Window Repair vs. Replacement

For Cost & Energy Savings In Canada

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It's true. Good looking windows help prospective tenants and buyers perceive value. So if you're responsible for a building with windows that are failing to do their job – keeping weather outside where it belongs – you will not be able to avoid this question. Is the aesthetic boost of installing brand new windows vital to the building's future revenue streams?

Consider the financial choice: A new window at a thousand dollars or more, or a new lease on life, improved occupant comfort and lower energy bills for about a hundred dollars. Multiply this by several hundred windows and the choice can be very convincing.

Field reports from the author's company show cost ratios between replacement and repair ranging from 12:1 to 8:1; it simply depends on the current state of repair of the existing windows and the scope of work needed to upgrade life expectancy by twenty years or more.

These numbers are well supported by a Canada Mortgage & Housing Corporation, CMHC, Research Report that describes in detail the results of a four building window repair study. In this article, the study's findings highlight the economic and practical opportunities of window repair vs. replacement.

Although the measures taken in the study exceed, from the author's experience, what is needed to achieve the required improvements in durability, comfort and energy efficiency, they still indicate a replacement to repair cost ratio of at least 6:1.

The State of Canada's Windows

For more than 30 years, aluminum slider doors and windows have been far and away the most popular choice for Canadian housing stock. They had a low initial cost and were generally installed by carpenters working for general contractors rather than specialized trades. Unfortunately, they are energy inefficient compared with the requirements of current standards and the 1995 edition of the National Building Code.

Much of the inefficiency results from the poor performance of sliders in terms of air leakage and deterioration of weatherstripping. Experience has shown that this leakage is one of the most common problems affecting building envelopes and their long-term durability. Faced with these problems, many owners have opted for replacement of the older units with newer, more efficient models. This systematic replacement of deficient units represents capital expenditures that are economically unjustifiable in terms of energy savings alone. But, retrofit measures that increase performance are proving to be a highly effective means of correcting these deficiencies.

The CMHC study chose four buildings – at least eight stories and built between the late 1950s and the mid 1970s. All buildings were located in the Montreal area for ease of testing, but represent units typical of stock found throughout the country. The windows that were upgraded and monitored were chosen at random. Goals of the study were to develop practical solutions to the problems associated with the typically reduced performance of existing sliding windows and doors in terms of weather tightness. The wearing of components and materials was the main cause of these problems.

The researchers accumulated performance data on existing assemblies to quantify the impact of the observed deficiencies, as well as to determine the anticipated benefit of upgrading the air and water tightness of the window units.

Pre-retrofit testing and repair measures

The researchers consulted manufacturers and specialized window and weatherstripping repair contractors to determine which existing products could be used in the retrofit. All windows tested were double sliders. Efforts were concentrated on the inner pair of sliders to ensure that they were more airtight than the outer pair — taking advantage of the pressure equalization principle. This enhances resistance to water penetration and reduces condensation forming on the inside of the outer pane.

The specific measures implemented were:

Weatherstripping:

Removed existing pile weatherstripping at the window jamb tracks and sash sill, head and meeting rails (interior side) and replaced with high-fin pile weatherstripping.

Pressure head:

Removed existing foam at the pressure head (on the interior side) and replaced it with new foam wrapped in a polyethylene film.

Other:

Applied a sealant joint around the outside perimeter of the interior tracks; installed pieces of foam tape at the top and bottom of the interior jamb tracks and dust plugs at the meeting rail locations on the interior head and sill tracks.

(In order to exceed the 6:1 replacement to repair cost ratio, the author's contracting team typically performs the weatherstripping upgrade plus minor caulking repair.)

Portable air leakage test apparatus was used to conduct air infiltration tests in accordance with ASTM E-783 test Standard Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors. The apparatus includes an exhaust blower, a control valve, flow meters, a differential manometer and a test chamber made of polyethylene film with retaining bars attached to the interior side of the window frame. Testing records the amount of air leakage across a specimen window at a test pressure differential of 75 Pa representing a wind speed of 40 kph (25 mph).

Repair cuts air leakage by 69%

After testing was complete, each window was modified and repaired to try to improve performance by reducing the amount of air leakage. Then the windows were retested to determine the air leakage and compare it with pre-retrofit performance (see test results summary, Table 1).

Table 1: Before and after air infiltration

Test specimen location	Air infiltration before repair	Air infiltration after repair	% Reduction in air infiltration
Building # 1	0.58 cfm/ linear ft.	0.27 cfm/ linear ft.	54%*
Building # 2	0.73 cfm/ linear ft.	0.22 cfm/ linear ft.	70%
Building # 3	0.73 cfm/ linear ft.	0.23 cfm/ linear ft.	68%
Building # 4	0.73 cfm/ linear ft.	0.12 cfm/ linear ft.	83%
Building # 5	0.85 cfm/ linear ft.	0.26 cfm/ linear ft.	69%
Average	0.72 cfm/ linear ft.	0.22 cfm/ linear ft.	69%

* Foam at the window head of this specimen had been recently replaced. This may account for the relatively lower air infiltration reading observed before repair.

In general, the results show an average reduction in air leakage in the order of 54 to 83 percent. CAN/CSA-A440 window standard for new windows requires certain performance from three categories of window (see Table 2).

Table 2: Window Rating and Air Leakage

Window Rating (Air Tightness)	Maximum Air Leakage Rate (cfm/ft)
A1	0.5
A2	0.3
A3	0.1

Comparing the test results with this table, the existing windows had an average air leakage rate before they were repaired of 46 to 70 percent over the lowest rating (A1). When repaired, the same windows met not only the A1 rating, but the stricter A2 as well. In terms of air leakage, the retrofitted windows are equivalent to many new units on the market today.

Economics of repair vs. replacement

As we see in Table 3, replacement of existing weatherstripping with new high performance weatherstripping is approximately one sixth the cost of replacement with new windows. Window retrofit can deliver a relatively short payback period in energy savings, an improvement in occupant comfort and a reduction in condensation forming on the exterior sashes.

Table 3: Economic Comparison (based on 500 windows)

Repair	Replacement
$75,875	$475,000

Note: Spec for replacement windows was 7 1/2” thermally broken aluminum framed slider type with 4 single glazed sashes and fly screen between two sashes.

As windows age, there will come a time when window replacement becomes a preferred option, driven by aesthetic, functional and property value considerations.

The payback from energy savings will, however, be much longer than with repair. The researchers compiled a cost estimate for window retrofit and window replacement. The scope of work for window retrofit was defined as:

- Replace existing weatherstripping at the window jamb tracks, bottom, top and meeting rails on the interior side.
- Replace existing foam at the pressure head on the interior side with a new foam wrapped in polyethylene film.
- Install dust plugs at the head and sill tracks, foam tape at the jamb corners (both on the interior side) and a sealant joint around the outside perimeter of the interior track.
- Replace plastic gliders at the top and bottom of the interior sashes, adjust and verify operation.
- Clean, adjust and lubricate sill tracks.

For window replacement, the scope was defined as:

- Remove existing windows, wood frame and interior mouldings.
- Remove and clean existing sealant from brick.
- Install and adjust new windows.
- Install a polyurethane based sealant joint around the exterior perimeter of the windows.
- Install sprayed-in-place polyurethane insulation around the interior perimeter of the windows.

What do the engineers say?

Remember that window problems are about three closely related problems: air infiltration, condensation and ice build-up. Condensation and frost formation on exterior sashes results from moist air exfiltrating through interior sashes. It condenses (or freezes during colder exterior temperatures) on the inside face of the exterior sashes before it has the opportunity to escape to the exterior. Making interior sashes more airtight will reduce condensation formation on the inside face of exterior sashes thanks to the net positive pressure of the inside of the building envelope compared with the outside. Stack effect makes this more likely to happen in winter at the top of the building.

Conclusion

The cost savings available to building managers from the retrofit option are substantial, given the large installed stock of this type of window and door nationwide. Many decisions are being made primarily on aesthetics and resale value, perhaps because many managers and owners simply do not know how retrofit can improve window performance.

Retrofitting can be carried out with relative ease and low cost. Combine this with potential energy savings and the forecast has to be for more repairs than replacements in the future.

About Canam Building Envelope Specialists Inc.

Canam Building Envelope Specialists Inc. is an affiliate of the Tremco Roofing & Building Maintenance Division of Tremco Incorporated. Canam offers a comprehensive range of environment and energy related services in all types of buildings. These include insulation, ventilation, air leakage control, air tightness and window testing, auditing and total tune-ups.