

COMPARISON OF DIFFERENT NUMERICAL SOLUTIONS OF GROUNDWATER INFLOW INTO A TUNNEL

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- hydrogeological model of the tunnel vicinity in the granite rock (in the first step rock with homogenous rock properties, then layered geometry)
- it is used special “multidimensional conception”
- comparison of several variants of the model with the tunnel
- Motivation: Decovalex project (simulation of thermo-hydro-mechano-chemical processes due to analysis of deep repositories and safe deposition of spent nuclear waste)
- Bedrichov tunnel – natural analogue of the deep repository in the light of similar conditions (tunnel in the deep granite rock)
- hydrogeological model (groundwater flow and surface water flow) with the possibility of the comparison models with real measured data from the site

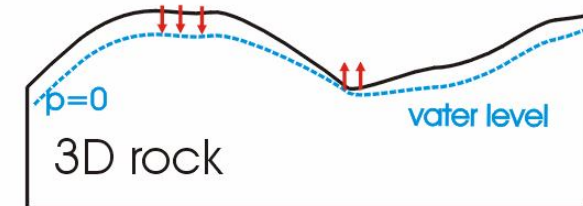


Interior of the tunnel

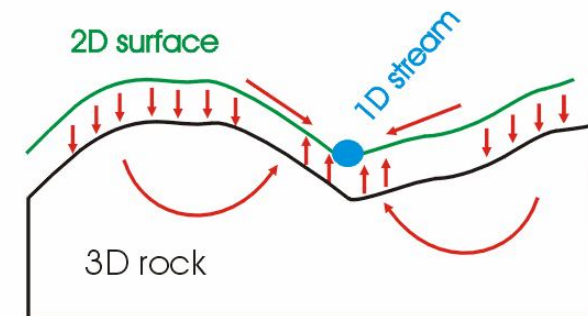
MULTIDIMENSIONAL CONCEPTION

- using 3D, 2D and 1D elements in one problem
 - 1D elements: rivers
 - 2D elements: surface sources of the water (rainfall)
 - 3D elements: inner elements of the rock
 - groundwater and surface water flow together (coupled problem)
- in the next step: 2D, 1D elements could simulate fractures in the rock
- mathematical model: Darcy's law, continuity equation
- prescribed Dirichlet and Neumann boundary conditions (values of pressure and flux)
- computing software: Flow123D, based on mixed hybrid formulation of FEM, developed at Technical University of Liberec

3D conception



3D model



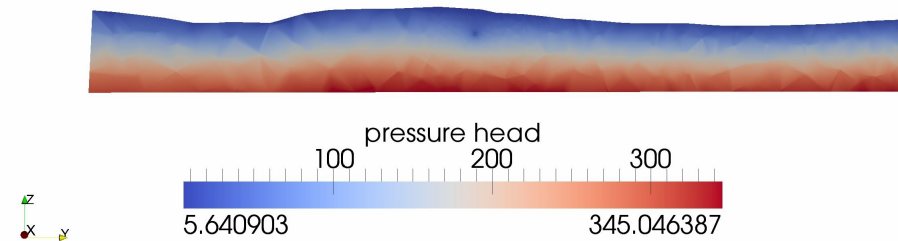
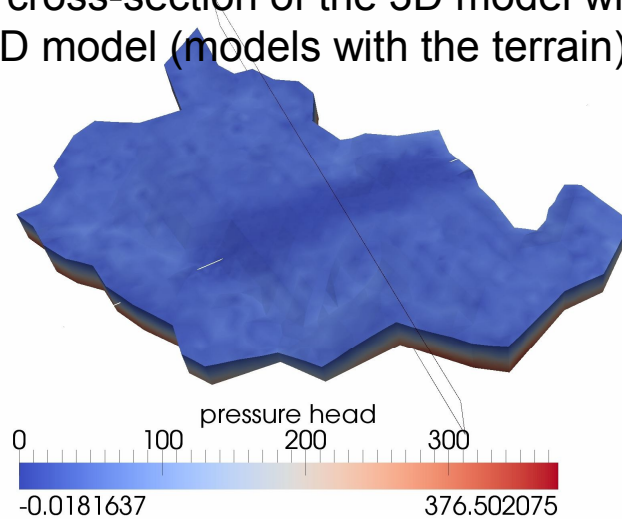
3D-2D-1D model

Multidimensional conception

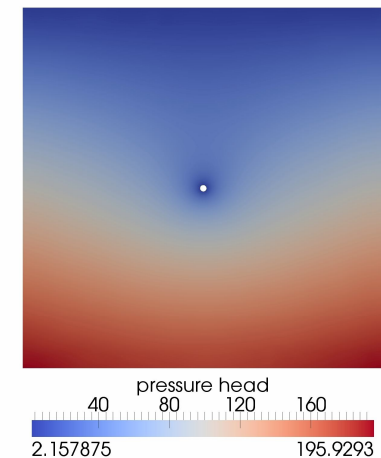
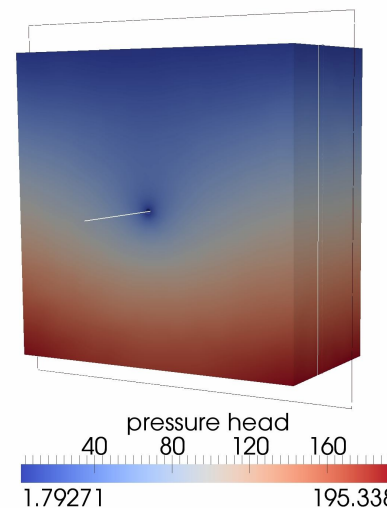
MODEL COMPARISON

- comparison of the models:

- cross-section of the 3D model with the tunnel in comparison to corresponding 2D model (models with the terrain)



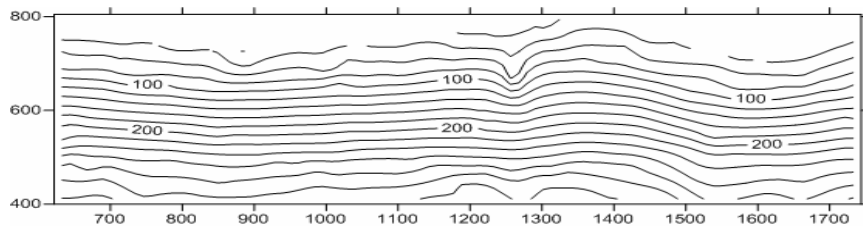
- cross-section of the 3D model in comparison to corresponding 2D model for a block geometry with the tunnel and plane surface
 - with corresponding boundary condition and the same tunnel diameter as previous model



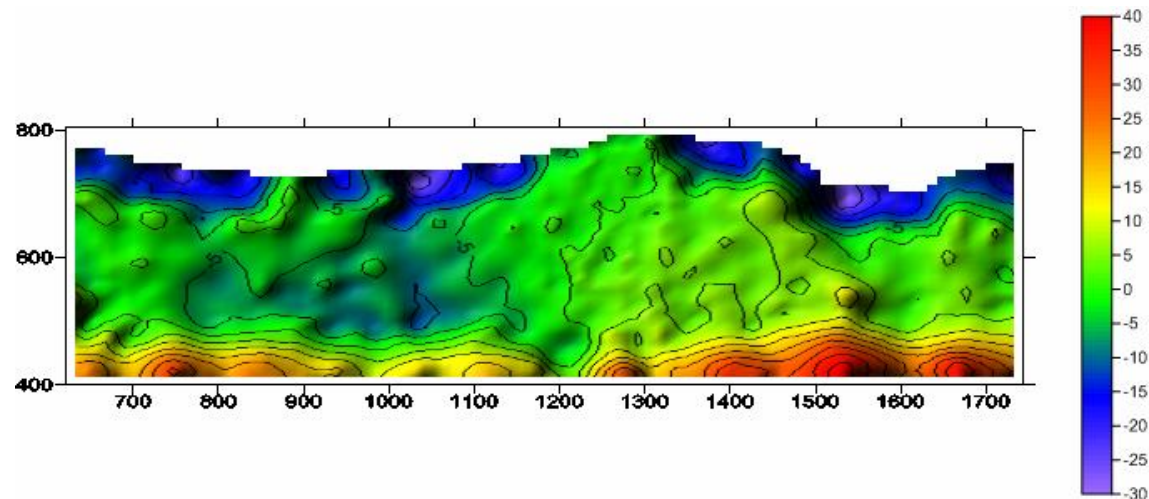
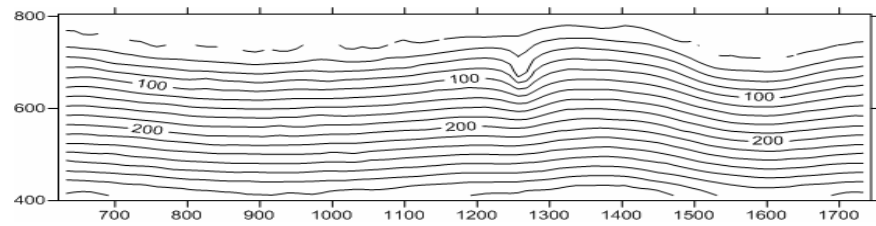
MODEL COMPARISON

- differences for the model with the terrain due to surrounding terrain (displayed contours of pressure head)

cross-section of 3D model



2D model with the finer mesh



THANK YOU FOR YOUR ATTENTION