



► Displacement ventilation
► General

1. Introduction

In climate technology a lot of interest has arisen for air supply systems that complement natural ventilation. Natural ventilation works by fresh air entering the building through gaps and openings. The heat sources in the building determine the air flow pattern. An equivalent system in a building corresponds to what people experience at home. For this reason this type of system is easily accepted.

A problem with natural ventilation is that only a limited volume of air can be supplied without annoying air movement being created and what's more the temperature of the air used for ventilation cannot be controlled. For rooms that have an average load this quickly results in unacceptably high temperatures.

In displacement ventilation, air is supplied at floor level with a low velocity and below room temperature. In this way a system arises that totally complements the natural flows in the room. The existence of high air velocities in the room can in this way be prevented. The temperature in the room has been made controllable and the polluted air can be efficiently removed from the room.

2. The operation of the system

In a displacement system cooled air is supplied at low velocity at floor level and at the top of the room the heated and polluted air is removed. The supplied air spreads over the floor. The heat sources in the room create rising convection currents. This air is taken from the cool supplied air at floor level. This continues until there is no more air available to allow the mass of the convection current to continue to grow. From this point any growth in the amount of air in the convection current must come from the air's own return eddy.

Three zones are created in this way. The supplied cool air at floor level, a mass of warm air at the top that circulates on its own and an area in between where the air velocities are very low with no clear direction of flow.

The dirt, dust, particles of skin, smoke etc. that are generated in the room will be carried upwards by the air currents in the room. This polluted air will be stored in the warm layer at the top of the room and will then be carried off with the return air. Consideration must be given to the fact that pollution due to gasses or vapours that are heavier than air will not move in

their entirety to the upper layer. Under the top layer the air is "clean". This area provides a suitable living environment for the occupants.

The system is in principle only suitable for cooling. If heating is required, it must be supplied by a separate system, for instance radiators or heated ceiling.

3. Application

Displacement systems can be used in a number of situations.

Their ability to quickly and efficiently remove polluted air combined with an optimum use of the cooling capacity, because they only treat the occupied zone, make this type of system attractive, especially in relatively high rooms, because there the advantages are most apparent. Because of this industrial applications occur very frequently. The principle is also used in theatres, concert halls and such like.

This system is increasingly used in offices, because in comfort applications the emphasis has become focused on the removal of pollution and the absence of drafts.

4. Design

In the central system a displacement installation is no different than any other system. What is different, is determining the cooling requirements and the volume of supplied air.

Comfort requirements

The eventual goal of the installation is to create the optimum comfort for the occupants. Therefore the currently applicable standards and regulations must be satisfied. However, a new element is introduced, the vertical temperature gradient. Because of the nature of the system, the temperature rises at the top. The difference between the temperature at ankle height and at head height must not be excessively large. Extensive research has shown that a maximum difference of 2 – 3 K between head and ankle height is permissible.

It is sensible to set the distance between ankle height and head height at 1.8 m so that activities can be carried out while sitting as well as while standing.

Room temperature

Because of the vertical temperature gradient it is sensible to agree where room temperature should be measured. A height of 1.2 m has been chosen. In any further discussion of room temperature the temperature measured at 1.2 m is meant.

Supply temperature

In an office environment the temperature of the supplied air should be chosen to be no lower than 3 K under room temperature. For industrial applications lower temperatures are allowed and it is recommended that an under temperature of 6 K should be used.

5. Calculating the volume of air

The calculations for the cooling load give the amount of heat that must be removed. The volume of air needed to do this can be calculated using the following formula.

Q = cp x @ x qv x (tu - ti)

Where:

Q	thermal load	W
cp	specific heat	1000 J/kg/K
@	specific gravity	1.2 kg/m ³
qv	volume debit	m ³ /s
tu	temperature return air	°C
ti	temperature supplied air	°C

The return air temperature is higher than room temperature t1.2. The question now is how much air needs to be supplied to achieve the room temperature. For this a more thorough understanding is needed of the temperature gradient in the room.

6. Temperature profile

in the room:

The figure shows a simplified view of the temperature gradient in the room.

Where:

t_i	temperature supplied air	°C
t_o	temperature at ankle height	°C
$t_{1.2}$	temperature at a height of 1.2 m	°C
$t_{1.8}$	temperature at a height of 1.8 m	°C
t_u	temperature return air	°C
H	room height	m

The temperature gradient shown is close to the actual temperature gradient in a room where the thermal load is distributed normally.

If the temperatures t_i , t_o and t_u are known, the total temperature gradient has been determined.

The return temperature is dependent on the thermal load in the room and the volume of supplied air in combination with its temperature, it is NOT dependent on the height of the room. Once the volume of supplied air and its temperature have been determined, the temperature difference between the supply and return temperature has been clearly determined.

The return temperature can be determined using the following formula:

$$Q = cp \times @ \times q_v \times (t_u - t_i)$$

The temperature at ankle height can be estimated by using the following formula:

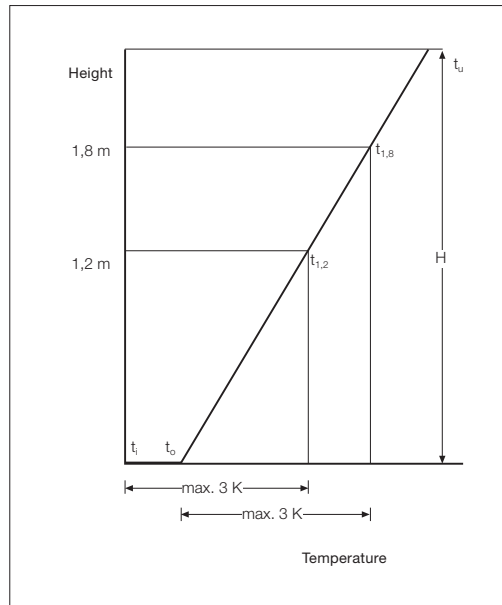
$$t_o = \frac{(2.15 \times t_u + 1200 \times q_v \times t_i)}{(1200 \times q_v + 2.15)}$$

Where:

Q	thermal load	W
c_p	specific heat	1000 J/kg/K
@	specific gravity	1.2 kg/m ³
q_v	volume debit	m ³ /s
t_u	temperature return air	°C
t_i	temperature supplied air	°C
t_o	temperature at ankle height	°C

Using these formulae the following table can be created. To make the table generally useable the thermal load and supply volume are calculated per square metre of floor area.

The temperatures t_o and t_u are given as differences in temperature with respect to the supply temperature.





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Determination of the difference in temperature at floor and ceiling level

Load in W/m ²		10		20		30		40		50		60	
Volume qv		Δto	Δtu	Δto	Δtu	Δto	Δtu	Δto	Δtu	Δto	Δtu	Δto	Δtu
m ³ /s/m ²	m ³ /h/m ²	K	K	K	K	K	K	K	K	K	K	K	K
0,0005	1,8	14,1	16,7	28,2	33,3	42,3	50,0	56,4	66,7	70,5	83,3	84,6	100,0
0,0010	3,6	6,1	8,3	12,2	16,7	18,3	25,0	24,4	33,3	30,6	41,7	36,7	50,0
0,0015	5,4	3,6	5,6	7,2	11,1	10,8	16,7	14,4	22,2	18,0	27,8	21,6	33,0
0,0020	7,2	2,4	4,2	4,8	8,3	7,2	12,5	9,6	16,7	12,1	20,8	14,5	25,0
0,0025	9,0	1,7	3,3	3,5	6,7	5,5	10,0	7,0	13,3	8,7	16,7	10,5	20,0
0,0030	10,8	1,3	2,8	2,7	5,6	4,0	8,3	5,3	11,1	6,6	13,9	8,0	16,7
0,0035	12,6	1,0	2,4	2,1	4,8	3,1	7,1	4,2	9,5	5,2	11,9	6,3	14,3
0,0040	14,4	0,8	2,1	1,7	4,2	2,5	6,3	3,4	8,3	4,2	10,4	5,1	12,5
0,0045	16,2	0,7	1,9	1,4	3,7	2,1	5,6	2,8	7,4	3,5	9,3	4,2	11,1
0,0050	18,0	0,6	1,7	1,2	3,3	1,8	5,0	2,4	6,7	3,0	8,3	3,5	10,0
0,0055	19,8	0,5	1,5	1,0	3,0	1,5	4,5	2,0	6,1	2,5	7,6	3,0	9,1
0,0060	21,6	0,4	1,4	0,9	2,8	1,3	4,2	1,7	5,6	2,2	6,9	2,6	8,3
0,0065	23,4	0,4	1,3	0,8	2,6	1,1	3,8	1,5	5,1	1,9	6,4	2,3	7,7
0,0070	25,2	0,3	1,2	0,7	2,4	1,0	3,6	1,3	4,8	1,7	6,0	2,0	7,1
0,0075	27,0	0,3	1,1	0,6	2,2	0,9	3,3	1,2	4,4	1,6	5,6	1,8	6,7
0,0080	28,8	0,3	1,0	0,5	2,1	0,8	3,1	1,1	4,2	1,3	5,2	1,6	6,2
0,0085	30,6	0,2	1,0	0,5	2,0	0,7	2,9	1,0	3,9	1,2	4,9	1,4	5,9
0,0090	32,4	0,2	0,9	0,4	1,9	0,7	2,8	0,9	3,7	1,1	4,6	1,3	5,6
0,0095	34,2	0,2	0,9	0,4	1,8	0,6	2,6	0,8	3,5	1,0	4,4	1,2	5,3
0,0100	36,0	0,2	0,8	0,4	1,7	0,5	2,5	0,7	3,3	0,9	4,2	1,1	5,0
0,0105	37,8	0,2	0,8	0,3	1,6	0,5	2,4	0,7	3,2	0,8	4,0	1,0	4,8

$$\Delta t_o = t_o - t_i$$

$$\Delta t_u = t_u - t_i$$

Now that the temperatures t_o and t_u have been calculated the other temperatures can be calculated from:

$$t_z = t_i + \Delta t + z/H \times (\Delta t_u - \Delta t_o)$$

The room temperature:

$$t_{1,2} = t_i + \Delta t_o + 1,2/H \times (\Delta t_u - \Delta t_o)$$

where:

H room height in m

z vertical co-ordinate m

The supply temperature can be calculated from the required room temperature. Tables are included on the following pages for a number of room heights to allow quick determination of the room temperatures.

7. Tables for determining the supplied air volume

The following pages contain tables that can be used to quickly and simply estimate the required air volume for both office and production systems. Tables have been made for ceiling heights that regularly occur. The tables contain the room temperature as a function of the power per square metre and the supplied volume per square metre.

Office system

The tables on pages 16 up to and including 21 are intended to be used for comfort installations. The temperature t_s is maintained at 20°C throughout. If another temperature is used all the temperature values shift accordingly. The difference between $t_{1,8}$ and t_o must not exceed 3°C. It is desirable that the difference between $t_{1,2}$ and $t_{1,8}$ does not exceed 3°C. If this occurs the area in which occupants cannot stay for an extended period will increase, for more information see the available documentation. An illustrative example follows:

Room:

height	2.7 m
width	3.6 m
length	5.4 m
thermal load	35 W/m ²
required $t_{1,2}$	23°C

Using the table on page 10:

q_v	0.0050 m/s
t_i	20 °C
t_o	22 °C
$t_{1,2}$	23 °C
$t_{1,8}$	24 °C
t_u	25 °C
volume	350 m ³ /h

Production room

The tables on page 22 up to and including 27 are intended for use for production installations. The temperature t_i is maintained at 17°C everywhere. The maximum allowable differences in temperature are larger than for comfort systems. A difference of 6°C between $t_{1,2}$ and t_i gives satisfactory results.

8. Index of temperature gradient tables

Comfort : $\Delta t=3K$

Room height in metres	Page:
2,4	14
2,7	15
3,0	16
3,3	17
3,6	18
4,2	19

Industry : $\Delta t=6K$

Room height in metres	Page:
3,0	20
4,0	21
5,0	22
6,0	23
8,0	24
10,0	25



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Temperature profile in the room height 2,4 m

Thermal load in W/m ²			5					10					15					20					25					
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	
0,0005	1,8	1	20	27	27	28	28	33	35	36	37																	
0,0010	3,6	2	20	23	23	24	24	25	27	28	28	28	30	31	33	31	34	35	37									
0,0015	5,4	2	20	22	22	22	23	23	24	25	26	25	26	27	28	26	29	30	31	28	31	32	34					
0,0020	7,2	3	20	21	22	22	22	22	23	23	24	23	25	25	26	24	26	27	28	25	28	29	30					
0,0025	9,0	4	20	21	21	21	22	21	22	23	23	22	24	24	25	23	25	26	27	23	26	27	28					
0,0030	10,8	5	20	21	21	21	21	21	22	22	23	22	23	24	24	22	24	25	26	23	25	26	27					
0,0035	12,6	5	20	20	21	21	21	21	22	22	22	21	22	23	24	22	23	24	25	22	24	25	26					
0,0040	14,4	6	20	20	21	21	21	21	21	22	22	21	22	23	23	21	23	23	24	22	23	24	25					
0,0045	16,2	7	20	20	21	21	21	21	21	22	22	21	22	22	23	21	22	23	24	21	23	24	25					
0,0050	18,0	8	20	20	21	21	21	20	21	21	22	21	22	22	23	21	22	23	23	21	23	23	24					
0,0055	19,8	8	20	20	20	21	21	20	21	21	22	21	21	22	22	21	22	22	23	21	22	23	24					
0,0060	21,6	9	20	20	20	21	21	20	21	21	21	20	21	22	22	21	22	22	23	21	22	23	23					
0,0065	23,4	10	20	20	20	21	21	20	21	21	21	20	21	22	22	21	22	22	23	21	22	23	23					
0,0070	25,2	11	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23					
0,0075	27,0	11	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23					
0,0080	28,8	12	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	20	22	22	23					
0,0085	30,6	13	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	22	22	20	21	22	22					
0,0090	32,4	14	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	21	22	20	21	22	22					
0,0095	34,2	14	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	21	22	20	21	22	22					
0,0100	36,0	15	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22					
0,0105	37,8	16	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22					

Thermal load in W/m ²			30					35					40					45					50						
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u		
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	
0,0005	1,8	1	20																										
0,0010	3,6	2	20																										
0,0015	5,4	2	20	29	33	35	37	31	35	37	39																		
0,0020	7,2	3	20	26	29	31	33	27	31	33	35	28	32	34	37	29	34	36	39										
0,0025	9,0	4	20	24	27	29	30	25	28	30	32	26	29	31	33	26	31	33	35	27	32	34	37						
0,0030	10,8	5	20	23	26	27	28	24	27	28	30	24	28	29	31	25	29	31	33	25	30	32	34						
0,0035	12,6	5	20	22	25	26	27	23	26	27	28	23	26	28	30	24	27	29	31	24	28	30	32						
0,0040	14,4	6	20	22	24	25	26	22	25	26	27	23	25	27	28	23	26	28	29	23	27	29	30						
0,0045	16,2	7	20	22	24	25	26	22	24	25	26	22	25	26	27	22	25	27	28	23	26	28	29						
0,0050	18,0	8	20	21	23	24	25	22	24	25	26	22	24	25	27	22	25	26	28	22	25	27	28						
0,0055	19,8	8	20	21	23	24	25	21	23	24	25	21	24	25	26	22	24	26	27	22	25	26	28						
0,0060	21,6	9	20	21	23	23	24	21	23	24	25	21	23	24	26	21	24	25	26	22	24	26	27						
0,0065	23,4	10	20	21	22	23	24	21	23	24	24	21	23	24	25	21	24	25	26	21	24	25	26						
0,0070	25,2	11	20	21	22	23	24	21	23	23	24	21	23	24	25	21	23	24	25	21	24	25	26						
0,0075	27,0	11	20	21	22	23	23	21	22	23	24	21	23	24	24	21	23	24	25	21	23	24	26						
0,0080	28,8	12	20	21	22	22	23	21	22	23	24	21	22	23	24	21	23	24	25	21	23	24	25						
0,0085	30,6	13	20	21	22	22	23	21	22	23	23	21	22	23	24	21	23	24	24	21	23	24	25						
0,0090	32,4	14	20	20	22	22	23	21	22	23	23	21	22	23	24	21	22	23	24	21	23	24	25						
0,0095	34,2	14	20	20	22	22	23	20	22	22	23	21	22	23	24	21	22	23	24	21	23	23	24						
0,0100	36,0	15	20	20	21	22	23	20	22	22	23	21	22	23	23	21	22	23	24	21	22	23	24						
0,0105	37,8	16	20	20	21	22	22	20	22	22	23	20	22	22	23	21	22	23	24	21	22	23	24						

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C

- Displacement ventilation
- Comfort: $\Delta t=3K$

Temperature profile in the room height 2,7 m

Thermal load in W/m ²			5					10					15					20					25						
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u		
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	
0,0005	1,8	1	20	27	27	28	28	33	35	35	37																		
0,0010	3,6	1	20	23	23	24	24	25	27	27	28	28	30	31	33	31	33	35	37										
0,0015	5,4	2	20	22	22	22	23	23	24	25	26	25	26	27	28	26	29	30	31	28	30	32	34						
0,0020	7,2	3	20	21	21	22	22	22	23	23	24	23	25	25	26	24	26	27	28	25	27	29	30						
0,0025	9,0	3	20	21	21	21	22	21	22	23	23	22	23	24	25	23	25	26	27	23	26	27	28						
0,0030	10,8	4	20	21	21	21	21	21	22	22	23	22	23	23	24	22	24	25	26	23	25	25	27						
0,0035	12,6	5	20	20	21	21	21	21	22	22	22	21	22	23	24	22	23	24	25	22	24	25	26						
0,0040	14,4	5	20	20	21	21	21	21	21	22	22	21	22	23	23	21	23	23	24	22	23	24	25						
0,0045	16,2	6	20	20	21	21	21	21	21	21	22	21	22	22	23	21	22	23	24	21	23	24	25						
0,0050	18,0	7	20	20	20	21	21	20	21	21	22	21	22	22	23	21	22	23	23	21	22	23	24						
0,0055	19,8	7	20	20	20	21	21	20	21	21	22	21	21	22	22	21	22	22	23	21	22	23	24						
0,0060	21,6	8	20	20	20	21	21	20	21	21	21	20	21	22	22	21	22	22	23	21	22	23	23						
0,0065	23,4	9	20	20	20	20	21	20	21	21	21	20	21	22	22	21	21	22	23	21	22	23	23						
0,0070	25,2	9	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23						
0,0075	27,0	10	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23						
0,0080	28,8	11	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	20	21	22	23						
0,0085	30,6	11	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	22	22	20	21	22	22						
0,0090	32,4	12	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22						
0,0095	34,2	13	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22						
0,0100	36,0	13	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22						
0,0105	37,8	14	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22						

Thermal load in W/m ²			30					35					40					45					50						
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u		
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	
0,0005	1,8	1	20																										
0,0010	3,6	1	20																										
0,0015	5,4	2	20	29	32	34	37	31	35	36	39																		
0,0020	7,2	3	20	26	29	30	33	27	30	32	35	28	32	34	37	29	33	35	39										
0,0025	9,0	3	20	24	27	28	30	25	28	29	32	26	19	31	33	26	30	32	35	27	31	33	37						
0,0030	10,8	4	20	23	25	27	28	24	26	28	30	24	27	29	31	25	28	30	33	25	29	31	34						
0,0035	12,6	5	20	22	25	26	27	23	25	26	28	23	26	27	30	24	27	28	31	24	28	29	32						
0,0040	14,4	5	20	22	24	25	26	22	24	26	27	23	25	26	28	23	26	27	29	23	26	28	30						
0,0045	16,2	6	20	22	23	24	26	22	24	25	26	22	24	26	27	22	25	26	28	23	26	27	29						
0,0050	18,0	7	20	21	23	24	25	22	23	24	26	22	24	25	27	22	24	26	28	22	25	26	28						
0,0055	19,8	7	20	21	23	23	25	21	23	24	25	21	24	25	26	22	24	25	27	22	24	26	28						
0,0060	21,6	8	20	21	22	23	24	21	23	24	25	21	23	24	26	21	24	25	26	22	24	25	27						
0,0065	23,4	9	20	21	22	23	24	21	23	23	24	21	23	24	25	21	23	24	26	21	23	24	26						
0,0070	25,2	9	20	21	22	23	24	21	22	23	24	21	23	23	25	21	23	24	25	21	23	24	26						
0,0075	27,0	10	20	21	22	22	23	21	22	23	24	21	22	23	24	21	23	24	25	21	23	24	25						
0,0080	28,8	11	20	21	22	22	23	21	22	23	24	21	22	23	24	21	23	23	25	21	23	24	25						
0,0085	30,6	11	20	21	22	22	23	21	22	22	23	21	22	23	24	21	23	24	25	21	23	24	25						
0,0090	32,4	12	20	20	21	22	23	21	22	22	23	21	22	23	24	21	22	23	24	21	22	23	25						
0,0095	34,3	13	20	20	21	22	23	21	22	22	23	21	22	23	24	21	22	23	24	21	23	23	24						
0,0100	36,0	13	20	20	21	22	23	21	22	22	23	21	22	23	23	21	22	23	24	21	22	23	24						
0,0105	37,8	14	20	20	21	22	22	20	21	22	23	20	22	22	23	21	22	23	24	21	22	23	24						

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C



- ▶ Displacement ventilation
- ▶ Comfort: $\Delta t=3K$

Temperature profile in the room height 3,0 m

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Thermal load in W/m ²			5					10					15					20					25					
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	1	20	27	27	28	28	33	34	35	37																	
0,0010	3,6	1	20	23	23	24	24	25	27	27	28	28	30	31	33	31	33	34	37									
0,0015	5,4	2	20	22	22	23	23	24	25	26	25	25	26	27	28	26	28	29	31	28	30	31	34					
0,0020	7,2	2	20	21	21	22	22	22	23	23	24	23	24	25	26	24	26	27	28	25	27	28	30					
0,0025	9,0	3	20	21	21	21	22	21	22	23	23	22	23	24	25	23	24	25	27	23	25	26	28					
0,0030	10,8	4	20	21	21	21	21	21	22	22	23	22	23	23	24	22	23	24	26	23	24	25	27					
0,0035	12,6	4	20	20	21	21	21	21	21	22	22	21	22	23	24	22	23	24	25	22	24	24	26					
0,0040	14,4	5	20	20	21	21	21	21	21	22	22	21	22	22	23	21	22	23	24	22	23	24	25					
0,0045	16,2	5	20	20	21	21	21	21	21	21	22	21	22	22	23	21	22	23	24	21	23	23	25					
0,0050	18,0	6	20	20	20	21	21	20	21	21	22	21	21	22	23	21	22	22	23	21	22	23	24					
0,0055	19,8	7	20	20	20	21	21	20	21	21	22	21	21	22	22	21	22	22	23	21	22	23	24					
0,0060	21,6	7	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23					
0,0065	23,4	8	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23					
0,0070	25,2	8	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23					
0,0075	27,0	9	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	21	22	23					
0,0080	28,8	10	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	21	22	20	21	22	23					
0,0085	30,6	10	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	21	22	20	21	22	22					
0,0090	32,4	11	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22					
0,0095	34,2	11	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22					
0,0100	36,0	12	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22					
0,0105	37,8	13	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22					

Thermal load in W/m ²			30					35					40					45					50					
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	1	20																									
0,0010	3,6	1	20																									
0,0015	5,4	2	20	29	32	34	37	31	34	36	39																	
0,0020	7,2	2	20	26	29	30	33	27	30	32	35	28	31	33	37	29	33	35	39									
0,0025	9,0	3	20	24	27	28	30	25	28	29	32	26	29	30	33	26	30	32	35	27	31	33	37					
0,0030	10,8	4	20	23	25	26	28	24	26	27	30	24	27	28	31	25	28	29	33	25	29	30	34					
0,0035	12,6	4	20	22	24	25	27	23	25	26	28	23	26	27	30	24	26	28	31	24	27	29	32					
0,0040	14,4	5	20	22	24	25	26	22	24	25	27	23	25	26	28	23	25	27	29	23	26	28	30					
0,0045	16,2	5	20	22	23	24	26	22	24	25	26	22	24	25	27	22	25	26	28	23	25	27	29					
0,0050	18,0	6	20	21	23	24	25	22	23	24	26	22	24	25	27	22	24	25	28	22	25	26	28					
0,0055	19,8	7	20	21	22	23	25	21	23	24	25	21	23	24	26	22	24	25	27	22	24	25	28					
0,0060	21,6	7	20	21	22	23	24	21	23	23	25	21	23	24	26	21	23	24	26	22	24	25	27					
0,0065	23,4	8	20	21	22	23	24	21	22	23	24	21	23	24	25	21	23	24	26	21	23	24	26					
0,0070	25,2	8	20	21	22	22	24	21	22	23	24	21	22	23	25	21	23	24	25	21	23	24	26					
0,0075	27,0	9	20	21	22	22	23	21	22	23	24	21	22	23	24	21	23	23	25	21	23	24	26					
0,0080	28,8	10	20	21	22	22	23	21	22	22	24	21	22	23	24	21	22	23	25	21	23	24	25					
0,0085	30,6	10	20	21	21	22	23	21	22	22	23	21	22	23	24	21	22	23	24	21	22	23	25					
0,0090	32,4	11	20	20	21	22	23	21	22	22	23	21	22	22	24	21	22	23	24	21	22	23	25					
0,0095	34,2	11	20	20	21	22	23	20	22	22	23	21	22	22	24	21	22	23	24	21	22	23	24					
0,0100	36,0	12	20	20	21	22	23	20	21	22	23	21	22	22	23	21	22	22	24	21	22	23	24					
0,0105	37,8	13	20	20	21	22	22	20	21	22	23	20	22	22	23	21	22	22	24	21	22	23	24					

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C

► Displacement ventilation

► Comfort: $\Delta t=3K$

Temperature profile in the room height 3,3 m

Thermal load in W/m ²			5					10					15					20					25				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u				
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C			
0,0005	1,8	1	20	27	27	28	28	33	34	35	37																
0,0010	3,6	1	20	23	23	24	24	25	27	27	28	28	30	31	33	31	33	34	37								
0,0015	5,4	2	20	22	22	23	23	24	25	26	25	25	26	27	28	26	28	29	31	28	30	31	34				
0,0020	7,2	2	20	21	21	22	22	22	23	23	24	23	24	25	26	24	26	27	28	25	27	28	30				
0,0025	9,0	3	20	21	21	21	22	21	22	23	23	22	23	24	25	23	24	25	27	23	25	26	28				
0,0030	10,8	3	20	21	21	21	21	22	22	23	22	22	23	23	24	22	23	24	26	23	24	25	27				
0,0035	12,6	4	20	20	21	21	21	21	21	22	22	21	22	23	24	22	23	24	25	22	24	24	26				
0,0040	14,4	4	20	20	21	21	21	21	21	22	22	21	22	22	23	21	22	23	24	22	23	24	25				
0,0045	16,2	5	20	20	21	21	21	21	21	21	22	21	22	22	23	21	22	23	24	21	23	23	25				
0,0050	18,0	5	20	20	20	21	21	20	21	21	22	21	21	22	23	21	22	22	23	21	22	23	24				
0,0055	19,8	6	20	20	20	21	21	20	21	21	22	21	21	22	22	21	22	22	23	21	22	23	24				
0,0060	21,6	7	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23				
0,0065	23,4	7	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23				
0,0070	25,2	8	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23				
0,0075	27,0	8	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	21	22	23				
0,0080	28,8	9	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	21	22	20	21	22	23				
0,0085	30,6	9	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	21	22	20	21	22	22				
0,0090	32,4	10	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22				
0,0095	34,2	10	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0100	36,0	11	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0105	37,8	11	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				

Thermal load in W/m ²			30					35					40					45					50				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u				
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C			
0,0005	1,8	1	20																								
0,0010	3,6	1	20																								
0,0015	5,4	2	20	29	32	34	37	31	34	35	39																
0,0020	7,2	2	20	26	29	30	33	27	30	32	35	28	31	33	37	29	32	34	39								
0,0025	9,0	3	20	24	27	28	30	25	28	29	32	26	29	30	33	26	29	31	35	27	30	32	37				
0,0030	10,8	3	20	23	25	26	28	24	26	27	30	24	27	28	31	25	28	29	33	25	28	30	34				
0,0035	12,6	4	20	22	24	25	27	23	25	26	28	23	26	27	30	24	26	28	31	24	27	28	32				
0,0040	14,4	4	20	22	24	25	26	22	24	25	27	23	25	26	28	23	25	27	29	23	26	27	30				
0,0045	16,2	5	20	22	23	24	26	22	24	25	26	22	24	25	27	22	25	26	28	23	25	26	29				
0,0050	18,0	5	20	21	23	24	25	22	23	24	26	22	24	25	27	22	24	25	28	22	25	26	28				
0,0055	19,8	6	20	21	22	23	25	21	23	24	25	21	23	24	26	22	24	25	27	22	24	25	28				
0,0060	21,6	7	20	21	22	23	24	21	23	23	25	21	23	24	26	21	23	24	26	22	24	25	27				
0,0065	23,4	7	20	21	22	23	24	21	22	23	24	21	23	24	25	21	23	24	26	21	23	24	26				
0,0070	25,2	8	20	21	22	22	24	21	22	23	24	21	22	23	25	21	23	24	25	21	23	24	26				
0,0075	27,0	8	20	21	22	22	23	21	22	23	24	21	22	23	24	21	23	23	25	21	23	24	26				
0,0080	28,8	9	20	21	22	22	23	21	22	22	24	21	22	23	24	21	22	23	25	21	23	24	25				
0,0085	30,6	9	20	21	21	22	23	21	22	22	23	21	22	23	24	21	22	23	24	21	22	23	25				
0,0090	32,4	10	20	20	21	22	23	21	22	22	23	21	22	22	24	21	22	23	24	21	22	23	25				
0,0095	34,2	10	20	20	21	22	23	20	22	22	23	21	22	22	24	21	22	23	24	21	22	23	24				
0,0100	36,0	11	20	20	21	22	23	20	21	22	23	21	22	22	23	21	22	22	24	21	22	23	24				
0,0105	37,8	11	20	20	21	22	22	20	21	22	23	20	22	22	23	21	22	22	24	21	22	22	24				

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C



- ▶ Displacement ventilation
- ▶ Comfort: $\Delta t=3K$

Temperature profile in the room height 3,6 m

Thermal load in W/m ²			5					10					15					20					25				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u				
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C				
0,0005	1,8	1	20	27	27	28	28	33	34	35	37																
0,0010	3,6	1	20	23	23	23	24	25	27	27	28	28	30	31	33	31	33	34	37								
0,0015	5,4	2	20	22	22	23	23	24	25	26	25	25	26	27	28	26	28	29	31	28	30	31	34				
0,0020	7,2	2	20	21	21	22	22	22	23	23	24	23	24	25	26	24	26	27	28	25	27	28	30				
0,0025	9,0	3	20	21	21	21	22	21	22	23	23	22	23	24	25	23	24	25	27	23	25	26	28				
0,0030	10,8	3	20	21	21	21	21	22	22	23	23	22	23	23	24	22	23	24	26	23	24	25	27				
0,0035	12,6	4	20	20	21	21	21	21	21	22	22	21	22	23	24	22	23	24	25	22	24	24	26				
0,0040	14,4	4	20	20	21	21	21	21	21	22	22	21	22	22	23	21	22	23	24	22	23	24	25				
0,0045	16,2	5	20	20	21	21	21	21	21	21	22	21	22	22	23	21	22	23	24	21	23	23	25				
0,0050	18,0	5	20	20	20	21	21	20	21	21	22	21	21	22	23	21	22	22	23	21	22	23	24				
0,0055	19,8	6	20	20	20	21	21	20	21	21	22	21	21	22	22	21	22	22	23	21	22	23	24				
0,0060	21,6	6	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23				
0,0065	23,4	7	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23				
0,0070	25,2	7	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	22	22	23				
0,0075	27,0	8	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	21	22	23				
0,0080	28,8	8	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	21	22	20	21	22	23				
0,0085	30,6	9	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	21	22	20	21	22	22				
0,0090	32,4	9	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	22	22				
0,0095	34,2	10	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0100	36,0	10	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0105	37,8	11	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				

Thermal load in W/m ²			30					35					40					45					50				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u				
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C			
0,0005	1,8	1	20																								
0,0010	3,6	1	20																								
0,0015	5,4	2	20	29	32	33	37	31	34	35	39																
0,0020	7,2	2	20	26	29	30	33	27	30	32	35	28	31	33	37	29	33	34	39								
0,0025	9,0	3	20	24	27	28	30	25	28	29	32	26	29	30	33	26	30	32	35	27	30	32	37				
0,0030	10,8	3	20	23	25	26	28	24	26	27	30	24	27	28	31	25	28	29	33	25	28	30	34				
0,0035	12,6	4	20	22	24	25	27	23	25	26	28	23	26	27	30	24	26	28	31	24	27	28	32				
0,0040	14,4	4	20	22	24	25	26	22	24	25	27	23	25	26	28	23	25	27	29	23	26	27	30				
0,0045	16,2	5	20	22	23	24	26	22	24	25	26	22	24	25	27	22	25	26	28	23	25	26	29				
0,0050	18,0	5	20	21	23	24	25	22	23	24	26	22	24	25	27	22	24	25	28	22	24	25	28				
0,0055	19,8	6	20	21	22	23	25	21	23	24	25	21	23	24	26	22	24	24	27	22	24	25	28				
0,0060	21,6	6	20	21	22	23	24	21	23	23	25	21	23	24	26	21	23	24	26	22	24	25	27				
0,0065	23,4	7	20	21	22	23	24	21	22	23	24	21	23	24	25	21	23	24	26	21	23	24	26				
0,0070	25,2	7	20	21	22	22	24	21	22	23	24	21	22	23	25	21	23	24	25	21	23	24	26				
0,0075	27,0	8	20	21	22	22	23	21	22	23	24	21	22	23	24	21	23	23	25	21	23	24	26				
0,0080	28,8	8	20	21	22	22	23	21	22	22	23	21	22	23	24	21	22	23	24	21	22	23	25				
0,0085	30,6	9	20	21	21	22	23	21	22	22	23	21	22	23	24	21	22	23	24	21	22	23	25				
0,0090	32,4	9	20	20	21	22	23	21	22	22	23	21	22	22	24	21	22	23	24	21	22	23	25				
0,0095	34,2	10	20	20	21	22	23	20	22	22	23	21	22	22	24	21	22	23	24	21	22	23	24				
0,0100	36,0	10	20	20	21	22	23	20	21	22	23	21	22	22	23	21	22	22	24	21	22	22	24				
0,0105	37,8	11	20	20	21	22	22	20	21	22	23	20	22	22	23	21	22	22	24	21	22	22	24				

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C

► Displacement ventilation

► Comfort: $\Delta t=3K$

Temperature profile in the room height 4,2 m

Thermal load in W/m ²			5					10					15					20					25				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u				
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C				
0,0005	1,8	0	20	27	27	27	28	33	34	35	37																
0,0010	3,6	1	20	23	23	23	24	25	27	27	28	28	30	31	33	31	33	34	37								
0,0015	5,4	1	20	22	22	23	23	24	25	26	25	25	26	27	28	26	28	29	31	28	29	30	34				
0,0020	7,2	2	20	21	21	22	22	22	23	23	24	23	24	25	26	24	26	27	28	25	26	27	30				
0,0025	9,0	2	20	21	21	21	22	21	22	23	23	22	23	23	26	23	24	25	27	23	25	26	28				
0,0030	10,8	3	20	21	21	21	21	21	22	22	23	22	23	23	24	22	23	24	26	23	24	24	27				
0,0035	12,6	3	20	20	21	21	21	21	21	22	22	21	22	23	24	22	23	24	25	22	24	24	26				
0,0040	14,4	3	20	20	21	21	21	21	21	22	22	21	22	22	23	21	22	23	24	22	23	24	25				
0,0045	16,2	4	20	20	21	21	21	21	21	21	22	21	22	22	23	21	22	23	24	21	22	23	25				
0,0050	18,0	4	20	20	20	21	21	20	21	21	22	21	21	22	23	21	22	22	23	21	22	22	24				
0,0055	19,8	5	20	20	20	21	21	20	21	21	22	21	21	22	22	21	22	22	23	21	22	22	24				
0,0060	21,6	5	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	22	22	23				
0,0065	23,4	6	20	20	20	20	21	20	21	21	21	20	21	21	22	21	21	22	23	21	21	22	23				
0,0070	25,2	6	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	21	21	22	23				
0,0075	27,0	6	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	22	22	20	21	21	23				
0,0080	28,8	7	20	20	20	20	21	20	21	21	21	20	21	21	22	20	21	21	22	20	21	21	23				
0,0085	30,6	7	20	20	20	20	20	20	21	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0090	32,4	8	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0095	34,2	8	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0100	36,0	9	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				
0,0105	37,8	9	20	20	20	20	20	20	20	21	21	20	21	21	21	20	21	21	22	20	21	21	22				

Thermal load in W/m ²			30					35					40					45					50				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u				
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C				
0,0005	1,8	0	20																								
0,0010	3,6	1	20																								
0,0015	5,4	1	20	29	31	32	37	31	33	34	39																
0,0020	7,2	2	20	26	28	29	33	27	29	30	35	28	30	32	37	29	32	33	39								
0,0025	9,0	2	20	24	26	27	30	25	27	28	32	26	28	29	33	26	29	30	35	27	30	31	37				
0,0030	10,8	3	20	23	25	25	28	24	25	26	30	24	26	27	31	25	27	28	33	25	28	29	34				
0,0035	12,6	3	20	22	24	24	27	23	24	25	28	23	25	26	30	24	6	27	31	24	26	28	32				
0,0040	14,4	3	20	22	23	24	26	22	24	24	27	23	24	25	28	23	25	26	29	23	25	26	30				
0,0045	16,2	4	20	22	23	23	26	22	23	24	26	22	24	24	27	22	24	25	28	23	25	25	29				
0,0050	18,0	4	20	21	22	23	25	22	23	23	26	22	23	24	27	22	24	24	28	22	24	25	28				
0,0055	19,8	5	20	21	22	23	25	21	23	24	25	21	23	23	26	22	23	24	27	22	23	25	28				
0,0060	21,6	5	20	21	22	22	24	21	22	23	24	21	22	23	26	21	23	23	26	22	23	25	27				
0,0065	23,4	6	20	21	22	22	24	21	22	22	24	21	22	23	25	21	23	23	26	21	23	24	26				
0,0070	25,2	6	20	21	22	22	24	21	22	22	24	21	22	23	25	21	22	23	25	21	23	24	26				
0,0075	27,0	6	20	21	21	22	23	21	22	22	24	21	22	22	24	21	22	23	25	21	22	24	26				
0,0080	28,8	7	20	21	22	22	23	21	22	22	24	21	22	23	24	21	22	22	25	21	22	24	25				
0,0085	30,6	7	20	21	21	22	23	21	21	22	23	21	22	23	24	21	22	23	24	21	22	23	25				
0,0090	32,4	8	20	20	21	21	23	21	21	22	23	21	21	22	24	21	22	22	24	21	22	22	25				
0,0095	34,2	8	20	20	21	21	23	20	21	22	23	21	21	22	24	21	22	22	24	21	22	22	24				
0,0100	36,0	9	20	20	21	21	23	20	21	22	23	21	21	22	23	21	21	22	24	21	22	22	24				
0,0105	37,8	9	20	20	21	21	22	20	21	21	23	20	21	22	23	21	21	22	24	21	22	22	24				

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C



- ▶ Displacement ventilation
- ▶ Industrial: $\Delta t=6K$

Temperature profile in the room height 3,0 m

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Thermal load in W/m ²			20				40				60				80				100				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	1	17	43	46	47	50																
0,0010	3,6	1	17	28	30	31	34	38	43	46	50												
0,0015	5,4	2	17	23	25	26	28	29	33	35	39	35	41	44	50								
0,0020	7,2	2	17	21	23	24	25	28	30	34	29	34	37	42	33	40	43	50					
0,0025	9,0	3	17	20	21	22	24	23	26	27	30	25	30	32	37	28	34	37	44	31	39	43	50
0,0030	10,8	4	17	19	20	21	23	21	24	25	28	23	27	29	34	25	31	34	39	27	34	38	45
0,0035	12,6	4	17	19	20	21	22	20	23	24	27	22	26	28	31	23	28	31	36	25	31	35	41
0,0040	14,4	5	17	18	19	20	21	20	22	23	25	21	24	26	30	22	27	29	34	23	29	32	38
0,0045	16,2	5	17	18	19	20	21	19	21	22	24	20	23	25	28	21	25	28	32	22	28	30	36
0,0050	18,0	6	17	18	19	19	20	19	21	22	24	20	23	24	27	21	24	26	30	21	26	29	34
0,0055	19,8	7	17	18	19	19	20	18	20	21	23	19	22	23	26	20	24	25	29	21	25	28	32
0,0060	21,6	7	17	18	18	19	20	18	20	21	23	19	21	23	25	20	23	25	28	20	24	27	31
0,0065	23,4	8	17	18	18	19	20	18	20	21	22	19	21	22	25	19	22	24	27	20	24	26	30
0,0070	25,2	8	17	17	18	19	19	18	19	20	22	18	21	22	24	19	22	23	27	19	23	25	29
0,0075	27,0	9	17	17	18	19	19	18	19	20	21	18	20	22	24	19	22	23	26	19	23	25	28
0,0080	28,8	10	17	17	18	18	19	18	19	20	21	18	20	21	23	19	21	23	25	19	22	24	27
0,0085	30,6	10	17	17	18	18	19	18	19	20	21	18	20	21	23	18	21	22	25	19	22	24	27
0,0090	32,4	11	17	17	18	18	19	18	19	19	21	18	20	21	23	18	21	22	24	19	22	23	26
0,0095	34,2	11	17	17	18	18	19	18	19	19	21	18	20	20	22	18	20	22	24	18	21	23	26
0,0100	36,0	12	17	17	18	18	18	19	18	19	19	20	18	19	20	22	18	20	21	24	18	21	23
0,0105	37,8	13	17	17	18	18	19	17	19	19	20	118	19	20	22	18	20	21	23	18	21	22	25

Thermal load in W/m ²			120				140				160				180				200				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	1	17																				
0,0010	3,6	1	17																				
0,0015	5,4	2	17																				
0,0020	7,2	2	17																				
0,0025	9,0	3	17																				
0,0030	10,8	4	17	29	38	42	50																
0,0035	12,6	4	17	27	34	38	46	28	37	42	50												
0,0040	14,4	5	17	25	32	35	42	26	34	38	46	27	37	41	50								
0,0045	16,2	5	17	23	30	33	39	24	32	36	43	25	34	38	47	26	36	41	50				
0,0050	18,0	6	17	22	28	31	37	23	30	33	40	24	32	36	44	25	34	38	47	26	36	41	50
0,0055	19,8	7	17	21	27	30	35	22	29	32	38	23	30	34	41	24	32	36	44	24	34	38	47
0,0060	21,6	7	17	21	26	29	34	21	27	30	36	22	29	32	39	23	30	34	42	23	32	36	45
0,0065	23,4	8	17	20	25	28	32	21	27	29	35	21	28	31	38	22	29	33	40	23	31	35	43
0,0070	25,2	8	17	20	24	27	31	20	26	28	34	21	27	30	36	21	28	32	38	22	29	33	41
0,0075	27,0	9	17	20	24	26	30	20	25	28	33	20	26	29	35	21	27	31	37	21	28	32	39
0,0080	28,8	10	17	19	23	25	29	20	24	27	32	20	25	28	34	20	27	30	36	21	28	31	38
0,0085	30,6	10	17	19	23	25	29	19	24	26	31	20	25	28	33	20	26	29	35	20	27	30	37
0,0090	32,4	11	17	19	23	24	28	19	23	26	30	19	24	27	32	20	25	28	34	20	26	29	36
0,0095	34,2	11	17	19	22	24	28	19	23	25	29	19	24	26	31	20	25	27	33	20	26	29	35
0,0100	36,0	12	17	19	22	24	27	19	23	25	29	19	24	26	30	19	24	27	32	20	25	28	34
0,0105	37,8	13	17	18	22	23	27	19	22	24	28	19	23	25	30	19	24	26	31	19	25	27	33

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C

► Displacement ventilation

► Industrial: $\Delta t=6K$

Temperature profile in the room height 4,0 m

Thermal load in W/m ²			20				40				60				80				100				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17	43	45	36	50																
0,0010	3,6	1	17	28	29	30	34	38	42	44	50												
0,0015	5,4	1	17	23	25	25	28	29	32	34	39	35	40	42	50								
0,0020	7,2	2	17	21	22	23	25	25	28	29	34	29	33	35	42	33	38	41	50				
0,0025	9,0	2	17	20	21	22	24	23	25	26	30	25	29	31	37	28	33	35	44	31	37	40	50
0,0030	10,8	3	17	19	20	21	23	21	23	24	28	23	26	28	34	25	29	32	39	27	33	35	45
0,0035	12,6	3	17	19	20	20	22	20	22	23	27	22	25	26	31	23	27	29	36	25	30	32	41
0,0040	14,4	4	17	18	19	20	21	20	21	22	25	21	23	25	30	22	26	27	34	23	28	30	38
0,0045	16,2	4	17	18	19	19	21	19	21	21	24	20	23	24	28	21	24	26	32	22	26	28	36
0,0050	18,0	5	17	18	19	19	20	19	20	21	24	20	22	23	27	21	23	25	30	21	25	27	34
0,0055	19,8	5	17	18	18	19	20	18	20	21	23	19	21	22	26	20	23	24	29	21	24	26	32
0,0060	21,6	5	17	18	18	19	20	18	20	20	23	29	21	22	25	20	22	23	28	20	23	25	31
0,0065	23,4	6	17	18	18	18	20	18	19	20	22	19	20	21	25	29	22	23	27	20	23	24	30
0,0070	25,2	6	17	17	18	18	19	18	19	20	22	18	20	21	24	19	21	22	27	19	22	24	29
0,0075	27,0	7	17	17	18	18	19	18	19	19	21	18	20	21	24	19	21	22	26	19	22	23	28
0,0080	28,8	7	17	17	18	18	19	18	19	19	21	18	20	20	23	19	21	22	25	19	21	23	27
0,0085	30,6	8	17	17	18	18	19	18	19	19	21	18	19	20	23	18	20	21	25	19	21	22	27
0,0090	32,4	8	17	17	18	18	19	18	19	19	21	18	19	20	23	18	20	21	24	19	21	22	26
0,0095	34,2	9	17	17	18	18	19	18	18	19	21	18	19	20	22	18	20	21	24	18	21	22	26
0,0100	36,0	9	17	17	18	18	19	18	18	19	21	18	19	20	22	18	20	21	24	18	20	21	25
0,0105	37,8	9	17	17	18	18	19	17	18	19	20	18	19	20	22	18	20	20	23	18	20	21	25

Thermal load in W/m ²			120				140				160				180				200				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17																				
0,0010	3,6	1	17																				
0,0015	5,4	1	17																				
0,0020	7,2	2	17																				
0,0025	9,0	2	17																				
0,0030	10,8	3	17	29	36	39	50																
0,0035	12,6	3	17	27	32	35	46	28	35	38	50												
0,0040	14,4	4	17	25	30	33	42	26	32	35	46	27	34	38	50								
0,0045	16,2	4	17	23	28	30	39	24	30	33	43	25	32	35	47	26	34	37	50				
0,0050	18,0	5	17	22	27	29	37	23	28	31	40	24	30	33	44	25	32	35	47	26	33	37	50
0,0055	19,8	5	17	21	26	28	35	22	27	29	38	23	28	31	41	24	30	33	44	24	31	35	47
0,0060	21,6	5	17	21	25	27	34	21	26	28	36	22	27	30	39	23	29	31	42	23	30	33	45
0,0065	23,4	6	17	20	24	26	32	21	25	27	35	21	26	29	38	22	27	30	40	23	29	32	43
0,0070	25,2	6	17	20	23	25	31	20	24	26	34	21	25	28	36	21	26	29	38	22	28	30	41
0,0075	27,0	7	17	20	23	24	30	20	24	26	33	20	25	27	35	21	26	28	37	21	27	29	39
0,0080	28,8	7	17	19	22	24	29	20	23	25	32	20	24	26	34	20	25	27	36	21	26	28	38
0,0085	30,6	8	17	19	22	23	29	19	23	24	31	20	24	26	33	20	24	27	35	20	25	28	37
0,0090	32,4	8	17	19	22	23	28	19	22	24	30	19	23	25	32	20	24	26	34	20	25	27	36
0,0095	34,2	9	17	19	21	23	28	19	22	24	29	19	23	25	31	20	23	25	33	20	24	26	35
0,0100	36,0	9	17	19	21	22	27	19	22	23	29	19	22	24	30	19	23	25	32	20	24	26	34
0,0105	37,8	9	17	18	21	22	27	19	21	23	28	19	22	24	30	19	23	25	31	19	23	25	33

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C



- ▶ Displacement ventilation
- ▶ Industrial: $\Delta t=6K$

Temperature profile in the room height 5,0 m

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Thermal load in W/m ²			20				40				60				80				100				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17	43	45	46	50																
0,0010	3,6	1	17	28	29	30	34	38	41	43	50												
0,0015	5,4	1	17	23	24	25	28	29	32	33	39	35	39	41	50								
0,0020	7,2	1	17	21	22	23	25	25	27	28	34	29	32	34	42	33	37	39	50				
0,0025	9,0	2	17	20	21	21	24	23	24	25	30	25	28	30	37	28	32	34	44	31	36	38	50
0,0030	10,8	2	17	19	20	20	23	21	23	24	28	23	26	27	34	25	29	30	39	27	32	34	45
0,0035	12,6	3	17	19	19	20	22	20	22	22	27	22	24	25	31	23	26	28	36	25	29	31	41
0,0040	14,4	3	17	18	19	19	21	20	21	22	25	21	23	24	30	22	25	26	34	23	27	29	38
0,0045	16,2	3	17	18	19	19	21	19	20	21	24	20	22	23	28	21	24	25	32	22	25	27	36
0,0050	18,0	4	17	18	18	19	20	19	20	21	24	20	21	22	27	21	23	24	30	21	24	26	34
0,0055	19,8	4	17	18	18	19	20	18	20	20	23	19	21	22	26	20	22	23	29	21	23	25	32
0,0060	21,6	4	17	18	18	18	20	18	19	20	23	19	20	21	25	20	22	23	28	20	23	24	31
0,0065	23,4	5	17	18	18	18	20	18	19	20	22	19	20	21	25	19	21	22	27	20	22	23	30
0,0070	25,2	5	17	17	18	18	19	18	19	19	22	18	19	21	24	19	21	22	27	19	22	23	29
0,0075	27,0	5	17	17	18	18	19	18	19	19	21	18	19	20	24	19	20	21	26	19	21	22	28
0,0080	28,8	6	17	17	18	18	19	18	19	19	21	18	19	20	23	19	20	21	25	19	21	22	27
0,0085	30,6	6	17	17	18	18	19	18	18	19	21	18	19	20	23	18	20	21	25	19	21	22	27
0,0090	32,4	6	17	17	18	18	19	18	18	19	21	18	19	20	23	18	20	20	24	19	20	21	26
0,0095	34,2	7	17	17	18	18	19	18	18	19	21	18	19	19	22	18	20	20	24	18	20	21	26
0,0100	36,0	7	17	17	18	18	19	18	18	19	20	18	19	19	22	18	19	20	24	18	20	21	25
0,0105	37,8	8	17	17	18	18	19	17	18	18	20	18	19	19	22	18	19	20	23	18	20	21	25

Thermal load in W/m ²			120				140				160				180				200				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17																				
0,0010	3,6	1	17																				
0,0015	5,4	1	17																				
0,0020	7,2	1	17																				
0,0025	9,0	2	17																				
0,0030	10,8	2	17	29	34	37	50																
0,0035	12,6	3	17	27	31	33	46	28	34	36	50												
0,0040	14,4	3	17	25	29	31	42	26	31	33	46	27	33	36	50								
0,0045	16,2	3	17	23	27	29	39	24	29	31	43	25	31	33	47	26	32	35	50				
0,0050	18,0	4	17	22	26	28	37	23	27	29	40	24	29	31	44	25	30	33	47	26	32	35	50
0,0055	19,8	4	17	21	25	26	35	22	26	28	38	23	27	30	41	24	29	31	44	24	30	33	47
0,0060	21,6	4	17	21	24	25	34	21	25	27	36	22	26	28	39	23	27	30	42	23	29	31	45
0,0065	23,4	5	17	20	23	25	32	21	24	26	35	21	25	27	38	22	26	28	40	23	27	30	43
0,0070	25,2	5	17	20	23	24	31	20	24	25	34	21	25	26	36	21	25	28	38	22	26	29	41
0,0075	27,0	5	17	20	22	23	30	20	23	25	33	20	24	26	35	21	25	27	37	21	26	28	39
0,0080	28,8	6	17	19	22	23	29	20	23	24	32	20	23	25	34	20	24	26	36	21	25	27	38
0,0085	30,6	6	17	19	21	23	29	19	22	23	31	20	23	24	33	20	24	25	35	20	24	26	37
0,0090	32,4	6	17	19	21	22	28	19	22	23	30	19	22	24	32	20	23	25	34	20	24	26	36
0,0095	34,2	7	17	19	21	22	28	19	21	23	29	19	22	23	31	20	23	24	33	20	23	25	35
0,0100	36,0	7	17	19	21	22	27	19	21	22	29	19	22	23	30	19	22	24	32	20	23	25	34
0,0105	37,8	8	17	18	20	21	27	19	21	22	28	19	21	23	30	19	22	23	31	19	23	24	33

Explanation	Name	Unit
qv	supply/m2	m ³ /s/m2
qv	supply volume/m2	m ³ /h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C

► Displacement ventilation

► Industrial: $\Delta t=6K$

Temperature profile in the room height 6,0 m

Thermal load in W/m ²			20				40				60				80				100				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17	43	45	45	50																
0,0010	3,6	1	17	28	29	29	34	38	41	42	50												
0,0015	5,4	1	17	23	24	25	28	29	32	32	39	35	38	40	50								
0,0020	7,2	2	17	21	22	22	25	25	27	28	34	29	31	33	42	33	36	38	50				
0,0025	9,0	2	17	20	21	21	24	23	24	25	30	25	28	29	37	28	31	33	44	31	35	37	50
0,0030	10,8	2	17	19	20	20	23	21	23	23	28	23	25	26	34	25	28	29	39	27	31	33	45
0,0035	12,6	2	17	19	19	20	22	20	21	22	27	22	24	25	31	23	26	27	36	25	28	30	41
0,0040	14,4	2	17	18	19	19	21	20	21	21	25	21	23	23	30	22	24	26	34	23	26	28	38
0,0045	16,2	3	17	18	19	19	21	19	20	21	24	20	22	23	28	21	23	24	32	22	25	26	36
0,0050	18,0	3	17	18	18	19	20	19	20	20	24	20	21	22	27	21	22	23	30	21	24	25	34
0,0055	19,8	3	17	18	18	18	20	18	19	20	23	19	21	21	26	20	22	23	29	21	23	24	32
0,0060	21,6	4	17	18	18	18	20	18	19	20	23	19	20	21	25	20	21	22	28	20	22	23	31
0,0065	23,4	4	17	18	18	18	20	18	19	19	22	19	20	20	25	19	21	22	27	20	22	23	30
0,0070	25,2	4	17	17	18	18	19	18	19	19	22	18	20	24	19	24	20	21	27	19	21	22	29
0,0075	27,0	5	17	17	18	18	19	8	19	19	21	18	19	20	24	19	20	21	26	19	21	22	28
0,0080	28,8	5	17	17	18	18	19	18	18	19	21	18	19	20	23	19	20	21	25	19	21	21	27
0,0085	30,6	5	17	17	18	18	19	18	19	19	21	18	19	19	23	18	20	21	25	19	20	21	27
0,0090	32,4	5	17	17	18	18	19	18	19	19	21	18	19	19	23	18	20	21	24	19	20	21	26
0,0095	34,2	6	17	17	18	18	19	18	18	19	21	18	19	19	22	18	20	21	24	18	20	21	26
0,0100	36,0	6	17	17	18	18	19	18	18	19	21	18	19	19	22	18	20	21	24	18	20	20	25
0,0105	37,8	6	17	17	18	18	19	17	18	19	20	18	19	19	22	18	20	20	23	18	20	20	25

Thermal load in W/m ²			120				140				160				180				200				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17																				
0,0010	3,6	1	17																				
0,0015	5,4	1	17																				
0,0020	7,2	2	17																				
0,0025	9,0	2	17																				
0,0030	10,8	2	17	29	34	36	50																
0,0035	12,6	2	17	27	30	32	46	28	33	35	50												
0,0040	14,4	2	17	25	28	30	42	26	30	32	46	27	32	34	50								
0,0045	16,2	3	17	23	27	28	39	24	28	30	43	25	30	32	47	26	31	34	50				
0,0050	18,0	3	17	22	25	27	37	23	27	28	40	24	28	30	44	25	29	32	47	26	31	33	50
0,0055	19,8	3	17	21	24	26	35	22	25	27	238	23	27	28	41	24	28	30	44	24	29	31	47
0,0060	21,6	4	17	21	23	25	34	21	24	26	36	22	26	27	39	23	27	29	42	23	28	30	45
0,0065	23,4	4	17	20	23	24	32	21	24	25	35	21	25	26	38	22	26	27	40	23	27	29	43
0,0070	25,2	4	17	20	22	23	31	20	23	24	34	21	24	25	36	21	25	26	38	22	26	28	41
0,0075	27,0	5	17	20	22	23	30	20	23	24	33	20	23	25	35	21	24	26	37	21	25	27	39
0,0080	28,8	5	17	19	21	22	29	20	22	23	32	20	23	24	34	20	23	25	36	21	24	26	38
0,0085	30,6	5	17	19	21	22	29	19	22	23	31	20	22	24	33	20	23	24	35	20	24	25	37
0,0090	32,4	5	17	19	21	22	28	19	21	22	30	19	22	23	32	29	23	24	34	20	23	25	36
0,0095	34,2	6	17	19	20	21	28	19	21	22	29	19	22	23	31	20	22	23	33	20	23	24	35
0,0100	36,0	6	17	19	20	21	27	19	21	22	29	19	21	22	30	19	22	23	32	20	22	24	34
0,0105	37,8	6	17	18	20	21	27	19	21	21	28	19	21	22	30	19	22	23	31	19	22	23	33

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C



- ▶ Displacement ventilation
- ▶ Industrial: $\Delta t=6K$

Temperature profile in the room height 8,0 m

1

Thermal load in W/m ²			20				40				60				80				100					
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	
0,0005	1,8	0	17	43	44	45	50																	
0,0010	3,6	0	17	28	29	29	34	38	40	41	50													
0,0015	5,4	1	17	23	24	24	28	29	31	31	39	35	37	39	50									
0,0020	7,2	1	17	21	22	22	25	25	26	27	34	29	31	32	42	33	35	37	50					
0,0025	9,0	1	17	20	20	21	24	23	24	24	30	25	27	28	37	28	30	32	44	31	34	35	50	
0,0030	10,8	1	17	19	20	20	23	21	22	23	28	23	25	26	34	25	27	28	39	27	30	31	45	
0,0035	12,6	2	17	19	19	19	22	20	21	22	27	22	23	24	31	23	25	26	36	25	27	29	41	
0,0040	14,4	2	17	18	19	19	21	20	20	21	25	21	22	23	30	22	24	25	34	23	26	27	38	
0,0045	16,2	2	17	18	18	19	21	19	20	20	24	20	21	22	28	21	23	24	32	22	24	25	36	
0,0050	18,0	2	17	18	18	18	20	19	19	20	24	20	21	21	27	21	22	23	30	21	23	24	34	
0,0055	19,8	2	17	18	18	18	20	18	19	20	23	19	20	21	26	20	21	22	29	21	22	23	32	
0,0060	21,6	3	17	18	18	18	20	18	19	19	23	19	20	20	25	20	21	21	28	20	22	23	31	
0,0065	23,4	3	17	18	18	18	20	18	19	19	22	19	20	20	25	19	20	21	27	20	21	22	30	
0,0070	25,2	3	17	17	18	18	19	18	19	19	22	18	19	19	24	19	19	21	27	19	21	22	29	
0,0075	27,0	3	17	17	18	18	19	18	18	19	21	18	19	19	24	19	20	20	26	19	20	21	28	
0,0080	28,8	4	17	17	18	18	19	18	18	19	21	18	19	19	23	19	20	20	25	19	20	21	27	
0,0085	30,6	4	17	17	18	18	19	18	18	18	21	18	19	19	23	18	19	20	25	19	20	21	27	
0,0090	32,4	4	17	17	18	18	19	18	18	18	21	18	19	19	23	18	19	20	24	19	20	20	26	
0,0095	34,2	4	17	17	17	18	19	18	18	18	21	18	18	19	22	18	19	19	24	18	19	20	26	
0,0100	36,0	5	17	17	17	18	19	18	18	18	20	18	18	19	22	18	19	19	24	18	19	20	25	
0,0105	37,8	5	17	17	17	18	19	17	18	18	20	18	18	19	22	18	19	19	23	18	19	20	25	

Thermal load in W/m ²			120				140				160				180				200					
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17																					
0,0010	3,6	1	17																					
0,0015	5,4	1	17																					
0,0020	7,2	1	17																					
0,0025	9,0	2	17																					
0,0030	10,8	1	17	29	33	34	50																	
0,0035	12,6	2	17	27	30	31	46	28	32	33	50													
0,0040	14,4	2	17	25	27	29	42	26	29	31	46	27	31	32	50									
0,0045	16,2	2	17	23	26	27	39	24	27	29	43	25	29	30	47	26	30	32	50					
0,0050	18,0	2	17	22	24	26	37	23	26	27	40	24	27	28	44	25	28	30	47	26	29	31	50	
0,0055	19,8	2	17	21	24	25	35	22	25	26	38	23	26	27	41	24	27	28	44	24	28	30	47	
0,0060	21,6	3	17	21	23	24	34	21	24	25	36	22	25	26	39	23	26	27	42	23	27	28	45	
0,0065	23,4	3	17	20	22	23	32	21	23	24	35	21	24	25	38	22	25	26	40	23	26	27	43	
0,0070	25,2	3	17	20	22	22	31	20	22	23	34	21	23	24	36	21	24	25	38	22	25	26	41	
0,0075	27,0	3	17	20	21	22	30	20	22	23	33	20	23	24	35	21	23	24	37	21	24	25	39	
0,0080	28,8	4	17	19	21	22	29	20	21	22	32	20	22	23	34	20	23	24	36	21	23	25	38	
0,0085	30,6	4	17	19	21	21	29	19	21	22	31	20	22	23	33	20	22	23	35	20	23	24	37	
0,0090	32,4	4	17	19	20	21	28	19	21	22	30	19	21	22	32	20	22	23	34	20	22	24	36	
0,0095	34,2	4	17	19	20	21	28	19	20	21	29	19	21	22	31	20	21	22	33	20	22	23	35	
0,0100	36,0	5	17	19	20	21	27	19	20	21	29	19	21	22	30	19	21	22	32	20	22	23	34	
0,0105	37,8	5	17	18	20	20	27	19	20	21	28	19	21	22	30	19	21	22	31	19	21	22	33	

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
qv	supply volume/m2	m3/h/m2
F	refresh rate	1/h
t _i	temperature supplied air	°C

Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C

► Displacement ventilation

► Industrial: $\Delta t=6K$

Temperature profile in the room height 10,0 m

Thermal load in W/m ²			20				40				60				80				100				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17	43	44	44	50																
0,0010	3,6	0	17	28	28	29	34	38	40	41	50												
0,0015	5,4	1	17	23	24	24	28	29	30	31	39	35	37	38	50								
0,0020	7,2	2	17	21	21	22	25	25	26	26	34	29	30	31	42	33	35	36	50				
0,0025	9,0	2	17	20	20	20	24	23	23	24	30	25	27	27	37	28	30	31	44	31	33	34	50
0,0030	10,8	2	17	19	19	20	23	21	22	22	28	23	24	25	34	25	27	28	39	27	29	31	45
0,0035	12,6	2	17	19	19	19	22	20	21	21	27	22	23	24	31	23	25	26	26	25	27	28	41
0,0040	14,4	2	17	18	19	19	21	20	20	21	25	21	22	22	30	22	24	24	34	23	25	26	38
0,0045	16,2	2	17	18	18	19	21	19	20	20	24	20	21	22	28	21	22	23	32	22	24	25	36
0,0050	18,0	3	17	18	18	18	20	19	19	20	24	20	21	21	27	21	22	22	30	21	23	24	34
0,0055	19,8	3	17	18	18	18	20	18	19	19	23	19	20	20	26	20	21	22	29	21	22	23	32
0,0060	21,6	3	17	18	18	18	20	18	19	19	23	19	20	20	25	20	21	21	28	20	21	22	31
0,0065	23,4	3	17	18	18	18	20	18	19	19	22	19	19	20	25	19	20	21	27	20	21	22	30
0,0070	25,2	3	17	17	18	18	19	18	18	19	22	18	19	19	24	19	20	20	27	19	21	21	29
0,0075	27,0	3	17	17	18	18	19	18	18	19	21	18	19	19	24	19	20	20	26	19	20	21	28
0,0080	28,8	3	17	17	18	18	19	18	18	18	21	18	19	19	23	19	19	20	25	19	20	20	27
0,0085	30,6	3	17	17	18	18	19	18	18	18	21	18	19	19	23	18	19	20	25	19	20	20	27
0,0090	32,4	3	17	17	17	18	19	18	18	18	21	18	18	19	23	18	19	19	24	19	19	20	26
0,0095	34,2	3	17	17	17	18	19	18	18	18	21	18	18	19	22	18	19	19	24	18	19	20	26
0,0100	36,0	4	17	17	17	18	19	18	18	18	20	18	18	19	22	18	19	19	24	18	19	20	25
0,0105	37,8	4	17	17	17	17	19	17	18	18	20	18	18	18	22	18	19	19	23	18	19	19	25

Thermal load in W/m ²			120				140				160				180				200				
Volume	qv	F	t _i	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u	t _o	t _{1,2}	t _{1,8}	t _u
m ³ /s	m ³ /h	l/h	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
0,0005	1,8	0	17																				
0,0010	3,6	0	17																				
0,0015	5,4	1	17																				
0,0020	7,2	2	17																				
0,0025	9,0	2	17																				
0,0030	10,8	2	17	29	32	33	50																
0,0035	12,6	2	17	27	29	30	46	28	31	32	50												
0,0040	14,4	2	17	25	27	28	42	26	28	30	46	27	30	31	50								
0,0045	16,2	2	17	23	25	26	39	24	27	28	43	25	28	29	47	26	29	31	50				
0,0050	18,0	3	17	22	24	25	37	23	25	26	40	24	26	28	44	25	28	29	47	26	29	30	50
0,0055	19,8	3	17	21	23	24	35	22	24	25	38	23	25	26	41	24	26	27	44	24	27	29	47
0,0060	21,6	3	17	21	22	23	34	21	23	24	36	22	24	25	39	23	25	26	42	23	26	27	45
0,0065	23,4	3	17	20	22	22	32	21	23	23	35	21	23	24	38	22	24	25	40	23	25	26	43
0,0070	25,2	3	17	20	21	22	31	20	22	23	34	21	23	24	36	21	23	24	38	22	24	25	41
0,0075	27,0	3	17	20	21	22	30	20	22	22	33	20	22	23	35	21	23	24	37	21	23	25	39
0,0080	28,8	3	17	19	21	21	29	19	21	21	31	20	21	22	33	20	22	23	36	21	23	24	38
0,0085	30,6	3	17	19	20	21	29	19	21	21	31	20	21	22	33	20	22	23	35	20	22	23	37
0,0090	32,4	3	17	19	20	21	28	19	20	21	30	19	21	22	32	20	21	22	34	20	22	23	36
0,0095	34,2	3	17	19	20	20	28	19	20	21	29	19	21	21	31	20	21	22	33	20	22	22	35
0,0100	36,0	4	17	19	20	20	27	19	20	21	29	19	20	21	30	19	21	22	32	20	21	22	34
0,0105	37,8	4	17	18	19	20	27	19	20	20	28	19	20	21	30	19	21	21	31	20	21	22	34

Explanation	Name	Unit
qv	supply/m2	m3/s/m2
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F	refresh rate	1/h
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Explanation	Name	Unit
t _o	temperature at ankle height	°C
t _{1,2}	temperature at a height of 1.2 m	°C
t _{1,8}	temperature at a height of 1.8 m	°C
t _u	temperature return air	°C