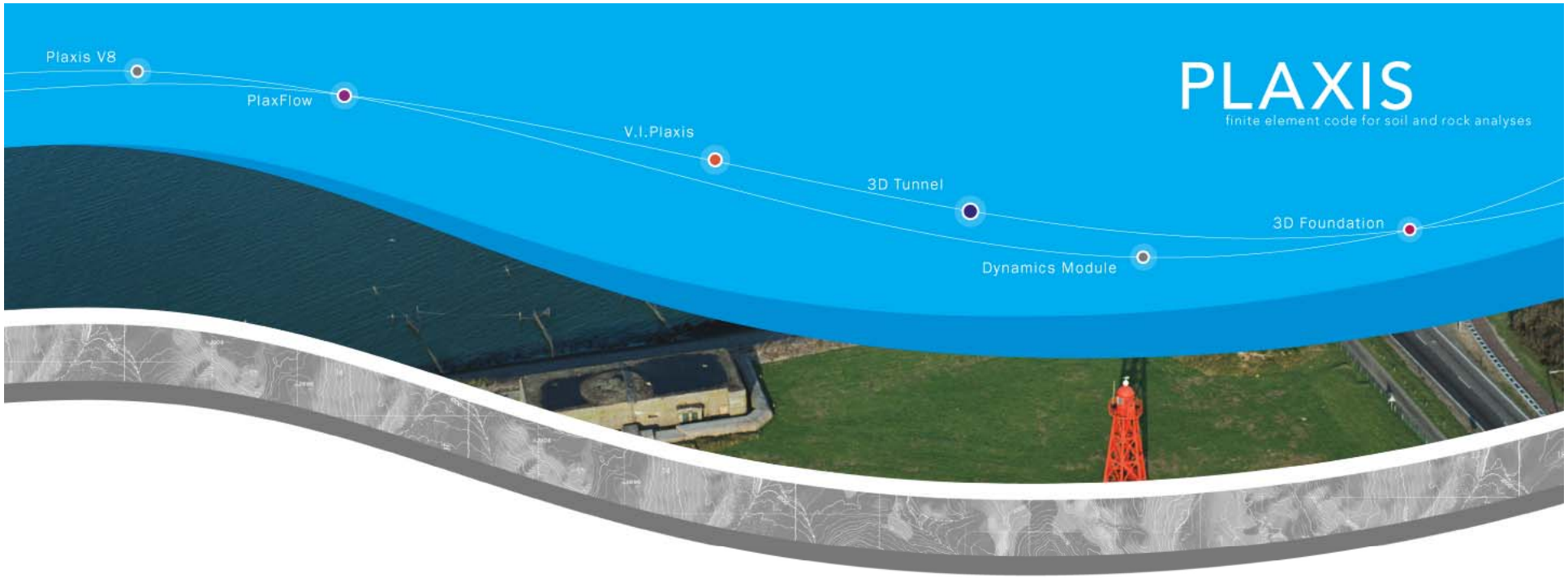


Excavation and dewatering

Dennis Waterman

Plaxis BV

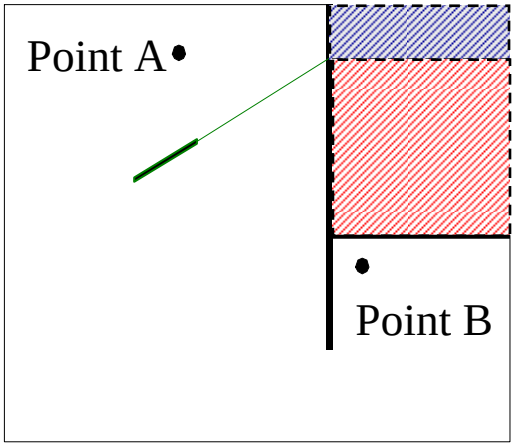
Material behaviour

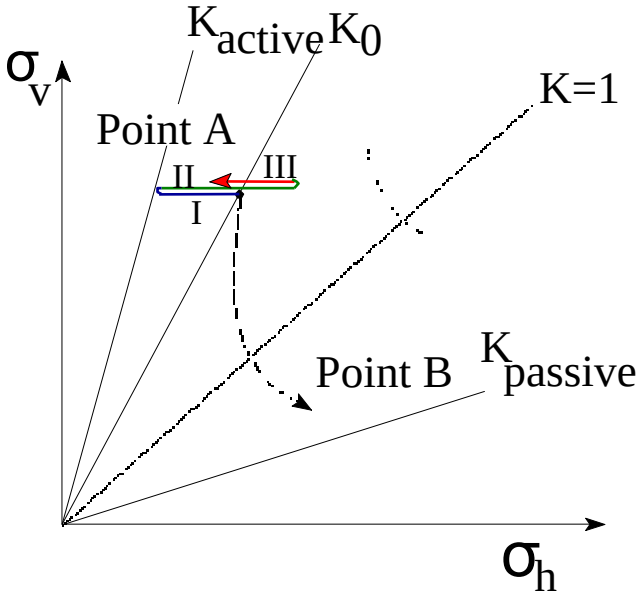
- Unloading due to excavation
- Primary loading due to pre-stressing
- Hardening Soil model is preferred
  - Non-linear elastic unloading/reloading behaviour
- Sometimes better to use Mohr-Coulomb with known parameters than HS with unverified parameters.
  - When using MC: E_{ur} should be used rather than E_{50}

Material behaviour: Stress paths

Construction phases:

- I 1st excavation
- II Pre-stressing anchor
- III Final excavation





Dewatering

- Wet excavation
  - Impermeable (concrete) excavation floor
- Dry excavation
  - Undisturbed water table outside excavation
  - Drawdown outside excavation

Dewatering: options

- General phreatic level
  Applies to all clusters that have not been separately defined.
- Cluster phreatic level
  Applies to one specific cluster.
- Cluster dry
  Makes a specific cluster dry.
- Interpolate
  Interpolate pore pressures between clusters above and below.
- User-defined pore pressure
  Specify pressure p_{ref} at level y_{ref} and increase p_{inc} per meter in y-direction.

Dewatering: wet excavation

- Excavate without changing water conditions (in stages or at once)
- Apply stabilising weight at the bottom
- Set excavated area dry
  - Use “cluster dry” option or
  - Use “cluster phreatic line”
- Pore pressures outside excavated area remain unchanged

Dewatering: dry excavation

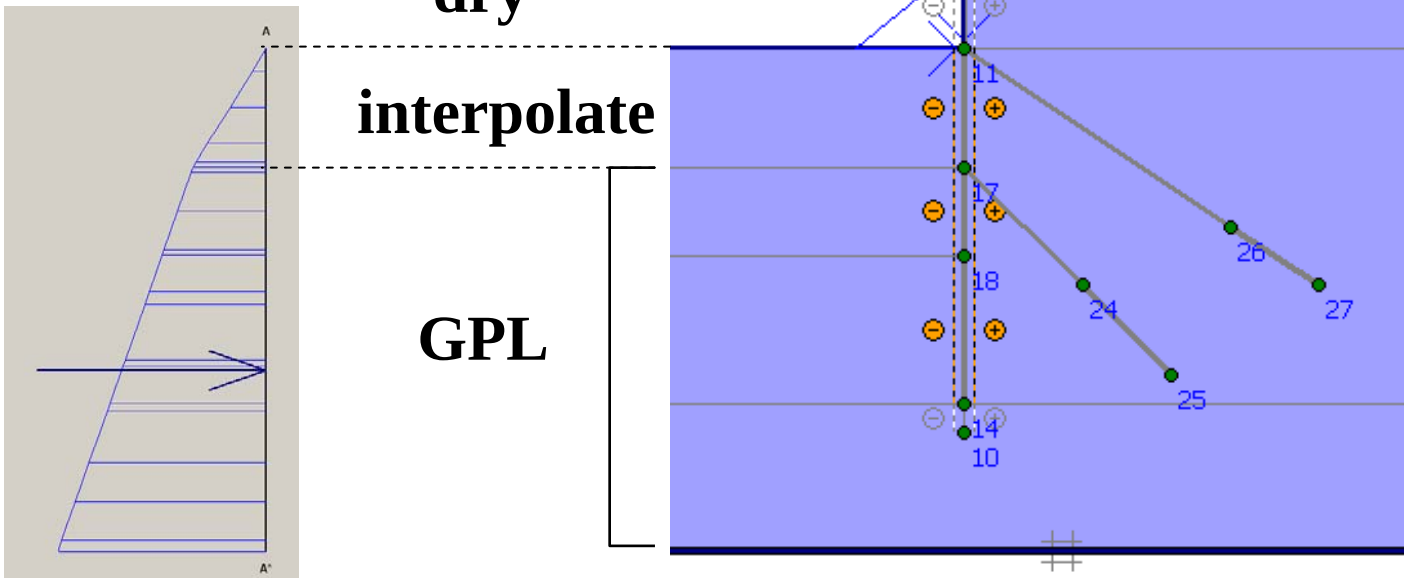
Undisturbed water table outside excavation

- For every excavation phase do
  - Excavate soil
  - Set excavated area dry
  - Define area just below excavation floor as *interpolate between lines or clusters*

Suitable for short-term excavations in low permeability soils

Dewatering: dry excavation

Undisturbed water table outside excavation



Dewatering: dry excavation

Drawdown outside excavation

- For every excavation phase do
  - Excavate soil
  - Define boundary conditions (heads)
  - Perform groundwater flow analysis.

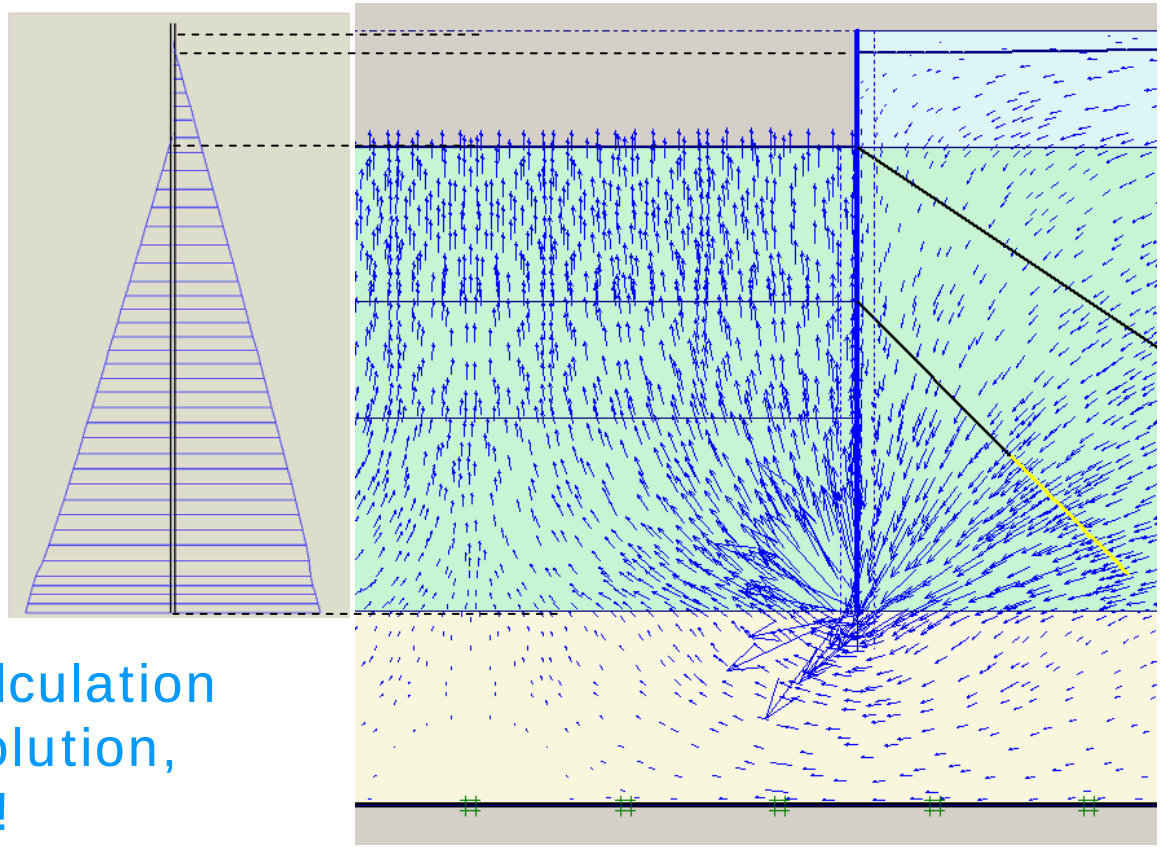
Suitable for long-term excavations or excavations in high permeability soils

Simplified alternative:

- Draw GPL according to expected groundwater level and generate pore pressures based on GPL.

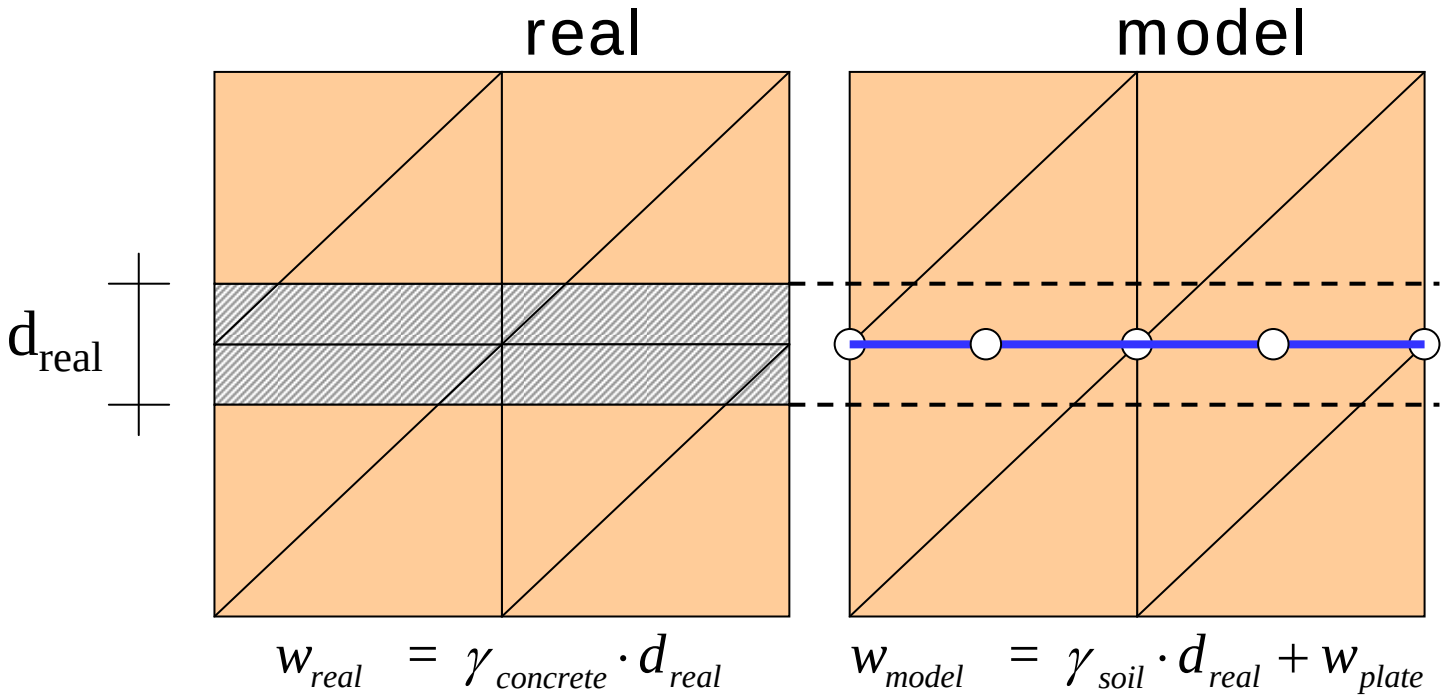
Dewatering: dry excavation

Drawdown outside excavation



Groundwater flow calculation
gives steady-state solution,
so for time is infinite!

Determine weight of plates – in soil



Below GPL

$\gamma_{soil} = \gamma_{sat}$

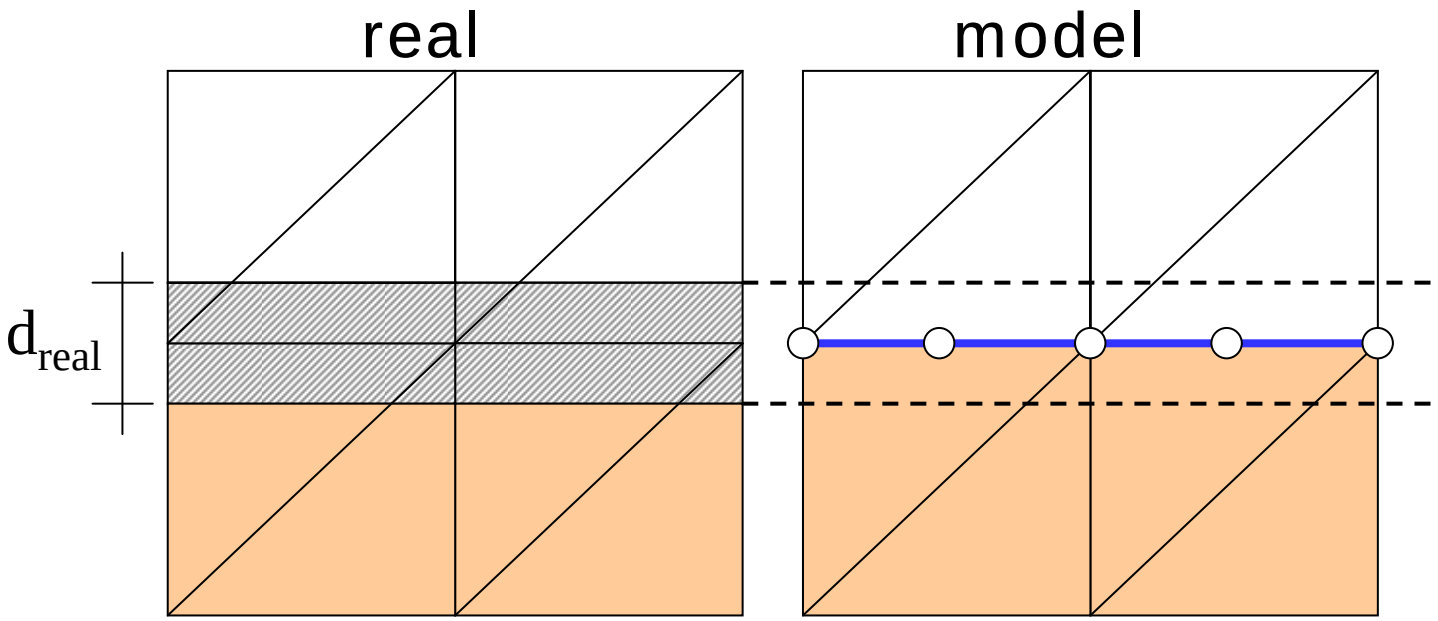
Above GPL

$\gamma_{soil} = \gamma_{unsat}$

$w_{real} = \gamma_{concrete} \cdot d_{real}$ $\quad$ $w_{model} = \gamma_{soil} \cdot d_{real} + w_{plate}$

$$w_{model} = w_{real} \Rightarrow w_{plate} = (\gamma_{concrete} - \gamma_{soil}) \cdot d_{real}$$

Determine weight of plates - excavation



Below GPL

$\gamma_{soil} = \gamma_{sat}$

Above GPL

$\gamma_{soil} = \gamma_{unsat}$

$$w_{real} = \gamma_{concrete} \cdot d_{real} \qquad w_{model} = \gamma_{soil} \cdot \frac{1}{2} d_{real} + w_{plate}$$

$$w_{model} = w_{real} \Rightarrow w_{plate} = (\gamma_{concrete} - \frac{1}{2}\gamma_{soil}) \cdot d_{real}$$