Spreadsheet to EN 16798-5-1

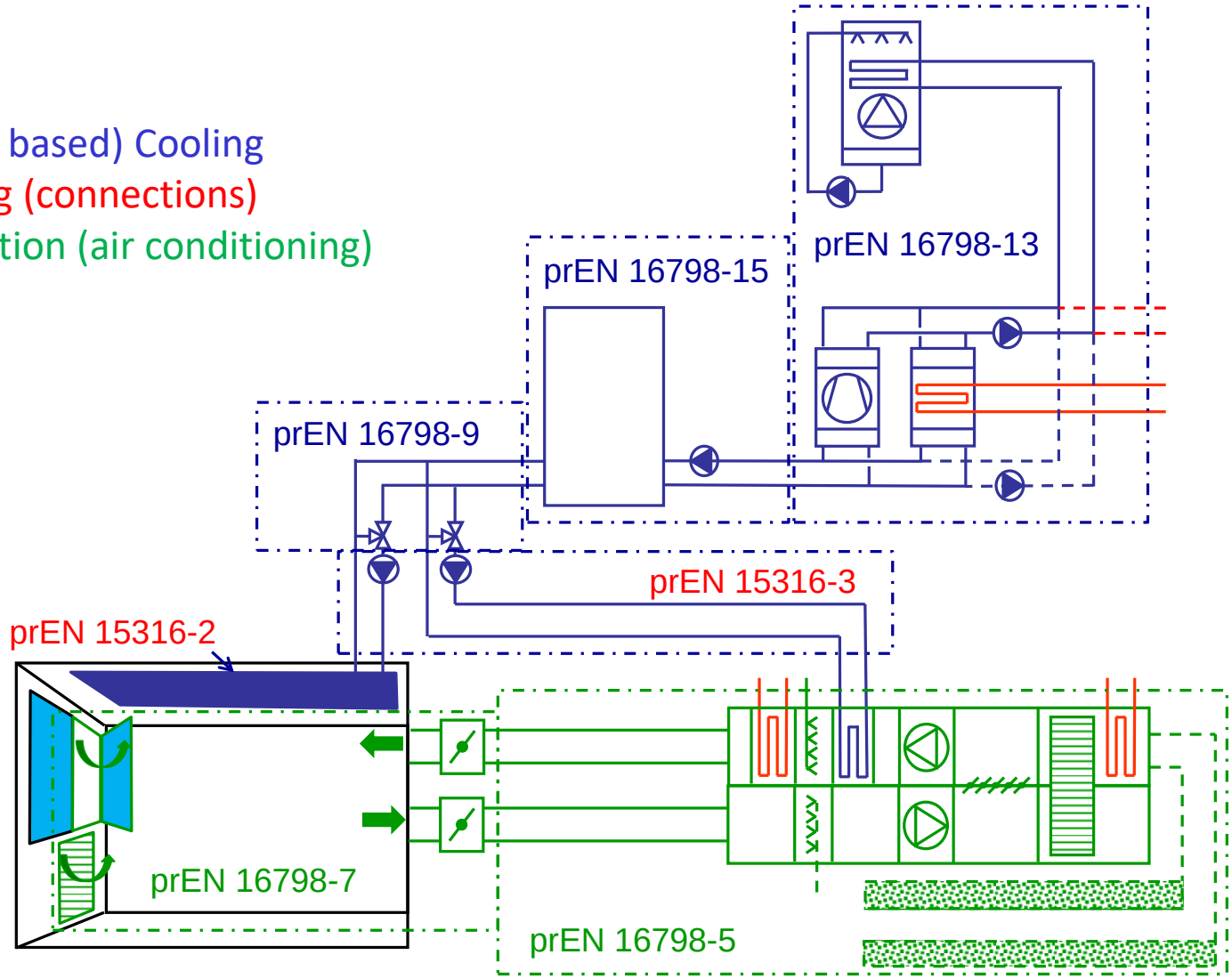
Prof. em. Gerhard Zweifel

Senior expert EPB Center

gerhard.zweifel@hslu.ch

CEN Cooling and ventilation calculation standards: overview

(Water based) Cooling
Heating (connections)
Ventilation (air conditioning)

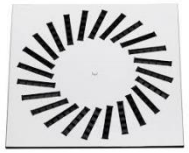


Ventilation standards

- **EN 16798-5-1:** Energy performance of buildings — Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 — Ventilation for buildings — Calculation methods for energy requirements of ventilation and air conditioning systems — Part 5-1: Distribution and generation (revision of EN 15241) — method 1
- **EN 16798-5-2:** Energy performance of buildings — Modules M5-6.2, M5-8.2 — Ventilation for buildings — Calculation methods for energy requirements of ventilation systems — Part 5-2: Distribution and generation — Method 2
- **EN 16798-7:** Energy performance of buildings — Part 7: Ventilation for buildings — Module M5-5— Calculation methods for the determination of air flow rates in buildings including infiltration

EN 16798-7: Ventilation standard – “emission” (= air flow rate calculation)

- Mechanical and natural ventilation
  - mechanical ventilation systems (mechanical exhaust, mechanical supply or balanced system)
  - passive duct ventilation systems for residential and low-rise non-residential buildings;
  - combustion appliances
  - window openings (manual or automatic operation)
  - kitchens where cooking is for immediate use (including restaurants)
- 2 Methods:
  - based on detailed building characteristics
  - based on statistical approach
- Monthly or hourly time step

- Connections to EN 16798-1 and/or EN ISO 52016-1 (inputs):
  - e.g. required flow rates
  - e.g. heating/cooling requirement for air based system
- Connections to EN 16798-5-1 or EN 16798-5-1 (output):
  - Required supply / extract air flow rates per zone (to be delivered to the grille or VAV box)
  - Zone level control based

EN 16798-5-2: Ventilation standards – “distribution” (= ducts) and “generation” (= AHU) - simplified

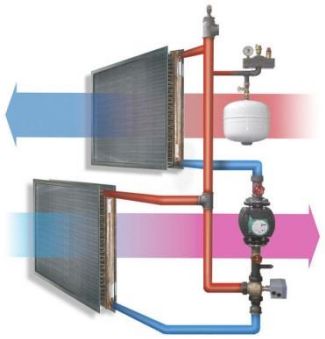
- Simplified calculation for compact systems
- Monthly, seasonal, bin
- Services: Ventilation, heating, cooling
- Includes generation for heating, cooling, DHW
- Not restricted to residential

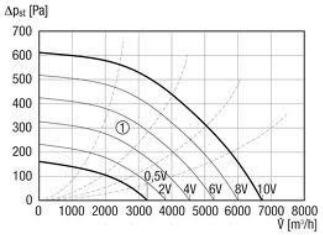
EN 16798-5-1: Ventilation standard – “distribution” (= ducts) and “generation” (= AHU) - detailed

- Comprehensive ventilation and air conditioning system calculation
- Hourly time step (or bin -> multiple criterion)

EN 16798-5-1: Ventilation standard – “distribution” (= ducts) and “generation” (= AHU) - detailed

- Services:
  - Ventilation
  - heating
  - cooling
  - humidification
  - dehumidification
- Technologies:
  - Ground air preheating /-cooling
  - Recirculation
  - heat recovery (plate, rotary, pumped circuit, incl. humidity recovery and frost protection)
  - Humidification (steam, contact, spray...)
  - adiabatic cooling





Demo_EN 16798-5-1: Fully functional spreadsheet with choice menu

- Fully functional for all option choices
- Navigation through drop down menus
  - Related to Schematic figure from standard
  - Related to option choice tables from standard

Demo_EN 16798-5-1: Navigation menu

Table B.6 — Default nominal temperature efficiencies and values for the constants

		HEAT_REC_TYPE						
Parameter	**Unit**	**PLATE**		**ROT_NH**	**ROT_HYG**	**ROT_SORP**	**PUMP_CIRC**	**OTHER**
		cross flow	**counter flow**					
$\eta_{\eta p;v o \mu}$	-	0.6	0.85	0.69	0.67	0.69	0.71	
$v_{hr;nom}$	m/s	3.5						
C_1		-0.0201	-0.0201	-0.0643	-0.0684	-0.0665	-0.0491	
C_2		1		1	1	1	1	
$\Phi_{hr;max}$	kW			0.5	0.5	0.5		
$n_{rot;max}$	min^{-1}			20	20	20		
$P_{hr;rot;max}$	*kW*			0.12	0.12	0.12		
$p_{el;hr;pu;max}$	kWh/m^3						0.03	
$f_{pl;hr;min}$	-						0.5	
$\Delta p_{SUP+ETA;des;hr}$	Pa	300	500	400	400	400	500	

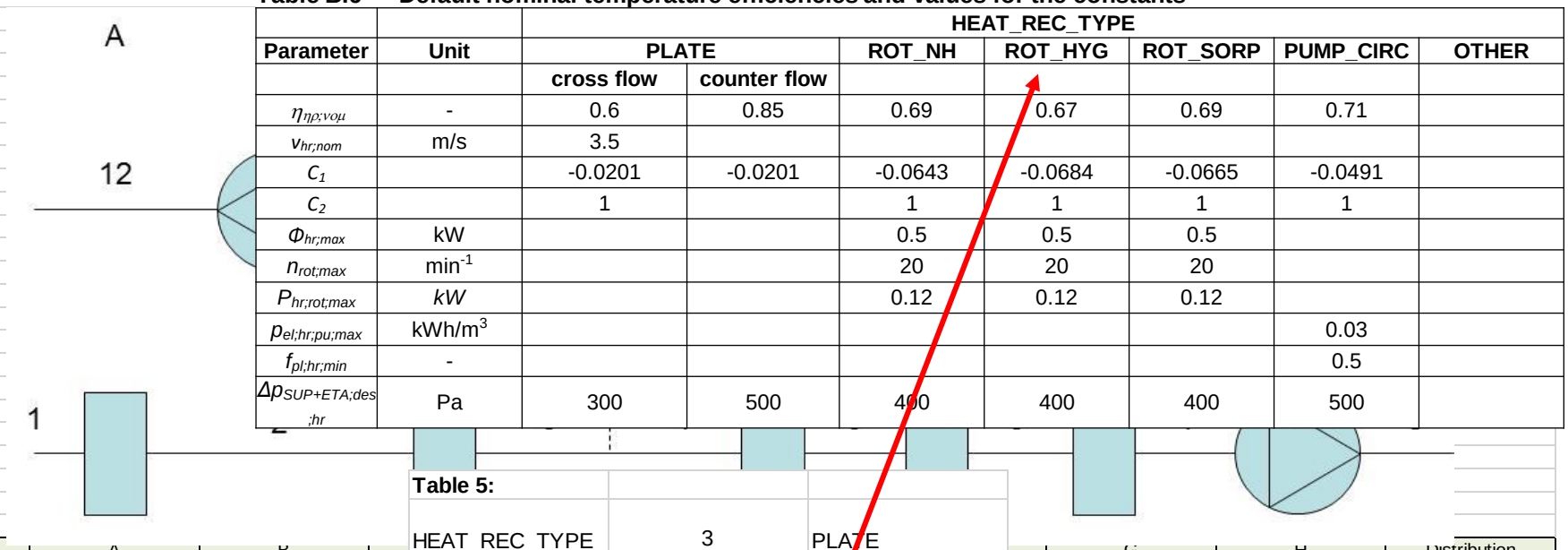


Table 5:		
HEAT_REC_TYPE	3	PLATE
		ROT_NH
		ROT_HYG
		ROT_SORBT
		PUMP_CIRC
		OTHER

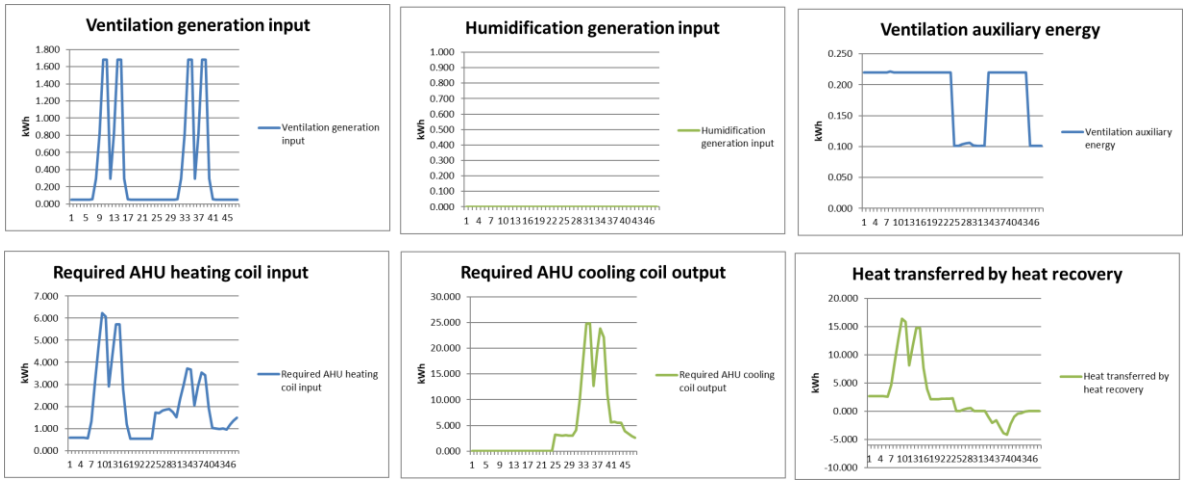
General	A	B				G	H	Distribution
AHU Leakage class	Frost protection / ground preheating/-cooling	Exhaust air fan	H		n	Heating	Supply fan	Ducts
L2								
Air handling unit localosation	Ground air preheating and -cooling	localisation	Hea		pe		Fan motor localisation	Volume flow rates
NC	BYPASS	UP_HR	ROT_HYG	yes		CONTACT		OUTS_AIR	Detailed
Supply air temperature control	Frost protection type		only for PLATE and ROT_HYG	Recirculation control		humidifier control		System type for variable air volume flow rate fan energy calculation	Ductwork leakage class
ODA_COMP	PREH		Residential	VARIABLE		ON_OFF		SINGLE_ZONE	B
Control of the volume flow rate	Control of the frost protection		Control of the heat recovery device			humidification energy carrier		Control of the fan	
ODA_COMP	INDIRECT		SPEED			HUM_CR_EL		DIRECT	
System testing type						Adiabatic cooling		localisation	
else						no		DOWN_HR	

Demo_EN 16798-5-1: Control issues

- Many option choices related to control
  - Recirculation
  - Heat recovery
  - Frost protection
  - Fan
  - …
- Example: Fan control
  - Required air volume flow rate -> input fromEN 16798-7
  - System can react in different ways:
    - On/off
    - Multi stage
    - Continuous
  - Flow rate provided may or may not be equal to required
    - Always ≥ required
  - Several options for fan control (≠ flow rate control)
    - E.g. single zone versus multi zone fan control
    - Position of pressure sensor -> constant part of pressure difference

Demo_EN 16798-5-1: Series calculation

- A series calculation is provided:
  - One typical heating day and one typical cooling day are covered
  - Can be expanded up to one year
  - Run by a macro
- Data correspond to the «worked out example» in the accompanying technical report CEN TR 16798-6
- Graphs are shown for the series calculation results



Recent developments and outlook

- Spreadsheet was updated for the EPB Center homepage:
  - «System configuration» sheet with drop down menus complemented and cleaned
  - (minor) errors eliminated
  - Explanation sheet added
  - One error in the standard
    - the rotary wheel humidity recovery calculation
    - detected by application of third party people, e.g. from implementation in simulation software
    - part of an amendment to EN 16798-5-1 currently underway