Report for D-Sheet Piling 18.1

Design of Diaphragm and Sheet Pile Walls
Developed by Deltares

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Verification according to National Annex of Eurocode 7 in the Netherlands (NEN 9997-1:2016)

1 Summary

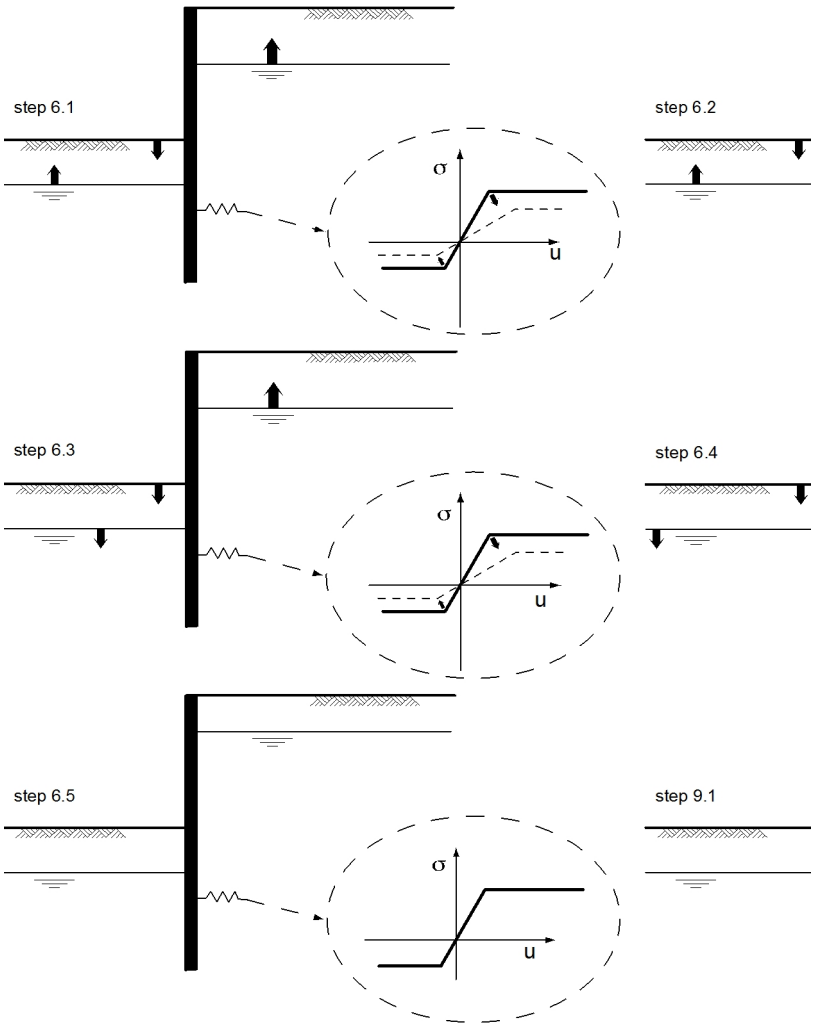
1.1 Overview per Stage and Test

Stage nr.	Verification	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
8	Not verified						
8	Not verified						
8	Not verified						
8	Not verified						
8	Not verified						
8	Not verified						
8	Not verified						
8	EC7(NL)-Step 6.3		-97,77	72,31	35,7	40,0	Upwards
8	EC7(NL)-Step 6.4		121,17	**-92,65**	39,3	43,9	Upwards
8	EC7(NL)-Step 6.5	-37,9	126,31	-66,21	20,5	24,5	Upwards
8	EC7(NL)-Step 6.5 * 1,20		151,57	-79,45			
10	Not verified						
10	EC7(NL)-Step 6.3		-91,79	71,98	36,4	40,7	Sufficient
10	EC7(NL)-Step 6.4		118,01	-90,59	**39,6**	**44,2**	Sufficient
10	EC7(NL)-Step 6.5	-37,8	125,31	-66,18	21,1	25,1	Upwards
10	EC7(NL)-Step 6.5 * 1,20		150,37	-79,41			
12	Not verified						
12	EC7(NL)-Step 6.3		128,73	76,79	24,6	28,9	Upwards
12	EC7(NL)-Step 6.4		128,73	76,79	24,6	28,9	Upwards
12	EC7(NL)-Step 6.5	-37,3	128,73	76,79	24,6	28,9	Upwards
12	EC7(NL)-Step 6.5 * 1,20		154,47	92,15			
Max			**154,47**	**-92,65**	**39,6**	**44,2**	Sufficient

1.2 Supports

Stage nr.	Verification type	Support Anker	
		Force [kN]	Moment [kNm]
8	EC7(NL)-Step 6.3	76,56	-
10	EC7(NL)-Step 6.3	63,89	-
12	EC7(NL)-Step 6.3	53,93	-
8	EC7(NL)-Step 6.4	74,98	-
10	EC7(NL)-Step 6.4	62,53	-
12	EC7(NL)-Step 6.4	53,93	-
8	EC7(NL)-Step 6.5 * 1,20	48,75	-
10	EC7(NL)-Step 6.5 * 1,20	42,66	-
12	EC7(NL)-Step 6.5 * 1,20	64,71	-
Max		**76,56**	**-**

1.3 CUR Verification Steps



2 Input Data for all Stages

2.1 General Input Data

Verification according to National Annex of Eurocode 7 in the Netherlands (NEN 9997-1:2016)

Model	Sheet piling
Check vertical balance	Yes
Number of construction stages	12
Unit weight of water	10,00 kN/m³
Number of curves for spring characteristics	3
Unloading curve on spring characteristic	No
Elastic calculation	Yes

2.2 Sheet Piling Properties

Length	9,70 m
Level top side	23,70 m
Number of sections	1
q_b;max	13,00 MPa
Xi factor	1,39

2.2.1 General properties

Section name	From [m]	To [m]	Material type	Acting width [m]
AZ 18	14,00	23,70	Steel	1,00

2.2.2 Stiffness EI (elastic behaviour)

Section name	Elastic stiffness EI [kNm²/m']	Red. factor on EI [-]	Corrected elas. stiffness EI [kNm²]	Note to reduction factor
AZ 18	7,1820E+04	1,00	7,1820E+04	

2.2.3 Maximum allowable moments

Section name	Mr;char;el [kNm/m']	Modification factor [-]	Material factor [-]	Red. factor allow. moment [-]	Mr;d;el [kNm]
AZ 18	432,00	1,00	1,00	1,00	432,00

2.2.4 Properties for vertical balance

Section name	From [m]	To [m]	Height [mm]	Coating area [m²/m² wall]	Section area [cm²/m']
AZ 18	14,00	23,70	380,00	1,35	150,00

2.3 Calculation Options

First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL - method B: Partial factors (design values) in verifie Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
Verification of stage	8: MHW - hoog + belasting
Used partial factor set	RC 1

Factors on loads	
- Permanent load, unfavourable	1,00
- Permanent load, favourable	1,00
- Variable load, unfavourable	1,00
- Variable load, favourable	0,00
Material factors	
- Cohesion	1,15
- Tangent phi	1,15
- Delta (wall friction angle)	1,15
- Modulus of low representative subgrade reaction	1,30
Geometry modification	
- Increase retaining height	10,00 %
- Maximum increase retaining height	0,50 m
- Reduction in phreatic line on passive side	0,20 m
- Raise in phreatic line on passive side	0,20 m
- Raise in phreatic line on active side	0,05 m
Vertical balance factors	
- Partial factor base resistance (gamma_b)	1,20
Verification of stage	10: Hoog - normaal + belasting
Used partial factor set	RC 1
Factors on loads	
- Permanent load, unfavourable	1,00
- Permanent load, favourable	1,00
- Variable load, unfavourable	1,00
- Variable load, favourable	0,00
Material factors	
- Cohesion	1,15
- Tangent phi	1,15
- Delta (wall friction angle)	1,15
- Modulus of low representative subgrade reaction	1,30
Geometry modification	
- Increase retaining height	10,00 %
- Maximum increase retaining height	0,50 m
- Reduction in phreatic line on passive side	0,20 m
- Raise in phreatic line on passive side	0,20 m
- Raise in phreatic line on active side	0,05 m
Vertical balance factors	
- Partial factor base resistance (gamma_b)	1,20
Verification of stage	12: MHW - laag + belasting
Used partial factor set	RC 0 RC0 is added for simple constructions. To be compared with CUR class I
Factors on loads	
- Permanent load, unfavourable	1,00
- Permanent load, favourable	1,00
- Variable load, unfavourable	1,00
- Variable load, favourable	0,00
Material factors	
- Cohesion	1,00
- Tangent phi	1,00User defined
- Delta (wall friction angle)	1,00User defined
- Modulus of low representative subgrade reaction	1,00User defined
Geometry modification	

- Increase retaining height	0,00 %	User defined
- Maximum increase retaining height	0,00 m	User defined
- Reduction in phreatic line on passive side	0,00 m	User defined
- Raise in phreatic line on active side	0,00 m	User defined
Vertical balance factors		
- Partial factor base resistance (gamma_b)	1,00	User defined

End of Report