Fluid Flow Systems

Mid-Term Test (14. November, 2013)

1. Water distribution systems

- Explain the basic principles of steady-state flow system analysis. (Conservation laws for incompressible liquid, pressure/head losses, characteristic curves of pipelines/pumps, operation point, parallel and series connections)
- Explain the basic principles of steady-state flow network analysis. (Concepts of nodes and branches, unknowns to be computed, nodal and branch equations, the concept of solving single nonlinear algebraic equation and generalization to solving equation system)
- Explain the steps of choosing a pump and sizing a reservoir for a simple water distribution system.

2. Compressible flows and natural gas pipeline system

- Give the general nodal and branch principal equations for compressible flows including boundary conditions. Derive the modified Bernoulli equation for compressible flows by assuming isothermal flow and ideal gas behaviour. Explain the basic principles of steady-state flow network analysis. (Concepts of nodes and branches, unknowns to be computed and the equation system)

3. Open channel flow

- Derive the main equation of describing open channel flows and explain the terms and quantities inside (flow cross section, wetted perimeter, hydraulic radius and Chezy coefficient). Give an example for open channel cross section, for instance circular rectangular or trapezoidal, and mark the necessary quantities introduced above. Explain the connection between the celerity of a shallow water wave and the Fr Froude number.
- Explain the features of the specific depths (normal and critical) and the basic idea of their computations. Give a graphical representation for the possible flow configurations in case of mild and steep slope. Describe the numerical solution technique of the ordinary differential equation (Explicit Euler method).

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