

THE MAGAZINE OF THE HERITAGE CANADA FOUNDATION



# Héritage

LE MAGAZINE DE LA FONDATION HÉRITAGE CANADA

## Taking it to the Street A Heritage Rehab in Saint John

## Une nouvelle vitalité pour de vieilles rues Réhabilitation patrimoniale à Saint John

SPRING

HÉRITAGE 2007

PRINTEMPS

PUBLICATIONS MAIL AGREEMENT / ENVOI DE POSTE PUBLICATIONS-ENREGISTREMENT 40052597



# Improving Thermal Performance of Historic Windows

By Craig Sims and Andrew Powter

*Editor's Note: This is the fourth and final instalment in a series of articles on preserving traditional wood windows in historic buildings. Previous articles addressed the subject of retention versus replacement from the perspectives of sustainability and the impact on heritage character with a focus on methods and materials used for repairing traditional wood windows. In the second article, the authors explained how, with some basic upgrades, a traditional window could approach or exceed CSA 440 performance standards. In this final article they describe the basics of window thermal performance and a range of strategies for optimizing the thermal performance of traditional windows.*

## HEAT LOSS MECHANISMS

In order to understand how windows can be thermally upgraded, it is necessary to understand how they gain or lose heat in the first place. Though not a complete list, the major heat transfer mechanisms can be summarized as follows:

### Air Leakage

Air infiltration is the biggest culprit affecting your heat bill and comfort level but it is the easiest and cheapest to remedy. Leakages occur through gaps in the window assembly—cold air leaks in or warm air leaks out. To overcome this weakness, use sealants at fixed joints, weather-stripping on operable joints and repair glazing putty. The use of sash locks also ensures a tight fit. Remember, some leakage is a good thing—it's called ventilation—but controlled ventilation is better than uncontrolled ventilation.

### Convection

The window might be tight, but room air cools against the cold glass and drops to the floor, creating air currents in the room and prompting complaints of drafts. This convection effect is usually resolved by a combination of approaches: adding a storm window, using curtains or locating a heat source beneath the window.

### Conduction

This is a measurement of the ability of certain materials to transmit cold or heat. Glass is a good conductor. For example, if the window is single glazed and it is minus 20 degrees Celsius on the exterior face of the window, you can be sure that it is just as cold on the interior face. Wood, on the other hand, is a poor conductor, which means it is a fairly good insulator. Heat loss by conduction is best overcome by adding a storm window—this is also the best way to improve condensation resistance.



This mock-up (by D. J. White Restorations) shows a type of weatherstripping where sheet metal fins fit into sheet metal-lined kerfs in the sash.

*Cette maquette (réalisée par D.J. White Restorations) montre un type de coupe-froid où l'empennage de tôle s'emboîte dans l'entaille pratiquée dans le châssis.*

## TESTING FOR PERFORMANCE

There are simple tests to determine the sources of air infiltration around a window. Thirty years ago, the common device used was a lit cigarette. Plumes of an ostrich feather, the smoke from incense or a smoke pencil (purchased from safety supply stores) also work. Measure air infiltration along various joints in a window, and drastic movement will indicate leakage. These are not quantitative tests but they will identify even the smallest leakage route.



## \_Heritage Matters

### SEALING MOVING SURFACES

Windows must move if they are to be opened. Air leakage occurs when there is too much space between the surfaces due to a poor fit or excessive wear. The solution is to install a high-quality, durable weather-stripping which will close the gaps yet allow movement. Moveable sashes should be sealed at the sides, meeting the rail and the sill. Good quality weather-stripping will be flexible, durable and maintain pressure against both surfaces. Metal weather-stripping, commonly in sprung bronze, is more durable than plastic or vinyl types and has a better memory.

### SEALING NON-MOVING SURFACES

The interior window construction joints are best sealed with caulking materials such as acrylic latex. It is easily tooled with a finger that's been dipped in water, cleans up with a wet cloth and holds paint well.

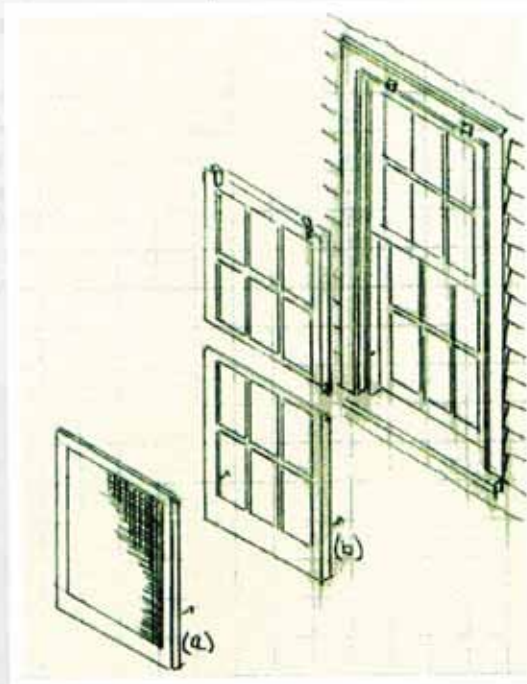
On the exterior side, make sure the caulking between the window and wall assemblies is in good condition and flexible. If not, remove it with a scraper and, if necessary, a little gentle heat, then re-caulk. If it is a wood-to-wood joint, then use the best quality exterior grade paintable acrylic latex caulking. If it is a wood-to-stone joint, use the best quality one-part urethane (such as "Dymonic" by Tremco™). However, as this does not hold paint well, it's best to match its colour to either the masonry or painted woodwork; there is a wide range of colours to choose from. If the stone sills have a good slope for shedding water, it is advisable not to seal the joint between the wood sill and masonry. Because the masonry is often damp, the risk of wood decay can be accelerated if constant drying is inhibited.

You can access other leakage areas by removing either the interior or exterior window casings (depending on the configuration). Removing historic window trim is a delicate task that requires care and patience to avoid damage. Casings are often held in place with few but possibly large finishing-type nails. (Trim held with 19th-century cut or forged nails is much easier to remove than when held with 20th-century wire nails.)

Break all paint seals then gently pry the casing free, allowing the nail heads to pull through. Remove the nails afterwards. Small fractures in the casing can be glued and clamped if necessary. Your primary tool, and new best friend, will be the small, sharp pry bar available from most large hardware stores and commonly marketed as a glazing bar.

With the trim removed, close the cold air routes by caulking around the frames and the joints in sash weight boxes and by filling gaps with insulation. We do not recommend replacing the counterweight system with modern spring balances in order to fill the weight pocket with insulation. Sealing it tight should be sufficient and it allows the original system to be retained. Modern spring balances have a relatively short service life.

Wider hidden gaps, such as the shim space between the window frame and the wall framing, are best sealed with a bead of no-expansion or low-expansion polyurethane foam, which bonds well to wood. Do not use the cheaper high-expansion types as these can exert sufficient pressure to distort the wood frame.



If new storm windows are fabricated they can be made as an upper and lower with a half lap at the false meeting rail. The upper portion hangs from hooks and this allows the lower half to be interchanged seasonally, from the interior, with an insect screen.

*Si de nouvelles contre-fenêtres sont fabriquées, elles peuvent être faites d'une partie supérieure et d'une partie inférieure, avec un joint à mi-bois à la fausse traverse de rencontre. La partie supérieure est pendue à des crochets et la partie inférieure peut être remplacée depuis l'intérieur, selon la saison, par une moustiquaire.*

### THE STORM WINDOW

A properly fitted traditional storm window is an important and very straightforward part of upgrading thermal performance. The fit is important because we are attempting to create a minimally vented airspace on the cold side of the primary windows. Minimal venting means exactly that, MINIMAL VENTING. Whenever additional layers of glass are added to a window, it is vital that the interstitial space be vented and drained to the exterior. This process is achieved by ensuring that any exterior glazing fits a little less tightly than the primary (interior) window. This discrepancy allows warm, moist air to leak past the primary window and into the interstitial space where it will condense on the coldest surface, namely the inside face of the storm window. By keeping the fit of the storm less tight, and by ensuring that there is a very slight gap across the underside of the storm, warm, moist air can be vented to the exterior and any moisture that forms will drain out.



## \_Heritage Matters



New storm window being fitted to the exterior of Runciman House, Annapolis Royal, NS, owned by the Heritage Canada Foundation.

*Une nouvelle contre-fenêtre est en train d'être ajustée à la maison Runciman d'Annapolis Royal (Nouvelle-Écosse), propriété de la FHC.*

If the storm window does not fit the frame evenly, this can be improved by installing a cushion foam gasket (4mm Ethafoam) to the top and sides of the storm window. The cushion foam will significantly reduce air leakage around the storm but more importantly, it will eliminate convection into the space between the windows at the bottom and out the top of the window, which can happen if the storm is too loose. To permit draining, the bottom of the storm should be a close fit, but not gasketed.

The right hardware is important to ensure that storm windows fit well. To achieve a snug fit, use a combination of exterior top hooks at the top rail and either exterior turn buttons near the bottom, or hooks and eyes on the interior.

Traditional storm windows can be large and heavy. If you don't want the trouble of taking them on and off, there are alternatives. Upper-floor windows can be hinged at the top for opening and left in place through the summer. Alternatively, if new storm windows are being made, use a design that allows the lower half to be interchanged seasonally with a screen accessed from the interior of the building. This way, the storm window can stay in place all year.

A third alternative to consider is the "interior storm" window. An interior storm is really a misnomer, as it actually becomes the new primary window. As such, it now must be as airtight as possible and, as stressed above, the exterior glazing must fit less tightly. Many buildings constructed in

Canada from late in the 19th century to the 1920s had "interior storms," usually mounted as a fixed full-width window over inward opening-casements. Often the only evidence of their former existence is the heavy rebate around the inside of the window frame and the mortices for the former hardware.

### INSULATED GLASS UNITS AND TRADITIONAL WINDOWS

Throughout the 1970s and '80s and continuing today, we are occasionally questioned about the benefits of installing new insulated glass (IG) units in traditional windows. The thermal performance benefits of this approach are negligible, and there are a number of other problems.

To begin with, sealed units require a deeper and wider rebate in the window sash compared to historic glass settings. Also, the National Research Council and the Insulated Glass Manufacturers of Canada recommend that the perimeter glazing channel for the IG unit be vented and drained to the exterior to protect the edge seal. It can be done in windows without muntin bars but is impossible to do with traditionally scaled muntin bars. This glitch leads us to the slippery slope of having to use the fake plastic muntin bar grille, or the fake muntin bars sandwiched within the IG unit, or fake muntin bars stuck on the outside. These problems plus others—such as the increased weight of the sash in combination with the comparably short service life of IG units (see *Heritage*, summer 2006, page 44)—leads us to favour traditional double-glazing solutions. If you must have sealed glazing units in your window system, we recommend that you install them in an "interior storm" window.

### DETERMINING ACTUAL PERFORMANCE IMPROVEMENT

After your upgrade is complete, try your qualitative tests with feathers and incense. You will have reduced convection coming down off the glass, and no evidence of air leakage should be present. If you have included this work in your Energuide project, the follow-up blower door test will reveal all.

*Craig Sims is a heritage building consultant based in Kingston, Ontario. Many of his projects involve building envelope work, including the restoration and upgrade of windows.*

*Andrew Powter has been involved in heritage programs and projects both nationally and internationally throughout his career. His main areas of interest include historic wood structures, building envelope performance and sustainable heritage conservation practice.*