Report to London Advisory Committee on Heritage

To: Chair and Members
London Advisory Committee on Heritage
From: Gregg Barrett
Director, City Planning and City Planner
Subject: Heritage Alteration Permit application by P. Scott at 40 & 42 Askin Street, By-law No. L.S.P.-2740-36 and Wortley Village-Old South Heritage Conservation District
Meeting on: Wednesday February 12, 2020

Recommendation

That, on the recommendation of the Director, City Planning & City Planner, with the advice of the Heritage Planner, the application under Section 42 of the *Ontario Heritage Act* seeking approval to remove the existing wooden windows and replace with vinyl windows on the property at 40 & 42 Askin Street, By-law No. L.S.P.-2740-36 and Wortley Village-Old South Heritage Conservation District, **BE REFUSED**.

Executive Summary

The windows of the properties at 40 & 42 Askin Street are an important heritage attribute of the properties that are protected by its designation pursuant to the *Ontario Heritage Act*. The property owner has applied for a Heritage Alteration Permit to remove all of the existing wood windows and replace them with vinyl windows. Insufficient information was provided to demonstrate the necessity for the removal of the existing wood windows. The proposed replacement vinyl windows do not appropriately replicate the historic qualities of the existing wood windows. The proposed alteration does not comply with the policies or guidelines of the *Wortley Village-Old South Heritage Conservation District Plan.* The Heritage Alteration Permit application should be refused.

Analysis

1.0 Background

1.1 Location

The properties at 40 & 42 Askin Street are located on the north side of Askin Street, between Cynthia Street and Teresa Street (Appendix A).

1.2 Cultural Heritage Status

The properties at 40 & 42 Askin Street are “double designated” under both Parts IV and V of the *Ontario Heritage Act*. The properties were individually designated pursuant to Part IV of the *Ontario Heritage Act* by By-law No. L.S.P.-2740-36 in 1984. The property is included in the Wortley Village-Old South Heritage Conservation District, designated pursuant to Part V of the *Ontario Heritage Act* by By-law No. L.S.P.-3439-321 in 2015.

1.3 Description

The existing semi-detached dwellings located at 40 & 42 Askin Street were built in 1890-1891 for Edward J. Powell. The two-and-a-half-storey building is built of buff brick, with a steeply pitched, cross gable roof, single eave brackets, and an arrangement of vertical, horizontal, and diagonal boards in the gable ends (see Appendix B). Its heritage designating by-law highlights the gingerbread fretwork of its gable bargeboards and its two verandahs on the front and west elevations.

The windows of the semi-detached dwelling are wood, two-over-two true divided light sash windows, with a segmented arch upper sash. Rectangular aluminum storm windows have been applied over the original windows; the aluminum storm windows can be seen on the 1985 photograph of the property (see Appendix B, Image 1).

The properties at 40 & 42 Askin Street were included in Nancy Tausky's *Historical Sketches of London: From Site to City* (1993) in a profile of "double houses" (semi-detached) (Appendix C). It is noted as a particularly unusual example of the "double house" as the two halves are entirely different, and "joined together to look from outside like a single family house" (Tausky 1993, 122).

2.0 Legislative/Policy Framework

2.1 Provincial Policy Statement

Heritage conservation is a matter of provincial interest (Section 2.d, *Planning Act*). The *Provincial Policy Statement* (2014) promotes the wise use and management of cultural heritage resources and directs that "significant built heritage resources and significant cultural heritage landscapes shall be conserved."

2.2 *Ontario Heritage Act*

Where a property(ies) are designated under both Parts IV and V of the *Ontario Heritage Act*, the process of Part V is followed for alterations per Section 41(2.3) of the *Ontario Heritage Act*.

Section 42 of the *Ontario Heritage Act* requires that a property owner not alter, or permit the alteration of, the property without obtaining Heritage Alteration Permit approval. The *Ontario Heritage Act* enables Municipal Council to give the applicant of a Heritage Alteration Permit:

a) The permit applied for
b) Notice that the council is refusing the application for the permit, or
c) The permit applied for, with terms and conditions attached (Section 42(4), Ontario Heritage Act)

Municipal Council must make a decision on the Heritage Alteration Permit application within 90 days or the request is deemed permitted (Section 42(4), *Ontario Heritage Act*).

2.2.1 Contravention of the *Ontario Heritage Act*

Pursuant to Section 69(1) of the *Ontario Heritage Act*, failure to comply with any order, direction, or other requirement made under the *Ontario Heritage Act* or contravention of the *Ontario Heritage Act* or its regulations, can result in the laying of charges and fines up to $50,000.

When the amendments to the *Ontario Heritage Act* in Bill 108 are proclaimed in force and effect, the maximum fine for the demolition or removing a building, structure, or heritage attribute in contravention of Section 42 of the *Ontario Heritage Act* will be increased to $1,000,000 for a corporation.

2.3 *The London Plan*

The policies of *The London Plan* found in the Cultural Heritage chapter support the conservation of London's cultural heritage resources. Policy 554_ of *The London Plan* articulates on of the primary initiatives as a municipality to "ensure that new development and public works are undertaken to enhance and be sensitive to our cultural heritage resources." To help ensure that new development is compatible, Policy 594_ (under appeal) of *The London Plan* provides the following direction:

1. *The character of the district shall be maintained by encouraging the retention of existing structures and landscapes that contribute to the character of the district.*
2. *The design of new development, either as infilling, redevelopment, or as additions to existing buildings, should complement the prevailing character of the area.*
3. *Regard shall be had at all times to the guidelines and intent of the heritage conservation district plan*.

Policy 13.3.6 of the *Official Plan* (1989, as amended) includes similar language and policy intent.

2.4 Wortley Village-Old South Heritage Conservation District

Windows are an important part of the heritage character of the Wortley Village-Old South Heritage Conservation District and are identified as heritage attributes. The policies of Section 5.10.1 of the *Wortley Village-Old South Heritage Conservation District Plan* requires Heritage Alteration Permit approval for major alterations, including replacement of windows. Importantly, the replacement, installation, or removal of storm windows does not require Heritage Alteration Permit approval.

Section 8.2.7, Heritage Attributes – Windows, Doors and Accessories, of the *Wortley Village-Old South Heritage Conservation District Plan* notes,

> *Doors and windows are necessary elements for any building, but their layout and decorative treatment provides a host of opportunities for the builder to flaunt their unique qualities and character of each building.*

Section 8.3.1.1.e, Design Guidelines – Alterations, provides the direction to:

> *Conserve; retain and restore heritage attributes wherever possible rather than replacing them, particularly for features such as windows, doors, porches and decorative trim.*

Section 8.3.1.1.f, Design Guidelines – Alterations, states,

> *Where replacement of features (e.g. doors, windows, trim) is unavoidable, the replacement components should be of the same style, size, proportions and material wherever possible.*

Specifically regarding potential replacement of wood windows, the Conservation and Maintenance Guidelines of Section 9.6 of the *Wortley Village-Old South Heritage Conservation District Plan* states,

> *The preservation of original doors and windows is strongly encouraged wherever possible as the frames, glass and decorative details have unique qualities and characteristics that are very difficult to replicate.*
>
> *Original wood framed doors and windows in most cases can be restored or replaced with new wooden products to match if the original cannot be salvaged, but may require a custom-made product. Take particular care that exact visible details are replicated in such elements as the panel mouldings and width and layout of the muntin bars between the panes of glass.*
>
> *The replacement of original wood framed windows by vinyl or aluminum clad windows is discouraged. If this is the only reasonable option, the replacement windows should mimic the original windows with respect to style, size and proportion, with a frame that is similar in colour, or can be painted, to match other windows.*

3.0 Heritage Alteration Permit Application

The former property owner of 40 & 42 Askin Street sold the properties in August-September 2019, generating a considerable volume of inquiries to the Heritage Planners. As a heritage designated property, the heritage designating by-laws applicable to the properties protect the properties' heritage attributes and require Heritage Alteration Permit approval to make changes. The heritage designating by-laws are registered on the title of the properties.

The new property owners of 40 & 42 Askin Street corresponded with the Heritage Planner in advance of their purchase of the property and were made aware of the heritage designations on the property. The Heritage Planner strongly encouraged the repair and retention of the existing wood windows.

A Heritage Alteration Permit application was submitted by the property owner and received on December 11, 2019. The property owner has applied for a Heritage Alteration Permit seeking:

- Removal of all original true divided light wood windows (27 windows in total);

and,
- Replacement with vinyl windows with faux grilles.

Limited information about the existing conditions of the wood windows and the proposed replacement windows was submitted by the property owner as part of the Heritage Alteration Permit application.

This Heritage Alteration Permit application has met a condition for referral requiring consultation with the London Advisory Committee on Heritage (LACH).

Per Section 42(4) of the *Ontario Heritage Act*, Municipal Council must make a decision on this Heritage Alteration Permit application by March 10, 2020 or the request is deemed permitted.

4.0 Analysis

The properties at 40 & 42 Askin Street are significant cultural heritage resources. The properties are "double designated" under the *Ontario Heritage Act* to protect and conserve their cultural heritage value and heritage attributes. The properties at 40 & 42 Askin Street retain a high degree of integrity, as their built form is able to articulate the values ascribed to the properties in the heritage designating by-law.

Windows are a valued heritage attribute of properties in the Wortley Village-Old South Heritage Conservation District. Window replacement requires Heritage Alteration Permit approval.

4.1 Existing Wood Windows – Do the Existing Wood Windows Need to Be Replaced?

In the Heritage Alteration Permit application, the property owners provided an opinion from the sales representative of the vinyl window company that they "do not believe your current windows are in any state to be repaired and are far past their life in terms of function and energy efficiency."

In the review of the Heritage Alteration Permit application, the Heritage Planner consulted with a local expert in wood window restoration to determine if the windows of the properties at 40 & 42 Askin Street were truly "far past their life." The Heritage Planner asked the expert window restorer to review the photographs submitted as part of the Heritage Alteration Permit in a blind test, without identifying the property. The restoration expert advised that, while the wood windows would benefit from repair, all of the wood windows were repairable.

The restoration expert recommended that the aluminum storm windows be removed and wood storm windows be constructed and installed. As the restoration expert has no potential benefit to replacing the windows, their opinion is of greater weight.

As it has not been demonstrated that the existing wood windows cannot be retained and restored (Policy 8.3.1.1.e, *Wortley Village-Old South Heritage Conservation District Plan*), the existing wood windows must be retained. The existing wood windows can be repaired and conserved.

Caution must be noted in this approach, as negligence towards the maintenance requirements for historic wood windows could result in the loss of a valued heritage attribute and the possible replacement with synthetic or poor quality replications. Retaining original wood windows is mark of quality in the preservation of a cultural heritage resource.

An alternative Heritage Alteration Permit application could be made for the removal of the existing aluminum storm windows and the installation of wood storm windows.

There are costs associated with the restoration of the original wood windows, as well as with the potential costs associated the production of wood storm windows. There are also costs for the replacement windows. No cost information was provided in the Heritage Alteration Permit application and does not typically factor in to the review and analysis of a Heritage Alteration Permit application. In their Heritage Alteration Permit application, the property owner states that this approach (wood storm windows) is "not financially possible." Nothing would require the property owner to undertake this approach all at once, but could be phased over several years and leverage grants available to heritage designated properties. Grants, such as those from the London Endowment for Heritage, could support the costs associated with the production of wood storm windows.

4.2 Wood Window Conservation – Why Should Wood Windows Be Retained?

In addition to the policy basis for refusing this Heritage Alteration Permit application, there are many other reasons to retain wood windows:

- Windows are the eyes of buildings – the illuminate interior spaces and give views out
- Preserving the original windows will preserve the architectural value of the property
- Wood windows are heritage attributes that contribute to a property's cultural heritage value
- Windows reflect the architectural style and period of construction of the building
- Original wood windows are irreplaceable
- Wood windows can be repaired; vinyl replacement windows cannot be repaired (see guides in Appendix C)
- Windows are generally considered to only account for 10-25% of heat loss from a building[a]
- Thermal performance of wood windows can be greatly improved by draught-proofing (e.g. weather stripping, storm windows, curtains) without their replacement
- Vinyl windows poorly attempt to replicate the details and profile of wood windows and true divided lights; vinyl windows are inauthentic
- Vinyl (poly-vinylchloride) is a non-renewal resource derived from petrochemicals
- Recycling does not exist for vinyl windows; they must be discarded in a landfill
- Vinyl windows have a very short lifespan (typically 10-25 years; warranties may only last 8 years); with maintenance, wood windows can last over 100+ years
- No material is "maintenance free"
- Wood window conservation is labour-intensive which supports skilled trades who use traditional methods
- Historic wood windows (especially those built before WWII) are likely made of old-growth wood – denser, more durable, more rot resistant, and dimensionally stable
- Installing new windows is not going to "pay for itself" in energy savings; replacing windows is the most costly intervention with a lower rate of return when compared to less costly interventions.[b] The savings in energy costs would experience an excessive payback period that would be longer than the lifespan of the replacement vinyl window. Some sources estimate the payback period as long as 100 years[c]
- Other interventions, such as insulating an attic, can have a more substantial impact on thermal performance of a home
- The greenest building is one that is already built
- Up to 85% of a window unit's heat loss can be through a poorly weather-sealed sash; weather-stripping and other improvements can reduce this loss by 95%[d]

---

[a] National Trust for Historic Preservation, *Repair or Replace Old Windows a Visual Look at the Impacts*.
[b] Preservation Green Lab, *Saving Windows, Saving Money*. 2012.
[c] The time to "payback" the costs for new windows is estimated to be as long as 100 years in Sedovic and Gotthelf (2005). It also cited a warranty lifespan of new windows as between 2 and 10 years, whereas wood windows can reach 100 years and more with minimal maintenance. See Appendix C.
[d] See article on restoration of wood windows (circa 1725) in the Milton House by John Stahl, "Saving Old Windows" in *This Old House Online.*

In 2009, English Heritage (now Historic England) and Historic Scotland funded research at Glasgow Caledonia University to study the energy performance of traditional wood windows (see Baker et al 2010). Traditional windows (wood windows) are often considered to be “drafty, prone to condensation, and hard to maintain.” The study found that,

> *…traditional methods can be used to improve thermal performance of windows and, in turn, the thermal comfort of a room… this study demonstrates that good thermal performance can be achieved by relative low-cost methods, such as employing shutters, blinds, and curtains. Further performance gain is achievable by using sensitive methods such as secondary glazing [storm windows], which allow the historic character of the window to be retained.*

In a study conducted in Boulder, Colorado in 2011, a properly-built wood storm window was found to outperform an aluminum storm window by a factor of 1.5. The best performance was achieved by restoring wood windows and installing new storm windows with insulated frames, with a 6.8 fold improvement in the energy performance over a wood window (see Kinney and Ellsworth 2011).

A study published by the Preservation Green Lab of the National Trust for Historic Preservation (US) in 2012 found that a number of existing window retrofit strategies can come very close to the energy performance of high-performance replacement windows at a fraction of the cost.

These studies were further validated by testing undertaken at Mohawk College, in Hamilton, Ontario, in 2017 under the direction of Shannon Kyles. Their research and testing found that restored wood windows were just as efficient as new windows when subjected to “blow test” (air infiltration).[e]

4.3 Proposed Replacement Windows

Notwithstanding the analysis of Section 4.1, Do the Existing Wood Windows Need to Be Replaced?, it is necessary to provide an analysis of the proposed replacement windows. Few details were provided in the Heritage Alteration Permit application.

The replacement windows proposed in the Heritage Alteration Permit application are incompatible for the following reasons:

- A faux grille pattern (a plastic muntin between the panes of glass) poorly replicates the true divided light style of the existing windows; other methods of replicating historic fenestration patterns are more successful
- Vinyl windows are bulkier and distort the proportions of wood windows; alternative materials better replicate the qualities of historic wood windows
- The property owner has not demonstrated that the segmented arch top sash of the existing windows will be replicated by the proposed windows, requiring flashing to fill in the void of the window opening; the original window shape and size should be maintained by replacement windows

5.0 Conclusion

The original wood windows of the properties at 40 & 42 Askin Street are a significant heritage attribute that contribute to the cultural heritage value of the “double designated” protected heritage property. The replacement of the original wood windows with vinyl replacement windows, as proposed in this Heritage Alteration Permit, would result in a negative impact on the cultural heritage value of this property. The proposed replacement with vinyl windows does not comply with the policies and guidelines of the *Wortley Village-Old South Heritage Conservation District*, does not conform to the direction of the policies of *The London Plan* for cultural heritage resources, and is inconsistent with the direction of the *Provincial Policy Statement* (2014) as it does not conserve the heritage attributes of this cultural heritage resource (built heritage resource). This Heritage Alteration Permit application should be refused.

[e] See Alter (2017) and Mahoney (2017) for reporting on the Mohawk College testing of wood windows compared to new replacement windows.

An alternative Heritage Alteration Permit application for the removal of the existing aluminum storm windows and their replacement with wood storm windows should be strongly considered should the property owner to address thermal issues related to the properties. This approach could be phased over several years and leverage grants available to heritage designated properties.

Many low cost interventions, such as weather stripping, would greatly improve the energy efficiency of the existing wood windows and not require their costly replacement.

Prepared by:	**Kyle Gonyou, CAHP** **Heritage Planner**
Submitted and Recommended by:	**Gregg Barrett, AICP** **Director, City Planning and City Planner**
Note: The opinions contained herein are offered by a person or persons qualified to provide expert opinion. Further detail with respect to qualifications can be obtained from City Planning.	

January 29, 2020
kg/

\\FILE2\users-z\pdpl\Shared\policy\HERITAGE\Heritage Alteration Permit Reports\Askin Street, 40-42\HAP19-102-L 40-42 Askin Street LACH 2020-02-12.docx

Appendix A Property Location
Appendix B Images
Appendix C Additional Information

Sources

Alter, Lloyd. “New study shows that restored 200 year old windows are as airtight as brand new replacements.” *Treehugger*. July 18, 2017. Retrieved from www.treehugger.com.

Baker, Paul, Roger Curtis, Craig Kennedy, and Chris Wood. “Thermal Performance of Traditional Windows and Low-Cost Energy Saving Retrofits.” *APT Bulletin: Journal of Preservation Technology* 41:1, 2010.

Cooper, Chris. “Draft Wood Windows, in Need of Repair? 9 Simple Tips – to Save You Money this Winter.” *Old Home Living.* February 1, 2016. Retrieved from: www.oldhomeliving.com. (Appendix C)

Historic England. *Energy Efficiency and Historic Buildings: Draught-Proofing Windows and Doors*. April 2016. Retrieved from: www.historicengland.org.uk.

National Trust for Historic Preservation (US). *Repair or Replace Old Windows A Visual Look at the Impacts*.

National Trust for Historic Preservation – Preservation Green Lab. *Saving Windows, Saving Money: Evaluating the Energy Performance of Window Retrofit and Replacement*. 2012. Retrieved from: https://forum.savingplaces.org/viewdocument/saving-windows-saving-money-evalu. (Appendix C)

Mahoney, Jeff. “Old windows part of the soul of our past.” *The Hamilton Spectator*. June 30, 2017.

Sedovic, Walter and Jill H. Gotthelf. “What Replacement Windows Can’t Replicate: The Real Cost of Removing Historic Windows.” *APT Bulletin: Journal of Preservation Technology* 36:4, 2005. (Appendix C)

Stahl, John. “Saving Old Windows.” *This Old House Online.*

Tausky, Nancy. *Historical Sketches of London: From Site to City*. 1993.

U.S. Department of the Interior, National Park Services, Cultural Resources – Heritage Preservation Services. *Preservation Briefs: 9 – The Repair of Historic Wooden Windows*. 1981.

Appendix A – Location

Figure 1: Location map of the subject properties at 40 & 42 Askin Street.

Appendix B – Images

Image 1: Photograph of the properties at 40 & 42 Askin Street (1985).

Image 2: Photograph of the properties at 40 & 42 Askin Street (December 7, 2017).

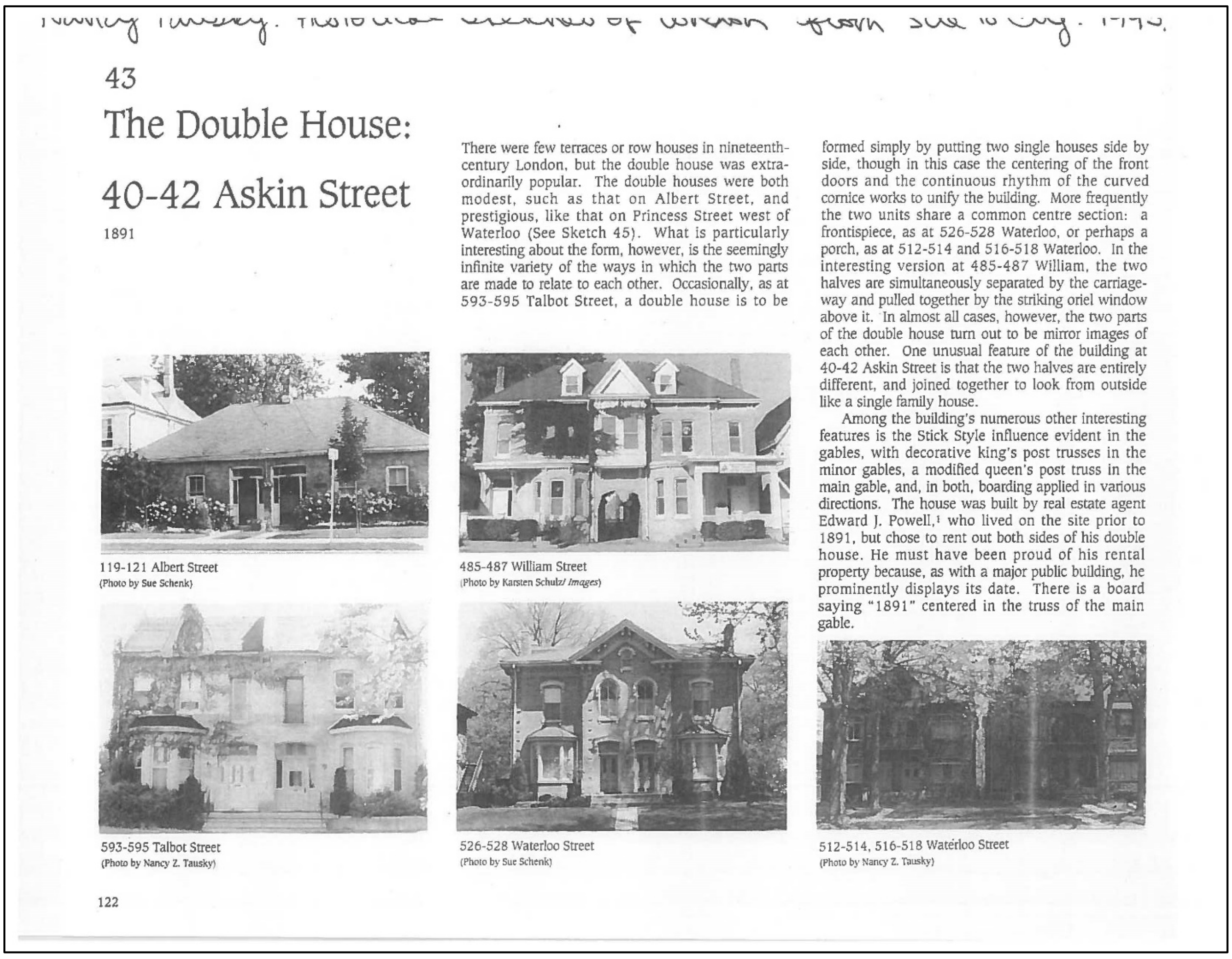
Image 3: Photograph of the properties at 40 & 42 Askin Street on January 16, 2020.

Image 4: Detail photograph of the windows under the porch on the property at 42 Askin Street. Note that the window openings are topped by a segmented arch brick voussoir; the wood windows feature a segmented arch top sash which is obscured by the rectangular aluminum storm window applied over top.

Image 5: Detail photograph of the exterior of the front windows (facing Askin Street) on the property at 40 Askin Street.

Image 6: Detail photograph of the exterior of the window on the easterly bay on the property at 40 Askin Street.

Appendix C – Additional Information



Nancy Tausky. Historical Sketches of London from Site to City. 1993.

43

The Double House: 40-42 Askin Street

1891

There were few terraces or row houses in nineteenth-century London, but the double house was extra-ordinarily popular. The double houses were both modest, such as that on Albert Street, and prestigious, like that on Princess Street west of Waterloo (See Sketch 45). What is particularly interesting about the form, however, is the seemingly infinite variety of the ways in which the two parts are made to relate to each other. Occasionally, as at 593-595 Talbot Street, a double house is to be formed simply by putting two single houses side by side, though in this case the centering of the front doors and the continuous rhythm of the curved cornice works to unify the building. More frequently the two units share a common centre section: a frontispiece, as at 526-528 Waterloo, or perhaps a porch, as at 512-514 and 516-518 Waterloo. In the interesting version at 485-487 William, the two halves are simultaneously separated by the carriage-way and pulled together by the striking oriel window above it. In almost all cases, however, the two parts of the double house turn out to be mirror images of each other. One unusual feature of the building at 40-42 Askin Street is that the two halves are entirely different, and joined together to look from outside like a single family house.

Among the building's numerous other interesting features is the Stick Style influence evident in the gables, with decorative king's post trusses in the minor gables, a modified queen's post truss in the main gable, and, in both, boarding applied in various directions. The house was built by real estate agent Edward J. Powell,[1] who lived on the site prior to 1891, but chose to rent out both sides of his double house. He must have been proud of his rental property because, as with a major public building, he prominently displays its date. There is a board saying "1891" centered in the truss of the main gable.

119-121 Albert Street
(Photo by Sue Schenk)

485-487 William Street
(Photo by Karsten Schulz/ *Images*)

593-595 Talbot Street
(Photo by Nancy Z. Tausky)

526-528 Waterloo Street
(Photo by Sue Schenk)

512-514, 516-518 Waterloo Street
(Photo by Nancy Z. Tausky)

122

Figure 2: The properties at 40 & 42 Askin Street were featured in a profile of “double houses” in Historical Sketches of London: From Site to City *(Tausky, 1993)*.

Figure 3: The properties at 40 & 42 Askin Street were featured in a profile of “double houses” in Historical Sketches of London: From Site to City *(Tausky, 1993)*.

HAP20-004-L

U.S. Department of the Interior, National Park Services, Cultural Resources – Heritage Preservation Services. *Preservation Briefs: 9 – The Repair of Historic Wooden Windows*. 1981.

U.S. Department of the Interior
National Park Service
Cultural Resources
Heritage Preservation Services

Preservation Briefs: 9

The Repair of Historic Wooden Windows

John H. Myers

The windows on many historic buildings are an important aspect of the architectural character of those buildings. Their design, craftsmanship, or other qualities may make them worthy of preservation. This is self-evident for ornamental windows, but it can be equally true for warehouses or factories where the windows may be the most dominant visual element of an otherwise plain building (see figure 1). Evaluating the significance of these windows and planning for their repair or replacement can be a complex process involving both objective and subjective considerations. The *Secretary of the Interior's Standards for Rehabilitation,* and the accompanying guidelines, call for respecting the significance of original materials and features, repairing and retaining them wherever possible, and when necessary, replacing them in kind. This **Brief** is based on the issues of significance and repair which are implicit in the standards, but the primary emphasis is on the technical issues of planning for the repair of windows including evaluation of their physical condition, techniques of repair, and design considerations when replacement is necessary.

Figure 1. *Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multi-pane windows here with larger panes could dramatically change the appearance of the building. The areas of missing windows convey the impression of such a change. Photo: John T. Lowe*

Much of the technical section presents repair techniques as an instructional guide for the do-it-yourselfer. The information will be useful, however, for the architect, contractor, or developer on large-scale projects. It presents a methodology for approaching the evaluation and repair of existing windows, and considerations for replacement, from which the professional can develop alternatives and specify appropriate materials and procedures.

Architectural or Historical Significance

Evaluating the architectural or historical significance of windows is the first step in planning for window treatments, and a general understanding of the function and history of windows is vital to making a proper evaluation. As a part of this evaluation, one must consider four basic window functions: admitting light to the interior spaces, providing fresh air and ventilation to the interior, providing a visual link to the outside world, and enhancing the appearance of a building. No single factor can be disregarded when planning window treatments; for example, attempting to conserve energy by closing up or reducing the size of window openings may result in the use of *more* energy by increasing electric lighting loads and decreasing passive solar heat gains.

Historically, the first windows in early American houses were casement windows; that is, they were hinged at the side and opened outward. In the beginning of the eighteenth century single- and double-hung windows were introduced. Subsequently many styles of these vertical sliding sash windows have come to be associated with specific building periods or architectural styles, and this is an important consideration in determining the significance of windows, especially on a local or regional basis. Site-specific, regionally oriented architectural comparisons should be made to determine the significance of windows in question. Although such comparisons may focus on specific window types and their details, the ultimate determination of significance should be made within the context of the whole building, wherein the windows are one architectural element (see figure 2).

After all of the factors have been evaluated, *windows should be considered significant to a building if they:* 1) are original, 2) reflect the original design intent for the building, 3) reflect period or regional styles or building practices, 4) reflect changes to the building resulting from major periods or events, or 5) are examples of exceptional craftsmanship or design. Once this evaluation of significance has been completed, it is possible to pro-

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

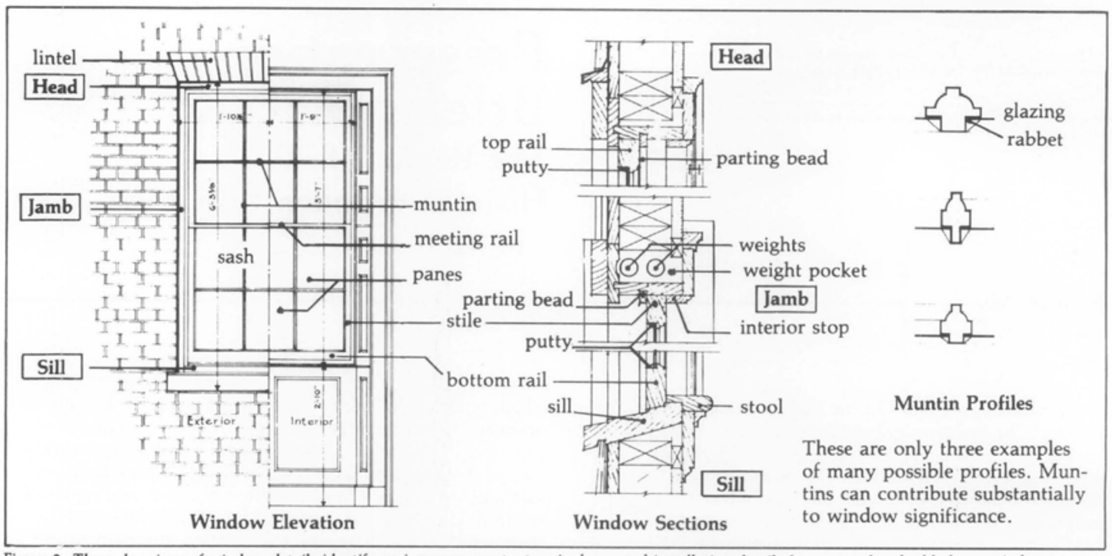


Figure 2. *These drawings of window details identify major components, terminology, and installation details for a wooden double-hung window.*

ceed with planning appropriate treatments, beginning with an investigation of the physical condition of the windows.

Physical Evaluation

The key to successful planning for window treatments is a careful evaluation of existing physical conditions on a unit-by-unit basis. A graphic or photographic system may be devised to record existing conditions and illustrate the scope of any necessary repairs. Another effective tool is a window schedule which lists all of the parts of each window unit. Spaces by each part allow notes on existing conditions and repair instructions. When such a schedule is completed, it indicates the precise tasks to be performed in the repair of each unit and becomes a part of the specifications. In any evaluation, one should note at a minimum, 1) window location, 2) condition of the paint, 3) condition of the frame and sill, 4) condition of the sash (rails, stiles and muntins), 5) glazing problems, 6) hardware, and 7) the overall condition of the window (excellent, fair, poor, and so forth).

Many factors such as poor design, moisture, vandalism, insect attack, and lack of maintenance can contribute to window deterioration, but moisture is the primary contributing factor in wooden window decay. All window units should be inspected to see if water is entering around the edges of the frame and, if so, the joints or seams should be caulked to eliminate this danger. The glazing putty should be checked for cracked, loose, or missing sections which allow water to saturate the wood, especially at the joints. The back putty on the interior side of the pane should also be inspected, because it creates a seal which prevents condensation from running down into the joinery. The sill should be examined to insure that it slopes downward away from the building and allows water to drain off. In addition, it may be advisable to cut a dripline along the underside of the sill. This almost invisible treatment will insure proper water run-off, particularly if the bottom of the sill is flat. Any conditions, including poor original design, which permit water to come in contact with the wood or to puddle on the sill must be corrected as they contribute to deterioration of the window.

One clue to the location of areas of excessive moisture is the condition of the paint; therefore, each window should be examined for areas of paint failure. Since excessive moisture is detrimental to the paint bond, areas of paint blistering, cracking, flaking, and peeling usually identify points of water penetration, moisture saturation, and potential deterioration. Failure of the paint should not, however, be mistakenly interpreted as a sign that the wood is in poor condition and hence, irreparable. Wood is frequently in sound physical condition beneath unsightly paint. After noting areas of paint failure, the next step is to inspect the condition of the wood, particularly at the points identified during the paint examination.

Each window should be examined for operational soundness beginning with the lower portions of the frame and sash. Exterior rainwater and interior condensation can flow downward along the window, entering and collecting at points where the flow is blocked. The sill, joints between the sill and jamb, corners of the bottom rails and muntin joints are typical points where water collects and deterioration begins (see figure 3). The operation of the window (continuous opening and closing over the years and seasonal temperature changes) weakens the joints, causing movement and slight separation. This process makes the joints more vulnerable to water which is readily absorbed into the end-grain of the wood. If severe deterioration exists in these areas, it will usually be apparent on visual inspection, but other less severely deteriorated areas of the wood may be tested by two traditional methods using a small ice pick.

An ice pick or an awl may be used to test wood for soundness. The technique is simply to jab the pick into a wetted wood surface at an angle and pry up a small sec-

Figure 3. *Deterioration of poorly maintained windows usually begins on horizontal surfaces and at joints where water can collect and saturate the wood. The problem areas are clearly indicated by paint failure due to moisture. Photo: Baird M. Smith, AIA*

tion of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

Another method of testing for soundness consists of pushing a sharp object into the wood, perpendicular to the surface. If deterioration has begun from the hidden side of a member and the core is badly decayed, the visible surface may appear to be sound wood. Pressure on the probe can force it through an apparently sound skin to penetrate deeply into decayed wood. This technique is especially useful for checking sills where visual access to the underside is restricted.

Following the inspection and analysis of the results, the scope of the necessary repairs will be evident and a plan for the rehabilitation can be formulated. Generally the actions necessary to return a window to "like new" condition will fall into three broad categories: 1) routine maintenance procedures, 2) structural stabilization, and 3) parts replacement. These categories will be discussed in the following sections and will be referred to respectively as Repair Class I, Repair Class II, and Repair Class III. Each successive repair class represents an increasing level of difficulty, expense, and work time. Note that most of the points mentioned in Repair Class I are routine maintenance items and should be provided in a regular maintenance program for any building. The neglect of these routine items can contribute to many common window problems.

Before undertaking any of the repairs mentioned in the following sections all sources of moisture penetration should be identified and eliminated, and all existing decay fungi destroyed in order to arrest the deterioration process. Many commercially available fungicides and wood preservatives are toxic, so it is extremely important to follow the manufacturer's recommendations for application, and store all chemical materials away from children and animals. After fungicidal and preservative treatment the windows may be stabilized, retained, and restored with every expectation for a long service life.

Repair Class I: Routine Maintenance

Repairs to wooden windows are usually labor intensive and relatively uncomplicated. On small scale projects this allows the do-it-yourselfer to save money by repairing all or part of the windows. On larger projects it presents the opportunity for time and money which might otherwise be spent on the removal and replacement of existing windows, to be spent on repairs, subsequently saving all or part of the material cost of new window units. Regardless of the actual costs, or who performs the work, the evaluation process described earlier will provide the knowledge from which to specify an appropriate work program, establish the work element priorities, and identify the level of skill needed by the labor force.

The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps: 1) some degree of interior and exterior paint removal, 2) removal and repair of sash (including reglazing where necessary), 3) repairs to the frame, 4) weatherstripping and reinstallation of the sash, and 5) repainting. These operations are illustrated for a typical double-hung wooden window (see figures 4a-f), but they may be adapted to other window types and styles as applicable.

Historic windows have usually acquired many layers of paint over time. Removal of excess layers or peeling and flaking paint will facilitate operation of the window and restore the clarity of the original detailing. Some degree of paint removal is also necessary as a first step in the proper surface preparation for subsequent refinishing (if paint color analysis is desired, it should be conducted prior to the onset of the paint removal). There are several safe and effective techniques for removing paint from wood, depending on the amount of paint to be removed. Several techniques such as scraping, chemical stripping, and the use of a hot air gun are discussed in "Preservation Briefs: 10 Paint Removal from Historic Woodwork" (see Additional Reading section at end).

Paint removal should begin on the interior frames, being careful to remove the paint from the interior stop and the parting bead, particularly along the seam where these stops meet the jamb. This can be accomplished by running a utility knife along the length of the seam, breaking the paint bond. It will then be much easier to remove the stop, the parting bead and the sash. The interior stop may be initially loosened from the sash side to avoid visible scarring of the wood and then gradually pried loose using a pair of putty knives, working up and down the stop in small increments (see figure 4b). With the stop removed, the lower or interior sash may be withdrawn. The sash cords should be detached from the sides of the sash and their ends may be pinned with a nail or tied in a knot to prevent them from falling into the weight pocket.

Removal of the upper sash on double-hung units is similar but the parting bead which holds it in place is set into a groove in the center of the stile and is thinner and more delicate than the interior stop. After removing any paint along the seam, the parting bead should be carefully pried out and worked free in the same manner as the interior stop. The upper sash can be removed in the same manner as the lower one and both sash taken to a convenient work area (in order to remove the sash the interior stop and parting bead need only be removed from one side of the window). Window openings can be covered with polyethylene sheets or plywood sheathing while the sash are out for repair.

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used (see figure 4c), the glass should be removed or protected from the sudden temperature change which can cause breakage. An

Figure 4a. *The following series of photographs of the repair of a historic double-hung window use a unit which is structurally sound but has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: John H. Myers*

Figure 4b. *After removing paint from the seam between the interior stop and the jamb, the stop can be pried out and gradually worked loose using a pair of putty knives as shown. To avoid visible scarring of the wood, the sash can be raised and the stop pried loose initially from the outer side. Photo: John H. Myers*

Figure 4c. *Sash can be removed and repaired in a convenient work area. Paint is being removed from this sash with a hot air gun while an asbestos sheet protects the glass from sudden temperature change. Photo: John H. Myers*

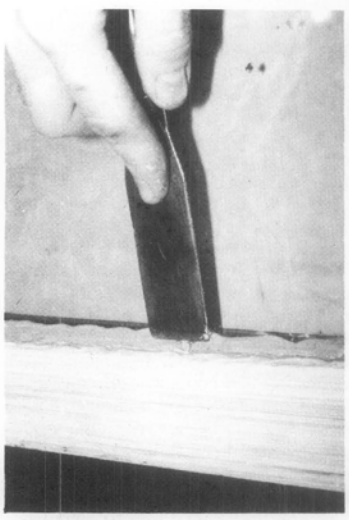


Figure 4d. *Reglazing or replacement of the putty requires that the existing putty be removed manually, the glazing points be extracted, the glass removed, and the back putty scraped out. To reglaze, a bed of putty is laid around the perimeter of the rabbet, the pane is pressed into place, glazing points are inserted to hold the pane (shown), and a final seal of putty is beveled around the edge of the glass. Photo: John H. Myers*

Figure 4e. *A common repair is the replacement of broken sash cords with new cords (shown) or with chains. The weight pocket is often accessible through a removable plate in the jamb, or by removing the interior trim. Photo: John H. Myers*

Figure 4f. *Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come. Both the historic material and the detailing and craftsmanship of this original window have been preserved. Photo: John H. Myers*

overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature change. It is important to protect the glass because it may be historic and often adds character to the window. Deteriorated putty should be removed manually, taking care not to damage the wood along the rabbet. If the glass is to be removed, the glazing points which hold the glass in place can be extracted and the panes numbered and removed for cleaning and reuse in the same openings. With the glass panes out, the remaining putty can be removed and the sash can be sanded, patched, and primed with a preservative primer. Hardened putty in the rabbets may be softened by heating with a soldering iron at the point of removal. Putty remaining on the glass may be softened by soaking the panes in linseed oil, and then removed with less risk of breaking the glass. Before reinstalling the glass, a bead of glazing compound or linseed oil putty should be laid around the rabbet to cushion and seal the glass. Glazing compound should only be used on wood which has been brushed with linseed oil and primed with an oil based primer or paint. The pane is then pressed into place and the glazing points are pushed into the wood around the perimeter of the pane (see figure 4d). The final glazing compound or putty is applied and beveled to complete the seal. The sash can be refinished as desired on the inside and painted on the outside as soon as a "skin" has formed on the putty, usually in 2 or 3 days. Exterior paint should cover the beveled glazing compound or putty and lap over onto the glass slightly to complete a weathertight seal. After the proper curing times have elapsed for paint and putty, the sash will be ready for reinstallation.

While the sash are out of the frame, the condition of the wood in the jamb and sill can be evaluated. Repair and refinishing of the frame may proceed concurrently with repairs to the sash, taking advantage of the curing times for the paints and putty used on the sash. One of the most common work items is the replacement of the sash cords with new rope cords or with chains (see figure 4e). The weight pocket is frequently accessible through a door on the face of the frame near the sill, but if no door exists, the trim on the interior face may be removed for access. Sash weights may be increased for easier window operation by elderly or handicapped persons. Additional repairs to the frame and sash may include consolidation or replacement of deteriorated wood. Techniques for these repairs are discussed in the following sections.

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to "like new" condition (see figure 4f). The techniques can be applied by an unskilled person with minimal training and experience. To demonstrate the practicality of this approach, and photograph it, a Technical Preservation Services staff member repaired a wooden double-hung, two over two window which had been in service over ninety years. The wood was structurally sound but the window had one broken pane, many layers of paint, broken sash cords and inadequate, worn-out weatherstripping. The staff member found that the frame could be stripped of paint and the sash removed quite easily. Paint, putty and glass removal required about one hour for each sash, and the reglazing of both sash was accomplished in about one hour. Weatherstripping of the sash and frame, replacement of the sash cords and reinstallation of the sash, parting bead, and stop required an hour and a half. These times refer only to individual operations; the entire process took several days due to the drying and curing times for putty, primer, and paint, however, work on other window units could have been in progress during these lag times.

Repair Class II: Stabilization

The preceding description of a window repair job focused on a unit which was operationally sound. Many windows will show some additional degree of physical deterioration, especially in the vulnerable areas mentioned earlier, but even badly damaged windows can be repaired using simple processes. Partially decayed wood can be waterproofed, patched, built-up, or consolidated and then painted to achieve a sound condition, good appearance, and greatly extended life. Three techniques for repairing partially decayed or weathered wood are discussed in this section, and all three can be accomplished using products available at most hardware stores.

One established technique for repairing wood which is split, checked or shows signs of rot, is to: 1) dry the wood, 2) treat decayed areas with a fungicide, 3) waterproof with two or three applications of boiled linseed oil (applications every 24 hours), 4) fill cracks and holes with putty, and 5) after a "skin" forms on the putty, paint the surface. Care should be taken with the use of fungicide which is toxic. Follow the manufacturers' directions and use only on areas which will be painted. When using any technique of building up or patching a flat surface, the finished surface should be sloped slightly to carry water away from the window and not allow it to puddle. Caulking of the joints between the sill and the jamb will help reduce further water penetration.

When sills or other members exhibit surface weathering they may also be built-up using wood putties or homemade mixtures such as sawdust and resorcinol glue, or whiting and varnish. These mixtures can be built up in successive layers, then sanded, primed, and painted. The same caution about proper slope for flat surfaces applies to this technique.

Wood may also be strengthened and stabilized by consolidation, using semi-rigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semi-rigid epoxy patching compound, sanded and painted (see figure 5). Epoxy patching compounds can be used to build up

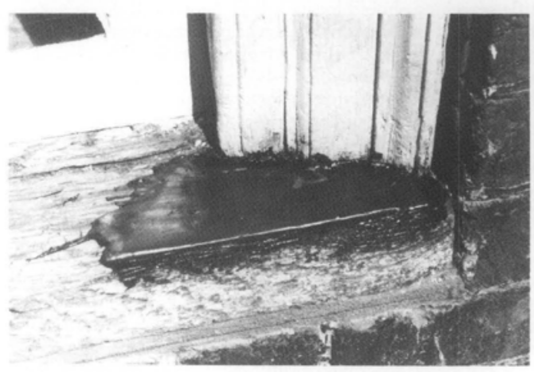


Figure 5. *This illustrates a two-part epoxy patching compound used to fill the surface of a weathered sill and rebuild the missing edge. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair. Photo: John H. Myers*

missing sections or decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile which has been rubbed with butcher's wax. This can be a very efficient technique where there are many typical repairs to be done. Technical Preservation Services has published *Epoxies for Wood Repairs in Historic Buildings* (see Additional Reading section at end), which discusses the theory and techniques of epoxy repairs. The process has been widely used and proven in marine applications; and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available for wood repair.

Any of the three techniques discussed can stabilize and restore the appearance of the window unit. There are times, however, when the degree of deterioration is so advanced that stabilization is impractical, and the only way to retain some of the original fabric is to replace damaged parts.

Repair Class III: Splices and Parts Replacement

When parts of the frame or sash are so badly deteriorated that they cannot be stabilized there are methods which permit the retention of some of the existing or original fabric. These methods involve replacing the deteriorated parts with new matching pieces, or splicing new wood into existing members. The techniques require more skill and are more expensive than any of the previously discussed alternatives. It is necessary to remove the sash and/or the affected parts of the frame and have a carpenter or woodworking mill reproduce the damaged or missing parts. Most millwork firms can duplicate parts, such as muntins, bottom rails, or sills, which can then be incorporated into the existing window, but it may be necessary to shop around because there are several factors controlling the practicality of this approach. Some woodworking mills do not like to repair old sash because nails or other foreign objects in the sash can damage expensive knives (which cost far more than their profits on small repair jobs); others do not have cutting knives to duplicate muntin profiles. Some firms prefer to concentrate on larger jobs with more profit potential, and some may not have a craftsman who can duplicate the parts. A little searching should locate a firm which will do the job, and at a reasonable price. If such a firm does not exist locally, there are firms which undertake this kind of repair and ship nationwide. It is possible, however, for the advanced do-it-yourselfer or craftsman with a table saw to duplicate moulding profiles using techniques discussed by Gordie Whittington in "Simplified Methods for Reproducing Wood Mouldings," *Bulletin* of the Association for Preservation Technology, Vol. III, No. 4, 1971, or illustrated more recently in *The Old House*, Time-Life Books, Alexandria, Virginia, 1979.

The repairs discussed in this section involve window frames which may be in very deteriorated condition, possibly requiring removal; therefore, caution is in order. The actual construction of wooden window frames and sash is not complicated. Pegged mortise and tenon units can be disassembled easily, *if* the units are out of the building. The installation or connection of some frames to the surrounding structure, especially masonry walls, can complicate the work immeasurably, and may even require dismantling of the wall. It may be useful, therefore, to take the following approach to frame repair: 1) conduct regular maintenance of sound frames to achieve the longest life possible, 2) make necessary repairs in place wherever possible, using stabilization and splicing techniques, and 3) if removal is necessary, thoroughly investigate the structural detailing and seek appropriate professional consultation.

Another alternative may be considered if parts replacement is required, and that is sash replacement. If extensive replacement of parts is necessary and the job becomes prohibitively expensive it may be more practical to purchase new sash which can be installed into the existing frames. Such sash are available as exact custom reproductions, reasonable facsimiles (custom windows with similar profiles), and contemporary wooden sash which are similar in appearance. There are companies which still manufacture high quality wooden sash which would duplicate most historic sash. A few calls to local building suppliers may provide a source of appropriate replacement sash, but if not, check with local historical associations, the state historic preservation office, or preservation related magazines and supply catalogs for information.

If a rehabilitation project has a large number of windows such as a commercial building or an industrial complex, there may be less of a problem arriving at a solution. Once the evaluation of the windows is completed and the scope of the work is known, there may be a potential economy of scale. Woodworking mills may be interested in the work from a large project; new sash in volume may be considerably less expensive per unit; crews can be assembled and trained on site to perform all of the window repairs; and a few extensive repairs can be absorbed (without undue burden) into the total budget for a large number of sound windows. While it may be expensive for the average historic home owner to pay seventy dollars or more for a mill to grind a custom knife to duplicate four or five bad muntins, that cost becomes negligible on large commercial projects which may have several hundred windows.

Most windows should not require the extensive repairs discussed in this section. The ones which do are usually in buildings which have been abandoned for long periods or have totally lacked maintenance for years. It is necessary to thoroughly investigate the alternatives for windows which do require extensive repairs to arrive at a solution which retains historic significance and is also economically feasible. Even for projects requiring repairs identified in this section, if the percentage of parts replacement per window is low, or the number of windows requiring repair is small, repair can still be a cost effective solution.

Weatherization

A window which is repaired should be made as energy efficient as possible by the use of appropriate weatherstripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top, bottom, and meeting rails, but may have the disadvantage of absorbing and holding moisture, particularly at the bottom rail. Rolled vinyl strips may also be tacked into place in appropriate locations to reduce infiltration. Metal strips or new plastic spring strips may be used on the rails and, if space permits, in the channels between the sash and jamb. Weatherstripping is a historic treatment, but old weatherstripping (felt) is not likely to perform very satisfactorily. Appropriate contemporary weatherstripping should be considered an integral part of the repair process for windows. The use of sash locks installed on the meeting rail will insure that the sash are kept tightly closed so that the weatherstripping will function more effectively to reduce infiltration. Although such locks will not always be historically accurate, they will usually be viewed as an acceptable contemporary modification in the interest of improved thermal performance.

Many styles of storm windows are available to improve the thermal performance of existing windows. The use of exterior storm windows should be investigated whenever feasible because they are thermally efficient, cost-effective, reversible, and allow the retention of original windows (see "Preservation Briefs: 3"). Storm window frames may be made of wood, aluminum, vinyl, or plastic; however, the use of unfinished aluminum storms should be avoided. The visual impact of storms may be minimized by selecting colors which match existing trim color. Arched top storms are available for windows with special shapes. Although interior storm windows appear to offer an attractive option for achieving double glazing with minimal visual impact, the potential for damaging condensation problems must be addressed. Moisture which becomes trapped between the layers of glazing can condense on the colder, outer prime window, potentially leading to deterioration. The correct approach to using interior storms is to create a seal on the interior storm while allowing some ventilation around the prime window. In actual practice, the creation of such a durable, airtight seal is difficult.

Window Replacement

Although the retention of original or existing windows is always desirable and this **Brief** is intended to encourage that goal, there is a point when the condition of a window may clearly indicate replacement. The decision process for selecting replacement windows should *not* begin with a survey of contemporary window products which are available as replacements, but should begin with a look at the windows which are being replaced. Attempt to understand the contribution of the window(s) to the appearance of the facade including: 1) the pattern of the openings and their size; 2) proportions of the frame and sash; 3) configuration of window panes; 4) muntin profiles; 5) type of wood; 6) paint color; 7) characteristics of the glass; and 8) associated details such as arched tops, hoods, or other decorative elements. Develop an understanding of how the window reflects the period, style, or regional characteristics of the building, or represents technological development.

Armed with an awareness of the significance of the existing window, begin to search for a replacement which retains as much of the character of the historic window as possible. There are many sources of suitable new windows. Continue looking until an acceptable replacement can be found. Check building supply firms, local woodworking mills, carpenters, preservation oriented magazines, or catalogs or suppliers of old building materials, for product information. Local historical associations and state historic preservation offices may be good sources of information on products which have been used successfully in preservation projects.

Consider energy efficiency as one of the factors for replacements, but do not let it dominate the issue. Energy conservation is no excuse for the wholesale destruction of historic windows which can be made thermally efficient by historically and aesthetically acceptable means. In fact, a historic wooden window with a high quality storm window added should thermally outperform a new double-glazed metal window which does not have thermal breaks (insulation between the inner and outer frames intended to break the path of heat flow). This occurs because the wood has far better insulating value than the metal, and in addition many historic windows have high ratios of wood to glass, thus reducing the area of highest heat transfer. One measure of heat transfer is the U-value, the number of Btu's per hour transferred through a square foot of material. When comparing thermal performance, the lower the U-value the better the performance. According to *ASHRAE 1977 Fundamentals*, the U-values for single glazed wooden windows range from 0.88 to 0.99. The addition of a storm window should reduce these figures to a range of 0.44 to 0.49. A non-thermal break, double-glazed metal window has a U-value of about 0.6.

Conclusion

Technical Preservation Services recommends the retention and repair of original windows whenever possible. We believe that the repair and weatherization of existing wooden windows is more practical than most people realize, and that many windows are unfortunately replaced because of a lack of awareness of techniques for evaluation, repair, and weatherization. Wooden windows which are repaired and properly maintained will have greatly extended service lives while contributing to the historic character of the building. Thus, an important element of a building's significance will have been preserved for the future.

Additional Reading

ASHRAE Handbook-1977 Fundamentals. New York: American Society of Heating, Refrigerating and Air-conditioning Engineers, 1978 (chapter 26).

Ferro, Maximillian. *Preservation: Present Pathway to Fall River's Future.* Fall River, Massachusetts: City of Fall River, 1979 (chapter 7).

"Fixing Double-Hung Windows." *Old House Journal* (no. 12, 1979): 135.

Look, David W. "Preservation Briefs: 10 Paint Removal from Historic Woodwork." Washington, DC: Technical Preservation Services, U.S. Department of the Interior, forthcoming.

Morrison, Hugh. *Early American Architecture.* New York: Oxford University Press, 1952.

Phillips, Morgan, and Selwyn, Judith. *Epoxies for Wood Repairs in Historic Buildings.* Washington, DC: Technical Preservation Services, U.S. Department of the Interior (Government Printing Office, Stock No. 024-016-00095-1), 1978.

Rehab Right. Oakland, California: City of Oakland Planning Department, 1978 (pp. 78-83).

"Sealing Leaky Windows." *Old House Journal* (no. 1, 1973): 5.

Smith, Baird M. "Preservation Briefs: 3 Conserving Energy in Historic Buildings." Washington, DC: Technical Preservation Services, U.S. Department of the Interior, 1978.

1981

Sedovic, Walter and Jill H. Gotthelf. "What Replacement Windows Can't Replicate: The Real Cost of Removing Historic Windows." *APT Bulletin: Journal of Preservation Technology* 36:4, 2005.

What Replacement Windows Can't Replace: The Real Cost of Removing Historic Windows

WALTER SEDOVIC and JILL H. GOTTHELF

Sustainability looks even better through a restored window.

	EMBODIED ENERGY	
MATERIALS	MJ/kg	MJ/m3
Aggregate	0.10	150
Straw bale	0.24	31
Soil-cement	0.42	819
Stone (local)	0.79	2030
Concrete block	0.94	2350
Concrete (30 Mpa)	1.3	3180
Concrete precast	2.0	2780
Lumber	2.5	1380
Brick	2.5	5170
Cellulose insulation	3.3	112
Gypsum wallboard	6.1	5890
Particle board	8.0	4400
Aluminum (recycled)	8.1	21870
Steel (recycled)	8.9	37210
Shingles (asphalt)	9.0	4930
Plywood	10.4	5720
Mineral wool insulation	14.6	139
Glass	15.9	37550
Fiberglass insulation	30.3	970
Steel	32.0	251200
Zinc	51.0	371280
Brass	62.0	519560
PVC	70.0	93620
Copper	70.6	631164
Paint	93.3	117500
Linoleum	116.0	150930
Polystyrene Insulation	117.0	3770
Carpet (synthetic)	148.0	84900
Aluminum (recycled)	227.0	515700
NOTE: Embodied energy values based on several international sources - local values may vary.		

Fig. 1. Comparative values of the embodied-energy levels of common building materials. Note that glass and aluminum (i.e., principal components of many replacement windows) are ranked among the highest levels of embodied energy, while most historic materials tend to possess much lower levels. Courtesy of Ted Kesik, Canadian Architect's Architectural Science Forum, Perspectives on Sustainability.

For all the brilliance reflected in efforts to preserve historic buildings in the U.S., the issue of replacing windows rather than restoring them remains singularly unresolved. Proponents on both sides of the issue may easily become frustrated by a dearth of useful data, as well as conflicting information, or misinformation, promulgated by manufacturers. Indeed, it often seems that many preservation practitioners and building owners remain in the sway of advertising claiming that the first order of business is to replace old windows. In the context of preservation and sustainability, however, it is well worth reconsidering this approach.

Sustainability and Authenticity

In considering alternatives to replacing historic windows, one needs to keep in mind two important elements: sustainability and authenticity. Sustainability (building green) and historic preservation are a natural marriage, so long as one remains mindful that sustainability is not just about energy conservation.[1] Preservation and sustainability involve myriad elements that can work in symbiotic and synchronized ways toward a favorable outcome. For example, preservation work is more labor- than material-intensive, which benefits local economies; natural ventilation afforded via operable windows can reduce the size of mechanical equipment, especially of air-conditioning; and salvaging historic materials, such as wood sash, obviates the need to harvest live trees and other natural resources for the manufacture of replacement units.

Similarly, retaining and celebrating authenticity is one key element of an exemplary preservation program. No one should take lightly the option of discarding authentic historic materials — in this case, windows — without fully evaluating the consequences. Once authentic material is lost, it is lost forever. It does not matter how accurate the replacement window, it never reflects the nuances of the original.

Taking the Long View

Historic windows possess aesthetic and material attributes that simply cannot be replaced by modern replacement windows. Like preserving whole buildings, restoring historic windows is a solid step forward into the realm of sustainability. The present approach to sustainability, however, still too often focuses on new construction and issues such as "intelligent" windows and energy efficiency, while overlooking other important, holistic benefits of preserving historic windows, such as the following:

- Conservation of embodied energy (i.e., the sum total of the energy required to extract raw materials, manufacture, transport, and install building products). Preserving historic windows not only conserves their embodied energy, it also eliminates the need to spend energy on replacement windows. Aluminum and vinyl — the materials used in many replacement windows — and new glass itself possess levels of embodied energy that are among the highest of most building materials (Fig. 1).[2]
- Reduction of environmental costs. Reusing historic windows reduces environmental costs by eliminating the need for removal and disposal of existing units, as well as manufacture and transportation of new units. Also, many replacement units are manufactured with such materials as

26 APT BULLETIN: JOURNAL OF PRESERVATION TECHNOLOGY / 36:4, 2005

MISSOURI DEPARTMENT OF NATURAL RESOURCES
ENERGY CENTER - ENERGY LOAN PROGRAM
WINDOW REPLACEMENT WORKSHEET

BUILDING	LOCATION	DATE

To estimate the savings of replacing existing windows with efficiency upgrades, the following information must be known:

The U-Factor of the existing window (See U-Value table below).
The U-Factor of the replacement window (See U-Value table below).
The total area of the windows being replaced (square feet).
The heating energy cost ($/million Btu).
The heating plant efficiency (in percent).

SAVINGS CALCULATIONS

1. Enter the U-Factor of the existing windows.. .... ______________
2. Enter the U-Factor of the replacement windows.. .... ______________
3. Subtract line 2 from line 1 .... ______________
4. Add 0.86 to line 3... ______________
5. Enter the total area of the windows to be replaced.................................... ______________
6. Multiply line 4 by line 5.. ______________
7. Multiply 0.1 by line 6 .... ______________
8. Enter the heating plant efficiency (percent divided by 100) .... ______________
9. Divide line 7 by line 8.. ______________
10. Enter the energy cost ($/million Btu)... .... ______________

YEARLY SAVINGS

11. Multiply line 9 by line 10.. $ ____________ /year

PROJECT COST

12. Enter the total cost of the window replacement including material, labor and design....................... $ ____________

SIMPLE PAYBACK

13. Divide line 12 by line 11 .... ______________ years

WINDOW U-VALUE TABLE

Window System Type	U-Factor*
Single Glass	1.10
Single Glass with storm window	0.50
Single Glass, low E coating	0.91
Single Glass, low E coating with storm window	0.44
Insulating Glass (double glass)	0.55
Insulating Glass (double glass) with storm window	0.35
Insulating Glass (double glass), low E coating	0.38
Insulating Glass (double glass), low E coating with storm window	0.32
Insulating Glass (triple glass)	0.35
Insulating glass (triple glass) with storm window	0.25

* U-Factor values adapted from the 1985 ASHRAE Fundamentals Handbook.

MO 780-1363 (5-98) DNR/TAREQV 3.5 (5-98)

Fig. 2. Many excellent worksheets are available for calculating payback of replacement windows; this one is produced by the Missouri Department of Natural Resources. Results of payback calculations often reveal grossly overstated claims. Courtesy of the Missouri Department of Natural Resources.

vinyl and PVC, whose production is known to produce toxic by-products. So, while energy savings is green, the vehicle toward its achievement — in this case, replacement windows — is likely to be the antithesis of green.[3]

- Economic benefits. Restoration projects are nearly twice as labor-intensive as new construction, meaning more dollars spent go to people, not materials. This type of spending, in turn, has the beneficial effect of producing stronger, more dynamic local economies.[4]
- Ease of maintenance. "Maintenance-free" is a convenient marketing slogan; many replacement windows, in reality, cannot be maintained well or conserved. Vinyl, fiberglass, sealants, desiccants, and coating systems all degrade, and they are materials that remain difficult or impossible to recycle or conserve.[5]
- Long-term performance. While manufacturers' warranties have been lengthened in the past few years (they are now generally from 2 to 10 years), they still pale in comparison to the actual performance life exhibited in historic windows, which can reach 60 to 100 years and more, often with just minimal maintenance.

Clearly, sustainability takes into account more than just the cost of energy savings. It also promotes salient social, economic, and environmental benefits, along with craftsmanship, aesthetics, and the cultural significance of historic fabric. Still, the issue of energy savings is often used to justify replacement over restoration, but just how valid is this argument?

Energy Savings

If the foremost goal for replacing historic windows is energy savings, beware of "facts" presented: they very likely will be — intentionally or not — skewed, misinformed, or outright fallacious. Window manufacturers universally boast about low U-values (the measure of the rate of heat loss through a material or assembly; a U-value is the reciprocal of an R-value, which is the measure of resistance to heat gain or loss). For example, U-values are often misleadingly quoted as the value for the entire window unit, when in fact it is the value through the center of the glass (the location of the best U-value), not that of the sash nor the average of the entire unit.[6] To be sure that data are being presented appropriately, request the U-values published by the National Fenestration Rating Council (NFRC), which rate whole-window performance.[7]

When U-values are offered for the entire window assembly, they often are significantly worse (i.e., higher) due to infiltration around the frame and rough opening.[8] In cases where replacements tend to warp and bow over time (and they do), this factor becomes ever more crucial.[9] It is also important to watch for comparative analyses: some replacement-window manufacturers compare their window units to an "equivalent" single-pane aluminum window. Clearly, this is an inappropriate analogy since these types of windows are not likely to be found in a preservation context.

Infiltration of Outside Air

Infiltration of outside air — rather than heat lost through the glass — is the principal culprit affecting energy; it can account for as much as 50 percent of the total heat loss of a building.[10] When retrofit windows are installed over or within the existing window frame, the argument for preservation already exists: restoring the integrity of the fit between the frame and building wall should be the first component of a preservation approach.

Sash pockets, pulleys, and meeting rails are areas prone to air infiltration in double-hung units. Yet, several weatherproofing systems for existing windows can overcome these heat-sapping short circuits.[11] Replacement-window manufacturers themselves admit that even among replacements, double-hung units present the greatest challenges for controlling heat loss because infiltration occurs most frequently at sash-to-sash and sash-to-frame interfaces, which are highly dependent on the quality of the installation.[12] The energy efficiency of restored windows incorporating retrofit components (weatherstripping and weatherseals combining pile, brush, bulb, or "Z" spring seals) can meet and even exceed the efficiency of replacement units.[13] This approach is suggested as the first alternative among green-building advocates.[14]

Payback

Focusing on windows as the principal source of heat transfer may lead to the conclusion that windows are more important than, say, insulating the attic, foundation, or walls. While data vary somewhat, up to 25 percent of heat may be lost through doors and windows.[15] But when the aforementioned potential 50 percent loss through infiltration is taken into account, the total effective percentage of heat loss attributed to the window units themselves would be only 12.5 percent. That is a relatively small percentage for a potentially large investment, especially when other options are available.

In actuality, typical window-replacement systems offer payback periods that are often nowhere near manufacturers' claims: the payback of a typical unit could take as long as 100 years (Fig. 2).[16]

Heat Loss/Heat Gain

Heat loss is often discussed, but what about heat gain? In summer, heat gain can add significantly to the energy costs associated with cooling a building.[17] Long waveforms within the daylight spectrum that enter through the glass must be able to exit, or else they degrade to heat that then must be overcome by the building's cooling system.[18] Low-emittance ("low-e" or "soft low-e") glass handles this task best, improving thermal performance by virtually eliminating infrared (long-wave) radiation through the window.[19] It accomplishes this task by allowing short-wave radiation through and reflecting long-wave heat back to its source, while at the same time providing an appearance that is virtually clear.[20]

Low-e glazing can be substituted into existing units that are only single-glazed and still achieve important energy savings. Single-pane low-e glass can provide a virtually equivalent level of combined energy savings as a standard new double-glazed unit when used in concert with an existing single-paned sash (e.g., as a storm or interior sash).[21] Replacing panes of glass, then tightening up the sash and frame, is a very simple and cost-effective way to achieve the desired whole-assembly U-value without having to modify visible light, mullions, or sash weights.[22]

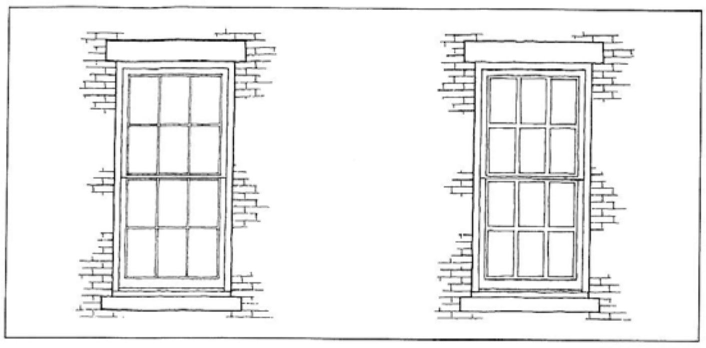


Fig. 3. At left is a drawing of a typical late-nineteenth- to early-twentieth-century six-over-six, double-hung window. At right is a modern "equivalent" replacement. The considerably thicker mullions and frame of the replacement unit (necessitated by the use of insulated glass) result in a nearly 15 percent reduction of visible light and views. Drawing by Walter Sedovic Architects.

Insulated Glass

Replacement windows nearly always incorporate insulated glass (IG) units. The effectiveness of an IG unit is greatly dependent on the depth of the airspace between inner and outer panes, as well as on the nature, type, and amount of desiccant and seals employed around the unit perimeter.[23] While manufacturing techniques for IG units have continued to improve, when IG units fail, they are difficult and time-consuming to replace.[24]

The additional weight and thickness of IG units preclude their use as retrofits in historic sashes of either wood or metal. Indeed, to compensate for their heft, virtually all IG replacement window mullions, sash, and frames are bulkier than their historic counterparts. The result is that visible daylight levels are reduced by 15 percent or more and views are interrupted.[25] Reducing daylight and negatively affecting views are explicitly not consistent with a sustainable approach (Fig. 3).

Laminated Glass as an Alternative

Laminated glass remains an often-overlooked alternative to IG units, perhaps because of the industry's focus on marketing it as "safety" glass. While laminated glass cannot compete with technologically advanced, complex IG units, it does offer enhanced U-values for monolithic glass without having to materially alter the mullions of the historic sash into which it is being fitted.[26] It is important to recognize, though, that a U-value is not the only criterion that determines the relative thermal efficiency of a window. Solar and light transmittance also affect performance, and they may be benefit when low-e laminated glass is selected.[27] The benefits of laminated glass, though, go much further when considered part of a comprehensive program to restore and thermally upgrade historic sash:

- Laminated glass offers significantly higher levels of noise abatement than IG.
- Historic glass may be laminated, offering energy and noise benefits while maintaining an authentic finish.
- Laminated glass is far easier and less expensive to procure and install and allows for field cutting.
- It offers superior safety and security features.
- Laminated glass may be equipped with low-e glazing to help offset heat gain.
- Historic sash, both metal and wood, can be outfitted with laminated glass without modifying or replacing mullions and frame elements (something that would be required by the installation of significantly thicker IG units).
- Condensation is reduced as a result of the internal thermal break of laminated glass.
- A variety of features (UV protection, polarization, translucency, etc.) can be incorporated as layers within laminated glass. Efforts to achieve the same results in IG units through the use of applied films (as opposed to an integral layer within the glass) has been shown to greatly reduce the life of double-glazed units by inhibiting the movement of their seals.[28]

Performance and Material Quality

A hallmark of sustainability is long-term performance. Intrinsic within that premise are issues about material quality, assembly, and conservability. As noted above, some material choices (e.g., PVC) incorporated into replacement-window units are inherently not able to be conserved.[29] When the material degrades, it then becomes necessary to replace the replacement.[30]

One of the great virtues of historic windows is the quality of the wood with which they were constructed. Historic windows incorporate both hardwoods and softwoods that were often harvested from unfertilized early-growth stock. Such wood has a denser, more naturally occurring grain structure than what is generally available today from second-growth stock or fertilized tree farms. Also, historically, greater concern was given to milling methods, such as quarter- or radial sawing. The resulting window performs with greater stability than its modern counterpart. This alone has far-reaching benefits, from minimizing dimensional change, to holding a paint coating, to securing mechanical fasteners.

No amount of today's staples, glue, finger-splices, and heat welds can match the performance of traditional joinery.[31] Similar comparisons could be made of the quality of hardware employed in replacement windows, such as spring-loaded balances and plastic locking hardware; they cannot compete with the lasting performance and durability of such historic elements as pulley systems and cast-metal hardware.

Ease of Maintenance

For cleaning windows, traditional single- and double-hung windows are often outfitted with interior sash stops that may be removed readily, allowing for full access to the interior and exterior, as well as to the pulley system. Both casement and pivot windows are inherently very easy to clean inside and out.

Replacement windows incorporating tilt-in sash — a feature that on its surface appears enticing — require that there is no interior stop, increasing the potential for air infiltration around the sash. Compressible jamb liners that allow for the tilt-in feature are often constructed of open-cell foams that, once they begin to degrade, lose both their compressibility and sash-to-frame infiltration buffer.

The ability to readily disassemble historic wood windows also allows for selectively restoring, upgrading, and adapting individual components of a window throughout its life. Most replacement-window systems cannot make that claim.

Aesthetics and Authenticity

Nuances in molding profiles, shadow, line, and color of windows, along with quality and appearance of the glass, contribute greatly to the overall building aesthetic and generally emulate the stylistic details of the building as a whole. Even what might seem like small changes in these elements can and does have a noticeable and usually detrimental effect on many historic facades. Outfitting historic buildings with modern replacement windows can and often does result in a mechanical, contrived, or uniformly sterile appearance. Worse, when historic windows are replaced, authenticity is lost forever.

Value and Cost

Repairs of historic windows should add to the value of the property, as an authentically restored automobile would command greater value than one "restored" with plastic replacement parts.

While there is a dearth of cost-comparative analyses between a replacement window and its restored, authentic counterpart, empirical knowledge based on field experience covering a wide variety of window types suggests that restoration is on a par, cost-wise, with a middle-of-the-road replacement. Corollary conclusions are that:

- cheap replacement windows will always exist to superficially counter the cost-basis argument for restoration; and
- high-quality equivalent replacement units have been shown in practice to cost as much as three times that of restoration.

Windows are a critical element of sustainability, but sustainability is not just about energy. It is about making environmentally responsible choices regarding historic windows that take into account the spectrum of associated costs and effects. The choice of whether to replace or restore requires embracing a more encompassing definition of sustainability. The answer is not as simplistic as some would have us believe.

WALTER SEDOVIC, the principal and CEO of Walter Sedovic Architects, works in historic preservation and sustainable design. His work and firm are recognized for integrating green-building approaches and ideologies into preservation projects.

JILL H. GOTTHELF is an associate at Walter Sedovic Architects, providing project management, design, and construction administration. She has extensive experience in integrating sustainable building technologies into preservation projects.

Notes

1. Walter Sedovic, "History's Green Genes" (Greenbuild 2003, The 2nd International Conference on Sustainability, U.S. Green Building Council, Pittsburgh, Pa., November 12-14, 2003).

2. Ted Kesik, "Embodied Energy Comparative Values," Canadian Architect, Architectural Science Forum, Perspectives on Sustainability, January 2002, http://www.canadianarchitect.com/asf/perspectives_sustainibility/measures_of_sustainablity/measures_of_sustainablity_embodied.htm (accessed November 1, 2005).

3. "Windows," Global Green USA, Public Housing Authority Toolbox, http://www.globalgreen.org/pha-energytoolbox/tech_windows.htm (accessed November 1, 2005).

4. Don Rypkema, "The Economics of Preservation" (keynote address, Preservation 360°, Saratoga Springs Preservation Foundation, Saratoga Springs, N.Y., March 18, 2005).

5. Paul Fisette, "Understanding Energy-Efficient Windows," *Fine Homebuilding* 114 (1998): 68–73.

6. Ibid.

7. National Fenestration Rating Council, http://www.nfrc.org.

8. Andrew M. Shapiro and Brad James, "Creating Windows of Energy-Saving Opportunity," *Home Energy* 14, no. 5 (1997).

9. Fisette, 68–73.

10. Ibid.

11. Shapiro and James.

12. Bill Mattinson, Ross DePaola, and Dariush Arasteh, "What Should I Do About My Windows?" *Home Energy* 19, no. 4 (2002).

13. The growing market for retrofit seals has resulted in an ever-increasing supply of high-quality weatherstripping products manufactured in a variety of materials and configurations for application in both typical and non-typical applications.

14. Shapiro and James.

15. Hastings Borough Council, "Have You Got Money to Burn?" http://www.hastings.gov.uk/energy_efficiency/heat_every_home.aspx#money_to_burn (accessed November 1, 2005).

16. Shapiro and James.

17. Fisette, 68–73.

18. Ibid.

19. The National Energy Foundation, "Energy Advice: Saving Energy: Insulation," http://www.nef.org.uk/energyadvice/insulation.htm (accessed September 16, 2005). A. Roos and J. Karlsson, "Performance Criteria for Coated Glazings in Windows," in *Proceedings from Glass Processing Days, Tampere, Finland*, 653–656 (Uppsala, Sweden: Dept. of Material Science, Angstrom Laboratory, Uppsala University, 2001). See also http://www.glassfiles.com/library/23/article440.htm (accessed November 1, 2005).

20. Roos and Karlsson, 653-656.

21. Mattinson, DePaola, and Arasteh.

22. Shapiro and James.

23. "Product Information: Insulating Glass," PPG Industries, Inc., http://www.ppg.com/gls_residential/share/res_ins.htm (accessed November 1, 2005).

24. James Piper, "Windows: Repair or Replace?" *Building Operating Management* (Jan. 2004).

25. Chad Randl, *Preservation Tech Notes, Windows*, No. 19, *Repairing Steel Casement Windows* (Washington, D.C.: U.S. Department of the Interior, National Park Service, Cultural Resources, 2002).

26. California Glass Bending Corporation, "Static-Exchange Correlation-Polarization (SECP) Tables," http://www.calglassbending.com/secptabl.htm (accessed November 1, 2005).

27. Roos and Karlsson, 653–656.

28. James Piper, "Avoiding Common Window and Window Film Mistakes," *Building Operating Management* (Oct. 2004).

29. Fisette, 68–73.

30. John M. Corbett, "A Last Look at Historic Wood Windows," *Traditional Building* 14, no. 6 (2001).

31. Fisette, 68–73.

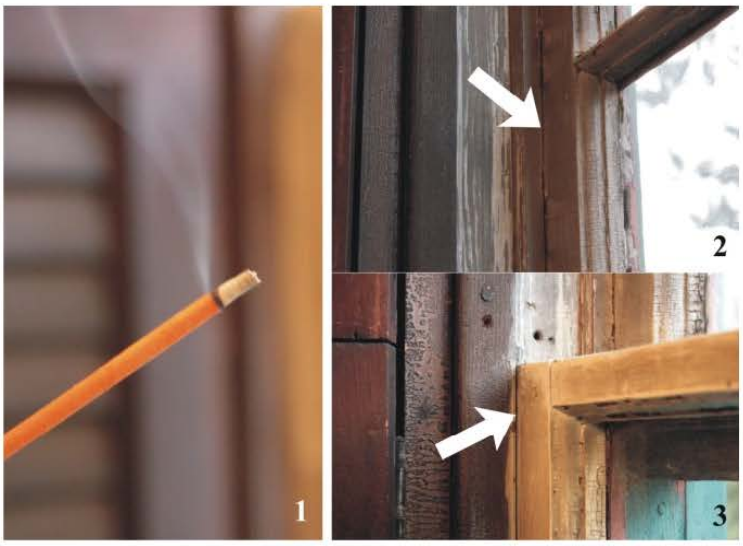
Cooper, Chris. "Draft Wood Windows, in Need of Repair? 9 Simple Tips – to Save You Money this Winter." *Old Home Living.* February 1, 2016.

Drafty Wood Windows, in Need of Repair? 9 Simple Tips – to Save You Money this Winter!

Editorial and Photography By: Dr. Christopher Cooper

I have found most people, including ourselves at our three Vintage Home Charm project houses, are in a flux of partially restored windows or windows that have been restored, however need a little extra work to make them a little less drafty for the winter months.

There are many options on the market to stop draft, notwithstanding this, most modern contrivances are damaging to a wood window. The plastic, two-sided tape, and a hair dryer over the window trick, does nothing but cause condensation on the principal window, which allows the principal windows to mold and rot. Moreover, the two-sided tape will destroy the paint on the window trim. Another product is a caulking that is supposed to be easily peeled-off in the spring, along with your paint too. And in most cases, you will have to scrape off the excess, damaging the underlying wood.



This article will take a low-tech approach to stopping drafts, and in turn save on energy consumption without any newfangled, new-and-improved, buy-it-now products. The first approach is to see if there is draft around the windows where the sash slides in the frame and comes in contact with the stool (on the lower edge of the sash). By using an incense stick, one can detect air infiltration by seeing a break in the smoke stream from the incense. Smoke rises without a draft, however when caught in a draft, the smoke will break in a horizontal stream **(see Image 1)**. By slowly running the incense stick around the window, areas that need attention will become very apparent.

An operating window should never be caulked rather only the window trim where it comes in to contact with the wall surface! Most air infiltration is found where the upper sash rides against the parting bead **(see Image 2, only in double-hung windows)** and where the lower sash rides up along the interior stop **(see Image 3)**.

HAP20-004-L

Another area for air infiltration is at the meeting rails **(see Image 4)** and where the lower sash rests behind the stool **(see Image 5)** and at the weight pulley **(see Image 6)**.

First, let's take a look at the meeting rails. Most people confuse the device shown in **Image 7** as a window lock, to lock your windows. These devices have been around for quite some time (mid 19th century) and in the days when you didn't lock your front door, you certainly were not going to lock your windows! These sash locks are actually devices to lock your meeting rails together to stop draft and should be installed on all operating windows.

There should be one sash lock for windows of 24″ and less, and two locks evenly spaced between the lights of larger windows **(see Image 8)**.

The areas located at Images 3 and 5 are the most notorious air infiltration points. I take care of these areas using a modern product. However, it will not damage the window in any way and can be installed in minutes! Foam backer rods (available at your local hardware store) can easily be pushed into the gap at the interior stop and at the stool, effectively stopping draft in its tracks. The backer rod is pushed into place using a wooden shim I have fashioned with soft rounded edges that does not damage the surrounding wooden surfaces or tear the backer rod **(see Image 9)**.

I am using a 3/8″ diameter backer rod, starting on the left side of the stop at the meeting rail and running the rod down and across the stool and up to the right side meeting rail **(see Images 10, 11 & 12)**. The results are amazing. This will completely stop the air infiltration, and if the space is bigger, the backer rods are available in many sizes starting at a 1/4″ diameter.

This same method can be done to the upper sash in double-hung windows and placed between the upper sash's stile and the parting bead **(see Image 2)**. Another low-tech product available for double-hung windows (again available at your local hardware store) is crack seal **(see Image 13)**. This product has been around for a very long time and is somewhat like the consistency of plasticine. You simply roll it out and push it in place. The product does not tear the paint and is easily removed in the spring **(see Image 14)**. I only use this product when the gap between the parting bead and the upper sash stile is too small to push in a backer rod.

The final air infiltration culprits are the sash pulleys. This is easily remedied with a small 4" length of a backer rod, pushed into the top of the pulley and the other end pushed into the bottom of the pulley **(see Image 15)**. The terrific thing about backer rod is that it can be reused for years. I will put the used backer rod in a large zip-top bag and use a permanent marker to mark which room and which window it came from, then store it away until next winter **(see Image 16)**. The crack seal can also be saved and reused!

A good fitting wood storm window is always important to achieve a better and in some cases, higher energy efficiency over any vinyl or wood replacement window on the market today, coupled with the tips noted in this article. Another important task to be performed on your original wood sash windows and storms is to properly re-putty the glazing **(see Image 17)**, however, we will leave that to a subsequent article.

Cracked Glass

Many of us, during the restoration of our houses, have had to deal with cracked window glass from time to time. Cracked glass can cause all sorts of discomforts when a cold breeze is finding its way through the gap during inclement weather.

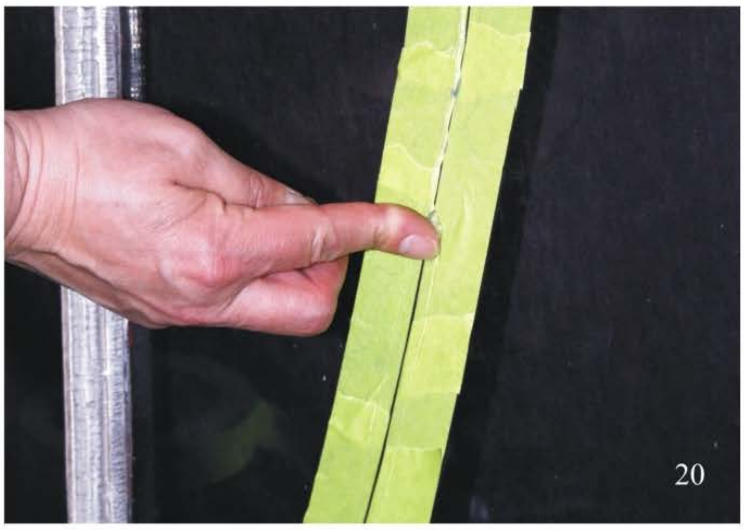
I hate to say it, but we as a society tend to only replace glass when it is completely broken-out; replacement of one cracked pane is usually low on our to-do-list. A testament to this is all the cracked glass in many of our project houses.

One of the biggest concerns for me is the large cylinder glass sheets in the 1877 replacement windows in the front facade of one of our project houses. They have large horizontal cracks from one side of the sash stile to the other; they have become very unstable and await final restoration before the glass is replaced. This type of crack could be potentially disastrous with our young daughters having the run of the place.

I have found that the best possible solution to stabilize cracked glass and to stop draft is to caulk both sides of the crack with a very high quality clear marine silicone caulk.

The Temporary Repair Process:

My apprentice, Janet, demonstrates placing masking tape on both sides of the window crack on the interior side of the window before using the silicone **(see image 18)**. Approximately a sixteenth of an inch on either side of the crack is needed. For wavy or arched cracks, use a 2-inch-wide roll of masking tape and use a razor to trim away an eighth of an inch swath where the crack is; this will allow a smoother appearance. This step with the masking tape can be skipped if appearance is not a concern. Janet then simply runs a bead of silicone over the crack between the masking tape **(see image 19)**.



Then, with a moistened finger, Janet smooths out the silicone **(see image 20)**. After the silicone is smoothed out, the masking tape is removed carefully so as not to ruin the uncured silicone (see image 21). Allow the interior repair to cure overnight and follow the same process as above on the exterior side of the glass.

The final temporary repair is relatively attractive and has stabilized the glass and stopped the draft. This is only a temporary fix and the cracked pane will eventually have to be replaced. However, it has made the pane safe for cleaning and for touching with little hands that have the run of the place!

How-To Projects, Workshops
DR CHRISTOPHER COOPER, DRAFTY WOOD WINDOWS, EDIFICE MAGAZINE, HOW TO REPAIR WOOD WINDOWS, HOW-TO PROJECTS, REPAIR DRAFTY WOOD WINDOWS

2 thoughts on "Drafty Wood Windows, in Need of Repair? 9 Simple Tips – to Save You Money this Winter!"

1. ***Angela***