8738

Research & Development Highlights

Technical Series
91-206

Effectiveness of a Hard-Connected Duct as a Source of Ventilation and Make-Up Air

Introduction

The National Building Code of Canada (1990) requires new houses to be equipped with a mechanical ventilation system capable of providing at least 0.3 air changes per hour (ach).

The system must also be capable of supplying make-up air to prevent depressurization levels that may lead to combustion spillage.

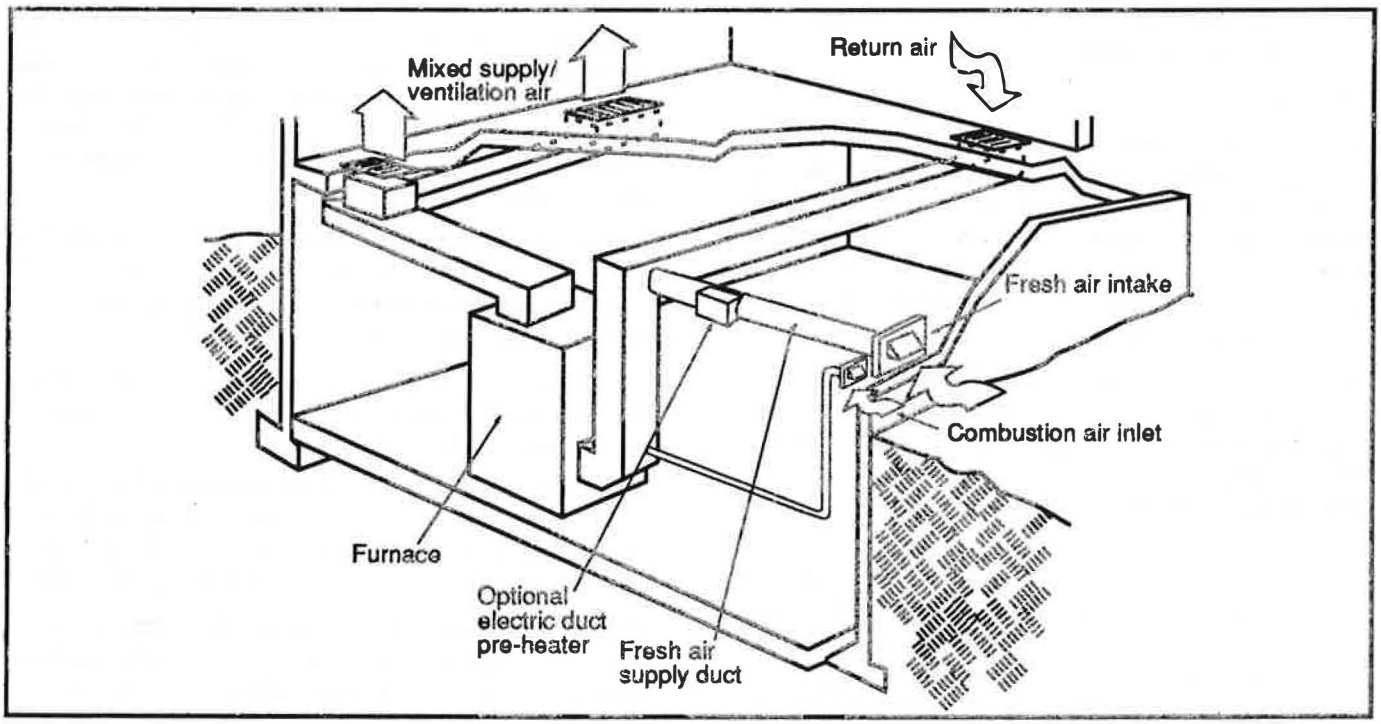
The simplest method of providing both ventilation and make-up air is to install a passive duct which allows the entry of fresh outdoor air. However, ducts of this type may cause cold drafts and are sometimes blocked off by homeowners who do not understand their purpose.

An alternative approach is to supply fresh outside air through a duct connected to the furnace return air system in houses with a forced air heating system. This provides a supply of fresh air which can be distributed throughout the house by the heating system. It also tends to pressurize the house, reducing the possibility of backdrafting.

Unfortunately, this system also has its potential problems. The furnace fan can be set to run even when the furnace itself is not operating. This provides continuous ventilation, but can lead to cold drafts when the furnace is not on. If the fan is not operating constantly, the system may not provide enough make-up air when the furnace is not operating, leading to combustion spillage or backdrafting, or insufficient ventilation.

If the incoming fresh air is too cold, it may cause condensation on the furnace heat exchanger, leading to premature corrosion. This can be prevented by the use of a pre–heater, but there are no standards for such devices, and their operating cost may be high.

In order to address these concerns and evaluate the effectiveness of the hard-connected duct as a source of ventilation and make-up air, Canada Mortgage and Housing Corporation (CMHC) commissioned a project to collect field data on the system. This project had several objectives, and took place in several phases.



Schematic of the hard-connected duct system as a source of ventilation and make-up air

NHA 6330

CMHC SCHL
Helping to house Canadians

Test Program

Heat Exchange Inspection: The first phase of the project sought to determine if connecting a fresh air duct to the return air system would cause furnace heat exchangers to rust prematurely, due to condensation caused by the cold incoming air. Heat exchangers in several houses in Ontario, Alberta and British Columbia were inspected by service technicians and compared to similar systems in houses without hard-connected fresh air ducts.

Owner Survey: The consultants interviewed owners of several homes containing the system to ascertain whether such systems were causing cool drafts. Owners were asked about their familiarity with and operation of the ventilation system, any comfort problems (such as cold drafts produced by the system when the furnace is not operating), and whether the house was too dry during the winter (a possible sign of excess ventilation).

High Wall Supply Outlets: One proposed solution to the problem of cold drafts is the installation of high inside wall supply outlets. These can be used to supply slightly cooler air than floor diffusers without causing discomfort. To determine the practicality of these outlets, two heating contractors were asked to calculate the additional cost required to install them.

Another solution to cold drafts is to use a duct heater to temper fresh air to a comfortable temperature. The operating cost of this approach was also calculated.

Test House: A test house was used to measure air flows, temperatures and pressures during various modes of ventilation system operation.

Findings

Heat Exchanger Inspections: No signs of premature heat exchanger corrosion were found in the few houses inspected. However, this does not indicate that such corrosion will not occur. Only one of the systems inspected was in continuous operation (the worst-case scenario). The furnace fans in most systems operated only when the furnace came on.

Even in the coldest regions surveyed, incoming air flow rates and temperatures were not sufficient to cause condensation on the heat exchanger. It should be noted, however, that the ventilation flow rates in these houses were much less than that required by the National Building Code.

The fresh air ducts in B.C. were not insulated and apparently were not experiencing any condensation, likely because of the mild climate. All ventilation ducts in the Alberta sample were insulated and enclosed with a vapour barrier. The ventilation ducts examined in Ontario usually had some fibreglass insulation wrapped around the first few feet from the wall penetration and no vapour barrier. The occupants reported that the ducts had condensation on them most of the winter and that the insulation quickly became soaked with water.

Owner Survey: Most owners surveyed knew their house had a fresh air ventilation system, though this may be partially due to the fact that many of them worked for the utility companies which conducted the inspections. Others knew the nature of the system either because they had had the system added to eliminate a moisture problem, or were paying high heating bills as a result of the high ventilation rates produced, in part, by the system.

The owners seldom used manual controls, if installed, probably because they would have had to open the furnace cabinet to activate the fan switch.

A number of the home owners interviewed did not have much understanding of the purpose of fresh air ventilation or the operation of their system. Except in British Columbia, most felt that their house was too dry in winter. If this was true, it may indicate that ventilation levels in those homes were too high.

There were few complaints of drafts, possibly because most of the systems only operated when the furnace was producing heat.

High Inside Wall Supply Outlets: Estimate of the additional cost of high inside wall outlets, compared to floor diffusers, ranged from $40 to $65 per run. As previously noted, air from high wall outlets can be at a lower temperature than air from floor diffusers without causing comfort problems. The reduced heating demand this creates can produce an annual heating cost savings, for an average house, of approximately $110. This would repay the additional cost of the high outlets over approximately six years.

A heat recovery ventilator (HRV) could also be used to temper the incoming fresh air. This would result in a high annual saving, but would require a longer payback period because of the higher initial cost of the HRV.

Test House: The Edmonton test house provided a great deal of valuable information about the interaction of various parts of the ventilation system.

With an exhaust fan operating and the furnace fan shut off, air pressure in the house fell to a level where combustion spillage was likely. In this situation, both the fresh air duct and the combustion air inlet acted as make-up air intakes.

Despite the presence of the fresh air duct, there was little air flowing upstream through the air return ducts when the furnace and furnace blower were shut off. Instead, the cold

air entering through the ventilation duct travelled towards the furnace and pooled there. When the outdoor temperature is below 0°C, this air could fall below the dew point, leading to condensation on the ducts and the furnace. When the furnace fan operates at a sufficiently high rate to produce 0.3 ac/h, it will slightly pressurize a tight house (3.3 Pa). If the furnace itself is not operating, the combustion air inlet may exhaust indoor air to the outdoors. This can lead to short-circuiting with the fresh air inlet, if it is located close to the combustion air inlet. When an open vent or chimney is present, it also exhausts air.

Operation of the furnace fan brings enough fresh air into the house to help compensate for the air being exhausted by exhaust devices. This reduces the risk of combustion spillage.

Project Officer: *Robin Sinha*

Research Report: *Evaluation of the Effectiveness of a Hard Connected Duct into the Return Air System of a Furnace Forced Air Duct System as a Means of Providing Ventilation and Make-up Air*

Research Consultant: *Geddes Enterprises*

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

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 factsheet is one of a series intended to inform you of the nature and scope of CMHC's technical research program.

This Research and Development Highlights factsheet is one of a wide variety of housing-related publications produced by CMHC.

For a complete list of Research and Development Highlights, or for more information on CMHC housing research and information, please contact:

The Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa (Ontario)
K1A 0P7

Telephone: (613) 748-2367
Fax: (613) 748-2098

Cette publication est aussi disponible en français.