RESEARCH HIGHLIGHT

September 2010 Technical Series 10-102

Increasing Nunavut Housing Ventilation Rates with HRVs

INTRODUCTION

In 2003, the Children's Hospital of Eastern Ontario (CHEO), in collaboration with researchers from Health Canada (HC), the Nunavut Housing Corporation (NHC) and Canada Mortgage and Housing Corporation, initiated a research project on Nunavut children and their homes to look for correlations between poor indoor air quality (IAQ) and the frequency of respiratory infections. The first two phases of this three phase, multi-year, research project involved a pilot project to characterize IAQ conditions in 20 Cape Dorset houses, and a study to measure ventilation rates in 100 houses from four communities. CMHC's role in the research was to support the development of the IAQ and ventilation rate test protocols in support of the broader health study. The studies showed that the combination of small-volume northern housing and relatively high occupancies led to indoor environments that were under-ventilated. Concentrations of carbon dioxide (CO_2), which can be used as an indicator of adequate ventilation, ranged up to 5000 parts per million (ppm) and averaged between 1000 and 2000 ppm in the houses surveyed. These concentrations are higher than those found in most southern Canadian houses. The results of the first two phases were reported in a CMHC Research Highlight "Nunavut Housing Ventilation Research 2003-2005" (see http://www.cmhc-schl.gc.ca/odpub/pdf/64913.pdf?fr=1261572508703).

The third phase of the research project studied the premise that ventilation, to provide more fresh air, could be increased through the installation and operation of a heat recovery ventilator (HRV) and that the increased ventilation rates would result in better child respiratory health. HRVs are suited to Nunavut where heating costs are high as the heat transfer between the supply and exhaust air streams can significantly reduce ventilation-related energy costs. HRVs can also raise the temperature of the incoming air so that it is more acceptable to the occupants.

There was a large medical component of this third phase of the study, which was led by Dr. Thomas Kovesi of the Children's Hospital of Eastern Ontario (CHEO). The team of researchers involved in the project also included professionals from Carleton University, CMHC, Natural Resources Canada, Nunavut Department of Health, Nunavut Housing Corporation, Health Canada, Venmar Ventilation Inc. and others. The conclusions about the impact of improved ventilation on respiratory health have been reported in several biomedical journals[1]. This CMHC Research Highlight concentrates on the housing-related aspects of the investigation.

Like many research projects conducted by medical authorities, the sample was designed to have a test group and a control group with placebos. The sample in this investigation was divided into two groups of houses: those with active HRVs that supplied and exhausted air from the houses, and a control group with HRVs which were installed and operated but did not introduce fresh air to the houses. The results were tracked over a winter of usage.

[1] "Indoor air quality and the risk of lower respiratory tract infection in young Canadian Inuit children," *Canadian Medical Association Journal*, 177:155, and "Heat recovery ventilators prevent respiratory disorders in Inuit children," *Indoor Air* 2009: 19: 489

Figure 1 Nunavut Housing

Photo: Dr. T. Kovesi

RESEARCH PROGRAM

The project aimed to have 100 HRVs installed in Nunavut homes, with that number being equally split between active HRVs and control units, to detect health effects associated with improved ventilation. The HRVs were modified by the manufacturer (Venmar Ventilation Inc.) so that an additional 25-30 litres per second (L/s) of ventilation air would be added to the test houses. Venmar also adjusted the control HRVs to operate, circulating inside air, without taking in fresh outdoor air. All control HRVs were returned to full operation at the end of the monitoring period.

Although it is preferable to install HRVs with exhaust air vented from the kitchen and bathrooms and fresh air delivery to the bedrooms, installing the HRV ducting inside of small, existing homes was a problem. Building chases around exposed ductwork would have added greatly to the inconvenience of the householders and to the cost of the project. For this reason, Nunavut communities and houses were selected where HRVs could be easily installed by making use of existing forced-air heating system ducting (Figure 2) or where the HRV would supply fresh air directly to each room and vent exhaust air directly from the kitchen and bathrooms via ducting located in an unused internal (but heated) crawl space (Figure 3). For HRVs attached to forced-air heating systems, the HRV operation was linked to the forced-air heating system usage so that fresh air was provided primarily when the heating system was in operation. This arrangement would also help to ensure that the fresh air was better tempered and less noticeable to the occupants. In the shoulder seasons, when the furnace would run less frequently, a timer activated the furnace fan on an hourly basis and the fresh air from the HRV was distributed by the furnace fan. The HRV flows were adjusted so that the average hourly target of 25-30 L/s was achieved even with only sporadic usage. The HRVs installed in crawl spaces were set up to provide continuous flows at this rate.

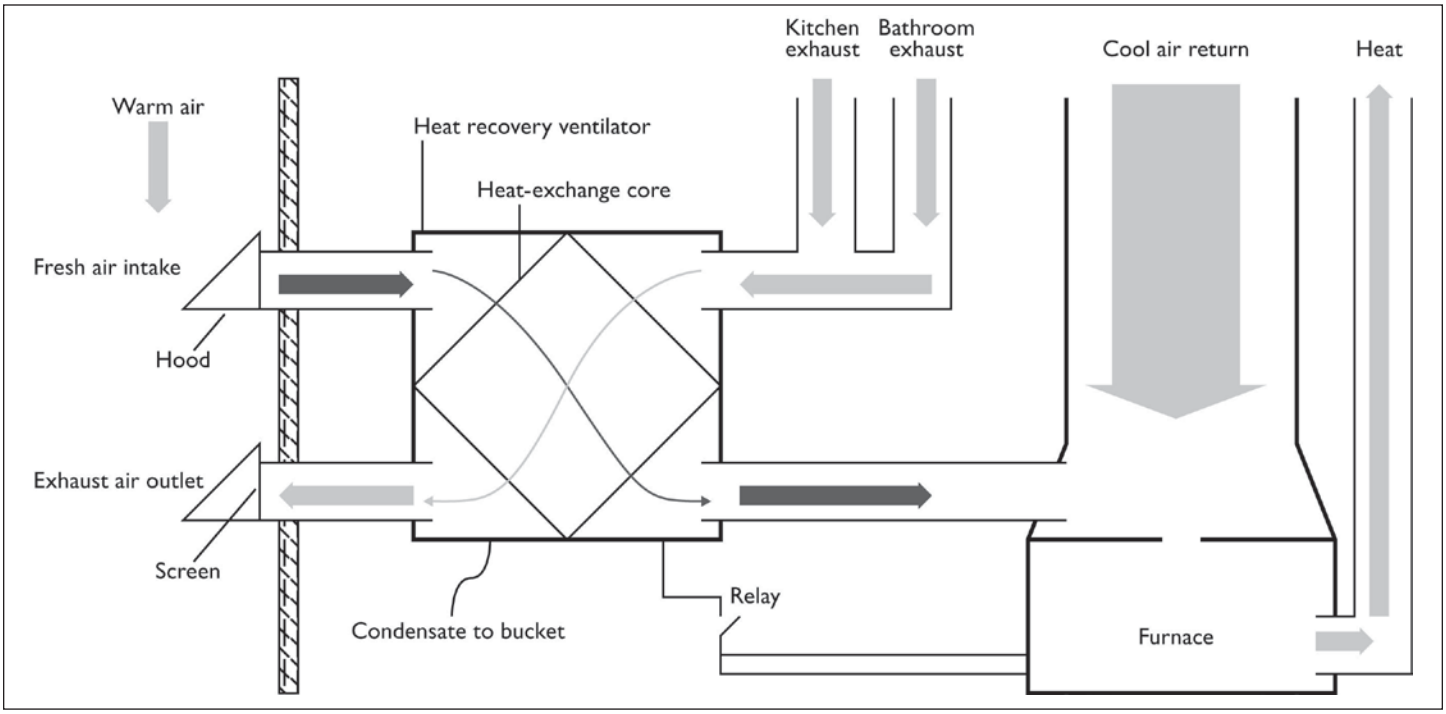

Figure 2 Nunavut HRV and furnace installation

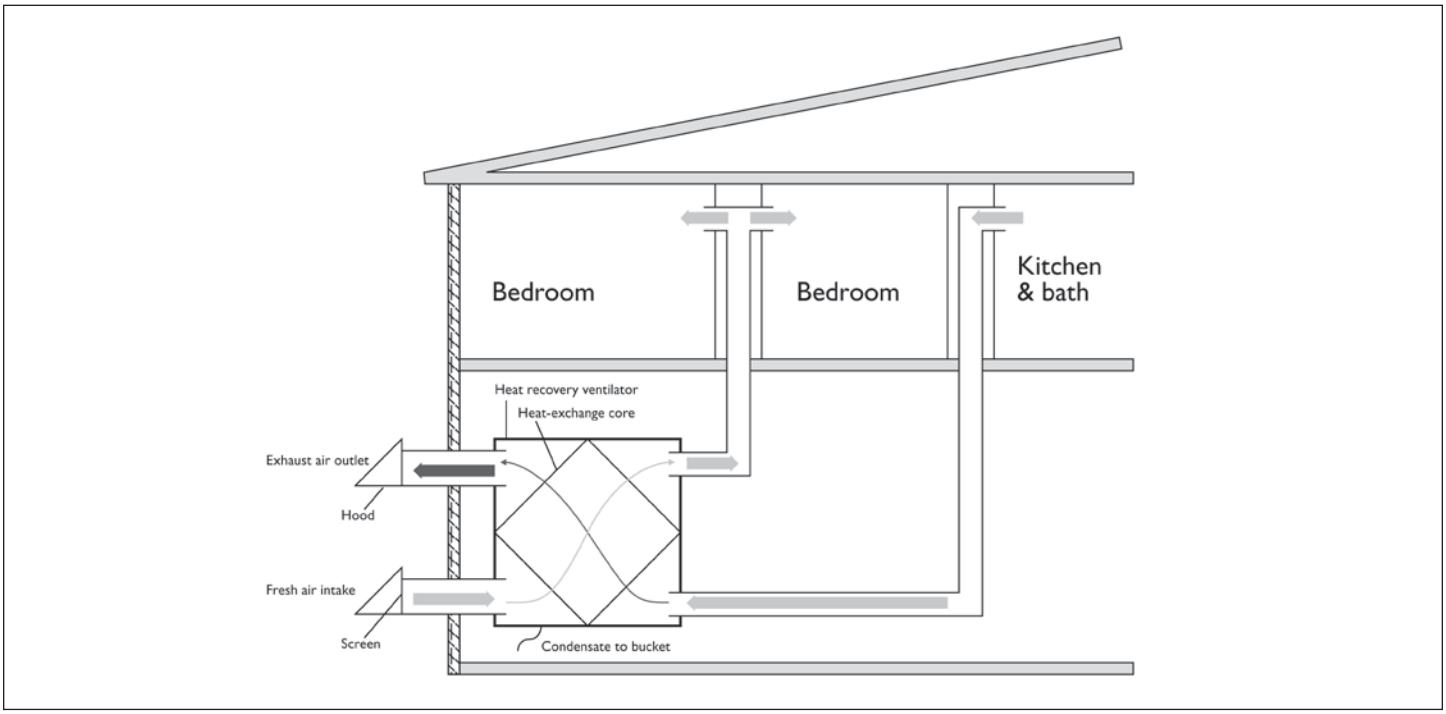

Figure 3 Nunavut HRV in crawl space installation

Four Nunavut communities were part of the research, each with its HRV installer and medical research coordinator. These communities were Clyde River, Igloolik, Pangnirtung and Pond Inlet. Each community was to host 25 sample houses, divided between test and control units. The houses were chosen on the basis of having an appropriately aged eligible child (< 6 years of age) and with the residents' desire to participate in the research. There was a nominal honorarium supplied to the resident family for the inconvenience of participating in this project. Although the HRVs were to have been installed in the fall of 2006, delays associated with recruiting willing and eligible participants and ensuring the proper installation of the HRVs resulted in the monitoring being delayed until the winter of 2007/2008. Two members of the research team visited all the houses in September 2007 to ensure that the HRVs were properly installed, balanced and operational.

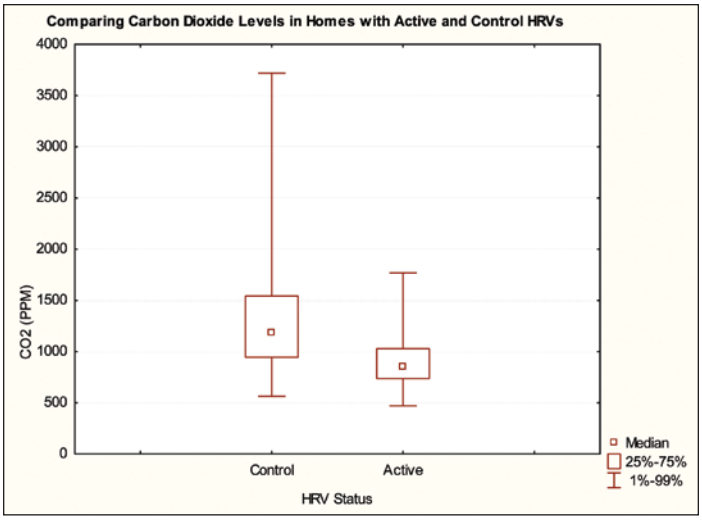

Figure 4

RESULTS

The medical results are reported in other publications[1].

The project showed that the HRVs provided the expected increase in ventilation. Figure 4 shows the mean CO_2 levels measured over several days in each of the houses. Those houses that had active HRVs had lower mean CO_2 concentrations which usually indicates that occupant-generated pollutants are lower as well. The highest house CO_2 concentration in the active HRV sample was about 1800 ppm. The house with the highest CO_2 (over 3500 ppm) during the measurement period had a control HRV.

Table 1 Mean relative humidity and indoor temperatures in sampled houses

Characteristic	Active HRVs	Control HRVs
Mean relative humidity (%)	25	30
Mean indoor temperature (°C)	23	24

Table 1 shows that the houses with active HRVs were slightly cooler and had lower relative humidity levels than the houses with control HRVs. Lower humidity levels in these houses are not necessarily a benefit. Complaints by residents about the HRV noise, discomfort or low humidity were common but were similarly spread between those with active HRVs and those with control units. It was noted that both the active and control HRVs were equally apt to be unplugged by residents.

This project reinforced the experience that it is difficult to conduct such experiments in Nunavut. The challenges included the brief, inflexible shipping season, recruiting eligible and willing participants in small communities, finding and retaining qualified contractors, getting the HRV systems properly installed, and ensuring the participants operated their HRV systems during the monitoring period. At the end of the monitoring period, the research project had only 51 houses with sufficient data to include in the analysis. Indoor air quality data was available for only 35 of these 51 houses. Nevertheless, the data gathered was sufficient to demonstrate a reduction in CO_2 levels.

IMPLICATIONS FOR THE HOUSING INDUSTRY

The increase in ventilation associated with the use of properly installed and operated HRVs in northern housing can reduce indoor air contaminants. However, it is clear that retrofitting HRVs into the existing Nunavut housing stock would require some adjustments by residents so that they are better able, and willing, to operate the systems. It would also require an increase in the number (and availability) of qualified contractors to supply, install and maintain the HRVs.

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Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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