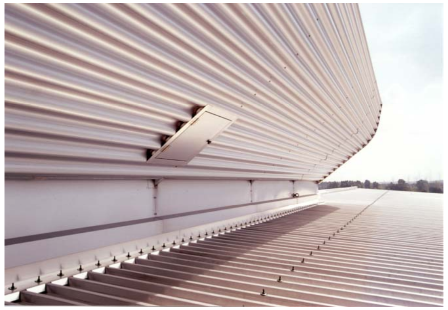


# *Intelligent products based on progressive technology*

The GAL Technology Centre for Applied Air Technology is another step in the direction of leading-edge technology. Over the years, GAL has built up vast expertise in the design and manufacture of ventilation systems of all sizes.

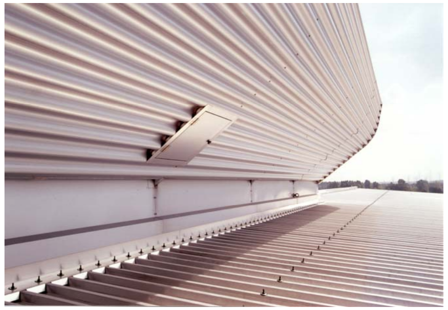
Our modern planning and execution concepts have contributed to our reputation as an industrial ventilation specialist. After analysing your requirements in detail, we develop the optimum solution. This is an aim that we have consistently pursued for many years in the fields of natural ventilation, smoke and heat exhaust systems, mechanical ventilation, heat recovery, sound insulation and daylight illumination technology.

An efficient ventilation system guarantees your productivity, boosts the morale of your workforce and reduces reject rates and downtime. We contribute to environmental technology because our designs enhance workplace conditions.


Insist on economical, intelligent ventilation concepts. Rely on our expertise.

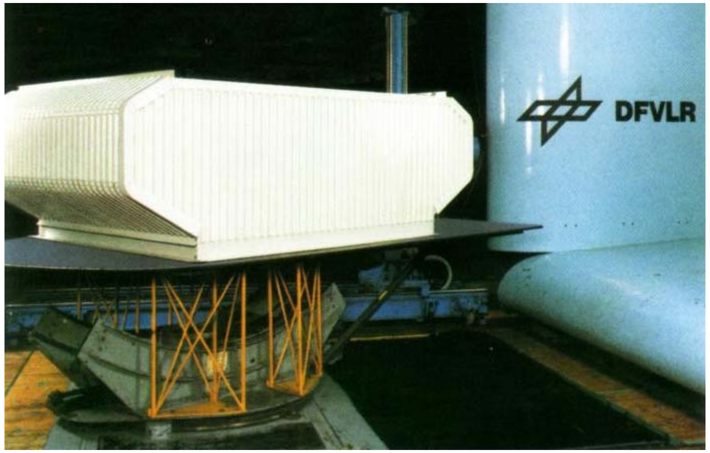
GAL offers a comprehensive portfolio of consulting and planning services:

- All-inclusive delivery and assembly of industrial ventilation systems
- Ventilation technology testing/expertises
- Design/dimensioning of ventilation system solutions
- CFD (computational fluid dynamics/numerical flow simulations)
- Model tests in the wind tunnel
- Preparation of requests for bids
- Technical controlling

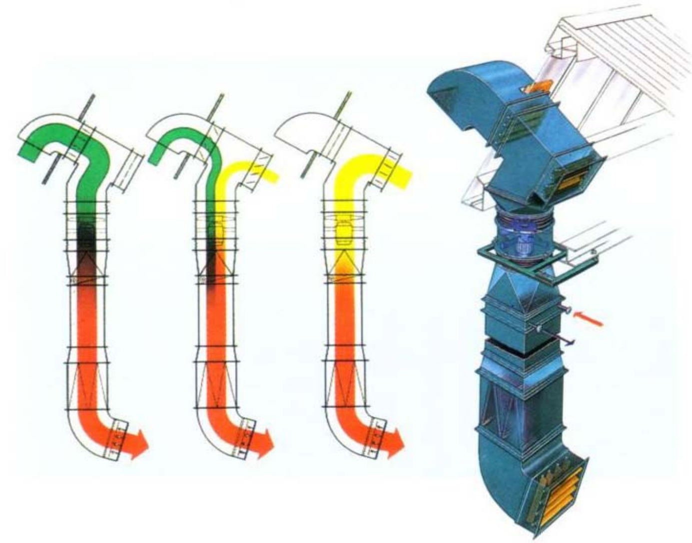


# Energy-efficient ventilation

## Energy-saving ventilation and fire ventilation systems




**Wind tunnel testing enables the optimisation of ventilation system design.**
These tests are essential to establish the ideal aerodynamic shape for the ventilation system components and enable the practical application of theoretical knowledge. The GAL gravity roof ventilators were specifically developed to satisfy the tough requirements of industrial buildings. They are robust, maintenance-free and - due to their high aerodynamic efficiency and the resulting maximum airflow rates - they are the perfect solution for the effective ventilation of problem zones.
These ventilators are distinguished by their flat, aerodynamic silhouette. They are fitted with maintenance-free control dampers. This enables the adaptation of the outside air temperatures. The control dampers are operated either electromechanically or pneumatically.



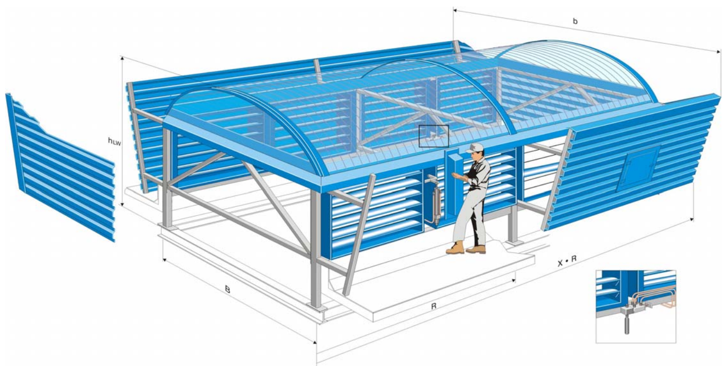
**Energy is a valuable resource. Don't waste it, recycle it!**
Aerotherm is an energy-saving concept for the ventilation and heating of industrial buildings and warehouses. It is suitable for diverse applications and therefore facilitates customised solutions:

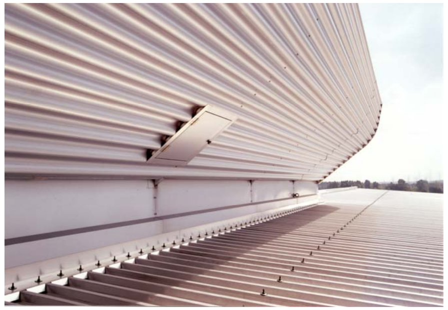
- Fresh air - mixed air - recirculating air
- Heating
- Reduction of power consumption through integrated heat recovery
- Air filtration

**The GAL multipurpose ventilator for:**
**Natural Ventilation · Fire Ventilation · Daylight Illumination**

This system enhances the quality of air and lighting at the workplace, thereby contributing to improving safety and saving energy. It has an optimum aerodynamic shape, delivers high extract air volume and guarantees permanent ventilation, even in adverse weather conditions. In the event of fire, the system automatically and effectively exhausts smoke and heat from the building.

Due to the special design of this system, it incorporates unbreakable, weatherproof, convex glass. It demonstrates excellent transparency (90%), low weight and outstanding flame-retardant properties.





# The principle of natural ventilation

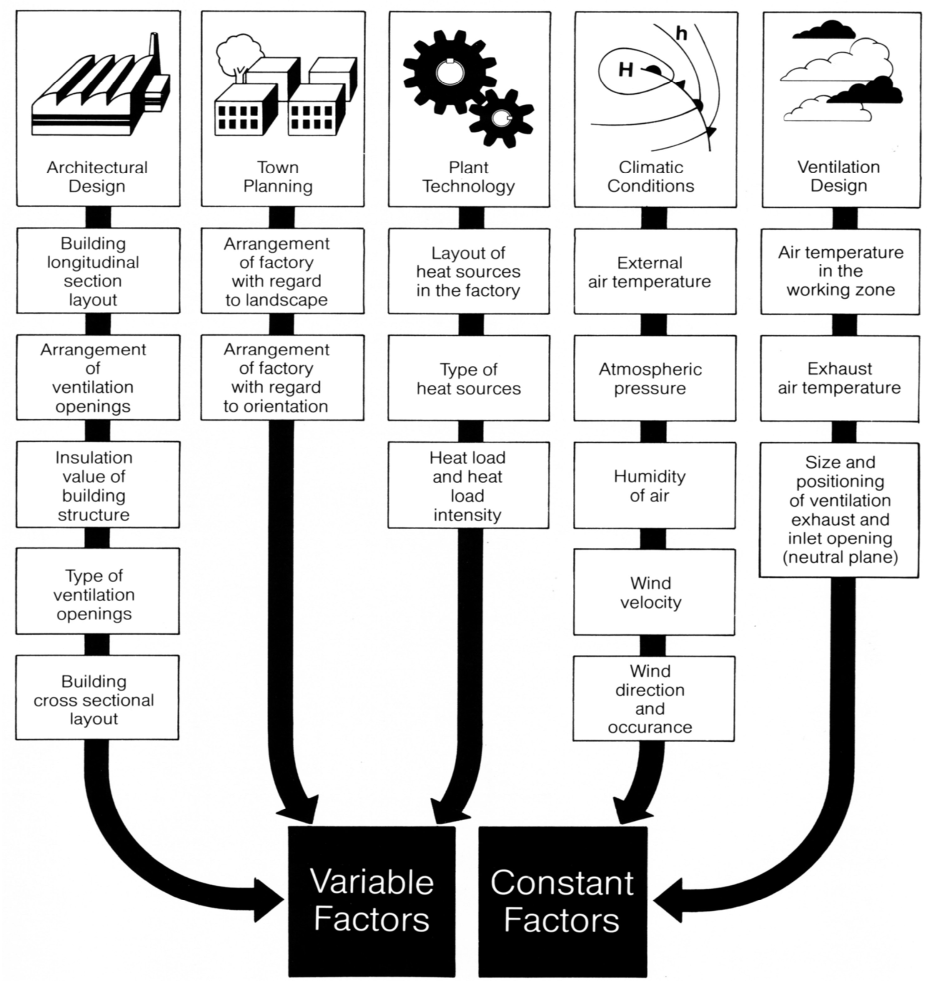
**The principle of natural ventilation**
Natural ventilation takes advantage of the thermal buoyancy of the air in the building, which is caused by the difference in density between the air in the building and the outside air.

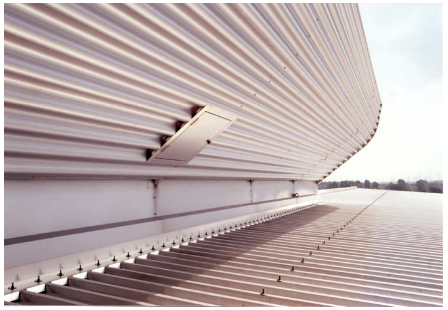
It is practical to install natural ventilation systems in buildings that contain heat-intensive technology. The technology used in these buildings emits convection and radiation heat into the environment, which means that extremely large mass air flows are necessary. Generally, these cannot be realised with mechanical ventilation. In some cases, it will be necessary to combine natural ventilation with mechanical ventilation, e.g. via local climate control or air heating units.

Natural ventilation requirements in accordance with the building plan must be ascertained at an early stage of the building project. Effective solutions are only possible if competent construction engineers, technologists and ventilation engineers work together as a team right from day one. As a result, project design expenditure and the cost of a natural ventilation system will be similar to the costs associated with the dimensioning of a mechanical ventilation system. These costs are generally justified, and the fact that the system is more economical in use means a higher return on investment.

GAL natural ventilation systems are extremely cost-effective because they operate without an additional power supply and are maintenance-free.

**Factors of influence on natural ventilation**
One of the most important parameters for the efficient performance of a natural ventilation system is the constructional and technological design of the building. At the same time, the system's efficiency results from the positive coaction of numerous other factors of influence.





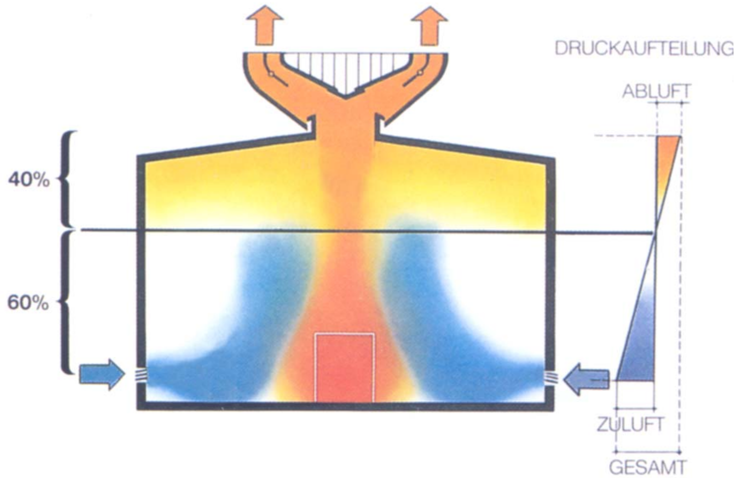
# The neutral plane

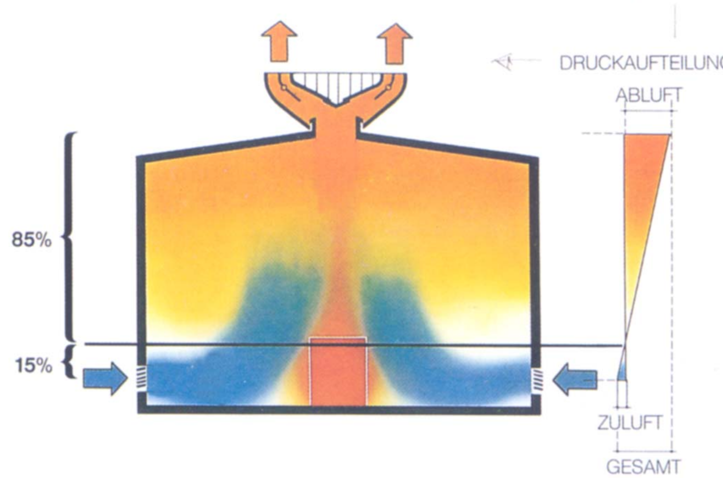
**The neutral plane is a decisive factor for cost and function**

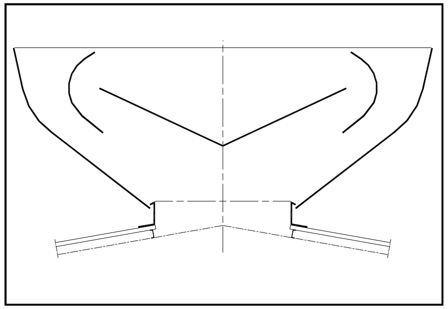
The neutral plane is an imaginary horizontal plane, where internal pressure is equal to external atmospheric pressure. Air inlet vents located here are ineffective. Above the neutral plane, internal pressure is higher than external atmospheric pressure. This is why the air outlet vents are always located here. The air inlet vents are always located below the neutral plane because a plane of sub-atmospheric pressure is produced there.

When designing a natural ventilation system, it is necessary to predetermine the height of the neutral plane and ascertain the proportion of pressure difference that is available to overcome flow losses in the air inlet vents and the proportion that will be used by the air outlet vents.

The precise position of the neutral plane and thus the arrangement of the air inlet vents on the building facades can only be ascertained according to the iteration method. Random position determination can lead to a completely incorrect measurement of surface ratios. As a result, predetermined inlet air velocities may not occur and computed temperature differences are often exceeded. In extreme cases, this may render a natural ventilation system ineffective.





# High-Performance Gravity Roof Ventilators

**Series RIF - an innovative ventilation system that sets standards for the future**

This high-performance gravity roof ventilator Series RIF is distinguished by the following features:

- The Series RIF gravity roof ventilator offers twice the capacity of conventional ventilators with the same constructional dimensions.
- The structural weight of the Series RIF gravity roof ventilator has been reduced by approximately 30% through improved design loads which have been verified in wind tunnel tests.

The world's highest coefficient of discharge $C_{vo}$ = 0.78 makes the Series RIF ventilator ideal for buildings with extreme heat loads resulting from technological processes.

**Aerodynamic optimisation**

In addition to architecture and process-related factors of influence, one of the basic prerequisites for the optimum design and performance of a ventilation system is a precise knowledge of the ventilator's aerodynamic properties.

The first ventilators were developed on the basis of tests carried out at the Mellon Research Institute in Pittsburgh back in 1923. From then up to the present day, the designs have been continuously optimised on the basis of relevant aerodynamic tests.

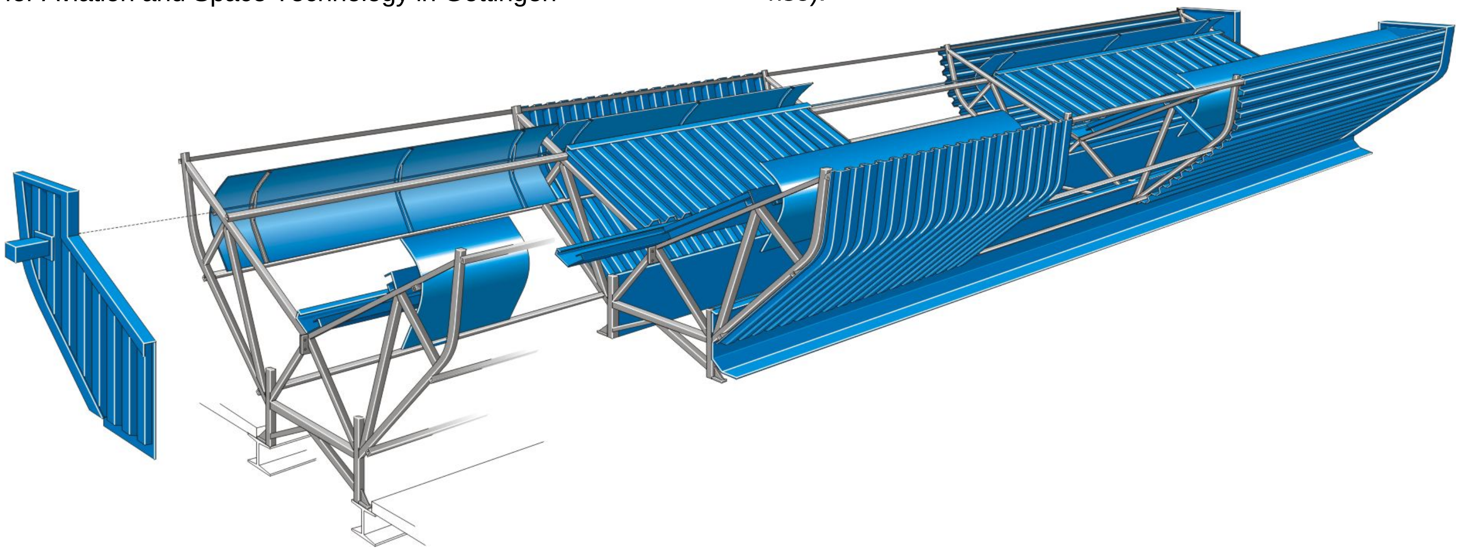
In conjunction with a new product range policy that was introduced for our ventilators in the 80s, comprehensive aerodynamic flow tests were carried out on many of our models at the DLR - German Research and Testing Institute for Aviation and Space Technology in Göttingen and at the MBB's aerodynamic testing department.

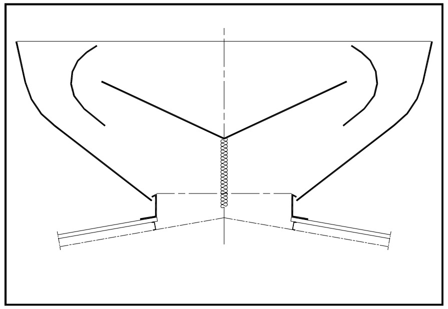
Supplementary studies were also commissioned at Arsenal in Vienna and at the Laboratorie Eiffel in Paris.

Flow visualisation on natural ventilator models in hydrodynamic tanks and using laser light section technology provided us with information about 'internal' and 'external' aerodynamics.

To improve the air flow rate in natural ventilators, it is necessary to prevent primary pressure losses caused by flow separations. In areas of separated flow, swirl effects can occur which consume energy and therefore lead to losses.

Such separations tend to occur in flows about sharp edges and in areas where the flow is extremely retarded (pressure rise).





# Sound Attenuated High-Performance Gravity Roof Ventilators Series RIF-A, A1 and A3

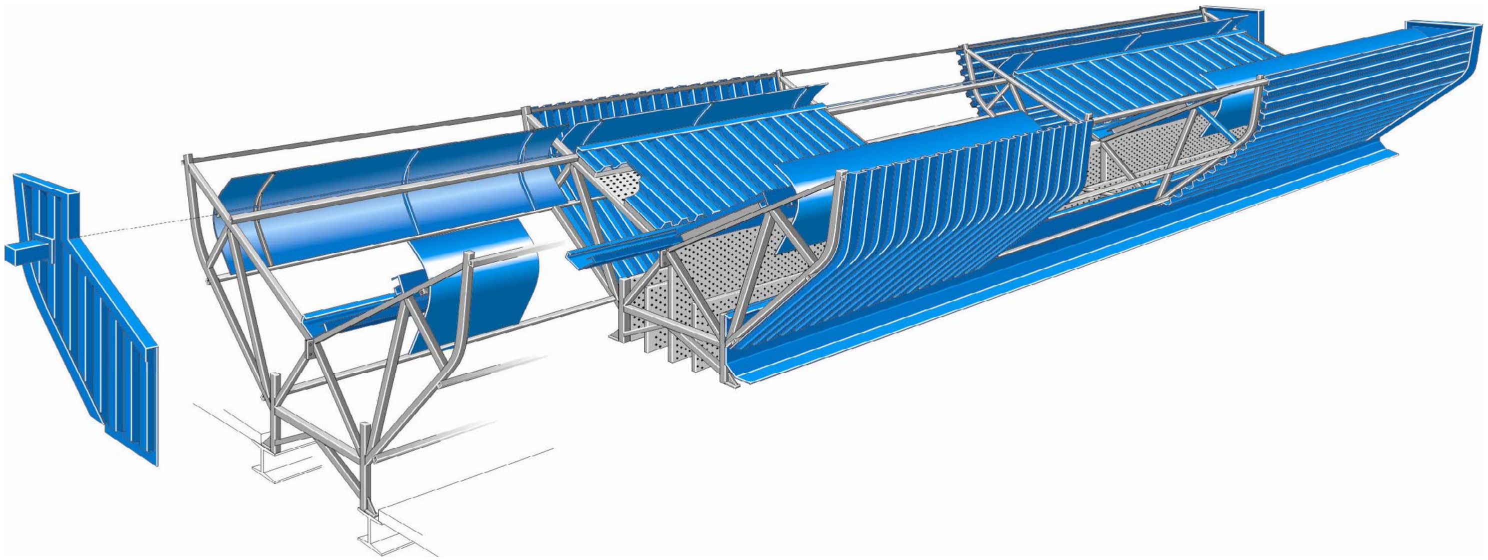
**Series RIF-A sound attenuated natural ventilator - the cost-effective solution for industrial ventilation and noise control.**

This sound attenuated gravity roof ventilator is based on the configuration of the basic Series RIF. These ventilators are used for applications with high noise reduction requirements in buildings with high specific heat loads or extensive heat sources. The ventilator shaft and the flow guide roof are cladded with non-combustible sound absorbing slabs.

The Series RIF-A sound attenuated gravity roof ventilators are subjected to large-scale noise tests in an echo chamber. These tests and measurements are essential to precisely ascertain and guarantee noise reduction properties for frequencies within audition limits. Natural ventilators in the Series RIF-A can deliver a sound insulation factor of up to R'w = 24 dB at a coefficient of discharge ($C_{vo}$) value of between 0.78 and 0.65.

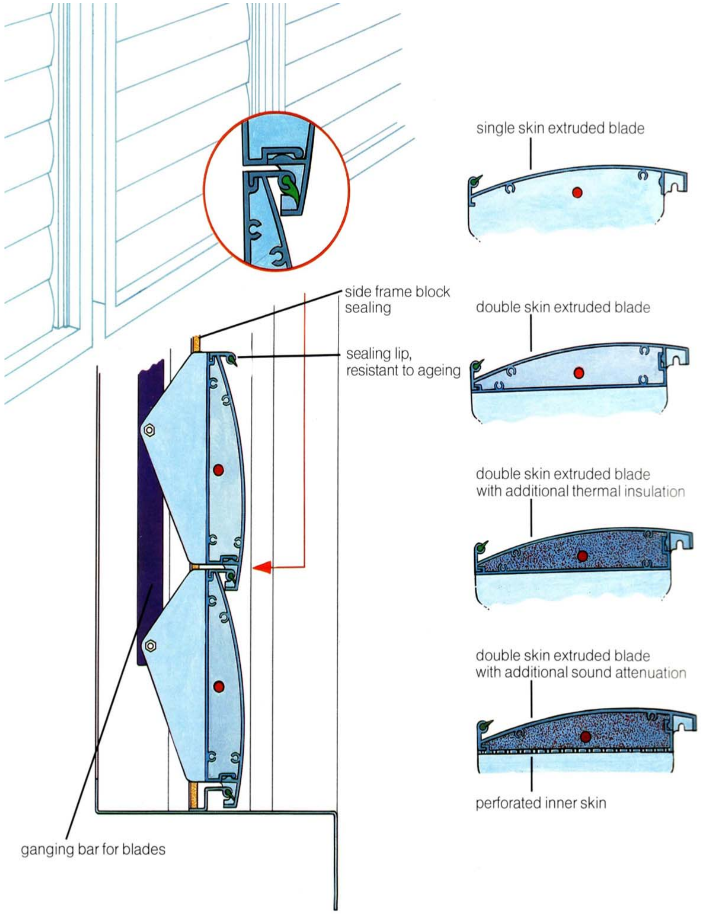
These ventilators offer an optimum combination of high aerodynamic coefficient of discharge $C_{vo}$ and maximum noise reduction efficiency.

The Series RIF-A ventilators are, just like the RIF series, optionally available with a certified heat and smoke extraction function.



# Series LUE/LUD
# Air inlet louvres for extreme requirements

GAL has developed an entirely novel type of louvre, Series LUE/LUE-F and LUD, that sets standards for the future. It is suitable for both architectural and industrial applications. The innovative design of the aerodynamically optimised blade profiles was developed on the basis of an aircraft wing profile and tested at the the DLR (German Research and Testing Institute for Aviation and Space Technology) in Göttingen. It enables maximum air intake capacity and optimum rain-tightness. This new louvre model with stormproof blades is still effective when installed in highly exposed locations, such as power stations (boiler houses) or in the steel/ aluminium-making industry, where high wind speeds can occur. The louvres can be individually adapted to match the architecture or colour of the building facade.




**Construction**

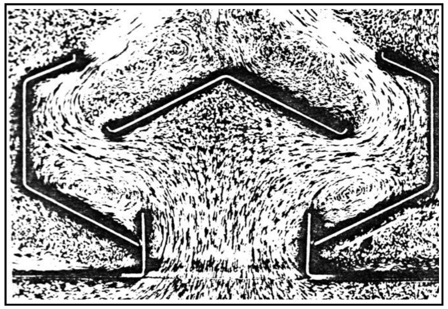
In the single-skin version of Series LUE/LUE-F, the blades are made of heavy gauge extruded aluminium sections that are inserted in a torsionally-rigid, aluminium frame. The single-skin model is optionally available in a fixed or operable blade version.

- Series LUE-F, the fixed blade version, is suitable for large-scale air supply systems due to its extremely favourable aerodynamic properties and its excellent rain-tightness.
- Series LUE-R, The operable version, can be fitted with the optional extra of integrated lip seals on the blade profile and with side frame block seals (special aluminium profile with inserted brush seal). This ensures increased air and dust tightness when the louvre is closed.
- Series LUD-R is the double-skin operable version. The blades consist of the above profile with an additional lower skin made of extruded aluminium. A non-combustible mineral wool slab can be inserted in the hollow space between the two skins.

The double-skin version offers the following advantages:

- Higher blade rigidity (stormproof)
- Better coefficient of discharge
- Larger louvre widths
- Sound attenuation
- Thermal insulation
- Air and dust tightness

thereby satisfying the very highest standards of modern ventilation technology.



# Design fundamentals

The size of the air inlet and exhaust air surfaces for the natural ventilation of a building are calculated on the basis of

- pressure balance
- air flow balance and
- heat flow balance

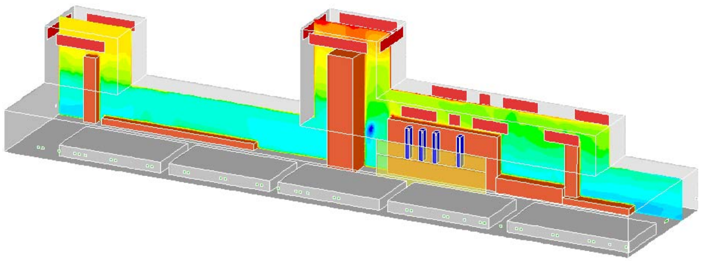
whereby the balance limit is the top outside surface of the building.The calculation is made according to a special procedure on the basis of a network plan, analogous to meshed electrical networks. The second degree equation that this produced is solved using a special arithmetical procedure.

This dimensioning procedure enables

- the calculation of any number of vents
- the variation of all relevant parameters for these vents, such as installation height, geometric or aerodynamically effective surface, pressure loss coefficient (or drag coefficient) and local wind pressure coefficient,
- taking the values for outside air temperature, wind direction and wind speed into account,
- an assessment of the effects of mechanical ventilation or air extraction on natural ventilation,
- the establishment of inside and outside heat flows.

**CFD - Computational Fluid Dynamics**

CFD software enables the computer simulation of flow patterns and the associated physical phenomena, such as heat and mass transfer, in industrial ventilation components and systems.
The applications for CFD extend from modelling laminar and turbulent outside air flows, though the calculation of temperatures, including heat exchange and radiation, to the acquisition of data on of mixing processes, mass transfer and the expansion of concentration fields, such as smoke spread and fire simulation.




**Wind tunnel tests**

When elaborating complex solutions, wind tunnel tests on the models provide additional confirmation of theoretical assumptions. These days, despite the existence of 3D computer models, aircraft are still tested in wind tunnels before the first prototype is built. Although vast progress has been made in the computerised adaptation of estimation models and an enormous increase in the computing power of modern-day PCs has occurred, wind tunnel tests are a practical and essential tool for obtaining verification of function-critical systems in borderline cases.