66,670	19,00	21,00	32,50	Sand	0,200
24	-79,628	19,00	21,00	32,50	Sand	0,200
25	-79,930	19,00	21,00	32,50	Sand	0,200

2.6.2 Soil Profile H3

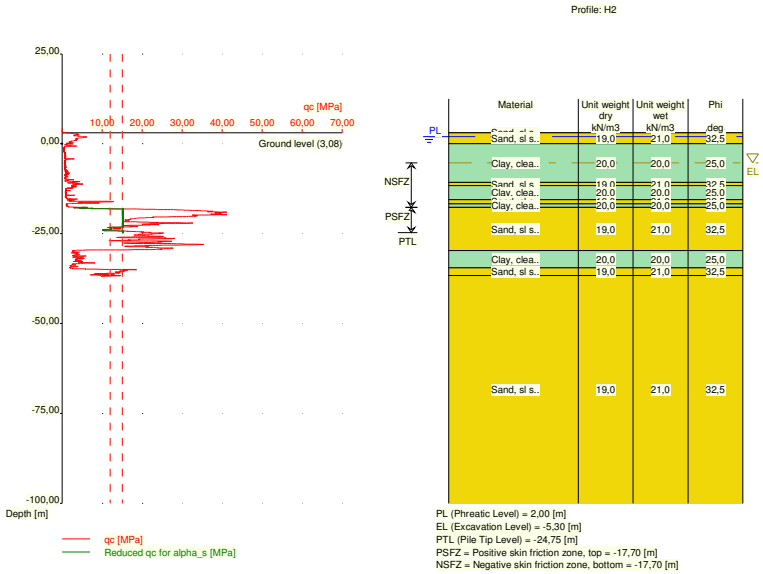
Belonging to CPT	H3
Surface level in [m. reference level] :	3,23
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-24,75
Top of positive skin friction zone in [m. reference level] :	-17,30
Bottom of negative skin friction zone in [m. reference level] :	-17,30
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	13



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,230	19,00	21,00	32,50	Sand	0,200
2	3,220	19,00	21,00	32,50	Sand	0,200
3	1,720	20,00	20,00	25,00	Clay	--
4	-2,480	19,00	21,00	32,50	Sand	0,200
5	-2,780	20,00	20,00	25,00	Clay	--
6	-12,400	19,00	21,00	32,50	Sand	0,200
7	-14,200	20,00	20,00	25,00	Clay	--
8	-14,800	19,00	21,00	32,50	Sand	0,200
9	-16,000	20,00	20,00	25,00	Clay	--
10	-17,200	19,00	21,00	32,50	Sand	0,200
11	-32,560	20,00	20,00	25,00	Clay	--
12	-34,360	19,00	21,00	32,50	Sand	0,200
13	-36,460	19,00	21,00	32,50	Sand	0,200

2.6.3 Soil Profile H2

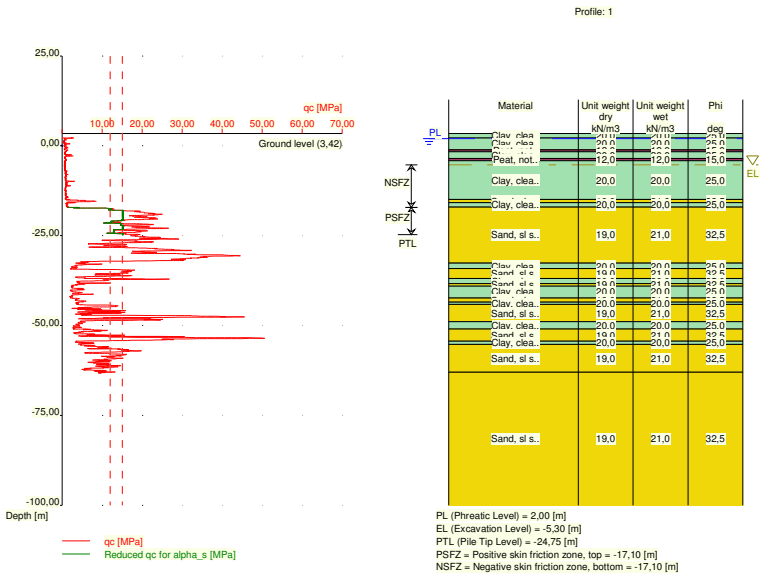
Belonging to CPT	H2
Surface level in [m. reference level] :	3,08
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-24,75
Top of positive skin friction zone in [m. reference level] :	-17,70
Bottom of negative skin friction zone in [m. reference level] :	-17,70
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	11



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,080	19,00	21,00	32,50	Sand	0,200
2	3,070	19,00	21,00	32,50	Sand	0,200
3	0,070	20,00	20,00	25,00	Clay	--
4	-10,749	19,00	21,00	32,50	Sand	0,200
5	-11,650	20,00	20,00	25,00	Clay	--
6	-15,550	19,00	21,00	32,50	Sand	0,200
7	-16,750	20,00	20,00	25,00	Clay	--
8	-17,650	19,00	21,00	32,50	Sand	0,200
9	-29,709	20,00	20,00	25,00	Clay	--
10	-34,510	19,00	21,00	32,50	Sand	0,200
11	-36,631	19,00	21,00	32,50	Sand	0,200

2.6.4 Soil Profile 1

Belonging to CPT	1
Surface level in [m. reference level] :	3,42
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-24,75
Top of positive skin friction zone in [m. reference level] :	-17,10
Bottom of negative skin friction zone in [m. reference level] :	-17,10
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	22



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,420	20,00	20,00	25,00	Clay	--
2	2,210	20,00	20,00	25,00	Clay	--
3	-1,090	12,00	12,00	15,00	Peat	--
4	-1,690	20,00	20,00	25,00	Clay	--
5	-3,490	12,00	12,00	15,00	Peat	--
6	-4,090	20,00	20,00	25,00	Clay	--
7	-14,910	19,00	21,00	32,50	Sand	0,200
8	-15,810	20,00	20,00	25,00	Clay	--
9	-17,010	19,00	21,00	32,50	Sand	0,200
10	-32,650	20,00	20,00	25,00	Clay	--
11	-34,150	19,00	21,00	32,50	Sand	0,200
12	-36,870	20,00	20,00	25,00	Clay	--
13	-38,370	19,00	21,00	32,50	Sand	0,200
14	-38,990	20,00	20,00	25,00	Clay	--
15	-42,290	19,00	21,00	32,50	Sand	0,200

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
16	-43,510	20,00	20,00	25,00	Clay	--
17	-44,110	19,00	21,00	32,50	Sand	0,200
18	-48,910	20,00	20,00	25,00	Clay	--
19	-51,010	19,00	21,00	32,50	Sand	0,200
20	-54,330	20,00	20,00	25,00	Clay	--
21	-55,230	19,00	21,00	32,50	Sand	0,200
22	-63,030	19,00	21,00	32,50	Sand	0,200

2.7 Pile Types

2.7.1 Pile type : LostTip 680

Pile type : Screw pile, cast in place, lost tip

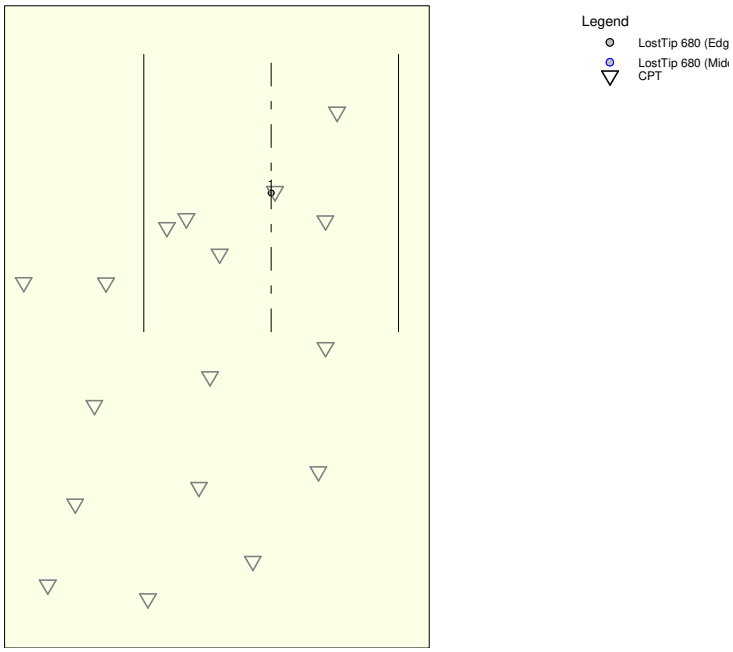
Materialtype for pile : Concrete
Slip layer : None
Pile shape : Round pile with lost tip
beta (user defined : Pile tip, shape factor) : 1,00
s (factor for the influence of the shape of the crosssection of the pile base) according to NEN 9997-1:2016.

Pile dimensions :
- Diameter at tip [m] : 0,680
- Diameter shaft [m] : 0,679
- Effective heigth enlarged base [m] : 0,000

2.8 Foundation Plan

Number of piles : 1
Number of collaborating piles* : 1
* : 0 = not defined, 1 = non rigid superstructure, >1 = rigid superstructure

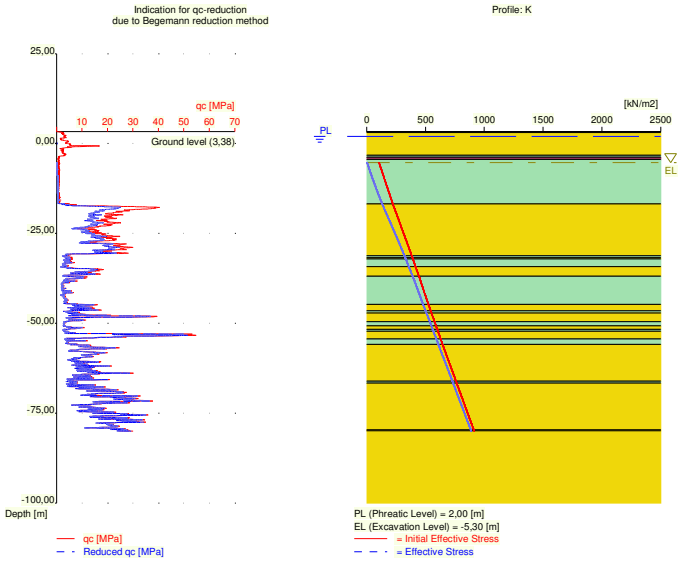
2.8.1 View of Foundation Plan



Pile nr/name	X-coordinate [m]	Y-coordinate [m]	Fc;d (EQU/STR/GEO) [kN]	Fc;d (SLS) [kN]	P0 [kN/m2]	Pile head level [m R.L.]
1: 1	93670,00	435342,00	3100,00	2133,00	0,00	-5,00

2.9 Excavation Data

Excavation level in [m. reference level] :	-5,30
Reduction model :	Begemann
Distance edge pile to excavation boundary [m] :	15,00



2.10 Totalized Loads (design values)

Total load on all piles
For limit state EQU/STR/GEO in [kN] : 3100,00
For Serviceability limit state in [kN] : 2133,00

2.11 Requirements

Limit state STR/GEO
Maximum allowed settlement in [m] : 0,150
Serviceability Limit State
Maximum allowed settlement in [m] : 0,150

2.12 Overruled Parameters

User defined Factor xi3 [-] : 1,17
User defined Factor xi4 [-] : 0,93

2.13 Model Options

Suppress pile group (for negative skin friction)
Do not create intermediate results file
Use reduction for continuous flight auger piles (standard)
Use the influence of excavations (standard).

2.14 Model Options

Selected pile types :
-LostTip 680

Selected profiles :
- -K
- -H3
- -H2
- -1

3 Bearing Piles (EC7-NL): Results Complete Verification

3.1 Remarks

When checking the survey and testing of soil according to NEN 9997-1:2016 art. 3.2.3 section (e), the program uses the provided CPT test level. It does NOT take into account possible different pile tip levels. When different pile tip levels are used in this calculation, the user itself must check for possibly required additional survey and testing of soil.

Performing the check on NEN 9997-1:2016 art. 3.2.3, the average distance between the different CPT's used for this check is 25 m.
The requirements set by NEN 9997-1:2016 art. 3.2.3 are met.

The requirements set by NEN 9997-1:2016 art. 3.3.3 are met. The variation (9,52%) is ok (<= 12%).

3.2 Calculation Parameters

3.2.1 Pile Factors

gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
xi3 (user defined) :	1,17
xi4 (user defined) :	0,93

Xi 3 has been used.

Even though it is possible, the pilegroup model has not been used to calculate the negative skin friction.

3.2.2 Pile type : LostTip 680

Pile type :	Screw pile, cast in place, lost tip
Materialtype for pile :	Concrete
Slip layer :	None
Pile shape :	Round pile with lost tip
beta (user defined : Pile tip, shape factor) :	1,00
s (NEN 9997-1:2016 art. 7.6.2.3(h) : factor for the influence of the shape of the crosssection of the pile base) :	1,00

Pile dimensions :

Diameter at tip [m] :	0,680
Diameter shaft [m] :	0,679
Effective heigth enlarged base [m] :	0,000

Number/Name CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
7:K	0,0090	--	0,6300
5:H3	0,0090	--	0,6300
4:H2	0,0090	--	0,6300
1:1	0,0090	--	0,6300

3.3 Verification of Limit State EQU

Required by NEN 9997-1:2016 art. 2.4.8: Ed <= Cd.
Non rigid superstructure, verify load per pile with bearing capacity per pile.

Fc;d = 3100,000 [kN]
Rc;d = 3114,504 [kN]

The requirements of limit state EQU are met, limit state EQU is ok.

Note: Negative skin friction plays NO part in Limit State EQU. Its influence is incorporated in the tests for Limit State STR/GEO and the Serviceability limit state. The intermediate results provide a full overview of all values that are calculated for the negative skin friction.
For this project, negative skin friction does not occur at all.

3.4 Verification of Serviceability Limit State

Required by NEN 9997-1:2016 art. 2.4.9: Sd <= Sreq.
For houses, the requirement is : Sreq = 0.05 m. For other types of superstructures a different (well considered) requirement can be specified.

Sd = 0,012 [m]
Sreq = 0,150 [m]

The settlement requirements of the Serviceability Limit State are met, this is ok.

As the superstructure was indicated to be rigid, settlement differences may be neglected, so rotations are not taken into consideration (NEN 9997-1:2016 art. 6.6.2 part c)!

3.5 Additional Information

The design values of the maximum shaft tensions (calculated at the transition of positive to negative skin friction) are

At Limit state EQU/STR/GEO: sigma = 8,56 [N/mm2]
At Serviceability Limit State: sigma = 5,89 [N/mm2]

The maximum settlement was found at:
Limit state STR/GEO
Number/Name 1
Pile name: 1

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 99,000 [m]
sel;d = 0,007 [m]
s2 = 0,000 [m]

Serviceability Limit State
Number/Name 1
Pile name: 1

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 0,007 [m]
sel;d = 0,005 [m]
s2 = 0,000 [m]

sneg stands for the settlement due to negative skin friction when the expected ground level settlement (egls) is within the next boundaries : 0.02 < egls <= 0.10 meter.

For expected ground level settlement beyond the boundaries, sneg = 0.

3.5.1 The bearing capacity of shaft and point at Limit state STR/GEO

The next table shows the values of the bearing capacities per CPT and these are purely informative.
The presented design values are determined using the maximum value of ksi3 and ksi4.

Number/Name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
7:K	1465,790	1754,135	3219,925
5:H3	1318,259	2052,607	3370,866
4:H2	1276,585	1903,686	3180,271
1:1	1316,650	1370,306	2686,956

3.5.2 The bearing capacity of shaft and point at the Serviceability Limit State

The next table shows the values of the bearing capacities per CPT and these are purely informative.
The presented design values are determined using the maximum value of ksi3 and ksi4.

Number/Name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
7:K	1758,948	2104,961	3863,909
5:H3	1581,910	2463,128	4045,038
4:H2	1531,902	2284,423	3816,325
1:1	1579,980	1644,367	3224,347

End of Report

Report for D-Foundations 22.1

Design and Verification according to Eurocode 7 of Bearing/Tension Piles and Shallow Foundations
Developed by Deltares

Company:	<Not Registered> <Not Registered>
Date of report:	11/12/2023
Time of report:	15:13:52
Report with version:	22.1.1.36055
Date of calculation:	11/12/2023
Time of calculation:	15:13:19
Calculated with version:	22.1.1.36055
File name:	Schroef-combipalen 540-680 -23,25
Project identification:	The View II Hoogbouw - Blok 2 D-Foundations Schroef-combipalen 540-680 -23,25

1 Table of Contents

2 Input Data

2.1 General Input Data

Model	Bearing Piles (EC7-NL)

2.2 General Report Data

Geotechnical consultant :	[redacted]
Design engineer superstructure :	[redacted]
Principal :	
Title 1 :	The View II
Title 2 :	Hoogbouw - Blok 2
Title 3 :	D-Foundations Schroef-combipalen 540-680 -23,25
Number of project :	
Location of project :	Rotterdam

2.3 Application Area Model Bearing Piles

The verifications performed by the model BEARING PILES of D-FOUNDATIONS concern pile foundations on which axial static or quasi-static loads cause pressures in the piles. The calculations of pile forces and pile displacements are based on Cone Penetration Tests. Possible rise of (tension-)piles and horizontal displacements of piles and/or pile groups are not taken into account.

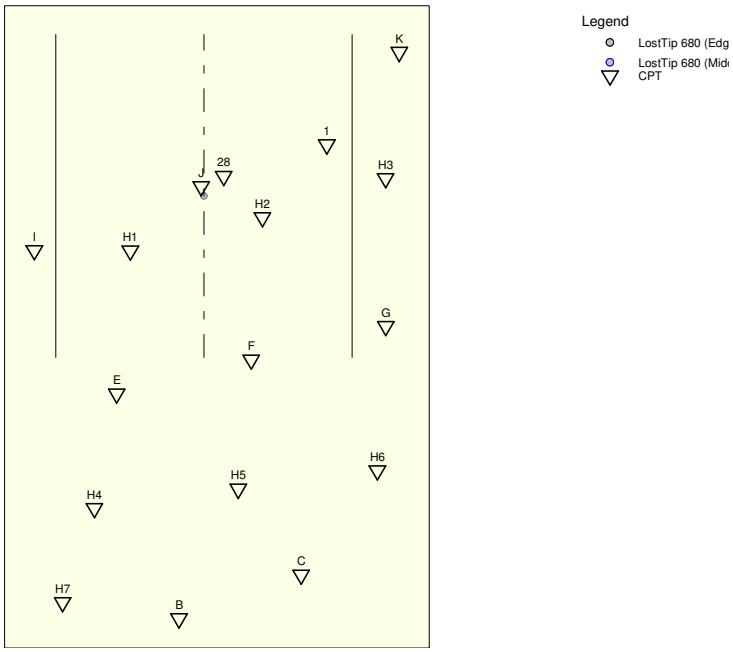
2.4 Superstructure

Rigidity of the superstructure :	Rigid

2.5 General CPT Data

Number of CPT's :	4
Timing of CPT's :	CPT - Excavation - Install

2.5.1 View of CPT's in Foundation Plan



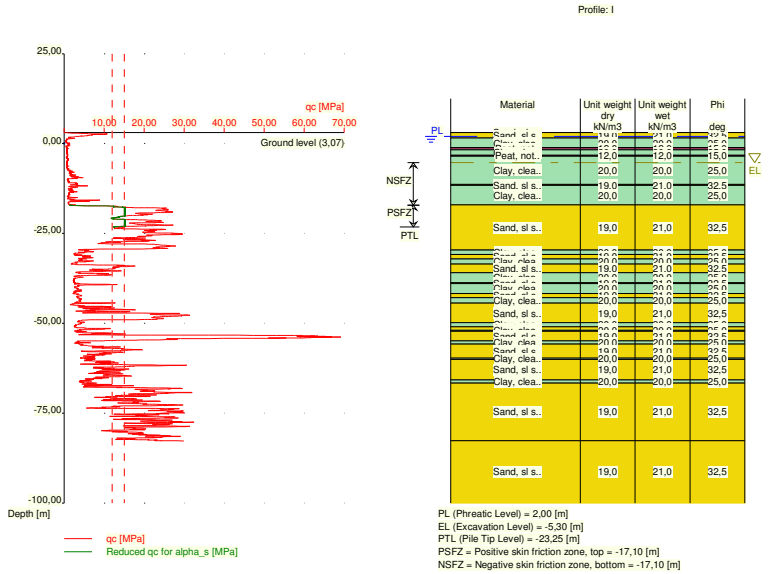
Name CPT	Pile tip level [m R.L.]	Top of pos. friction zone [m R.L.]	Bottom of neg. friction zone [m R.L.]	X-coor-dinate [m]	Y-coor-dinate [m]
I	-23,25	-17,10	-17,10	93640,84	435331,47
J	-23,25	-18,00	-18,00	93657,72	435337,95
H1	-23,25	-17,70	-17,70	93650,55	435331,44
28	-23,25	-17,60	-17,60	93660,00	435339,00

2.6 Soil Data

Number of soil profiles (= number of CPT's) : 4

2.6.1 Soil Profile I

Belonging to CPT	I
Surface level in [m. reference level] :	3,07
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,25
Top of positive skin friction zone in [m. reference level] :	-17,10
Bottom of negative skin friction zone in [m. reference level] :	-17,10
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	31

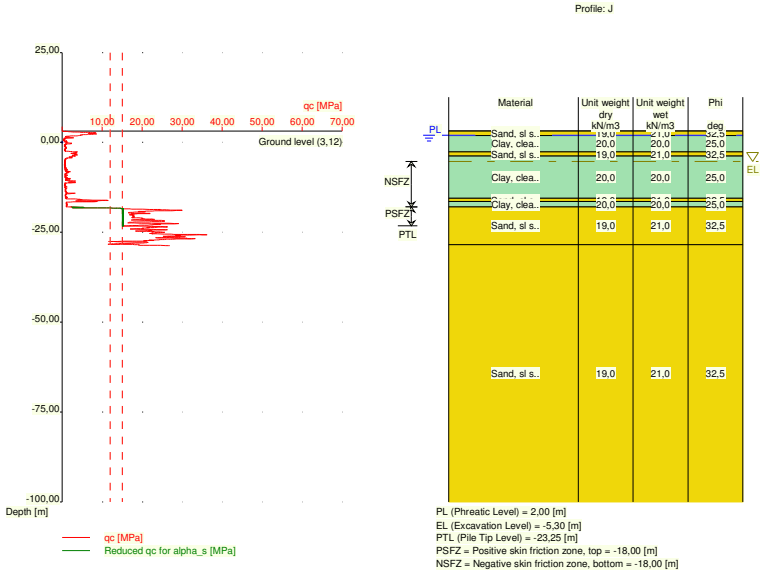


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,070	19,00	21,00	32,50	Sand	0,200
2	3,060	19,00	21,00	32,50	Sand	0,200
3	1,560	20,00	20,00	25,00	Clay	--
4	-1,140	12,00	12,00	15,00	Peat	--
5	-1,740	20,00	20,00	25,00	Clay	--
6	-3,240	12,00	12,00	15,00	Peat	--
7	-3,540	20,00	20,00	25,00	Clay	--
8	-11,340	19,00	21,00	32,50	Sand	0,200
9	-11,640	20,00	20,00	25,00	Clay	--
10	-17,040	19,00	21,00	32,50	Sand	0,200
11	-29,660	20,00	20,00	25,00	Clay	--
12	-30,860	19,00	21,00	32,50	Sand	0,200
13	-32,060	20,00	20,00	25,00	Clay	--
14	-33,560	19,00	21,00	32,50	Sand	0,200
15	-35,960	20,00	20,00	25,00	Clay	--
16	-38,680	19,00	21,00	32,50	Sand	0,200
17	-38,980	20,00	20,00	25,00	Clay	--
18	-41,680	19,00	21,00	32,50	Sand	0,200
19	-42,880	20,00	20,00	25,00	Clay	--
20	-44,400	19,00	21,00	32,50	Sand	0,200
21	-49,800	20,00	20,00	25,00	Clay	--
22	-51,000	19,00	21,00	32,50	Sand	0,200
23	-51,900	20,00	20,00	25,00	Clay	--
24	-52,200	19,00	21,00	32,50	Sand	0,200
25	-54,920	20,00	20,00	25,00	Clay	--
26	-55,820	19,00	21,00	32,50	Sand	0,200
27	-59,740	20,00	20,00	25,00	Clay	--

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
28	-60,040	19,00	21,00	32,50	Sand	0,200
29	-65,740	20,00	20,00	25,00	Clay	--
30	-66,640	19,00	21,00	32,50	Sand	0,200
31	-82,640	19,00	21,00	32,50	Sand	0,200

2.6.2 Soil Profile J

Belonging to CPT	J
Surface level in [m. reference level] :	3,12
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,25
Top of positive skin friction zone in [m. reference level] :	-18,00
Bottom of negative skin friction zone in [m. reference level] :	-18,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	9

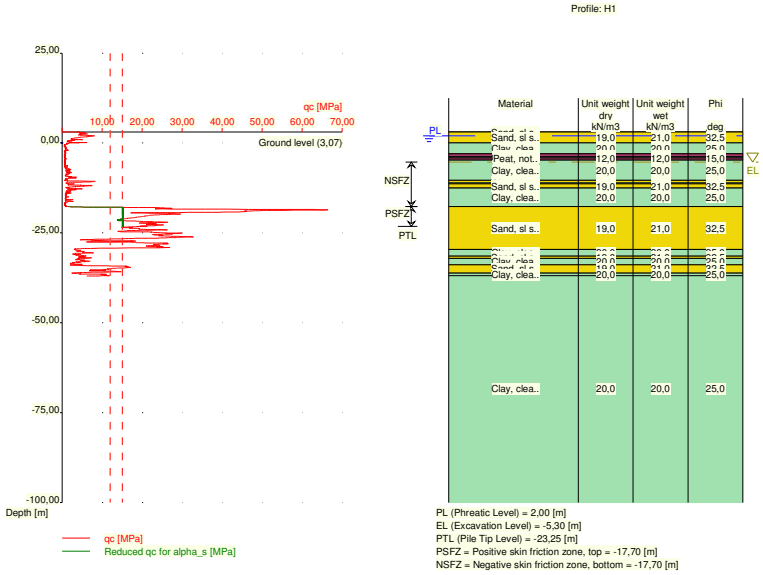


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,120	19,00	21,00	32,50	Sand	0,200
2	3,110	19,00	21,00	32,50	Sand	0,200
3	1,910	20,00	20,00	25,00	Clay	--
4	-2,590	19,00	21,00	32,50	Sand	0,200
5	-3,790	20,00	20,00	25,00	Clay	--
6	-15,550	19,00	21,00	32,50	Sand	0,200
7	-16,450	20,00	20,00	25,00	Clay	--
8	-17,950	19,00	21,00	32,50	Sand	0,200

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
9	-28,450	19,00	21,00	32,50	Sand	0,200

2.6.3 Soil Profile H1

Belonging to CPT	H1
Surface level in [m. reference level] :	3,07
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,25
Top of positive skin friction zone in [m. reference level] :	-17,70
Bottom of negative skin friction zone in [m. reference level] :	-17,70
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	18

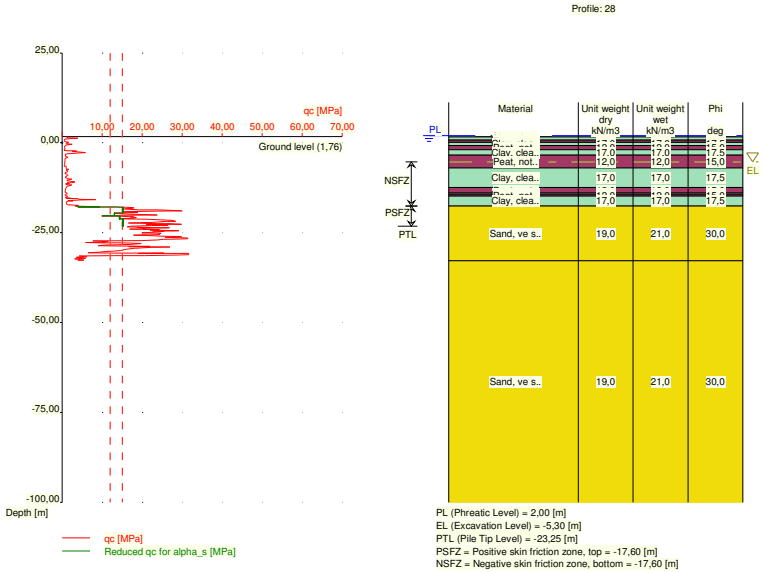


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,070	19,00	21,00	32,50	Sand	0,200
2	3,060	19,00	21,00	32,50	Sand	0,200
3	0,060	20,00	20,00	25,00	Clay	--
4	-2,940	12,00	12,00	15,00	Peat	--
5	-3,840	20,00	20,00	25,00	Clay	--
6	-4,140	12,00	12,00	15,00	Peat	--
7	-4,740	20,00	20,00	25,00	Clay	--
8	-10,440	19,00	21,00	32,50	Sand	0,200
9	-11,040	20,00	20,00	25,00	Clay	--
10	-11,340	19,00	21,00	32,50	Sand	0,200
11	-12,540	20,00	20,00	25,00	Clay	--

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
12	-17,640	19,00	21,00	32,50	Sand	0,200
13	-29,640	20,00	20,00	25,00	Clay	--
14	-31,460	19,00	21,00	32,50	Sand	0,200
15	-32,060	20,00	20,00	25,00	Clay	--
16	-33,860	19,00	21,00	32,50	Sand	0,200
17	-36,260	20,00	20,00	25,00	Clay	--
18	-36,860	20,00	20,00	25,00	Clay	--

2.6.4 Soil Profile 28

Belonging to CPT	28
Surface level in [m. reference level] :	1,76
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-23,25
Top of positive skin friction zone in [m. reference level] :	-17,60
Bottom of negative skin friction zone in [m. reference level] :	-17,60
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	14



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	1,760	17,00	17,00	17,50	Clay	--
2	1,660	17,00	17,00	17,50	Clay	--
3	0,760	12,00	12,00	15,00	Peat	--
4	0,160	17,00	17,00	17,50	Clay	--
5	-0,740	12,00	12,00	15,00	Peat	--

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
6	-1,940	17,00	17,00	17,50	Clay	--
7	-3,440	12,00	12,00	15,00	Peat	--
8	-7,040	17,00	17,00	17,50	Clay	--
9	-12,440	12,00	12,00	15,00	Peat	--
10	-13,940	17,00	17,00	17,50	Clay	--
11	-14,240	12,00	12,00	15,00	Peat	--
12	-14,840	17,00	17,00	17,50	Clay	--
13	-17,540	19,00	21,00	30,00	Sand	0,200
14	-32,840	19,00	21,00	30,00	Sand	0,200

2.7 Pile Types

2.7.1 Pile type : LostTip 680

Pile type : Screw pile, cast in place, lost tip

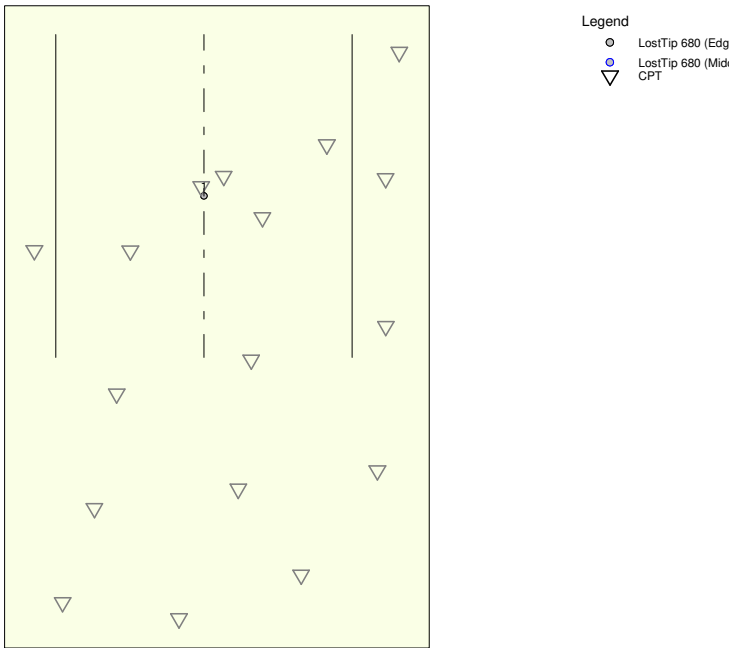
Materialtype for pile : Concrete
Slip layer : None
Pile shape : Round pile with lost tip
beta (user defined : Pile tip, shape factor) : 1,00
s (factor for the influence of the shape of the crosssection of the pile base) according to NEN 9997-1:2016.

Pile dimensions :
- Diameter at tip [m] : 0,680
- Diameter shaft [m] : 0,679
- Effective heigth enlarged base [m] : 0,000

2.8 Foundation Plan

Number of piles : 1
Number of collaborating piles* : 1
* : 0 = not defined, 1 = non rigid superstructure, >1 = rigid superstructure

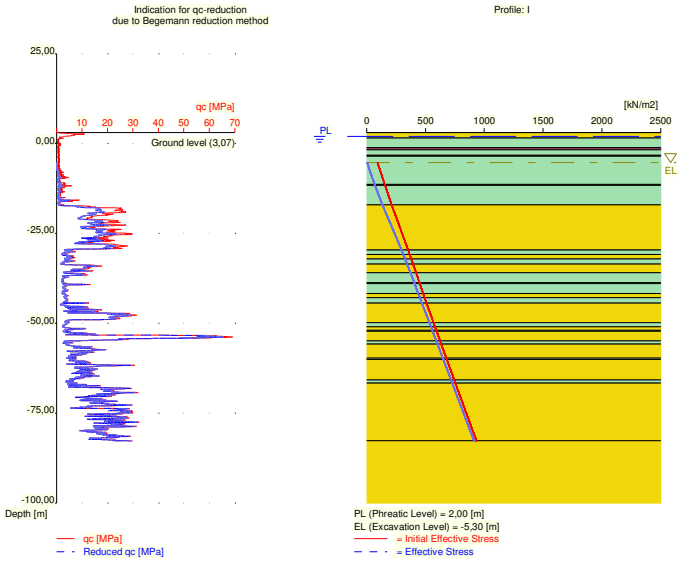
2.8.1 View of Foundation Plan



Pile nr/name	X-coordinate [m]	Y-coordinate [m]	Fc;d (EQU/STR/GEO) [kN]	Fc;d (SLS) [kN]	P0 [kN/m2]	Pile head level [m R.L.]
1: 1	93658,00	435337,00	3100,00	2133,00	0,00	-5,00

2.9 Excavation Data

Excavation level in [m. reference level] :	-5,30
Reduction model :	Begemann
Distance edge pile to excavation boundary [m] :	15,00



2.10 Totalized Loads (design values)

Total load on all piles
For limit state EQU/STR/GEO in [kN] : 3100,00
For Serviceability limit state in [kN] : 2133,00

2.11 Requirements

Limit state STR/GEO
Maximum allowed settlement in [m] : 0,150
Serviceability Limit State
Maximum allowed settlement in [m] : 0,150

2.12 Overruled Parameters

User defined Factor xi3 [-] : 1,17
User defined Factor xi4 [-] : 0,93

2.13 Model Options

Suppress pile group (for negative skin friction)
Do not create intermediate results file
Use reduction for continuous flight auger piles (standard)
Use the influence of excavations (standard).

2.14 Model Options

Selected pile types :
-LostTip 680

Selected profiles :
- -I
- -J
- -H1
- -28

3 Bearing Piles (EC7-NL): Results Complete Verification

3.1 Remarks

When checking the survey and testing of soil according to NEN 9997-1:2016 art. 3.2.3 section (e), the program uses the provided CPT test level. It does NOT take into account possible different pile tip levels. When different pile tip levels are used in this calculation, the user itself must check for possibly required additional survey and testing of soil.

Performing the check on NEN 9997-1:2016 art. 3.2.3, the average distance between the different CPT's used for this check is 25 m.
The requirements set by NEN 9997-1:2016 art. 3.2.3 are met.

The requirements set by NEN 9997-1:2016 art. 3.3.3 are met. The variation (6,59%) is ok (<= 12%).

3.2 Calculation Parameters

3.2.1 Pile Factors

gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
xi3 (user defined) :	1,17
xi4 (user defined) :	0,93

Xi 3 has been used.

Even though it is possible, the pilegroup model has not been used to calculate the negative skin friction.

3.2.2 Pile type : LostTip 680

Pile type :	Screw pile, cast in place, lost tip
Materialtype for pile :	Concrete
Slip layer :	None
Pile shape :	Round pile with lost tip
beta (user defined : Pile tip, shape factor) :	1,00
s (NEN 9997-1:2016 art. 7.6.2.3(h) : factor for the influence of the shape of the crosssection of the pile base) :	1,00

Pile dimensions :

Diameter at tip [m] :	0,680
Diameter shaft [m] :	0,679
Effective heigth enlarged base [m] :	0,000

Number/Name CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
14:I	0,0090	--	0,6300
6:J	0,0090	--	0,6300
3:H1	0,0090	--	0,6300
2:28	0,0090	--	0,6300

3.3 Verification of Limit State EQU

Required by NEN 9997-1:2016 art. 2.4.8: Ed <= Cd.
Non rigid superstructure, verify load per pile with bearing capacity per pile.

Fc;d = 3100,000 [kN]
Rc;d = 3189,463 [kN]

The requirements of limit state EQU are met, limit state EQU is ok.

Note: Negative skin friction plays NO part in Limit State EQU. Its influence is incorporated in the tests for Limit State STR/GEO and the Serviceability limit state. The intermediate results provide a full overview of all values that are calculated for the negative skin friction.
For this project, negative skin friction does not occur at all.

3.4 Verification of Serviceability Limit State

Required by NEN 9997-1:2016 art. 2.4.9: Sd <= Sreq.
For houses, the requirement is : Sreq = 0.05 m. For other types of superstructures a different (well considered) requirement can be specified.

Sd = 0,012 [m]
Sreq = 0,150 [m]

The settlement requirements of the Serviceability Limit State are met, this is ok.

As the superstructure was indicated to be rigid, settlement differences may be neglected, so rotations are not taken into consideration (NEN 9997-1:2016 art. 6.6.2 part c)!

3.5 Additional Information

The design values of the maximum shaft tensions (calculated at the transition of positive to negative skin friction) are

At Limit state EQU/STR/GEO: sigma = 8,56 [N/mm2]
At Serviceability Limit State: sigma = 5,89 [N/mm2]

The maximum settlement was found at:
Limit state STR/GEO
Number/Name I
Pile name: 1

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 99,000 [m]
sel;d = 0,006 [m]
s2 = 0,000 [m]

Serviceability Limit State
Number/Name I
Pile name: 1

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 0,007 [m]
sel;d = 0,005 [m]
s2 = 0,000 [m]

sneg stands for the settlement due to negative skin friction when the expected ground level settlement (egls) is within the next boundaries : 0.02 < egls <= 0.10 meter.

For expected ground level settlement beyond the boundaries, sneg = 0.

3.5.1 The bearing capacity of shaft and point at Limit state STR/GEO

The next table shows the values of the bearing capacities per CPT and these are purely informative.
The presented design values are determined using the maximum value of ksi3 and ksi4.

Number/Name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
14:I	1096,932	1792,578	2889,510
6:J	971,162	2326,326	3297,488
3:H1	1082,962	2123,970	3206,932
2:28	1022,089	2341,834	3363,923

3.5.2 The bearing capacity of shaft and point at the Serviceability Limit State

The next table shows the values of the bearing capacities per CPT and these are purely informative.
The presented design values are determined using the maximum value of ksi3 and ksi4.

Number/Name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
14:I	1316,318	2151,093	3467,411
6:J	1165,394	2791,591	3956,985
3:H1	1299,554	2548,764	3848,318
2:28	1226,507	2810,201	4036,708

End of Report

Report for D-Foundations 22.1

Design and Verification according to Eurocode 7 of Bearing/Tension Piles and Shallow Foundations
Developed by Deltares

Company:	<Not Registered> <Not Registered>
Date of report:	18/12/2023
Time of report:	16:08:55
Report with version:	22.1.1.36055
Date of calculation:	18/12/2023
Time of calculation:	16:07:10
Calculated with version:	22.1.1.36055
File name:	Schroef-combipalen 540-680 -22,75
Project identification:	The View II Hoogbouw - Blok 3 D-Foundations Schroef-combipalen 540-680 -22,75

1 Table of Contents

2 Input Data

2.1 General Input Data

Model	Bearing Piles (EC7-NL)

2.2 General Report Data

Geotechnical consultant :	[redacted]
Design engineer superstructure :	[redacted]
Principal :	
Title 1 :	The View II
Title 2 :	Hoogbouw - Blok 3
Title 3 :	D-Foundations Schroef-combipalen 540-680 -22,75
Number of project :	
Location of project :	Rotterdam

2.3 Application Area Model Bearing Piles

The verifications performed by the model BEARING PILES of D-FOUNDATIONS concern pile foundations on which axial static or quasi-static loads cause pressures in the piles. The calculations of pile forces and pile displacements are based on Cone Penetration Tests. Possible rise of (tension-)piles and horizontal displacements of piles and/or pile groups are not taken into account.

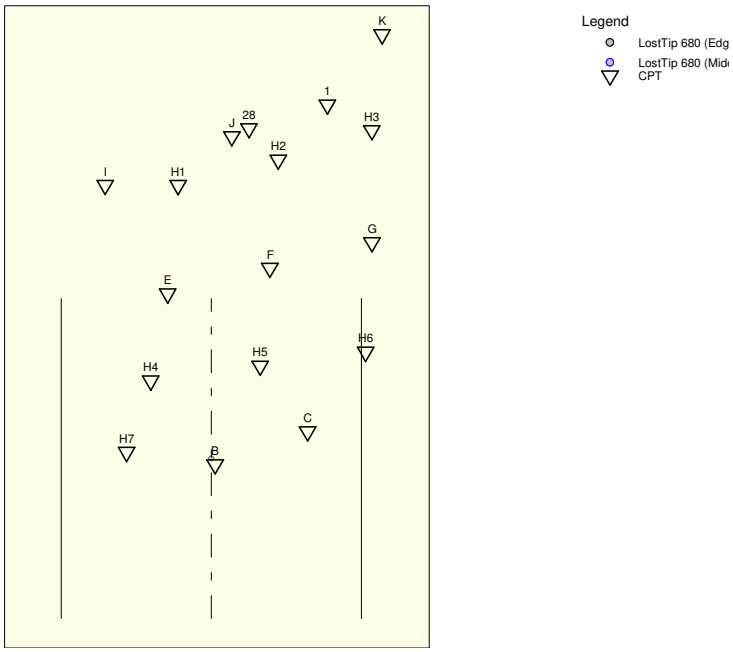
2.4 Superstructure

Rigidity of the superstructure :	Rigid

2.5 General CPT Data

Number of CPT's :	9
Timing of CPT's :	CPT - Excavation - Install

2.5.1 View of CPT's in Foundation Plan



Name CPT	Pile tip level [m R.L.]	Top of pos. friction zone [m R.L.]	Bottom of neg. friction zone [m R.L.]	X-coor-dinate [m]	Y-coor-dinate [m]
C	-22,75	-17,20	-17,20	93667,83	435298,63
H7	-22,75	-17,10	-17,10	93643,69	435295,86
B	-22,75	-18,90	-18,90	93655,48	435294,21
H6	-22,75	-16,20	-16,20	93675,56	435309,20
H5	-22,75	-16,30	-16,30	93661,48	435307,34
H4	-22,75	-17,00	-17,00	93646,91	435305,37
G	-22,75	-17,40	-17,40	93676,41	435323,81
F	-22,75	-16,80	-16,80	93662,79	435320,40
E	-22,75	-16,20	-16,20	93649,17	435316,98

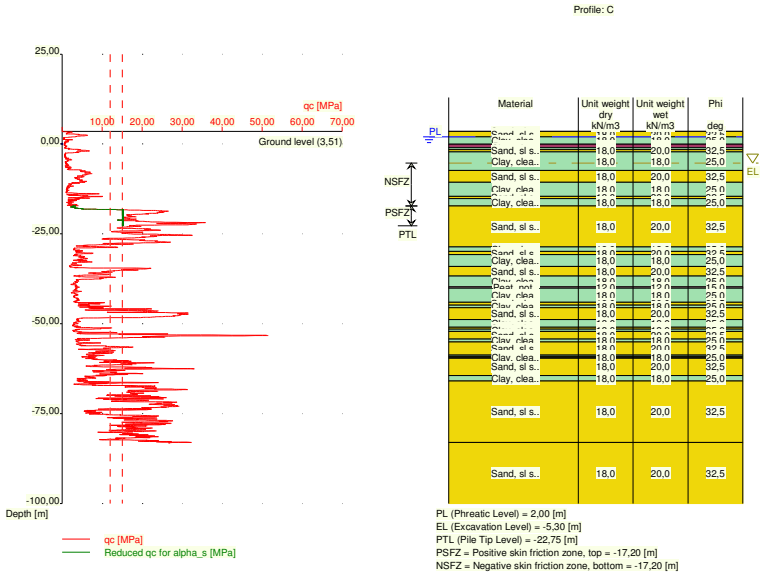
2.6 Soil Data

Number of soil profiles (= number of CPT's) : 9

2.6.1 Soil Profile C

Belonging to CPT	C
Surface level in [m. reference level] :	3,51
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-17,20
Bottom of negative skin friction zone in [m. reference level] :	-17,20
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01

Number of layers in profile : 35

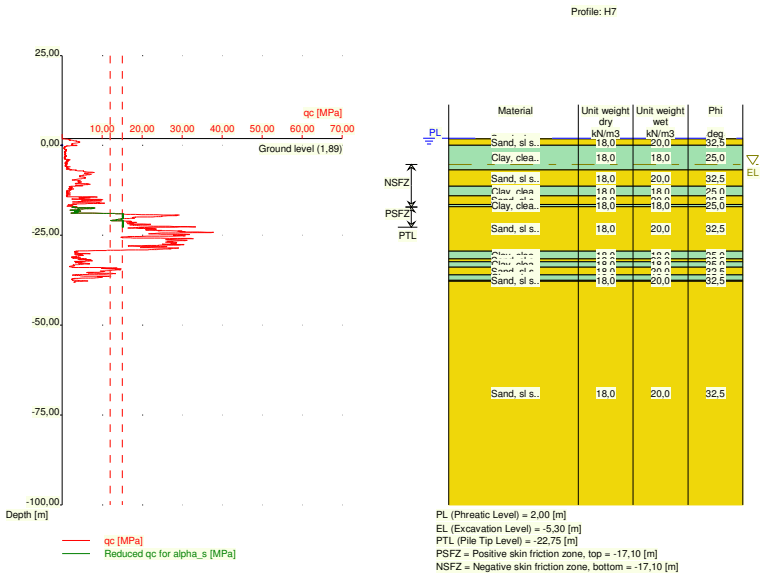


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,510	18,00	20,00	32,50	Sand	0,200
2	3,500	18,00	20,00	32,50	Sand	0,200
3	2,000	18,00	18,00	25,00	Clay	--
4	-0,100	12,00	12,00	15,00	Peat	--
5	-1,000	18,00	18,00	25,00	Clay	--
6	-1,600	18,00	20,00	32,50	Sand	0,200
7	-2,200	18,00	18,00	25,00	Clay	--
8	-7,339	18,00	20,00	32,50	Sand	0,200
9	-10,639	18,00	18,00	25,00	Clay	--
10	-14,560	18,00	20,00	32,50	Sand	0,200
11	-15,160	18,00	18,00	25,00	Clay	--
12	-17,190	18,00	20,00	32,50	Sand	0,200
13	-28,660	18,00	18,00	25,00	Clay	--
14	-29,860	18,00	20,00	32,50	Sand	0,200
15	-30,760	18,00	18,00	25,00	Clay	--
16	-34,079	18,00	20,00	32,50	Sand	0,200
17	-36,780	18,00	18,00	25,00	Clay	--
18	-39,780	12,00	12,00	15,00	Peat	--
19	-40,080	18,00	18,00	25,00	Clay	--
20	-44,000	18,00	20,00	32,50	Sand	0,200
21	-44,900	18,00	18,00	25,00	Clay	--
22	-45,500	18,00	20,00	32,50	Sand	0,200
23	-48,820	18,00	18,00	25,00	Clay	--
24	-50,920	18,00	20,00	32,50	Sand	0,200
25	-51,520	18,00	18,00	25,00	Clay	--
26	-52,121	18,00	20,00	32,50	Sand	0,200

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
27	-54,240	18,00	18,00	25,00	Clay	--
28	-55,140	18,00	20,00	32,50	Sand	0,200
29	-58,740	18,00	18,00	25,00	Clay	--
30	-59,040	18,00	20,00	32,50	Sand	0,200
31	-59,340	18,00	18,00	25,00	Clay	--
32	-59,641	18,00	20,00	32,50	Sand	0,200
33	-64,460	18,00	18,00	25,00	Clay	--
34	-65,960	18,00	20,00	32,50	Sand	0,200
35	-83,080	18,00	20,00	32,50	Sand	0,200

2.6.2 Soil Profile H7

Belonging to CPT	H7
Surface level in [m. reference level] :	1,89
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-17,10
Bottom of negative skin friction zone in [m. reference level] :	-17,10
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	15

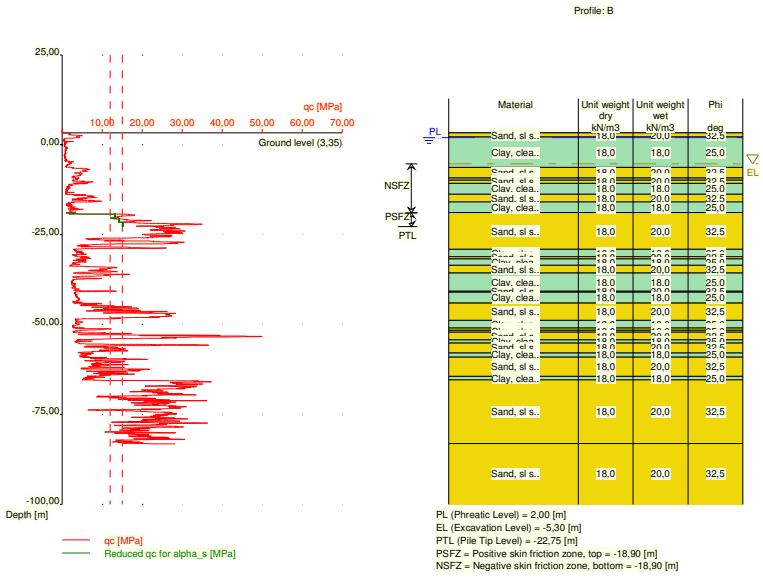


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	1,890	18,00	20,00	32,50	Sand	0,200
2	1,880	18,00	20,00	32,50	Sand	0,200
3	0,080	18,00	18,00	25,00	Clay	--

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
4	-6,839	18,00	20,00	32,50	Sand	0,200
5	-11,340	18,00	18,00	25,00	Clay	--
6	-14,040	18,00	20,00	32,50	Sand	0,200
7	-16,440	18,00	18,00	25,00	Clay	--
8	-17,040	18,00	20,00	32,50	Sand	0,200
9	-29,400	18,00	18,00	25,00	Clay	--
10	-31,520	18,00	20,00	32,50	Sand	0,200
11	-32,420	18,00	18,00	25,00	Clay	--
12	-33,920	18,00	20,00	32,50	Sand	0,200
13	-36,020	18,00	18,00	25,00	Clay	--
14	-37,521	18,00	20,00	32,50	Sand	0,200
15	-37,837	18,00	20,00	32,50	Sand	0,200

2.6.3 Soil Profile B

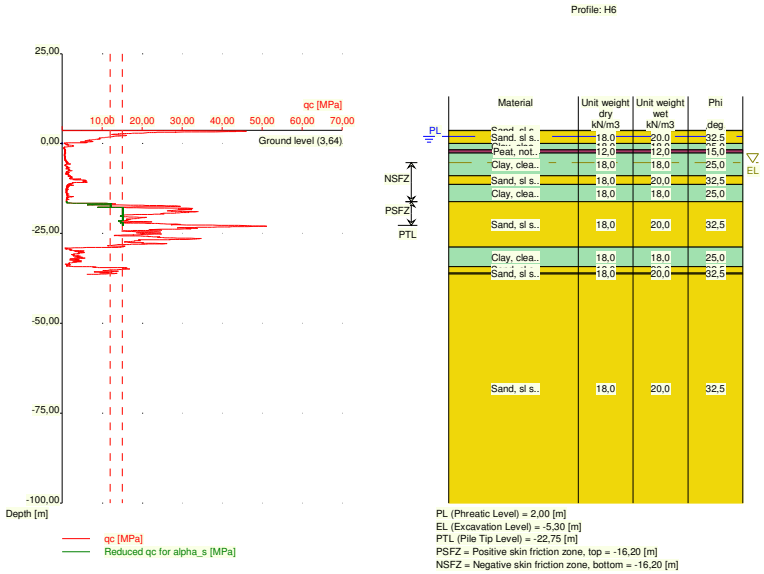
Belonging to CPT	B
Surface level in [m. reference level] :	3,35
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-18,90
Bottom of negative skin friction zone in [m. reference level] :	-18,90
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	29



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,350	18,00	20,00	32,50	Sand	0,200
2	3,340	18,00	20,00	32,50	Sand	0,200
3	2,140	18,00	18,00	25,00	Clay	--
4	-6,260	18,00	20,00	32,50	Sand	0,200
5	-9,260	18,00	18,00	25,00	Clay	--
6	-9,860	18,00	20,00	32,50	Sand	0,200
7	-10,760	18,00	18,00	25,00	Clay	--
8	-13,760	18,00	20,00	32,50	Sand	0,200
9	-15,860	18,00	18,00	25,00	Clay	--
10	-18,860	18,00	20,00	32,50	Sand	0,200
11	-29,060	18,00	18,00	25,00	Clay	--
12	-31,160	18,00	20,00	32,50	Sand	0,200
13	-31,760	18,00	18,00	25,00	Clay	--
14	-33,560	18,00	20,00	32,50	Sand	0,200
15	-35,660	18,00	18,00	25,00	Clay	--
16	-40,760	18,00	20,00	32,50	Sand	0,200
17	-41,060	18,00	18,00	25,00	Clay	--
18	-44,060	18,00	20,00	32,50	Sand	0,200
19	-48,860	18,00	18,00	25,00	Clay	--
20	-50,960	18,00	20,00	32,50	Sand	0,200
21	-51,560	18,00	18,00	25,00	Clay	--
22	-52,160	18,00	20,00	32,50	Sand	0,200
23	-54,260	18,00	18,00	25,00	Clay	--
24	-55,160	18,00	20,00	32,50	Sand	0,200
25	-57,860	18,00	18,00	25,00	Clay	--
26	-59,060	18,00	20,00	32,50	Sand	0,200
27	-64,460	18,00	18,00	25,00	Clay	--
28	-65,360	18,00	20,00	32,50	Sand	0,200
29	-83,100	18,00	20,00	32,50	Sand	0,200

2.6.4 Soil Profile H6

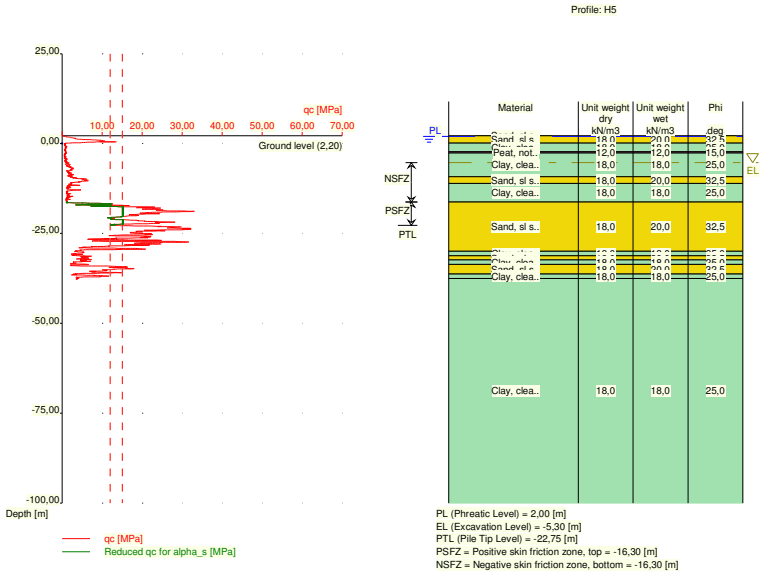
Belonging to CPT	H6
Surface level in [m. reference level] :	3,64
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-16,20
Bottom of negative skin friction zone in [m. reference level] :	-16,20
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	12



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	3,640	18,00	20,00	32,50	Sand	0,200
2	3,630	18,00	20,00	32,50	Sand	0,200
3	0,030	18,00	18,00	25,00	Clay	--
4	-1,770	12,00	12,00	15,00	Peat	--
5	-2,670	18,00	18,00	25,00	Clay	--
6	-8,970	18,00	20,00	32,50	Sand	0,200
7	-11,370	18,00	18,00	25,00	Clay	--
8	-16,170	18,00	20,00	32,50	Sand	0,200
9	-28,790	18,00	18,00	25,00	Clay	--
10	-34,210	18,00	20,00	32,50	Sand	0,200
11	-36,010	18,00	20,00	32,50	Sand	0,200
12	-36,310	18,00	20,00	32,50	Sand	0,200

2.6.5 Soil Profile H5

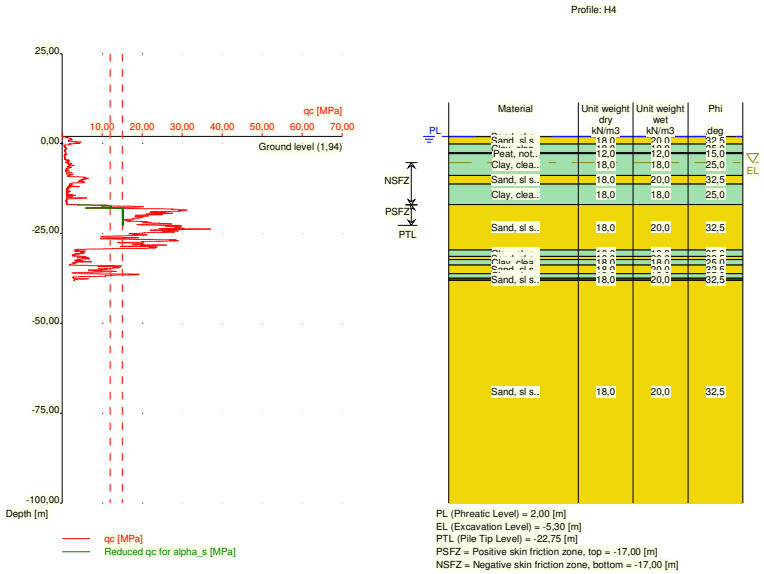
Belonging to CPT	H5
Surface level in [m. reference level] :	2,20
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-16,30
Bottom of negative skin friction zone in [m. reference level] :	-16,30
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	14



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	2,200	18,00	20,00	32,50	Sand	0,200
2	2,190	18,00	20,00	32,50	Sand	0,200
3	0,090	18,00	18,00	25,00	Clay	--
4	-2,310	12,00	12,00	15,00	Peat	--
5	-2,610	18,00	18,00	25,00	Clay	--
6	-9,230	18,00	20,00	32,50	Sand	0,200
7	-11,030	18,00	18,00	25,00	Clay	--
8	-16,230	18,00	20,00	32,50	Sand	0,200
9	-29,990	18,00	18,00	25,00	Clay	--
10	-31,190	18,00	20,00	32,50	Sand	0,200
11	-32,390	18,00	18,00	25,00	Clay	--
12	-33,610	18,00	20,00	32,50	Sand	0,200
13	-36,310	18,00	18,00	25,00	Clay	--
14	-37,510	18,00	18,00	25,00	Clay	--

2.6.6 Soil Profile H4

Belonging to CPT	H4
Surface level in [m. reference level] :	1,94
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-17,00
Bottom of negative skin friction zone in [m. reference level] :	-17,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	16

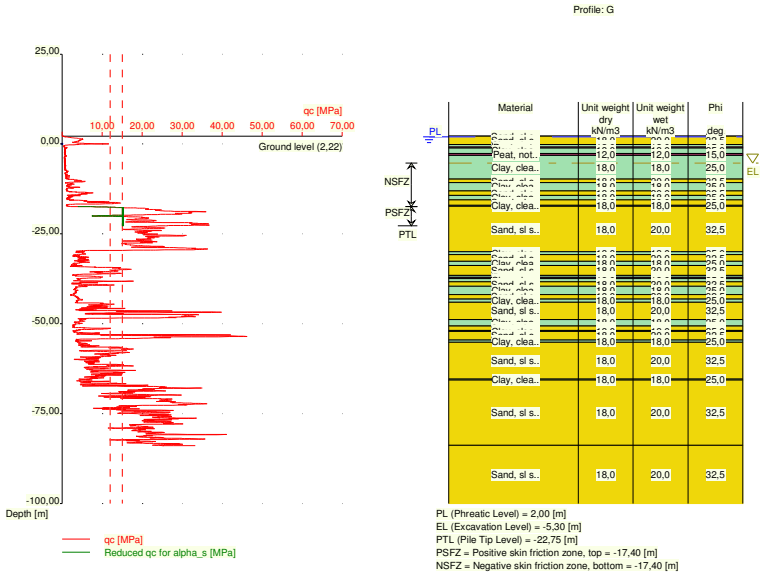


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	1,940	18,00	20,00	32,50	Sand	0,200
2	1,930	18,00	20,00	32,50	Sand	0,200
3	-0,170	18,00	18,00	25,00	Clay	--
4	-2,570	12,00	12,00	15,00	Peat	--
5	-2,870	18,00	18,00	25,00	Clay	--
6	-8,870	18,00	20,00	32,50	Sand	0,200
7	-11,289	18,00	18,00	25,00	Clay	--
8	-16,990	18,00	20,00	32,50	Sand	0,200
9	-29,610	18,00	18,00	25,00	Clay	--
10	-31,410	18,00	20,00	32,50	Sand	0,200
11	-32,310	18,00	18,00	25,00	Clay	--
12	-33,810	18,00	20,00	32,50	Sand	0,200
13	-36,210	18,00	18,00	25,00	Clay	--
14	-37,410	18,00	20,00	32,50	Sand	0,200
15	-37,710	18,00	20,00	32,50	Sand	0,200
16	-38,010	18,00	20,00	32,50	Sand	0,200

2.6.7 Soil Profile G

Belonging to CPT	G
Surface level in [m. reference level] :	2,22
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-17,40
Bottom of negative skin friction zone in [m. reference level] :	-17,40
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01

Number of layers in profile : 35

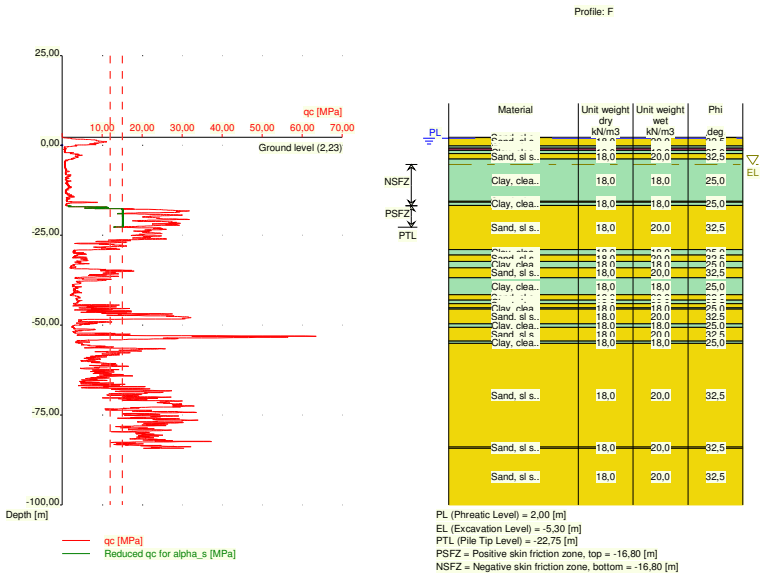


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	2,220	18,00	20,00	32,50	Sand	0,200
2	2,210	18,00	20,00	32,50	Sand	0,200
3	-0,190	18,00	18,00	25,00	Clay	--
4	-0,790	12,00	12,00	15,00	Peat	--
5	-1,090	18,00	18,00	25,00	Clay	--
6	-2,590	12,00	12,00	15,00	Peat	--
7	-3,190	18,00	18,00	25,00	Clay	--
8	-9,810	18,00	20,00	32,50	Sand	0,200
9	-10,710	18,00	18,00	25,00	Clay	--
10	-13,110	18,00	20,00	32,50	Sand	0,200
11	-14,310	18,00	18,00	25,00	Clay	--
12	-15,510	18,00	20,00	32,50	Sand	0,200
13	-17,010	18,00	18,00	25,00	Clay	--
14	-17,310	18,00	20,00	32,50	Sand	0,200
15	-29,910	18,00	18,00	25,00	Clay	--
16	-30,810	18,00	20,00	32,50	Sand	0,200
17	-32,630	18,00	18,00	25,00	Clay	--
18	-33,830	18,00	20,00	32,50	Sand	0,200
19	-36,530	18,00	18,00	25,00	Clay	--
20	-37,130	12,00	12,00	15,00	Peat	--
21	-37,430	18,00	18,00	25,00	Clay	--
22	-38,330	18,00	20,00	32,50	Sand	0,200
23	-39,530	18,00	18,00	25,00	Clay	--
24	-41,930	18,00	20,00	32,50	Sand	0,200
25	-43,131	18,00	18,00	25,00	Clay	--
26	-44,050	18,00	20,00	32,50	Sand	0,200

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
27	-48,850	18,00	18,00	25,00	Clay	--
28	-50,650	18,00	20,00	32,50	Sand	0,200
29	-51,850	18,00	18,00	25,00	Clay	--
30	-52,150	18,00	20,00	32,50	Sand	0,200
31	-54,550	18,00	18,00	25,00	Clay	--
32	-55,150	18,00	20,00	32,50	Sand	0,200
33	-65,390	18,00	18,00	25,00	Clay	--
34	-65,690	18,00	20,00	32,50	Sand	0,200
35	-83,790	18,00	20,00	32,50	Sand	0,200

2.6.8 Soil Profile F

Belonging to CPT	F
Surface level in [m. reference level] :	2,23
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-16,80
Bottom of negative skin friction zone in [m. reference level] :	-16,80
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	26

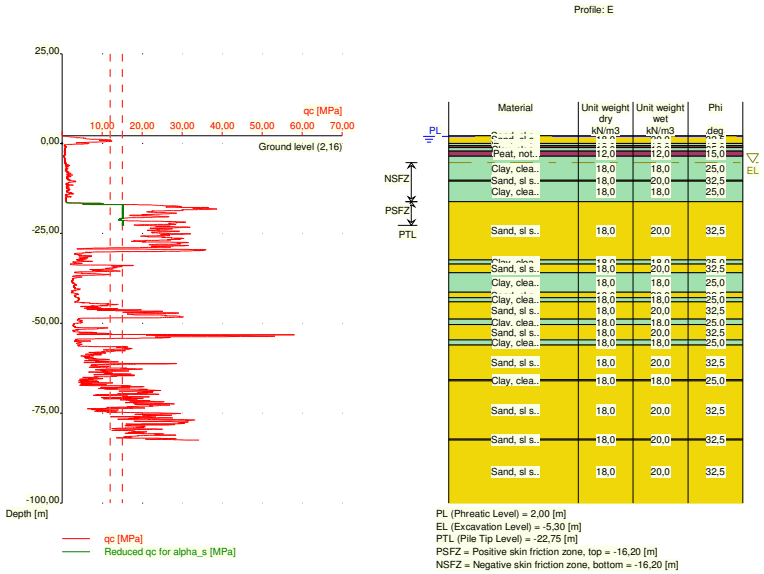


Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	2,230	18,00	20,00	32,50	Sand	0,200
2	2,220	18,00	20,00	32,50	Sand	0,200
3	-0,180	18,00	18,00	25,00	Clay	--

Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
4	-0,780	12,00	12,00	15,00	Peat	--
5	-1,380	18,00	18,00	25,00	Clay	--
6	-2,280	18,00	20,00	32,50	Sand	0,200
7	-3,780	18,00	18,00	25,00	Clay	--
8	-15,500	18,00	20,00	32,50	Sand	0,200
9	-15,800	18,00	18,00	25,00	Clay	--
10	-16,700	18,00	20,00	32,50	Sand	0,200
11	-29,000	18,00	18,00	25,00	Clay	--
12	-30,500	18,00	20,00	32,50	Sand	0,200
13	-32,300	18,00	18,00	25,00	Clay	--
14	-34,100	18,00	20,00	32,50	Sand	0,200
15	-36,800	18,00	18,00	25,00	Clay	--
16	-41,600	18,00	20,00	32,50	Sand	0,200
17	-43,100	18,00	18,00	25,00	Clay	--
18	-44,000	18,00	20,00	32,50	Sand	0,200
19	-45,200	18,00	18,00	25,00	Clay	--
20	-45,500	18,00	20,00	32,50	Sand	0,200
21	-49,700	18,00	18,00	25,00	Clay	--
22	-50,600	18,00	20,00	32,50	Sand	0,200
23	-54,500	18,00	18,00	25,00	Clay	--
24	-55,100	18,00	20,00	32,50	Sand	0,200
25	-83,920	18,00	20,00	32,50	Sand	0,200
26	-84,220	18,00	20,00	32,50	Sand	0,200

2.6.9 Soil Profile E

Belonging to CPT	E
Surface level in [m. reference level] :	2,16
Phreatic level in [m. reference level] :	2,00
Pile tip level in [m. reference level] :	-22,75
Top of positive skin friction zone in [m. reference level] :	-16,20
Bottom of negative skin friction zone in [m. reference level] :	-16,20
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,01
Number of layers in profile :	24



Number layer	Top layer [m R.L.]	Gamma [kN/m3]	Gamma;sat [kN/m3]	Phi [deg]	Soil Type	Median (Sand/Gravel) [mm]
1	2,160	18,00	20,00	32,50	Sand	0,200
2	2,150	18,00	20,00	32,50	Sand	0,200
3	0,050	18,00	18,00	25,00	Clay	--
4	-0,550	12,00	12,00	15,00	Peat	--
5	-1,150	18,00	18,00	25,00	Clay	--
6	-2,050	12,00	12,00	15,00	Peat	--
7	-3,550	18,00	18,00	25,00	Clay	--
8	-10,170	18,00	20,00	32,50	Sand	0,200
9	-10,470	18,00	18,00	25,00	Clay	--
10	-16,170	18,00	20,00	32,50	Sand	0,200
11	-32,370	18,00	18,00	25,00	Clay	--
12	-33,570	18,00	20,00	32,50	Sand	0,200
13	-35,970	18,00	18,00	25,00	Clay	--
14	-41,370	18,00	20,00	32,50	Sand	0,200
15	-42,870	18,00	18,00	25,00	Clay	--
16	-44,070	18,00	20,00	32,50	Sand	0,200
17	-48,870	18,00	18,00	25,00	Clay	--
18	-50,370	18,00	20,00	32,50	Sand	0,200
19	-54,570	18,00	18,00	25,00	Clay	--
20	-56,070	18,00	20,00	32,50	Sand	0,200
21	-65,690	18,00	18,00	25,00	Clay	--
22	-65,990	18,00	20,00	32,50	Sand	0,200
23	-82,210	18,00	20,00	32,50	Sand	0,200
24	-82,510	18,00	20,00	32,50	Sand	0,200

2.7 Pile Types

2.7.1 Pile type : LostTip 680

Pile type :	Screw pile, cast in place, lost tip
Materialtype for pile :	Concrete
Slip layer :	None
Pile shape :	Round pile with lost tip
beta (user defined : Pile tip, shape factor) :	1,00

s (factor for the influence of the shape of the crosssection of the pile base) according to NEN 9997-1:2016.

Pile dimensions :

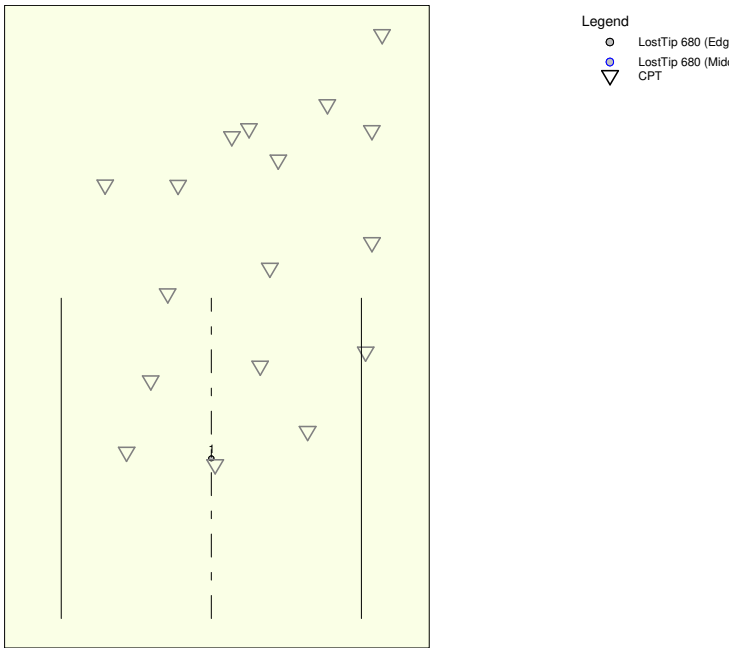
Diameter at tip [m] :	0,680
Diameter shaft [m] :	0,679
Effective heigth enlarged base [m] :	0,000

2.8 Foundation Plan

Number of piles :	1
Number of collaborating piles* :	1

* : 0 = not defined, 1 = non rigid superstructure, >1 = rigid superstructure

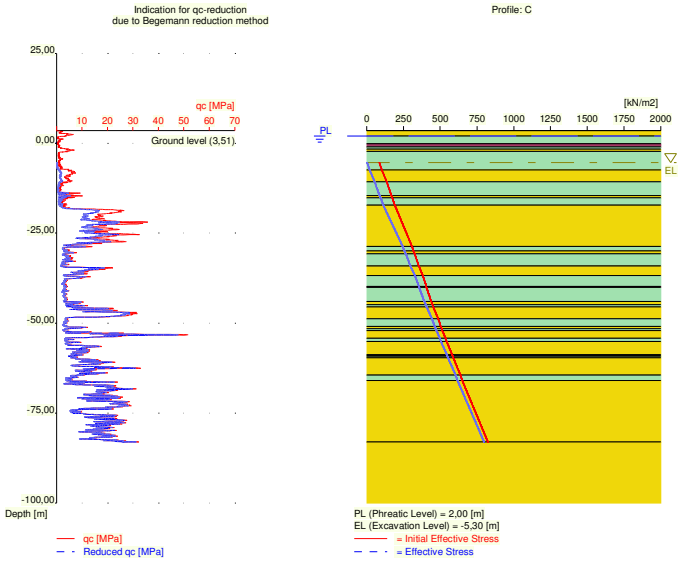
2.8.1 View of Foundation Plan



Pile nr/name	X-coor-dinate [m]	Y-coor-dinate [m]	Fc;d (EQU/STR/GEO) [kN]	Fc;d (SLS) [kN]	P0 [kN/m2]	Pile head level [m R.L.]
1: 1	93655,00	435295,00	3100,00	2133,00	0,00	-5,00

2.9 Excavation Data

Excavation level in [m. reference level] : -5,30
Reduction model : Begemann
Distance edge pile to excavation boundary [m] : 20,00



2.10 Totalized Loads (design values)

Total load on all piles
For limit state EQU/STR/GEO in [kN] : 3100,00
For Serviceability limit state in [kN] : 2133,00

2.11 Requirements

Limit state STR/GEO
Maximum allowed settlement in [m] : 0,150
Serviceability Limit State
Maximum allowed settlement in [m] : 0,150

2.12 Overruled Parameters

User defined Factor xi3 [-] : 1,15
User defined Factor xi4 [-] : 0,92

2.13 Model Options

Suppress pile group (for negative skin friction)
Do not create intermediate results file
Use reduction for continuous flight auger piles (standard)
Use the influence of excavations (standard).

2.14 Model Options

Selected pile types :
- -LostTip 680

Selected profiles :
- -C
- -H7
- -B
- -H6
- -H5
- -H4
- -G
- -F
- -E

3 Bearing Piles (EC7-NL): Results Complete Verification

3.1 Remarks

When checking the survey and testing of soil according to NEN 9997-1:2016 art. 3.2.3 section (e), the program uses the provided CPT test level. It does NOT take into account possible different pile tip levels. When different pile tip levels are used in this calculation, the user itself must check for possibly required additional survey and testing of soil.

Performing the check on NEN 9997-1:2016 art. 3.2.3, the average distance between the different CPT's used for this check is 20 m.
The requirements set by NEN 9997-1:2016 art. 3.2.3 are met.

The requirements set by NEN 9997-1:2016 art. 3.3.3 are met. The variation (11,86%) is ok (<= 12%).

3.2 Calculation Parameters

3.2.1 Pile Factors

gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;b (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, Limit State EQU/STR/GEO) :	1,20
gamma;s (NEN 9997-1:2016, table A.6 A.7 A.8, the Serviceability Limit State) :	1,00
xi3 (user defined) :	1,15
xi4 (user defined) :	0,92

Xi 3 has been used.

Even though it is possible, the pilegroup model has not been used to calculate the negative skin friction.

3.2.2 Pile type : LostTip 680

Pile type :	Screw pile, cast in place, lost tip
Materialtype for pile :	Concrete
Slip layer :	None
Pile shape :	Round pile with lost tip
beta (user defined : Pile tip, shape factor) :	1,00
s (NEN 9997-1:2016 art. 7.6.2.3(h) : factor for the influence of the shape of the crosssection of the pile base) :	1,00

Pile dimensions :

Diameter at tip [m] :	0,680
Diameter shaft [m] :	0,679
Effective heigth enlarged base [m] :	0,000

Number/Name CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
16:C	0,0090	--	0,6300
17:H7	0,0090	--	0,6300
15:B	0,0090	--	0,6300
13:H6	0,0090	--	0,6300
12:H5	0,0090	--	0,6300
11:H4	0,0090	--	0,6300

Number/Name CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
10:G	0,0090	--	0,6300
9:F	0,0090	--	0,6300
8:E	0,0090	--	0,6300

3.3 Verification of Limit State EQU

Required by NEN 9997-1:2016 art. 2.4.8: Ed <= Cd.
Non rigid superstructure, verify load per pile with bearing capacity per pile.

Fc;d = 3100,000 [kN]
Rc;d = 3316,514 [kN]

The requirements of limit state EQU are met, limit state EQU is ok.

Note: Negative skin friction plays NO part in Limit State EQU. Its influence is incorporated in the tests for Limit State STR/GEO and the Serviceability limit state. The intermediate results provide a full overview of all values that are calculated for the negative skin friction.
For this project, negative skin friction does not occur at all.

3.4 Verification of Serviceability Limit State

Required by NEN 9997-1:2016 art. 2.4.9: Sd <= Sreq.
For houses, the requirement is : Sreq = 0.05 m. For other types of superstructures a different (well considered) requirement can be specified.

Sd = 0,015 [m]
Sreq = 0,150 [m]

The settlement requirements of the Serviceability Limit State are met, this is ok.

As the superstructure was indicated to be rigid, settlement differences may be neglected, so rotations are not taken into consideration (NEN 9997-1:2016 art. 6.6.2 part c)!

3.5 Additional Information

The design values of the maximum shaft tensions (calculated at the transition of positive to negative skin friction) are

At Limit state EQU/STR/GEO: sigma = 8,56 [N/mm2]
At Serviceability Limit State: sigma = 5,89 [N/mm2]

The maximum settlement was found at:
Limit state STR/GEO
Number/Name B
Pile name: 1

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 99,000 [m]
sel;d = 0,007 [m]
s2 = 0,000 [m]

Serviceability Limit State
Number/Name B
Pile name: 1

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 0,010 [m]
sel;d = 0,005 [m]

s2 = 0,000 [m]

sneg stands for the settlement due to negative skin friction when the expected ground level settlement (egls) is within the next boundaries : 0.02 < egls <= 0.10 meter.

For expected ground level settlement beyond the boundaries, sneg = 0.

3.5.1 The bearing capacity of shaft and point at Limit state STR/GEO

The next table shows the values of the bearing capacities per CPT and these are purely informative.
The presented design values are determined using the maximum value of ksi3 and ksi4.

Number/Name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
16:C	922,141	1883,633	2805,774
17:H7	829,896	2141,666	2971,562
15:B	629,294	2311,167	2940,461
13:H6	1116,717	2434,293	3551,010
12:H5	1123,923	2246,054	3369,977
11:H4	1101,239	2578,546	3679,785
10:G	1029,109	2093,780	3122,889
9:F	1106,426	2289,315	3395,741
8:E	1222,068	2789,355	4011,423

3.5.2 The bearing capacity of shaft and point at the Serviceability Limit State

The next table shows the values of the bearing capacities per CPT and these are purely informative.
The presented design values are determined using the maximum value of ksi3 and ksi4.

Number/Name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
16:C	1106,570	2260,360	3366,930
17:H7	995,875	2569,999	3565,874
15:B	755,153	2773,401	3528,554
13:H6	1340,060	2921,152	4261,212
12:H5	1348,708	2695,264	4043,972
11:H4	1321,487	3094,255	4415,742
10:G	1234,930	2512,536	3747,466
9:F	1327,711	2747,177	4074,888
8:E	1466,482	3347,227	4813,709

End of Report