



Displacement Ventilation Theory

Principles, applications and engineering

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From principle to practice

An illustrated technical guide to displacement ventilation: terminal geometry, local comfort, calculation and application.

03	The displacement principle	19	Sensitivity to effectiveness
04	Temperature and thermal plumes	20	Outdoor air is a separate duty
05	Why floor velocity can increase	21	Pressure loss and acoustic duty
06	Define the project before selection	22	Controls, energy and humidity
07	DD series / DD01–DD08	23	A simulation must state its physics
08	Shock-proof surface engineering	24	Commission and retain the evidence
09	Comfort is local	25	Airports: placement and comfort
10	Define the near-zone correctly	26	Stages and film studios
11	Spacing changes interaction	27	Offices and changing interiors
12	Divide the duty, then verify	28	Selection record and notation
13	Single outlet, row or wall band	29	References and evidence boundaries
14	Coverage and obstructions		
15	Special supply arrangements		
16	Close the sensible heat balance		
17	Worked layout: a 70 m ² office		
18	Auditoriums: layout and calculation		

READING THE FIGURES

Photographs show application and detailing. Concept sketches explain mechanisms. Calculation plots state their inputs. Product selection requires data for the actual terminal and duty.

The displacement principle

Displacement ventilation

Airflow principle

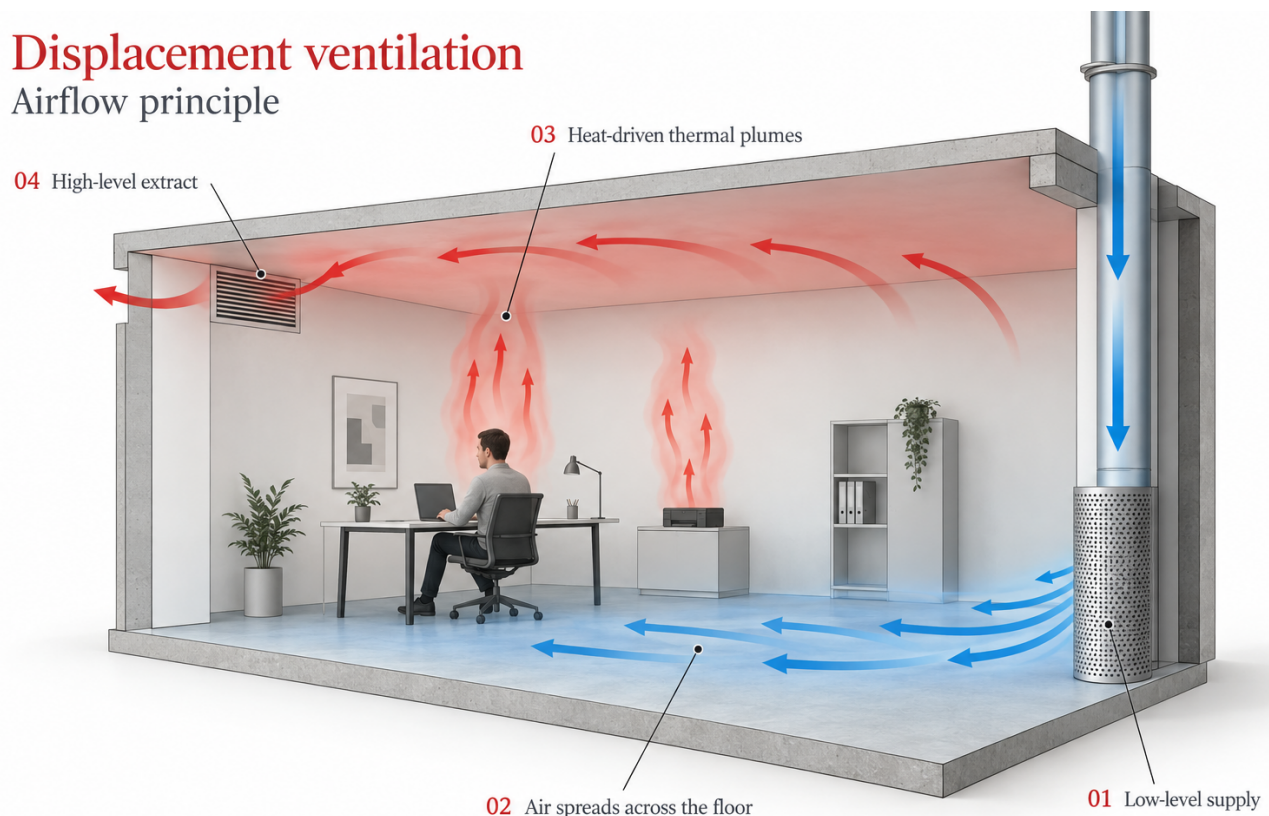


Figure 01. Low-level supply, thermal plumes and high-level extraction.

Displacement ventilation introduces air cooler than the room at low level and with limited momentum. A shallow floor flow supplies air to the occupied region. Heat from people and equipment produces rising plumes that entrain surrounding air and transport heat toward a high-level return or exhaust.

Read the illustration as a connected air path. Supply enters on the right, spreads across the floor, joins the thermal plumes and leaves at high level. The arrows explain the mechanism; they are not predicted velocities.

The system deliberately allows vertical differences in temperature and concentration. The boundary between lower and upper regions is gradual and changes with occupancy, load and airflow. A universally clean lower layer should not be assumed.

Pollutants coupled to buoyant sources may follow the rising flow. Source position, particle behaviour and crossflows still matter. Provide dedicated capture for emissions that require it. Classical cool-air displacement is primarily a ventilation and cooling strategy; heating requires a separate system or a verified special mode. [S1, S2]

Temperature and thermal plumes

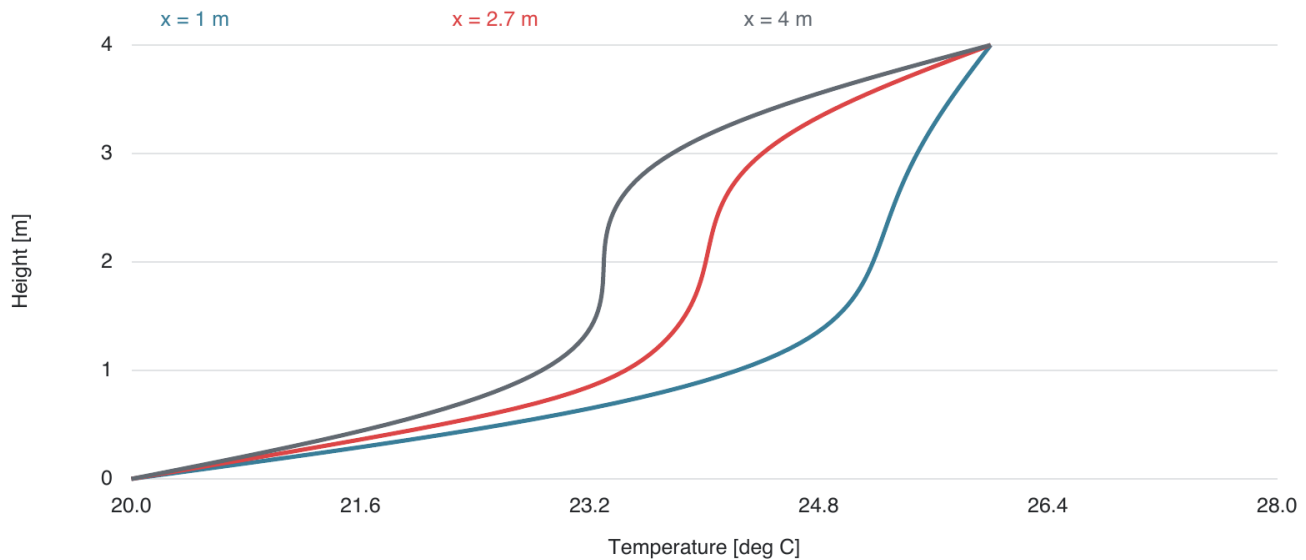


Figure 02. Vertical temperature profiles at three room positions.

Air close to the floor is generally warmer than the terminal supply because of heat transfer and entrainment. Temperatures within rising plumes differ from those in the surrounding room. A single room sensor cannot describe this field.

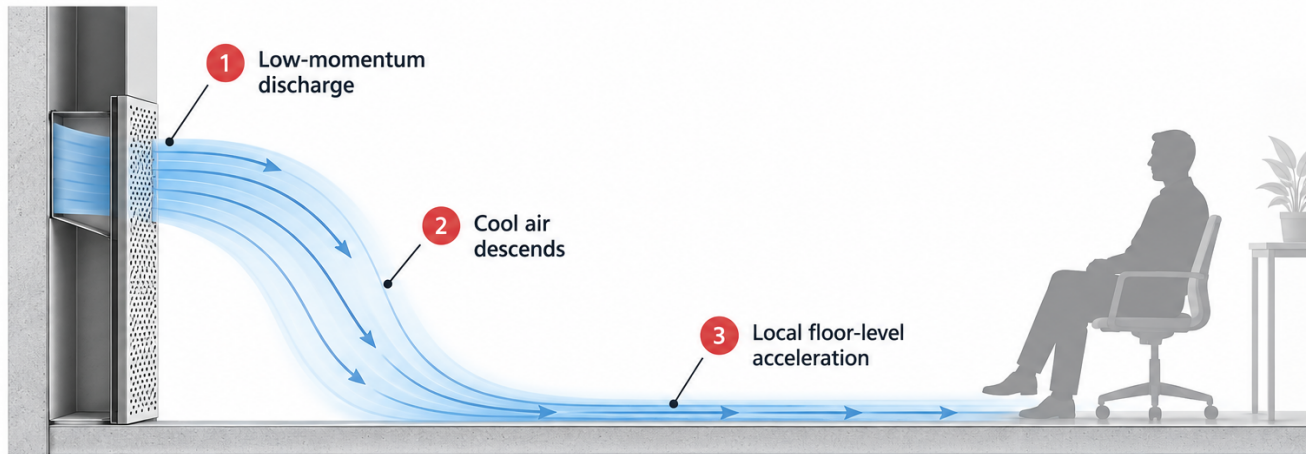
Use explicit reference heights. In this book, t_s denotes terminal supply temperature, t_r the occupied-zone reference temperature, t_f a stated near-floor measurement and t_e the high-level leaving-air temperature. A useful profile records the location as well as the height of each reading.

The traditional 50% rule divides the supply-to-extract temperature rise into a floor-level rise and a rise through the room. It is a screening model, not a local comfort prediction. Do not derive a compliant head-to-ankle difference from ceiling height alone.

Plume flow increases through entrainment as it rises. Compare supply and plume flows at a defined height in a consistent room model; a sum of generic plume allowances is not the outdoor-air requirement. [S1, S2]

Why floor velocity can increase

Why floor velocity can exceed face velocity



Side view – low-level tall wall displacement diffuser (cutaway).

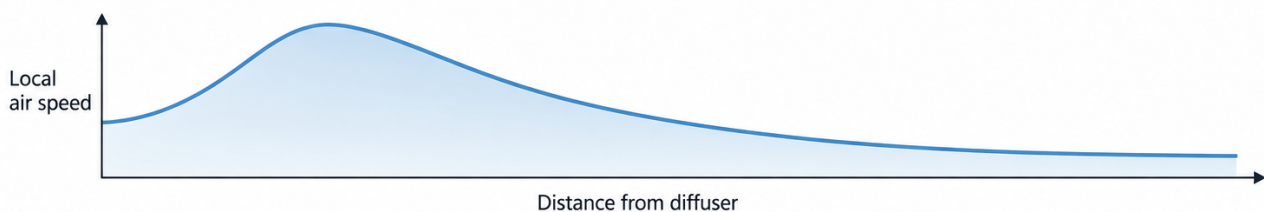


Figure 03. Floor-flow acceleration downstream of the diffuser.

A low face velocity does not guarantee a low velocity immediately in front of a terminal. Cooler air can descend under negative buoyancy and form a faster shallow floor flow. The local maximum may occur downstream of the face before velocity decreases.

Assess the complete terminal duty. Outlet height, geometry, airflow and supply-to-room temperature difference influence this behaviour. Face velocity alone cannot establish the near-zone boundary.

The 2014 layout guide describes this effect for several outlet types and gives distances and speeds for its own selection conditions. Those values are not universal clearances and are not GERHMAN ratings. Use tested velocity maps for the actual terminal and operating point. [S2]

Keep permanent occupied positions outside the assessed unsuitable local-velocity region. Verify critical ankle locations after installation, including part-load conditions and changed furniture layouts.

Define the project before selection

Start with the occupied positions, load distribution and available air paths. Select the architectural mounting concept only after checking that it can serve those positions without obstruction.

Room and load inputs

Floor area and height; façade orientation and glazing; convective and radiant load fractions; equipment and people schedules; entrances; required indoor conditions; sensible load assigned to air and any supplementary cooling.

Air-system inputs

Total supply flow; outdoor-air requirement; supply-temperature range; return locations; available pressure; filtration and humidity strategy; zoning and minimum operating duty.

Terminal inputs

Dimensions, face and free area, inlet connection, pressure-flow curve, octave-band sound power, near-zone data and measurement definition. Include floor or wall construction, brackets, plinths, duct covers and removal access.

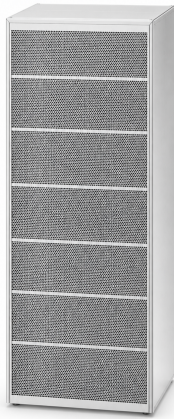
Acceptance inputs

Adopted comfort method, acoustic targets, air-balance tolerance, measurement locations and test conditions. Include seated and standing use where relevant.

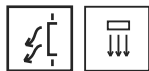
Complete the process as a loop: **load** → **airflow** → **terminal duty** → **near-zone** → **comfort and acoustics** → **revised layout**. A selection based only on nominal airflow is incomplete. [S1–S3]

DD series / DD01–DD08

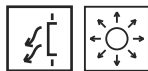
GERHMAN displacement diffusers



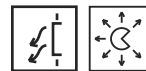
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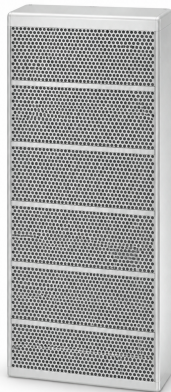
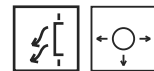
DD02



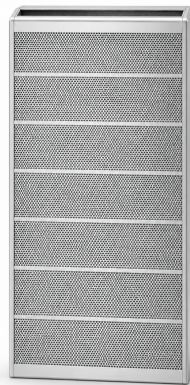
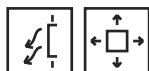
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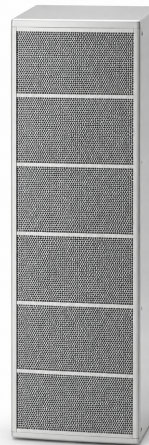
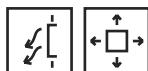
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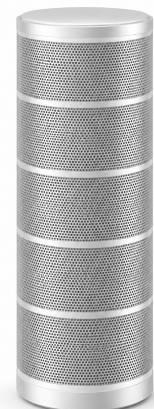
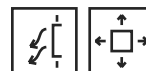
DD05



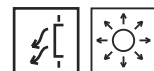
DD06



DD07



DD08



Shock-proof surface engineering

Shock-Proof SS304 Stainless Steel Face Grille

Designed for demanding applications, the face grille combines a robust exposed surface with an aerodynamic profile. The SS304 stainless steel construction and open-area geometry support the intended balance of durability and airflow.

Distinguish the areas. Gross face area is the overall reference area. Free area is the unobstructed geometric opening area. Effective area is an aerodynamic quantity defined by the applicable test method; it is not automatically equal to free area.

For a simple area-average calculation, $v = q_v / A$. State which area is used. Local velocities through openings will differ from a gross-face average.

Specify mechanical duty, panel supports, fixings, finish and cleaning access together. The term shock-proof is the supplied product description; a numerical impact or load class needs its own test record. Airflow and acoustic ratings also require the complete panel assembly.

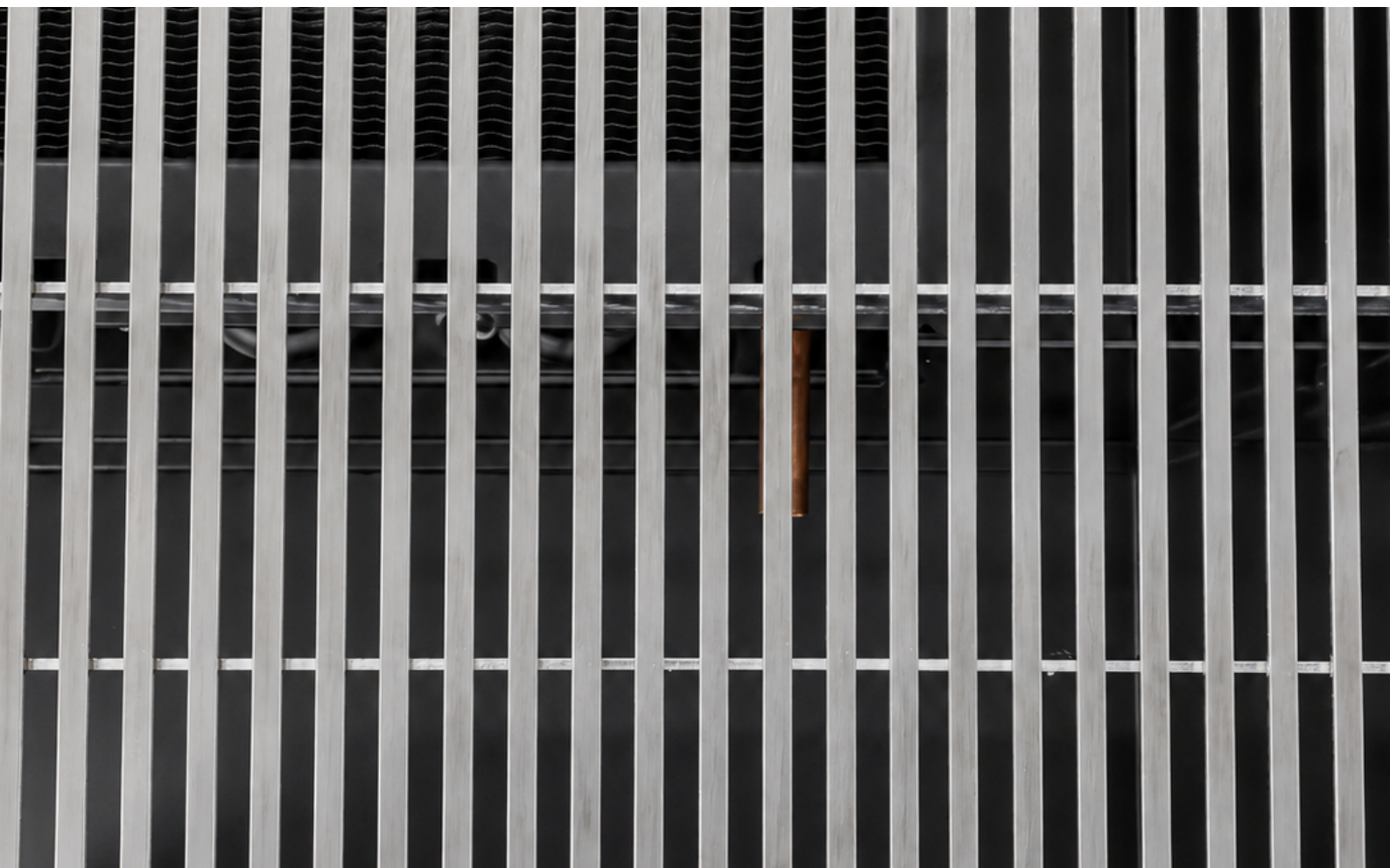


Figure 04. Shock-Proof SS304 stainless steel face grille.

Comfort is local

Check air speed, turbulence, vertical temperature difference, radiant temperature, humidity, activity and clothing together. Room-average air temperature is not sufficient to establish occupant comfort. [R1]

Head-to-ankle difference

$\Delta t = t(z_2) - t(z_1)$, in K. State the two heights and whether the occupant is seated or standing.

Mean vertical gradient

$G = [t(z_2) - t(z_1)] / (z_2 - z_1)$, in K/m. A temperature difference in K and a gradient in K/m are not interchangeable.

For example, a 1.4 K difference between 0.1 m and 1.1 m corresponds to 1.4 K/m over that interval. This arithmetic does not itself establish comfort compliance.

Historic guides give temperature and velocity limits under particular categories and test assumptions. Apply the project's adopted standard and its applicability conditions. The official ASHRAE 55 overview describes an updated vertical-gradient assessment in the 2023 edition. [R1]

Locate measurements at representative occupied positions, near terminals and at façades. Keep operative temperature distinct from air temperature. A cold window or warm radiant surface can affect comfort even where the air profile appears acceptable.

Define the near-zone correctly

A near-zone is a selection envelope tied to a specified air-velocity criterion. It must include the measurement height or maximum-velocity search method, airflow and supply-to-room temperature difference.

$L_{0.2}$ commonly denotes a distance associated with a maximum local speed of 0.2 m/s under the published conditions. It is a catalogue descriptor, not a universal comfort boundary.

The reference origin matters. The supplied 2014 guide measures some circular and half-round distances from the terminal axis, while rectangular distances follow a face-based convention. Check the actual drawing before placing a clearance on the room plan. [S2]

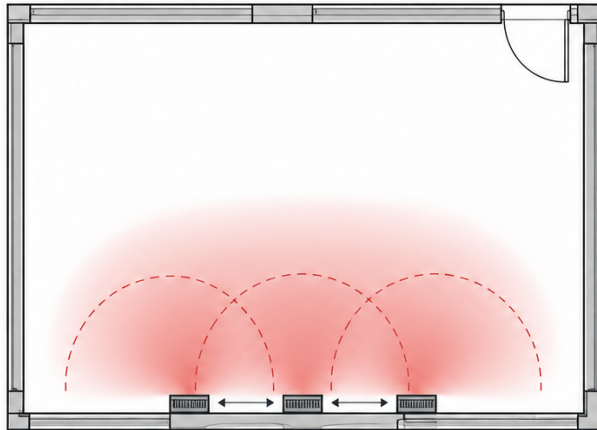
Conditional conversion example

Where a validated selection method explicitly permits $L_u = L_{0.2} \times 0.2 / u$, a stated $L_{0.2}$ of 2.1 m gives $L_{0.25} = 1.68$ m. This inverse relation belongs to that method and its stated 0.15–0.30 m/s range; it must not be assumed for every terminal, band or installation.

Do not scale an envelope from a photograph. Record the selected duty and its evidence beside the layout. Changes to face material, distributor setting or inlet arrangement require review.

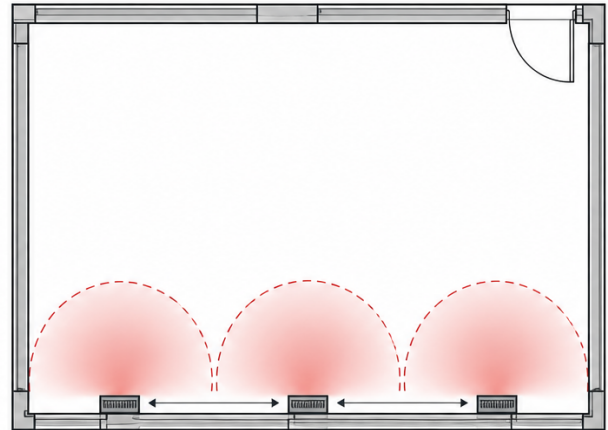
Spacing changes interaction

Near-zone interaction



Closely spaced terminals

Adjacent discharge patterns may interact.



Coordinated spacing

Check separation at the selected duty point.

Figure 05. Near-zone interaction and diffuser spacing.

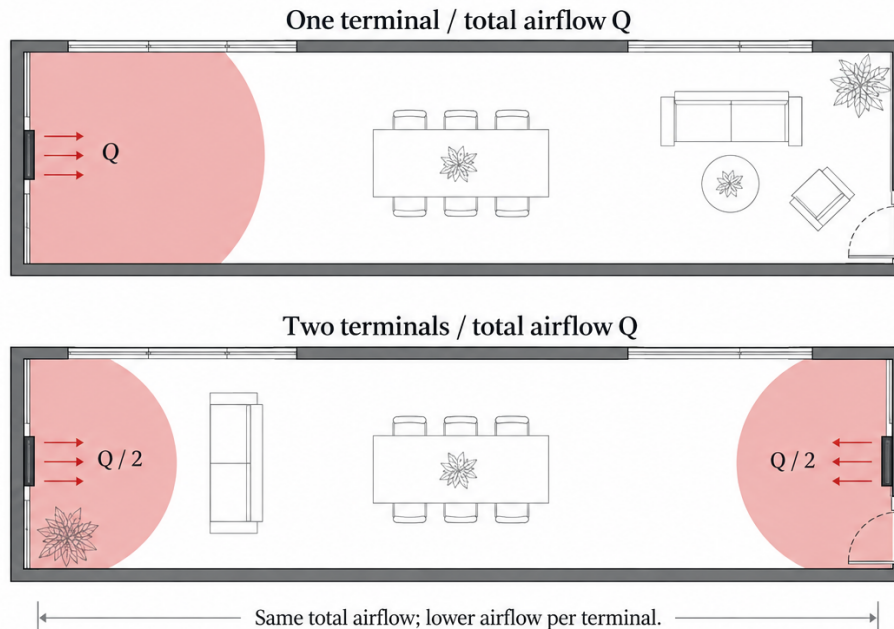
Several terminals on one wall do not necessarily behave as isolated units. Their streams may interact and form a broader region of elevated velocity. Use data applicable to the row or band when the individual patterns merge. [S1, S2]

The comparison shows the layout question: can the individual discharge regions develop without creating an unsuitable combined flow at occupied positions? The illustrated gaps do not specify a minimum distance.

Check adjacent walls and corners as well as a single straight wall. Furniture, local heat sources and opposing air streams can change the result. Keep seating and fixed workstations coordinated with the assessed envelopes.

Divide the duty, then verify

Distribute airflow. Coordinate the near-zone.



Lower terminal duty can reduce the individual near-zone.

Actual size depends on terminal design, temperature difference and the specified velocity criterion.

Figure 06. Airflow distribution: one terminal at Q and two terminals at $Q/2$.

For the same total supply flow, distributing duty between terminals can reduce individual near-zones. The result depends on terminal design and operating conditions; radius is not assumed to scale linearly with flow.

More terminals also add connections, balancing points and maintenance interfaces. The objective is a coordinated distribution, not the largest possible number of outlets.

After dividing the flow, recheck pressure, sound, minimum duty and mutual interaction. A smaller individual region does not prove coverage of the remaining room or compliance at every occupied position. [S1, S2]

Single outlet, row or wall band

Geometry changes the discharge pattern

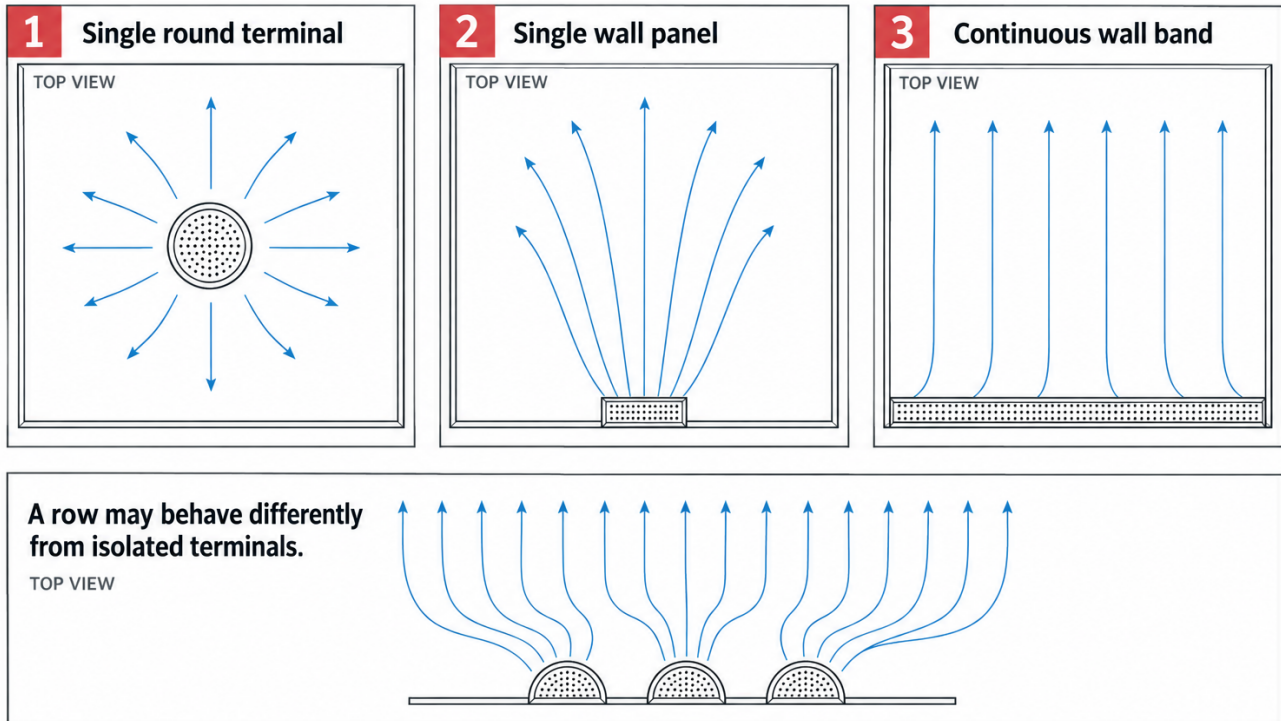


Figure 07. Radial, forward and linear discharge patterns.

Round and half-round terminals spread air radially to different degrees. A rectangular face tends to produce a more forward-directed flow. A long band or a row of interacting terminals may retain a more nearly linear flow away from the wall.

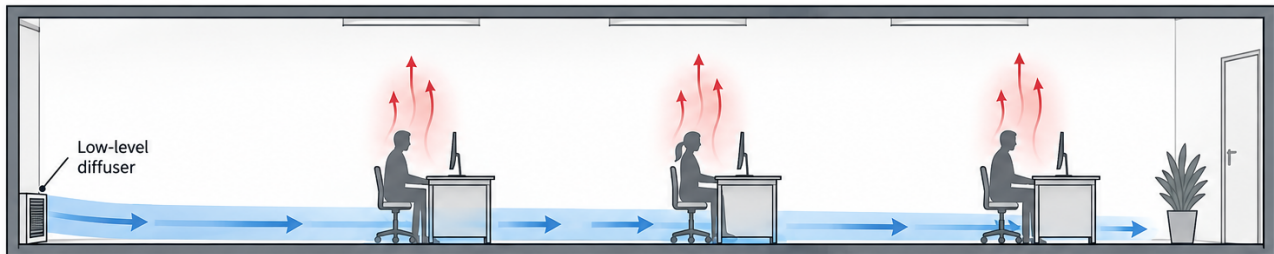
Use the right flow basis. Flow per terminal, flow per metre of active band and flow per square metre of floor are different quantities. State whether a row's reference length is active outlet width or overall occupied wall length.

Low and tall rectangular bands may require different selection methods. The 500 mm division used in the 2014 guide belongs to its product assessment; it is not a general physical discontinuity. Do not transfer a single-terminal curve to a band. [S2]

Coverage and obstructions

Coverage follows the available air path

Clear floor path



Coordinate terminal location with occupied positions.

Obstructed or locally heated path

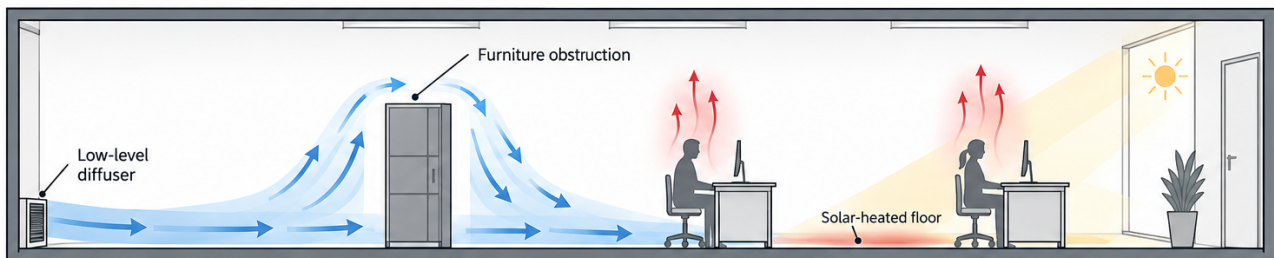


Figure 08. The influence of obstructions and local heating on floor airflow.

Penetration depth depends on the available path and the balance of supply flow and thermal loads. The supply must remain suitable for the intended cool-air displacement mode; warmer low-level air can rise before serving the floor region.

Storage, dense seating, heated floor patches and entrance crossflows can divert or disrupt the shallow supply layer. The illustrated cabinet represents a changed path, not a prediction that air will follow one fixed route.

If coverage is inadequate, consider terminals at columns, on another wall or within the floor, then reassess interactions. Historical guide distances are conditional examples. A fixed coverage radius must not replace a project assessment. [S1, S2]

Special supply arrangements

Special arrangements need dedicated verification

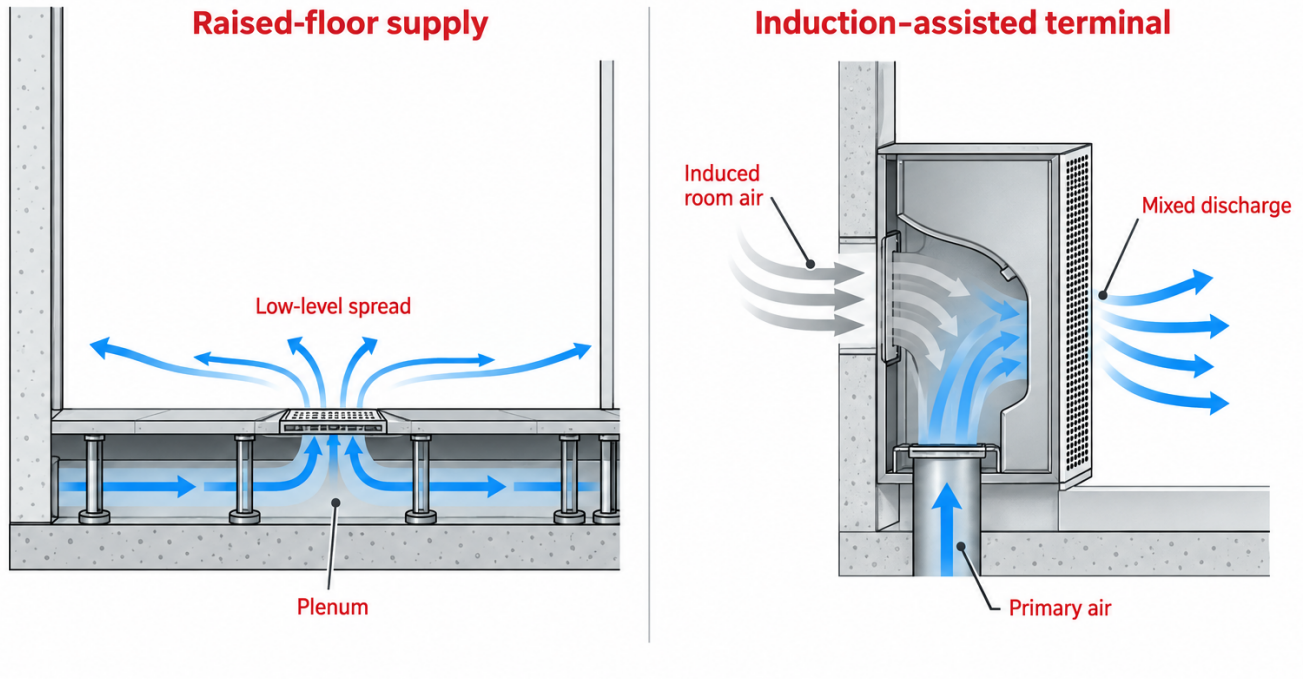


Figure 09. Raised-floor supply and induction-assisted air distribution.

Raised-floor supply. Verify plenum pressure, leakage, temperature and outlet balance. Not every floor diffuser operates in displacement mode; discharge momentum and room conditions determine the resulting pattern.

Induction-assisted supply. Secondary room air mixes with primary air before discharge. For sensible mixing at similar density, $t_{mix} = (q_p t_p + q_s t_{room}) / (q_p + q_s)$. The mixing ratio and final discharge conditions need tested data.

High-level special terminals. Some designs guide cool air down a wall to the floor. They require dedicated selection because descending air can accelerate through occupied space. Do not apply low-level clearances or the older guide's temperature limits without validation. [S2]

Close the sensible heat balance

Use the air-side sensible load after accounting for any radiant or other supplementary system. For a defined steady control volume:

$$\Phi = \rho c_p q_v (t_e - t_s)$$

Φ is heat removed by the air [W]; ρ is density [kg/m^3]; c_p is specific heat [$\text{J}/(\text{kg}\cdot\text{K})$]; q_v is total supply flow [m^3/s]. t_e is the high-level leaving-air temperature, not automatically the room setpoint.

$$\epsilon_t = (t_e - t_s) / (t_r - t_s)$$

Temperature effectiveness compares temperature differences. A value of 1.5 means 150%; it does not mean 50% energy savings or a cooling-machine efficiency.

The balance alone does not predict t_e . Close it with measured temperatures, a justified effectiveness assumption or a validated room model. Ceiling height and floor load are inputs to a model, not proof of a particular ϵ_t .

For examples here, $\rho = 1.20 \text{ kg}/\text{m}^3$ and $c_p = 1006 \text{ J}/(\text{kg}\cdot\text{K})$. Adjust for project conditions. Moisture and latent loads are separate calculations.

Unit check: $1 \text{ m}^3/\text{s} = 1000 \text{ l/s} = 3600 \text{ m}^3/\text{h}$. A temperature difference of 1 K equals a difference of 1 °C. Flow per floor area uses $\text{l}/(\text{s}\cdot\text{m}^2)$; flow per band length uses $\text{l}/(\text{s}\cdot\text{m})$.

Worked layout: a 70 m² office

This independent arithmetic example uses the scale of the supplied layout example but does not adopt its product ratings or nomogram as GERHMAN data.

Inputs: 70 m² floor area; 3.5 m room height; air-side sensible load 2570 W; $t_s = 20\text{ °C}$; $t_r = 23\text{ °C}$; assumed $t_e = 26\text{ °C}$. The vertical profile remains to be verified.

1 / Total flow

$$q_v = 2570 / (1.20 \times 1006 \times 6) = 0.355\text{ m}^3/\text{s}$$

Result: approximately **355 l/s** or **1277 m³/h**.

2 / Specific flow

$355 / 70 = 5.07\text{ l/(s}\cdot\text{m}^2)$. This is an example result, not an office limit.

3 / Terminal allocation

Five equal terminals would each carry approximately **71 l/s**. Select face area, connection, pressure and sound from verified data at this duty, then plot the correct near-zones.

4 / Check the assumption

The assumed temperatures imply $\varepsilon_t = (26 - 20)/(23 - 20) = 2.0$. The room height alone does not justify this value. If the leaving-air rise were only 5 K, required flow would increase to approximately 426 l/s.

5 / Complete the design

Calculate outdoor air independently. Verify local comfort, façade effects, control range and terminal access. At exactly 350 l/s and a 6 K rise, the same heat balance gives 2.535 kW; rounded guide inputs should not be mistaken for exact equality.

Auditoriums: layout and calculation

Under-seat displacement diffusers integrate low-level supply with opera and cultural-centre seating. Coordinate chair supports, outlet orientation, row spacing and floor-plenum balance.

Worked example

120 seats; one terminal per seat; 12 l/s per terminal; supply 20 °C; leaving air 26 °C.

$$q_{\text{total}} = 120 \times 12 = \mathbf{1440 \text{ l/s.}}$$

$$\Phi = 1.20 \times 1006 \times 1.440 \times 6 \\ = \mathbf{10.43 \text{ kW.}}$$

A 14 kW air-side load at the same 6 K temperature rise requires **1933 l/s**, or **16.1 l/s per seat**.



Figure 10. Under-seat displacement ventilation.

Design and verification

Before increasing flow, check ankle-level speed, temperature difference and octave-band sound with the actual chair and riser geometry. Consider additional outlets, another discharge arrangement or supplementary sensible cooling.

Balance the plenum across rows and verify full and partial occupancy. Assess audience areas, balconies, orchestra pit and stage separately where their requirements differ.

The calculated flow is total supply; determine minimum outdoor air independently. One terminal per seat is the example arrangement. [S3]

Sensitivity to effectiveness

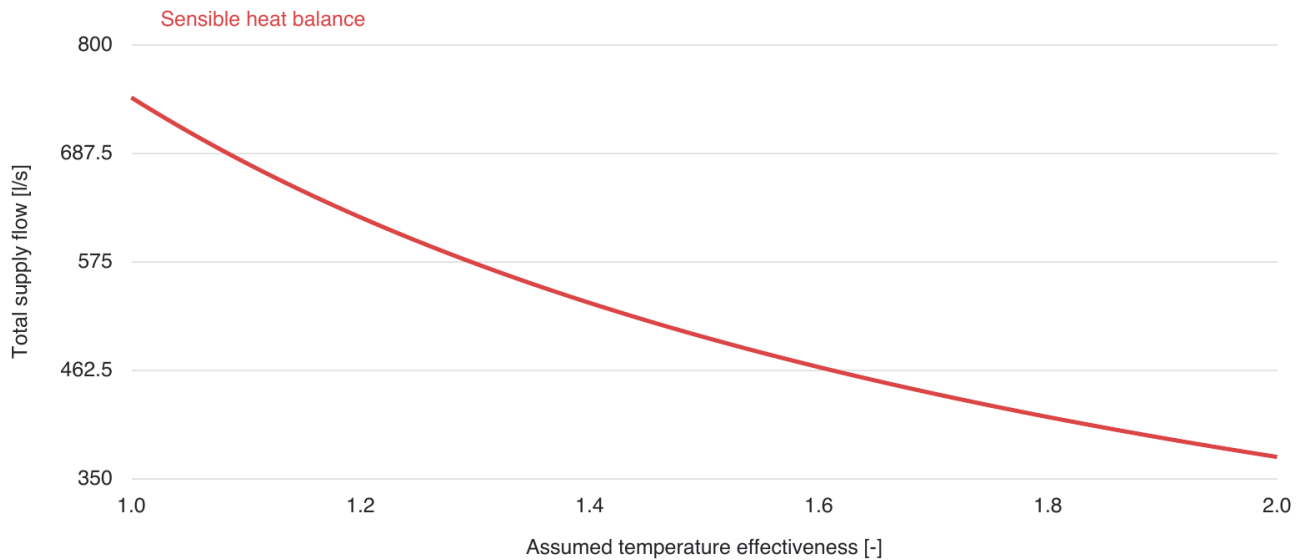


Figure 11. Supply airflow as a function of temperature effectiveness.

For an independent 80 m² office example with a 3600 W air-side load, $t_r = 24$ °C and $t_s = 20$ °C:

$$q_v = 3600 / (1.20 \times 1006 \times 4 \times \epsilon_t)$$

At $\epsilon_t = 1.20$, 1.50 and 1.80, the calculated supply flows are approximately **621**, **497** and **414 l/s**. An optimistic assumption can therefore materially undersize the system.

At $\epsilon_t = 1.50$, $t_e = 20 + 1.50 \times 4 = 26$ °C. Four equal terminals would carry approximately 124 l/s each. This closes the example heat balance, not the comfort or acoustic assessment.

The algebraic curve is independent of the educational transport model. Do not use agreement between these two graphics as validation.

Outdoor air is a separate duty

Total supply flow removes the assigned air-side heat and establishes distribution. Outdoor air addresses ventilation requirements. The quantities are equal only in an all-outdoor-air arrangement.

$$V_{bz} = R_p P_z + R_a A_z$$

$$V_{oz} = V_{bz} / E_z$$

R_p and R_a are the applicable person and area rates; P_z and A_z are occupancy and floor area. Select rates and E_z from the adopted standard for the actual supply arrangement. A floor-level terminal does not automatically qualify for a favourable factor. [R2]

For arithmetic only, assume 12 people, 80 m², $R_p = 5 \text{ l/(s·person)}$, $R_a = 0.5 \text{ l/(s·m}^2\text{)}$ and $E_z = 1.0$. Then $V_{bz} = V_{oz} = 100 \text{ l/s}$. These are illustrative coefficients, not quoted category requirements.

Within the preceding 497 l/s supply example, this would mean 100 l/s of zone outdoor air, subject to the complete system calculation. An all-outdoor-air system would supply all 497 l/s as outdoor air.

Keep three concepts distinct. Temperature effectiveness ϵ_t concerns heat balance. Zone distribution effectiveness E_z belongs to a ventilation method. Contaminant-removal effectiveness depends on the pollutant and concentration measurements. None is a direct annual energy-saving percentage.

Multi-zone ventilation, exhaust replacement, building pressure and minimum-load control may add requirements. Check the entire system, not only the room terminal.

Pressure loss and acoustic duty

Select the terminal at its actual connection and flow. Total pressure loss at the terminal is only part of fan duty; include ducts, filters, coils, attenuators and controls. An elbow, restrictive plenum or altered inlet may differ from the test arrangement.

$L_w = 10 \log_{10}(W / W_0)$, with $W_0 = 10^{-12} \text{ W}$.

$L_p = 20 \log_{10}(p / p_0)$, with $p_0 = 20 \text{ } \mu\text{Pa}$.

Sound power describes the source. Sound pressure describes the field at a receiver and depends on absorption, distance and other sources. Do not transfer a sound-power rating directly into a room acceptance level.

$L_{\text{total}} = 10 \log_{10}[\sum 10^{(L_i/10)}]$

Two independent contributions of 30 dB at the same receiver combine to approximately 33 dB. Levels from different receiver positions cannot be combined this way.

Use octave-band source data and the room acoustic design. A-weighted levels, NC and NR describe different things; there is no universal conversion offset. Check regenerated damper noise and duct-borne transmission.

Low-momentum supply can support a quiet installation, but its result depends on the complete assembly. Assess full and part load, especially for recording studios and performance spaces.

Controls, energy and humidity

A warmer terminal supply setpoint may extend economizer operation where outdoor temperature and humidity permit. Compare alternatives at the same indoor targets, occupancy and ventilation duty; include fan, cooling, heating and reheat energy. [R3]

Sensible and latent treatment. Air may need to be cooled below its terminal supply temperature to remove moisture, then adjusted before delivery. Check condensation risk at chilled surfaces and coordinate any radiant cooling with dew-point control.

Minimum operation. Reducing flow changes both near-zone behaviour and the balance of supply with thermal plumes. Establish a minimum that maintains required outdoor air, coverage and comfort; do not reduce solely from a room-temperature signal.

Locate control sensors in representative occupied conditions. The warmer upper room should not be assumed to represent the occupants. CO₂ trends can inform occupancy-related ventilation but do not describe every pollutant or establish overall air quality. [R4]

Heating mode. Warm low-level supply can rise before serving the intended floor region. Use a separate heating solution or validated changeover arrangement.

The cited classroom demonstration study illustrates how commissioning and operating settings affect measured results. A favourable monitoring period is not a general annual saving, and no guaranteed percentage is claimed here. [R3]

A simulation must state its physics

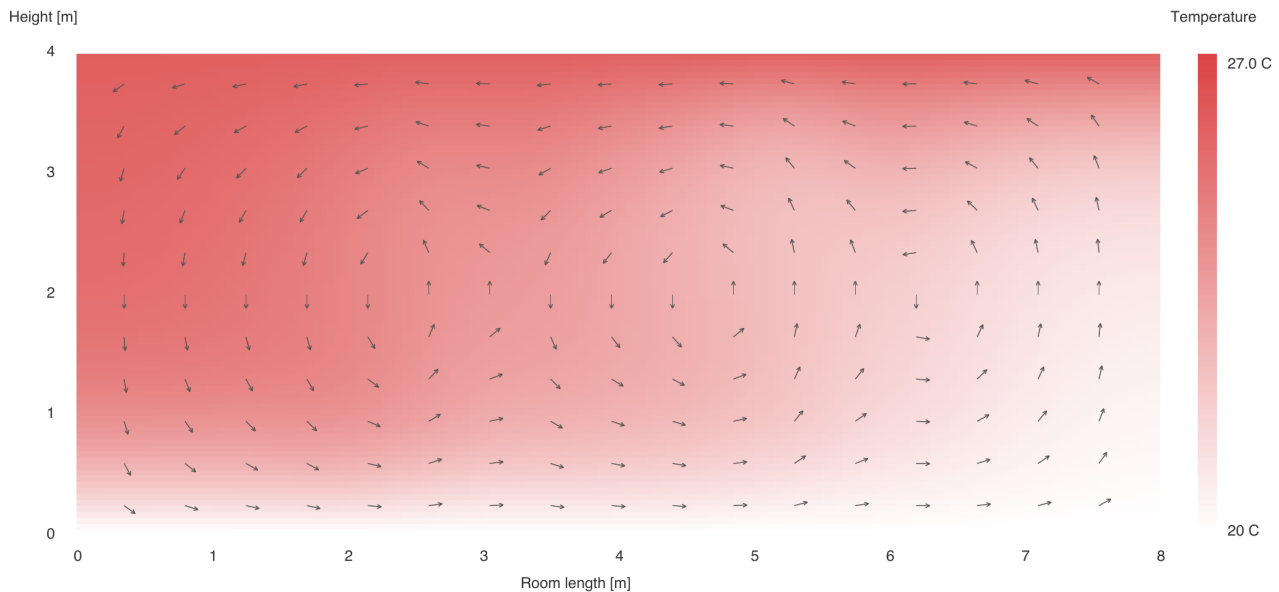


Figure 12. Temperature distribution in the scalar-transport model.

This field illustrates scalar transport over an 8×4 m domain using 161×81 nodes, a 0.02 s step and a 360 s calculation period. The effective diffusivity is $0.014 \text{ m}^2/\text{s}$. Two local source terms represent heat release.

Floor and ceiling temperatures are fixed at 20 and 26 °C; side boundaries are adiabatic. The velocity field is prescribed. Momentum and buoyancy are not solved, and there are no supply or extract mass-flow boundaries.

Consequently, the image is not a GERHMAN product test, a comfort prediction or CFD validation of displacement ventilation. The imposed temperatures partly establish the stratification.

For project CFD, use actual terminals, loads, geometry and boundary conditions; document mesh and convergence checks and compare relevant outputs with measurements. A colourful field image alone is not evidence of performance.

Commission and retain the evidence

Air balance. Measure terminal flows, total supply and outdoor air separately. Record balancing settings and available pressure. Use suitable methods for low-velocity discharge and document instrument uncertainty.

Comfort survey. Record supply temperature, vertical profiles and local velocities at occupied positions, façades and terminal-adjacent locations. State measurement heights, load and occupancy. Include sound measurements under agreed conditions.

Operating range. Test peak and partial load, minimum outdoor air, humidity control and response to occupancy change. An empty, unloaded room is not a direct test of occupied design performance.

Representative mock-up. For critical seating arrangements, test terminal, chair, riser, decorative surfaces and plenum together at the proposed duty. Record the physical arrangement so that results are transferable only within justified limits.

Handover record. Provide the terminal schedule, test data, balancing report, sensor locations, control sequence and maintenance instructions. Preserve original photographs and test records separately from presentation retouches.

Reassess the air path after changes to seating, partitions, scenery, storage, face panels or distributor settings. Keep removal and cleaning access available throughout operation.

Airports: placement and comfort

Tall departure spaces combine variable passenger numbers, extensive glazing and long operating hours. Coordinate low-level supply with waiting, working and circulation areas.

Placement and air paths

Columns and façade recesses offer installation opportunities but may restrict discharge. Keep active faces clear of seating, luggage and temporary retail elements; assess adjacent terminals together.

Comfort and operation

Check façade downdraughts, solar gains, entrance crossflows, peak queues and minimum operation. Coordinate high-level collection points with the intended air path.

Access and protection

Allow panel removal, cleaning and balancing without moving fixed furniture. Consider trolley and luggage impacts. Reassess the layout after fit-out changes.

The photograph illustrates integration; installed airflow and performance require project data. Confirm the function of architectural metalwork from system drawings.



Figure 13. Displacement diffusers integrated beside an airport terminal column.

Stages and film studios

Black-painted wall-mounted diffusers blend into dark stage surroundings. This cultural-centre installation illustrates visual integration; similar placement principles can inform film-studio layouts.

Keep the air path clear

Scenery, curtains and production equipment must not cover active faces. Review the arrangement when sets, lighting or heat loads change, and retain cleaning and balancing access.

Coordinate acoustics

Assess terminal and system noise by frequency band at performance or recording positions. Include duct-borne transmission and damper noise.

Coordinate the systems

Review stage and audience ventilation together with the venue fire and smoke strategy. Production fog, haze and other emissions need a separate assessment.

The photograph shows a cultural-centre application, not a film-studio reference. Thermal and acoustic performance require project data and testing.

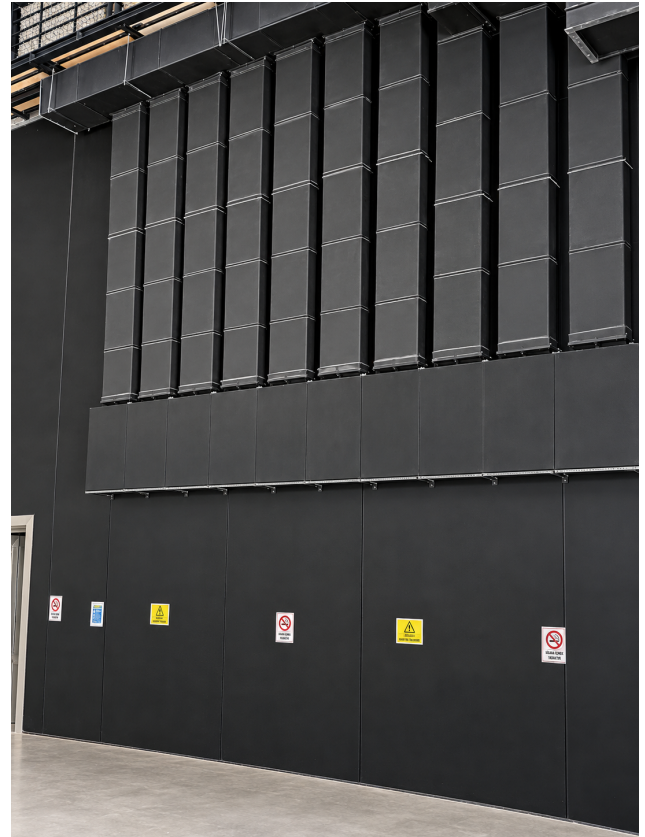


Figure 14. Black wall-mounted displacement diffusers integrated into a cultural-centre stage.

Offices and changing interiors



Figure 15. Displacement ventilation in an open-plan office.

An open office combines seated occupants, equipment gains and changing layouts. Wall, recessed and freestanding terminals should serve workstations without placing users in unsuitable near-zones.

Coordinate desks, partitions and storage before selecting terminal positions. Check perimeter solar and radiant effects as well as the air profile. Sensors should represent occupied conditions.

Low ceiling height is not an automatic exclusion, but the usable stratification region and local comfort become particularly important. Where the air-side cooling duty is constrained, consider supplementary sensible cooling with coordinated humidity control.

Retain an airflow review in fit-out changes. Cleaning access, active-face clearance and minimum outdoor air remain necessary after furniture is moved.

Selection record and notation

Minimum terminal schedule

Location and served zone; terminal model and size; inlet and mounting arrangement; face material; airflow range; supply-temperature range; total pressure loss; octave-band sound power; near-zone definition; balancing setting; access requirements.

Core symbols

q_v : total supply airflow [m^3/s]. Φ : air-side sensible heat [W]. ρ : air density [kg/m^3]. c_p : specific heat [$\text{J}/(\text{kg}\cdot\text{K})$]. t_s : supply temperature. t_r : stated occupied reference temperature. t_e : high-level leaving temperature. ε_t : temperature effectiveness. E_z : zone air-distribution effectiveness.

Area and length

A_{floor} : floor area [m^2]. A_{face} : stated terminal face area [m^2]. A_{free} : geometric free area [m^2]. L_u : near-zone distance for the stated criterion. Define the measurement origin and height.

Quality checks

Confirm l/s versus m^3/h ; K versus K/m; sound power versus sound pressure; total supply versus outdoor air; gross area versus free or effective area.

Do not turn a historical guide graph, conceptual illustration or AI-assisted photograph into a performance claim. Use verified product data and project measurements for the selected assembly.

References and evidence boundaries

Supplied technical sources

[S1] Displacement diffuser theory, supplied 2015 edition: stratification, effectiveness, near-zone interaction and terminal selection.

[S2] General layout specifications, DS 4069 E, April 2014, pp. 2–9: floor acceleration, outlet geometries, penetration, special arrangements and a layout example.

[S3] Theatre diffuser theory, supplied September 2021 edition: seating integration and representative terminal duty.

These historical sources informed the synthesis. Their commercial model codes, performance curves and catalogue ratings are not reproduced as GERHMAN data. A separate source-review file records the exact documents and adaptation decisions.

Independent references

[R1] ASHRAE Standard 55, [official overview](#). Apply the project-adopted edition.

[R2] ASHRAE Standard 62.1, [official standards access](#). Use applicable ventilation coefficients and system method.

[R3] Eley, Arent and Meister (2006), Displacement Ventilation in Action: Performance Monitoring of Demonstration Classrooms, [ACEEE paper](#).

[R4] Corsi et al. (2002), Carbon Dioxide Levels and Dynamics in Elementary Schools: Results of the TESIAS Study, [paper](#).

Visual provenance

Original GERHMAN logo retained. Application photographs are user-supplied processed images or AI-assisted retouches. Generated concepts and numerical teaching figures are identified in their captions. Source photographs are not evidence of certified performance.

English edition 4.0 / September 2026. Austria contact details sourced from gerhman.com/contact.



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