Simulation of the Water Balance in earth dams and dikes using the software PCSiWaPro®

Water balance in the dam body during flood retention

Landslides occur already in partly saturated areas!

Simulation by means of PCSiWaPro®

Advantages of the simulation software PCSiWaPro®
- 2D-simulation of water balance and transport processes
- Exact calculation of seepage line in dams
- Consideration of atmospheric boundary conditions, root water uptake and soil evaporation
- Easy to use Windows based software
- flexible choice of boundary conditions
- Interface to GeODin-datenbases
- Consideration of hysteresis in unsaturated zone
- integrated weather generator for arbitrary time series in high resolution
- implemented parameter identification algorithm
- Automatic discretization with finite element - mesh generator
- Soil databases according to DIN 4022 and DIN 4220 plus pedotransferfunctions

Mathematical basis of PCSiWaPro®
- RICHARDS-equation \( \frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x} \left( K \left( \frac{\partial h}{\partial x} + K' \right) \right) \)
- Parameterization of soil characteristics by VAN GENUCHTEN-LUCKNER

\[
\theta = \theta_r \left( \frac{\theta - \theta_r}{\theta_a - \theta_r} \right)^{n-1} + \theta_r
\]
- \( \theta \) - volumetric water content
- \( t \) - time
- \( K(x) = x \cdot (1 - x^2)^{\alpha} \) - hydraulic conductivity
- \( h \) - pressure head
- \( S \) - capillary pressure
- \( \phi \) - porosity
- \( \theta_r \) - residual water content
- \( \theta_a \) - residual air content
- \( \alpha \) - scaling factor
- \( n \) - slope factor
- \( H_c \) - capillary pressure head

PCSiWaPro® - Application
Investigation of existing and prognostic flow conditions under special consideration of water-saturated and –unsaturated zones in a protective structure (earth dam)

variable boundary conditions and water saturation

The sensitivity of hydraulic material parameters (VAN GENUCHTEN-LUCKNER)

Although the water level in the dam embankment hardly changed, a significant difference from the partially saturated zone above the seepage line could be observed.

Comparison between the computed and measured water levels in the dam embankment

PCSiWaPro® enables the user to calculate transient flux processes with the help of the weather generator considering atmospheric boundary conditions, root water uptake and soil evaporation.

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