

BASIC PRINCIPLES OF INTERACTION BETWEEN HEATING AND VENTILATION SYSTEMS IN THE COLD SEASON

N.U. Toshmatov

Jiz PI

<https://doi.org/10.5281/zenodo.20321519>

Abstract: This article examines issues related to ensuring effective air exchange in a building. It also discusses how to properly combine and design heating and ventilation systems to minimize heat loss, ensure effective air exchange, and create a truly comfortable and healthy indoor climate.

Keywords: Energy efficiency, air exchange, minimize, layout, combine, integration, thermal insulation, indoor climate.

ОСНОВНЫЕ ПРИНЦИПЫ ВЗАИМОДЕЙСТВИЯ ОТОПЛЕНИЯ С СИСТЕМОЙ ВЕНТИЛЯЦИИ В ХОЛОДНОЕ ВРЕМЯ ГОДА

Анотация: В статье рассмотрены вопросы связанное обеспечение эффективного воздухообмена в помещении. Как правильно совмещать а также проектировать системы отопления и вентиляции, чтобы минимизировать потери тепла, обеспечить эффективный воздухообмен и создать в доме действительно комфортный и здоровый микроклимат.

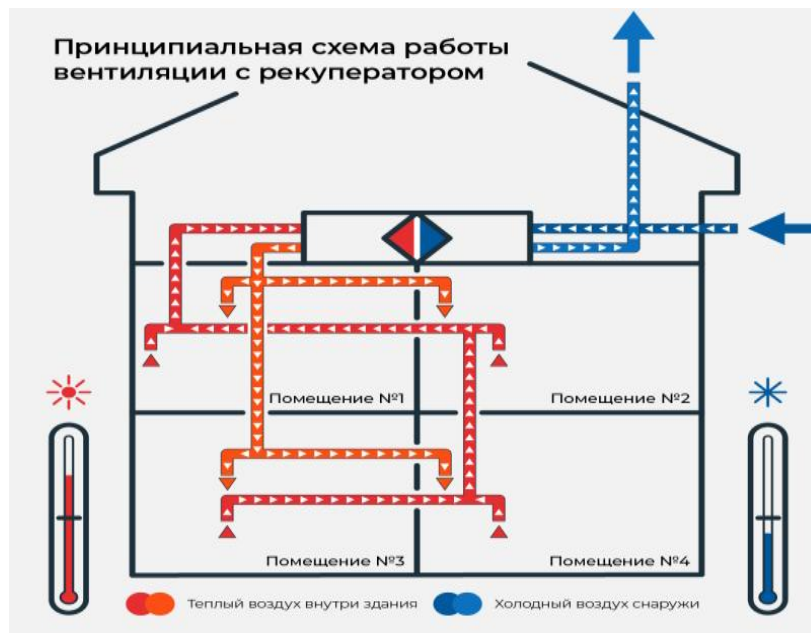
Ключевое слово: Энергоэффективность, воздухообмен, минимизировать, планировка, совмещать, интеграция, теплоизоляция, микроклимат.

Integrating heating and ventilation systems isn't just a trendy trend, it's a vital necessity. Ineffective ventilation in winter can lead to significant heat loss. Ventilation, especially during the cold season, can lead to a drop in indoor temperatures even when the air inside the home is a comfortable 22°C. The ventilation system expels this warm air outside, where the temperature can be significantly lower, for example, -15°C. In exchange, cold air from outside enters the room, which, of course, needs to be heated.

The problem is that traditional ventilation systems often rely on exhaust. Every time the ventilation system "refreshes" the air in a room, we lose some of the heat used to warm it. In other words, they simply expel heated air from the room, replacing it with cool air from outside. As a result, we experience constant heat loss and, consequently, increased heating costs. Furthermore, ineffective fresh air supply can lead to uneven humidity levels in rooms, condensation, mold, and other unpleasant phenomena that negatively impact our health and well-being.

In this article, we'll look at how to properly integrate heating and ventilation systems to minimize heat loss, ensure effective air exchange, and create a truly comfortable and healthy indoor climate.

One of the most important ways to save energy is to use ventilation systems equipped with heat recovery. Modern heat recovery units can "recover" most of the heat from exhaust air, warming the fresh air flow from outside. Essentially, the heat recovery unit captures heat from the exhaust air and transfers it to the fresh air entering the room. This reduces the load on the heating system and results in significant energy savings. The level of savings can reach up to 80% compared to a ventilation system without such heat recovery.



It's important to properly calculate and select ventilation equipment to avoid pumping excessive air volumes and venting excess heat. The amount of air entering and exiting the room should be precisely the volume required for ventilation. Air quality sensors, such as humidity sensors, CO₂ sensors, VOC sensors, and others, can help with this. Using modern automation systems with the ability to manage them via a smartphone or PC app can further reduce costs by up to 30%.

It's also important to pay attention to the thermal insulation of ventilation system components and ducts. For example, if ventilation ducts pass through spaces with large temperature differences (such as an uninsulated attic), without proper insulation, these areas will become "thermal bridges." Tight fit of materials and the absence of cracks also help prevent unwanted infiltration, when warm air escapes through gaps and cold air enters from outside.

To achieve maximum energy conservation and reduce heating costs when creating ventilation systems, professionally designed and expertly installed engineering systems are essential. It is at the design stage that key technical decisions are made that will impact comfort and energy efficiency during subsequent operation.

Below, we recommend a number of interrelated factors, highlighting the key aspects of optimal design and installation of heating and ventilation systems:

Space size and layout. The size and configuration of the building or space determine the length of air ducts, the installation locations of heating devices, and the location of ventilation ducts.

- **Heat loads.** Different areas of the building may require different heating intensities due to usage patterns, the number of occupants, the type of building materials, and insulation.
- **Nature of use.** Residential, office, or industrial spaces have different air exchange and temperature requirements. For example, in industrial spaces, it is important to ensure proper contaminant removal, while in residential spaces, optimal humidity levels and air quality are essential.
- **Optimal placement of air ducts.** Ventilation lines should be laid to minimize duct length, reducing airflow resistance and energy consumption for pumping it.

- Consider the installation locations of heating devices. Heating equipment (radiators, convectors, underfloor heating, etc.) should be positioned to ensure uniform heat distribution. Avoiding areas with high humidity or risk of surface overheating is recommended, as well as considering safe installation and accessibility for maintenance. Through meticulous calculations performed by specialists, the optimal number of ventilation points, the type and capacity of heating equipment, and process automation methods are determined. To achieve maximum energy efficiency and comfort, it is important that all system elements operate smoothly.

- Integrated control units. Modern integrated systems allow you to connect heating boilers, heat recovery units, air conditioners, humidifiers, and other equipment into a single network. This allows you to establish precise operating algorithms, such as allowing a ventilation unit to reduce or increase airflow during heating or cooling.

- Automated modes. Configuring the system for specific scenarios (night mode, occupancy, peak hours, etc.) allows you to save energy without compromising comfort.

Monitoring of indicators. Temperature, humidity, and CO₂ sensors can work in conjunction with control devices and regulate system operation in real time. This helps respond to changes in operating conditions (the presence of people in the room, changes in outside temperature, etc.).

- Smart home integration. Heating and ventilation control is often included in comprehensive home automation systems. This allows you to control the microclimate remotely (via smartphone or tablet), receive notifications about malfunctions, and promptly respond to deviations from set parameters.

Experience from many large construction projects shows that investing in proper design documentation and an integrated management system allows for the recoupment of modernization costs within 3–5 years due to a significant reduction in energy consumption.

Литература

1. СНиП 31-06-2009 Общественные здания и сооружения (Актуализированная редакция СНиП 2.08.02-89*).
2. СП 60.13330.2012 «Отопление, вентиляция и кондиционирование. Актуализированная версия СНиП 41-01–2003».
3. Мансурова Ш.П. Децентрализация—один из способов энергоэффективности теплоснабжения //Академическая публицистика. – С. 30.
4. Saydullaev S.R. Decision-making system for the rational use of water resources //Journal of Central Asian Social Studies. – 2020. – Т. 1. – №. 01. – С. 56-65.
5. Тошматов Н.У., Сайдуллаев С.Р. О методах определения потери и подсосов воздуха в вентиляционных сетях //Молодой ученый. – 2016. – №. 7-2. – С. 72-75.
6. Saydullaev S.R., Sattorov A.B. Analysis of fuel consumption and elimination of shortcomings in traditional boiler furnaces //Nauchno-metodicheskiy zhurnal “Uz Akademia. – 2020. – С. 198-204.
7. Toshmatov N.U., Saidullaev S.R. On methods for determining air loss and air leaks in ventilation networks //Young scientist. – 2016. – №. 7-2. – С. 72-75. European Journal of Innovation in Nonformal Education www.innovatus.es

8. Sh.P. Mansurova. (2021). Application of renewable energy sources in buildings. *Galaxy International Interdisciplinary Research Journal*, 9(12), 1218–1224. Retrieved from <https://www.giirj.com/index.php/giirj/article/view/897>.
9. Tashmatov, N.U., & Mansurova, S.P. (2022). Some Features of Heat and Moisture Exchange in Direct Contact of Air with a Surface of a Heated Liquid. *International Journal of Innovative Analyses and Emerging Technology*, 2(1), 26–31.
10. Tashmatov, N.U., & Mansurova, S.P. (2022). Specific Features of Change in Surface Temperature of Evaporating Liquid from Hydrodynamic and Temperature-Humidity Conditions. *International Journal of Innovative Analyses and Emerging Technology*, 2(1), 20–25.
11. Усмонкулов, А., Ташматов, Н.У., & Мансурова, М.Ш. (2020). Некоторые аспекты автоматического регулирования теплового режима многоэтажных зданий, оборудованных системой вытяжной вентиляции помещения. *Science and Education*, 1(8).
12. Obidovich, S.A. (2020). The use of Modern Automated Information Systems as the Most Important Mechanism for the use of Water Resources in the Region. *Test Engineering and Management*, 83, 1897-1901.
13. Glovatskiy O. et al. Improvement of water distribution management methods for operating modes of machine channels //E3S Web of Conferences. – EDP Sciences, 2023. – Т. 401. – С. 01023. <https://doi.org/10.1051/e3sconf/202340101023>
14. Бобомуродов, У.С., & Султонов, А.О. (2016). Методы улучшения реагентного умягчения воды в осветлителях. *Молодой ученый*, (7-2), 51-53.
15. Kenjabaev, A.T., & Sultonov, A.O. (2018). The role and place of agro clusters in improving the economic efficiency of water use in the region. *Asian Journal of Multidimensional Research (AJMR)*, 7(11), 147-151.
16. Akhundov R., Tangirov A., Sultonov A. Political Dimensions of Global Ecological Governance Frameworks //BIO Web of Conferences. – EDP Sciences, 2025. – Т. 151. – С. 02008. <https://doi.org/10.1051/bioconf/202515102008>
17. Karimovich, T. M., & Obidovich, S. A. (2021). To increase the effectiveness of the use of Information Systems in the use of water. *Development issues of innovative economy in the agricultural sector*, 222-225.
18. Мансурова, Ш.П. (2020). Вопросы особенности проектирования воздушных завес. *European science*, (2-2 (51)), 35-38.