

Examination of Indoor Air Quality of Naturally Ventilated Dwellings During Winters in Mega-City Kolkata

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Abstract : The US Environmental Protection Agency defines indoor air quality as “The air quality within and around buildings, especially as it relates to the health and comfort of building occupants”. According to the 2021 report by the Energy Policy Institute at Chicago, Indian residents, a country which is home to the highest levels of air pollution in the world, lose about 5.9 years from life expectancy due to poor air quality and yet has numerous dwellings dependent on natural ventilation. Currently the urban population spends 90% of the time indoors, this scenario raises a concern for occupant health and well-being. The built environment can affect health directly and indirectly through immediate or long-term exposure to indoor air pollutants. Health effects associated with indoor air pollutants include eye/nose/throat irritation, respiratory diseases, heart disease, and even cancer. This study attempts to demonstrate the causal relationship between the indoor air quality and its determining aspects. Detailed indoor air quality audits were conducted in residential buildings located in Kolkata, India in the months of December and January 2021. According to the air pollution knowledge assessment city program in India, Kolkata is also the second most polluted mega-city after Delhi. Although the air pollution levels are alarming year-long, the winter months are most crucial due to the unfavorable environmental conditions. While emissions remain typically constant throughout the year, cold air is denser and moves slower than warm air, trapping the pollution in place for much longer and consequently is breathed in at a higher rate than the summers. The air pollution monitoring period was selected considering environmental factors and major pollution contributors like traffic and road dust. This study focuses on the relationship between the built environment and the spatial-temporal distribution of air pollutants in and around it. The measured parameters include, temperature, relative humidity, air velocity, particulate matter, volatile organic compounds, formaldehyde, and benzene. A total of 56 rooms were audited, selectively targeting the most dominant middle-income group. The data-collection was conducted using a set of instruments positioned in the human breathing-zone. The study assesses indoor air quality based on factors determining natural ventilation and air pollution dispersion such as surrounding environment, dominant wind, openable window to floor area ratio, windward or leeward side openings, and natural ventilation type in the room: single side or cross-ventilation, floor height, residents cleaning habits, etc.

Keywords : indoor air quality, occupant health, urban housing, air pollution, natural ventilation, architecture, urban issues

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