# Research & Development Highlights

## Attic Ventilation and Moisture

93-201 Technical Series

### Introduction

Attic ventilation is specified in building codes as a means of reducing the moisture levels in the attic framing and sheathing, as well as providing some cooling of the attic space in hot summer conditions. The actual effectiveness of this ventilation is not well known. Earlier CMHC research showed wide ranges of attic ventilation rates and moisture levels in 20 sample attics, however, there were no good correlations established between the type or location of attic vents and the dryness of the wood members. A University of Alberta team was contracted to monitor attic venting conditions in two test huts over two winters. The team was also to develop a comprehensive attic simulation computer model and use it to look at the effects of various attic venting strategies on wood moisture levels.

### Project Objectives

The project objectives were:

- to use the continuous monitoring data to find out the relationships between outside conditions (wind, temperature, humidity levels) and attic performance (ventilation rate, wood moisture levels); and

- to develop an accurate attic venting model that could be extended to different attic designs, climates, venting systems, etc.

### Research Program

The field studies were built around two similar test houses: one with no intentional attic ventilation openings and one with traditional soffit and roof venting. These buildings were monitored over two winters. Measurements included attic wood moisture levels, attic air humidity levels, continuous air change testing, and environmental conditions.
In addition to passive venting, one attic was retrofitted with a fan to force the ventilation rate. This fan was operated both as an air supply and as an exhaust to the attic during different periods.

The researchers developed the computer model from both existing programs and new original research. The model was verified using the test house data.

### Findings

The project had a host of findings, including the apparently contradictory conclusion that too much or too little attic ventilation will increase the moisture levels in attic wood members. The field work showed that stack effects usually determined the rate of infiltration of moist house air into the attic but that the attic ventilation rates were more dependent upon wind conditions (see Figures 1 and 2).

The researchers produced the first attic simulation program that models thermal, moisture, and airflow variations in attics. The model compares quite well with the results from the two field huts monitored. They ran numerous simulations showing the effects of climate, cloud cover, wind speed and direction, and the use of fans (as opposed to passive openings) to promote ventilation. Figure 3 is a sample of the model output.

### Implications for the Housing Industry

The research explains attic behaviour in a comprehensive fashion, and continued use of the model will expand this knowledge. Some preliminary conclusions include:

- Attic ventilation rates are dominated by wind speed and can easily vary by a factor of ten, depending on the wind conditions at the time of measurement.

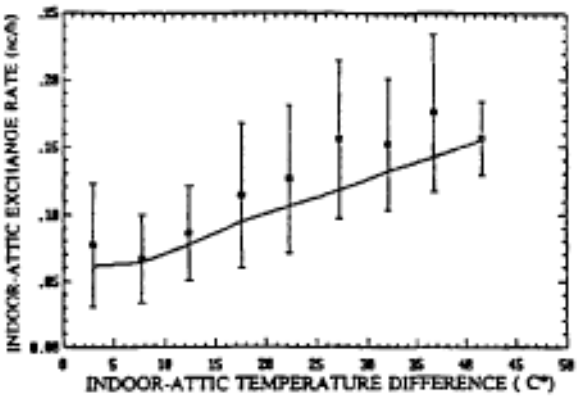
- When there is significant air movement into attics from the house below, an unventilated attic will result in a higher wood moisture content than a vented attic.
- Conversely, if the attic-house junction is nearly airtight, increasing attic ventilation will result in higher wood moisture levels due to reduced attic temperatures.

- The use of fans to ventilate an attic did not offer significant advantages over passive ventilation, in the cases modelled for this report.

- The attic simulation program allows for the extension of the research findings to different climate zones and ventilation strategies.

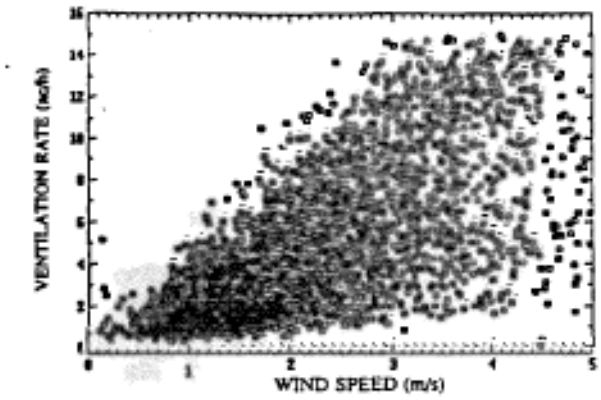
## Figure 1. Stack Effect vs. Indoor Attic Exchange Rate

Comparisons of measured (binned) and predicted (line) indoor-attic exchange razes for attic 5 for wind speeds < 2 m/s (990 hours) showing mean and standard deviation of



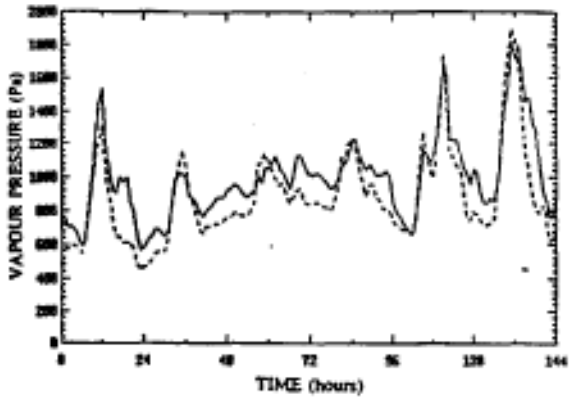

binned measured data and a line connecting the mean predicted values for each bin.

## Figure 2. Wind Speed vs. Ventilation Rate




Measured ventilation rates in attic 6 for wind speeds up to 5 m/s and all temperature differences (3522 data points).

## Figure 3. Sample of Model Output for Vapour Pressure vs. Time




Measured (solid line) and predicted (dashed line) vapour pressure for attic 6 over 6 day period from May 15 through 20, 1991.

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*Research Report: Attic Ventilation and Moisture (1993)*
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*A full report on this research project is available from the Canadian Housing Information Centre at the address below.*

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