

### Algemeen

Referentie: Aanvraag 10 november 2017

Aanvrager:

Emailadres:

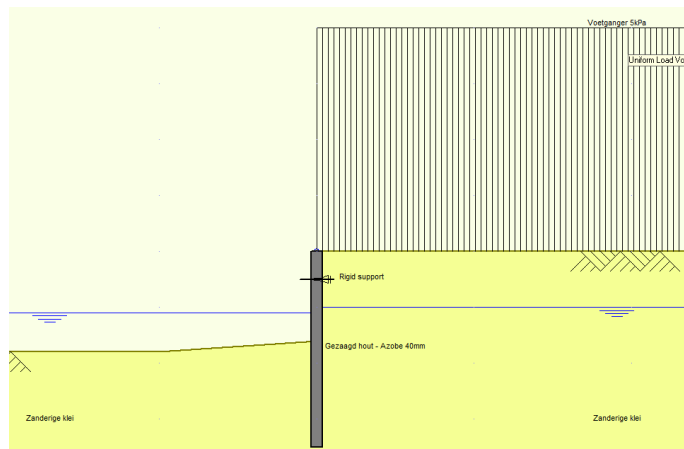
Telefoonnummer:

### Input (opgave klant)

Projectlocatie:

Doel berekening: controle berekening houten damwand met door opdrachtgever bepaalde afmetingen.

Boven-belasting: voetganger 5kPa.



### Geometrie:

- NAP hoogtes onbekend;
- Kerende hoogte damwand: 1,40 m;
- Taludhoogte: 0,40 m;
- Taludbreedte: 1,0 m;
- Grondwaterstand: 1,2 m onder maaiveld (-1,0 gehanteerd);
- Open waterstand: 1,10 m onder bovenkant damwand.

### Verankering: JA

- Gehanteerd niveau: 0,5m onder b.k. damwand.

### Gegevens damwandplank (opgave klant)

Soort: Hout

Kwaliteit: Azobé, sterkteklasse D60

Lengte plank: 3,5 m

Dikte plank: 40 mm

### Overige uitgangspunten

Bodemopbouw conform opgave opdrachtgever: klei zanderig

Grondeigenschappen ingeschat conform Tabel 2.b – NEN9997-1.

Berekening conform NEN9997-1, Veiligheidsklasse RC0.

### Resultaat

- Maximaal opneembaar moment van  $9,2 \text{ kNm/m}^1 > 3,9 \text{ kNm/m}^1$  (Voldoet)
- Gemobiliseerde grond van ca. 68 % (Voldoet)
- Veiligheid tegen afschuiven 1,43 – RC0 (Voldoet)
- Maximale doorbuiging BGT = 4 mm
- Rekenwaarde ankerkracht =  $11,4 \text{ kN/m}^1$

### Conclusie

De Azobé houten damwandplanken (D60) met een lengte van 3,5m en een dikte van 40mm voldoen in de beschouwde situatie.

Op basis van de bepaalde ankerkracht kan men de gewenste hart-op-hart afstand van de ankers bepalen en zowel de ankers als gordingen controleren.

### Opmerkingen

Het toetsen van de (houten) gordingen evenals het voorzien in een advies betreffende de verankering valt buiten de scope van deze opdracht. Indien gewenst kunnen wij u hiervoor een aanvullend advies leveren.

**Report for D-Sheet Piling 17.1**  
Design of Diaphragm and Sheet Pile Walls  
Developed by Deltares

Company:

Date of report: 11/28/2017  
Time of report: 12:39:16 PM

Date of calculation: 11/20/2017  
Time of calculation: 11:05:56 AM

Filename: X:\.\3. Berekeningen GEO2\3.1\voorbeeld

Project identification: 117004\_10 Voorbeeld  
Houten damwand

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

## 1 Table of Contents

1 Table of Contents	2
2 Summary	3
2.1 Overview per Stage and Test	3
2.2 Supports	3
2.3 Overall Stability per Stage	3
2.4 CUR Verification Steps	4
3 Input Data for all Stages	5
3.1 General Input Data	5
3.2 Sheet Piling Properties	5
3.2.1 General properties	5
3.2.2 Stiffness EI (elastic behaviour)	5
3.2.3 Maximum allowable moments	5
3.3 Calculation Options	5
4 Outline Stage 1: Rigid support	7
5 Overall Stability Stage 1: Rigid support	8
5.1 Overall Stability	8
6 Step 6.5 Stage 1: Rigid support	9
6.1 Calculation Results	9
6.1.1 Charts of Moments, Forces and Displacements	9
6.1.2 Rigid and Spring Supports	9
7 Outline Stage 2: load	10
8 Overall Stability Stage 2: load	11
8.1 Overall Stability	11
9 Step 6.5 Stage 2: load	12
9.1 Calculation Results	12
9.1.1 Charts of Moments, Forces and Displacements	12
9.1.2 Rigid and Spring Supports	12

## 2 Summary

### 2.1 Overview per Stage and Test

Stage nr.	Verification type	Displacement [mm]	Moment [kNm]	Shear force [kN]	Mob. perc. moment [%]	Mob. perc. resistance [%]	Vertical balance
1	EC7(NL)-Step 6.3		2,71	-6,27	53,8	57,8	---
1	EC7(NL)-Step 6.4		2,44	-5,69	54,5	58,9	---
1	EC7(NL)-Step 6.5	-2,3	1,40	-4,23	39,3	42,4	---
1	EC7(NL)-Step 6.5 * 1,20		1,68	-5,08			
2	EC7(NL)-Step 6.3		<b>3,89</b>	<b>-9,01</b>	61,9	66,2	---
2	EC7(NL)-Step 6.4		3,61	-8,52	<b>62,9</b>	<b>67,5</b>	---
2	EC7(NL)-Step 6.5	<b>-3,7</b>	2,11	-6,32	45,1	48,9	---
2	EC7(NL)-Step 6.5 * 1,20		2,53	-7,58			
Max		<b>-3,7</b>	<b>3,89</b>	<b>-9,01</b>	<b>62,9</b>	<b>67,5</b>	---

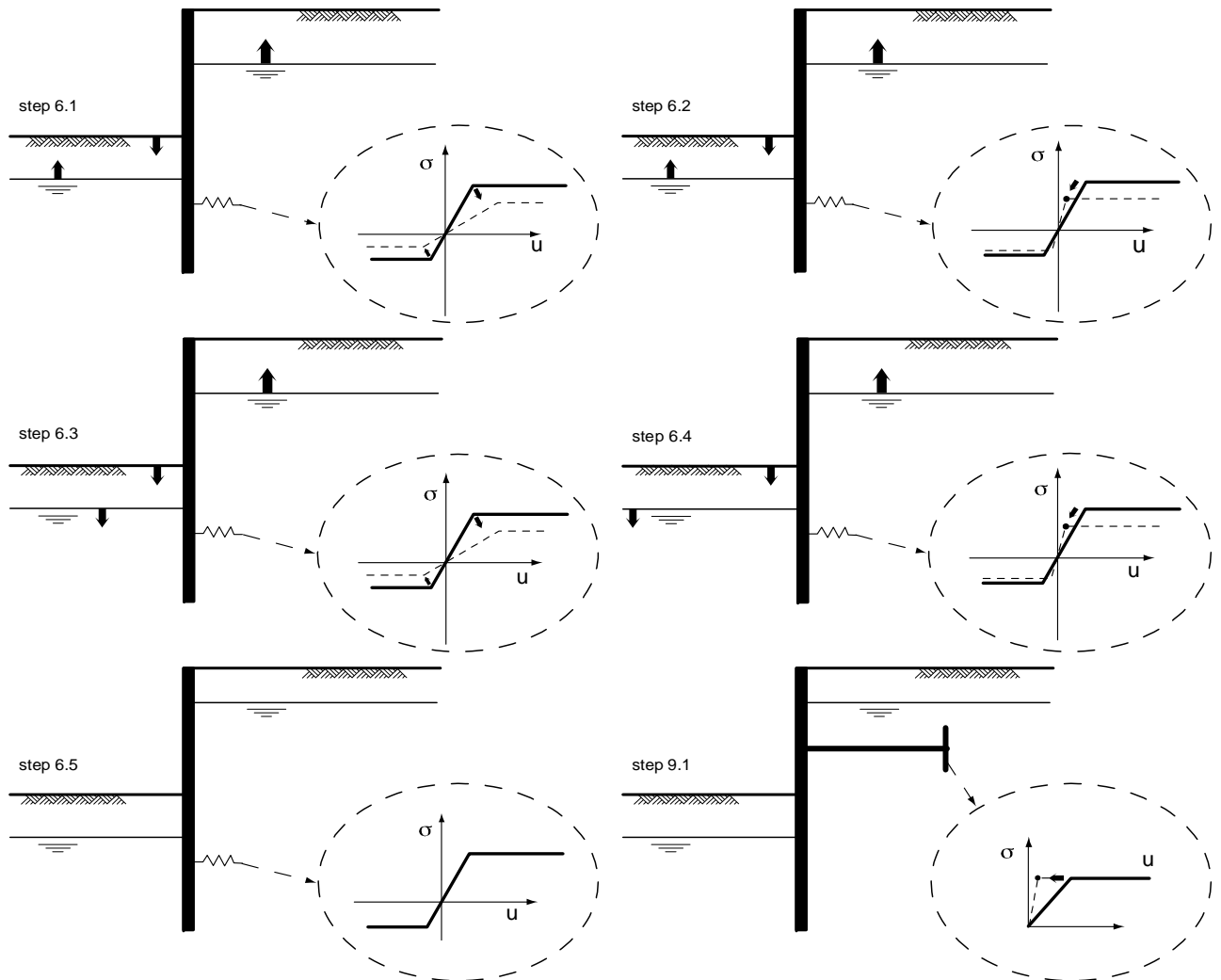
### 2.2 Supports

Stage nr.	Verification type	Support Rigid support	
		Force [kN]	Moment [kNm/m']
1	EC7(NL)-Step 6.3	7,45	2,54
2	EC7(NL)-Step 6.3	11,37	3,47
1	EC7(NL)-Step 6.4	6,75	2,30
2	EC7(NL)-Step 6.4	10,62	3,28
1	EC7(NL)-Step 6.5 * 1,20	6,43	1,49
2	EC7(NL)-Step 6.5 * 1,20	10,28	2,06
Max		<b>11,37</b>	<b>3,47</b>

### 2.3 Overall Stability per Stage

Stage name	Stability factor [-]
Rigid support	1,62
load	1,43

2.4 CUR Verification Steps



### 3 Input Data for all Stages

#### 3.1 General Input Data

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

Model	Sheet piling
Check vertical balance	No
Number of construction stages	2
Unit weight of water	9,81 kN/m <sup>3</sup>
Number of curves for spring characteristics	3
Unloading curve on spring characteristic	No
Elastic calculation	Yes

#### 3.2 Sheet Piling Properties

Length	3,50 m
Level top side	0,00 m
Number of sections	1

##### 3.2.1 General properties

Section name	From [m]	To [m]	Material type	Acting width [m]
Gezaagd hout - ...	-3,50	0,00	User defined	1,00

##### 3.2.2 Stiffness EI (elastic behaviour)

Section name	Elastic stiffness EI [kNm <sup>2</sup> /m']	Red. factor on EI [-]	Corrected elas. stiffness EI [kNm <sup>2</sup> ]	Note to reduction factor
Gezaagd hout - ...	7,6300E+01	1,00	7,6300E+01	

##### 3.2.3 Maximum allowable moments

Section name	Mr,char;el [kNm/m']	Modification factor [-]	Material factor [-]	Red. factor allow. moment [-]	Mr;d;el [kNm]
Gezaagd hout - ...	9,20	1,00	1,00	1,00	9,20

#### 3.3 Calculation Options

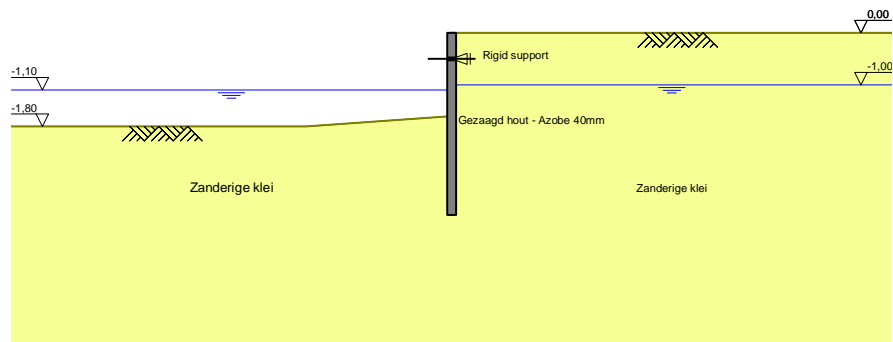
First stage represents initial situation	No
Calculation refinement	Coarse
Reduce delta(s) according to CUR	Yes
Verification	EC7 NA NL - method B: Partial factors (design values) in verification of Eurocode 7 using the factors as described in the National Annex of the Netherlands. It is basically design approach III.
Verification of stage	1: Rigid support
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	1,05
- Delta (wall friction angle)	1,05
- 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	0,15 m
- Raise in phreatic line on passive side	0,15 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
Verification of stage	2: load
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	1,05
- Delta (wall friction angle)	1,05
- 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	0,15 m
- Raise in phreatic line on passive side	0,15 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

## 4 Outline Stage 1: Rigid support

Outline - Stage 1: Rigid support



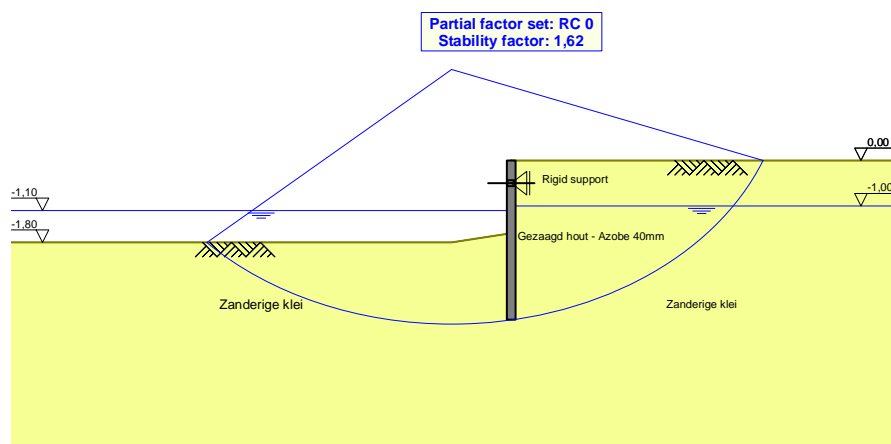


## 5 Overall Stability Stage 1: Rigid support

Stability factor : 1,62

### 5.1 Overall Stability

Overall Stability - Stage 1: Rigid support

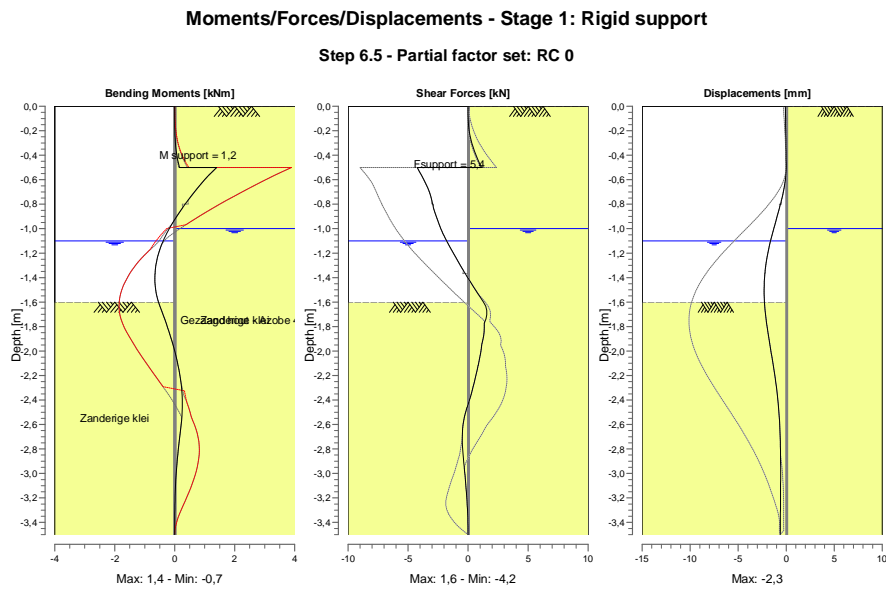


## 6 Step 6.5 Stage 1: Rigid support

### 6.1 Calculation Results

Number of iterations: 5

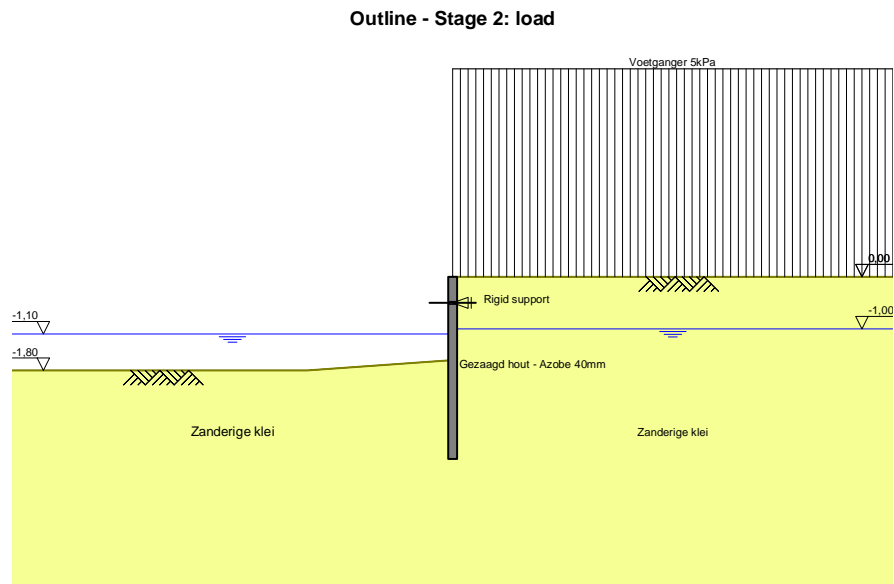
#### 6.1.1 Charts of Moments, Forces and Displacements



#### 6.1.2 Rigid and Spring Supports

Node number	Level [m]	Force [kN]	Moment [kNm]
4	-0,50	5,36	1,24

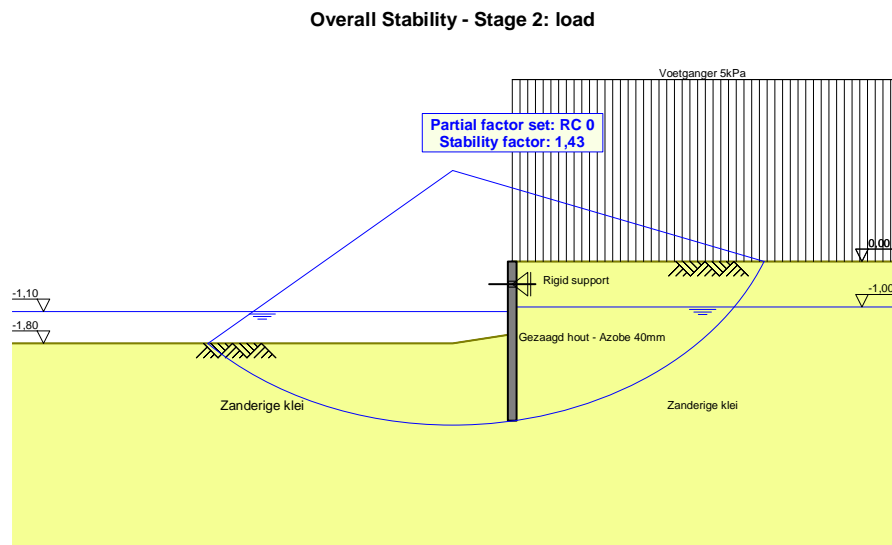
## 7 Outline Stage 2: load



## 8 Overall Stability Stage 2: load

Stability factor : 1,43

### 8.1 Overall Stability



## 9 Step 6.5 Stage 2: load

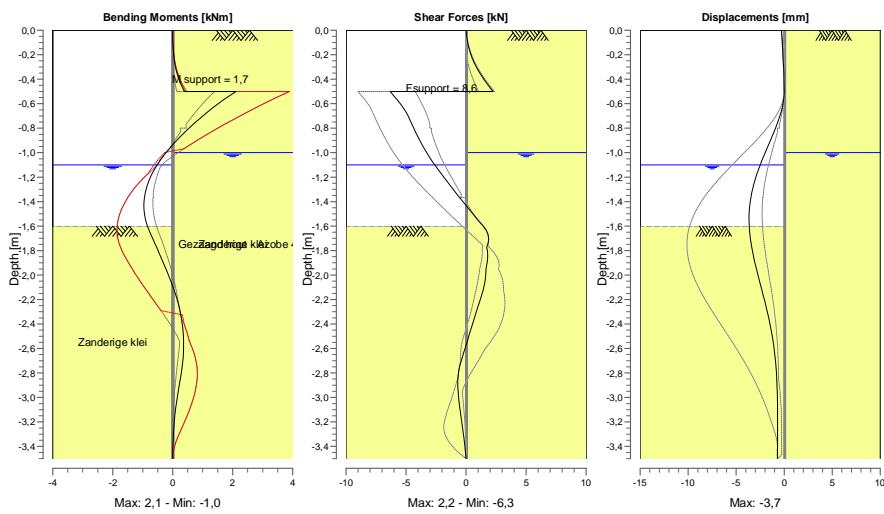
### 9.1 Calculation Results

Number of iterations: 4

#### 9.1.1 Charts of Moments, Forces and Displacements

##### Moments/Forces/Displacements - Stage 2: load

Step 6.5 - Partial factor set: RC 0



#### 9.1.2 Rigid and Spring Supports

Node number	Level [m]	Force [kN]	Moment [kNm]
4	-0,50	8,57	1,72

End of Report