

VENTILATION SYSTEMS

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VENTILATION SYSTEMS

- The ventilation lies in the piping fresh air into the room and removal of polluted air from the room;
- The fresh air is the subject of the treatment.
- The basic aim of the ventilation is the improvement (adjustment to the organisms's needs or production processes) of the states and the composition of the air through its exchange.



IAQ - indoor air quality

- The state of the air in the closed room is dependent on:
 - type of the room
 - the amount of people, animals and machines in the ventilated room
 - the distribution and the way of the spread of the pollution.
- Air-conditioning – is the process of the imparting the air in the closed room certain specified values of parameters and properties desired for the sake of hygiene and the good mood of people or the values of the parameters required production technology.



VENTILATION SYSTEMS

- Natural ventilation
 - Mechanical ventilation
- and
- Hybrid ventilation



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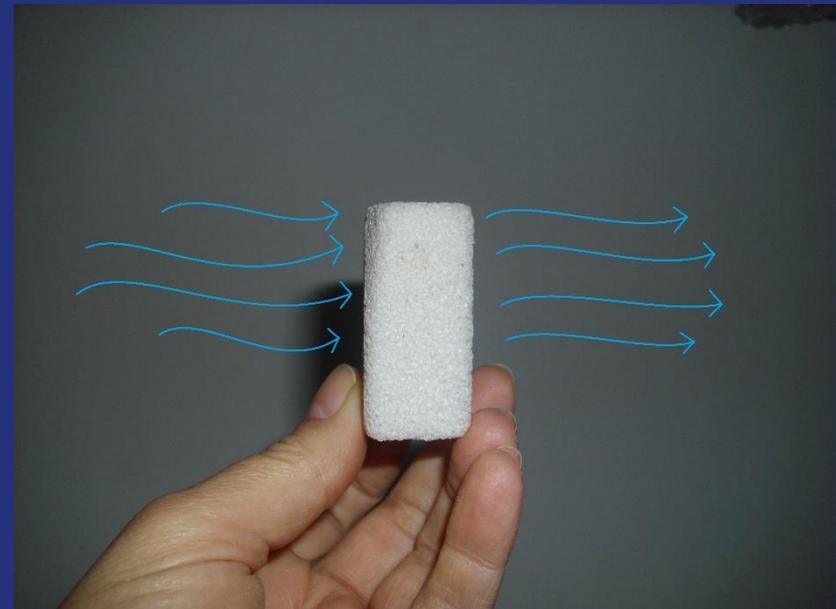
Natural – the air exchange is caused by the action of the gravity forces, wind or both this factor altogether.

- **Airing – periodic air refreshment in the rooms through opening the vents in the bulkheads.**



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- Infiltration – the air permeation through porous building materials, leaks of the bulkhead and cracks around the windows and the doors.



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- Stack ventilation – with the vertical canals the air is eliminated from the room as a result of the difference of the densities of the indoor and outdoor air.



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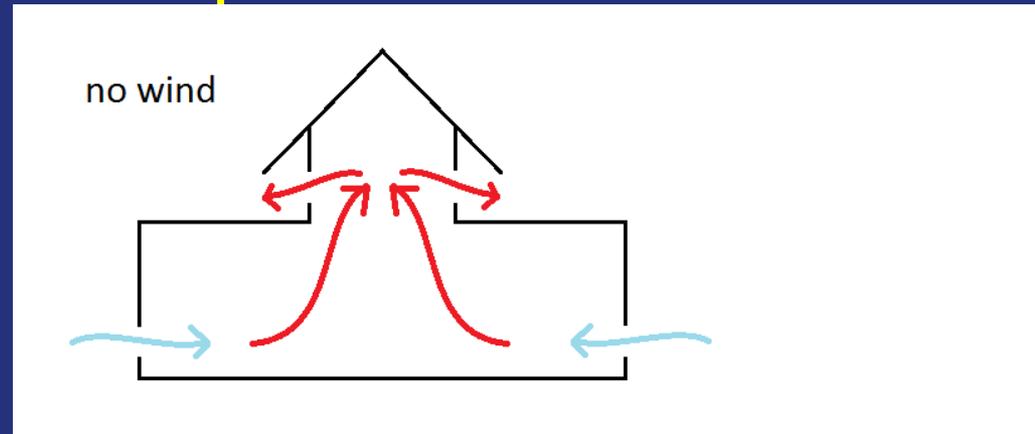


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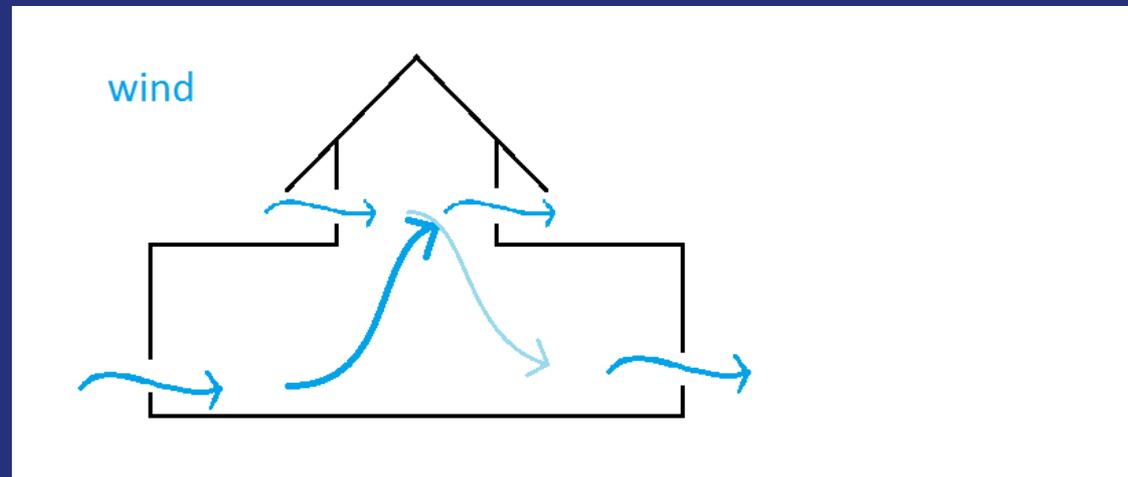
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- Aeration – the mobilized exchange of the air which flows through the proper vents deployed in the outdoor bulkheads, the exchange is reached due to the difference of pressure of the outdoor and indoor air.



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- The aeration intensity depend on the difference of the temperatures outside and inside the bulding and the wind force.



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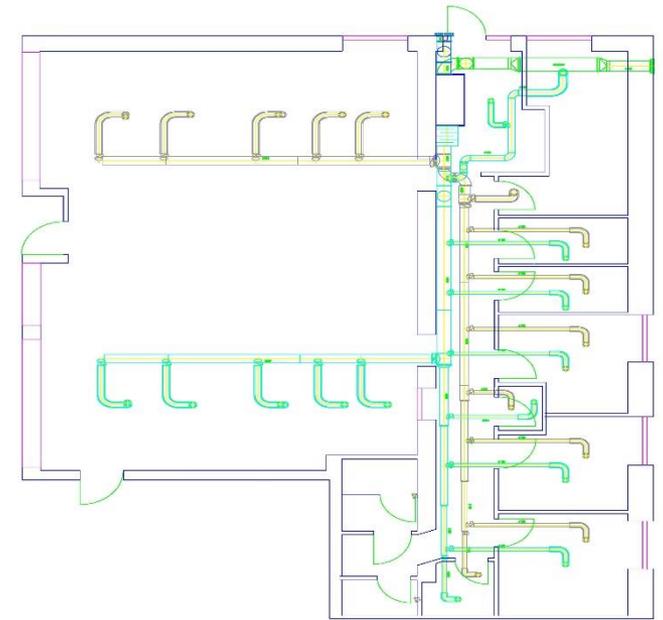
Mechanical – the air exchange in the room is not dependent on atmospheric influences; the forced air is achieved due to use of fans or steam injectors (ejectors).

- **General**

- **Local**

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- General – even air exchange in the whole room; ventilation of the rooms, in which people stay and do not do specific tasks.



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- Local – pollution removal in the places where pollution is excreted.



Hybrid ventilation

Hybrid ventilation combines the strengths of natural and mechanical ventilation in the best possible way.

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Hybrid ventilation

- Hybrid navigation is the most common term used to describe systems in which ventilation is completely natural rather than mechanical. This is the best solution to meet the ventilation room, while minimizing costs, maintenance and energy consumption.

Hybrid ventilation

- For example, hybrid system utilizes efficient centrifugal fans to provide mixing ventilation in a small product with mold. The design works with the window opening enhancing the natural ventilation strategy - so the low energy solution works all year round and can be reliably used.

Hybrid ventilation

- Natural ventilation is used during the summer months securing a minimum use of energy.
- Mechanical ventilation with heat recovery is used during the winter securing a low usage of heat.
- The indoor climate is ensured all year round with hybrid ventilation.

Hybrid ventilation

- For example, in periods of low wind, mechanical ventilation systems will take over in order to ventilate the spaces.
- Hybrid ventilation is normally operated automatically, when a natural ventilation system needs extra assistance. The system will then switch to a mechanical system, and back again when wind and other natural forces pick back up.

Microclimate

- Microclimate is formed by many parameters like air purity, its chemical, biological, physical composition and indoor temperature, relative humidity, as well as the velocity of air or the temperature of the surrounding areas.



Microclimate

☐ PHYSICAL:

- noise;
- vibration;
- ionizing radiation;
- electromagnetic radiation.



Microclimate

□ BIOLOGICAL:

- dust;
- mites and saprophytes;
- mould;
- Bacterias....

Microclimate

☐ CHEMICAL:

- Nitrogen dioxide;
- Ammonia;
- Carbon dioxide;
- Volatile organic compounds;
- Sulphur dioxide;
- Carbon monoxide;
- Ozone;
- Smoke.

Microclimate

All components of the microclimate have a huge impact on human mood, mental and physical performance, work efficiency and good health.

- It is necessary to systematically provide fresh air to rooms, in impure areas after previous filtration.
- In most buildings with natural ventilation problems with maintaining proper indoor microclimate are connected with tight window frames which effectively block the flow of fresh air and reduce the effectiveness of ventilation.



STANDARDS

- PN-EN 13779:2008 Ventilation of residential buildings. Requirements for the properties of ventilation and air conditioning.
- Air Quality Guidelines for Europe, Second Edition 2000, WHO Regional Office for Europe Copenhagen, European Series, No. 91.
- ASHRAE Standard 62-1989, Ventilation for acceptable Indoor Air Quality, Atlanta 1989.

Relative humidity

- Relative humidity is the amount of water vapour present in air expressed as a percentage of the amount needed for saturation at the same temperature.
- During air parameters tests relative humidity is always used.
- The relative humidity in most rooms like education buildings should be in range between 40 and 60% (PN-EN 13779).



Temperature

- Room temperature are normal temperature of a room like education buildings in which people live. Room temperature is defined as a comfortable indoor temperature typically 20 to 23°C; neither heated nor chilled (ASHRAE 1989, PN-EN 13779, WHO 2000).
- An example of room temperature is the temperature of a cup of water that has been sitting in a room for an hour 😊

Carbon dioxide concentration

- One of the main parameter determining the indoor air quality is the concentration of carbon dioxide in residential and public buildings, including education buildings like a university classrooms.
- When the carbon dioxide level reaches 2500 ppm (0.25%), it is regarded as dangerous for human health.

Carbon dioxide concentration

- In Poland and in throughout the EU there is no relevant legislation regarding the level of carbon dioxide concentration in the indoor air, however mostly 1000 ppm is considered to be recommended limit in the rooms where people live and it is called maximum hygienic value (ASHRAE 1989, PN-EN 13779, WHO 2000).

Carbon dioxide concentration

CO ₂ concentration		Observed effect
mg/m ³	ppm	
1997	1000	Limit of CO ₂ in rooms proposed by Pettenkofer (Pettenkofer, 1851, ASHRAE 1989, WHO 2000, PN-EN 13779).
2965-9885	1500-5000	Values observed in classes, cinemas, conference rooms.

Carbon dioxide concentration

Low concentration of carbon dioxide is naturally present in the atmospheric air.

Should the CO₂ concentration in the air rise:

- headaches,
- decline in concentration,
- sore eyes,
- breathing difficulties,
- and other symptoms may occur 😞

The air exchange rate

- The requirements for rooms and equipment in educational buildings are set out in the guidelines. In particular, it specifies that every classroom in educational building facility equipped with a ventilation system that should provide at least from 3 to 5 air changes per hour.

Noise

- The noise is loud, confused, or senseless shouting or outcry the noise of the rioters, any sound that is undesired or interferes with one's hearing of something. Noise it causes irritability, fatigue and fatigue of the whole body, especially a hearing. The noise has a negative action on the human condition and the human health.
- The most commonly used measure of noise is the sound level is expressed in dB. The noise in education buildings in Polish and European standards is 40 dB.

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