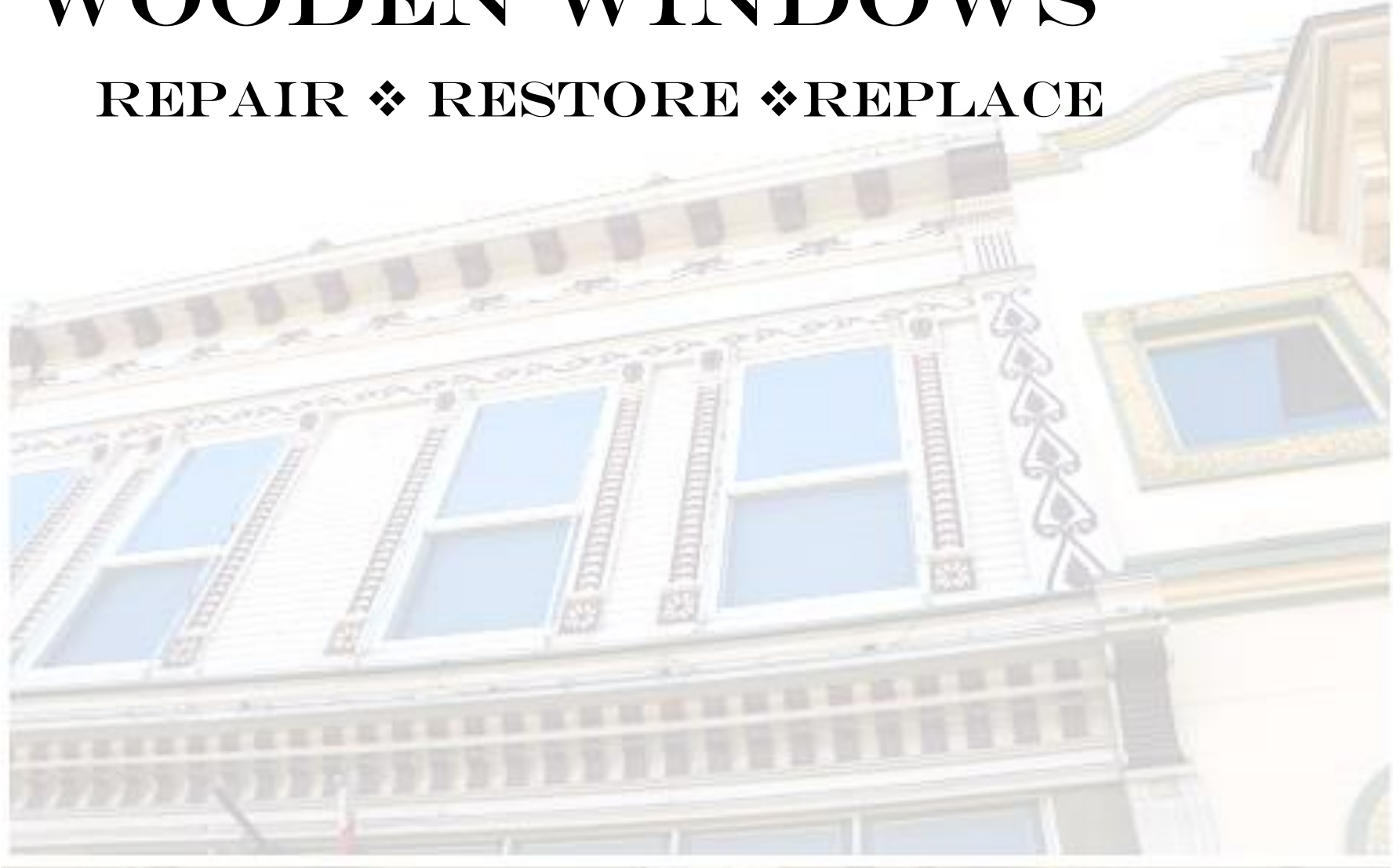


WOODEN WINDOWS

REPAIR ❖ RESTORE ❖ REPLACE



Acknowledgment

Development of this publication was made possible through a Certified Local Government (CLG) grant obtained by the City of Eureka. CLG grants, administered by the California State Office of Historic Preservation, are Federal funds from the National Park Service, Department of the Interior, under the National Historic Preservation Act of 1966, as amended. The content and opinions of this publication do not necessarily reflect the views or policies of the Department of the Interior, nor does the mention of trade names or commercial products constitute endorsement or recommendation by the Department of the Interior.

Under Title VI of the Civil Rights Act of 1964 and Section 504 of the Rehabilitation Act of 1973, the U.S. Department of the Interior strictly prohibits unlawful discrimination on the basis of race, color, national origin, age, or handicap in its federally assisted programs. If you believe you have been discriminated against in any program, activity, or facility as described above, or if you desire further information, please write to:

Office for Equal Opportunity

National Park Service

1849 C Street, NW

WASHINGTON D.C. 20240



Development Services Department
September, 2019

Raquel Menanno, Assistant Planner
Kristen M. Goetz, Senior Planner
William "Bill" Hole, Consultant

Information contained in this document was sourced from multiple sources and compiled by City Staff and Consultants. Specific sources are referenced when available.

Introduction

Windows connect the outside of a building to the inside. Windows allow light and air into buildings and allow occupants to see out from inside. Windows form a barrier against sound and provide ventilation. The form, structure, and placement of windows in a building facade defines the architectural character of the building. Original windows, such as wooden windows on historic structures, can provide valuable clues to a building's history. Wooden windows are an important distinguishing characteristic and an integral part of the character of historic buildings. The design, craftsmanship, and materials used in wooden windows often make them worthy of preservation. Determining whether repair or replacement of wooden windows is the best option can be a complicated process.

Historic buildings make up the fabric of our Victorian Seaport. This document has been created to assist owners of buildings with old or original windows to understand the challenges of maintaining these special windows.

This document is intended as a guide to educate the reader about the logical steps necessary to make the challenging decisions about building maintenance, especially as it relates to "those old wooden windows". The document addresses energy concerns, and provides resources that will lead to successful and long-term preservation, repair, and restoration decisions to maintain Eureka's "historic fabric".

The National Historic Preservation Act was passed by Congress in 1966, and, in part, authorized the Secretary of the Interior to establish standards for the preservation of historic properties. The Secretary of the Interior's Standards for the Treatment of Historic Properties ("the Standards") are historic preservation principles. They serve to advocate for historic preservation "best practices", aiding in the conservation of our irreplaceable cultural resources, both locally and nationally.



To Repair, Restore, or Replace – *that is the question!*

Windows that have been well maintained, and continue to be maintained, should last for years. But what about the wooden window that has not been maintained? Just because a window is in poor condition doesn't mean it has to be replaced. Repairing or restoring historic windows can be economical and environmentally-friendly, and is almost always the right choice.

Guidance for the treatment of historic windows begins with Standard 6 of the [Secretary of the Interior's Standards for Rehabilitation](#): *"Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and,*



where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence."

The Standards *always* recommend repair as the first option, before replacement. Repair can include renewal of finishes, material repair, replacement of component parts, and additions, such as weather stripping. While it may be possible to repair even severely deteriorated windows, repair of deterioration beyond a certain level is not always practical or reasonable, and replacement then becomes the appropriate treatment.

The Standards also prescribe, *"The removal of historic materials or alterations of features and spaces that characterize a property shall be avoided."* Although most windows are significant to the character of a property, every window on all properties is not, and it is in these cases that considerations beyond deterioration are appropriate.

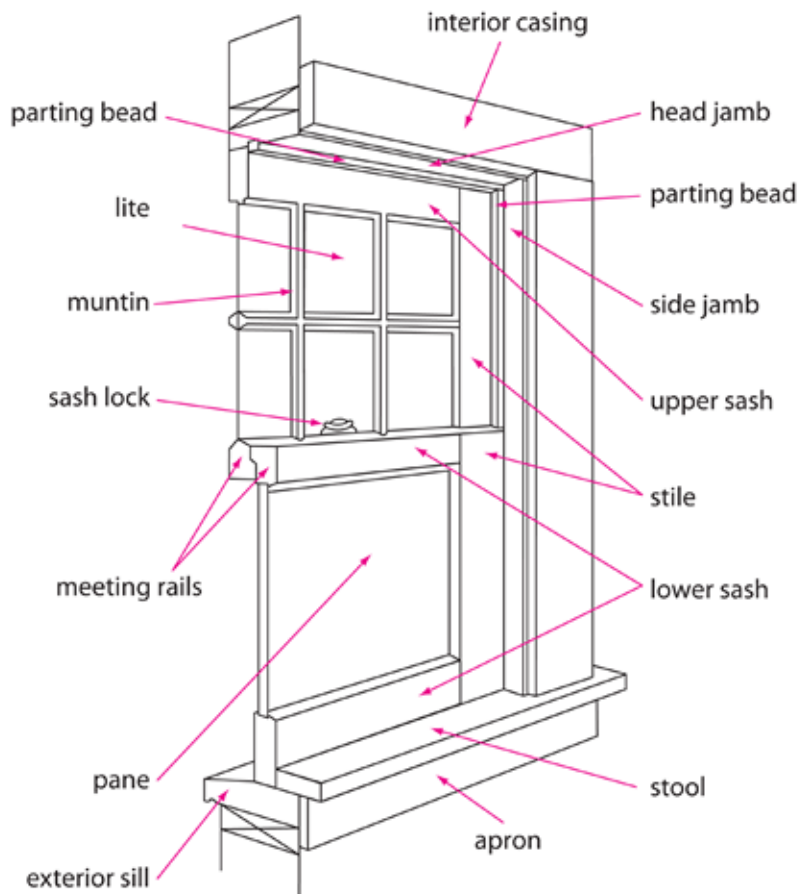
Wood windows made before the 1940s are mostly made from old growth wood, which is denser, more durable and more rot resistant. Historic wood windows were made specifically to fit the window opening and were custom installed, so each window is probably a little different. After 100 years, the window openings on historic buildings may no longer be exactly square due to settling of the building, but in most cases, the window still fits the opening. New windows installed in an opening that is no longer square may leave gaps.

Prior to repairing windows, it's important to evaluate the conditions and conduct a window inspection.

Evaluate the Conditions

Inspect the Window

Careful inspection and evaluation of existing physical conditions on a window-by-window basis is the key to successful planning for window treatment. Take photographs to record the existing conditions, and then create a window schedule that lists all parts of each window, with space for notes about the condition and repair instructions. The scope and priority of repairs should be evident as a result of this inspection.



Generally, the actions necessary to return a window to “like new” condition will fall into three broad categories:

1. Routine maintenance
2. Structural stabilization
3. Parts replacement

If most of the work falls into the first two categories, the windows should be repaired. But, if a large number of new parts are required, then it may be appropriate to consider investing in a good, matching replacement window.

Document the Condition

Determining when deterioration is sufficiently severe to justify replacement is based on documentation of the condition of the windows. Exactly what constitutes effective documentation may vary with the circumstances of the project, but at a minimum, good quality photographs clearly depicting the full range of conditions are required. If a large number of windows are deteriorated, explaining and documenting the specific aspects of the deterioration may be a substitute for photographs and descriptions of every window.

Repair and Maintenance

Many character-defining historic wood windows have survived the “test of time,” lasting 60 or even 120 years. If repaired and properly maintained, these windows can continue to function another 60+ years. Problems arise from a lack of maintenance, water and condensation damage, and ultraviolet light degradation. Excessive layers of paint build-up make windows unattractive and difficult to operate.

A selling point of replacement windows is that they are maintenance free. Replacement windows are called “replacement” for a reason. In truth, replacement windows have a relatively short life expectancy. Based on their

materials, replacement of the “replacement windows” will likely be required in less than 20 years. Unlike historic windows, new window assemblies cannot be repaired; they can only be replaced, adding more debris to local landfills. The sustainable choice is to repair historic windows whenever possible.¹

Replacement windows that contain vinyl or PVC are toxic to produce and create toxic byproducts. Installing these types of windows is not a ‘green’ approach. Each year, Americans demolish 200,000 buildings. That is 124 million tons of debris, or enough waste to construct a wall 30 feet high and 30 feet thick around the entire U.S. coastline. Every window that goes into the dump is adding to this problem.

Not a DIY-er? There are people who can restore windows. Hiring a skilled tradesperson to repair windows fuels the local economy by providing jobs that in turn circulate the income into our local community.

If wooden windows are replaced, save them in the attic or crawl space – a future owner may want to restore and use them. The windows in many historic buildings have functioned for more than 100 years and, with regular maintenance, will usually survive longer.

The cost of repairing or replacing wooden windows is also a concern. It is far more economical to repair, rather than purchasing all new replacement windows when considering the value added to an authentic historic property.

Dollars and Duration

A study from Vermont shows the savings gained from replacement windows, as opposed to a restored wooden

window with a storm window, is only about cents.² The added problem is, most replacement windows will not last for 40 years, much less for another hundred years. Some replacement windows are being replaced only 10 years later.

Do the Math:

- 8 windows on the house
- \$500 -1,000 for each replacement window unit
- Total costs for new windows: \$4,000-8,000
- Average savings gained from replacement windows (in comparison to similar, restored windows with storm windows): \$25.00 —50.00 per month
- The return on investment will take between 7 and 26 years.



¹ National Park Service. *Technical preservation services*. Retrieved from <https://www.nps.gov/tps/sustainability/energy-efficiency/weatherization/windows-doors.htm>

² Flanders, S., Hemenway, D., James, B., Shapiro, A., (1996). Testing the energy performance of wood windows in cold climates.

Building owners must assess the cost-benefit or 'payback' that comes with repairing or replacing wood windows. Do replacement windows really make economic sense?



Can similar energy savings be achieved by repairing the existing windows?

Retrofitting windows with high performance enhancements can result in substantial energy savings. Choosing to retrofit existing windows is the most cost-effective way to achieve these energy savings while lowering a home's carbon footprint-by avoiding production of new materials, reduce waste and preserve a home's character.

Typically, replacement windows are vinyl, aluminum, or a composite with wood, and will not last as long as the original window. Repairing, rather than replacing wooden windows is



likely to be the “greener option” and a more sustainable building practice.³

Retrofit measures can achieve performance results comparable to new replacement windows. There are readily available retrofit measures that can achieve energy savings close to new, high performance replacement windows, when the performance for each upgrade option is Considering the Repair, Retrofit, and Replacement of Historic Windows. (Preservation Pennsylvania. Considering the Repair, Retrofit, and Replacement of Historic Windows.).

Almost every retrofit option offers a better Return on Investment (ROI) than replacement windows.⁴ Findings from cost analysis demonstrate that new, high performance windows are by far the most expensive, costing at least double that of common retrofit options when considering materials, installation and general construction commonly required for an existing home.

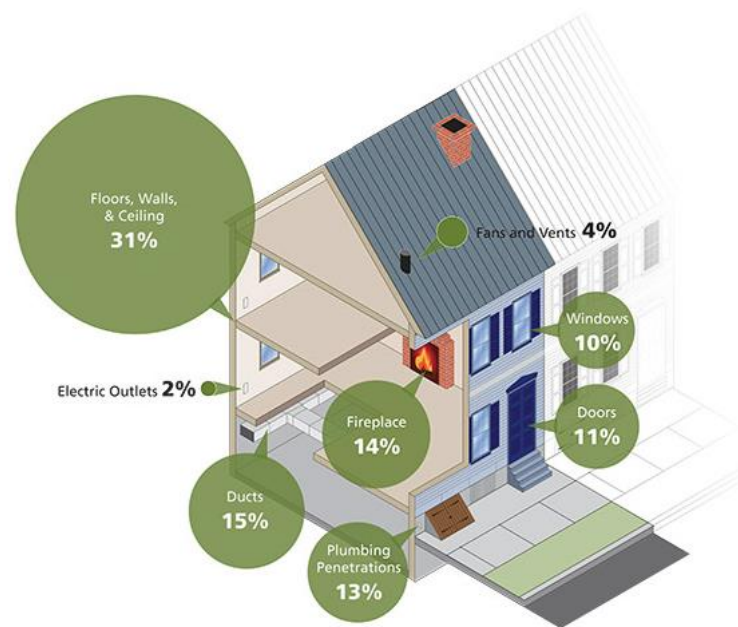
Almost every retrofit option offers a better Return on Investment (ROI) than replacement windows.⁵ Findings from cost analysis demonstrate that new, high performance windows are by far the most expensive, costing at least double that of common retrofit options when considering materials, installation and general construction commonly required for an existing home.

Energy Efficiency

What about energy efficiency? Most people believe their windows are the main source of heat loss, however most traditionally constructed wood-frame buildings lose more heat

through the roof and un-insulated wall-cavities than through the windows. Although data varies, only somewhere between 10 and 25% of total heat loss in a building is actually attributed to windows. Adding just 12-inches of insulation in the attic can save more energy than replacing the windows. Given that an average historic house can have between 24 and 30 windows, and a typical replacement window unit costs between \$500 - \$1,000 each, an investment of \$15,000 or more may not make sense when the lifespan of the replacement window is included. On the flipside, the cost to restore an existing wood window and

Eliminate Air Infiltration



Major Sources of Air Leaks (Data source: U.S. Department of Energy)

³ National Trust for Historic Preservation. Historic Wood Windows.

⁴ National Trust for Historic Preservation/Preservation Green Lab. Saving Windows, Saving Money: Evaluating the Energy Performance of Window Retrofit and Replacement.

⁵ National Trust for Historic Preservation/Preservation Green Lab. Saving Windows, Saving Money: Evaluating the Energy Performance of Window Retrofit and Replacement.

add storm windows (where appropriate) will generally be much less (depending on if you do it yourself or hire a contractor), approximately \$500 each.



Replacing a historic single-pane window also may not substantially increase energy efficiency or save much money in the long run. While the exact figure will vary depending on the type of window installed and whether or not a storm window is used, it could take 100 years or more for a replacement window to pay for itself in energy savings. According to an Old House Journal article⁶, it could take 240 years to recoup the cost of replacing a single-pane window-storm window combination with a low-E glass, double-pane thermal replacement window.

An analysis conducted by the [U.S. Department of Energy \(DOE\)](#) has shown that window attachments (shades, shutters, storm windows, etc.) have the potential to save significant energy in residential and commercial buildings.⁷

When considering whether to repair or replace wooden windows, energy efficiency is usually a topic of concern. Energy conservation often requires a series of changes to a building, more than just “take out the old wooden window and replace it with a new double-pane window”. Older windows can often be made more energy efficient by sealing gaps with appropriate weather-stripping, replacing glazing compound, fixing broken glass, repairing and replacing loose or broken wooden parts.

Storm Windows

A properly maintained historic wooden window, weather-stripped and with a storm window, can be just as energy efficient as a new window. In all climate zones analyzed, cellular shades, interior storm panels and various exterior storm window configurations offer a higher average return on investment compared to new, efficient replacement windows.

Windows, whether historic or new, are a source of heat loss because they are a poor thermal barrier compared to solid walls. Adding storm windows can improve the thermal efficiency of any window. If a building has existing storm windows, ensure they are tight fitting and in good working condition. Consult the energy audit (<https://www.nps.gov/tps/sustainability/energy-efficiency/weatherization/energy-audit.htm>) to determine if adding storm windows will significantly improve the building's energy efficiency.

⁶ Jordan, Steve. “Strips and Storms: Techniques for tuning up sash windows for winter.” Old House Journal (November/December 2004): 46-51.

⁷ Bickel, S., Phan-Gruber, E., Christie, S. 2013. Residential Windows and Window Coverings: A Detailed View of the Installed Base and User Behavior. Building

Technologies Office, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

A 2002 study confirmed that installing a storm window over a historic window can achieve a similar thermal performance to that of a new low-E vinyl replacement window. The study, conducted by Lawrence Berkeley National Laboratory, also noted that remaining air infiltration around the historic window



and storm assembly is a matter of occupant comfort rather than energy efficiency.⁸ However, much of the air infiltration around windows can be addressed by following the recommendations in “Eliminate Air Infiltration” (<https://www.nps.gov/tps/sustainability/energy-efficiency/weatherization/air-infiltration.htm>).⁹

For more information, see the full report of the study, *Measured Winter Performance of Storm Windows*.¹⁰

An appropriate exterior storm window will also help reduce heat loss while retaining original windows, especially in conjunction with weather-stripping.¹¹ A restored wooden window unit performs as close to, or better than, a newly installed vinyl window over the “test of time”.

Storm window meeting rails and other divisions should match the location of the same elements of the historic windows. Painting storm windows to match the historic window frames will help diminish their visual impact on the building.

Adding exterior storm windows to highly decorative or multi-light windows may conceal important details. In these situations, interior storm windows may be preferable.

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.¹²

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 window, potentially leading to deterioration. The correct approach to using interior storm windows is to create a seal on the interior storm window while allowing some ventilation around the outer

⁸ Lawrence Berkeley National Laboratory. *Measured winter performance of storm windows*.

⁹ <https://www.nps.gov/tps/sustainability/energy-efficiency/weatherization/air-infiltration.htm>

¹⁰ Klems, J. *Measured winter performance of storm windows*. Lawrence Berkeley National Laboratory. (2002).

¹¹ Preservation Pennsylvania. *Considering the Repair, Retrofit, and Replacement of Historic Windows*.

¹² National Park Service. *Improving energy efficiency in historic buildings*. Retrieved from <https://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm>

window. In actual practice, the creation of such a durable, airtight seal is difficult.

Weatherization

A window which is repaired should be made as energy efficient as possible by the use of appropriate weather-stripping to reduce air infiltration. A wide variety of products are available to assist in this task. New 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. Weather-stripping is a historic treatment, but old weather-stripping (felt) is not likely to perform very satisfactorily. Appropriate contemporary weather-stripping 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 is kept tightly closed so that the weather-stripping 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 and safety.

Considerations Beyond Deterioration

While condition is the primary determinant in decisions regarding the treatment of historic windows, the importance of the windows to the historic character of the building can also be considered. The design and location of windows and their relationship to the design of the building can affect their role in the character of a building. Windows that are or have distinctive features or exemplify fine craftsmanship are more critical to retain and repair than those that play a lesser supporting role in the design of the building. The more important the elevation,

feature or space surrounding the window, the more important it is to retain the historic window.

While factors including occupant operation, presence of hazardous materials, code requirements, or energy performance, if taken individually, are not reasons to replace windows, these may be issues to consider, in conjunction with deterioration, in establishing a need for window replacement. In many cases these requirements can be met without losing the historic windows.



The overall number of windows being replaced may allow for window replacement that is not based on deterioration. Replacement of a few windows may have only an inconsequential effect on the character of an elevation that contains many windows. Thus, where a need such as egress can be achieved with little change to the appearance of the building, a few windows may be replaced irrespective of their condition.

Code requirements in response to severe weather conditions or mandates such as impact resistance may make it impossible for a building to have certain uses with the historic windows in place, particularly on taller buildings. For example, a structure with windows with extremely low sill heights may not be suitable for a child day-care facility. In these cases, replacement of the historic windows will not be dependent on documentation of deterioration, but documentation of the requirement or mandate should be provided.

Role of the Historic Preservation Commission (HPC)



For properties included on Eureka's Local Register of Historic Places (LRHP), it is necessary to understand the role of the City of Eureka's Historic Preservation Commission (HPC) as it relates to modification or replacement of wooden windows.

The HPC reviews applications for additions, alterations, new construction, demolition of all, or parts, of a structure. The seven Commissioners are volunteers appointed by the Mayor, and the Commission meets monthly to act on applications and receive public testimony and comment. The Commission interprets local Historic Preservation issues based on the Secretary of the Interior's Standards, their own expertise, and has a responsibility to the community and City Council to protect and conserve historic structures.

HPC may negotiate with owners of properties having potentially significant historical characteristics, and for proposals of changes that conflict with the intent of historic preservation guidelines. The HPC may recommend the



approval of owner proposals, and/or contracts to restrict adverse effects of historic properties to the City Council, in order to retain historical characteristics.

The HPC may consider other methods to encourage and achieve preservation of worthy structures, resources, sites, and districts or areas, including exploring means to finance restoration, rehabilitation, and/or maintenance.

The HPC also makes appropriate recommendations to the Planning Commission, City Council, City Departments, other public and private agencies and bodies, to the general public, and property owners to assist with repair, modification, improvement, rehabilitation, and/or restoration, using archaic materials (especially recycled building materials), State Historic Building Codes, and design criteria sensitive to the particular property and surrounds.

Questions or need a list of consultants or contractors for historic projects?

Contact the City of Eureka Development Services Department, 531 K Street, Third Floor, Eureka City Hall. 707-441-4160 or planning@ci.eureka.ca.gov