



Project Summary

Ventilation Research: A Review of Recent Indoor Air Quality Literature

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The objective of this literature review was to survey and summarize recent and ongoing research into indoor air quality (IAQ)-related ventilation topics.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Purpose

This review was undertaken for two reasons:

1. to investigate and evaluate the possibilities, capabilities, and limitations of ventilation and ventilation systems as a means to improve IAQ, and
2. to recommend for consideration those areas of ventilation research that might prove helpful in solving the IAQ problem in commercial and other buildings.

General Description

The review showed that there are three general types of IAQ research activities currently under way:

1. basic laboratory investigations into the characteristics of sources and processes that influence IAQ,
2. applied engineering research into transport, dispersion, control devices, control strategies, and costs, and

3. surveys and evaluations of the energy/economic impact of IAQ and communication of research results to users.

The ventilation research encompassed by the scope of this review largely falls in the second category. This broad category of IAQ applied engineering research is reviewed within the following framework:

1. *Pollutant Transport*—from source to building envelope boundary (dispersion/wind transport) to entry into the envelope (heating, ventilation, and air conditioning (HVAC), infiltration, and doors/windows),
2. *Air Cleaner Research*—in-duct air cleaners, in-room air cleaners, and radon control by particle capture,
3. *Diffuser Research*—room airflow and pollutant dispersion, fundamental source/sink transport, and jet/diffuser flow,
4. *Single-Room Flow and Dispersion*—single rooms and macromodels,
5. *Building HVAC Flow and Dispersion*—multizone buildings and macromodels, schools, hospitals, and other special buildings,
6. *HVAC/Building Design, Operation, and Control*—HVAC system design and selection, innovative ventilation delivery designs such as ventilated workstations, personally controlled ventilation systems, displacement ventilation, demand-controlled ven-

tilation, and energy recovery systems,

7. *Applied Biocontaminant Research*—principles of microbiological reduction and control,
8. *Building Performance*—evaluation and measurement of air exchange rate, ventilation effectiveness, and interzonal transfers.

The review included appropriate literature citations for the past 5 years. It also captured current information from research programs from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the Department of Energy (DOE), and the National Institute of Standards and Technology (NIST).

Review Findings and Recommendations

The review led to the following research recommendations:

1. *Pollutant Transport*—there are many important areas of concern in the pollutant transport research topic; however, the area of building infiltration seems to be understudied.

The need arises from the fact that infiltration air can become contaminated by building materials or by materials of microbiological origin. Little research has been conducted in this area.

Another area of concern is the effect of wind pressure fields on building ventilation in general and outdoor air exchange rates.

2. *Air Cleaner Research*—the performance of air cleaners should be evaluated with tests that provide HVAC system designers the needed information to specify air cleaners and reliably predict their performance.

Standard air cleaner test methods for both particle and gas-phase contaminants need to be developed.

3. *Diffuser Research*—development of improved models of diffuser flow (particularly for cold-air distribution systems) and the impact of diffuser design on ventilation effectiveness is a very useful research topic.
4. *Single-Room Flow and Dispersion*—a primary knowledge gap that exists appears to be experimental measurements that can be used to evaluate the many available computational flow dynamics (CFD) models.
5. *Building HVAC Flow and Dispersion*—the most important need appears to be improved measurement techniques, including the development of standardized methods. Development of such methods would encourage their use, ensure a supply of consistent data for model development, and increase the overall amount of performance data available. These data could be used to validate and improve CFD computer models.

6. *HVAC/Building Design, Operation, and Control*—an important need appears to be in gathering and organizing what is known about designing buildings and choosing HVAC systems to ensure good IAQ.

This information would then be communicated to the building industry. A good approach would be to use a cost and energy modeling simulation program to determine the best energy/cost/IAQ design for HVAC systems used in different types of buildings located in various climates and with varying space usage.

A systematic investigation of the performance, costs, and benefits (including energy impact) of standard and innovative ventilation schemes would allow designers to make early use of these technologies if they prove worthy.

7. *Applied Biocontamination Research*—there are two areas of concern with this topic: strengthened HVAC maintenance practices, need to be strengthened, possibly through education or maintenance standards, and basic research into the conditions and materials that affect microbial growth in HVAC systems.
8. *Building Performance*—as with the air distribution category, the primary research needs for building performance evaluation are for improved sensors and measurement techniques, and a standardized evaluation protocol.

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Russell N. Kulp is the EPA Project Officer (see below).

The complete report, entitled "Ventilation Research: A Review of Recent Indoor Air Quality Literature," (Order No. PB95-129086/AS; Cost: \$19.50; subject to change) will be available only from:

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