



# Research & Development Highlights

95-211 Technical Series

## Performance of Simplified Ventilation Systems

### Introduction

The proposed adoption of performance based ventilation requirements in the 1990 National Building Code was problematic for the residential construction industry. There was a concern that the lack of specific design and installation guidelines would complicate the industry's ability to comply with the proposed requirements.

CMHC initiated a research project to develop and demonstrate prescriptive guidelines for simple, effective, low cost ventilation systems. This project looked at the systems developed for houses heated by baseboard or radiant heating systems. The project evaluated the performance (air flow, noise, energy consumption, etc) of three ventilation strategies employed in five test houses in Nova Scotia. Two ventilation system control strategies were also developed and evaluated. It should be noted that some aspects of the systems evaluated may not meet the new 1995 National Building Code requirements.

### Project Objectives:

The project objectives were:

- to demonstrate simple and effective ventilation systems designed in accordance with the 1990 National Building Code,

- to evaluate these ventilation systems with respect to distribution capabilities, noise levels and power usage, and
- to demonstrate various control strategies for the ventilation systems.

### Research Program

Ventilation systems were designed and installed in five test houses. The systems consisted of:

- two exhaust-only systems,
- two ducted heat recovery ventilation (HRV) systems, and,
- one balanced supply/recirculation/exhaust system.

The systems were designed to ventilate the houses at rates based on 15 L/s for the master bedroom plus 7.5 L/s for each additional bedroom.

During the eight week study period, the performance of the ventilation systems was evaluated by the project consultants and householders. The air leakage characteristics and operating pressures of the host houses were also determined. Air change rates within an "exhaust only" system test house were measured to determine the natural and forced air change rates of the house and a selected number of rooms.

Two control strategies for the ventilation systems were evaluated: time-of-day and temperature difference controllers. Time-of-day controllers activated the systems for several hours each morning and evening. The temperature difference controllers were used to activate the ventilation systems whenever the indoor-outdoor air temperature difference fell below 25 degrees Celsius (the minimum temperature difference assumed necessary to induce sufficient amounts of outdoor air into the houses). This system would activate when outside temperatures were warmer than -5 degrees Celsius. Both control systems were supplemented with manual override switches.

### **Findings**

The ventilation systems were found to be simple and inexpensive to design and install in accordance with the 1990 National Building Code. The occupants of the houses provided with the exhaust-only and HRV systems were relatively satisfied with the performance of the systems. The balanced supply/exhaust/recirculation system caused occupant comfort problems due to insufficient tempering of incoming fresh air.

Some problems were experienced establishing specific system airflows. Single blade balancing dampers were found to be difficult to accurately adjust. Additionally, the solid state motor controllers affected fan-motor speed stability when used to establish lower airflow rates.

The noise generated by the ventilation systems was generally within ASHRAE guidelines. Two noise problems noted were caused by inadequate vibration isolation of a ventilator and the proximity of a fan to a bedroom. The power requirements of the

motors were measured to be within the rated voltage and amperage of the ventilation units.

The tracer gas decay tests of the house with an "exhaust only" system found that the system could induce the overall house air change rate required by the 1990 National Building Code. Ventilation by natural air leakage alone was found to be insufficient. The testing also revealed that the ventilation rates in the closed bedrooms were inadequate unless the rooms were connected to the operating ventilation system.

The time-of-day control strategy was preferred to the temperature difference control strategy by most occupants. The effectiveness, predictability and automatic operation were perceived to be the advantages of the time of day control strategy. The occupants reacted negatively to the temperature controller due to the irregular and seemingly less effective operation of the ventilation system.

### **Implications for the Housing Industry**

The results of this research project imply that ventilation systems must be connected, directly or indirectly, to all habitable rooms in order to be effective. Natural ventilation (air leakage) and multi-point exhaust systems do not appear to be capable of inducing sufficient amounts of ventilation air into areas not connected the systems. These findings tend to support the distribution system provisions of the 1995 National Building Code ventilation requirements.

Effective control strategies for ventilation systems should be automatic and forgettable by the occupants of the dwelling. The controls should allow for the consistent, or predictable, operation of ventilation systems.

Ventilation systems must be carefully designed to ensure that the individual components of the systems are properly sized for the application. The field adjustment of motor speed and duct balancing dampers can be a difficult and unreliable means of establishing required airflows.

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A full report on this research project is available on loan from the Canadian Housing Information Centre at the address below.

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