Climate imposition in the hot and humid summer

Employees in open-plan offices often have to do without thermal comfort according to DIN 1946, because some incorrigible planning engineers have put out a completely wrong tender. Firstly, a much too dry outside air of 32°C/40% was chosen. The meteorological data for Bern are shown below without extreme values. The red isenthalps clearly show, that there is far too much risk. Secondly, no exhaust air humidification was put out to tender, because the exhaust air conditioning unit is arranged on top of the supply air conditioning unit and therefore the drip tray would only cause problems. Thirdly, cold recovery can do almost nothing. Fourthly, the aftercooler has to do too much. Fifthly, this results in a cooling load, that is totally insufficient. The problem is, that the sequence of the air processes is incorrect, as the cooling load would first have to be calculated with regard to sensitive and latent capacity. For this purpose, very complicated software applications such as IDA, DOE, TRNSYS, etc. are available. It is said, that if you were to hire 10 engineers to calculate a heat load for the same open-plan office, you would get 10 different solutions with variations of up to 30%, not to mention the time required in the order of 1 to 2 full working days. This has prompted us, to respond to the request of many serious planning engineers and to develop a simplified calculation of the cooling load, **see the software AHH (Mollier-HX-Diagram) under CLR (Cooling Load Rooms).** However, this requires a lot of experience, when using this simplified calculation, which can be assumed by serious planning engineers.

Software AHH

Mollier-HX-Diagram

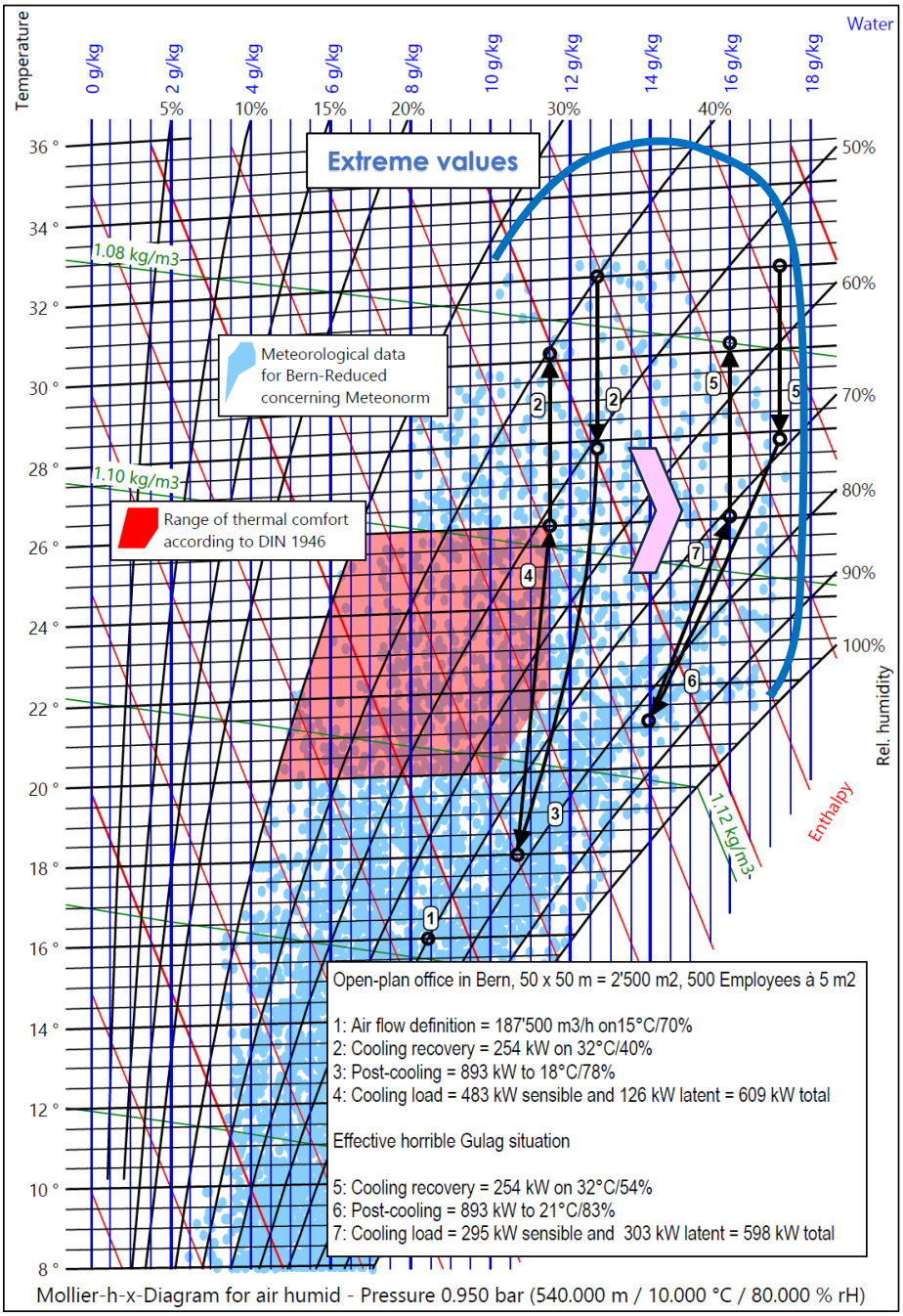
Why was 16°C/70% chosen for the air volume definition, see Process 1? Because on the next page we will show you, how to plan and write out something like this correctly. The CLR software is available for this purpose, which is part of the AHH-Professional version software.

The meteorological data of Bern are shown opposite, with all extreme values hidden.

The red isenthalps clearly show, that there is far too much risk.

Therefore, in the hot and humid summer, all processes will migrate to the right into the unbearable wetland, with the result, that work performance will decrease drastically.

To make matters worse, the so-called architects of today no longer have the faintest idea of how to build, see, for example, administrative buildings.



Calculation with the software CLR (Cooling Load Rooms), an application within the AHH professional version

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	%	70.000
Room humidity	af	g/kg	8.437
Room air vapor partial pressure	pd	mbar	12.707
Room type			Büro
Room width	B	m	50.000
Room length	H	m	50.000
Room height	H	m	3.000
Room volume	V	m³	7500.000
Air change rate	n	1/h	25.000
Amount of outside air	Vl	m³/h	187500.000
Water pool	Evaporation amount according to VDI 2089		
Water pool use			Nassräume
Evaporation coefficient	ε	g / (mbar m² h)	20
Pool width	b	m	10.000
Pool length	l	m	50.000
Water pool surface	A	m²	500.000
Temperature of the water	tw	°C	35.000
Saturation vapor pressure of water	ps	mbar	56.016
Amount of evaporation	W_1	g/h	433087.863
Persons	Evaporation amount according to DIN EN ISO 7730		
Activity level III			Light physical activity
Number of people in the room	m	Number	500.000
Evaporative emission per person	W_p	g/h	107.000
Evaporative emission of all persons	W_2	g/h	53500.000
Room	Rough estimate of cooling needs		
Room volume	V	m³	7500.000
Cooling demand	H_r	W/m³	60.000
Cooling demand	H_1	W	450000.000
Persons	Heat emission according to DIN EN ISO 7730		
Activity level III			Light physical activity
Number of people in the room	m	Number	500.000
Heat output per person	H_p	W	231.558
Heat dissipation of all people	H_2	W	115778.789
Total amount of evaporation	W	g/h	486587.863
Amount of outside air	Vl	m³/h	187500.000
Outside air temperature	t	°C	32.000
Relative outside air humidity	rf	%	54.000
Absolute outside air humidity	af	g/kg	17.223
Evaporation per m³	w	g/m3	2.595
Air density	d	kg/m³	1.138
Evaporation per kg	w	g/kg	2.299
Heat of vaporization	Ro	J/kg	2547160.263
Heat emission latent	Wl	kW	344.283
Heat emission sensitive	Ws	kW	565.779
Total heat emission = Cooling load	Wt	kW	910.061
Exhaust air temperature	t	°C	25.414
Relative humidity	rf	%	49.771
Absolute humidity	af	g/kg	10.736
Exhaust air humidification		**kg/h**	**650.184**
Recuperator (CC-System, Plate)-Temperature efficiency		**%**	**70.000**
Recuperator (CC-System, Plate)-Humidity efficiency		**%**	**0.000**
Recuperator (CC-System, Plate)-Performance		**kW**	**593.954**
Air cooler-Performance		**kW**	**2019.000**
Air heater-Performance		**kW**	**329.284**

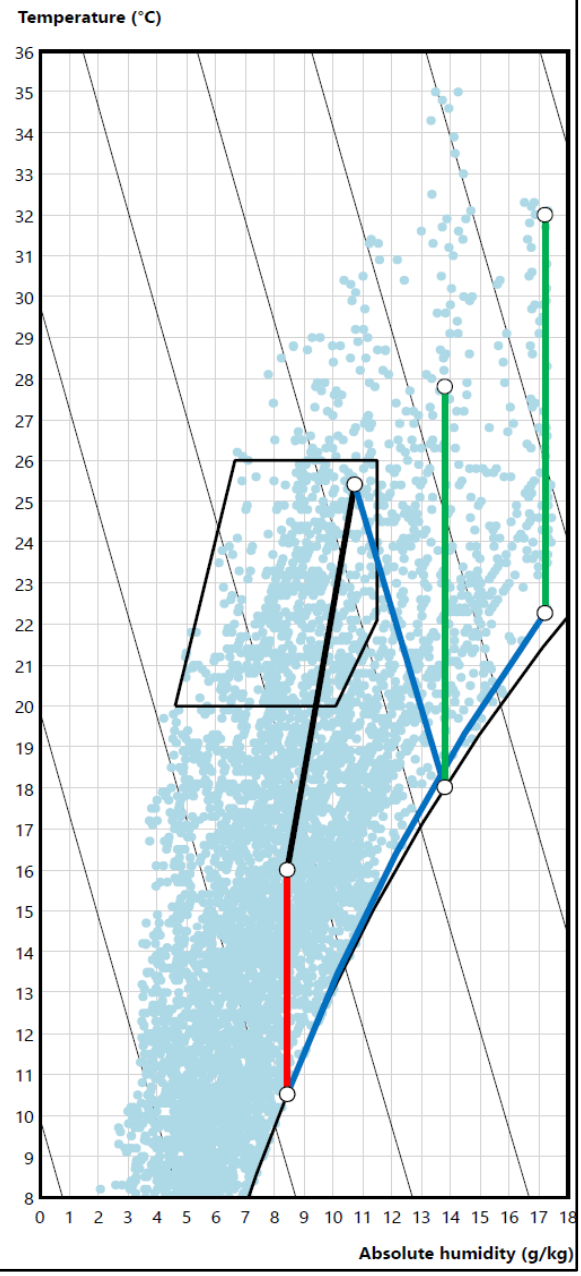
The present method is a simplification and therefore only suitable for long-standing experienced experts on the subject. The guideline VDI 2078 is taken as a basis for the cooling load calculation for planning an air conditioning system. This is issued by the VDI. It contains recommendations and rules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

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

$$W_2 = mW_p$$

$$H_1 = VH_r$$

$$H_2 = mH_p$$



Comparison of calculations	Risk management	Correct calculation	Deviation
Outside air	32°C/40%	32°C/54%	see humidity area
Adiabatic exhaust air humidification	No	Yes,	stupider? Impossible!
Cold recovery	254 kW	594 kW	Factor 2.34
Post-cooling	893 kW	2,019 kW	Factor 2.26
Post-heating	0 kW	329 kW	Factor infinity
Cooling load sensible	483 kW	566 kW	Factor 1.17
Cooling load latent	126 kW	344 kW	Factor 2.73
Cooling load total	609 kW	910 kW	Factor 1.49

Still open questions about the unbearable open-plan office climate? Then you too are an incorrigible planning engineer!