Technical Series 00-140

COMPENDIUM OF RESEARCH ON THE CONSERVATION CO-OP BUILDING

Introduction

In 1995, the Conservation Co-op, a four-storey, 9,070 m^2 (97,632 sq. ft.), 84-unit residential building in Ottawa, was constructed. The building embodied as many environmentally sound concepts and technologies as possible within the confines of an extremely tight budget. The objective of the development team was to provide affordable housing with minimal environmental impact, enhanced durability and superior occupant health and comfort. After five full years of occupancy, Canada Mortgage and Housing Corporation initiated a review of the performance of the building, particularly with respect to energy and water consumption, indoor air quality and the operational experience with many of the "green" innovations included in the building.

Description of Publication

The research report contains a summary of the findings of the individual research projects conducted over the first five years of the Conservation Co-op. The projects assessed the annual energy and water consumption, embodied energy and water reuse system and the relative strengths and weaknesses of the innovative, green technologies employed in the building. The original research reports are contained in the appendices to the report for reference and are not published elsewhere.

Results

The Conservation Co-op is one of a growing number of multi-unit residential buildings in North America to incorporate a wide range of innovative design, construction and operational features. More important, this was accomplished within the context of an affordable housing project. After 9 ½ months of construction, the Conservation Co-op was completed at a cost of $5,950,000 ($654 CDN/m^2), which is similar to the construction costs of conventional buildings in the Ottawa area.

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Table 1 lists the primary environmental features of the Conservation Co-op.

Table 1: Innovative Features of the Conservation Co-op

Energy efficiency

- High thermal resistance walls (RSI 4.93) and roof (RSI 7.04
- Low-E windows
- High efficiency, natural gas-fired, integrated space and water heating systems
- Building orientation for maximum passive solar gains
- Photovoltaic site lighting
- Natural and architectural shading of windows
- Energy-efficient fluorescent lighting
- Heat recovery ventilation
- Programmable thermostats
- No thermal bridges in the building envelope

Indoor environment

- Continuous ventilation for each apartment
- Materials selection promotes clean air
- Apartments have no carpets
- Solarium in common area
- Glass block used for natural light in stairwells
- Sealed-combustion, gas-fired appliances

Biodiversity and ecology

- Rooftop planters
- Infiltration pond and reservoir for storm water runoff control
- Retention of large, mature trees during construction
- Use of indigenous plantings
- Sheltered courtyard complete with extensive garden plots
- Building located in urban core
- Occupant Environmental Code of Practice

Conservation of materials

- Carpets made from recycled pop bottles
- Steel studs, gypsum board with recycled content
- Construction waste reduction/recycling

Waste reduction

- Ambitious recycling programs for organic and inorganic waste
- Low-flow toilets and plumbing fixtures
- Light, grey-water reclamation system
- No garbage chute—recycling rooms on each floor

Energy Consumption

The initial energy embodied in the building was calculated to be 47,800 GJ or 5.25 GJ/m^2 of floor area. Figure 1 shows the relative amounts of energy embodied in the different building materials used in the Co-op building.

Life-cycle embodied energy accounts for the initial energy embodied in the construction of the building and in the materials and activities required for the repair, maintenance and the eventual demolition and disposal of the building. The life-cycle energy requirement for the 40-year life of the building is estimated to be 79,000 GJ. Figure 2 compares the initial embodied energy to the life cycle-embodied energy for the main building assemblies.

Figure 1: Embodied Energy Proportions by Building Systems

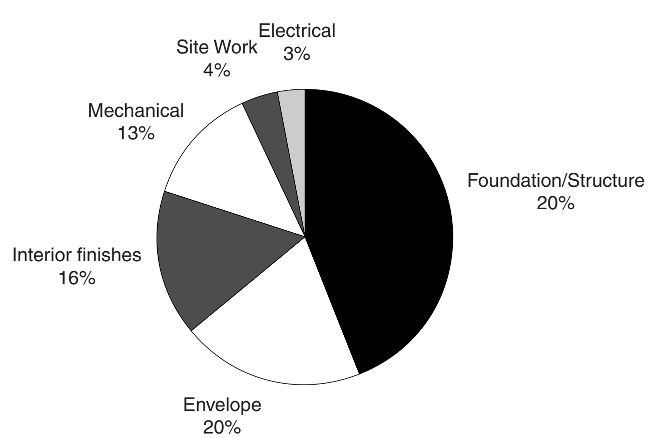


Figure 2: Initial Embodied Energy and Life Cycle Embodied Energy

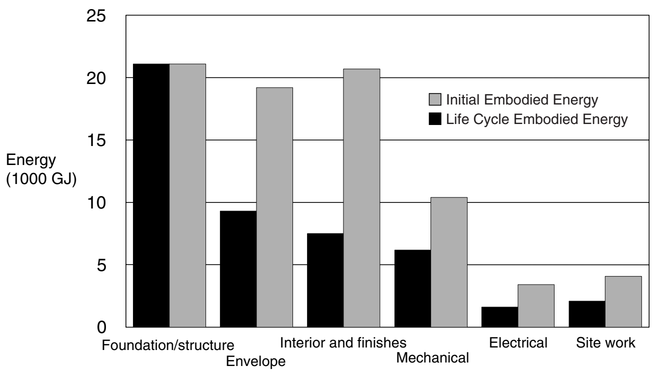
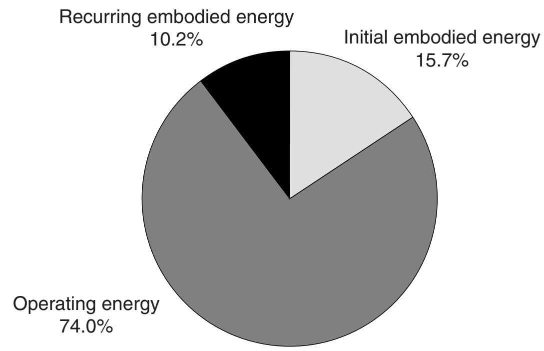


Figure 3: Distribution of Life-cycle Energy Consumption



Concrete work is the largest component of the life-cycle embodied energy. The results also show that the interior finishes (carpeting, paint, flooring, etc.) are a significant component of the life-cycle embodied energy of the building.

The U.S. Department of Energy (DOE) DOE-2.1E building energy simulation computer program was used in conjunction with utility records to estimate annual energy consumption and savings associated with specific technologies. Table 2 is a summary of the total energy consumption and costs.

Life-cycle energy is the sum of life-cycle embodied energy and ongoing operating energy of the building. The life-cycle energy consumption total for the Conservation building is 0.877 GJ/m2/yr. Figure 3 shows the distribution of the energy components that make up the life-cycle energy consumption.

The operating energy consumption represents almost three-quarters of the total life-cycle energy consumption of the building, indicating that the efforts to reduce operating energy were well placed given the significance of operating energy over the life of the building.

Table 2: Annual Energy Consumption and Costs

Description	Energy consumption	Cost ($CDN)
Gas equipment. rent	N/A	$20,109.60
Gas use	103 636 m^3 (1,071,699 kWhe—kilowatt-hour equivalent) (12,746 kWhe/suite or 117kWhe/m^2)	$20,663.89
Electricity use	628,961 kWh (7,490 kWh/suite or 69.4 kWh/m^2)	$44,122.57
Taxes	-	$5,942.72
Total	**1,700,661 kWhe (186 kWhe/m^2)**	**$107,225.92**

Table 3: Summary of the Cost Benefit of the Energy-efficient Features

Component	Annual savings		Capital cost	Simple payback (years)
	Energy [KWhe/yr]	$/yr		
Low E windows	151,502	$4,531	$36,143	8
Air leakage control	41,081	$1,229	$5,880	4.8
Higher insulation levels	180,475	$5,398	$60,424	11.2
Heat recovery ventilation	225,921*	$6,757	$88,200	13.1
High efficiency gas water heaters	242,931	$7,266	$54,600	7.5
Total of components	**841,910**	**$25,180**	**$245,247**	**9.7**

*over base case with same ventilation rate without heat recovery

Table 3 summarizes the incremental costs of the energy-efficient features of the Conservation Co-op and the associated savings. When the measures are bundled together, the overall pay-back period has an attractive time frame of 10 years.

Lessons Learned

The Conservation Co-op is a very successful building project. However, areas where the original intentions of the development team were not realized, or where unforeseen problems later developed, include building energy use, indoor comfort conditions, the grey-water reclamation project, apartment space and domestic hot water heating systems and some of the "green" building products. The research report summary examines each subject with the benefit of five years of operational history.

Implication for the Housing Industry

To a large extent, the Conservation Co-op building achieved its goals of conserving energy and water and reducing waste while promoting healthy, affordable community living. The review revealed that the enhanced insulation levels, high-efficiency space and domestic hot water heating appliances, low-E windows and heat recovery ventilation were economically and environmentally sound choices. It also illustrated the costs associated with continuous ventilation strategies and the need for more efficient fan-motor set technologies and distribution systems. Many of the "green" features met, or exceeded, expectations while others did not. Overall, the building is a successful project, as it managed to incorporate many environmentally sound design and construction practices that are readily applicable to other, similar innovative building projects.

CMHC Project manager:
Duncan Hill, P. Eng., Research Division

Research consultants:
Scanada Consultants Limited: *Energy Efficiency Audit of the Conservation Co-operative Housing*

Sheltair Scientific Ltd: *Analysis of the Embodied Energy of the Conservation Co-op*

Totten, Sims Hubicki Associates: *Conservation Co-op Residential Water Reclamation Case Study*

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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The Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, ON K1A 0P7

Telephone: 1 800 668-2642
FAX: 1 800 245-9274

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