ONTARIO HERITAGE TRUST

An agency of the Government of Ontario

Window Rehabilitation and Restoration Guidelines for Heritage Conservation and to Reduce Greenhouse Gas Emissions

Houses and other small private buildings comprise the vast majority of building stock in North American cities and account for approximately half of total greenhouse gas emissions from buildings.

What can you do?

One of the simplest and most cost-effective ways to improve energy efficiency and reduce GHG emissions is to repair and restore operability of existing windows and window systems. The original windows in most houses and smaller buildings erected before 1940 were wood sash systems (i.e. double hung windows, one above the other, with both sashes able to move up and down in the window frame or single hung windows with only the bottom sash moving up). Restoring these window systems can achieve similar energy savings to modern window replacements with a much shorter payback period and much less waste.

Traditional wood windows can be repaired using like materials (i.e., putty, glass, wood). They can also be restored to operable condition by ensuring the weights, pulleys, and cords are in good condition and that the windows are well balanced for ease of use. It is preferable to make both top and bottom sashes operable as this encourages a convection current that cools the interior especially if multiple windows are used on opposing sides of the building. Finally, wood windows can be rehabilitated through the introduction of interlocking weather stripping, the application of exterior storm windows, introduction of removable interior sashes (i.e., a sull sash), and the introduction of operable awnings/canopies to shade the windows during the summer on the most exposed elevations.

Mechanical or forced ventilation is a powered system used to cool a building or house, e.g. ceiling fans and air conditioning units. **Passive ventilation** is using the windows in your house to release warmer air and cool the house with outdoor wind and air, e.g. opening multiple windows.

Every effort should be made to rehabilitate existing heritage windows, which are typically wood and which will last almost indefinitely if properly maintained. This approach reduces construction material sent to landfill, limits the amount of carbon and energy invested in the manufacture and shipping of new window systems, stops an endless cycle of removing and replacing windows and encourages the use of natural ventilation as an alternative to mechanical ventilation. This advantage is so significant that some buildings can forgo mechanical ventilation during the shoulder seasons and the summer months (6-8 months of the

year) thereby dramatically reducing energy consumption, saving money and greenhouse gas emissions.

Changes in Building Technology-circa 1940

The year 1940 has been identified as an important threshold in North American building technology. Industrialization, mass production and the building sector was radically transformed by wartime technical innovations and post-war economic growth. During the construction boom that started in the 1940s and ramped up after the Second World War, ceiling heights were typically lowered to 8 feet (2.4m), which reduced the effectiveness and potential of convention cooling and double-hung wood windows., Operable transoms become much less common. (Transoms are a strengthening crossbar with panel above, in particular an operable panel set above a window or door.)

Casements, single hung, sliding and picture windows (fixed) became popular – though operable these windows lacked the full ventilating capacity of double hung windows. While wood was still used for window sashes and frames, aluminum and metal alloys came into use. Starting in the mid-1950s and growing in popularity in the 1970s and 1980s, vinyl windows and storms began to outpace all other window system in popularity. Although developed in the 1940s, thermally insulated windows became more common in the 1960s and the norm in the 1970s. In North America, mechanical ventilation became a typical design feature in homes in the late 1940s with the installation of central air furnaces. As a result, most buildings built after 1940 are designed to incorporate artificial /forced air ventilation, have reduced capacity for natural ventilation and rarely have operable double-hung windows.

Repairing Historic Wood Windows

Windows contribute greatly to the architectural character of a building and constitute valuable historic fabric when they survive on existing historic structures. They also allow for natural light and fresh air to enter a building, making them important to ensure that historic windows are properly maintained to ensure their longevity. When properly cared for a historic window can last for hundreds of years. However, even with proper maintenance it may become necessary to repair and/or replace components of historic wood windows from time-to-time.

Despite the many attributes that heritage windows possess, many property owners wish to replace their historic windows because they believe the windows have deteriorated beyond repair. This is seldom the case. The condition of the windows should be assessed on an individual basis to determine what level of repair is required. The

condition of the windows, along with their location, form, style and materials, should be documented prior to proceeding with any work. Another reason often cited for replacement is to increase the thermal performance of the assembly. There are other options for upgrading the thermal performance of existing historic windows that can be explored.

Guidelines

The guidelines that follow provide advice on the routine maintenance, stabilization and replacement of select components of a window. Advice on increasing the thermal efficiency of historic wood windows is also included. A heritage consultant, craftsperson or architect with experience repairing heritage buildings and windows could be hired to help assess the condition of the windows to help determine whether minor repair could be done by the owner or more involved extensive repair would be needed. Routine maintenance could then be done following the instructions below.

Routine Maintenance, Refinishing and Minor Repair

Ongoing maintenance of heritage wood windows will ensure they continue to operate as designed, avoiding the need to for more significant repairs down the road.

Note: The measures described below may not apply to all scenarios and are intended to provide general guidance on repairs only

- Start your routine maintenance with carefully removing excessive paint build-up. This should be done manually by scraping paint with either a putty knife or paint scraper. A heat gun or plate can also be used to facilitate the removal of paint but precautions must be taken to protect the glass panes. Paint should be removed until sound substrate is reached. Take appropriate precautions if you suspect lead containing paint is present.

- After removing the damaged layer or layers by scraping, the uneven surface will need to be sanded smooth.
- Loose and dried traditional glazing putty may be removed carefully with a chisel. Care should be taken to replace any missing glazing brads. Any putty remaining on the glass can be softened by soaking the panes in linseed oil.
- Once the paint is removed the wood then needs to be treated with 1-2 applications of boiled linseed oil and turpentine (1:1 mix). This will help the putty adhere to the wood surface and prevent the oils from the putty migrating to the wood resulting in the premature drying out of the putty. Apply the coats at 24 hour intervals.
- Traditional linseed-oil based putty, should be then reapplied to the window. Once the putty has set (allow at least 3 days), the window should be primed (with an alkyd-based or linseed oil based primer) and repainted. The paint film on the putty should slightly lap over onto the glass to form a weather tight seal.
- New paint should match an existing colour. An alternative colour would require research and professional advice or approval in the case of protected buildings.

Stabilization and Repairs

If windows have not been properly maintained then more significant repairs may be required. The guidelines below may not apply to all scenarios however, they provide direction on the types of stabilization work typically required for stabilization and restoration of historic wood windows.

- Paint should be scrapped and/or sanded only as necessary to reach sound substrate. Any new paint should match the existing in colour.
- The wood should be dry, decayed areas removed to sound wood and any dirt and debris cleared. Repairs to the existing wood windows may include epoxy patching andilling, “dutchman” insertions or replacement of part or entire components (ie. muntins, rails or stiles). Most weather related damage occurs to the lower, more exposed components of a window.
- Any holes or cracks should be filled with a flexible epoxy (best formulated for architectural wood repair). The holes or cracks should be filled with one or more layers so it stands proud of the surrounding surface. Once set, the patch can then be planed and sanded smooth.
- The wood should be treated with 1-2 coats of boiled linseed oil and turpentine (1:1) after epoxy repairs and before priming. Allow for 24 hours between coats.
- Where decayed wood is to be removed to allow a splice repair, a minimum amount of existing wood should be removed necessary to form a repairAny new wood should be spliced in to match the original details and profiles and should match the existing in terms of species, moisture content, grain direction, and quality. Mixing timber species will often cause the joint between old and new to fail from different rates of expansion and contraction during dry and damp conditions.

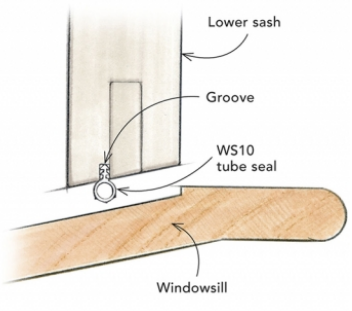
- Splice repairs should be designed to ensure that moisture is directed towards the outer face of the timber and moisture does not lay on the repair joint.

Where a window component is deteriorated beyond repair then replacement with like materials in the element may be acceptable. The deteriorated element needs to be replaced with new matching pieces. This allows as much of the historic fabric to be retained as possible. If a window unit is missing, or has deteriorated to the point where repair is not feasible, replacement may be necessary. A qualified heritage consultant or contractor with heritage building experience can assess the windows first and determine whether this is actually the case. The new unit should match the design of the original with respect to pattern and size of openings, proportions, muntin profiles and material.

Thermal Efficiency

There are many options for increasing the thermal performance of an historic wood window. Air infiltration can be minimized by adjusting the interior and exterior stops and parting strip so that they fit snuggly against the sash without binding. Counter-weights can be adjusted so that the bottom sash is drawn downward and the upper sash upwards for proper sealing. Weatherstripping the windows along with the addition of storm windows or interior glazing can also help achieve a higher thermal efficiency. The addition of storm windows when done properly can minimize damage to the historic fabric and preserve the visual qualities of historic windows. Prior to proceeding with thermal upgrades the window should be in sound condition with all necessary repairs complete.

- Weatherstripping – Install metal weatherstipping at operable joints to help minimize air infiltration (interlocking metal strip, bronze or copper V-shaped strip or felt). Strippable caulking can also be used on the inside of the windows to help prevent air leakage. Caulking should be applied during the colder months and removed in the warmer weather to allow the windows to remain operable.



- Storm Windows –Operable awning style storm windows will allow for ventilation and if the storms are permanently fixed and non-operable they should be

ventilated at the top and bottom. General divisions may match those of the existing sashes or storm windows may be constructed in a 1/1 format in order to not visually compete with the historic sash they are protecting

- Inter-changeable Storms and Insect Screens – wood framed storms and screens swapped out on a seasonal basis are the tradition pattern. If this is not practical, a permanent, fixed exterior frame with glass or insect screen panels top and bottom interchagable from the interior is a practical alternative
- Interior glazing – Another option would be to add a removeable, “interior” storm. This would be secondary glazing on the inside of the building. Condensation that builds between the glazing layers must be vented to the exterior. The interior glazing should form a tight seal around the opening and the air space should vent to the exterior. This means that your primary glazing (interior) needs to be airtight while your secondary glazing (existing window) needs to allow moisture to travel to the exterior to prevent the build-up of condensation in the air space.

The Trust does not recommend the replacement of existing windows as a means of increasing thermal efficiency. Historic windows that are in a good state of repair and properly sealed will minimize air infiltration. When storm windows are added to a historic window assembly they will perform just as well, if not better, than a newly manufactured double-glazed unit.

If windows are properly cared for it is unlikely that they will need to be replaced. In terms of maintenance, historic wood windows still need to be painted and puttied and while this approach is more labour intensive, it is more cost effective than window replacement when considering a life-cycle approach.

Additional reading

The following articles provide further guidance on the process for repairing and maintaining historic wood windows:

Saskatchewan Heritage Foundation Conservation Bulletin Series Window http://www.tpcs.gov.sk.ca/WindowConservationBooklet

Myers, John H., 1981. "The Repair of Historic Wood Windows". Preservation Brief No. 9. Washington DC: National Park Service. Available at: http://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-windows.htm

Sims, Craig and Powter, Andrew, 2006. "Maintenance and Repair of Historic Wood Windows". National Trust Canada. Available at: http://www.nationaltrustcanada.ca/sites/heritagecanada.org/files/magazines/2006/fall/Fall2006_Winter2007_Glass.pdf

Sims, Craig and Powter, Andrew, 2006. "Repair or Replace - Windows in Historic Buildings: Arriving at a Sustainable Solution". National Trust Canada. Available at: http://www.nationaltrustcanada.ca/sites/heritagecanada.org/files/magazines/2006/summer/Summer2006_Windows2.pdf

For guidelines on how to conserve/repair, restore and rehabilitate historic windows consult the following:

- Standards and Guidelines for the Conservation of Historic Places in Canada, Section 4.3.5 Windows, Doors and Storefronts, page 153 http://www.historicplaces.ca/media/18072/81468-parks-s+g-eng-web2.pdf

- Building Resilience: Practical Guidelines for the Sustainable Rehabilitation of Buildings in Canada, Section 3.8 Windows, Doors and Storefronts, page 72-77 http://historicplaces.ca/media/49493/resilience_en_june 2016.pdf
- US National Park Services Technical Preservation Brief #9 on The Repair of Historic Wooden Windows: https://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-windows.htm
- US National Park Services Technical Preservation Brief #3 on Improving Energy Efficiency in Historic Buildings: https://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm