



VALIDATION REPORT

SPREADSHEET "EC GE Uplift"

Version 1.0

Date: 1-12-2012
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APPENDIX A RESULTS SHEET EC GE UPLIFT



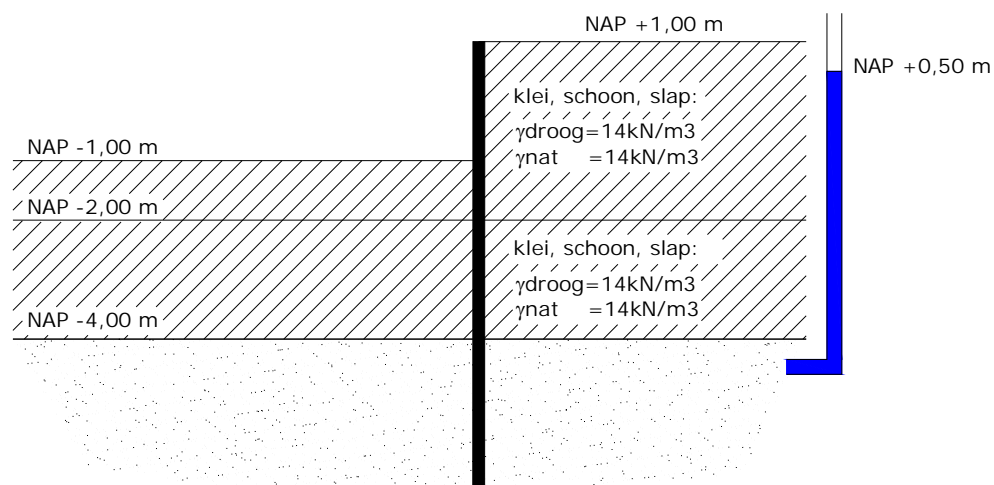
1 VERIFICATION SPREADSHEET

The spread sheet "EC GE Uplift" determines the safety against uplift failure for excavations between retaining walls as well as excavations with slopes according to NEN9997-1

Verification is done by means of carrying out a hand calculation which is presented in paragraph 1.1.

1.1 Verification calculation

1) Calculation for uplift failure between retaining walls



$$p_{z;d} \leq \sum_{j=1}^{j=n} \gamma_{j;d} \times d_{j;d}$$

$$4.50 \text{ m} \times 10.00 \text{ kN/m}^3 \leq (14.00 \text{ kN/m}^3 \times 3.00 \text{ m}) \times 0.9$$
$$45.00 \text{ kN/m}^2 > 37.8 \text{ kN/m}^2 \text{ (Not OK)}$$

$$\text{S.F.} = 37.8 / 45 = 0.84$$

$$\text{u.c.} = 1 / 0.84 = 1.19$$



1.2 Spread sheet calculation

The calculation using the spread sheet is presented in Appendix A. Below, concise screen captures of the in- and output are given.

1) Calculation for uplift failure between retaining walls

Assessment of uplift failure

Input | Information |

General Information

Consultant: Rene Thijssen

Project name: verification

Project number: 1234

Description: verification

Name reference level: NAP

Surface load p_0 [kN/m²]: 0

γ_{water} [kN/m³]: 10

Geometry

Ground level ([m] ref.): 1

Excavation level ([m] ref.): -1

Water level excavation ([m] ref.): -1

Calculation / material factors

Include undrained shear strength

γ_{Cu} : 1.5

$\gamma_{\text{unit weight}}$: 0.9

$\gamma_{\text{water pressure}}$: 1

Type of excavation

Between retaining walls Sloping

Width [m]: 10

Width [m] (2b):

Slope v:h :

Soil Profile

Profile below excavation (d2)

Layer no.	Layer name	Bottom	γ [kN/m ³]	C_u [kPa]
1.	Clay 1	-2	14	
2.	Clay 2	-4	14	
3.				
4.				
5.				
6.				

Profile outside excavation (d1)

Layer no.	Layer name	Bottom	γ [kN/m ³]
1.			
2.			
3.			
4.			
5.			
6.			

Uplift pressure

Level aquifer ([m] ref): -4

Hydraulic head ([m] ref): 0.5

Results

Upward [kPa]: 45.0

Downward [kPa]: 37.8

Safety factor: 0.84

Update form | OK



2) Calculation for uplift failure with slopes

Assessment of uplift failure

Input | Information

General Information

Consultant: Rene Thijssen

Project name: verification

Project number: 1234

Description: verification

Name reference level: NAP

Surface load p_0 [kN/m²]: 0

γ_{water} [kN/m³]: 10

Geometry

Ground level ([m] ref.): 1

Excavation level ([m] ref.): -1

Water level excavation ([m] ref.): -1

Calculation / material factors

Include undrained shear strength

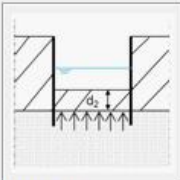
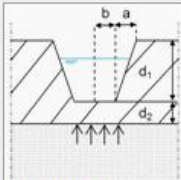
γ_{Cu} : 1.5

$\gamma_{\text{unit weight}}$: 0.9

$\gamma_{\text{water pressure}}$: 1

Type of excavation

Between retaining walls Sloping

Width [m]:

Width [m] (2b): 4

Slope v:h: 2 : 3

Soil Profile

Profile below excavation (d2)

Layer no.	Layer name	Bottom	γ [kN/m ³]	C_u [kPa]
1.	Clay 1	-2	14	
2.	Clay 2	-4	14	
3.				
4.				
5.				
6.				

Profile outside excavation (d1)

Layer no.	Layer name	Bottom	γ [kN/m ³]
1.	Clay 1	-2	14
2.	Clay 2	-4	14
3.			
4.			
5.			
6.			

Uplift pressure

Level aquifer ([m] ref.): -4

Hydraulic head ([m] ref.): 0.5

Results

Upward [kPa]: 45.0

Downward [kPa]: 41.7

Safety factor: 0.93

Update form | OK



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1.3 Summary results

All differences are marginal and acceptable.



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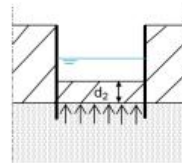
APPENDIX A RESULTS SHEET EC GE UPLIFT



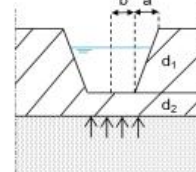
Project name:	verification			
Project number:	1234	Part:	verification	
Engineer:	Rene Thijssen	Date:	03-03-13	Version: 1.00
Assessment of uplift failure				

<u>General</u>	
Ground level	1 [m NAP]
Excavation level	-1 [m NAP]
Water level excavation	-1 [m NAP]
Surface load p_0	0 [kN/m ²]
γ_{water}	10 [kN/m ³]
Excavation	Retaining walls [-]
Width excavation B	10 [m]
Include C_u	No [-]
$\gamma_{unit\ weight}$	0.9 [-]
γ_{G1}	1.5 [-]

Excavation between retaining walls



Excavation with slopes



Width 10

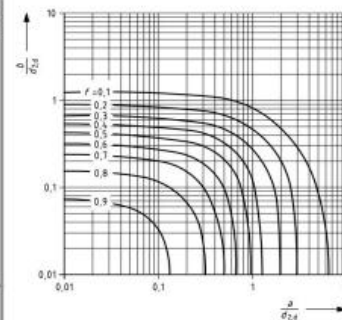
Soil profile below excavation (d2)

Layer name [-]	Bottom layer [m NAP]	h_{layer} [m]	γ_{sat} [kN/m ³]	γ^*h [kPa]	C_u [kPa]	C_u^*h/B [kPa]
Water load (in excavation):						
				0		
Clay 1	-2	1.0	14	14	0	
Clay 2	-4	2.0	14	28	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
G2v;rep [kPa]				42	0	
γ [-]				0.9	1.5	
G2v;d [kPa]				37.8	0.0	

Soil profile outside excavation (d1)

Layer name [-]	Bottom layer [m NAP]	h_{layer} [m]	γ_{sat} [kN/m ³]	γ^*h [kPa]
Surface load:				
G1v;rep [kPa]				0
γ [-]				0.9
G1v;d [kPa]				
f [-]				
G1;d [kPa]				

<u>Total upward</u>	
Level top aquifer	-4 [m NAP]
Hydraulic head aquifer	0.5 [m NAP]
Uplift pressure rep. $u_{des;rep}$	45 [kPa]
γ_{unit}	1.0 [-]
Uplift pressure design $u_{des;d}$	45.0 [kPa]
<u>Total downward</u>	
G2;d (weight)	37.8 [kPa]
G2;d (C_u ; shear strength)	0.0 [kPa]
G1;d	37.8 [kPa]
Safety against uplift	0.84
Unity check	1.19





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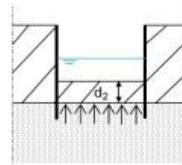


Project name:	verification			
Project number:	1234	Part:	verification	
Engineer:	Rene Thijssen	Date:	03-03-13	Version: 1.00
Assessment of uplift failure				

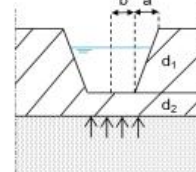
General

Ground level	1 [m NAP]
Excavation level	-1 [m NAP]
Water level excavation	-1 [m NAP]
Surface load p_0	0 [kN/m ²]
γ_{water}	10 [kN/m ³]

Excavation between retaining walls



Excavation with slopes



Excavation

Slopes [-]	
Width excavation B	10 [m]
Include C_u	No [-]
$\gamma_{unit-weight}$	0.9 [-]
γ_{Cu}	1.5 [-]

Width [m]:	4
Slope [v:h]:	2:3
a: [m]	3
b: [m]	2

Soil profile below excavation (d2)

Layer name [-]	Bottom layer [m NAP]	h_{layer} [m]	γ_{sat} [kN/m ³]	γ^*h [kPa]	C_u [kPa]	C_u^*h/B [kPa]
Water load (in excavation):						
				0		
Clay 1	-2	1.0	14	14	0	
Clay 2	-4	2.0	14	28	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
0	0	0.0	0	0	0	
G2;v;rep [kPa]				42	0	
γ [-]				0.9	1.5	
G2;v;d [kPa]				37.8	0.0	

Soil profile outside excavation (d1)

Layer name [-]	Bottom layer [m NAP]	h_{layer} [m]	γ_{sat} [kN/m ³]	γ^*h [kPa]
Surface load:				
				0
Clay 1	-2	2.0	14	28
Clay 2	-4	0.0	14	0
0	0	0.0	0	0
0	0	0.0	0	0
0	0	0.0	0	0
0	0	0.0	0	0
0	0	0.0	0	0
G1;v;rep [kPa]				28
γ [-]				0.9
G1;v;d [kPa]				25.2
f [-]				0.156
G1;d [kPa]				3.9

Total upward	
Level top aquifer	-4 [m NAP]
Hydraulic head aquifer	0.5 [m NAP]
Uplift pressure rep. $u_{des,rep}$	45 [kPa]
γ_{unit}	1.0 [-]
Uplift pressure design $u_{des,d}$	45.0 [kPa]
Total downward	
G2;d (weight)	37.8 [kPa]
G2;d (C_u ; shear strength)	0.0 [kPa]
G1;d	3.9 [kPa]
	41.7 [kPa]
Safety against uplift	0.93
Unity check	1.08

