Research & Development Highlights

Technical Series
90-232

Air Tightness, Air Movement and Indoor Air Quality in British Columbia High-Rise Apartment Buildings

Introduction

In many high-rise apartment buildings, air leakage through exterior walls, between units, and to and from service chases provides the majority of ventilation. Unplanned leakage can result in problems with indoor air quality (IAQ), moisture, energy costs, and ventilation.

Life safety may even be a concern if fire barriers are not well sealed against smoke passage.

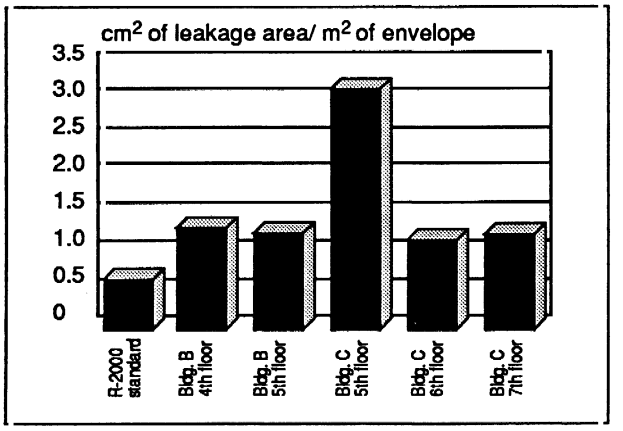
In order to respond to these concerns, Canada Mortgage and Housing Corporation (CMHC) commissioned a consultant to evaluate the following characteristics of several British Columbia high-rise apartment buildings:

- air leakage,
- indoor air quality, and
- air movement patterns.

Air Leakage

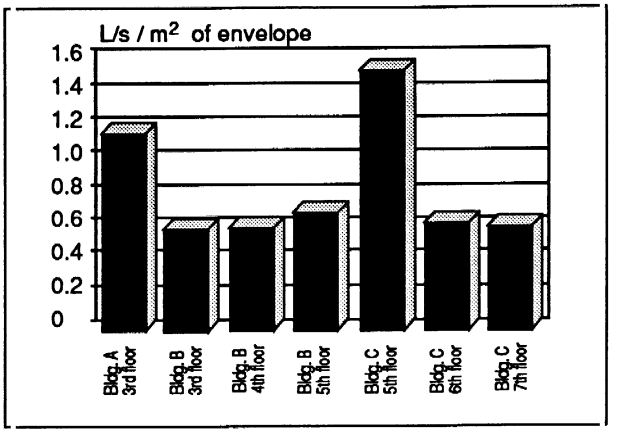
Five high-rise buildings, ranging from seven to eleven stories, were studied. Two had been built in the early 80s and three were new. All were equipped with electric baseboard heating. The study found:

- The rates of leakage in apartment buildings can vary considerably from building to building, and from floor to floor within a particular building.



Normalized leakage areas

- Of the five floors whose depressurization test data has sufficiently high correlation coefficients, four have similar rates of leakage. The average Normalized Leakage Area (NLA) for these floors is 1,25 cm2 per m2 of envelope area. This is 1.8 times greater than the maximum allowable NLA for R-2000 houses. The remaining floor had an NLA of 3.17 cm2 per m2 of envelope area.



Comparative leakage at -40 Pa

- The greatest sources of air leakage, from most to least, are:
- elevator shafts;
- floors and ceilings;
- stairwell doors;
- sliding glass patio doors;
- suite fans with ineffective backdraft dampers; and
- various other service shafts.

Fireplaces were not significant sources of leakage.

- It would appear that stack effect makes the leakage from major shafts more pronounced on higher floors.

The protocol used for leakage testing (establishing the protocol for measuring air leakage and air flow patterns in high-rise apartment buildings) was found to be difficult to implement, particularly in large occupied buildings.

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Occupant concerns and wind conditions can easily prevent proper test conditions and data collection.

Indoor Air Quality

Numerous minor IAQ problems were encountered, but conditions are generally very good in these buildings. The IAQ of the buildings studied is higher than in average commercial buildings, and higher than in single family dwellings containing similar ventilation technology.

The only potentially serious problem discovered was relatively high concentrations of carbon monoxide (CO) due to poor garage ventilation within one of the buildings. Spot testing showed CO levels in excess of unofficial comfort levels in the lobby and on the top floor.

The concentration in the lobby was equal to Health and Welfare Canada Residential Exposure Guidelines for eight-hour exposure.

Moisture problems associated with rain penetration were encountered in each of the three buildings tested. There were very few other moisture-related problems discovered.

Air Movement Patterns

Overall ventilation is generally adequate in most of the high-rise apartments tested. The lack of control with respect to volume and location of ventilation can cause comfort problems and structural concerns. Build-up of dirt, lint, grease, etc. on suite exhaust fan backdraft dampers can render them ineffective. Exhaust fans with ineffective back flow prevention become significant sources of infiltration.

Conclusions

Air Tightness

Air leakage was found to be approximately twice the level allowed in R-2000 houses.

The discrepancy is overstated due to the lack of suite exhaust fan sealing. Most of the air leakage into the suites could be traced to deliberate openings in the building such as elevator shafts, stairwells, garbage chutes, exhaust fans and opening windows.

The only other noticeable through-wall air leakage entered the suites through the electrical outlets on the outside walls.

Indoor Air Quality

Indoor air quality of the buildings studied herein was higher er than average for commercial buildings, and higher than in single family dwellings containing similar ventilation technology. Thermal comfort can be compromised by excessive infiltration due to wind and stack effecL

Moisture Problems

Water penetration from outdoors is common in high-rise apartment buildings. Wind-driven rain penetration was reported by the tenants. No problems associated with moisture penetration of walls from the inside of any of the buildings were discovered.

Although we encountered no evidence of serious condensation, the possibility of structural and subassembly damage was a concern. Constant passive ventilation during cold weather helps to maintain suite relative humidity at comfortable levels.

Mechanical Ventilation

Build-up of dirt, lint, grease, etc. on suite exhaust fan backdraft dampers can render them ineffective. Exhaust fans with ineffective back flow prevention become significant sources of infiltration. Underground parking, garbage disposal and combustion vents present ventilation design challenges which are often overlooked.

Overall Ventilation

Overall ventilation is generally adequate. The lack of control, however, can cause comfort problems and structural concerns.

See also:

Air Tightness, Air Movement and Indoor Air Quality in Atlantic Region High-Rise Apartment Buildings (91-203)

Air Tightness, Air Movement and Indoor Air Quality in Quebec High-Rise Apartment Buildings (91-205)

Project Manager: Jacques Rousseau

Research Report: Field Investigation and Survey of Air Tightness, Air Movement and Indoor Air Quality in B.C. High-Rise Apartment Buildings

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

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

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Under Part JX 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.