Ventilation Requirements for Residential Buildings in Cold Climates

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ABSTRACT

Proper ventilation is essential in ensuring appropriate Indoor Air Quality (IAQ) in residential buildings and is an important consideration for the health and productivity of its occupants. Typical methods of mitigation, include introducing fresh air into space by implementing dedicated outdoor air ventilation systems. Residential buildings in cold climates face specific challenges related to maintaining indoor air quality (IAQ). Not only do people spend more time indoors, but they also tend to live in more efficient, airtight homes that can trap excess moisture and pollutants indoors if not properly ventilated, leading to problems for the both the building structure and occupant health. Ventilating such buildings is important to maintain appropriate IAQ but strategies that are currently available can be very energy consumptive. Therefore, alternative measures need to be researched that would reduce ventilation requirements and at the same time optimize IAQ in residential buildings located in cold climates.

This study evaluates the impact of ventilation and filtration measures on IAQ and energy efficiency in residential buildings in cold climates. The goal of this study is to ensure energy efficient operation, adequate indoor environmental quality in such buildings by incorporating ventilation and air cleaning strategies within the environmental control system of the building.

An experiment to test out these different cases of ventilation and filtration systems was devised. Once the data was collected, appropriate statistical methods were selected and utilized to peruse the data and come up with recommendations and solutions to address the research questions.

Several conclusions were made in the study that include:

- Airtight construction and the use of high-performance filters in the air intake system play an important role in disassociating outdoor pollutant levels from indoor pollutant levels.
- House characteristics such as space volumes and level of enclosure contribute to pollutant buildup in these spaces and appropriate measures should be implemented to mitigate such buildup.
- Pollutant levels also depend on the type of mechanical system installed, with radiant system providing better control of PM levels when compared to forced air mechanical systems.
- When comparing continuous and intermittent heat recovery ventilators (HRV), factors such as outdoor air temperature and rate of PM generation indoors significantly impacted the resultant PM levels indoors leading to the conclusion that these performance of systems in mitigating PM levels is comparable.
- Implementation of strategies such as high-performance filters and air-purifiers have a significant impact on resulting PM levels. However, factors such as space configuration, rate of PM generation indoors, and location of air-purifiers significantly impacted the resultant performance.
- It was determined that while CO2 levels were good indicators of occupancy, these levels were independent of the pollutant levels in the houses.
- When considering energy consumption from HRV systems, the operation of intermittent HRV system resulted in lower energy consumption when compared to operation of continuous HRV system. On the other hand, the use of high-performance filters including activated carbon filters did not have a significant impact on resulting energy consumption.