Bijlage I

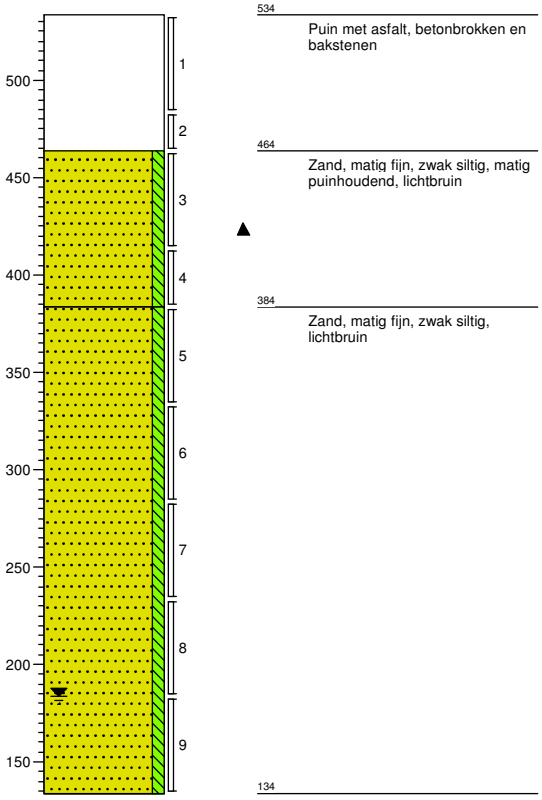
Tekeningen T009 en T010

Bijlage II

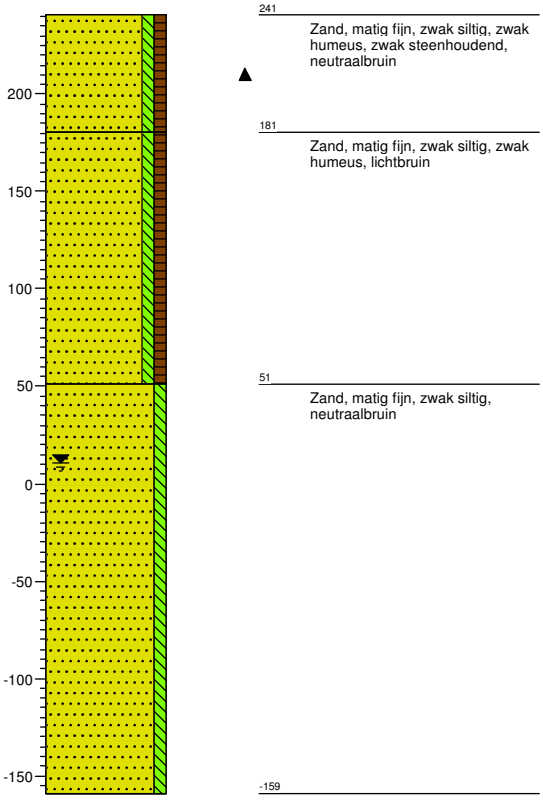
Relevant grondonderzoek

Boorprofielen

Boormeester: W. Langerak
Boring: HB04
Datum: 22-06-2016



Boormeester: W. Langerak
Boring: HB16
Datum: 22-06-2016



Projectcode: BTYM160624

Boorprofielen

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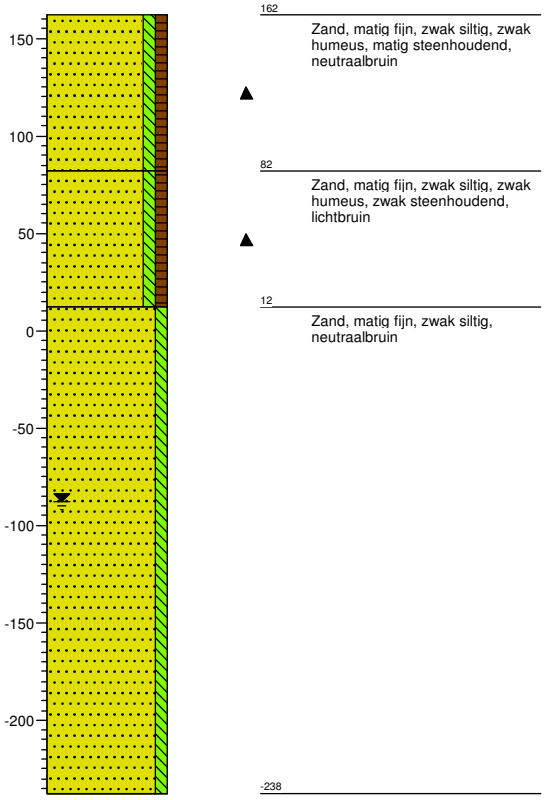
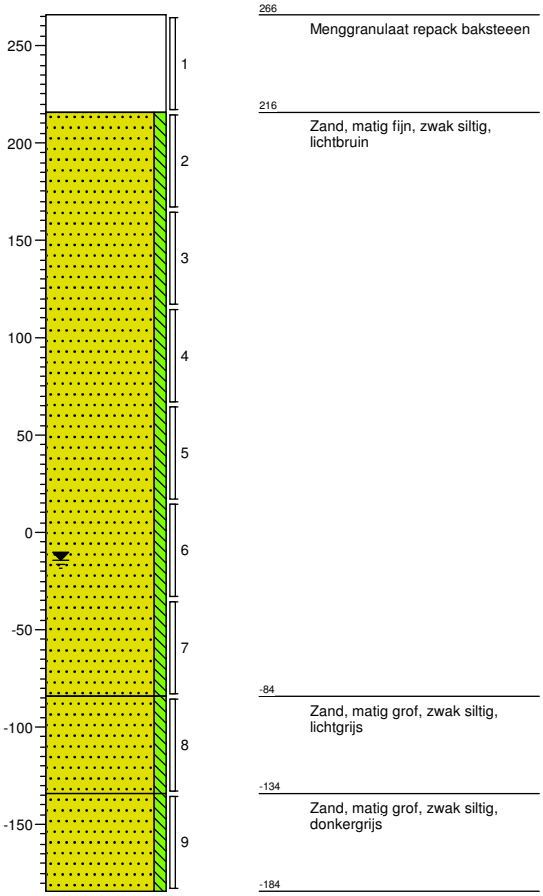
Boring: HB26
Datum: 22-06-2016



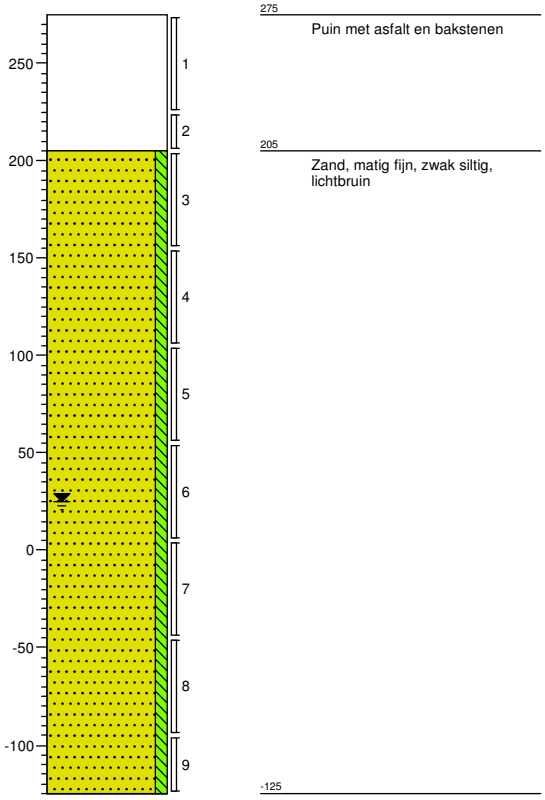
Boormeester: W. Langerak
Boring: HB33
Datum: 22-06-2016



Projectcode: BTYM160624

Boorprofielen

Boormeester: W. Langerak
Boring: HB38
Datum: 22-06-2016



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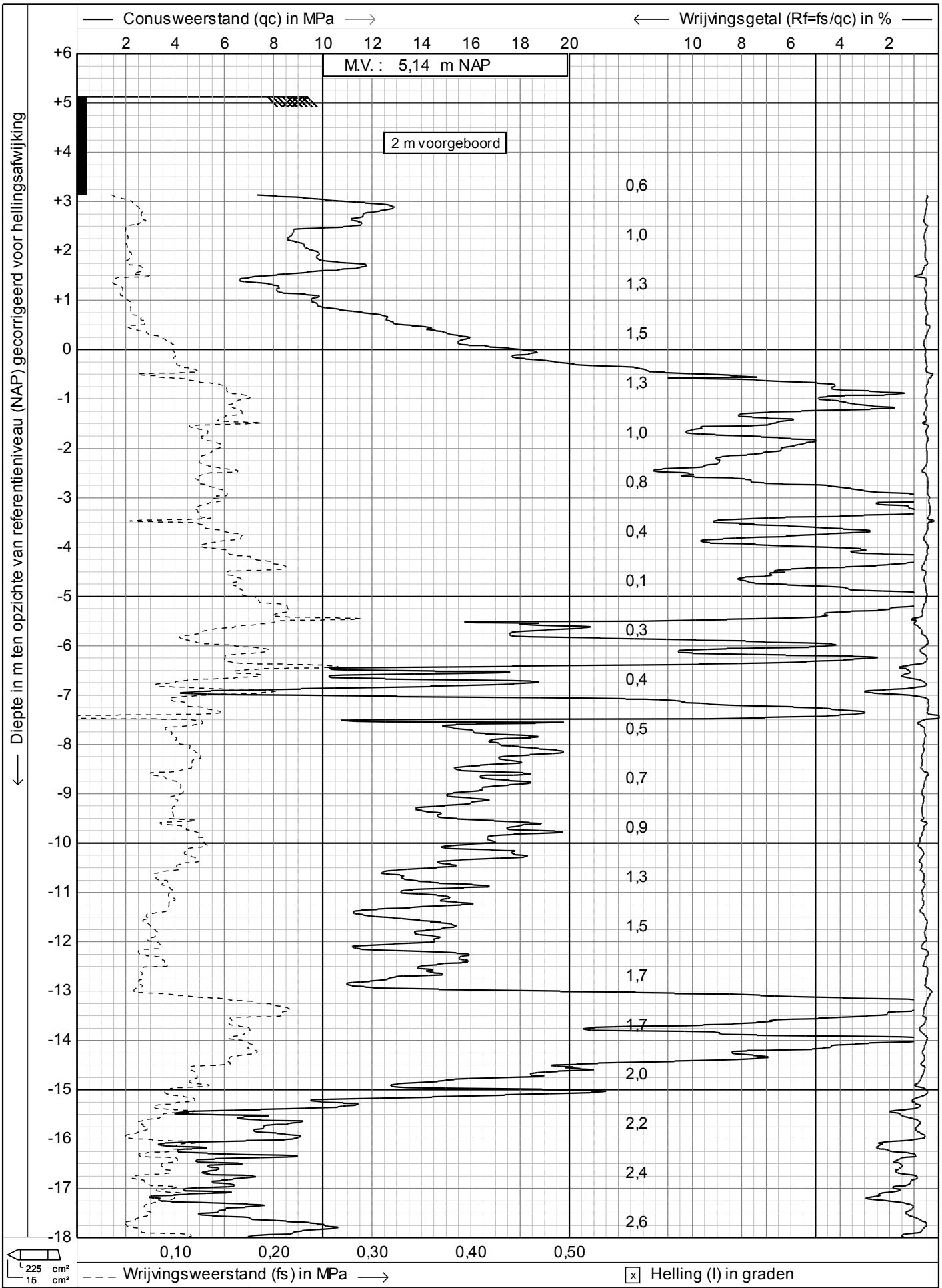

GEOMET ☎ 0172 449822	sondering volgens NEN-EN-ISO 22476-1 Project : **WINDMOLENPARK SPUISLUIS** Locatie : **IJMUIDEN**	Datum : **23-6-2016** Conusnr. : **S15CFII.S15460** Projectnr. : **AA15448** Sondeernr.: **DKM-02** 1/2

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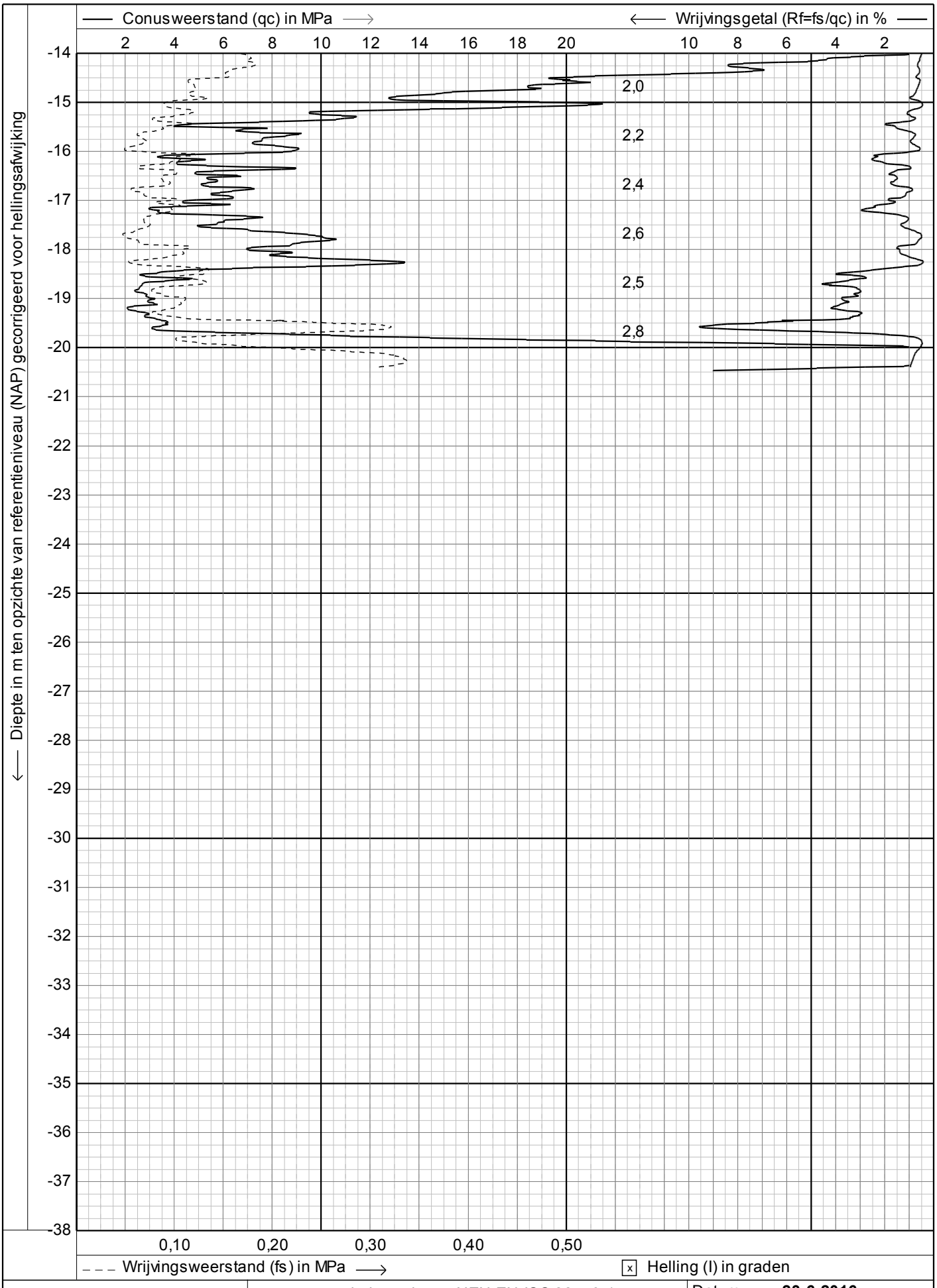


GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

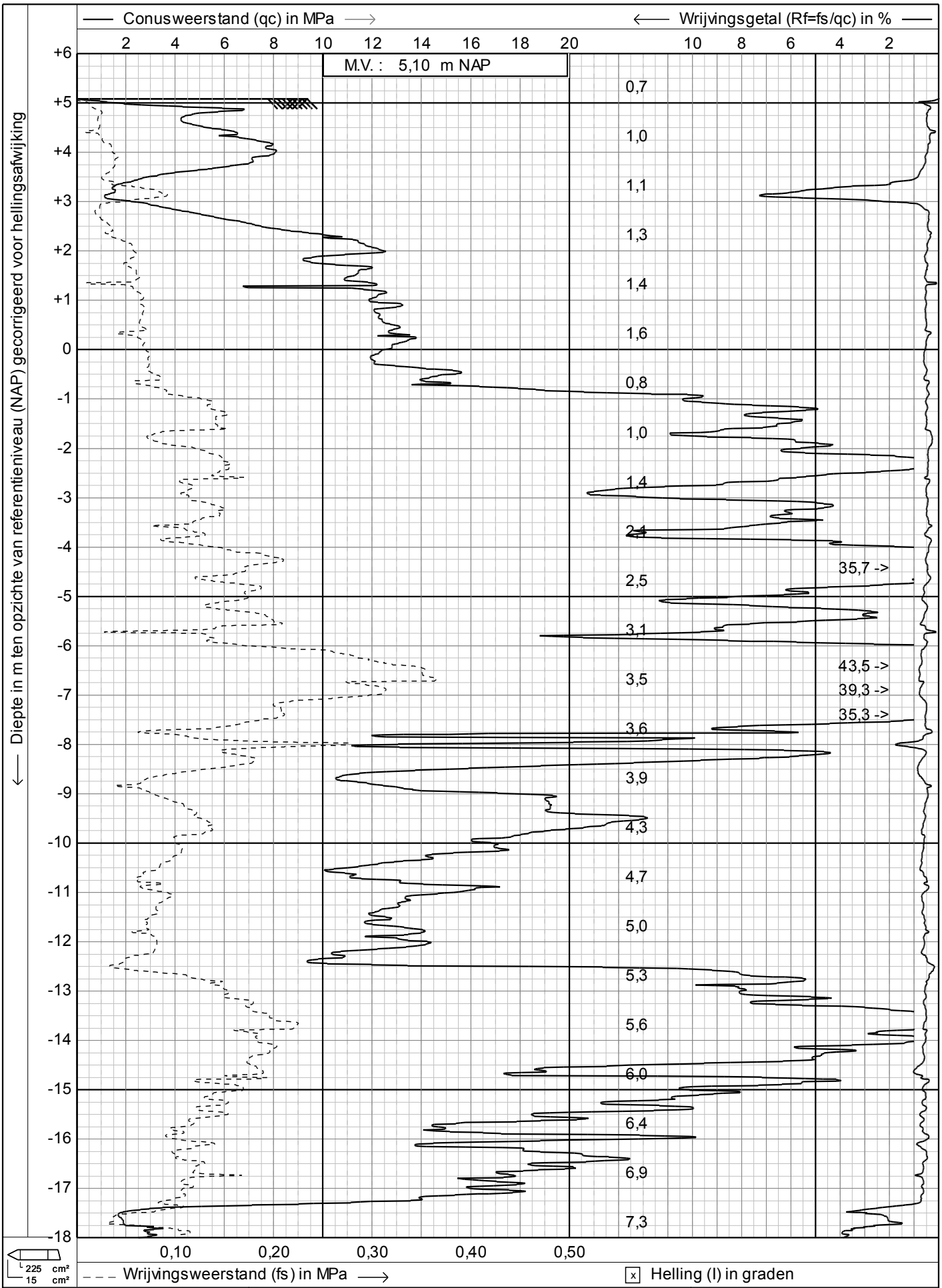
Datum : **23-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-02** **2/2**

1.45



GEOMET ☎ 0172 449822	sondering volgens NEN-EN-ISO 22476-1 Project : **WINDMOLENPARK SPUISLUIS** Locatie : **IJMUIDEN**	Datum : **22-6-2016** Conusnr. : **S15CFII.S15460** Projectnr. : **AA15448** Sondeernr.: **DKM-08** 1/2

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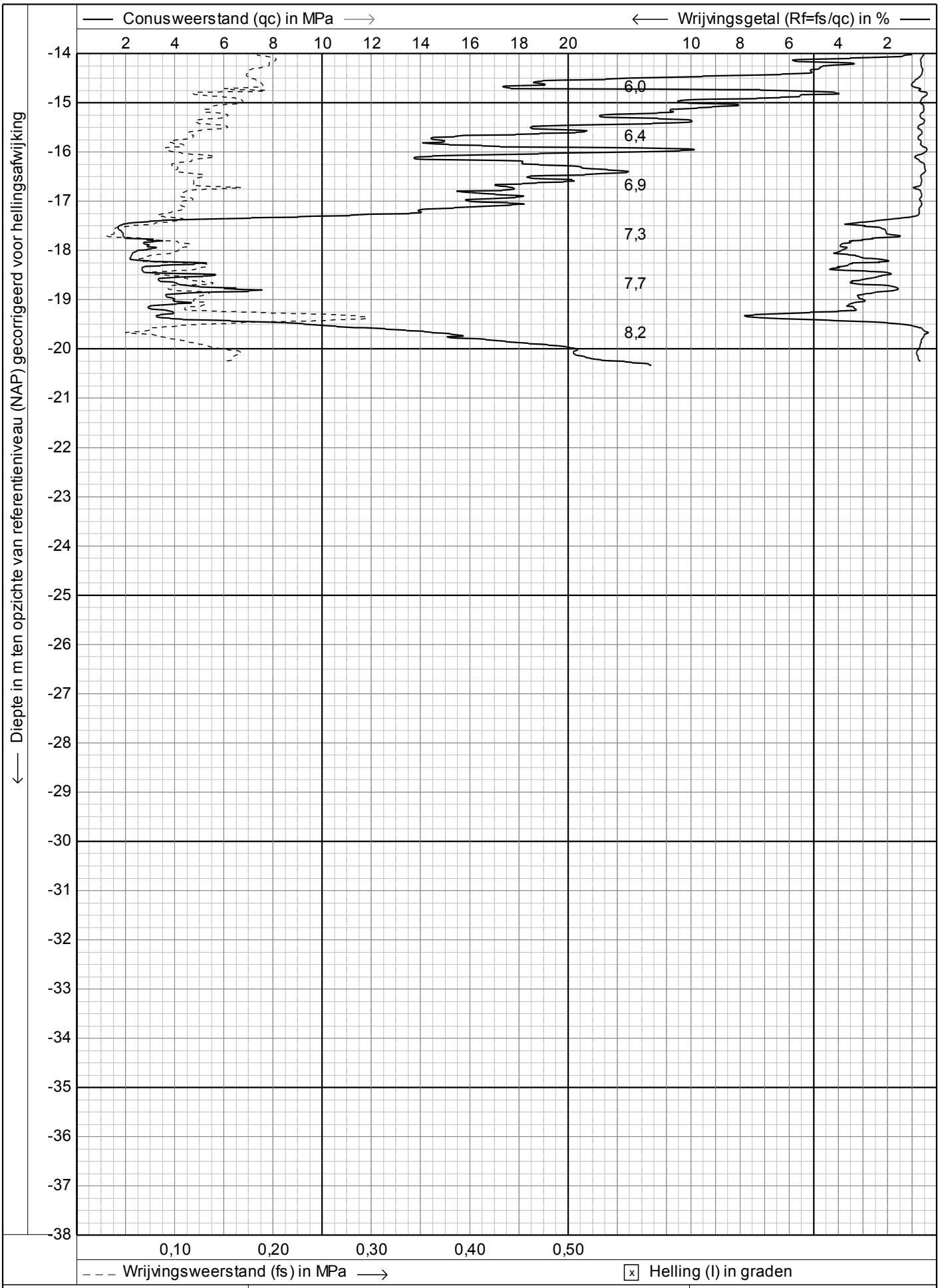

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-08** **2/2**

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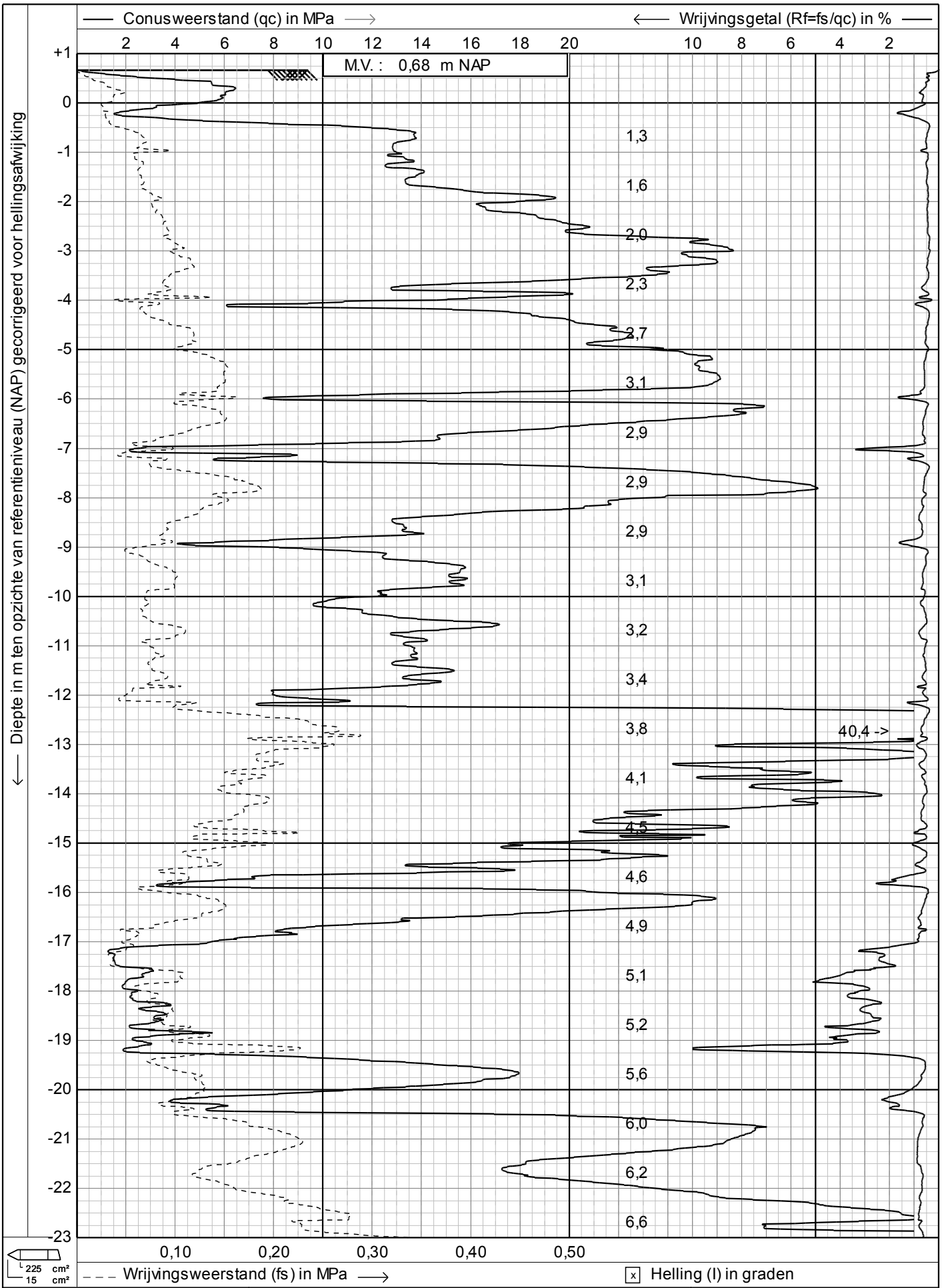

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-10** 1/2

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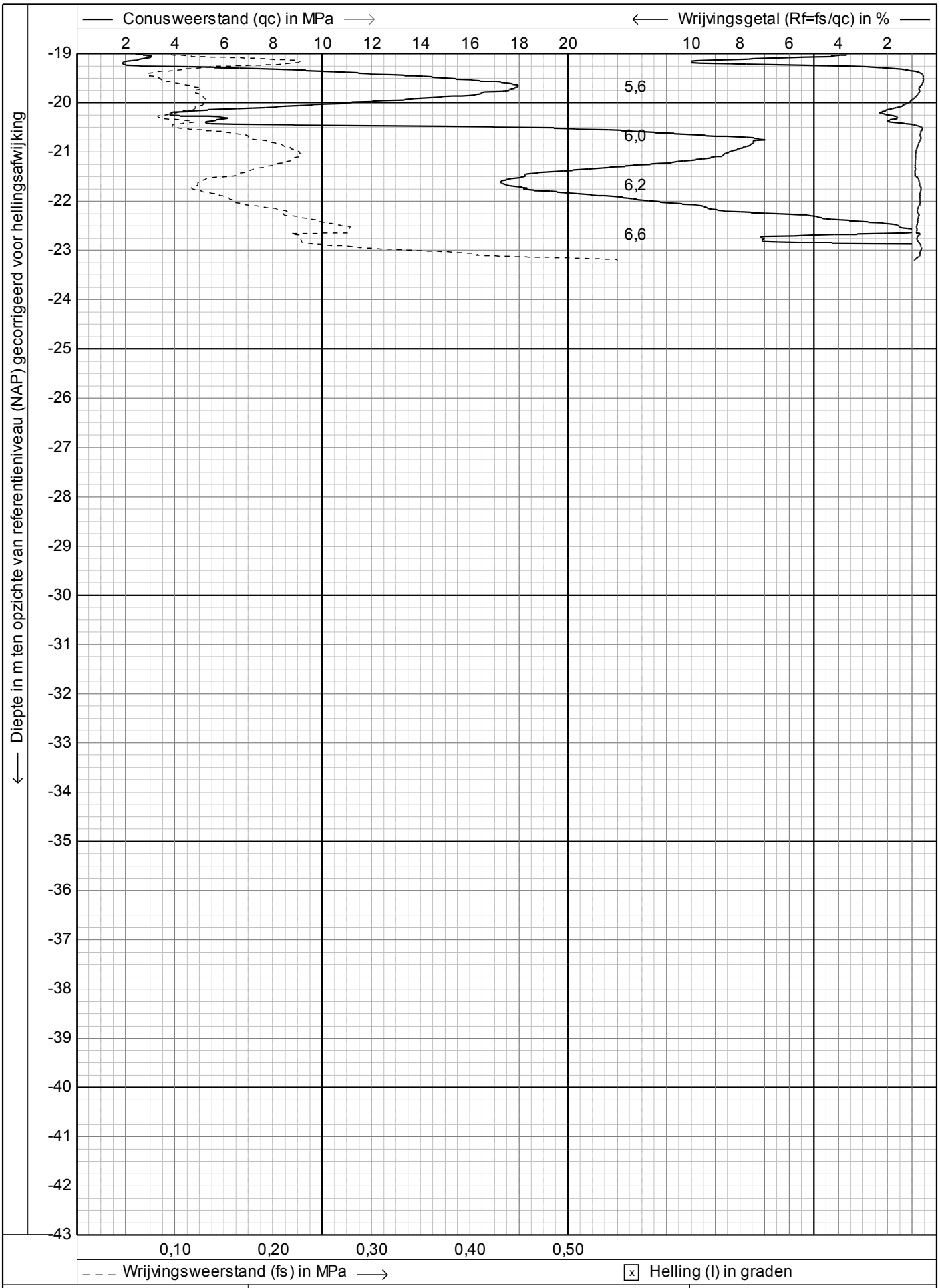

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-10** **2/2**

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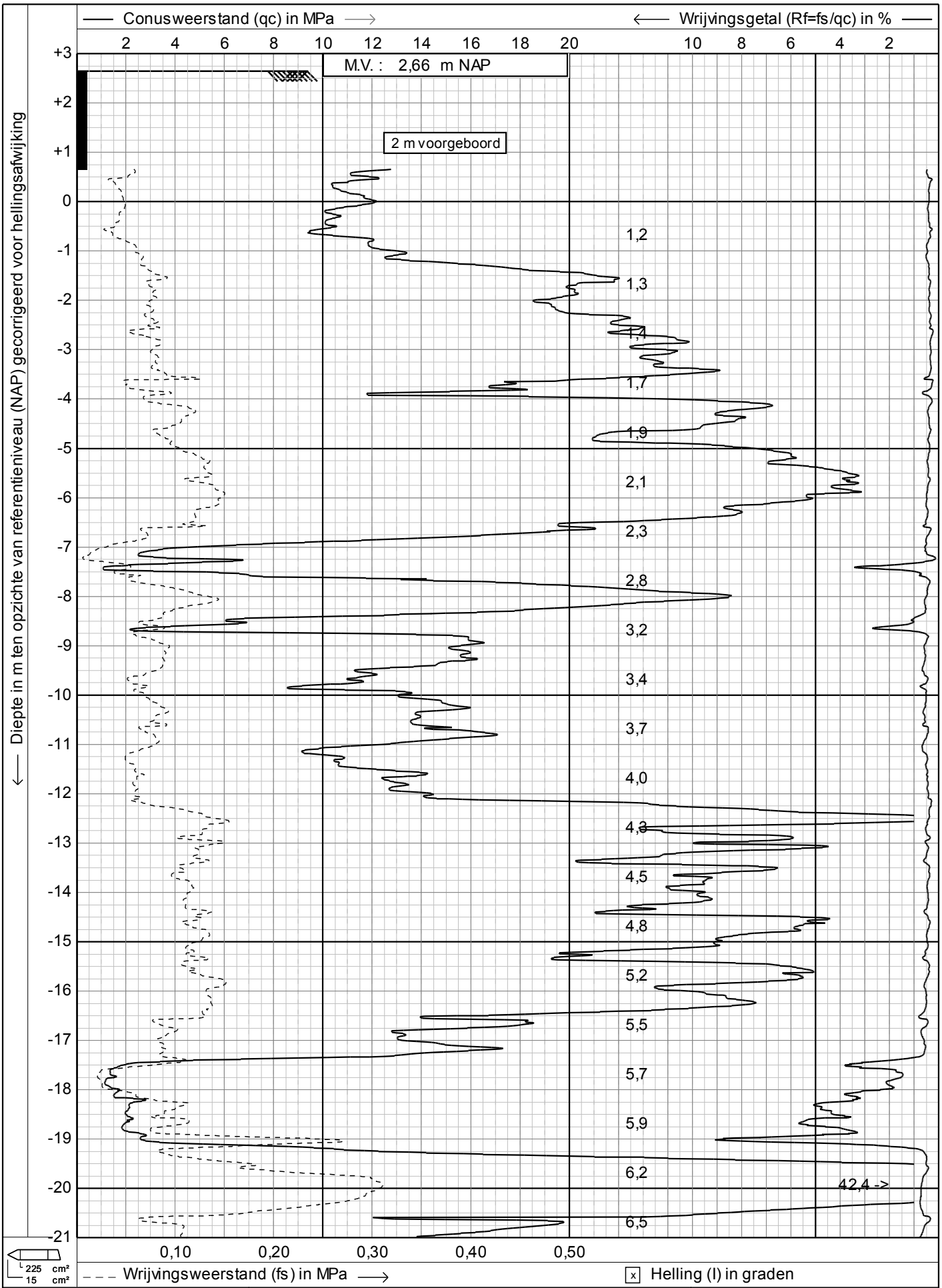

GEOMET
0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **7-6-2016**

Conusnr. : **S15CFII.924**

Projectnr. : **AA15448**

Sondeernr.: **DKM-14** **1/2**

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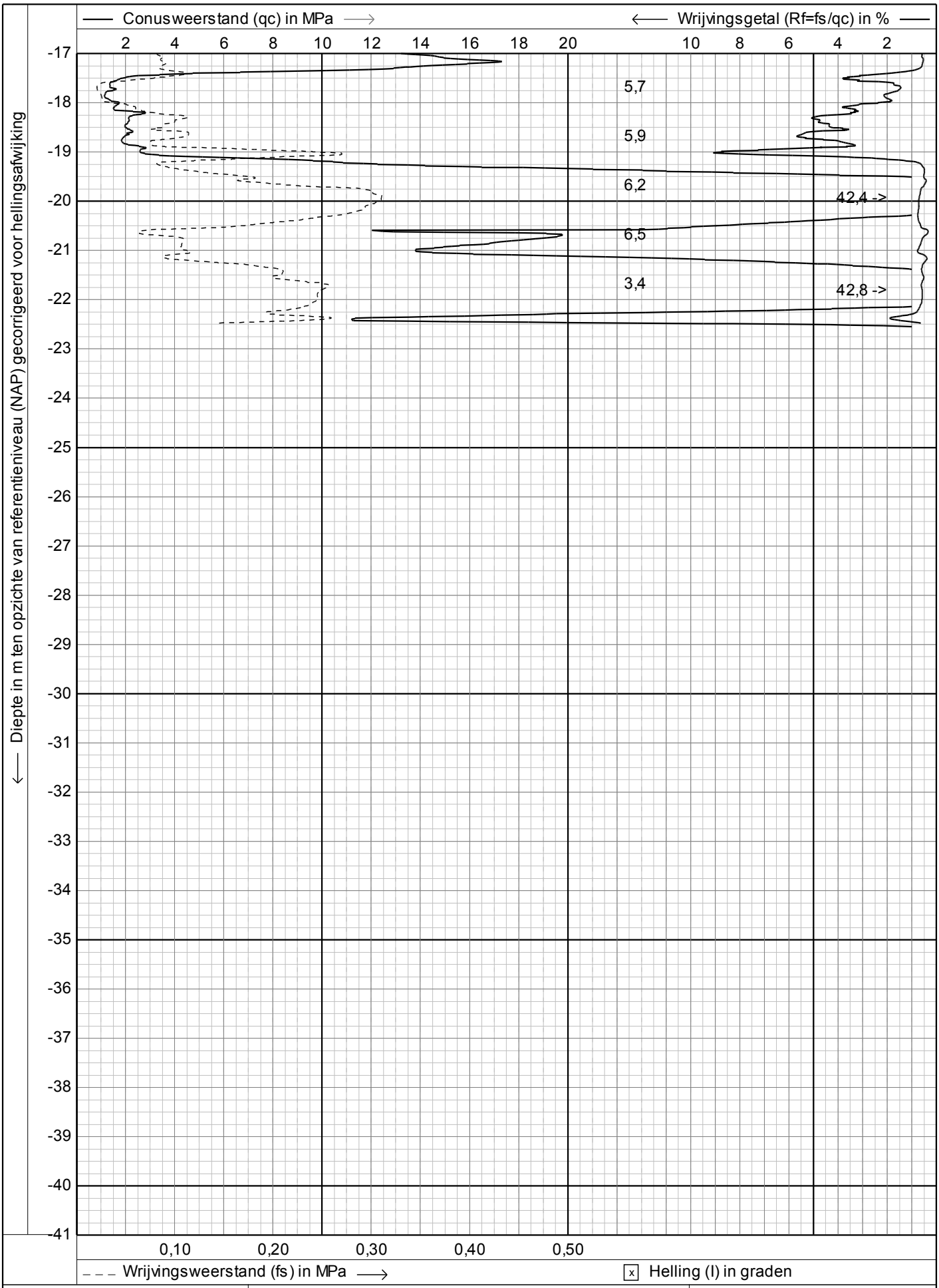

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **7-6-2016**

Conusnr. : **S15CFII.924**

Projectnr. : **AA15448**

Sondeernr.: **DKM-14** **2/2**

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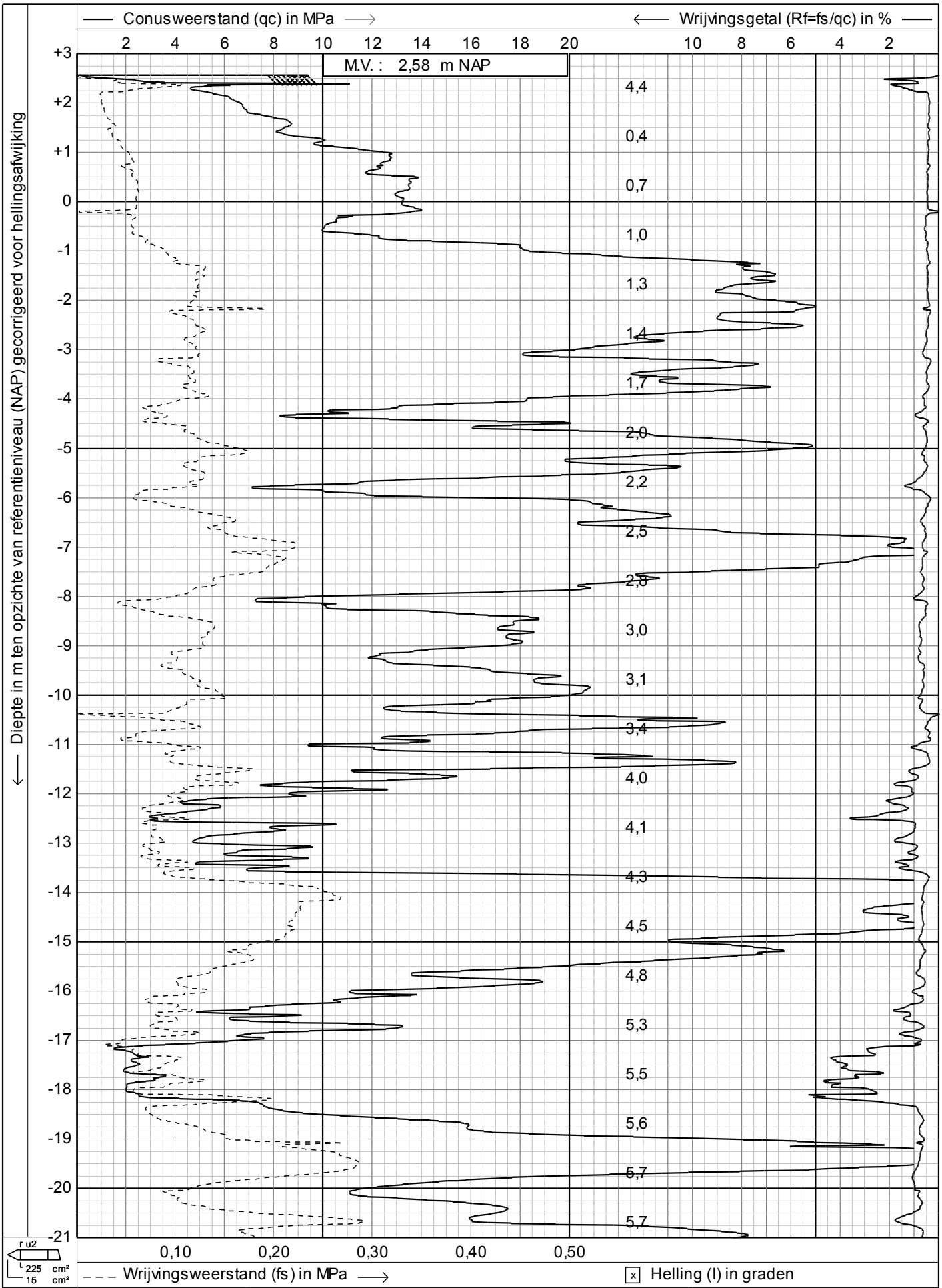

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-17** **1/2**

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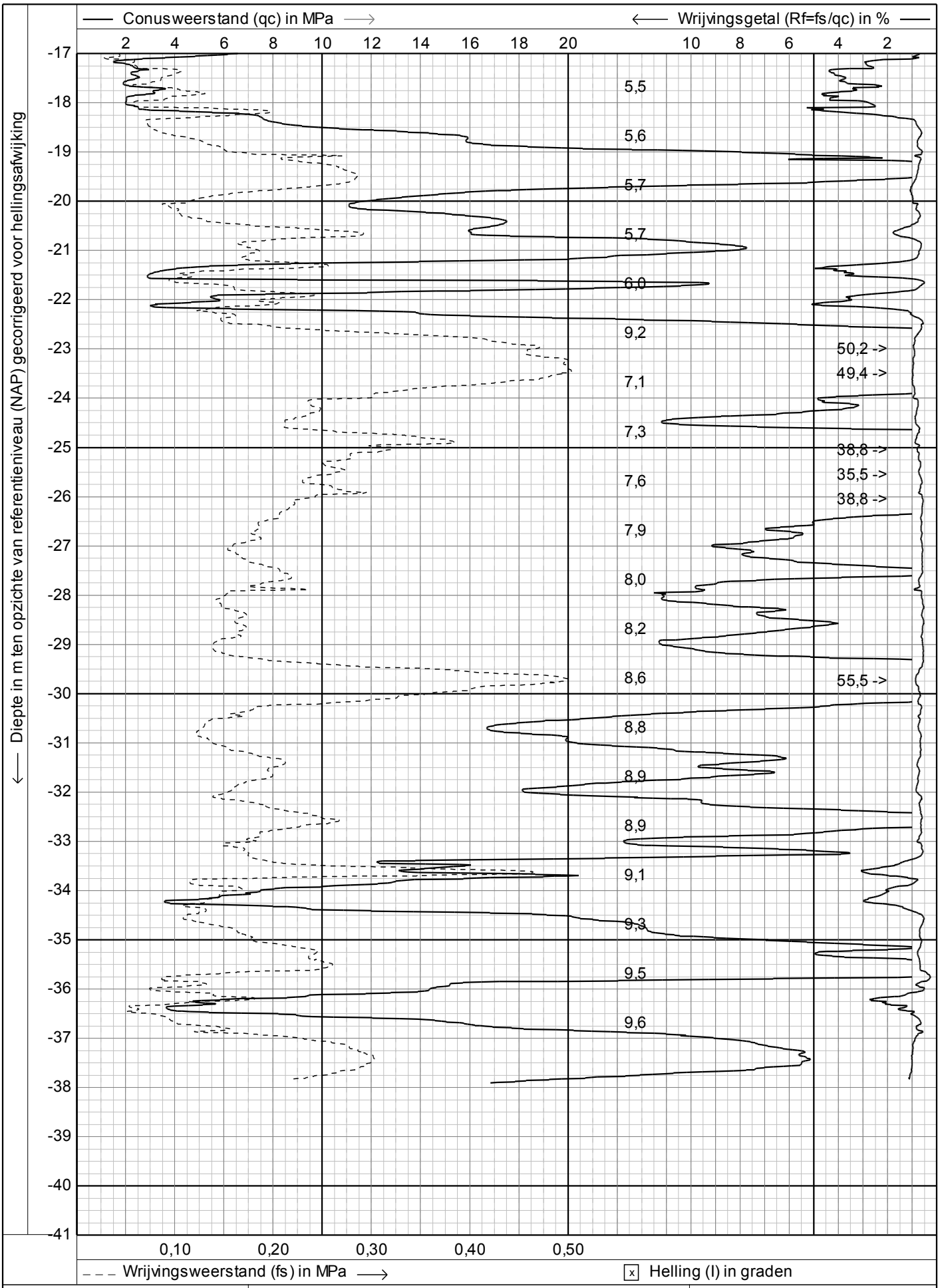


GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

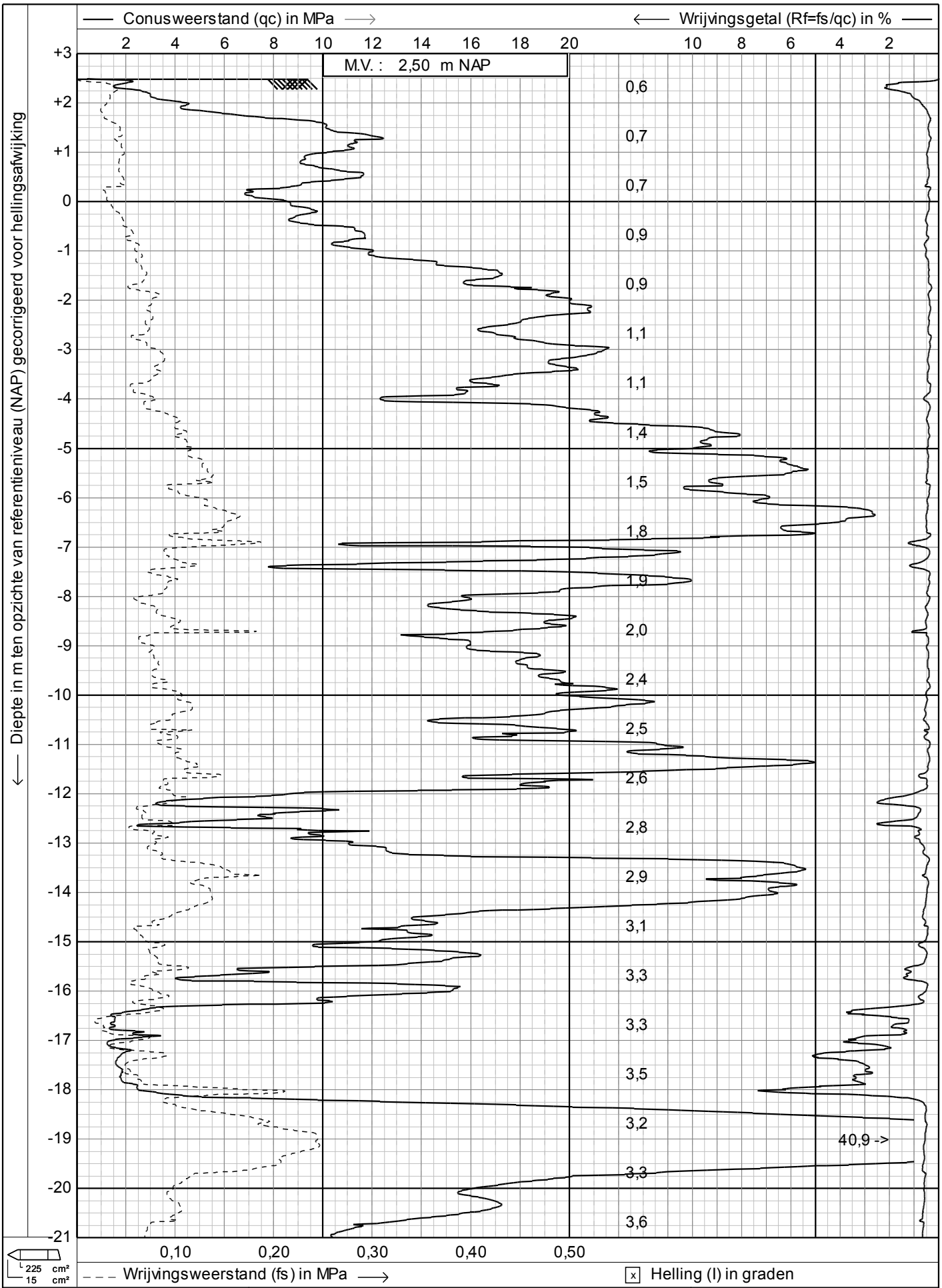
Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-17** **2/2**

1.45



GEOMET

0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **7-6-2016**

Conusnr. : **S15CFII.924**

Projectnr. : **AA15448**

Sondeernr.: **DKM-21** 1/2

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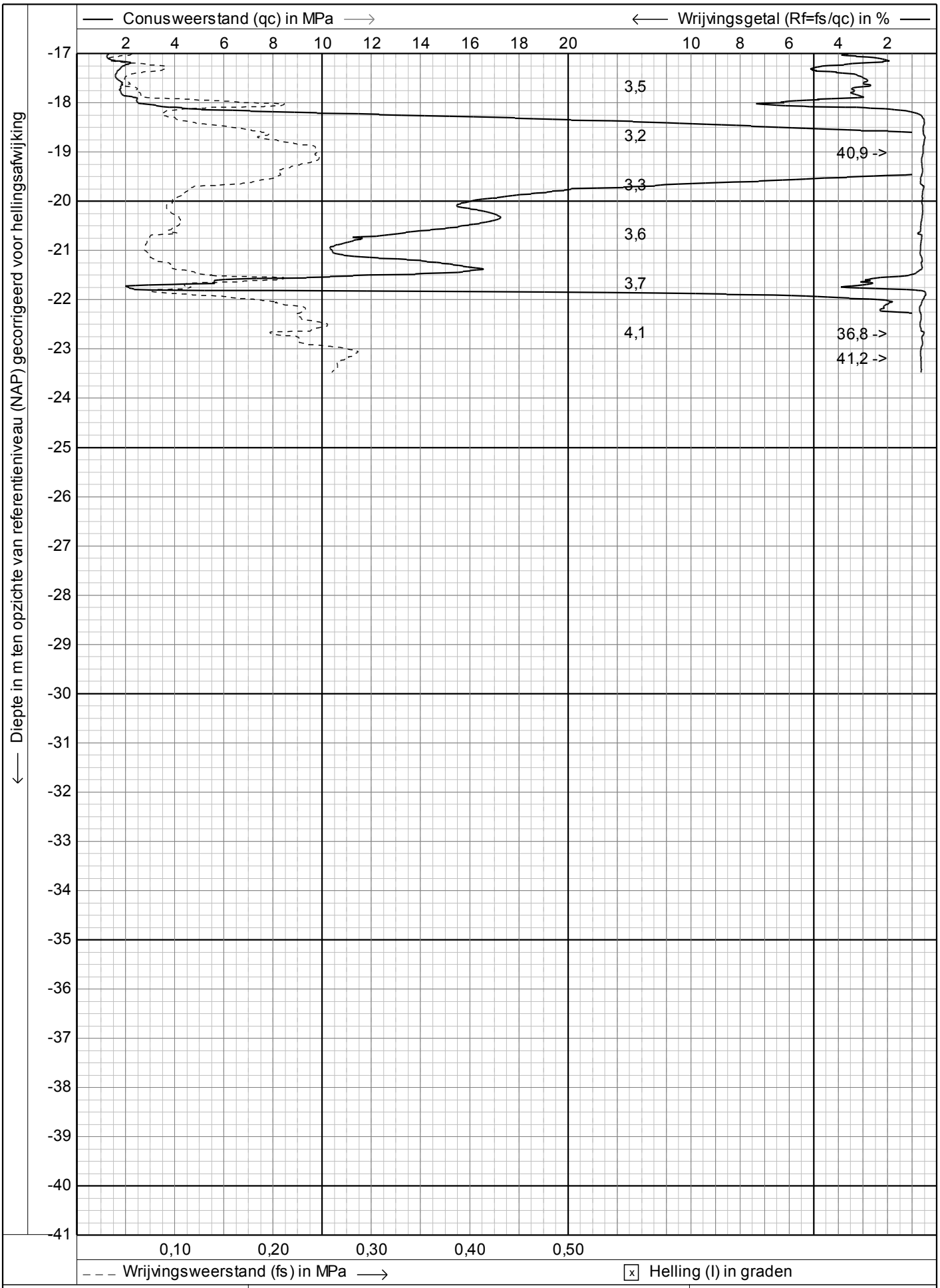

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **7-6-2016**

Conusnr. : **S15CFII.924**

Projectnr. : **AA15448**

Sondeernr.: **DKM-21** **2/2**

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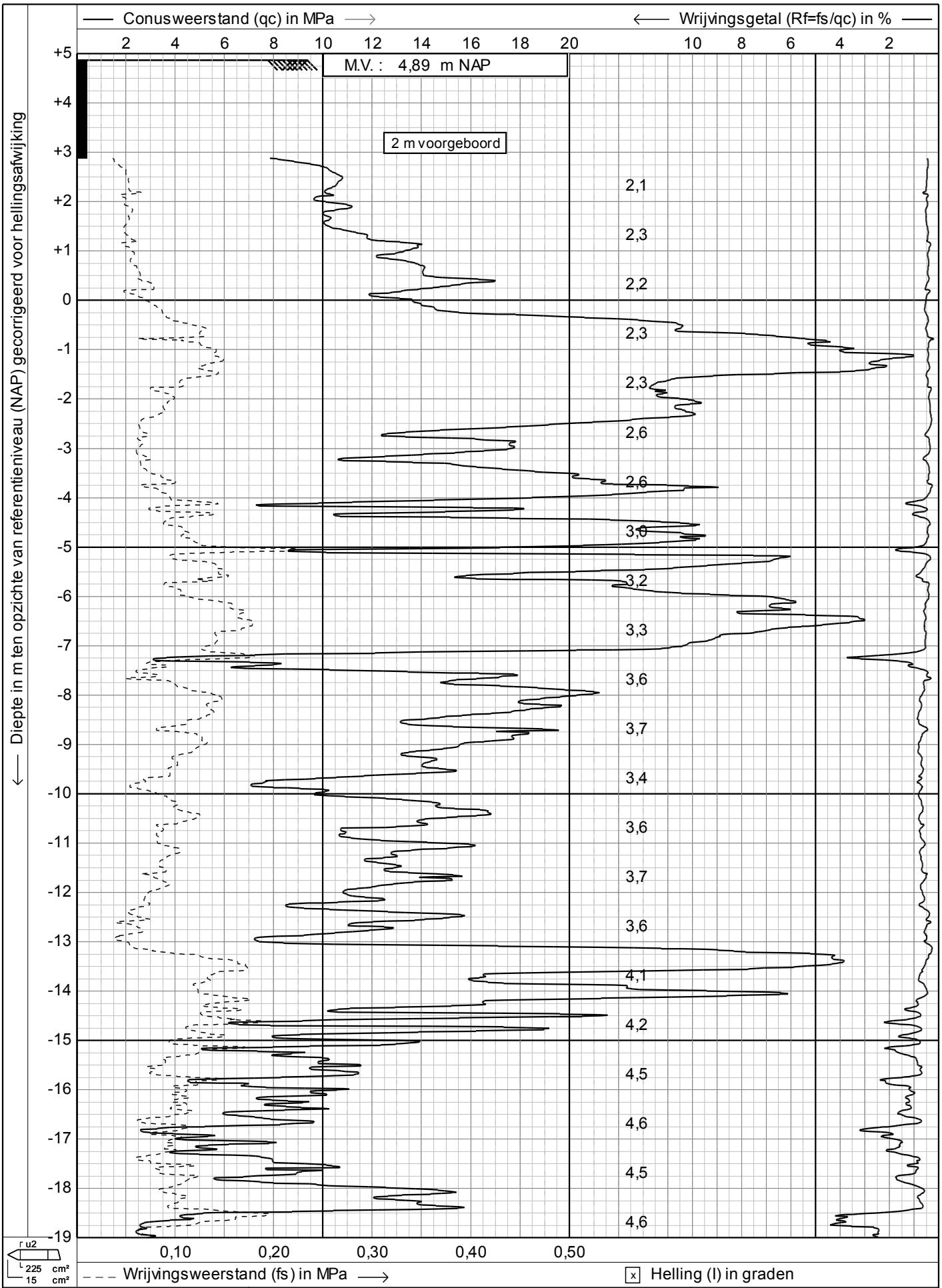

GEOMET ☎ 0172 449822	sondering volgens NEN-EN-ISO 22476-1 Project : **WINDMOLENPARK SPUISLUIS** Locatie : **IJMUIDEN**	Datum : **23-6-2016** Conusnr. : **S15CFIIP.1105** Projectnr. : **AA15448** Sondeernr.: **DKM-D-01**	**1/4**

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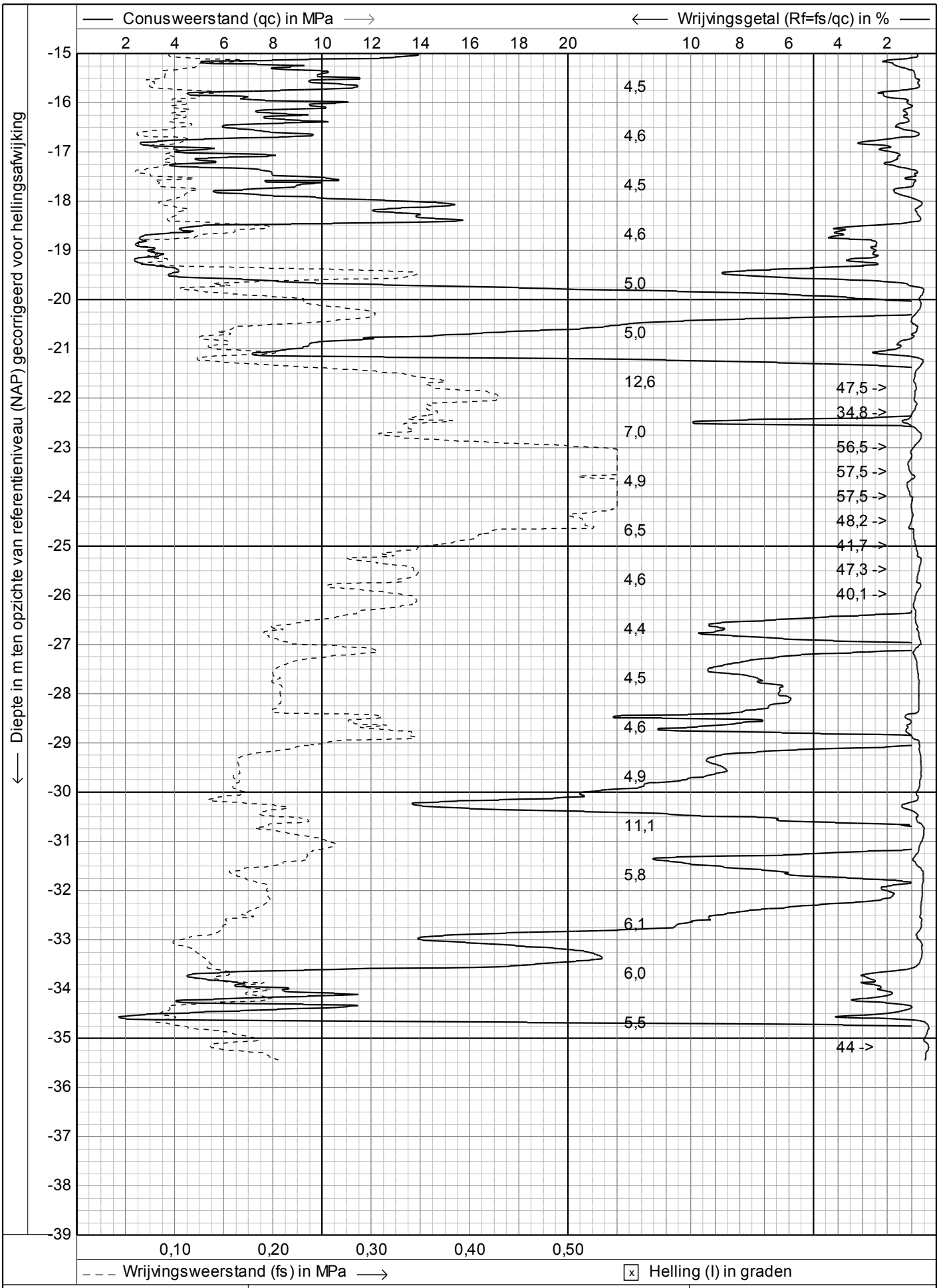

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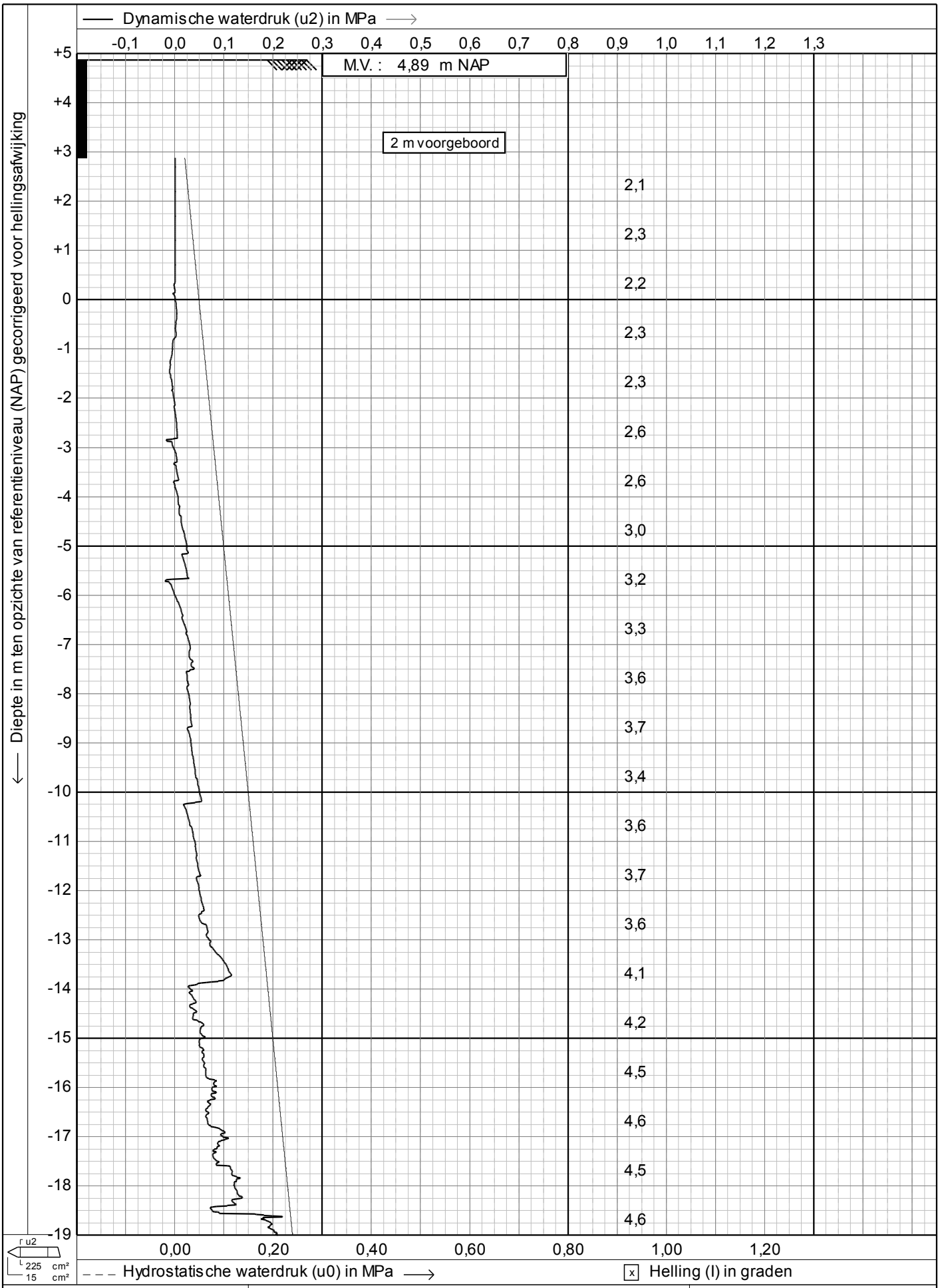

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum	: **23-6-2016**
Conusnr.	: **S15CFIIP.1105**
Projectnr.	: **AA15448**
Sondeernr.:	**DKM-D-01**

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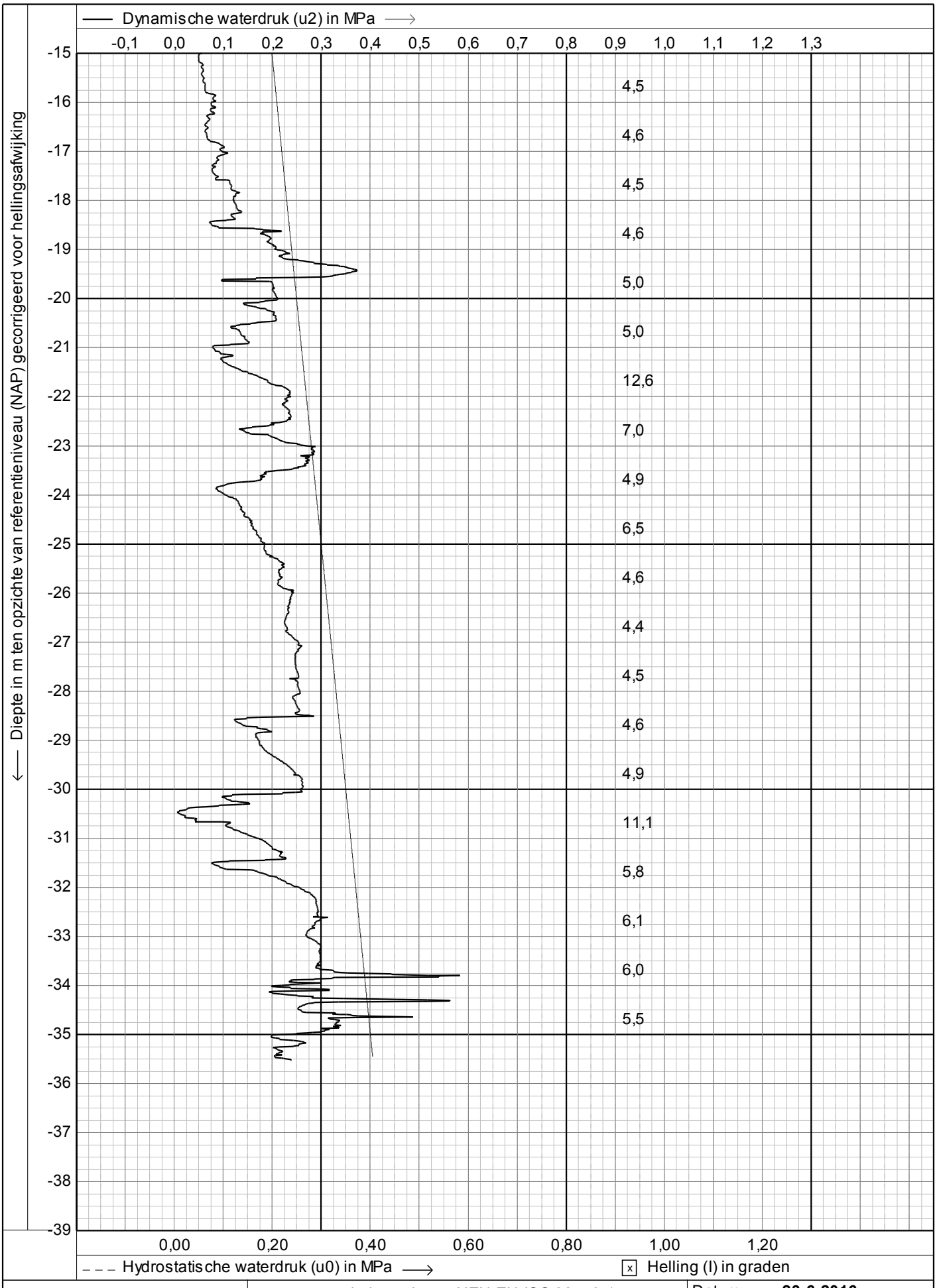

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-01** **4/4**

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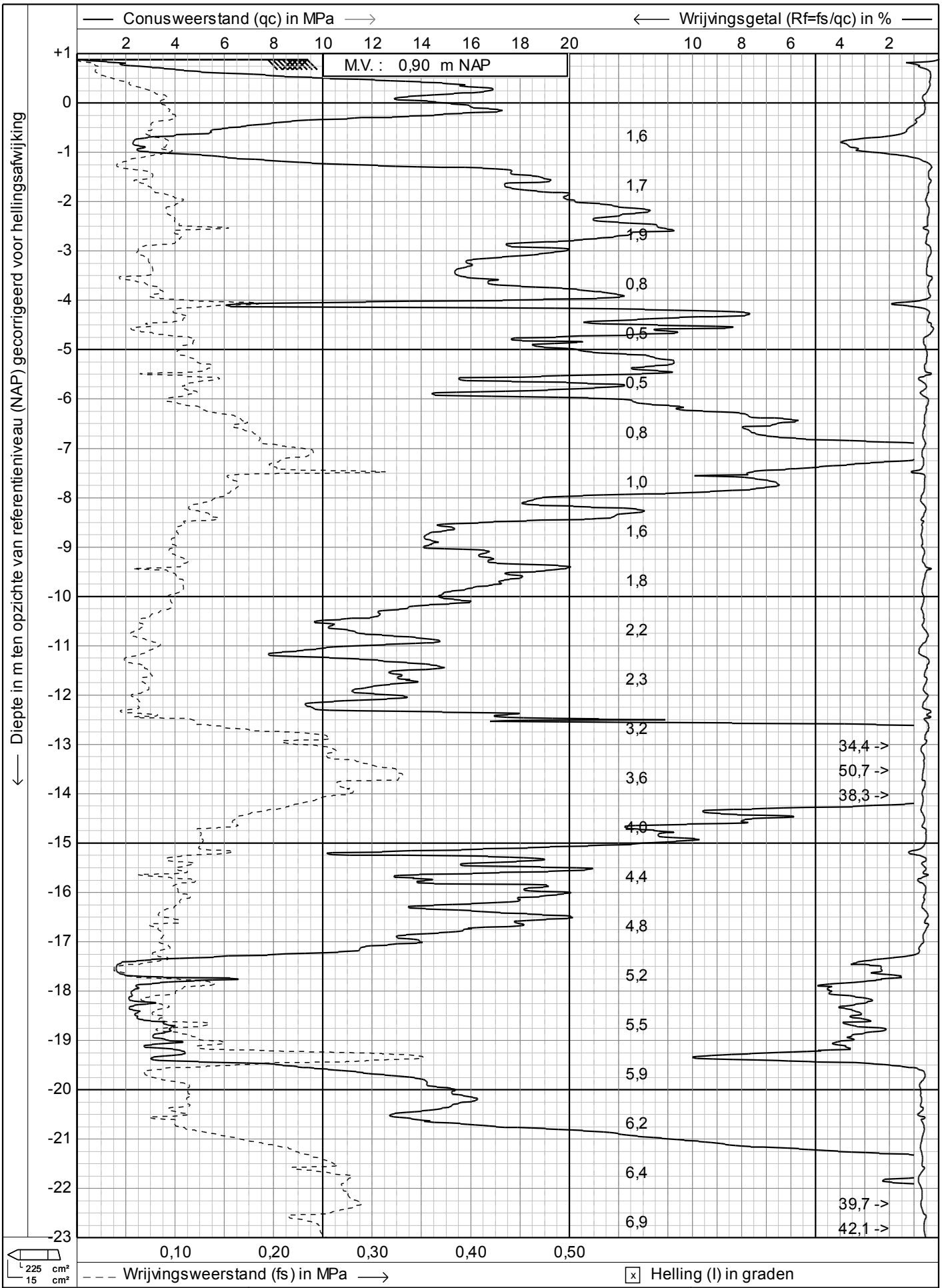

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-04**

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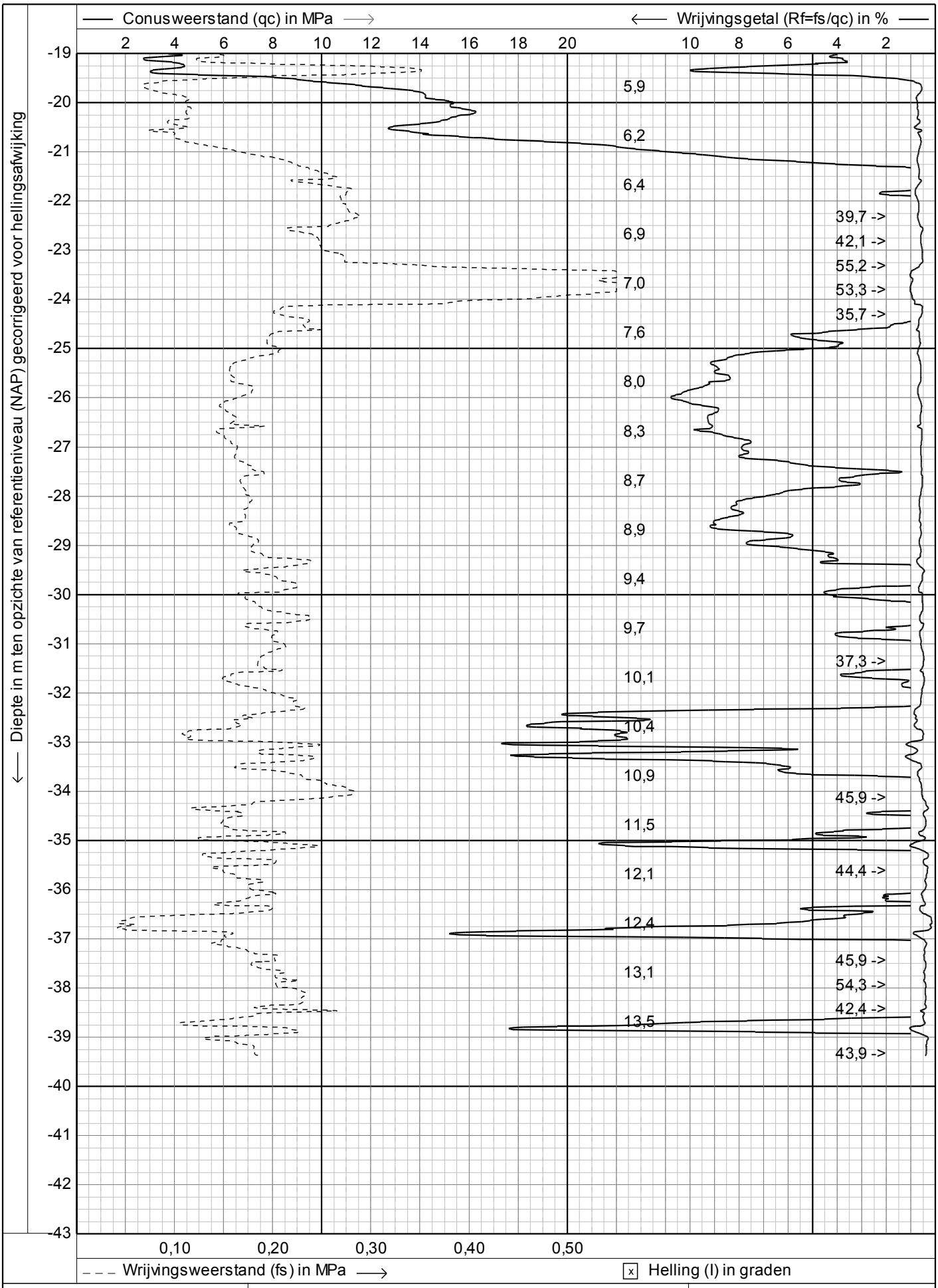

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-04** **2/2**

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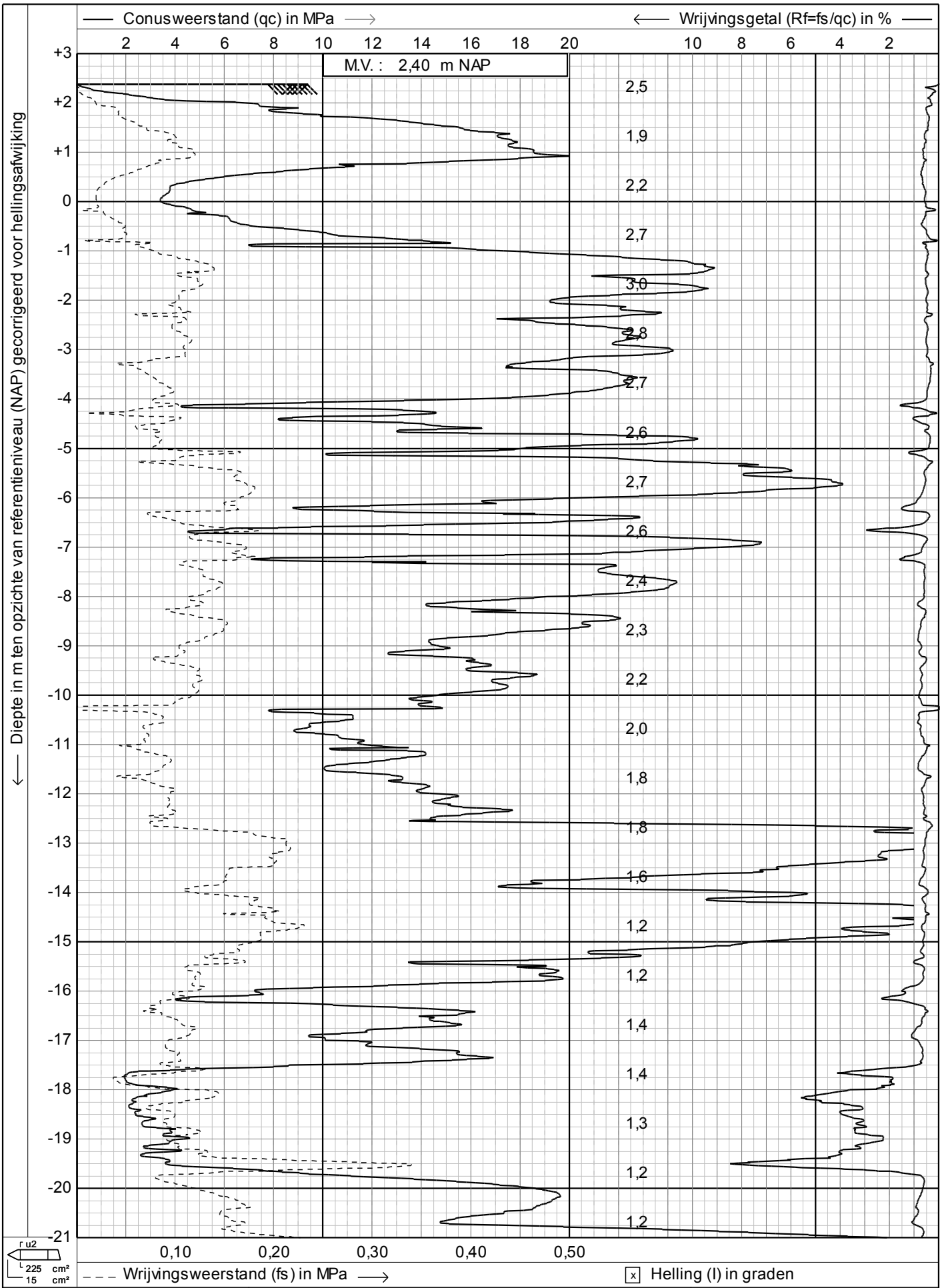

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-05** **1/4**

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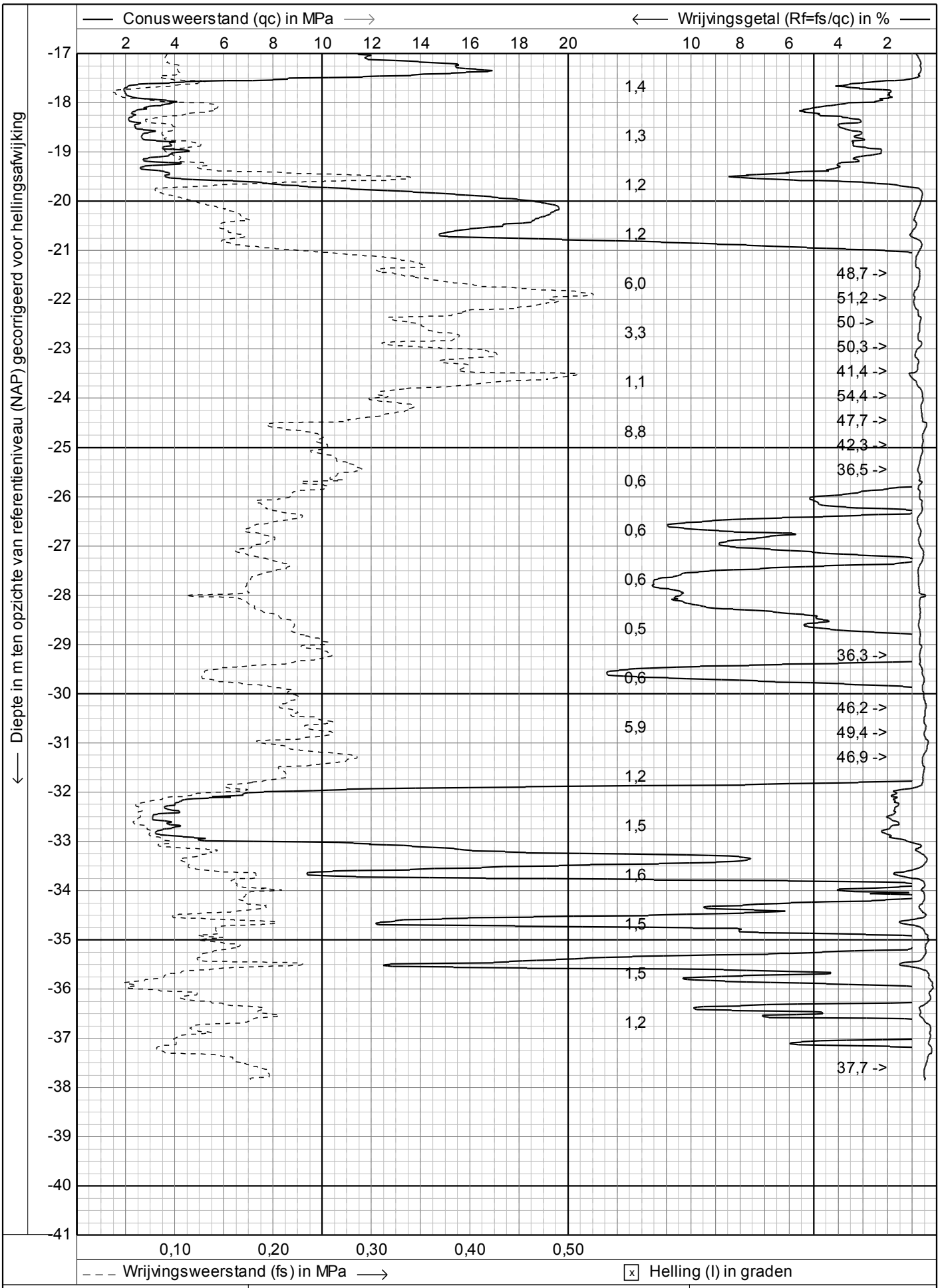

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-05** **2/4**

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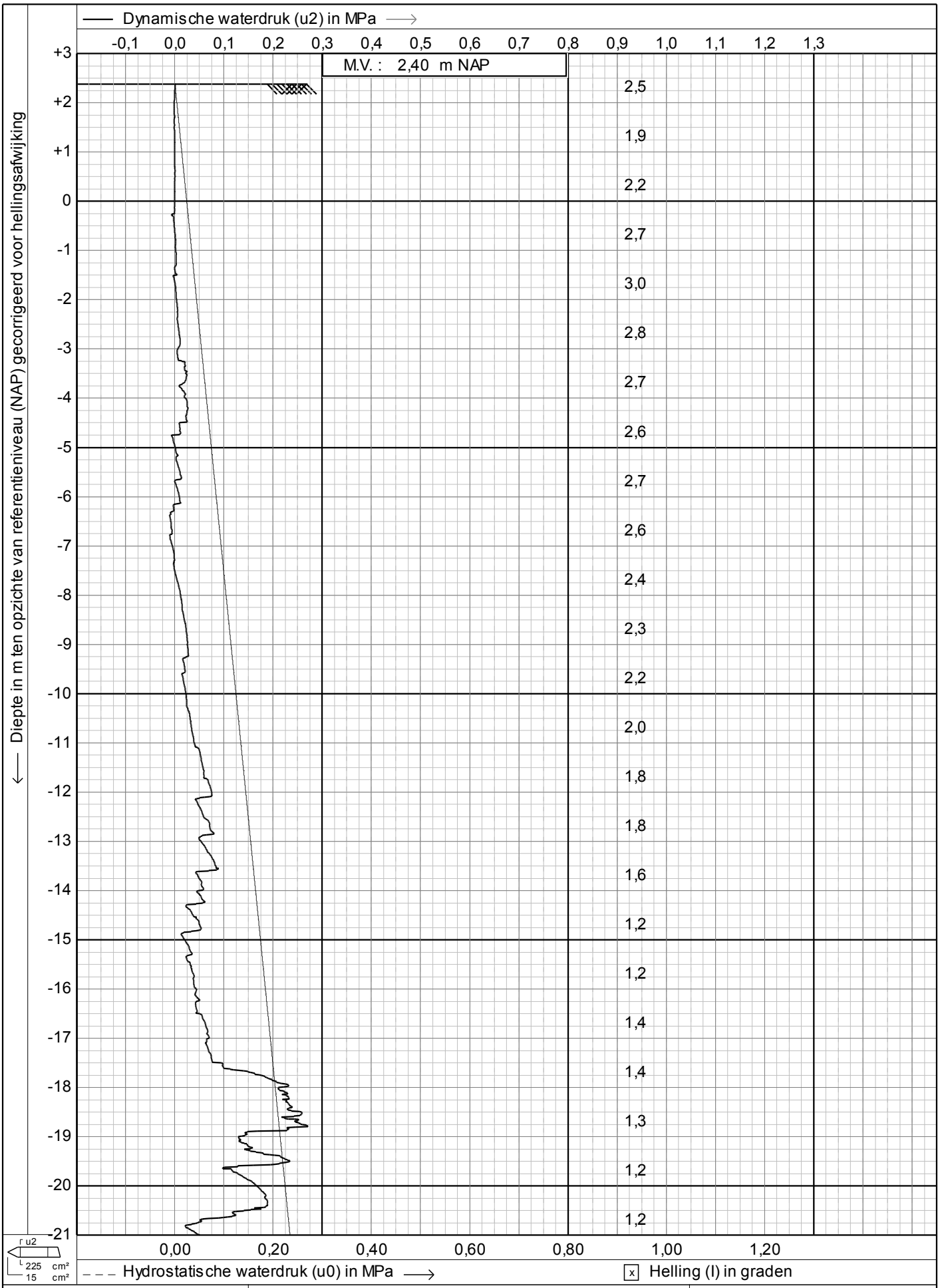

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-05** **3/4**

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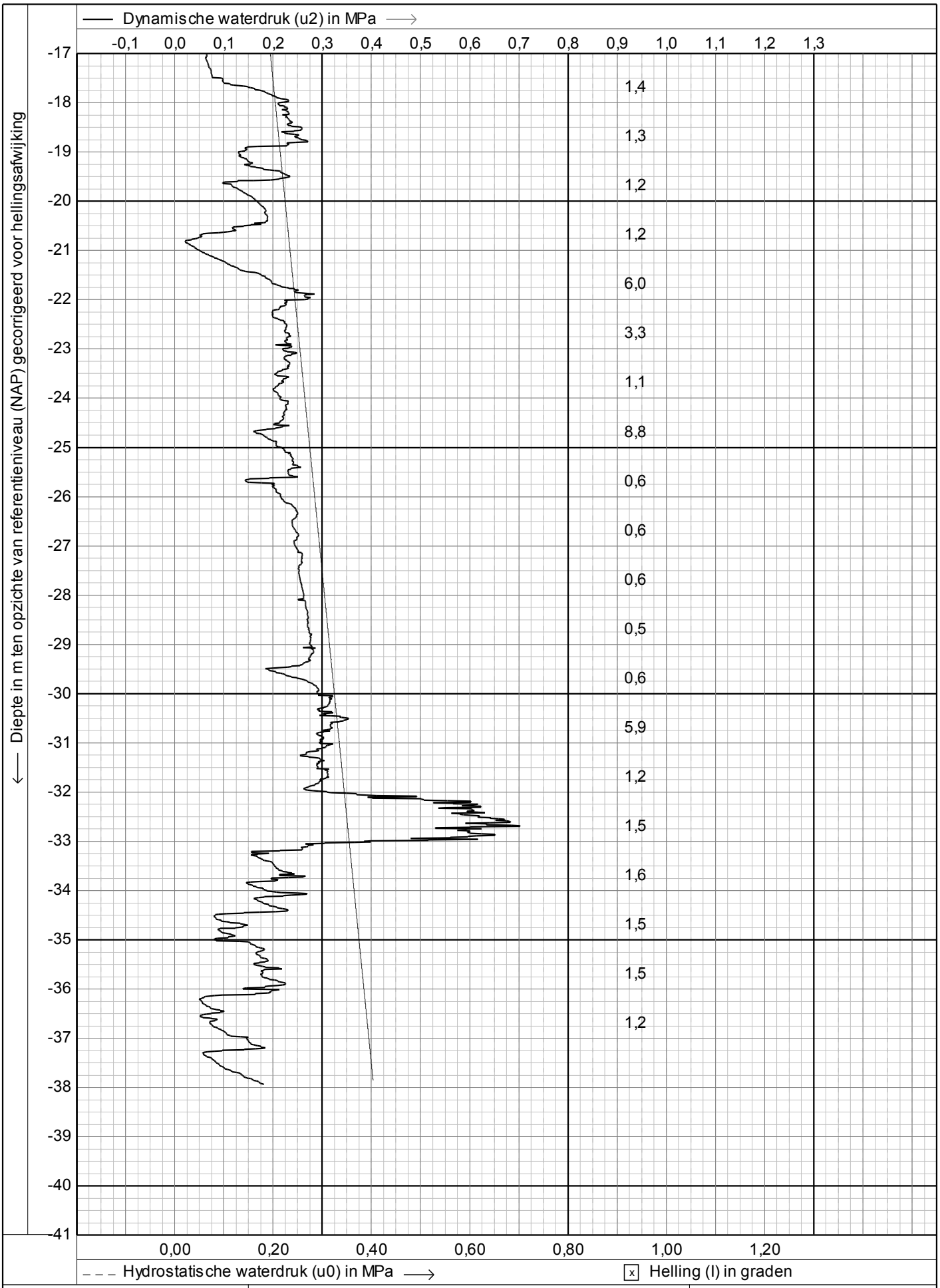

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-05** **4/4**

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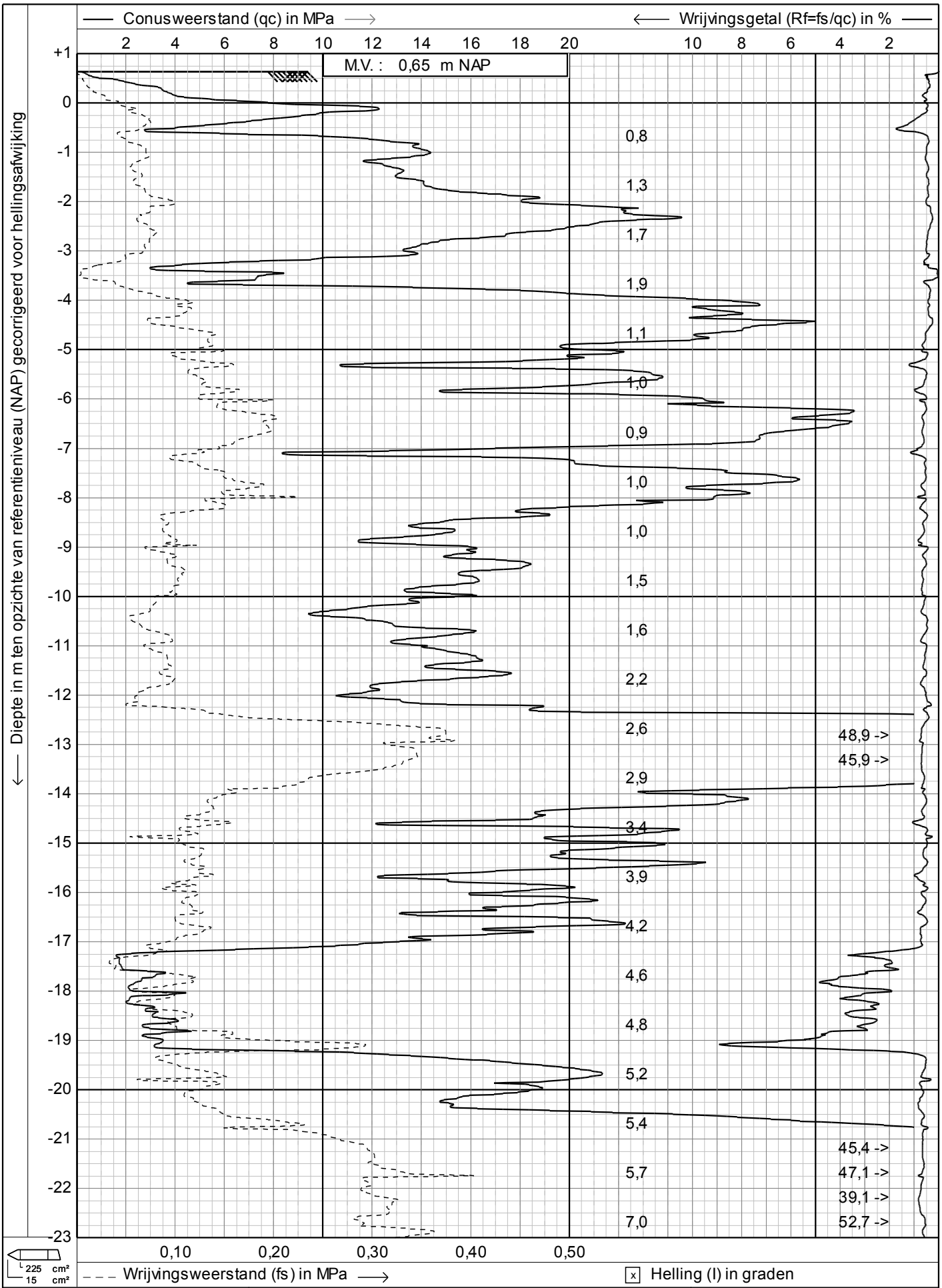

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-06**

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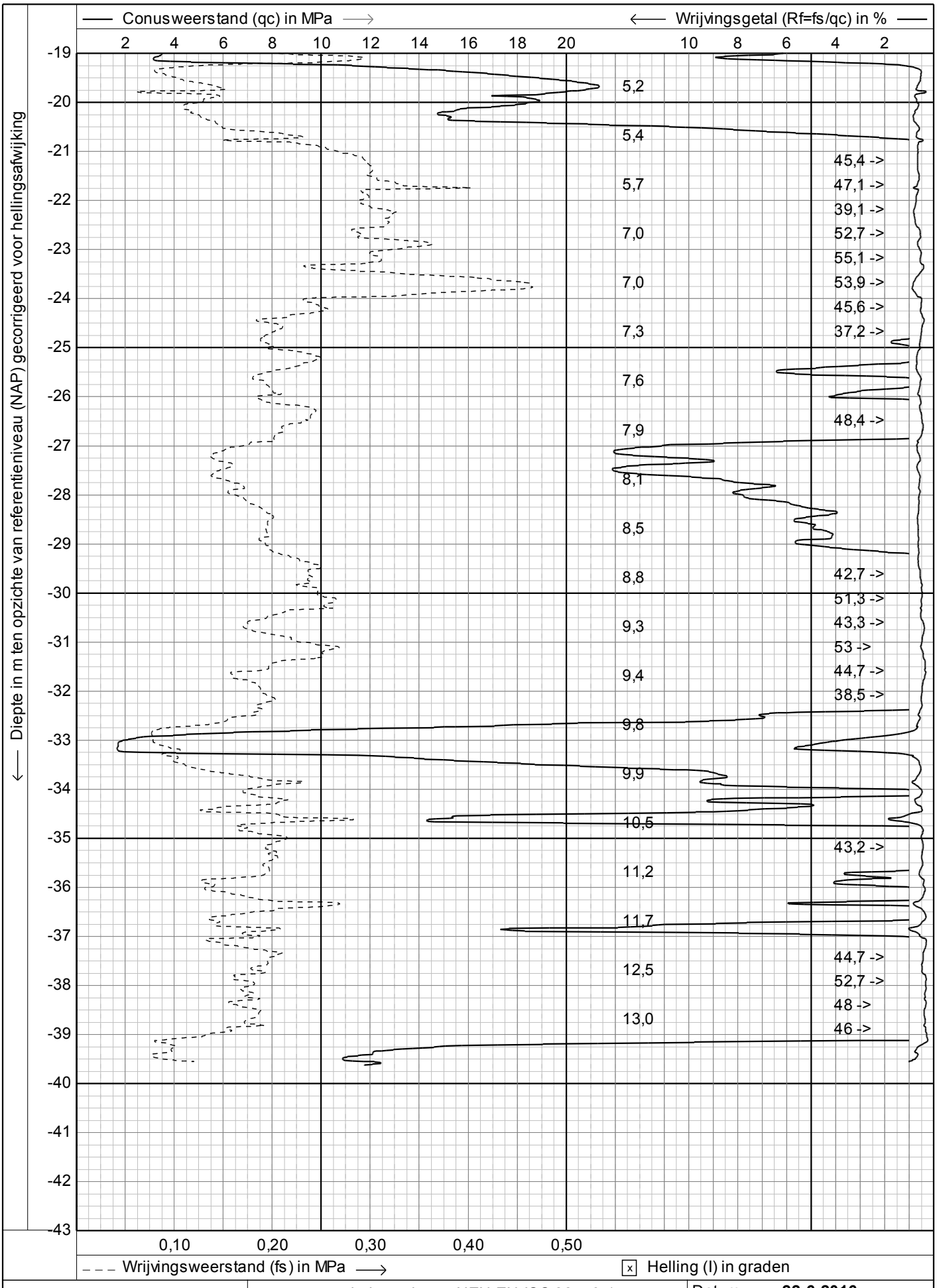

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **22-6-2016**

Conusnr. : **S15CFII.S15460**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-06** **2/2**

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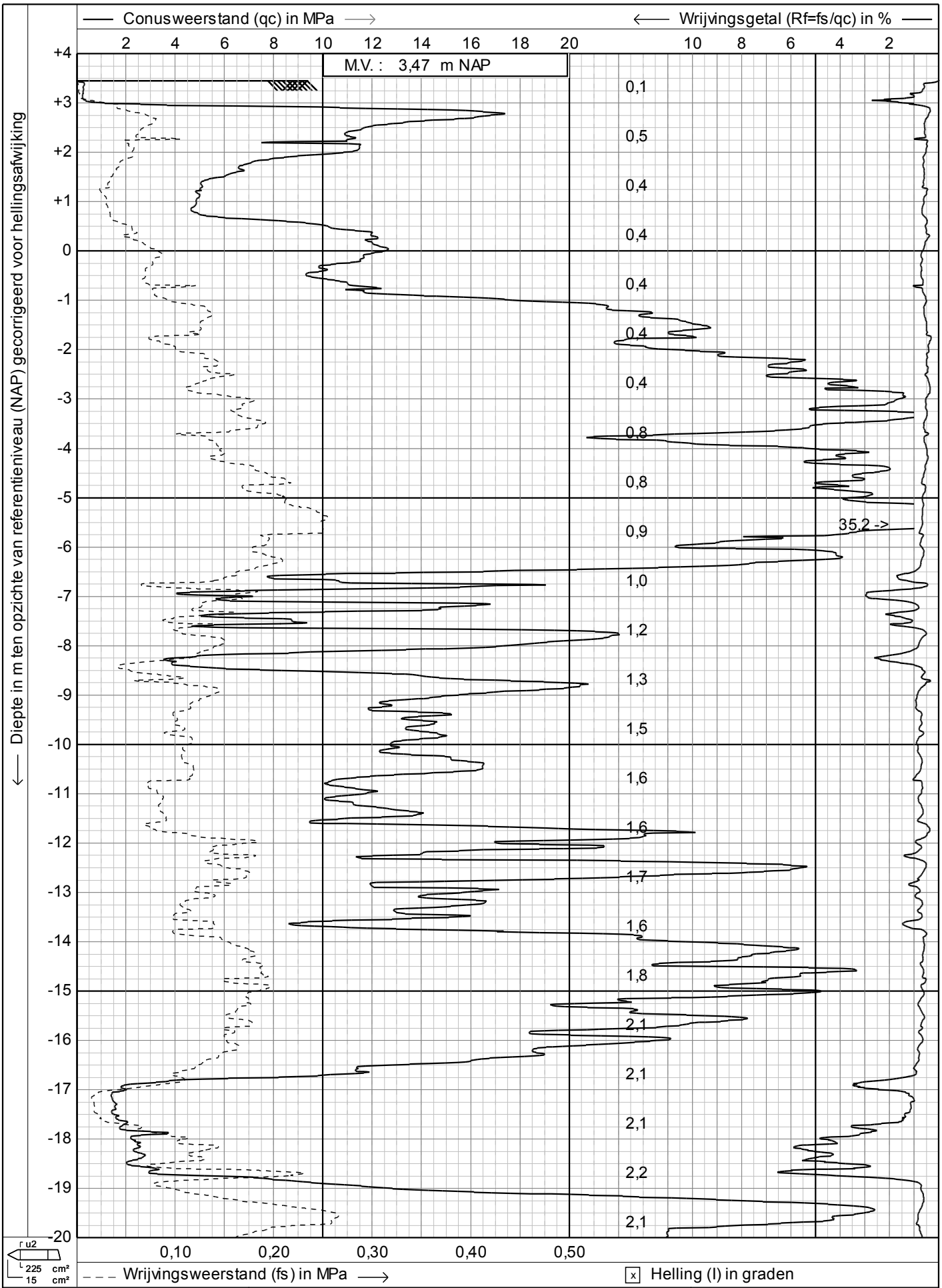

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **7-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM- D-09**

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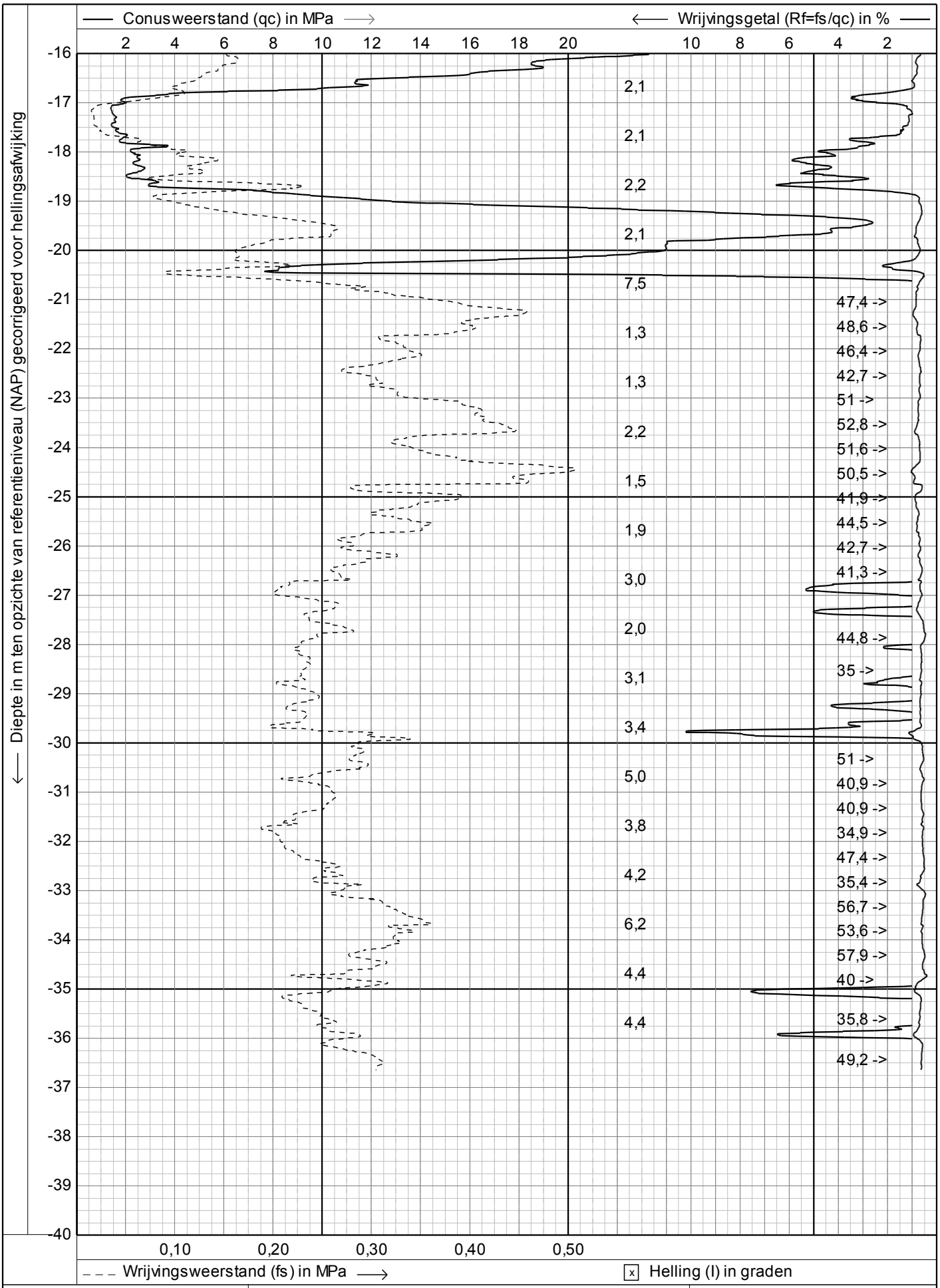

GEOMET ☎ 0172 449822	sondering volgens NEN-EN-ISO 22476-1 Project : **WINDMOLENPARK SPUISLUIS** Locatie : **IJMUIDEN**	Datum : **7-6-2016** Conusnr. : **S15CFIIP.1105** Projectnr. : **AA15448** Sondeernr.: **DKM- D-09** **2/4**

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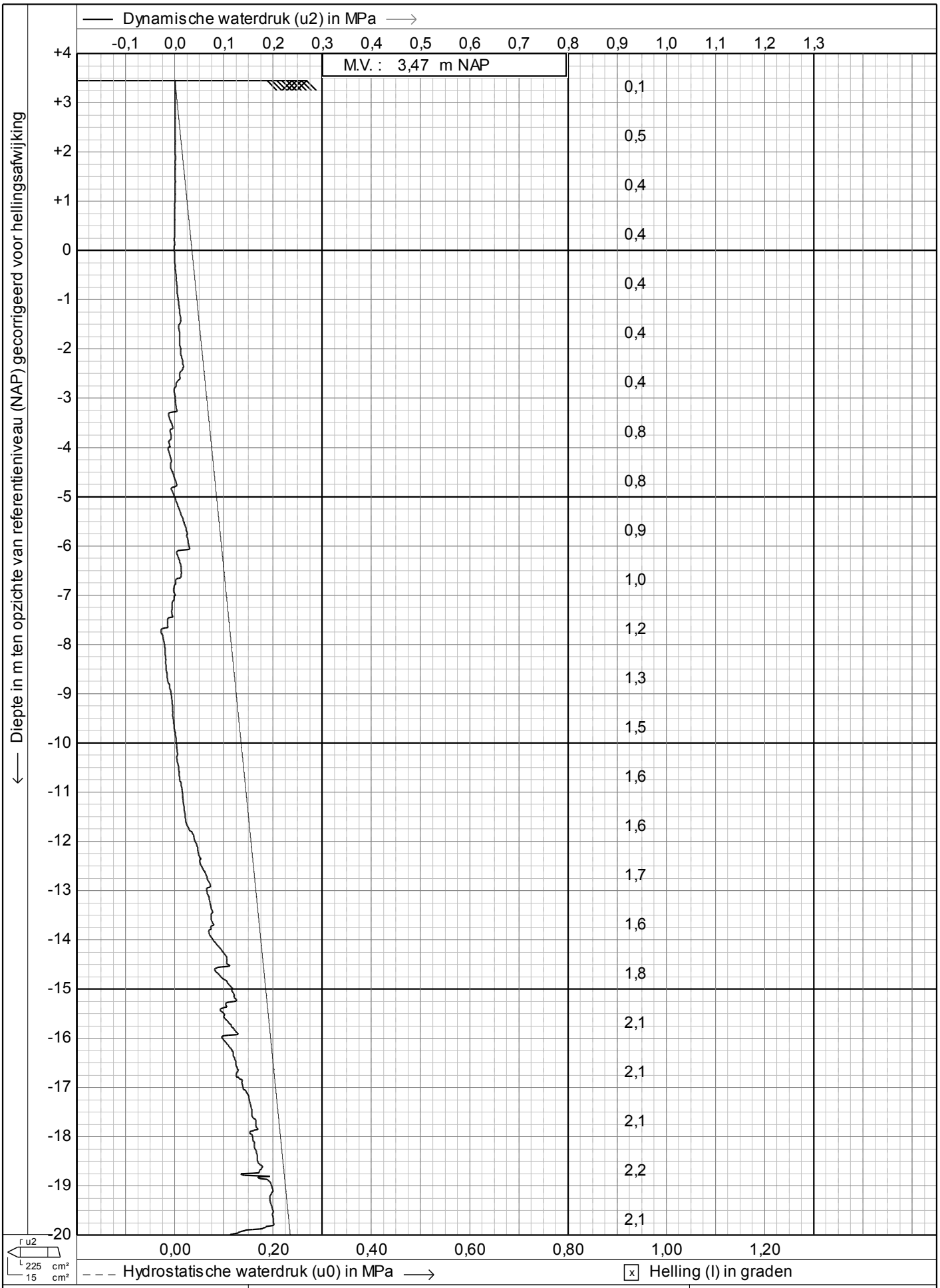

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum	: **7-6-2016**
Conusnr.	: **S15CFIIP.1105**
Projectnr.	: **AA15448**
Sondeernr.:	**DKM- D-09**

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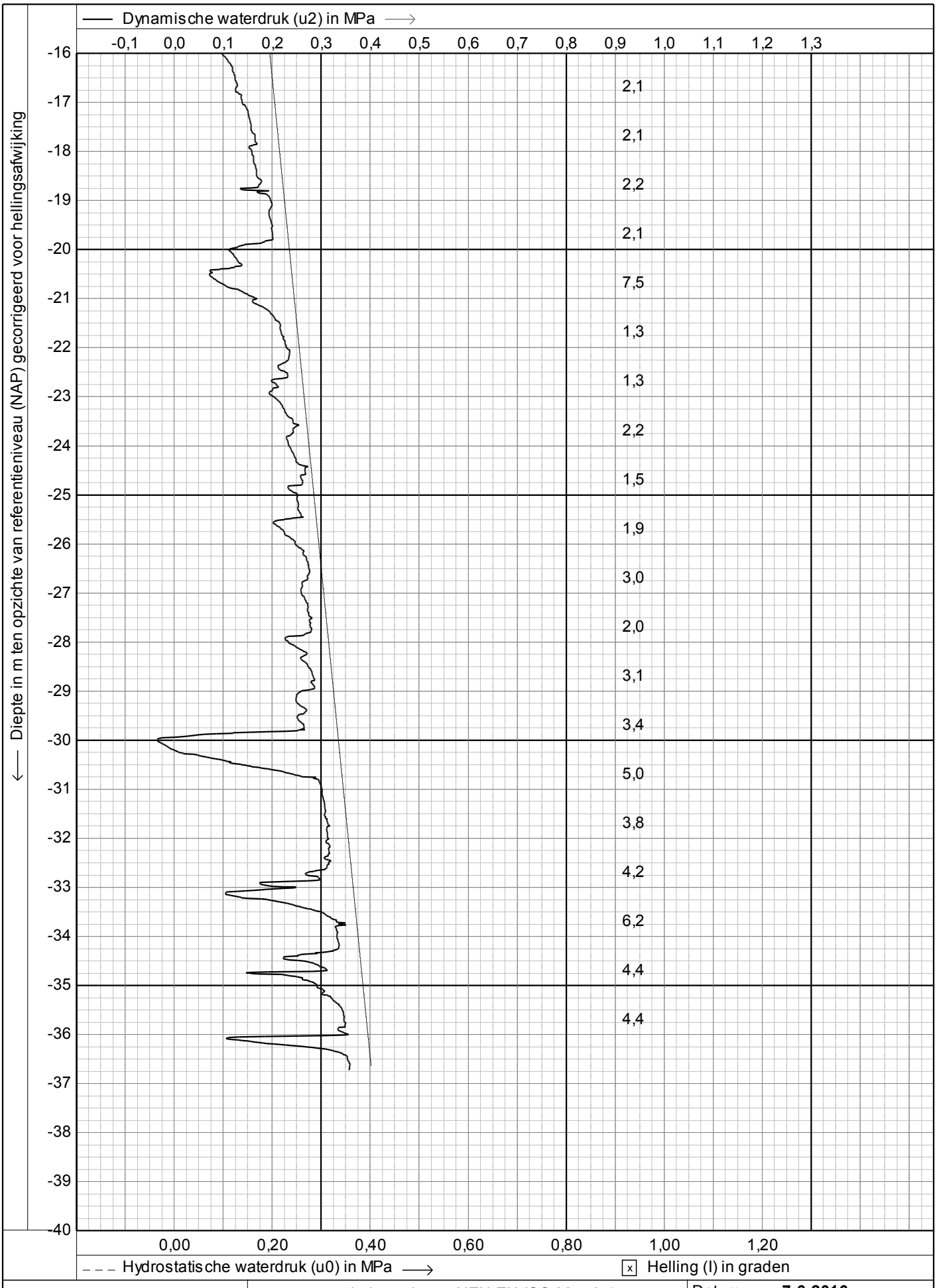

GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum	: **7-6-2016**
Conusnr.	: **S15CFIIP.1105**
Projectnr.	: **AA15448**
Sondeernr.:	**DKM- D-09** **4/4**

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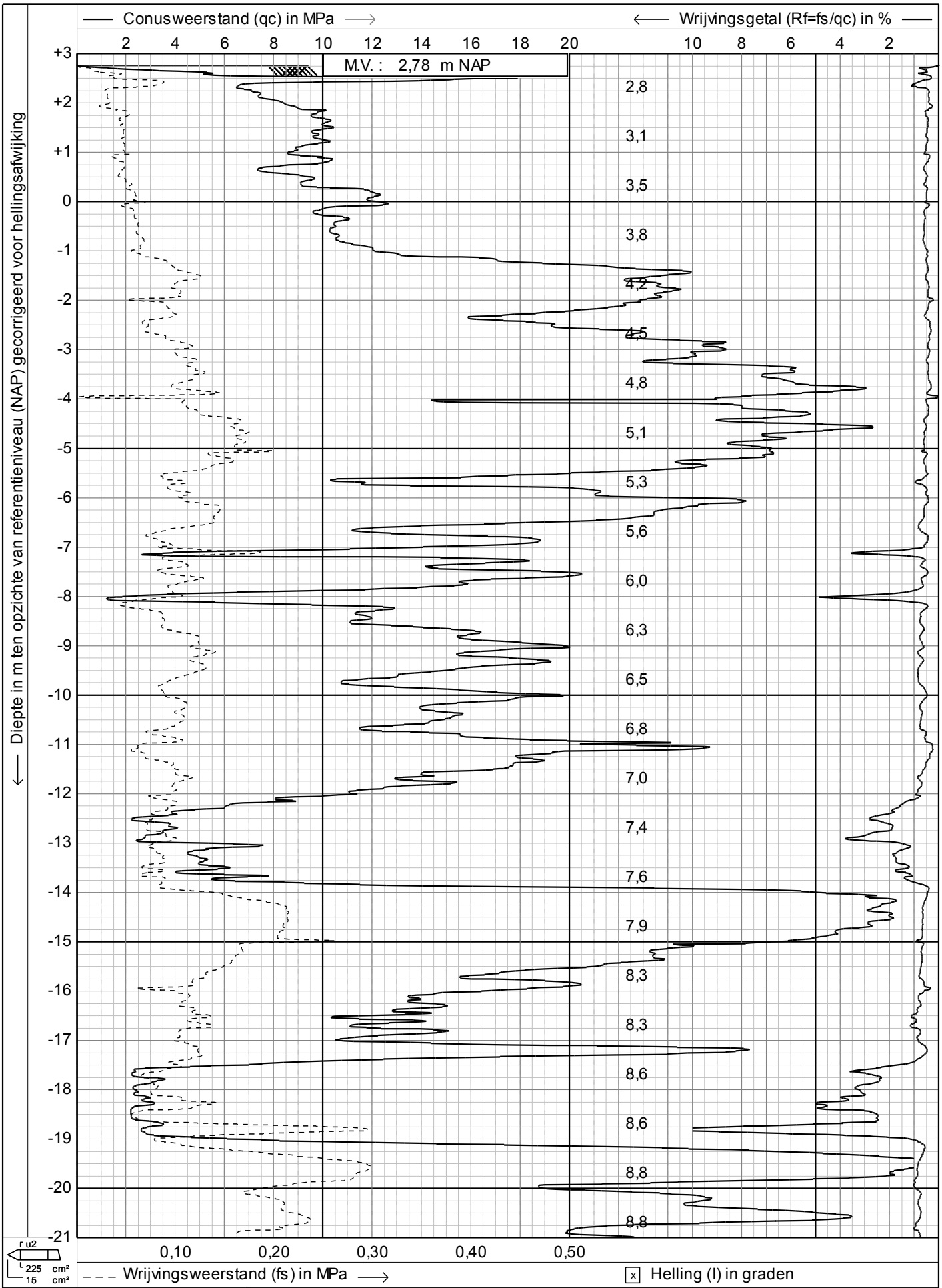

GEOMET

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sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-11**

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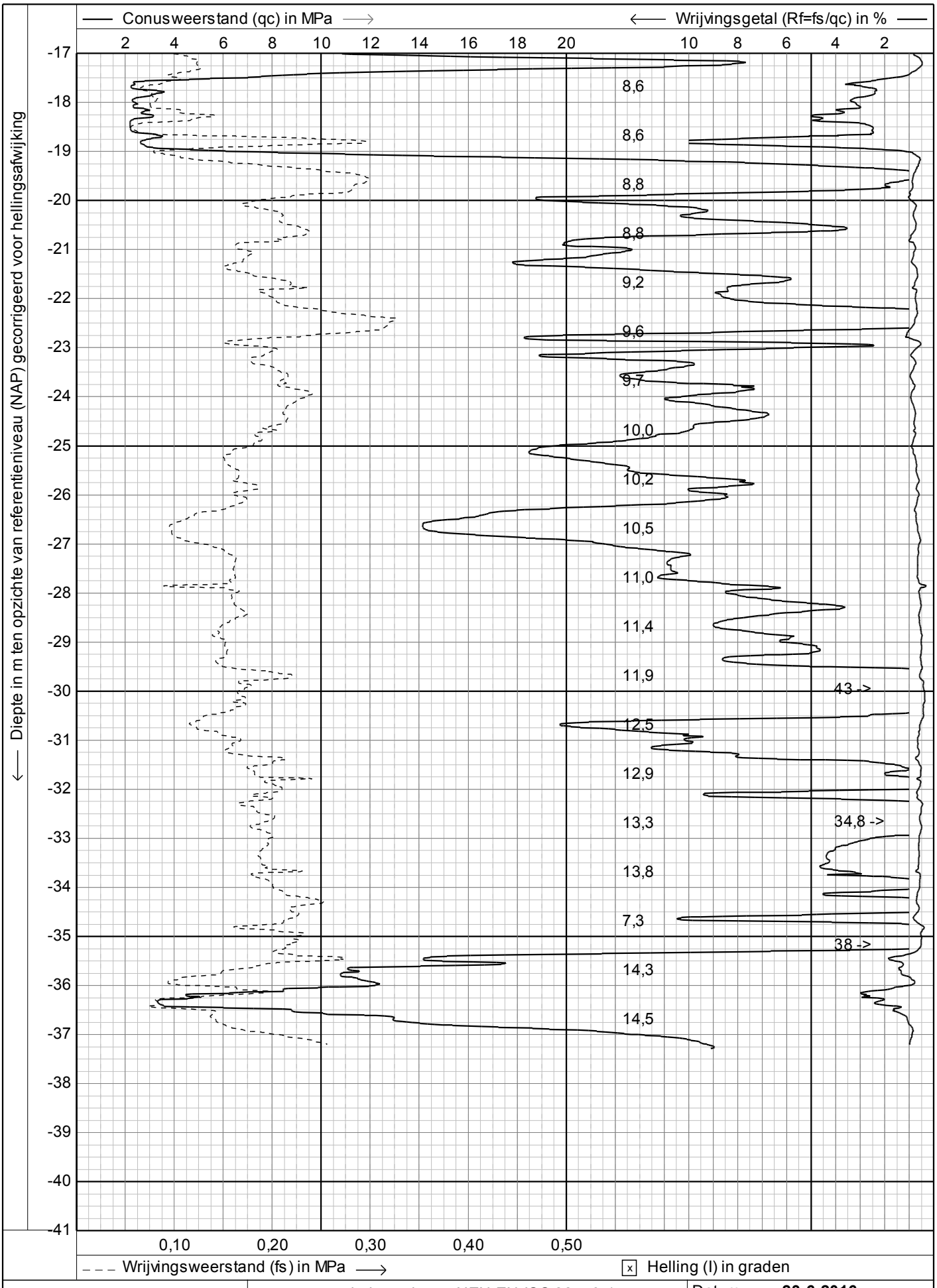


GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

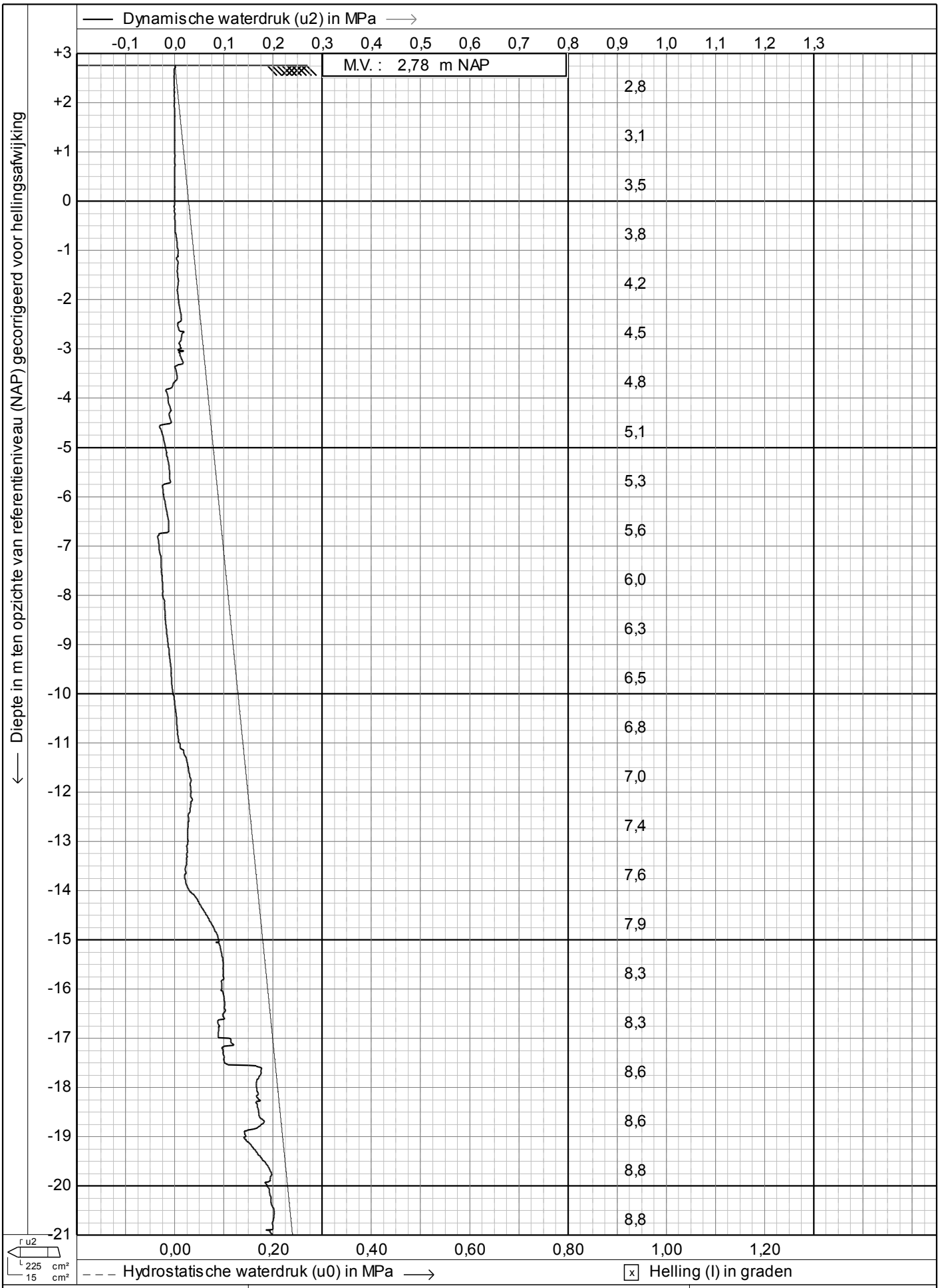
Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-11** **2/4**

1.45



GEOMET

0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

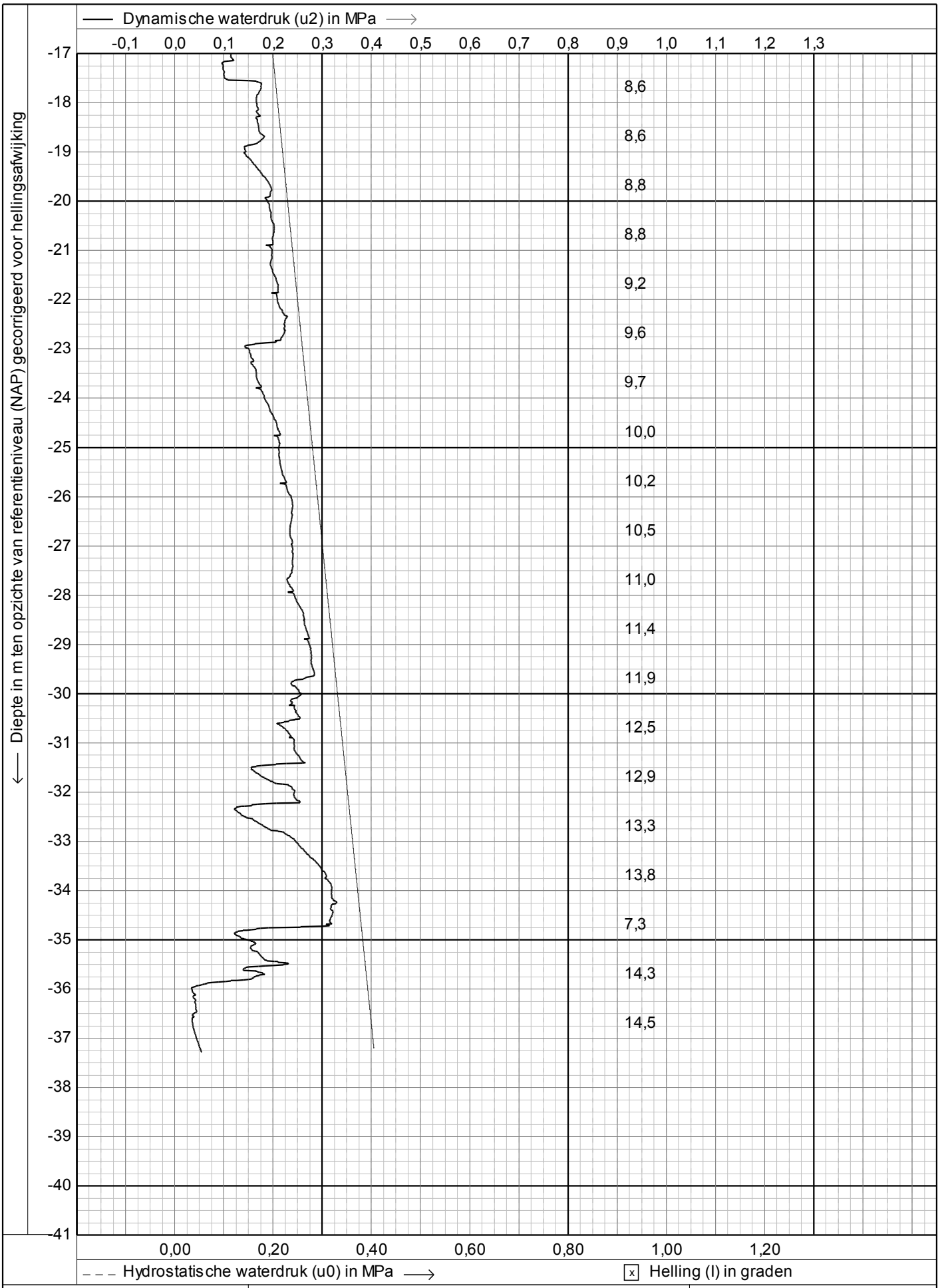
Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-11** **3/4**

1.45



GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

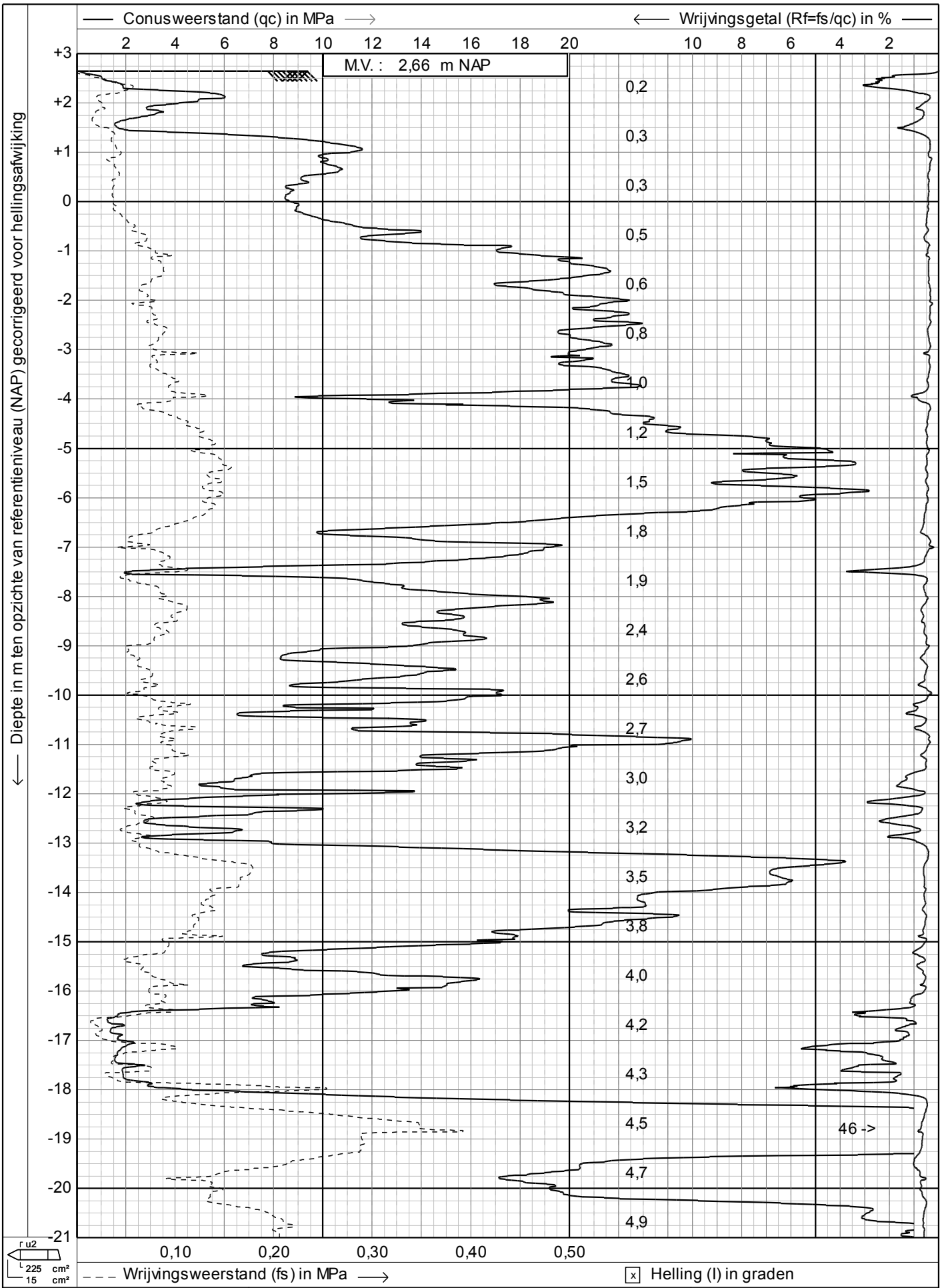
Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-11** **4/4**

1.45



GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

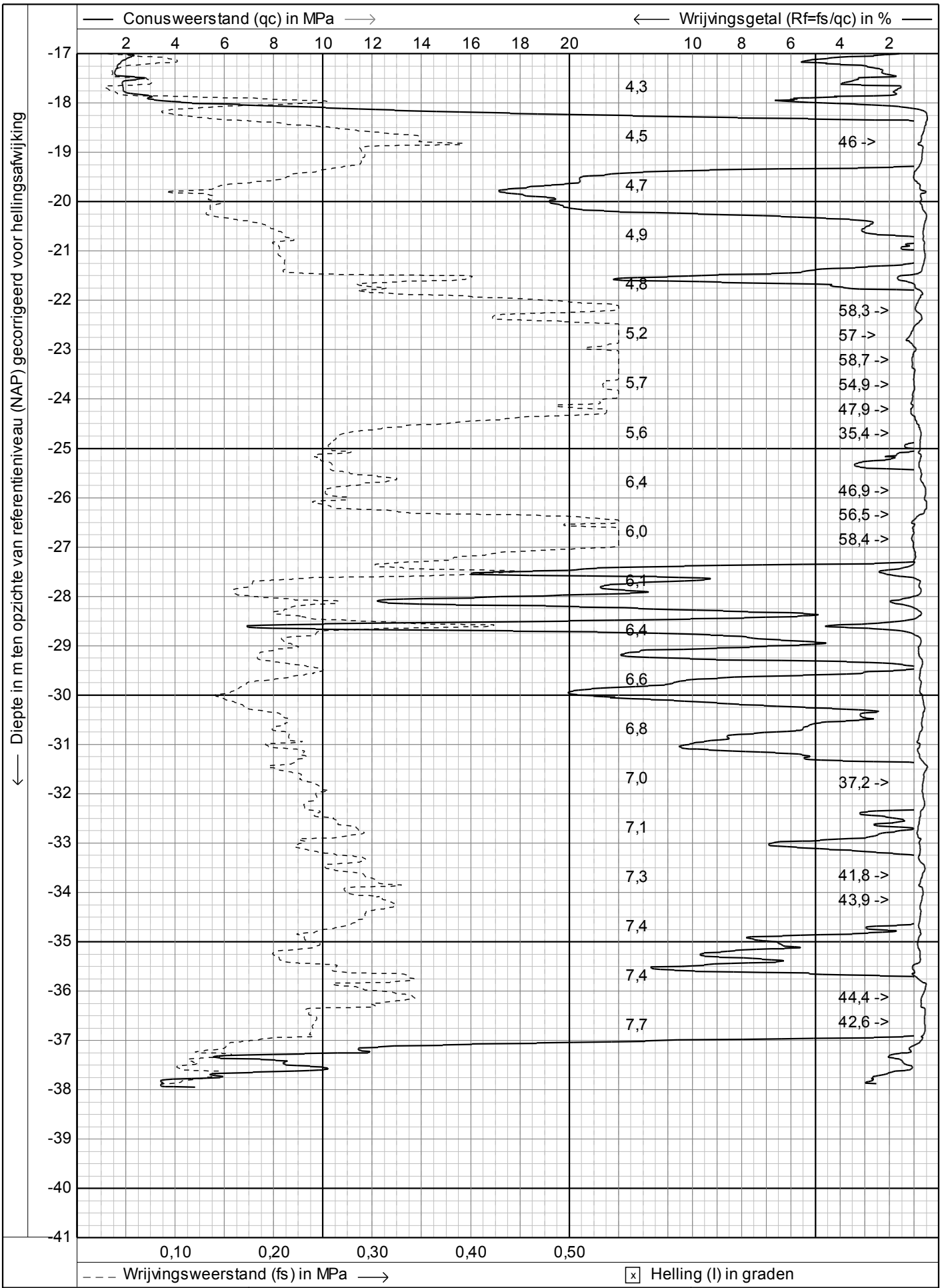
Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-14**

1.45



GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

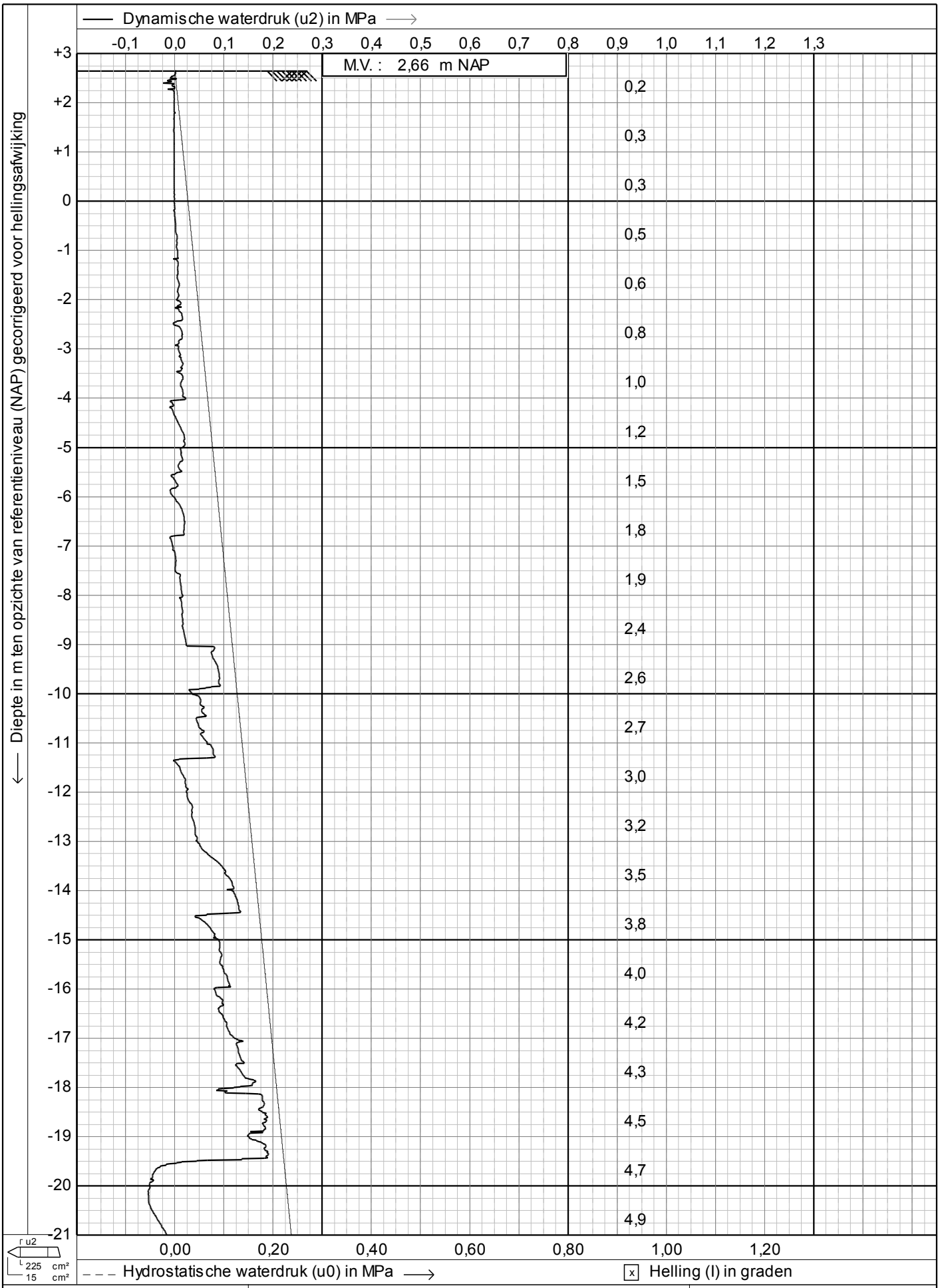
Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-14** **2/4**

1.45



GEOMET

0172 449822

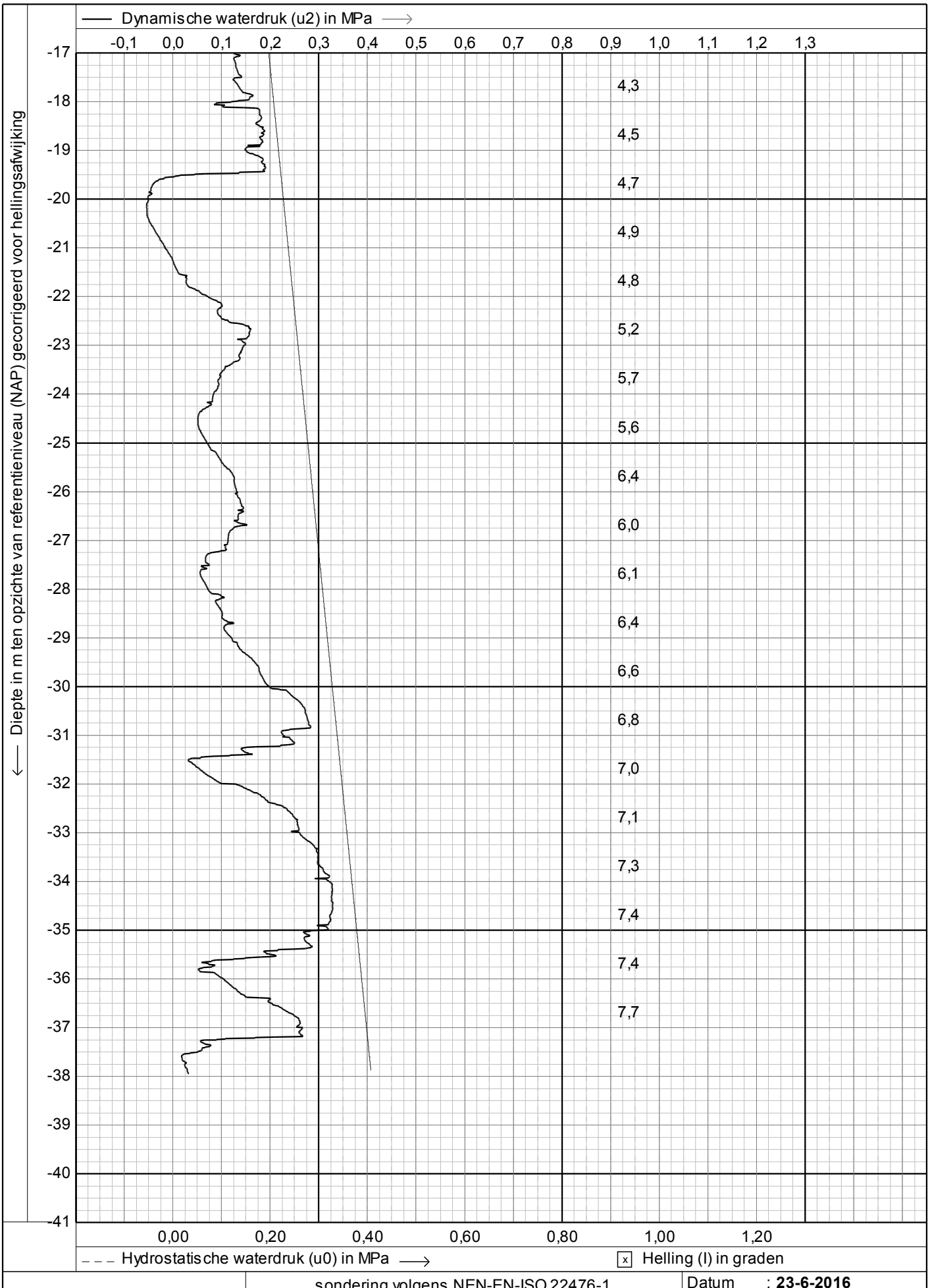
sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum	: **23-6-2016**
Conusnr.	: **S15CFIIP.1105**
Projectnr.	: **AA15448**
Sondeernr.:	**DKM-D-14**

1,45



GEOMET

☎ 0172 449822

sondering volgens NEN-EN-ISO 22476-1

Project : **WINDMOLENPARK SPUISLUIS**

Locatie : **IJMUIDEN**

Datum : **23-6-2016**

Conusnr. : **S15CFIIP.1105**

Projectnr. : **AA15448**

Sondeernr.: **DKM-D-14** **4/4**

1.45

Bijlage III

Relevante gegevens windturbine

Lastspezifikation / *Load Specification*

Fundament / *Foundation*

N117/3000 R120 IEC2a/DIBt2

Rotorblatt / Rotor blades: NR58.5

Klimatische Bedingungen / *Climate conditions*: NCV; CCV

Dokumentnummer / *Document number*

K0822_041549_IN

Revision / *Revision*

00

Datum / *Date*

18.09.2012

Verantwortliche Abteilung / *Department responsible*

CE/SDT

Klassifikation / *Classification*

Nordex Intern (IP)

Status / *Status*

Final

AST

7588

Ersatz für Revision / *Replaces Revision*

-

Ersteller / *Created*:

A. Schröder/SDT

Prüfer / *Checked*:

R. Laudien/SDT

Freigabe / *Released*:

H.Muuß/SDT

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Document published in electronic form. Original at Central Engineering/PQP.

ÄNDERUNGSINDEX / *REVISION INDEX*

Änderung / ***Revision***	**Datum** / ***Date***	**Bearbeiter** / ***Author***	**Modifikation (Sektion)** / ***Modification (Section)***	**AST**
00	18.09.2012	A. Schröder	Erstellt / *Created*	7588

INHALTSVERZEICHNIS / *TABLE OF CONTENT*

1. ALLGEMEINES / *GENERAL*

1.1 Gültigkeitsbereich / *Scope*

Diese Lastspezifikation stellt die Basisinformation für die Bemessung von Fundamenten für folgende Windenergieanlage der Firma Nordex dar. Darin sind die Technischen Basisdaten sowie die Bemessungslasten für die Klimatischen Bedingungen (NCV und CCV) enthalten. Die Spezifikation F302_0148 ist grundsätzlich einzuhalten.

This specification serves as input information for the design of foundations for the following Nordex wind turbine. Therefore it defines its main parameters and the design loads for the two different climate conditions NCV and CCV. The specification F302_148 is strictly to follow.

Typ / T*ype*: **N117/3000**
Nabenhöhe / *Hub height*: **120m**
Turm / *Tower*: **R120**
Windklasse / *Wind class*: **IEC2a/DIBt2**
Rotorblätter / *Rotor blades*: **NR58.5**

1.2 Referenzen / *References*

Dokumentennr., Revision, Ausgabe / ***Document Number, Rev. / Edition***	**Bezeichnung** / ***Description***
	Nordex Dokumente / ***Nordex Specifications***
NALL22_004598_EN F302_148_EN_01	Technical Specification Design Site Specific Foundation
NALL01_011953_DE_00	Externe Bedingungen und Anforderungen an NORDEX-Windenergieanlagen
K0817_043718_DE_00	Turmspezifikation - Rohrturm N117 R120MT IEC2A/DIBt2A
K0801_043449_EN_00	Loads Report N117 NR58.5 R120MT 3.0MW 50/60Hz IEC2A (Ed.3) NCV
K0801_043450_EN_00	Loads Report N117 NR58.5 R120MT 3.0MW 50/60Hz IEC2A (Ed.3) CCV (Idling/CCV-B)
K0801_043452_EN_00	Loads Report N117 NR58.5 R120MT 3.0MW 50Hz DIBt2A
K0802_043788_DE_00	Bemessung Stahlrohrturm - N117/3000 R120 TiT IEC2a/DIBt2
	Normen / ***Standards***
GL IV-1:Edition 2010	Guideline for the certification of wind turbines. Hamburg : Germanischer Lloyd WindEnergie, 2010
EN 1998-1:2010	Eurocode 8 - Design of structures for earthquake resistance Part 1: General rules, Seismic action and rules for buildings
IEC 61400-1 (Ed.3)	Windturbine generator systems. Part 1: Safety requirements
DIBt RiLi 2004-03	DIBt Richtlinie für Windenergieanlagen - Einwirkungen und Standsicherheitsnachweise für Turm und Gründung

2 LASTEN / *LOADS*

2.1 Technische Basisdaten / *Parameters*

f_0 [Hz] =	**0,230**	1. Biegeeigenfrequenz / *First eigenfreqency in bending*
$k_{\varphi,dyn}$ [MNm/rad] =	**140000**	berücksichtigte Bodendrehfeder / *respective rotating spring rate*
$k_{\varphi,stat}$ [MNm/rad] =	**35000**	
Schiefstellung Turm [mm/m] / Inclination tower [mm/m] =	**10,7**	
h_{TB} [m] =	**1.1**	Höhe Unterkante Turmfuß über Geländeoberkante / *Position of tower bottom respective to top ground surface*
m_{tower} [t] =	**447,2**	Turmmasse inkl. Einbauten / *Mass of tower incl. Tower interiors*
$m_{nacelle}$ [t] =	**175,7**	Gondelmasse (inkl. Rotorblätter) / *Total mass of nacelle incl. blades*

2.1.1 Bedingungen für Erdbeben / *Earthquake conditions*

Norm / *Standard*: EN 1998-1:2010

Bodenklasse / *Soil class*: **A, B, C, D, E**

a [m/s²] =	**0.3*g**	(DIBt)	Bodenbeschleunigung / *peak ground acceleration (PGA)*
a [m/s²] =	**0.3*g**	(IEC)	Bodenbeschleunigung / *peak ground acceleration (PGA)*

2.1.2 Klimatische Bedingungen / *Climate conditions*

NCV : Normal climate version (englisch). "Normal climate" bedeutet volle Produktion bis -10°C und Stillstand bzw. Trudeln zwischen -10°C und -20°C.

Normal climate version. Normal climate means full production down to -10°C and standstill or idling between -10°C and -20°C.

CCV : Cold climate version (englisch). "Cold climate" bedeutet volle Produktion bis -10°C, reduzierte Produktion zwischen -10°C und -30°C und Stillstand bzw. Trudeln zw. -30°C und -40°C.

Cold climate version. Cold climate means full production down to -10°C, reduced power production between -10°C and -30°C and standstill or idling between -30°C and -40°C.

2.2 Zusammenfassung der Lasten / *Summary of Loads*

2.2.1 Extremlasten NCV & CCV / *Extreme Loads NCV & CCV*

System TB Definition: Turmfuß / *Tower Bottom*

Extremlasten (absolute Maxima) inkl. Erdbebenlastfälle inkl. Sicherheit /
Extreme Loads (absolute maxima) *incl. earthquake + synchrone components (including safety-factors)*

LC	LC-Def.	FXTB	MXTB	FYZTB	MYZTB	ΔMres	M_{res}	γ_f
		kN	kNm	kN	kNm	[kNm]	[kNm]	-
8.1	08010000_DIBt_ZY_D_17_(DIBt2_5	**10166**	979	158	17984	5482 *	23466	1,60
2.1	CCV_B_02010204_ZZ_C_24_07.av	8755	**-8801**	295	33885	5482 *	39367	1,35
5.2	05020000_ZZ_B_07_07.ave_(IEC2a	6959	246	**1660**	72367	5482 *	77848	1,00
1.5	01050000_DIBt_ZY_B_0_24_(DIBt2	8662	-1727	1170	**137700**	5482 *	143182	1,35

Extremlasten (absolute Maxima) inkl. Erdbebenlastfälle exkl. Sicherheit /
Extreme Loads (absolute maxima) *incl. earthquake + synchrone components (excl. safety-factors)*

LC	LC-Def.	FXTB	MXTB	FYZTB	MYZTB	ΔMres	M_{res}	γ_f
		kN	kNm	kN	kNm	[kNm]	[kNm]	-
5.2	05020000_ZY_B_07_01.ave_(IEC2a	**8489**	123	712	48023	5482 *	53505	1,00
2.2	CCV_B_02020204_ZZ_B_24_03.av	6548	**-6628**	360	33948	5482 *	39430	1,00
5.2	05020000_ZZ_B_07_07.ave_(IEC2a	6959	246	**1660**	72367	5482 *	77848	1,00
2.2	CCV_B_02020204_ZY_A_12_02.av	6475	80	970	**104633**	5482 *	110115	1,00

Extremlasten (absolute Maxima) exkl. Erdbebenlastfälle inkl. Sicherheit /
Extreme Loads (absolute maxima) *excl. earthquake + synchrone components (incl. safety-factors)*

LC	LC-Def.	FXTB	MXTB	FYZTB	MYZTB	ΔMres	M_{res}	γ_f
		kN	kNm	kN	kNm	[kNm]	[kNm]	-
8.1	08010000_DIBt_ZY_D_17_(DIBt3_5	**10166**	979	158	17984	5482 *	23466	1,60
2.1	CCV_B_02010204_ZZ_C_24_07.av	8755	**-8801**	295	33885	5482 *	39367	1,35
1.5	01050000_DIBt_ZY_C_1_24_(DIBt3	8655	-2980	**1212**	127508	5482 *	132989	1,35
1.5	01050000_DIBt_ZY_B_0_24_(DIBt3	8662	-1727	1170	**137700**	5482 *	143182	1,35

Extremlasten (absolute Maxima) exkl. Erdbebenlastfälle exkl. Sicherheit /
Extreme Loads (absolute maxima) *excl. earthquake + synchrone components (excl. safety-factors)*

LC	LC-Def.	FXTB	MXTB	FYZTB	MYZTB	ΔMres	M_{res}	γ_f
		kN	kNm	kN	kNm	[kNm]	[kNm]	-
6.5	06050000_DIBt_ZY_E_1_41_(DIBt3	**6849**	-875	441	49450	5482 *	54932	1,00
2.2	CCV_B_02020204_ZZ_B_24_03.av	6548	**-6628**	360	33948	5482 *	39430	1,00
2.2	CCV_B_02020204_ZZ_A_12_09.av	6495	-95	**983**	103373	5482 *	108855	1,00
2.2	CCV_B_02020204_ZY_A_12_02.av	6475	80	970	**104633**	5482 *	110115	1,00

*) maximaler ΔMres- Wert aus N117/3000 R120 IEC2a/DIBt2 / max ΔMres value from N117/3000 R120 IEC2a/DIBt2

	Ständige Lasten (klaffende Fuge) nach DIBt-Richtlinie 2004-03 und Korrektur 2006-12 *Permanent Loads (gaping joint) acc. to DIBt 2004-03 & corr. 2006-12*			
	FXTB [kN]	**FZTB** [kN]	**MXTB** [kNm]	**MresTB** [kNm]
DIBt	6770	540	2100	63000
IEC 50Hz	6780	560	2400	64000
IEC 60Hz	6780	560	2400	64000

2.2.2 Betriebslasten Turmfuß / *Fatigue Loads Tower bottom*

Betriebslasten Schädigungsäquivalente ESK / ***Fatigue Loads*** *Damage Equivalent Load Spectrum*					
N	**m**	**FXTB**	**FZTB**	**MXTB**	**MYTB**
Lastspiele ***Cycles***		kN	kN	kNm	kNm
1,00E+07	3	148	512	5240	32041
1,00E+07	4	115	434	4501	31626
1,00E+07	5	103	414	4321	33081
1,00E+07	6	99	415	4351	35304
1,00E+07	7	98	426	4466	37921
1,00E+07	8	99	444	4612	40709
1,00E+07	9	102	466	4766	43506
1,00E+07	10	105	490	4919	46205
1,00E+07	11	109	514	5068	48750
1,00E+07	12	113	537	5211	51120
gamma-f - FAT		1,0	1,0	1,0	1,0
Mittellast *Mean load*		6443	254	112	30149

Die Rain Flow Counts (RFCs) werden im Excel-Format beigefügt. / The rain flow counts (RFCs) are attached as Excel-file.

Specification of echnical Requirements

Foundation Design

for steel towers

Document Num er:
K0822_064192_EN

Revision:
05

Created:
A.E. Dang

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2015-08-26

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R. Johnas

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9518

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K08	**F**	**delta**	**P**

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Platform/Type Code	Type Name

Revision Index

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05	26.08.2015	AD	Page 7: reference to Annex A corrected	9518
04	25.06.2015	AD	Editorial modifications	9518
03	26.05.2015	AD	Modification Annex A	9518
02	30.03.2015	AD	Re-tensioning intervals	9518
01	13.02.2015	AD	Modification pretension of anchor olts	9518
00	12.02.2015	AD	creation	9518

References

Document No., Revision/Edition	Description
	Nordex Documents
0822 064192 A01 EN 00	Specification of echnical Requirements oundation – Annex A: Pretension forces for foundation anchor olts
	Standards/Guidelines
DI t – Schriften des Deutschen Instituts f r autechnik, Reihe , Heft 8	Richtlinie f r Windenergieanlagen – Einwirkungen und Standsicherheitsnachweise f r urm und r ndung, assung Okto er 2012
DIN EN 1990-2	Eurocode 3: rundlagen der ragwerksplanung / Eurocode: asis of structural design
DIN EN 1992	Eurocode 2: emessung und onstruktion von Stahl eton- und Spann etontragwerken / Eurocode 2: Design of concrete structures
DIN EN 1997-1	Eurocode 7: Entwurf, erechnung und emessung in der eotechnik - eil 1: Allgemeine Regeln / Eurocode 7: eotechnical design - Part 1: eneral rules
CE - IP Model Code 1990	Comit Euro-International du Béton, Bulletin d'Information No 203, CE - IP Model Code 1990 inal Draft, uly 1991
i Model Code for Concrete Structures 2010	
EN 206-1:2001	eton - eil 1: estlegung, Eigenschaften, Herstellung und onformit t / Concrete - Part 1: Specification, performance, production and conformity
IEC 62079:2001	Erstellen von Anleitungen - liederung, Inhalt und Darstellung (IEC 62079:2001) / Preparation of instructions - Structuring, content and presentation (IEC 62079:2001)

Document No., Revision/Edition	Description
L IV-1-1/11: 2010	Rules and guidelines - IV: Industrial services - Part 1: uideline for the certification of wind tur ines - Chapter 1-11 Ham urg : ermanischer Lloyd WindEnergie, 2010
DIN 1045, eil 2 (2008) + 3 (2012) (only for ermany)	ragwerke aus eton, Stahl eton und Spann eton / Concrete, reinforced and prestressed concrete structures
DIN 1054: 2010 (only for ermany)	augrund - Sicherheitsnachweise im Erd- und rund au - Erg nzende Regelungen zu DIN EN 1997-1 / Su soil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1
DIN 4017: 2006 (only for ermany)	augrund - erechnung des rund ruchwiderstands von lachgr ndungen / Soil - Calculation of design earing capacity of soil eneath shallow foundations

he edition/revision stated was used in preparation of this document. If not stated otherwise, the newest edition/revision of a document or guideline shall e used.

Table of Contents

1 General

1.1 Subject of this Report

his specification serves as a requirement specification for the design of foundations for Nordex wind tur ines.

he design of a foundation includes the structural calculation and the construction drawings of the foundation.

1.2 General proceeding

he author of the foundation design shall define three milestones within the design process.

he complete documentation according to chapter 6 shall e su mitted at least 4 weeks efore the agreed date if not stated otherwise. Nordex will review and comment the complete documentation according to the Nordex specification to the agreed date. he author of the foundation design has to su mit the revised documentation (if necessary) y the agreed date.

he result of the Nordex review will e a statement, if the structural calculation and the related design drawings are within the Nordex specifications. he responsi ility for the correct content of the documents exclusively remains at the supplier. Nordex informs the supplier immediately if errors in the documents are found.

All changes and/or corrections in the design, verification or the drawings after the release must e immediately announced to Nordex in writing.

1.3 Abbreviations, Definitions, Symbols

Fx:	vertical orce
Fy, Fz, Fyz, Fres:	horizontal orces
Mx:	torsional Moment
My, Mz, Myz, Mres:	ending Moments
TB:	ower ottom, ottom edge of the ase flange of the tower, upper edge of the load spreading plate
ULS:	ltimate Limit state
SLS:	Service Limit State
γ:	safety factor
foundation:	foundation of the wind tur ine including concrete ody and soil
ductwork:	ca le ducts
ground gap:	theoretic tension in ground level (soil under foundation)
elastic modulus:	Young's modulus
N_{tot}:	total mass of wind tur ine (nacelle, tower, foundation)

2 Input Information

he necessary input for the design of a foundation is defined elow. Missing input information has to e demanded efore start of work y the foundation designer.

2.1. ype of tur ine

2.2. Stiffness for foundation-soil interaction, Eigenfrequency of the system tur ine/foundation

2.3. Loads (extreme loads incl./excl. γ, fatigue loads, permanent loads, Markov matrices of the type of tur ine)

2.4. Specification of standard ductwork

2.5. Load Specification – oundation for the wind tur ine type

2.6. Drawing of anchor cage

2.7. Project specific requirements earthing design (oundation earthing is within the responsi ility of the electrical expert in charge)

3 Requirements for foundation design

3.1 General requirements

In order to achieve the necessary hu height the position of the tower ottom ( ) must e taken from the related Nordex foundation load specification.

In addition, Nordex requires a horizontal ackfilling on top of the foundation sla (within the foundation area) as ase for the tower access stairs as well as working area for maintenance activities during the tur ine lifetime. he top level of the ackfilling shall e at 10 to 20 cm elow top of foundation.

3.1.1 Eigenfrequencies

or the foundation design the soil properties have to e taken into consideration in order to ensure that the eigenfrequencies of the entire system wind tur ine-foundation meet the requirements of the load calculation.

herefore, a minimum dynamic stiffness of the foundation is specified, defined y minimum rotating spring rates $k_{\varphi dyn}$ (and static spring rates $k_{\varphi,stat}$). he values are stated in the foundation load specification.

Either the required soil's elastic modulus has to comply with the soil conditions or the dynamic spring rate $k_{\varphi dyn}$ and the static spring rate $k_{\varphi,stat}$ are to e confirmed y a soil engineer.

or shallow foundations the minimum soil's elastic modulus can e derived from the required rotational spring stiffness.

or pile foundations a horizontal spring rate $k_{h,dyn}$ depending of the total mass of the wind tur ine incl. foundation is defined (see ta le 1). Intermediate values can e interpolated.

ur ine	$k_{h,dyn}$ approx. N_{tot} = 100 t	$k_{h,dyn}$ approx. N_{tot} = 3000 t
All tur ines	$4 \cdot 10^7$ N/m	$1 \cdot 10^9$ N/m

a le 1

3.1.2 Inclination

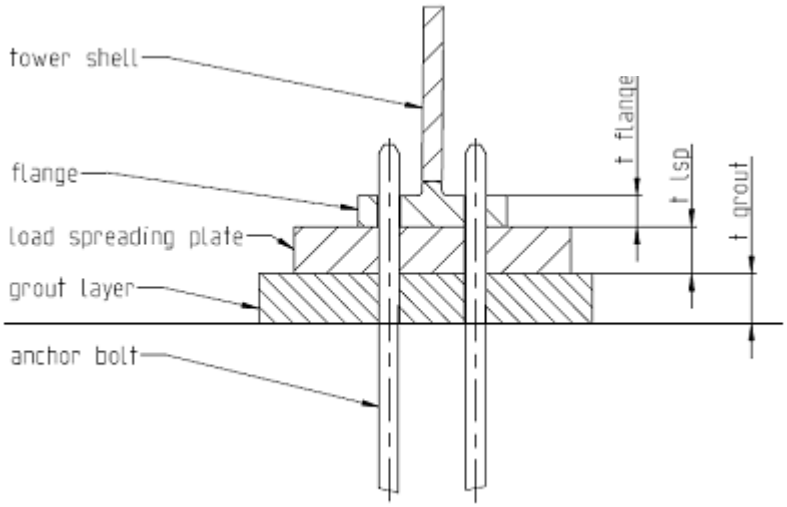
A maximum inclination of the foundation of 3mm/m due to settlements of the soil must not e exceeded within the lifetime of the wind tur ine (20 years).

3.2 Materials

or the design of the foundation materials shall e used which are state of the art and of common use in the respective country.

3.3 Connection Tower-Foundation

he tu ular tower is connected to the foundation y an anchor cage, consisting of anchor olts (e.g. M36 or M42), an anchor plate (ottom), which is concreted into the foundation and a load spreading plate (top). he ottom flange of the tower (tower ase flange) will e positioned on top of the load spreading plate (see sketch). he anchor olts are pre-tensioned to increase the fatigue resistance and to have a sta le connection.



sketch – connection of tu ular tower to foundation

he pretension force v of one anchor olt has to e considered according to 0822 064192 A01 EN 00.

he loss of pre-tension has to e determined for the intervals listed in the ta le elow:

1. control	48 days after concreting
2. control	483 days after concreting
3. control	1853 days after concreting
4. control	3678 days after concreting
5. control	5503 days after concreting
6. control	7300 days after concreting

In case of rock anchored foundations alternative connections to the tower have to e released y Nordex. he anchor cage is the preferred connection.

Generally the anchor cage is part of the wind turbine's type certificate. In case an alternative tower-foundation connection is chosen, the type certificate is not valid anymore and requires an additional certification.

3.4 Loads

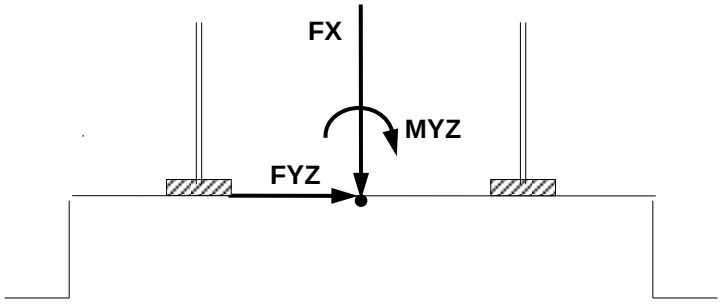
he calculation of the loads is ased on accepted standards for wind tur ines, e.g. IEC, L, DI t.

In general the wind tur ine model includes several wind conditions (e.g. tur ulences, etc.), earthquake loads and dynamic ehaviour of the entire structure (lades, nacelle, tower, foundation).

he loads are not valid any longer if a higher wind class is considered or the required eigenfrequencies are not met.

3.4.1 Definitions

All loads are given respective to the intersection tower axis - (see sketch). Loads may appear in all directions.



sketch - reference point for effect of loads

he tower is connected to the foundation y an anchor cage except for rock anchored foundations. Pressure is transmitted to the foundation via the load spreading plate or adapter while tension is su mitted via the anchor olts to the anchor plate or via an alternative.

he safety factors are defined y the asis standard for the load calculation. If different safety factors are applied for the verification these must e justified and Nordex has to e informed immediately.

3.4.2 Extreme loads

he extreme loads are given for LS, SLS and load cases considering earthquake. LS loads include a safety factor γ according to the respective standard. As γ is varying the load cases given for LS and SLS do not have to e identical.

or the verification of the foundation design Myz and yz are to e superimposed in a conservative manner.

3.4.3 Fatigue loads

he fatigue loads are given as load collectives for n = 10^7 cycles with different gradients and as Markov matrices. he fatigue loads implement a safety of γ=1,0. ased on conservative verification procedures only x, z, Mx and My have to e considered for the fatigue resistance.

he maximum load ranges can e calculated with their related mean loads.

Minimum: mean – 0.5 range

Maximum: mean + 0.5 range

hus the load range of fatigue loads is defined as 2 x amplitude.

3.4.4 Permanent Loads

Permanent loads are stated in the related oundation Design Load Specification.

nder permanent loads (γ=1,0) no gap elow the foundation (tension in the sole level) may occur.

4 Verification of the foundation

Verification shall e provided in accordance with accepted norms and standards and have to comply with the state of the art and existing law in the respective country. It shall also comply with the requirements of the *Guideline for the Certification of Wind Turbines* of ermanischer Lloyd (L- uideline IV). he foundation must e designed for a lifetime of a minimum of 20 years.

4.1 Minimum Content of the verification

4.1.1 Revision Index

4.1.2 Description of the wind turbine generator

- tur ine and foundation (incl. type of anchor cage)
- dimensions of the foundation (incl. amount of concrete)
- dimensions of piles, if piled foundation
- dimensions of anchors, if rock anchored foundation
- uilt-in materials with information a out material characteristics
- applied safety factors for the materials
- assumptions for soil conditions
- used loads and their safety factors (incl. pretension force of anchor olts)
- used literature and standards

4.1.3 Sketch of the foundation with main measures

4.1.4 Static proofs

Any analysis must include the verification for **fatigue** and **extreme loads** and **serviceability**.

4.1.4.1 Inner resistance (minimum scope)

- main reinforcement top and ottom and concrete
- main and shear reinforcement of piles and concrete if piled foundation
- shear resistance concrete
- shear reinforcement / punching
- load spreading plate
- anchor plate
- anchor olts including loss of pre-tension
- load concentration at the load spreading plate – grouting layer
- load concentration at the load spreading plate – concrete elow grouting layer
- load concentration in concrete a ove the anchor plate
- ond etween tendon strands and grouting
- horizontal shear reinforcement / tensile reinforcement
- crack width
- stress limitation
- ar-to- ar-distance of reinforcement
- anchorage and overlapping length of reinforcement
- anchor spacing if rock anchored foundation
- load concentration area (in concrete) due to rock anchor if rock anchored foundation
- limitation of load amplitude in rock anchor if rock anchored foundation
- optional (on specific request): verification of load spreading plate, anchor plate and anchor olts
- summary of the results

4.1.4.2 External resistance (minimum scope)

- soil shear failure ⇒ soil requirements if not already considered / verified in the geotechnical report
- soil pressures, divided up in edge and mean pressure ⇒ soil requirements
- avoidance of ground gap under permanent loads
- tilting (overturning)
- sliding (horizontal shifting)
- uoyancy
- settlement if not already considered / verified in the geotechnical report
- rock failure due to rock anchor if rock anchored foundation
- earing capacity of rock anchor if rock anchored foundation
- summary of the results

4.1.5 Soil requirements

- Max. soil pressure
- Min. elastic stiffness modulus (static, dynamic) and respective Poisson's ratio for the verification of the required rotating spring rate / static spring rate
- earing pressure due to reaction force of external stair case

4.1.6 Others

- Design of a foundation for the tower access stairs
- Indication of a flat working area (10m x 10m at the ackfilling area) in front of the tower door (in case of internal transformer)

4.2 Formal aspects

- all pages must e clearly num ered
- all used models must e indicated extraordinary models must e explained and references e attached
- all used formulas must e indicated completely at their first use, e.g. $f_{cd} = \gamma_c$ f_{ck}
- references in the calculation must e clearly indicated and marked
- the calculation shall e easy to follow and check
- program prints or input lists which don't give final results shall e in the appendix
- results shall e edited graphically whenever possi le

5 Verification by a third party

he documentation shall e prepared in a way ena ling easy verification and validation. If required, third party verification has to e supported y the designer.

6 Documentation

6.1 General requirements

All documentation shall at least e provided in English or erman.

Documents intended for use y the end user or on site, such as construction drawings, shall e provided in English/ erman and in the language of the country of the installation site.

he documents shall e supplied on paper and in electronic form and comply with the respective guidelines and standards of technical documentation (in particular IEC 62079).

Amendments to any part of the documentation shall e su mitted in writing.

6.2 Extent of Documentation

- Verification of the foundation design acc. to chapter 4
- Construction drawings
- List of reinforcement ars (standard, material, diameter, length, weight, overlapping length)
- Work instruction for the installation of the reinforcement

6.3 Construction drawings

Drawings must e designed according to accepted norms and standards and have to comply with the current state of the art. All information on the construction drawings must e indicated in English/ erman and the language of the respective country.

he drawings must indicate the quantity and quality of steel and concrete. In addition, the foundation formwork drawing has to include information a out (ut not limited to)

- the grout material
- the dimensions of the grouting layer
- groundwater ta le
- dimensions of linding layer
- height of ackfilling
- indication of ground level
- specific weight of ackfilling
- concrete exposure classes
- humidity class
- any necessary information a out the concrete properties (e.g. max. grain size, cement type, etc.)
- specification of tendons if pre-stressed hy rid tower
- specification of rock anchor if rock anchored foundation
- earthing
- duct work

he reinforcement drawings shall include (at least)

- information a out position, diameter, length, overlapping length and relative shift etween the overlaps of all reinforcement ars
- minimum concrete cover

The building contractor must be able to order the correct materials (concrete, reinforcement, grout, cable tubes, earthing rods, etc.) and to fabricate the foundation with these drawings without any further information.

he integration of general drawings for earthing and ca le tu es in the foundation drawings must e agreed with Nordex.

6.4 Electronic document formats

- 2D drawings: .dxf, .dwg, Ado e Acro at Document (PD)
- Calculations: Excel, Ado e Acro at Document (PD)
- Lists: Excel, Access, Ado e Acro at Document (PD)
- ext documents: Word, Ado e Acro at Document (PD)

Bijlage IV

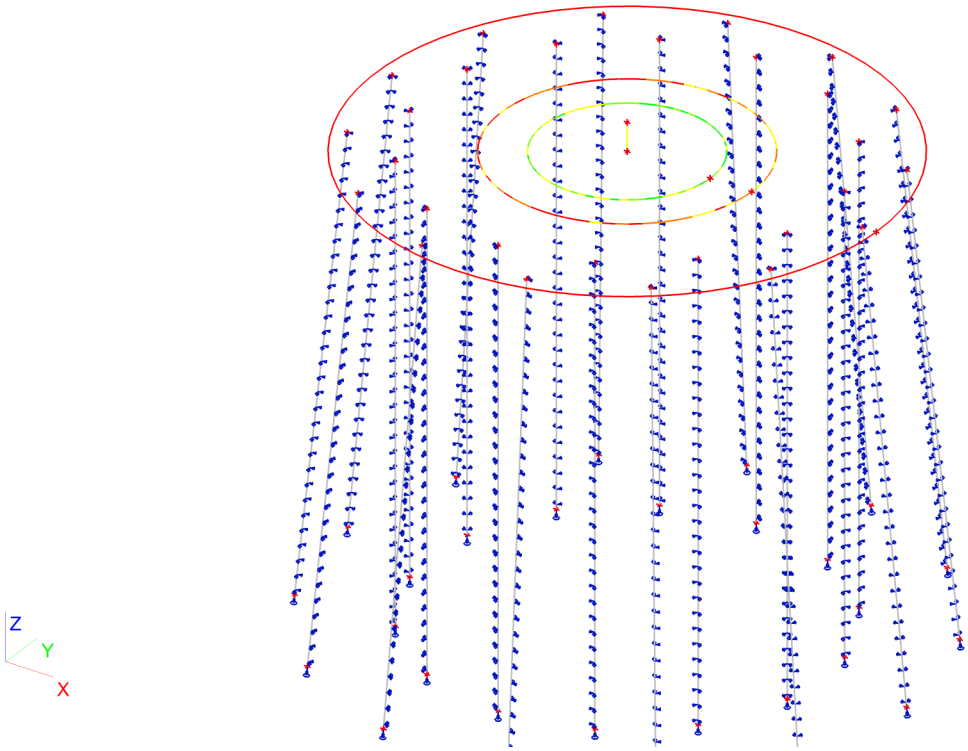
Resultaten paalbelastingen Windturbine

Bijlage IVa

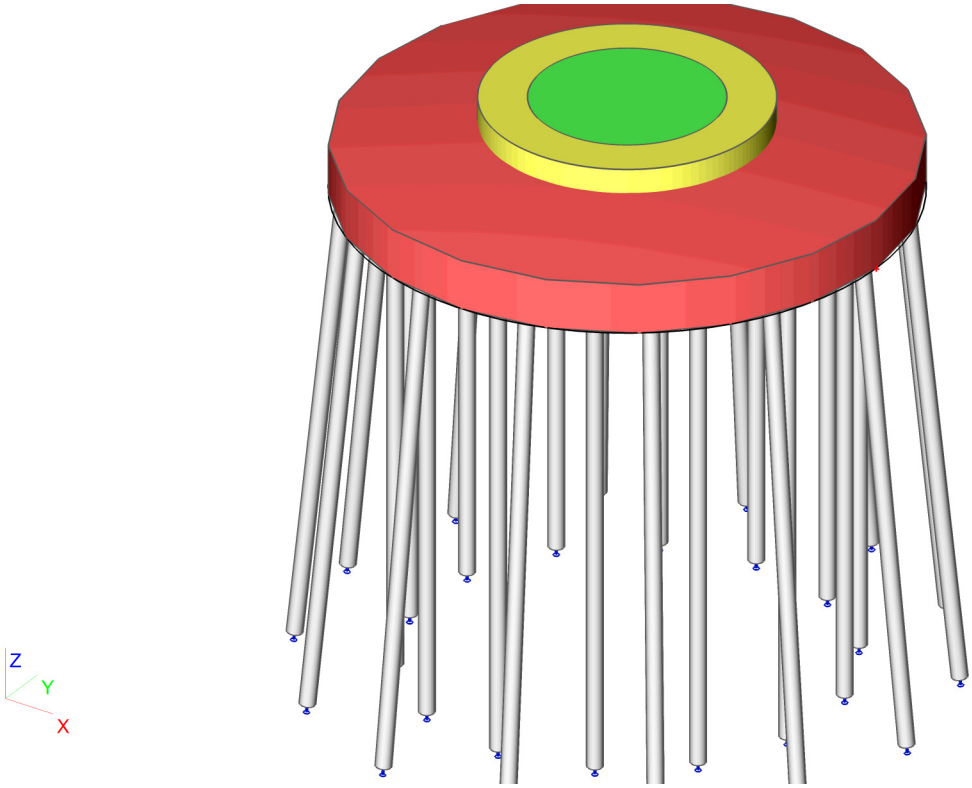
Resultaten maatgevende paalbelastingen

1. Inhoudsopgave

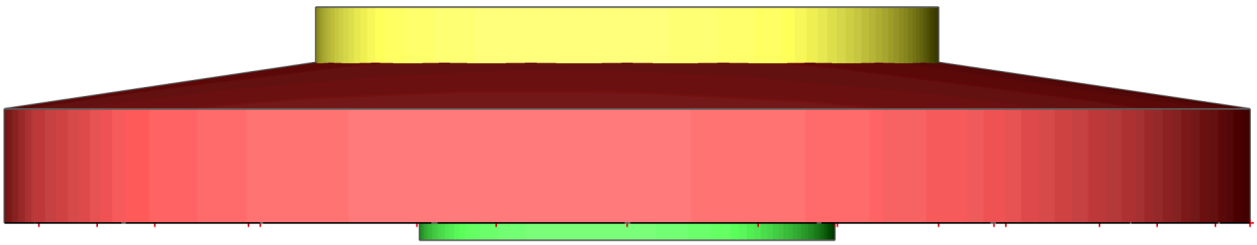
2. Rekenmodel



3. Rekenmodel



4. Rekenmodel



5. 2D-element

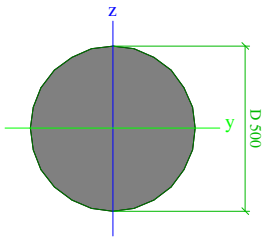
Naam	Materiaal	Dikte buitenzijde [mm]	Dikte type	Type	Laag
E2	C30/37	2990 1650	variabel	vloer (90)	Buitende
E3	C30/37	3120	konstant	vloer (90)	Binnen1
E4	C30/37	3370	konstant	vloer (90)	Binnen2

6. Opening

Naam	2D-element
Sparing1	E2
Sparing2	E3

7. Doorsneden

Naam	CS1	
Type	Cirkel	
Uitgebreid	500	
Onderdeelmateriaal	C30/37	
Bouwwijze	beton	
Knik y-y, z-z	b	b
EEM berekening	×	



A [m²]	1.9631e-01	
A y, z [m²]	1.6686e-01	1.6686e-01
I y, z [m⁴]	3.0667e-03	3.0667e-03
I w [m⁶], t [m⁴]	0.0000e+00	6.1334e-03
Wel y, z [m³]	1.2267e-02	1.2267e-02
Wpl y, z [m³]	2.0827e-02	2.0827e-02
d y, z [mm]	0	0
c YLCS, ZLCS [mm]	0	0
alpha [deg]	0.00	
AL [m²/m]	1.5707e+00	

8. Ondersteuningen op staaf

Naam	Type	Coör Systeem	Pos x Oors	Herh (n)	X	Stijfheid X [MN/m]	Y	Z	Rx	Ry	Rz
Sb16	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb18	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb21	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb22	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb23	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb24	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb25	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb26	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb27	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij

Naam	Type	Coör Systeem	Pos x Oors	Herh (n)	X	Stijfheid X [MN/m]	Y	Z	Rx	Ry	Rz
Sb28	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb29	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb30	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb31	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb32	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb33	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb35	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb38	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb39	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb40	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb41	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb46	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb47	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb48	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb49	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb50	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb51	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb52	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb53	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij

9. Lijnondersteuning op staaf

Naam	Staaf Systeem	Pos x_1 Pos x_2	Coör Oors	X	Y	Stijfheid Y [MN/m²]	Z	Stijfheid Z [MN/m²]	Rx	Ry	Rz
Slb24	S17 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb26	S19 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb29	S22 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb30	S23 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb31	S24 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb32	S25 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb33	S26 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb34	S27 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb35	S28 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb36	S29 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij

Naam	Staaf Systeem	Pos x_1 Pos x_2	Coör Oors	X	Y	Stijfheid Y [MN/m²]	Z	Stijfheid Z [MN/m²]	Rx	Ry	Rz
Slb37	S30 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb38	S31 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb39	S32 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb40	S33 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb41	S34 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb43	S36 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb46	S39 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb47	S40 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb48	S41 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb49	S42 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb50	S43 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb52	S45 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb53	S46 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb54	S47 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb55	S48 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb56	S49 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb57	S50 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb58	S51 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij

10. Puntlasten in knopen

Naam	Knoop	Belastingsgeval	Systeem	Rich	Type	Waarde - F [kN]
Puntlast2	K1	BG3 - UGT Fvert	GCS	Z	Kracht	-6416.00
Puntlast3	K1	BG4 - UGT Fhor	GCS	X	Kracht	867.00
Puntlast4	K1	BG6 - BGT Fvert	GCS	Z	Kracht	-6780.00
Puntlast5	K1	BG7 - BGT Fhor	GCS	X	Kracht	560.00
Puntlast6	K1	BG9 - Vermoeiing Fvert	GCS	Z	Kracht	-6443.00
Puntlast7	K1	BG10 - Vermoeiing Fhor	GCS	X	Kracht	254.00
Puntlast8	K1	BG2 - EG BTG	GCS	Z	Kracht	-14000.00

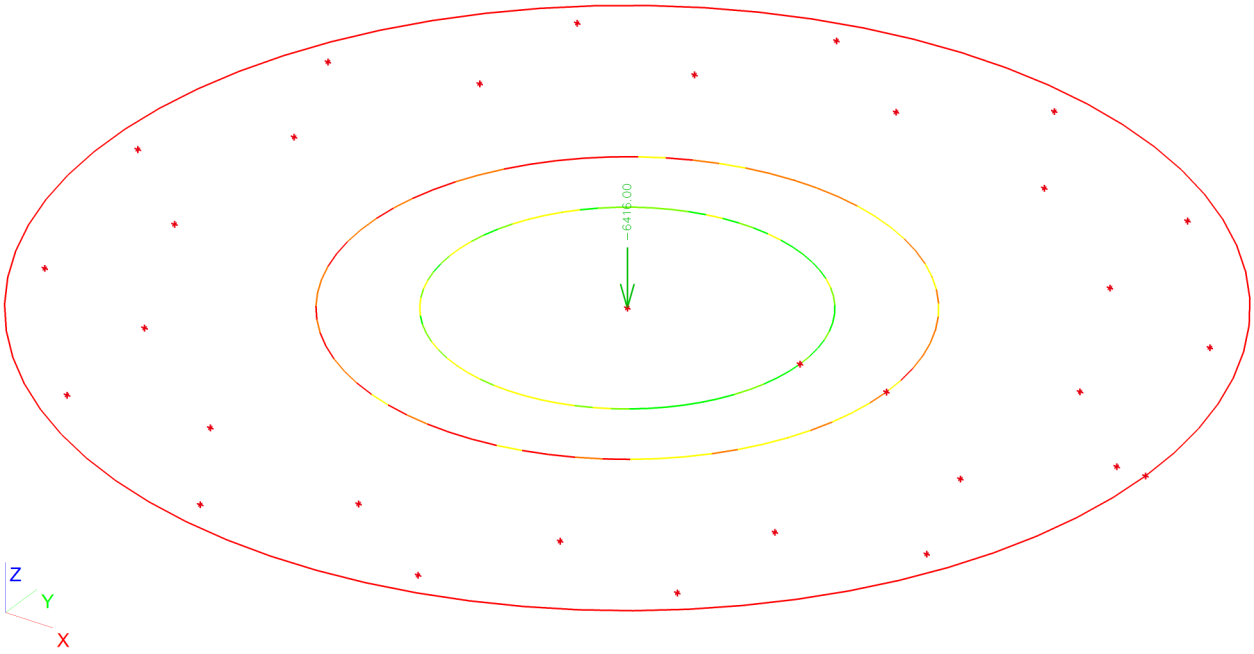
11. Momenten in knopen

Naam	Knoop	Belastingsgeval	Systeem	Rich	Type	Waarde - M [kNm]
M1	K1	BG5 - UGT M	GCS	My	Moment	106061.00
M2	K1	BG8 - BGT M	GCS	My	Moment	64000.00
M3	K1	BG11 - Vermoeiing M	GCS	My	Moment	30149.00

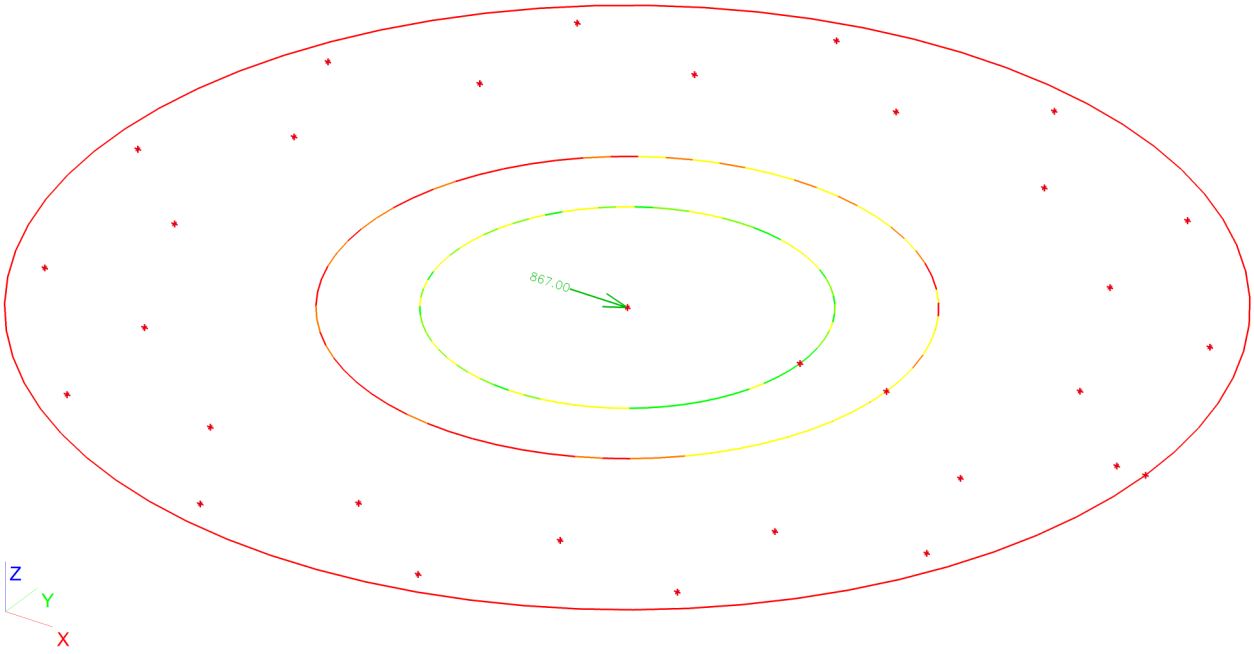
12. Belastingsgevallen

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Richting
BG1		Permanent	LG1	Eigen gewicht	-Z
BG2	EG BTG	Permanent	LG1	Standaard	
BG3	UGT Fvert	Permanent	LG1	Standaard	
BG4	UGT Fhor	Permanent	LG1	Standaard	
BG5	UGT M	Permanent	LG1	Standaard	
BG6	BGT Fvert	Permanent	LG1	Standaard	
BG7	BGT Fhor	Permanent	LG1	Standaard	
BG8	BGT M	Permanent	LG1	Standaard	
BG9	Vermoeiing Fvert	Permanent	LG1	Standaard	
BG10	Vermoeiing Fhor	Permanent	LG1	Standaard	
BG11	Vermoeiing M	Permanent	LG1	Standaard	
BG12	Fcorr UGT1	Permanent	LG1	Standaard	

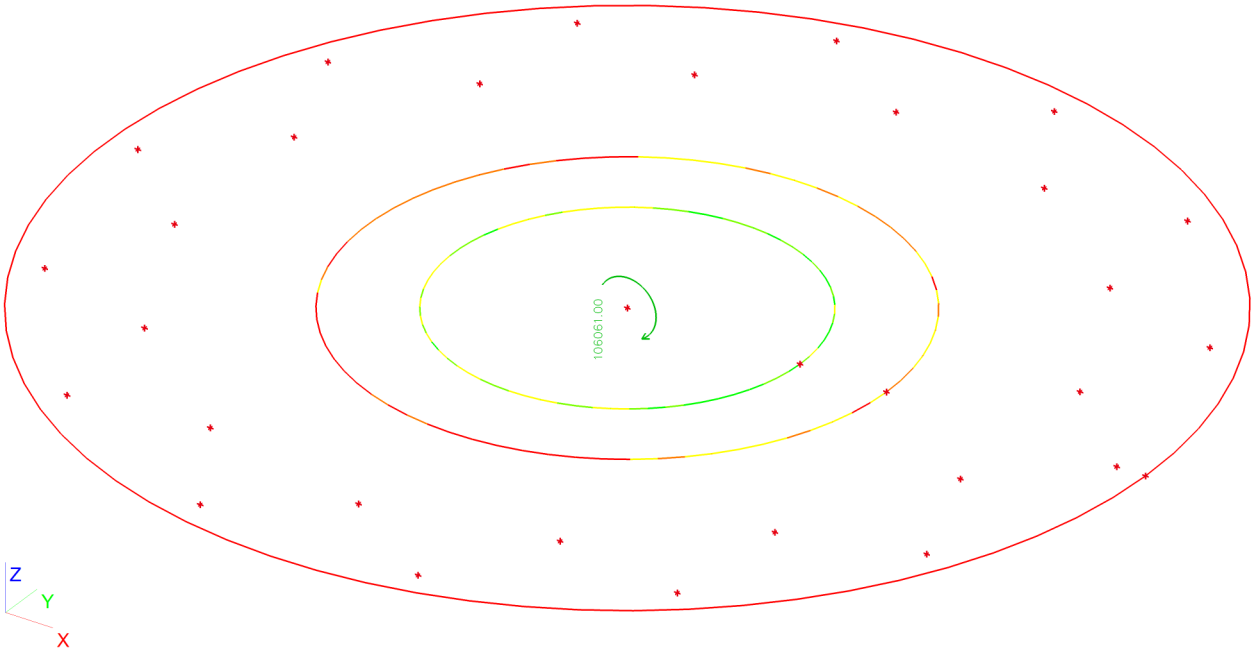
13. BG3 / Totale waarde UGT Fvert



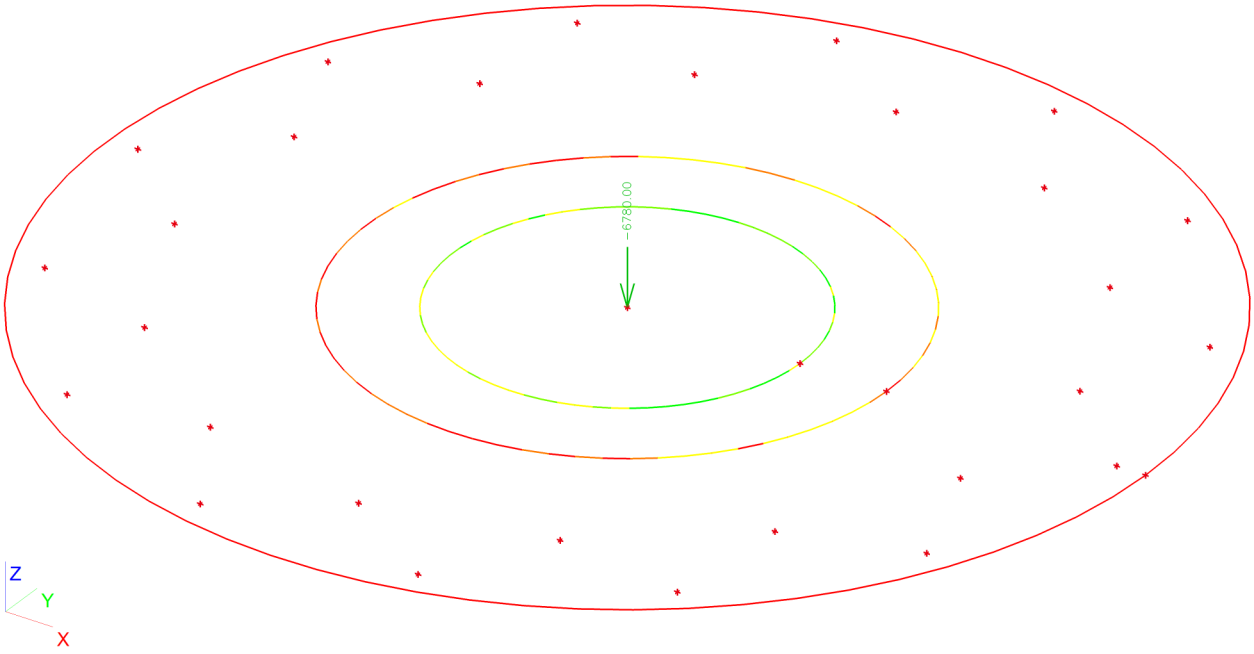
14. BG4 / Totale waarde UGT Fhor



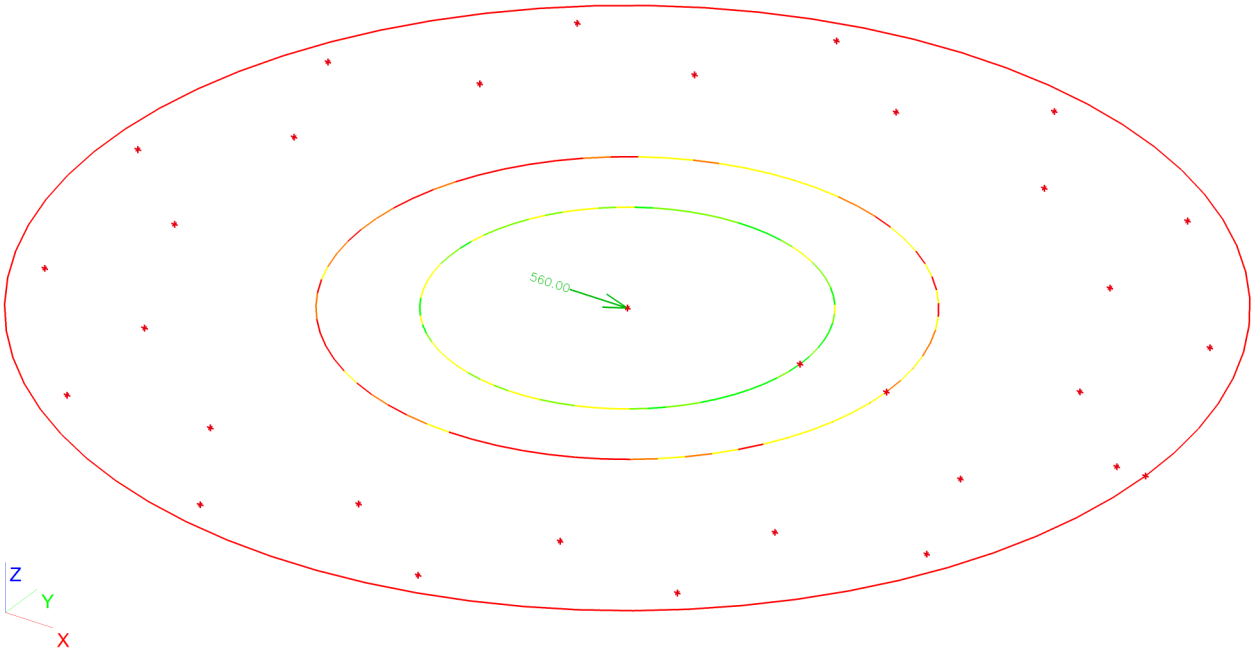
15. BG5 / Totale waarde UGT M



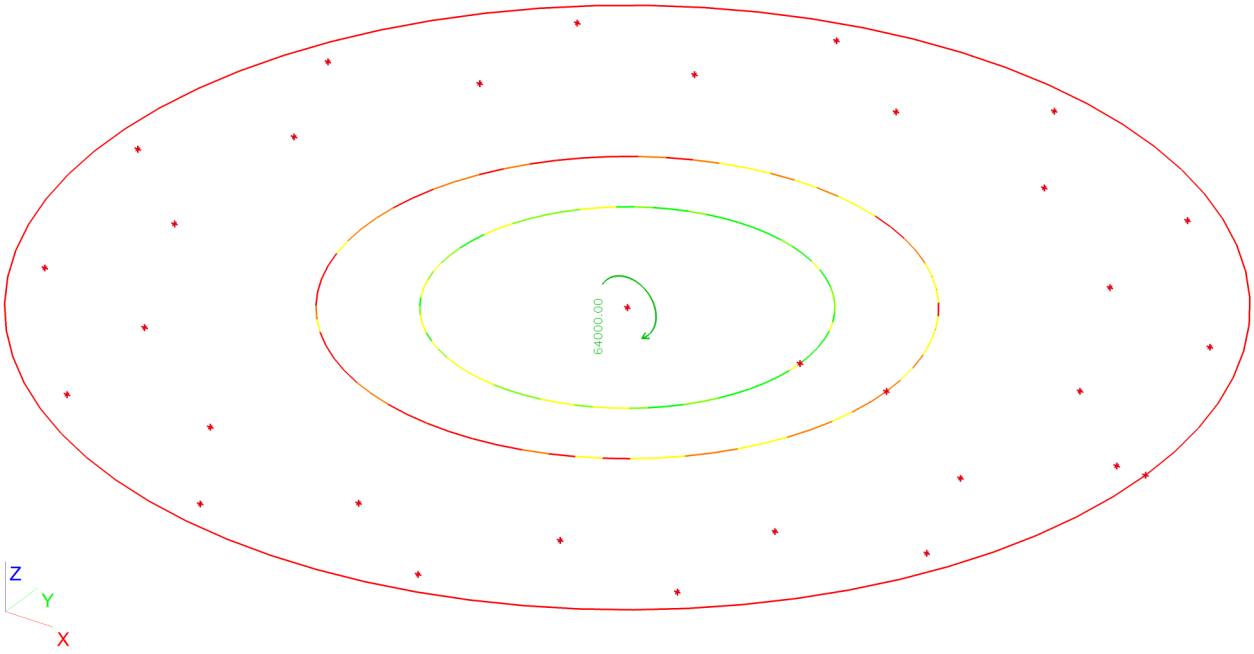
16. BG6 / Totale waarde BGT Fvert



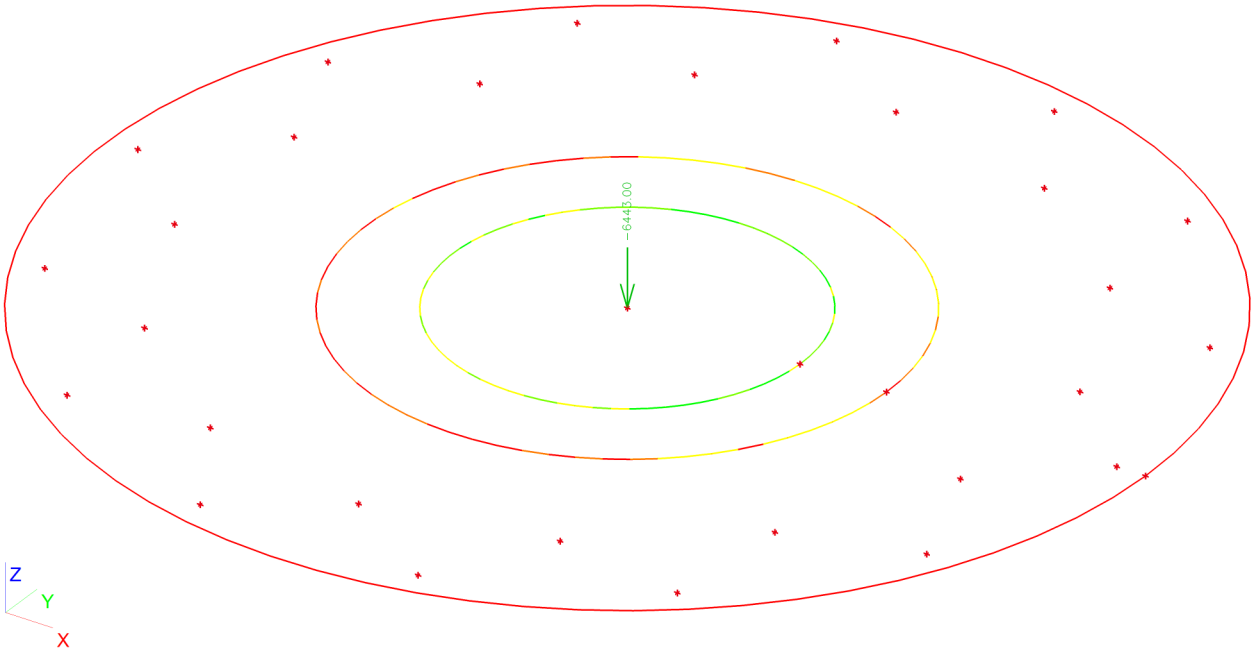
17. BG7 / Totale waarde BGT Fhor



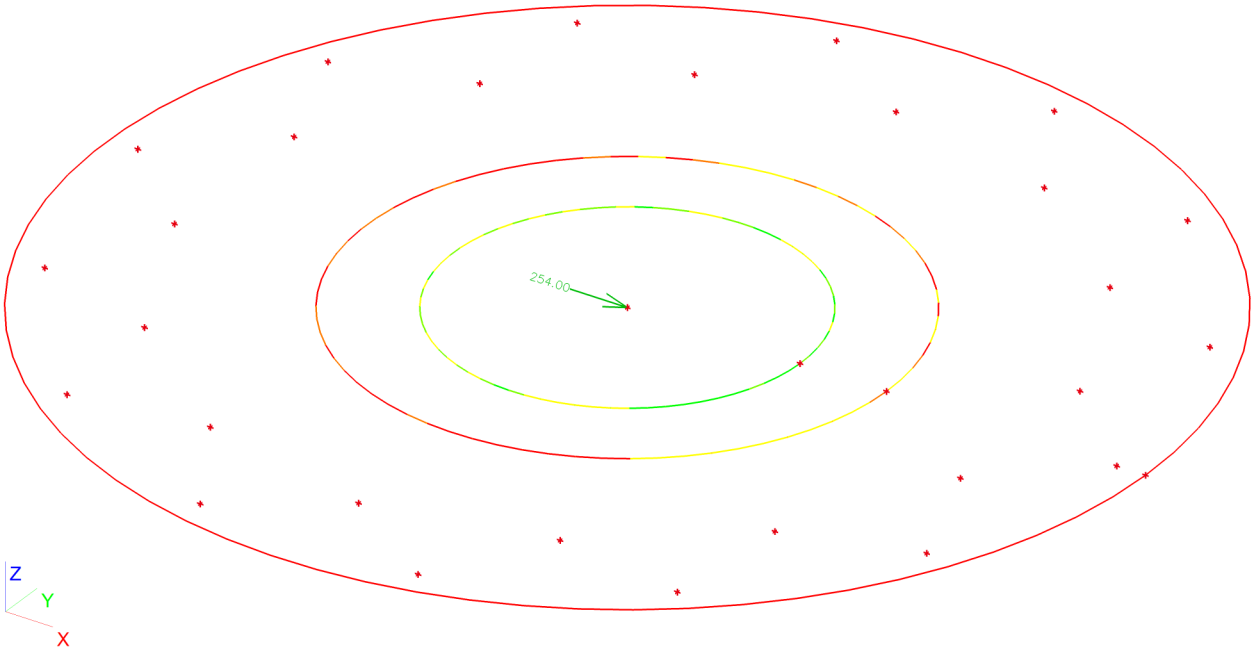
18. BG8 / Totale waarde BGT M



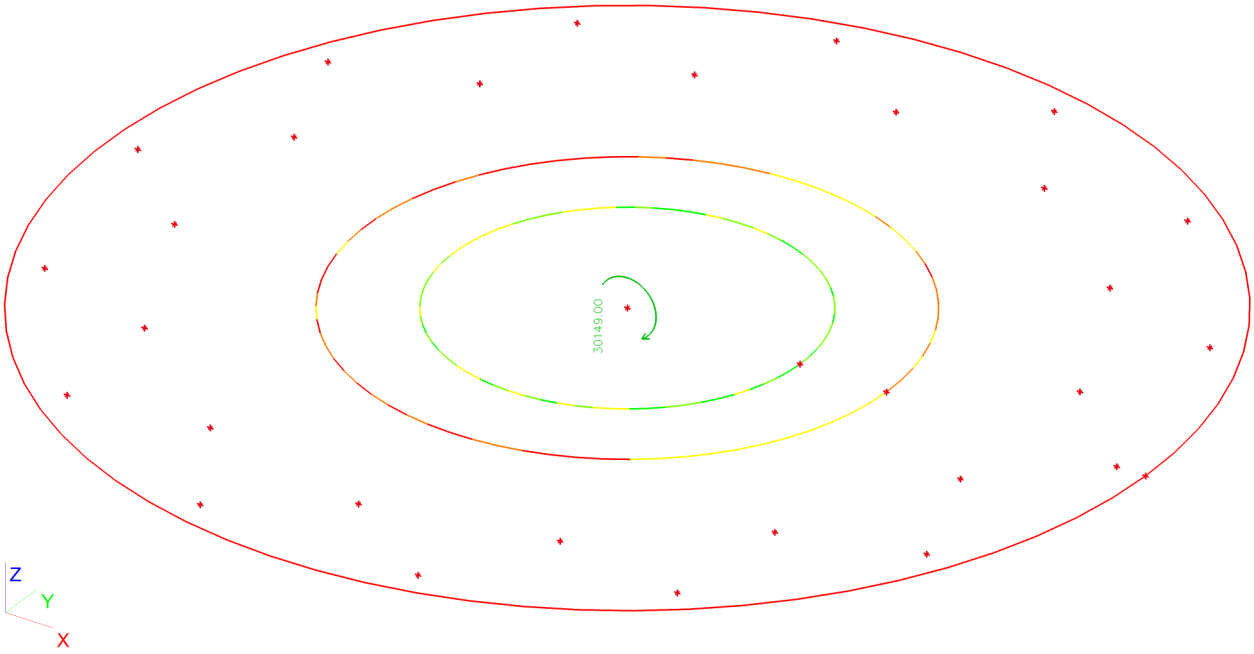
19. BG9 / Totale waarde Verm. Fvert



20. BG10 / Totale waarde Verm. Fhor



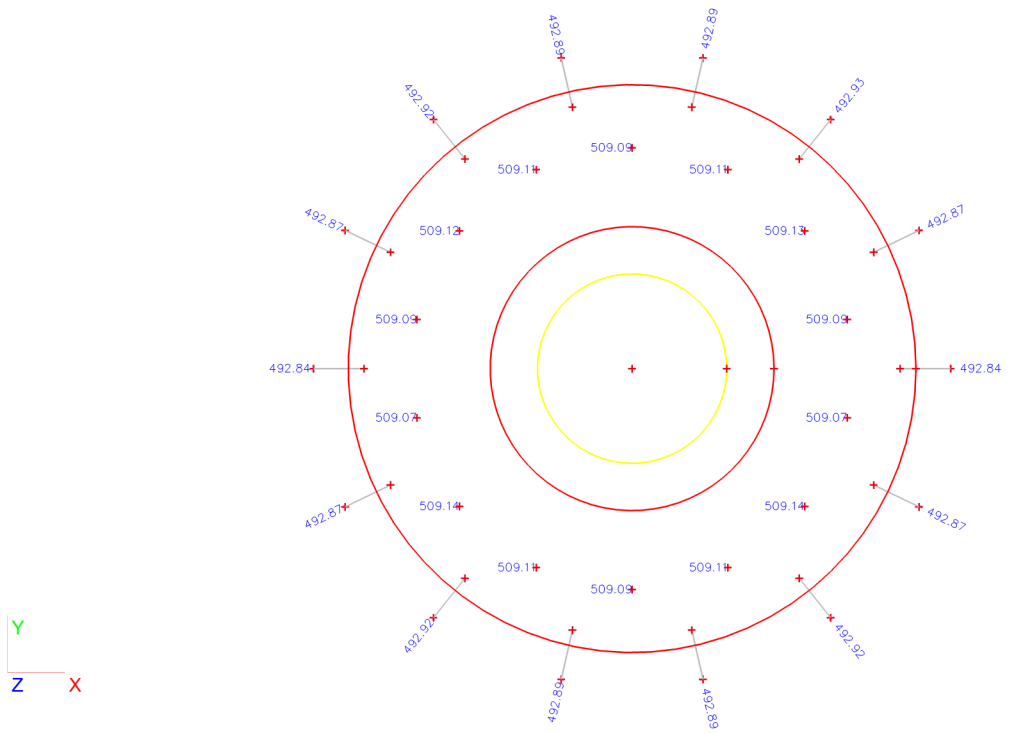
21. BG11 / Totale waarde Verm. M



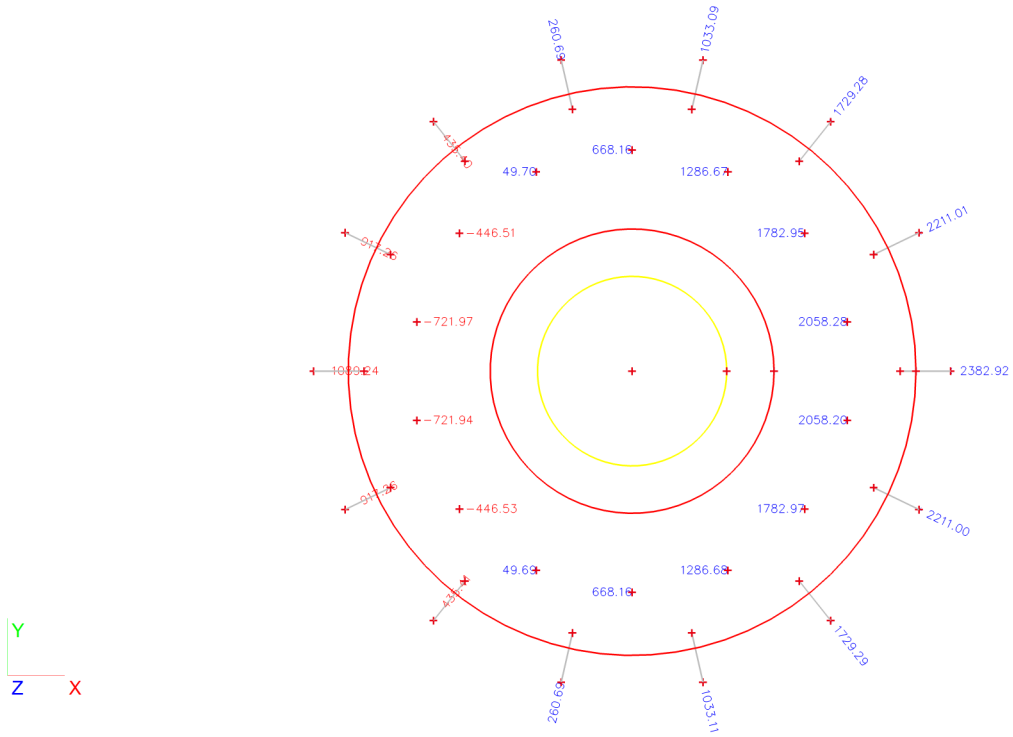
22. Combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
UGT1	Lineair - UGT	BG2 - EG BTG	0.90
		BG3 - UGT Fvert	0.90
		BG4 - UGT Fhor	1.65
		BG5 - UGT M	1.65
		BG12 - Fcorr UGT1	0.00
UGT2	Lineair - UGT	BG2 - EG BTG	1.50
		BG3 - UGT Fvert	1.50
		BG4 - UGT Fhor	1.65
		BG5 - UGT M	1.65
BGT1	Lineair - BGT	BG2 - EG BTG	1.00
		BG6 - BGT Fvert	1.00
		BG7 - BGT Fhor	1.00
		BG8 - BGT M	1.00
Vermoeiing	Lineair - BGT	BG2 - EG BTG	1.00
		BG9 - Vermoeiing Fvert	1.00
		BG10 - Vermoeiing Fhor	1.00
		BG11 - Vermoeiing M	1.00

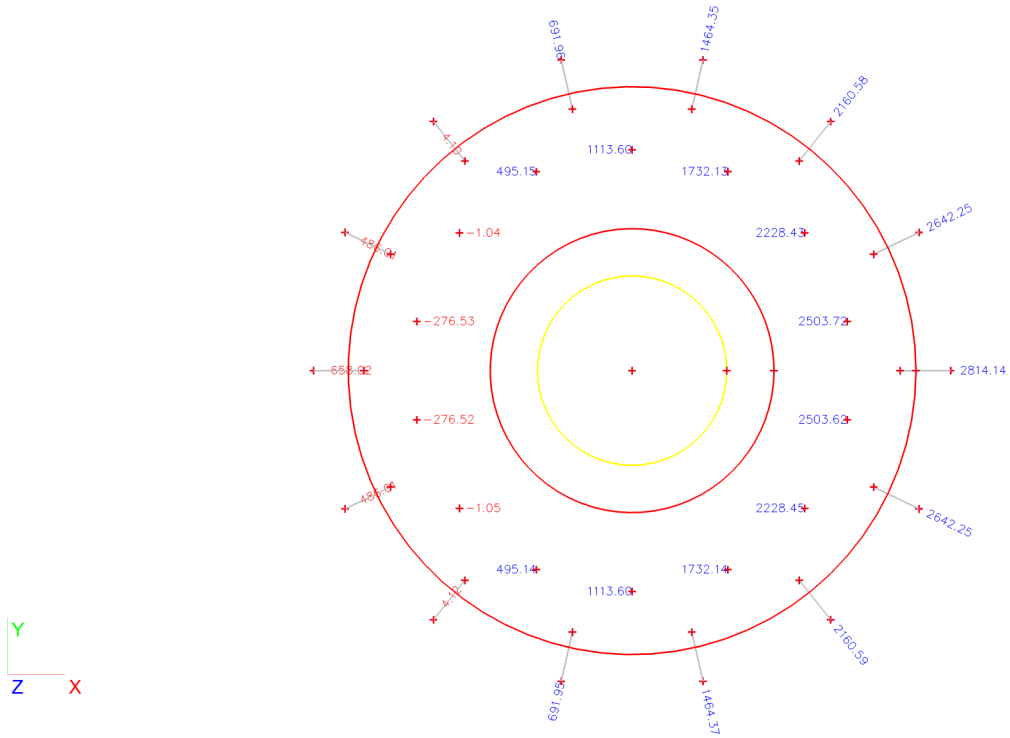
23. BG2 BTG Reacties; Rz



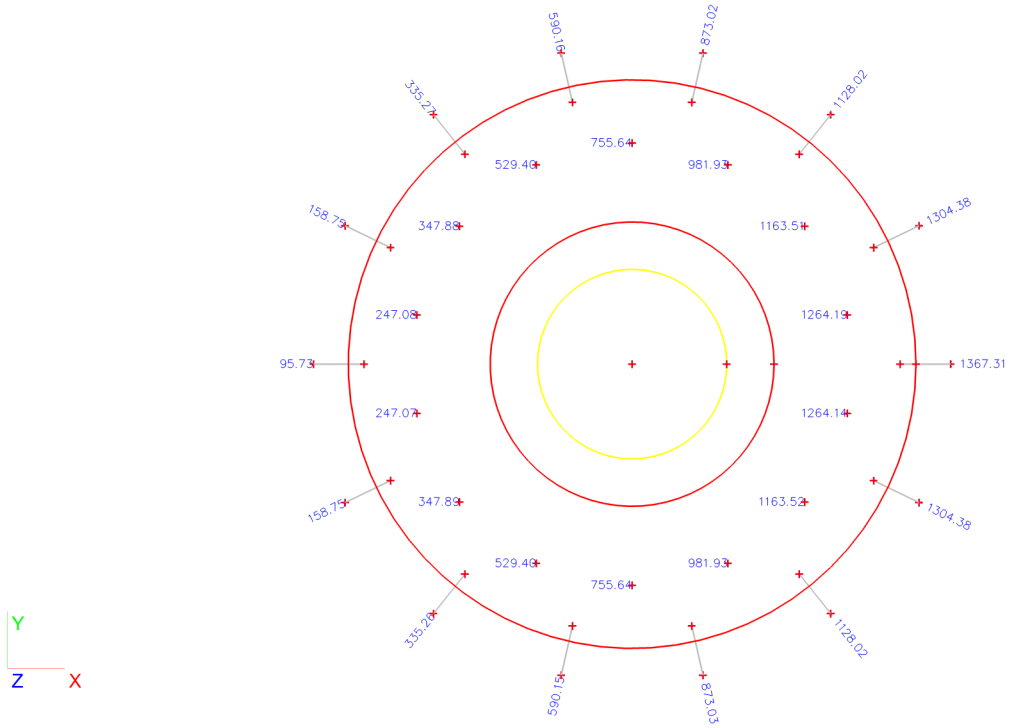
24. UGT1 Reacties; Rz



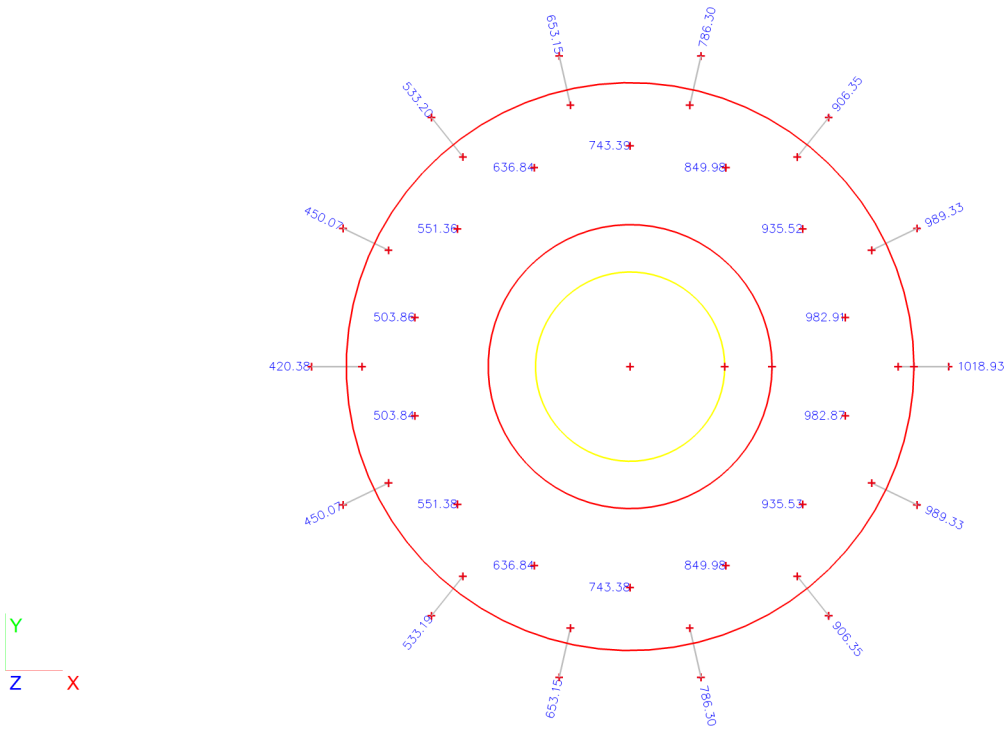
25. UGT2 Reacties; Rz



26. BGT1 Reacties; Rz



27. Vermoeiing Reacties; Rz

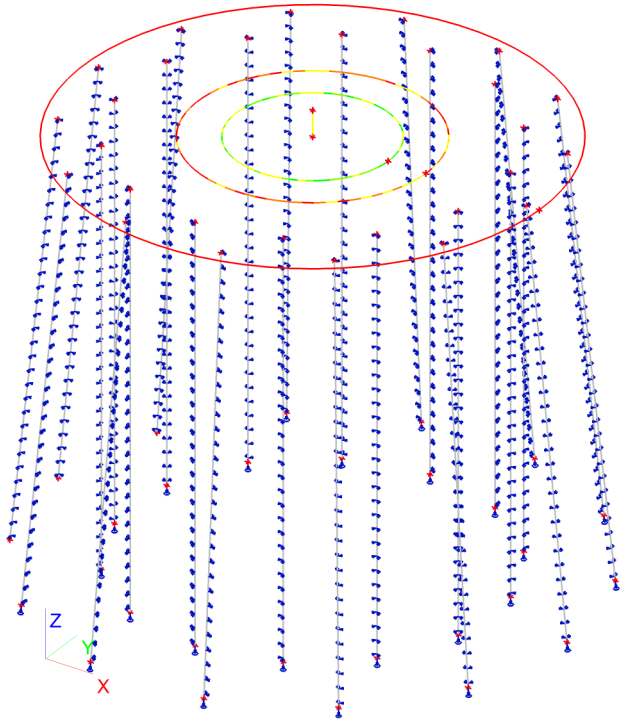


Bijlage IVb

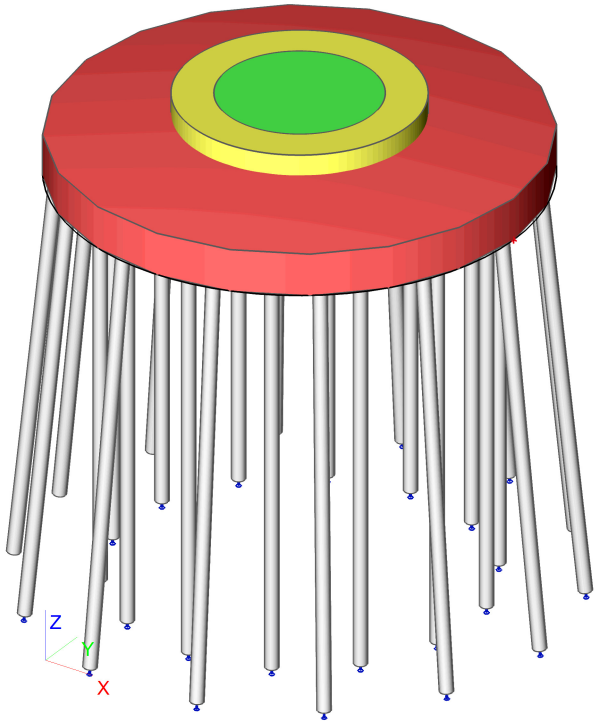
Resultaten Toets UGT1

1. Inhoudsopgave

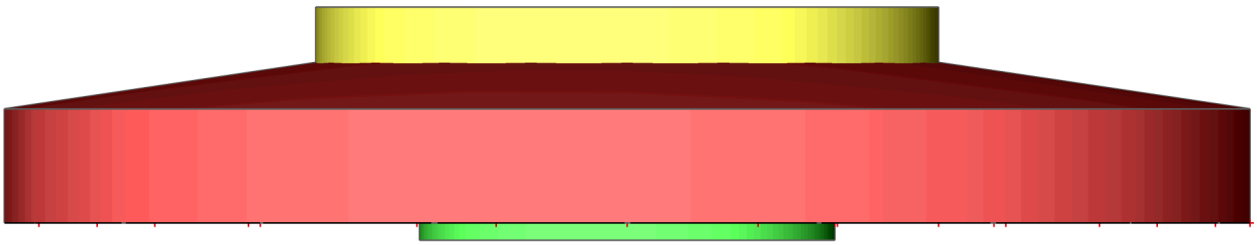
2. Rekenmodel



3. Rekenmodel



4. Rekenmodel



5. 2D-element

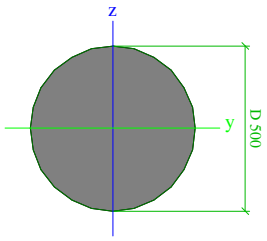
Naam	Materiaal	Dikte buitenzijde [mm]	Dikte type	Type	Laag
E2	C30/37	2990 1650	variabel	vloer (90)	Buitende
E3	C30/37	3120	konstant	vloer (90)	Binnen1
E4	C30/37	3370	konstant	vloer (90)	Binnen2

6. Opening

Naam	2D-element
Sparing1	E2
Sparing2	E3

7. Doorsneden

Naam	CS1	
Type	Cirkel	
Uitgebreid	500	
Onderdeelmateriaal	C30/37	
Bouwwijze	beton	
Knik y-y, z-z	b	b
EEM berekening	×	



A [m²]	1.9631e-01	
A y, z [m²]	1.6686e-01	1.6686e-01
I y, z [m⁴]	3.0667e-03	3.0667e-03
I w [m⁶], t [m⁴]	0.0000e+00	6.1334e-03
Wel y, z [m³]	1.2267e-02	1.2267e-02
Wpl y, z [m³]	2.0827e-02	2.0827e-02
d y, z [mm]	0	0
c YLCS, ZLCS [mm]	0	0
alpha [deg]	0.00	
AL [m²/m]	1.5707e+00	

8. Ondersteuningen op staaf

Naam	Type	Coör Systeem	Pos x Oors	Herh (n)	X	Stijfheid X [MN/m]	Y	Z	Rx	Ry	Rz
Sb16	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb18	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb21	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb22	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb23	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb24	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb25	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb26	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb27	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij

Naam	Type	Coör Systeem	Pos x Oors	Herh (n)	X	Stijfheid X [MN/m]	Y	Z	Rx	Ry	Rz
Sb28	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb29	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb30	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb31	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb32	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb33	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb35	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb38	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb39	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb40	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb41	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb46	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb47	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb48	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb49	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij
Sb50	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	9.0000e+01	Vrij	Vrij	Vrij	Vrij	Vrij

9. Lijnondersteuning op staaf

Naam	Staaf Systeem	Pos x_1 Pos x_2	Coör Oors	X	Y	Stijfheid Y [MN/m²]	Z	Stijfheid Z [MN/m²]	Rx	Ry	Rz
Slb24	S17 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb26	S19 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb29	S22 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb30	S23 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb31	S24 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb32	S25 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb33	S26 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb34	S27 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb35	S28 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb36	S29 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb37	S30 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb38	S31 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb39	S32 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij

Naam	Staaf Systeem	Pos x_1 Pos x_2	Coör Oors	X	Y	Stijfheid Y [MN/m²]	Z	Stijfheid Z [MN/m²]	Rx	Ry	Rz
Slb40	S33 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb41	S34 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb43	S36 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb46	S39 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb47	S40 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb48	S41 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb49	S42 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb50	S43 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb52	S45 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb53	S46 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb54	S47 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb55	S48 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb56	S49 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb57	S50 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb58	S51 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij

10. Puntlasten in knopen

Naam	Knoop	Belastingsgeval	Systeem	Rich	Type	Waarde - F [kN]
Puntlast2	K1	BG3 - UGT Fvert	GCS	Z	Kracht	-6416.00
Puntlast3	K1	BG4 - UGT Fhor	GCS	X	Kracht	867.00
Puntlast4	K1	BG6 - BGT Fvert	GCS	Z	Kracht	-6780.00
Puntlast5	K1	BG7 - BGT Fhor	GCS	X	Kracht	560.00
Puntlast6	K1	BG9 - Vermoeiing Fvert	GCS	Z	Kracht	-6443.00
Puntlast7	K1	BG10 - Vermoeiing Fhor	GCS	X	Kracht	254.00
Puntlast8	K1	BG2 - EG BTG	GCS	Z	Kracht	-14000.00

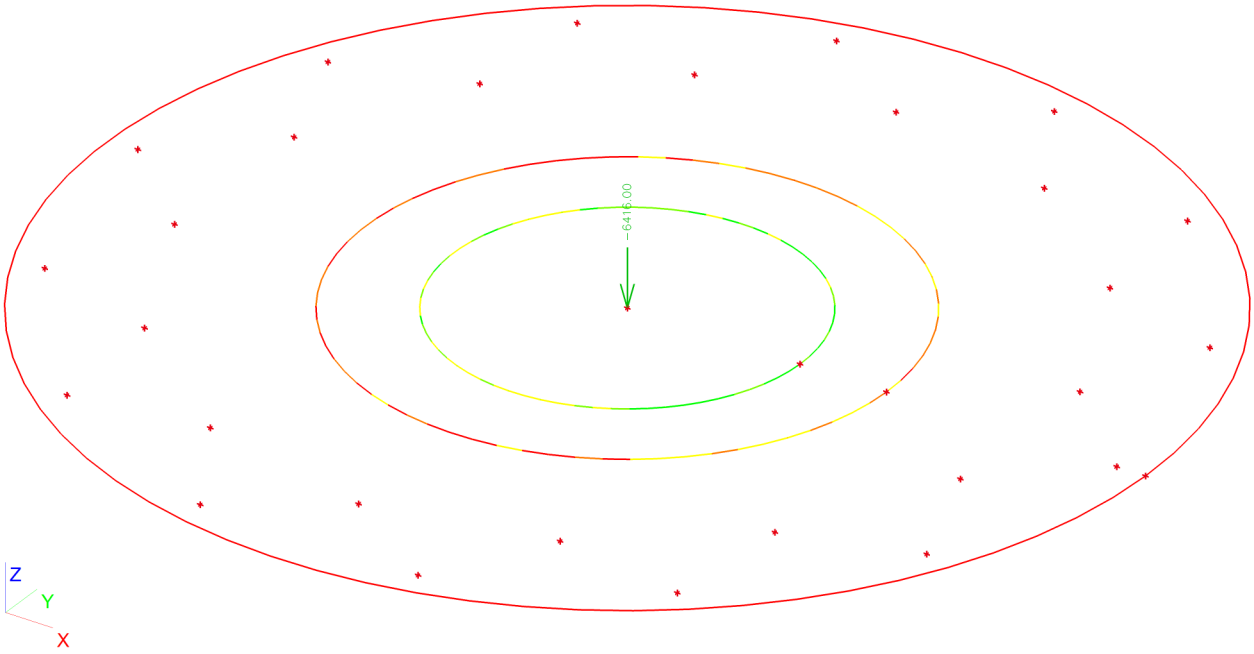
11. Momenten in knopen

Naam	Knoop	Belastingsgeval	Systeem	Rich	Type	Waarde - M [kNm]
M1	K1	BG5 - UGT M	GCS	My	Moment	106061.00
M2	K1	BG8 - BGT M	GCS	My	Moment	64000.00
M3	K1	BG11 - Vermoeiing M	GCS	My	Moment	30149.00

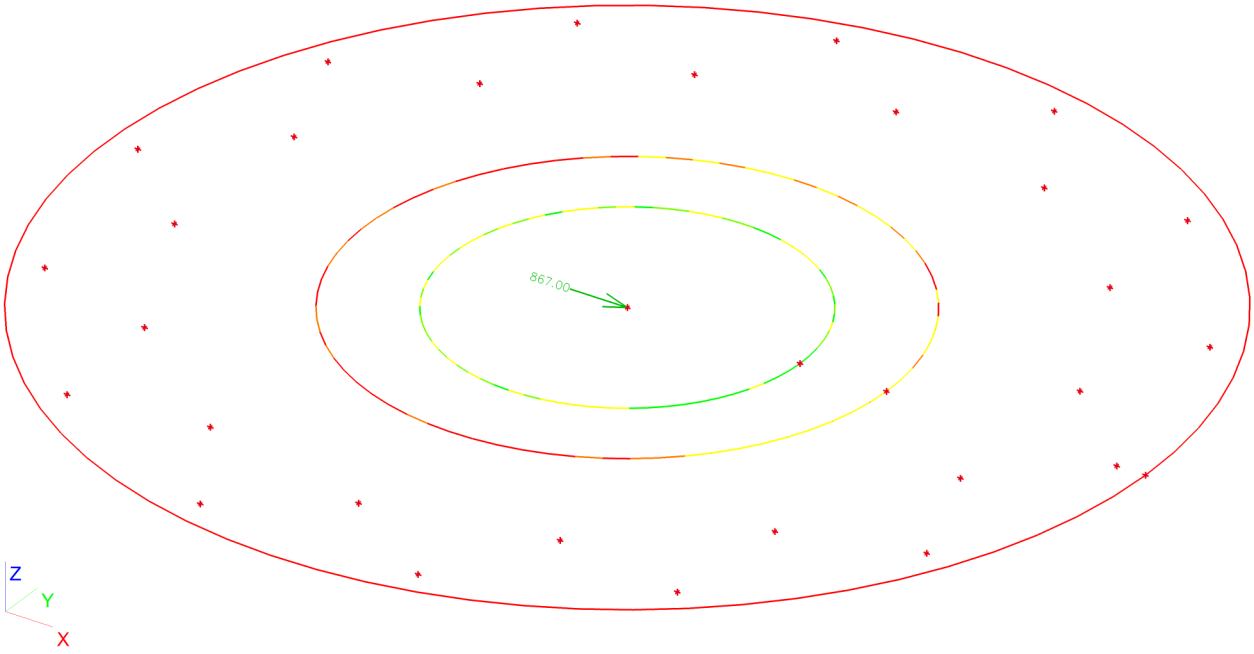
12. Belastingsgevallen

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Richting
BG1		Permanent	LG1	Eigen gewicht	-Z
BG2	EG BTG	Permanent	LG1	Standaard	
BG3	UGT Fvert	Permanent	LG1	Standaard	
BG4	UGT Fhor	Permanent	LG1	Standaard	
BG5	UGT M	Permanent	LG1	Standaard	
BG6	BGT Fvert	Permanent	LG1	Standaard	
BG7	BGT Fhor	Permanent	LG1	Standaard	
BG8	BGT M	Permanent	LG1	Standaard	
BG9	Vermoeiing Fvert	Permanent	LG1	Standaard	
BG10	Vermoeiing Fhor	Permanent	LG1	Standaard	
BG11	Vermoeiing M	Permanent	LG1	Standaard	
BG12	Fcorr UGT1	Permanent	LG1	Standaard	

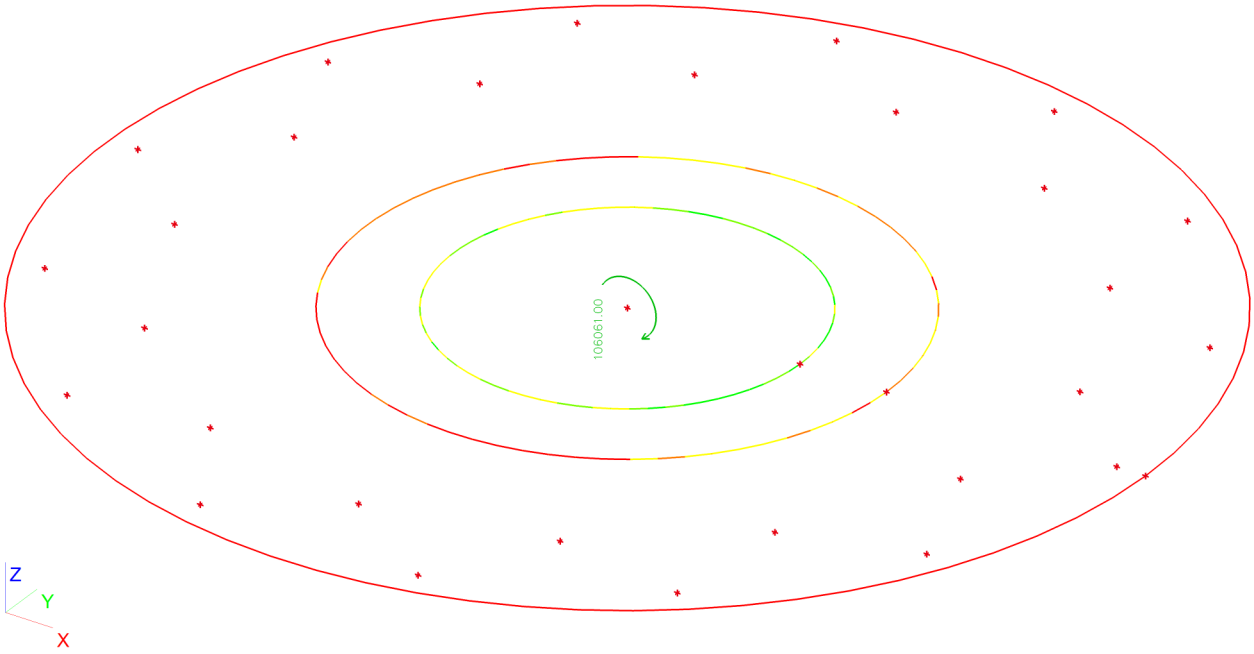
13. BG3 / Totale waarde UGT Fvert



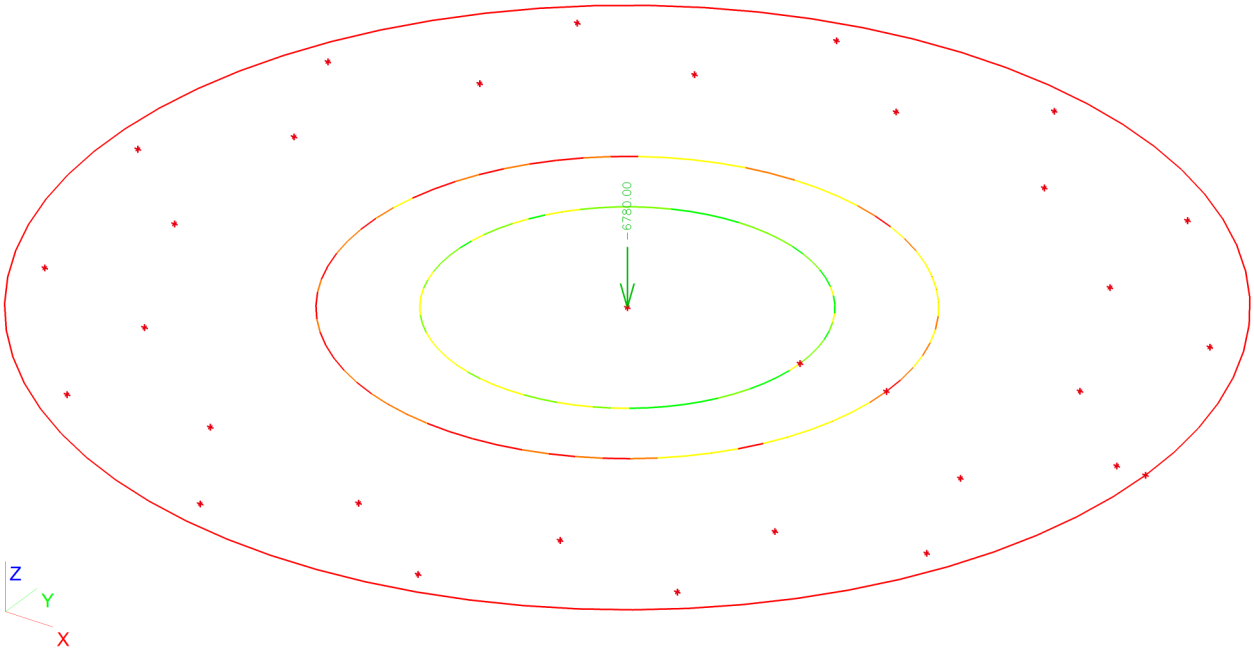
14. BG4 / Totale waarde UGT Fhor



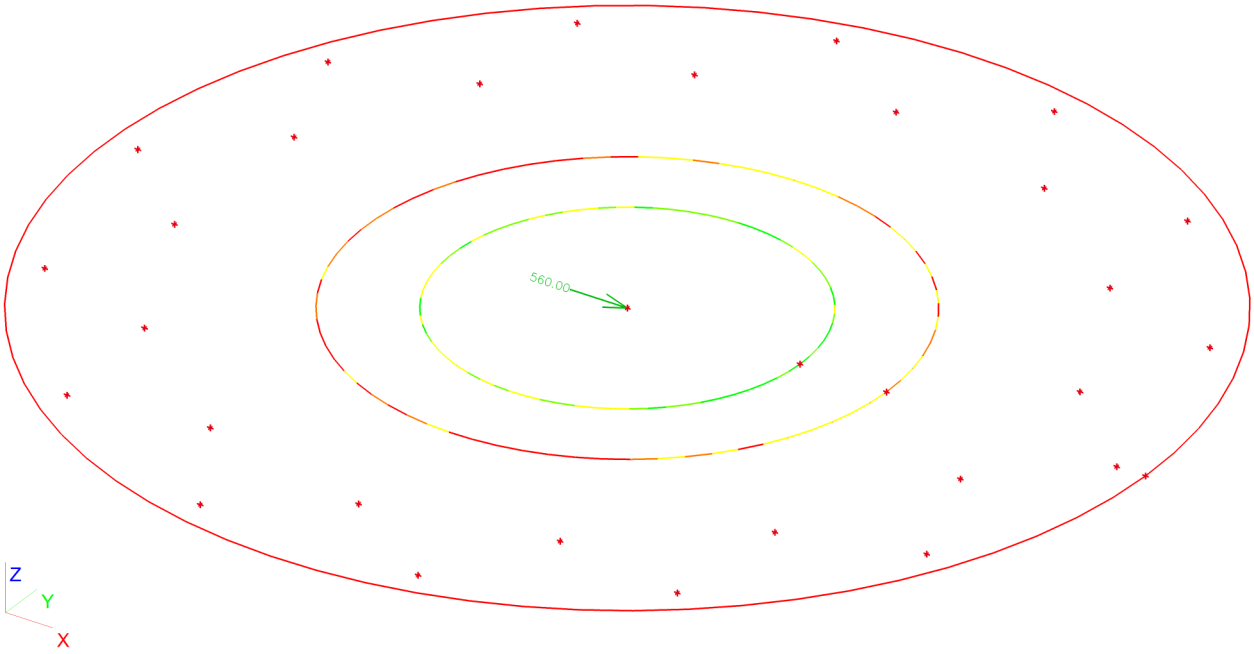
15. BG5 / Totale waarde UGT M



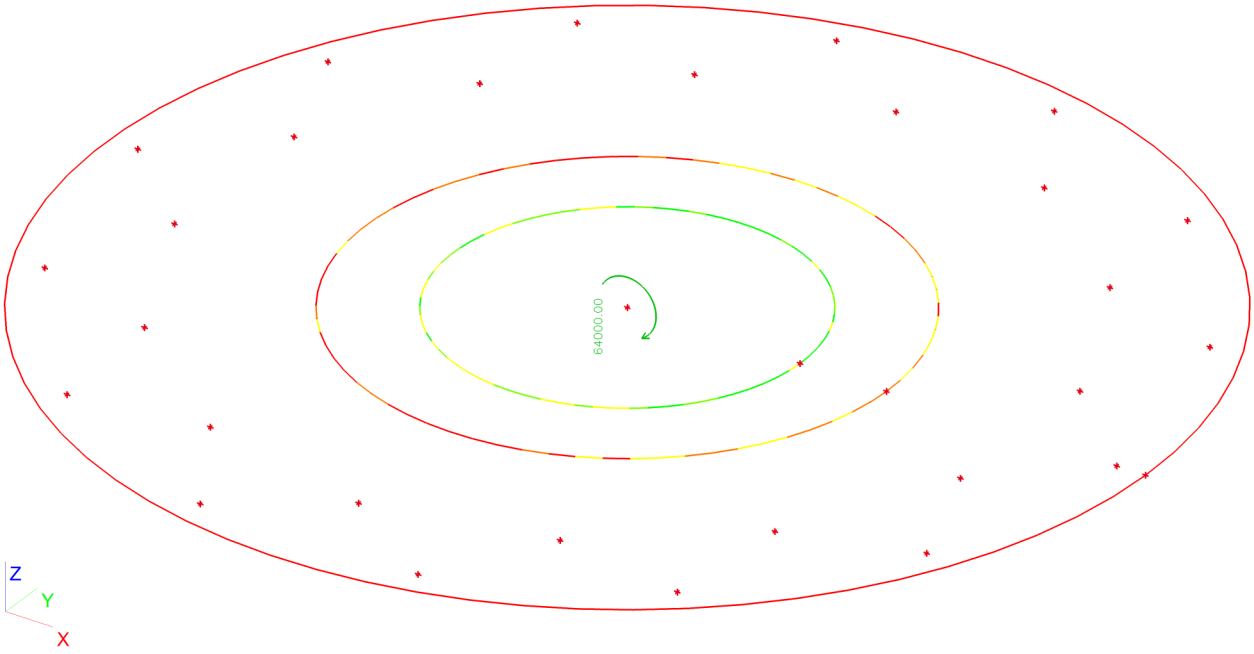
16. BG6 / Totale waarde BGT Fvert



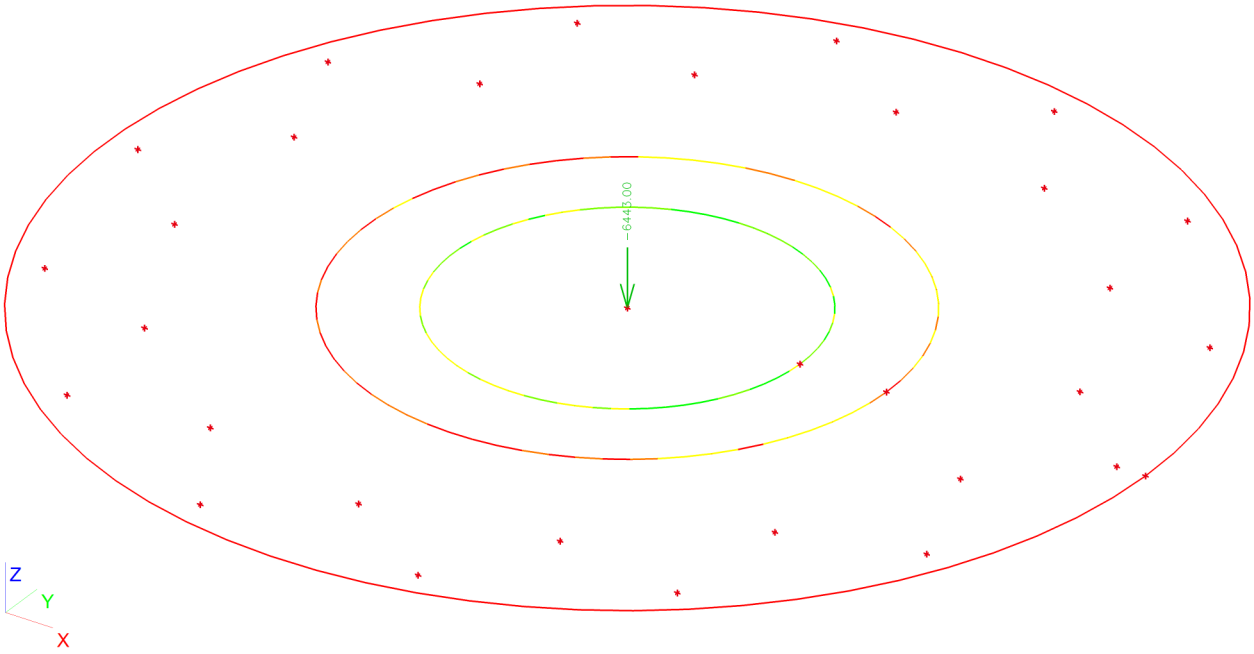
17. BG7 / Totale waarde BGT Fhor



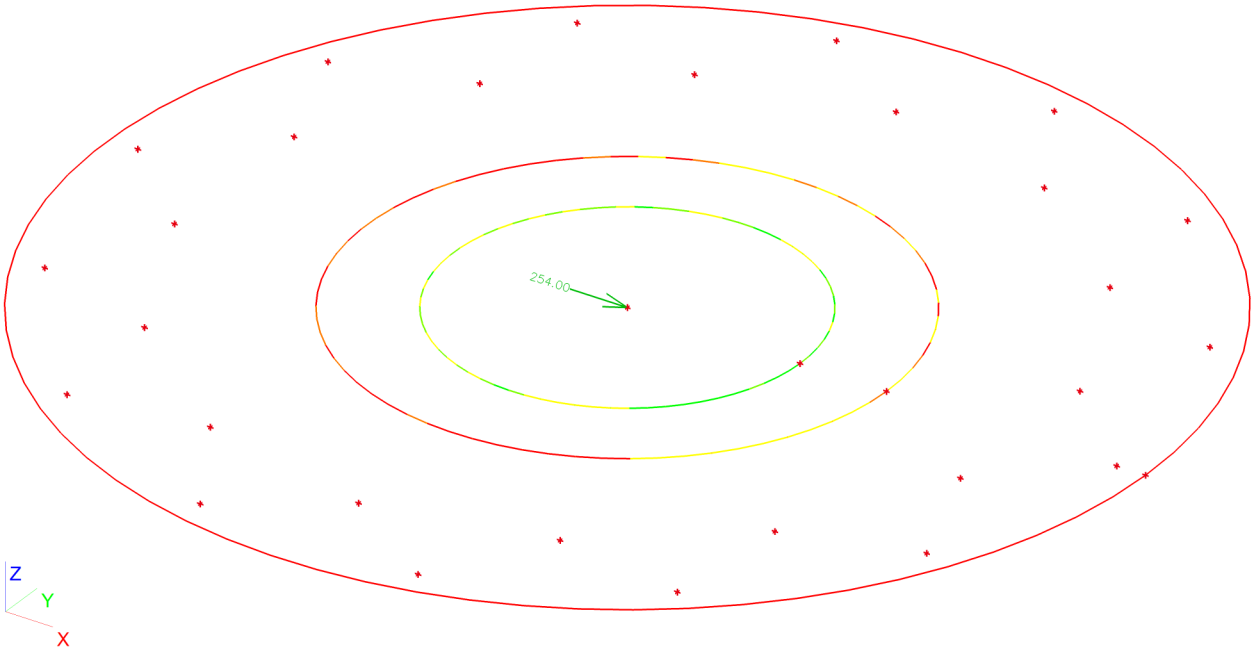
18. BG8 / Totale waarde BGT M



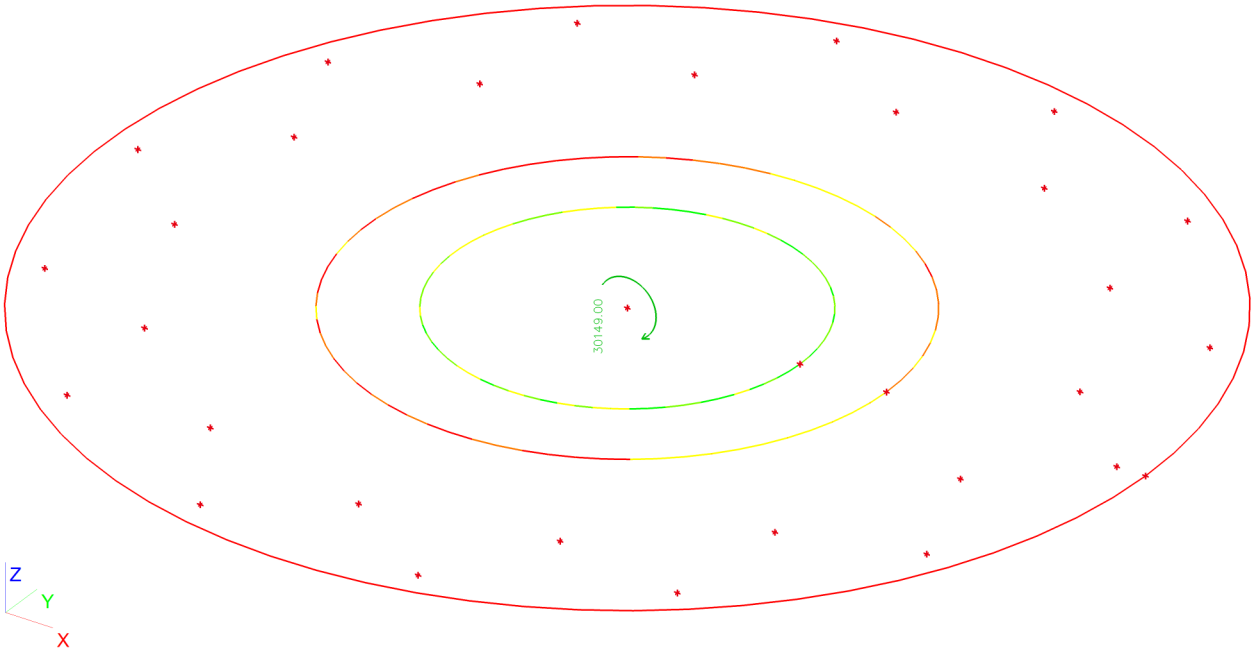
19. BG9 / Totale waarde Verm. Fvert



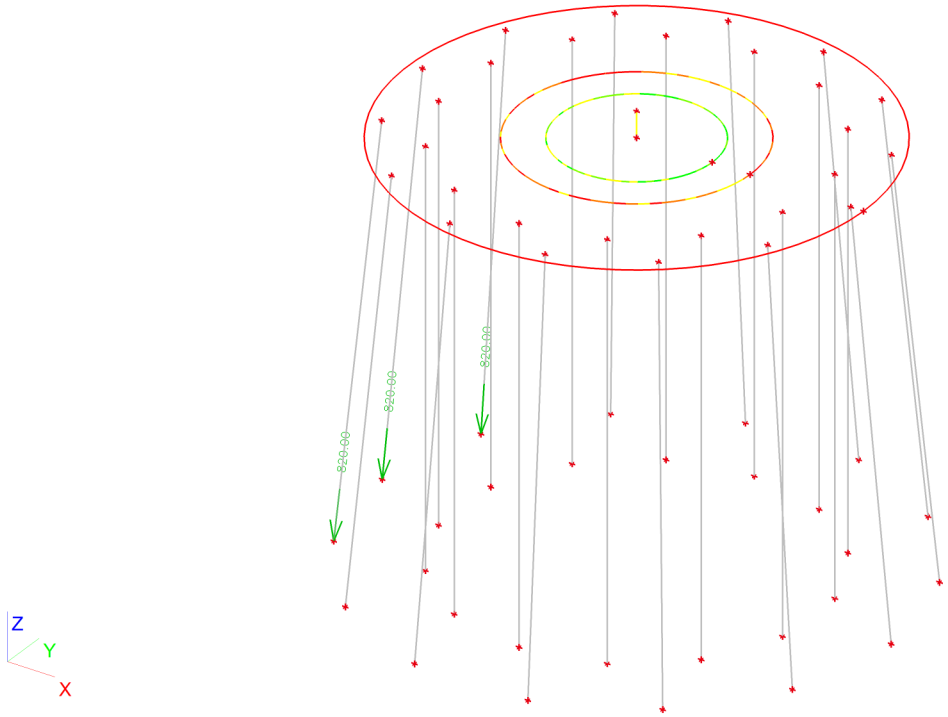
20. BG10 / Totale waarde Verm. Fhor



21. BG11 / Totale waarde Verm. M



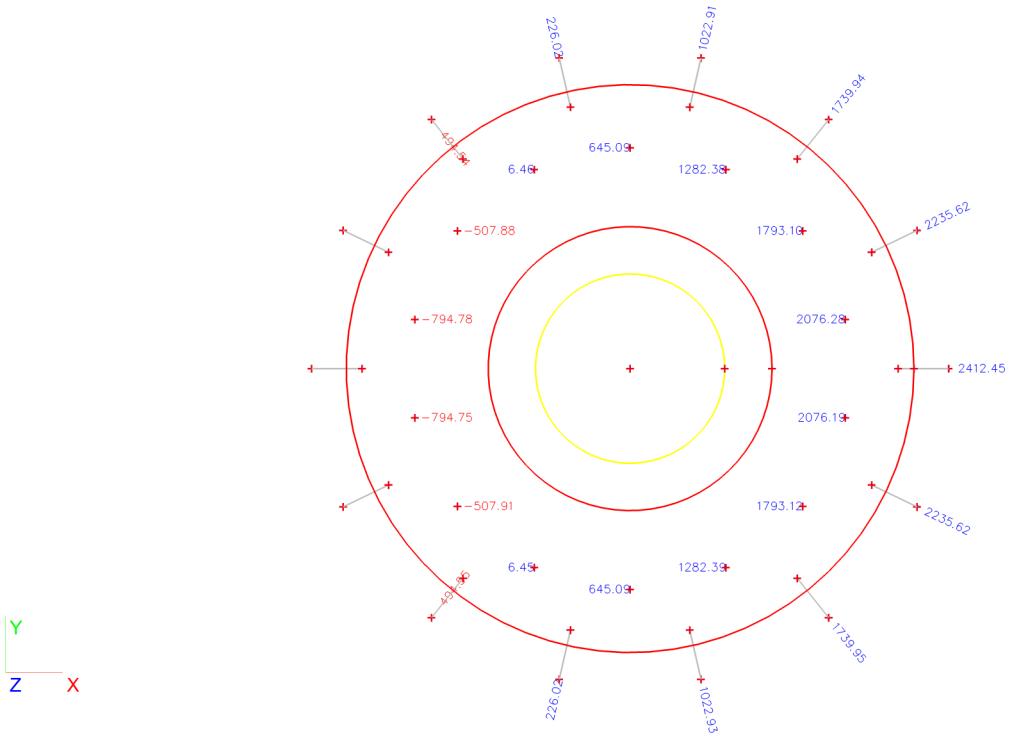
22. BG12 / Totale waarde - Correctie tbv max. Trekcapaciteit Palen



23. Combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
UGT1	Lineair - UGT	BG2 - EG BTG	0.90
		BG3 - UGT Fvert	0.90
		BG4 - UGT Fhor	1.65
		BG5 - UGT M	1.65
		BG12 - Fcorr UGT1	1.00
UGT2	Lineair - UGT	BG2 - EG BTG	1.50
		BG3 - UGT Fvert	1.50
		BG4 - UGT Fhor	1.65
		BG5 - UGT M	1.65
BGT1	Lineair - BGT	BG2 - EG BTG	1.00
		BG6 - BGT Fvert	1.00
		BG7 - BGT Fhor	1.00
		BG8 - BGT M	1.00
Vermoeiing	Lineair - BGT	BG2 - EG BTG	1.00
		BG9 - Vermoeiing Fvert	1.00
		BG10 - Vermoeiing Fhor	1.00
		BG11 - Vermoeiing M	1.00

24. UGT1 Reacties; Rz

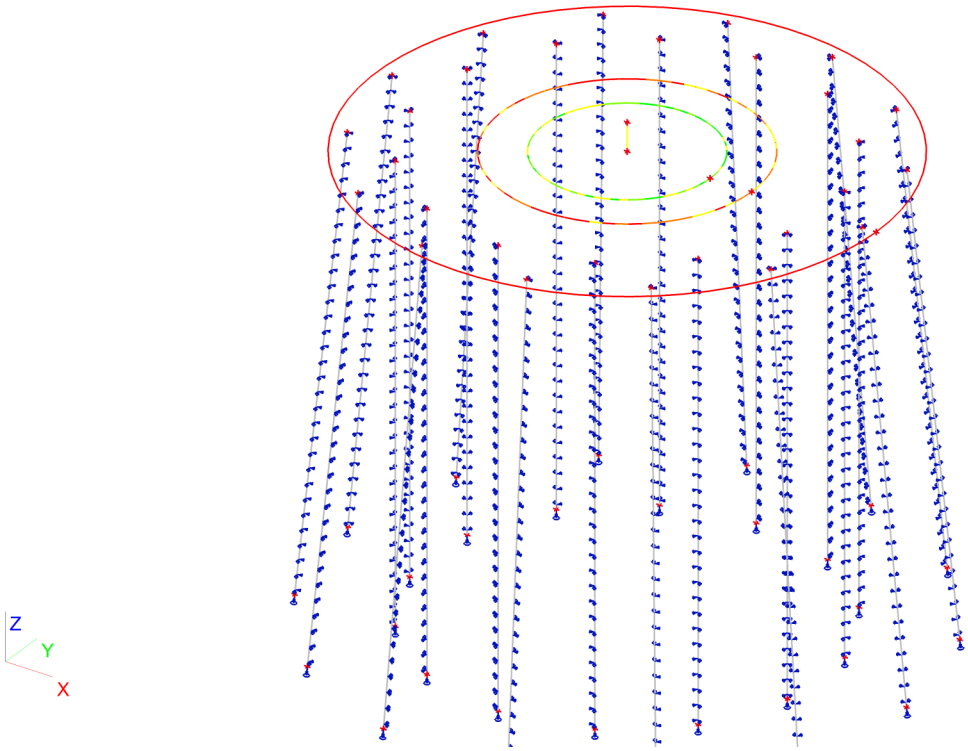


Bijlage IVc

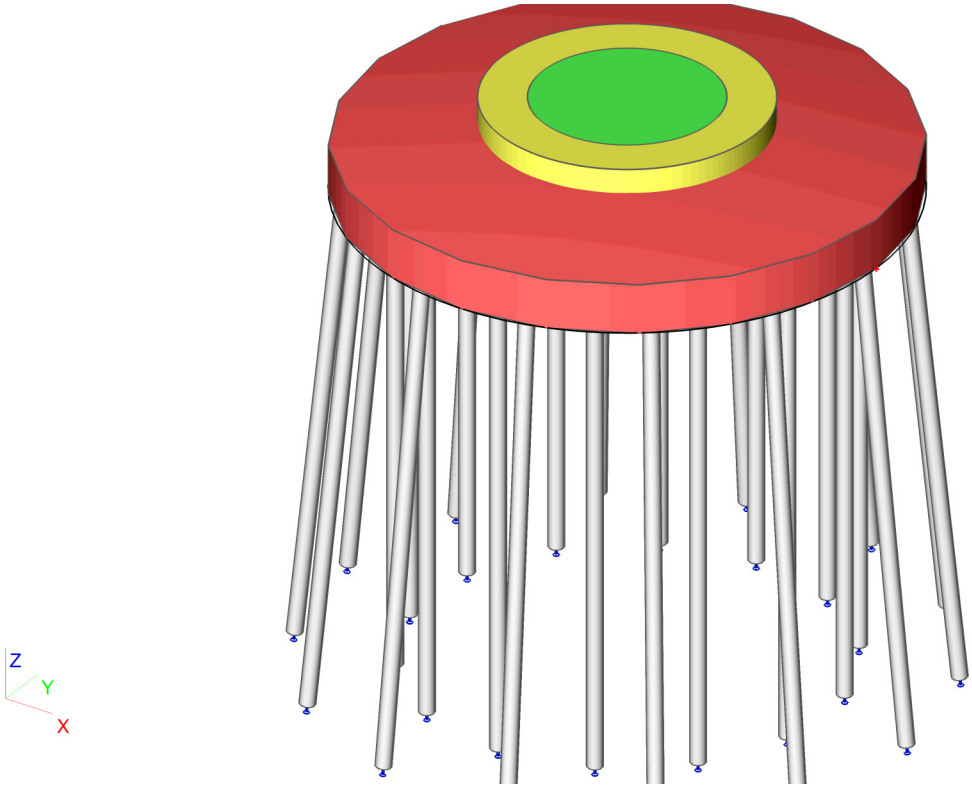
Resultaten vervormingen BGT combinaties

1. Inhoudsopgave

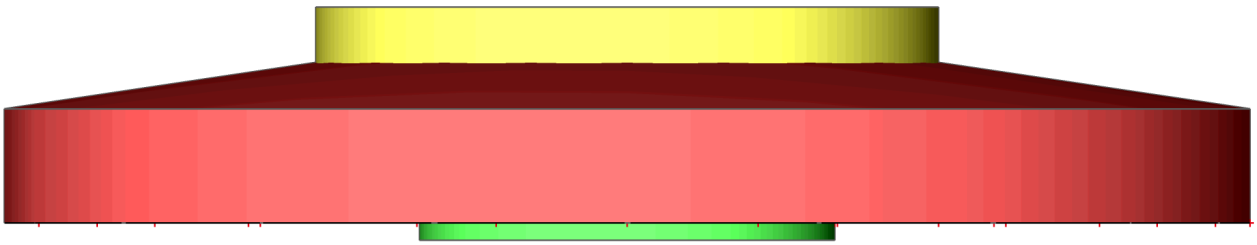
2. Rekenmodel



3. Rekenmodel



4. Rekenmodel



5. 2D-element

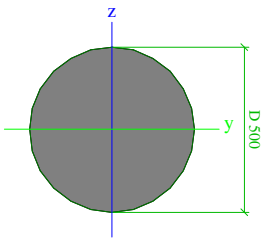
Naam	Materiaal	Dikte buitenzijde [mm]	Dikte type	Type	Laag
E2	C30/37	2990 1650	variabel	vloer (90)	Buitende
E3	C30/37	3120	konstant	vloer (90)	Binnen1
E4	C30/37	3370	konstant	vloer (90)	Binnen2

6. Opening

Naam	2D-element
Sparing1	E2
Sparing2	E3

7. Doorsneden

Naam	CS1	
Type	Cirkel	
Uitgebreid	500	
Onderdeelmateriaal	C30/37	
Bouwwijze	beton	
Knik y-y, z-z	b	b
EEM berekening	×	



A [m²]	1.9631e-01	
A y, z [m²]	1.6686e-01	1.6686e-01
I y, z [m⁴]	3.0667e-03	3.0667e-03
I w [m⁶], t [m⁴]	0.0000e+00	6.1334e-03
Wel y, z [m³]	1.2267e-02	1.2267e-02
Wpl y, z [m³]	2.0827e-02	2.0827e-02
d y, z [mm]	0	0
c YLCS, ZLCS [mm]	0	0
alpha [deg]	0.00	
AL [m²/m]	1.5707e+00	

8. Ondersteuningen op staaf

Naam	Type	Coör Systeem	Pos x Oors	Herh (n)	X	Stijfheid X [MN/m]	Y	Z	Rx	Ry	Rz
Sb16	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb18	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb21	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb22	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb23	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb24	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb25	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb26	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb27	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij

Naam	Type	Coör Systeem	Pos x Oors	Herh (n)	X	Stijfheid X [MN/m]	Y	Z	Rx	Ry	Rz
Sb28	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb29	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb30	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb31	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb32	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb33	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb35	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb38	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb39	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb40	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb41	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb46	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb47	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb48	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb49	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb50	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb51	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb52	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij
Sb53	Standaard	Rela LCS	0.000 Vanaf begin	1	Verend	1.9000e+02	Vrij	Vrij	Vrij	Vrij	Vrij

9. Lijnondersteuning op staaf

Naam	Staaf Systeem	Pos x_1 Pos x_2	Coör Oors	X	Y	Stijfheid Y [MN/m²]	Z	Stijfheid Z [MN/m²]	Rx	Ry	Rz
Slb24	S17 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb26	S19 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb29	S22 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb30	S23 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb31	S24 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb32	S25 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb33	S26 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb34	S27 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb35	S28 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb36	S29 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij

Naam	Staaf Systeem	Pos x_1 Pos x_2	Coör Oors	X	Y	Stijfheid Y [MN/m²]	Z	Stijfheid Z [MN/m²]	Rx	Ry	Rz
Slb37	S30 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb38	S31 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb39	S32 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb40	S33 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb41	S34 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb43	S36 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb46	S39 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb47	S40 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb48	S41 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb49	S42 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb50	S43 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb52	S45 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb53	S46 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb54	S47 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb55	S48 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb56	S49 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb57	S50 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij
Slb58	S51 LCS	0.010 1.000	Rela Vanaf begin	Vrij	Verend	5.0000e+00	Verend	5.0000e+00	Vrij	Vrij	Vrij

10. Puntlasten in knopen

Naam	Knoop	Belastingsgeval	Systeem	Rich	Type	Waarde - F [kN]
Puntlast2	K1	BG3 - UGT Fvert	GCS	Z	Kracht	-6416.00
Puntlast3	K1	BG4 - UGT Fhor	GCS	X	Kracht	867.00
Puntlast4	K1	BG6 - BGT Fvert	GCS	Z	Kracht	-6780.00
Puntlast5	K1	BG7 - BGT Fhor	GCS	X	Kracht	560.00
Puntlast6	K1	BG9 - Vermoeiing Fvert	GCS	Z	Kracht	-6443.00
Puntlast7	K1	BG10 - Vermoeiing Fhor	GCS	X	Kracht	254.00
Puntlast8	K1	BG2 - EG BTG	GCS	Z	Kracht	-14000.00

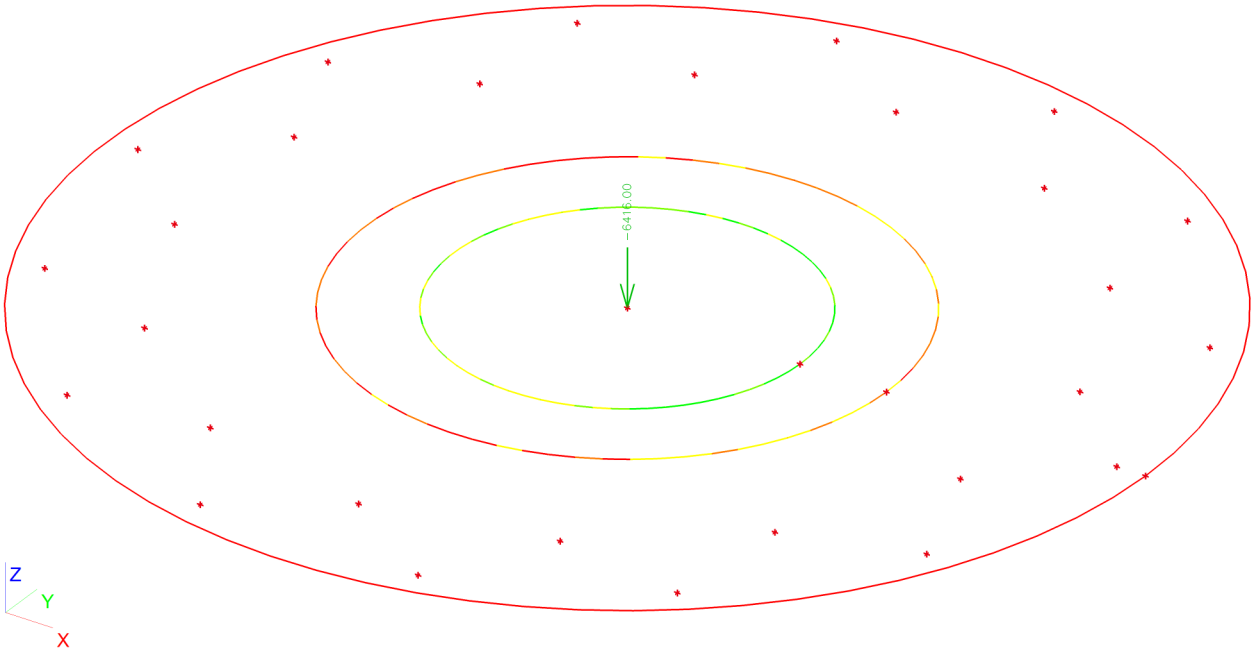
11. Momenten in knopen

Naam	Knoop	Belastingsgeval	Systeem	Rich	Type	Waarde - M [kNm]
M1	K1	BG5 - UGT M	GCS	My	Moment	106061.00
M2	K1	BG8 - BGT M	GCS	My	Moment	64000.00
M3	K1	BG11 - Vermoeiing M	GCS	My	Moment	30149.00

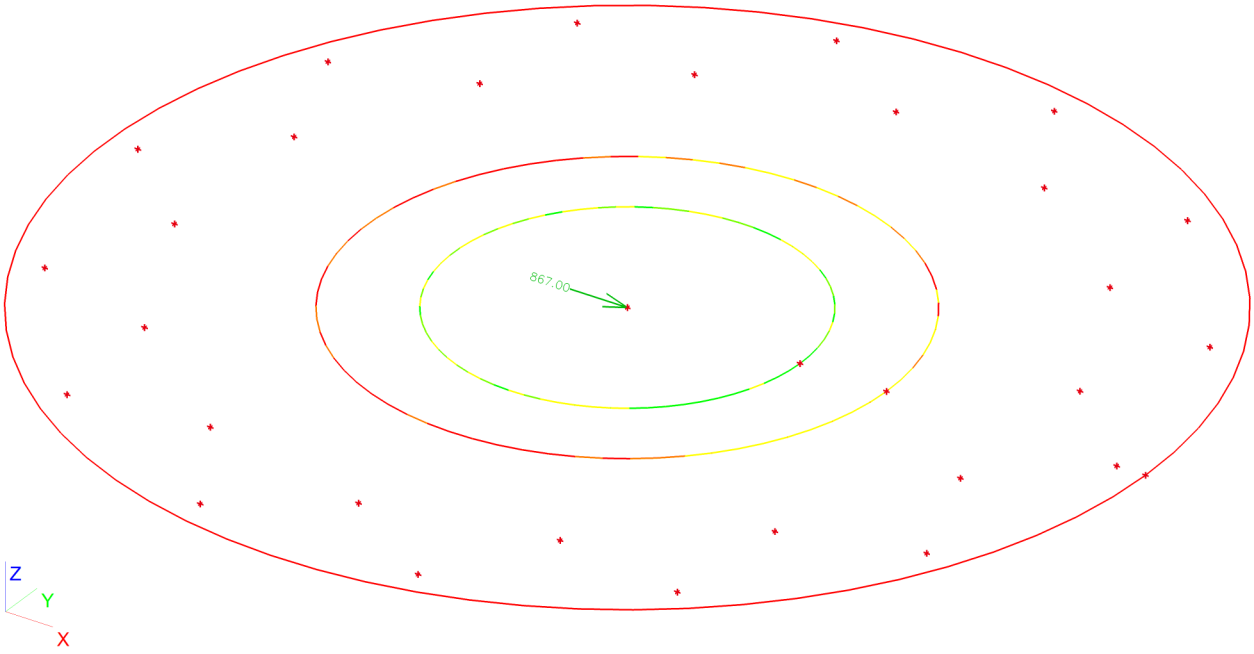
12. Belastingsgevallen

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Richting
BG1		Permanent	LG1	Eigen gewicht	-Z
BG2	EG BTG	Permanent	LG1	Standaard	
BG3	UGT Fvert	Permanent	LG1	Standaard	
BG4	UGT Fhor	Permanent	LG1	Standaard	
BG5	UGT M	Permanent	LG1	Standaard	
BG6	BGT Fvert	Permanent	LG1	Standaard	
BG7	BGT Fhor	Permanent	LG1	Standaard	
BG8	BGT M	Permanent	LG1	Standaard	
BG9	Vermoeiing Fvert	Permanent	LG1	Standaard	
BG10	Vermoeiing Fhor	Permanent	LG1	Standaard	
BG11	Vermoeiing M	Permanent	LG1	Standaard	
BG12	Fcorr UGT1	Permanent	LG1	Standaard	

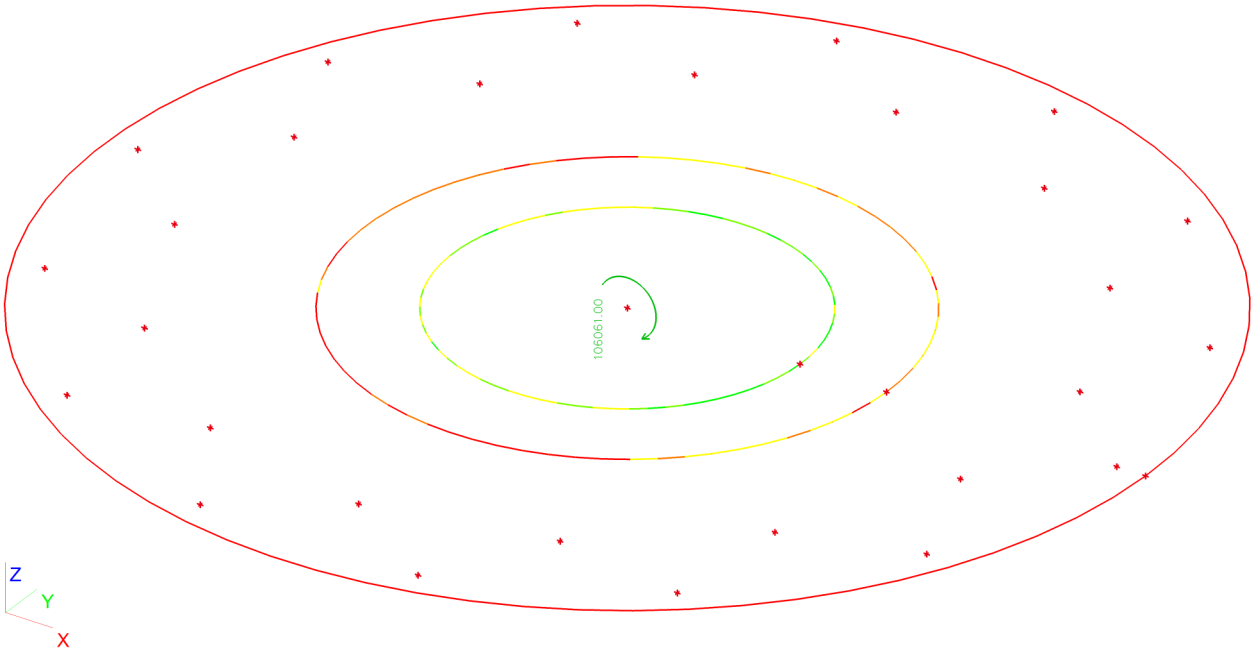
13. BG3 / Totale waarde UGT Fvert



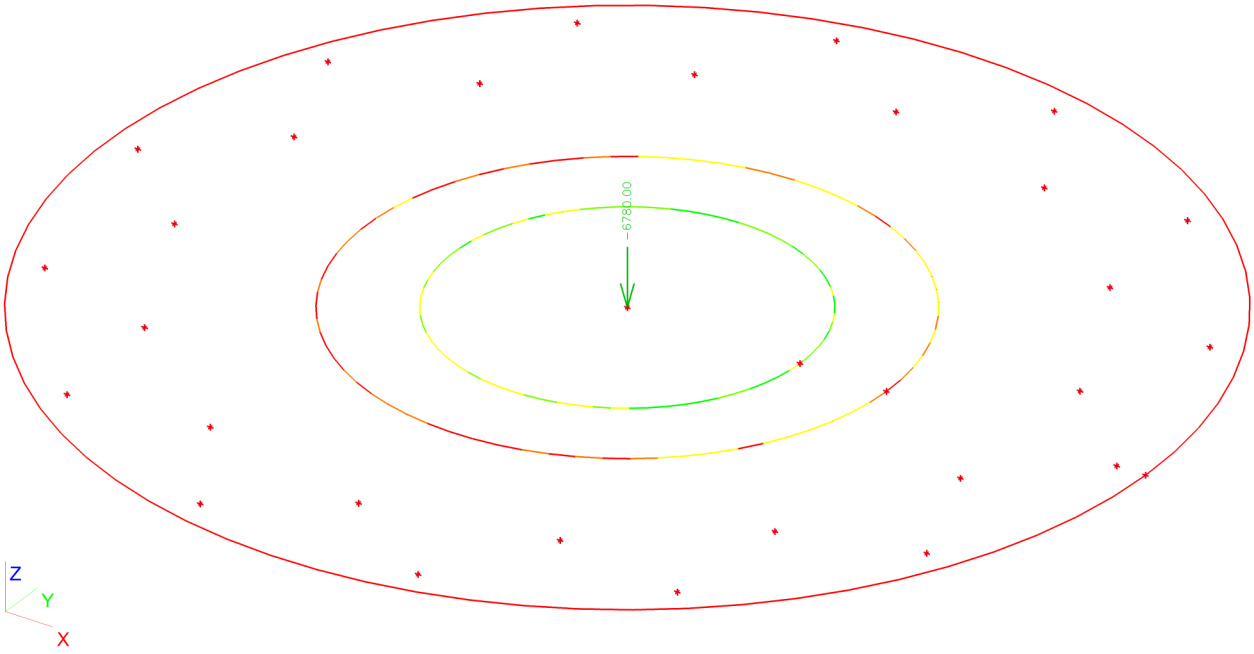
14. BG4 / Totale waarde UGT Fhor



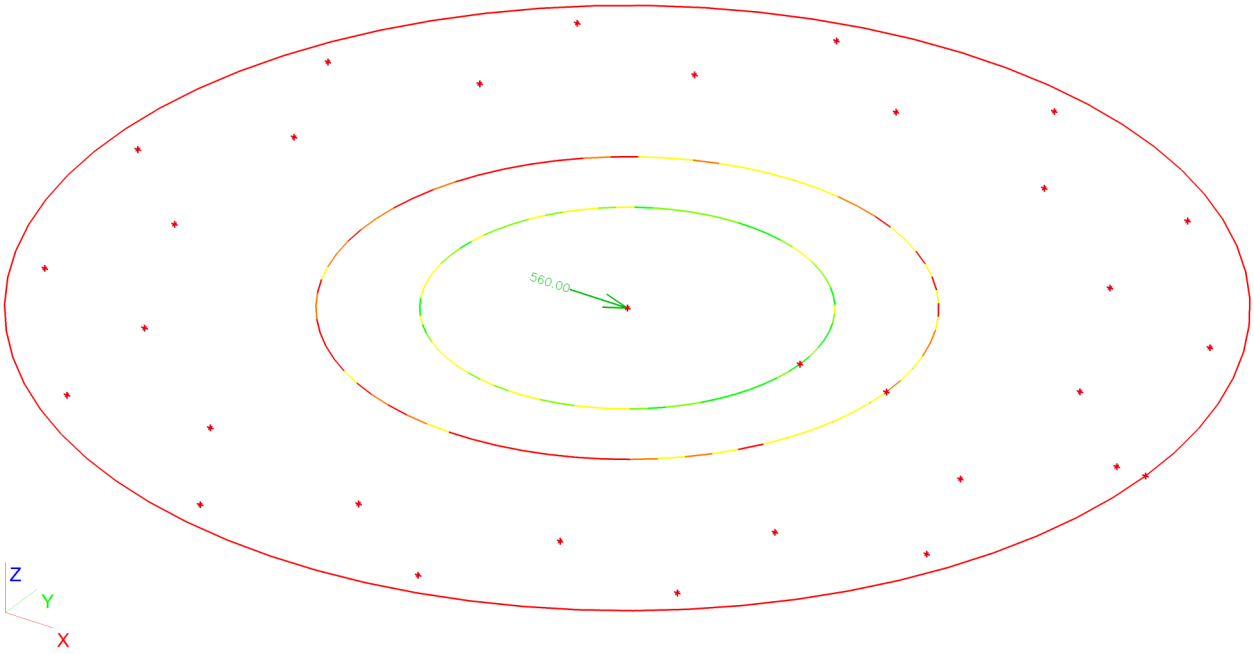
15. BG5 / Totale waarde UGT M



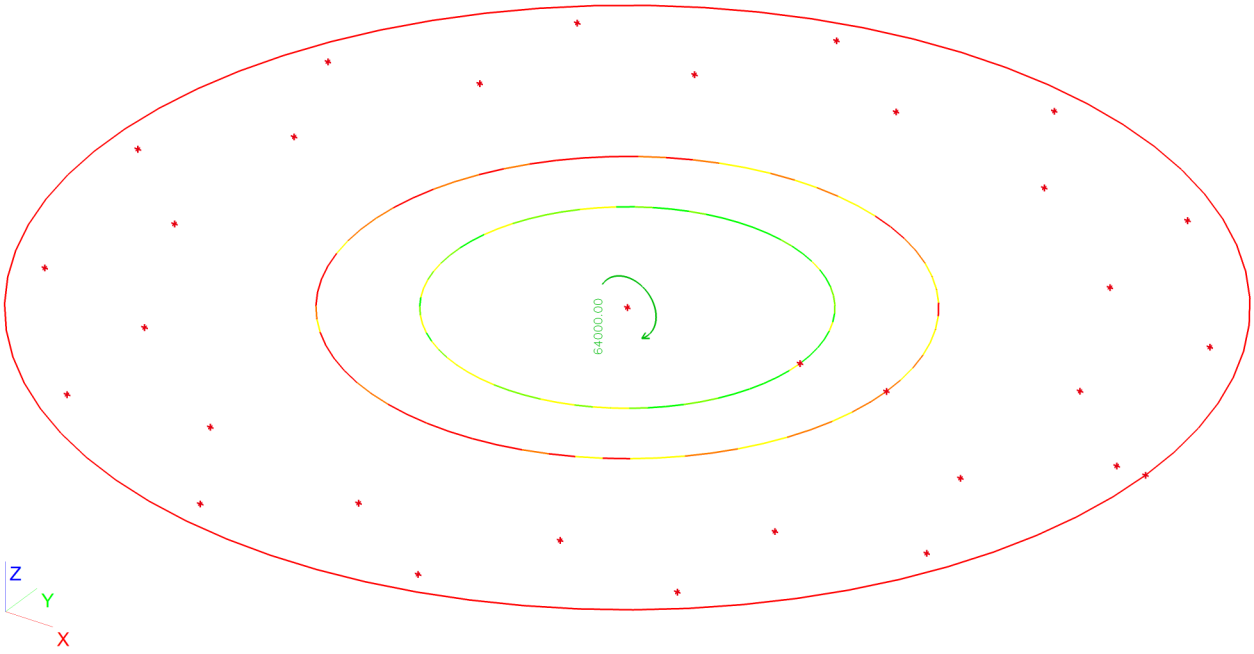
16. BG6 / Totale waarde BGT Fvert



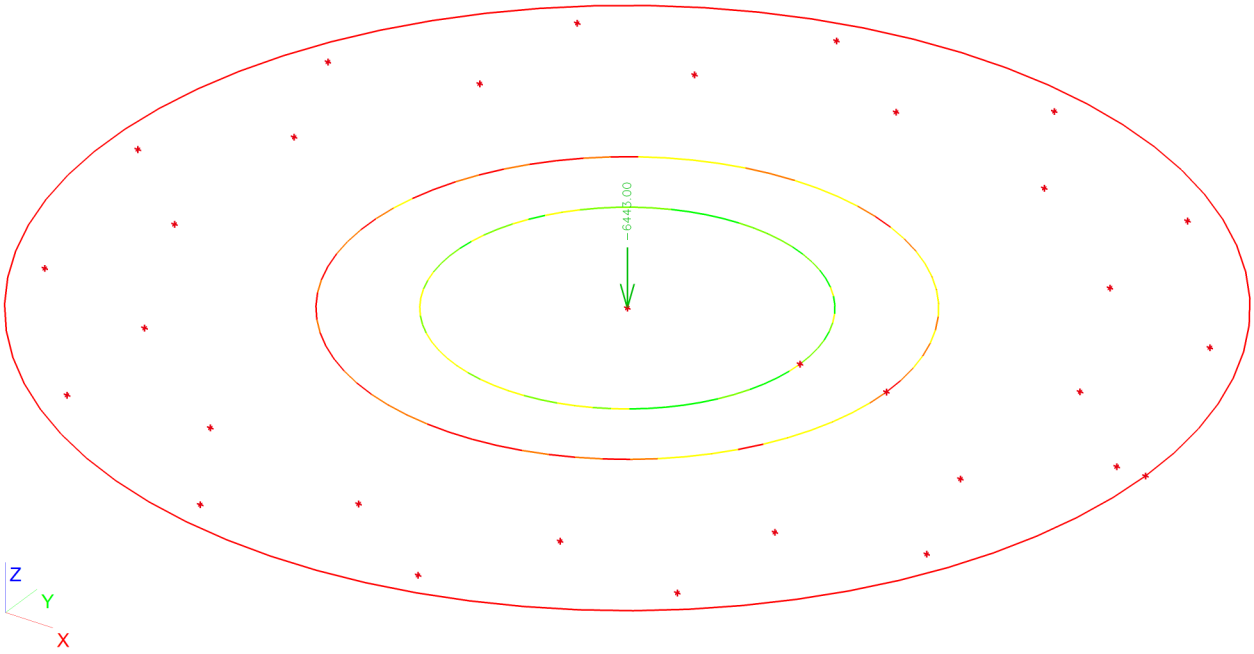
17. BG7 / Totale waarde BGT Fhor



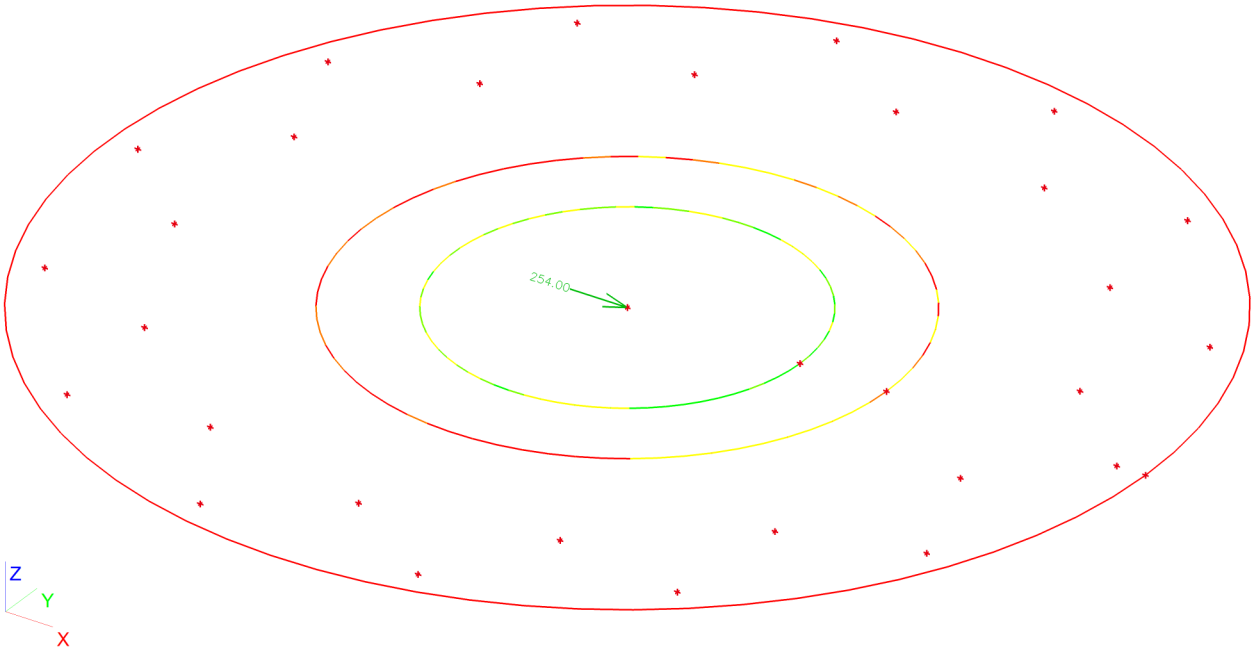
18. BG8 / Totale waarde BGT M



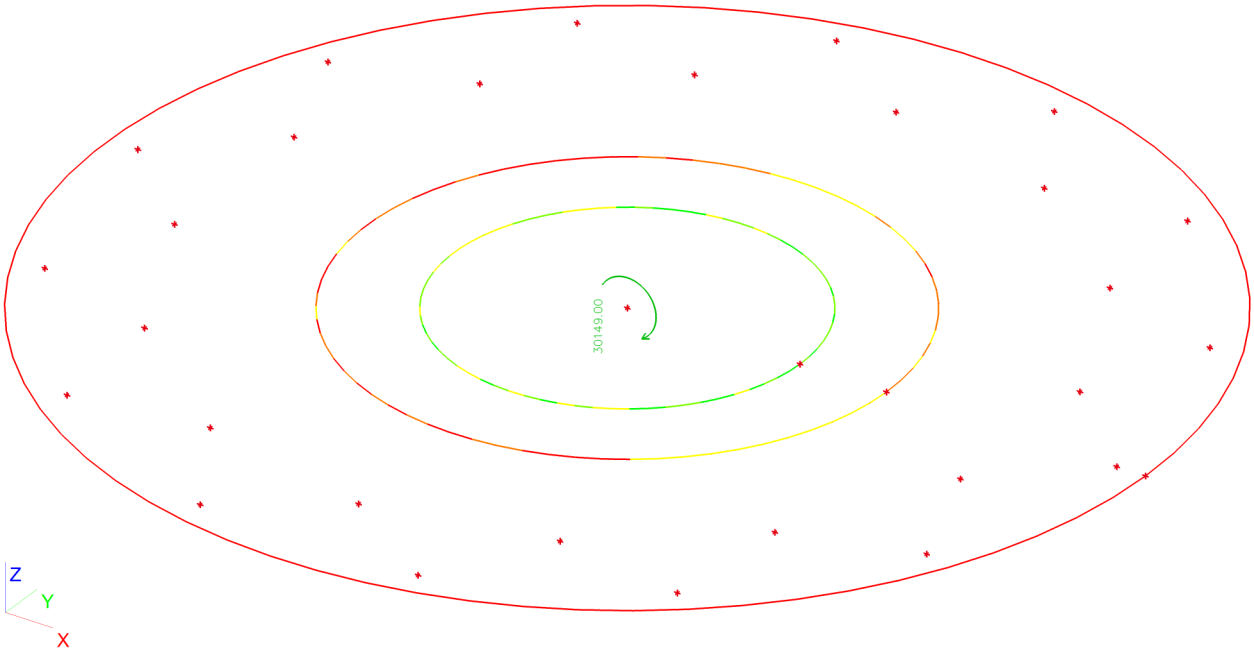
19. BG9 / Totale waarde Verm. Fvert



20. BG10 / Totale waarde Verm. Fhor



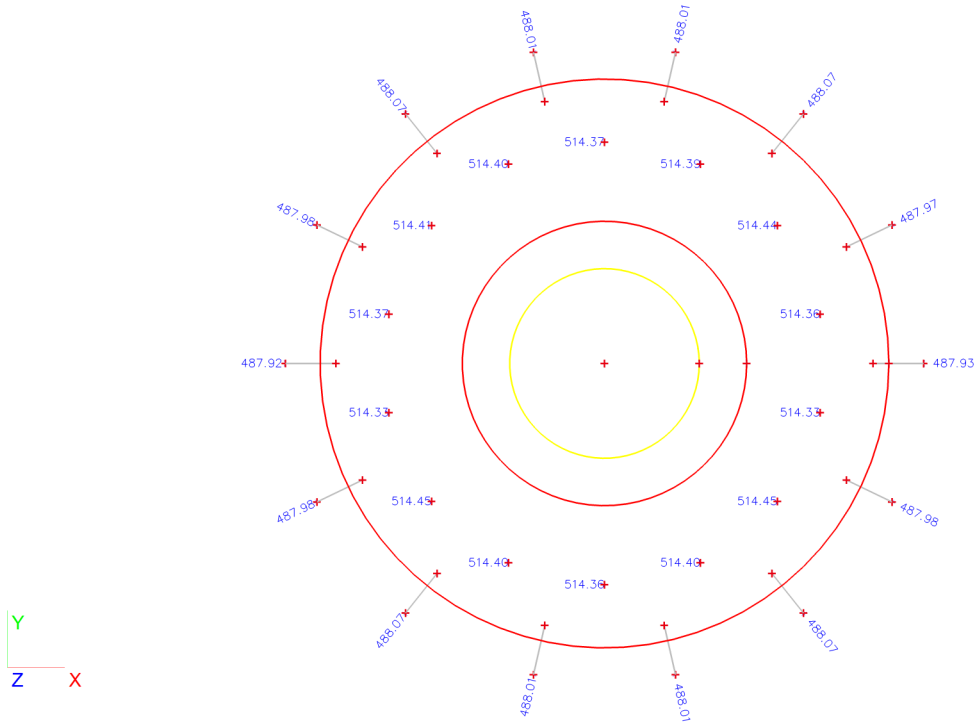
21. BG11 / Totale waarde Verm. M



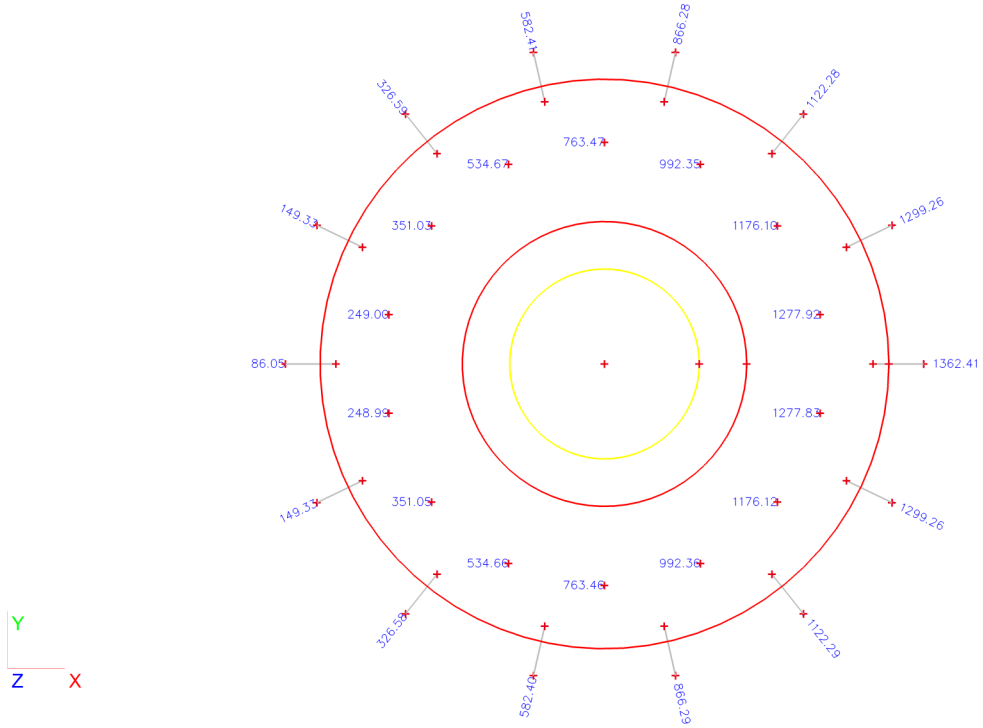
22. Combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
UGT1	Lineair - UGT	BG2 - EG BTG	0.90
		BG3 - UGT Fvert	0.90
		BG4 - UGT Fhor	1.65
		BG5 - UGT M	1.65
		BG12 - Fcorr UGT1	1.00
UGT2	Lineair - UGT	BG2 - EG BTG	1.50
		BG3 - UGT Fvert	1.50
		BG4 - UGT Fhor	1.65
		BG5 - UGT M	1.65
BGT1	Lineair - BGT	BG2 - EG BTG	1.00
		BG6 - BGT Fvert	1.00
		BG7 - BGT Fhor	1.00
		BG8 - BGT M	1.00
Vermoeiing	Lineair - BGT	BG2 - EG BTG	1.00
		BG9 - Vermoeiing Fvert	1.00
		BG10 - Vermoeiing Fhor	1.00
		BG11 - Vermoeiing M	1.00
BGT2	Lineair - BGT	BG2 - EG BTG	1.00
		BG6 - BGT Fvert	1.00
BGT3	Lineair - BGT	BG2 - EG BTG	1.00
		BG6 - BGT Fvert	1.00
		BG8 - BGT M	1.00

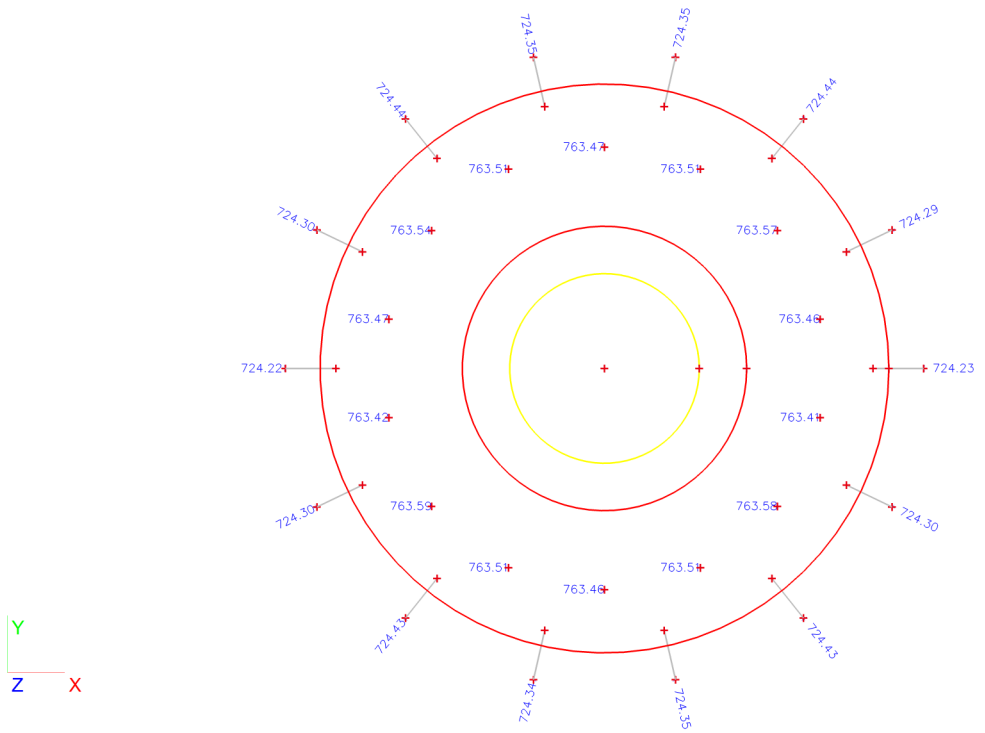
23. BG2 BTG Reacties; Rz



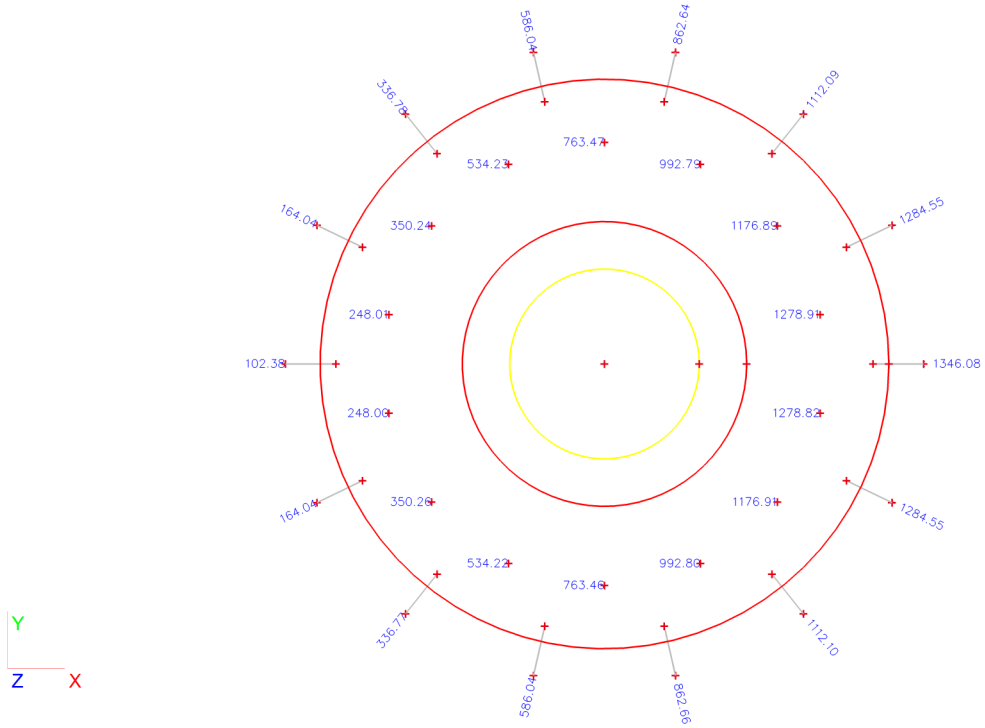
24. BGT1 Reacties; Rz



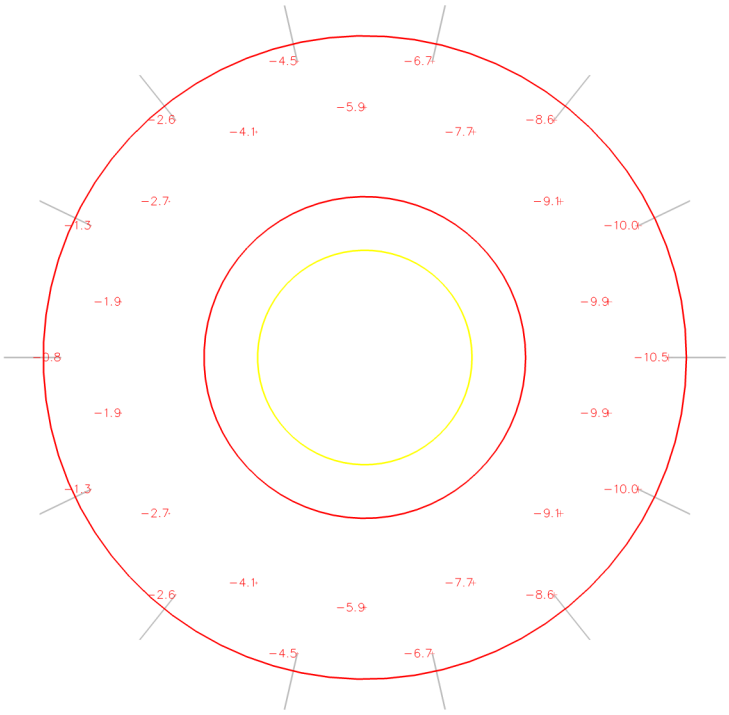
25. BGT2 Reacties; Rz



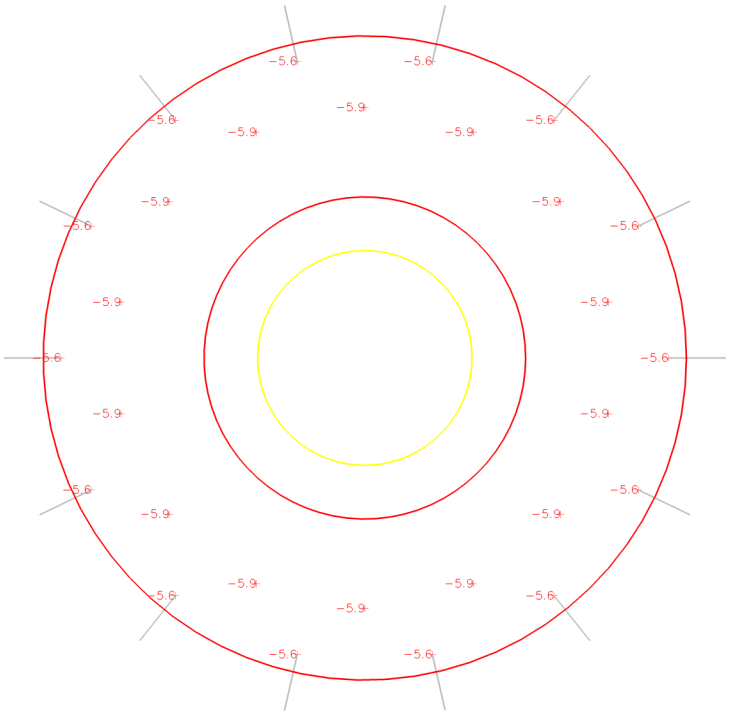
26. BGT3 Reacties; Rz



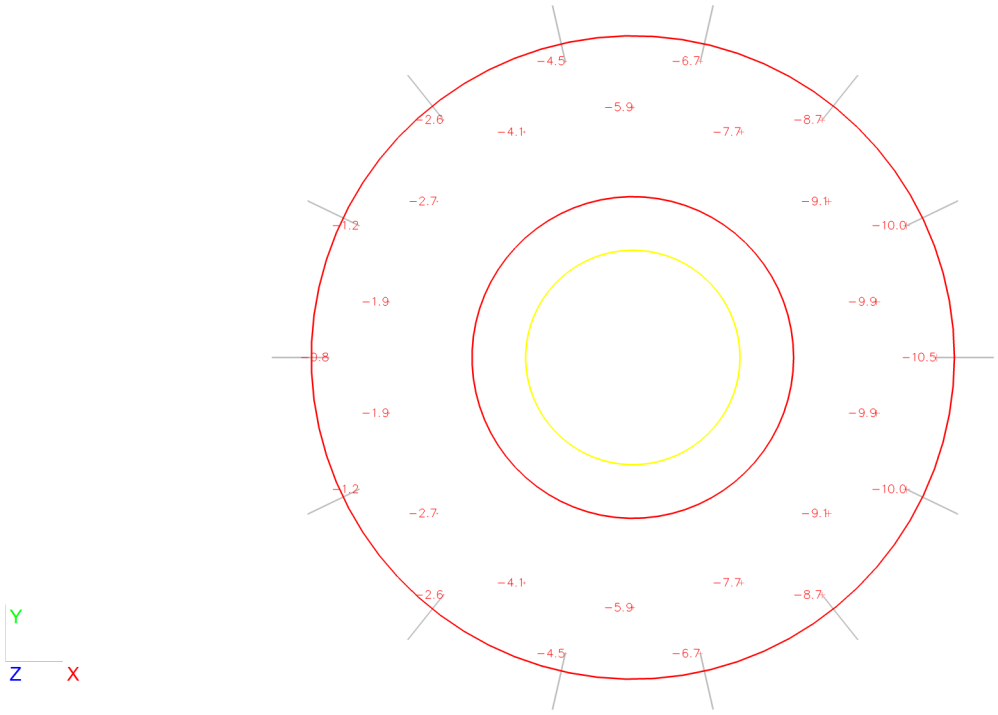
27. BGT1 Verplaatsing van knopen; Uz, Vervormde constructie, Vervormd net



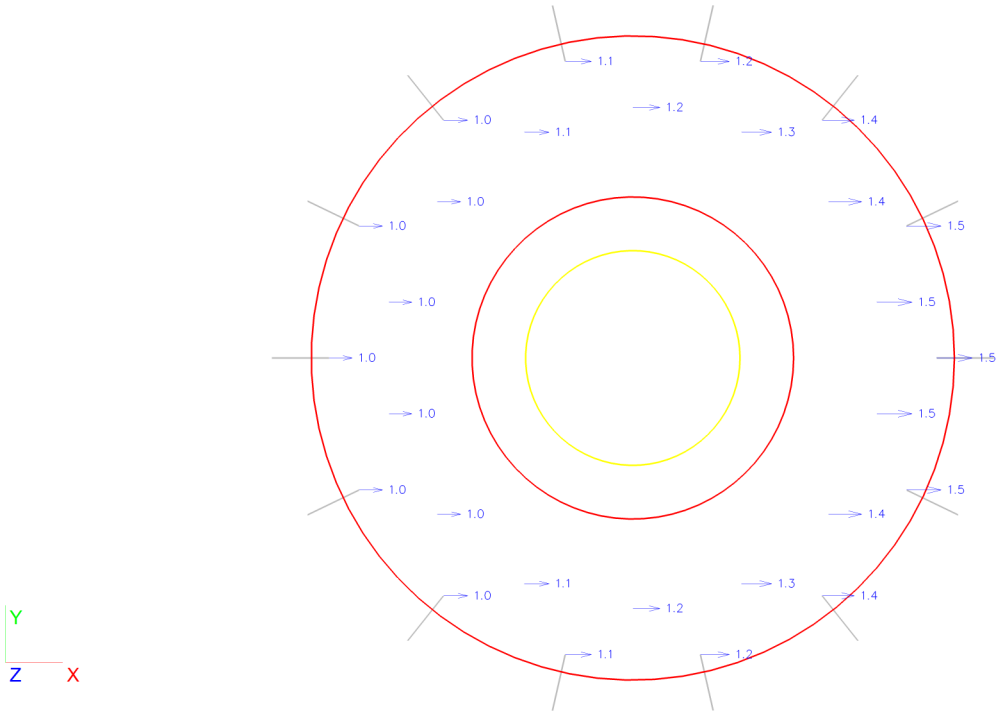
28. BGT2 Verplaatsing van knopen; Uz, Vervormde constructie, Vervormd net



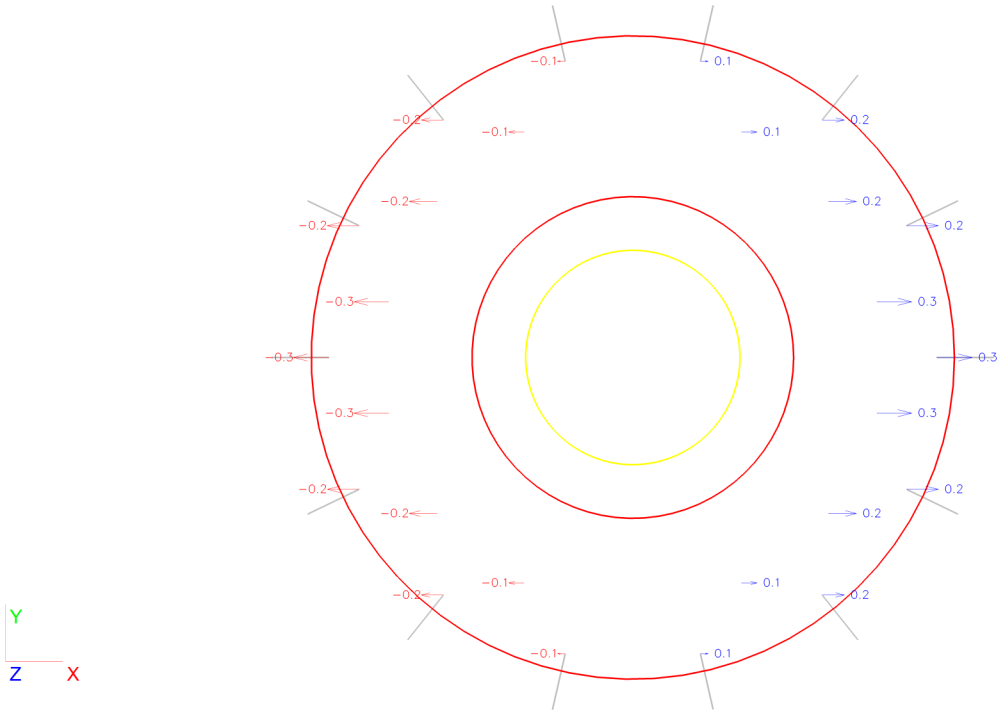
29. BGT3 Verplaatsing van knopen; Uz, Vervormde constructie, Vervormd net



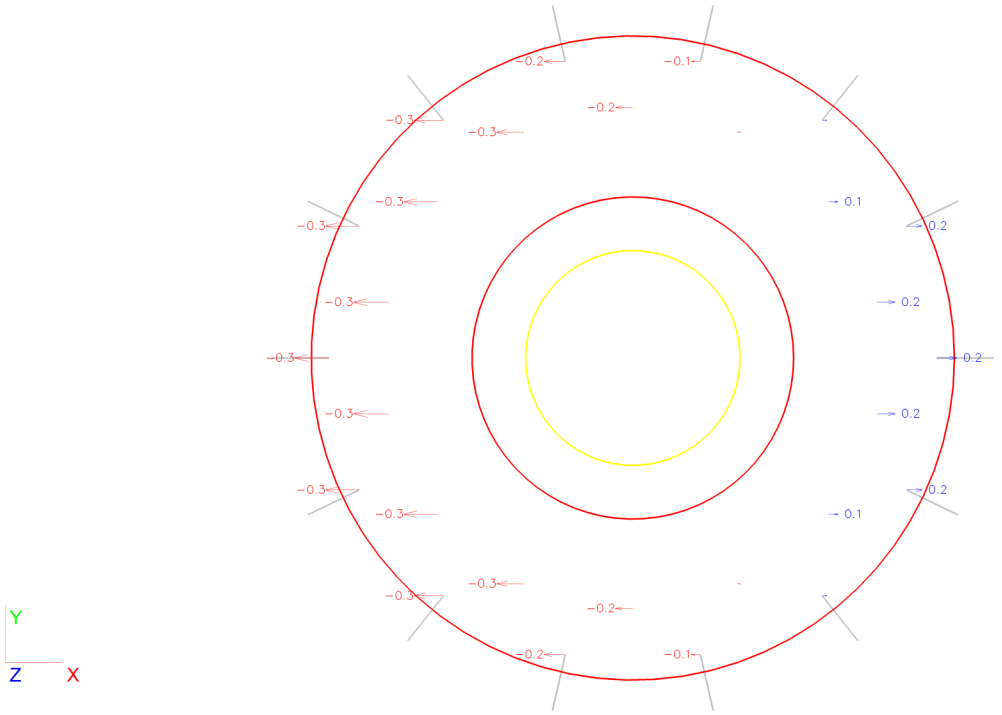
30. BGT1 Verplaatsing van knopen; Ux, Vervormde constructie, Vervormd net



31. BGT2 Verplaatsing van knopen; Ux, Vervormde constructie, Vervormd net



32. BGT3 Verplaatsing van knopen; Ux, Vervormde constructie, Vervormd net



Bijlage V

Resultaten funderingsanalyse windturbine

Bijlage Va

Resultaten geotechnisch drukdraagvermogen

Report for D-Foundations 16.1

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

Company:	Deltares
Date of report:	26-8-2016
Time of report:	12:05:01
Date of calculation:	26-8-2016
Time of calculation:	12:03:50
Filename:	\..\20160715- 1438\WTG2 druk 28 palen 2 ringen (2642)
Project identification:	Eneco Windpark Spuisluis te IJmuiden Turbinefundering D-Foundations WTG2 druk 28 palen 2 ringen (2642)

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 :	Eneco Windpark Spuisluis te IJmuiden
Title 2 :	Turbinefundering
Title 3 :	D-Foundations WTG2 druk 28 palen 2 ringen (2642)
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.

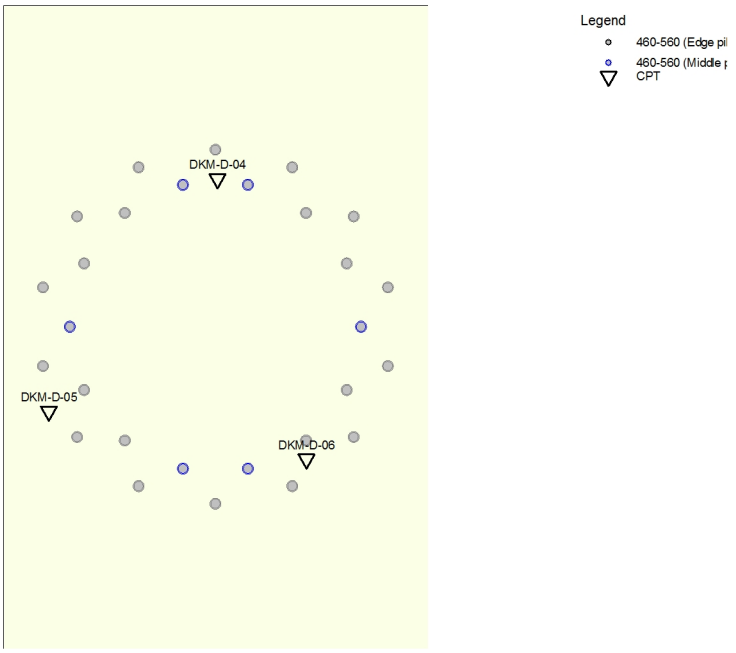
2.4 Superstructure

Rigidity of the superstructure :	Rigid

2.5 General CPT Data

Number of CPT's :	3
Timing of CPT's :	CPT - Excavation - Install

2.5.1 View of CPT's in Foundation Plan



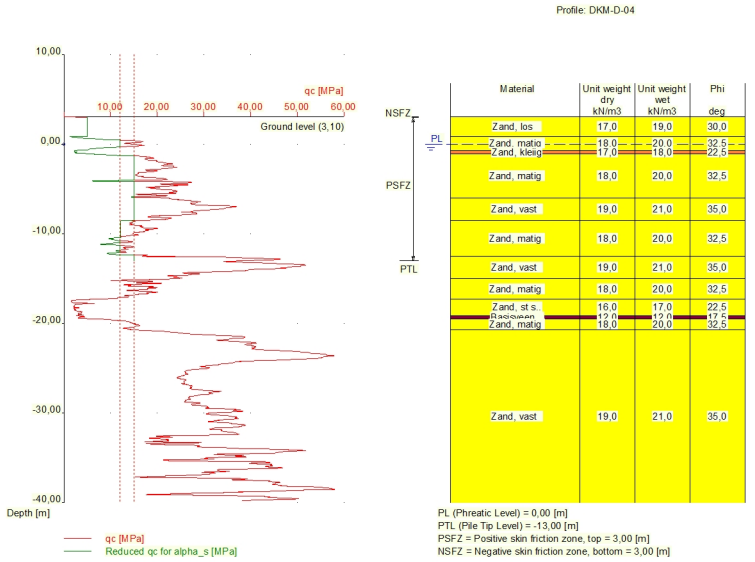
Number/Name CPT	Pile tip level [m R.L.]	Top of pos. friction zone [m R.L.]	Bottom of neg. friction zone [m R.L.]	X-coor-dinate [m]	Y-coor-dinate [m]
1: DKM-D-04	-13,00	3,00	3,00	102023,09	498447,10
2: DKM-D-05	-13,00	3,00	3,00	102014,98	498435,94
3: DKM-D-06	-13,00	3,00	3,00	102027,38	498433,63

2.6 Soil Data

Number of soil profiles (= number of CPT's) : 3

2.6.1 Soil Profile DKM-D-04

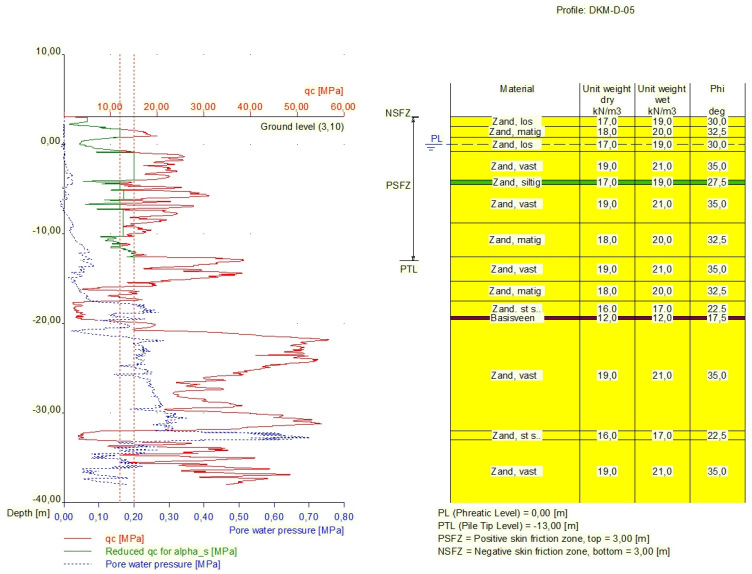
Belonging to CPT	DKM-D-04
Surface level in [m. reference level] :	3,10
Phreatic level in [m. reference level] :	0,00
Pile tip level in [m. reference level] :	-13,00
Top of positive skin friction zone in [m. reference level] :	3,00
Bottom of negative skin friction zone in [m. reference level] :	3,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,11
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	3,100	17,00	19,00	30,00	Sand	0,200
2	0,900	18,00	20,00	32,50	Sand	0,200
3	-0,700	17,00	18,00	22,50	Sand	0,200
4	-1,100	18,00	20,00	32,50	Sand	0,200
5	-6,000	19,00	21,00	35,00	Sand	0,200
6	-8,500	18,00	20,00	32,50	Sand	0,200
7	-12,500	19,00	21,00	35,00	Sand	0,200
8	-15,000	18,00	20,00	32,50	Sand	0,200
9	-17,300	16,00	17,00	22,50	Sand	0,200
10	-19,100	12,00	12,00	17,50	Peat	--
11	-19,500	18,00	20,00	32,50	Sand	0,200
12	-20,700	19,00	21,00	35,00	Sand	0,200

2.6.2 Soil Profile DKM-D-05

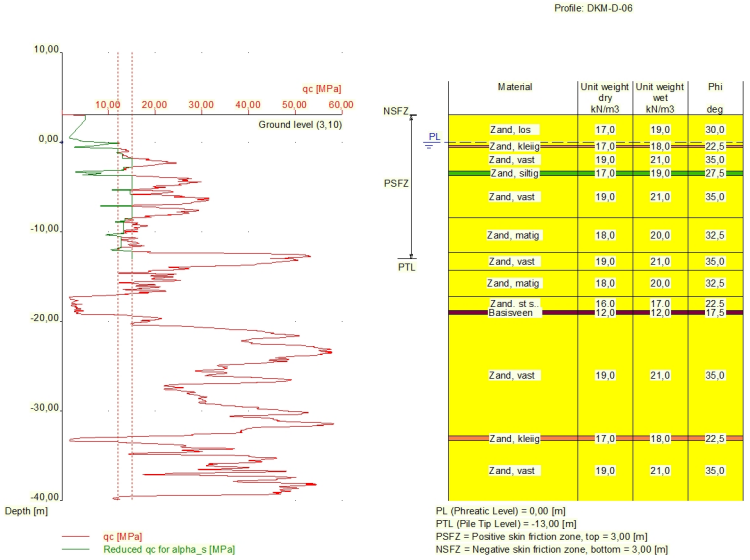
Belonging to CPT	DKM-D-05
Surface level in [m. reference level] :	3,10
Phreatic level in [m. reference level] :	0,00
Pile tip level in [m. reference level] :	-13,00
Top of positive skin friction zone in [m. reference level] :	3,00
Bottom of negative skin friction zone in [m. reference level] :	3,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,11
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	3,100	17,00	19,00	30,00	Sand	0,200
2	2,000	18,00	20,00	32,50	Sand	0,200
3	0,800	17,00	19,00	30,00	Sand	0,200
4	-0,800	19,00	21,00	35,00	Sand	0,200
5	-4,000	17,00	19,00	27,50	Sand	0,200
6	-4,500	19,00	21,00	35,00	Sand	0,200
7	-8,800	18,00	20,00	32,50	Sand	0,200
8	-12,600	19,00	21,00	35,00	Sand	0,200
9	-15,300	18,00	20,00	32,50	Sand	0,200
10	-17,500	16,00	17,00	22,50	Sand	0,200
11	-19,200	12,00	12,00	17,50	Peat	--
12	-19,600	19,00	21,00	35,00	Sand	0,200
13	-32,000	16,00	17,00	22,50	Sand	0,200
14	-33,000	19,00	21,00	35,00	Sand	0,200

2.6.3 Soil Profile DKM-D-06

Belonging to CPT	DKM-D-06
Surface level in [m. reference level] :	3,10
Phreatic level in [m. reference level] :	0,00
Pile tip level in [m. reference level] :	-13,00
Top of positive skin friction zone in [m. reference level] :	3,00
Bottom of negative skin friction zone in [m. reference level] :	3,00
OCR-value foundation layer :	1,00
Expected groundlevel settlement in [m] :	0,11
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	3,100	17,00	19,00	30,00	Sand	0,200
2	-0,300	17,00	18,00	22,50	Sand	0,200
3	-0,600	19,00	21,00	35,00	Sand	0,200
4	-3,200	17,00	19,00	27,50	Sand	0,200
5	-3,700	19,00	21,00	35,00	Sand	0,200
6	-8,400	18,00	20,00	32,50	Sand	0,200
7	-12,300	19,00	21,00	35,00	Sand	0,200
8	-14,300	18,00	20,00	32,50	Sand	0,200
9	-17,200	16,00	17,00	22,50	Sand	0,200
10	-18,800	12,00	12,00	17,50	Peat	--
11	-19,200	19,00	21,00	35,00	Sand	0,200
12	-32,800	17,00	18,00	22,50	Sand	0,200
13	-33,300	19,00	21,00	35,00	Sand	0,200

2.7 Pile Types

2.7.1 Pile type : 460-560

Pile type : Screw pile, cast in place, lost tip
Note: Factor alpha_p has the pre 2016 value.

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-EN 9997-1:2012.

Pile dimensions :

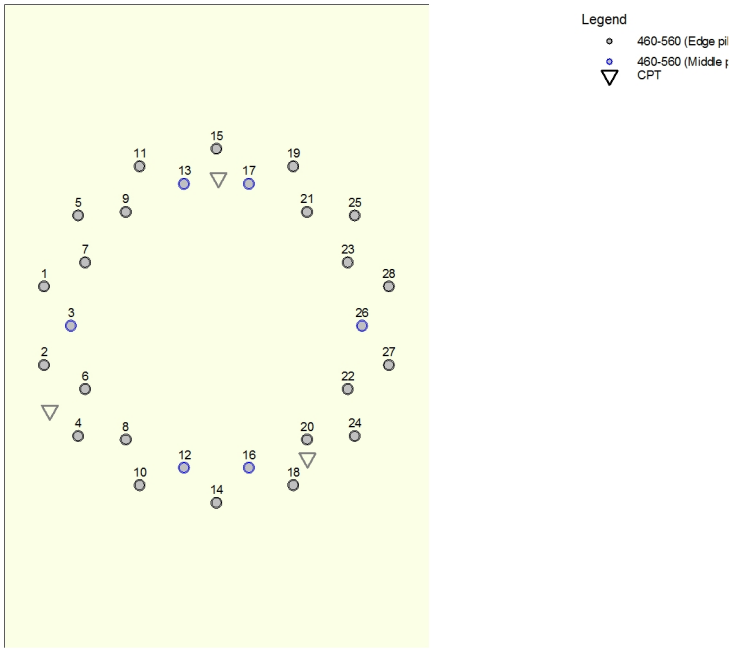
Diameter at tip [m] :	0,560
Diameter shaft [m] :	0,460
Effective heigth enlarged base [m] :	0,000

2.8 Foundation Plan

Number of piles :	28
Number of collaborating piles* :	28

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

2.8.1 View of Foundation Plan

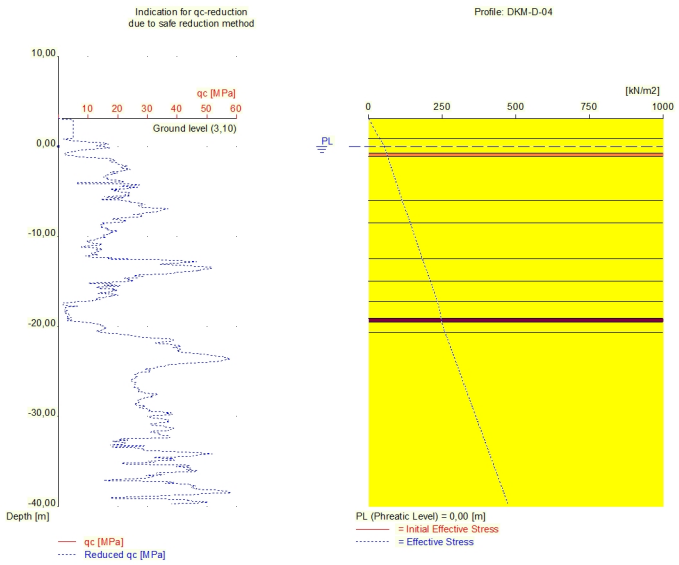


Pile nr/name	X-coor-dinate [m]	Y-coor-dinate [m]	Fc;d (STR/GEO) [kN]	Fc;d (SLS) [kN]	P0 [kN/m2]	Pile head level [m R.L.]
1: 1	102014,71	498441,89	495,00	96,00	0,00	3,10
2: 2	102014,71	498438,11	495,00	159,00	0,00	3,10
3: 3	102016,00	498440,00	495,00	247,00	0,00	3,10
4: 4	102016,35	498434,70	495,00	335,00	0,00	3,10
5: 5	102016,35	498445,30	495,00	159,00	0,00	3,10
6: 6	102016,69	498436,96	495,00	348,00	0,00	3,10
7: 7	102016,69	498443,04	495,00	247,00	0,00	3,10
8: 8	102018,64	498434,53	600,00	529,00	0,00	3,10
9: 9	102018,64	498445,47	495,00	348,00	0,00	3,10
10: 10	102019,31	498432,34	692,00	590,00	0,00	3,10
11: 11	102019,31	498447,66	495,00	335,00	0,00	3,10

Pile nr/name	X-coor-dinate [m]	Y-coor-dinate [m]	Fc;d (STR/GEO) [kN]	Fc;d (SLS) [kN]	P0 [kN/m2]	Pile head level [m R.L.]
12: 12	102021,44	498433,18	1114,00	756,00	0,00	3,10
13: 13	102021,44	498446,82	600,00	529,00	0,00	3,10
14: 14	102023,00	498431,50	900,00	873,00	0,00	3,10
15: 15	102023,00	498448,50	600,00	590,00	0,00	3,10
16: 16	102024,56	498433,18	1732,00	982,00	0,00	3,10
17: 17	102024,56	498446,82	1114,00	756,00	0,00	3,10
18: 18	102026,69	498432,34	2161,00	1128,00	0,00	3,10
19: 19	102026,69	498447,66	1464,00	873,00	0,00	3,10
20: 20	102027,36	498434,53	2228,00	1164,00	0,00	3,10
21: 21	102027,36	498445,47	1732,00	982,00	0,00	3,10
22: 22	102029,31	498436,96	2504,00	1264,00	0,00	3,10
23: 23	102029,31	498443,04	2228,00	1164,00	0,00	3,10
24: 24	102029,65	498434,70	2642,00	1304,00	0,00	3,10
25: 25	102029,65	498445,30	2160,00	1128,00	0,00	3,10
26: 26	102030,00	498440,00	2504,00	1264,00	0,00	3,10
27: 27	102031,29	498438,11	2770,00	1367,00	0,00	3,10
28: 28	102031,29	498441,89	2642,00	1304,00	0,00	3,10

2.9 Excavation Data

Excavation level in [m. reference level] : 3,10
Reduction model : Safe (NEN)



2.10 Totalized Loads (design values)

Total load on all piles
For limit state STR/GEO in [kN] : 36842,00

For Serviceability limit state in [kN] : 20821,00

2.11 Requirements

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

2.12 Overruled Parameters

User defined gamma;b [-] : 1,80
User defined gamma;s [-] : 1,80

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 :
- -460-560

Selected profiles :
- -DKM-D-04
- -DKM-D-05
- -DKM-D-06

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

3.1 Errors and Warnings

Warning : The factor gamma;b (NEN-EN 1997 1:2005 NEN-EN 9997-1, annex A) is user defined. Evidence to support this from the NEN deviating value has to be provided.
Warning : The factor gamma;s (NEN-EN 1997 1:2005 NEN-EN 9997-1, annex A) is user defined. Evidence to support this from the NEN deviating value has to be provided.
Pile Type 460-560: Warning : The factor Beta (NEN-EN 1997 1:2005 par. 7.6.2.3(g): NEN-EN 9997-1) 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-EN 9997-1 art 3.2.3 lid (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-EN 9997-1 par 3.2.3, the average distance between the different CPT's used for this check is 25 m.
The requirements set by NEN-EN 9997-1 par 3.2.3 are met.

The requirements set by NEN-EN 9997-1 par 3.3.3 are met. The variation (1,56%) is ok (<= 12%).

3.3 Calculation Parameters

3.3.1 Pile Factors

gamma;b (Limit State STR/GEO, user defined) :	1,80
gamma;s (Limit State STR/GEO, user defined) :	1,80
xi3 (NEN-EN 9997-1:2012, annex A, table 10b, for N = 3) :	1,18
xi4 (NEN-EN 9997-1:2012, annex A, table 10b, for N = 3) :	0,94

Xi 3 has been used.

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

3.3.2 Pile type : 460-560

Pile type : Screw pile, cast in place, lost tip
Note: Factor alpha_p has the pre 2016 value.

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-EN 1997 1:2005 par. 7.6.2.3(h), NEN-EN 9997-1 : factor for the influence of the shape of the crosssection of the pile base) :	1,00

Pile dimensions :

Diameter at tip [m] :	0,560
Diameter shaft [m] :	0,460
Effective heigth enlarged base [m] :	0,000

CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
DKM-D-04	0,0090	--	0,9000

CPT	Alpha_s Sand/ Gravel	Alpha_s Clay/Loam Peat	Alpha_p
DKM-D-05	0,0090	--	0,9000
DKM-D-06	0,0090	--	0,9000

3.4 Verification of Limit State STR

Required by NEN-EN 9997-1:2012 section 2.4.7 / 2.4.8: Ed <= Cd.
Rigid superstructure, verify total load on all piles with total bearing capacity

Fc;d = 36842,000 [kN]
Rc;d = 78828,318 [kN]

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

Note: Negative skin friction plays NO part in Limit State STR. Its influence is incorporated in the tests for Limit State 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.

3.5 Verification of Limit State GEO

Required by NEN-EN 9997-1:2012 paragraaf 2.4.9; NEN-EN 9997-1: Sd <= Sreq.

Sd = 0,033 [m]
Sreq = 0,150 [m]

The settlement requirements of limit state GEO 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 EN 1997 1:2005 par. 6.6.2: NEN-EN 9997-1 part c)!

3.6 Verification of Serviceability limit state

Required by NEN-EN 9997-1:2012 paragraaf 2.4.9; NEN-EN 9997-1: 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 = 0,013 [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 EN 1997 1:2005 par. 6.6.2: NEN-EN 9997-1 part c)!

3.7 Additional Information

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

At Limit state STR, GEO :sigma = 16,67 [N/mm2]
At Serviceability Limit Statesigma = 8,23 [N/mm2]

The maximum settlement was found at :
Limit state GEO
CPT name DKM-D-04
Pile name: 27

Components of the maximum settlement are :

sneg = 0,000 [m]
sb = 0,059 [m]
sel;d = 0,011 [m]
s2 = 0,020 [m]

Serviceability Limit State
CPT name DKM-D-04
Pile name: 27

Components of the maximum settlement are :
sneg = 0,000 [m]
sb = 0,001 [m]
sel;d = 0,005 [m]
s2 = 0,011 [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.

3.7.1 The bearing capacity of shaft and point at Limit state GEO

name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
DKM-D-04	1160,982	1609,554	2770,536
DKM-D-05	1134,284	1723,961	2858,245
DKM-D-06	1119,339	1697,772	2817,111

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

name CPT	Bearing Cap. Shaft [kN] Rs;d	Bearing Cap. Point [kN] Rb;d	Bearing Cap. Total [kN]
DKM-D-04	2089,767	2897,197	4986,964
DKM-D-05	2041,711	3103,130	5144,841
DKM-D-06	2014,811	3055,989	5070,800

End of Report

Bijlage Vb

Resultaten geotechnisch trekdraagvermogen

Report for D-Foundations 16.1

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

Company:	Deltares
Date of report:	26-8-2016
Time of report:	10:09:32
Date of calculation:	26-8-2016
Time of calculation:	10:01:28
Filename:	\..\online rekenen AR\20160715- 1438\WTG2 trek 28 palen 2 ringen
Project identification:	Eneco Windpark Spuisluis te IJmuiden Turbinefundering D-Foundations WTG2 trek 28 palen 2 ringen

1 Table of Contents

2 Input Data

2.1 General Input Data

Model	Tension Piles (EC7-NL)

2.2 General Report Data

Geotechnical consultant :	
Design engineer superstructure :	
Principal :	
Title 1 :	Eneco Windpark Spuisluis te IJmuiden
Title 2 :	Turbinefundering
Title 3 :	D-Foundations WTG2 trek 28 palen 2 ringen
Number of project :	-2015-1438
Location of project :	

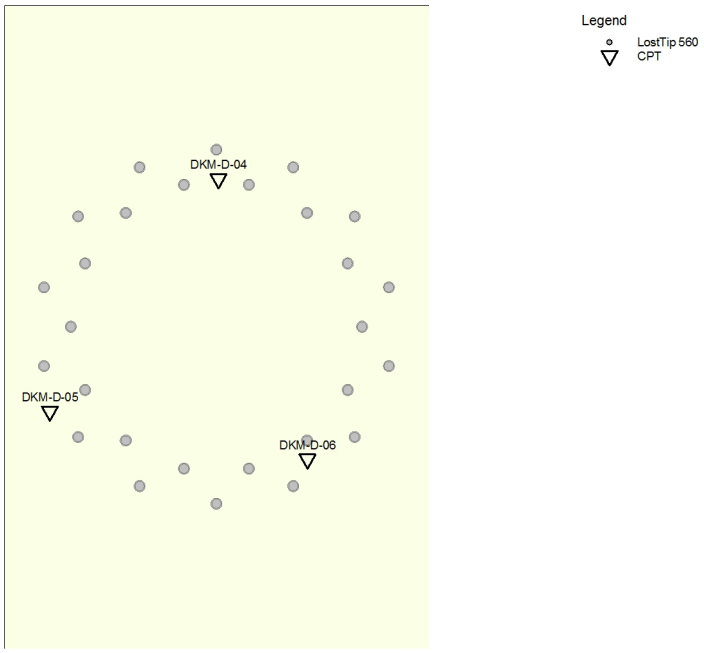
2.3 Application Area Model Tension Piles (NEN-EN)

The design and verifications performed by the TENSION PILES (NEN-EN) model of D-FOUNDATIONS concern pile foundations on which axial static or quasi-static loads cause tensile forces in the piles. Pilegroup effects are taken into account. Calculation of pile forces is based on Cone Penetration Tests. Pile capacities are based on the NEN-EN 9997-1:2012, chapter 7 and where pile/safety factors are concerned, on Dutch Standards NEN-EN 9997-1:2012. Horizontal displacements of piles are not taken into account. Vertical displacements of piles are not calculated. Design of Tension piles based on NEN-EN 9997-1:2012 is limited to piles with lengths between 7 and 50 m and a minimum Length over (equivalent) diameter ratio of 13.5.

2.4 General CPT Data

Number of CPT's :	3
Timing of CPT's :	CPT - Excavation - Install

2.4.1 View of CPT's in Foundation Plan



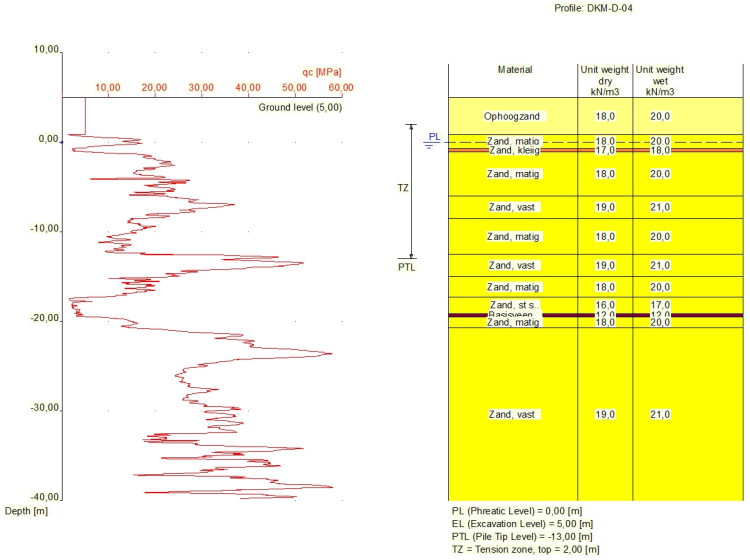
Number/name CPT	X-coor-dinate [m]	Y-coor-dinate [m]
1: DKM-D-04	102023,09	498447,10
2: DKM-D-05	102014,98	498435,94
3: DKM-D-06	102027,38	498433,63

2.5 Soil Data

Number of soil profiles (= number of CPT's) : 3

2.5.1 Soil Profile DKM-D-04

Belonging to CPT	DKM-D-04
Surface level in [m. reference level] :	5,00
Phreatic level in [m. reference level] :	0,00
Top of tension zone [m. reference level]:	2,00
Pile tip level in [m. reference level] :	-13,00
Number of layers in profile :	12



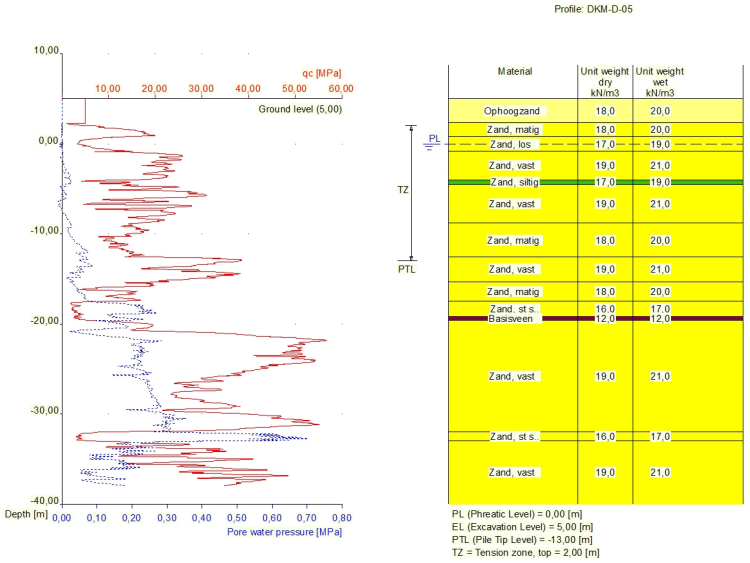
Number layer	Top layer [m R.L.]	Soil Type	Gamma [kN/m3]	Gamma sat [kN/m3]	Min. Void Ratio [%]	Max. Void Ratio [%]	Median [mm]	Max. Cone resistance [kPa]	Use Max. Cone resistance
1	5,000	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
2	0,900	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
3	-0,700	Sand	17,00	18,00	0,00	0,00	0,200	12/15	Standa...
4	-1,100	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
5	-6,000	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
6	-8,500	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
7	-12,500	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
8	-15,000	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
9	-17,300	Sand	16,00	17,00	0,00	0,00	0,200	12/15	Standa...
10	-19,100	Peat	12,00	12,00	0,40	0,80		12/15	Standa...
11	-19,500	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
12	-20,700	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...

Number layer	Top layer [m R.L.]	Soil Type	Phi [deg]	Addit. PP at top [kN/m2]	Addit. PP at bottom [kN/m2]	OCR value [-]	Use Tension
1	5,000	Sand	32,50	0,00	0,00	1,000	True
2	0,900	Sand	32,50	0,00	0,00	1,000	True
3	-0,700	Sand	22,50	0,00	0,00	1,000	True
4	-1,100	Sand	32,50	0,00	0,00	1,000	True
5	-6,000	Sand	35,00	0,00	0,00	1,000	True
6	-8,500	Sand	32,50	0,00	0,00	1,000	True
7	-12,500	Sand	35,00	0,00	0,00	1,000	True
8	-15,000	Sand	32,50	0,00	0,00	1,000	True
9	-17,300	Sand	22,50	0,00	0,00	1,000	True
10	-19,100	Peat	17,50	0,00	0,00	1,000	False

Number layer	Top layer [m R.L.]	Soil Type	Phi [deg]	Addit. PP at top [kN/m2]	Addit. PP at bottom [kN/m2]	OCR value [-]	Use Tension
11	-19,500	Sand	32,50	0,00	0,00	1,000	True
12	-20,700	Sand	35,00	0,00	0,00	1,000	True

2.5.2 Soil Profile DKM-D-05

Belonging to CPT	DKM-D-05
Surface level in [m. reference level] :	5,00
Phreatic level in [m. reference level] :	0,00
Top of tension zone [m. reference level]:	2,00
Pile tip level in [m. reference level] :	-13,00
Number of layers in profile :	14



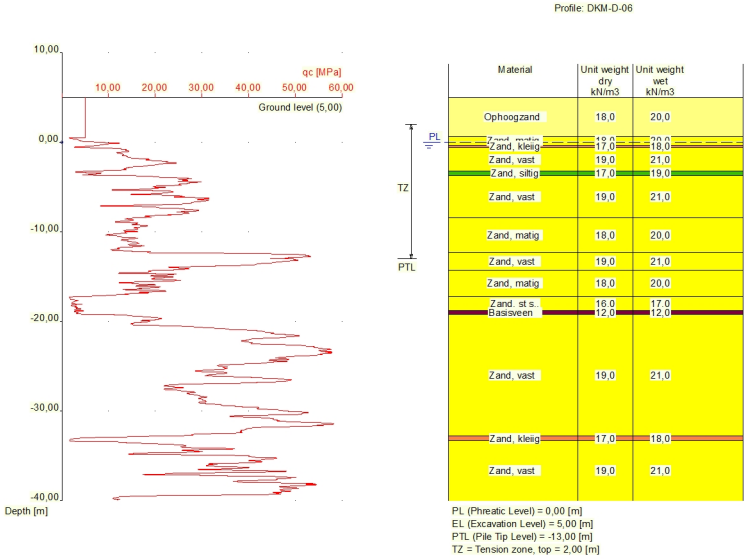
Number layer	Top layer [m R.L.]	Soil Type	Gamma [kN/m3]	Gamma sat [kN/m3]	Min. Void Ratio [%]	Max. Void Ratio [%]	Median [mm]	Max. Cone resistance [kPa]	Use Max. Cone resistance
1	5,000	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
2	2,400	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
3	0,800	Sand	17,00	19,00	0,40	0,80	0,200	12/15	Standa...
4	-0,800	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
5	-4,000	Sand	17,00	19,00	0,40	0,80	0,200	12/15	Standa...
6	-4,500	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
7	-8,800	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
8	-12,600	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
9	-15,300	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
10	-17,500	Sand	16,00	17,00	0,00	0,00	0,200	12/15	Standa...
11	-19,200	Peat	12,00	12,00	0,40	0,80		12/15	Standa...
12	-19,600	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...

Number layer	Top layer [m R.L.]	Soil Type	Gamma [kN/m3]	Gamma sat [kN/m3]	Min. Void Ratio [%]	Max. Void Ratio [%]	Median [mm]	Max. Cone resistance [kPa]	Use Max. Cone resistance
13	-32,000	Sand	16,00	17,00	0,00	0,00	0,200	12/15	Standa...
14	-33,000	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...

Number layer	Top layer [m R.L.]	Soil Type	Phi [deg]	Addit. PP at top [kN/m2]	Addit. PP at bottom [kN/m2]	OCR value [-]	Use Tension
1	5,000	Sand	32,50	0,00	0,00	1,000	True
2	2,400	Sand	32,50	0,00	0,00	1,000	True
3	0,800	Sand	30,00	0,00	0,00	1,000	True
4	-0,800	Sand	35,00	0,00	0,00	1,000	True
5	-4,000	Sand	27,50	0,00	0,00	1,000	True
6	-4,500	Sand	35,00	0,00	0,00	1,000	True
7	-8,800	Sand	32,50	0,00	0,00	1,000	True
8	-12,600	Sand	35,00	0,00	0,00	1,000	True
9	-15,300	Sand	32,50	0,00	0,00	1,000	True
10	-17,500	Sand	22,50	0,00	0,00	1,000	True
11	-19,200	Peat	17,50	0,00	0,00	1,000	False
12	-19,600	Sand	35,00	0,00	0,00	1,000	True
13	-32,000	Sand	22,50	0,00	0,00	1,000	True
14	-33,000	Sand	35,00	0,00	0,00	1,000	True

2.5.3 Soil Profile DKM-D-06

Belonging to CPT	DKM-D-06
Surface level in [m. reference level] :	5,00
Phreatic level in [m. reference level] :	0,00
Top of tension zone [m. reference level]:	2,00
Pile tip level in [m. reference level] :	-13,00
Number of layers in profile :	14



Number layer	Top layer [m R.L.]	Soil Type	Gamma [kN/m3]	Gamma sat [kN/m3]	Min. Void Ratio [%]	Max. Void Ratio [%]	Median [mm]	Max. Cone resistance [kPa]	Use Max. Cone resistance
1	5,000	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
2	0,650	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
3	-0,300	Sand	17,00	18,00	0,00	0,00	0,200	12/15	Standa...
4	-0,600	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
5	-3,200	Sand	17,00	19,00	0,40	0,80	0,200	12/15	Standa...
6	-3,700	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
7	-8,400	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
8	-12,300	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
9	-14,300	Sand	18,00	20,00	0,40	0,80	0,200	12/15	Standa...
10	-17,200	Sand	16,00	17,00	0,00	0,00	0,200	12/15	Standa...
11	-18,800	Peat	12,00	12,00	0,40	0,80		12/15	Standa...
12	-19,200	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...
13	-32,800	Sand	17,00	18,00	0,00	0,00	0,200	12/15	Standa...
14	-33,300	Sand	19,00	21,00	0,40	0,80	0,200	12/15	Standa...

Number layer	Top layer [m R.L.]	Soil Type	Phi [deg]	Addit. PP at top [kN/m2]	Addit. PP at bottom [kN/m2]	OCR value [-]	Use Tension
1	5,000	Sand	32,50	0,00	0,00	1,000	True
2	0,650	Sand	32,50	0,00	0,00	1,000	True
3	-0,300	Sand	22,50	0,00	0,00	1,000	True
4	-0,600	Sand	35,00	0,00	0,00	1,000	True
5	-3,200	Sand	27,50	0,00	0,00	1,000	True
6	-3,700	Sand	35,00	0,00	0,00	1,000	True
7	-8,400	Sand	32,50	0,00	0,00	1,000	True
8	-12,300	Sand	35,00	0,00	0,00	1,000	True

Number layer	Top layer [m R.L.]	Soil Type	Phi [deg]	Addit. PP at top [kN/m2]	Addit. PP at bottom [kN/m2]	OCR value [-]	Use Tension
9	-14,300	Sand	32,50	0,00	0,00	1,000	True
10	-17,200	Sand	22,50	0,00	0,00	1,000	True
11	-18,800	Peat	17,50	0,00	0,00	1,000	False
12	-19,200	Sand	35,00	0,00	0,00	1,000	True
13	-32,800	Sand	22,50	0,00	0,00	1,000	True
14	-33,300	Sand	35,00	0,00	0,00	1,000	True

2.6 Pile Types

Note : if alpha;t is not user defined, the next rules apply :
- alpha;t according to table 7.g and table 7.h of NEN-EN 9997-1
- for clay: alpha;t depends on the CPT-value and relative depth
- for peat: alpha;t = 0
- for sand/gravel: alpha;t also depends on the median

Number of pile types : 1

2.6.1 Pile type : LostTip 560

Pile type for shaft friction factor (alpha;t) sand/gravel/loam : Screw pile, cast in place, lost tip

Pile type for shaft friction factor (alpha;t) clay : According to standard
Materialtype for pile : Concrete
Pile shape : Round pile with lost tip

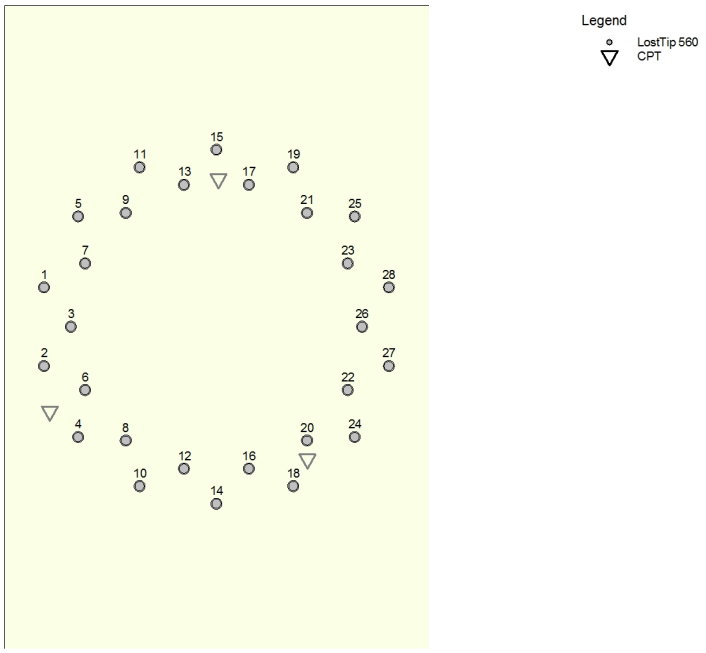
Pile dimensions :
- Diameter at tip [m] : 0,560
- Diameter shaft [m] : 0,460
- Effective heigth enlarged base [m] : 0,000

Note : this pile type is regarded as a low vibration pile. Reduction for pile installation after excavation according to NEN 9997-1.

2.7 Foundation Plan

Number of piles : 28
Number of collaborating piles* : 28
* : 0 = not defined, 1 = non rigid superstructure, >1 = rigid superstructure

2.7.1 View of Foundation Plan



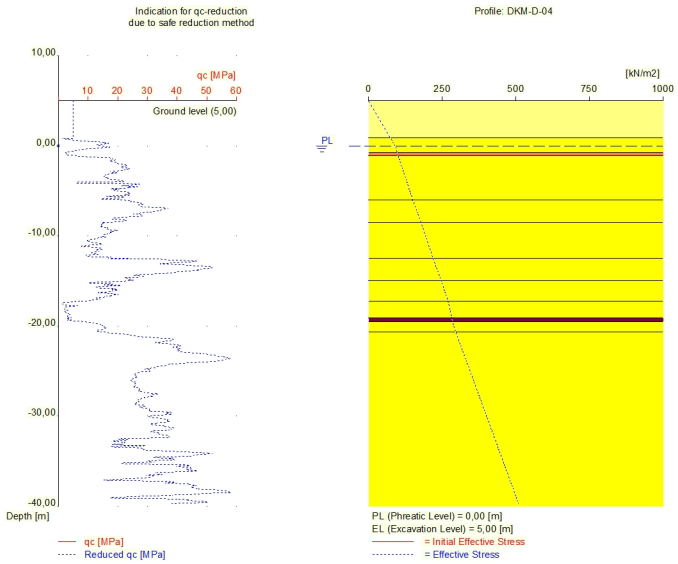
Pile nr./code	X-coor-dinate [m]	Y-coor-dinate [m]	Maximum load [kN]	Minimum load [kN]	Pile head level [m R.L.]	Use alternat. loads	Factor Gamma;var
1: 1	102014,71	498441,89	820,00	-495,00	3,00	False	n.a.
2: 2	102014,71	498438,11	820,00	-495,00	3,00	False	n.a.
3: 3	102016,00	498440,00	820,00	-495,00	3,00	False	n.a.
4: 4	102016,35	498434,70	820,00	-495,00	3,00	False	n.a.
5: 5	102016,35	498445,30	820,00	-495,00	3,00	False	n.a.
6: 6	102016,69	498436,96	795,00	-495,00	3,00	False	n.a.
7: 7	102016,69	498443,04	795,00	-495,00	3,00	False	n.a.
8: 8	102018,64	498434,53	795,00	-600,00	3,00	False	n.a.
9: 9	102018,64	498445,47	795,00	-495,00	3,00	False	n.a.
10: 10	102019,31	498432,34	820,00	-692,00	3,00	False	n.a.
11: 11	102019,31	498447,66	820,00	-495,00	3,00	False	n.a.
12: 12	102021,44	498433,18	795,00	-1114,00	3,00	False	n.a.
13: 13	102021,44	498446,82	795,00	-600,00	3,00	False	n.a.
14: 14	102023,00	498431,50	820,00	-900,00	3,00	False	n.a.
15: 15	102023,00	498448,50	820,00	-600,00	3,00	False	n.a.
16: 16	102024,56	498433,18	795,00	-1732,00	3,00	False	n.a.
17: 17	102024,56	498446,82	795,00	-1114,00	3,00	False	n.a.
18: 18	102026,69	498432,34	820,00	-2161,00	3,00	False	n.a.
19: 19	102026,69	498447,66	820,00	-1464,00	3,00	False	n.a.
20: 20	102027,36	498434,53	795,00	-2228,00	3,00	False	n.a.
21: 21	102027,36	498445,47	795,00	-1732,00	3,00	False	n.a.
22: 22	102029,31	498436,96	795,00	-2504,00	3,00	False	n.a.
23: 23	102029,31	498443,04	795,00	-2228,00	3,00	False	n.a.
24: 24	102029,65	498434,70	820,00	-2642,00	3,00	False	n.a.

Pile nr./code	X-coor-dinate [m]	Y-coor-dinate [m]	Maximum load [kN]	Minimum load [kN]	Pile head level [m R.L.]	Use alternat. loads	Factor Gamma;var
25: 25	102029,65	498445,30	820,00	-2160,00	3,00	False	n.a.
26: 26	102030,00	498440,00	795,00	-2504,00	3,00	False	n.a.
27: 27	102031,29	498438,11	820,00	-2814,00	3,00	False	n.a.
28: 28	102031,29	498441,89	820,00	-2642,00	3,00	False	n.a.

Note regarding the loads: tension forces are positive, compressive forces are negative
Note 2: See OVERRULED PARAMETERS for gamma;var

2.8 Excavation Data

Excavation level in [m. reference level] : 5,00
Reduction model : Safe (NEN)



2.9 Optional Parameters

Unit weight water [kN/m3] : 9,81
Surcharge [kN/m2] : 0,00

2.10 Overruled Parameters

User defined gamma;var [-] 1,50

2.11 Model Options

Suppress compaction
If compaction is used, according to NEN-EN 9997-1 CPT's should be made after installation to verify this assumption
Use the influence of excavations (standard).

Use excess pore pressure

2.12 Model Options

Selected pile types :
- -LostTip 560

Selected profiles :
- -DKM-D-04
- -DKM-D-05
- -DKM-D-06

3 Tension Piles (EC7-NL): Bearing capacity at fixed pile tip levels

3.1 Errors and Warnings

Warning : The factor gamma;var (NEN-EN 1997 1:2005 NEN-EN 9997-1, annex A) is user defined. Evidence to support this from the NEN deviating value has to be provided.
At pile type LostTip 560 :
Due to the use of a low vibrating pile type, the reduction of CPT-value due to the excavation is done using NEN-EN 9997-1.

When reviewing the following results, warnings listed above should be considered.

3.2 Remarks

When calculating the max. mobilized soil weight, the topangle is used according to NEN-EN 9997-1.

3.3 Calculation Parameters

3.3.1 Pile Factors

xi3 (NEN-EN 9997-1:2012, annex A, table 10a, for N = 3) :	1,18
xi4 (NEN-EN 9997-1:2012, annex A, table 10a, for N = 3) :	0,94
User defined gamma;var [-]	1,500
Factor gamma;st according to NEN 1997-1 annex A.3.3.2 [-]	1,350
Factor gamma;gamma according to NEN-EN 9997-1:2012 annex A.3 table A2 [-]	
Above excavation level	1,0
Below excavation level	1,1

3.3.2 Pile type : LostTip 560

Pile type for shaft friction factor (alpha;t) sand/gravel/loam :	Screw pile, cast in place, lost tip
Pile type for shaft friction factor (alpha;t) clay :	According to standard
Materialtype for pile :	Concrete
Pile shape :	Round pile with lost tip
Pile dimensions :	
Diameter at tip [m] :	0,560
Diameter shaft [m] :	0,460
Effective heigth enlarged base [m] :	0,000

Note : this pile type is regarded as a low vibration pile. Reduction for pile installation after excavation according to NEN 9997-1.

3.4 Results for all CPT's

3.4.1 Results for pile type : LostTip 560

3.4.1.1 Pile group 1

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
1
2
27
28

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	967,67	827,93	827,93	Ksi3

3.4.1.2 Pile group 2

Number of piles belonging to this pile group : 2
Names of piles belonging to this pile group
3
26

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	917,00	794,77	794,77	Ksi3

3.4.1.3 Pile group 3

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
4
5
24
25

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	969,91	829,45	829,45	Ksi3

3.4.1.4 Pile group 4

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
6
7
22
23

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	913,34	792,37	792,37	Ksi3

3.4.1.5 Pile group 5

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
8
9
20
21

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	913,34	792,43	792,43	Ksi3

3.4.1.6 Pile group 6

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
10
11
18

19

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	970,99	830,18	830,18	Ksi3

3.4.1.7 Pile group 7

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
12
13
16
17

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	910,61	790,60	790,60	Ksi3

3.4.1.8 Pile group 8

Number of piles belonging to this pile group : 2
Names of piles belonging to this pile group
14
15

Level [m R.L.]	Rt;d min [kN]	Rt;d avg [kN]	Rt;d [kN]	Ksi used [-]
-13,00	973,97	832,21	832,21	Ksi3

3.5 INDICATIVE: Results using Ksi3

3.5.1 Results for pile type : LostTip 560

3.5.1.1 Pile group 1

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
1
2
27
28

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	844,27	6885,33	36,82	0,00
DKM-D-05	-13,00	817,74	6970,11	36,82	0,00
DKM-D-06	-13,00	821,79	7009,75	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.2 Pile group 2

Number of piles belonging to this pile group : 2
Names of piles belonging to this pile group
3
26

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	808,71	3409,44	36,82	0,00
DKM-D-05	-13,00	785,18	3475,89	36,82	0,00
DKM-D-06	-13,00	790,41	3493,80	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.3 Pile group 3

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
4
5
24
25

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	845,89	7014,74	36,82	0,00
DKM-D-05	-13,00	819,22	7102,29	36,82	0,00
DKM-D-06	-13,00	823,23	7142,52	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.4 Pile group 4

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
6
7
22
23

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	806,13	2608,42	36,82	0,00
DKM-D-05	-13,00	782,83	2657,41	36,82	0,00
DKM-D-06	-13,00	788,14	2669,21	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.5 Pile group 5

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
8
9
20
21

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	806,20	2271,07	36,82	0,00
DKM-D-05	-13,00	782,89	2313,09	36,82	0,00
DKM-D-06	-13,00	788,21	2322,68	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.6 Pile group 6

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
10
11
18
19

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	846,68	7274,82	36,82	0,00
DKM-D-05	-13,00	819,94	7367,73	36,82	0,00
DKM-D-06	-13,00	823,93	7409,72	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.7 Pile group 7

Number of piles belonging to this pile group : 4
Names of piles belonging to this pile group
12
13
16
17

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	804,23	2103,14	36,82	0,00
DKM-D-05	-13,00	781,09	2141,61	36,82	0,00
DKM-D-06	-13,00	786,46	2150,43	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

3.5.1.8 Pile group 8

Number of piles belonging to this pile group : 2
Names of piles belonging to this pile group
14
15

CPT name	Level [m R.L.]	Rt;d Indicative [kN]	Max. mobilized soil weight [kN]	Pile weight [kN]	Tension derived from clay [%]
DKM-D-04	-13,00	848,85	7101,24	36,82	0,00
DKM-D-05	-13,00	821,92	7217,04	36,82	0,00
DKM-D-06	-13,00	825,87	7257,34	36,82	0,00

CPT name	Alpha t aver. overall	Alpha t aver. sand/gravel/loam	Alpha t aver. clay/peat
DKM-D-04	0,0090	0,0090	0,0000
DKM-D-05	0,0090	0,0090	0,0000
DKM-D-06	0,0090	0,0090	0,0000

End of Report

Bijlage VI

Resultaten funderingsanalyse kraanopstelplaats

Report for D-Foundations 16.1

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

Company:	Deltares
Date of report:	18-7-2016
Time of report:	15:14:01
Date of calculation:	18-7-2016
Time of calculation:	15:12:54
Filename:	\..\Kraanopstelplaats WTG2 (op staal) (incl ophoging) v2
Project identification:	Windpark SPuisluis te IJmuiden Kraanopstelplaats WT2, fund op staal D-Foundations Kraanopstelplaats WTG2 (op staal) (incl ophoging) v2

1 Table of Contents

2 Input Data

2.1 General Input Data

Model	Shallow Foundations (EC7-NL)

2.2 General Report Data

Geotechnical consultant :	
Design engineer superstructure :	
Principal :	
Title 1 :	Windpark SPuisluis te IJmuiden
Title 2 :	Kraanopstelplaats WT2, fund op staal
Title 3 :	D-Foundations Kraanopstelplaats WTG2 (op staal) (incl ophoging) v2
Number of project :	-
Location of project :	

2.3 Application Area Model Shallow Foundations

The verifications performed by the model Shallow Foundation of D-FOUNDATIONS concern shallow foundations on which only static or quasi-static loads work. The foundation surface must be practically level and should not exceed an angle of 2.5 degrees with the horizon.

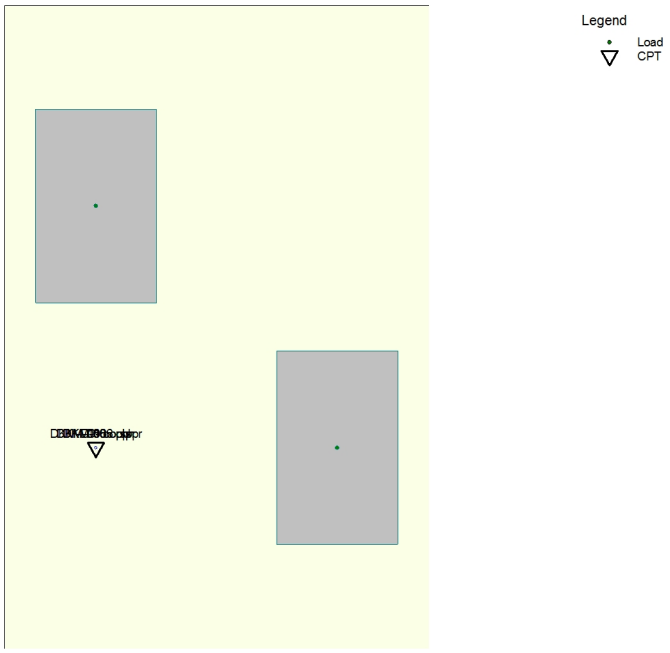
2.4 Superstructure

Rigidity of the superstructure :	Non-Rigid

2.5 General CPT Data

Number of CPT's :	6

2.5.1 View of CPT's in Foundation Plan



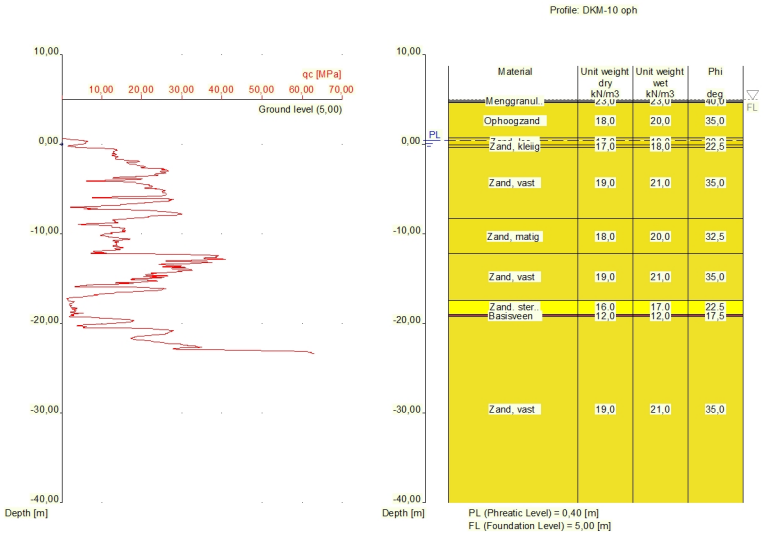
Number/name CPT	X-coor-dinate [m]	Y-coor-dinate [m]
1: DKM-08 oph	0,00	0,00
2: DKM-10 oph	0,00	0,00
3: DKM-D-06 oph	0,00	0,00
4: DKM-08 oor..	0,00	0,00
5: DKM-10 oor..	0,00	0,00
6: DKM-D-06 o..	0,00	0,00

2.6 Soil Data

Number of soilprofiles: 6

2.6.1 Soil Profile DKM-10 oph

Belonging to CPT	DKM-10 oph
Surface level in [m. reference level] :	5,00
Phreatic level in [m. reference level] :	0,40
Placement depth of foundation element in [m R.L.] =	5,00
Concentration value according to Frohlich [-] =	3
Number of layers in profile :	10

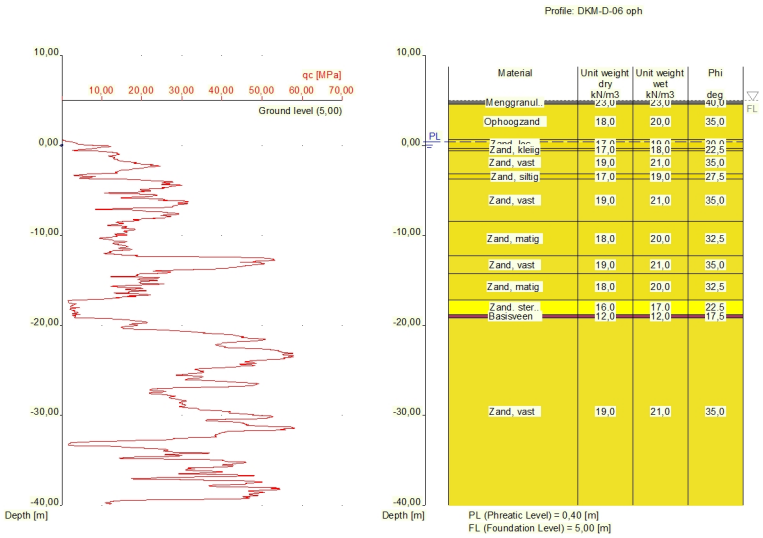


Number layer	Level top layer [m R.L.]	Gamma [kN/m3]	Gamma sat [kN/m3]	Phi [deg]	Cohesion [kPa]	f;undr [kPa]	Cc [-]	Ca [-]
1	5,000	23,00	23,00	40,00	0,00	0,00	0,00	0,00
2	4,600	18,00	20,00	35,00	0,00	0,00	0,00	0,00
3	0,680	17,00	19,00	30,00	0,00	0,00	0,01	0,00
4	-0,100	17,00	18,00	22,50	1,00	0,00	0,01	0,00
5	-0,300	19,00	21,00	35,00	0,00	0,00	0,00	0,00
6	-8,300	18,00	20,00	32,50	0,00	0,00	0,00	0,00
7	-12,200	19,00	21,00	35,00	0,00	0,00	0,00	0,00
8	-17,400	16,00	17,00	22,50	0,00	0,00	0,23	0,01
9	-19,000	12,00	12,00	17,50	3,00	20,00	0,46	0,02
10	-19,200	19,00	21,00	35,00	0,00	0,00	0,00	0,00

Number layer	Level top layer [m R.L.]	e0 [-]	Mate-rial type
1	5,000	0,26	Gravel
2	4,600	0,26	Sand
3	0,680	0,26	Sand
4	-0,100	0,26	Sand
5	-0,300	0,26	Sand
6	-8,300	0,26	Sand
7	-12,200	0,26	Sand
8	-17,400	0,00	Sand
9	-19,000	0,00	Peat
10	-19,200	0,26	Sand

2.6.2 Soil Profile DKM-D-06 oph

Belonging to CPT	DKM-D-06 oph
Surface level in [m. reference level] :	5,00
Phreatic level in [m. reference level] :	0,40
Placement depth of foundation element in [m R.L.] =	5,00
Concentration value according to Frohlich [-] =	3
Number of layers in profile :	13



Number layer	Level top layer [m R.L.]	Gamma [kN/m3]	Gamma sat [kN/m3]	Phi [deg]	Cohesion [kPa]	f;undr [kPa]	Cc [-]	Ca [-]
1	5,000	23,00	23,00	40,00	0,00	0,00	0,00	0,00
2	4,600	18,00	20,00	35,00	0,00	0,00	0,00	0,00
3	0,650	17,00	19,00	30,00	0,00	0,00	0,01	0,00
4	-0,300	17,00	18,00	22,50	1,00	0,00	0,01	0,00
5	-0,600	19,00	21,00	35,00	0,00	0,00	0,00	0,00
6	-3,200	17,00	19,00	27,50	0,00	0,00	0,01	0,00
7	-3,700	19,00	21,00	35,00	0,00	0,00	0,00	0,00
8	-8,400	18,00	20,00	32,50	0,00	0,00	0,00	0,00
9	-12,300	19,00	21,00	35,00	0,00	0,00	0,00	0,00
10	-14,300	18,00	20,00	32,50	0,00	0,00	0,00	0,00
11	-17,200	16,00	17,00	22,50	0,00	0,00	0,23	0,01
12	-18,800	12,00	12,00	17,50	3,00	20,00	0,46	0,02
13	-19,200	19,00	21,00	35,00	0,00	0,00	0,00	0,00

Number layer	Level top layer [m R.L.]	e0 [-]	Mate-rial type
1	5,000	0,26	Gravel
2	4,600	0,26	Sand
3	0,650	0,26	Sand
4	-0,300	0,26	Sand
5	-0,600	0,26	Sand
6	-3,200	0,26	Sand
7	-3,700	0,26	Sand
8	-8,400	0,26	Sand
9	-12,300	0,26	Sand
10	-14,300	0,26	Sand
11	-17,200	0,00	Sand
12	-18,800	0,00	Peat
13	-19,200	0,26	Sand

2.6.3 Slopes Data

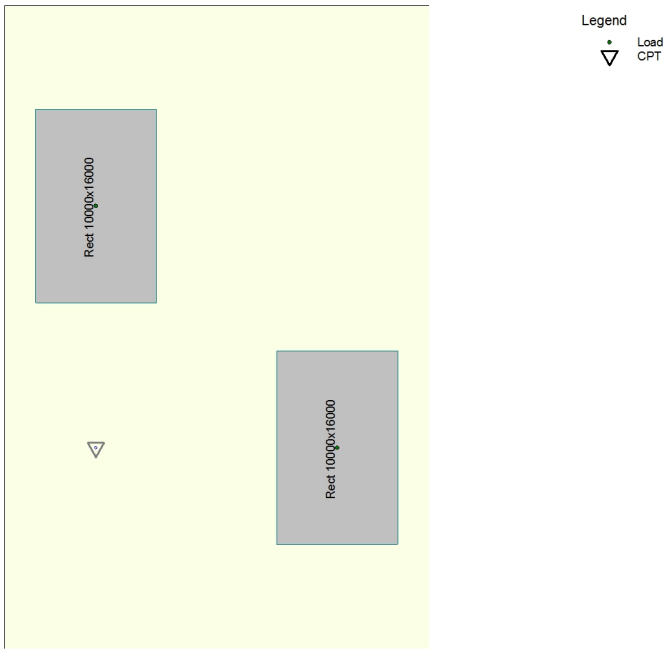
Slope Name	Berm Width (B) [m]	Slope Length (L) [m]	Slope Height (H) [m]
talud	3,00	10,00	4,65

2.7 Foundation Data

Element name	Element shape	Width [m]	Length [m]	Diameter [m]	Type
Rect 10000x1600...	Rectangular elem.	10,00	16,00	n.a.	Prefab

2.8 Foundation Plan

2.8.1 View of Foundation Plan



Element number/ name	Xm [m]	Ym [m]	angle [deg]	Matching type name	Matching profile name	Matching load name	Nearby slope
1: DKM10 ...	20,00	0,00	0,00	Rect 10000x16..	DKM-10 ...	10x16	talud
2: DKM6	0,00	20,00	0,00	Rect 10000x16..	DKM-D-...	10x16	talud

2.9 Load Data

2.9.1 Vertical Loads

Load	LS STR/GEO			SLS		
	eLat. [m]	eLong. [m]	Vd [kN]	eLat. [m]	eLong. [m]	Vd [kN]
10x16	0,00	0,00	40000,00	0,00	0,00	26720,00

2.9.2 Horizontal Loads

Load	LS STR/GEO		SLS		
	eH [m]	Hd [kN]	eH [m]	Hd [kN]	Kappa [deg]
10x16	0,00	4000,00	0,00	2672,00	45,00

2.10 Requirements

Limit state GEO
Maximum allowed settlement in [m] : 0,150

Maximum allowed (relative) rotation :	1 / 100
Serviceability Limit State	
Maximum allowed settlement in [m] :	0,150
Maximum allowed (relative) rotation :	1 / 300

2.11 Overruled Parameters

All parameters according to standard.

2.12 Model Options

Create intermediate results file
Do not use the interaction model.

3 Shallow Foundations (EC7-NL): Results of Verification

3.1 Verification of Limit State STR

Required by NEN-EN 9997-1:2012 section 2.4.7 / 2.4.8: Ed <= Cd.

3.1.1 Vertical Bearing Capacity, Undrained Situation

Found elem. name	Calc. case	Vd [kN]	Rd [kN]	Rd (Squeeze) [kN]	Fpull [kN]	Result of verification
DKM10	NONE					
DKM6	NONE					

- the highest value of Rd is used in the verification!
-Fpull (0.5 * w' * cu;d) is the tension force in the element per meter which should be handled by the element in case of squeeze (see last paragraph 6.5.2.2 NEN-9097-1 (r), NEN-EN).

3.1.2 Vertical Bearing Capacity, Drained Situation

Found elem. name	Calc. case	Vd [kN]	Rd [kN]	Vd (Punch) [kN]	Rd (Punch) [kN]	Result of verification
DKM10	Case C	40000,00	46985,82	56835,41	154322,15	PASSED
DKM6	Case C	40000,00	44205,35	56960,56	143814,61	PASSED

Note: both the situation with and without punch through are checked!

3.1.3 Horizontal Bearing Capacity

Found elem. name	Hd [kN]	Rd undrained [kN]	Rd drained [kN]	Result of verification undrained	Result of verification drained
DKM10	4000,00	0,00	8988,36	n.a.	PASSED
DKM6	4000,00	0,00	9065,66	n.a.	PASSED

3.1.4 Stability

Found elem. name	Minimum l' [m]	Minimum w' [m]	Phi`d [deg]	Tip over stability	Total stability
DKM10	16,00	10,00	30,26	PASSED	FAILED
DKM6	16,00	10,00	29,71	PASSED	FAILED

Note: When the check on the tip over stability failed, additional calculations taking into account a crack between foundation and subsoil are needed.
When the check on the total stability failed, additional calculations according to NEN-EN 9997-1:2012 chapter 11 are needed.

3.2 Verification of Limit State GEO

Required by NEN-EN 9997-1:2012 paragraaf 2.4.9; NEN-EN 9997-1: Sd <= Sreq.Sreq = 0,150 [m] Sd = s1;d + s2;d

3.2.1 Verification of Settlement at Limit State GEO

Found elem. name	s1 (20%) [m]	s1;gd (5%) [m]	s2 [m]	Result of verification (20%)	Result of verification (5%)
DKM10	0,037	0,067	0,000	PASSED	PASSED
DKM6	0,040	0,078	0,000	PASSED	PASSED

Note: the verification at 20% is demanded by the NEN, at 5% is recommended by Deltares!

The maximum increase in soil tension found while calculating the settlement, is100 % of the effective foundation pressure.

The interaction model is not used. Hence a comparisment at individual level of the different (types of) foundation elements is performed. Rotation is therefore not an issue.

3.3 Verification of Serviceability limit state

Required by NEN-EN 9997-1:2012 paragraaf 2.4.9; NEN-EN 9997-1: Sd <= Sreq.
For houses, the requirement is : Sreq = 0.05 m. For other types of superstructures a different (well considered) requirement can be specified.
Seq = 0,150 Sd = s1;d + s2;d

3.3.1 Verification of the Serviceability Limit State

Found elem. name	s1 (20%) [m]	s1;gd (5%) [m]	s2 [m]	Result of verification (20%)	Result of verification (5%)
DKM10	0,021	0,036	0,000	PASSED	PASSED
DKM6	0,023	0,041	0,000	PASSED	PASSED

Note: the verification at 20% is demanded by the NEN, at 5% is recommended by Deltares!

The maximum increase in soil tension found while calculating the settlement, is100 % of the effective foundation pressure.
The interaction model is not used. Hence a comparisment at individual level of the different (types of) foundation elements is performed. Rotation is therefore not an issue.

3.4 Additional Information

The maximum settlement at limit state GEO is 0,040 meter and
has been found at foundation element DKM6
The maximum settlement at the Serviceability Limit State is 0,023 meter and
has been found at foundation element DKM6

End of Report

Bijlage VII

Resultaten stabiliteitsanalyses

Bepalen rekenwaarden sterkteparameters grond

Projectlocatie:	Ijmijden	**BTG-projectnummer:**	2016-1438
Projectomschrijving:	Windpark Spuisluis te IJmuiden	**Profiel:**	S25A01441 DKMD06 en DKMD08
Opmerkingen:	t.b.v. stabiliteitsanalyse dijkovergang en kraanopstelplaats WTG02		

Invoer Parameters

Factor t.b.v. rekenwaarde hoek van inwendige wrijving	φ'	=	1,3	[-]
Factor t.b.v. rekenwaarde effective cohesie	c'	=	1,6	[-]
Factor t.b.v. ongedraineerde schuifsterkte	cu'	=	2	[-]

Bronnen

- NEN 9997-1+C1:2012 Tabel A.4a - Partiële factoren voor grondparameters (γ_M)
- Grondmechanica A. Verruijt (herzien door S. van Baars) H21 Schuifsterkte

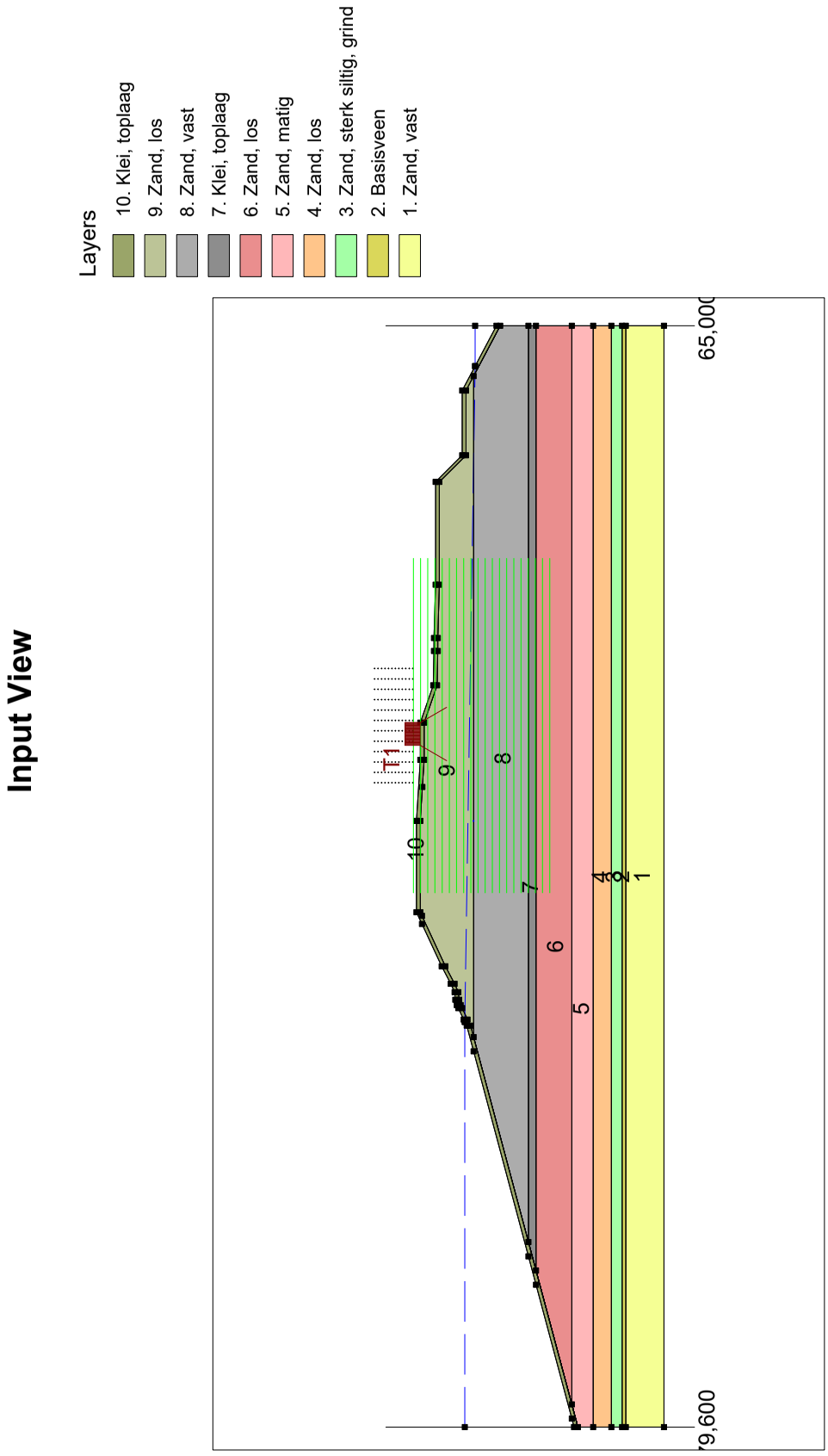
Gebruikte formules en grafieken

- Schuifsterkte (Coulomb):

Uitgangspunten bij opzet en gebruik rekensheet

Grondopbouw

Grondsoort	Droog/nat	Volumiek gewicht	Representatieve sterkteparameters			Rekenwaarden sterkteparameters		
		$\gamma_{uns}/\gamma_{sat}$	cu'	c'	φ'	cu'	c'	φ'
[-]	[-]	[kN/m^3]	[kPa]	[kPa]	[°]	[kPa]	[kPa]	[°]
Klei, toplaag	droog	16,0	50,0	5,0	17,5	25,0	3,1	13,6
	nat	16,0						
Zand, kleiig	droog	17,0	0,0	1,0	22,5	0,0	0,6	17,7
	nat	18,0						
Zand, los	droog	17,0	0,0	0,0	30,0	0,0	0,0	23,9
	nat	19,0						
Zand, matig	droog	18,0	0,0	0,0	32,5	0,0	0,0	26,1
	nat	20,0						
Zand, vast	droog	18,0	0,0	0,0	35,0	0,0	0,0	28,3
	nat	20,0						
Zand, sterk siltig, grindig	droog	16,0	0,0	0,0	22,5	0,0	0,0	17,7
	nat	17,0						
Basisveen	droog	12,0	20,0	2,0	17,5	10,0	1,3	13,6
	nat	12,0						
Ophoogzand	droog	18,0	0,0	0,0	35,0	0,0	0,0	28,3
	nat	20,0						
Klei, humeus	droog	15,0	25,0	2,0	17,5	12,5	1,3	13,6
	nat	15,0						
Zand, siltig	droog	17,0	0,0	0,0	27,5	0,0	0,0	21,8
	nat	19,0						
	droog					0,0	0,0	0,0
	nat							
	droog					0,0	0,0	0,0
	nat							
	droog					0,0	0,0	0,0
	nat							
	droog					0,0	0,0	0,0
	nat							
	droog					0,0	0,0	0,0
	nat							



D-Geo Stability 16.1 : Dijkovergang Binnentalud.sti

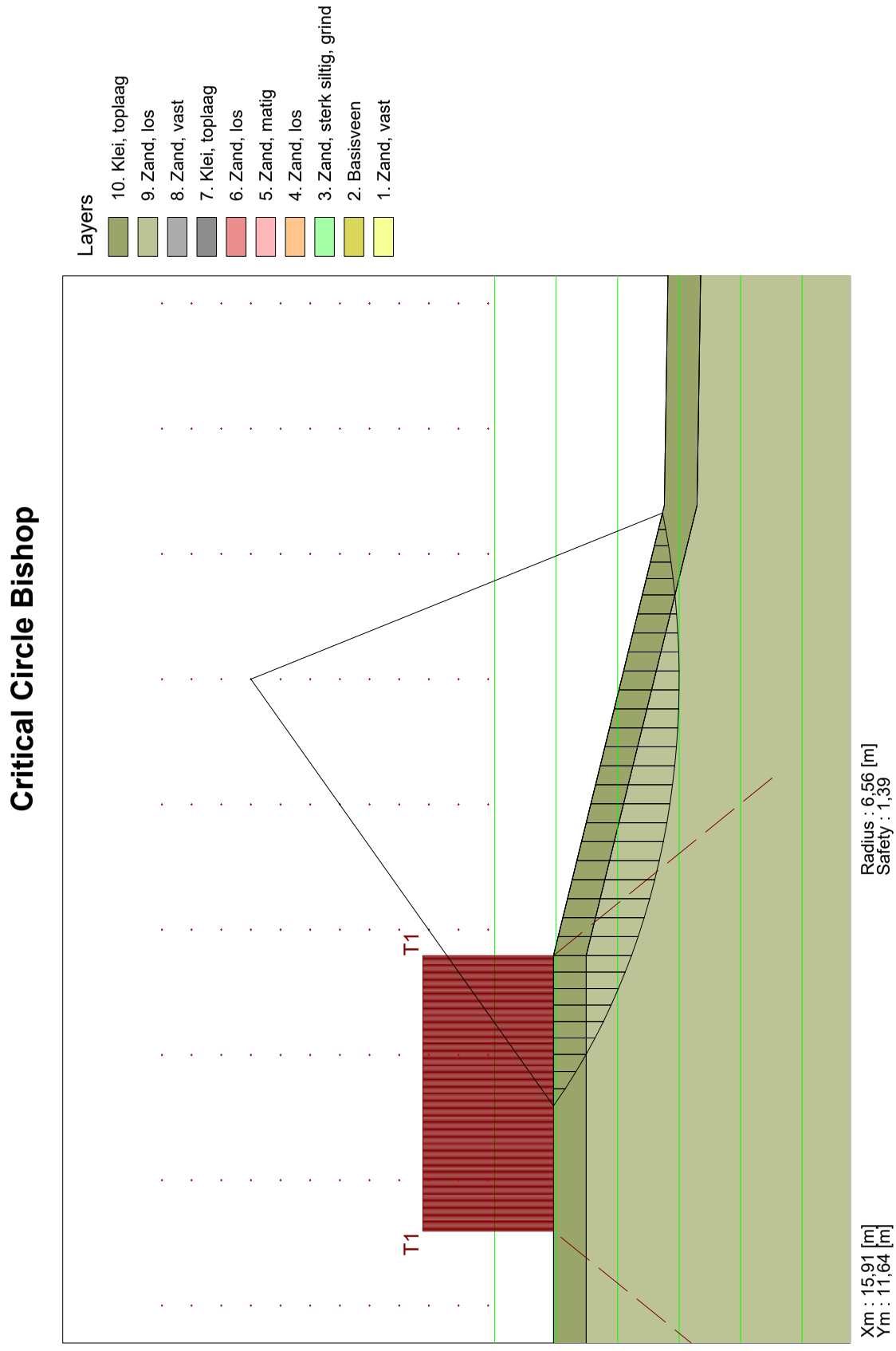
BT Geoconsult BV
INGENIEURSBUREAU
Neherkade 1
2521VA Den Haag
Phone 070-4159002
Fax 070-3077925

date	drw.
20-7-2016	LH

Windpark Spuisluis IJmuiden
Stabiliteitsanalyse

2015-1438	ctr.
Annex	form. A4

Dijkovergang (richting WTG1) binnentalud



D-Geo Stability 16.1 : Dijkovergang Binnentalud.sti

BT Geoconsult BV
INGENIEURSBUREAU
Neherkade 1
2521VA Den Haag
Phone 070-4159002
Fax 070-3077925

date	drw.
20-7-2016	LH

Windpark Spuisluis IJmuiden
Stabiliteitsanalyse

Dijkovergang (richting WTG1) binnentalud

2015-1438	ctr.
Annex	form. A4

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Program     : D-Geo Stability
Version     : 16.1.2.1
License     : Unknown
Company     : BT Geoconsult B.V.
Date        : 20-7-2016
Time        : 11:36:57

Output file : Z:\Projecten\2015-1438\03 Calc\03 Stab\Dijkovergang\Dijkovergang Binnentalud.sto
Input file  : Z:\Projecten\2015-1438\03 Calc\03 Stab\Dijkovergang\Dijkovergang Binnentalud.sti
==========================    BEGINNING OF DATA     ==========================


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


 Problem identification : Windpark Spuisluis IJmuiden
                        : Stabiliteitsanalyse

 Calculation model      : Bishop
 Default shear strength : C phi

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

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
  10  - X -  | -79.60   -78.48   -60.91   -57.17   -30.26   -26.90
  10  - Y -  | -13.20   -12.90    -8.20    -7.20     0.00     0.90
             |
  10  - X -  | -26.40   -26.10   -24.60   -24.20   -23.50   -22.50
  10  - Y -  |   1.15     1.30     2.00     2.20     2.40     2.50
             |
  10  - X -  | -21.40   -19.10   -13.54   -12.00     0.00     8.00
  10  - Y -  |   3.00     4.20     6.78     7.50     7.50     7.00
             |
  10  - X -  |  12.90    17.80    22.30    24.00    31.00    44.50
  10  - Y -  |   7.00     5.30     5.20     5.20     5.00     5.00
             |
  10  - X -  |  48.00    56.51    59.71    65.00
  10  - Y -  |   1.50     1.50    -0.20    -3.00
             |
   9  - X -  | -79.60   -76.61   -59.04   -55.31   -28.39   -26.90
   9  - Y -  | -13.70   -12.90    -8.20    -7.20     0.00     0.40
             |
   9  - X -  | -26.10   -24.60   -24.20   -23.50   -22.50   -21.40
   9  - Y -  |   0.80     1.50     1.70     1.90     2.00     2.50
             |
   9  - X -  | -19.10   -12.48   -12.00     0.00     4.44     8.00
   9  - Y -  |   3.70     6.78     7.00     7.00     6.72     6.50
             |
   9  - X -  |  12.90    17.80    22.30    24.00    31.00    44.50
   9  - Y -  |   6.50     4.80     4.70     4.70     4.50     4.50
             |
   9  - X -  |  48.00    56.50    56.51    58.39    65.00
   9  - Y -  |   1.00     1.00     1.00    -0.00    -3.50
             |
   8  - X -  | -79.60   -76.61   -59.04   -55.31   -28.39    58.39
   8  - Y -  | -13.70   -12.90    -8.20    -7.20     0.00    -0.00
             |
   8  - X -  |  65.00
   8  - Y -  |  -3.50
             |
   7  - X -  | -79.60   -76.61   -59.04   -55.31    65.00
   7  - Y -  | -13.70   -12.90    -8.20    -7.20    -7.20
             |
   6  - X -  | -79.60   -76.61   -59.04    65.00
   6  - Y -  | -13.70   -12.90    -8.20    -8.20
             |
   5  - X -  | -79.60   -76.61    65.00
   5  - Y -  | -13.70   -12.90   -12.90
             |
   4  - X -  | -79.60    65.00
   4  - Y -  | -15.70   -15.70
             |
   3  - X -  | -79.60    65.00
   3  - Y -  | -18.10   -18.10
```

2	- X -	-79.60 65.00
2	- Y -	-19.50 -19.50
1	- X -	-79.60 65.00
1	- Y -	-20.00 -20.00
0	- X -	-79.60 65.00
0	- Y -	-25.00 -25.00

PL-LINES
========

Pl-line no.		Co-ordinates [m]			
1	- X -	-79.60	-26.40	59.71	65.00
1	- Y -	1.15	1.15	-0.20	-0.20

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

FORBIDDEN LINES
===============

No forbidden lines were input.

SOIL PROPERTIES
===============

Layer no.	Material name
10	Klei, toplaag
9	Zand, los
8	Zand, vast
7	Klei, toplaag
6	Zand, los
5	Zand, matig
4	Zand, los
3	Zand, sterk siltig, grind
2	Basisveen
1	Zand, vast

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	Pl-line top	Pl-line bottom
10	16.00	16.00	1	1
9	17.00	19.00	1	1
8	19.00	21.00	1	1
7	16.00	16.00	1	1
6	17.00	19.00	1	1
5	18.00	20.00	1	1
4	17.00	19.00	1	1
3	16.00	17.00	1	1
2	12.00	12.00	1	1
1	19.00	21.00	1	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
10	3.10	13.60	-	-	-	-	-
9	0.00	23.90	-	-	-	-	-
8	0.00	28.30	-	-	-	-	-
7	3.10	13.60	-	-	-	-	-
6	0.00	23.90	-	-	-	-	-
5	0.00	26.10	-	-	-	-	-
4	0.00	23.90	-	-	-	-	-
3	0.00	17.70	-	-	-	-	-
2	1.30	13.60	-	-	-	-	-

1	0.00	28.30	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : 5.00 [m]
X co-ordinate grid right : 20.00 [m]
Number of grid points in X - direction : 12

Y co-ordinate grid bottom : 8.00 [m]
Y co-ordinate grid top : 13.00 [m]
Number of grid points in Y - direction : 12

Y co-ordinate tangent smallest circle : 7.90 [m]
Y co-ordinate tangent biggest circle : -10.00 [m]
Number of circles per grid point : 20

No fixed points input.

Total number of center points in the grid: 144
Total number of slip circles in the grid : 2880

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	20.00	9.90	12.90	30.00	Temporary

TREE ON SLOPE

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS

Layer number	Degree of consolidation
10	10
9	100
8	100
7	10
6	100
5	100
4	100
3	10
2	10
1	100

EARTHQUAKE

No earth quake factors were input.

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

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

Information on the critical circle : Fmin = 1.388
Calculation method used : Bishop - C phi
==========

X co-ordinate center point	:	15.91 [m]
Y co-ordinate center point	:	11.64 [m]
Radius of critical circle	:	6.56 [m]

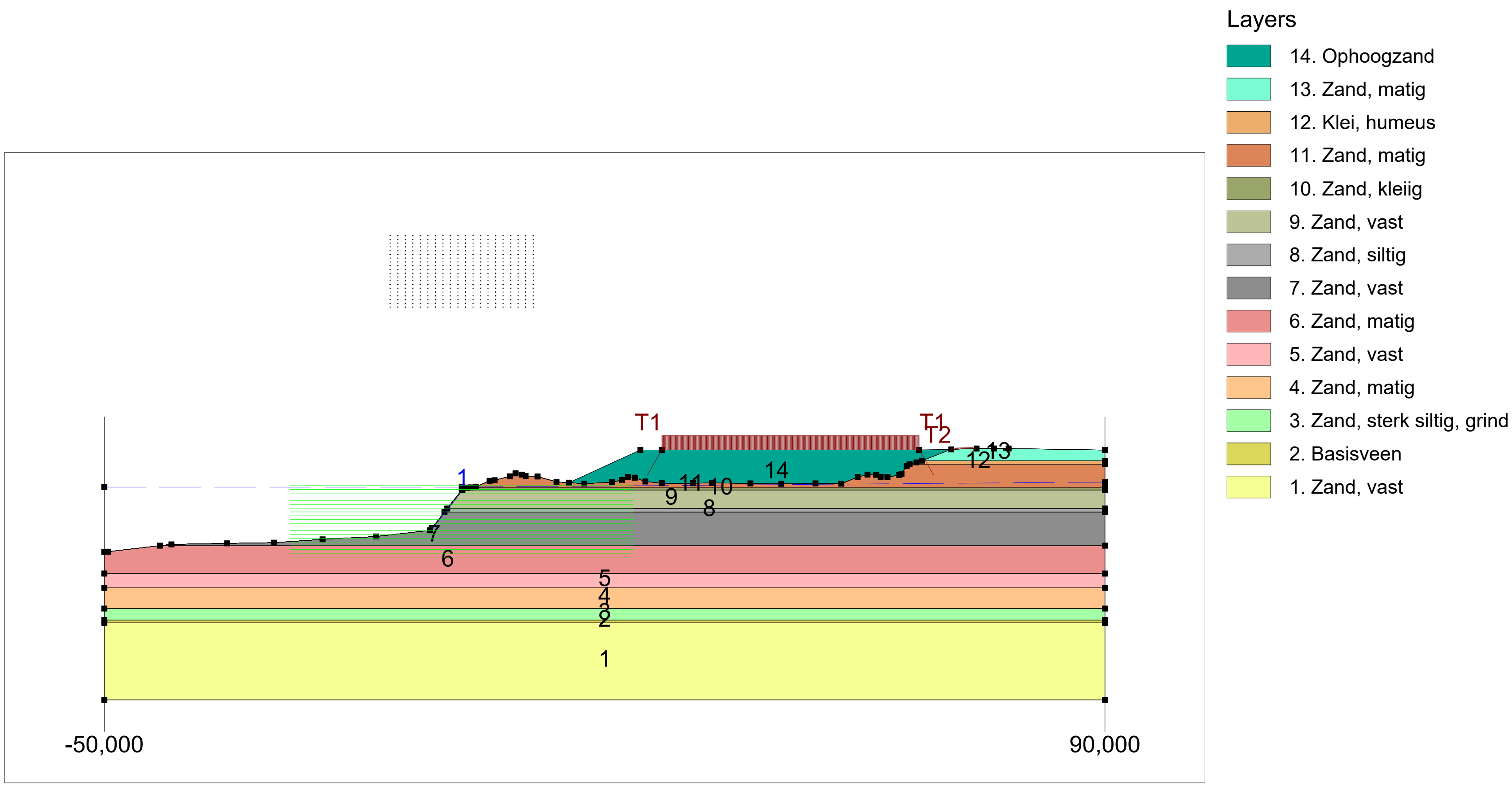
The center point of the critical circle is enclosed

Total driving moment	:	271.32 [kNm/m]
Driving moment free water	:	0.00 [kNm/m]
Driving moment external loads	:	125.18 [kNm/m]
Iterated resisting moment	:	376.52 [kNm/m]
Non-iterated resisting moment	:	363.97 [kNm/m]

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

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

Input View



D-Geo Stability 16.1 : kraanopstelplaats WTG02.sti

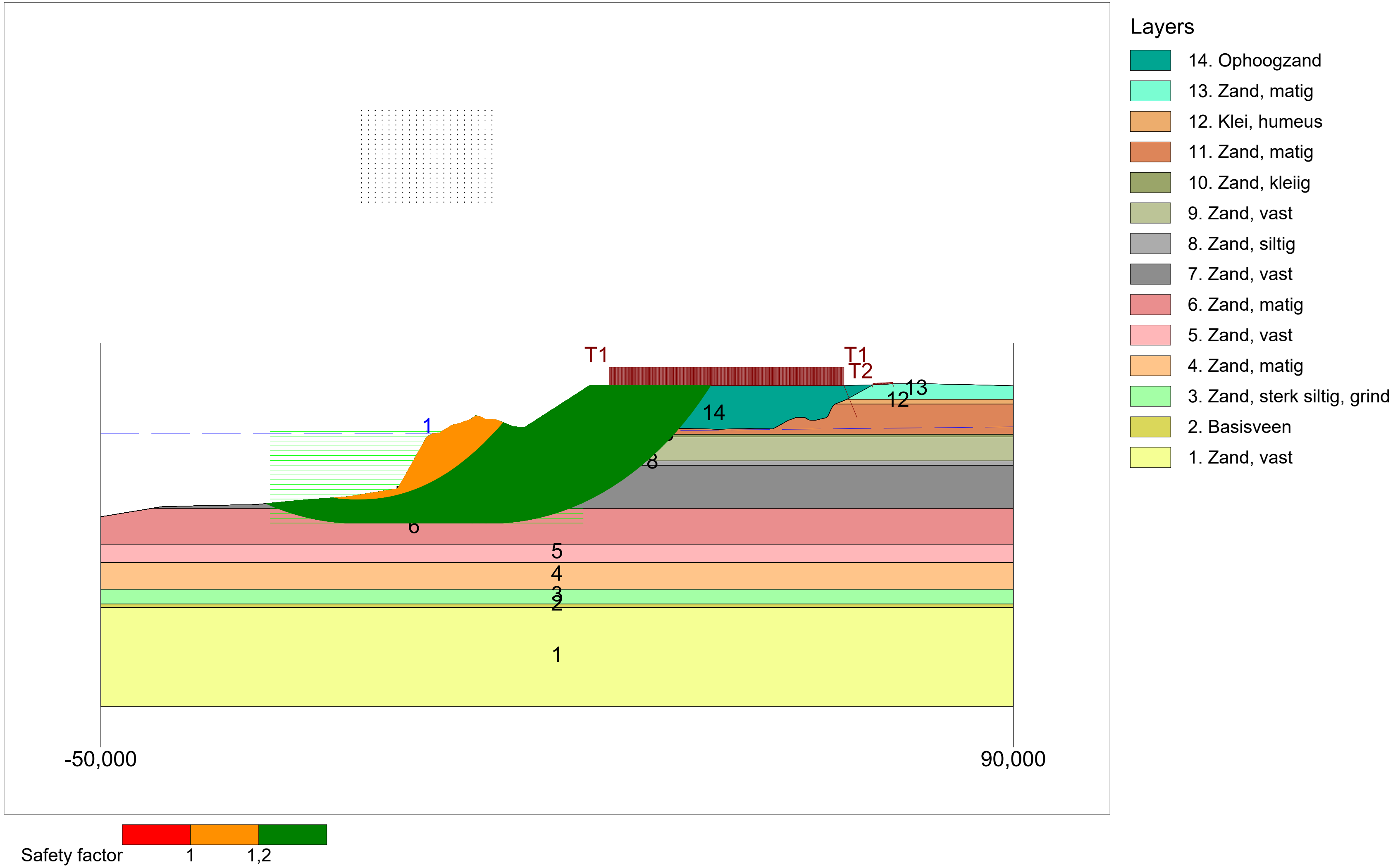
Kraanopstelplaats WTG02

Windpark Spuisluis IJmuiden
Stabiliteitsanalyse

BT Geoconsult BV
Neherkade 1
2521VA Den Haag
Phone 070-4159002
Fax 070-3077925

date	20-7-2016	drw. LH
	2015-1438	ctr.
Annex	-	form. A4

Safety Overview



D-Geo Stability 16.1 : kraanopstelplaats WTG02.sti

BT Geoconsult BV
Neherkade 1
2521VA Den Haag
Phone 070-4159002
Fax 070-3077925

Windpark Spuisluis IJmuiden
Stabiliteitsanalyse

Kraanopstelplaats WTG02

date	20-7-2016
	2015-1438
Annex	-
drw.	LH
ctr.	
form.	A4

```
Program     : D-Geo Stability
Version     : 16.1.2.1
License     : Unknown
Company     : BT Geoconsult B.V.
Date        : 20-7-2016
Time        : 11:31:56

Output file : Z:\Projecten\2015-1438\03 Calc\03 Stab\Kraanopstelplaats WTG02\kraanopstelplaats
Input file  : Z:\Projecten\2015-1438\03 Calc\03 Stab\Kraanopstelplaats WTG02\kraanopstelplaats
==========================    BEGINNING OF DATA     ==========================


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


 Problem identification : Windpark Spuisluis IJmuiden
                        : Stabiliteitsanalyse

 Calculation model      : Bishop
 Default shear strength : C phi

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

 Boundary no.| Co-ordinates [m]
 ------------|-----------------------------------------------------
             |
  14  - X -  | -50.00   -49.49   -42.24   -40.62   -32.83   -26.28
  14  - Y -  |  -9.29    -9.25    -8.40    -8.21    -8.07    -7.98
             |
  14  - X -  | -19.46   -11.95    -4.43    -2.42    -2.02     0.00
  14  - Y -  |  -7.52    -7.11    -6.25    -3.70    -3.20    -0.64
             |
  14  - X -  |   0.09     0.76     0.83     1.29     2.02     3.89
  14  - Y -  |  -0.60    -0.30    -0.27    -0.24    -0.14     0.69
             |
  14  - X -  |   4.61     6.74     7.54     8.43     8.93    10.60
  14  - Y -  |   0.77     1.31     1.72     1.55     1.34     1.28
             |
  14  - X -  |  13.25    15.00    25.00    28.00    64.00    68.48
  14  - Y -  |   0.52     0.42     5.00     5.00     5.00     5.09
             |
  14  - X -  |  72.04    74.47    76.52    90.00
  14  - Y -  |   5.20     5.21     5.21     4.99
             |
  13  - X -  | -50.00   -49.49   -42.24   -40.62   -32.83   -26.28
  13  - Y -  |  -9.29    -9.25    -8.40    -8.21    -8.07    -7.98
             |
  13  - X -  | -19.46   -11.95    -4.43    -2.42    -2.02     0.00
  13  - Y -  |  -7.52    -7.11    -6.25    -3.70    -3.20    -0.64
             |
  13  - X -  |   0.09     0.76     0.83     1.29     2.02     3.89
  13  - Y -  |  -0.60    -0.30    -0.27    -0.24    -0.14     0.69
             |
  13  - X -  |   4.61     6.74     7.54     8.43     8.93    10.60
  13  - Y -  |   0.77     1.31     1.72     1.55     1.34     1.28
             |
  13  - X -  |  13.25    15.00    17.15    21.01    22.43    23.24
  13  - Y -  |   0.52     0.42     0.29     0.49     0.81     1.22
             |
  13  - X -  |  24.22    25.69    28.01    32.36    35.01    40.41
  13  - Y -  |   1.12     0.59     0.34     0.34     0.38     0.32
             |
  13  - X -  |  44.73    49.50    53.10    55.42    56.78    57.99
  13  - Y -  |   0.25     0.32     0.27     1.20     1.55     1.53
             |
  13  - X -  |  58.63    59.56    61.21    61.53    62.26    62.66
  13  - Y -  |   1.25     1.21     1.49     1.65     2.75     3.00
             |
  13  - X -  |  63.63    64.43    68.48    72.04    74.47    76.52
  13  - Y -  |   3.26     3.50     5.09     5.20     5.21     5.21
             |
  13  - X -  |  90.00
  13  - Y -  |   4.99
             |
  12  - X -  | -50.00   -49.49   -42.24   -40.62   -32.83   -26.28
  12  - Y -  |  -9.29    -9.25    -8.40    -8.21    -8.07    -7.98
```

12 - X -	-19.46	-11.95	-4.43	-2.42	-2.02	0.00
12 - Y -	-7.52	-7.11	-6.25	-3.70	-3.20	-0.64
12 - X -	0.09	0.76	0.83	1.29	2.02	3.89
12 - Y -	-0.60	-0.30	-0.27	-0.24	-0.14	0.69
12 - X -	4.61	6.74	7.54	8.43	8.93	10.60
12 - Y -	0.77	1.31	1.72	1.55	1.34	1.28
12 - X -	13.25	15.00	17.15	21.01	22.43	23.24
12 - Y -	0.52	0.42	0.29	0.49	0.81	1.22
12 - X -	24.22	25.69	28.01	32.36	35.01	40.41
12 - Y -	1.12	0.59	0.34	0.34	0.38	0.32
12 - X -	44.73	49.50	53.10	55.42	56.78	57.99
12 - Y -	0.25	0.32	0.27	1.20	1.55	1.53
12 - X -	58.63	59.56	61.21	61.53	62.26	62.66
12 - Y -	1.25	1.21	1.49	1.65	2.75	3.00
12 - X -	63.63	64.43	90.00			
12 - Y -	3.26	3.50	3.50			
11 - X -	-50.00	-49.49	-42.24	-40.62	-32.83	-26.28
11 - Y -	-9.29	-9.25	-8.40	-8.21	-8.07	-7.98
11 - X -	-19.46	-11.95	-4.43	-2.42	-2.02	0.00
11 - Y -	-7.52	-7.11	-6.25	-3.70	-3.20	-0.64
11 - X -	0.09	0.76	0.83	1.29	2.02	3.89
11 - Y -	-0.60	-0.30	-0.27	-0.24	-0.14	0.69
11 - X -	4.61	6.74	7.54	8.43	8.93	10.60
11 - Y -	0.77	1.31	1.72	1.55	1.34	1.28
11 - X -	13.25	15.00	17.15	21.01	22.43	23.24
11 - Y -	0.52	0.42	0.29	0.49	0.81	1.22
11 - X -	24.22	25.69	28.01	32.36	35.01	40.41
11 - Y -	1.12	0.59	0.34	0.34	0.38	0.32
11 - X -	44.73	49.50	53.10	55.42	56.78	57.99
11 - Y -	0.25	0.32	0.27	1.20	1.55	1.53
11 - X -	58.63	59.56	61.21	61.53	62.26	62.66
11 - Y -	1.25	1.21	1.49	1.65	2.75	3.00
11 - X -	90.00					
11 - Y -	3.00					
10 - X -	-50.00	-49.49	-42.24	-40.62	-32.83	-26.28
10 - Y -	-9.29	-9.25	-8.40	-8.21	-8.07	-7.98
10 - X -	-19.46	-11.95	-4.43	-2.42	-2.02	0.00
10 - Y -	-7.52	-7.11	-6.25	-3.70	-3.20	-0.64
10 - X -	0.09	0.76	90.00			
10 - Y -	-0.60	-0.30	-0.30			
9 - X -	-50.00	-49.49	-42.24	-40.62	-32.83	-26.28
9 - Y -	-9.29	-9.25	-8.40	-8.21	-8.07	-7.98
9 - X -	-19.46	-11.95	-4.43	-2.42	-2.02	0.00
9 - Y -	-7.52	-7.11	-6.25	-3.70	-3.20	-0.64
9 - X -	0.09	90.00				
9 - Y -	-0.60	-0.60				
8 - X -	-50.00	-49.49	-42.24	-40.62	-32.83	-26.28
8 - Y -	-9.29	-9.25	-8.40	-8.21	-8.07	-7.98
8 - X -	-19.46	-11.95	-4.43	-2.42	-2.02	90.00
8 - Y -	-7.52	-7.11	-6.25	-3.70	-3.20	-3.20
7 - X -	-50.00	-49.49	-42.24	-40.62	-32.83	-26.28
7 - Y -	-9.29	-9.25	-8.40	-8.21	-8.07	-7.98

7	- X -	-19.46	-11.95	-4.43	-2.42	90.00
7	- Y -	-7.52	-7.11	-6.25	-3.70	-3.70
6	- X -	-50.00	-49.49	-42.24	90.00	
6	- Y -	-9.29	-9.25	-8.40	-8.40	
5	- X -	-50.00	90.00			
5	- Y -	-12.30	-12.30			
4	- X -	-50.00	90.00			
4	- Y -	-14.30	-14.30			
3	- X -	-50.00	90.00			
3	- Y -	-17.20	-17.20			
2	- X -	-50.00	90.00			
2	- Y -	-18.80	-18.80			
1	- X -	-50.00	90.00			
1	- Y -	-19.20	-19.20			
0	- X -	-50.00	90.00			
0	- Y -	-30.00	-30.00			

PL-LINES

Pl-line no.		Co-ordinates [m]				
1	- X -	-50.00	0.00	90.00		
1	- Y -	-0.20	-0.20	0.50		

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

FORBIDDEN LINES

Line number	X-start [m]	Y-start [m]	X-end [m]	Y-end [m]
1	0.11	-0.69	-4.32	-6.30

SOIL PROPERTIES

Layer no.	Material name
14	Ophoogzand
13	Zand, matig
12	Klei, humeus
11	Zand, matig
10	Zand, kleiig
9	Zand, vast
8	Zand, siltig
7	Zand, vast
6	Zand, matig
5	Zand, vast
4	Zand, matig
3	Zand, sterk siltig, grind
2	Basisveen
1	Zand, vast

Layer number	Gam usat [kN/m3]	Gam sat [kN/m3]	Pl-line top	Pl-line bottom
14	18.00	20.00	1	1

13	18.00	20.00	1	1
12	15.00	15.00	1	1
11	18.00	20.00	1	1
10	17.00	18.00	1	1
9	19.00	21.00	1	1
8	17.00	19.00	1	1
7	19.00	21.00	1	1
6	18.00	20.00	1	1
5	19.00	21.00	1	1
4	18.00	20.00	1	1
3	16.00	17.00	1	1
2	12.00	12.00	1	1
1	19.00	21.00	1	-

Layer number	Cohesion [kN/m2]	Phi [degrees]	Cu/Pc [-]	POP [kN/m2]	Cu top [kN/m2]	Cu bot. [kN/m2]	Cu grad. [kN/m2/m]
14	0.00	28.30	-	-	-	-	-
13	0.00	26.10	-	-	-	-	-
12	1.30	13.60	-	-	-	-	-
11	0.00	26.10	-	-	-	-	-
10	0.60	17.70	-	-	-	-	-
9	0.00	28.30	-	-	-	-	-
8	0.00	21.80	-	-	-	-	-
7	0.00	28.30	-	-	-	-	-
6	0.00	26.10	-	-	-	-	-
5	0.00	28.30	-	-	-	-	-
4	0.00	26.10	-	-	-	-	-
3	0.00	17.70	-	-	-	-	-
2	1.30	13.60	-	-	-	-	-
1	0.00	28.30	-	-	-	-	-

No degree of consolidation <> 100% input.

CENTER POINT GRID AND TANGENT LINES

X co-ordinate grid left : -10.00 [m]
X co-ordinate grid right : 10.00 [m]
Number of grid points in X - direction : 20

Y co-ordinate grid bottom : 25.00 [m]
Y co-ordinate grid top : 35.00 [m]
Number of grid points in Y - direction : 20

Y co-ordinate tangent smallest circle : 0.00 [m]
Y co-ordinate tangent biggest circle : -10.00 [m]
Number of circles per grid point : 20

No fixed points input.

Total number of center points in the grid: 400
Total number of slip circles in the grid : 8000

LINE LOADS

No line loads input.

UNIFORM LOAD

Uniform load number	Magnitude [kN/m]	X start [m]	X end [m]	Distrib. degrees	Load Type
1	250.00	28.00	64.00	30.00	Temporary
2	20.00	68.48	71.48	30.00	Temporary

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

No tree on slope was input.

DEGREE OF CONSOLIDATION : TEMPORARY LOADS
==========

Layer number	Degree of consolidation
14	100
13	100
12	10
11	100
10	10
9	100
8	100
7	100
6	100
5	100
4	100
3	10
2	10
1	100

EARTHQUAKE
==========

No earth quake factors were input.

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

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

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

New grid with : X minimum = -11.05 [m]
X maximum = 8.95 [m]
Y minimum = 24.47 [m]
Y maximum = 34.47 [m]

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

New grid with : X minimum = -11.05 [m]
X maximum = 8.95 [m]
Y minimum = 23.95 [m]
Y maximum = 33.95 [m]

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

New grid with : X minimum = -11.05 [m]
X maximum = 8.95 [m]
Y minimum = 23.42 [m]
Y maximum = 33.42 [m]

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

New grid with : X minimum = -11.05 [m]
X maximum = 8.95 [m]
Y minimum = 22.89 [m]
Y maximum = 32.89 [m]

```
Information on the critical circle  : Fmin =      1.077
Calculation method used             : Bishop - C phi
================================================================================

X co-ordinate center point      :       -10.00 [m]
Y co-ordinate center point      :        23.42 [m]
Radius of critical circle       :        30.26 [m]

The center point of the critical circle is enclosed

Total driving moment            :     -7313.71 [kNm/m]
Driving moment free water       :      4079.21 [kNm/m]
Driving moment external loads   :         0.00 [kNm/m]
Iterated resisting moment       :      7880.31 [kNm/m]
Non-iterated resisting moment   :      7767.08 [kNm/m]


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


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