



# Research & Development Highlights

Technical Series  
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## Mechanical Systems in High-Rise Residential Buildings

### Introduction

A literature review and field survey of 150 organizations representing 25,000 dwelling units in 260 buildings was undertaken to determine typical practice, as well as state-of-the-art, of the mechanical (plumbing, heating, ventilating and air conditioning) systems in high-rise residential buildings.

### Research Program

The 1981 Canadian Census indicates that apartments having less than five storeys constitute 16.3 per cent of occupied private dwellings, while those having five or more storeys (high-rise) constitute 9 per cent. The multi-storey high-rise segment ranges from low-cost rental apartments to luxury condominiums. They frequently consume a higher density of energy, provide a lower standard of comfort, and demonstrate a disproportionate share of physical defects when compared to low-rise housing. Further, the ultimate owner and user generally have little or no involvement in the construction process.

### Findings

- Electric baseboard is the most popular form of heating and has the fewest operational complaints. Central gas boiler(s) with hydronic perimeter (baseboard) units are next in popularity. In Montreal virtually all installations are electric but through the Prairies it is unusual if gas is not used. Oil heating systems are limited to the Maritimes and the North.
- Virtually all buildings (95 per cent) have a central make-up air system supplying into the corridor where it passes through door undercuts and cracks into the individual suites. Two respondents reported that air was ducted into the suites in at least one instance and two other buildings used a transfer grill between the corridor and suites. The make-up air systems typically run continuously, although they may be turned off via timeclocks to conserve energy.
- Forty-eight per cent of the buildings had simple central exhaust systems, 14 per cent had a variation on a central arrangement, and 38 per cent had individual kitchen and bathroom exhaust fans. Central exhaust systems frequently are controlled in the same manner as the make-up air system while local manual or humidity switches control the individual fans.
- Ventilation system performance and/or air leakage, or movement, were responsible for the greatest number of complaints.
- System commissioning was frequently reported to be less than satisfactory.
- Approximately one-third of the units were air conditioned by permanent (non-window) equipment. Condominiums accounted for 38 per cent of these units. Common areas and lobbies are normally air conditioned if the suites are; however, the corridor make-up air system generally is not.
- Approximately 75 per cent have domestic water heated at a central location. Most of the remainder have electrical units in each suite, while there are some high efficiency gas installations in southwestern Ontario. The current approach in B.C. is to electrically "heat trace" mains rather than provide a recirculation loop and pump. Approximately 10 per cent of the installations are heated by the space heating boiler. Eighty per cent of the central systems have insulated piping.
- Fifty-three per cent of the buildings had heated garages, 24 per cent had unheated, and the remainder either had on grade or open parking structures. Parking in colder climates tended to be in enclosed, heated areas. Sixty-one per cent of the heated garages used electric unit heaters. In Montreal there were 84 per cent.
- Garage ventilation was normally unheated (72 per cent). Heat recovery was not incorporated in any installation. 78 per cent of the systems were controlled by carbon monoxide detectors. The remainder were either operated continuously, via a timeclock, or had manual intervention.
- Services in unheated garages are protected from freezing via trace heating, insulation, constructing a heated ceiling space or using dry standpipe and sprinkler systems.

- Routine operating and maintenance tasks are normally performed by the building janitor/superintendent. Larger organizations may have skilled resources in-house but most (78 per cent) also utilize outside contractors.
- Problems associated with operating and maintenance skill requirements are biased to the perceptions of owners, operators, developers and property managers as 74 per cent of the survey respondents were from this group.

## Implications for the Housing Industry

A number of recommendations for research, development and demonstration activities are defined. They include:

- creation of a multidisciplinary review panel to balance functional priorities (e.g. lower energy consumption, improved comfort, energy source, etc.) and budget constraints for activities to be undertaken;
- development of practical, economical systems to control infiltration and odour transfer while providing quality, economical ventilation;
- preparation of good-practice manuals reflecting current knowledge. It was found that problems were most frequently due to personal, rather than collective, lack of knowledge;
- enhancement of education and skills upgrading through courses at community colleges, videos defining operating, servicing and maintenance functions for systems, enhancing commissioning, etc.;
- development of innovative electric baseboard controls;
- demonstration of control strategies and heat usage metering for hydronic systems; and
- development and adoption of building codes which provide clearer definitions of system performance requirements. Current references such as "in accordance with good engineering practice" are a problem for many practitioners.

*Project Manager: Wayne Webster*

*Research Report: HVAC Systems in Multi-Unit High-Rise Residential Buildings (1991)*

*Research Consultant: Leslie Jones and Associates*

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

## **Housing Research at CMHC**

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