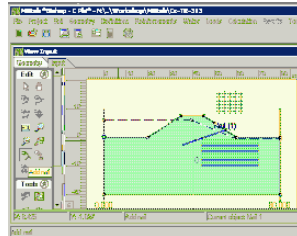


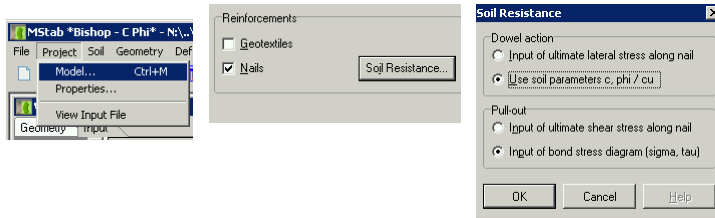
# Workshop Grondvernageling



MStab: Invoer + Achtergrond  
Han Best, Marcel Visschedijk (GeoDelft)



## Modelkeuzes

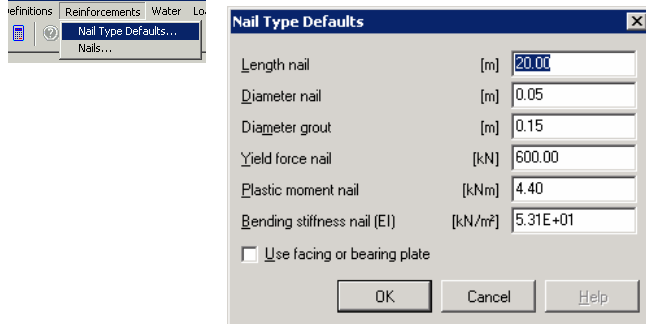


### Invoer spanning langs nagel

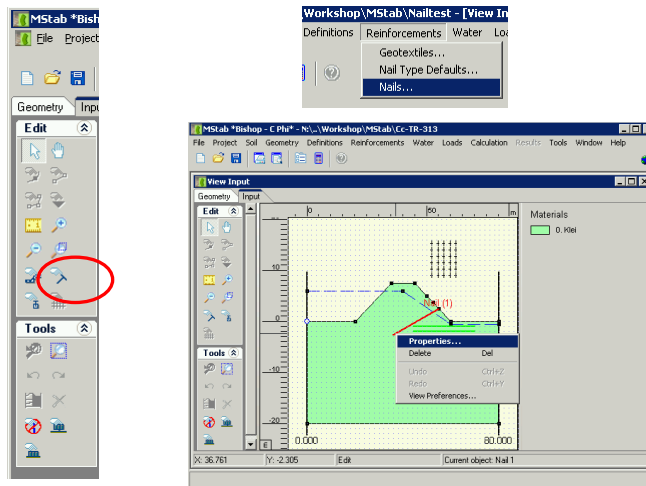
- Rechstreekse invoer
  - *Lateral stress, Shear Stress*
- Via grondeigenschappen
  - *c, phi / cu, Bond Stress Diagram*



# Standaard nagel type (default)



# Voer nagel in



## Nails – Geometry

Options for all nails

Critical angle [deg] 5.00

Nail name

- Nail (1)

Geometry | Nail Type | Lateral Stress | Shear Stress

X co-ordinate head [m] 55.000

Y co-ordinate head [m] 2.500

Horizontal spacing [m] 1.500

Angle with x-axis [deg] -165.00

Buttons: Add, Insert, Delete, Rename, OK, Cancel, Help

## Nails – Nail Type

Options for all nails

Critical angle [deg] 5.00

Nail name

- Nail (1)

Geometry | Nail Type | Lateral Stress | Shear Stress

Use defaults

Length nail [m] 20.00

Diameter nail [m] 0.05

Diameter grout [m] 0.15

Yield force nail [kN] 600.00

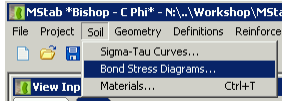
Elastic moment nail [kNm] 4.40

Bending stiffness nail (EI) [kN/m²] 5.31E+01

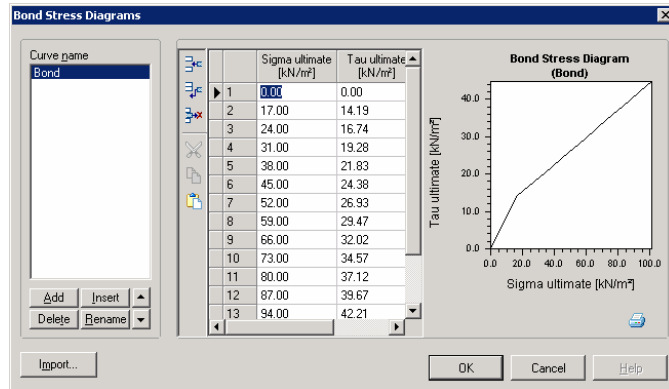
Use facing or bearing plate

Buttons: Add, Insert, Delete, Rename, OK, Cancel, Help

# Invoer Bond Stress diagram

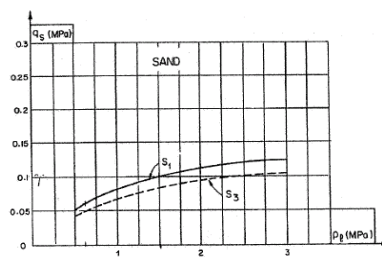


## Schuif vs Lateraal



# Bond-stress diagram

## Diagram volgt uit testen (Clouterre)



## Invoer grondeigenschappen

Standaard grondsoorten

## MStab berekent lateral stress ( $p_u$ )

### Niet-cohesieve materialen [12]:

$$p_u = \sigma_{\max,h} = s \cdot \sigma'_v \cdot K_p \quad (P_{u1}), (5.31)$$

$\sigma_{\max,h}$  maximale horizontale spanning bij horizontaal belaste palen

$s$  schelpfactor = 3

$\sigma'_v$  effectieve verticale spanningen

$K_p$  passieve gronddruk coëfficiënt =  $\frac{1 + \sin \varphi}{1 - \sin \varphi}$  (voor  $\delta=0$ )

### Cohesieve materialen [12]:

$$p_u = \sigma_{\max,h} = 9 \cdot C_u \quad (z > 3D) \quad (P_{u1}), (5.32)$$

$C_u$  ongedraineerde schuifsterkte

$z$  diepte

$D$  diameter nagel

MStab berekent beddingsconst. ( $E_s$ )

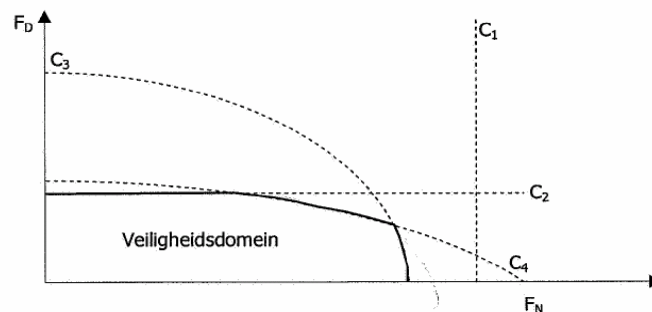
$$E_{oed} = \frac{E_M}{\alpha} \quad E_{oed} = \sigma \frac{(1+e_0) \ln 10}{C_c}$$

$$\frac{E_s}{E_M} = \frac{1}{\left(\frac{2}{9} 2,65^\alpha + \frac{\alpha}{6}\right)}$$

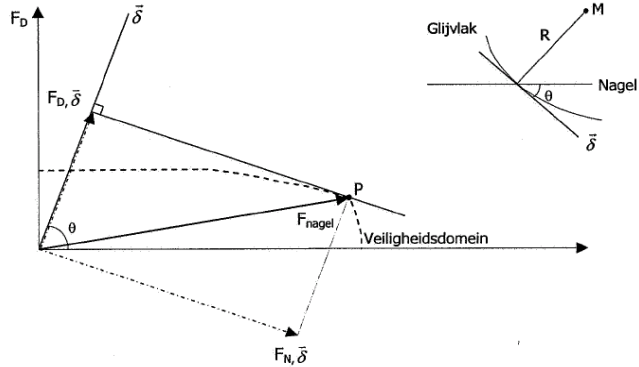
$E_M$	Elasticiteitsmodulus met Ménard-pressiometertest
$E_s$	Elasticiteitsmodulus
$E_{oed}$	Elasticiteitsmodulus uit oedometertest
$\alpha$	rheologische coëfficiënt
	$\alpha$ 2/3 voor klei
	$\alpha$ 1/2 voor silt
	$\alpha$ 1/3 voor zand

## MStab stelt bezwijkcriteria samen

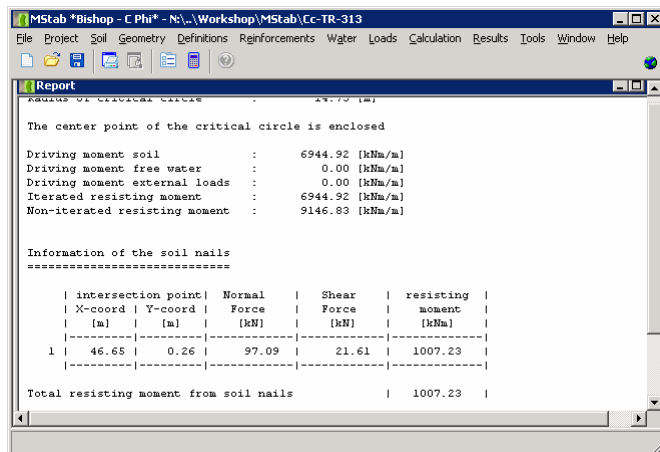
- 1: Pull-out, 2: Deuver (grondsterkte)
- 3: dwarskracht, 4: moment (nagel)



# MStab berekent Nagelkracht



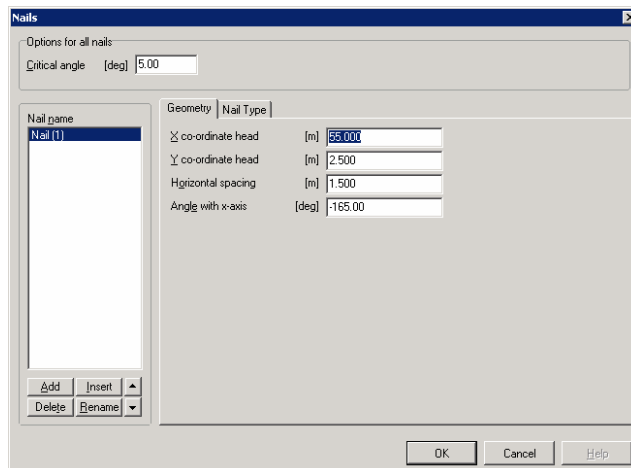
# MStab berekent Nagelkracht



## Opdracht

- Open startgeometrie (Basis)
- Bepaal initiele veiligheid
- Voeg nagel toe
- Voer nageleigenschappen in
- Bekijk bond stress diagram
- Voer extra grondparameters in
- Bepaal toegenomen veiligheid
- Varieer met: positie, hoek, lengte, h.o.h. afstand

## Invoer nagel geometrie



Nails

Options for all nails

Critical angle [deg] 5.00

Nail name

Nail (1)

Geometry | Nail Type

X co-ordinate head [m] 65.000

Y co-ordinate head [m] 2.500

Horizontal spacing [m] 1.500

Angle with x-axis [deg] -165.00

Add Insert

Delete Rename

OK Cancel Help

## Invoer nagel type

Options for all nails:

Critical angle [deg] 5.00

Nail name

- Nail (1)

Geometry Nail Type

Use defaults

Length nail [m] 20.00

Diameter nail [m] 0.05

Diameter grout [m] 0.15

Yield force nail [kN] 600.00

Elastic moment nail [kNm] 4.40

Bending stiffness nail (EI) [kN/m<sup>2</sup>] 5.31E+01

Use facing or bearing plate

Add Insert

Delete Rename

OK Cancel Help

## Extra grondeigenschappen

Materials

Material name

- Klei

Total unit weight

Above phreatic level [kN/m<sup>3</sup>] 17.00

Below phreatic level [kN/m<sup>3</sup>] 17.00

Shear strength model Default [C phi]

Cohesion (c) [kN/m<sup>2</sup>] 8.00

Friction angle (phi) [deg] 20.00

Nails

Use soil type

Soil type Clay

Compression ratio (Co/1+eo) [] 0.1258740

Rheological coefficient (alpha) [] 0.67

Bond stress Bond

Add Insert

Delete Rename

OK Cancel Help