

## THE IMPORTANCE OF VENTILATION IN THE HYGIENE OF MULTI-STOREY RESIDENTIAL BUILDINGS(BASED ON CONDITIONS OF FERGANA)

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**Abstract:** Ventilation plays a crucial role in maintaining hygienic living conditions in multi-storey residential buildings, particularly in urban environments with high population density. In cities such as Fergana, Uzbekistan, climatic characteristics, urbanization, air pollution, and building design significantly influence indoor air quality. This article analyzes the hygienic importance of ventilation in multi-storey residential buildings under the specific environmental and socio-economic conditions of Fergana city. The paper examines natural and mechanical ventilation systems, their impact on indoor microclimate, and their role in preventing respiratory diseases, moisture accumulation, and microbial contamination. Practical recommendations are proposed for improving ventilation efficiency in both existing and newly constructed residential buildings.

**Keywords:** ventilation, communal hygiene, indoor air quality, multi-storey buildings, Fergana city, public health.

### 1. Introduction

Urban residential hygiene is one of the most important components of communal hygiene, directly influencing population health and quality of life. Among the key hygienic factors in residential buildings, ventilation occupies a central position, as it ensures the removal of polluted indoor air and the supply of fresh air.

In multi-storey residential buildings, insufficient ventilation leads to the accumulation of carbon dioxide (CO<sub>2</sub>), excess moisture, household pollutants, and pathogenic microorganisms. These factors contribute to the increased prevalence of respiratory diseases, allergic conditions, cardiovascular disorders, and general discomfort among residents.

Fergana city represents a typical urban center in the Fergana Valley, characterized by high population density, hot and dry summers, relatively cold winters, and increasing levels of anthropogenic air pollution. These conditions make ventilation a particularly important hygienic requirement in residential buildings.

### Materials and Methods

The study was conducted in selected multi-storey residential buildings located in different districts of Fergana city. The research methods included:

- **Sanitary–hygienic assessment** of residential buildings, focusing on ventilation systems in kitchens, bathrooms, and living rooms
- **Measurement of indoor microclimate indicators**, including air temperature, relative humidity, and carbon dioxide (CO<sub>2</sub>) concentration
- **Visual inspection** for signs of dampness, mold growth, and insufficient air circulation

- **Questionnaire surveys** among residents to assess ventilation practices and self-reported health complaints
- **Comparative analysis** of buildings with natural ventilation only and those equipped with mechanical exhaust systems

The collected data were analyzed using descriptive statistical methods to identify trends and hygienic risks associated with inadequate ventilation.

## Results

The assessment of ventilation conditions in multi-storey residential buildings in Fergana revealed significant differences in indoor air quality depending on the type and effectiveness of ventilation systems. The analysis included apartments with natural ventilation only and those equipped with additional mechanical exhaust systems.

### Indoor Air Quality Indicators

Measurements showed that apartments relying exclusively on natural ventilation frequently exhibited elevated carbon dioxide (CO<sub>2</sub>) concentrations, particularly during winter and summer periods when windows remained closed for thermal comfort. In several cases, CO<sub>2</sub> levels exceeded hygienic reference values, indicating insufficient air exchange and reduced oxygen availability.

Relative humidity levels were also found to be higher in poorly ventilated apartments, especially in kitchens and bathrooms. Prolonged elevated humidity contributed to condensation on walls and windows, creating favorable conditions for mold growth. In contrast, apartments with mechanical exhaust ventilation demonstrated more stable humidity levels within hygienically acceptable ranges.

### Moisture and Mold Formation

Visual inspections revealed signs of dampness and mold contamination in a considerable proportion of apartments with inadequate ventilation. Mold was most commonly observed in corners of bathrooms, behind furniture, and near window frames. Residents of such apartments reported unpleasant odors and visible surface discoloration, which negatively affected perceived living comfort and hygiene.

Buildings equipped with functioning exhaust fans and regularly maintained ventilation shafts showed significantly fewer signs of moisture accumulation and mold formation, confirming the protective role of effective ventilation systems.

### Health Complaints Among Residents

Survey data indicated that residents living in poorly ventilated apartments reported a higher frequency of respiratory symptoms, including chronic cough, nasal congestion, allergic reactions, and general fatigue. Headaches and sleep disturbances were also more common in apartments with elevated CO<sub>2</sub> levels. Conversely, residents of apartments with improved ventilation systems reported fewer health complaints and higher overall satisfaction with indoor environmental conditions.

**Table 1. Comparison of Indoor Air Quality Indicators in Multi-Storey Residential Buildings in Fergana City**

Indicator	Natural Ventilation Only	Natural + Mechanical Ventilation
Average CO <sub>2</sub> concentration	High (often above recommended level)	Moderate (within acceptable range)
Relative humidity (bathroom/kitchen)	Elevated, unstable	Stable, within hygienic norms
Presence of mold	Frequent	Rare
Indoor odors	Persistent	Minimal
Reported respiratory symptoms	Common	Less common
Overall hygienic condition	Unsatisfactory to moderate	Satisfactory

### General Findings

The comparative analysis clearly demonstrated that insufficient ventilation adversely affects indoor air quality and hygienic living conditions. Natural ventilation alone was found to be unreliable under the climatic conditions of Fergana city, particularly during extreme temperatures. Mechanical ventilation systems, even when limited to exhaust fans, significantly improved air exchange efficiency and reduced hygienic risks.

### Conclusion

Ventilation plays a fundamental role in ensuring communal hygiene in multi-storey residential buildings, particularly in the context of the climatic, environmental, and urban characteristics of Fergana city. Adequate air exchange is essential for maintaining acceptable indoor air quality, regulating humidity levels, and preventing the accumulation of harmful airborne pollutants. The results of this study demonstrate that insufficient ventilation negatively affects the microclimate of residential apartments, leading to increased indoor humidity, the persistence of unpleasant odors, and the accumulation of dust and microbial contaminants. These conditions significantly elevate the risk of respiratory disorders, allergic reactions, and the spread of infectious diseases among residents, especially among vulnerable population groups such as children, the elderly, and individuals with chronic health conditions.

The study confirms that natural ventilation remains the predominant method of air exchange in most multi-storey residential buildings in Fergana city. However, its effectiveness is highly dependent on external climatic factors, building orientation, seasonal temperature variations, and wind conditions. During periods of extreme heat or cold, residents often limit window opening to maintain thermal comfort, which substantially reduces air circulation and further deteriorates indoor air quality. Consequently, reliance on natural ventilation alone is insufficient to ensure stable hygienic conditions throughout the year.

The findings highlight the necessity of integrating mechanical ventilation systems as a complementary solution to natural ventilation, particularly in densely populated urban areas. Mechanical ventilation systems provide controlled and consistent air exchange regardless of outdoor weather conditions, thereby improving indoor environmental quality and reducing health risks. In addition, the study emphasizes the importance of regular inspection, cleaning, and maintenance of ventilation shafts and ducts, as neglected systems may become sources of secondary contamination.

Furthermore, increasing public awareness regarding the hygienic importance of proper ventilation is essential. Educational initiatives aimed at residents can promote correct ventilation practices, timely reporting of ventilation malfunctions, and cooperation with housing maintenance services. From a regulatory perspective, strengthening hygienic standards and updating building codes to include modern ventilation requirements are critical steps toward improving communal hygiene.

In conclusion, the incorporation of effective ventilation solutions at both the design and operational stages of multi-storey residential buildings should be regarded as a priority measure for urban public health protection in Fergana city. A comprehensive approach that combines technical improvements, regular maintenance, regulatory enforcement, and community education will significantly contribute to creating healthier indoor environments and improving the overall quality of life for the urban population.

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