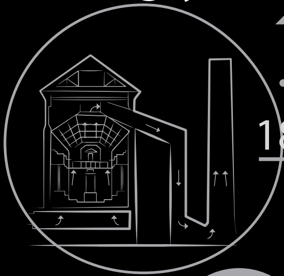
TO NOW

HISTORY of Ventilation Technology



1854

FROM THEN

From a Western Perspective

CONTENT

FORE WORD

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The primary purpose of all buildings is either to house people or to provide suitable spaces where activities of different kinds can be pursued. To achieve this, the indoor climate must be such that the occupants can experience comfort and avoid being subject to health hazards. Importantly, the quality of the indoor air must be maintained an acceptable level, which means, among other things, being totally void of smells and any substances that could lead to health risks.

This is what a ventilation system does and its proper functioning is a prerequisite for us to be able to remain indoors. However, ventilation is and always has been an essential ingredient in the art of designing and constructing buildings.

In the following ***HISTORY OF VENTILATION TECHNOLOGY*** - ***From a Western Perspective***, the subject is examined in its historical context from a western-world perspective, from ancient times until the present day. A picture is provided of how ventilation has always been a part of the building process and how the methods to provide suitable ventilation have advanced alongside the developments in building techniques. The ventilation solutions now available are directly related to the way in which we design and build, as well as to the demands we make on the indoor climate.

The following historical overview is a contribution worth considering to the understanding of the fact that evercontinuing developments of both building techniques and methods of ventilation are really important.

VENTILATION TECHNOLOGY

VENTILATION, VENTILATIO, VENTUS!
VIND, LOFT, LUFT!

Ventilation technology has a long history and has gradually developed alongside the changes brought about by the evolution of industries and buildings as well as changes in our personal needs.

The word 'ventilation' comes from the Latin ventilatio, in turn from ventus meaning wind, which was described in 1660 as a process to *'replace poor air in an enclosed space with new and clean air'*. It was also used early on to mean 'breathing', i.e. the exchange of oxygen and carbon dioxide in our lungs. The term was thus used to describe a process that was that was liberating, cleansing and necessary.

The Swedish word vind, meaning both wind and loft, is also derived from ventus. In Old Swedish, the vind was the highest part of a building, the place under the roof where it was draughty. The word 'loft' in Swedish is also related to the Swedish words for air - luft and for smell - lukt. There is obviously a very early connection between the idea of ventilation and air quality, and it is, therefore, not so surprising that ventilation and health were linked together from a very early date. However, from a technical perspective, ventilation and heating were, for a long time, the results of one and the same idea. Consequently, there was no specific point in time when the very first system was invented or put into use purely for ventilation purposes.

MANUALLY-DRIVEN WOODEN FANS AND BELLOWS

During the Middle Ages, air was still regarded as one of the four elements, which, together with fire, earth and water, made up the world. The purpose of breathing was to cool the heart, which was filled with the element fire. Furthermore, at this time, it was commonly known that poor, standing air contained mysterious gases that caused diseases and even death. This was readily observed, as mines were being excavated to increasingly deeper depths. The economic incentives to continue mining eventually led to a number of technically advanced ventilation solutions in the middle of the 1500s. These involved not only the use of fire as a driving force but also manually-driven wooden fans and bellows. Later on, these ideas were adapted for use in buildings and remained in use for a long time to come.

When towns began to grow in the 1700s, and housing conditions became more cramped and sanitary solutions inadequate, health issues became increasingly more acute. It was suspected that certain diseases were airborne and ventilation to create sound indoor air was given high priority, especially in buildings where it was particularly obvious that diseases and ill-health were easily spread. Included in this category were prisons, ships, military barracks and, ironically, hospitals. Around 1770, there was scientific proof that fresh air was, in fact, healthier than stale indoor air. Poor air was also known to contain high concentrations of carbon dioxide, moisture and pollutants emanating from various sources such as humans, torches and fuel lamps.

HEAT-DRIVEN VENTILATION

Before steam engines and electricity made it possible to run fans efficiently, airing was often the only available ventilation solution for buildings. However, there was always a certain flow of air through the chimneys thanks to the so-called stack effect. The principle is simple - warm, less-dense air will rise up through a building, creating an under-pressure at the lower levels, thus drawing in fresh outdoor air through any openings, intentional or not. Heating offered free ventilation and this became known as heat-driven ventilation. Until the middle of the 1900s, airing and *heat-driven ventilation* systems were often sufficient for use in housing. However, in other types of buildings, such as schools, hospitals, industrial plants, prisons etc. they were often inadequate. Consequently, nearly all aspects of modern ventilation technology were originally developed to meet the needs of non-residential buildings. It was only later that advanced solutions were adapted for housing.

FIRE-DRIVEN VENTILATION

During the 1800s, technical developments were made in which fire was the main driving force for creating air flows in buildings. In other words, ventilation was still based on the same basic principles as used in medieval mines. However, in comparison to mines, buildings required considerably more sophisticated solutions, not least to introduce air into spaces without causing discomfort. This type of ventilation was known as *fire-driven ventilation*. Manually-driven wooden fans and bellows had already been used in a few buildings in the middle of the 1700s but these solutions had an obvious disadvantage: they required a great deal of manpower. For example, two men were required to operate the ventilation for Queen Victoria's box at the opera in London.

MAN-POWERED AND ENGINE-DRIVEN MECHANICAL VENTILATION

If water power was available, which was primarily the case in spinning mills, it was also used to its full advantage to power fans. Otherwise, there were few good alternatives to heat- and fire-driven ventilation or to man-powered mechanical ventilation, despite ingenious attempts to use falling weights, tensioned steel springs and other devices as sources of power. By the time steam engine-driven mechanical ventilation made its breakthrough during the second half of the 1800s, the fire-driven technology had been refined to such an extent that both the flow of the air and its temperature could be regulated. There were also solutions in which the air could be purified and humidified before it was drawn into a building. However, as the fire-driven technology was susceptible to imbalances it was used almost exclusively in special buildings or in laboratories.

COOLING IN BUILDINGS

Over time, there arose an increasingly large need to cool certain buildings. The primary purpose of ventilation was, of course, to remove polluted air but it had also gained

acceptance for cooling purposes. During the 1800s, supply air was cooled either by spraying it with water or by letting it flow over blocks of ice in the air intakes. The ice industry was quite large at this time and, for example, Norway had a considerable shipping fleet that supplied winter ice to numerous countries and, not least, to the USA where there were numerous buildings that required cooling. However, towards the end of the 1800s, winter ice for ventilation cooling was replaced by machine-made ice. One of the major users was the Madison Square Theater in New York. In order to maintain a comfortable indoor temperature for the audiences, no fewer than 4 tons of ice were used during every evening performance!

VENTILATION, INDOOR ENVIRONMENT AND DESIGN OF A BUILDING

One of the most important and prominent figures in the history of ventilation was David Boswell Reid, from Edinburgh, who energetically drove development forward during the 1800s. Reid mastered the fire-driven technology to almost complete perfection and was instrumental in bringing ventilation into the age of machines with steam-driven fans and systems, which, in many respects, are similar to those we use today. Reid realized, perhaps more than anyone else in his day, the importance of the interplay between ventilation, the indoor environment and the design of a building. In his opinion, architecture was all about *enveloping a building and supplying it with a desired indoor environment*.

HISTORICAL TIMELINE

200 BC

FIRE-HEATED FLOORS AND SMOKY SUPPLY AIR

Perhaps the very first steps towards present-day ventilation can be attributed to the Greeks who were the pioneers of the so-called hypocaust system (from the Greek meaning 'under' and 'burnt'). Wood-burning furnaces were sited below floor level and the resulting hot air and smoke would find its way out via smoke ducts in the floors and walls before being led out through rooftop chimneys. After the fire had burnt out, small floor hatches were opened, releasing warm air into the rooms above.

It is doubtful whether the hypocaust system can be regarded as a true ventilation system. And the warm air released into the rooms after the fires had gone out was smoky and most probably unpleasant to inhale. It was not until much later, however, that the idea of using rising hot air was used successfully for more specific ventilation purposes.

The Middle Ages

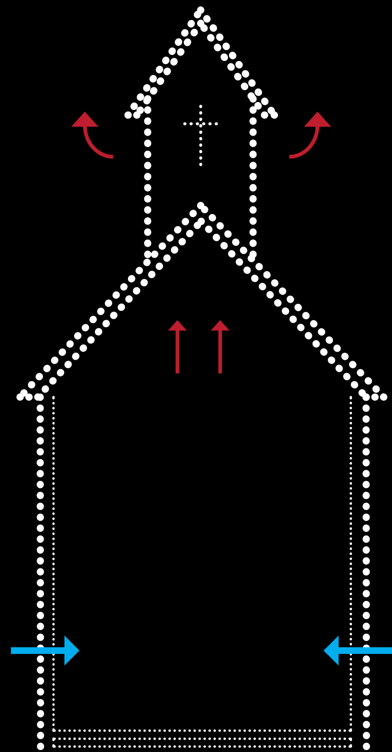
MEDIEVAL CHURCHES WITH HIGH CEILINGS

In buildings with very high ceilings, and especially in churches, there is an enormous volume of air and it would take a long time before it became polluted, longer than the time needed for a service. In this case, warm polluted air would rise up towards the roof to be released at a great height through openings in the bell or clock tower.

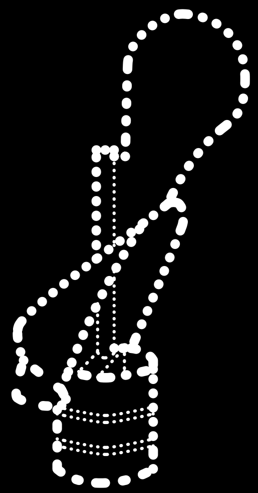
The Middle Ages

POISONOUS AIR IN COAL MINES REMOVED BY USING FIRES

In deep mines, the air was often almost stagnant, resulting in an exceedingly polluted and, occasionally, poisonous atmosphere. In order to introduce a clean supply, the air in the mine was heated by lighting fires. The resulting rising air was then removed via ducts and chimneys, and fresh air subsequently drawn in via other remote ducts. The capacity of such systems was limited and they required enormous amounts of fuel.



Medieval churches with high ceilings



Chimney cowls

The High Middle Ages

CHIMNEY COWLS HELPED CREATE BETTER DRAUGHTS

Rotatable cowls on the tops of chimneys became more common. These could turn with the wind, so that the smoke outlet was always on the downwind side. The wind would also create a stronger draught up through the chimney and help discharge the smoke more effectively.

The 1500s

VENTILATION TOWERS FOR WARM RISING AIR

A number of non-ecclesiastical public meeting rooms were equipped with towers or heightened chimneys to increase the stack effect. These ventilation towers increased the upward draughts and drew out the poor air from the buildings. Two early examples, both in Belgium, were the Old Civil Registry in Bruges completed in 1537 and the Town Hall in Antwerp completed in 1565.

1556

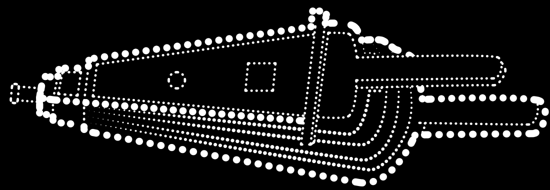
ADVANCED VENTILATION SOLUTIONS FOR MINES

In 1556, the forerunner of all mining engineers, Georgius Agricola, published, posthumously, a highly acknowledged book containing no fewer than twelve different ventilation principles for mines. These included the use of man-powered, water-powered and wind-powered wooden fans.

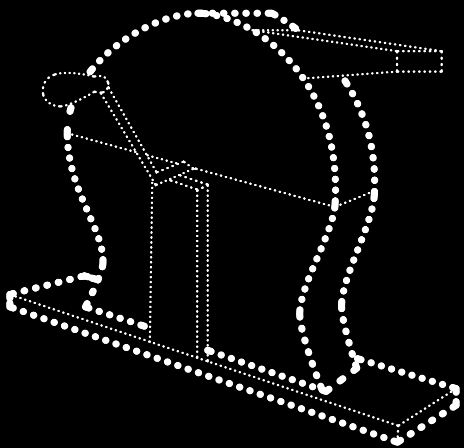
The 1700s

VENTILATION TOWERS BECOME COMMON THROUGHOUT EUROPE

Around Europe, ventilation towers were added to an increasing number of public buildings in order to achieve higher air flows thanks to an enhanced stack effect. These roof additions could be clearly seen in the silhouettes of numerous towns.



Man-powered bellow fans



Hand-driven wooden fans

1736

HAND-DRIVEN WOODEN FANS IN THE HOUSES OF PARLIAMENT

A manually cranked wooden fan (then known as the ‘blowing wheel’), just over two metres in diameter and similar to those proposed by Agricola in his book in 1556, was installed in the House of Commons in London. This innovation immediately improved the quality of the air, as previous solutions only comprised a fire-driven set-up. Its inventor, John Desaguilers, called the men who operated the fan “ventilators” and it is reported that the wooden fan was in operation for at least 50 years.

1752

GIANT BELLOWS FAN VENTILATES A PRISON

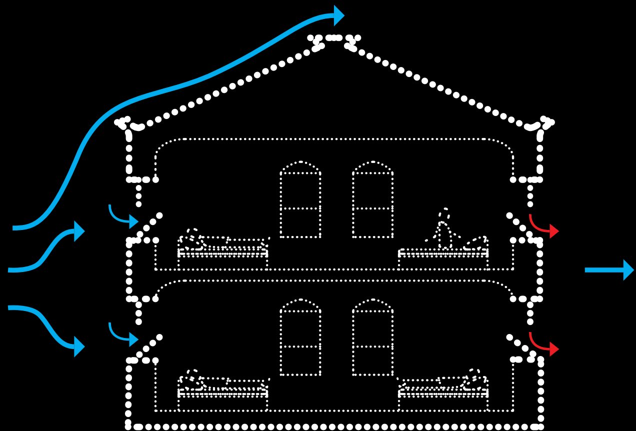
The governors of Newgate Prison in London were persuaded by the English scientist Stephen Hales to open up ventilation holes in the cell walls. A giant bellows was installed to force fresh air into the cells and the health of the inmates was subsequently dramatically improved. Perhaps Hales was driven by a measure of personal feelings, as his brother had died of prison sickness (probably typhus) while in Newgate.

11 years previously, the bellows principle had made a significant breakthrough in the Royal Navy, where it was used to ventilate the manned spaces below deck. Contemporary writings compared ships to large whales and bellows to their lungs. After proving successful in the prison application, bellows were installed in a number of buildings around the world, for example, in Naples and St. Petersburg, and even in Lapland.

1762

MEASURES TO REDUCE THE RISK OF INFECTION IN HOSPITALS

One of the first hospitals to implement the latest findings concerning air purity and airborne disease was the Royal Naval Hospital in Plymouth, England. Wards were isolated from each other using dividing walls and they were also fitted with openable windows in opposite facades to enable constant through-draughts. Fresh air was thus introduced and poor indoor air removed.

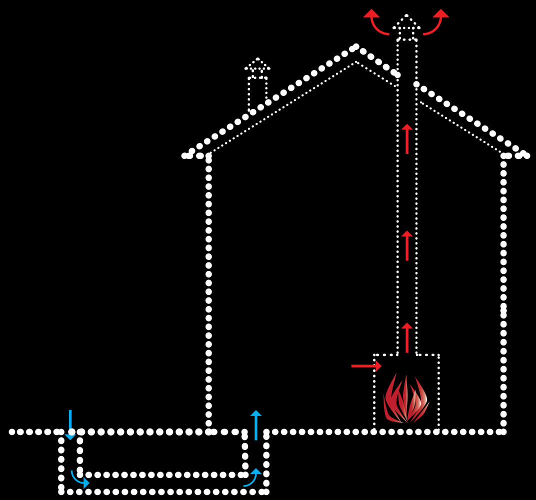


Natural ventilation in hospitals

1810

HEATED SUPPLY AIR IN WINTER AND COOL SUPPLY AIR IN SUMMER

In the then hyper-modern William Strutt Infirmary (later Derbyshire General Infirmary, now London Road Community Hospital) in England, a fire-driven ventilation system was installed that could supply the building with warm air in winter and cool air in summer. The ventilation stacks were fitted with revolving cowls to increase efficiency. Supply air was introduced via 70-m-long tunnels in which the temperature was relatively constant all year round. If necessary, in winter, this air could be post-heated in stoves situated on each floor. It is also worth mentioning here that the ventilation system was not the only technically advanced installation in the hospital. Other innovations included automatically flushing toilets, adjustable beds with foot heaters, washing machines and a transportation system via which wet washing was moved to drying rooms on rail-bound drying racks. William Strutt was an English businessman and innovator.



Heated supply air in winter and cool supply air in summer

1821

CALORIFIERS USED TO HEAT SUPPLY AIR

In Germany, a fire-driven ventilation system was developed using so-called calorifiers. Later on, these also became very popular in other countries. This was actually a heating system based on airborne heat, with ventilation as an added bonus.

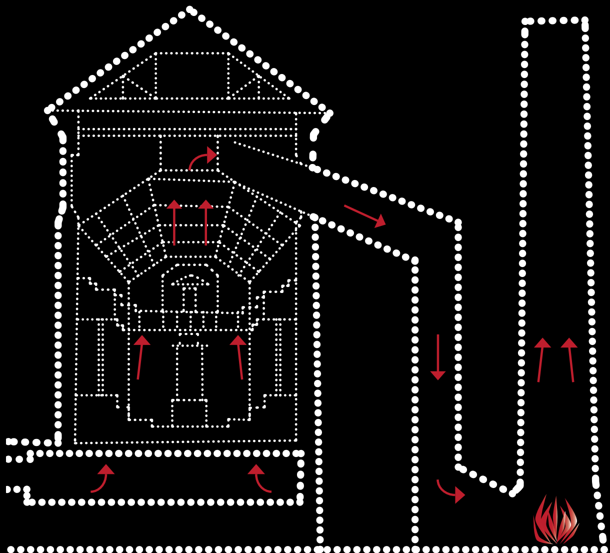
In principle, the system comprised a stove being placed in an air intake. The surface of the stove was enlarged by using a folded mantel. Calorifiers were mostly used in large public buildings such as churches, military barracks and hospitals. However, their high surface temperatures made the heated air smell of burnt dust. The technology was used as late as the first part of the 1900s, though the calorifiers were then often fitted with fans.

1835

PURIFIED SUPPLY AIR HEATED IN WINTER AND COOLED IN SUMMER

This innovation is given a more thorough account than others, as it embraces such a large part of the technical development in the field. Once more, though not for the last time, the Houses of Parliament in London are at the centre of attention.

The previous year, the House of Commons and the House of Lords had been destroyed by fire and temporary buildings had been quickly erected to accommodate members until a new permanent building was completed. The task of creating a good indoor climate, right next to the stinking River Thames, was given to the Scottish scientist and inventor David Boswell Reid, who was known for his advanced ventilation solutions in laboratory environments. The temporary building for the House of Commons was fitted with an innovative fire-driven ventilation system that removed the polluted indoor air through hatches in the ceiling of the debating chamber. This airflow created an under-pressure, drawing in outdoor air from the old palace gardens, where the air was regarded as being reasonably clean. It was then led to a space underneath



Temporary House of Commons

the chamber where it could be purified, heated, cooled and humidified. Hot gas lamps, installed behind panes of glass close to the air vents in the ceiling, helped increase the extraction flows. In this way, the hall could be lit without introducing heat or fumes.

The air was purified in different stages, with soot and other particles being removed first using a filter in the form of a 70-square-metre sheet of damp cloth. After filtration, the air was cleaned by allowing it to flow through a spray of ordinary clean water and then through a spray of lime water. The acidity of the air was then neutralized using ammonia after which it was finally disinfected using chlorine. Before the purified and moisturised air was introduced into the chamber, through a myriad of apertures in the floor, it could be either heated or cooled by letting it flow over loops of piping containing hot or cold water. In order to avoid draughts caused by the jets of air, the floor was covered with a roughly patterned horse-hair carpet.

Depending on how cold it was outdoors, unheated and heated air would be mixed in the correct proportions to achieve a comfortable indoor temperature.

During mild weather, the piping was not used at all and, during warm weather, cold town water was used to cool the supply air. On occasionally very hot days, the air was allowed to flow over blocks of ice to cool it before being purified. In the summertime, preventative cooling of the chamber was carried out at night.

The plant operators were instructed to strive to achieve an indoor temperature of just over 16 °C when the chamber was not in use and never more than 21 °C in session, which, by today's standards, would be regarded as quite cool. The temperature was continually monitored using a thermometer, which now and again made an appearance through the holes in the floor.

The volume of the air flow was regulated via a nearly 5-square-metre valve in the extract air duct. This was manually adjusted up to 100 times per session depending on the indoor and outdoor temperatures, the wind conditions, and the number of members in the chamber.

Even if the ventilated floor was sometimes blamed for causing cold feet, Reid's solution became a widely acknowledged success and "members of the House of Commons can now pursue their senatorial duties without a sacrifice of either health or comfort."

1852

POOR VENTILATION IN THE HOUSES OF PARLIAMENT DESPITE MAJOR INVESTMENTS

Following the encouraging experiences gained from the temporary building for the House of Commons, the next aim was to achieve an equally good indoor climate in the new permanent buildings. Reid was once again commissioned to tackle this infinitely larger and more complex building with all its chambers, corridors and innumerable rooms. The two large towers of the new parliamentary building, one of which houses the world famous Big Ben bell, were used for shafts for the supply air. The building's central and somewhat lower tower was used for ducts for removing the extract air. In Reid's opinion, the fire-driven ventilation system would have to be helped along and steam-driven fans were installed to blow air into the building while the extraction system was still fire-driven. The system and its controls were very advanced for that time and, among other things, it was possible to choose from which of the high towers fresh air would be drawn in, depending on where the outdoor air was deemed to be least polluted at any particular time.

Never-ending conflicts between the architect Charles Barry and David Reid meant that, from the very beginning, the ventilation of the building was divided into two separate systems. Reid was made responsible for the House of Commons but the ventilation system here never became fully functional, as he now only had access to one of the towers for the supply air. Despite great efforts to regulate the ventilation according to the members' wishes, there were numerous complaints. Experts condemned the system as being "too advanced to work in practice" and it was redesigned after being in operation for only 14 months.

The indoor environment of the Houses of Parliament was to be subject to complaints for decades to come.

1854

THE FIRST LARGE-SCALE MECHANICAL VENTILATION SYSTEM IN THE WORLD

A few years after the ventilation fiasco in the new, permanent parliamentary buildings, Reid moved to the USA. However, before doing so, he managed to develop and complete a, for that time, technologically highly-advanced fan-driven ventilation system that would be in operation for nearly 130 years and one which is regarded by many as the first of its kind.

Under St. George´s Hall, a monumental structure in Liverpool built for festivals, meetings and concerts, four steam engine-driven speed-controlled fans, each 3 metres in diameter, were installed. These could supply a variable air flow for up to 5,000 visitors, equivalent to around 5 l/s per person, which is approximately the same as the present-day recommended flow. After filtering, heating and cooling, and even moisturising if desired, the air was distributed along the walls through thousands of small holes close to the floor. The indoor climate was continually monitored and meticulously controlled, requiring an army of employees.

1858

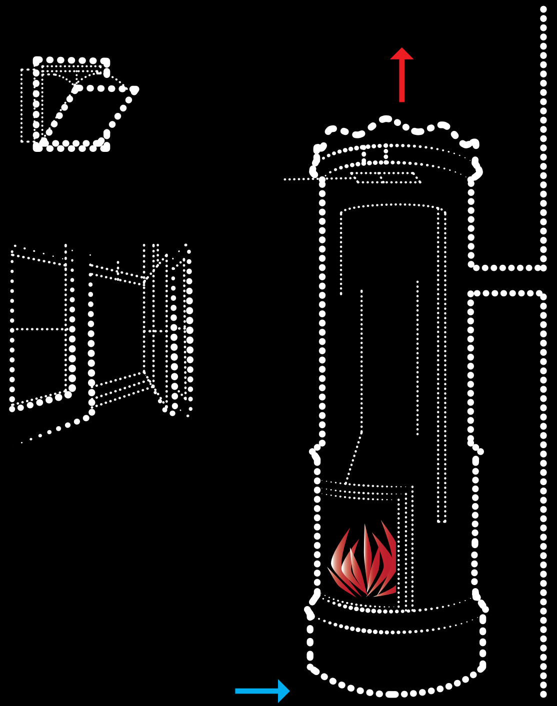
CARBON DIOXIDE AS AN INDICATOR OF INDOOR POLLUTION

The German scientist Max von Pettenkofer started to show interest in the ‘air toxins’ that caused smells in overcrowded rooms. He did not know what sort of poisons they were, how dangerous they might be or how they could be measured but he was satisfied that measuring the levels of carbon monoxide would provide an indirect indication of their presence. He was also aware that carbon dioxide itself was not dangerous in reasonable concentrations. Pettenkofer found that people entering an occupied room would perceive a ‘human smell’ if the concentration of carbon dioxide in the air was more than 1,000 millionths (ppm) above its concentration in the outdoor air. He stipulated this as a suitable maximum level and it is a measure of air purity that still stands today, even if it is sometimes proposed to be changed.

1870s

VENTILATION POSSIBLE USING STEAM ENGINE-DRIVEN COOLING

The need to cool buildings continued to increase but the creation of cold air was, until then, still achieved by using water sprays, blocks of ice or long underground ducts. Although the first refrigerator had been invented as far back as in 1775 by the Scottish professor William Cullen, it had taken a long time to develop the technology to such an extent that it could provide a feasible solution for buildings. However, in the 1870s, the Swedish locomotive engineer Carl von Linde managed to develop refrigerators for making ice that were considerably more efficient than previous designs. In 1877, one of Linde’s refrigerators was installed in a German brewery, enabling beer to be made in the summertime too. The days of the ice-exporting industry, for example in Norway, were then numbered.



Ventilation stoves in Scandinavia

1880s

VENTILATION STOVES BECOME COMMONPLACE, ESPECIALLY IN SCANDINAVIA

Tiled stoves had been in use in southern Europe since the Middle Ages but, by the late 1700s, stove technology had been fully refined in Sweden and the same design principles are still implemented today. In the 1880s, the tiled stove was given a special but rather short-lived task – that of driving a hot-air fan. Outdoor air was drawn in at the base of the stove and then released as heated air at the top. The fumes were removed via a chimney, which created an under-pressure that would then suck up the room air. Again, it was heat that was used to drive both the supply air and extract air flows.

1880s

HIGH ROOMS COUNTERACT POOR AIR QUALITY

Primarily for air quality reasons, the height of rooms had been gradually raised over the years. This made it possible to install high windows with separate, openable frames of which the top part could be used for airing, even in winter. During the 1880s, the heights of rooms reached a maximum and were subsequently reduced.

1902

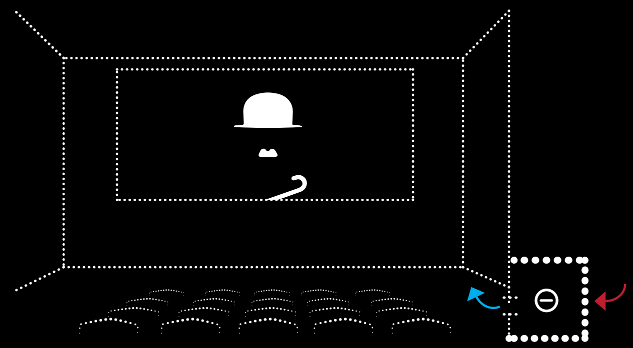
ELECTRICALLY-POWERED AIR CONDITIONING SYSTEM

A printing works in New York installed an electrically-powered air conditioning plant designed by an American, Willis Carrier. The equipment could cool, heat and moisturize the supply air, which was a prerequisite for four-colour printing. Initially, the supply air was cooled using groundwater flowing through coils. However, in the following year, a special refrigerator was installed to manage this task. The equipment at the printing works was regarded as the first system that could be controlled in a reliable way.

1920s

AIR CONDITIONING UNITS BECOME COMMON IN THE USA

After the tremendous breakthrough for electricity at the beginning of the 1900s, electrically-powered equipment began to be installed on a grand scale, especially in the USA where it became commonplace in industrial plants, hotels, theatres and cinemas. It is said that a contributing factor to the rise of the American film industry was the fact that cinemas could offer a few hours of relaxation in a pleasantly cool venue.



Air conditioned cinemas in USA

1930

MECHANICALLY VENTILATED APARTMENT BLOCKS AND NEW AIR FLOW PRINCIPLES

Until the 1930s, apartment blocks around the world were ventilated exclusively using natural ventilation. However, as buildings became higher, one of the dilemmas caused by natural ventilation became clear – the need to reserve large spaces for the ventilation ducts, with an individual vertical duct being required for each room!

In 1931, the Swedish housing engineer Sven Romedahl published an article in which he drew attention to the fact that as buildings were becoming increasingly higher, rooms were becoming smaller and smaller because of all the ventilation ducts. To provide a solution, he launched the so-called overflow principle for apartment blocks by which fresh air was introduced into 'fine' rooms and then fed into 'poor' rooms before being removed. In practice, this often meant that air would enter via bedrooms and living rooms and be extracted via bathrooms, toilets and kitchens. In his opinion, one and the same vertical ventilation duct could then be used for a number of apartments as long as they were located above each other. However, in order to achieve this, the buildings would have to be ventilated mechanically.

To reduce the discomfort caused by draughts in the vicinity of air intakes, Romedahl proposed a number of solutions in which the intakes were located close to radiators. Cold down-draughts next to windows could then be avoided and the supply air also slightly pre-heated.

The first apartment block to be ventilated using Romedahl's principles was built in 1931 in Stockholm and was fitted with mechanical ventilation based on electrically-driven extract air fans. Just over 20 years later, mechanical ventilation made its real breakthrough in apartment blocks, especially in those three or more storeys high.

1950s

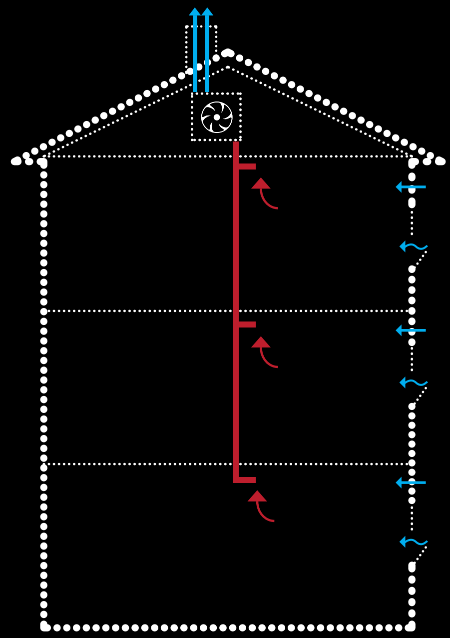
MECHANICAL SUPPLY AND EXTRACT AIR VENTILATION BECOMES COMMON IN EUROPEAN BUILDINGS

After the Second World War, there was a great demand for new housing and non-residential buildings. In order to reduce building costs, ceiling heights were lowered and, subsequently, the need for well-functioning ventilation systems increased. American ventilation technology, with mechanical supply and extract air solutions, was introduced in a number of countries in Europe. To save heating energy, the return air principle was used, whereby a proportion of the extract air was mixed with the fresh supply air. In wintertime, more than half of the extract air was often reused in this way. This was a cheap and very efficient solution and was used almost exclusively in non-residential buildings. However, in the early 1980s, in Sweden as well as in other countries, critical voices were raised challenging the suitability of having to breathe extract air, even if diluted with fresh air. In the USA and countries with humid climates, the return air principle is still used and is the completely dominant solution.

1960s

MECHANICAL SUPPLY AND EXTRACT AIR VENTILATION INTRODUCED INTO APARTMENT BLOCKS

Even if mechanical extract air systems were the most common forms of ventilation solutions in housing in the 1960s, apartment blocks were sometimes built with supply and extract air solutions. However, in contrast to non-residential buildings, the return air principle was only used to a small extent.



Mechanical extract air ventilation in apartments

1970s

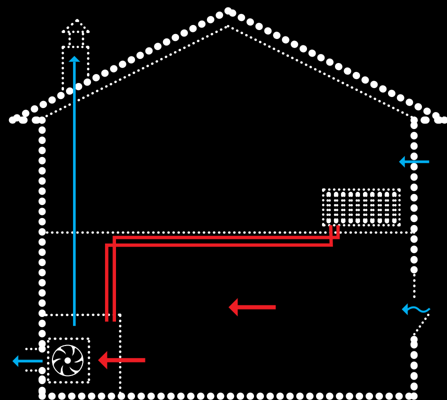
EXTRACT AIR VENTILATION IN DETACHED HOUSES, ESPECIALLY IN NORTHERN EUROPE

Buildings started to be designed with increasingly more air-tight envelopes.
To ensure the desired ventilation flows all year round, mechanical extract ventilation systems, and even supply and extract systems, also began to be installed in new detached houses.

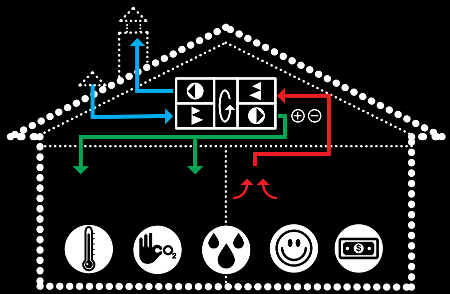
1980s

EXTRACT AIR HEAT PUMPS INSTALLED IN DETACHED HOUSES, ESPECIALLY IN SCANDINAVIA

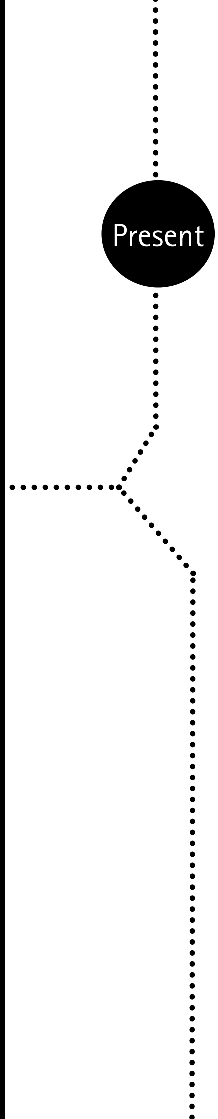
The oil crisis had serious repercussions among house owners. Extract air heat pumps became more popular as everyone strived to save energy. Today, this solution is also quite common in apartment blocks.



Extract air heat pump in homes



Mechanical supply and extract air system with heat recovery



PRESENT

In numerous countries around the world with cold winter climates, the installation of mechanical supply and extract air systems with heat recovery (MVHR systems) are now taken for granted when constructing both residential and non-residential buildings.

The enormous housing volumes built in the decades after the Second World War are now due for extensive renovation measures. In a large number of these buildings, it has been estimated that it will be cost-effective to convert to MVHR systems, if they are installed at the same time as the renovation work is carried out.

WANT TO KNOW MORE?

If you find this subject interesting, a number of suggestions for further reading have been set out. Some of the publications can be bought while others are only available in libraries. And some can be downloaded from the Internet. Parts of this publication are based on books in the following list.

And, for the very inquisitive, more information is available, both about the history of ventilation and its related topics heating and cooling.

RECOMMENDED BOOKS

B Addis	*3000 years of Design, Engineering and Construction.* Phaidon Press Inc., 2007
B Platen, C Munters	*Om alstring av kyla.* Svenska Teknologiförenigen nr 1, 1925
G Sttålbom	*Varmt och vädrat – VVS-teknik i äldre byggnader.* Sveriges VVS, Musem, SBUF, VVS Företagen, 2010
H Theorell	*Värme ventilation och sanitet Del 1 - Historisk återblick på uppvärmnings- och ventilationstekniken.* Natur och kultur, 1940
L Ekberg (ed)	*AIR.* Swegon Air Academy, 2008

INTERNET ARTICLES

N Sturrock	*The Pioneer who Rid Parliament of Hot Air.* CIBSE Journal January, 2015
R Bruegmann	*Central Heating and Forced Ventilation: Origins and Effects on Architectural Design.* Journal of the Society of Architectural Historians. Vol. 37, no. 3, 1978
J Janssen	*The History of Ventilation and Temperature Control - The First Century of Air Conditioning.* ASHRAE Journal, September 1999
H Schoenefeldt	*The Temporary Houses of Parliament and David Boswell Reid's Architecture of Experimentation.* Architectural History 57, 2014

Ventilation in historic buildings, National Property Board Sweden, 2009

EPILOGUE

Petra Vladykova Bednarova
Manager of the Swegon Air Academy

One of the primary goals of the Swegon Air Academy is to share knowledge about ventilation and indoor air climate in buildings and explain how the two are interconnected. And where best to start than in Ancient Greece, where it all began? History and knowledge form essential parts of our lives and this book provides a short but comprehensive source for learning.

Most information about the history of ventilation is spread over a wide range of publications and other sources. Our challenge was to gather a sufficiently broad amount of key knowledge on the subject and make it available in a simple pocket guide book.

Our previous books – “AIR” (also known as “the Bible” with regard to the fields of ventilation, heating and cooling), “Simply EPBD” and “Simply GREEN” (the first two in our series of ‘Simply…’ guidebooks, on building legislation and building certification systems) – were received very well by the market. We believe and hope that this new guide book ***HISTORY OF VENTILATION TECHNOLOGY – From a Western Perspective*** will be received in a similar positive way: there is great need of a general and descriptive publication that summarizes the development of ventilation from a Western perspective.

We have once again enlisted the help of Daniel Olsson from CIT Energy Management. We have engaged the services of John Bitton for translation and editing of the final manuscripts in Swedish and English. Markéta Brávková helped us with the graphics, design and layout of the book.

COLOPHON

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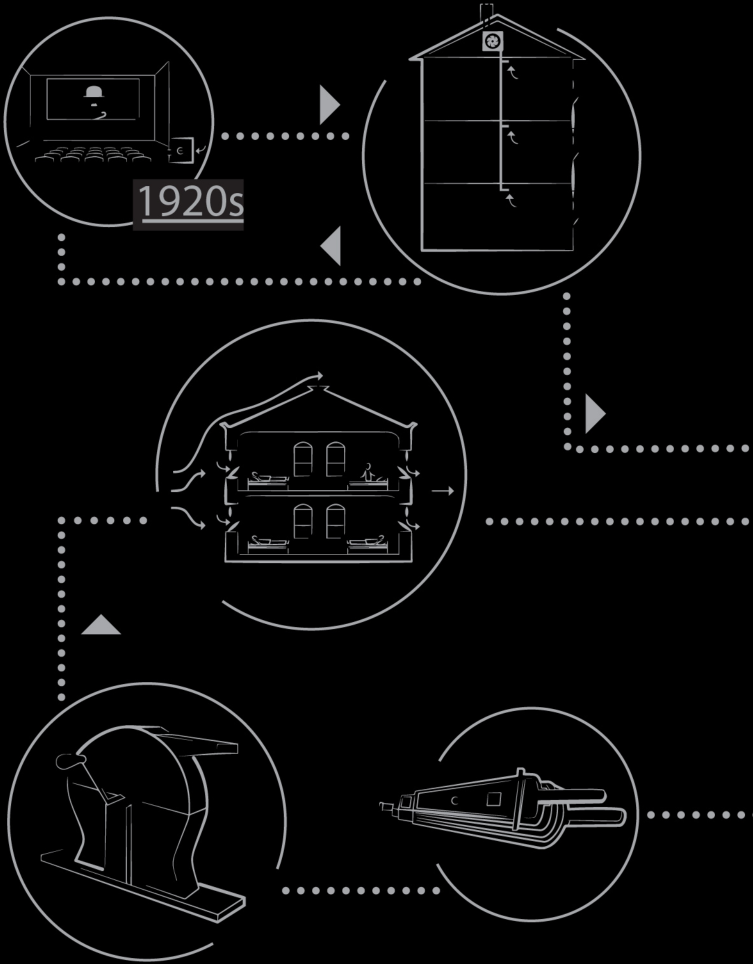
VENTILATIONSTEKNIKEN I HISTORIEN
- En västerländsk tillbakablick – Swedish edition

December 2016, Gothenburg, Sweden

ISBN 978-91-981955-4-5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