CHECK CALCULATION PIPEBRIDGE OVER ROAD

Chemours Netherlands BV – vestiging Dordrecht

FOC AIR ABATEMENT

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Revision record
Write Initial & Surname in full in the last 3 columns

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	Name	Date	Sign
Made by	2E [redacted]	25/03/2021	
Checked by	2E [redacted]	25/03/2021	C. Kortleve
Approved by			

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1. PURPOSE/INTRODUCTION

This document is part of the project "Foc Air Abetement" on the terrein of Chemours located on the Baanhoekweg 22 in Dordrecht.

Document scope

- Within this project an existing pipe bridge over a road must be checked on new pipe loads.
- This document contains the preliminary check of this structure. Loads are preliminary and will be finilized in next project phase. After final loads, this structure must be checked on the final loads. This is a firtst check.

1.1 Terrain overview

Figure 1: Terrain overview

1.2 Project location

The figure below shows the location of the existing pipebridge over the road.

Figure 2: project location

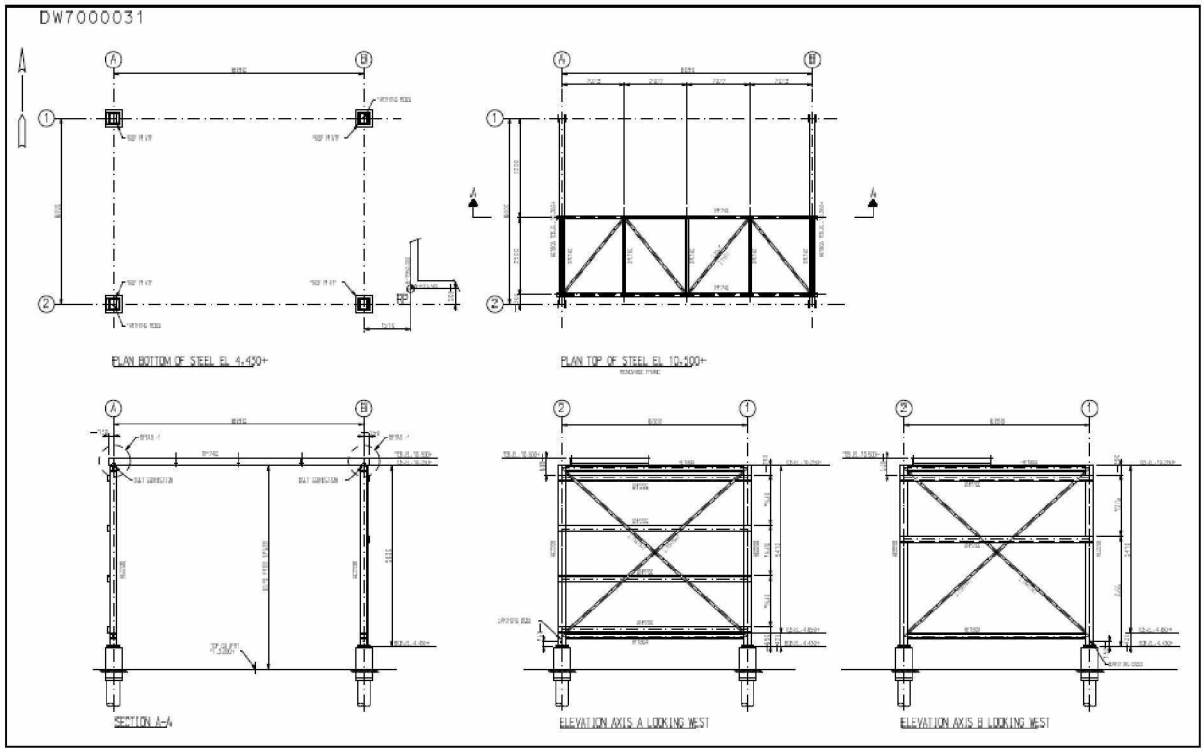


Figure 3: existing pipebridge

2. BASIS OF DESIGN

2.1 Design Codes and Standards

Number code	Title
NEN-EN 1990 NA	Basis of structural design
NEN-EN 1991 NA	Actions on structures – Densities, self-weight, imposed loads for buildings
NEN-EN 1992 NA	Design of concrete structures – General rules and rules for buildings
NEN-EN 1993 NA	Design of steel structures

2.2 Consequence Class and Partial Factors

2.2.1 New foundation

The foundation is classified in: Consequence Class 2

Load factors ultimate limit state (ULS)

- Permanent loads γ_g = 0,9 / 1,35 / 1,2
- Variable loads γ_g = 1,5

Load factors service limit state (SLS)

- Permanent loads γ_g = 1,0
- Variable loads γ_g = 1,0

2.2.2 Existing structures - pipebridge

Classification of the construction according NEN-EN 1990 + NA in consequence class CC2.

However, for the check of the existing structure load factors of CC2 (without NEN8700) are used, this is a conservative approach.

- Note: (structure date according construction drawings 2015):

2.3 Materials

Structural steel S235

Concrete C30/37

Reinforcement FeB500

2.4 Fire resistance

Fire resistance for the structure = 0 (zero) minutes.

2.5 Anti collision

The existing structure is protected by a guardrail.

2.6 Loads

The following loads are applicable:

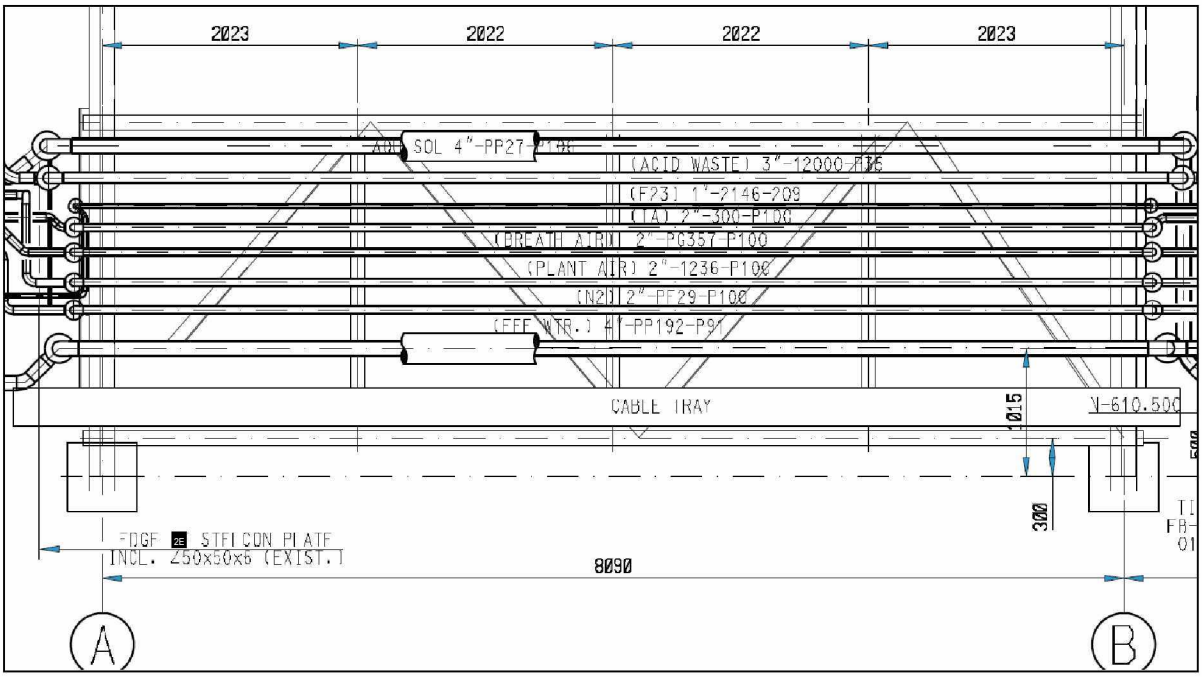
2.6.1 Self weight (permanent load)

Self weight of the modeled structure will automatically be generated by the software SCIA Engineer.

- Concrete 25 kN/m^3
- Steel 78,5 kN/m^3
- Water 10 kN/m^3

2.6.2 Piping loads

The figure below shows the top view of the pipe bridge and indicates the current pipes.



For this calculation, the complete width of 2500 mm is calculated with water filled 4" pipes. This is a conservative approach.

NPS	DN	OD	Pipe schedule	Max. span	Self weight pipe	Self weigth pipe filled with water	Vertical load	Vertical load	Horizontal load	Horizontal load with water
				[1]	[2]	[3]	Fv,1 = [1] * [2]	Fv,2 = [1] * [3]	Fh,1 = Fv,1 *µ	Fh,1 = Fv,2 *µ
[Inch]	[mm]	[mm]	[mm]	[mm]	[kg/m]	[kg/m]	[kN]	[kN]	[kN]	[kN]
2	25	60,3	40	5810	5,442	7,61	0,3	0,4	0,1	0,1
3	80	88,9	40	7290	11,286	16,06	0,8	1,2	0,2	0,4
4	100	114,3	40	8220	16,075	24,29	1,3	2,0	0,4	0,6
6	150	168,3	40	9880	28,267	46,91	2,8	4,6	0,8	1,4
8	200	219,1	40	11220	42,54	74,81	4,8	8,4	1,4	2,5
10	250	273	40	11620	60,31	111,18	7,0	12,9	2,1	3,9
12	300	323,8	STD	12340	73,84	146,8	9,1	18,1	2,7	5,4
Friction coeficient			µ		0,3 [-]					

Assume bridge full of 4" pipes
Width bridge B 2500 mm
Outer pipe diameter 114 mm
Max pipes in B 21,92982 -> 21 pipes
Span 8,1 m
Area 20,25 m2

	Vertical pipe loads							
	Mass	Weight	Span	Load	Max pipes	Total load	Area	SCIA Loads
		(A)	(B)	C= A*B	D	E=C*D	F	G = E/F
	kg/m	kN/m	[m]	[kN]	[-]	[kN]	[m2]	[kN/m2]
SW	16,075	0,16075	8,1	1,30	21	27,343575	20,25	**1,35**
SW+Water	24,29	0,2429	8,1	1,97	21	41,31729	20,25	**2,04**

- Note: pipe bridge has been calculated with a vertical piping load of **2,0 kN/m²**.
- Vertical loads
  - Vertical line load = span * load = 2,02 m * 2,0 kN/m² = **4,0 kN/m.**
  - Loads are taken into account as variable loads (conservative approach).
- Horizontal loads
  - Maximum horizontal piping load = vertical load * μ = 4,0 *0,3 = **1,2 kN/m.**
  - Loads are taken into account as variable loads (conservative approach).
  - Loads are not combined with wind loads, according Fluor guideline and international standards.

2.6.3 Wind loads (variable load)

Wind loads are based on NEN-EN 1991-1-4.

- Environmental conditions, wind area II, non build environmental.
- Maximum vessel height (H) 6 m
- Wind pressure (p_w) 0,71 kN/m²
- Form factor vessel (c_f) 2,0 (angle profiles)
- Load combination factors for wind (ψ_0 = 0,0; ψ_1 = 0,2; ψ_2 = 0,0).

Profile	Max [b,h] [mm]	c_f [-]	p_w [kN/m²]	Q [kN/m]
HEB220	220	2,0	0,71	0,31 -> 0,3
HEA180	180	2,0	0,71	0,26 -> 0,3
UNP200	200	2,0	0,71	0,28 -> 0,3
L75*7	75	2,0	0,71	0,1 -> 0,1

Note:

- q = max[b,h] *cf*pw
- b = profile width
- h = profile height

3. DIMENSIONS

For the structural drawings, see annex B.

Top view

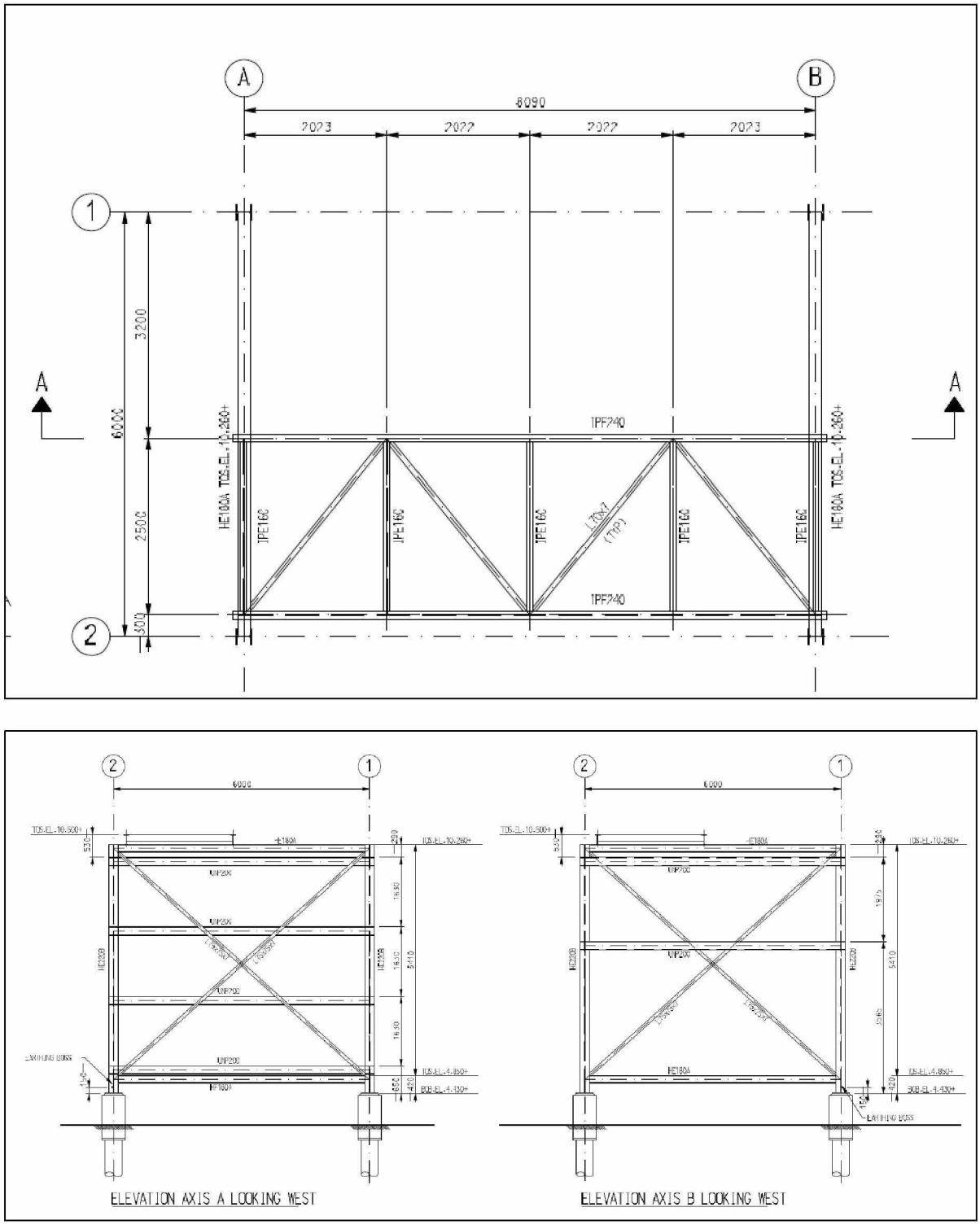


Figure 4: existing pipebridge

4. CALCULATION MODEL

For the calculation the 3D design software SCIA Engineer has been used. Calculation model has based on the following criteria:

- The new foundation has been modeled as a plate (isotropic stiffness).
- Structure stability:
  - Stability elements in Y direction.
  - Columns are cantilevers in X direction.
- Piles are modeled as:
  - Hinge supports in the Y direction.
  - Moment connections X direction.
- Calculation type: linear elastic analysis.
- UNP profiles no main steel structure, SCIA model only contains main steel.
- In Annex A, the SCIA in- and output can be found.

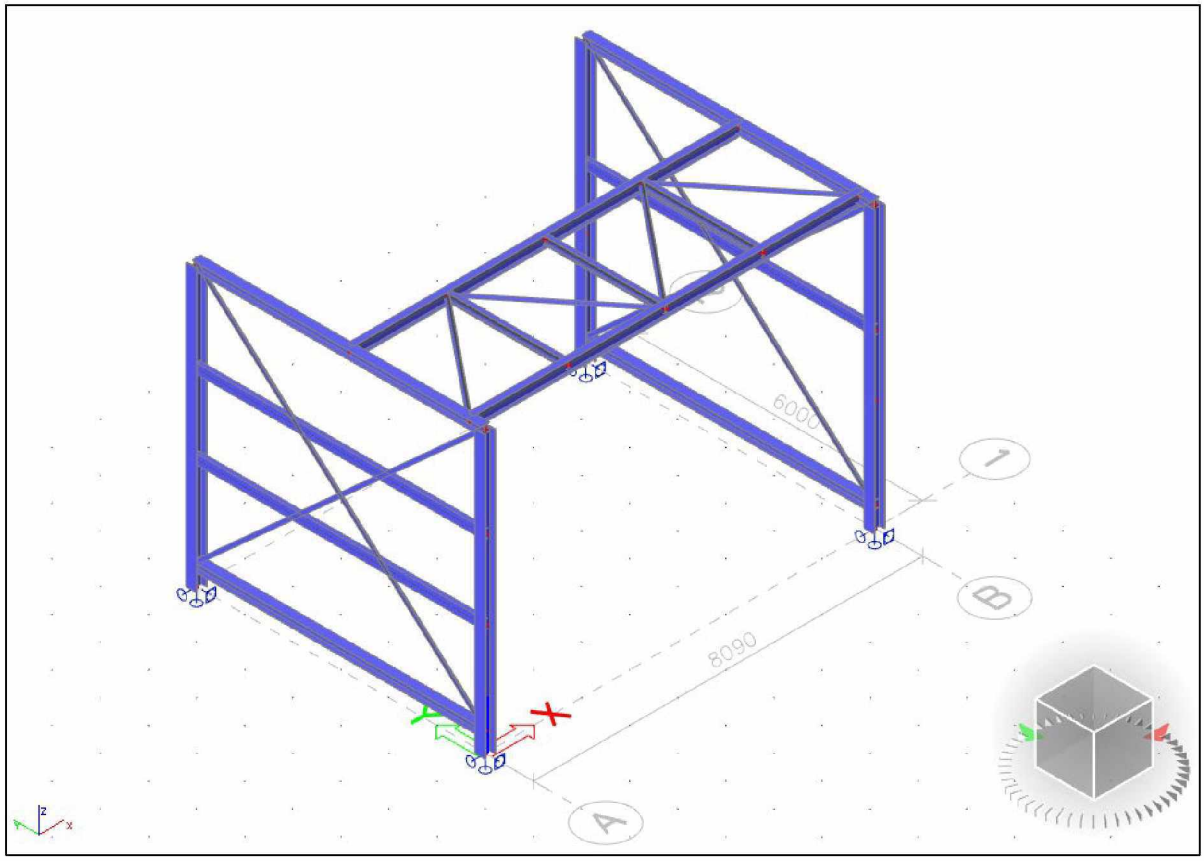


Figure 5: calculation model

4.1 Loads and load cases

See annex A.

4.2 Combinations

The load combinations are according NEN-EN-1990:

- For ULS, formula 6.10a and 6.10b.
- For SLS, formula 6.14a (characteristic load combination for displacements check).

For load combinations, see annex A.

4.3 Summarizing calculation results

Results can be found in annex [redacted] main results are summarized in this paragraph.

[redacted] Piling loads

Pile loads

	Vertical	Horizontal		Torsion	Bending moment	
	Rz	Rx	Ry	Mx	My	Mz
	[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
All piles	**50 (compr.) 0 (tension)**	**9**	**5**	**0**	**50,2**	**0**

- For results, see annex A.
- Note: moment on pile = 50,2 kNm + (√(9^2+5^2)) * 1 m = 61 kNm
- Note: pile moments 61 kNm < 65 kNm -> anchor loads are not changed.

Pile capacities

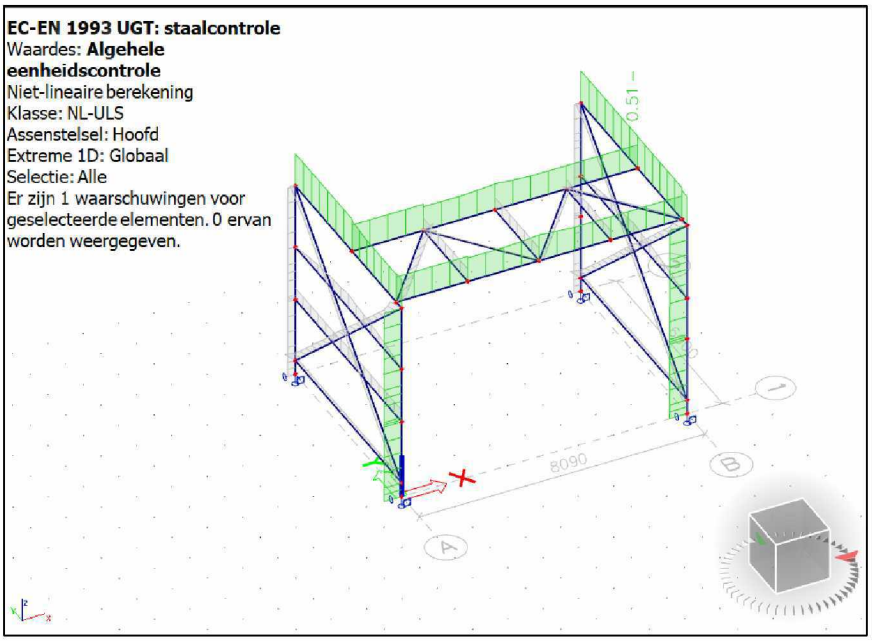
PILING SCHEDULE

PILE NUMBER	SCHAFT/TIP DIAM MM (millimetres)	PILE LENGTH (APPROX) M (metres)	CUT OFF ELEVATION N.A.P. M (metres)	TIP ELEVATION N.A.P. M (metres)	DESIGN LOAD KN				CAPACITY KN			
					COMPRES	TENSION	HOR.	MOMENT IN PILE HEAD	COMPRES	TENSION	HOR.	MOMENT IN PILE HEAD
1	ø406/ø560	17.430	+3.430	−14.000	50	10	15	65	250	30	15	80
2	ø406/ø560	17.430	+3.430	−14.000	50	10	15	65	250	30	15	80
3	ø406/ø560	17.430	+3.430	−14.000	50	10	15	65	250	30	15	80
4	ø406/ø560	17.430	+3.430	−14.000	50	10	15	65	250	30	15	80

- For reference, see annex B.

Conclusion: calculated design pile loads (ULS) are lower than the pile capacities, meet the strength requirements.

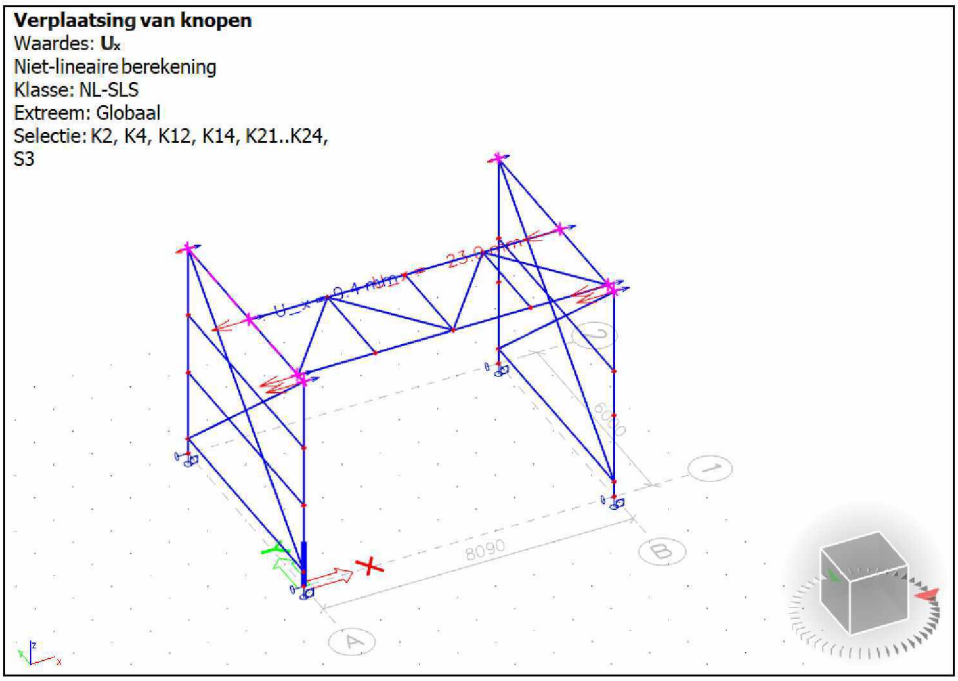
4.3.2 Steel checks – ULS



Conclusion: maximum UC (ULS) is 0,51 < 1,0 -> meets the strength requirements.

4.3.3 Steel checks – SLS

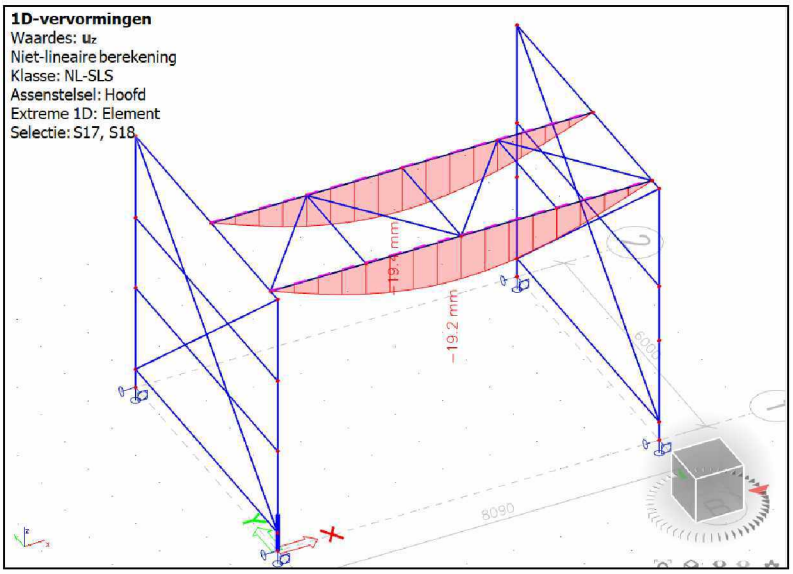
Horizontal displacements



Allowable : h/150 = 39 mm

Conclusion: calculated displacements are lower than the allowable displacements -> meet the requirements.

Vertical displacements



Allowable : L/250 = 32 mm

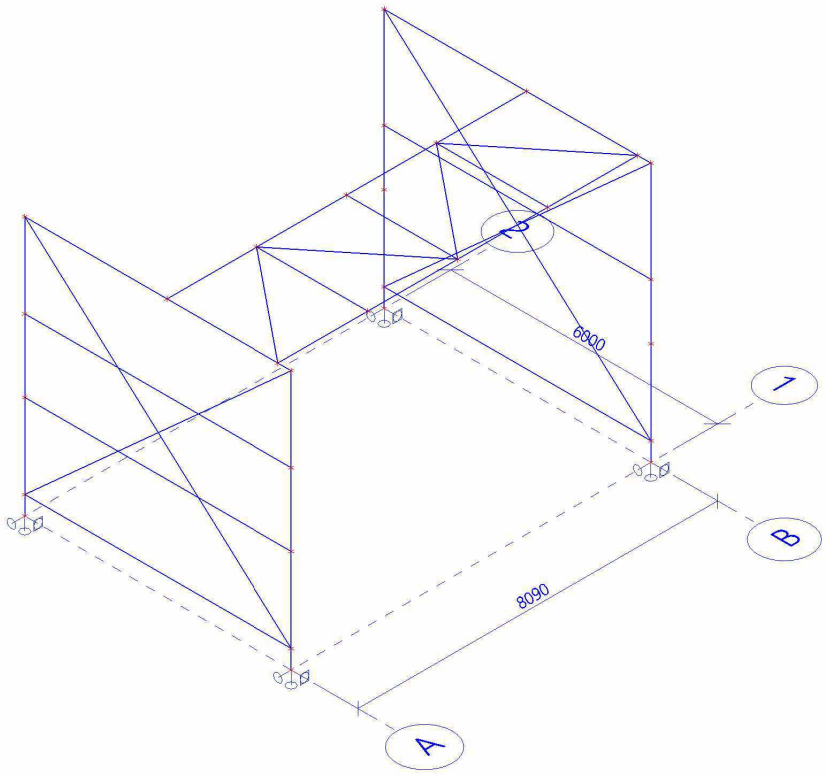
Conclusion: calculated displacements are lower than the allowable displacements -> meet the requirements.

ANNEX A: SCIA ENGINEER IN- OUTPUT

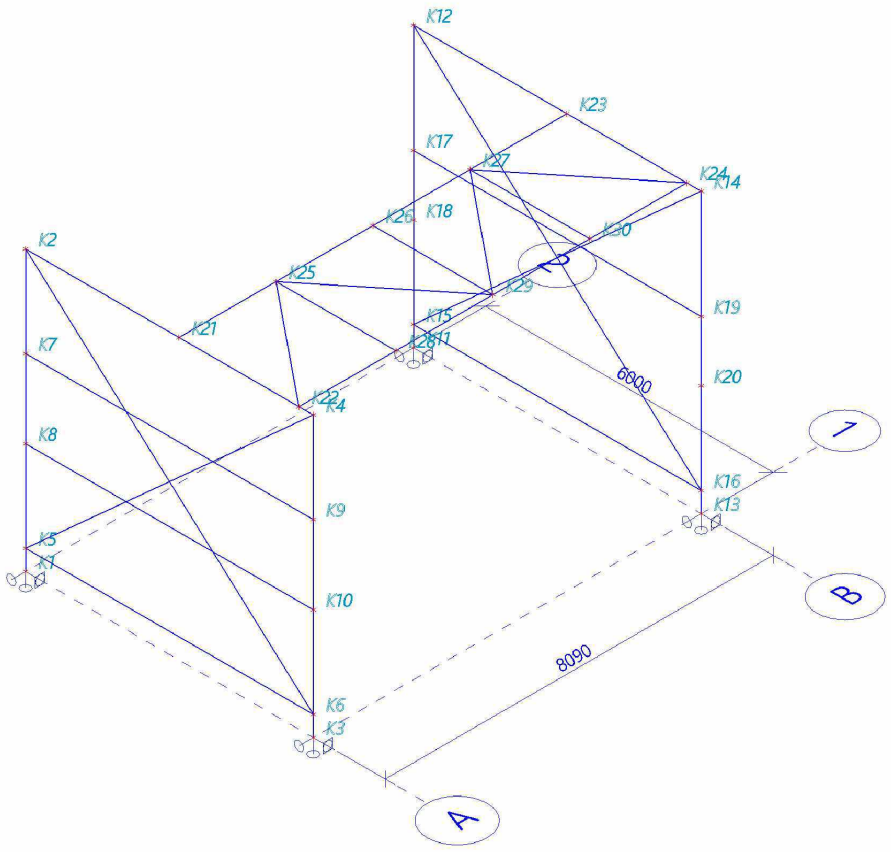
1. Table of contents

2. Geometrie

2.1. Calculation model



2.2. Nodes



2.3. Nodes

Name	Coord X [m]	Coord Y [m]	Coord Z [m]
K1	0.000	6.000	0.000
K2	0.000	6.000	5.830
K3	0.000	0.000	0.000
K4	0.000	0.000	5.830
K5	0.000	6.000	0.420
K6	0.000	0.000	0.420
K7	0.000	6.000	3.940
K8	0.000	6.000	2.310
K9	0.000	0.000	3.940
K10	0.000	0.000	2.310

Name	Coord X [m]	Coord Y [m]	Coord Z [m]
K11	8.090	6.000	0.000
K12	8.090	6.000	5.830
K13	8.090	0.000	0.000
K14	8.090	0.000	5.830
K15	8.090	6.000	0.420
K16	8.090	0.000	0.420
K17	8.090	6.000	3.565
K18	8.090	6.000	2.310
K19	8.090	0.000	3.565
K20	8.090	0.000	2.310

Name	Coord X [m]	Coord Y [m]	Coord Z [m]
K21	0.000	2.800	5.830
K22	0.000	0.300	5.830
K23	8.090	2.800	5.830
K24	8.090	0.300	5.830
K25	2.022	2.800	5.830
K26	4.045	2.800	5.830
K27	6.067	2.800	5.830
K28	2.022	0.300	5.830
K29	4.045	0.300	5.830
K30	6.067	0.300	5.830

2.4. 2D members

Empty table

2.5. 2D member internal edges

Empty table

2.6. Nodal supports

Name	Node	System	Type	X	Y	Z	Rx	Ry	Rz
Sn1	K1	GCS	Standard	Rigid	Rigid	Rigid	Free	Rigid	Free
Sn2	K3	GCS	Standard	Rigid	Rigid	Rigid	Free	Rigid	Free
Sn3	K11	GCS	Standard	Rigid	Rigid	Rigid	Free	Rigid	Free
Sn4	K13	GCS	Standard	Rigid	Rigid	Rigid	Free	Rigid	Free

2.7. 2D member standard FEM

Empty table

2.8. Materials

Steel EC3

Name	ρ [kg/m³]	E_{mod} [MPa]	μ	Onderlimiet [mm]	Bovenlimiet [mm]	F_y [MPa]	F_u [MPa]	Colour
		G_{mod} [MPa]	α [m/mK]					
S 235	7850.0	2.1000e+05	0.3	0	40	235.0	360.0	
		8.0769e+04	0.00	40	80	215.0	360.0	

Name	Type	ρ [kg/m³]	Density in fresh state [kg/m³]	E_{mod} [MPa]	μ	α [m/mK]	$f_{c.k.28}$ [MPa]	Colour
C30/37	Concrete	2500.0	2600.0	3.2800e+04	0.2	0.00	30.00	

Explanations of symbols	
Density in fresh state	The value in the density in fresh state property is used only in case a composite deck is input and its self-weight load is taken into account.

2.9. Mesh setup

Name	NetInstelling1
Generation of eccentric elements on members with variable height	✗
Generation of nodes in connections of beam elements	✗
Generation of nodes under concentrated loads on beam elements	✓
Elastic mesh	✓
Use automatic mesh refinement	✗
Connect members/nodes	✓
Division on haunches and arbitrary members	5
Division for 2D-1D upgrade	50
Average number of tiles of 1d element	1
Average size of 2d element/curved element [m]	0.250
Minimal length of beam element [m]	0.100
Maximal length of beam element [m]	1000.000
Average size of cables, tendons, elements on subsoil, nonlinear soil spring [m]	1.000
Maximal out of plane angle of a quadrilateral [mrad]	30.0
Predefined mesh ratio	1.5
Minimal distance between definition point and line [m]	0.001
Average size of panel element [m]	1.000
Mesh refinement following the beam type	None
Definition of mesh element size for panels	Manual

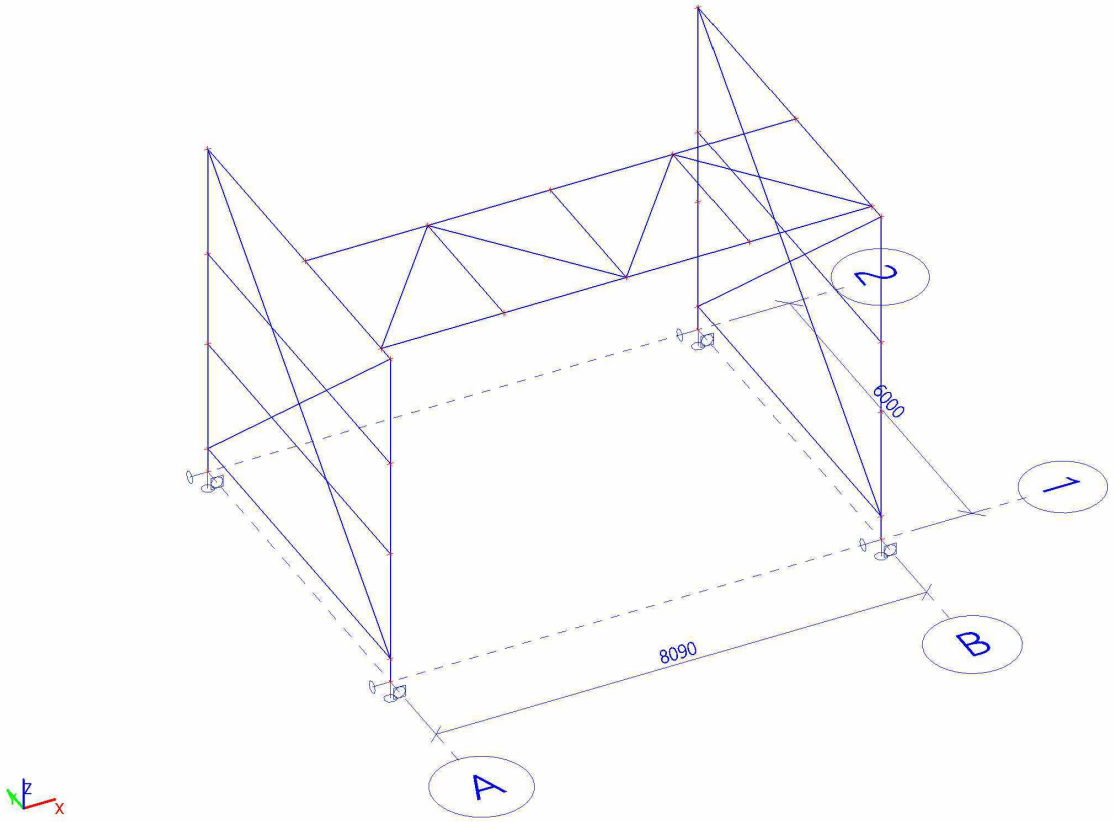
3. Loads

3.1. Load cases

3.1.1. Load cases - IC1 - SW

Name	Description	Action type	Load group	Direction
	Spec	Load type		
IC1 - SW	Self weigth	Permanent	LG1	-Z
		Self weight		

3.1.1.1. Loads



3.1.1.2. Resultant of reactions

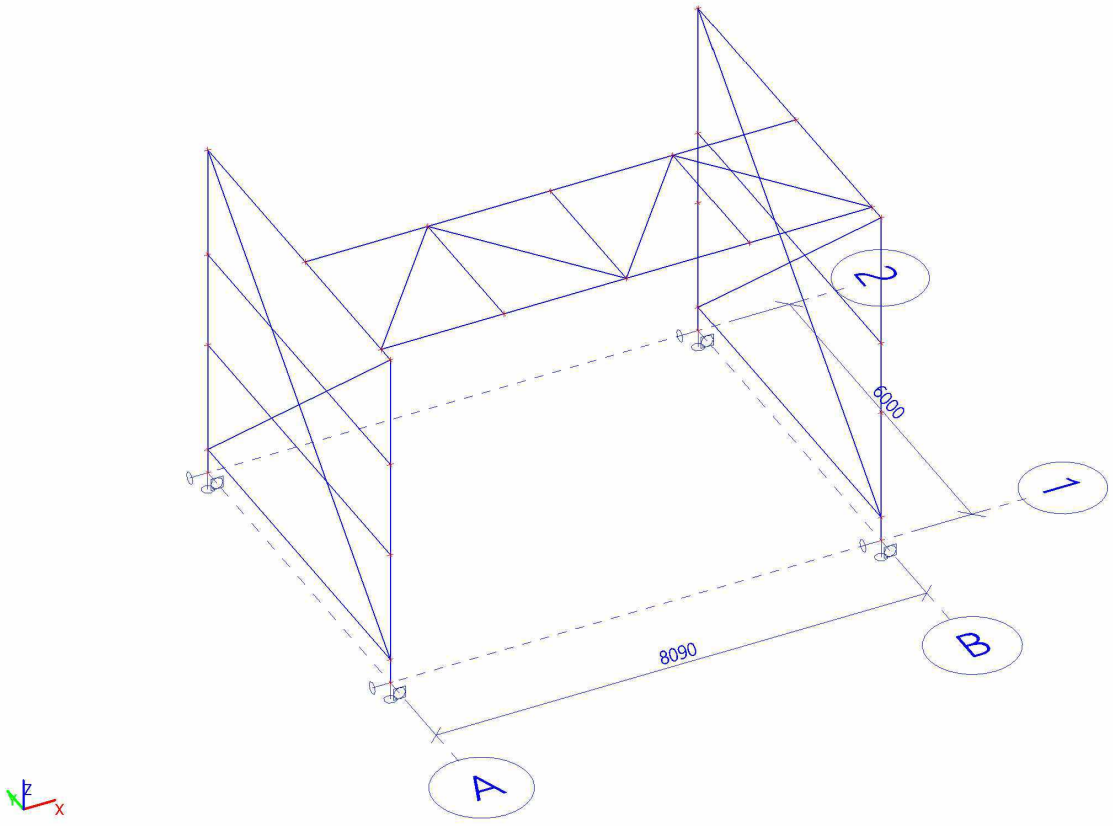
Linear calculation
Load case: IC1 - SW
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC1 - SW	**0.00**	**0.00**	**38.74**	**-10.20**	**6.02**	**0.00**

3.1.2. Load cases - IC2 - DL

Name	Description	Action type	Load group
	Spec	Load type	
IC2 - DL	Dead load	Permanent	LG1
		Standard	

3.1.2.1. Loads



3.1.2.2. Resultant of reactions

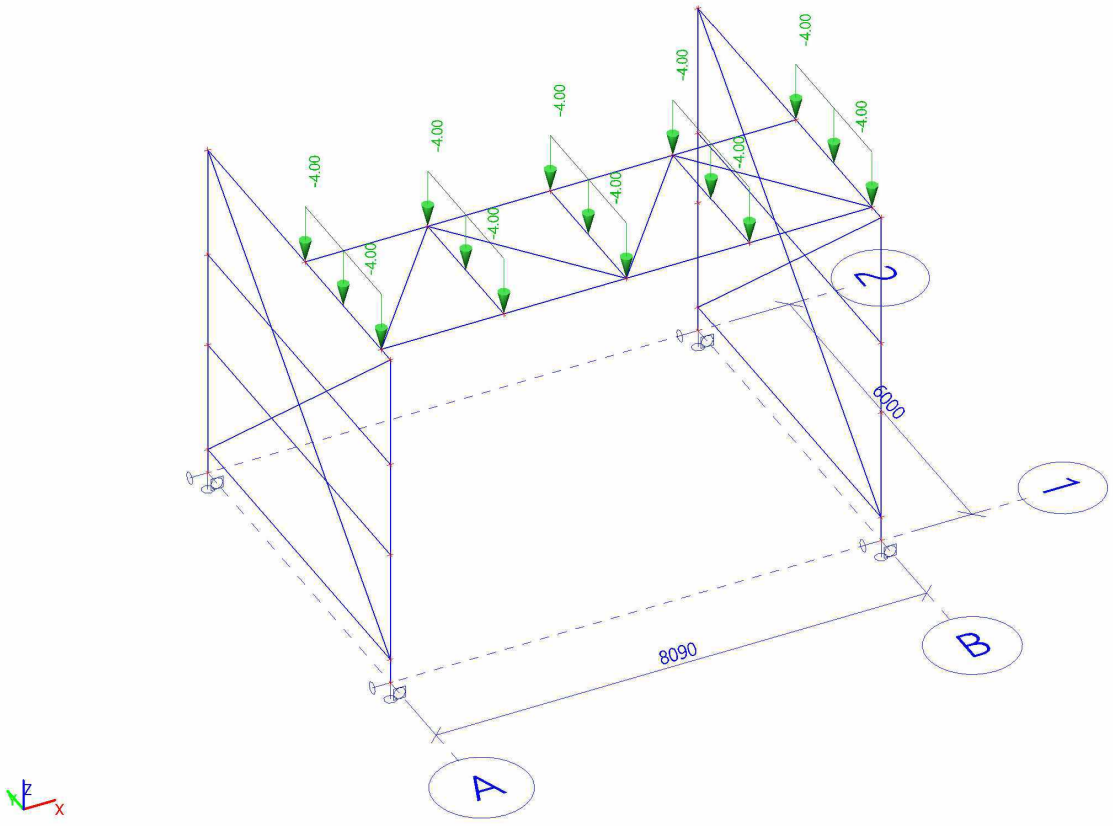
Linear calculation
Load case: IC2 - DL
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC2 - DL	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.1.3. Load cases - IC3 - LL1

Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
IC3 - LL1	Piping vertical loads	Variable	LG2	Short	None
	Standard	Static			

3.1.3.1. Loads



3.1.3.2. Resultant of reactions

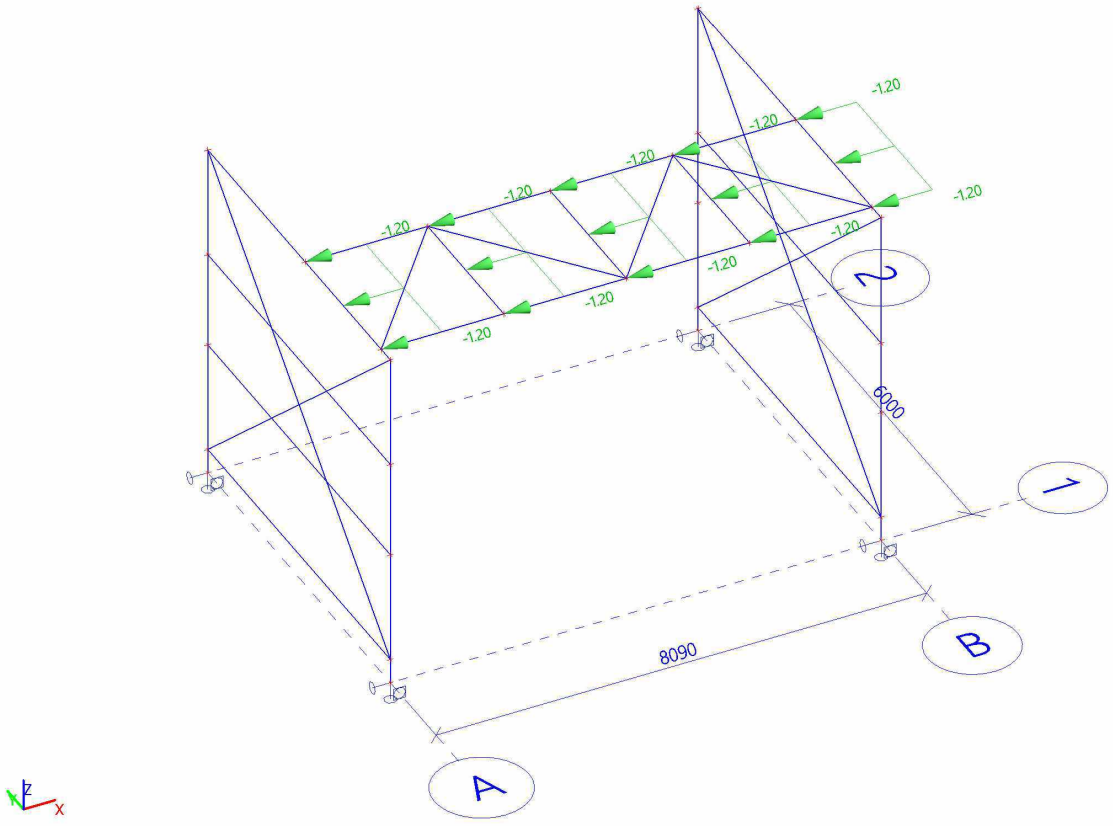
Linear calculation
Load case: IC3 - LL1
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC3 - LL1	**0.00**	**0.00**	**50.00**	**-72.50**	**0.00**	**0.00**

3.1.4. Load cases - IC3A - piping friction loads

Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
IC3A - piping friction loads		Variable	LG2	Short	None
	Standard	Static			

3.1.4.1. Loads



3.1.4.2. Resultant of reactions

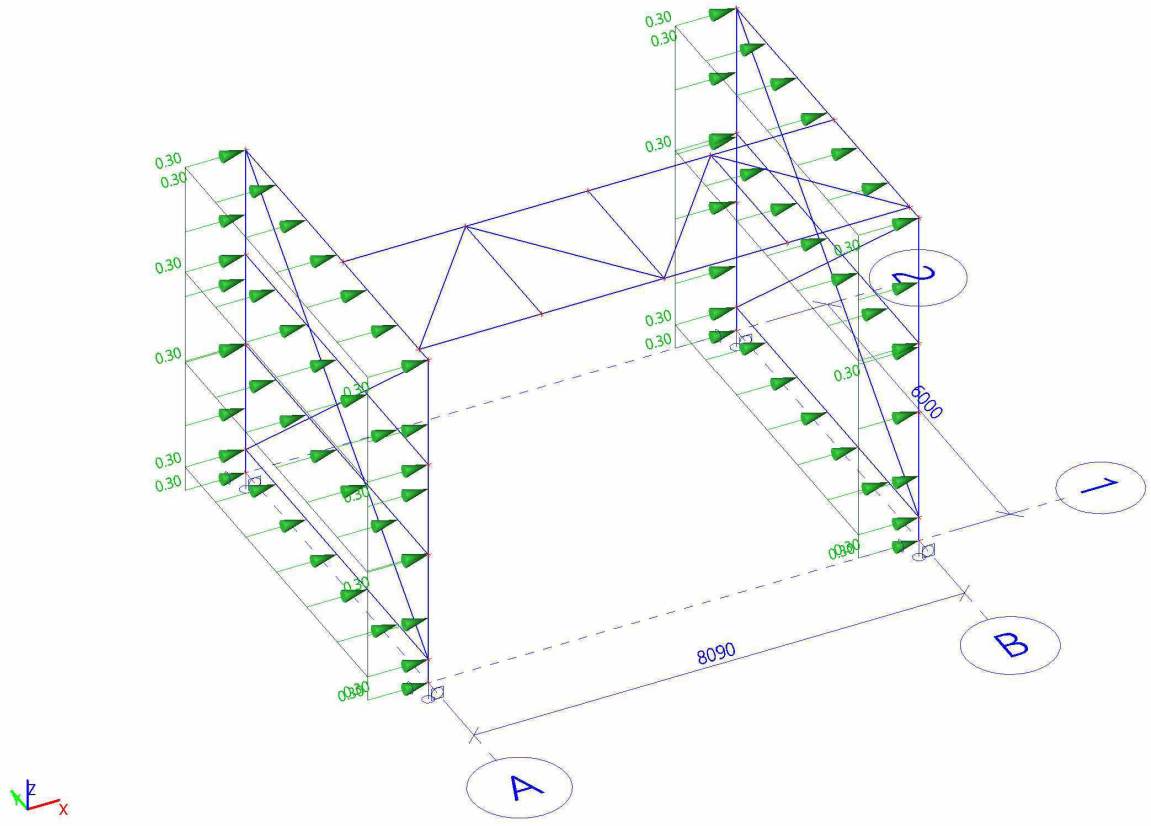
Linear calculation
Load case: IC3A - piping friction loads
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC3A - piping friction loads	**15.00**	**0.00**	**0.00**	**0.00**	**87.45**	**21.75**

3.1.5. Load cases - IC4 - wind +X

Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
IC4 - wind +X	Wind +X	Variable	LG2	Short	None
	Standard	Static			

3.1.5.1. Loads



3.1.5.2. Resultant of reactions

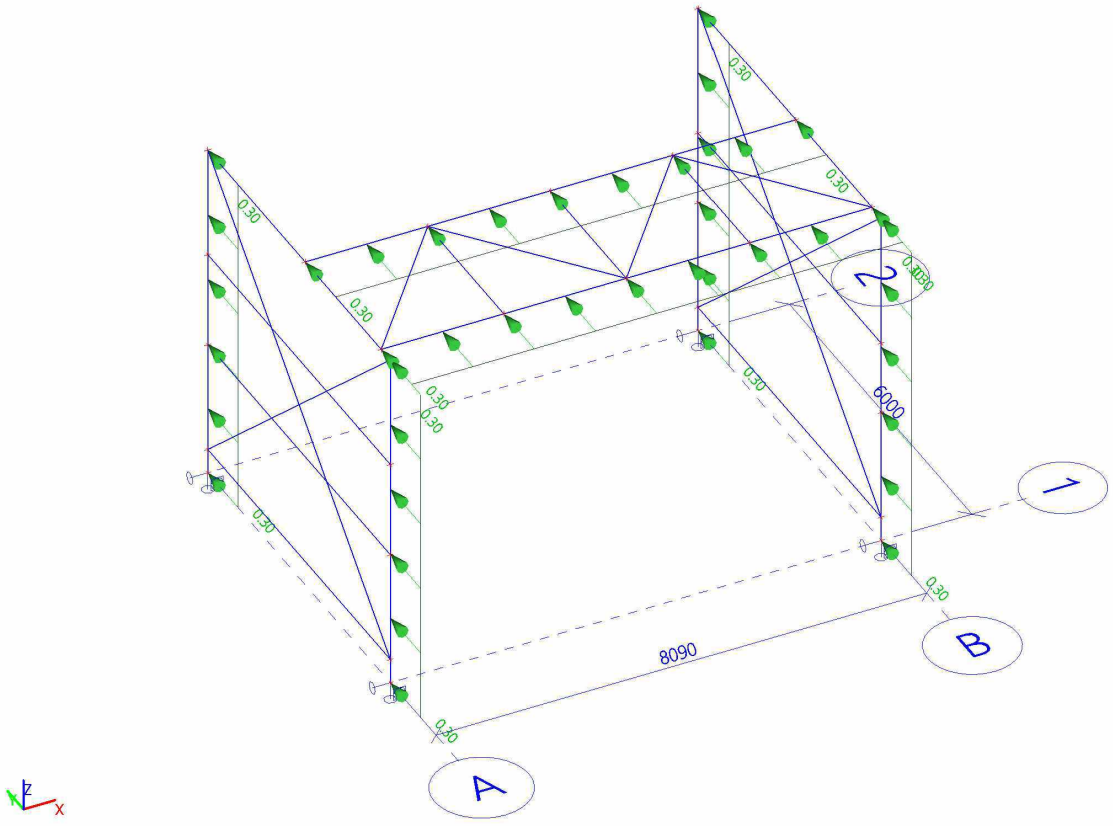
Linear calculation
Load case: IC4 - wind +X
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC4 - wind +X	**-19.60**	**0.00**	**0.00**	**0.00**	**-60.56**	**0.00**

3.1.6. Load cases - IC5 - wind +Y

Name	Description	Action type	Load group	Duration	Master load case
	Spec	Load type			
IC5 - wind +Y	Wind +Y	Variable	LG2	Short	None
	Standard	Static			

3.1.6.1. Loads



3.1.6.2. Resultant of reactions

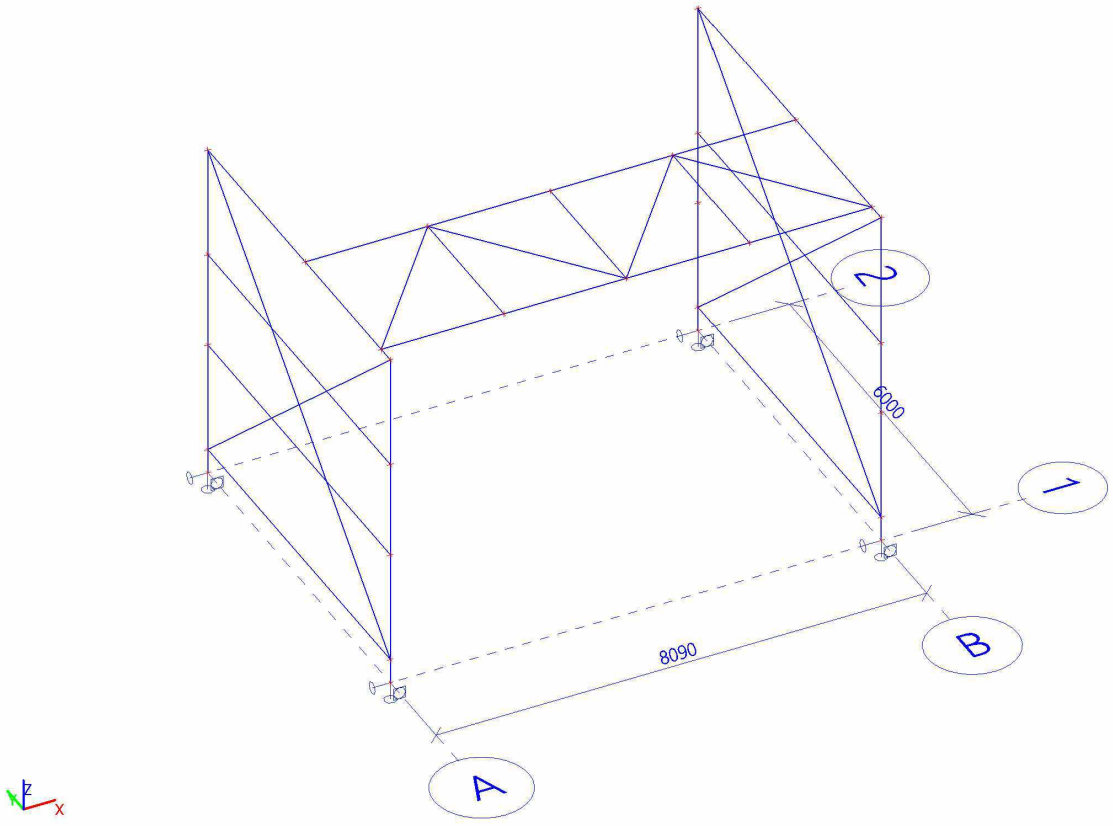
Linear calculation
Load case: IC5 - wind +Y
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC5 - wind +Y	**0.00**	**-11.85**	**0.00**	**48.69**	**0.00**	**0.00**

3.1.7. Load cases - IC6 - test load 1

Name	Description	Action type	Load group
	Spec	Load type	
IC6 - test load 1	Water test	Permanent	LG1
		Standard	

3.1.7.1. Loads



3.1.7.2. Resultant of reactions

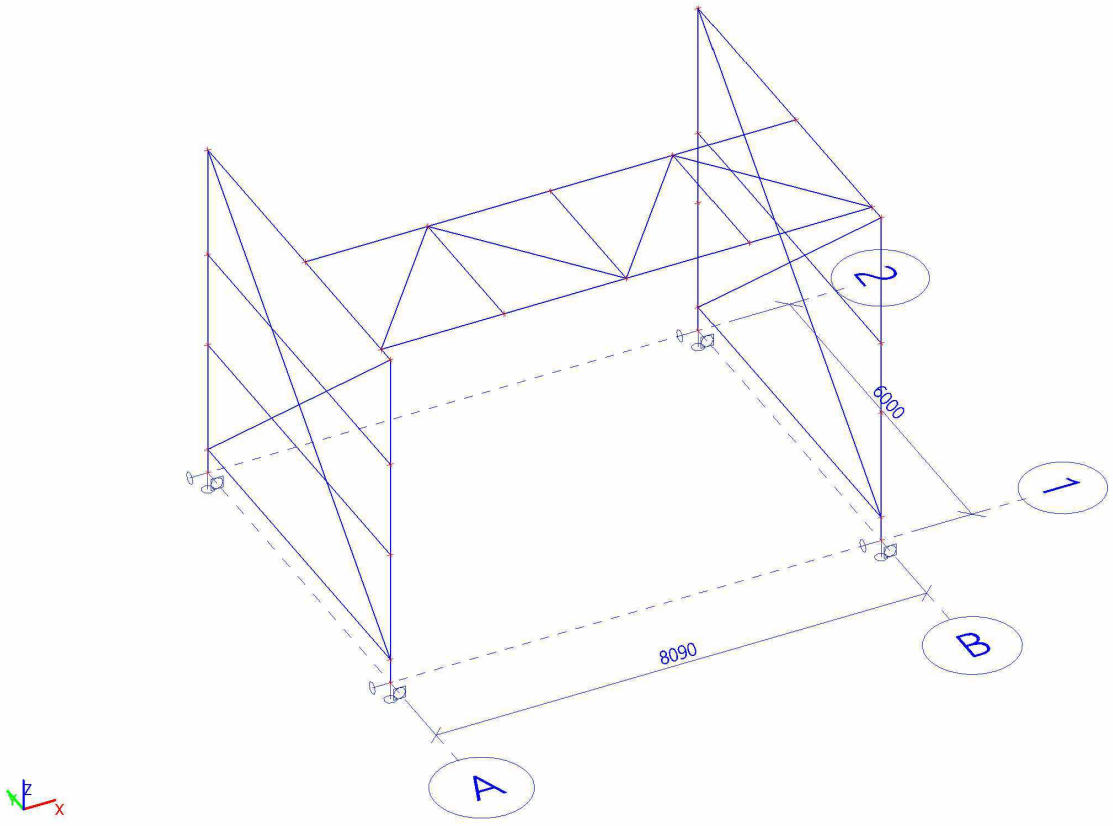
Linear calculation
Load case: IC6 - test load 1
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC6 - test load 1	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.1.8. Load cases - IC7 - test load 2

Name	Description	Action type	Load group
	Spec	Load type	
IC7 - test load 2	Water test	Permanent	LG1
		Standard	

3.1.8.1. Loads



3.1.8.2. Resultant of reactions

Linear calculation
Load case: IC7 - test load 2
Extreme: Global
Selection: All
System: Global

x [m]	y [m]	z [m]	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]
4.045	3.000	0.000	IC7 - test load 2	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.2. Line force on 2D member edge

Empty table

3.3. Surface load

Empty table

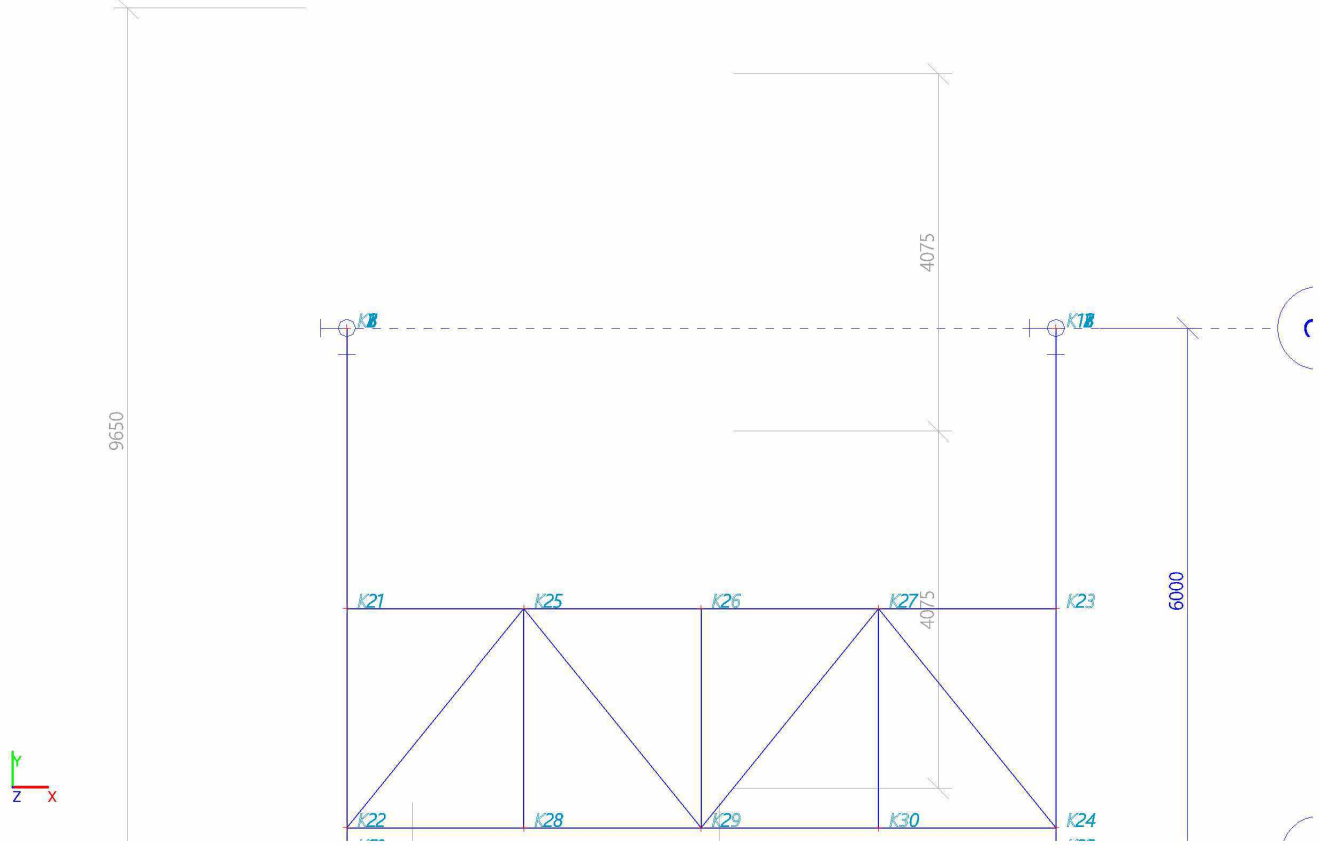
3.4. Combinations

Name	Description	Type	Load cases	Coeff. [-]
UGT-Set B (automatisch)		EN-ULS (STR/GEO) Set B	IC1 - SW - Self weigth	0.00
			IC2 - DL - Dead load	0.00
			IC3 - LL1 - Piping vertical loads	0.00
BGT-kar (automatisch)		EN-SLS Characteristic	IC1 - SW - Self weigth	0.00
			IC2 - DL - Dead load	0.00
			IC3 - LL1 - Piping vertical loads	0.00
BGT-quasi (automatisch)		EN-SLS Quasi-permanent	IC1 - SW - Self weigth	0.00
			IC2 - DL - Dead load	0.00
			IC3 - LL1 - Piping vertical loads	0.00
ULS-1		Linear - ultimate	IC1 - SW - Self weigth	1.35
			IC2 - DL - Dead load	1.35
			IC3 - LL1 - Piping vertical loads	1.50

Name	Description	Type	Load cases	Coeff. [-]
ULS-1A		Linear - ultimate	IC1 - SW - Self weigth	1.20
			IC2 - DL - Dead load	1.20
			IC3 - LL1 - Piping vertical loads	1.50
			IC3A - piping friction loads	1.50
ULS-1B		Linear - ultimate	IC1 - SW - Self weigth	0.90
			IC2 - DL - Dead load	0.90
			IC3 - LL1 - Piping vertical loads	1.50
			IC3A - piping friction loads	1.50
ULS-2		Linear - ultimate	IC1 - SW - Self weigth	1.20
			IC2 - DL - Dead load	1.20
			IC3 - LL1 - Piping vertical loads	1.50
			IC4 - wind +X - Wind +X	1.50
ULS-3		Linear - ultimate	IC1 - SW - Self weigth	1.20
			IC2 - DL - Dead load	1.20
			IC3 - LL1 - Piping vertical loads	1.50
			IC4 - wind +X - Wind +X	-1.50
ULS-4		Linear - ultimate	IC1 - SW - Self weigth	1.20
			IC2 - DL - Dead load	1.20
			IC3 - LL1 - Piping vertical loads	1.50
			IC5 - wind +Y - Wind +Y	1.50
ULS-5		Linear - ultimate	IC1 - SW - Self weigth	1.20
			IC2 - DL - Dead load	1.20
			IC3 - LL1 - Piping vertical loads	1.50
			IC5 - wind +Y - Wind +Y	-1.50
ULS-6		Linear - ultimate	IC1 - SW - Self weigth	0.90
			IC2 - DL - Dead load	0.90
			IC3 - LL1 - Piping vertical loads	0.00
			IC4 - wind +X - Wind +X	1.50
ULS-7		Linear - ultimate	IC1 - SW - Self weigth	0.90
			IC2 - DL - Dead load	0.90
			IC3 - LL1 - Piping vertical loads	0.00
			IC4 - wind +X - Wind +X	-1.50
ULS-8		Linear - ultimate	IC1 - SW - Self weigth	0.90
			IC2 - DL - Dead load	0.90
			IC3 - LL1 - Piping vertical loads	0.00
			IC5 - wind +Y - Wind +Y	1.50
ULS-9		Linear - ultimate	IC1 - SW - Self weigth	0.90
			IC2 - DL - Dead load	0.90
			IC3 - LL1 - Piping vertical loads	0.00
			IC5 - wind +Y - Wind +Y	-1.50
SLS - kar-1		Linear - serviceability	IC1 - SW - Self weigth	1.00
			IC2 - DL - Dead load	1.00
			IC3 - LL1 - Piping vertical loads	1.00
			IC4 - wind +X - Wind +X	1.00
SLS - kar-2		Linear - serviceability	IC1 - SW - Self weigth	1.00
			IC2 - DL - Dead load	1.00
			IC3 - LL1 - Piping vertical loads	1.00
			IC4 - wind +X - Wind +X	-1.00
SLS - kar-3		Linear - serviceability	IC1 - SW - Self weigth	1.00
			IC2 - DL - Dead load	1.00
			IC3 - LL1 - Piping vertical loads	1.00
			IC5 - wind +Y - Wind +Y	1.00
SLS - kar-4		Linear - serviceability	IC1 - SW - Self weigth	1.00
			IC2 - DL - Dead load	1.00
			IC3 - LL1 - Piping vertical loads	1.00
			IC5 - wind +Y - Wind +Y	-1.00
SLS - kar-5		Linear - serviceability	IC1 - SW - Self weigth	1.00
			IC2 - DL - Dead load	1.00
			IC3 - LL1 - Piping vertical loads	1.00
			IC3A - piping friction loads	1.00

4. Results

4.1. Reaction



4.2. Reactions - All ULS

Linear calculation
Class: All ULS
System: Global
Extreme: Member
Selection: All

Nodal reactions

Name	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]	e_x [mm]	e_y [mm]
Sn1/K1	ULS-4/1	0.01	**-5.18**	**26.82**	0.00	0.07	0.00	0.0	2.5
Sn1/K1	ULS-9/2	-0.01	**3.98**	2.20	**0.00**	-0.06	**0.00**	0.0	-25.4
Sn1/K1	UGT-Set B (automatisch)/3	0.00	0.00	**0.00**	0.00	0.00	0.00	-	-
Sn1/K1	ULS-3/4	**7.56**	-0.41	20.15	0.00	**21.82**	0.00	0.0	1082.9
Sn1/K1	ULS-6/5	**-7.56**	-0.79	8.87	0.00	**-21.81**	**0.00**	0.0	-2459.1
Sn2/K3	ULS-8/6	-0.01	**-3.96**	3.73	0.00	-0.03	0.00	0.0	-7.0
Sn2/K3	UGT-Set B (automatisch)/3	0.00	0.00	**0.00**	0.00	0.00	0.00	-	-
Sn2/K3	ULS-5/7	0.01	**5.16**	**46.99**	**0.00**	0.04	**0.00**	0.0	0.8
Sn2/K3	ULS-1A/8	**8.62**	0.91	41.30	0.00	**50.23**	0.00	0.0	1216.1
Sn2/K3	ULS-6/5	**-8.24**	0.19	9.23	0.00	**-25.75**	**0.00**	0.0	-2789.1
Sn3/K11	ULS-4/1	-0.01	**-5.29**	**25.93**	0.00	-0.08	0.00	0.0	-3.1
Sn3/K11	ULS-9/2	0.01	**3.86**	1.53	**0.00**	0.07	**0.00**	0.0	45.5
Sn3/K11	UGT-Set B (automatisch)/3	0.00	0.00	**0.00**	0.00	0.00	0.00	-	-
Sn3/K11	ULS-7/9	**6.33**	-0.88	8.20	0.00	**18.89**	0.00	0.0	2303.5
Sn3/K11	ULS-2/10	**-6.33**	-0.56	19.26	0.00	**-18.90**	**0.00**	0.0	-981.4
Sn4/K13	ULS-8/6	0.00	**-3.86**	3.06	0.00	0.04	0.00	0.0	13.1
Sn4/K13	UGT-Set B (automatisch)/3	0.00	0.00	**0.00**	0.00	0.00	0.00	-	-
Sn4/K13	ULS-5/7	-0.01	**5.29**	**46.09**	**0.00**	-0.05	**0.00**	0.0	-1.1
Sn4/K13	ULS-1B/11	**8.62**	0.43	36.56	0.00	**50.22**	0.00	0.0	1373.7
Sn4/K13	ULS-2/10	**-7.27**	1.16	40.59	0.00	**-24.38**	**0.00**	0.0	-600.6

Name	Combination key
ULS-4/1	1.20*lC1 - SW + 1.20*lC2 - DL + 1.50*lC3 - LL1 + 1.50*lC5 - wind +Y
ULS-9/2	0.90*lC1 - SW + 0.90*lC2 - DL - 1.50*lC5 - wind +Y
UGT-Set B (automatisch)/3	No load cases.

Name	Combination key
ULS-3/4	1.20*IC1 - SW + 1.20*IC2 - DL + 1.50*IC3 - LL1 - 1.50*IC4 - wind +X
ULS-6/5	0.90*IC1 - SW + 0.90*IC2 - DL + 1.50*IC4 - wind +X
ULS-8/6	0.90*IC1 - SW + 0.90*IC2 - DL + 1.50*IC5 - wind +Y
ULS-5/7	1.20*IC1 - SW + 1.20*IC2 - DL + 1.50*IC3 - LL1 - 1.50*IC5 - wind +Y
ULS-1A/8	1.20*IC1 - SW + 1.20*IC2 - DL + 1.50*IC3 - LL1 + 1.50*IC3A - piping friction loads
ULS-7/9	0.90*IC1 - SW + 0.90*IC2 - DL - 1.50*IC4 - wind +X
ULS-2/10	1.20*IC1 - SW + 1.20*IC2 - DL + 1.50*IC3 - LL1 + 1.50*IC4 - wind +X
ULS-1B/11	0.90*IC1 - SW + 0.90*IC2 - DL + 1.50*IC3 - LL1 + 1.50*IC3A - piping friction loads

4.3. Reactions

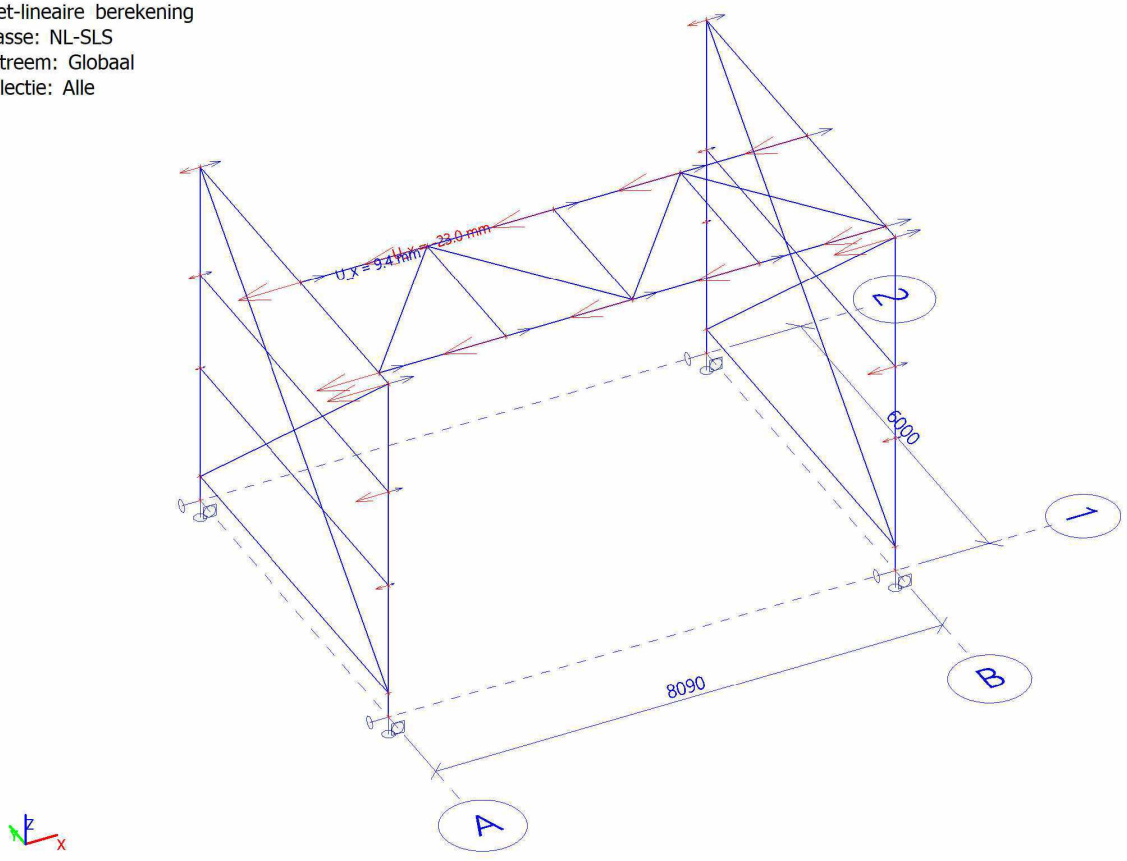
Nonlinear calculation
Class: NL-ULS
System: Global
Extreme: Global
Selection: All

Nodal reactions

Name	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]	e_x [mm]	e_y [mm]
Sn3/K11	NC_ULS-4	-0.01	**-4.83**	25.93	0.00	-0.08	0.00	0.0	-3.3
Sn4/K13	NC_ULS-5	-0.01	**4.84**	46.09	**0.00**	-0.05	**0.00**	0.0	-1.1
Sn3/K11	NC_ULS-9	0.01	4.23	**1.53**	0.00	0.07	0.00	0.0	43.7
Sn2/K3	NC_ULS-5	0.01	4.54	**46.99**	0.00	0.04	0.00	0.0	0.8
Sn2/K3	NC_ULS-6	**-8.23**	0.11	9.24	0.00	**-25.73**	0.00	0.0	-2785.0
Sn2/K3	NC_ULS-1B	**8.62**	0.60	38.02	0.00	**50.18**	0.00	0.0	1319.8

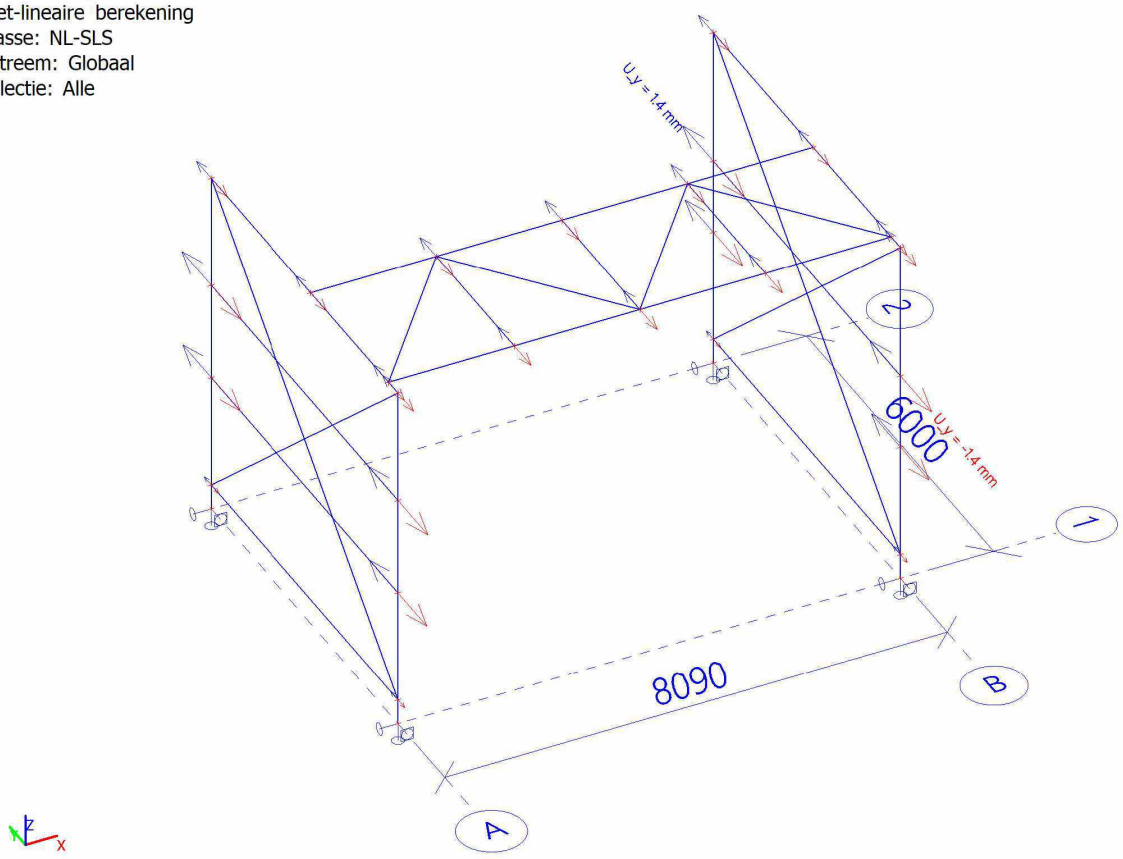
4.4. Node displacements U_x

Waardes: **U_x**
Niet-lineaire berekening
Klasse: NL-SLS
Extreem: Globaal
Selectie: Alle



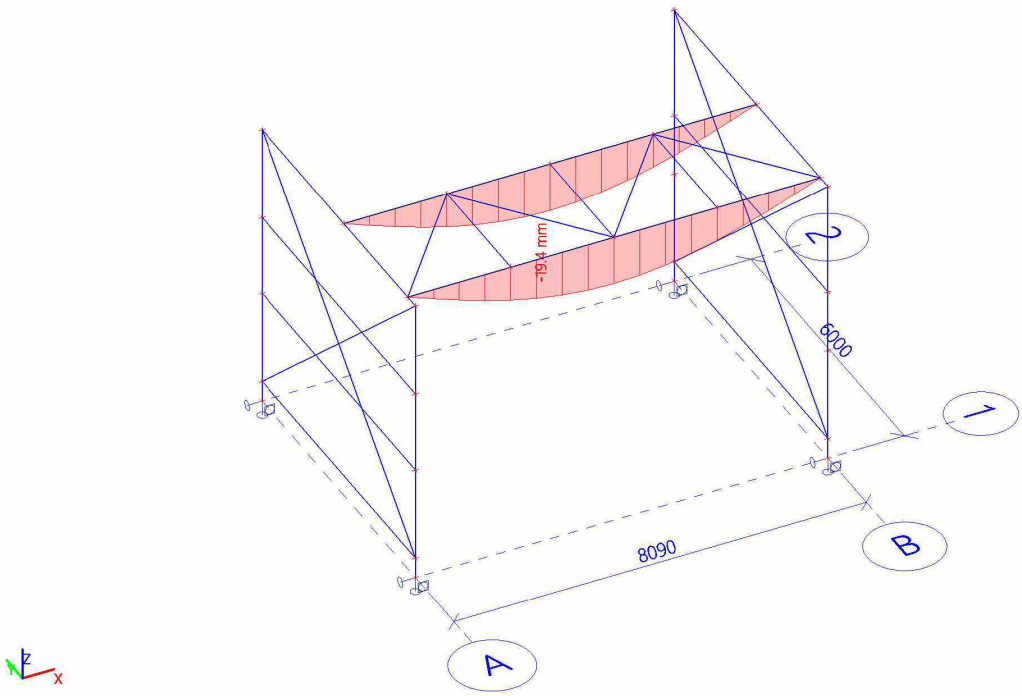
4.5. Node displacements U_y

Waardes: **U_y**
Niet-lineaire berekening
Klasse: NL-SLS
Extreem: Globaal
Selectie: Alle



4.6. Displacements u_z

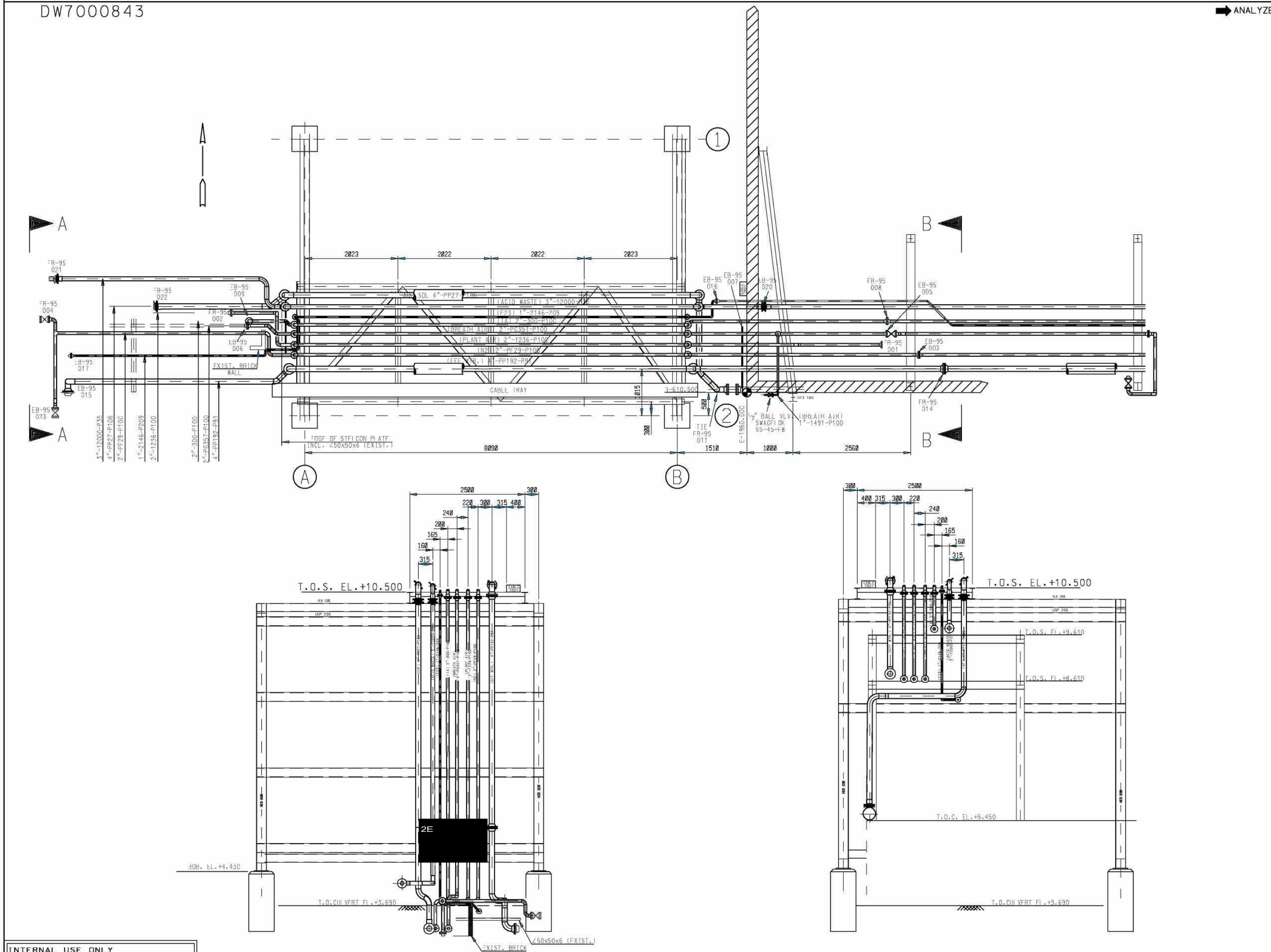
Waardes: **u_z**
Niet-lineaire berekening
Klasse: NL-SLS
Assenstelsel: Hoofd
Extreme 1D: Globaal
Selectie: S17, S18



ANNEX B: STRUCTURAL INFORMATION

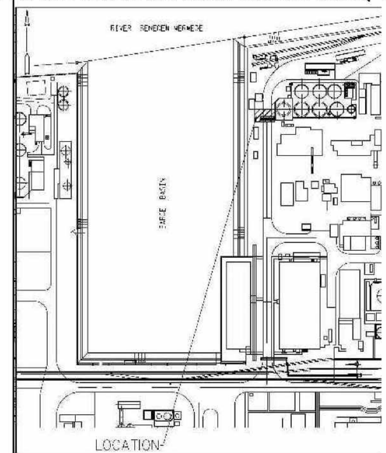
DW7000843

ANALYZE FOR SAFETY, ECOLOGY, AND MINIMUM ESSENTIAL DESIGN



SECTION A_A

SECTION B_B



REFERENCE DRAWING
- CONCRETE DW7000029
- PILING AND FOUNDATION PIPEBRIDGE DW7000030
- STEEL STRUCTURE DW7000031

BLDG	PROJ	AREA	TYPE		LAST REV
0000	C-EB95	1421	23	DW7000843	2

TFE/HFP MONOMER
TFE MONOMER COMMON FACILITIES
LAYOUT PIPEBRIDGE
PIPING ARRANGEMENT

PROJ	NO	REVISION	RVSD	CHKD	APPROVED
PCR C-EB95	1	FINAL ISSUE MECHANICAL	LAUWR 02-06-15	REIJENMA 02-06-15	WESTDIH 02-06-15
ASB PCR C-EB95	2	FINAL ISSUE MECHANICAL	BAXR 03-11-15	REIJENMA 09-11-15	REIJENMA 09-11-15

REFERENCE DRAWINGS	
DW7000029	CONCREET
DW7000030	PILLING FOUNDATION
DW7000031	STEEL STRUCTURE

		DATE
PROJECT	PCR-C-EB95	
SCALE	1:33 1/3	
DRAWN	R.L.	02-05-15
CHECKED	WeH	02-05-15
APPROVED DESIGN RELEASE	WeH	02-05-15
APPROVED CONSTR. RELEASE	WeH	02-05-15

THE CHEMOURS COMPANY (NED)
DORDRECHT, NEDERLAND

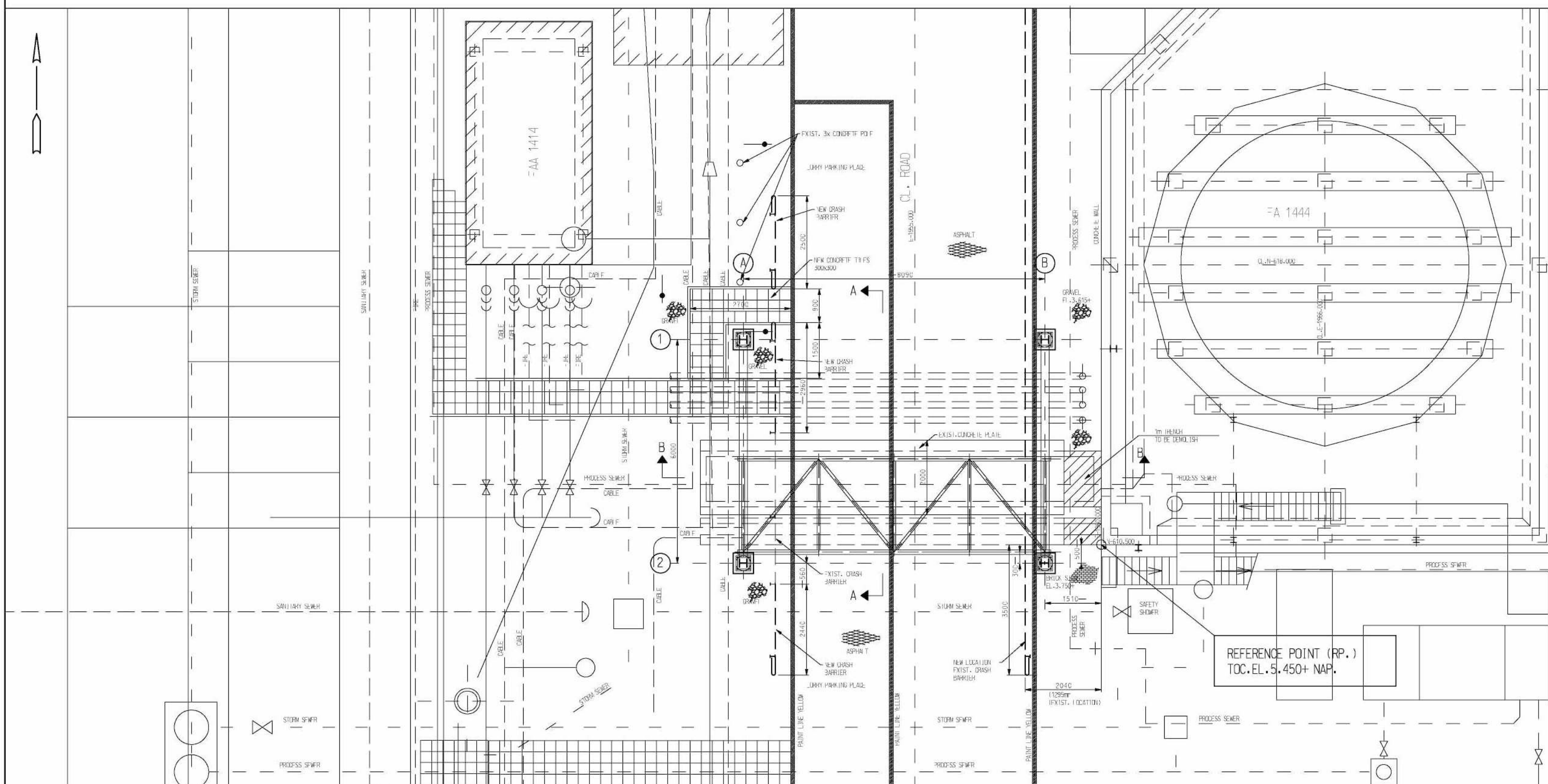
DW7000843

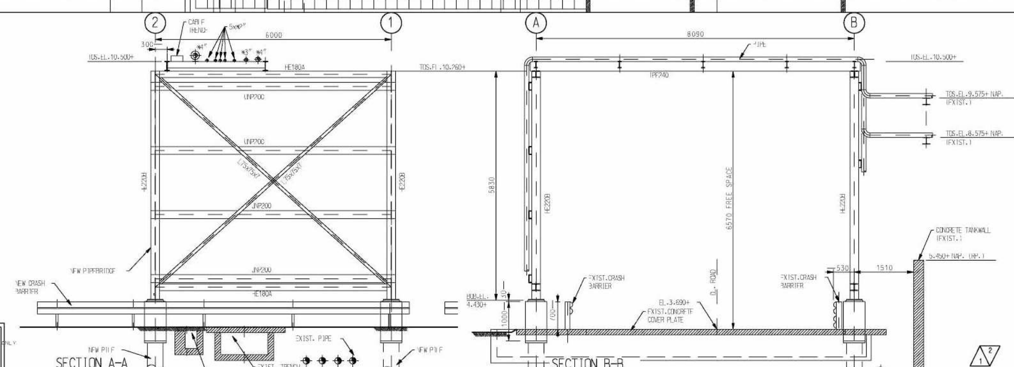
INTERGRAPH COMPUTER DRAWING

$$DATE$$ $$TEXT1$$

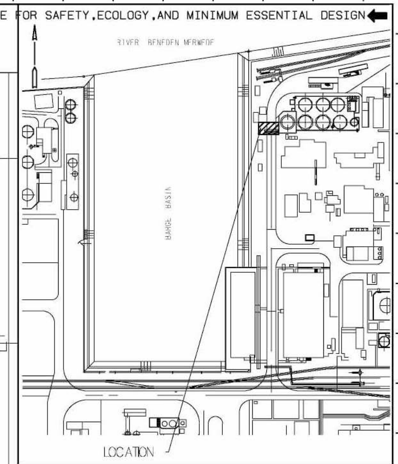
DW7000029

➡ ANALYZE FOR SAFETY, ECOLOGY, AND MINIMUM ESSENTIAL DESIGN ⬅





INTERNAL USE ONLY



KEY-PLAN

GENERAL NOTES

- ALL DIMENSIONS ARE IN MILLIMETRES (mm)
- ALL ELEVATIONS ARE IN METRES (m) AND REFER TO NAP
- STEEL QUALITY S235JR
- STEEL STRUCTURE SHALL BE HOT DIP GALVANIZED
- TOC - TOP OF CONCRETE
- TOS - TOP OF STEEL
- BOB - BOTTOM OF BASE PLATE
- EL - ELEVATION
- TYP - TYPICAL
- RP. - REFERENCE POINT
- CITY WATER
- GROUNDWATER REMEDIATION
- FIBRE OPTIC CABLES

REFERENCE DRAWING

- PILING AND FOUNDATION PIPEBRIDGE -DW7000030
- PIPEBRIDGE BY DELUGE VALVE HOUSE -DW7000031

0 1 2 3 4 5m
1:50

BLDG	PROJ	AREA	TYPE		LAST REV
1414	C-EB95	1407	42c	DW7000029	2

TFE/HFP MONOMER
TFE/HFP MONOMER DELUGE HOUSE
CONCRETE LAY OUT PIPEBRIDGE
CIVIL

PROJ	NO	REVISION	RVSD	CHKD	APPROVED
PCR C-EB95	1	FINAL ISSUE CIVIL			
ASB PCR C-EB95	2	FINAL ISSUE CIVIL			

STANDARDS

REFERENCE DRAWINGS

PROJECT C-EB95
SCALE 1:50
DATE
DRAWN C V/D PLIGHT 30-03-15
CHECKED J DE GROOT 30-03-15
APPROVED J VONK 30-03-15
DESIGN RELEASE
APPROVED J VONK 30-03-15
CONSTR. RELEASE

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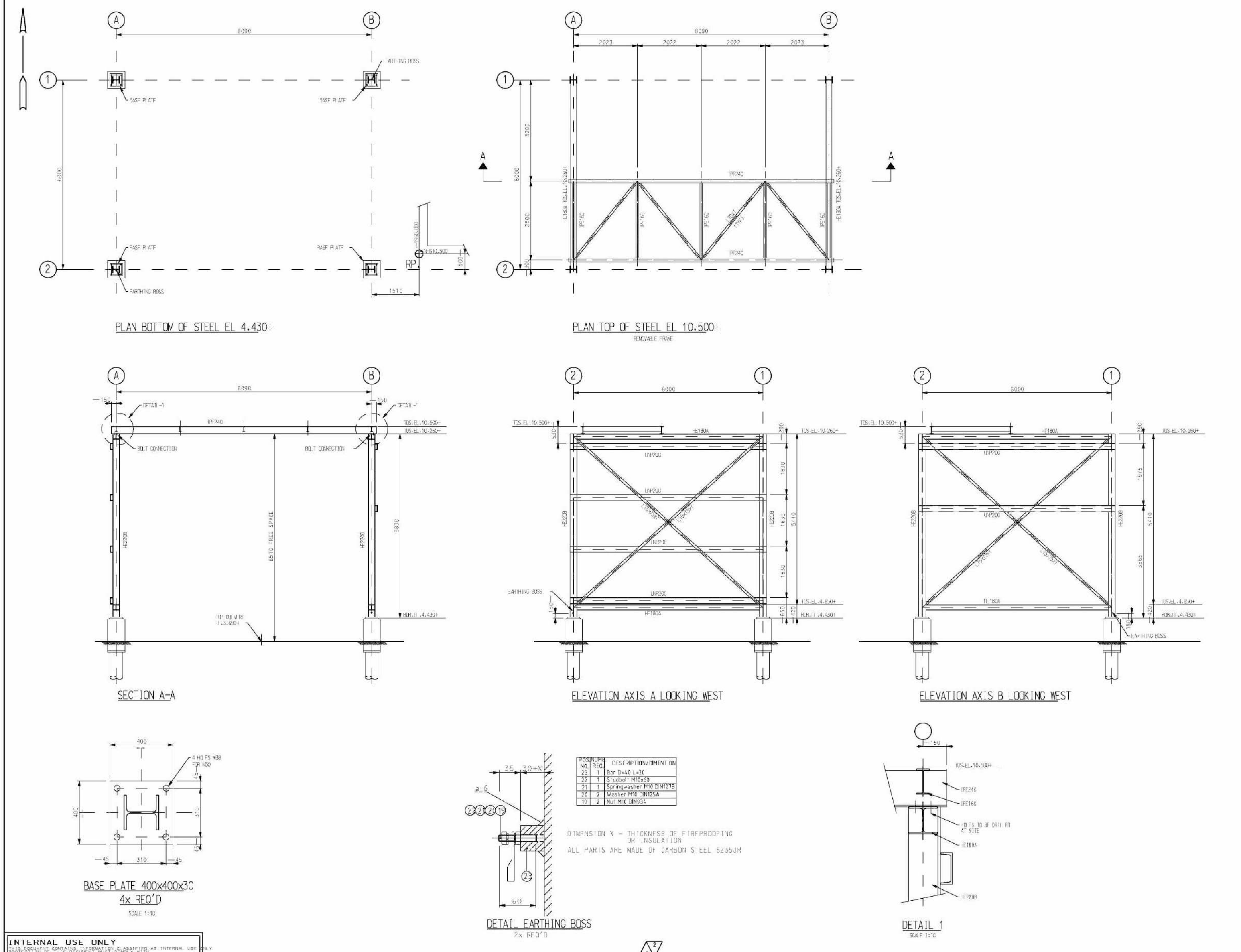
DW7000029

$$DATE$$
$$TEXT1$$

INTERGRAPH COMPUTER DRAWING

DW7000031

➡ ANALYZE FOR SAFETY, ECOLOGY, AND MINIMUM ESSENTIAL DESIGN ⬅



POS NO.	NUMB. REQ	DESCRIPTION/DIMENTION
23	1	Bar D=40 L=30
22	1	Studbolt M10x60
21	1	Springwasher M10 DIN127B
20	2	Washer M10 DIN125A
19	2	Nut M10 DIN934

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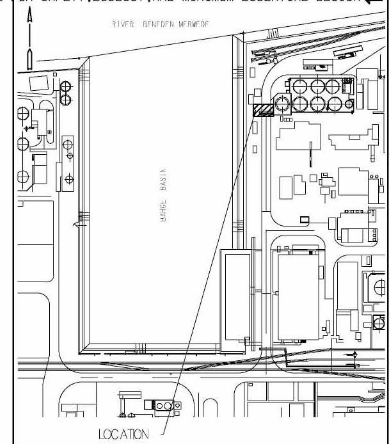

KEY-PLAN

GENERAL NOTES

- ALL DIMENSIONS ARE IN MILLIMETRES (mm)
- ALL ELEVATIONS ARE IN METRES (m) AND REFER TO NAP
- STEEL QUALITY S235JR
- STEEL STRUCTURE SHALL BE HOT DIP GALVANIZED
- BOLTS QUALITY 8.8 MINIMUM BOLT M16
- WELD a=5mm (MIN)
- TOC - TOP OF CONCRETE
- TOS - TOP OF STEEL
- BOB - BOTTOM OF BASE PLATE
- EL - ELEVATION
- TYP - TYPICAL
- MC - MOMENT CONNECTION
- RP. - REFERENCE POINT

REFERENCE DRAWING

- LAY OUT PIPEBRIDGE BY DELUGE VALVE HOUSE -DW7000029
- PILING AND FOUNDATION PIPEBRIDGE -DW7000030

1:50

BLDG	PROJ	AREA	TYPE		LAST REV
1414	C-EB95	1407	45c	DW7000031	2

TFE/HFP MONOMER
TFE/HFP MONOMER DELUGE HOUSE
PIPEBRIDGE BY DELUGE VALVE HOUSE
STRUCTURAL STEEL

PROJ	NO	REVISION	RVSD	CHKD	APPROVED
PCR C-EB95	1	FINAL ISSUE CIVIL			
ASB PCR C-EB95	2	FINAL ISSUE CIVIL			

STANDARDS | REFERENCE DRAWINGS

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		DATE
PROJECT	C-EB95	
SCALE	1:50	
DRAWN	C v/d PLICHT	30-03-15
CHECKED	J de GROOT	30-03-15
APPROVED	J VONK	30-03-15
DESIGN RELEASE		
APPROVED	J VONK	30-03-15
CONSTR. RELEASE		

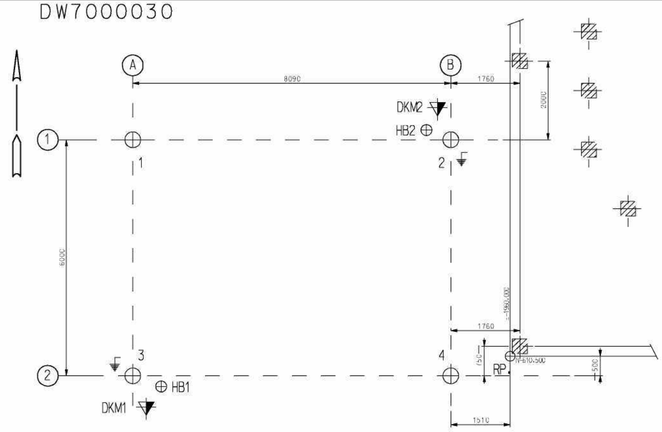
THE CHEMOURS COMPANY (NED)
DORDRECHT, NEDERLAND

DW7000031

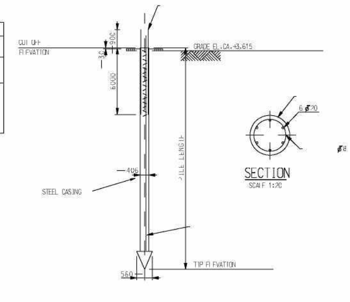
INTERGRAPH COMPUTER DRAWING

DW7000030

ANALYZE FOR SAFETY, ECOLOGY, AND MINIMUM ESSENTIAL DESIGN

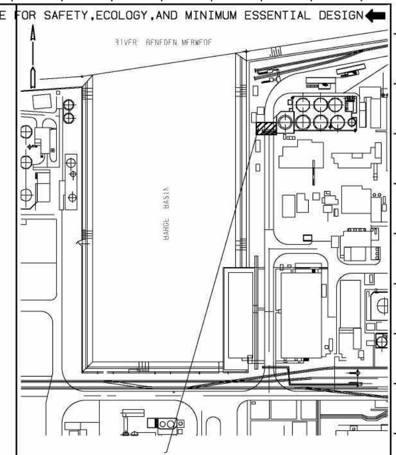


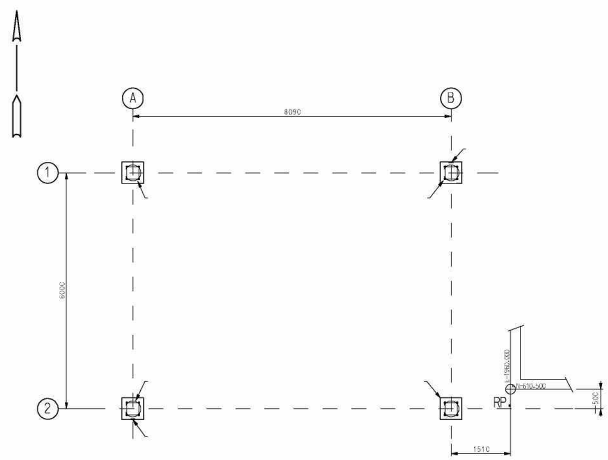
PILING PLAN



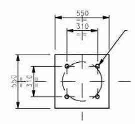
PILE DETAIL

PILE WITH STEEL CASING LEFT IN PLACE.
CONCRETE QUALITY PILE C20/25



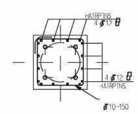


FOUNDATION PLAN



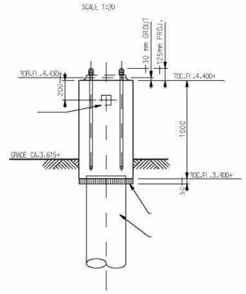
PLAN PILE CAP

SCALE 1:20



PLAN PILE CAP REINF.

SCALE 1:20

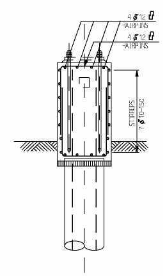


PILE CAP 4x REQ'D

SCALE 1:20

ANCHOR DETAIL 4x4 REQ'D

SCALE 1:20



PILE CAP REINF. 4x REQ'D

SCALE 1:20

GENERAL NOTES

DKM- DEEP SOUNDING (2x) SEE DOC NR. 1315-0049-000 FUGRO FOUNDATION ADVICE

HB- BORING (2x)

EXISTING PILE SEE PILING PLAN 001-1570

1:50

AANDUIDING VLOER EN WANDWAPENING		OMBUIGINGEN HOOFDWAPENING
BOUW ONDERDEEL	BETONDEKKING IN mm. CONTROLEERBAAR	NIET CONTROLEERBAAR
VLOER	50	50
BALK	50	50
KOLOM/POER	50	50
BETON RAND/OPSTORTING	35	35
-	-	-

ALGEMEEN BETON
STERKTEKLASSE BETON: C30/37
STERKTEKLASSE WERKVLOER: C12/15
MILIEUKLASSE
- Boven: XC4, XD3
- Onder: XC2, XA2
GROOTSTE KORRELAFMETING: 31.5mm
CEMENTSOORT: CEM III/A of CEM III/B
STAALSOORT STAVEN: B500 B
STAALSOORT WAP. NETTEN: B500 B
DRUKSTERKTE BIJ ONTKIST.: -

TOEGEPASTE NORMEN / VOORSCHRIFTEN
NEN 3550 CEMENT VOLGENS NEN-EN 197-1, NEN-EN 197-4 OF NEN-EN 14216, MET AANVULLENDE SPECIALE EIGENSCHAPPEN-DEFINITIES EN EISEN.
NEN-EN 13670 VERVAARDIGEN VAN BETONCONSTRUCTIES.
NEN-EN 206-1 BETON - DEEL 1: SPECIFICATIE, EIGENSCHAPPEN, VERVAARDIGING EN CONFORMITEIT.
NEN 8005 NEDERLANDSE INVULLING VAN NEN-EN 206-1: BETON - DEEL 1: SPECIFICATIE, EIGENSCHAPPEN, VERVAARDIGING EN CONFORMITEIT.
NEN 6146 WAPENINGSTAVEN VOOR GEWAPEND BETON
NEN 6008 BETONSTAAL

MINIMALE LAS EN VERANKERING LENGTE

	VERANKERING IN mm AANHECHTING GOED	AANHECHTING SLECHT
ØK	GOED	SLECHT
Ø8	290	410
Ø10	360	520
Ø12	430	620
Ø16	580	820
Ø20	720	1030
Ø25	900	1280

BLDG	PROJ	AREA	TYPE		LAST
1414	C-EB95	1407	42c	DW7000030	2 REV

TFE/HFP MONOMER
TFE/HFP MONOMER DELUGE HOUSE
PILING AND FOUNDATION PIPEBRIDGE
CIVIL

PROJ	NO	REVISION	RVSD	CHKD	APPROVED
PCR C-EB95	1	FINAL ISSUE CIVIL	C-PLICHT 30-03-15	J-GROOT 30-03-15	J VONK 30-03-15
ASB PCR C-EB95	2	FINAL ISSUE CIVIL	C-PLICHT 09-11-15	REIJENMA 10-11-15	REIJENMA 10-11-15

STANDARDS

REFERENCE DRAWINGS

		DATE
PROJECT	C-EB95	
SCALE	1:50	
DRAWN	C v/d PLICHT	30-03-15
CHECKED	J de GROOT	30-03-15
APPROVED DESIGN RELEASE	J VONK	30-03-15
APPROVED CONSTR. RELEASE	J VONK	30-03-15

THE CHEMOURS COMPANY (NED)
DORDRECHT, NEDERLAND

DW7000030

INTERGRAPH COMPUTER DRAWING

$$DATE$$
$$TEXT1$$

Document:	**Rapportage Casing Draaipaal met groutinjectie**
Projectomschrijving :	Leidingbrug Du Pont
Projectlocatie :	Dordrecht
	Draagvermogen en wapening
Documentnummer :	PB 150598-1
Datum :	28 mei 2015

HEKTEC

Document: **Rapportage Casing Draaipaal met groutinjectie**

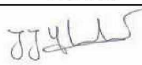
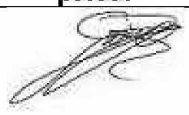
Projectomschrijving : Leidingbrug Du Pont
Projectlocatie : Dordrecht

Draagvermogen en wapening

Documentnummer : PB 150598-1
Datum : 28-05-2015

Opdrachtgever : **Servicis BV**
Postbus 170
3190 AD Hoogvliet

Hektec BV
Nekkerweg 63
Postbus 88
1462 ZH Midden Beemster
T: 0299 42 08 08
F: 0299 31 30 25

Documentbeheer					
versie	**datum**	**Auteur**	**Paraaf**	**verificatie**	**paraaf**
-	28-05-2015	Ir. J.J. v.d. Wiel		Ing. [redacted]	

HEKTEC

Projectomschrijving : Leidingbrug Du Pont
Projectlocatie : Dordrecht
Documentnummer : PB 150598-1
Datum : 28 mei 2015

Inhoudsopgave

Bijlagen

1 Inleiding

Dit rapport omvat de berekening van het draagvermogen en de wapening van de Casing Draaipaal met groutinjectie ten behoeve van het project Leidingbrug Du Pont te Dordrecht.

De Casing Draaipaal met groutinjectie worden aangebracht door De Waalpaal [redacted] bv heeft in opdracht van hen een wapeningsberekening uitgevoerd ten behoeve van de Casing Draaipaal met groutinjectie.

De in het rapport gehanteerde uitgangspunten en bouwfasering dienen door de opdrachtgever gecontroleerd te worden.

2 Algemene gegevens.

Aangeleverde gegevens

- Du Pont de Nemours B.B., Piling and Foundation Pipebridge, project nr. C-EB95, tek.nr. DW7000030, rev. A, d.d. 30-03-15.
- Fugro Geoservices B.V., geotechnisch onderzoek en funderingsadvies betreffende Leingbrug Dupont, opdr. Nr. 1315-0049-000, versie 1, d.d. 26 maart 2015.

Normen, richtlijnen en software

De volgende normen, richtlijnen en software zijn gebruikt:

- NEN-EN 1992-1+C2 Eurocode 2:
  Ontwerp en berekening van betonconstructies deel 1-1 Algemene regels en regels voor gebouwen
- Nationale bijlage bij NEN-EN 1992-1-1+C2 Eurocode 2
- NEN-EN 1997-1+C1 2012 nl Eurocode 7: Geotechnisch ontwerp deel 1 Algemene regels
- Nationale bijlage bij NEN-EN 1997-1 Eurocode 7: Geotechnisch ontwerp deel 1 Algemene regels
- DBET EC2 version 2.2.

3 Berekeningsuitgangspunten

Type paal
Casing Draaipaal met groutinjectie: Grondverdingende geschroefde stalen buispaal met groutinjectie

Afmetingen Casing Draaipaal met groutinjectie:
Schachtdiameter: Ø 406 mm[1]
Puntdiameter: Ø 556 mm[1] / diameter groutlichaam

Belastingen:
$F_{c;d;max}$: 250 kN
$F_{t;d}$: 30 kN
V_d: 15 kN
M_d: 80 kNm

Casing:
Staalkwaliteit: S235 niet gecertificeerde handelskwaliteit

Beton
Betonkwaliteit: C30/37
Milieuklasse: XC2
Consistentiegebied: S3

Grout
Kwaliteit, grout: WP2 (≈C30/37)

Wapening
Staalkwaliteit: B500B

Constructieklasse
Levensduur 50 jaar S4

4 Grondmechanisch draagvermogen – druk –

Paalschachtdiameter ϕ406 mm, paalpuntdiameter ϕ556 mm alsmede paalpuntniveau -14,00 m NAP conform Palenplan en geotechnisch advies.
Ter verlaging van de schroefweerstand wordt water- en over het laatste deel groutinjectie toegepast. Vanwege de hogere paalklassefactoren levert dit ook een hoger geotechnisch draagvermogen op.

5 Wapeningsberekening

De wapening voor de palen wordt berekend op grond van de opgegeven belastingen op de paalkop. Gerekend is met de door Fugro berekende kop- en paalschachtmomenten (Funderingsadvies tabel 3-5, zie ook bijlage A).

5.1 Op druk belaste palen

De op druk belaste palen worden gecontroleerd op basis van een combinatie van drukbelasting met horizontaalbelasting en kopmoment. In verband met plaatstolerantie is aanvullend een excentriciteit van 50 mm in rekening gebracht

Belastingcombinatie

$F_{c;d}$	= 250 kN	
V_d	= 15 kN	
$M_{d;kop}$	= 12,5+65 = 77,5 kNm	$[(F_{c;d} * 0,05) + M_{d;paalkop}]$
$M_{d;veld}$	= 12,5+79 = 91,5 kNm	$[(F_{c;d} * 0,05) + M_{d;veld}]$

Keuze beton & wapeningskorf:

Beton:	C30/37
Casing:	ϕ406 mm
Staven:	6ϕ20-7.000 mm
Beugels:	ϕ8-750 mm
Stek:	900 mm
Korfdiameter:	ϕ300 mm
Paaltekening:	150598-1, bijlage C

In bijlage B.1 is middels het programma DBET EC2 version 2.2 het maximaal toelaatbaar moment berekend bij de maximale paalbelasting, gekozen betonkwaliteit en wapening.
Het berekende opneembaar moment bedraagt: M_{Rd} = 116,9 kNm (bijlage B.1, blad 3).
Wapeningkorf 6ϕ20 mm voldoet, $M_{Rd} \geq M_{d;kop;max}$ & $M_{d;veld}$

5.2 Op trek belaste palen

De op trek belaste palen worden gecontroleerd op basis van een combinatie van trekbelasting met horizontaalbelasting en kopmoment. In verband met plaatstolerantie is aanvullend een excentriciteit van 50 mm in rekening gebracht

Belastingcombinatie

$F_{t;d}$	= 30 kN	
V_d	= 15 kN	
$M_{d;kop}$	= 1,5+65 = 66,5 kNm	$[(F_{c;d} * 0,05) + M_{d;paalkop}]$
$M_{d;veld}$	= 1,5+79 = 80,5 kNm	$[(F_{c;d} * 0,05) + M_{d;veld}]$

Keuze beton & wapeningskorf:

Beton:	C30/37
Casing:	ϕ406 mm
Staven:	6ϕ20-7.000 mm
Beugels:	ϕ8-750 mm
Stek:	900 mm
Korfdiameter:	ϕ300 mm
Paaltekening:	150598-1, bijlage C

In bijlage B.2 is middels het programma DBET EC2 version 2.2 het maximaal toelaatbaar moment berekend bij de maximale paalbelasting, gekozen betonkwaliteit en wapening.
Het berekende opneembaar moment bedraagt: M_{Rd} = 98,75 kNm (bijlage B.2, blad 3).
Wapeningkorf 6ϕ20 mm voldoet, $M_{Rd} \geq M_{d;kop;max}$ & $M_{d;veld}$

6 Conclusie

Casing Draaipaal met groutinjectie Ø406/Ø556:

Casing:	Ø406
Schroefpunt:	Ø556
Paalpuntniveau:	-14,00 m[1] NAP
Langswapening:	6Ø20 mm[1]
Beugels:	Ø8-750 mm[1]
Wapeningskorf:	Ø300 mm[1]
Steklengte:	min. 0,90 m[1]
Lengte wapeningskorf:	7,00 m[1], incl. steklengte
Paaltekening:	zie bijlage C

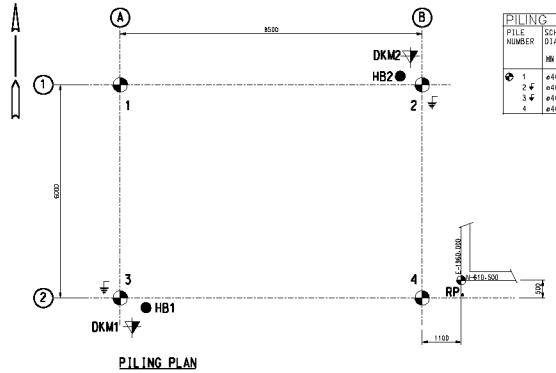
HEKTEC

BIJLAGE A

Gegevens

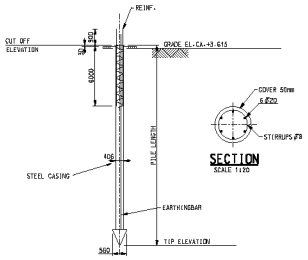
DW7000030

➡ANALYZE FOR SAFETY,ECOLOGY,AND MINIMUM ESSENTIAL DESIGN⬅



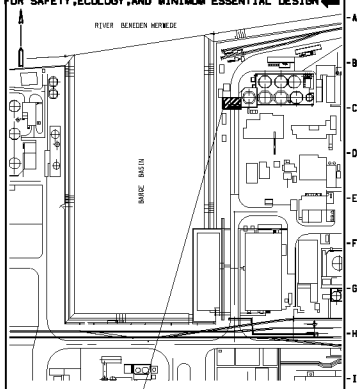
PILING PLAN

PILING SCHEDULE													
PILE NUMBER	SCHAFT/TIP DIAM MM (millimetres)	PILE LENGTH (APPROX) M (metres)	CUT OFF ELEVATION N.A.P. M (metres)	TIP ELEVATION N.A.P. M (metres)	DESIGN LOAD KN COMPRES	TENSION	HOR.	MOMENT IN PILE HEAD	CAPACITY KN COMPRES	TENSION	HOR.	MOMENT IN PILE HEAD
1	ø406/ø560	17.430	+3.430	-14.000	50	10	15	65	250	30	15	80
2	ø406/ø560	17.430	+3.430	-14.000	50	10	15	65	250	30	15	80
3	ø406/ø560	17.430	+3.430	-14.000	50	10	15	65	250	30	15	80
4	ø406/ø560	17.430	+3.430	-14.000	50	10	15	65	250	30	15	80



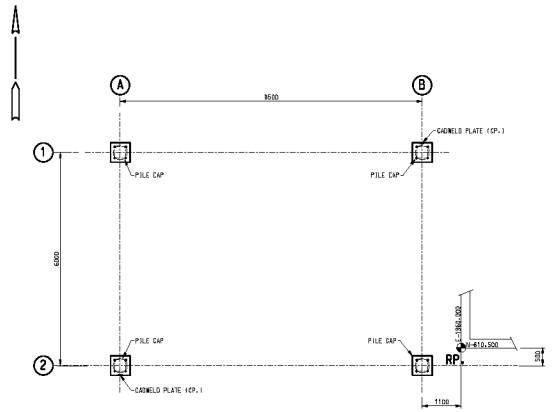
PILE DETAIL

PILE WITH STEEL CASING LEFT IN PLACE.
CONCRETE QUALITY PILE C20/25

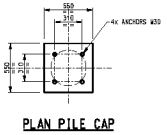


LOCATION

KEY-PLAN

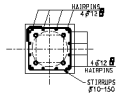


FOUNDATION PLAN



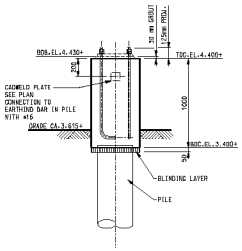
PLAN PILE CAP

SCALE 1:20



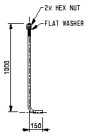
PLAN PILE CAP REINF.

SCALE 1:20



PILE CAP 4x REQ'D

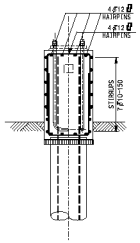
SCALE 1:20



ANCHOR M30 QUALITY 4.6
HOT DIP GALVANIZED
THREAD LENGTH=150mm

ANCHOR DETAIL 4x4 REQ'D

SCALE 1:20



PILE CAP REINF. 4x REQ'D

SCALE 1:20

GENERAL NOTES

-ALL DIMENSIONS ARE IN MILLIMETRES (mm)
-ALL ELEVATIONS ARE IN METRES (m) AND REFER TO NAP

- TOC - TOP OF CONCRETE
- TOS - TOP OF STEEL
- BOB - BOTTOM OF BASE PLATE
- EL - ELEVATION
- TYP - TYPICAL
- CP - CADWELD PLATE TYPE B161 (M10) ERICO AAN BUITENKANT
- RP. - REFERENCE POINT

NEW PILE - VIBRATION FREE INSTALLED PILE ø406/560 WITH STEEL CASING LEFT IN PLACE (SCREW GROUT INJECTION PILE)

PILE WITH EARTHING BAR ø16mm Fe8220HWL TIL TIP PILE CONFORM PS-0-14

DKM- DEEP SOUNDING (2x) SEE DOC NR. 1315-0049-000 FUGRO FOUNDATION ADVICE

HB- BORING (2x)

REFERENCE DRAWING

-LAY OUT PIPEBRIDGE BY DELUGE VALVE HOUSE -DW7000029
-PIPEBRIDGE BY DELUGE VALVE HOUSE -DW7000031

AANDUIDING VLOER EN WANDWAPENING	ONDERSCHEIDEN HOOFDWAPENING	ALGEMEEN BETON	
		STERKTEKLASSE BETON:	C30/37
		STERKTEKLASSE MORTELDEK:	C12/15
		MILIEUKLASSE - Boven:	XC4 , XD3
		- Onder:	XC2 , XA2
BEGIN ONDERGRENS	BETONDEKKING IN mm CONTROLEERBAAR	NIET CONTROLEERBAAR	GROOTSTE KORRELAFMETING: 31.5mm
VLOER	50	50	CEMENTSOORT: CEM III/A of CEM III/B
BALK	50	50	STAALSOORT STAVEN: B500 B
KOLOM/PEER	50	50	STAALSOORT WAP. NETTEN: B500 B
BETON RAND/OPSTORTING	35	35	DRUKSTERKTE BIJ ONTKIST.: -
-		-	

TOEGEPASTE NORMEN / VOORSCHRIFTEN		HORIZONTALE LAS EN VERANKERING LENGTE	
NEN 3550	CEMENT VOLGENS NEN-EN 197-1, NEN-EN 197-4 OF NEN-EN 14216, MET AANVULLENDE SPECIALE EIGENSCHAPPEN-DEFINITIES EN EISEN.		VERANKERING IN mm
			AANHECHTING
NEN-EN 13670	VERVAARDIGEN VAN BETONCONSTRUCTIES.	wk	GOED SLECHT
NEN-EN 206-1	BETON - DEEL 1: SPECIFICATIE, EIGENSCHAPPEN, VERVAARDIGING EN CONFORMITEIT.	ø8	260 410
		ø10	360 520
NEN 8005	NEDERLANDSE UITVOLLING VAN NEN-EN 206-1: BETON - DEEL 1: SPECIFICATIE, EIGENSCHAPPEN, VERVAARDIGEN EN CONFORMITEIT.	ø12	420 620
		ø16	580 820
NEN 6146	WAPENINGSSTAVEN VOOR GEWAPEND BETON	ø20	720 1030
NEN 6008	BETONSTAAL	ø25	900 1280

0 1 2 3 4 5m
1:50

BLDG	PROJ	AREA	TYPE		LAST
1414	C-E895	140T	42c	DW7000030	A REV

TFE/HFP MONOMER
TFE/HFP MONOMER DELUGE HOUSE
PILING AND FOUNDATION PIPEBRIDGE
CONCRETE

INTERNAL USE ONLY

PROJ	NO	REVISION	RVSD	CHKD	APPROVED
C-E895	A	FOR PERMIT			

STANDARDS	REFERENCE DRAWINGS

PROJECT C-E895
SCALE 1:50 DATE
DRAWN C.v/d PLICHT 30-03-15
CHECKED J. de GROOT 30-03-15
APPROVED J. VONK 30-03-15
DESIGN RELEASE
APPROVED
CONSTR. RELEASE

DU PONT DE NEMOURS (NED)B.V.
DORDRECHT, NEDERLAND

DW7000030

INTERGRAPH COMPUTER DRAWING

$$DATE$$
$$TEXT1$$
$$

GEOTECHNISCH ONDERZOEK EN
FUNDERINGSADVIES
betreffende

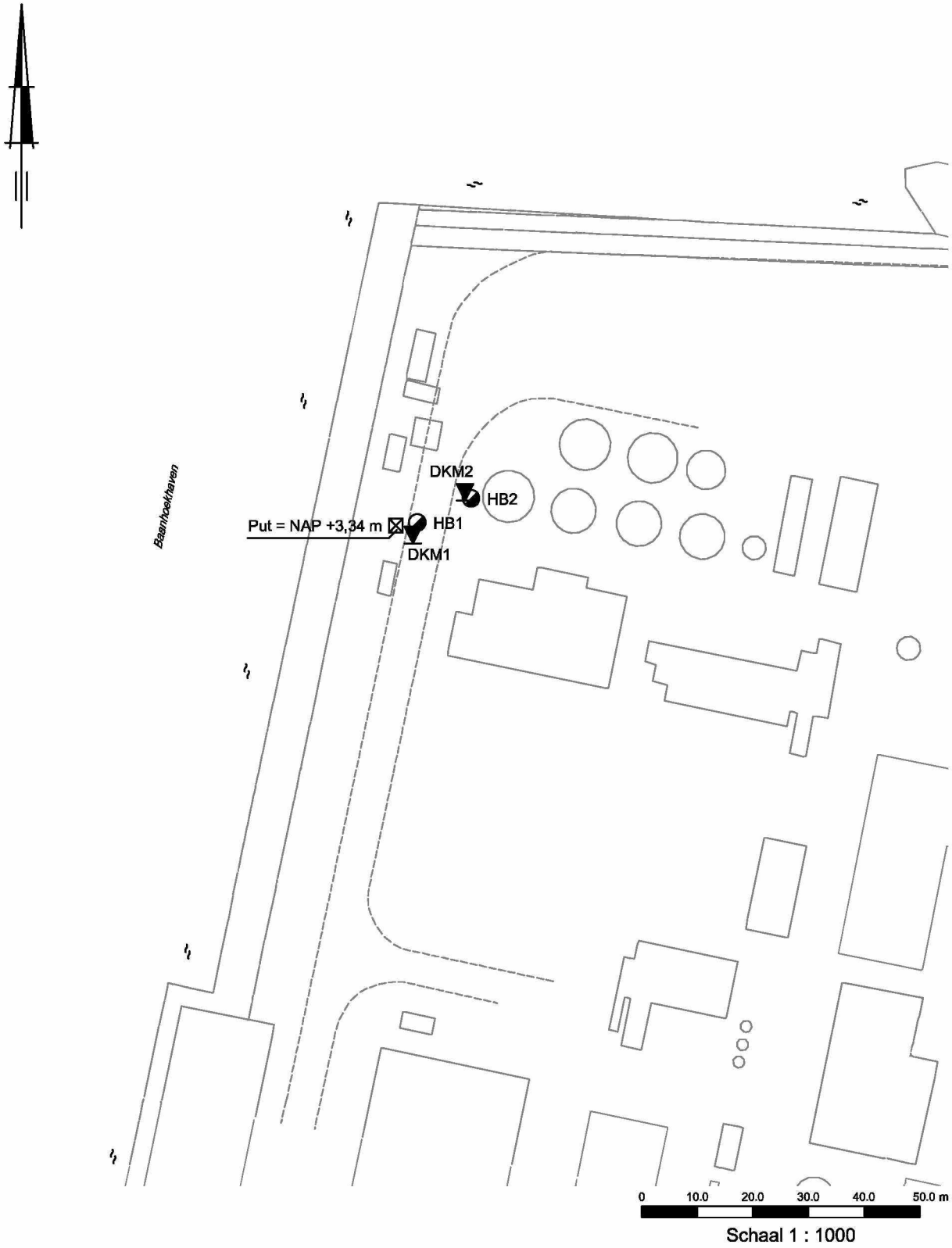
LEIDINGENBRUG DUPONT

Opdrachtnummer: 1315-0049-000

Opdrachtgever	[redacted]-Verzijl B.V. Postbus 158 3330 AD Zwijndrecht
Constructeur	Jacobs Nederland B.V Koddeweg 77 3194 DH Hoogvliet
Datum grondonderzoek	11 maart 2015
Projectleider	ing. [redacted] Senior Projectleider
Opgesteld door	S.I.L. Stoffels MSc Adviseur Geotechniek
Gecontroleerd door	ing. [redacted] Senior Adviseur Geotechniek

VERSIE	DATUM	OMSCHRIJVING WIJZIGING
1	26 maart 2015	

PRO DER



Schaal 1 : 1000

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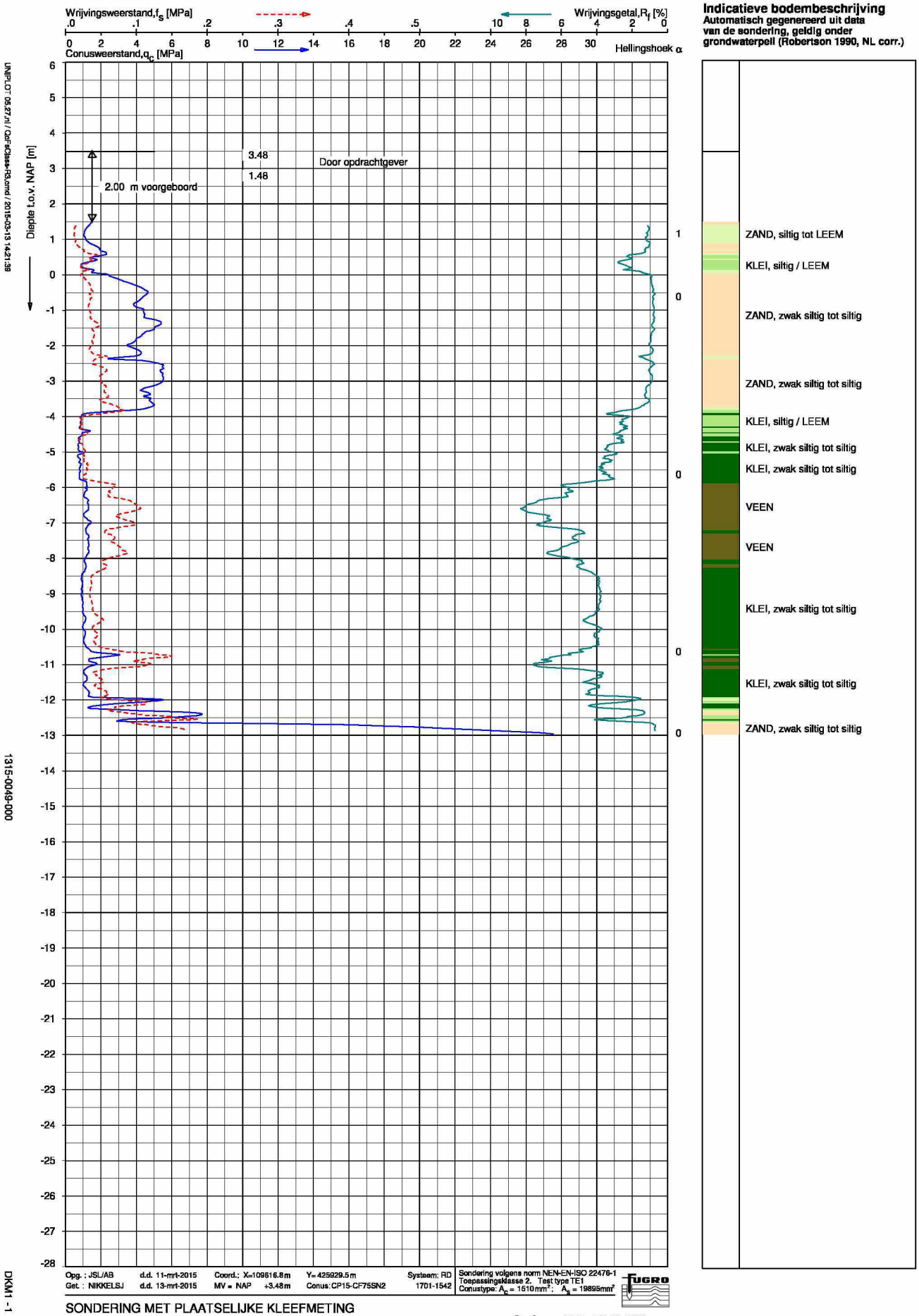
Get.: JNI dd: 13-03-2015 Versie : Revisie Datum :

SITUATIE

Opdr.: 1315-0049-000

FUNDERINGSADVIES DUPONT

Bijl. : 1



UNIPLOT 05.27.n1 / CptFugro+R3.cmd / 2015-03-13 14:21:39

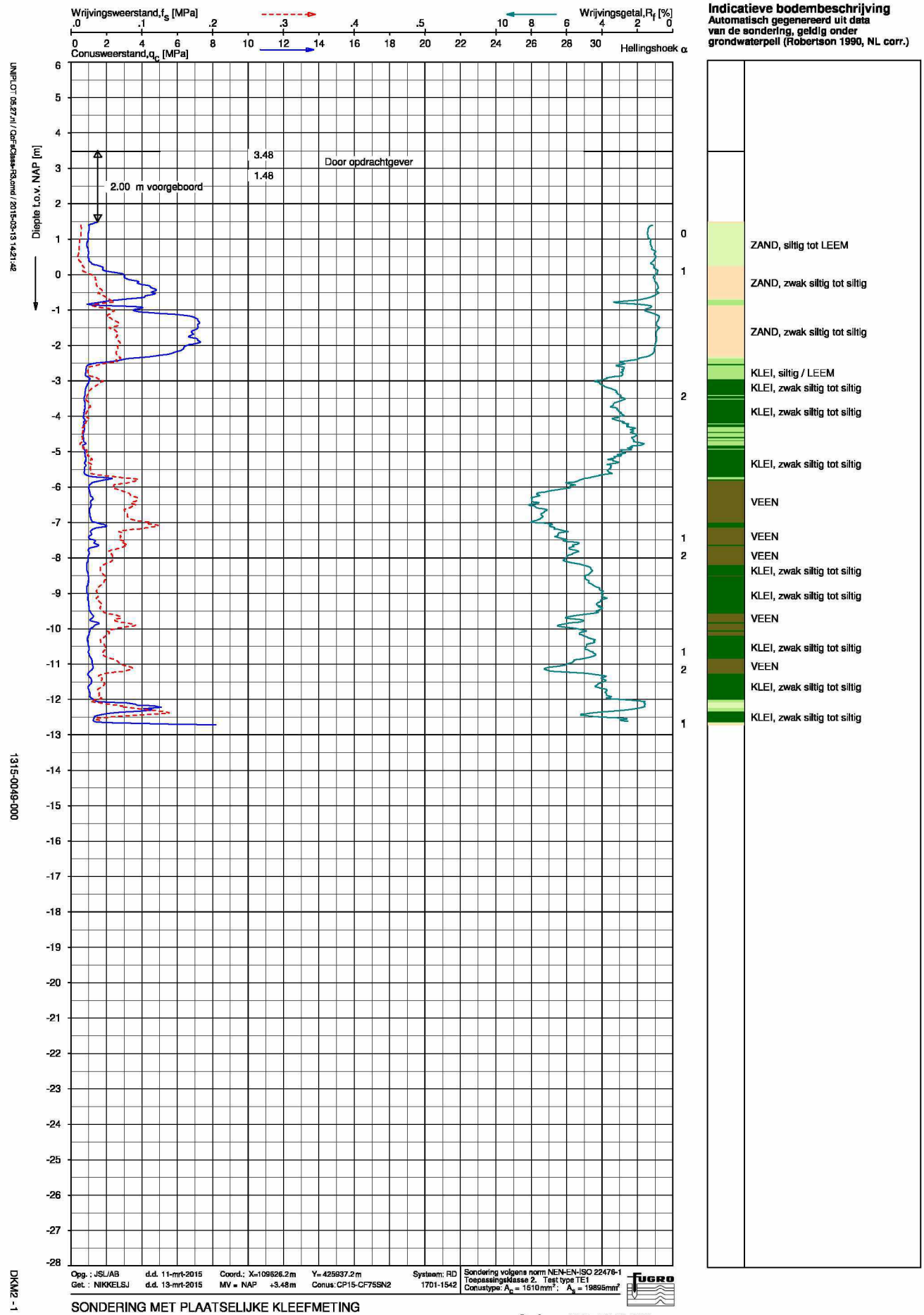
1315-0049-000

DKM1 - 1

SONDERING MET PLAATSELIJKE KLEEFMETING

FUNDERINGSADVIES DUPONT

Opdr. 1315-0049-000
Sond. DKM1



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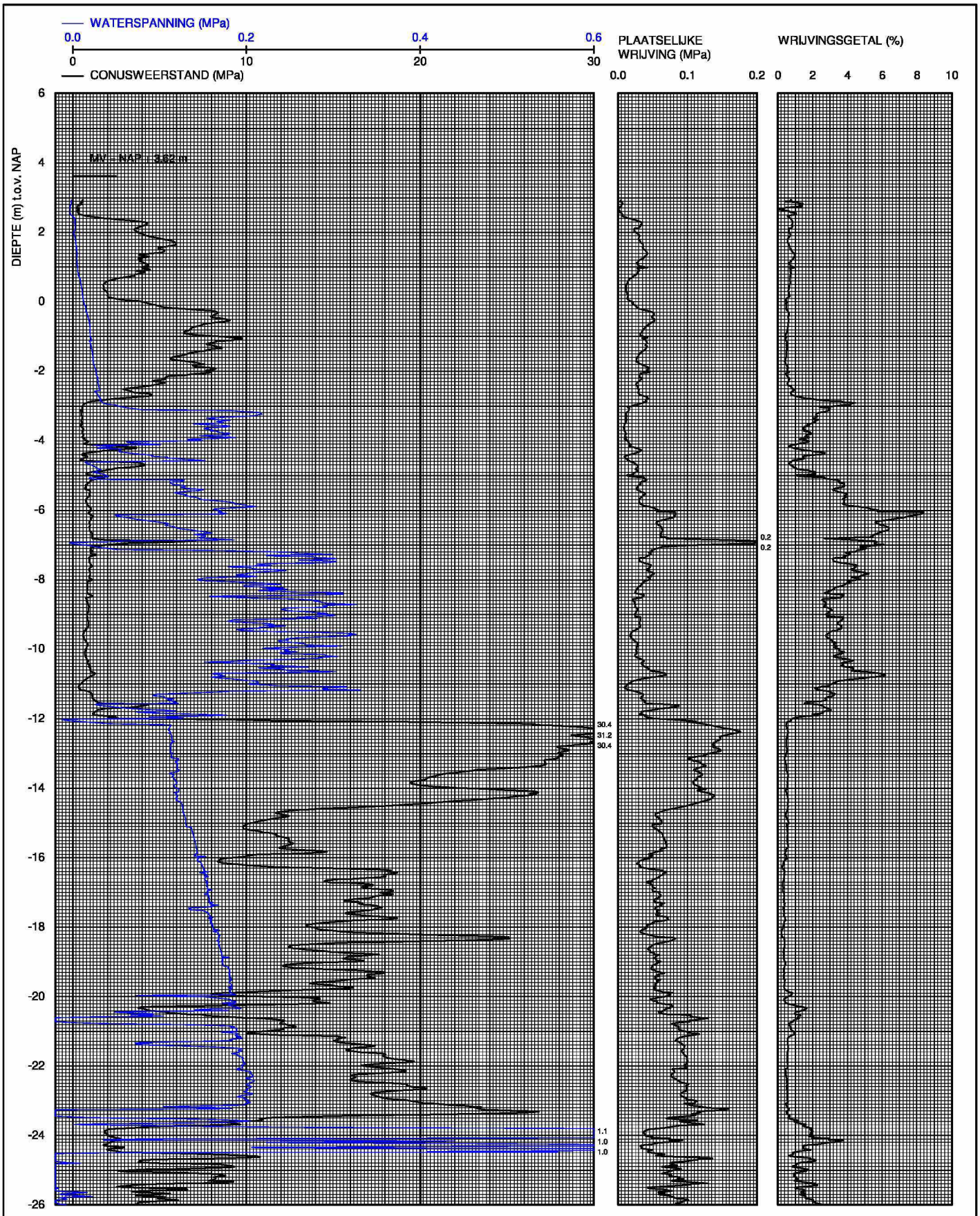
1315-0049-000

DKM2 - 1

SONDERING MET PLAATSELIJKE KLEEFMETING

FUNDERINGSADVIES DUPONT

Opdr. 1315-0049-000
Sond. DKM2



Deltares
Rotterdamseweg 185
2600 MH Delft
Telefoon 088 335 8273
Telefax

datum 1995-11-28	get. Mar	Piezosondering uitgevoerd volgens NEN 3680 Conus nr. 'CKR10/1-342', voorzien van electrische opnemers voor conusweerstand, plaatselijke wrijving, waterspanning en conushelling.
	gez.	
CO-360400/300		Geodetische bijzonderheden: MV = NAP + 3.62 m X = 0 m Y = 0 m
BIJL. 3.13	form. A3	Meetbereiken: Conusweerstand: 50 MPa Plaatselijke wrijving: 0.7 MPa Waterspanning: 1 MPa Conushelling: 0 mRad

DUPONT DE NEMOURS TE DORDRECHT
FEITELIJK RAPPORT VELDWERK 1995
Sondering SONDERING MF-8 [Blad 1 / 3]

tabel 3-4: Karakteristieke waarden sterkteparameters

bovenkant laag [m t.o.v. NAP]	grondlaag	γ/γ_{sat} [kN/m^3]	φ' [^{0}]	K_0 [-]	c_u [kN/m^2]
+3,5	ZAND, geroerd, siltig	17/19	27,5	0,5	-
0,0	ZAND, los	17/19	30,0	0,5	-
-2,5	KLEI	15/15	-	-	25
-6,0	VEEN	12/12	-	-	20
-8,0	KLEI	15/15	-	-	25
-12,5	ZAND, matig vast tot vast	18/20	32,5	0,5	-

Opmerkingen bij de tabel:

- γ en γ_{sat} volumiek gewicht; sat = verzadigd. Voor de berekeningen in grenstoestand 1 is conform tabel A.4a van NEN 9997-1 een partiële factor van 1,1 gehanteerd.
- φ' effectieve hoek van inwendige wrijving. Voor de berekeningen in grenstoestand 1 is conform tabel A.4a van NEN 9997-1 een partiële factor van 1,15 gehanteerd.
- K_0 neutrale gronddrukfactor, welke in dit geval gelijk is aan $K_0 = 1 - \sin \varphi'$
- c_u ongedraineerde schuifsterkte. Voor de berekeningen in grenstoestand 1 is conform tabel A.4a van NEN 9997-1 een partiële factor van 1,35 gehanteerd.

tabel 3-5: Berekeningsresultaten alleenstaande horizontaal belaste paal

Paaldiameter	Berekeningsresultaten			
	UGT		BGT	
	Maximaal kopmoment	Maximaal veldmoment	Paalkop verplaatsing	Hoekverdraaiing op paalkopniveau
[mm]	[kNm]	[kNm]	[mm]	[^{o}]
355/450	65	78 (op NAP -1,3 m)	7	0,28
406/560	65	79 (op NAP -1,3 m)	5	0,17

Door de constructeur dient gecontroleerd te worden of de optredende momenten en vervormingen toelaatbaar zijn. Hierbij dienen de palen tot voldoende diepte te worden gewapend.

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BIJLAGE B

DBET

ENGINEERING EN MONITORING VOOR
GWW EN GEOTECHNIEK

Project:	**150598 Du Pont Leidingbrug**
Controle :	**druk + moment**
Paal :	**Buispaal Ø406 mm**
Datum :	**27/05/2015**

Applied Standard

NEN-EN 1992-1-1+C2 : 2011 (Buildings).

The National Annex of 'The Netherlands NEN-EN 1992-1-1+C2/NB:2011 is applied.

Topology of the section

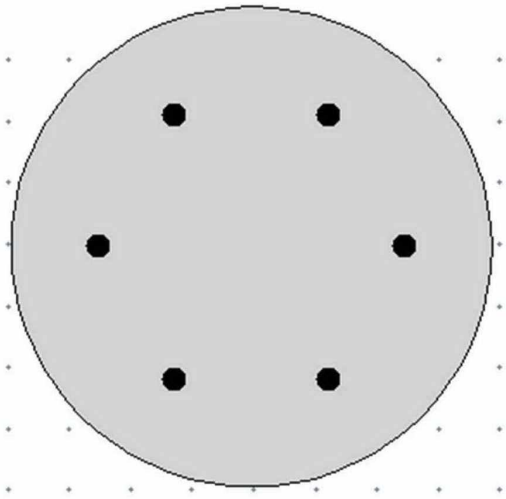

Figure 1 Topology of the section

Details of the basic shapes

Solid Circles

Shape No	Xm [mm]	Ym [mm]	R [mm]	Bars number	Spacing [mm]	C [mm]	Φ1 [mm]	Φ2 [mm]	Quality
1	198,0	198,0	195,0	6	124,0	53,0	20,0	20,0	B500C

Shape No	Border No	Exposure classes	Structural class
1	1	XC2	S4

Details of the converted shapes

The (net) statical properties of the parts constructed out of the converted shapes

Part No	A [mm2]	Sx [mm3]	Sy [mm3]	Ixx [mm4]	Ixy [mm4]	Iyy [mm4]
1	1,176E+005	2,328E+007	2,328E+007	5,730E+009	4,609E+009	5,730E+009

Project:	**150598 Du Pont Leidingbrug**
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Datum :	**27/05/2015**

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Check on cover

Converted reinforcement bars

Bar No	Source	Unfav. S - B	Cmin,b [mm]	Cmin,dur [mm]	Cmin [mm]	ΔCdev [mm]	Cnom [mm]	Cover [mm]	Result
1	Border 1 - 1	1 - 1	20	25	25	0	25	61,0	OK
2	Border 1 - 1	1 - 1	20	25	25	0	25	61,0	OK
3	Border 1 - 1	1 - 1	20	25	25	0	25	61,0	OK
4	Border 1 - 1	1 - 1	20	25	25	0	25	61,0	OK
5	Border 1 - 1	1 - 1	20	25	25	0	25	61,0	OK
6	Border 1 - 1	1 - 1	20	25	25	0	25	61,0	OK

Concrete strength classes and tendon stresses in stages

Stage 1
Part 1 Strength class :C30/37

Load case: UGT

General settings

The position of the (variable) normal force N (Xn,Yn) is (198,0 , 198,0) [mm]
The angle between the X-axis and A-axis is 180,00 [Degrees]
The load is persistent.
The selected stage is: 1
Rotations around both X and Y axes are possible.
The position of the elastic centre (Xe,Ye) is (198,0 , 198,0) [mm]
The position of the system axes (Xs,Ys) is equal to that of the elastic centre (198,0 , 198,0) [mm]
In SLS the load is considered to be of short term.

Present materials and their basic properties

Concretes

Strength class	fck [MPa]	fctm [MPa]	Ecm [MPa]
C30/37	30,0	2,9	32837

Reinforcement steels

Type	fyk [MPa]	k	εuk [o/oo]	εud/εuk	E modulus [GPa]
B500C	500	1,08	50,00	0,9	200

ULS article 6.1 (fEd/fRd)

Present materials, partial factors and design values

Concretes

Strength class	γc	αcc	fcd [MPa]
C30/37	1,50	1,00	20,00

Reinforcement steels

Type	γs	fyd [MPa]	fyud [MPa]	εud [o/oo]
B500C	1,15	435	466	45,00

Composition of load vector fEd (with respect to Xs and Ys)

Vector	N [kN]	Mx [kNm]	My [kNm]	Ma [kNm]	Mb [kNm]
fp (ext.)	0,000E+000	0,000E+000	0,000E+000	0,000E+000	0,000E+000
fn (other)	-2,500E+002	0,000E+000	0,000E+000	0,000E+000	0,000E+000
fm (other)	0,000E+000	-7,750E+001	0,000E+000	7,750E+001	0,000E+000
fEd	-2,500E+002	-7,750E+001	0,000E+000	7,750E+001	0,000E+000

To compute fRd moment Ma is chosen as variable in vector fm(other).

Project:	**150598 Du Pont Leidingbrug**
Controle :	**druk + moment**
Paal :	**Buispaal Ø406 mm**
Datum :	**27/05/2015**

Results

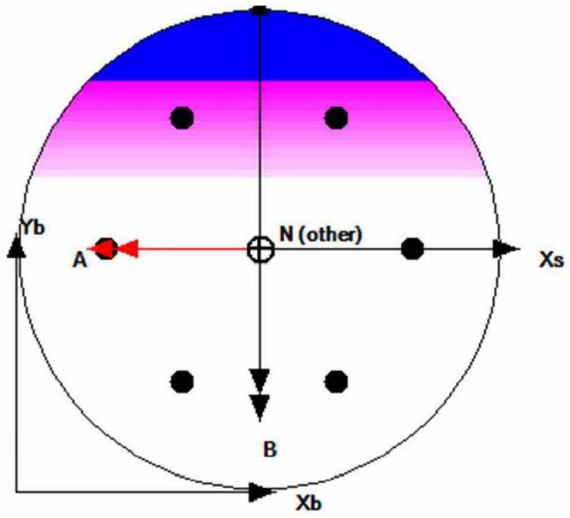

Figure 2 Computed situation for fRd.

Comparison between fEd and fRd

Vector	N [kN]	Mx [kNm]	My [kNm]	Ma [kNm]	Mb [kNm]
fEd	-2,500E+002	-7,750E+001	0,000E+000	7,750E+001	0,000E+000
fRd	-2,500E+002	-1,169E+002	0,000E+000	1,169E+002	0,000E+000

Conclusion: Ma in vector fRd >= Ma in vector fEd ---> OK !

Project:	**150598 Du Pont Leidingbrug**
Controle :	**trek + moment**
Paal :	**Buispaal Ø406 mm**
Datum :	**27/05/2015**

Applied Standard

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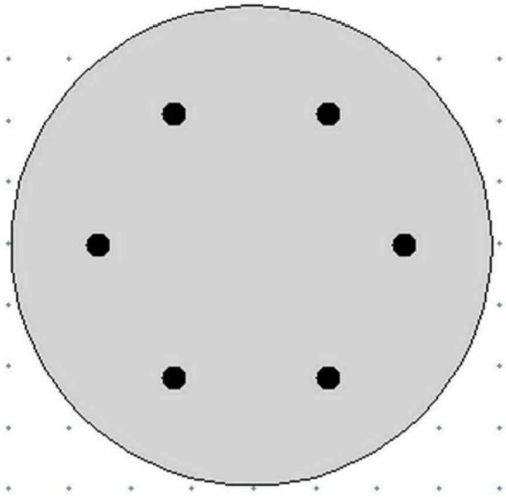

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Concrete strength classes and tendon stresses in stages

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Part 1 Strength class :C30/37

Project:	**150598 Du Pont Leidingbrug**
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HEKTEC

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fn (other)	3,000E+001	0,000E+000	0,000E+000	0,000E+000	0,000E+000
fm (other)	0,000E+000	-6,650E+001	0,000E+000	6,650E+001	0,000E+000
fEd	3,000E+001	-6,650E+001	0,000E+000	6,650E+001	0,000E+000

To compute fRd moment Ma is chosen as variable in vector fm(other).

Project:	**150598 Du Pont Leidingbrug**
Controle :	**trek + moment**
Paal :	**Buispaal Ø406 mm**
Datum :	**27/05/2015**

Results

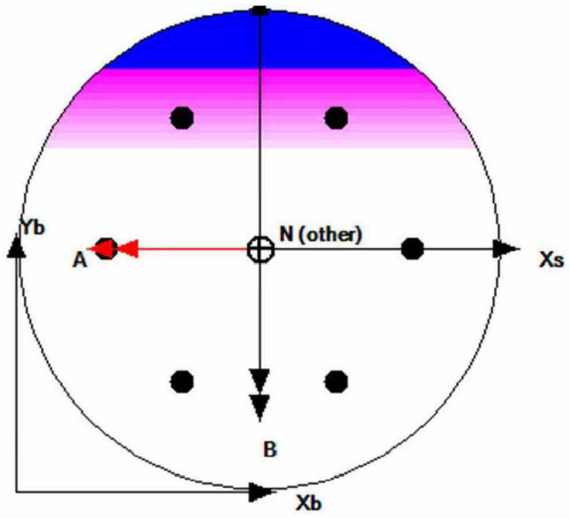

Figure 2 Computed situation for fRd.

Comparison between fEd and fRd

Vector	N [kN]	Mx [kNm]	My [kNm]	Ma [kNm]	Mb [kNm]
fEd	3,000E+001	-6,650E+001	0,000E+000	6,650E+001	0,000E+000
fRd	3,000E+001	-9,875E+001	0,000E+000	9,875E+001	0,000E+000

Conclusion: Ma in vector fRd >= Ma in vector fEd ---> OK !

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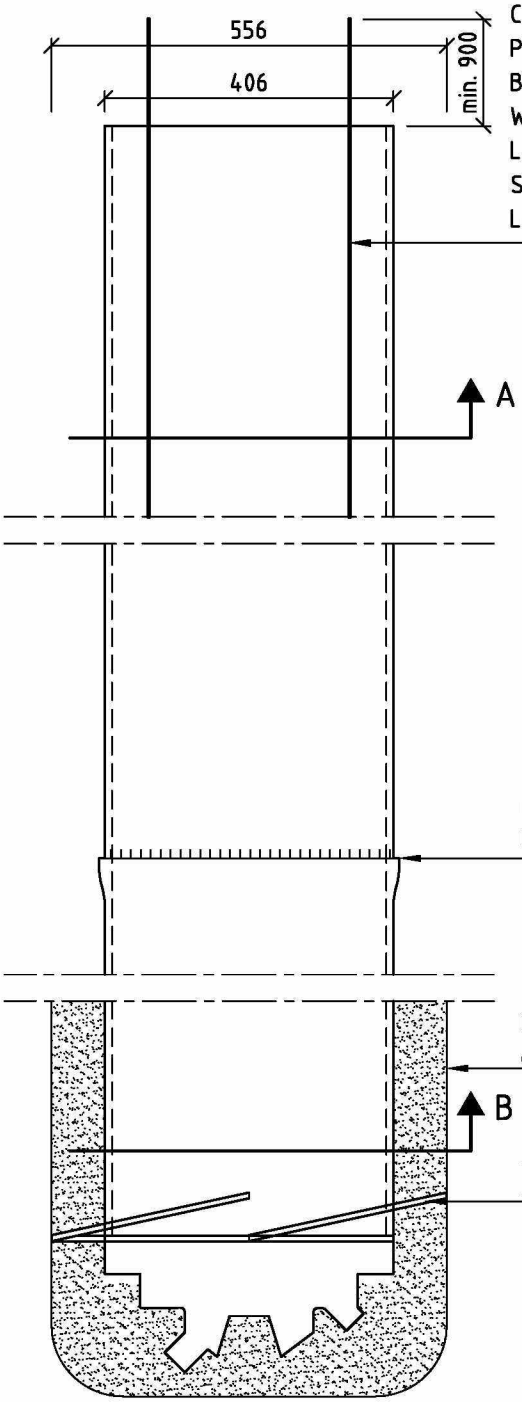
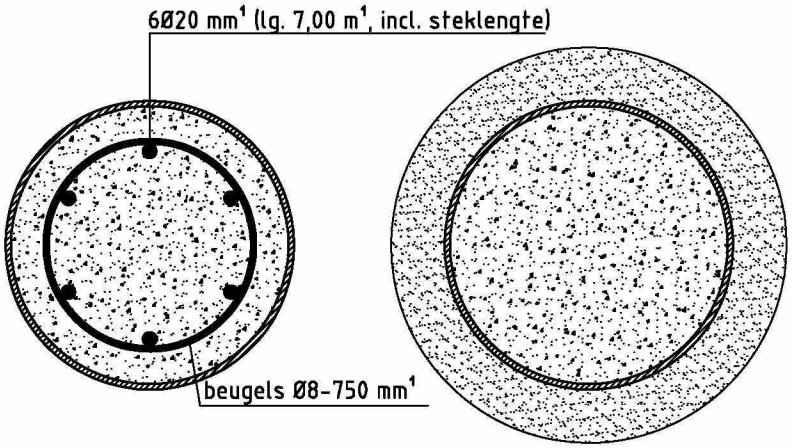
BIJLAGE C

Paaltekening



Casing:	Ø406/8,0 mm¹, S235 o.g
Paalpuntniveau:	NAP -14,00 m¹
Beugels:	Ø8-750 mm¹
Wapeningskorf:	Ø300 mm¹
Langswapening:	6Ø20 mm¹
Steklengte:	min. 0,90 m¹
Lengte wapeningskorf:	7,00 m¹, incl. steklengte



Doorsnede A

Doorsnede B

Betonkwaliteit: C30/37

Groutkwaliteit: WP2

Milieuklasse: XC2

Consistentiegebied: S3

Staalkwaliteit casing: S235 , handelskwaliteit

Staalkwaliteit wapening: B500B

Lasdikte: a= ca. t/√(2),

t= min. plaat- of wanddikte, a>4mm

Betondekking buitenste wapening: >40 mm

Datum: 28-05-2015 Opdrachtgever: Servicis BV

Hektec BV
Postbus 88
1462 ZH Middenbeemster

tel [redacted]
fax [redacted]
e-mail: info@hektec.nl

Project: **Dordrecht - Du Pont Leidingbrug.**

PAALWAPENING

Casing-Draaipaal met groutinjectie Ø406/556 mm¹

Schaal:	1:10
Formaat:	A4
Projectnr.:	15.0598
Getekend:	-
Verificatie:	Gecontroleerd
Volgnr.:	1

ENGINEERING EN MONITORING VOOR
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