Aalto-University, Department of Energy Technology
HVAC-technology

Themes for material processing sessions spring 2019

Thermal modelling	difference formulation of second derivative
Finite differences basics (Myers)	physical formulation 1D steady state
	mathematical formulation 1D steady state
	convection boundary condition
	adiabatic boundary condition
	physical formulation 2D steady state
	physical formulation 1D transient
	mathematical formulation 1D transient
	Euler method
	Crank-Nicolson method
	pure implicit method
	matrix formulation + solution Euler/CN/implicit
Finite differences advanced	optimal placing of the node points (Waters &Wright)
	computational accuracy (Myers + Waters & Wright)
	oscillations and stability (Myers)
	oscillations and stability (Waters & Wright)
	variable thermal properties (Myers)
	radiation boundary condition (Myers)
	convection by integral method (Miettinen F)
	simplified handling of radiation (Davies)
Hydraulic models of networks	description of network topology
Matrix methods (Siren)	mass balance of node points / connectivity matrix
	loop pressure condition / loop matrix t
	computation of the mass flows and node pressures
	mathematical solution of non-linear equations
Hardy-Cross method (Siren)	principle and solution procedure of the HC method
Applications (Siren)	building pressure distributions (F)
	building leakage paths (F)
	computation of leakage air flows (F)
Modelling of contaminant penetration	mass balance of contaminant (NA)
Penetration model fundamentals (Siren)	1-zone model (NA)
	2-zone model, fundamentals (F)
	2-zone model applications (F)
	2-zone pattern (Trzeciakiewicz)
Penetration model advanced (Siren)	n-zone model, analytical approach
	n-zone model, finite differences approach (NA)
	flow through doorways

Thermal and hydraulic models of components	pipes, ducts, thermal behaviour (Malmström) controller (Laitinen et al) actuator (Laitinen et al) 3-way mixing valve (Laitinen et al) damper (Vihanby) radiator, steady-state and dynamic models (Stephan) radiator, applicability and accuracy thermostatic valve, thermal (Ast) thermostatic valve, hydraulic fin-tube coil (Yu et al, BSER) fin-tube coil (Yu et al, E&B) fin-tube coil (Zhou et al, HVAC&R)
Large systems simulation	successive approximation method (Wright et al) interaction of sub-models in large systems (Exercise)
Scale model techniques	reduced scale models (Siren F)
Validation of models	validation of energy modelling tools (Ryan et al) verification of space conditioning equipment models (Neymark el al) model validation and testing (Judkoff et al) solar model validation (Loutzenhiser et al) fin-tube coil validation (Zhou at al, HVAC&R)
Software (based on web-search)	coding environments mathematical libraries modelling environments component models simulation programmes input data for simulation (weather etc.)
Simulation tools	IDA-ICE exercise 1(Vuolle) IDA-ICE exercise 2 (Vuolle) IDA-ICE exercise 3 (Vuolle)

F in Finnish
NA no material available, based on own knowledge