



HVAC-Software for planning engineers

The AHH software contains not only a Mollier- & Carrier-Diagram for humid air, but also 17 applications, that allow calculations to be carried out far beyond the HVAC industry.

For this purpose, not only individual but also very easy-to-install network licenses are available, which make it possible to use these applications on any number of computers.

In May 2026, 6,700 licenses in 8 languages (Danish, Dutch, English, French, German, Italian, Russian, Spanish) were in use worldwide, which can be changed interactively.

AHH: Mollier- & Psychrometric-Chart, air processes, meteorological Data
DWT: Conversion: Temperature - Relative humidity - Abs. humidity
MDI: Meteorological data interface, service time selection
TEM: Calculation of all mean logarithmic temperature differences
GLY: Brine properties and efficiency comparison for CC-Systems
FRO: Calculation of defrosting time of finned heat exchangers
RFT: Calculation of rib foot temperature in air coolers
REF: Optimize subcritical processes in refrigerant circuits
HPD: Calculation of two-stage heat pumps for various refrigerants
HPC: Calculation of two-stage heat pumps for CO₂, high-pressure supercritical stage
KES: Calculation of ice storage for cold water production 6/12°C
HDH: Calculation of heating and cooling degree days
MRM: Cooling requirements in midsummer – Meteorol. risk management
CLR: Calculating of the cooling load of rooms
HLR: Calculation of the heating load of rooms
AHU: Neutral air handling unit configurator for projects
GHH: Mollier-Diagram for gas-steam mixtures to condensing the steam

All
in
one

Example 1

In metal processing, a solvent is often used for workpieces, which leaves a steam mixture of 95% water and 5% acetone in the exhaust air, which must be condensed out by cooling.

This is where the **GHH application** comes into play, a special Mollier-Diagram for gas-vapor mixtures, which takes into account the lower partial pressure according to Raoult and Dalton and makes it necessary, to cool down much deeper, as if it were only water vapor.

For example, at a pressure of 1.0 bar and at 30°C you have an absolute humidity of 20 g/kg of this water-acetone mixture in the air.

Then you would have to cool down to -18°C in order to be able to condense out 90%, i.e. to achieve an absolute humidity of 2 g/kg.

However, this requires a droplet eliminator with a minimum pressure drop of 75 Pa, otherwise Sisyphus sends his regards.

It makes sense to do this with energy recovery in order to minimize the capacity consumption.

Example 2

Conference room in Bern (540 meters above sea level) for 50 people.

An area of 10 x 10 m = 100 m², height 3 m, volume = 300 m³, is to be supplied with fresh air.

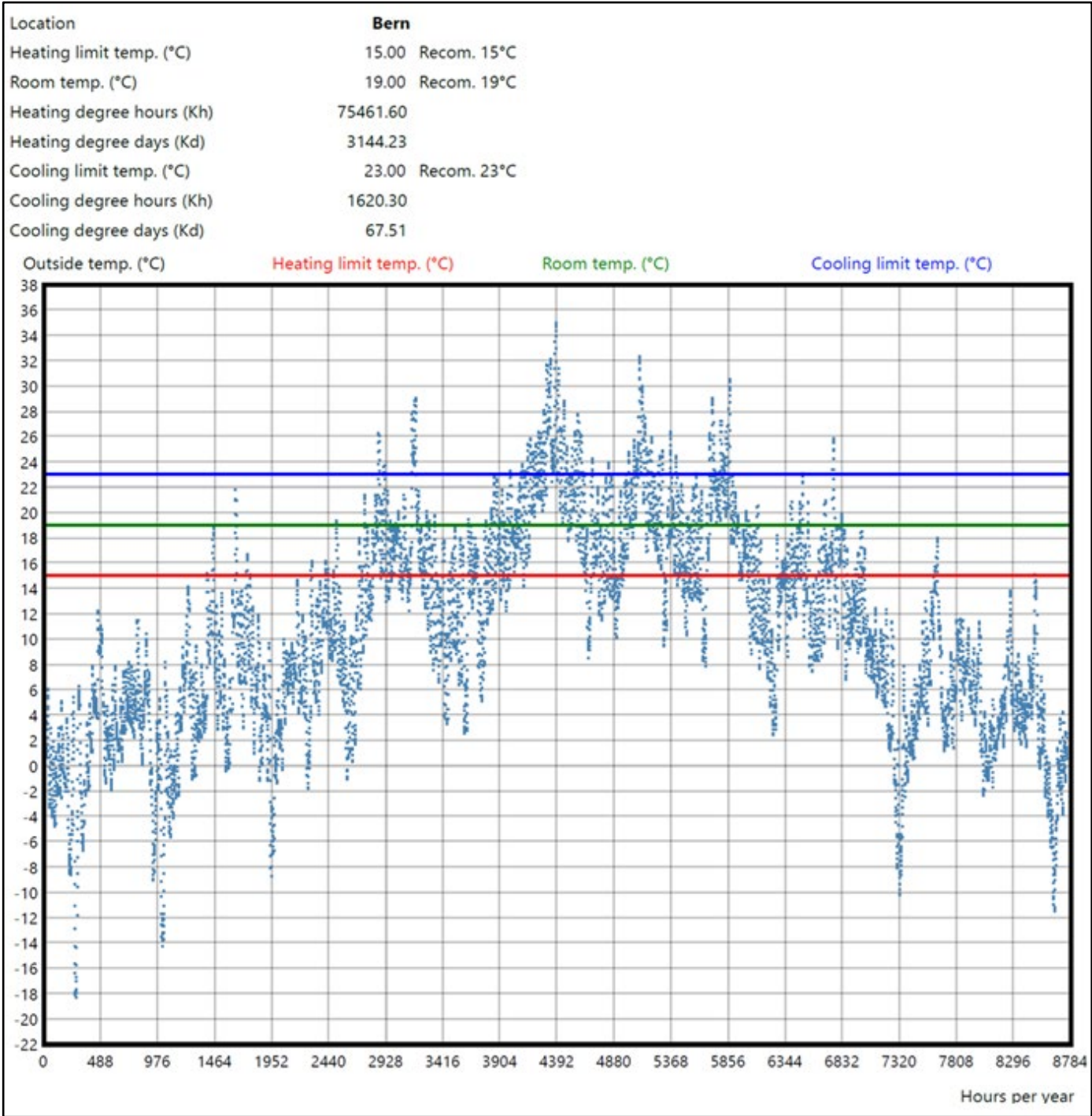
What **cooling loads** in summer and **heating loads** in winter should be planned with?

What components does an **air handling unit** have to contain and how much does it cost?

What do the processes in the **Mollier-HX-Diagram** look like in summer and winter?

What kind of **risk** do you take, if you only assume an outside air of **32°C/40%** in summer, although according there are maximum values of enthalpy at **32.1°C/54%** of **76.66 kJ/kg**?

Application HDH: Heating degree days are a measure of the influence of the weather on a building heating energy needs. Heating degree days are the difference between the desired room temperature and the outside temperature, if this outside temperature is below a certain heating limit temperature. For Bern, this is 3,144 heating degree days according to the following figure. While the heating oil lobby only talks about heating degree days, in order to be able to sell totally oversized boilers, no one but us talks about the 68 cooling degree days, although it is getting warmer. In 2025, maximum temperatures of 41.5°C were measured in Grono (Misox) and in Geneva of 39.7°C. And the extremely clean, frequently used Aare River in Bern reached a fabulous temperature of 22.3°C, which tempted a brain amputee Federal Council (far-right full-post minister) to say: “Thanks to global warming, you no longer have to travel to the Caribbean during the summer holidays”



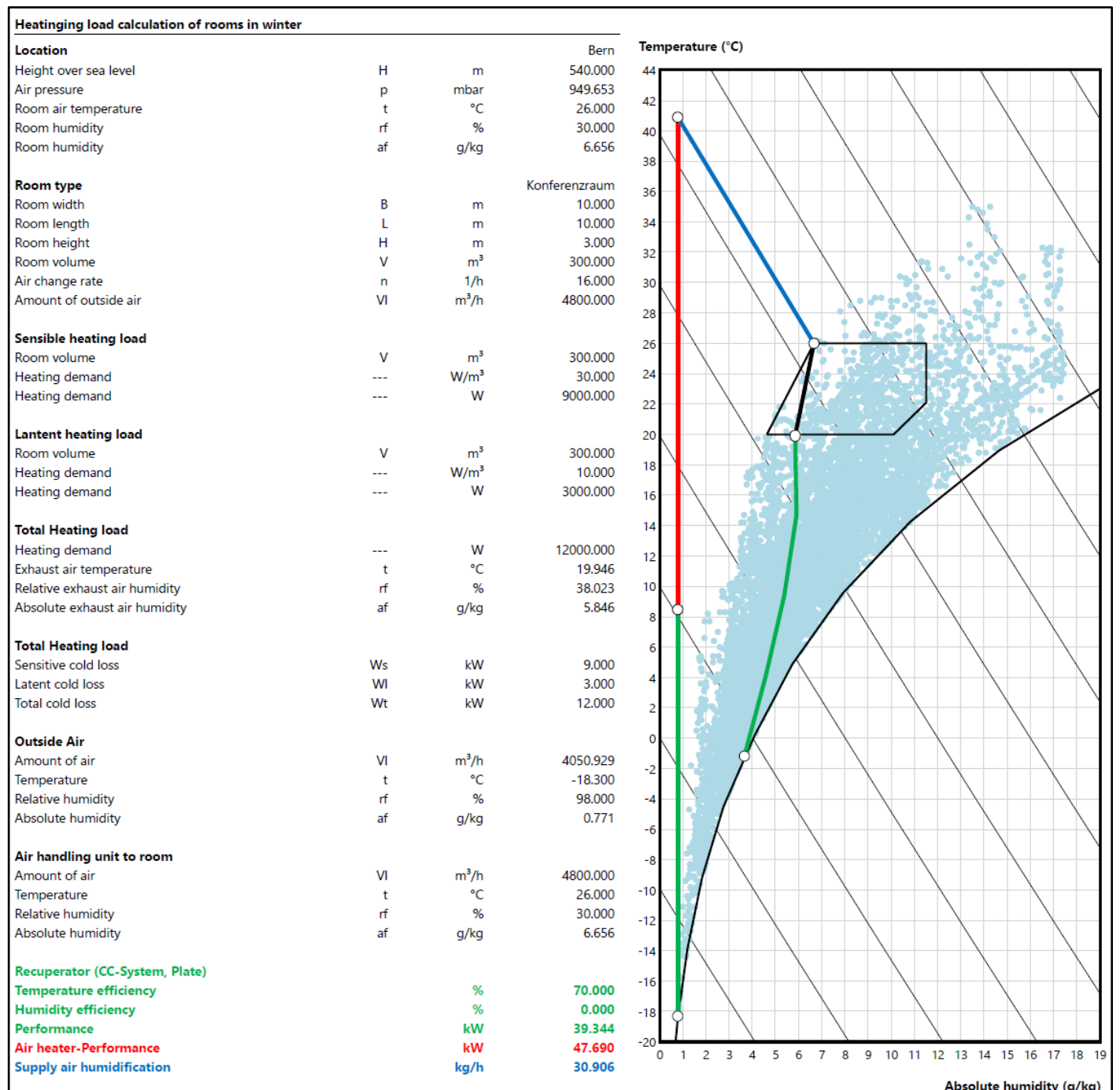
Application HLR

Subsequently, **without meteorological risk management**, based on www.meteonorm.com, the lowest outside temperature of -18.3°C was expected, not for the reason, that such values are to be expected in this century (except for a nuclear winter triggered by Putin), but because anyone who calculates so conservatively, does not want to take any risks at all.

Despite heat recovery with a temperature efficiency of 70%, corresponding to an capacity of 39 kW, a re-heater of 48 kW is required, which heats the outside air to 41°C.

Subsequently, the adiabatic humidification of the outside air takes place to 26°C/30%, which is far too much dispensed with. Nasal mucous membranes, like Sahara desert, are then the logical consequence.

In order to keep the **heating load (black)** within the comfort range, an air exchange rate of 16 was required, corresponding to 4,800 m³/h, although guidelines state, that this is sufficient for conference rooms with 8 to 10.



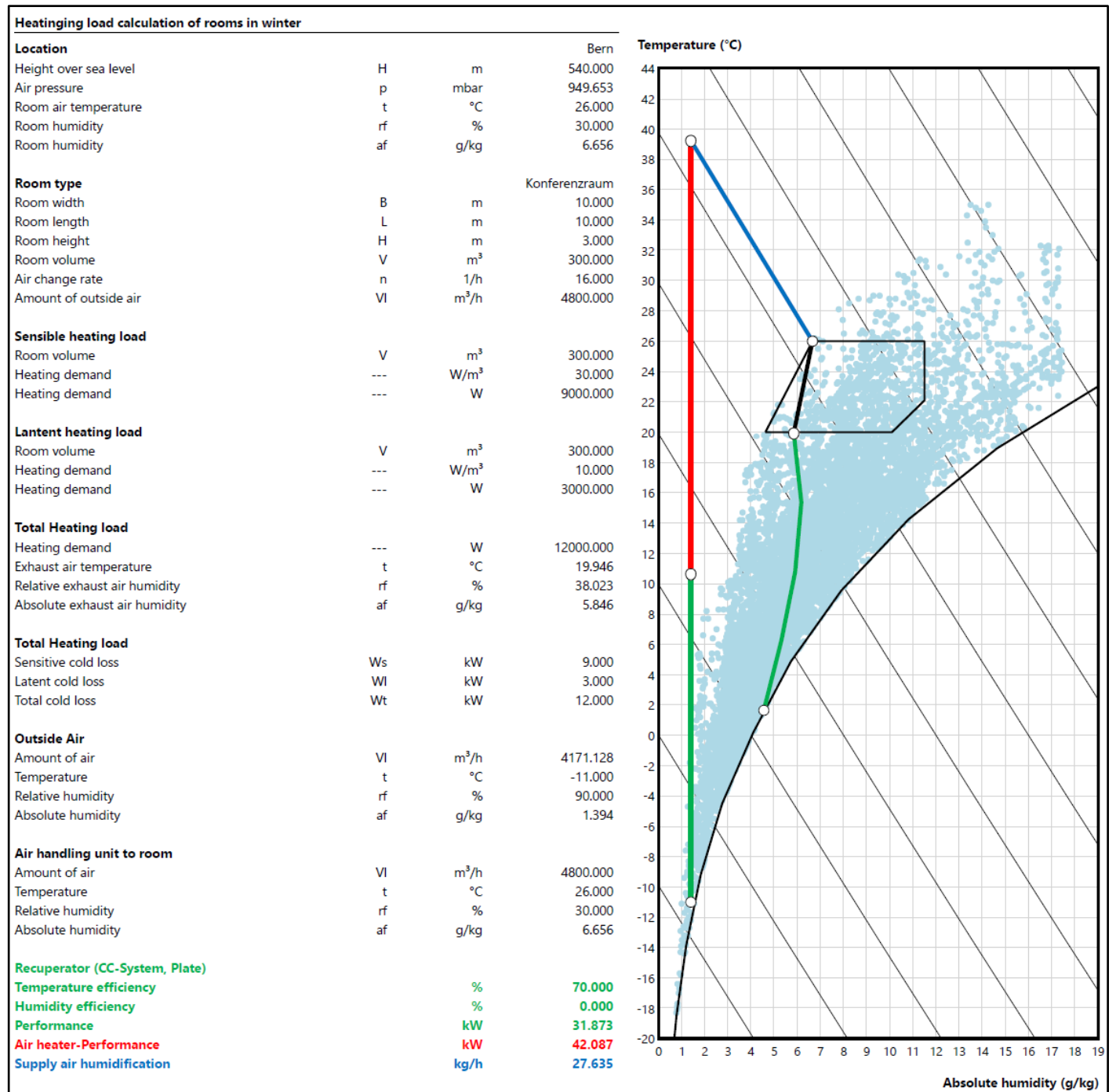
Application HLR

Subsequently, **with meteorological risk management**, i.e. a lowest outside temperature of -11°C, was calculated, not for the reason, that such values will not be undercut in this century, but because those who calculate in this way, will only take a relatively small risk as a result of global warming.

Despite heat recovery with a temperature efficiency of 70%, corresponding to an capacity of 32 kW, a re-heater of 42 kW is required, which heats the outside air to 39°C.

Subsequently, the adiabatic humidification of the outside air takes place to 26°C/30%, which is far too much dispensed with. Nasal mucous membranes, like Sahara desert, are then the logical consequence.

In order to keep the heating load (black) within the comfort range, an air exchange rate of 16 was required, corresponding to 4,800 m³/h, although guidelines state that this is sufficient for conference rooms with 8 to 10.



Application CLR

Subsequently, **without meteorological risk management**, based on www.meteonorm.com, the largest enthalpy of 76.66 kJ/kg (32.1°C/54%) was calculated. Despite heat recovery with a temperature efficiency of 70%, corresponding to a capacity of 32 kW, a aftercooler of 87 kW is required. This is followed by an 8 kW reheater, which heats the outside air to 16°C/85%. In order to keep the cooling load (black) within the comfort range, an air exchange rate of 34 was required, corresponding to 10,200 m³/h, although guidelines state that this is sufficient for conference rooms with 8 to 10.

Cooling load calculation of rooms in midsummer

Location			Bern
Height over sea level	H	m	540.000
Air pressure	p	mbar	949.653
Room air temperature	t	°C	16.000
Room humidity	rf	%	85.000
Room humidity	af	g/kg	10.275
Room air vapor partial pressure	pd	mbar	15.430

Room type			Konferenzraum
Room width	B	m	10.000
Room length	H	m	10.000
Room height	H	m	3.000
Room volume	V	m ³	300.000
Air change rate	n	1/h	34.000
Amount of outside air	VI	m ³ /h	10200.000

Water pool			Evaporation amount according to VDI 2089
Water pool use			Covered water surface
Evaporation coefficient	ε	g / (mbar m ² h)	0.5
Pool width	b	m	1.000
Pool length	l	m	1.000
Water pool surface	A	m ²	1.000
Temperature of the water	tw	°C	35.000
Saturation vapor pressure of water	ps	mbar	56.016
Amount of evaporation	W ₁	g/h	20.293

Persons			Evaporation amount according to DIN EN ISO 7730
Activity level II			Very light physical activity
Number of people in the room	m	Number	100.000
Evaporative emission per person	W _p	g/h	80.000
Evaporative emission of all persons	W ₂	g/h	8000.000

Room			Rough estimate of cooling needs
Room volume	V	m ³	300.000
Cooling demand	H _r	W/m ³	30.000
Cooling demand	H ₁	W	9000.000

Persons			Heat emission according to DIN EN ISO 7730
Activity level III			Light physical activity
Number of people in the room	m	Number	100.000
Heat output per person	H _p	W	231.558
Heat dissipation of all people	H ₂	W	23155.758

Total amount of evaporation	W	g/h	8020.293
Amount of outside air	VI	m ³ /h	10200.000
Outside air temperature	t	°C	32.100
Relative outside air humidity	rf	%	54.000
Absolute outside air humidity	af	g/kg	17.324
Evaporation per m ³	w	g/m ³	0.786
Air density	d	kg/m ³	1.137
Evaporation per kg	w	g/kg	0.699
Heat of vaporization	Ro	J/kg	2547920.913
Heat emission latent	Wl	kW	5.676
Heat emission sensitive	Ws	kW	32.156
Total heat emission = Cooling load	Wt	kW	37.832
Exhaust air temperature	t	°C	25.832
Relative humidity	rf	%	49.609
Absolute humidity	af	g/kg	10.973

Exhaust air humidification	kg/h	35.767
Recuperator (CC-System, Plate)-Temperature efficiency	%	70.000
Recuperator (CC-System, Plate)-Humidity efficiency	%	0.000
Recuperator (CC-System, Plate)-Performance	kW	31.740
Air cooler-Performance	kW	86.715
Air heater-Performance	kW	8.261

The present method is a simplification and therefore only suitable for long-standing experienced experts on the subject. The guideline VDI 2078 is taken as a basis for the cooling load calculation for planning an air conditioning system. This is issued by the VDI. It contains recommendations and rules and thus represents the state of the art. All parameters that influence the thermal room behavior in any way are taken into account.

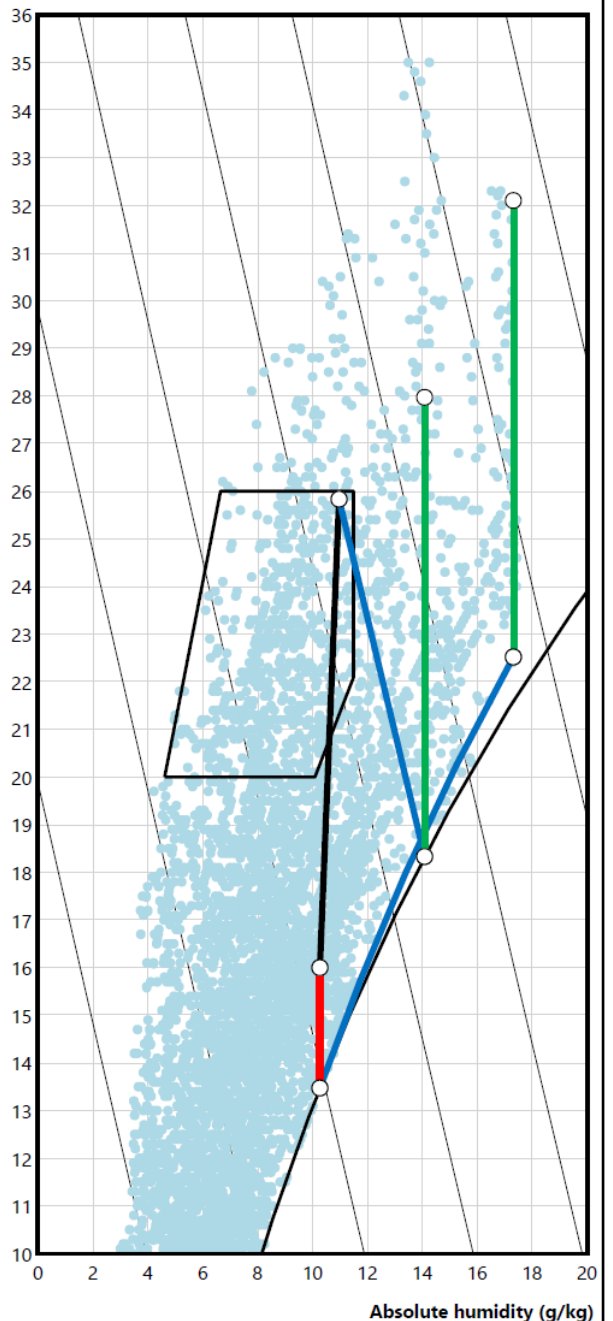
$$W_1 = \varepsilon A(p_s - p_d)$$

$$W_2 = mW_p$$

$$H_1 = VH_r$$

$$H_2 = mH_p$$

Temperature (°C)



Application CLR

Subsequently, **with meteorological risk management**, i.e. 32°C/54%, was expected. Despite heat recovery with a temperature efficiency of 70%, which corresponds to a capacity of 32 kW, an aftercooler of 49 kW is required. This is followed by an 8 kW reheater, which heats the outside air to 16°C/85%. In order to keep the cooling load (black) within the comfort range, an air exchange rate of 34 was required, corresponding to 10,200 m³/h, although guidelines state that this is sufficient for conference rooms with 8 to 10.

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Air change rate	n	1/h	34.000
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Amount of evaporation	W ₁	g/h	20.293

Persons			Evaporation amount according to DIN EN ISO 7730
Activity level II			Very light physical activity
Number of people in the room	m	Number	100.000
Evaporative emission per person	W _p	g/h	80.000
Evaporative emission of all persons	W ₂	g/h	8000.000

Room			Rough estimate of cooling needs
Room volume	V	m ³	300.000
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Activity level III			Light physical activity
Number of people in the room	m	Number	100.000
Heat output per person	H _p	W	231.558
Heat dissipation of all people	H ₂	W	23155.758

Total amount of evaporation	W	g/h	8020.293
Amount of outside air	VI	m ³ /h	10200.000
Outside air temperature	t	°C	32.000
Relative outside air humidity	rf	%	40.000
Absolute outside air humidity	af	g/kg	12.667
Evaporation per m ³	w	g/m ³	0.786
Air density	d	kg/m ³	1.137
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Recuperator (CC-System, Plate)-Temperature efficiency	%	70.000
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Recuperator (CC-System, Plate)-Performance	kW	31.509
Air cooler-Performance	kW	48.614
Air heater-Performance	kW	8.261

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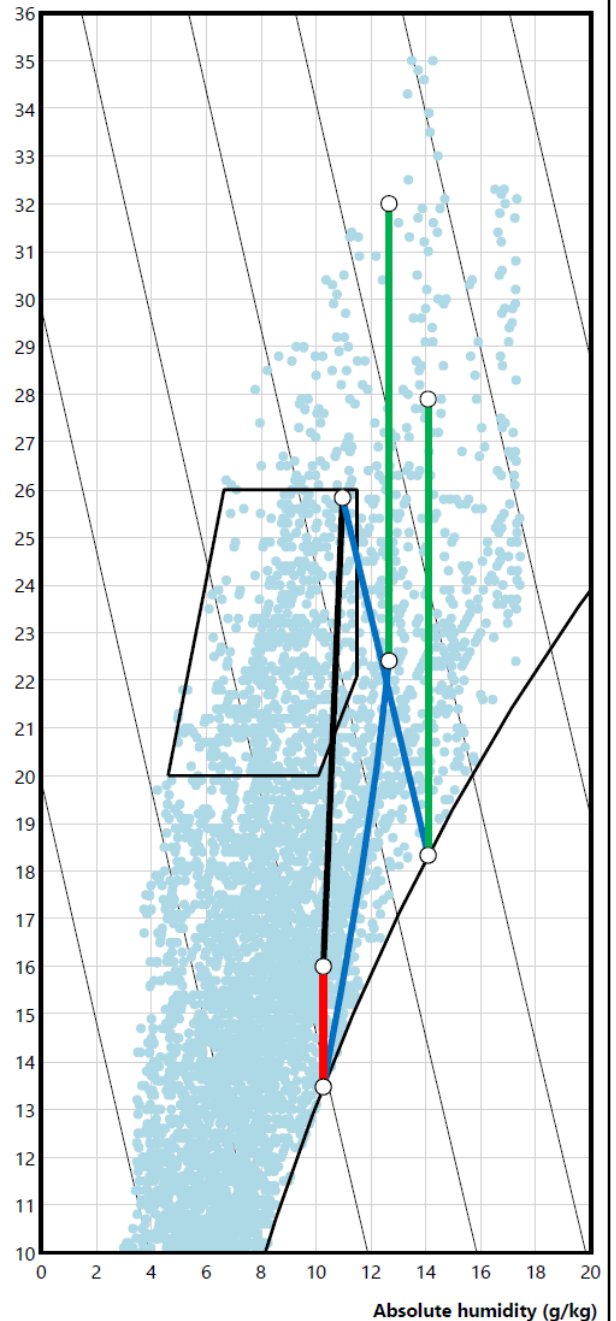
$$W_1 = \varepsilon A(p_s - p_d)$$

$$W_2 = mW_p$$

$$H_1 = VH_r$$

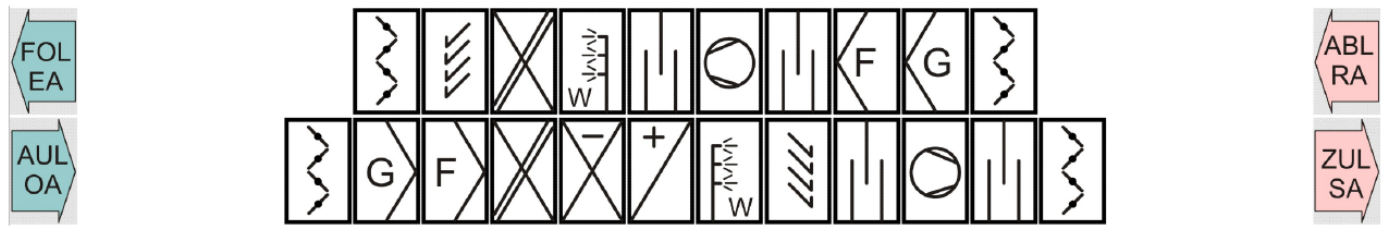
$$H_2 = mH_p$$

Temperature (°C)



Application AHU

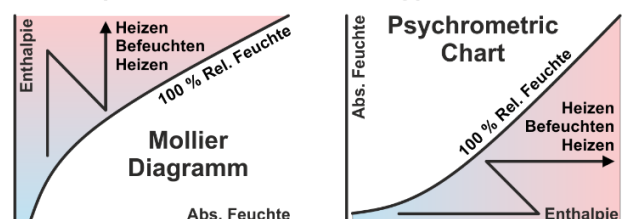
Now the air handling unit with all the necessary components has been put together for the larger amount of air required in summer. You have to reckon with a length of 8400 mm, an empty weight of 2430 kg and a price of EUR 48,630. If you want to know more, you start inquiries with several manufacturers of air handling units, whereupon their salespeople are at the door the very next day, even though they are still in the project stage and the realization may take years.

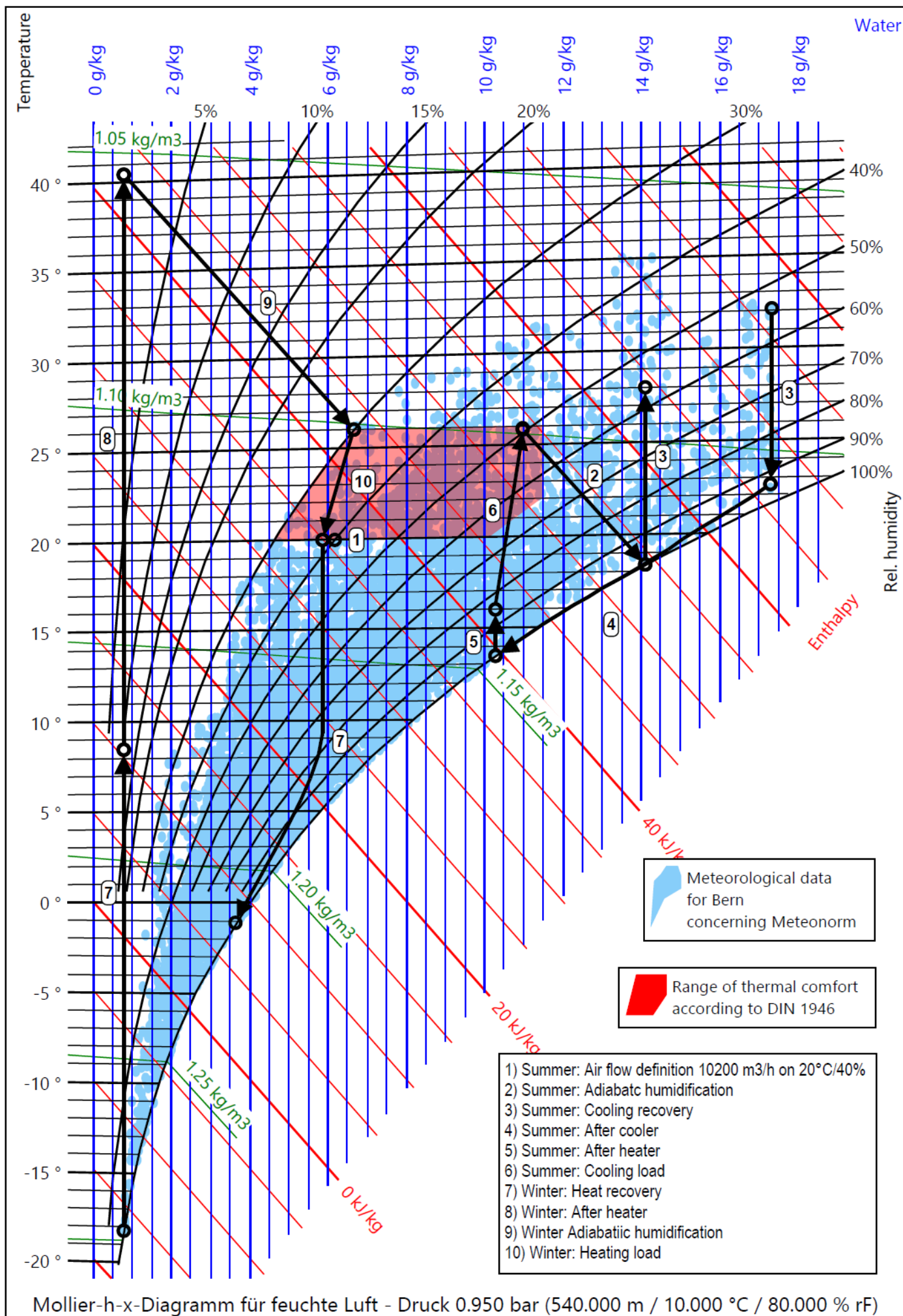
				
Air-Handling Unit (H x W = 1248 x 1553 mm)	Length mm	Weight kg	Pressure drop Pa	Price EUR
Outside air (10200 m³/h - Filter 1.78 m/s)				
Outside air			100.00	
Empty part little with flaps	350.00	50.00	24.00	1100.00
Filter G	450.00	60.00	99.00	1100.00
Filter F	650.00	90.00	131.00	1620.00
CC-System	650.00	200.00	111.00	3350.00
Cooler	400.00	130.00	69.00	2140.00
Heater	200.00	80.00	25.00	1290.00
Humidifier water	1300.00	140.00	80.00	3150.00
Droplet separator	150.00	30.00	80.00	690.00
Sound absorber	1300.00	140.00	48.00	3150.00
Fan - Efficiency 70.00 % - Capacity 4.53 kW	1300.00	210.00	80.00	4190.00
Sound absorber	1300.00	140.00	48.00	3150.00
Empty part little with flaps	350.00	50.00	24.00	1100.00
Supply air			200.00	
Total	8400.00	1320.00	1119.00	26030.00
Air-Handling Unit (H x W = 1248 x 1553 mm)	Length mm	Weight kg	Pressure drop Pa	Price EUR
Return air (10200 m³/h - Filter 1.78 m/s)				
Return air			100.00	
Empty part little with flaps	350.00	50.00	24.00	1100.00
Filter G	450.00	60.00	99.00	1100.00
Filter F	650.00	90.00	131.00	1620.00
Sound absorber	1300.00	140.00	48.00	3150.00
Fan - Efficiency 70.00 % - Capacity 4.15 kW	1300.00	210.00	80.00	4190.00
Sound absorber	1300.00	140.00	48.00	3150.00
Humidifier water	1300.00	140.00	80.00	3150.00
CC-System	650.00	200.00	111.00	3350.00
Droplet separator	150.00	30.00	80.00	690.00
Empty part little with flaps	350.00	50.00	24.00	1100.00
Exhaust air			200.00	
Total	7800.00	1110.00	1025.00	22600.00

Application AHH

Only now is the software AHH, the Mollier-HX diagram or the Psychrometric chart for French, Italians, English, etc. used, see the following pages, where you can see all the processes with data on performance, the comfort range and the meteorological data.

AHH (Air Humid Handling) = All in one!





1) Point

Air		
Temperature	°C	20.000
Rel. humidity	%	40.000
Abs. humidity	g/kg	6.174
Density humid	kg/m ³	1.124
Enthalpy humid	kJ/kg	35.794
Volume flow humid	m ³ /h	10200.000
Massflow dry	kg/h	11394.999

2) Moistening of air with water

Capacity	kW	0.614
Moistening flow	kg/h	35.508
Moistening temperature	°C	15.000
Moistening enthalpy	kJ/kg	62.302

Air In			Air Out	
Temperature	°C	25.832	18.332	
Rel. humidity	%	49.609	100.000	
Abs. humidity	g/kg	10.974	14.090	
Density humid	kg/m ³	1.099	1.125	
Enthalpy humid	kJ/kg	53.964	54.158	
Volume flow humid	m ³ /h	10482.301	10269.772	
Massflow dry	kg/h	11394.999	11394.999	

3) Heat recovery - Circuit connect-system - Surface relation hot/cold 1.000 - Partition of fins (2.5 - 3.5 mm)

Efficiency temperature	%	70.000
Efficiency hygroscopic	%	0.000
Efficiency humid	%	0.000
Capacity	kW	31.509
Mean temp.diff.	K	4.184
Coefficient	kW/K	7.531

		Cold air In	Cold air Out	Hot air In	Hot air Out
Temperature	°C	18.332	27.970	32.100	22.571
Rel. humidity	%	100.000	55.920	54.000	94.135
Abs. humidity	g/kg	14.090	14.090	17.325	17.304
Density humid	kg/m ³	1.125	1.089	1.072	1.107
Enthalpy humid	kJ/kg	54.158	64.112	76.659	66.705
Volume flow humid	m ³ /h	10269.772	10609.313	10809.513	10471.748
Massflow dry	kg/h	11394.999	11394.999	11394.999	11394.999
Condensed water	kg/h		0.000		0.231
Surface temperature	°C				21.002

4) Cooling of air - Partition of fins (2.5 - 3.5 mm)

Capacity	kW	86.210
Mean temp.diff.	K	8.925
Coefficient	kW/K	9.659

Coolant In	°C	6.000
Coolant Out	°C	12.000

Air In			Air Out	
Temperature	°C	22.571	13.460	
Rel. humidity	%	94.135	100.000	
Abs. humidity	g/kg	17.304	10.266	
Density humid	kg/m ³	1.107	1.147	
Enthalpy humid	kJ/kg	66.706	39.470	
Volume flow humid	m ³ /h	10471.738	10037.414	
Massflow dry	kg/h	11394.999	11394.999	
Condensed water	kg/h		80.201	
Surface temperature	°C		7.940	

5) Heating

Capacity	kW	8.245
Mean temp.diff.	K	27.298
Coefficient	kW/K	0.302
Heating medium In	°C	50.000
Heating medium Out	°C	35.000

		Air In	Air Out
Temperature	°C	13.460	16.000
Rel. humidity	%	100.000	84.926
Abs. humidity	g/kg	10.266	10.266
Density humid	kg/m³	1.147	1.137
Enthalpy humid	kJ/kg	39.470	42.074
Volume flow humid	m³/h	10037.414	10126.361
Massflow dry	kg/h	11394.999	11394.999

6) Heat load with air

Sensible heat	kW	32.156
Latent heat	kW	5.676
Heat Load	kW	37.832

		Air In	Air Out
Temperature	°C	16.000	25.904
Rel. humidity	%	84.926	49.380
Abs. humidity	g/kg	10.266	10.970
Density humid	kg/m³	1.137	1.099
Enthalpy humid	kJ/kg	42.074	54.026
Volume flow humid	m³/h	10126.361	10484.851
Massflow dry	kg/h	11394.999	11394.999

7) Heat recovery - Circuit connect-system - Surface relation hot/cold 1.000 - Partition of fins (2.5 - 3.5 mm)

Efficiency temperature	%	70.000
Efficiency hygroscopic	%	0.000
Efficiency humid	%	0.000
Capacity	kW	40.178
Mean temp.diff.	K	14.135
Coefficient	kW/K	2.842

		Cold air In	Cold air Out	Hot air In	Hot air Out
Temperature	°C	-18.300	8.472	19.946	-1.120
Rel. humidity	%	98.000	10.607	38.023	98.870
Abs. humidity	g/kg	0.771	0.771	5.846	3.627
Density humid	kg/m³	1.297	1.174	1.124	1.213
Enthalpy humid	kJ/kg	-16.509	10.464	34.907	7.934
Volume flow humid	m³/h	4137.015	4571.595	4796.615	4436.134
Massflow dry	kg/h	5362.353	5362.353	5362.353	5362.353
Condensed water	kg/h		0.000		11.900
Surface temperature	°C				-7.477

Danger of FREEZING!

8) Heating

Capacity	kW	48.108
Mean temp.diff.	K	16.582
Coefficient	kW/K	2.901
Heating medium In	°C	50.000
Heating medium Out	°C	35.000

		Air In	Air Out
Temperature	°C	8.472	40.500
Rel. humidity	%	10.607	1.558
Abs. humidity	g/kg	0.771	0.771
Density humid	kg/m³	1.174	1.054
Enthalpy humid	kJ/kg	10.464	42.761
Volume flow humid	m³/h	4571.595	5091.485
Massflow dry	kg/h	5362.353	5362.353

9) Moistening of air with water

Capacity	kW	0.546
Moistening flow	kg/h	31.556
Moistening temperature	°C	15.000
Moistening enthalpy	kJ/kg	62.302

		Air In	Air Out
Temperature	°C	40.500	25.997
Rel. humidity	%	1.558	30.000
Abs. humidity	g/kg	0.771	6.656
Density humid	kg/m³	1.054	1.101
Enthalpy humid	kJ/kg	42.762	43.128
Volume flow humid	m³/h	5091.543	4901.951
Massflow dry	kg/h	5362.353	5362.353

10) External process

Capacity	kW	12.245
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		Air In	Air Out
Temperature	°C	25.997	19.946
Rel. humidity	%	30.000	38.023
Abs. humidity	g/kg	6.656	5.846
Density humid	kg/m³	1.101	1.124
Enthalpy humid	kJ/kg	43.128	34.907
Volume flow humid	m³/h	4901.951	4796.615
Massflow dry	kg/h	5362.353	5362.353

If a planning engineering office wants to know more about it, you can also purchase software from us for the calculation of heat exchangers and energy recovery systems.

Only then do you have precise information about pressure drops, installation depths, weights and amortization periods of the energy recovery.

For the example at hand, the HES software would be recommended, downloadable under www.zcs.ch. It works as a demo without any restrictions for 30 days and calculates up to 40 different conventional and state-of-the-art geometries in less than 1 second.

State-of-the-art geometry with sinusoidal fins in air direction



Application MRM

Which would finally bring us to meteorological risk management, if one were to create an absolutely irresponsible plan by standard with an outside air of 32°C/40%.

Instead of 122 kW, a cooler of only 83 kW would have been provided, i.e. a **narrow-gauge cooler**, which would be 32% too small. Then the staff should simply surrender quietly throughout the middle of summer, sweat to themselves, doze off and reduce the output to half, just because an irresponsible planning engineer has built absolute bullshit.

Improvements are then no longer used in the majority of cases, because there is simply not enough space for a cooler with a greater installation depth in the air conditioning unit.

The same planners did not provide a droplet eliminator after the cooler, because they claim, that the drop flight in the air handling unit is only a few centimeters and that all condensate therefore ends up in the drip tray.

Then there are the planners who claim, that an exhaust air handling unit, which is often arranged on the supply air handling unit, is impossible to have a drip tray to adiabatically pre-cool the exhaust air in summer. Then the cold recovery does almost nothing and the aftercooler becomes even bigger, ergo it doesn't get any more stupid!

Then you have to finally change the manufacturer of the air handling units, who insists on such bullshit or even better finally change your profession! How about chimney sweep, for example, which hopefully gets irreversibly stuck in the chimney when it is used for the first time?

Cooling requirements in midsummer - Meteorological risk management

Cooler	Entry after Meteo	Inlet	Outlet	Definition
Location				Bern
Height over sea level	m			540.000
Pressure	hPa			949.653
Temperature	°C	32.100	32.000	20.000
Rel. humidity	%	54.000	40.000	40.000
Abs. humidity	g/kg	17.324	12.667	9.770
Density humid	kg/m³	1.072	1.076	1.124
Enthalpy humid	J/kg	76.657	64.635	35.793
Volume flow humid	m³/h	10809.503	10727.266	10200.000
Mass flow dry	kg/h	11395.642	11395.642	11395.642
Condensate flow	kg/h	86.082	33.018	
Cooling brine	°C	6.000	6.000	12.000
Capacity sensible	kW	61.167	60.334	
Capacity latent	kW	60.385	23.161	
Frost capacity	kW	0.000	0.000	
Capacity total	kW	121.552	83.496	Indoor climate risk 45.578 % !
Hours with higher temperatures	h	0.000	14.000	
Hours with higher enthalpies	h	0.000	133.000	
Reheater		Inlet	Outlet	
Temperature	°C	13.500	16.000	
Rel. humidity	%	95.000	80.889	
Abs. humidity	g/kg	9.770	9.770	Reheater 8.108 kW
Heat Load		Inlet	Outlet	
Temperature	°C	16.000	26.000	
Rel. humidity	%	80.889	51.433	
Abs. humidity	g/kg	9.770	11.500	Capacity sensible 32.441 kW Capacity latent 13.956 kW Capacity total 46.397 kW

