

Bijlage 5

Resultaten analyse microstabiliteit (STMI)

cohesive slope protection layer: uplift pressure and shear

Input cell

Output/calculation cell

Version 1.3

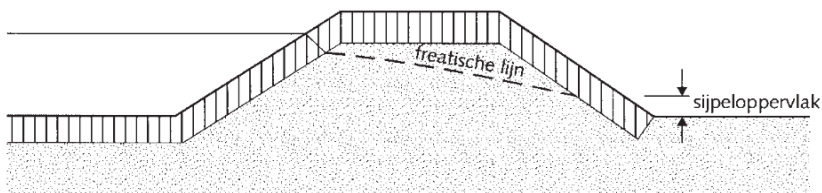


Project	Ooijen en Wanssum
Projectcode	9Y3672-105-104
Subject	Opdrukken en afschuiven kleibekleding standaardprofiel
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1. Equilibrium cohesive slope protection layer due to uplift pressure in dike core

1.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondconstructies (2001)
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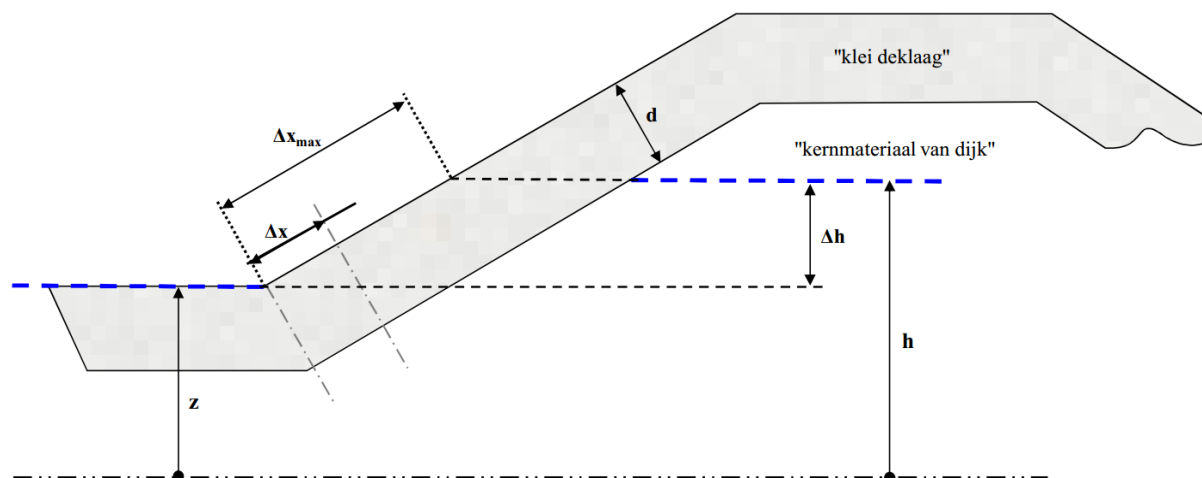
Formula 1: 1-dimentional exclusive friction in clay (in pressures)

$$\cos \alpha \geq \frac{\gamma_d \gamma_{m,\rho} \gamma_n \rho_w (h - z)}{\rho_g d}$$

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\frac{2cd}{\gamma_{m;c}} + \frac{\rho_g g}{\gamma_{m;\rho}} \Delta x d \cos \alpha + \frac{\rho_g g}{\gamma_{m;\rho}} \Delta x d \sin \alpha \frac{\tan \varphi}{\gamma_{m;\varphi}} \geq \gamma_n \gamma_d \left(\Delta h - \frac{1}{2} \Delta x \sin \alpha \right) \frac{\rho_g g}{\gamma_{m;\rho}} \Delta x$$

1.2 Input



Parameter	symbol	value	unit
cohesion	c	3	kN/m ²
friction angle (effective)	φ	27	degr
thickness of clay layer (perpendicular to slope)	d	1,2	m
gravity	g	9,81	m/s ²
volumetric mass of water	ρ _w	1000	kg/m ³
volumetric mass of soil (clay)	ρ _g	1700	kg/m ³
Slope		1: 3	-
slope angle	α	18,42	degr
head difference on lowest point	Δh	1,5	m

Partial factor	symbol	value	unit
volumetric mass of water	γ _{m,ρ}	1	-
volumetric mass of soil (clay)	γ _{m,ρ}	1	-
cohesion	γ _{m,c}	1,25	-
friction angle (effective)	γ _{m,φ}	1,1	-
overall load factor (product of schadefactor and modelfactor)	γ _d * γ _n	2	-

1.3 Output

Formula 1: exclusive friction in clay (in pressures)

	value	unit	
Resistance:	18,99	<i>kN/m²</i>	weight perpendicular to slope
Action:	29,43	<i>kN/m²</i>	uplift pressure perpendicular to slope
Resistance / Action	0,645156	-	no uplift if resistance/action >= 1

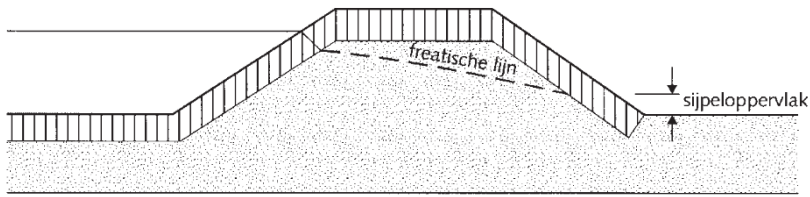
Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Δx_{\max}	4,75	<i>m</i>	maximum width of the slice of clay
Δx	1,35	<i>m</i>	width of clay belonging to the lowest resistance/action value
Check if $\Delta x < \Delta x_{\max}$	OK	-	check error in sheet
Resistance:	35,35	<i>kN/m</i>	resistance force belonging to the lowest resistance/action value
Action:	34,08	<i>kN/m</i>	action force belonging to the lowest resistance/action value
Resistance / Action	1,0371505	-	no uplift if resistance/action >= 1

2. Equilibrium cohesive slope protection layer due to shear

2.1 Method used

Source: TAW-publication (Dutch guideline) Technisch Rapport Waterkerende Grondconstructies (2001)
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Formula 1: 1-dimentional exclusive friction in clay (in pressures)

Formula 2: Complex 2-dimentional inclusive friction in clay (in forces per meter run)

$$\gamma_n \gamma_d \left[\Delta h d \frac{\rho_g g}{\gamma_{m,\rho}} - \left(\frac{cd}{\gamma_{m,c}} + \frac{c\Delta h}{\gamma_{m,c} \sin \alpha} + \left(\frac{\Delta h}{\tan \alpha} d \frac{\rho_g g}{\gamma_{m,\rho}} - \frac{1}{2} \frac{\rho_w g \Delta h^2}{\gamma_{m,\rho} \sin \alpha} \right) \frac{\tan \phi}{\gamma_{m,\phi}} \right) \right] \leq \frac{cd}{\gamma_{m,c} \sin \alpha} + \frac{1}{2} \frac{d^2 \rho_g g}{\sin \alpha \gamma_{m,\rho}}$$

2.2 Input

Parameter	symbol	value	unit
cohesion	c	3	kN/m ²
friction angle (effective)	φ	27	degr
thickness of clay layer (perpendicular to slope)	d	1,2	m
gravity	g	9,81	m/s ²
volumetric mass of water	ρ _w	1000	kg/m ³
volumetric mass of soil (clay)	ρ _g	1700	kg/m ³
Slope	1:	3	-
slope angle	α	18,42	degr
head difference on lowest point	Δh	1,5	m

Partial factor	symbol	value	unit
volumetric mass of water	γ _{m,ρ}	1	-
volumetric mass of soil (clay)	γ _{m,ρ}	1	-
cohesion	γ _{m,c}	1,25	-
friction angle (effective)	γ _{m,φ}	1,1	-
load factor - schadefactor	γ _d	1,1	-
load factor - modelfactor	γ _n	1,1	-

2.4 Output

Formula 1: exclusive friction in clay

Formula 2: inclusive friction in clay (in forces per meter run)

	value	unit	
Action:	-11,89	kN/m ²	shear pressure perpendicular to slope
Resistance:	47,11	kN/m ²	resistance clay
Resistance / Action	OK	-	no shear if resistance/action >= 1, or OK