Ottawa Community Housing Case Study

Save Energy and Extend Building Life—Window and Balcony Door Replacements

PROPERTIES

OCH identified five suitable multi-unit residential apartment buildings for window and balcony door replacements: 280 Rochester, 380 Murray, MacLaren Towers (415 MacLaren), Golden Manor (445 Richmond)[1] and Bellevue Manor (1465/1485 Caldwell) (table 1).

All of these buildings were constructed between 1970 and 1973 and typically still had original windows and doors installed. The windows consisted of aluminum frames with paired, single-glazed, sliding operable sashes. The balcony doors were commonly made of wood.

The windows and/or doors were typically in poor condition at the selected buildings. For example, the window and door weatherstripping was worn and contributed to air and water leakage. OCH noted complaints by residents of cold drafts and localized deterioration of the building walls due to water leakage. The windows and doors also functioned poorly and often required extra effort to close completely, further contributing to air leakage.

OPPORTUNITY

Building components are generally expected to perform over a certain service life. As windows and doors age, they become vulnerable to air and water leakage and can pose a deterioration risk for building envelopes and interior finishes. Improper function can also reduce interior comfort conditions. Maintenance and repairs can prolong the service life of these components until they deteriorate and fail to meet the user's needs, resulting in a decision to proceed with a program of work for their replacement.

While the return on investment from energy savings for window and door replacement projects is typically low, there are other considerations that make performing such retrofits appealing. These include improved durability of other exterior and interior wall components compared to current air and water leakage resistance, improved interior comfort, better operability and reduced maintenance calls. In 2008, a federal government grant for social housing energy retrofits provided Ottawa Community Housing (OCH) with the necessary capital to proceed with window and door replacement projects at select buildings.

PROCESS

OCH property managers prioritized the five selected buildings based on resident complaints and life-cycle analysis. OCH head office then decided where capital investments would yield the greatest benefit. The properties selected were deemed the most straightforward to retrofit.

Table 1: Site characteristics

Addresses	Number of Units	Primary Heating Type	Build Year	Floor Area (sq. ft)
415 MacLaren	249	Electric	1972	178,434
380 Murray	230	Hydronic	1973	245,925
280 Rochester	241	Electric	1972	194,103
445 Richmond	239	Hydronic	1971	166,158
1465/1485 Caldwell	319	Hydronic	1970	433,352
TOTAL	**1,278**			**1,217,972**

[1] Only windows were replaced at 445 Richmond, as this site has no balconies.

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Given the scope and cost of this project, OCH engaged professional services firms to develop specifications and details for the replacement program. These documents were developed in line with the CSA A440 standard, Window, Door and Skylight installation and the project was publicly tendered to obtain competitive pricing from qualified contractors. The successful contractors were selected based on the lowest price that met the specified performance requirements.

The replacement work required access to the windows and doors from the interior and exterior of the apartment units. Exterior access was provided either through the units to the balconies or using a suspended stage on elevations without balconies. Windows were removed and replaced on the same day to avoid unprotected openings and manage the risk of weather damage to the interior of the units.

The new windows were constructed with thermally broken aluminum frames with a combination of fixed glazing and paired, double-glazed sliding windows or compression-seal, operable window sashes. The fixed glazing consisted of insulating glass units (thermal panes) with low-emissivity coatings and argon gas fill. The new prefinished metal insulated doors had vertical sliding window inserts. Aluminum from the old windows and doors was recycled and diverted from landfill.

During the course of the retrofit, OCH engaged a specialist testing company to check that sample window assemblies met CSA water and gas infiltration standards and performed according to the manufacturer's specifications pre-installation and in situ. Some windows did not meet these quality standards and were returned to the manufacturer for replacement or reinstalled by the contractor.

The window and balcony door replacements cost between $1.7 and $4.9 million per building. The total cost of the retrofit was $15.5 million across all five buildings.

Total cost of retrofit: $15.5 million across all five buildings ($12,128 per unit)

Windows and balcony doors: replacement cost between $1.7 and $4.9 million per building

RESULTS

In the 12 months prior to the retrofits, the total energy consumption of the buildings was approximately 30 million equivalent kilowatt-hours (ekWh).[2] In the 12-month period after the retrofits were completed, energy consumption decreased to 26 million ekWh (figure 1),[3] saving $145,000 in costs.[4] Replacing the windows and balcony doors resulted in average energy savings of 14 per cent. Each property reduced its energy intensity by between 0 to 6.5 ekWh per square foot per year (table 2).

MacLaren Towers (415 MacLaren), which is electrically heated, achieved the greatest electricity savings post-retrofit. The other electrically heated building retrofitted at 280 Rochester saw a slight increase in electricity consumption but achieved the greatest natural gas savings and had the highest reduction in overall energy consumption among the five buildings.

Replacing the windows and balcony doors resulted in average energy savings of 14 per cent.

The buildings at 1465/1485 Caldwell, which are gas-heated, also had a slight increase in electricity consumption but had no change in overall post-retrofit energy consumption.

Although unconfirmed, variances in results may be attributed to changes in tenant behaviour and stack effect. Unlike the old windows, many of which could not be opened, the improved operability of the new windows provides greater opportunity for windows to be left open during cooler weather, allowing heat to escape. Although new windows and doors improve air leakage resistance, open windows can actually increase stack effect by drawing heated air from common areas throughout the building and exhauting it out the windows, which requires more energy to condition the air.

The remaining two buildings, 380 Murray and 445 Richmond, are both heated by hydronic gas-heated radiators and achieved significant natural gas savings following the retrofits.

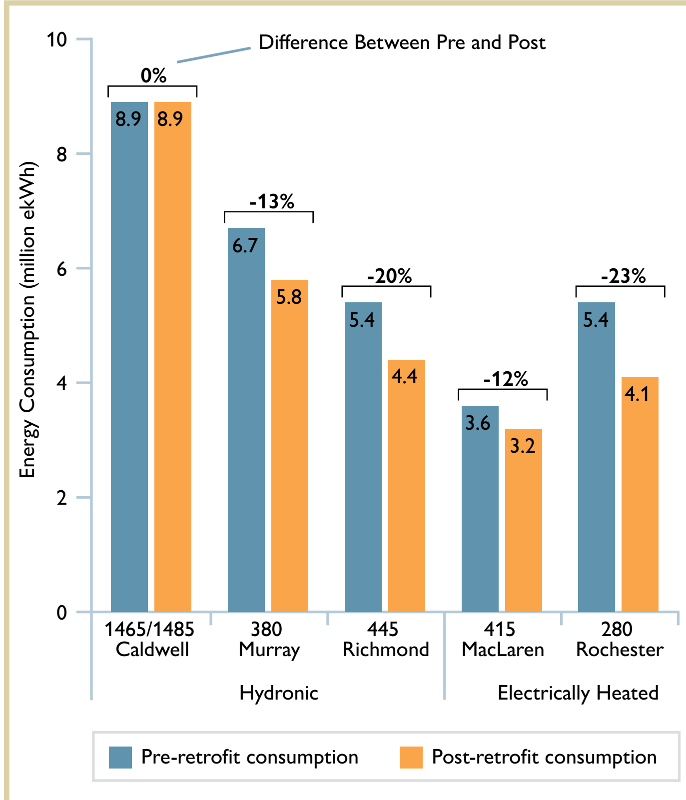

Figure 1 Pre- versus post-retrofit energy consumption

[2] Pre-retrofit consumption data was based on the following periods and was normalized for weather:
280 Rochester – July 1, 2009, to June 30, 2010,
380 Murray – June 1, 2009, to May 31, 2010,
415 MacLaren – March 1, 2009, to Feb 28, 2010,
445 Richmond – September 1, 2009, to August 30, 2010 and
1465/1485 Caldwell – September 1, 2009, to August 30, 2010.

[3] Post-retrofit energy consumption data was based on October 1, 2013, to September 30, 2014, for all sites, except 280 Rochester, for which it was based on October 1, 2012, to September 30, 2013 (because 2014 natural gas data was not available for this site), and was normalized for weather.

[4] Cost savings were based on an average 2014 natural gas rate of $0.36/m^3 and an electricity rate of $0.11/kWh.

Table 2: Energy and cost savings

Addresses	Electricity Savings (kWh)	Natural Gas Savings (m^3)	Energy Savings (ekWh)	Cost Savings ($)	Savings Per Area (ekWh/sq.ft)
415 MacLaren	290,000	15,000	450,000	$39,000	2.5
380 Murray	0	85,000	900,000	$31,000	3.7
280 Rochester	-33,000	120,000	1,300,000	$40,000	6.5
445 Richmond	21,000	98,000	1,100,000	$38,000	6.4
1465/1485 Caldwell	-23,000	20	-22,000	-$3,000	0.0

LESSONS LEARNED

New windows and balcony doors were easier to operate and more functional and improved tenant comfort. They also increased building energy efficiency at most sites, resulting in energy and cost savings. Other benefits included improved leakage resistance and reduced risk for deterioration of the building interior finishes and exterior walls from water penetration and window condensation.

Identifying issues with window installations is difficult, which is why including a budget for window testing at the project outset was crucial. It ensured the quality of the product as well as the quality of the installation.

It is also important to note that replacing windows does not automatically translate to energy savings. Tenant behaviour and other building systems can have significant impacts on performance. Educating tenants on optimal window operation could reduce energy lost to open windows.

Recognizing that communication was central to the project's success, OCH coordinated building meetings, circulated flyers and distributed letters to inform the tenants about the retrofit program. These materials included detailed information about the status of the project and the ways in which tenants should prepare for the retrofits. Tenants received regular advance scheduling notices posted in building common areas as well as unit-specific notices 24 hours in advance of work in their units.

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ALTERNATIVE TEXT AND DATA FOR FIGURES

Figure 1: Pre- versus post-retrofit energy consumption

Heat Source	Addresses	Pre-Retrofit Consumption	Post-Retrofit Consumption	Difference Between Pre and Post
Hydronic	1465/1485 Caldwell	8.9	8.9	0%
	380 Murray	6.7	5.8	-13%
	445 Richmond	5.4	4.4	-20%
Electrically Heated	415 MacLaren	3.6	3.2	-12%
	280 Rochester	5.4	4.1	-23%