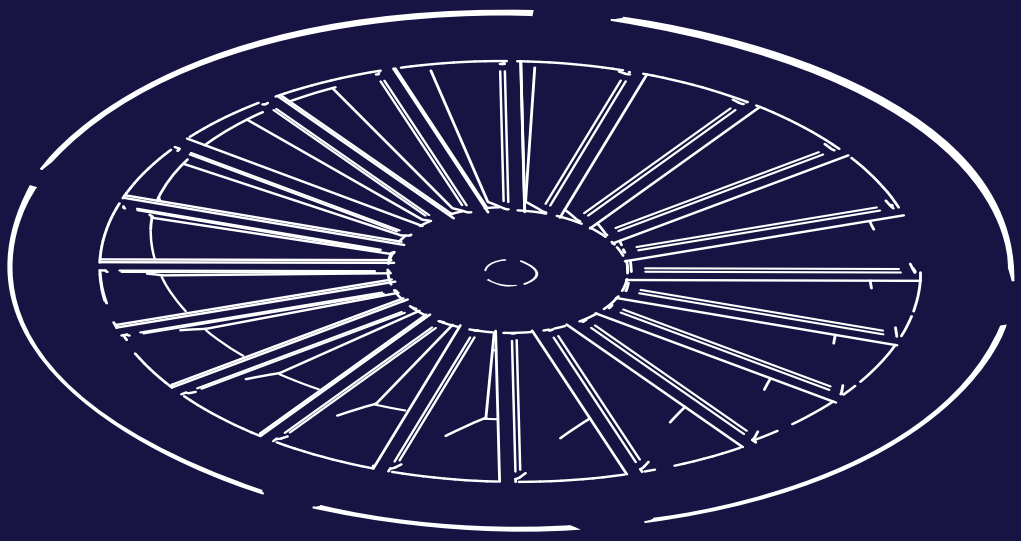

Swirl diffuser, type VFK

BARCOL-AIR

Foreword

Barcol-Air introduces the swirl diffuser
The well known Jet Flo type CSV,
includes now a swirl diffuser specifically suited for
installations with chilled ceilings.

During the development of the swirl
diffuser, the following principles played an important role:

- Flat and central appearance, while maintaining functionality.
- Integration with all kind of chilled celing panels, wherein the flange of the diffuser is positioned in the same lane as the ceiling panel itself.
- Small diameter of the appearance part, as well as little mounting height.

The swirl diffuser measures up to all
these principles. Next to this, the selection method has
been composed in such a way that the diffuser can be
selected from a ventilation rate.

For special applications or diffuser selections we advise
you to contact our technical staff.

Let yourself be convinced by the advantages of these
new swirl diffusers

Barcol-Air

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Air distribution & application

In general

During the selection of a climate installation for an office building, a climate ceiling can be chosen for various reasons. As a part of this choice, because of the Building decision, the construction of fresh air facilities should be taken into consideration. These facilities can also be used for additional cooling.

There are various solutions available for supplying fresh air, amongst which Linear Jet Flo diffusers*, swirl diffusers and perforated grills. For these solutions the rule, according to NEN-ISSO-7730, applies that the air velocity can not be higher than 20 cm/s.

The swirl diffuser has been specially designed for application in climate ceilings, whereas the emphasis during development has been put on finding the balance between aesthetics and functionality.

The aesthetics are expressed in the shape; the grill is very flat, there is hardly any interruption in the stark exterior of the of the climate ceiling.
The functionality of the grill is simple: achieving a good comfort in the living zone, at which the air velocity and temperature are experienced as pleasant.

Air distribution

Next to the air velocity in the living zone, it is at least as important to realise an optimal air distribution. Generally speaking it can be said that a larger number of grills creates a better distribution. Application of multiple swirl grills in one space leads to a larger mutual influence. This has been taken into consideration in the selection tables.

Swirl diffuser type VFK intergrated in ceiling.

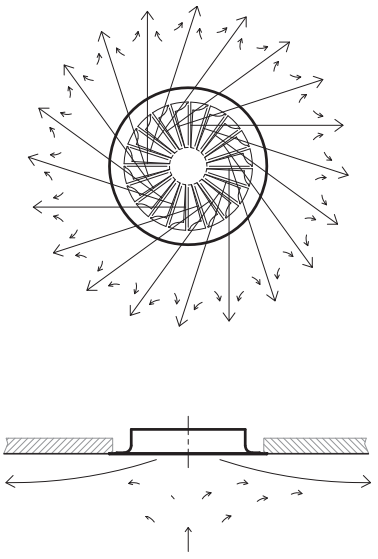
Function

The functioning of the diffuser is based on achieving a Coanda-effect at a radial discharge pattern. Due to the velocity of the discharged air, room air is inducted and mixing takes place. The differences between the velocity and temperature of discharged air and room air are diminished in order for both to measure up to the comfort requirements when they reach the living zone.

Applications

The swirl diffuser can also be applied when more air needs to be supplied than is required according to the Building regulation, so legally.

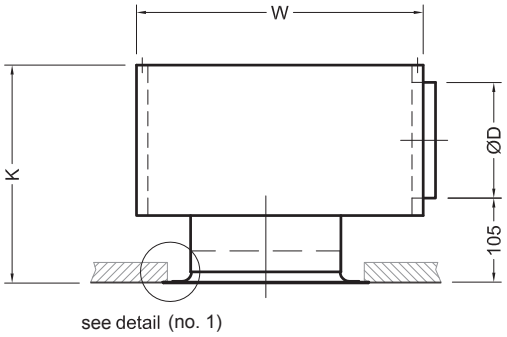
The swirl diffuser can be applied with air quantities from 20 to 140 m^3/h and a temperature difference up until 10 K, because of that additional cooling can be provided.

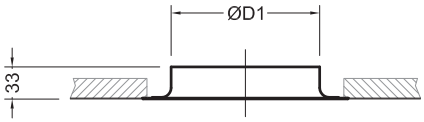


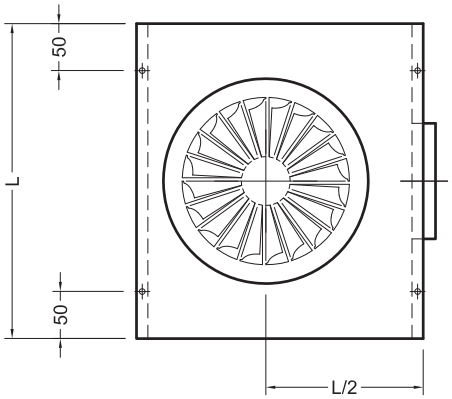
induction

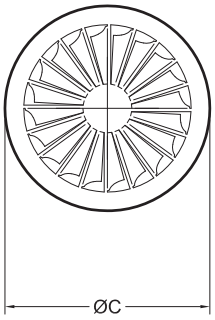
** There are seperate brochures available of the Linear Jet Flo, type CSV.*

Measuring

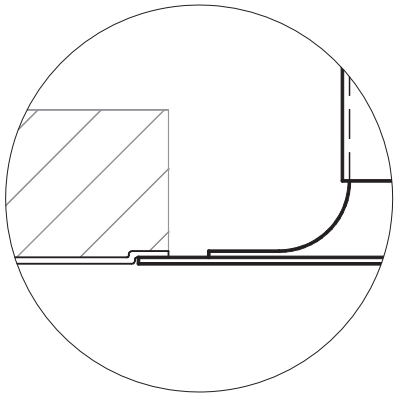








Detail no. 1:



Measurements

Model	C	ØD	ØD1	K	L	W
125	193	98	123	220	305	280
160	228	123	158	245	335	280

Note: all dimensions in mm.

Selection table

Table1 - VFK diffuser, model 125 of 160

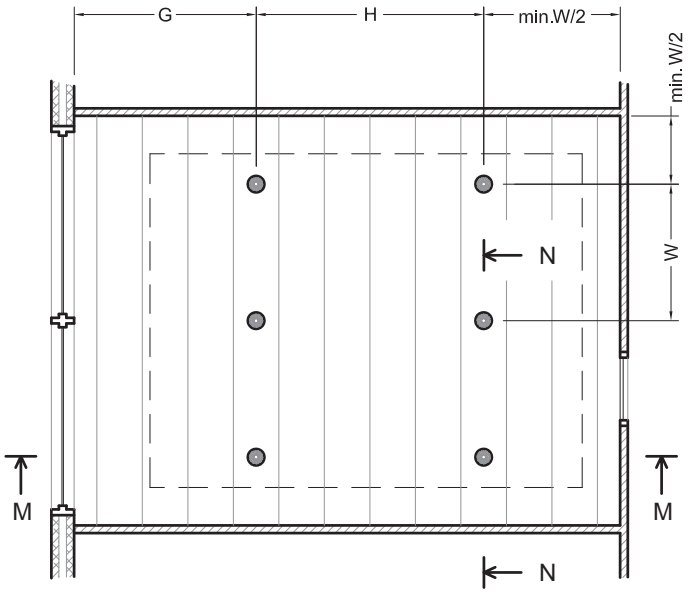
Model	Volume Flow Rate		Ps	LpA	Diffuser mounting in one or mutiple tracks Mutual track distance H ≥ 2.6 m				Air velocity at point 2 (cm/s)
					Mutual diffuser distance (W)				
	m^3/s	m^3/h	Pa	dB(A)	1.2	1.5	1.8	2.4	
					air velocity at point 1 (cm/s)				
125	0.006	20	2	--	--	--	--	--	4
	0.007	25	4	--	--	--	--	--	5
	0.008	30	6	--	--	--	--	--	6
	0.010	35	8	--	13	12	--	--	7
	0.011	40	10	--	15	14	13	--	7
	0.013	45	13	--	17	16	15	13	8
	0.014	50	16	20	19	18	16	14	9
160	0.013	45	3	--	12	--	--	--	6
	0.014	50	3	--	13	12	--	--	6
	0.015	55	4	--	15	13	12	--	7
	0.017	60	5	--	16	15	13	--	8
	0.018	65	6	--	17	16	15	13	8
	0.019	70	6	--	19	17	16	14	9
	0.021	75	7	--	20	18	17	15	10
	0.022	80	8	--	21	20	18	16	10
	0.024	85	10	--	23	21	19	17	11
	0.025	90	11	--	24	22	20	17	12
	0.026	95	12	--	25	23	21	18	12
	0.028	100	13	--	27	24	22	19	13
	0.029	105	14	--	28	26	24	20	14
	0.031	110	16	21	29	27	25	21	14
	0.032	115	18	22	31	28	26	22	15
	0.033	120	20	24	32	29	27	23	16
	0.035	125	22	25	33	31	28	24	16
	0.036	130	23	26	35	32	29	25	17
	0.038	135	24	27	36	33	30	26	17
	0.039	140	25	28	37	34	31	27	18

1. *Selectiondatas are based on the supply of cooled air with ΔT - 10 K in relation to the room temperature, at a room height of 2.70 - 3.00 m and mounting of a diffuser in a plane ceiling.*
2. *The given air velicities are average air velocities measured on 2 points:*
   *point 1 = between the diffuser on **1.7 m** (from the floor up),*
   *punt 2 = 0.5 m vanaf de wand op **0.1 m** (from the floor up).*
   The last is useful at selecting one diffuser in the room
3. *Air pressure level data and pressure loss data apply to diffusers with or without entirely opened volume control.*
4. *In the assigned LpA-values, a volume reduction of 10 dB due to space is maintained.*
5. *Sound pressure level lower than 20dB(A) are indicated by '--'.*
6. *Air velocities lower then 12 cm/s are indicated by '--'.*
7. *The recommended minimum distance G, between the diffuser and the front will be 1.8 m.*
8. *The recommended minimum distance betweem the diffuser and the wall will be W/2.*
9. *The values for "insertion loss insulated plenum box" do not include end reflection.*
10. *For non standard selections and/or applications, please contact our technical staff.*

Table 2 - Correctiontabel room heights

Room height in meters	Air velocity in cm/s
2.6	x 1.10
2.7	x 1.00
3.0	x 0.80

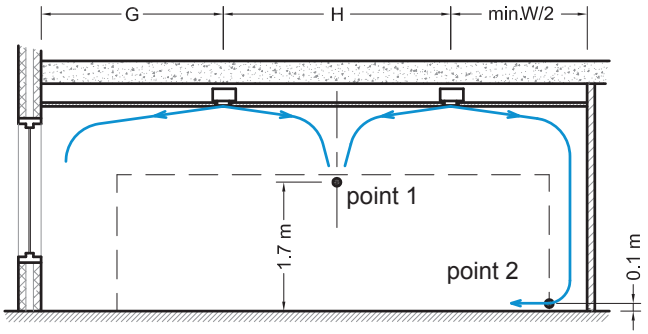
Principles selection table (mounting diffuser)



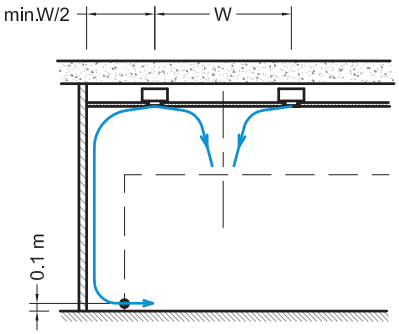
Mounting diffuser

Due to the radial discharge patter of the diffuser, a correct mounting in relation to the façade, wall and another diffuser is important. In table 1 and in the drawings, the distances are indicated which should be maintained to achieve an acceptable air velocity in the comfort zone.

= comfort zone



section M-M



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Sounddata

Table 3 - Correctiontable for diffuser with or without insulated plenum

Model	With uninsulated plenum		Without plenum	
	Pa x	dB(A) +	Pa x	dB(A) +
125	1.4	3	1	-11
160	1.8	4	1	-9

Table 4 - Soundproof of insulated plenum

Model	Insertion loss in dB/oct.					
	125	250	500	1000	2000	4000
125	5	1	0	9	4	10
160	4	1	3	7	5	9

Air supply calculations

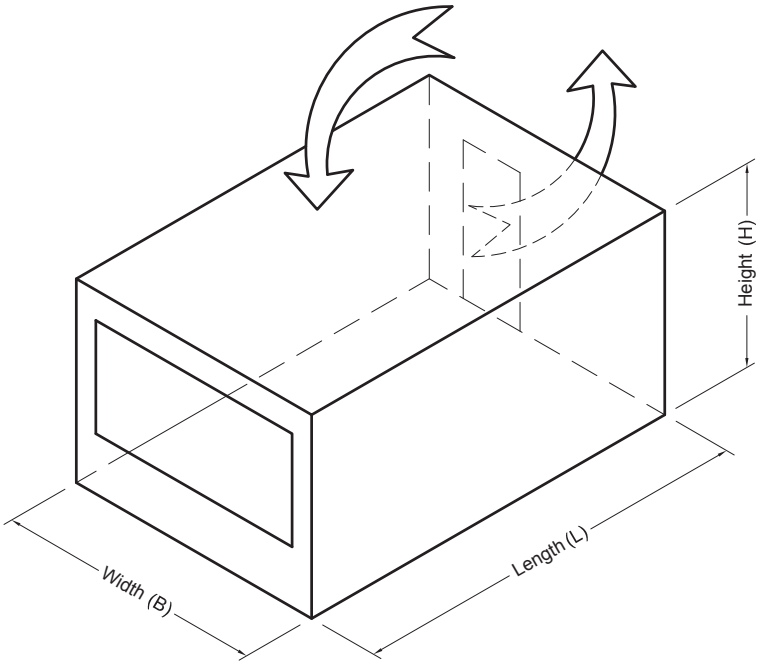
Air supply per diffuser

To determine the air supply per diffuser, the room dimensions must be defined.

If these results are known, one can calculate the air added to the room must become by means of the desiried air changes (m3/h):

Formula: Q = L x W x H x AC

Q	=	Air supply	(m^3/h)
L	=	Length	(m)
W	=	Width	(m)
H	=	Height	(m)
AC	=	Air Changes	



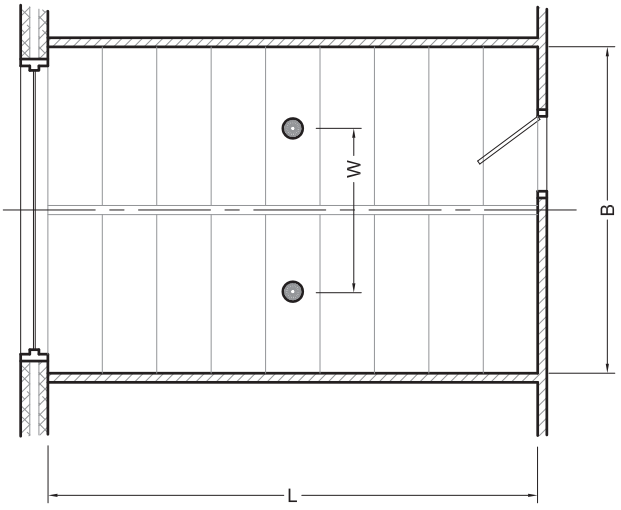
Air supply calculations

Example space calculation:

- Desired ventilation rate (AC): 2.5
- Room volume (in m^3): L x W x H = 5.40 x 3.60 x 2.85

Calculation air quantity per hour:

5.40 x 3.60 x 2.85 x 2.5 = **138** m^3/h



Divided over 2 grills this means an air quantity of 69 m^3/h per diffuser. For a good air distribution the grills should be divided proportionally over the space.

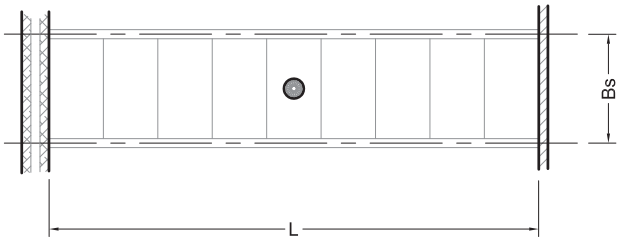
From the selection table it follows that the model VFK 160 is suitable for this application.
From table 1 (page 4) it follows that the air velocity thereof (grill distance (W) of 1.8 m.) amounts to approximately 16cm/s.

Example raster calculation

- Desired ventilation rate (AC): 2.0
- Room volume (in m^3): L x W x H = 5.40 x 1.20 x 3.00

Calculation air quantity per hour:

5.40 x 1.20 x 3.00 x 2 = **39** m^3/h



For this diffuser only model VFK 125 is suitable.

From table 1 (page 4) it follows that at a diffuser distance of 1.2 m an air velocity follows of 15cm/s.

Technical information & specifications

Application

The swirl diffuser type VFKO.O4 is a highly inducing ceiling grill, especially suited for the supply of cooled of heated air with a large temperature difference in relation to the average space temperature. The diffuser type VFK is specifically designed for the climate ceiling, but can also be applied in regular ceilings.

Technische informatie

Properties:
- *Fixed, radial discharge pattern.*
- *Highly inducing.*
- *Suitable for a large number of air changes.*
- *Suitable for application with lowered ceilings.*
- *Suitable for climate ceilings.*
- *Low sound volume.*

Type:
- *Diffuser and discharge cone effectuated in plate steel.*
- *Basic finish: nr. 4 white RAL 9010, 20% polish.*
- *Plenumbox with or without interior isolation, effectuated in zinc plate steel.*

Delivery:
- *Diffuser and plenumbox are delivered separately.*

Mounting:
- *The plenumbox is equipped with suspension holes on the top side.*
- *The special flange ridge is adapted to the push through cores of the climate ceilings.*

Common types

- VFKOOO4: Diffuser without accessories.
- VFKO1O4: Same, with non-isolated plenumbox.
- VFKO3O4: Same, with isolated plenumbox.

Specifications

Example:
Ceiling swirl diffuser, circular type, with a radial discharge pattern especially suitable for application in climate ceilings. The diffuser can be mounted to the plenum and against the ceiling by use of a central screw.
Material: Galvanised plate steel.
Barcol-Air type: VFKO1O4.
Exterior: white (RAL 9010) with 20% polish.
Barcol-Air type: VFKO1O4.

Productcode

Construction & explanation:

Position 1/2/3: **Type diffuser**

VFK= circular swirl diffuser

Position xxx: **Model**

125 = model 125
160 = model 160

Position 4: **Accessories**

O = not applicable

Position 7: **Finish**

1 = special finish
4 = white, RAL 9010, 20% gloss (standard)

Position 5: **Plenumbox**

O = no plenumbox
1 = uninsulated plenum with circular side inlet connection (standard)
3 = insulated plenum with circular side inlet connection
5 = adaptor with circular top inlet connection

Position 6: **Mounting**

O = normal mounting
1 = special mounting, to be specified

Order example:

VFKO1O4-125-0000 : standard VFK diffuser model 125.

Example measuring air pattern conform ISO-7726

Climateroom

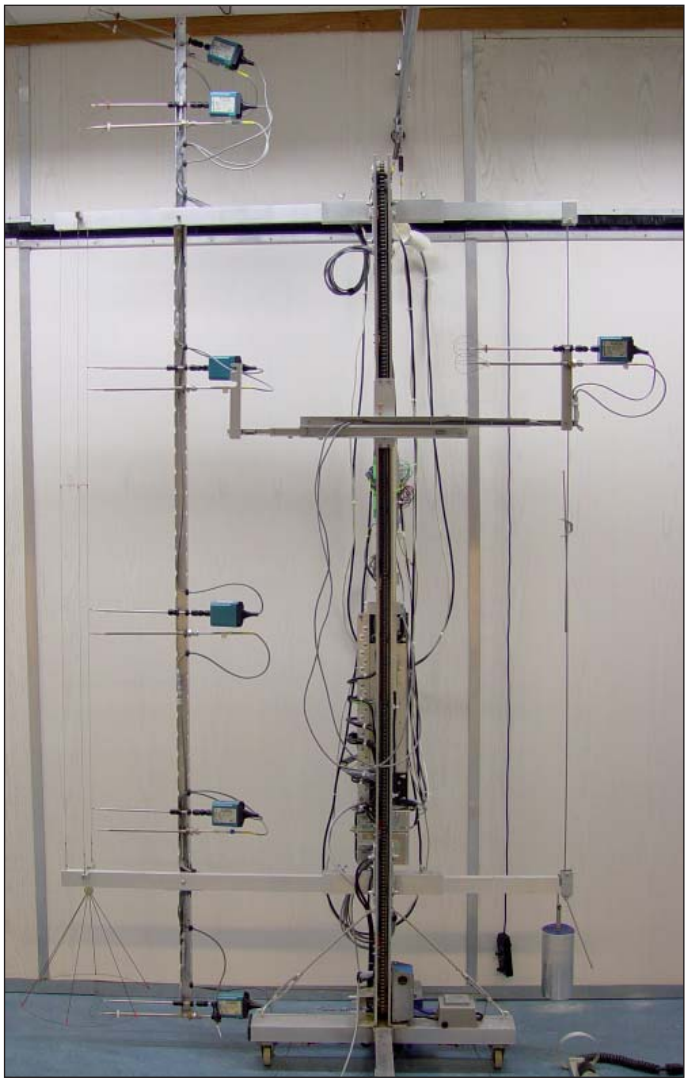
Our climateroom offers the possibility to simulate office rooms on real scale. In several mock up's under summer - and winter conditions tests are performed, to determine the room temperatures and the end velocities in the comfortzone. In the past 25 years more than 250 full-scale climate tests have been carried out.

Data Aquisition System

All measuring data is collected and processed with a, by "labVIEW®" supported, automatic "Data Acquisition System". "labVIEW®" is a software program of National Instruments for virtual instrumentation.

Measuringrobots

The most important part of the test facility, is the automatic moving measuring robot with accurate air temperature and velocity sensors. The height of the measuring sensors is according NEN-ISO standards 0,1 – 0,6 – 1,1 and 1,7 meter above the floor. These heights represent ankles, bottom, trunk and head of the human body. The robot measures the area from floor to ceiling and from front to back of the test room.
Extra sensors are mounted on the robot on other heights and in different measuring areas to detect possible irregularities (for instance asymmetry) of the air pattern. Extra sensors are also mounted 5 cm below the ceiling to check the air pattern of the supply diffusers.



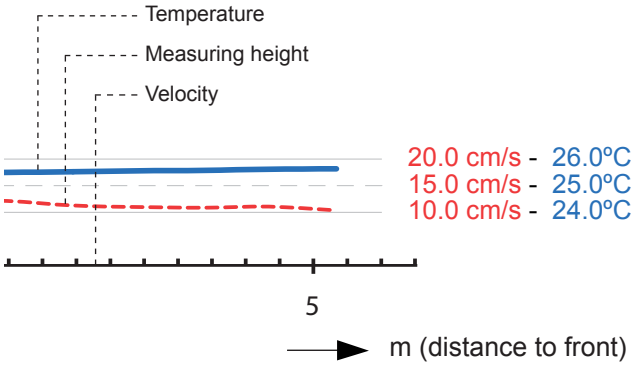
Measuringrobot

Measuring results

The resluts from "LABVIEW®"-measuring are presented as followed:

1. Graphic reproduction of the room temperature and the air velocity profile in a section of the room, the "temperature/velocity-traverse".
2. The same data in given in a table.

In the temperature/velocity-traverses on vertical axis the temperatures are reflected in ^{0}C and the axis Air velocity's cm's. Horizontal dotted lines indicates the measuring height. Besides these lines serve as a reference for the particular measuring heights.



Test measuring cooling with 2 diffusers:

2 x VFK-diffuser, model 160
Distance to front : 1.80 m
Mutual distance : 1.80 m

Cooling situation:

a. Room Temperature 1.5 m 24.0 °C
Supply air temperature 14.0 °C
b. Air supply per diffuser 95 m³/h
Temperature difference -10 K

Graph 1 - Measuring results 2 x VFK diffuser, model 160

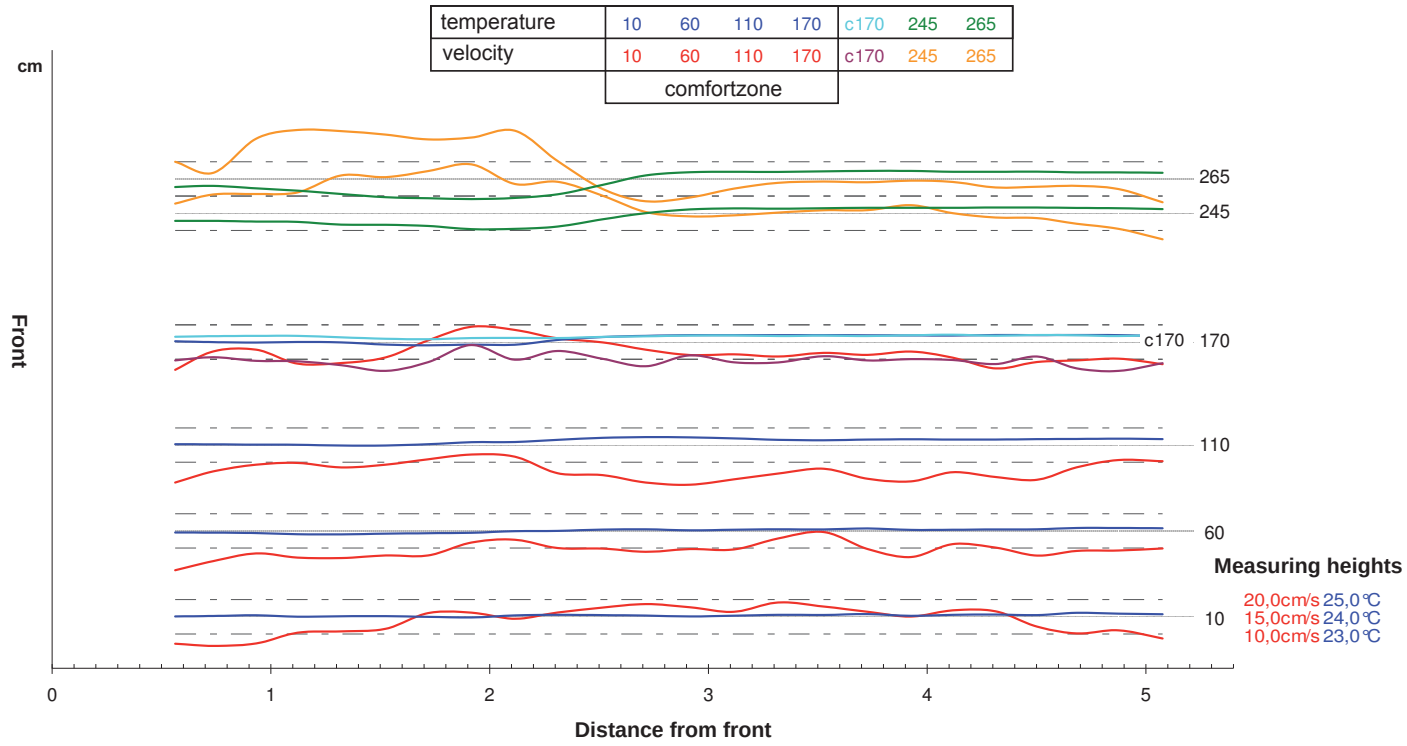


Table 4 - Test results 2 x VFK diffuser, model 160

Height	Air velocity	= comfortzone																						
2.65 m	cm/s	20.0	16.8	26.7	29.2	28.9	27.9	26.5	27.0	29.0	20.2	12.1	8.5	9.6	12.1	13.8	14.2	14.0	14.5	14.1	12.5	12.7	13.0	12.0	8.2
2.45 m	cm/s	17.8	20.5	20.6	21.1	26.0	25.5	27.3	29.1	23.5	24.2	20.1	15.3	14.1	14.4	15.2	15.9	15.9	17.3	15.0	13.8	13.6	11.9	10.5	7.4
2.2 m	cm/s	9.7	10.6	9.5	9.4	8.2	6.6	9.1	14.1	9.9	12.4	10.1	8.0	11.1	9.1	9.1	10.9	9.6	10.0	9.8	8.6	10.8	7.3	6.6	8.8
1.7 m	cm/s	6.9	12.3	12.8	8.7	8.9	10.5	15.5	**19.4**	18.5	16.1	14.9	12.8	11.2	11.4	10.8	11.9	11.2	12.2	10.4	7.3	9.2	9.6	10.1	8.5
1.1 m	cm/s	4.1	7.3	9.3	9.8	8.5	9.3	10.9	12.3	11.6	6.8	6.2	4.1	3.4	5.0	6.7	8.1	5.2	4.4	7.1	5.7	4.9	8.5	10.7	10.3
0.6 m	cm/s	3.6	6.2	8.5	7.2	7.1	7.9	7.9	11.6	12.4	10.0	9.8	8.9	9.7	9.6	12.8	14.7	9.7	7.4	11.2	10.1	7.8	9.2	9.3	9.9
0.1 m	cm/s	7.1	6.5	7.2	10.4	10.7	11.5	16.1	16.2	14.4	16.2	17.7	18.7	17.7	16.4	19.2	18.0	16.5	15.0	16.9	16.6	12.1	10.2	11.0	8.7
Height	Air temperature	= comfortzone (distance from front)																						
2.65 m	°C	23.5	23.6	23.5	23.3	23.3	22.9	22.9	22.8	22.9	23.1	23.7	24.2	24.4	24.4	24.4	24.4	24.5	24.5	24.4	24.4	24.4	24.4	24.4	24.4
2.45 m	°C	23.6	23.6	23.5	23.5	23.5	23.3	23.3	23.1	23.1	23.2	23.6	24.0	24.2	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.2
2.2 m	°C	24.3	24.3	24.4	24.4	24.4	24.2	24.2	24.2	24.2	24.2	24.3	24.3	24.4	24.4	24.3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4
1.7 m	°C	24.0	24.0	24.0	24.0	24.0	23.9	23.8	23.8	23.8	24.1	24.3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.3
1.1 m	°C	24.1	24.0	24.0	24.0	24.0	24.0	24.0	24.2	24.2	24.3	24.4	24.5	24.4	24.4	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.4	24.4	24.3
0.6 m	°C	23.9	23.9	23.9	23.8	23.8	23.8	23.9	23.9	24.0	24.0	24.1	24.1	24.0	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.2	24.2	24.2
0.1 m	°C	24.0	24.0	24.1	24.0	24.0	24.0	24.0	24.0	24.1	24.1	24.1	24.1	24.0	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.2	24.2	24.1

See page 4 for the associated selection table.

Computional Fluid Dynamics (CFD)

Introduction CFD

Computational Fluid Dynamics (CFD) or numerical flow is the technique of using numerical methods and algorithms to analyse and predict (air) flows. The process encompasses millions of calculations, which are executed by a computer with sufficient calculating power.

Simulation process

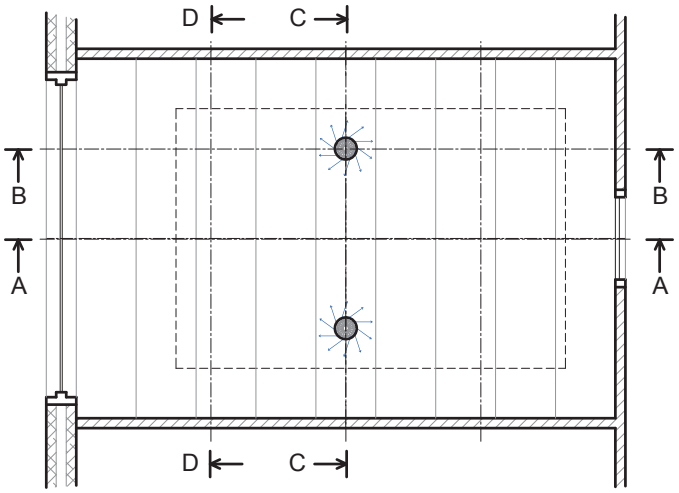
For the simulation the geometrics are constructed three dimensionally and the medium is determined with its properties; with the development of diffusers this medium is air. Next the space conditions are constructed and are given physical boundaries like, for example, the air access grill properties and the air outflow properties (the opening below the door). The volume is divided in sufficient small cells ('meshing') and the simulation is started. The required comparisons are solved iterative until a preset accuracy is achieved. The result can then be visualized, analyzed and, if required, validated in the climate room.

Conditions

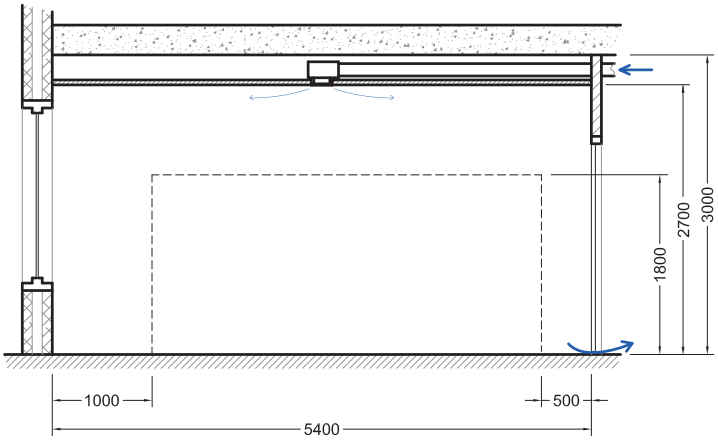
- Room dimensions: 5.4 x 3.6 x 2.7 m, façade with window
- 2 x grill VFK model 160, centrally positioned
- Ventilation rate: fourfold ventilation (210 m^3/h)
- Space temperature 24 °C
- Discharge temperature 14 °C (additional cooling 700 W)
- Climate ceiling, cooling 54 W/m^2 (total 1050 W)
- Simplified influence of the sun: façade as a heat source = 140 W/m^2 (total 1361 W)
- Simplified influence of the space load: floor as a heat source = 20 W/m^2 (total 389 W)

*) As example a room with a high cooling load (90 W/m^2) has been chosen. The combination of a cooling ceiling with a fourfold ventilation as additional cooling provides a high cooling capacity and still guarantees low air velocities in the living zone. At lower ventilation rates lower air velocities will proceed.

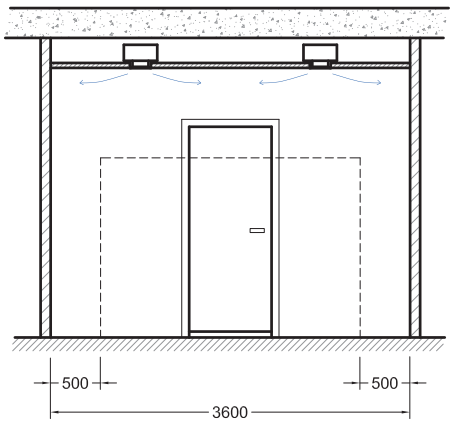
*) The balance between cooling and heating capacity has been harmonised to simulate a stable situation.



= Comfort zone



Section A-A



Section C-C

CFD Calculation: visualisation air velocities

Visualizing

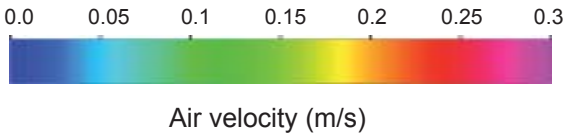
The values of the desired variables can be demonstrated in different ways. For example by using colour and/or directional arrows, but it's also possible by generating graphs or tables.
Below various cross-cuts of the model are show in which the air velocity is show by using different colours.

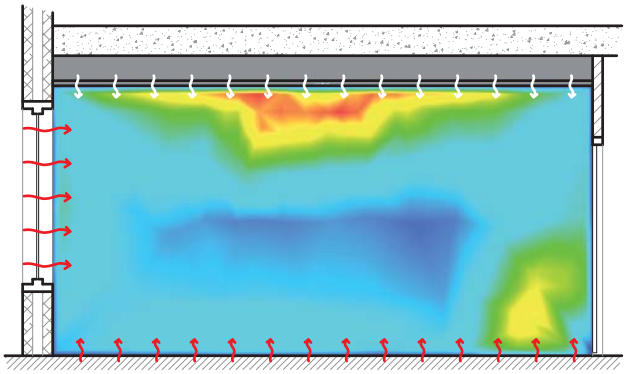
Validating

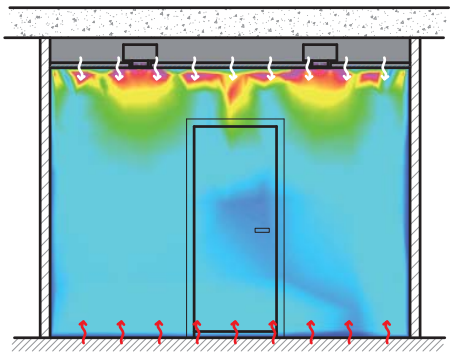
Even with simple processes the outcome of a calculation cannot be accurate enough, which is why it remains of importance to validate predictions. For this reason, during the development of our products, this technique is used as a resource and the final results are check in the climate room.

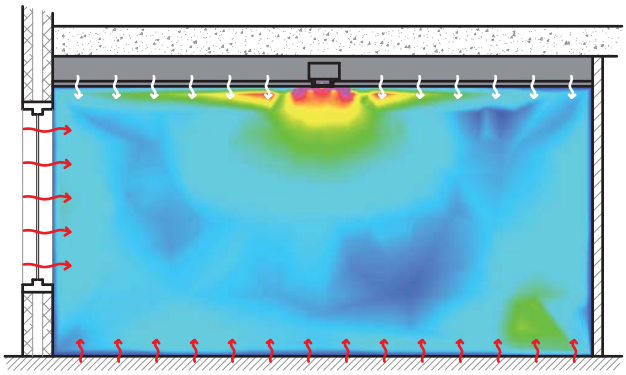
Analyzing

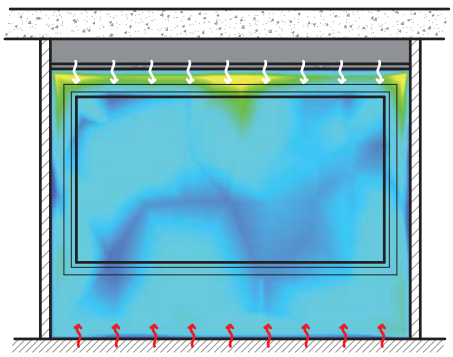
The results can be analyzed to achieve rapid insight in the discharge pattern. Next to this the influence of certain adaptations in the design is easily deducted. This way a design can be optimized faster and easier.




Section A_A


Section C-C


Section B-B


Section D-D

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