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

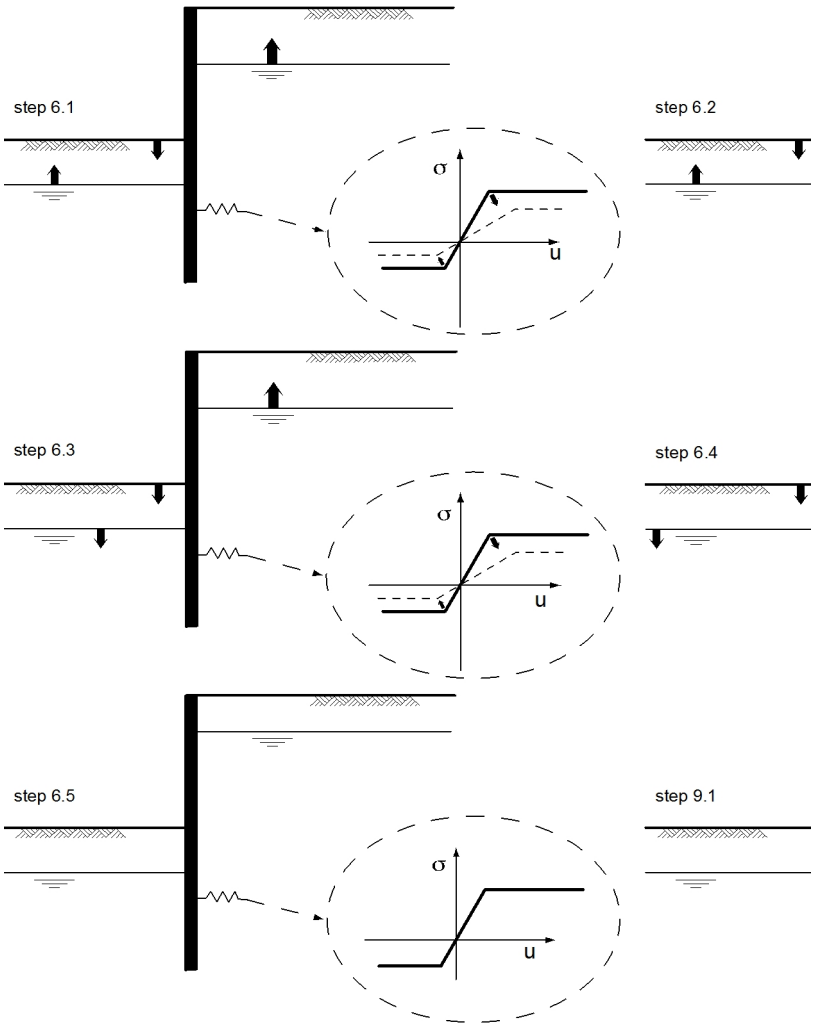
1.1 Overview per Stage and Test

Stage nr.	Verification	Displace-ment [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
7	Not verified						
7	Not verified						
7	Not verified						
7	Not verified						
7	Not verified						
7	Not verified						
7	EC7(NL)-Step 6.3		156,81	-101,80	**0,0**	38,8	Upwards
7	EC7(NL)-Step 6.4		156,62	-100,72	**0,0**	38,5	Upwards
7	EC7(NL)-Step 6.5	-17,4	74,41	-34,64	**0,0**	18,1	Upwards
7	EC7(NL)-Step 6.5 * 1,20		89,29	-41,57			
9	Not verified						
9	EC7(NL)-Step 6.3		**207,30**	**-147,50**	**0,0**	**49,8**	Upwards
9	EC7(NL)-Step 6.4		207,29	-146,93	**0,0**	49,7	Upwards
9	EC7(NL)-Step 6.5	-25,6	103,25	-49,84	**0,0**	21,0	Upwards
9	EC7(NL)-Step 6.5 * 1,20		123,90	-59,81			
11	Not verified						
11	EC7(NL)-Step 6.3		150,66	-77,89	**0,0**	25,4	Upwards
11	EC7(NL)-Step 6.4		150,68	-77,91	**0,0**	25,4	Upwards
11	EC7(NL)-Step 6.5	-40,8	150,66	-77,89	**0,0**	25,4	Upwards
11	EC7(NL)-Step 6.5 * 1,20		180,80	-93,47			
Max			**207,30**	**-147,50**	**0,0**	**49,8**	Sufficient

1.2 Overall Stability per Stage

Stage name	Stability factor [-]
MHW + hoog + ...	2,56
Hoog - normaal ...	2,37
MHW - laag + b...	2,71

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	11
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	8,30 m
Level top side	22,30 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	22,30	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	22,30	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	7: 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
Overall stability factors	
- Cohesion	1,30
- Tangent phi	1,20
- Factor on unit weight soil	1,00
Vertical balance factors	
- Partial factor base resistance (gamma_b)	1,20
Verification of stage	9: 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
Overall stability factors	
- Cohesion	1,30
- Tangent phi	1,20
- Factor on unit weight soil	1,00
Vertical balance factors	
- Partial factor base resistance (gamma_b)	1,20
Verification of stage	11: 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 mUser defined
- Reduction in phreatic line on passive side	0,00 mUser defined
- Raise in phreatic line on active side	0,00 mUser defined

Overall stability factors	
- Cohesion	1,00User defined
- Tangent phi	1,00User defined
- Factor on unit weight soil	1,00

Vertical balance factors	
- Partial factor base resistance (gamma_b)	1,00User defined

End of Report